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***Consultative  
Committee for  
Space Data Systems***

REPORT COMPARING:

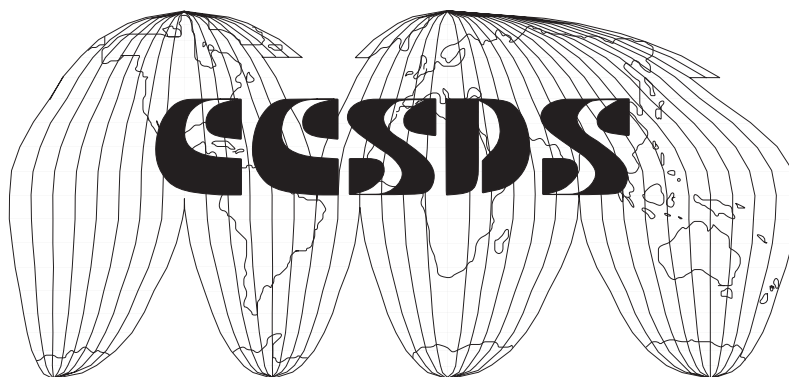
**RADIO FREQUENCY AND  
MODULATION SYSTEMS**

PART 1  
EARTH STATIONS

CCSDS 411.0-G-3

GREEN BOOK

May 1997



## Earth Stations

**CAUTION**

The information contained in this CCSDS Report is intended for planning purposes only. While great care was taken during the preparation of this document, there are no assurances as to the accuracy of the data. Therefore, mission and spacecraft designs should be based solely upon those documents provided by the agency responsible for the tracking system. Titles of reference documents will be found in Section 5.

Inter-agency agreements may affect the availability of certain equipment in some stations. Requests for the use of specific stations and / or equipment should be directed to the facility owner. Names and addresses of cognizant agency personnel are listed in Section 5.

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CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

Earth Stations

AUTHORITY

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This document has been approved for publication by the Management Council of the Consultative Committee for Space Data Systems (CCSDS) and represents the consensus technical agreement of the participating CCSDS Member Agencies. The procedure for review and authorization of CCSDS Recommendations is detailed in Reference (1) and the record of Agency participation in the authorization of this document can be obtained from the CCSDS Secretariat at the address below.

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Washington, DC 20546, USA

CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

Earth Stations

FOREWORD

This Report contains specific Radio Frequency and Modulation characteristics of the spacecraft tracking and data capture networks operated by the Consultative Committee for Space Data Systems (CCSDS) Agencies. The Report is intended as a high-level compendium of information for use by flight projects and others wishing to ensure compatibility with these agencies' tracking and data collection facilities.

Radio communication provides the vital link between ground-based personnel and spacecraft instruments. The CCSDS's objective is to optimize the design of the data capture system so as to furnish the maximum benefit to flight projects.

This Report comprises RF and Modulation characteristics of the tracking systems which are currently planned for the post 1996 time period. Many of these capabilities are based upon the *Recommendations for Space Data Systems* promulgated by the CCSDS.

Because this is a Report rather than a Recommendation, it does not represent a commitment by the agencies to provide or to maintain the characteristics described on the following pages. Nevertheless, it is expected that the capabilities enumerated here will be available for several years. Readers should refer to: *CCSDS Recommendations for Space Data System Standards, Radio Frequency and Modulation Systems, Part 1, Earth Stations and Spacecraft* (CCSDS 401 B) for guidelines in developing future capabilities.

Through the process of normal evolution, it is expected that expansion, deletion, or modification of this document may occur. This Report is therefore subject to CCSDS document management and change control procedures which are defined in reference [1]. Current versions of CCSDS documents are maintained at the CCSDS Web site:

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## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

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At time of publication, the active Member and Observer Agencies of the CCSDS were:

Member Agencies

- Agenzia Spaziale Italiana (ASI)/Italy.
- British National Space Centre (BNSC)/United Kingdom.
- Canadian Space Agency (CSA)/Canada.
- Centre National d'Etudes Spatiales (CNES)/France.
- Deutsche Forschungsanstalt für Luft- und Raumfahrt e.V. (DLR)/Germany.
- European Space Agency (ESA)/Europe.
- Instituto Nacional de Pesquisas Espaciais (INPE)/Brazil.
- National Aeronautics and Space Administration (NASA)/USA.
- National Space Development Agency of Japan (NASDA)/Japan.
- Russian Space Agency (RSA)/Russian Federation.

Observer Agencies

- Austrian Space Agency (ASA)/Austria.
- Central Research Institute of Machine Building (TsNIIMash)/Russian Federation.
- Centro Tecnico Aeroespacial (CTA)/Brazil.
- Chinese Academy of Space Technology (CAST)/China.
- Commonwealth Scientific and Industrial Research Organization (CSIRO)/Australia.
- Communications Research Laboratory (CRL)/Japan.
- Danish Space Research Institute (DSRI)/Denmark.
- European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)/Europe.
- European Telecommunications Satellite Organization (EUTELSAT)/Europe.
- Federal Service of Scientific, Technical & Cultural Affairs (FSST&CA)/Belgium.
- Hellenic National Space Committee (HNSC)/Greece.
- Indian Space Research Organization (ISRO)/India.
- Industry Canada/Communications Research Centre (CRC)/Canada.
- Institute of Space and Astronautical Science (ISAS)/Japan.
- Institute of Space Research (IKI)/Russian Federation.
- KFKI Research Institute for Particle & Nuclear Physics (KFKI)/Hungary.
- MIKOMTEK: CSIR (CSIR)/Republic of South Africa.
- Korea Aerospace Research Institute (KARI)/Korea.
- Ministry of Communications (MOC)/Israel.
- National Oceanic & Atmospheric Administration (NOAA)/USA.
- National Space Program Office (NSPO)/Taipei.
- Swedish Space Corporation (SSC)/Sweden.
- United States Geological Survey (USGS)/USA.

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DOCUMENT CONTROL

| DOCUMENT              | TITLE   | DATE           | STATUS/REMARKS   |
|-----------------------|---|----------------|--|
| CCSDS<br>(Unnumbered) | Report Comparing Systems<br>for Radio Frequency and Modulation:<br>Earth Stations, Issue-1          | August<br>1984 | Original Issue   |
| CCSDS 411.0 G-2       | Report Comparing Systems for:<br>Radio Frequency and Modulation:<br>Part 1: Earth Stations, Issue-2 | June<br>1990   | Completely revised<br>tables showing Earth<br>Station characteristics. |
| CCSDS 411.0-G-3       | Report Comparing Systems for:<br>Radio Frequency and Modulation:<br>Part 1: Earth Stations, Issue 3 | May<br>1997    | Completely revised<br>tables showing Earth<br>Station Characteristics  |

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REFERENCES

- [1] *Procedures Manual for the Consultative Committee for Space Data Systems*, Issue 1, Consultative Committee for Space Data Systems, August 1985 or later issue.
- [2] *Radio Frequency and Modulation Systems, Part 1: Earth Stations and Spacecraft Recommendations*, CCSDS 401.0 B, September 1989, or latest edition.
- [3] *Radio Regulations*, International Telecommunication Union, Geneva, Switzerland, 1982.
- [4] *Recommendations and Reports of the CCIR*, 1986 Plenary Assembly, Dubrovnik, Yugoslavia, 1986.

The latest issues of CCSDS documents may be obtained from the CCSDS Secretariat at the address indicated on page i.

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## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

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**1.0 INTRODUCTION****1.1 PURPOSE**

This Report summarizes the characteristics and capabilities of Consultative Committee for Space Data Systems (CCSDS) Agencies' Earth Stations. It has been designed to:

- (1) Serve as a reference work for persons seeking information about earth stations operated by CCSDS space agencies.
- (2) Facilitate cross-support of one agency's spacecraft by another agency's tracking system by providing spacecraft designers with CCSDS Agencies' earth station locations and nominal operating parameters.

This document is a CCSDS informational Report and, therefore, is not to be construed as a CCSDS Recommendation for Data System Standards.

**1.2 SCOPE**

The RF and Modulation system characteristics found in this Report are designed for the support of conventional, contemporary, free flyer spacecraft. The capabilities enumerated herein, are those that the CCSDS Agencies state are either in place or will be constructed within the next two years. It is expected that these data will be valid for the 1996-2001 time period.

**1.3 BACKGROUND**

As space missions have become more expensive, the search for methods to improve efficiency has intensified. One approach offering great potential focuses upon multi-mission designs in order to avoid early obsolescence. Data handling systems are attractive candidates for the multi-mission concept because of their high cost of redesign and because the process should be amenable to a high degree of uniformity.

However, multi-mission systems require the designer to exercise great care to ensure flexibility without sacrificing efficiency. Each step of the process must be examined to determine whether it has been optimized to meet the requirements and constraints imposed by a variety of users. The end product of this analytical process is a set of guidelines or recommendations which govern the implementation of future systems.

By cooperating in the specification of their data systems, CCSDS members should achieve significant uniformity. Apart from improving the design, this unified approach will facilitate the cross-support of one Agency's spacecraft by the other Agency's tracking network.

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Systems commonality is a cornerstone of the cross-support concept. Without substantial similarities in the data transfer process, it may not be possible to provide tracking to another Agency's spacecraft. Thus, systems standardization is intrinsic in the notion of cross-support agreements.

Here, we are concerned with the radio frequency subsystem which links spacecraft instruments with ground-based users. In large measure, the telecommunications systems' characteristics are determined by the ground station's design. For the concept of cross-support to succeed, there must be significant uniformity between these designs.

Ideally, all tracking networks should employ communications systems having identical radio frequency and modulation characteristics. Unfortunately, reality often misses the mark of perfection. It is not surprising that there are differences in the several Agencies' facilities, for their programs developed quite independently. Yet, the objectives of these programs are not so dissimilar, and one might expect to find significant commonality in the support systems.

Most CCSDS members have large capital investments in their ground networks. While it might be theoretically satisfying to speak of a single ground system configuration for all Agencies, the high cost of the required revisions render this approach practically un-achievable.

Hence, the focus of this document is upon those radio frequency and modulation characteristics which are currently planned for the post-1990 time period. Using this Report, it should be possible to design a flight project which will be compatible with several agencies' existing tracking networks.

The CCSDS comprises both member and observer agencies. Earth station facilities of all CCSDS agencies responding to Subpanel 1E's [*RF and Modulation*] request for information are contained in this Report. Agencies are arranged in alphabetical order without regard to their status as a CCSDS member or observer Agency. Using this information, needless duplication of facilities can be avoided through cross-support agreements.

#### 1.4 DOCUMENT FORMAT

This Report is organized into several sections, each providing different information about the CCSDS Agencies' spacecraft tracking facilities. Naturally, these data are summary for an exhaustive description which would require several volumes. Nevertheless, a review of each section should enable readers to determine whether or not another Agency's tracking network could provide useful tracking support to their project. A description of this Report's contents may be helpful.

Following these introductory remarks, Section 2 describes both frequency allocations and mission categories. The effect of this section is to limit the scope of the Report. Only spacecraft having communications systems employing certain frequency bands and operating within the *Space Operation Service* or the *Space Research Service* are covered by this document.

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

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Section 3 begins with a single map summarizing the geographical placement of both members' and observers' facilities. Thereafter, the section contains a map for each member and observer Agency showing the size and location of that Agency's ground-based tracking stations. Given the spacecraft's trajectory and the mission's objectives, certain geographical locations are likely to be preferable to others. Using this section, one can assemble a list of stations that should be considered for cross-support. Later sections will be useful to cull this list for those facilities having the necessary capabilities.

Section 4 contains electrical characteristics, by subsystem, for each Agency's earth stations. Issue-2 of this Report separated electrical capabilities for Category A and B missions. That distinction has been eliminated in this edition. Generally, Category B missions demand greater performance from the earth stations because of their very great distances and concomitantly weak signals. However, many of the capabilities required to support the two categories are very similar.

With Issue-1 of this Report, it was discovered that agencies tend to build facilities to specifically support either Category A or Category B spacecraft. On that rare occasion when a Category A spacecraft is serviced by a facility designed for Category B missions, the project is the beneficiary of improved performance. Thus, it was found to be unnecessary to create separate, and largely redundant, sections for the two mission categories.

Where possible, Section 4 presents the data by subnetwork, rather than by station. A subnetwork consists of two or more stations with sufficiently similar electrical characteristics so that they are indistinguishable from one another. While such stations may have differing geographical locations or mechanical configurations, they appear to have identical communication link capabilities. The three 70-meter stations situated in the USA, Australia, and Spain, which are operated by NASA's Deep Space Network, are an example of a subnetwork. In each case, the general information provided at the top of each page in Section 4 is sufficient to permit a reader to locate the individual stations in Sections 3 and 4.

As with earlier chapters, Section 4 is organized alphabetically by Agency. However, each Agency's material is further subdivided into *Earth-to-Space*, *Space-to-Earth*, *Radio Metric*, and *Frequency and Timing System*, *Geographical* and *Mechanical* modules. The latter module is new with this issue and has been added pursuant to an agreement with Subpanel 1D. These five modules are arranged in the order listed for each pair of stations or subnetworks so that a full description of the facilities will be found in each consecutive group of five sheets. If a CCSDS member or observer has more than two stations or subnetworks, additional sets of similar modules are utilized until that Agency's tracking system is fully described.

Section 5 contains the names of cognizant persons to contact for additional information as well as a list of published references. Since this Report is summary in nature, it should be used cautiously. ***NO SPACECRAFT OR MISSION DESIGNS SHOULD BE PREDICATED SOLELY UPON THE INFORMATION IN THIS REPORT.*** Rather, after identifying specific stations as potential cross-support candidates, the reader should consult the persons and references contained in Section 5 to determine whether or not such cross-support is feasible.

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

Section 6 contains Terminology and a Glossary of Terms. The high density of information provided by this Report makes the use of abbreviations mandatory. These sections provide definitions and explanations for most such terms and abbreviations.

**1.5 REVISIONS**

As a compendium of CCSDS member and observer Agency's earth stations, this Report's value depends on the accuracy and currency of its contents. Accordingly, each insert should be reviewed periodically and revised as necessary. Subpanel 1E has determined that an examination is needed every two to three years to meet these objectives. The Table of Contents contains a column showing the issue date of each module in the Report.

Each CCSDS member or observer Agency, whose earth stations are included in this Report, should review the present contents each year. When information contained in this document is found to be incorrect, the agency should provide a red-lined copy of the information sheet(s) to the Chairman of CCSDS Subpanel 1E as soon as practicable. Periodically, a call for current information will be made by Subpanel 1E.

New or corrected information may be published at any time without waiting for the next formal revision cycle if such a delay would significantly increase risks or costs to users of this Report. Partial revisions are appropriate when an agency makes major changes in its earth stations which either increase or decrease the capabilities. Here, delaying publication of the information until the entire book is revised could result in spacecraft designs based upon obsolete information. In such circumstances, it may be possible to revise and republish a single agency's data. When such conditions occur, it is imperative that the Chairman of Subpanel 1E be apprised of the changes and the urgency of re-publication at the earliest possible time.

Subpanel 1E hopes that this Report will prove to be a valuable reference work. However, to remain viable, it must contain current information. To facilitate revision, the document has been organized in modular form so that individual sections can be easily modified.

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

**2.0 FREQUENCY ALLOCATIONS****2.1 INTRODUCTION**

The use of frequencies by radio-communication services is governed by provisions of the Radio Regulations promulgated by the International Telecommunication Union (ITU/RR). Frequency assignments made to a particular user must be made in accordance with the ITU/RR, which:

- define the various radio-communication services (see paragraph 2.2);
- list frequency allocations for these services (see paragraph 2.4);
- specify technical conditions for the frequency's use; and
- state procedures to be followed for obtaining frequency assignments and notifying the ITU International Frequency Registration Board (IFRB).

Two services are commonly employed by CCSDS Agencies for communicating with their spacecraft. These have been named by the ITU as the Space Operation Service and the Space Research Service.

**2.2 ITU/RR DEFINITIONS****2.2.1 SPACE OPERATION SERVICE (ITU/RR/25)**

*A radio-communication service concerned exclusively with the operation of spacecraft, in particular space tracking, space telemetry and space telecommand (TTC). These functions will normally be provided within the service in which the spacecraft is operating.*

**2.2.2 SPACE RESEARCH SERVICE (ITU/RR/52)**

*A radio-communication service in which spacecraft and other objects in space are used for scientific and technological research.*

**2.3 DEEP SPACE AND NON-DEEP SPACE**

Much of the radio frequency standardization has already been accomplished by the International Telecommunications Union (ITU) and will be found in the Radio Regulations. The provisions contained in the ITU Radio Regulations, as well as applicable CCIR documents, are adopted and incorporated here by reference.

Four *radiocommunication services* are of interest to the CCSDS. In accordance with the ITU definitions these are: the Space Research Service, the Space Operation Service, the Earth Exploration Satellite Service, and the Meteorological Satellite Service.

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

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Within the Space Research Service, a distinction is made between *Deep Space* and *non-Deep Space* spacecraft. Those bands allocated to *Space Research/Deep Space* shall only be used by spacecraft engaged in interplanetary research, whose range exceeds a specified distance.

Earth station - spacecraft distance is important for two reasons. First, certain frequencies are reserved for spacecraft operating in *Deep Space*. Second, some of the RF and modulation characteristics may be different for the two categories.

Formerly, the Radio Regulations set the *Deep Space* boundary at lunar distance. However, the advent of spacecraft in highly elliptical earth orbits that go beyond lunar distance, or which may be in orbits around the sun-earth libration points, resulted in non-optimum use of the *Deep Space* bands when frequency assignments for these missions were based upon the former definition.

In October 1988, the World Administrative Radio Conference (WARC) ORB-88 revised the boundary for *Deep Space* contained in Article 1 of the ITU Radio Regulations. The new boundary for *Deep Space*, which became effective on 16 March 1990, has been established to be at a distance equal to, or greater than,  $2.0 \times 10^6$  km.

While the Radio Regulations contain a definition for *Deep Space*, they do not specifically name that zone lying closer to the earth. Thus, there is no internationally recognized term for *non-Deep Space* missions.

Several years ago, the CCSDS recognized the deficiencies with the ITU's lunar distance *Deep Space* boundary. Accordingly, CCSDS members agreed among themselves to establish the *Deep Space* boundary at  $2.0 \times 10^6$  km whenever that was possible under the then existing Radio Regulations. To avoid confusion with the ITU's definition for *Deep Space*, as well as to simplify the nomenclature for missions at any distance, the CCSDS defined the following mission categories:

|            |  |
|------------|--|
| Category A | Those missions having an altitude above the earth of less than, $2.0 \times 10^6$ km.              |
| Category B | Those missions having an altitude above the earth equal to, or greater than, $2.0 \times 10^6$ km. |

Figure 2.3-1 pictorially depicts the Category A and B mission regions.

Because this terminology has become well established over the years, and because the ITU has still failed to define that region lying closer to earth than  $2.0 \times 10^6$  km, the CCSDS will continue to use the two Categories to represent the applicability of a Recommendation to a specific class of mission.

Therefore, the letter A or B following the Recommendation number means that the Recommendation applies solely to Category A or Category B missions respectively. If the Recommendation number stands alone, with neither an A or B following, then that Recommendation applies equally to both Category A and Category B missions.

Earth Stations

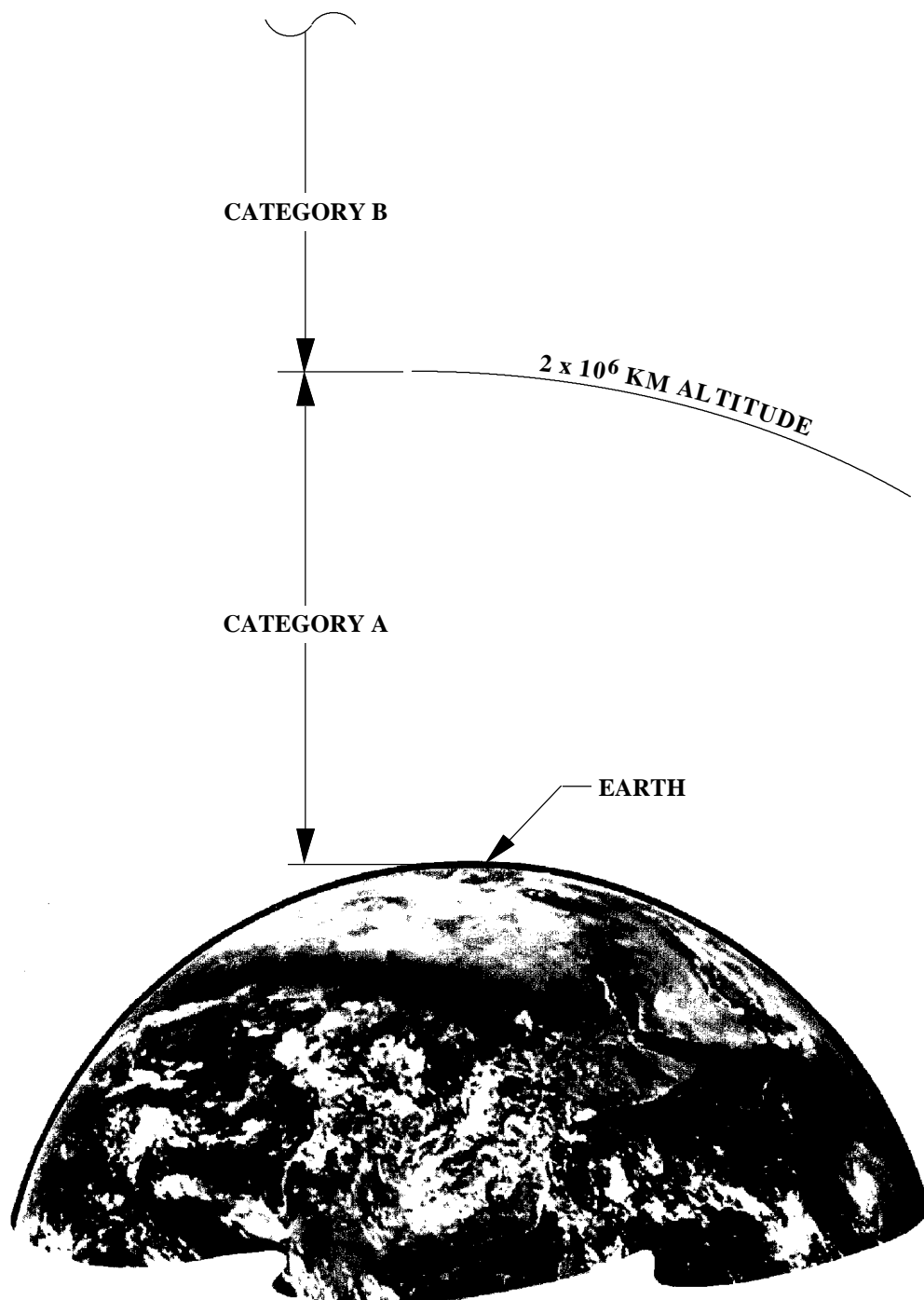


FIGURE 2.3-1 MISSION CATEGORIES

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

## 2.4 FREQUENCY BANDS ALLOCATED TO THE SPACE OPERATION AND SPACE RESEARCH SERVICES

Tables 2.4-1, 2.4-2, and 2.4-3 list the frequency bands allocated by the World Administrative Radio Conference, Geneva 1979.

Although the allocations shown in Table 2.4-2 have traditionally been utilized for Category A spacecraft, there is no regulatory restriction preventing their use for Category B missions.

However, typically, there is a large disparity in received signal strength from Category A and B missions. Strong signals in a band increase the difficulty of assigning frequencies in order to protect weaker signals from interference. Therefore, the CCSDS recommends that Category B missions communicate using only those frequencies which are reserved solely for their use as shown in Table 2.4-3.

**TABLE 2.4-1**

**FREQUENCY ALLOCATIONS IN THE SPACE OPERATION SERVICE**

| FREQUENCY<br>BAND   | DIRECTION<br>INDICATOR | ALLOCATION<br>STATUS   |
|---------------------|------------------------|------------------------|
| 136 - 137 MHz       | Space-Earth            | Secondary              |
| 137 - 138 MHz       | Space-Earth            | Primary                |
| 148 - 149.9 MHz     | Earth-Space            | FN (Art. 14)           |
| 267 - 272 MHz       | Space-Earth            | Secondary              |
| 272 - 273 MHz       | Space-Earth            | Primary                |
| 400.15 - 401 MHz    | Space-Earth            | Secondary              |
| 401 - 402 MHz       | Space-Earth            | Primary                |
| 449.75 - 450.25 MHz | Earth-Space            | FN (Art. 14)           |
| 1427 - 1429 MHz     | Earth-Space            | Primary                |
| 1525 - 1535 MHz     | Space-Earth            | Primary                |
| 2025 - 2110 MHz     | Earth-Space            | FN (Art. 14)           |
| 2200 - 2290 MHz     | Space-Earth            | FN (Art. 14)           |
| 7125 - 7155 MHz     | Earth-Space            | FN (Art. 14), Region 2 |

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## Earth Stations

TABLE 2.4-2

## FREQUENCY ALLOCATIONS IN THE SPACE RESEARCH SERVICE

## CATEGORY A MISSIONS

| FREQUENCY<br>BAND | DIRECTION<br>INDICATOR | ALLOCATION<br>STATUS    |
|-------------------|------------------------|-------------------------|
| 136 - 137 MHz     | Space-Earth            | Secondary               |
| 137 - 138 MHz     | Space -Earth           | Primary                 |
| 400.15 - 401 MHz  | Space-Earth            | Primary                 |
| 2025 - 2110 MHz   | Earth-Space            | FN (Art. 14)            |
| 2200 - 2290 MHz   | Space-Earth            | FN (Art. 14)            |
| 7190 - 7235 MHz   | Earth-Space            | FN (Art. 14)            |
| 8450 - 8500 MHz   | Space-Earth            | Primary                 |
| 13.25 - 13.4 GHz  | Earth-Space            | FN (Secondary, Art. 14) |
| 13.4 - 14.3 GHz   | None                   | Secondary               |
| 14.4 - 14.47 GHz  | Space-Earth            | Secondary               |
| 14.5 - 15.35 GHz  | None                   | Secondary               |
| 31.0 - 31.3 GHz   | None                   | Secondary               |
| 31.8 - 32.3 GHz   | Space-Earth            | Secondary               |
| 34.7 - 35.2 GHz   | None                   | Secondary               |
| 65.0 - 66.0 GHz   | None                   | Primary                 |

TABLE 2.4-3

## FREQUENCY ALLOCATIONS IN THE SPACE RESEARCH SERVICE

## CATEGORY B MISSIONS

| FREQUENCY<br>BAND | DIRECTION<br>INDICATOR | ALLOCATION<br>STATUS          |
|-------------------|------------------------|-------------------------------|
| 2110 - 2120 MHz   | Earth-Space            | FN (Art. 14)                  |
| 2290 - 2300 MHz   | Space-Earth            | Primary                       |
| 7145 - 7190 MHz   | Earth-Space            | FN (Art. 14)                  |
| 8400 - 8450 MHz   | Space-Earth            | Primary                       |
| 12.75 - 13.25 GHz | Space-Earth            | Secondary                     |
| 16.6 - 17.1 MHz   | Earth-Space            | Secondary                     |
| 31.8 - 32.3 MHz   | Space-Earth            | Primary, (Australia/Spain/US  |
| 34.2 - 34.7 MHz   | Earth-Space            | Secondary, (Cat. A elsewhere) |

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**2.4.1 ALLOCATION STATUS OF FREQUENCY BANDS**

Most frequency bands are shared by several services. Within a given band, a different allocation status may be assigned to the various services. Primary and Secondary allocations are employed to ensure maximum band utilization while providing the greatest protection to the Primary users.

All services having the same status are on an equal footing and must resolve interference problems between themselves. However, where different classifications are involved, those services with a Primary status are granted a superior right to those with a Secondary allocation status. Generally, services having a Secondary allocation shall not cause harmful interference to any station of a service in the same frequency band with a Primary allocation. Moreover, a service having a Secondary allocation cannot claim protection from interference caused by stations with a Primary status sharing the same frequency band.

Allocations created by Footnote (FN) frequently appear in the Radio Regulations. Often this method is used when additional regulatory conditions are placed on the use of a frequency band by the named service. An example is the requirement for supplementary coordination imposed by Article 14 of the Radio Regulations.

Article 14 (Art. 14) is a provision within the Radio Regulations that sets forth a specific coordination procedure. This Article is typically used in conjunction with a Footnote allocation and requires that an agreement be reached with other services in the same frequency band having a Primary allocation.

**Earth Stations**

**3.0 STATION LOCATION AND SUMMARY PERFORMANCE**

This section contains a graphical display of the distribution of CCSDS ground stations. A data base has been added that will allow preliminary selection of a set of ground stations that meet mission requirements by summarizing the antenna diameter, uplink frequency and EIRP, downlink frequency and G/T. Later, the five detailed data sheets for each antenna can be consulted to select the particular station that best fits the requirements.

Earth Stations

| CCSDS GROUND STATION DATABASE |                  |                 |                |               |                 |                |                |             |                |             |                |             |               |              |  |
|-------------------------------|------------------|-----------------|----------------|---------------|-----------------|----------------|----------------|-------------|----------------|-------------|----------------|-------------|---------------|--------------|--|
| AGENCY                        | SITE             | ANT<br>DIAM (m) | Fxmit<br>(GHz) | EIRP<br>(dBW) | Fxmit2<br>(GHz) | EIRP2<br>(dBW) | Frcv1<br>(GHz) | GT1<br>(dB) | Frcv2<br>(GHz) | GT2<br>(dB) | Frcv3<br>(GHz) | GT3<br>(dB) | Long<br>(deg) | Lat<br>(deg) |  |
| CCRS                          | GATINEAO         | 10 (2)          |                |               |                 |                | 2.2 - 2.3      | 21          | 8.025 - 8.4    | 31.5        |                |             | 284           | 45           |  |
| CCRS                          | PRINCE ALBERT    | 10 (2)          |                |               |                 |                | 2.2 - 2.3      | 21          | 8.025 - 8.4    | 31.5        |                |             | 254           | 53           |  |
| CLRC/RAL                      | CHILTON          | 12.5            | 2 - 2.1        | 66            |                 |                | 2.2 - 2.3      | 26          |                |             |                |             | 358E          | 51N          |  |
| CLTC                          | YW-TWO ICB       | 9               | 5.9 - 6.4      | 84            |                 |                | 3.7 - 4.2      | 25          |                |             |                |             | 121E          | 32N          |  |
| CLTC                          | QINGDAO USB      | 10              | 2.025 - 2.1    | 69            |                 |                | 2.2 - 2.3      | 20.5        |                |             |                |             |               |              |  |
| CLTC                          | WEINAN USB       | 10              | 2.025 - 2.1    | 69            |                 |                | 2.2 - 2.3      | 20.5        |                |             |                |             |               |              |  |
| CLTC                          | XIAMEN USB       | 10              | 2.025 - 2.1    | 69            |                 |                | 2.2 - 2.3      | 20.5        |                |             |                |             |               |              |  |
| CLTC                          | KASHI USB        | 12              | 2.025 - 2.1    | 71            |                 |                | 2.2 - 2.3      | 22.5        |                |             |                |             |               |              |  |
| CLTC                          | NANNING USB      | 12              | 2.025 - 2.1    | 71            |                 |                | 2.2 - 2.3      | 22.5        |                |             |                |             |               |              |  |
| CLTC                          | WEINAN ICB       | 15              | 5.9 - 6.4      | 88            |                 |                | 3.7 - 4.2      | 32          |                |             |                |             | 110E          | 34N          |  |
| CLTC                          | XIAMEM ICB       | 15              | 5.9 - 6.4      | 88            |                 |                | 3.7 - 4.2      | 32          |                |             |                |             | 118E          | 24N          |  |
| CNES                          | KERGUELEN        | 10              | 2.025 - 2.22   | 72            |                 |                | 2.2 - 2.29     | 23          |                |             |                |             | 70E           | 49S          |  |
| CNES                          | AUSSAGUEL        | 11              | 2.025 - 2.22   | 71            |                 |                | 2.2 - 2.29     | 22.5        |                |             |                |             | 1E            | 43N          |  |
| CNES                          | KOUROU           | 11              | 2.025 - 2.22   | 71            |                 |                | 2.2 - 2.29     | 22.5        |                |             |                |             | 307E          | 5N           |  |
| CRL                           | KASHIMA CS       | 10              | 5.9 - 6.4      | 76            |                 |                | 3.7 - 4.2      | 32.9        |                |             |                |             | 140           | 35           |  |
| CRL                           | KASHIMA          | 11              |                |               |                 |                | 2.2 - 2.3      | 24          |                |             |                |             | 140           | 35           |  |
| CRL                           | KASHIMA BS       | 13              | 14 - 14.5      | 96.2          |                 |                | 11.7 - 12.2    | 33.5        |                |             |                |             | 140           | 35           |  |
| CRL                           | KASHIMA          | 26              |                |               |                 |                | 2.2 - 2.32     | 30.5        | 8.18 - 8.6     | 41.2        |                |             | 140           | 35           |  |
| CRL                           | KASHIMA          | 34              |                |               |                 |                | 2.15 - 2.35    | 38          | 8.18 - 8.6     | 50          |                |             | 140           | 35           |  |
| CSA                           | SASKATOON        | 10              | 2.025 - 2.12   | 59            |                 |                | 2.2 - 2.3      | 20          |                |             |                |             | 253           | 52           |  |
| CSA                           | ST. HUBERT       | 10              | 2.025 - 2.12   | 59            |                 |                | 2.2 - 2.3      | 20          |                |             |                |             | 286           | 45           |  |
| CSIR                          | SGS OTB          | 2               | 2.025 - 2.12   | 46            |                 |                | 2.2 - 2.3      | 5.6         |                |             |                |             | 20E           | 34S          |  |
| CSIR                          | OTB-MS2          | 4.6             |                |               |                 |                | 2.18 - 2.47    | 12.4        |                |             |                |             | 20E           | -34S         |  |
| CSIR                          | OTB-ML2 (MOBILE) | 4.6             |                |               |                 |                | 2.18 - 2.47    | 12.4        |                |             |                |             |               | -            |  |
| CSIR                          | HBK              | 6.1             | 2 - 2.1        | 77            |                 |                |                |             |                |             |                |             | 27E           | 25S          |  |
| CSIR                          | HBK              | 10              |                |               |                 |                | 1.65 - 1.75    | 20.5        | 2.2 - 2.3      |             | 20.5           |             | 27E           | 25S          |  |
| CSIR                          | SGS OTB          | 10              | 2.025 - 2.12   | 60            |                 |                | 2.2 - 2.3      | 19.9        | 7.94 - 8.55    | 32.4        |                |             | 20E           | 34S          |  |
| CSIR                          | HBK              | 12              |                |               |                 |                | 1.65 - 1.75    | 22.1        | 2.2 - 2.3      |             |                |             | 27E           | 25S          |  |

CCSDS HISTORICAL DOCUMENT

CCSDS GROUND STATION DATABASE

| AGENCY   | SITE            | ANT<br>DIAM (m) | Fxmit<br>(GHz) | EIRP<br>(dBW) | Fxmit2<br>(GHz) | EIRP2<br>(dBW) | Frcv1<br>(GHz) | GT1<br>(dB) | Frcv2<br>(GHz) | GT2<br>(dB) | Frcv3<br>(GHz) | GT3<br>(dB) | Long<br>(deg) | Lat<br>(deg) |
|----------|-----------------|-----------------|----------------|---------------|-----------------|----------------|----------------|-------------|----------------|-------------|----------------|-------------|---------------|--------------|
| CSIRO    | PARKES DSS 49   | 64              |                |               |                 |                | 2.29 - 2.3     | 49          |                |             |                |             | 148           | -32          |
| DLR      | DFD-AVHHR       | 2.4             |                |               |                 |                | 1.65 - 1.755   |             |                |             |                |             | 11E           | 48N          |
| DLR      | S/X NEUSTRELITZ | 7.3             |                |               |                 |                | 1.67 - 1.72    | 12          | 2.2 - 2.3      | 17          |                |             | 13            | 53           |
| DLR      | LIBREVILLE      | 8               |                |               |                 |                | 1.7 - 2.3      |             | 8 - 8.4        |             |                |             | 9             | 0.2          |
| DLR      | GARS            | 9               |                |               |                 |                | 1.65 - 1.75    |             | 2.2 - 2.3      | 20.5        | 8.025 - 8.5    | 31.1        | 57W           | 63S          |
| DLR      | LEOP KU         | 11.1            | 13.75 - 14.5   | 90            |                 |                | 10.7 - 12.75   | 37.5        |                |             |                |             | 10            | 47           |
| DLR      | 15M 1 STATION   | 15              | 2.025 - 2.12   | 80            |                 |                | 2.2 - 2.3      | 26.9        |                |             |                |             | 11            | 47           |
| DLR      | 15M 2 STATION   | 15              | 2.025 - 2.12   | 80            |                 |                | 2.2 - 2.3      | 29          |                |             |                |             | 11            | 47           |
| DLR      | 30M             | 30              | 2.025 - 2.12   | 94            |                 |                | 2.29 - 2.3     | 33.5        | 8.4 - 8.44     | 46          | 5.825 - 5.925  |             | 11            | 47           |
| DRA      | LASHAM          | 2.4             |                |               |                 |                | 1.54 - 1.72    | 7.1         |                |             |                |             | 358E          | 51N          |
| DRA      | LASHAM          | 3.6             |                |               |                 |                | 1.54 - 1.72    | 27.6        |                |             |                |             | 358E          | 51N          |
| DRA      | LASHAM          | 4.6             |                |               |                 |                | 1.544 - 1.72   | 12.4        |                |             |                |             | 358E          | 51N          |
| DRA      | LASHAM          | 12.2            | 2.0975         | 52            |                 |                | 1.5 - 2.1      | 13.8        |                |             |                |             | 358E          | 51N          |
| ESA      | KIRUNA          | 15              | 2.025 - 2.12   | 71            |                 |                | 2.2 - 2.3      | 28.9        | 8.025 - 8.5    | 34.5        |                |             | 20E           | 67N          |
| ESA      | KOUROU-93       | 15              | 2.025 - 2.12   | 73            |                 |                | 2.2 - 2.3      | 30.1        | 8.025 - 8.5    | 38.2        |                |             | 307E          | 5N           |
| ESA      | PERTH           | 15              | 2.025 - 2.12   | 72            |                 |                | 2.2 - 2.3      | 28.2        | 8.025 - 8.5    | 38.2        |                |             | 115E          | 31S          |
| ESA      | REDU            | 15              | 2.025 - 2.12   | 73            |                 |                | 2.2 - 2.3      | 30.1        |                |             |                |             | 5E            | 50N          |
| ESA      | VILSPA -1       | 15              | 2.025 - 2.12   | 73            |                 |                | 2.2 - 2.3      | 30.1        |                |             |                |             | 356E          | 40N          |
| ESA      | VILSPA -2       | 15              | 2.025 - 2.12   | 72            |                 |                | 2.2 - 2.3      | 29          |                |             |                |             | 356E          | 40N          |
| ESA      | PERTH           | 32              | 2.025 - 2.12   | 72            |                 |                | 2.2 - 2.3      | 37.5        | 8.4 - 8.5      | 50.1        |                |             | 115E          | 31S          |
| EUTELSAT | TR2 RAMBOUILLET | 3.7             | 14 - 14.5      | 71            |                 |                | 10.95 - 11.7   | 29.7        |                |             |                |             | 01E           | 48N          |
| EUTELSAT | TS1 SINTRA      | 3.7             | 14 - 14.5      | 71            |                 |                | 10.95 - 11.7   | 29.7        |                |             |                |             | 9W            | 38N          |
| EUTELSAT | TR3-TR6         | 4.57 (4)        | 14 - 14.5      | 71            |                 |                | 10.95 - 11.7   | 29.7        |                |             |                |             | 01E           | 48N          |
| EUTELSAT | TS2-TS6 SINTRA  | 4.57 (5)        | 14 - 14.5      | 71            |                 |                | 10.95 - 11.7   | 29.7        |                |             |                |             | 9W            | 38N          |
| EUTELSAT | TSU SINTRA      | 7.3             | 2.08 - 2.095   | 61            |                 |                | 2.26 - 2.275   | 17          |                |             |                |             | 9W            | 38N          |
| INPE     | DSA GRD STATION | 3.6             |                |               |                 |                | 1.65 - 1.75    |             |                |             |                |             | 45            | 22           |
| INPE     | ALCANTARA ETA   | 11              | 2.025 - 2.12   | 72            |                 |                | 2.2 - 2.3      | 23          |                |             |                |             | 44W           | 2S           |
| INPE     | CUIABA ETC      | 11              | 2.025 - 2.12   | 72            |                 |                | 2.2 - 2.3      | 22          |                |             |                |             | 56W           | 15S          |
| ISAS     | USUDA           | 64              | 2.08 - 2.12    | 107           |                 |                | 2.2 - 2.3      | 46.7        | 8.4 - 8.5      | 51.2        |                |             | 138E          | 36N          |

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| CCSDS GROUND STATION DATABASE |                    |                 |                |               |                 |                |                |             |                |             |                |             |               |              |  |
|-------------------------------|--------------------|-----------------|----------------|---------------|-----------------|----------------|----------------|-------------|----------------|-------------|----------------|-------------|---------------|--------------|--|
| AGENCY                        | SITE               | ANT<br>DIAM (m) | Fxmit<br>(GHz) | EIRP<br>(dBW) | Fxmit2<br>(GHz) | EIRP2<br>(dBW) | Frcv1<br>(GHz) | GT1<br>(dB) | Frcv2<br>(GHz) | GT2<br>(dB) | Frcv3<br>(GHz) | GT3<br>(dB) | Long<br>(deg) | Lat<br>(deg) |  |
| ISRO                          | PORT BLAIR         | 8               | 2.025 - 2.12   | 73            |                 |                | 2.2 - 2.29     | 18          |                |             |                |             | 92            | 9            |  |
| ISRO                          | TRIVANDRUM         | 8               |                |               |                 |                | 2.2 - 2.29     | 17.5        |                |             |                |             | 76            | 8            |  |
| ISRO                          | BANGALORE          | 10              | 2.025 - 2.12   | 74            |                 |                | 2.2 - 2.29     | 19.5        |                |             |                |             | 77            | 13           |  |
| ISRO                          | LUCKNOW            | 10              | 2.025 - 2.12   | 74            |                 |                | 2.2 - 2.29     | 19.5        |                |             |                |             | 80            | 26           |  |
| ISRO                          | MAURITIUS          | 10              | 2.025 - 2.12   | 74            |                 |                | 2.2 - 2.29     | 19.5        |                |             |                |             | 57            | -20          |  |
| ISRO                          | SHAR-1             | 10              | 2.025 - 2.12   | 74            |                 |                | 2.2 - 2.29     | 19.5        |                |             |                |             | 80            | 13           |  |
| ISRO                          | SHAR-2             | 10              | 2.025 - 2.12   | 71            |                 |                | 2.2 - 2.29     | 19.5        |                |             |                |             | 80            | 13           |  |
| NASA/DSN                      | 9M (DSS 17)        | 9               | 2.025 - 2.12   | 85            |                 |                | 2.2 - 2.3      | 22.8        |                |             |                |             | 243           | 35           |  |
| NASA/DSN                      | 11M (DSS 23)       | 11              | 7.145 - 7.19   | 62.2          | 15.25 - 15.35   | 59.2           | 8.02 - 8.5     | 35.3        | 14 - 15.25     | 39.3        |                |             | 243           | 35           |  |
| NASA/DSN                      | 11M (DSS 33)       | 11              | 7.145 - 7.19   | 62.2          | 15.25 - 15.35   | 59.2           | 8.02 - 8.5     | 35.3        | 14 - 15.25     | 39.3        |                |             | 148           | -35          |  |
| NASA/DSN                      | 11M (DSS 53)       | 11              | 7.145 - 7.19   | 62.2          | 15.25 - 15.35   | 59.2           | 8.02 - 8.5     | 35.3        | 14 - 15.25     | 39.3        |                |             | 355           | 40           |  |
| NASA/DSN                      | 26M (DSS 16)       | 26              | 2.025 - 2.12   | 93            |                 |                | 2.2 - 2.3      | 31.6        |                |             |                |             | 243           | 35           |  |
| NASA/DSN                      | 26M (DSS 46)       | 26              | 2.025 - 2.12   | 93            |                 |                | 2.2 - 2.3      | 31.6        |                |             |                |             | 148           | -35          |  |
| NASA/DSN                      | 26M (DSS 66)       | 26              | 2.025 - 2.12   | 93            |                 |                | 2.2 - 2.3      | 31.6        |                |             |                |             | 355           | 40           |  |
| NASA/DSN                      | 34M BWG-1 (DSS 24) | 34              | 2.025 - 2.12   | 98.5          |                 |                | 2.2 - 2.3      | 41.5        | 8.4 - 8.5      | 53.9        |                |             | 243           | 35           |  |
| NASA/DSN                      | 34M BWG-1 (DSS 34) | 34              | 2.025 - 2.12   | 98.5          | 7.145 - 7.19    | 105            | 2.2 - 2.3      | 41.5        | 8.4 - 8.5      | 53.9        |                |             | 148           | -35          |  |
| NASA/DSN                      | 34M BWG-1 (DSS 54) | 34              | 2.025 - 2.12   | 98.5          | 7.145 - 7.19    | 105            | 2.2 - 2.3      | 41.5        | 8.4 - 8.5      | 53.9        |                |             | 355           | 40           |  |
| NASA/DSN                      | 34M BWG-2 (DSS 25) | 34              | 7.145 - 7.19   | 105           |                 |                | 8.4 - 8.5      | 53.9        | 31.8 - 32.3    | 61.7        |                |             | 243           | 35           |  |
| NASA/DSN                      | 34M BWG-3 (DSS 26) | 34              | 7.145 - 7.19   | 105           |                 |                | 8.4 - 8.5      | 54.2        |                |             |                |             | 243           | 35           |  |
| NASA/DSN                      | 34M HEF (DSS 15)   | 34              | 7.145 - 7.19   | 110           |                 |                | 2.2 - 2.3      | 39.6        | 8.4 - 8.5      | 55.1        |                |             | 243           | 35           |  |
| NASA/DSN                      | 34M HEF (DSS 45)   | 34              | 7.145 - 7.19   | 110           |                 |                | 2.2 - 2.3      | 39.6        | 8.4 - 8.5      | 55.1        |                |             | 148           | -35          |  |
| NASA/DSN                      | 34M HEF (DSS 65)   | 34              | 7.145 - 7.19   | 110           |                 |                | 2.2 - 2.3      | 39.6        | 8.4 - 8.5      | 55.1        |                |             | 355           | 40           |  |
| NASA/DSN                      | 34M HSB (DSS 27)   | 34              | 2.025 - 2.12   | 77            |                 |                | 2.2 - 2.3      | 34.8        |                |             |                |             | 243           | 35           |  |
| NASA/DSN                      | 34M STD (DSS 42)   | 34              | 2.025 - 2.12   | 98            |                 |                | 2.2 - 2.3      | 42.8        | 8.4 - 8.5      | 52.2        |                |             | 243           | 35           |  |
| NASA/DSN                      | 34M STD (DSS 61)   | 34              | 2.025 - 2.12   | 98            |                 |                | 2.2 - 2.3      | 42.8        | 8.4 - 8.5      | 52.2        |                |             | 355           | 40           |  |
| NASA/DSN                      | 70M (DSS 14)       | 70              | 2.09 - 2.094   | 85.5          | 2.11 - 2.12     | 105.5          | 2.2 - 2.3      | 51.2        | 8.4 - 8.5      | 60.7        |                |             | 243           | 35           |  |
| NASA/DSN                      | 70M (DSS 43)       | 70              | 2.09 - 2.094   | 85.5          | 2.11 - 2.12     | 105.5          | 2.2 - 2.3      | 51.2        | 8.4 - 8.5      | 60.7        |                |             | 148           | -35          |  |
| NASA/DSN                      | 70M (DSS 63)       | 70              | 2.09 - 2.094   | 85.5          | 2.11 - 2.12     | 105.5          | 2.2 - 2.3      | 51.2        | 8.4 - 8.5      | 60.7        |                |             | 355           | 40           |  |
| NASA/GSFC                     | BERMUDA            | 9 (2)           | 2.025 - 2.12   | 83            |                 |                | 2.2 - 2.3      | 24          |                |             |                |             | 295           | 32           |  |
| NASA/GSFC                     | MERRITT ISLAND     | 9 (2)           | 2.025 - 2.12   | 83            |                 |                | 2.2 - 2.3      | 24          |                |             |                |             | 279           | 28           |  |

CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT  
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CCSDS GROUND STATION DATABASE

| AGENCY       | SITE                 | ANT<br>DIAM (m) | Fxmit<br>(GHz) | EIRP<br>(dBW) | Fxmit2<br>(GHz) | EIRP2<br>(dBW) | Frcv1<br>(GHz) | GT1<br>(dB) | Frcv2<br>(GHz) | GT2<br>(dB) | Frcv3<br>(GHz) | GT3<br>(dB) | Long<br>(deg) | Lat<br>(deg) |
|--------------|----------------------|-----------------|----------------|---------------|-----------------|----------------|----------------|-------------|----------------|-------------|----------------|-------------|---------------|--------------|
| NASA/MOBILE  | MOBILE 8-Ft. No. 1 & | 2.4 (2)         |                |               |                 |                | 1.435 - 1.535  | 3.3         | 1.67 - 1.72    | 4.5         | 2.2 - 2.4      | 7           |               |              |
| NASA/MOBILE  | MOBILE 10-Ft. No. 1  | 3               |                |               |                 |                | 1.435 - 1.535  | 3.3         | 1.67 - 1.72    | 4.5         | 2.2 - 2.4      | 7           |               |              |
| NASA/MOBILE  | MOBILE 10-Ft. No. 2  | 3               | 2.025 - 2.12   | 4.2           |                 |                | 1.435 - 1.535  | 3.3         | 1.67 - 1.72    | 4.5         | 2.2 - 2.4      | 7           |               |              |
| NASA/MOBILE  | MOBILE 18-Ft. No. 1  | 5.5             |                |               |                 |                | 1.435 - 1.535  | 9.4         | 1.67 - 1.72    | 11.6        | 2.2 - 2.4      | 14.6        |               |              |
| NASA/MOBILE  | MOBILE 20-Ft. No. 1  | 6.1             |                |               |                 |                | 1.435 - 1.535  | 10.3        | 1.67 - 1.72    | 12.5        | 2.2 - 2.4      | 15.5        |               |              |
| NASA/MOBILE  | TOTS No. 1 & 2       | 8               | 2.025 - 2.12   | 62            |                 |                | 2.2 - 2.4      | 21          |                |             |                |             | 147W          | 65N          |
| NASA/MOBILE  | TOTS No. 3           | 8               | 2.025 - 2.12   | 62            |                 |                | 2.2 - 2.4      | 21          |                |             |                |             | 77W           | 37N          |
| NASA/WALLOPS | AK 2.4               | 2.4             |                |               |                 |                | 2.2 - 2.3      | 7           |                |             |                |             | 147W          | 65N          |
| NASA/WALLOPS | MET                  | 2.4             |                |               |                 |                | 1.435 - 1.535  | 3.3         | 1.67 - 1.72    | 4.5         | 2.2 - 2.4      | 7           | 75W           | 37N          |
| NASA/WALLOPS | TM                   | 2.4             |                |               |                 |                | 1.435 - 1.535  | 3.3         | 1.67 - 1.72    |             | 2.2 - 2.4      | 7           | 75W           | 37N          |
| NASA/WALLOPS | AK 4.9               | 4.9             |                |               |                 |                | 1.435 - 1.535  | 8           | 1.67 - 1.72    | 1           | 2.2 - 2.3      | 12          | 147W          | 65N          |
| NASA/WALLOPS | WALLOPS 6-METER      | 6               | 2.025 - 2.12   | 58.5          |                 |                |                |             |                |             |                |             | 75W           | 37N          |
| NASA/WALLOPS | METEOSAT             | 7.3             |                |               |                 |                | 1.685 - 1.71   | 12          |                |             |                |             | 75W           | 37N          |
| NASA/WALLOPS | MG-NORTH             | 7.3             |                |               |                 |                | 1.435 - 1.535  | 11          | 1.67 - 1.72    | 12.5        | 2.2 - 2.4      | 15.5        | 75W           | 37N          |
| NASA/WALLOPS | MG-SOUTH             | 7.3             |                |               |                 |                | 1.435 - 1.535  | 11          | 1.67 - 1.72    | 12.5        | 2.2 - 2.4      | 15.5        | 75W           | 37N          |
| NASA/WALLOPS | REDSTONE SYSTEM      | 9               |                |               |                 |                | 2.2 - 2.4      | 22          |                |             |                |             | 106W          | 32N          |
| NASA/WALLOPS | REDSTONE SYSTEM      | 9               |                |               |                 |                | 2.2 - 2.4      | 22          |                |             |                |             | 147W          | 65N          |
| NASA/WALLOPS | WALLOPS 9-METER      | 9               | 2.025 - 2.12   | 62            |                 |                | 2.2 - 2.4      | 24          |                |             |                |             | 75W           | 37N          |
| NASA/WALLOPS | AFS 10               | 10              |                |               |                 |                | 2.2 - 2.4      | 21.1        | 8.025 - 8.4    | 32.5        |                |             | 147W          | 64N          |
| NASA/WALLOPS | Mc MURDO             | 10              |                |               |                 |                | 2.2 - 2.4      | 21.1        | 8.025 - 8.4    | 32.5        |                |             | 193W          | -77          |
| NASA/WALLOPS | 11-METER SYSTEM 1    | 11.3            |                |               |                 |                | 2.2 - 2.4      | 23          | 8 - 9          | 35          |                |             | 147W          | 64N          |
| NASA/WALLOPS | 11-METER SYSTEM 2    | 11.3            | 2.025 - 2.12   | 66            |                 |                | 2.2 - 2.4      | 23          | 8 - 9          | 35          |                |             | 75W           | 37N          |
| NASA/WALLOPS | 11-METER SYSTEM 3    | 11.3            | 2.025 - 2.12   | 66            |                 |                | 2.2 - 2.4      | 23.2        | 8 - 9          | 38          |                |             |               |              |
| NASA/WALLOPS | 11-METER SYSTEM 4    | 11.3            | 2.025 - 2.12   | 66            |                 |                | 2.2 - 2.4      | 23.2        | 8 - 9          | 38          |                |             |               |              |
| NASA/WALLOPS | ADAS                 | 18              |                |               |                 |                | 1.435 - 1.535  | 23.2        | 1.67 - 1.72    | 47.5        | 2.2 - 2.4      | 50.1        | 75W           | 37N          |
| NASDA        | KATSUURA No. 2       | 13              | 2.025 - 2.12   | 82            |                 |                | 2.2 - 2.3      | 23          |                |             |                |             | 140           | 35           |
| NASDA        | MASUDA No. 2         | 13              | 2.025 - 2.12   | 82            |                 |                | 2.2 - 2.3      | 22          |                |             |                |             | 131           | 30           |
| NASDA        | KATSUURA No. 1       | 18              | 2.025 - 2.12   | 84            |                 |                | 2.2 - 2.3      | 24          |                |             |                |             | 140           | 35           |
| NASDA        | MASUDA No. 1         | 18              | 2.025 - 2.12   | 84            |                 |                | 2.2 - 2.3      | 26          |                |             |                |             | 131           | 30           |
| NASDA        | OKINAWA No. 1        | 18              | 2.025 - 2.11   | 84            |                 |                | 2.2 - 2.29     | 25          |                |             |                |             | 127           | 26           |
| NASDA        | OKINAWA No. 2        | 18              | 2.025 - 2.11   | 83            |                 |                | 2.2 - 2.29     | 24          |                |             |                |             | 127           | 26           |

Earth Stations

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3.1-5

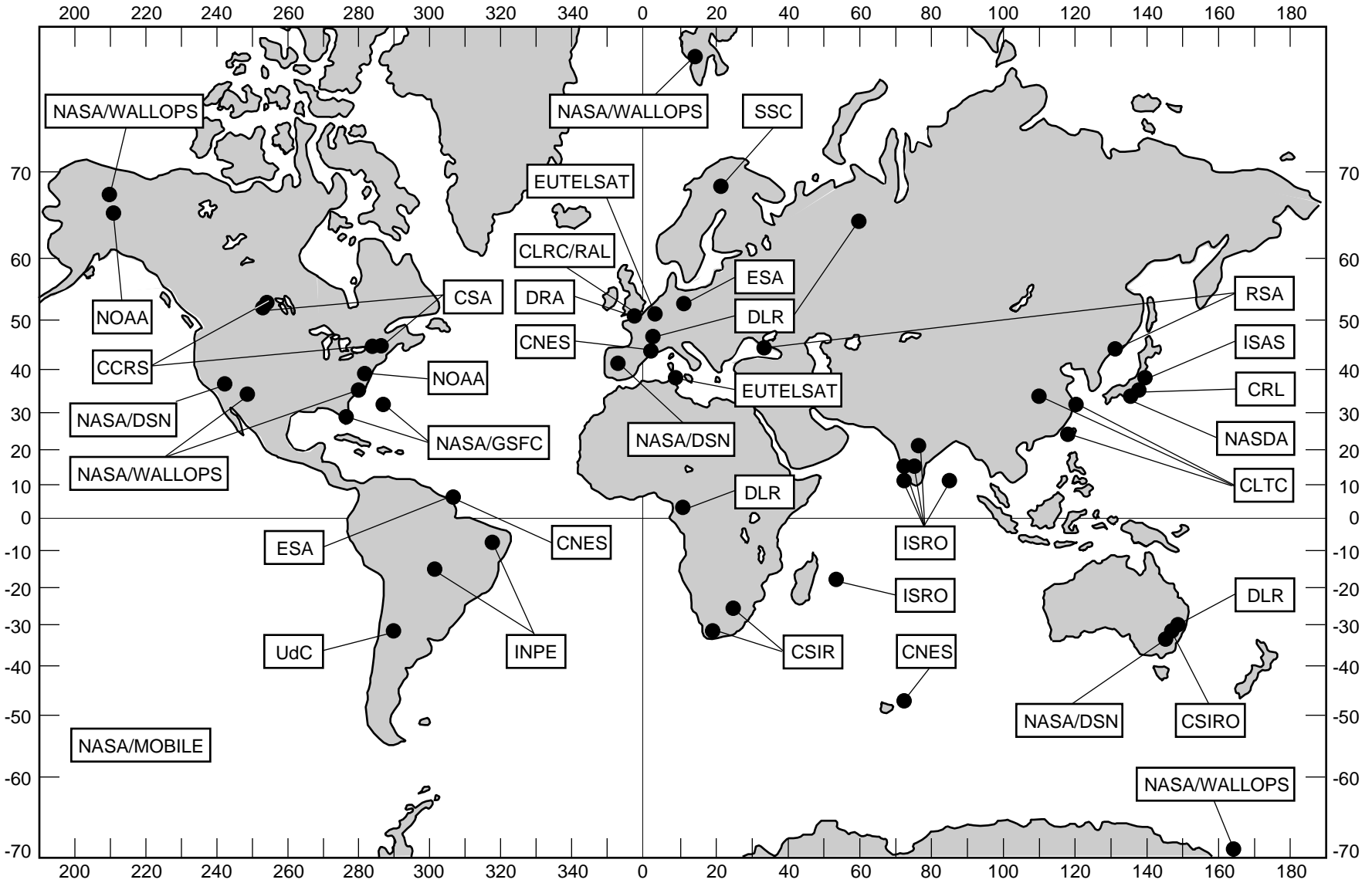
May 1997

| CCSDS GROUND STATION DATABASE |                |                 |                |               |                 |                |                |             |                |             |                |             |               |              |  |
|-------------------------------|----------------|-----------------|----------------|---------------|-----------------|----------------|----------------|-------------|----------------|-------------|----------------|-------------|---------------|--------------|--|
| AGENCY                        | SITE           | ANT<br>DIAM (m) | Fxmit<br>(GHz) | EIRP<br>(dBW) | Fxmit2<br>(GHz) | EIRP2<br>(dBW) | Frcv1<br>(GHz) | GT1<br>(dB) | Frcv2<br>(GHz) | GT2<br>(dB) | Frcv3<br>(GHz) | GT3<br>(dB) | Long<br>(deg) | Lat<br>(deg) |  |
| NOAA                          | FAIRBANKS CDA  | 4               | 2.02 - 2.12    | 67            |                 |                |                |             |                |             |                |             | 148           | 64           |  |
| NOAA                          | WALLOPS CDA    | 4               | 2.02 - 2.12    | 67            |                 |                |                |             |                |             |                |             | 75            | 37           |  |
| NOAA                          | FAIRBANKS CDA  | 6               | 2.02 - 2.12    | 82            |                 |                | 2.2 - 2.3      | 21.7        |                |             |                |             | 148           | 64           |  |
| NOAA                          | FAIRBANKS CDA  | 12              |                |               |                 |                | 1.69 - 1.71    | 21          | 2.2 - 2.3      | 23.2        |                |             | 148           | 64           |  |
| NOAA                          | WALLOPS CDA    | 14.2            | 2.02 - 2.12    | 79.8          |                 |                | 1.69 - 1.71    | 22.5        | 2.2 - 2.3      | 24.4        |                |             | 75            | 37           |  |
| NOAA                          | FAIRBANKS CDA  | 26              |                |               |                 |                | 1.69 - 1.71    | 27          | 2.2 - 2.3      | 29          |                |             | 148           | 64           |  |
| NOAA                          | FAIRBANKS VLBI | 26              |                |               |                 |                | 8.18 - 8.98    | 46          |                |             |                |             | 75            | 37           |  |
| NOAA                          | WALLOPS CDA    | 26              |                |               |                 |                | 1.69 - 1.71    | 18.2        | 2.2 - 2.3      | 23.9        |                |             | 75            | 37           |  |
| RSA                           | ECDSC-25       | 25              | 7.72275        | 93            |                 |                | 5.87 - 5.89    | 41.5        | 0.92 - 0.935   | 26.5        |                |             | 131E          | 44N          |  |
| RSA                           | ECDSC-32       | 32              |                |               |                 |                | 5.87 - 5.89    |             | 0.92 - 0.935   |             |                |             | 131E          | 44N          |  |
| RSA                           | WCDSC-32       | 32              | 5 - 5.025      | 100           | 0.772275        | 94             |                |             |                |             |                |             | 33E           | 45N          |  |
| RSA                           | ECDSC-70       | 70              | 5 - 5.025      | 116           | 0.772275        | 105            | 2.2 - 2.3      | 57          | 5.87 - 5.89    | 45          | 8.37 - 8.53    | 58.5        | 131E          | 44N          |  |
| RSA                           | WCDSC-70       | 70              | 5 - 5.025      | 122           | 0.772275        | 105            | 2.2 - 2.3      | 45          | 5.87 - 5.89    | 57          | 8.37 - 8.53    | 58.5        | 33E           | 45N          |  |
| SSC                           | KIRUNA TTC     | 6.1             | 2.025 - 2.12   | 69            |                 |                |                |             |                |             |                |             | 21            | 67           |  |
| SSC                           | KIRUNA ELS     | 9.1             |                |               |                 |                | 2.2 - 2.3      | 21          | 8.025 - 8.4    | 31          |                |             | 21            | 67           |  |
| SSC                           | KIRUNA ESX     | 9.1             |                |               |                 |                | 2.2 - 2.3      | 21          | 8.025 - 8.4    | 31          |                |             | 21            | 67           |  |
| SSC                           | KIRUNA ETX     | 13              | 2.025 - 2.12   | 70            |                 |                | 2.2 - 2.3      | 23.9        | 8.025 - 8.4    | 33.6        |                |             | 21            | 67           |  |
| UdC                           | SANTIAGO       | 9               | 2.025 - 2.12   | 83            |                 |                | 2.2 - 2.3      | 21.8        |                |             |                |             | 289           | -33          |  |
| UdC                           | SANTIAGO       | 12              |                |               |                 |                | 2.2 - 2.3      | 27          | 8 - 8.9        | 40          |                |             | 289           | -33          |  |

Earth Stations

# TRACKING STATIONS SUMMARY

## STATION LOCATIONS



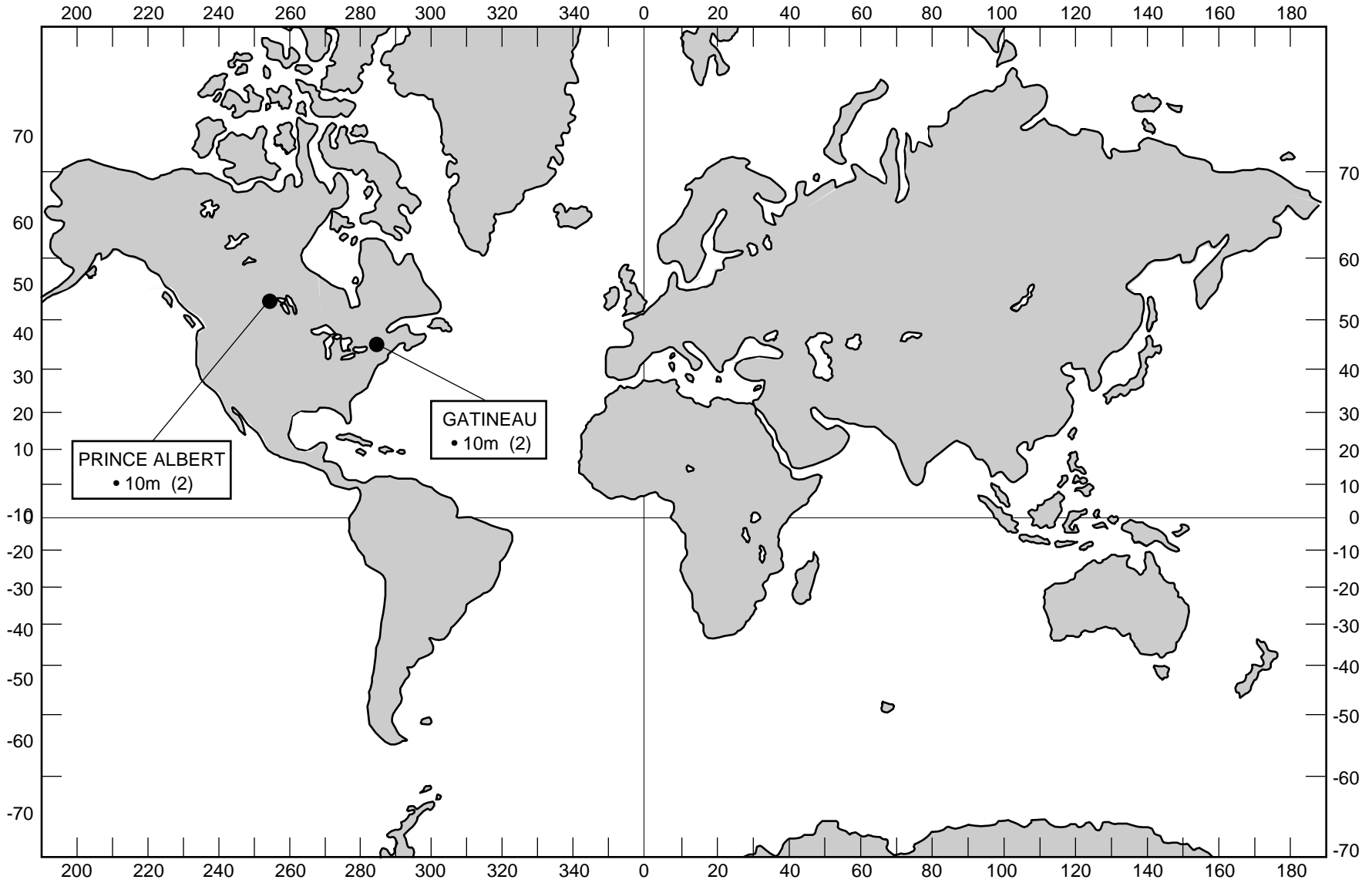
CCSDS 411 G-3

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May 1997

6445-4717

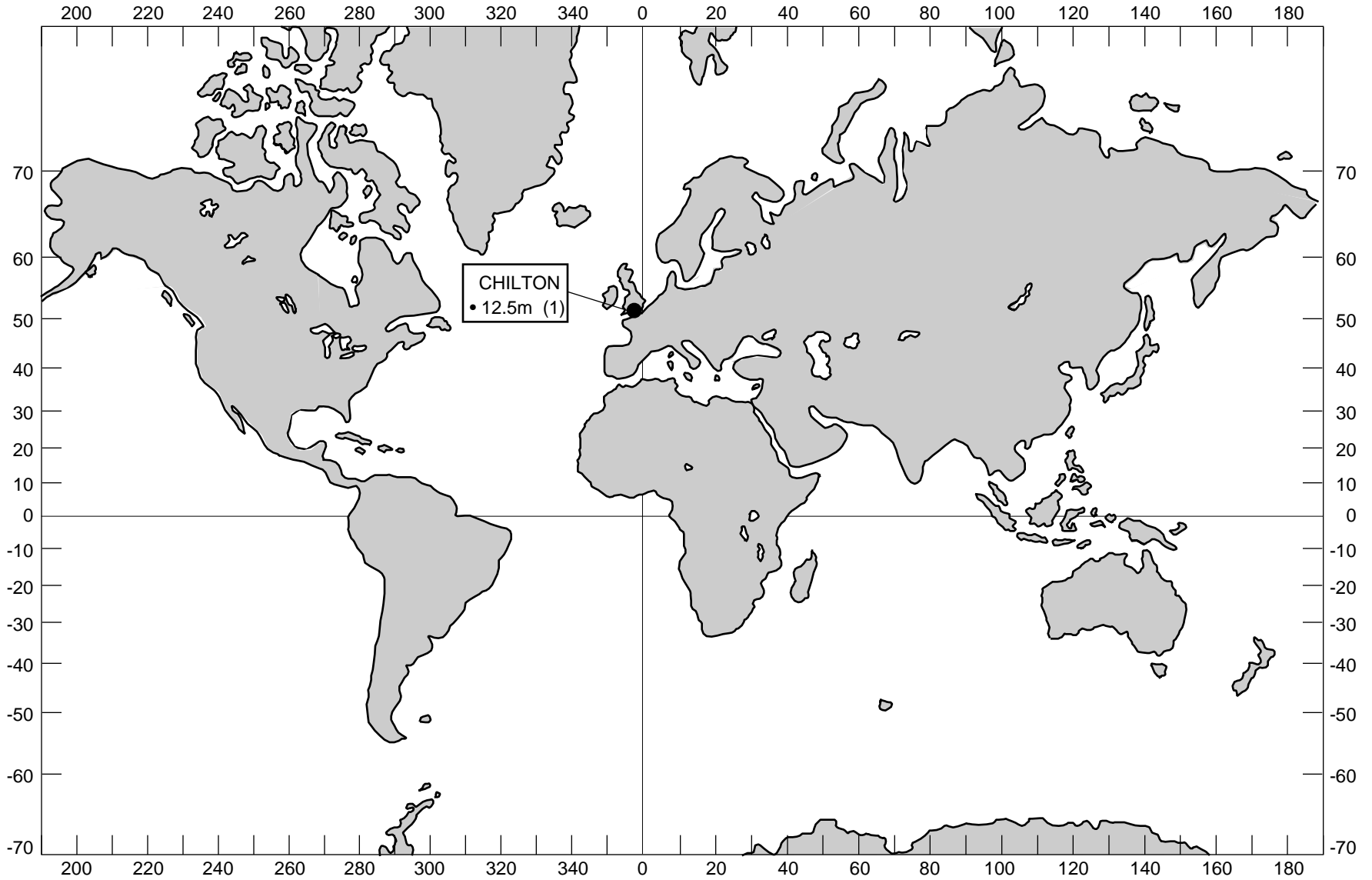
### CCRS RECEIVING STATIONS STATION LOCATIONS



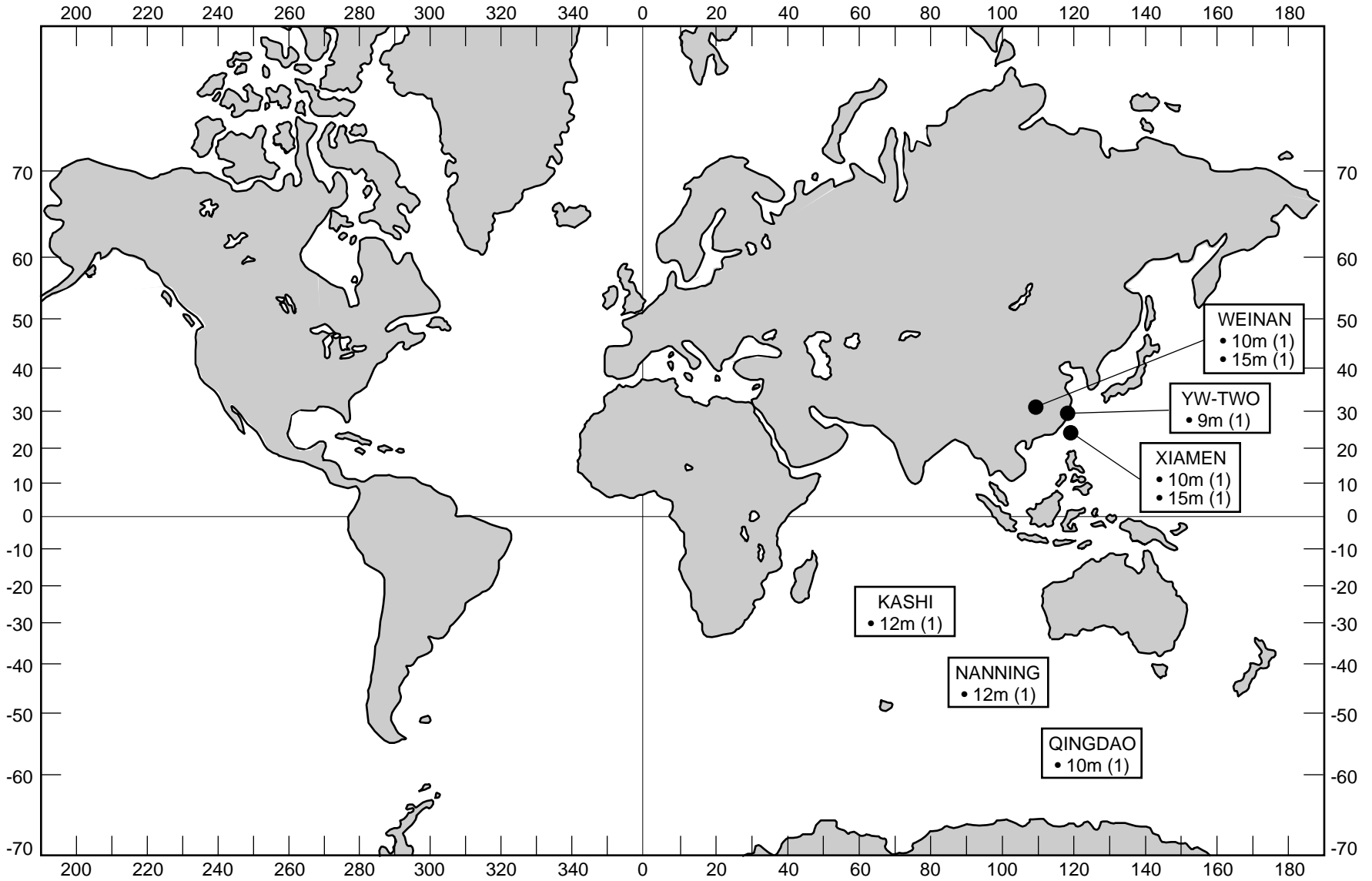
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# CLRC / RAL TRACKING SYSTEM

## STATION LOCATIONS



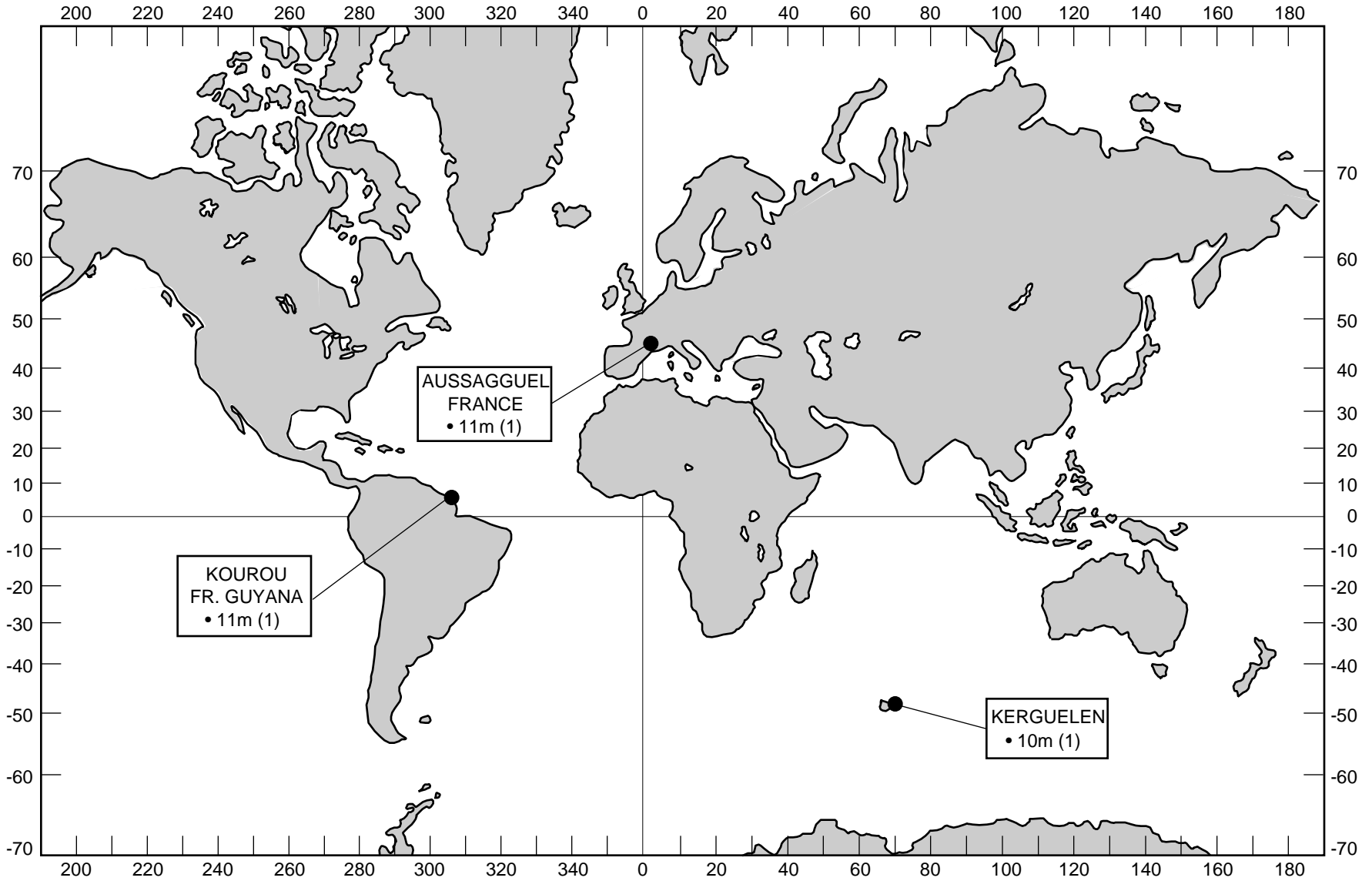
### CLTC TRACKING SYSTEM STATION LOCATIONS



6445-4787

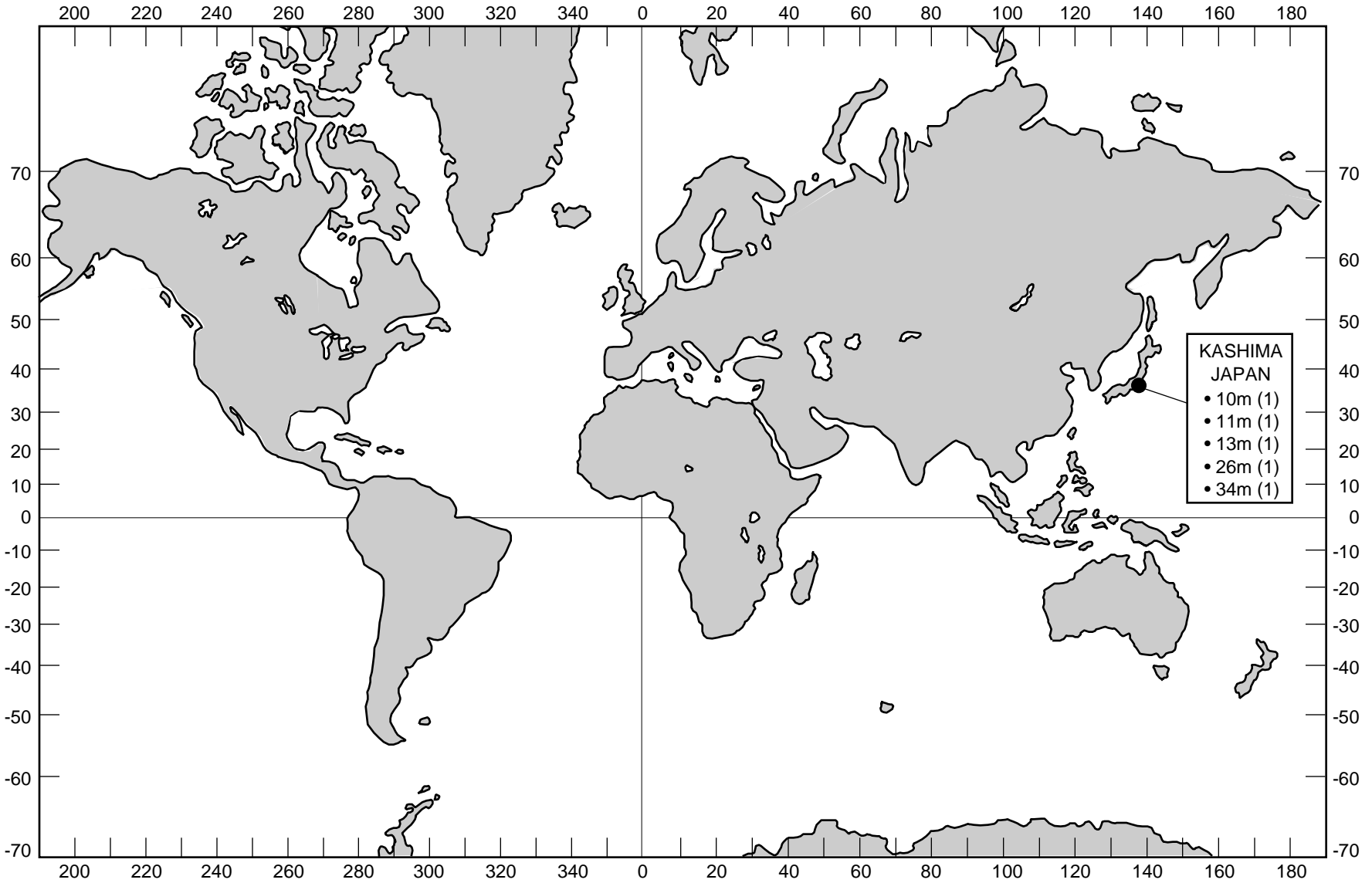
# CNES TRACKING SYSTEM

## STATION LOCATIONS



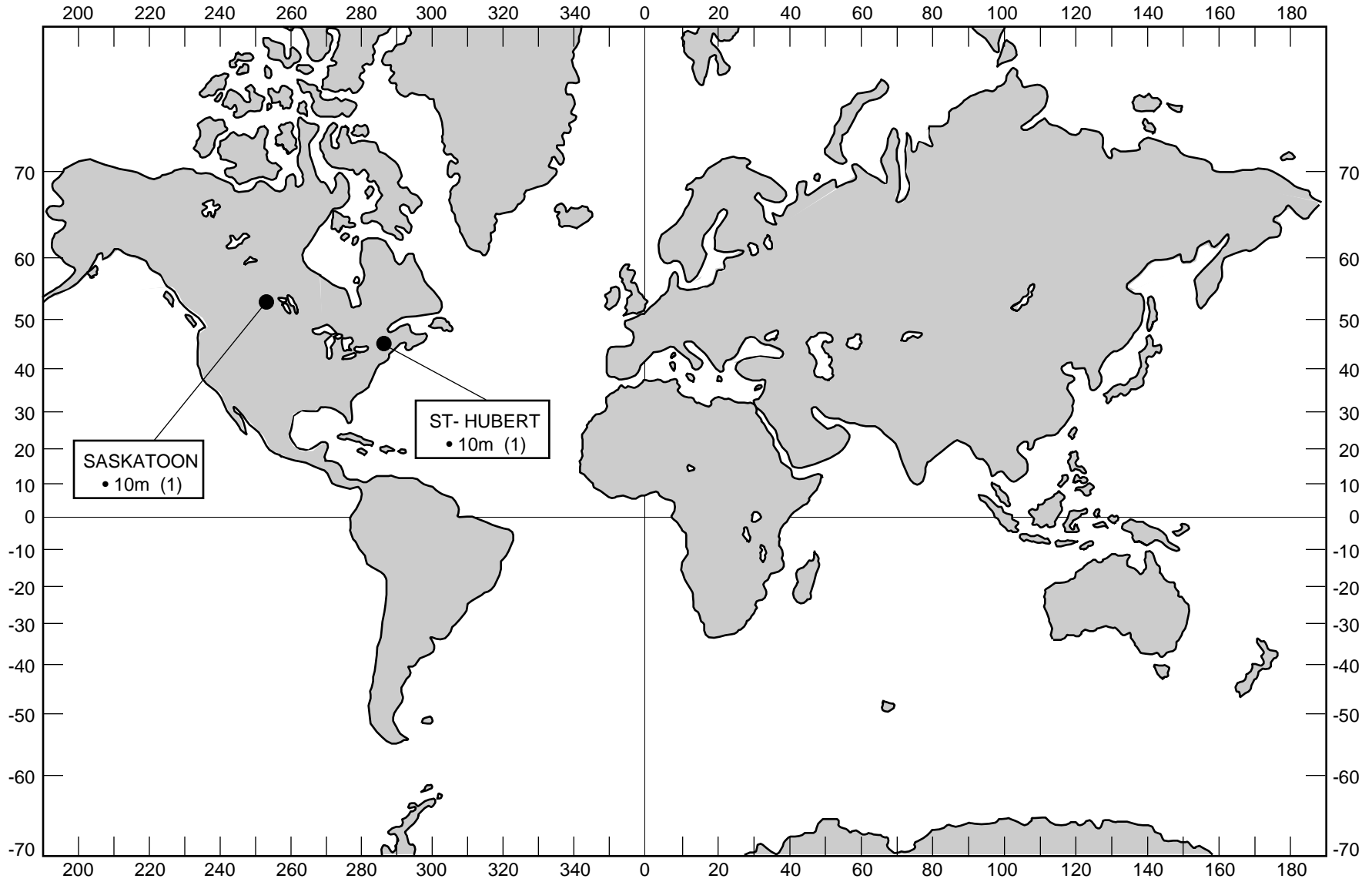
6445-4719

### CRL TRACKING SYSTEM STATION LOCATIONS



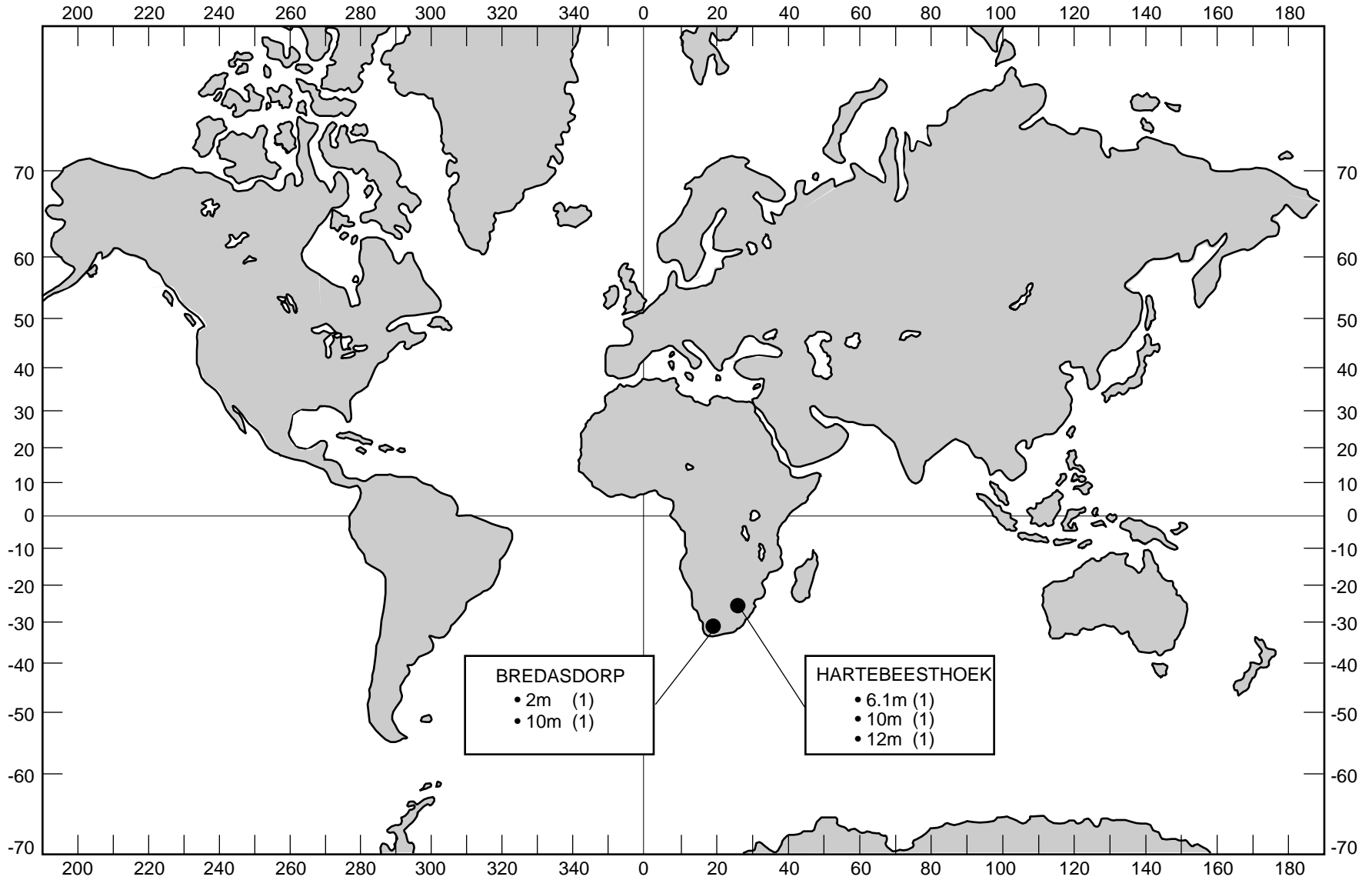
6445-4720

### CSA SATELLITE CONTROL STATIONS STATION LOCATIONS

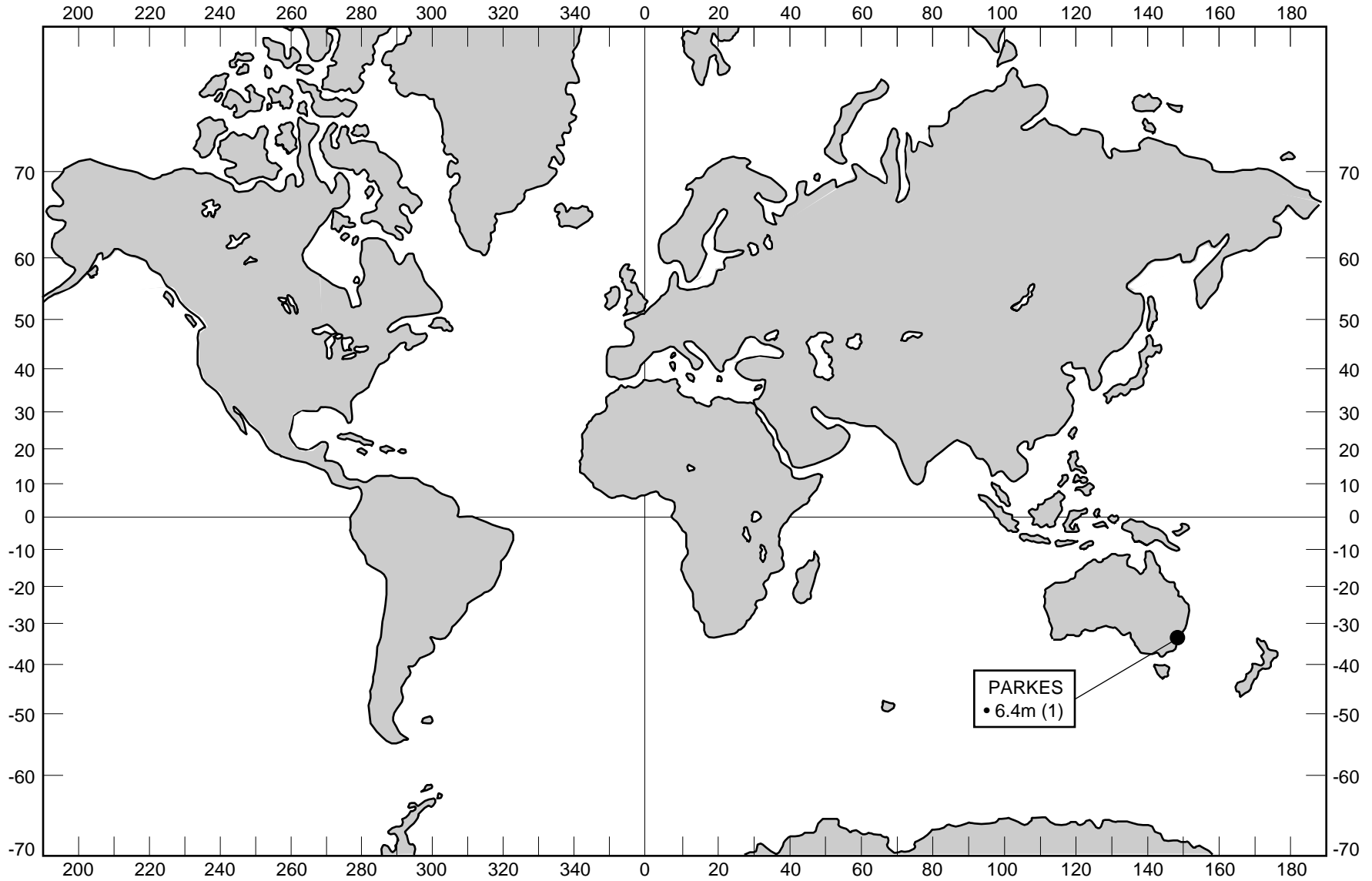


6445-5047

# CSIR TRACKING SYSTEM STATION LOCATIONS

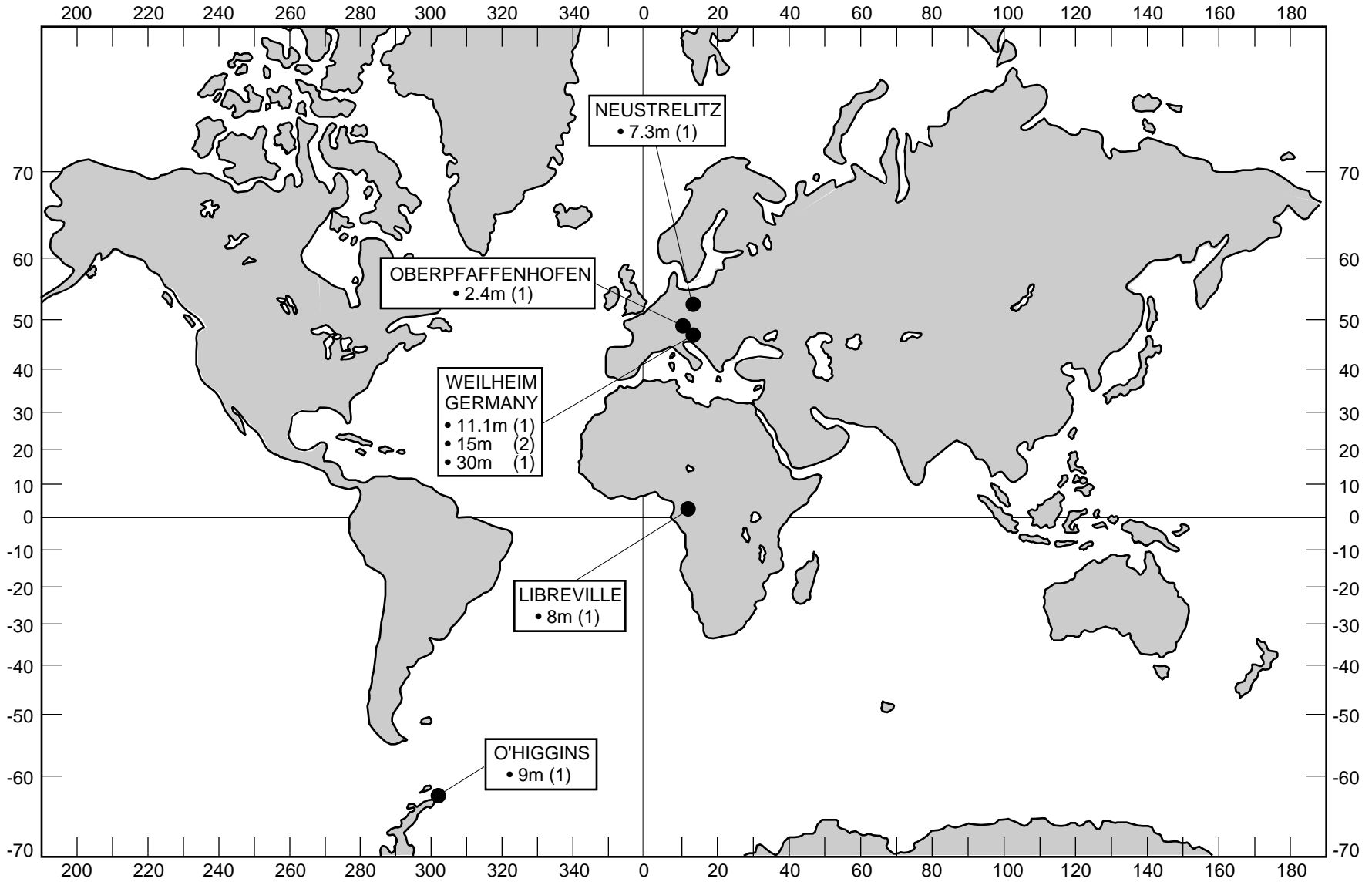


# CSIRO TRACKING SYSTEM STATION LOCATIONS



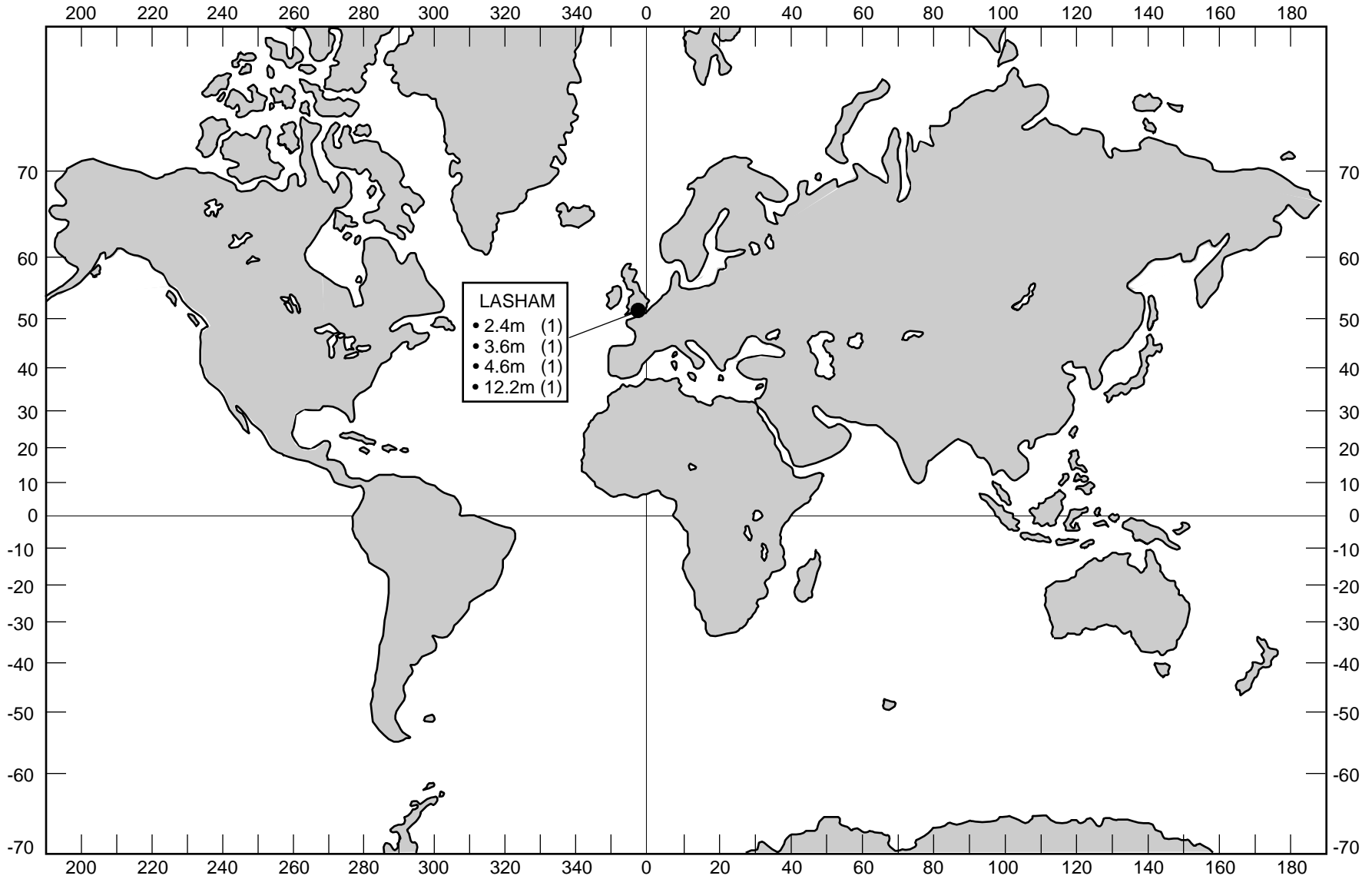
6445-4722

# DLR TRACKING SYSTEM STATION LOCATIONS

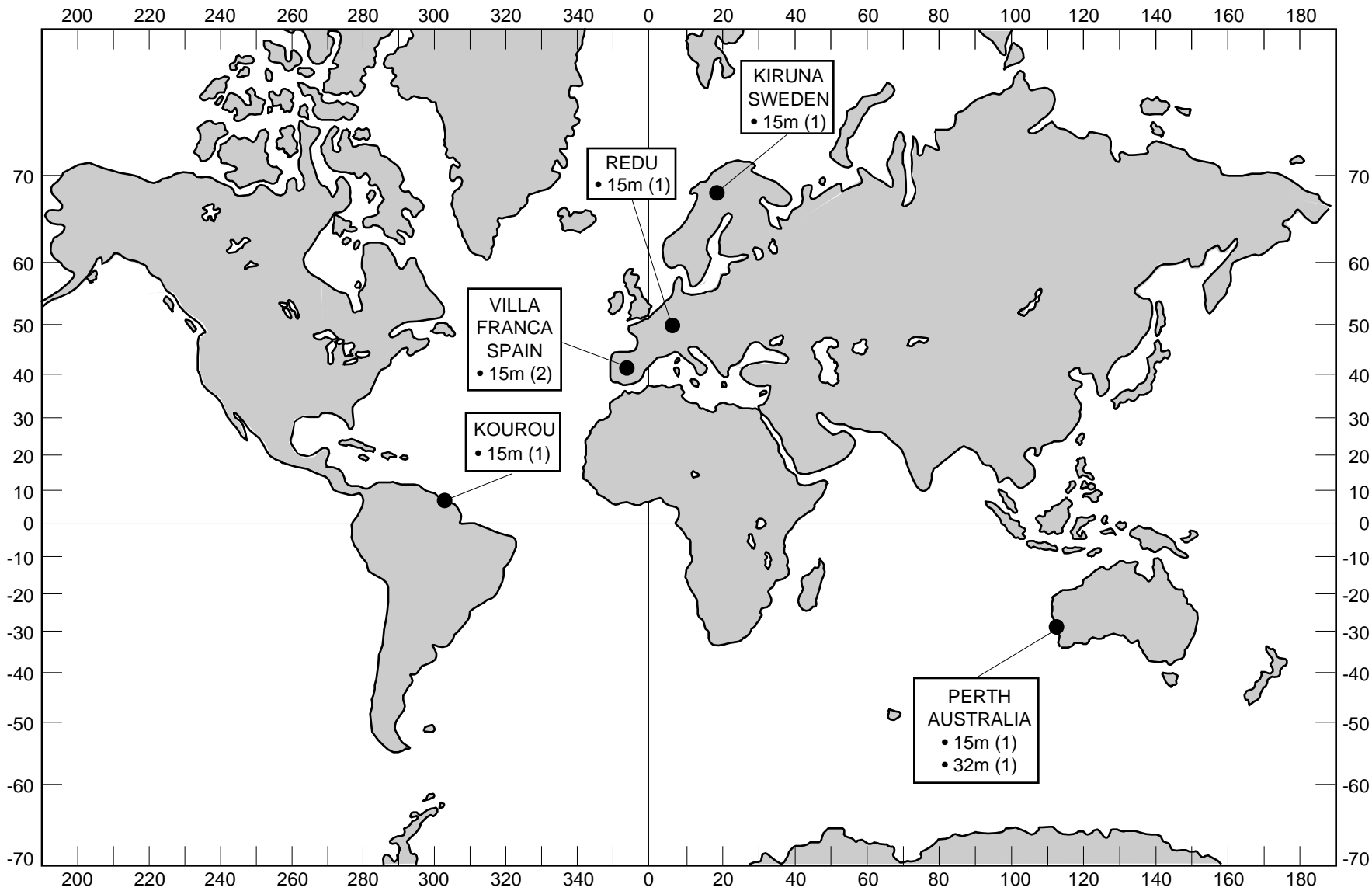


6445-4723

### DRA TRACKING SYSTEM STATION LOCATIONS



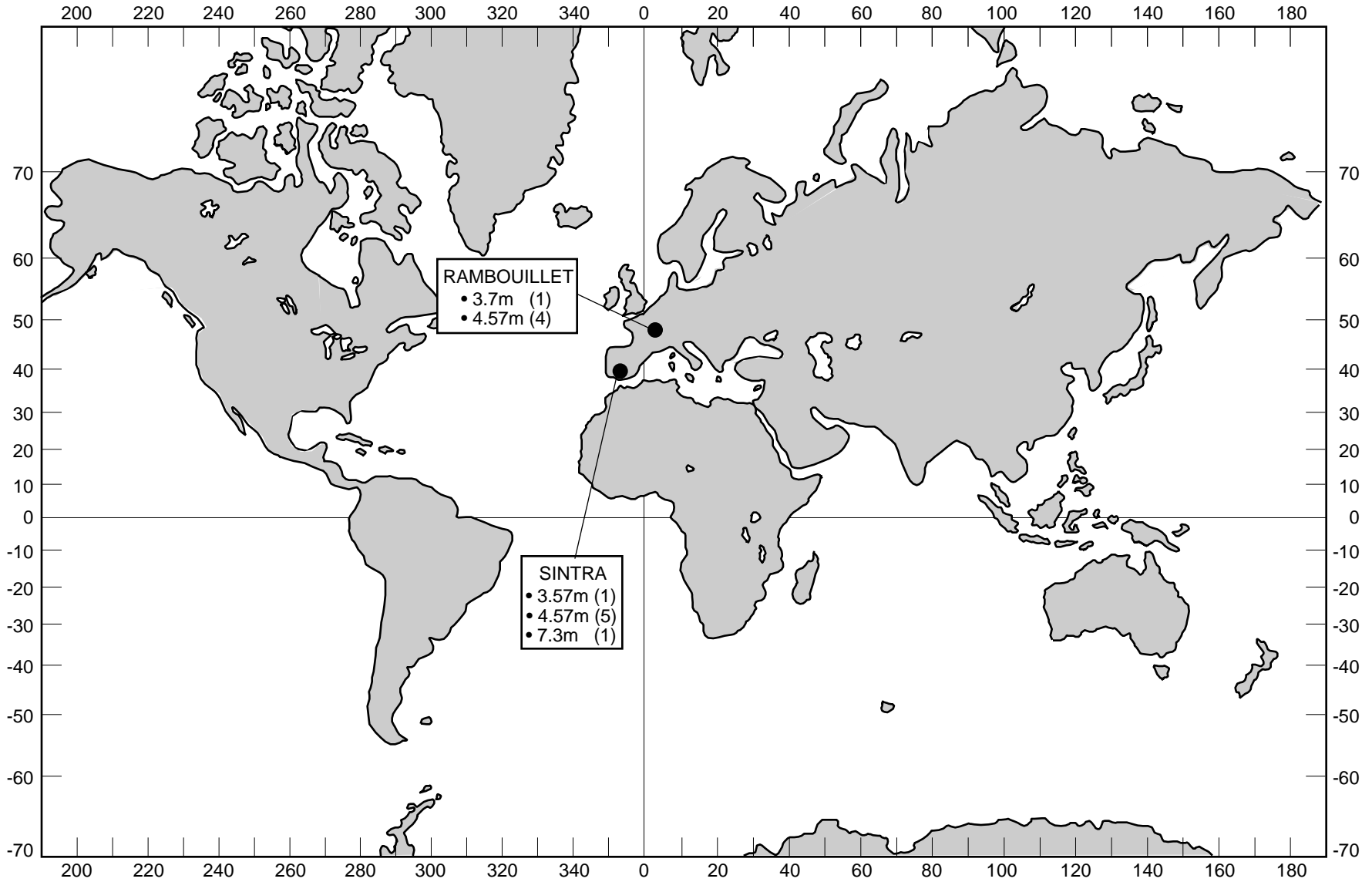
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6445-4724

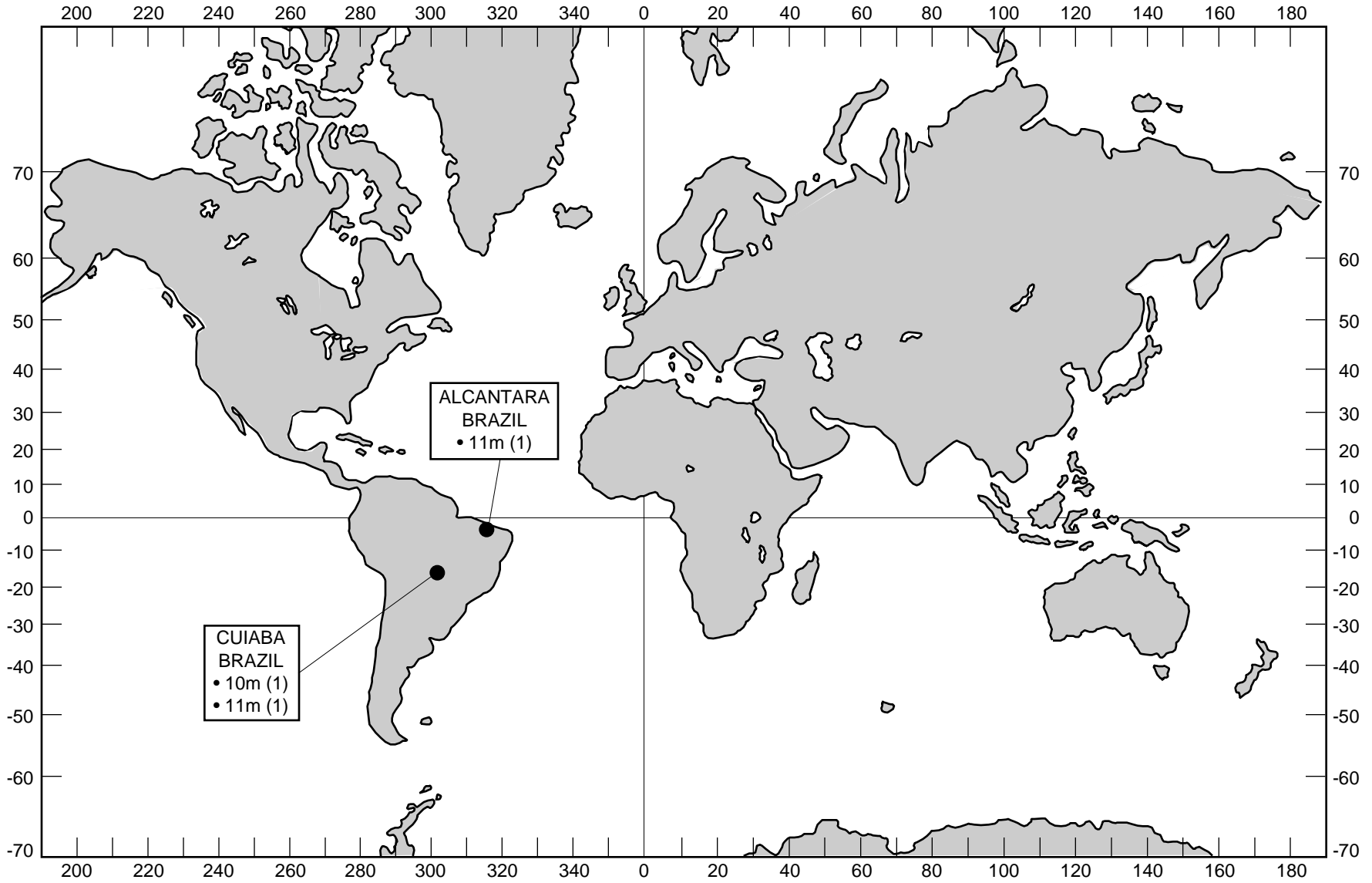
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## STATION LOCATIONS



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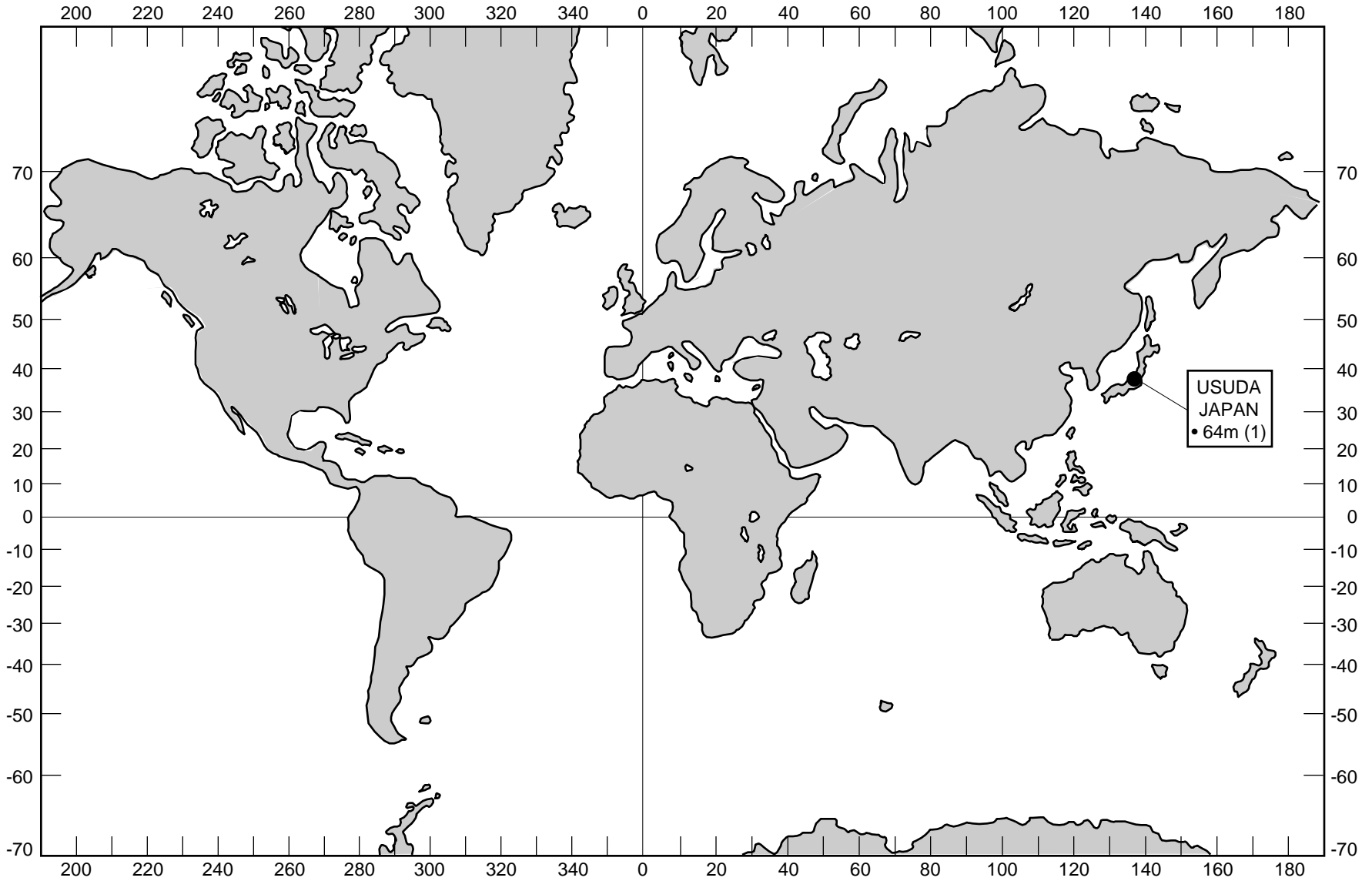
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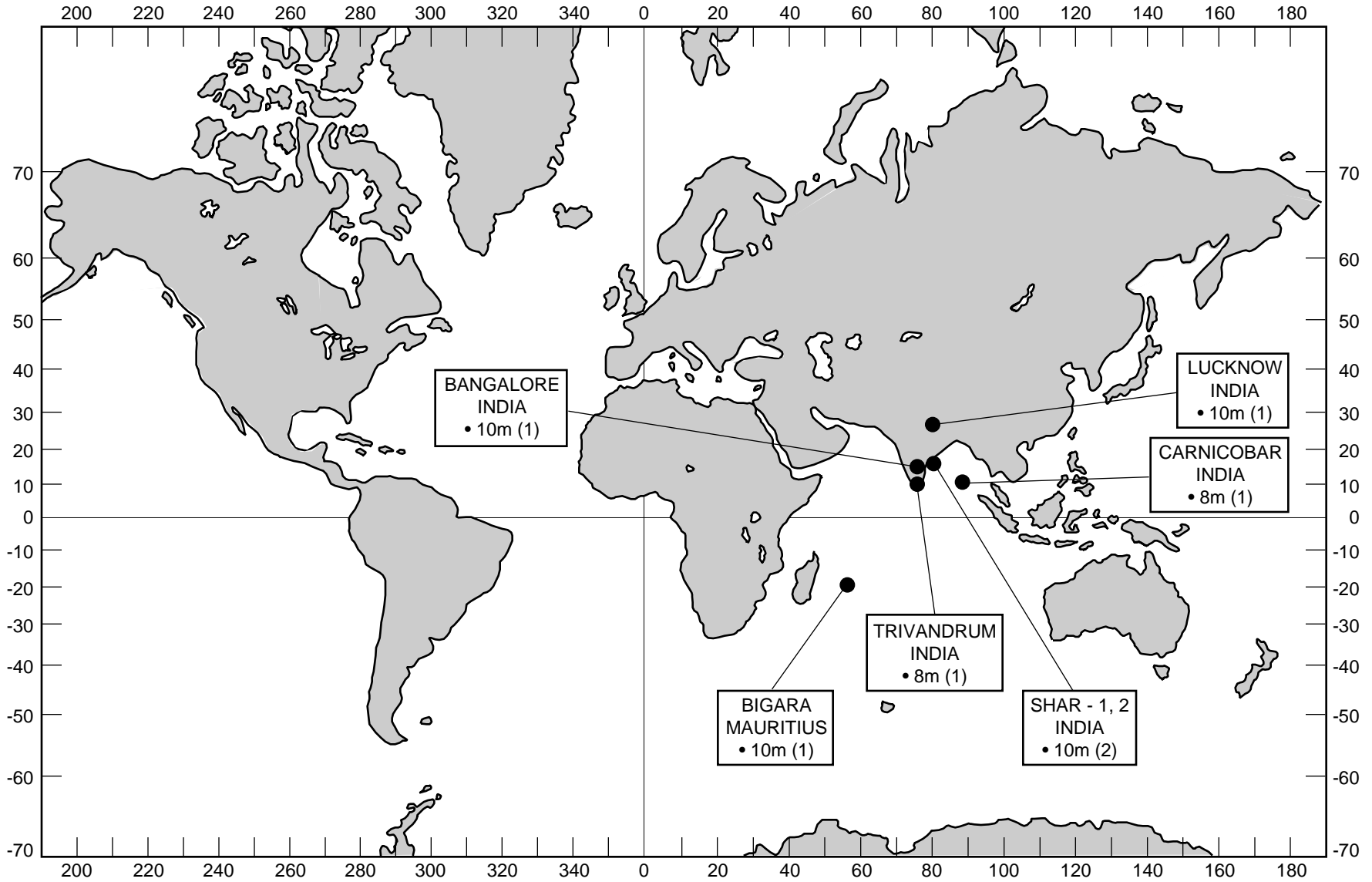
# ISAS TRACKING SYSTEM

## STATION LOCATIONS



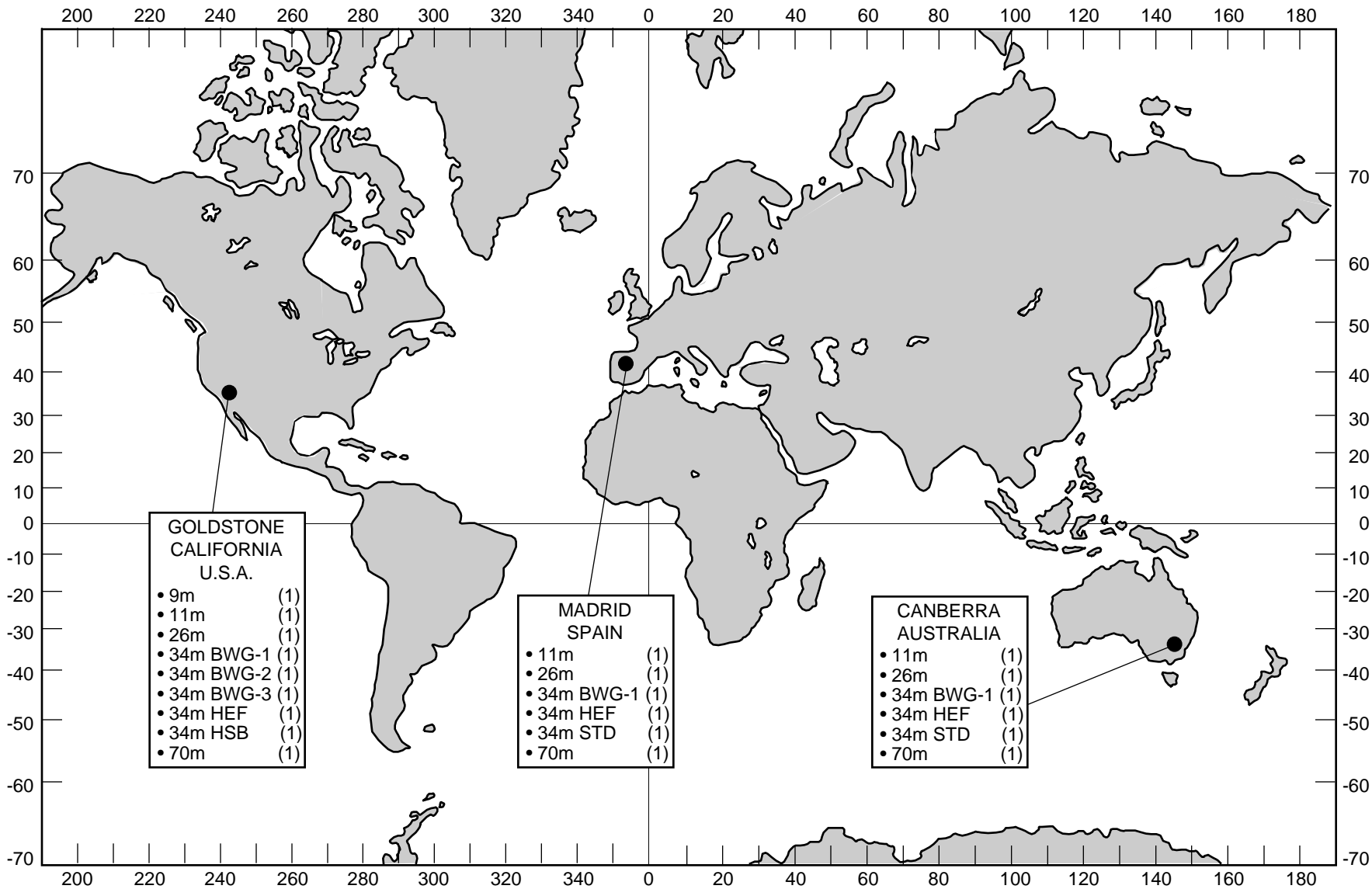
6445-4727

### ISRO ISTRAC STATION LOCATIONS



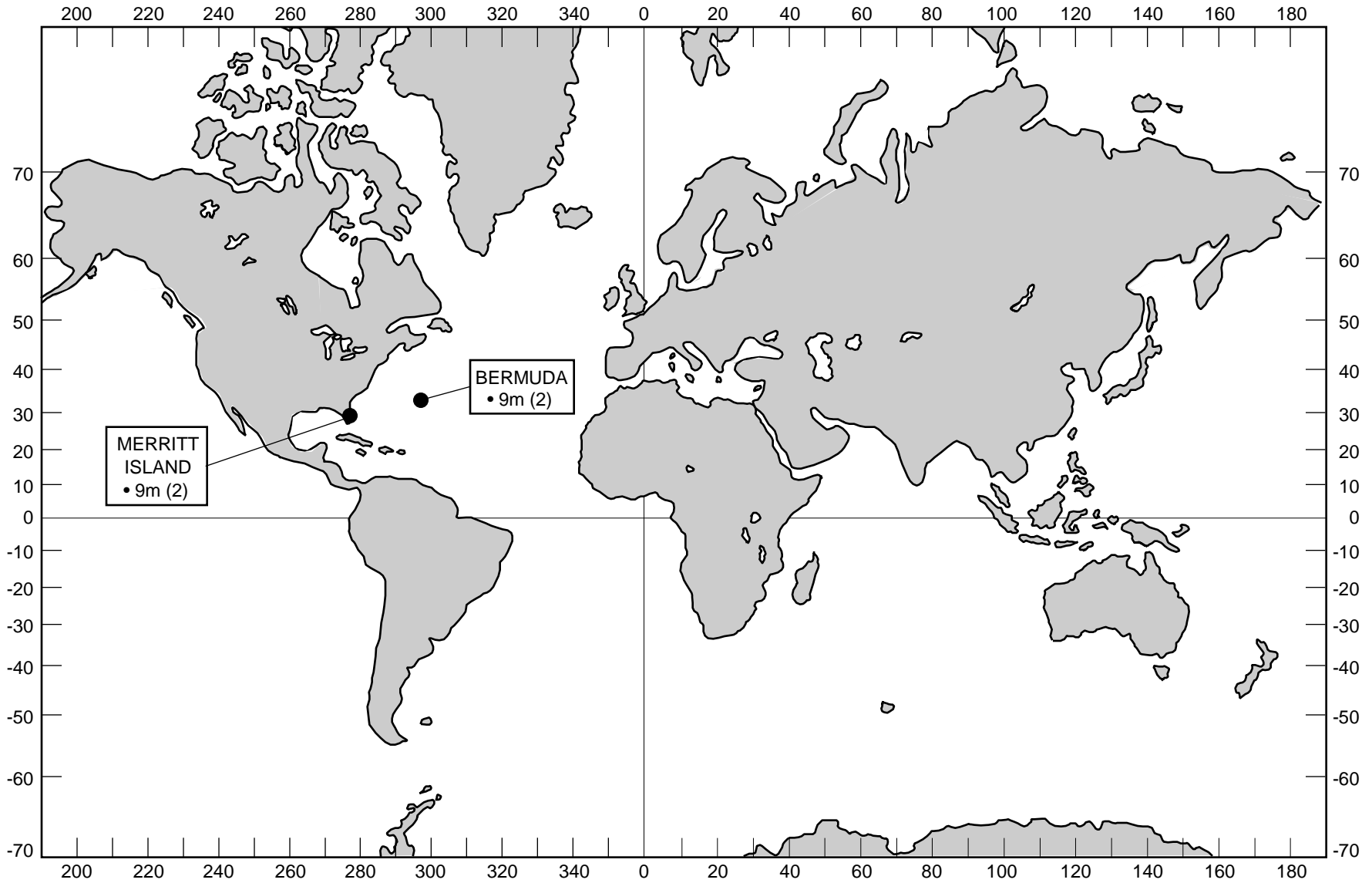
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# NASA DEEP SPACE NETWORK STATION LOCATIONS



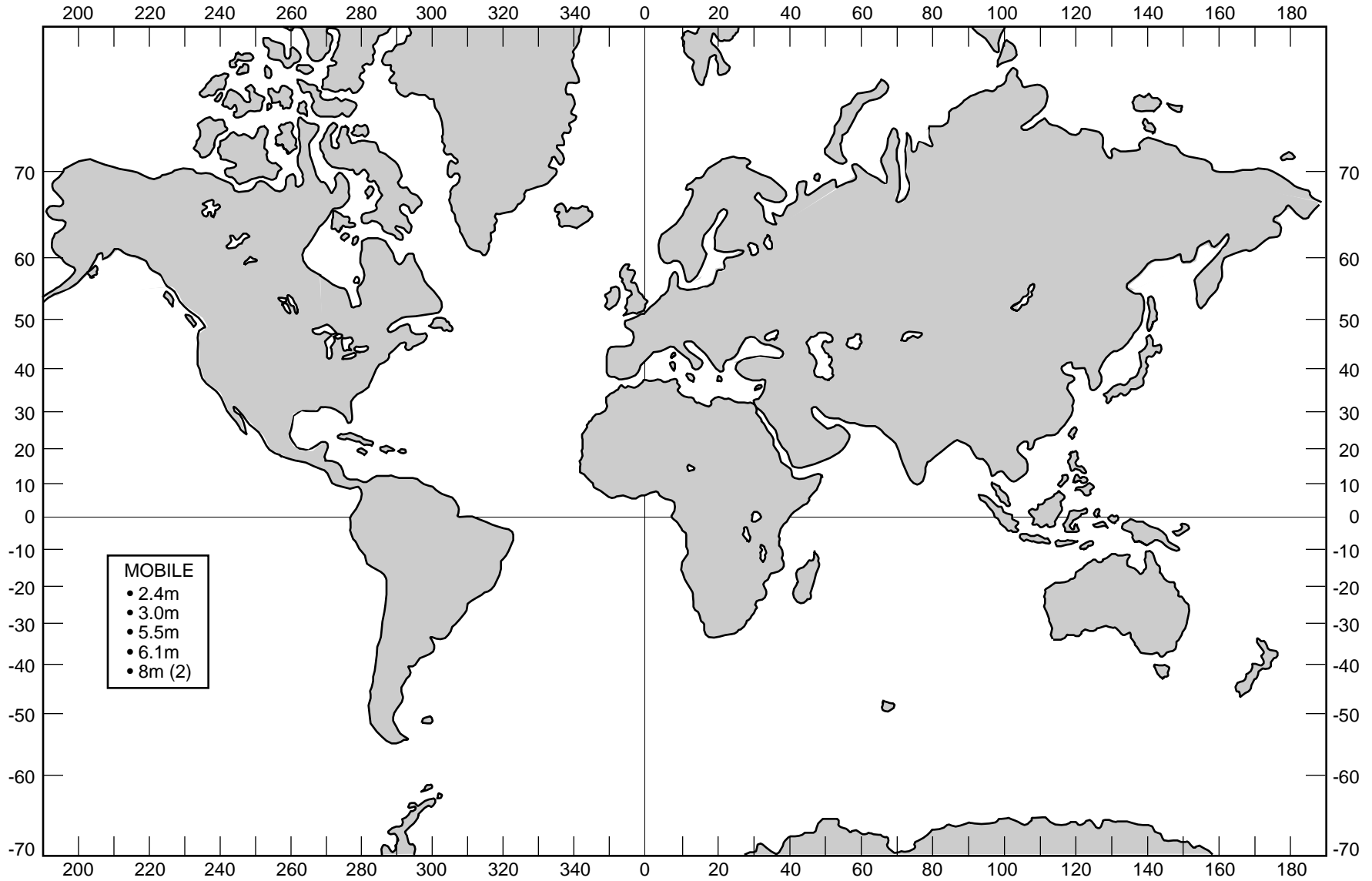
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### NASA / GSFC TRACKING SYSTEM STATION LOCATIONS

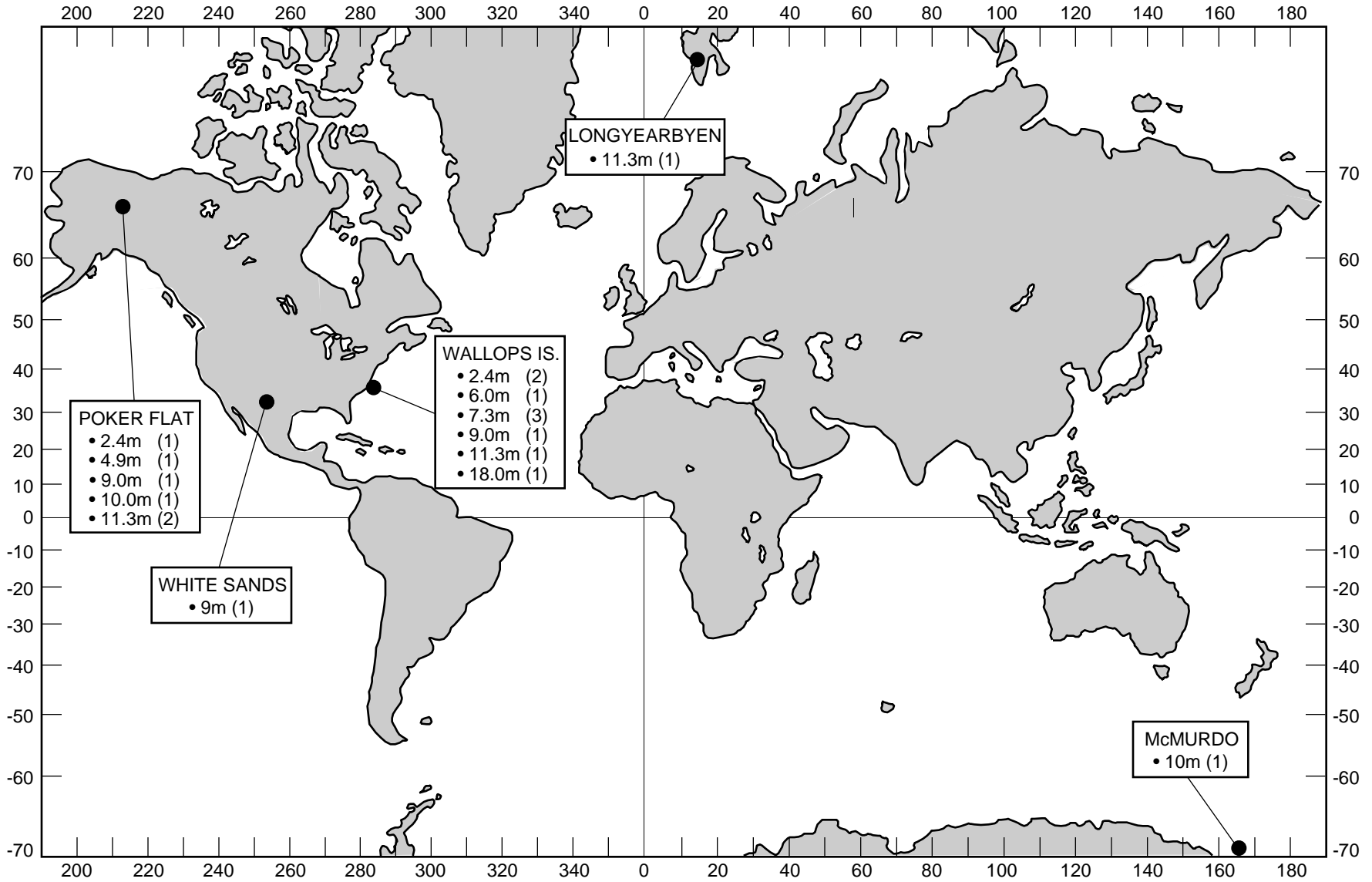


6445-4730

### NASA / MOBILE STATION LOCATIONS

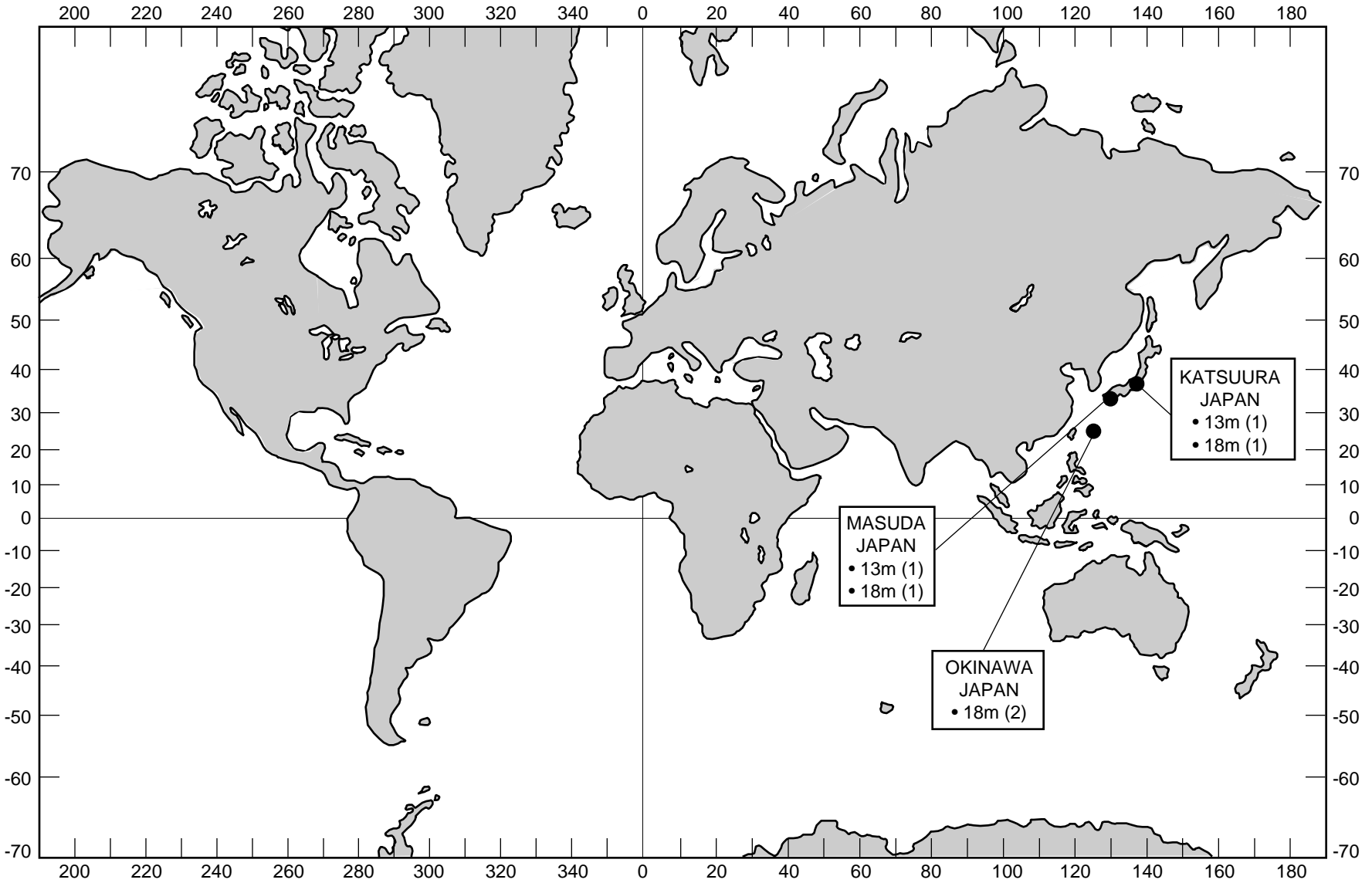


# NASA / WALLOPS TRACKING SYSTEM STATION LOCATIONS



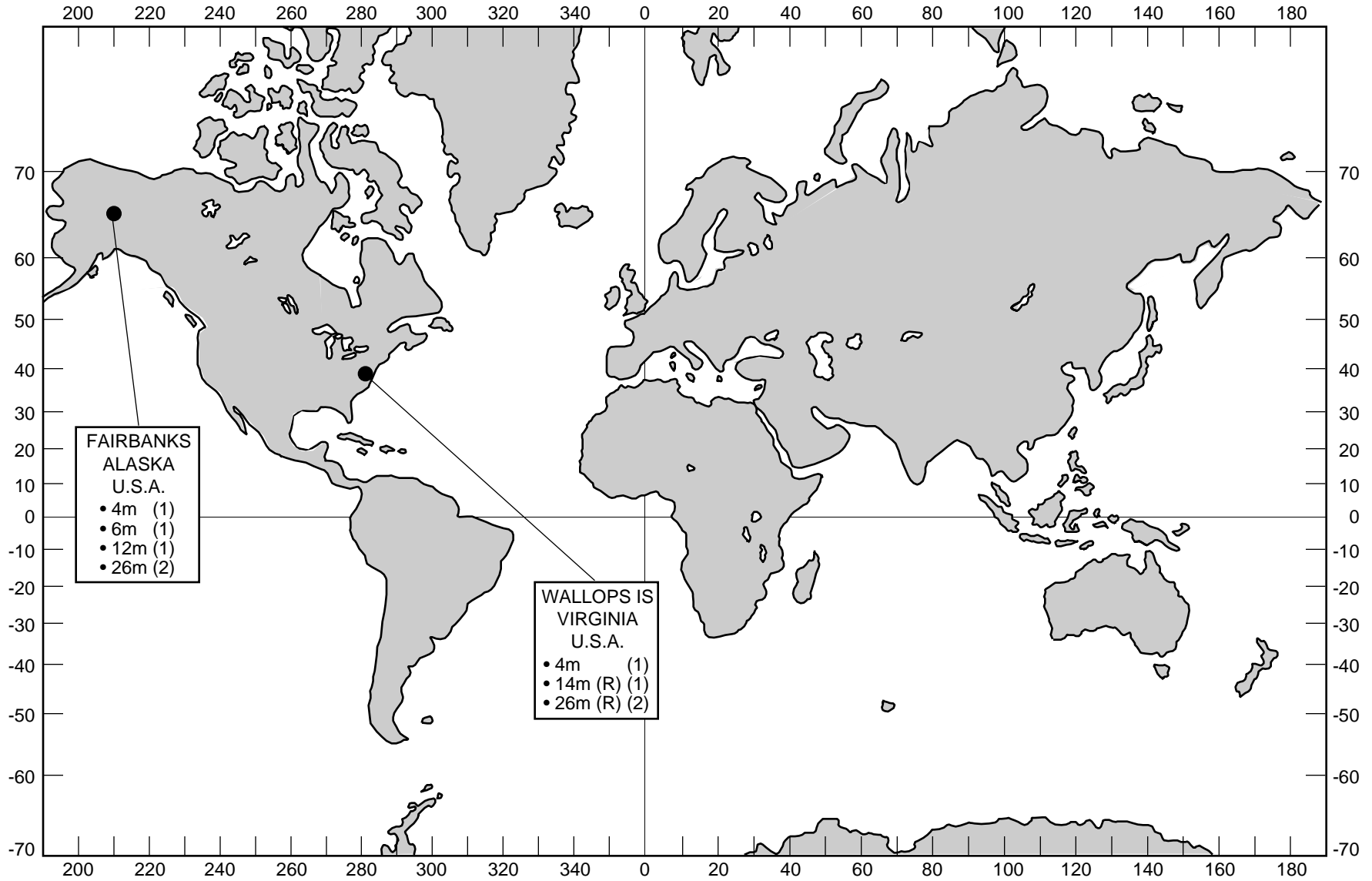
6445-4732

# NASDA TRACKING SYSTEM STATION LOCATIONS



6445-4733

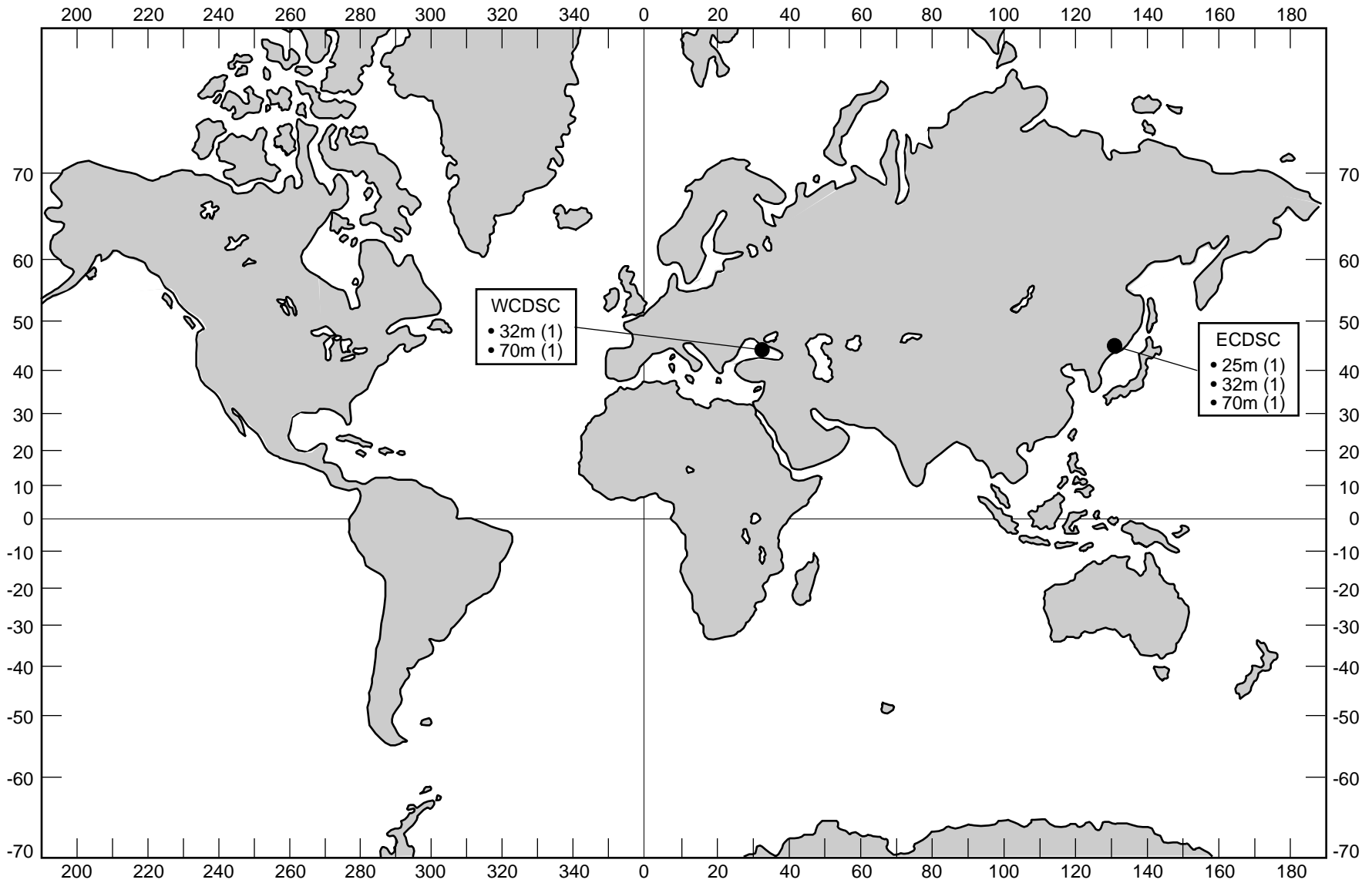
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6445-4734

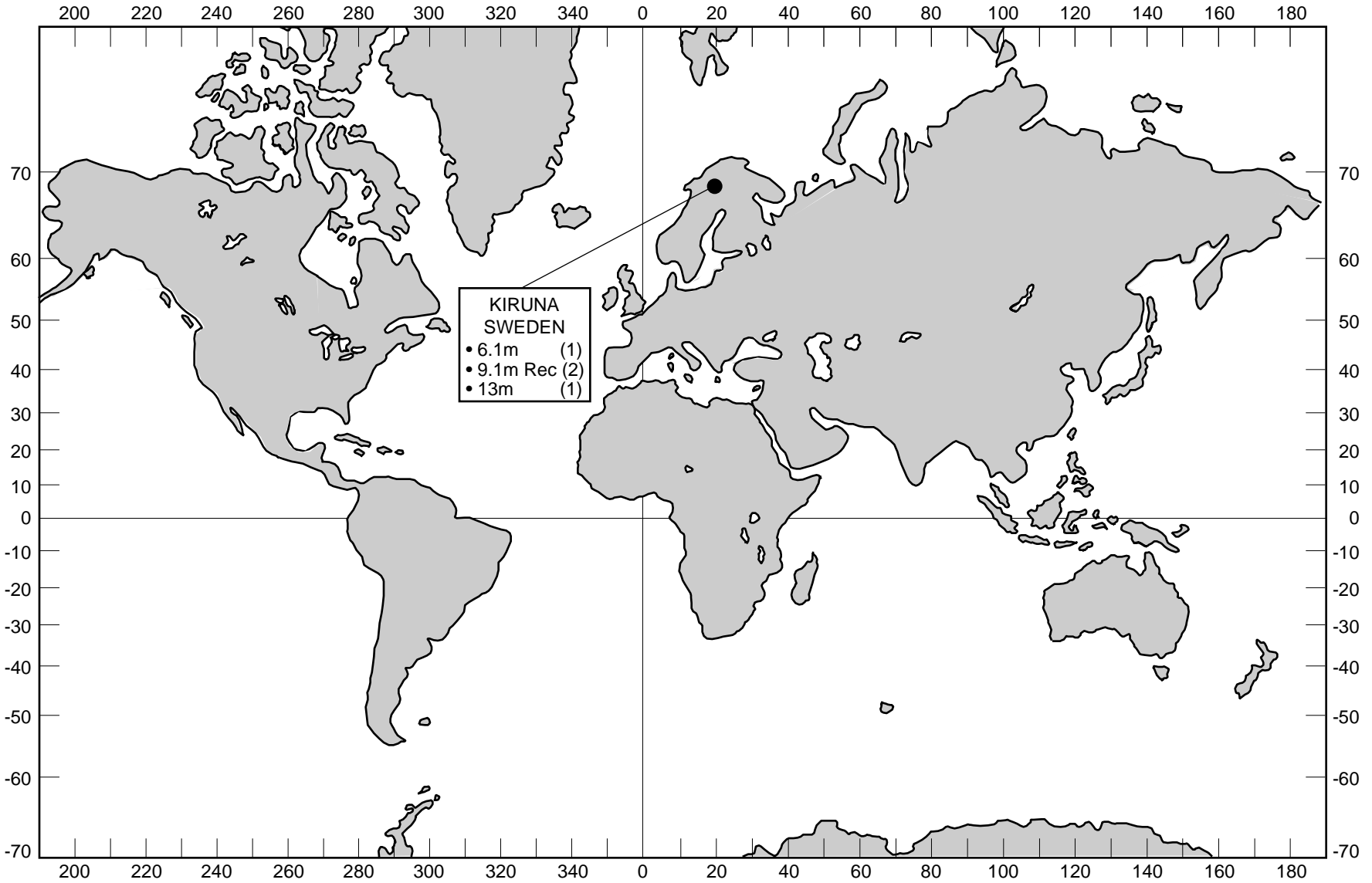
# RSA TRACKING SYSTEM

## STATION LOCATIONS



6445-4788

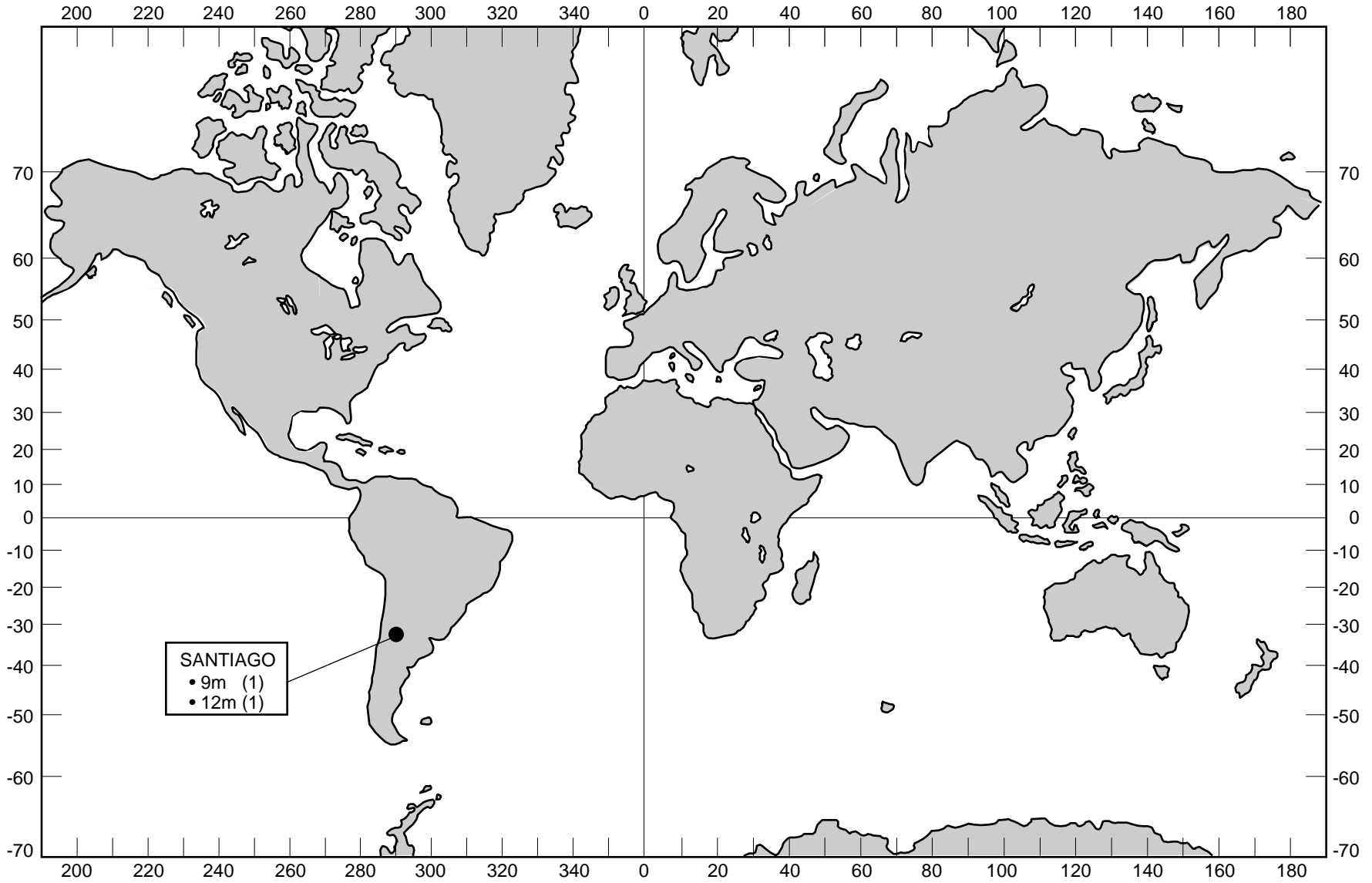
### SSC ESRANGE STATION LOCATIONS



6445-4735

# UdC TRACKING SYSTEM

## STATION LOCATIONS



## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

**4.0 ELECTRICAL CHARACTERISTICS**

This section contains information describing the electrical characteristics of the several CCSDS Agencies' earth stations. Issue-1 of this Report separated electrical capabilities for Category A and Category B missions. That distinction has been eliminated in this edition. Generally, Category B missions demand greater performance from earth stations because of their very great distances and concomitantly weak signals. However, many of the capabilities required to support the two categories are very similar.

Where possible, data are provided by subnetwork rather than by station. A subnetwork consists of two or more stations with sufficiently similar electrical characteristics so that they are indistinguishable from one another. While such stations may have differing geographical locations or mechanical configurations, they appear to have identical communications link capabilities. NASA's three 70-meter stations situated in the USA, Australia, and Spain, which are operated the Deep Space Network, are an example of a subnetwork.

As with earlier chapters, Section 4 is organized alphabetically by Agency. Each Agency's material is further subdivided into *Earth-to-Space*, *Space-to-Earth*, *Radio Metric*, *Frequency and Timing System* and *Geographical and Mechanical* modules. The *Geographical and Mechanical* module is new with this issue and has been added pursuant to an agreement with CCSDS Subpanel 1D. These five modules are arranged in the order listed for each pair of stations or subnetworks so that a full description of each facility will be found in a consecutive set of four sheets. If a CCSDS Agency has more than two stations or subnetworks, additional sets of four modules are utilized until that agency's tracking system is fully described.

Capabilities are described using a tabular format. Characteristics appear in the left-most column, followed to the right by a column showing the units in which that characteristic is specified. Sufficient station or subnetwork descriptions are provided at the top of the right two columns so that a reader can easily correlate the data in that column with information about the same facility found in other parts of this Report.

A note stating: *SOME LIMITATIONS APPLY TO THIS CAPABILITY* will be found in the notes at the bottom of the page. When such limitations apply, superscript number will be placed next to the relevant characteristic in the table. Users of the Report are then on notice to carefully check the marked data to determine the nature of these restrictions, either by consulting the references contained in section 5, or by contacting the specific organization responsible for the facility.

**CCSDS HISTORICAL DOCUMENT**  
**CCRS RECEIVING STATIONS**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION      |                                     |
|---|--------------|----------------------------|-------------------------------------|
|   |              | GATINEAU SATELLITE STATION | PRINCE ALBERT SATELLITE STATION     |
| <b>GENERAL</b>  |              |                            |                                     |
| STATION DESIGNATION   | -            | Gatineau Satellite Station | Prince Albert Satellite Station     |
| LOCATION(S)   | -            | Cantley, Québec, Canada    | Prince Albert, Saskatchewan, Canada |
| DIAMETER  | m            | 10 (2)                     | 10 (2)                              |
| <b>TRANSMIT</b>   |              | None                       | None                                |
| FREQUENCIES   | MHz          |                            |                                     |
| FREQUENCY RESOLUTION  | Hz           |                            |                                     |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ |                            |                                     |
| TRANSMIT POWER 1  | W            |                            |                                     |
| EIRP RANGE 1  | dBW          |                            |                                     |
| TRANSMIT POWER 2  | W            |                            |                                     |
| EIRP RANGE 2  | dBW          |                            |                                     |
| POLARIZATION  | -            |                            |                                     |
| ANTENNA GAIN  | dBi          |                            |                                     |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          |                            |                                     |
| ANTENNA ELLIPTICITY   | dB           |                            |                                     |
| RF FREQ SWEEP RANGE   | kHz          |                            |                                     |
| MIN FREQ SWEEP RATE   | Hz/s         |                            |                                     |
| MAX FREQ SWEEP RATE   | kHz/s        |                            |                                     |
| PROGRAMMED UPLINK FREQ  | Yes/No       |                            |                                     |
|   |              |                            |                                     |
|   |              |                            |                                     |
|   |              |                            |                                     |
|   |              |                            |                                     |
|   |              |                            |                                     |
|   |              |                            |                                     |
| <b>COMMAND</b>  |              | None                       | None                                |
| RF CARRIER MOD TYPE   | -            |                            |                                     |
| RF CARRIER MOD INDEX RNG  | Rad Pk       |                            |                                     |
| SUBCARRIER FREQUENCY(S)   | Hz           |                            |                                     |
| SUBCARRIER STEP SIZE  | Hz           |                            |                                     |
| SUBCARRIER FREQ STABILITY   | ppm          |                            |                                     |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                            |                                     |
| SUBCARRIER MOD TYPE   | -            |                            |                                     |
| SUBCARRIER/BIT RATE LIMIT   | -            |                            |                                     |
| BIT RATE RANGE  | b/s          |                            |                                     |
| FORMATS AVAILABLE   | -            |                            |                                     |
|   |              |                            |                                     |
|   |              |                            |                                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE     2. SOME LIMITATIONS APPLY TO THIS CAPABILITY     3. NOT RECOMMENDED BY CCSDS |              |                            |                                     |

6445-4836

**CCSDS HISTORICAL DOCUMENT**  
**CCRS RECEIVING STATIONS**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION        |                              |                                     |                              |
|---|--------------|------------------------------|------------------------------|-------------------------------------|------------------------------|
|   |              | GATINEAU SATELLITE STATION   |                              | PRINCE ALBERT SATELLITE STATION     |                              |
| <b>GENERAL</b>  |              |                              |                              |                                     |                              |
| STATION DESIGNATION   | -            | Gatineau Satellite Station   |                              | Prince Albert Satellite Station     |                              |
| LOCATION(S)   | -            | Cantley, Québec, Canada      |                              | Prince Albert, Saskatchewan, Canada |                              |
| DIAMETER  | m            | 10 (2)                       |                              | 10 (2)                              |                              |
| <b>RECEIVE</b>  |              |                              |                              |                                     |                              |
| FREQUENCIES   | MHz          | 2200 - 2300                  | 8025 - 8400                  | 2200 - 2300                         | 8025 - 8400                  |
| FREQUENCY RESOLUTION  | Hz           | 200 000                      | 200 000                      | 200 000                             | 200 000                      |
| ANTENNA GAIN  | dBi          | 44.9                         | 56.1                         | 43.4                                | 55.1                         |
| SYS NOISE TEMP @ 5 deg  | K            | 229                          | 257                          | 173                                 | 229                          |
| G/T @ 5 deg   | dB           | 21                           | 31.5                         | 21                                  | 31.5                         |
| POLARIZATION  | -            | RHCP, LHCP                   | RHCP                         | RHCP, LHCP                          | RHCP                         |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.9                          | 0.25                         | 0.9                                 | 0.25                         |
| ANTENNA ELLIPTICITY   | dB           | 2                            | 2                            | 2                                   | 2                            |
| L.O. REF FREQ STAB (0 -60°C)  | $\Delta f/f$ | $\pm 1 \times 10^{-8}$       | $\pm 1 \times 10^{-8}$       | $\pm 1 \times 10^{-8}$              | $\pm 1 \times 10^{-8}$       |
| RCVR AGC DYNAMIC RANGE  | dB           | 130                          | 130                          | 130                                 | 130                          |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -146 in 2 Blo = 30 Hz        | -147 in 2 Blo = 30 Hz        | -146 in 2 Blo = 30 Hz               | -147 in 2 Blo = 30 Hz        |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 100, 300, 1 K, 3 K, 10 K | 30, 100, 300, 1 K, 3 K, 10 K | 30, 100, 300, 1 K, 3 K, 10 K        | 30, 100, 300, 1 K, 3 K, 10 K |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                        | Adapt                        | Adapt                               | Adapt                        |
| RCVR PLL ORDER(S)   | No.          | 2                            | 2                            | 2                                   | 2                            |
| ACQ SWEEP RANGE   | kHz          | $\pm 250$                    | $\pm 250$                    | $\pm 250$                           | $\pm 250$                    |
| MIN ACQ SWEEP RATE  | Hz/s         | Depends on Loop BW           | Depends on Loop BW           | Depends on Loop BW                  | Depends on Loop BW           |
| MAX ACQ SWEEP RATE  | kHz/s        | Depends on Loop BW           | Depends on Loop BW           | Depends on Loop BW                  | Depends on Loop BW           |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                   | Continuous                   | Continuous                          | Continuous                   |
| PROGRAMMED L.O.   | Yes/No       | No                           | No                           | No                                  | No                           |
|   |              |                              |                              |                                     |                              |
|   |              |                              |                              |                                     |                              |
|   |              |                              |                              |                                     |                              |
|   |              |                              |                              |                                     |                              |
| <b>TELEMETRY</b>  |              |                              |                              |                                     |                              |
| MODULATION TYPE(S)  | -            | (1)                          | BPSK, QPSK, UQPSK            | PM, FM, AM                          | BPSK, QPSK, UQPSK            |
| MODULATION FORMAT(S)  | -            | (1)                          | NRZ - L                      | NRZ, RZ, Bi - $\phi$                | NRZ - L                      |
| MOD INDEX RANGE   | Rad Pk       | (1)                          | (1)                          | 0.2 - 2.8                           | (1)                          |
| SUBCARRIER FREQ RANGE   | kHz          | (1)                          | (1)                          | 0 - 2000                            | (1)                          |
| SUBCARRIER WAVEFORM   | Sin/Sq       | (1)                          | (1)                          | Sine                                | (1)                          |
| SYMBOL RATE RANGE   | s/s          | (1)                          | 60 M, 85 M, 105 M            | 1 - 5 000 000                       | 50 M, 60 M, 85 M, 105 M      |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)                          | (1)                          | > 1.5                               | (1)                          |
| ARRAYS WITH STATIONS  | -            | (1)                          | None                         | None                                | None                         |
| CHANNEL DECODING  | Type         | (1)                          | (1)                          | (1)                                 | (1)                          |
| DATA FORMAT   | -            | (1)                          | (1)                          | (1)                                 | (1)                          |
|   |              |                              |                              |                                     |                              |
|   |              |                              |                              |                                     |                              |
|   |              |                              |                              |                                     |                              |
|   |              |                              |                              |                                     |                              |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                              |                              |                                     |                              |

6445-4837

**CCSDS HISTORICAL DOCUMENT**  
**CCRS RECEIVING STATIONS**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION      |                                     |
|---|--------------|----------------------------|-------------------------------------|
|   |              | GATINEAU SATELLITE STATION | PRINCE ALBERT SATELLITE STATION     |
| <b>GENERAL</b>  |              |                            |                                     |
| STATION DESIGNATION   | -            | Gatineau Satellite Station | Prince Albert Satellite Station     |
| LOCATION(S)   | -            | Cantley, Québec, Canada    | Prince Albert, Saskatchewan, Canada |
| DIAMETER  | m            | 10 (2)                     | 10 (2)                              |
| <b>FREQUENCIES</b>  |              |                            |                                     |
| TRANSMIT FREQUENCIES  | MHz          | None                       | None                                |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300, 8025 - 8400   | 2200 - 2300, 8025 - 8400            |
| TURNAROUND FREQ RATIO   | -            | (1)                        | (1)                                 |
| <b>DOPPLER</b>  |              |                            |                                     |
| COHERENT/NON-COHERENT   | -            | None                       | None                                |
| COUNTER RESOLUTION  | Cycles       |                            |                                     |
| MAX DOPPLER FREQ SHIFT  | MHz          |                            |                                     |
| DOPPLER BIAS FREQ   | MHz          |                            |                                     |
| DRIFT   | $\Delta f/f$ |                            |                                     |
| OUTPUT EQUATION   | -            |                            |                                     |
| DIRECTION INDICATOR   | -            |                            |                                     |
|   |              |                            |                                     |
|   |              |                            |                                     |
|   |              |                            |                                     |
| <b>RANGING</b>  |              |                            |                                     |
| COHERENT/NON-COHERENT   | -            | None                       | None                                |
| RANGE CODE WAVEFORM   | Sin/Sq       |                            |                                     |
| EARTH STATION MOD INDEX   | Rad Pk       |                            |                                     |
| RANGE CODE FREQ RATIO   | -            |                            |                                     |
| MAJOR CODE FREQ(S)  | kHz          |                            |                                     |
| MINOR CODE FREQ(S)  | kHz          |                            |                                     |
| MIN RECEIVED CARRIER SNR  | dB           |                            |                                     |
| MIN REQ CODE PWR/ $N_0$   | dB-Hz        |                            |                                     |
| CODE INTEGRATION TIME   | s            |                            |                                     |
| ACQUISITION SEQUENCE  | -            |                            |                                     |
| RANGE DATA UNITS  | -            |                            |                                     |
| RANGE QUANTIZATION  | -            |                            |                                     |
| ACCURACY (STRONG SIGNAL)  | m            |                            |                                     |
| MAX UNAMBIGUOUS RANGE   | km           |                            |                                     |
| TRANSPONDER BW  | MHz          |                            |                                     |
|   |              |                            |                                     |
|   |              |                            |                                     |
|   |              |                            |                                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                            |                                     |

6445-4838

**CCSDS HISTORICAL DOCUMENT**  
**CCRS RECEIVING STATIONS**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION      |                |                                     |                       |
|--|---------------|----------------------------|----------------|-------------------------------------|-----------------------|
|  |               | GATINEAU SATELLITE STATION |                | PRINCE ALBERT SATELLITE STATION     |                       |
| <b>GENERAL</b>   |               |                            |                |                                     |                       |
| STATION DESIGNATION  | -             | Gatineau Satellite Station |                | Prince Albert Satellite Station     |                       |
| LOCATION(S)  | -             | Cantley, Québec, Canada    |                | Prince Albert, Saskatchewan, Canada |                       |
| DIAMETER   | m             | 10 (2)                     |                | 10 (2)                              |                       |
| <b>FREQUENCY STD</b>   |               |                            |                |                                     |                       |
| STANDARD TYPE  | Name          | Rubidium                   |                | Quartz                              |                       |
| STANDARD MFG   | Name          | HP 5065 A                  |                | HP 105 C                            |                       |
| STABILITY AT:  |               | <b>Allan Variance</b>      | <b>Drift</b>   | <b>Allan Variance</b>               | <b>Drift</b>          |
| 1 - SECOND   | $\Delta f/f$  | $< 5 \times 10^{-12}$      |                | $< 1 \times 10^{-11}$               |                       |
| 1000 - SECONDS   | $\Delta f/f$  | $< 5 \times 10^{-12}$      |                |                                     |                       |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  |                            |                |                                     | $< 5 \times 10^{-10}$ |
| 1 - MONTH  | $\Delta f/f$  |                            |                |                                     |                       |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>               | <b>100 MHz</b> | <b>5 MHz</b>                        | <b>100 MHz</b>        |
| 1 Hz OFFSET  | dBc/Hz        |                            |                |                                     | -90                   |
| 10 Hz OFFSET   | dBc/Hz        |                            |                |                                     | -120                  |
| 100 Hz OFFSET  | dBc/Hz        |                            |                |                                     | -126                  |
| 1000 Hz OFFSET   | dBc/Hz        |                            |                |                                     | -146                  |
| REF FREQS AVAILABLE  | MHz           | 0.1, 1, 5                  |                | 0.1, 1, 5                           |                       |
| MAX STA-TO-STA OFFSET  | Hz            |                            |                |                                     |                       |
|  |               |                            |                |                                     |                       |
|  |               |                            |                |                                     |                       |
|  |               |                            |                |                                     |                       |
| <b>TIMING SYSTEM</b>   |               |                            |                |                                     |                       |
| MASTER REFERENCE AGENCY  | Name          | GPS                        |                | GPS                                 |                       |
| REFERENCE TIME   | Name          | UTC                        |                | UTC                                 |                       |
| TIME CODE EPOCH  | Yr            | 1 January 1958             |                | 1 January 1958                      |                       |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG-A, IRIG-B             |                | IRIG-A, IRIG-B, NASA-36             |                       |
| MAX TIME RESOLUTION  | s             | $10^{-7}$                  |                | $10^{-7}$                           |                       |
| TIME TRANSFER METHOD   | Name          | GPS                        |                | GPS                                 |                       |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 0.25                       |                | 0.25                                |                       |
| MAX OFFSET FROM REF  | $\mu$ -sec    | 1                          |                | 1                                   |                       |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | (1)                        |                | (1)                                 |                       |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                        |                | (1)                                 |                       |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 10 000                     |                | 10 000                              |                       |
|  |               |                            |                |                                     |                       |
|  |               |                            |                |                                     |                       |
|  |               |                            |                |                                     |                       |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                            |                |                                     |                       |

6445-4839

CCSDS HISTORICAL DOCUMENT  
**CCRS RECEIVING STATIONS**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION      |                                     |
|---|--------------------|----------------------------|-------------------------------------|
|   |                    | GATINEAU SATELLITE STATION | PRINCE ALBERT SATELLITE STATION     |
| <b>GENERAL</b>  |                    |                            |                                     |
| STATION DESIGNATION   | -                  | Gatineau Satellite Station | Prince Albert Satellite Station     |
| LOCATION(S)   | -                  | Cantley, Québec, Canada    | Prince Albert, Saskatchewan, Canada |
| DIAMETER  | m                  | 10 (2)                     | 10 (2)                              |
| <b>GEOGRAPHICAL</b>   |                    |                            |                                     |
| LOCATION, COUNTRY/STATE   | Name               | Québec, Canada             | Saskatchewan, Canada                |
| LOCATION, CITY  | Name               | Cantley                    | Prince Albert                       |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 284, 11, 37.7              | 254, 3, 59.3                        |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | + 45, 34, 52.7             | + 53, 12, 45.4                      |
|   |                    |                            |                                     |
|   |                    |                            |                                     |
|   |                    |                            |                                     |
| <b>MECHANICAL</b>   |                    |                            |                                     |
| TYPE OF MOUNT   | -                  | Az - El                    | Az - El                             |
| AZIMUTH LIMITATIONS   | -                  | ± 360                      | ± 360                               |
| TRACKING SPEED RANGE  | deg/s              | 0 - 16 (Az), 0 - 8.5 (El)  | 0 - 16 (Az), 0 - 8.5 (El)           |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 16 (Az), 8.5 (El)          | 16 (Az), 8.5 (El)                   |
| TYPE OF POINTING  | Type               | Autotrack, Manual, Predict | Autotrack, Manual, Predict          |
| POINTING ACCURACY   | deg                | 0.05 (Az), 0.05 (El)       | 0.05 (Az), 0.05 (El)                |
| MIN TRANSMIT ELEV ANGLE   | deg                | (1)                        | (1)                                 |
| MIN RECEIVE ELEV ANGLE  | deg                | 5                          | 5                                   |
|   |                    |                            |                                     |
|   |                    |                            |                                     |
|   |                    |                            |                                     |
|   |                    |                            |                                     |
| <b>SUPPORT</b>  |                    |                            |                                     |
| TRANSMIT FREQ BAND(S)   | GHz                | None                       | None                                |
| RECEIVE FREQ BAND(S)  | GHz                | 2.2 - 2.3, 8.025 - 8.4     | 2.2 - 2.3, 8.025 - 8.4              |
| ACQ AID FREQ BAND(S)  | GHz                | None                       | None                                |
| MISSION CATEGORIES  | Cat                | A                          | A                                   |
|   |                    |                            |                                     |
|   |                    |                            |                                     |
|   |                    |                            |                                     |
|   |                    |                            |                                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                            |                                     |

6445-4840

**CCSDS HISTORICAL DOCUMENT**  
**CLRC / RAL TRACKING SYSTEM**  
**EARTH-TO-SPACE LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION |  |
|--|--------------|-----------------------|--|
|  |              | CHILTON               |  |
| <b>GENERAL</b>   |              |                       |  |
| STATION DESIGNATION  | -            | Chilton               |  |
| LOCATION(S)  | -            | Didcot, UK            |  |
| DIAMETER   | m            | 12.5                  |  |
| <b>TRANSMIT</b>  |              |                       |  |
| FREQUENCIES  | MHz          | 2000 - 2100           |  |
| FREQUENCY RESOLUTION   | Hz           | 6224                  |  |
| RF FREQUENCY STAB @ 1 Hr   | $\Delta f/f$ | 7                     |  |
| TRANSMIT POWER 1   | W            | 100                   |  |
| EIRP RANGE 1   | dBW          | 66                    |  |
| TRANSMIT POWER 2   | W            | 1                     |  |
| EIRP RANGE 2   | dBW          | 46                    |  |
| POLARIZATION   | -            | RCP or LCP            |  |
| ANTENNA GAIN   | dBi          | 46                    |  |
| ANTENNA BEAMWIDTH (-3 dB)  | deg          | 0.8                   |  |
| ANTENNA ELLIPTICITY  | dB           | < 6 dB                |  |
| RF FREQ SWEEP RANGE  | kHz          | $\pm 100$             |  |
| MIN FREQ SWEEP RATE  | Hz/s         | 1                     |  |
| MAX FREQ SWEEP RATE  | kHz/s        | 20                    |  |
| PROGRAMMED UPLINK FREQ   | Yes/No       | No                    |  |
|  |              |                       |  |
|  |              |                       |  |
|  |              |                       |  |
|  |              |                       |  |
|  |              |                       |  |
|  |              |                       |  |
|  |              |                       |  |
|  |              |                       |  |
|  |              |                       |  |
|  |              |                       |  |
|  |              |                       |  |
|  |              |                       |  |
| <b>COMMAND</b>   |              |                       |  |
| RF CARRIER MOD TYPE  | -            | PM (Synchronous)      |  |
| RF CARRIER MOD INDEX RNG   | Rad Pk       | 0 - 1.5               |  |
| SUBCARRIER FREQUENCY(S)  | Hz           | 16 000                |  |
| SUBCARRIER STEP SIZE   | Hz           | None                  |  |
| SUBCARRIER FREQ STABILITY  | ppm          | 0.1                   |  |
| SUBCARRIER WAVEFORM  | Sin/Sq       | Sine                  |  |
| SUBCARRIER MOD TYPE  | -            | PSK                   |  |
| SUBCARRIER/BIT RATE LIMIT  | -            | 1:16                  |  |
| BIT RATE RANGE   | b/s          | 1000                  |  |
| FORMATS AVAILABLE  | -            | Bi - $\phi$ - L       |  |
|  |              |                       |  |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |                       |  |

6445-2149

CCSDS HISTORICAL DOCUMENT  
**CLRC / RAL TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION |  |
|-----------------------------|--------------|-----------------------|--|
|                             |              | CHILTON               |  |
| <b>GENERAL</b>              |              |                       |  |
| STATION DESIGNATION         | -            | Chilton               |  |
| LOCATION(S)                 | -            | Didcot, UK            |  |
| DIAMETER                    | m            | 12.5                  |  |
| <b>RECEIVE</b>              |              |                       |  |
| FREQUENCIES                 | MHz          | 2200 - 2300           |  |
| FREQUENCY RESOLUTION        | Hz           | 4506                  |  |
| ANTENNA GAIN @ 45 deg       | dBi          | 46                    |  |
| SYS NOISE TEMP @ ZENITH     | K            | 115                   |  |
| G/T @ 45 deg                | dB           | 26                    |  |
| POLARIZATION                | -            | RCP or LCP            |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.8                   |  |
| ANTENNA ELLIPTICITY         | dB           | < 6 dB                |  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | 5                     |  |
| RCVR AGC DYNAMIC RANGE      | dB           | 80                    |  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -172 in 2 Blo = 0.16  |  |
| RCVR LOOP BANDWIDTHS        | Hz           | 0.16, 1.6, 6          |  |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adaptive              |  |
| RCVR PLL ORDER(S)           | No.          | 2                     |  |
| ACQ SWEEP RANGE             | kHz          | $\pm 100$             |  |
| MIN ACQ SWEEP RATE          | Hz/s         | 1                     |  |
| MAX ACQ SWEEP RATE          | kHz/s        | 20                    |  |
| ACQ SWEEP STEP SIZE         | Hz           | Variable              |  |
| PROGRAMMED L.O.             | Yes/No       | No                    |  |
|                             |              |                       |  |
|                             |              |                       |  |
|                             |              |                       |  |
|                             |              |                       |  |
| <b>TELEMETRY</b>            |              |                       |  |
| MODULATION TYPE(S)          | -            | PSK                   |  |
| MODULATION FORMAT(S)        | -            | Direct Carrier Mod    |  |
| MOD INDEX RANGE             | Rad Pk       | 0.1 - 1.5             |  |
| SUBCARRIER FREQ RANGE       | kHz          | None                  |  |
| SUBCARRIER WAVEFORM         | Sin/Sq       | None                  |  |
| SYMBOL RATE RANGE           | s/s          | 1 - 1 000 000         |  |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)                   |  |
| ARRAYS WITH STATIONS        | -            | None                  |  |
| CHANNEL DECODING            | Type         | CONV, r - 1/2, k = 7  |  |
| DATA FORMAT                 | -            | None                  |  |
|                             |              |                       |  |
|                             |              |                       |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-2153

CCSDS HISTORICAL DOCUMENT  
**CLRC / RAL TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION |  |
|--------------------------|--------------|-----------------------|--|
|                          |              | CHILTON               |  |
| <b>GENERAL</b>           |              |                       |  |
| STATION DESIGNATION      | -            | Chilton               |  |
| LOCATION(S)              | -            | Didcot, UK            |  |
| DIAMETER                 | m            | 12.5                  |  |
| <b>FREQUENCIES</b>       |              |                       |  |
| TRANSMIT FREQUENCIES     | MHz          | 2000 - 2100           |  |
| RECEIVE FREQUENCIES      | MHz          | 2200 - 2300           |  |
| TURNAROUND FREQ RATIO    | -            | 240 / 221             |  |
| <b>DOPPLER</b>           |              |                       |  |
| COHERENT/NON-COHERENT    | -            | Coherent              |  |
| COUNTER RESOLUTION       | Cycles       | 100                   |  |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 0.045               |  |
| DOPPLER BIAS FREQ        | MHz          | (1)                   |  |
| DRIFT                    | $\Delta f/f$ | (1)                   |  |
| OUTPUT EQUATION          | -            | (1)                   |  |
| DIRECTION INDICATOR      | -            | (1)                   |  |
|                          |              |                       |  |
|                          |              |                       |  |
|                          |              |                       |  |
| <b>RANGING</b>           |              |                       |  |
| COHERENT/NON-COHERENT    | -            | (1)                   |  |
| RANGE CODE WAVEFORM      | Sin/Sq       | (1)                   |  |
| EARTH STATION MOD INDEX  | Rad Pk       | (1)                   |  |
| RANGE CODE FREQ RATIO    | -            | (1)                   |  |
| MAJOR CODE FREQ(S)       | kHz          | (1)                   |  |
| MINOR CODE FREQ(S)       | kHz          | (1)                   |  |
| MIN RECEIVED CARRIER SNR | dB           | (1)                   |  |
| MIN REQ CODE PWR/No      | dB-Hz        | (1)                   |  |
| CODE INTEGRATION TIME    | s            | (1)                   |  |
| ACQUISITION SEQUENCE     | -            | (1)                   |  |
| RANGE DATA UNITS         | -            | (1)                   |  |
| RANGE QUANTIZATION       | -            | (1)                   |  |
| ACCURACY (STRONG SIGNAL) | m            | (1)                   |  |
| MAX UNAMBIGUOUS RANGE    | km           | (1)                   |  |
| TRANSPONDER BW           | MHz          | (1)                   |  |
|                          |              |                       |  |
|                          |              |                       |  |
|                          |              |                       |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

6445-2152

**CCSDS HISTORICAL DOCUMENT**  
**CLRC / RAL TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                |                |                       |                |
|--|---------------|--------------------------------------|----------------|-----------------------|----------------|
|  |               | CHILTON                              |                |                       |                |
| <b>GENERAL</b>   |               |                                      |                |                       |                |
| STATION DESIGNATION  | -             | Chilton                              |                |                       |                |
| LOCATION(S)  | -             | Didcot, UK                           |                |                       |                |
| DIAMETER   | m             | 12.5                                 |                |                       |                |
| <b>FREQUENCY STD</b>   |               |                                      |                |                       |                |
| STANDARD TYPE  | Name          | Rubidium                             |                |                       |                |
| STANDARD MFG   | Name          | Rhode and Schwarz                    |                |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b>                | <b>Drift</b>   | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | (1)                                  |                |                       |                |
| 1 - HOUR   | $\Delta f/f$  | $< 5 \times 10^{-11}$                |                |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                                  |                |                       |                |
| 1 - MONTH  | $\Delta f/f$  | $5 \times 10^{-11}$                  |                |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>                         | <b>100 MHz</b> | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                                  |                |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | (1)                                  |                |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | (1)                                  |                |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | (1)                                  |                |                       |                |
| REF FREQS AVAILABLE  | MHz           | 0.1, 1, 5                            |                |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                                  |                |                       |                |
|  |               |                                      |                |                       |                |
|  |               |                                      |                |                       |                |
|  |               |                                      |                |                       |                |
|  |               |                                      |                |                       |                |
| <b>TIMING SYSTEM</b>   |               |                                      |                |                       |                |
| MASTER REFERENCE AGENCY  | Name          | GPS                                  |                |                       |                |
| REFERENCE TIME   | Name          | ITC                                  |                |                       |                |
| TIME CODE EPOCH  | Yr            | (1)                                  |                |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG - 36<br>NASA - 36               |                |                       |                |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$                   |                |                       |                |
| TIME TRANSFER METHOD   | Name          | (1)                                  |                |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | (1)                                  |                |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | (1)                                  |                |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | (1)                                  |                |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                                  |                |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, $10^6$ , $5 \times 10^6$ , $10^2$ |                |                       |                |
|  |               |                                      |                |                       |                |
|  |               |                                      |                |                       |                |
|  |               |                                      |                |                       |                |
|  |               |                                      |                |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                                      |                |                       |                |

6445-2150

CCSDS HISTORICAL DOCUMENT  
**CLRC / RAL TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION |  |
|---|--------------------|-----------------------|--|
|   |                    | CHILTON               |  |
| <b>GENERAL</b>  |                    |                       |  |
| STATION DESIGNATION   | -                  | Chilton               |  |
| LOCATION(S)   | -                  | Didcot, UK            |  |
| DIAMETER  | m                  | 12.5                  |  |
| <b>GEOGRAPHICAL</b>   |                    |                       |  |
| LOCATION, COUNTRY/STATE   | Name               | Chilton, UK           |  |
| LOCATION, CITY  | Name               | Didcot                |  |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 358, 41, 18.73 E      |  |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 51, 34, 19.2 N        |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
| <b>MECHANICAL</b>   |                    |                       |  |
| TYPE OF MOUNT   | -                  | EI over Az            |  |
| AZIMUTH LIMITATIONS   | -                  | ± 270                 |  |
| TRACKING SPEED RANGE  | deg/s              | 7                     |  |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 32                    |  |
| TYPE OF POINTING  | Type               | Autotrack             |  |
| POINTING ACCURACY   | deg                | 0.1                   |  |
| MIN TRANSMIT ELEV ANGLE   | deg                | 8                     |  |
| MIN RECEIVE ELEV ANGLE  | deg                | 0                     |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
| <b>SUPPORT</b>  |                    |                       |  |
| TRANSMIT FREQ BAND(S)   | GHz                | 2.0 - 2.1             |  |
| RECEIVE FREQ BAND(S)  | GHz                | 2.2 - 2.3             |  |
| ACQ AID FREQ BAND(S)  | GHz                | 2.2 - 2.3             |  |
| MISSION CATEGORIES  | Cat                | A                     |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                       |  |

6445-2151

CCSDS HISTORICAL DOCUMENT  
**CLTC TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION     |                             |
|---|--------------|---------------------------|-----------------------------|
|   |              | YW-TWO ICB STATION        | XIAMEN USB STATION          |
| <b>GENERAL</b>  |              |                           |                             |
| STATION DESIGNATION   | -            | Yw-Two ICB Station        | Xiamen USB Station          |
| LOCATION(S)   | -            | Jiangyin, China, Moveable | Xiamen, China               |
| DIAMETER  | m            | 9                         | 10                          |
| <b>TRANSMIT</b>   |              |                           |                             |
| FREQUENCIES   | MHz          | 5925 - 6425               | 2025 - 2120                 |
| FREQUENCY RESOLUTION  | Hz           | 1000                      | 1000                        |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $1 \times 10^{-10}$ @ 1s  | $1 \times 10^{-10}$ @ 20 ms |
| TRANSMIT POWER 1  | W            | 3000                      | 1000                        |
| EIRP RANGE 1  | dBW          | 64 - 84                   | 49 - 69                     |
| TRANSMIT POWER 2  | W            | None                      | None                        |
| EIRP RANGE 2  | dBW          | None                      | None                        |
| POLARIZATION  | -            | HLP, VLP, RHCP or LHCP    | RCP or LCP                  |
| ANTENNA GAIN  | dBi          | 52                        | 42                          |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.38                      | 1.04                        |
| ANTENNA ELLIPTICITY   | dB           | 1.5                       | 1.5                         |
| RF FREQ SWEEP RANGE   | kHz          | $\pm 200$                 | $\pm 150$                   |
| MIN FREQ SWEEP RATE   | Hz/s         | 5000                      | 5000                        |
| MAX FREQ SWEEP RATE   | kHz/s        | 150                       | 180                         |
| PROGRAMMED UPLINK FREQ  | Yes/No       | No                        | Yes                         |
|   |              |                           |                             |
|   |              |                           |                             |
|   |              |                           |                             |
|   |              |                           |                             |
|   |              |                           |                             |
|   |              |                           |                             |
|   |              |                           |                             |
|   |              |                           |                             |
|   |              |                           |                             |
|   |              |                           |                             |
| <b>COMMAND</b>  |              |                           |                             |
| RF CARRIER MOD TYPE   | -            | FM, PM                    | FM, PM                      |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | (1)                       | (1)                         |
| SUBCARRIER FREQUENCY(S)   | Hz           | 5 000, 60 000             | 5 000, 60 000               |
| SUBCARRIER STEP SIZE  | Hz           | (1)                       | (1)                         |
| SUBCARRIER FREQ STABILITY   | ppm          | 50                        | 50                          |
| SUBCARRIER WAVEFORM   | Sin/Sq       | (1)                       | (1)                         |
| SUBCARRIER MOD TYPE   | -            | ASK, PSK, FSK             | ASK, PSK, FSK               |
| SUBCARRIER/BIT RATE LIMIT   | -            | (1)                       | (1)                         |
| BIT RATE RANGE  | b/s          | (1)                       | (1)                         |
| FORMATS AVAILABLE   | -            | (1)                       | (1)                         |
|   |              |                           |                             |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA <span style="float: right;">6445-4696</span> |              |                           |                             |

**CCSDS HISTORICAL DOCUMENT**  
**CLTC TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                 |                                      |
|-----------------------------|--------------|---------------------------------------|--------------------------------------|
|                             |              | YW-TWO ICB STATION                    | XIAMEN USB STATION                   |
| <b>GENERAL</b>              |              |                                       |                                      |
| STATION DESIGNATION         | -            | Yw-Two ICB Station                    | Xiamen USB Station                   |
| LOCATION(S)                 | -            | Jiangyin, China, Moveable             | Xiamen, China                        |
| DIAMETER                    | m            | 9                                     | 10                                   |
| <b>RECEIVE</b>              |              |                                       |                                      |
| FREQUENCIES                 | MHz          | 3700 - 4200                           | 2200 - 2300                          |
| FREQUENCY RESOLUTION        | Hz           | 1000                                  | 1000                                 |
| ANTENNA GAIN @ 45 deg       | dBi          | 51                                    | 43                                   |
| SYS NOISE TEMP @ ZENITH     | K            | 150                                   | 150                                  |
| G/T @ 45 deg                | dB           | 25                                    | 20.5                                 |
| POLARIZATION                | -            | HLP, VLP, RHCP or LHCP                | RCP or LCP, RCP and LCP              |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.58                                  | 0.95                                 |
| ANTENNA ELLIPTICITY         | dB           | 1.5                                   | 1.5                                  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $1 \times 10^{-5}$ @ 1s               | $5 \times 10^{-5}$ @ 1s              |
| RCVR AGC DYNAMIC RANGE      | dB           | 60                                    | 60                                   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -130 in 2 Blo = 2000 Hz               | -130 in 2 Blo = 2000 Hz              |
| RCVR LOOP BANDWIDTHS        | Hz           | 2000                                  | 2000                                 |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                                 | Adapt                                |
| RCVR PLL ORDER(S)           | No.          | 2                                     | 2                                    |
| ACQ SWEEP RANGE             | kHz          | $\pm 150$                             | $\pm 150$                            |
| MIN ACQ SWEEP RATE          | Hz/s         | 5000                                  | 5000                                 |
| MAX ACQ SWEEP RATE          | kHz/s        | 150                                   | 150                                  |
| ACQ SWEEP STEP SIZE         | Hz           | None                                  | None                                 |
| PROGRAMMED L.O.             | Yes/No       | Yes                                   | Yes                                  |
|                             |              |                                       |                                      |
|                             |              |                                       |                                      |
|                             |              |                                       |                                      |
|                             |              |                                       |                                      |
| <b>TELEMETRY</b>            |              |                                       |                                      |
| MODULATION TYPE(S)          | -            | FM, PM                                | PM                                   |
| MODULATION FORMAT(S)        | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S  | NRZ - L, M, S; Bi - $\phi$ - L, M, S |
| MOD INDEX RANGE             | Rad Pk       | 0.2 - 1.6                             | 0.2 - 1.5                            |
| SUBCARRIER FREQ RANGE       | kHz          | TMC: 5 - 320; TMA: 162, 164, 166, 168 | 5 - 512                              |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine                                  | Sine                                 |
| SYMBOL RATE RANGE           | s/s          | 10 - 50 000                           | 100 - 64 000                         |
| SUBCARRIER/SYM RATE LIMIT   | -            | No                                    | 2 - 512                              |
| ARRAYS WITH STATIONS        | -            | None                                  | None                                 |
| CHANNEL DECODING            | Type         | None                                  | None                                 |
| DATA FORMAT                 | -            | CCSDS Xfer Frame / VC Servers         | CCSDS Xfer Frame / VC Servers        |
|                             |              |                                       |                                      |
|                             |              |                                       |                                      |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS  
4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA

**CCSDS HISTORICAL DOCUMENT**  
**CLTC TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION     |   |
|---|--------------|---------------------------|---|
|   |              | YW-TWO ICB STATION        | XIAMEN USB STATION                          |
| <b>GENERAL</b>  |              |                           |   |
| STATION DESIGNATION   | -            | Yw-Two ICB Station        | Xiamen USB Station                          |
| LOCATION(S)   | -            | Jiangyin, China, Moveable | Xiamen, China                               |
| DIAMETER  | m            | 9                         | 10  |
| <b>FREQUENCIES</b>  |              |                           |   |
| TRANSMIT FREQUENCIES  | MHz          | 5925 - 6425               | 2025 - 2100                                 |
| RECEIVE FREQUENCIES   | MHz          | 3700 - 4200               | 2200 - 2300                                 |
| TURNAROUND FREQ RATIO   | -            | None                      | 221 - 240                                   |
| <b>DOPPLER</b>  |              |                           |   |
| COHERENT/NON-COHERENT   | -            | None                      | Coherent                                    |
| COUNTER RESOLUTION  | Cycles       |                           | 1   |
| MAX DOPPLER FREQ SHIFT  | MHz          |                           | 0.15  |
| DOPPLER BIAS FREQ   | MHz          |                           | None  |
| DRIFT   | $\Delta f/f$ |                           | $1 \times 10^{-10}$                         |
| OUTPUT EQUATION   | -            |                           | None  |
| DIRECTION INDICATOR   | -            |                           | Yes   |
| <b>RANGING</b>  |              |                           |   |
| COHERENT/NON-COHERENT   | -            | Non-Coherent              | Coherent                                    |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine                      | Sine  |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.2 - 1.5                 | 0.2 - 1.5                                   |
| RANGE CODE FREQ RATIO   | -            | 7, 14, 8                  | 5   |
| MAJOR CODE FREQ(S)  | kHz          | 27.7                      | 100   |
| MINOR CODE FREQ(S)  | kHz          | 3.968, 0.283, 0.035       | 20, 16, (0.8, 0.16, 0.032, 0.008 on 16 kHz) |
| MIN RECEIVED CARRIER SNR  | dB           | 10                        | 10  |
| MIN REQ CODE PWR/ $N_0$   | dB-Hz        | 41                        | 27  |
| CODE INTEGRATION TIME   | s            | 0.75                      | None  |
| ACQUISITION SEQUENCE  | -            | Major $\rightarrow$ Minor | Major $\rightarrow$ Minor                   |
| RANGE DATA UNITS  | -            | m                         | m   |
| RANGE QUANTIZATION  | -            | None                      | None  |
| ACCURACY (STRONG SIGNAL)  | m            | 15                        | 10  |
| MAX UNAMBIGUOUS RANGE   | km           | 45 000                    | 45 000                                      |
| TRANSPONDER BW  | MHz          | None                      | (1)   |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> <p>4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA</p> |              |                           |   |

**CCSDS HISTORICAL DOCUMENT**  
**CLTC TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS   | UNITS         | SUBNETWORK OR STATION      |                     |                            |                     |
|---|---------------|----------------------------|---------------------|----------------------------|---------------------|
|   |               | YW-TWO ICB STATION         |                     | XIAMEN USB STATION         |                     |
| <b>GENERAL</b>  |               |                            |                     |                            |                     |
| STATION DESIGNATION   | -             | Yw-Two ICB Station         |                     | Xiamen USB Station         |                     |
| LOCATION(S)   | -             | Jiangyin, Chine, Moveable  |                     | Xiamen, China              |                     |
| DIAMETER  | m             | 9                          |                     | 10                         |                     |
| <b>FREQUENCY STD</b>  |               |                            |                     |                            |                     |
| STANDARD TYPE   | Name          | Rubidium Oscillator        |                     | Rubidium Oscillator        |                     |
| STANDARD MFG  | Name          | Xinghua Instrument Factory |                     | Xinghua Instrument Factory |                     |
| STABILITY AT:   |               | <b>Allan Variance</b>      | <b>Draft</b>        | <b>Allan Variance</b>      | <b>Draft</b>        |
| 1 - SECOND  | $\Delta f/f$  | $1 \times 10^{-11}$        | (1)                 | $1 \times 10^{-11}$        | (1)                 |
| 1 - HOUR  | $\Delta f/f$  | (1)                        | (1)                 | (1)                        | (1)                 |
| 1 - DAY (24 HOURS)  | $\Delta f/f$  | (1)                        | $1 \times 10^{-12}$ | (1)                        | $1 \times 10^{-12}$ |
| 1 - MONTH   | $\Delta f/f$  | (1)                        | (1)                 | (1)                        | $4 \times 10^{-11}$ |
| REF FREQS PHASE NOISE   | $S_{\phi}(f)$ | <b>5 MHz</b>               | <b>100 MHz</b>      | <b>5 MHz</b>               | <b>100 MHz</b>      |
| 1 Hz OFFSET   | dBc/Hz        | (1)                        | (1)                 | (1)                        | (1)                 |
| 10 Hz OFFSET  | dBc/Hz        | (1)                        | (1)                 | (1)                        | (1)                 |
| 100 Hz OFFSET   | dBc/Hz        | (1)                        | (1)                 | -120                       | (1)                 |
| 1000 Hz OFFSET  | dBc/Hz        | (1)                        | (1)                 | -145                       | (1)                 |
| REF FREQS AVAILABLE   | MHz           | 5                          |                     | 5                          |                     |
| MAX STA-TO-STA OFFSET   | Hz            | (1)                        |                     | (1)                        |                     |
| <b>TIMING SYSTEM</b>  |               |                            |                     |                            |                     |
| MASTER REFERENCE AGENCY   | Name          | CSAO                       |                     | CSAO                       |                     |
| REFERENCE TIME  | Name          | NTC                        |                     | UTC                        |                     |
| TIME CODE EPOCH   | Yr            | (1)                        |                     | (1)                        |                     |
| TIME CODES AVAILABLE  | CCSDS Codes   | (1)                        |                     | (1)                        |                     |
| MAX TIME RESOLUTION   | s             | (1)                        |                     | (1)                        |                     |
| TIME TRANSFER METHOD  | Name          | BPL                        |                     | BPL                        |                     |
| MAX TRANS ERROR REF   | $\mu$ -sec    | 10                         |                     | 10                         |                     |
| MAX OFFSET FROM REF   | $\mu$ -sec    | 30                         |                     | 30                         |                     |
| MAX OFFSET MEAS ERROR   | $\mu$ -sec    | (1)                        |                     | (1)                        |                     |
| MAX STA-TO-STA OFFSET   | $\mu$ -sec    | 50                         |                     | 50                         |                     |
| TIMING SIGNALS AVAILABLE  | pulse/s       | 1, 1/60                    |                     | 1, 1/60                    |                     |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br/> 4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA    5. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA    6445-4699</p> |               |                            |                     |                            |                     |

CCSDS HISTORICAL DOCUMENT  
**CLTC TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS  | UNITS              | SUBNETWORK OR STATION                 |                                      |
|--|--------------------|---------------------------------------|--------------------------------------|
|  |                    | YW-TWO ICB STATION                    | XIAMEN USB STATION                   |
| <b>GENERAL</b>   |                    |                                       |                                      |
| STATION DESIGNATION  | -                  | Yw-Two ICB Station                    | Xiamen USB Station                   |
| LOCATION(S)  | -                  | Jiangyin, China, Moveable             | Xiamen, China                        |
| DIAMETER   | m                  | 9                                     | 10                                   |
| <b>GEOGRAPHICAL</b>  |                    |                                       |                                      |
| LOCATION, COUNTRY/STATE  | Name               | China                                 | China                                |
| LOCATION, CITY   | Name               | Jiangyin, Can be Movable in the Ocean | Xiamen                               |
| LONGITUDE (site 1/site 2/site 3)   | d, m, s            | 121 E                                 | 118 E                                |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 32 N                                  | 24 N                                 |
|  |                    |                                       |                                      |
|  |                    |                                       |                                      |
|  |                    |                                       |                                      |
|  |                    |                                       |                                      |
| <b>MECHANICAL</b>  |                    |                                       |                                      |
| TYPE OF MOUNT  | -                  | Az - El                               | Az - El                              |
| AZIMUTH LIMITATIONS  | -                  | 0 deg - 360 deg (No Limit)            | 0 deg - 360 deg (No Limit)           |
| TRACKING SPEED RANGE   | deg/s              | Az: 0.05 - 34; El: 0.05 - 18          | Az: 0.01 - 5; El: 0.01 - 3           |
| MAX TRACK ACCELERATION   | deg/s <sup>2</sup> | Az: 30; El: 12                        | Az: 20; El: 10                       |
| TYPE OF POINTING   | Type               | Autotrack, Manual, Predicts, Program  | Autotrack, Manual, Predicts, Program |
| POINTING ACCURACY  | deg                | 0.025                                 | 0.025                                |
| MIN TRANSMIT ELEV ANGLE  | deg                | 5                                     | 5                                    |
| MIN RECEIVE ELEV ANGLE   | deg                | 3                                     | 3                                    |
|  |                    |                                       |                                      |
|  |                    |                                       |                                      |
|  |                    |                                       |                                      |
|  |                    |                                       |                                      |
| <b>SUPPORT</b>   |                    |                                       |                                      |
| TRANSMIT FREQ BAND(S)  | GHz                | 5.925 - 6.425                         | 2.025 - 2.12                         |
| RECEIVE FREQ BAND(S)   | GHz                | 3.7 - 4.2                             | 2.2 - 2.3                            |
| ACQ AID FREQ BAND(S)   | GHz                | 3.7 - 4.2                             | 2.2 - 2.3                            |
| MISSION CATEGORIES   | Cat                | A                                     | A                                    |
|  |                    |                                       |                                      |
|  |                    |                                       |                                      |
|  |                    |                                       |                                      |
|  |                    |                                       |                                      |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES<br>6. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA |                    |                                       |                                      |

6445-4700

CCSDS HISTORICAL DOCUMENT  
**CLTC TRACKING SYSTEM**  
EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION       |                             |
|---------------------------|--------------|-----------------------------|-----------------------------|
|                           |              | QINGDAO USB STATION         | WEINAN USB STATION          |
| <b>GENERAL</b>            |              |                             |                             |
| STATION DESIGNATION       | -            | Qingdao USB Station         | Weinan USB Station          |
| LOCATION(S)               | -            | Qingdao, China              | Weinan, China               |
| DIAMETER                  | m            | 10                          | 10                          |
| <b>TRANSMIT</b>           |              |                             |                             |
| FREQUENCIES               | MHz          | 2025 - 2100                 | 2025 - 2100                 |
| FREQUENCY RESOLUTION      | Hz           | 1000                        | 1000                        |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $1 \times 10^{-10}$ @ 20 ms | $1 \times 10^{-10}$ @ 20 ms |
| TRANSMIT POWER 1          | W            | 1000                        | 1000                        |
| EIRP RANGE 1              | dBW          | 49 - 69                     | 49 - 69                     |
| TRANSMIT POWER 2          | W            | None                        | None                        |
| EIRP RANGE 2              | dBW          | None                        | None                        |
| POLARIZATION              | -            | RCP or LCP                  | RCP or LCP                  |
| ANTENNA GAIN              | dBi          | 42                          | 42                          |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 1.04                        | 1.04                        |
| ANTENNA ELLIPTICITY       | dB           | 1.5                         | 1.5                         |
| RF FREQ SWEEP RANGE       | kHz          | $\pm 150$                   | $\pm 150$                   |
| MIN FREQ SWEEP RATE       | Hz/s         | 5000                        | 5000                        |
| MAX FREQ SWEEP RATE       | kHz/s        | 180                         | 180                         |
| PROGRAMMED UPLINK FREQ    | Yes/No       | Yes                         | Yes                         |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
| <b>COMMAND</b>            |              |                             |                             |
| RF CARRIER MOD TYPE       | -            | PM                          | PM                          |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | (1)                         | (1)                         |
| SUBCARRIER FREQUENCY(S)   | Hz           | 2000 - 100 000              | 2000 - 100 000              |
| SUBCARRIER STEP SIZE      | Hz           | (1)                         | (1)                         |
| SUBCARRIER FREQ STABILITY | ppm          | 10                          | 10                          |
| SUBCARRIER WAVEFORM       | Sin/Sq       | (1)                         | (1)                         |
| SUBCARRIER MOD TYPE       | -            | ASK, PSK, FSK               | ASK, PSK, FSK               |
| SUBCARRIER/BIT RATE LIMIT | -            | (1)                         | (1)                         |
| BIT RATE RANGE            | b/s          | (1)                         | (1)                         |
| FORMATS AVAILABLE         | -            | (1)                         | (1)                         |
|                           |              |                             |                             |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS  
4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA

**CCSDS HISTORICAL DOCUMENT**  
**CLTC TRACKING SYSTEM**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                |                                      |
|-----------------------------|--------------|--------------------------------------|--------------------------------------|
|                             |              | QINGDAO USB STATION                  | WEINAN USB STATION                   |
| <b>GENERAL</b>              |              |                                      |                                      |
| STATION DESIGNATION         | -            | Qingdao USB Station                  | Weinan USB Station                   |
| LOCATION(S)                 | -            | Qingdao, China                       | Weinan, China                        |
| DIAMETER                    | m            | 10                                   | 10                                   |
| <b>RECEIVE</b>              |              |                                      |                                      |
| FREQUENCIES                 | MHz          | 2200 - 2300                          | 2200 - 2300                          |
| FREQUENCY RESOLUTION        | Hz           | 1000                                 | 1000                                 |
| ANTENNA GAIN @ 45 deg       | dBi          | 43                                   | 43                                   |
| SYS NOISE TEMP @ ZENITH     | K            | 150                                  | 150                                  |
| G/T @ 45 deg                | dB           | 20.5                                 | 20.5                                 |
| POLARIZATION                | -            | RCP or LCP, RCP and LCP              | RCP or LCP, RCP and LCP              |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.95                                 | 0.95                                 |
| ANTENNA ELLIPTICITY         | dB           | 1.5                                  | 1.5                                  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $5 \times 10^{-5}$ @ 1s              | $5 \times 10^{-5}$ @ 1s              |
| RCVR AGC DYNAMIC RANGE      | dB           | 60                                   | 60                                   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | (1)                                  | (1)                                  |
| RCVR LOOP BANDWIDTHS        | Hz           | 2000                                 | 2000                                 |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                                | Adapt                                |
| RCVR PLL ORDER(S)           | No.          | 2                                    | 2                                    |
| ACQ SWEEP RANGE             | kHz          | $\pm 150$                            | $\pm 150$                            |
| MIN ACQ SWEEP RATE          | Hz/s         | 5000                                 | 5000                                 |
| MAX ACQ SWEEP RATE          | kHz/s        | 150                                  | 150                                  |
| ACQ SWEEP STEP SIZE         | Hz           | 5000                                 | 5000                                 |
| PROGRAMMED L.O.             | Yes/No       | Yes                                  | Yes                                  |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
| <b>TELEMETRY</b>            |              |                                      |                                      |
| MODULATION TYPE(S)          | -            | PM                                   | PM                                   |
| MODULATION FORMAT(S)        | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S | NRZ - L, M, S; Bi - $\phi$ - L, M, S |
| MOD INDEX RANGE             | Rad Pk       | 0.2 - 1.5                            | 0.2 - 1.5                            |
| SUBCARRIER FREQ RANGE       | kHz          | 5 - 512                              | 5 - 512                              |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine                                 | Sine                                 |
| SYMBOL RATE RANGE           | s/s          | 100 - 64 000                         | 100 - 64 000                         |
| SUBCARRIER/SYM RATE LIMIT   | -            | 2 - 512                              | 2 - 512                              |
| ARRAYS WITH STATIONS        | -            | None                                 | None                                 |
| CHANNEL DECODING            | Type         | (1)                                  | (1)                                  |
| DATA FORMAT                 | -            | CCSDS Xfer Frame / VC Service        | CCSDS Xfer Frame / VC Service        |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |

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4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA

**CCSDS HISTORICAL DOCUMENT**  
**CLTC TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                       |   |
|---|--------------|---|---|
|   |              | QINGDAO USB STATION                         | WEINAN USB STATION                          |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | Qingdao USB Station                         | Weinan USB Station                          |
| LOCATION(S)   | -            | Qingdao, China                              | Weinan, China                               |
| DIAMETER  | m            | 10  | 10  |
| <b>FREQUENCIES</b>  |              |   |   |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2100                                 | 2025 - 2100                                 |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300                                 | 2200 - 2300                                 |
| TURNAROUND FREQ RATIO   | -            | 221 - 240                                   | 221 - 240                                   |
| <b>DOPPLER</b>  |              |   |   |
| COHERENT/NON-COHERENT   | -            | Coherent                                    | Coherent                                    |
| COUNTER RESOLUTION  | Cycles       | 1   | 1   |
| MAX DOPPLER FREQ SHIFT  | MHz          | 0.15  | 0.15  |
| DOPPLER BIAS FREQ   | MHz          | None  | None  |
| DRIFT   | $\Delta f/f$ | $1 \times 10^{-10}$                         | $1 \times 10^{-10}$                         |
| OUTPUT EQUATION   | -            | (1)   | (1)   |
| DIRECTION INDICATOR   | -            | Yes   | Yes   |
| <b>RANGING</b>  |              |   |   |
| COHERENT/NON-COHERENT   | -            | Coherent                                    | Coherent                                    |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine  | Sine  |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.2 - 1.5                                   | 0.2 - 1.5                                   |
| RANGE CODE FREQ RATIO   | -            | 5   | 5   |
| MAJOR CODE FREQ(S)  | kHz          | 100   | 100   |
| MINOR CODE FREQ(S)  | kHz          | 20, 16, (0.8, 0.16, 0.032, 0.008 on 16 kHz) | 20, 16, (0.8, 0.16, 0.032, 0.008 on 16 kHz) |
| MIN RECEIVED CARRIER SNR  | dB           | 10  | 10  |
| MIN REQ CODE PWR/ $N_0$   | dB-Hz        | 27  | 27  |
| CODE INTEGRATION TIME   | s            | (1)   | (1)   |
| ACQUISITION SEQUENCE  | -            | Major → Minor                               | Major → Minor                               |
| RANGE DATA UNITS  | -            | m   | m   |
| RANGE QUANTIZATION  | -            | (1)   | (1)   |
| ACCURACY (STRONG SIGNAL)  | m            | 10  | 10  |
| MAX UNAMBIGUOUS RANGE   | km           | 45 000                                      | (1)   |
| TRANSPONDER BW  | MHz          | (1)   | (1)   |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> <p>4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA</p> |              |   |   |

6445-4703

**CCSDS HISTORICAL DOCUMENT**  
**CLTC TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION      |                     |                            |                     |
|--|---------------|----------------------------|---------------------|----------------------------|---------------------|
|  |               | QINGDAO USB STATION        |                     | WEINAN USB STATION         |                     |
| <b>GENERAL</b>   |               |                            |                     |                            |                     |
| STATION DESIGNATION  | -             | Qingdao USB Station        |                     | Weinan USB Station         |                     |
| LOCATION(S)  | -             | Qingdao, China             |                     | Weinan, China              |                     |
| DIAMETER   | m             | 10                         |                     | 10                         |                     |
| <b>FREQUENCY STD</b>   |               |                            |                     |                            |                     |
| STANDARD TYPE  | Name          | Rubidium Oscillator        |                     | Rubidium Oscillator        |                     |
| STANDARD MFG   | Name          | Xinghua Instrument Factory |                     | Xinghua Instrument Factory |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>      | <b>Draft</b>        | <b>Allan Variance</b>      | <b>Draft</b>        |
| 1 - SECOND   | $\Delta f/f$  | $1 \times 10^{-11}$        | (1)                 | $1 \times 10^{-11}$        | (1)                 |
| 1 - HOUR   | $\Delta f/f$  | (1)                        | (1)                 | (1)                        | (1)                 |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                        | $1 \times 10^{-12}$ | (1)                        | $1 \times 10^{-12}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)                        | $4 \times 10^{-11}$ | (1)                        | $4 \times 10^{-11}$ |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>               | <b>100 MHz</b>      | <b>5 MHz</b>               | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | (1)                        | (1)                 | (1)                        | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | (1)                        | (1)                 | (1)                        | (1)                 |
| 100 Hz OFFSET  | dBc/Hz        | -120                       | (1)                 | -120                       | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz        | -145                       | (1)                 | -145                       | (1)                 |
| REF FREQS AVAILABLE  | MHz           | 5                          |                     | 5                          |                     |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                        |                     | (1)                        |                     |
| <b>TIMING SYSTEM</b>   |               |                            |                     |                            |                     |
| MASTER REFERENCE AGENCY  | Name          | CSAO                       |                     | CSAO                       |                     |
| REFERENCE TIME   | Name          | UTC                        |                     | UTC                        |                     |
| TIME CODE EPOCH  | Yr            | None                       |                     | None                       |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | None                       |                     | None                       |                     |
| MAX TIME RESOLUTION  | s             | None                       |                     | None                       |                     |
| TIME TRANSFER METHOD   | Name          | BPL                        |                     | BPL                        |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 10                         |                     | 10                         |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | 30                         |                     | 30                         |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | (1)                        |                     | (1)                        |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 50                         |                     | 50                         |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 1/60                    |                     | 1, 1/60                    |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA    5. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA    6445-4704 |               |                            |                     |                            |                     |

CCSDS HISTORICAL DOCUMENT  
**CLTC TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS  | UNITS              | SUBNETWORK OR STATION                |                                      |
|--|--------------------|--------------------------------------|--------------------------------------|
|  |                    | QINGDAO USB STATION                  | WEINAN USB STATION                   |
| <b>GENERAL</b>   |                    |                                      |                                      |
| STATION DESIGNATION  | -                  | Qingdao USB Station                  | Weinan USB Station                   |
| LOCATION(S)  | -                  | Qingdao, China                       | Weinan, China                        |
| DIAMETER   | m                  | 10                                   | 10                                   |
| <b>GEOGRAPHICAL</b>  |                    |                                      |                                      |
| LOCATION, COUNTRY/STATE  | Name               | China                                | China                                |
| LOCATION, CITY   | Name               | Qingdao                              | Weinan                               |
| LONGITUDE (site 1/site 2/site 3)   | d, m, s            | 170 E                                | 110 E                                |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 36 N                                 | 34 N                                 |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
| <b>MECHANICAL</b>  |                    |                                      |                                      |
| TYPE OF MOUNT  | -                  | Az - El                              | Az - El                              |
| AZIMUTH LIMITATIONS  | -                  | 0 deg - 360 deg (No Limit)           | 0 deg - 360 deg (No Limit)           |
| TRACKING SPEED RANGE   | deg/s              | Az: 0.01 - 5; El: 0.01 - 3           | Az: 0.01 - 5; El: 0.01 - 3           |
| MAX TRACK ACCELERATION   | deg/s <sup>2</sup> | Az: 20; El: 10                       | Az: 20; El: 10                       |
| TYPE OF POINTING   | Type               | Autotrack, Manual, Predicts, Program | Autotrack, Manual, Predicts, Program |
| POINTING ACCURACY  | deg                | 0.025                                | 0.025                                |
| MIN TRANSMIT ELEV ANGLE  | deg                | 5                                    | 5                                    |
| MIN RECEIVE ELEV ANGLE   | deg                | 3                                    | 3                                    |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
| <b>SUPPORT</b>   |                    |                                      |                                      |
| TRANSMIT FREQ BAND(S)  | GHz                | 2.025 - 2.12                         | 2.025 - 2.12                         |
| RECEIVE FREQ BAND(S)   | GHz                | 2.2 - 2.0                            | 2.2 - 2.3                            |
| ACQ AID FREQ BAND(S)   | GHz                | 2.2 - 2.3                            | 2.2 - 2.3                            |
| MISSION CATEGORIES   | Cat                | A                                    | A                                    |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES<br>6. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA |                    |                                      |                                      |

6445-4705



CCSDS HISTORICAL DOCUMENT  
**CLTC TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                |                                      |
|-----------------------------|--------------|--------------------------------------|--------------------------------------|
|                             |              | KASHI USB STATION                    | NANNING USB STATION                  |
| <b>GENERAL</b>              |              |                                      |                                      |
| STATION DESIGNATION         | -            | Kashi USB Station                    | Nanning USB Station                  |
| LOCATION(S)                 | -            | Kashi, China                         | Nanning, China                       |
| DIAMETER                    | m            | 12                                   | 12                                   |
| <b>RECEIVE</b>              |              |                                      |                                      |
| FREQUENCIES                 | MHz          | 2200 - 2300                          | 2200 - 2300                          |
| FREQUENCY RESOLUTION        | Hz           | 1000                                 | 1000                                 |
| ANTENNA GAIN @ 45 deg       | dBi          | 46                                   | 46                                   |
| SYS NOISE TEMP @ ZENITH     | K            | 150                                  | 150                                  |
| G/T @ 45 deg                | dB           | 22.5                                 | 22.5                                 |
| POLARIZATION                | -            | RCP or LCP, RCP and LCP              | RCP or LCP, RCP and LCP              |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.95                                 | 0.95                                 |
| ANTENNA ELLIPTICITY         | dB           | 1.5                                  | 1.5                                  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $5 \times 10^{-5}$ @ 1s              | $5 \times 10^{-5}$ @ 1s              |
| RCVR AGC DYNAMIC RANGE      | dB           | 60                                   | 60                                   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -130 in 2 Blo = 2000 Hz              | -130 in 2 Blo = 2000 Hz              |
| RCVR LOOP BANDWIDTHS        | Hz           | 2000                                 | 2000                                 |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                                | Adapt                                |
| RCVR PLL ORDER(S)           | No.          | 2                                    | 2                                    |
| ACQ SWEEP RANGE             | kHz          | $\pm 150$                            | $\pm 150$                            |
| MIN ACQ SWEEP RATE          | Hz/s         | 5000                                 | 5000                                 |
| MAX ACQ SWEEP RATE          | kHz/s        | 150                                  | 150                                  |
| ACQ SWEEP STEP SIZE         | Hz           | 5000                                 | 5000                                 |
| PROGRAMMED L.O.             | Yes/No       | Yes                                  | Yes                                  |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
| <b>TELEMETRY</b>            |              |                                      |                                      |
| MODULATION TYPE(S)          | -            | PM                                   | PM                                   |
| MODULATION FORMAT(S)        | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S | NRZ - L, M, S; Bi - $\phi$ - L, M, S |
| MOD INDEX RANGE             | Rad Pk       | 0.2 - 1.5                            | 0.2 - 1.5                            |
| SUBCARRIER FREQ RANGE       | kHz          | 5 - 512                              | 5 - 512                              |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine                                 | Sine                                 |
| SYMBOL RATE RANGE           | s/s          | 100 - 64 000                         | 100 - 64 000                         |
| SUBCARRIER/SYM RATE LIMIT   | -            | 2 - 512                              | 2 - 512                              |
| ARRAYS WITH STATIONS        | -            | None                                 | None                                 |
| CHANNEL DECODING            | Type         | CCSDS R/S Conv Concat                | CCSDS R/S Conv Concat                |
| DATA FORMAT                 | -            | CCSDS Xfer Frame / VC Service        | CCSDS Xfer Frame / VC Service        |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |

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4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA

**CCSDS HISTORICAL DOCUMENT**  
**CLTC TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION                       |   |
|--------------------------|--------------|---|---|
|                          |              | KASHI USB STATION                           | NANNING USB STATION                         |
| <b>GENERAL</b>           |              |   |   |
| STATION DESIGNATION      | -            | Kashi USB Station                           | Nanning USB Station                         |
| LOCATION(S)              | -            | Kashi, China                                | Nanning, China                              |
| DIAMETER                 | m            | 12  | 12  |
| <b>FREQUENCIES</b>       |              |   |   |
| TRANSMIT FREQUENCIES     | MHz          | 2025 - 2120                                 | 2025 - 2120                                 |
| RECEIVE FREQUENCIES      | MHz          | 2200 - 2300                                 | 2200 - 2300                                 |
| TURNAROUND FREQ RATIO    | -            | 221 - 240                                   | 221 - 240                                   |
| <b>DOPPLER</b>           |              |   |   |
| COHERENT/NON-COHERENT    | -            | Coherent                                    | Coherent                                    |
| COUNTER RESOLUTION       | Cycles       | 1   | 1   |
| MAX DOPPLER FREQ SHIFT   | MHz          | 0.15  | 0.15  |
| DOPPLER BIAS FREQ        | MHz          | None  | None  |
| DRIFT                    | $\Delta f/f$ | $1 \times 15^{-10}$                         | $1 \times 15^{-10}$                         |
| OUTPUT EQUATION          | -            | None  | None  |
| DIRECTION INDICATOR      | -            | Yes   | Yes   |
| <b>RANGING</b>           |              |   |   |
| COHERENT/NON-COHERENT    | -            | Coherent                                    | Coherent                                    |
| RANGE CODE WAVEFORM      | Sin/Sq       | Sine  | Sine  |
| EARTH STATION MOD INDEX  | Rad Pk       | 0.2 - 1.5                                   | 0.2 - 1.5                                   |
| RANGE CODE FREQ RATIO    | -            | 5   | 5   |
| MAJOR CODE FREQ(S)       | kHz          | 100   | 100   |
| MINOR CODE FREQ(S)       | kHz          | 20, 16, (0.8, 0.16, 0.032, 0.008 on 16 kHz) | 20, 16, (0.8, 0.16, 0.032, 0.008 on 16 kHz) |
| MIN RECEIVED CARRIER SNR | dB           | 10  | 10  |
| MIN REQ CODE PWR/No      | dB-Hz        | 27  | 27  |
| CODE INTEGRATION TIME    | s            | None  | None  |
| ACQUISITION SEQUENCE     | -            | Major → Minor                               | Major → Minor                               |
| RANGE DATA UNITS         | -            | m   | m   |
| RANGE QUANTIZATION       | -            | (1)   | (1)   |
| ACCURACY (STRONG SIGNAL) | m            | 10  | 10  |
| MAX UNAMBIGUOUS RANGE    | km           | 45 000                                      | 45 000                                      |
| TRANSPONDER BW           | MHz          | (1)   | (1)   |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS  
4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA

6445-4708

**CCSDS HISTORICAL DOCUMENT**  
**CLTC TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION      |                     |                            |                     |
|--|---------------|----------------------------|---------------------|----------------------------|---------------------|
|  |               | KASHI USB STATION          |                     | NANNING USB STATION        |                     |
| <b>GENERAL</b>   |               |                            |                     |                            |                     |
| STATION DESIGNATION  | -             | Kashi USB Station          |                     | Nanning USB Station        |                     |
| LOCATION(S)  | -             | Kashi, China               |                     | Nanning, China             |                     |
| DIAMETER   | m             | 12                         |                     | 12                         |                     |
| <b>FREQUENCY STD</b>   |               |                            |                     |                            |                     |
| STANDARD TYPE  | Name          | Rubidium Oscillator        |                     | Rubidium Oscillator        |                     |
| STANDARD MFG   | Name          | Xinghua Instrument Factory |                     | Xinghua Instrument Factory |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>      | <b>Draft</b>        | <b>Allan Variance</b>      | <b>Draft</b>        |
| 1 - SECOND   | $\Delta f/f$  | $1 \times 10^{-11}$        | (1)                 | $1 \times 10^{-11}$        | (1)                 |
| 1 - HOUR   | $\Delta f/f$  | (1)                        | (1)                 | (1)                        | (1)                 |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                        | $1 \times 10^{-12}$ | (1)                        | $1 \times 10^{-12}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)                        | $4 \times 10^{-11}$ | (1)                        | $4 \times 10^{-11}$ |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>               | <b>100 MHz</b>      | <b>5 MHz</b>               | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | (1)                        | (1)                 | (1)                        | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | (1)                        | (1)                 | (1)                        | (1)                 |
| 100 Hz OFFSET  | dBc/Hz        | -120                       | (1)                 | -120                       | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz        | -145                       | (1)                 | -145                       | (1)                 |
| REF FREQS AVAILABLE  | MHz           | 5                          |                     | 5                          |                     |
| MAX STA-TO-STA OFFSET  | Hz            | None                       |                     | None                       |                     |
|  |               |                            |                     |                            |                     |
|  |               |                            |                     |                            |                     |
|  |               |                            |                     |                            |                     |
| <b>TIMING SYSTEM</b>   |               |                            |                     |                            |                     |
| MASTER REFERENCE AGENCY  | Name          | CSAO                       |                     | CSAO                       |                     |
| REFERENCE TIME   | Name          | UTC                        |                     | UTC                        |                     |
| TIME CODE EPOCH  | Yr            | None                       |                     | None                       |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | None                       |                     | None                       |                     |
| MAX TIME RESOLUTION  | s             | None                       |                     | None                       |                     |
| TIME TRANSFER METHOD   | Name          | BPC                        |                     | BPC                        |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 10                         |                     | 10                         |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | 30                         |                     | 30                         |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | None                       |                     | None                       |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 50                         |                     | 50                         |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 1/60                    |                     | 1, 1/60                    |                     |
|  |               |                            |                     |                            |                     |
|  |               |                            |                     |                            |                     |
|  |               |                            |                     |                            |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA    5. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA    6445-4709 |               |                            |                     |                            |                     |

**CCSDS HISTORICAL DOCUMENT**  
**CLTC TRACKING SYSTEM**  
**GEOGRAPHICAL AND MECHANICAL**

| CHARACTERISTICS  | UNITS              | SUBNETWORK OR STATION                |                                      |
|--|--------------------|--------------------------------------|--------------------------------------|
|  |                    | KASHI USB STATION                    | NANNING USB STATION                  |
| <b>GENERAL</b>   |                    |                                      |                                      |
| STATION DESIGNATION  | -                  | Kashi USB Station                    | Nanning USB Station                  |
| LOCATION(S)  | -                  | Kashi, China                         | Nanning, China                       |
| DIAMETER   | m                  | 12                                   | 12                                   |
| <b>GEOGRAPHICAL</b>  |                    |                                      |                                      |
| LOCATION, COUNTRY/STATE  | Name               | China                                | China                                |
| LOCATION, CITY   | Name               | Kashi                                | Nanning                              |
| LONGITUDE (site 1/site 2/site 3)   | d, m, s            | 76 E                                 | 108 E                                |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 39 N                                 | 23 N                                 |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
| <b>MECHANICAL</b>  |                    |                                      |                                      |
| TYPE OF MOUNT  | -                  | Az - El                              | Az - El                              |
| AZIMUTH LIMITATIONS  | -                  | 0 deg - 360 deg (No Limit)           | 0 deg - 360 deg (No Limit)           |
| TRACKING SPEED RANGE   | deg/s              | Az: 0.01 - 5; El: 0.01 - 3           | Az: 0.01 - 5; El: 0.01 - 3           |
| MAX TRACK ACCELERATION   | deg/s <sup>2</sup> | Az: 20; El: 10                       | Az: 20; El: 10                       |
| TYPE OF POINTING   | Type               | Autotrack, Manual, Predicts, Program | Autotrack, Manual, Predicts, Program |
| POINTING ACCURACY  | deg                | 0.022                                | 0.022                                |
| MIN TRANSMIT ELEV ANGLE  | deg                | 5                                    | 5                                    |
| MIN RECEIVE ELEV ANGLE   | deg                | 3                                    | 3                                    |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
| <b>SUPPORT</b>   |                    |                                      |                                      |
| TRANSMIT FREQ BAND(S)  | GHz                | 2.025 - 2.12                         | 2.025 - 2.12                         |
| RECEIVE FREQ BAND(S)   | GHz                | 2.2 - 2.3                            | 2.2 - 2.3                            |
| ACQ AID FREQ BAND(S)   | GHz                | 2.2 - 2.3                            | 2.2 - 2.3                            |
| MISSION CATEGORIES   | Cat                | A                                    | A                                    |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES<br>6. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA |                    |                                      |                                      |

6445-4710

**CCSDS HISTORICAL DOCUMENT**  
**CLTC TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION    |                          |
|---------------------------|--------------|--------------------------|--------------------------|
|                           |              | WEINAN ICB STATION       | XIAMEN ICB STATION       |
| <b>GENERAL</b>            |              |                          |                          |
| STATION DESIGNATION       | -            | Weinan ICB Station       | Xiamen ICB Station       |
| LOCATION(S)               | -            | Weinan, China            | Xiamen, China            |
| DIAMETER                  | m            | 15                       | 15                       |
| <b>TRANSMIT</b>           |              |                          |                          |
| FREQUENCIES               | MHz          | 5925 - 6425              | 5925 - 6425              |
| FREQUENCY RESOLUTION      | Hz           | 1000                     | 1000                     |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $1 \times 10^{-10}$ @ 1s | $1 \times 10^{-10}$ @ 1s |
| TRANSMIT POWER 1          | W            | 3000                     | 3000                     |
| EIRP RANGE 1              | dBW          | 68 - 88                  | 88 - 88                  |
| TRANSMIT POWER 2          | W            | None                     | None                     |
| EIRP RANGE 2              | dBW          | None                     | None                     |
| POLARIZATION              | -            | HLP, VLP, RHCP or LHCP   | HLP, VLP, RHCP or LHCP   |
| ANTENNA GAIN              | dBi          | 57                       | 57                       |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.23                     | 0.23                     |
| ANTENNA ELLIPTICITY       | dB           | 1.5                      | 1.5                      |
| RF FREQ SWEEP RANGE       | kHz          | $\pm 200$                | $\pm 200$                |
| MIN FREQ SWEEP RATE       | Hz/s         | 5000                     | 5000                     |
| MAX FREQ SWEEP RATE       | kHz/s        | 150                      | 150                      |
| PROGRAMMED UPLINK FREQ    | Yes/No       | Yes                      | Yes                      |
| <b>COMMAND</b>            |              |                          |                          |
| RF CARRIER MOD TYPE       | -            | FM, PM                   | FM, PM                   |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | (1)                      | (1)                      |
| SUBCARRIER FREQUENCY(S)   | Hz           | 5000 - 60 000            | 5000 - 60 000            |
| SUBCARRIER STEP SIZE      | Hz           | (1)                      | (1)                      |
| SUBCARRIER FREQ STABILITY | ppm          | 50                       | 50                       |
| SUBCARRIER WAVEFORM       | Sin/Sq       | (1)                      | (1)                      |
| SUBCARRIER MOD TYPE       | -            | ASK, PSK, FSK            | ASK, PSK, FSK            |
| SUBCARRIER/BIT RATE LIMIT | -            | (1)                      | (1)                      |
| BIT RATE RANGE            | b/s          | (1)                      | (1)                      |
| FORMATS AVAILABLE         | -            | (1)                      | (1)                      |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS  
 4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA

6445-4711

**CCSDS HISTORICAL DOCUMENT**  
**CLTC TRACKING SYSTEM**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                 |                                       |
|-----------------------------|--------------|---------------------------------------|---------------------------------------|
|                             |              | WEINAN ICB STATION                    | XIAMEN ICB STATION                    |
| <b>GENERAL</b>              |              |                                       |                                       |
| STATION DESIGNATION         | -            | Weinan ICB Station                    | Xiamen ICB Station                    |
| LOCATION(S)                 | -            | Weinan, China                         | Xiamen, China                         |
| DIAMETER                    | m            | 15                                    | 15                                    |
| <b>RECEIVE</b>              |              |                                       |                                       |
| FREQUENCIES                 | MHz          | 3700 - 4200                           | 3700 - 4200                           |
| FREQUENCY RESOLUTION        | Hz           | 1000                                  | 1000                                  |
| ANTENNA GAIN @ 45 deg       | dBi          | 54                                    | 54                                    |
| SYS NOISE TEMP @ ZENITH     | K            | 150                                   | 150                                   |
| G/T @ 45 deg                | dB           | 32                                    | 32                                    |
| POLARIZATION                | -            | HLP, VLP, RHCP or LHCP                | HLP, VLP, RHCP or LHCP                |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.35                                  | 0.35                                  |
| ANTENNA ELLIPTICITY         | dB           | 1.5                                   | 1.5                                   |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $1 \times 10^{-5}$ @ 1s               | $1 \times 10^{-5}$ @ 1s               |
| RCVR AGC DYNAMIC RANGE      | dB           | 80                                    | 80                                    |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -130 in 2 Blo = 2000 Hz               | -130 in 2 Blo = 2000 Hz               |
| RCVR LOOP BANDWIDTHS        | Hz           | 2000                                  | 2000                                  |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                                 | Adapt                                 |
| RCVR PLL ORDER(S)           | No.          | 2                                     | 2                                     |
| ACQ SWEEP RANGE             | kHz          | $\pm 150$                             | $\pm 150$                             |
| MIN ACQ SWEEP RATE          | Hz/s         | 5000                                  | 5000                                  |
| MAX ACQ SWEEP RATE          | kHz/s        | 150                                   | 150                                   |
| ACQ SWEEP STEP SIZE         | Hz           | (1)                                   | (1)                                   |
| PROGRAMMED L.O.             | Yes/No       | Yes                                   | Yes                                   |
|                             |              |                                       |                                       |
|                             |              |                                       |                                       |
|                             |              |                                       |                                       |
|                             |              |                                       |                                       |
| <b>TELEMETRY</b>            |              |                                       |                                       |
| MODULATION TYPE(S)          | -            | FM, PM                                | FM, PM                                |
| MODULATION FORMAT(S)        | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S  | NRZ - L, M, S; Bi - $\phi$ - L, M, S  |
| MOD INDEX RANGE             | Rad Pk       | 0.2 - 1.5                             | 0.2 - 1.5                             |
| SUBCARRIER FREQ RANGE       | kHz          | TMC: 5 - 320; TMA: 162, 164, 166, 168 | TMC: 5 - 320; TMA: 162, 164, 166, 168 |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine                                  | Sine                                  |
| SYMBOL RATE RANGE           | s/s          | 10 - 50 000                           | 10 - 50 000                           |
| SUBCARRIER/SYM RATE LIMIT   | -            | None                                  | None                                  |
| ARRAYS WITH STATIONS        | -            | No                                    | No                                    |
| CHANNEL DECODING            | Type         | (1)                                   | (1)                                   |
| DATA FORMAT                 | -            | CCSDS Xfer from / VC Service          | CCSDS Xfer from / VC Service          |
|                             |              |                                       |                                       |
|                             |              |                                       |                                       |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS  
4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA

**CCSDS HISTORICAL DOCUMENT**  
**CLTC TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |                    |
|---|--------------|-----------------------|--------------------|
|   |              | WEINAN ICB STATION    | XIAMEN ICB STATION |
| <b>GENERAL</b>  |              |                       |                    |
| STATION DESIGNATION   | -            | Weinan ICB Station    | Xiamen ICB Station |
| LOCATION(S)   | -            | Weinan, China         | Xiamen, China      |
| DIAMETER  | m            | 15                    | 15                 |
| <b>FREQUENCIES</b>  |              |                       |                    |
| TRANSMIT FREQUENCIES  | MHz          | 5925 - 6425           | 5925 - 6425        |
| RECEIVE FREQUENCIES   | MHz          | 3700 - 4200           | 3700 - 4200        |
| TURNAROUND FREQ RATIO   | -            | None                  | None               |
| <b>DOPPLER</b>  |              |                       |                    |
| COHERENT/NON-COHERENT   | -            | None                  | None               |
| COUNTER RESOLUTION  | Cycles       |                       |                    |
| MAX DOPPLER FREQ SHIFT  | MHz          |                       |                    |
| DOPPLER BIAS FREQ   | MHz          |                       |                    |
| DRIFT   | $\Delta f/f$ |                       |                    |
| OUTPUT EQUATION   | -            |                       |                    |
| DIRECTION INDICATOR   | -            |                       |                    |
| <b>RANGING</b>  |              |                       |                    |
| COHERENT/NON-COHERENT   | -            | Non-Coherent          | Non-Coherent       |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine                  | Sine               |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.2 - 1.5             | 0.2 - 1.5          |
| RANGE CODE FREQ RATIO   | -            | 7, 14, 8              | 7, 14, 8           |
| MAJOR CODE FREQ(S)  | kHz          | 27.7                  | 27.7               |
| MINOR CODE FREQ(S)  | kHz          | 3.968, 0.283, 0.35    | 3.968, 0.283, 0.35 |
| MIN RECEIVED CARRIER SNR  | dB           | 10                    | 10                 |
| MIN REQ CODE PWR/ $N_0$   | dB-Hz        | 41                    | 41                 |
| CODE INTEGRATION TIME   | s            | 0.75                  | 0.75               |
| ACQUISITION SEQUENCE  | -            | Major → Minor         | Major → Minor      |
| RANGE DATA UNITS  | -            | m                     | m                  |
| RANGE QUANTIZATION  | -            | (1)                   | (1)                |
| ACCURACY (STRONG SIGNAL)  | m            | 15                    | 15                 |
| MAX UNAMBIGUOUS RANGE   | km           | 45 000                | 45 000             |
| TRANSPONDER BW  | MHz          | (1)                   | (1)                |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> <p>4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA</p> |              |                       |                    |

**CCSDS HISTORICAL DOCUMENT**  
**CLTC TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS          | SUBNETWORK OR STATION      |                     |                            |                     |
|--|----------------|----------------------------|---------------------|----------------------------|---------------------|
|  |                | WEINAN ICB STATION         |                     | XIAMEN ICB STATION         |                     |
| <b>GENERAL</b>   |                |                            |                     |                            |                     |
| STATION DESIGNATION  | -              | Weinan ICB Station         |                     | Xiamen ICB Station         |                     |
| LOCATION(S)  | -              | Weinan, China              |                     | Xiamen, China              |                     |
| DIAMETER   | m              | 15                         |                     | 15                         |                     |
| <b>FREQUENCY STD</b>   |                |                            |                     |                            |                     |
| STANDARD TYPE  | Name           | Rubidium Oscillator        |                     | Rubidium Oscillator        |                     |
| STANDARD MFG   | Name           | Xinghua Instrument Factory |                     | Xinghua Instrument Factory |                     |
| STABILITY AT:  |                | Allan<br>Variance          | Draft               | Allan<br>Variance          | Draft               |
| 1 - SECOND   | $\Delta f/f$   | $1 \times 10^{-11}$        | (1)                 | $1 \times 10^{-11}$        | (1)                 |
| 1 - HOUR   | $\Delta f/f$   | (1)                        | (1)                 | (1)                        | (1)                 |
| 1 - DAY (24 HOURS)   | $\Delta f/f$   | (1)                        | $1 \times 10^{-12}$ | (1)                        | $1 \times 10^{-12}$ |
| 1 - MONTH  | $\Delta f/f$   | (1)                        | (1)                 | (1)                        | (1)                 |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$  | <b>5 MHz</b>               | <b>100 MHz</b>      | <b>5 MHz</b>               | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz         | (1)                        | (1)                 | (1)                        | (1)                 |
| 10 Hz OFFSET   | dBc/Hz         | (1)                        | (1)                 | (1)                        | (1)                 |
| 100 Hz OFFSET  | dBc/Hz         | (1)                        | (1)                 | (1)                        | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz         | (1)                        | (1)                 | (1)                        | (1)                 |
| REF FREQS AVAILABLE  | MHz            | 5                          |                     | 5                          |                     |
| MAX STA-TO-STA OFFSET  | Hz             | None                       |                     | None                       |                     |
|  |                |                            |                     |                            |                     |
|  |                |                            |                     |                            |                     |
|  |                |                            |                     |                            |                     |
| <b>TIMING SYSTEM</b>   |                |                            |                     |                            |                     |
| MASTER REFERENCE AGENCY  | Name           | CSAO                       |                     | CSAO                       |                     |
| REFERENCE TIME   | Name           | NTC                        |                     | NTC                        |                     |
| TIME CODE EPOCH  | Yr             | None                       |                     | None                       |                     |
| TIME CODES AVAILABLE   | CCSDS<br>Codes | None                       |                     | None                       |                     |
| MAX TIME RESOLUTION  | s              | None                       |                     | None                       |                     |
| TIME TRANSFER METHOD   | Name           | BPL                        |                     | BPL                        |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec     | 10                         |                     | 10                         |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec     | 30                         |                     | 30                         |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec     | (1)                        |                     | (1)                        |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec     | 50                         |                     | 50                         |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s        | 1, 1/60                    |                     | 1, 1/60                    |                     |
|  |                |                            |                     |                            |                     |
|  |                |                            |                     |                            |                     |
|  |                |                            |                     |                            |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA    5. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA    6445-4714 |                |                            |                     |                            |                     |

CCSDS HISTORICAL DOCUMENT  
**CLTC TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS  | UNITS              | SUBNETWORK OR STATION                |                                      |
|--|--------------------|--------------------------------------|--------------------------------------|
|  |                    | WEINAN ICB STATION                   | XIAMEN ICB STATION                   |
| <b>GENERAL</b>   |                    |                                      |                                      |
| STATION DESIGNATION  | -                  | Weinan ICB Station                   | Xiamen ICB Station                   |
| LOCATION(S)  | -                  | Weinan, China                        | Xiamen, China                        |
| DIAMETER   | m                  | 15                                   | 15                                   |
| <b>GEOGRAPHICAL</b>  |                    |                                      |                                      |
| LOCATION, COUNTRY/STATE  | Name               | China                                | China                                |
| LOCATION, CITY   | Name               | Weinan                               | Xiamen                               |
| LONGITUDE (site 1/site 2/site 3)   | d, m, s            | 110 E                                | 118 E                                |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 34 N                                 | 24 N                                 |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
| <b>MECHANICAL</b>  |                    |                                      |                                      |
| TYPE OF MOUNT  | -                  | Az - El                              | Az - El                              |
| AZIMUTH LIMITATIONS  | -                  | 0 deg - 360 deg (No Limit)           | 0 deg - 360 deg (No Limit)           |
| TRACKING SPEED RANGE   | deg/s              | Az: 0.01 - 5; El: 0.01 - 3           | Az: 0.01 - 5; El: 0.01 - 3           |
| MAX TRACK ACCELERATION   | deg/s <sup>2</sup> | Az: 1.5; El: 0.7                     | Az: 1.5; El: 0.7                     |
| TYPE OF POINTING   | Type               | Autotrack, Manual, Predicts, Program | Autotrack, Manual, Predicts, Program |
| POINTING ACCURACY  | deg                | 0.025                                | 0.025                                |
| MIN TRANSMIT ELEV ANGLE  | deg                | 5                                    | 5                                    |
| MIN RECEIVE ELEV ANGLE   | deg                | 3                                    | 3                                    |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
| <b>SUPPORT</b>   |                    |                                      |                                      |
| TRANSMIT FREQ BAND(S)  | GHz                | 5.925 - 6.425                        | 5.925 - 6.425                        |
| RECEIVE FREQ BAND(S)   | GHz                | 3.7 - 4.2                            | 3.7 - 4.2                            |
| ACQ AID FREQ BAND(S)   | GHz                | 3.7 - 4.2                            | 3.7 - 4.2                            |
| MISSION CATEGORIES   | Cat                | A                                    | A                                    |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
|  |                    |                                      |                                      |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES<br>6. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA |                    |                                      |                                      |

**CCSDS HISTORICAL DOCUMENT**  
**CNES TRACKING SYSTEM**  
**EARTH-TO-SPACE LINK CHARACTERISTICS**

| CHARACTERISTICS   | UNITS           | SUBNETWORK OR STATION                     |  |
|---|-----------------|---|--|
|   |                 | KERGUELEN                                 |  |
| <b>GENERAL</b>  |                 |   |  |
| STATION DESIGNATION   | -               | Kerguelen                                 |  |
| LOCATION(S)   | -               | Kerguelen Islands                         |  |
| DIAMETER  | m               | 10  |  |
| <b>TRANSMIT</b>   |                 |   |  |
| FREQUENCIES   | MHz             | 2025 - 2110                               |  |
| FREQUENCY RESOLUTION  | Hz              | 1   |  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$    | $3.10^{-5}$ @ 1 sec                       |  |
| TRANSMIT POWER 1  | W               | 10 - 1000                                 |  |
| EIRP RANGE 1  | dBW             | 51 - 72                                   |  |
| TRANSMIT POWER 2  | W               | None                                      |  |
| EIRP RANGE 2  | dBW             | None                                      |  |
| POLARIZATION  | -               | RCP or LCP                                |  |
| ANTENNA GAIN  | dB <sub>i</sub> | 44  |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg             | 0.8                                       |  |
| ANTENNA ELLIPTICITY   | dB              | (1)                                       |  |
| RF FREQ SWEEP RANGE   | kHz             | $\pm 150$                                 |  |
| MIN FREQ SWEEP RATE   | Hz/s            | 5000                                      |  |
| MAX FREQ SWEEP RATE   | kHz/s           | 50  |  |
| PROGRAMMED UPLINK FREQ  | Yes/No          | YES                                       |  |
|   |                 |   |  |
|   |                 |   |  |
|   |                 |   |  |
|   |                 |   |  |
|   |                 |   |  |
|   |                 |   |  |
|   |                 |   |  |
|   |                 |   |  |
| <b>COMMAND</b>  |                 |   |  |
| RF CARRIER MOD TYPE   | -               | PM  |  |
| RF CARRIER MOD INDEX RNG  | Rad Pk          | 0.2 - 2                                   |  |
| SUBCARRIER FREQUENCY(S)   | Hz              | 2000, 4000, 8000, 16 000                  |  |
| SUBCARRIER STEP SIZE  | Hz              | 2000, 4000, 8000                          |  |
| SUBCARRIER FREQ STABILITY   | ppm             | $\pm 51$ @ 1 year                         |  |
| SUBCARRIER WAVEFORM   | Sin/Sq          | Sine                                      |  |
| SUBCARRIER MOD TYPE   | -               | PSK, FSK <sup>2</sup>                     |  |
| SUBCARRIER/BIT RATE LIMIT   | -               | < 1024                                    |  |
| BIT RATE RANGE  | b/s             | $4000 / 2^\eta$ ; $\eta = 0, 1, \dots, 9$ |  |
| FORMATS AVAILABLE   | -               | NRZ - L, M; Bi - $\phi$ - L, M            |  |
|   |                 |   |  |
|   |                 |   |  |
|   |                 |   |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |                 |   |  |

6445-3078

CCSDS HISTORICAL DOCUMENT  
**CNES TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION           |  |
|---|--------------|---------------------------------|--|
|   |              | KERGUELEN                       |  |
| <b>GENERAL</b>  |              |                                 |  |
| STATION DESIGNATION   | -            | Kerguelen                       |  |
| LOCATION(S)   | -            | Kerguelen Islands               |  |
| DIAMETER  | m            | 10                              |  |
| <b>RECEIVE</b>  |              |                                 |  |
| FREQUENCIES   | MHz          | 2200 - 2290                     |  |
| FREQUENCY RESOLUTION  | Hz           | 10                              |  |
| ANTENNA GAIN @ 45 deg   | dBi          | 45                              |  |
| SYS NOISE TEMP @ ZENITH   | K            | 158                             |  |
| G/T @ 45 deg  | dB           | 23                              |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | RCP and LCP                     |  |
| ANTENNA ELLIPTICITY   | dB           | 0.8                             |  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $5 \times 10^{-5}$              |  |
| RCVR AGC DYNAMIC RANGE  | dB           | 80                              |  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -147.9 in 2 Blo = 30 Hz         |  |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 100, 300, 1 K               |  |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Fix                             |  |
| RCVR PLL ORDER(S)   | No.          | 2                               |  |
| ACQ SWEEP RANGE   | kHz          | $\pm 15$ ; $\pm 50$ ; $\pm 150$ |  |
| MIN ACQ SWEEP RATE  | Hz/s         | 1000                            |  |
| MAX ACQ SWEEP RATE  | kHz/s        | 100                             |  |
| ACQ SWEEP STEP SIZE   | Hz           | 1                               |  |
| PROGRAMMED L.O.   | Yes/No       | Yes                             |  |
| <b>TELEMETRY</b>  |              |                                 |  |
| MODULATION TYPE(S)  | -            | PM / (PM, PSK / PM, FM) PM, AM  |  |
| MODULATION FORMAT(S)  | -            | Bi - $\phi$ - L, M; NRZ - L, M  |  |
| MOD INDEX RANGE   | Rad Pk       | 0.1 - 1.6                       |  |
| SUBCARRIER FREQ RANGE   | kHz          | 0.1 - 500                       |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                            |  |
| SYMBOL RATE RANGE   | s/s          | 8 bps - 1 Mbps                  |  |
| SUBCARRIER/SYM RATE LIMIT   | -            | $\leq 1024$                     |  |
| ARRAYS WITH STATIONS  | -            | (1)                             |  |
| CHANNEL DECODING  | Type         | (1)                             |  |
| DATA FORMAT   | -            | (1)                             |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                                 |  |

6445-3079

CCSDS HISTORICAL DOCUMENT  
**CNES TRACKING SYSTEM**  
RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                           |  |
|---|--------------|---|--|
|   |              | KERGUELEN                                       |  |
| <b>GENERAL</b>  |              |   |  |
| STATION DESIGNATION   | -            | Kerguelen                                       |  |
| LOCATION(S)   | -            | Kerguelen Islands                               |  |
| DIAMETER  | m            | 10  |  |
| <b>FREQUENCIES</b>  |              |   |  |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2110                                     |  |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2290                                     |  |
| TURNAROUND FREQ RATIO   | -            | 240 / 221                                       |  |
| <b>DOPPLER</b>  |              |   |  |
| COHERENT/NON-COHERENT   | -            | Either  |  |
| COUNTER RESOLUTION  | Cycles       | 0.1   |  |
| MAX DOPPLER FREQ SHIFT  | MHz          | ± 0.2   |  |
| DOPPLER BIAS FREQ   | MHz          | 60  |  |
| DRIFT   | $\Delta f/f$ | $2 \times 10^{-11}$                             |  |
| OUTPUT EQUATION   | -            | Bias Freq + (240 / 221) ( $f_{up}$ ) (-2 v / c) |  |
| DIRECTION INDICATOR   | -            | + $\Delta f = -\Delta r$                        |  |
| <b>RANGING</b>  |              |   |  |
| COHERENT/NON-COHERENT   | -            | Either  |  |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine  |  |
| EARTH STATION MOD INDEX   | Rad Pk       | Major ≤ 1.5; Minor ≤ 1.5                        |  |
| RANGE CODE FREQ RATIO   | -            | 5:1; 4:1  |  |
| MAJOR CODE FREQ(S)  | kHz          | 100   |  |
| MINOR CODE FREQ(S)  | kHz          | 20, 16 (0.8, 0.16, 0.032, 0.008 on 16 kHz)      |  |
| MIN RECEIVED CARRIER SNR  | dB           | -20 @ 500 kHz IF BW                             |  |
| MIN REQ CODE PWR/ $N_0$   | dB-Hz        | Major ≥ 25; Minor ≥ 20                          |  |
| CODE INTEGRATION TIME   | s            | 0.5 - 2.5                                       |  |
| ACQUISITION SEQUENCE  | -            | seq; Major Code First                           |  |
| RANGE DATA UNITS  | -            | Nanoseconds                                     |  |
| RANGE QUANTIZATION  | -            | 2 ns  |  |
| ACCURACY (STRONG SIGNAL)  | m            | 15  |  |
| MAX UNAMBIGUOUS RANGE   | km           | 18 750  |  |
| TRANSPONDER BW  | MHz          | ≥ 0.3   |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |   |  |

6445-3080

**CCSDS HISTORICAL DOCUMENT**  
**CNES TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION               |                         |                       |                |
|--|---------------|-------------------------------------|-------------------------|-----------------------|----------------|
|  |               | KERGUELEN                           |                         |                       |                |
| <b>GENERAL</b>   |               |                                     |                         |                       |                |
| STATION DESIGNATION  | -             | Kerguelen                           |                         |                       |                |
| LOCATION(S)  | -             | Kerguelen Islands                   |                         |                       |                |
| DIAMETER   | m             | 10                                  |                         |                       |                |
| <b>FREQUENCY STD</b>   |               |                                     |                         |                       |                |
| STANDARD TYPE  | Name          | Cesium                              |                         |                       |                |
| STANDARD MFG   | Name          | Oscilloquartz                       |                         |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b>               | <b>Drift</b>            | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | (1)                                 | (1)                     |                       |                |
| 1 - HOUR   | $\Delta f/f$  | (1)                                 | $\pm 2 \times 10^{-11}$ |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                                 | (1)                     |                       |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                                 | (1)                     |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>                        | <b>100 MHz</b>          | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                                 | (1)                     |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | -102                                | (1)                     |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | -136                                | (1)                     |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | -154                                | (1)                     |                       |                |
| REF FREQS AVAILABLE  | MHz           | 1, 5, 10                            |                         |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | $1 \times 10^{-4}$ @ 5 MHz          |                         |                       |                |
|  |               |                                     |                         |                       |                |
|  |               |                                     |                         |                       |                |
|  |               |                                     |                         |                       |                |
| <b>TIMING SYSTEM</b>   |               |                                     |                         |                       |                |
| MASTER REFERENCE AGENCY  | Name          | USNO                                |                         |                       |                |
| REFERENCE TIME   | Name          | UTC                                 |                         |                       |                |
| TIME CODE EPOCH  | Yr            | 1 January 1958                      |                         |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | (1)                                 |                         |                       |                |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-3}$                  |                         |                       |                |
| TIME TRANSFER METHOD   | Name          | GPS                                 |                         |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 0.1$                           |                         |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 50$                            |                         |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 1 \times 10^{-2}$              |                         |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 100                                 |                         |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | from $1 \times 10^{-3}$ to 100 days |                         |                       |                |
|  |               |                                     |                         |                       |                |
|  |               |                                     |                         |                       |                |
|  |               |                                     |                         |                       |                |
|  |               |                                     |                         |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                                     |                         |                       |                |

6445-3081

CCSDS HISTORICAL DOCUMENT  
**CNES TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION      |  |
|---|--------------------|----------------------------|--|
|   |                    | KERGUELEN                  |  |
| <b>GENERAL</b>  |                    |                            |  |
| STATION DESIGNATION   | -                  | Kerguelen                  |  |
| LOCATION(S)   | -                  | Kerguelen Islands          |  |
| DIAMETER  | m                  | 10                         |  |
| <b>GEOGRAPHICAL</b>   |                    |                            |  |
| LOCATION, COUNTRY/STATE   | Name               | Kerguelen Islands, France  |  |
| LOCATION, CITY  | Name               | Port Aux Francais          |  |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 70, 15, 25 E               |  |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 49, 21, 10 S               |  |
|   |                    |                            |  |
|   |                    |                            |  |
|   |                    |                            |  |
|   |                    |                            |  |
| <b>MECHANICAL</b>   |                    |                            |  |
| TYPE OF MOUNT   | -                  | AZ - EL                    |  |
| AZIMUTH LIMITATIONS   | -                  | + 360 (Ref. N)             |  |
| TRACKING SPEED RANGE  | deg/s              | 0 - 15                     |  |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 15                         |  |
| TYPE OF POINTING  | Type               | Autotrack, Manual, Predict |  |
| POINTING ACCURACY   | deg                | 0.13                       |  |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5                          |  |
| MIN RECEIVE ELEV ANGLE  | deg                | 0 - 2                      |  |
|   |                    |                            |  |
|   |                    |                            |  |
|   |                    |                            |  |
|   |                    |                            |  |
|   |                    |                            |  |
| <b>SUPPORT</b>  |                    |                            |  |
| TRANSMIT FREQ BAND(S)   | GHz                | 2.025 - 2.11               |  |
| RECEIVE FREQ BAND(S)  | GHz                | 2.2 - 2.29                 |  |
| ACQ AID FREQ BAND(S)  | GHz                | 2.2 - 2.29                 |  |
| MISSION CATEGORIES  | Cat                | A                          |  |
|   |                    |                            |  |
|   |                    |                            |  |
|   |                    |                            |  |
|   |                    |                            |  |
|   |                    |                            |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES |                    |                            |  |

**CCSDS HISTORICAL DOCUMENT**  
**CNES TRACKING SYSTEM**  
**EARTH-TO-SPACE LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION                          |  |
|--|--------------|--|--|
|  |              | AUSSAGUEL                                      | KOUROU   |
| <b>GENERAL</b>   |              |  |  |
| STATION DESIGNATION  | -            | Aussaguel 11                                   | Kourou 11                                      |
| LOCATION(S)  | -            | Toulouse, France                               | Kourou, French Guyana                          |
| DIAMETER   | m            | 11   | 11   |
| <b>TRANSMIT</b>  |              |  |  |
| FREQUENCIES  | MHz          | 2025 - 2110                                    | 2025 - 2110                                    |
| FREQUENCY RESOLUTION   | Hz           | 10   | 10   |
| RF FREQ STABILITY @ 1 Hr   | $\Delta f/f$ | $3 \times 10^{-5}$ @ 1 sec                     | $3 \times 10^{-5}$ @ 1 sec                     |
| TRANSMIT POWER 1   | W            | 10 - 1000                                      | 10 - 1000                                      |
| EIRP RANGE 1   | dBW          | 51 - 71  | 51 - 71  |
| TRANSMIT POWER 2   | W            | None   | None   |
| EIRP RANGE 2   | dBW          | None   | None   |
| POLARIZATION   | -            | RCP or LCP                                     | RCP or LCP                                     |
| ANTENNA GAIN   | dBi          | 44.5   | 44.5   |
| ANTENNA BEAMWIDTH (-3 dB)  | deg          | 0.75   | 0.75   |
| ANTENNA ELLIPTICITY  | dB           | (1)  | (1)  |
| RF FREQ SWEEP RANGE  | kHz          | $\pm 150$                                      | $\pm 150$                                      |
| MIN FREQ SWEEP RATE  | Hz/s         | 1000   | 1000   |
| MAX FREQ SWEEP RATE  | kHz/s        | 100  | 100  |
| PROGRAMMED UPLINK FREQ   | Yes/No       | Yes  | Yes  |
|  |              |  |  |
|  |              |  |  |
|  |              |  |  |
|  |              |  |  |
|  |              |  |  |
|  |              |  |  |
| <b>COMMAND</b>   |              |  |  |
| RF CARRIER MOD TYPE  | -            | PM   | PM   |
| RF CARRIER MOD INDEX RNG   | Rad Pk       | 0.1 - 2  | 0.1 - 2  |
| SUBCARRIER FREQUENCY(S)  | Hz           | 2000, 4000, 8000, 16 000                       | 2000, 4000, 8000, 16 000                       |
| SUBCARRIER STEP SIZE   | Hz           | 2000, 4000, 8000                               | 2000, 4000, 8000                               |
| SUBCARRIER FREQ STABILITY  | ppm          | $\pm 51$ @ 1 yr                                | $\pm 51$ @ 1 yr                                |
| SUBCARRIER WAVEFORM  | Sin/Sq       | Sine   | Sine   |
| SUBCARRIER MOD TYPE  | -            | PSK  | PSK  |
| SUBCARRIER/BIT RATE LIMIT  | -            | $\leq 256$ ; Coh $\pm 10$ deg                  | $\leq 256$ ; Coh $\pm 10$ deg                  |
| BIT RATE RANGE   | b/s          | $2000 / 2^{\eta}$ ; $\eta = 0, 1, 2, \dots, 8$ | $2000 / 2^{\eta}$ ; $\eta = 0, 1, 2, \dots, 8$ |
| FORMATS AVAILABLE  | -            | NRZ - L, M; Bi - $\phi$ - L, M                 | NRZ - L, M; Bi - $\phi$ - L, M                 |
|  |              |  |  |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |  |  |

6445-3064

**CCSDS HISTORICAL DOCUMENT**  
**CNES TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                           |   |
|---|--------------|---|---|
|   |              | AUSSAGUEL                                       | KOUROU  |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | Aussaguel 11                                    | Kourou 11                                       |
| LOCATION(S)   | -            | Toulouse, France                                | Kourou, French Guyana                           |
| DIAMETER  | m            | 11  | 11  |
| <b>RECEIVE</b>  |              |   |   |
| FREQUENCIES   | MHz          | 2200 - 2290                                     | 2200 - 2290                                     |
| FREQUENCY RESOLUTION  | Hz           | 10  | 10  |
| ANTENNA GAIN @ 45 deg   | dBi          | 46.4  | 46.4  |
| SYS NOISE TEMP @ ZENITH   | K            | 250   | 250   |
| G/T @ 45 deg  | dB           | 22.5  | 22.5  |
| POLARIZATION  | -            | RCP and LCP                                     | RCP and LCP                                     |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.75  | 0.75  |
| ANTENNA ELLIPTICITY   | dB           | (1)   | (1)   |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $5 \times 10^{-5}$                              | $5 \times 10^{-5}$                              |
| RCVR AGC DYNAMIC RANGE  | dB           | 80  | 80  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -147 in 2 Blo = 100 Hz                          | -147 in 2 Blo = 100 Hz                          |
| RCVR LOOP BANDWIDTHS  | Hz           | 100, 300, 1 K                                   | 100, 300, 1 K                                   |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Fix   | Fix   |
| RCVR PLL ORDER(S)   | No.          | 2   | 2   |
| ACQ SWEEP RANGE   | kHz          | $\pm 15, \pm 50, \pm 150$                       | $\pm 15, \pm 50, \pm 150$                       |
| MIN ACQ SWEEP RATE  | Hz/s         | 1000  | 1000  |
| MAX ACQ SWEEP RATE  | kHz/s        | 100   | 100   |
| ACQ SWEEP STEP SIZE   | Hz           | 1   | 1   |
| PROGRAMMED L.O.   | Yes/No       | Yes   | Yes   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| <b>TELEMETRY</b>  |              |   |   |
| MODULATION TYPE(S)  | -            | PCM / PM; PCM / PSK / PM; PCM / FM; PM - Analog | PCM / PM; PCM / PSK / PM; PCM / FM; PM - Analog |
| MODULATION FORMAT(S)  | -            | NRZ - L, M; Bi - $\phi$ - L, M                  | NRZ - L, M; Bi - $\phi$ - L, M                  |
| MOD INDEX RANGE   | Rad Pk       | 0.1 - 1.6                                       | 0.1 - 1.6                                       |
| SUBCARRIER FREQ RANGE   | kHz          | 0.1 - 500                                       | 0.1 - 500                                       |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine or Square                                  | Sine or Square                                  |
| SYMBOL RATE RANGE   | s/s          | 8 - 50 000                                      | 8 - 50 000                                      |
| SUBCARRIER/SYM RATE LIMIT   | -            | $\leq 1024$                                     | $\leq 1024$                                     |
| ARRAYS WITH STATIONS  | -            | (1)   | (1)   |
| CHANNEL DECODING  | Type         | (1)   | (1)   |
| DATA FORMAT   | -            | (1)   | (1)   |
|   |              |   |   |
|   |              |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |   |   |

6445-3065

**CCSDS HISTORICAL DOCUMENT**  
**CNES TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                           |   |
|---|--------------|---|---|
|   |              | AUSSAGUEL                                       | KOUROU  |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | Aussaguel 11                                    | Kourou 11                                       |
| LOCATION(S)   | -            | Toulouse, France                                | Kourou, French Guyana                           |
| DIAMETER  | m            | 11  | 11  |
| <b>FREQUENCIES</b>  |              |   |   |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2110                                     | 2025 - 2110                                     |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2290                                     | 2200 - 2290                                     |
| TURNAROUND FREQ RATIO   | -            | 240 / 221                                       | 240 / 221                                       |
| <b>DOPPLER</b>  |              |   |   |
| COHERENT/NON-COHERENT   | -            | Either  | Either  |
| COUNTER RESOLUTION  | Cycles       | 0.1   | 0.1   |
| MAX DOPPLER FREQ SHIFT  | MHz          | ± 0.15  | ± 0.15  |
| DOPPLER BIAS FREQ   | MHz          | 59.3  | 59.3  |
| DRIFT   | $\Delta f/f$ | $5 \times 10^{-11}$                             | $5 \times 10^{-11}$                             |
| OUTPUT EQUATION   | -            | Bias Freq + (240 / 221) ( $f_{up}$ ) (-2 v / c) | Bias Freq + (240 / 221) ( $f_{up}$ ) (-2 v / c) |
| DIRECTION INDICATOR   | -            | + $\Delta f = -\Delta r$                        | + $\Delta f = -\Delta r$                        |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| <b>RANGING</b>  |              |   |   |
| COHERENT/NON-COHERENT   | -            | Either  | Either  |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine  | Sine  |
| EARTH STATION MOD INDEX   | Rad Pk       | Major ≤ 1.5; Minor ≤ 1                          | Major ≤ 1.5; Minor ≤ 1                          |
| RANGE CODE FREQ RATIO   | -            | 5:1; 4:1  | 5:1; 4:1  |
| MAJOR CODE FREQ(S)  | kHz          | 100   | 100   |
| MINOR CODE FREQ(S)  | kHz          | 20, 16, (0.8, 0.16, 0.032, 0.008 on 16 kHz)     | 20, 16, (0.8, 0.16, 0.032, 0.008 on 16 kHz)     |
| MIN RECEIVED CARRIER SNR  | dB           | -20 @ IF BW = 500 kHz                           | -20 @ IF BW = 500 kHz                           |
| MIN REQ CODE PWR/No   | dB-Hz        | Major ≥ 25; Minor ≥ 20                          | Major ≥ 25; Minor ≥ 20                          |
| CODE INTEGRATION TIME   | s            | 0.5 - 2.5                                       | 0.5 - 2.5                                       |
| ACQUISITION SEQUENCE  | -            | Seq; Major Code First                           | Seq; Major Code First                           |
| RANGE DATA UNITS  | -            | Nanoseconds                                     | Nanoseconds                                     |
| RANGE QUANTIZATION  | -            | 2 ns  | 2 ns  |
| ACCURACY (STRONG SIGNAL)  | m            | 15  | 15  |
| MAX UNAMBIGUOUS RANGE   | km           | 18 750  | 18 750  |
| TRANSPONDER BW  | MHz          | ≥ 0.3   | ≥ 0.3   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |   |   |

6445-3066

**CCSDS HISTORICAL DOCUMENT  
CNES TRACKING SYSTEM**

**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION               |                         |                                     |                         |
|--|---------------|-------------------------------------|-------------------------|-------------------------------------|-------------------------|
|  |               | AUSSAGUEL                           |                         | KOUROU                              |                         |
| <b>GENERAL</b>   |               |                                     |                         |                                     |                         |
| STATION DESIGNATION  | -             | Aussaguel 11                        |                         | Kourou 11                           |                         |
| LOCATION(S)  | -             | Toulouse, France                    |                         | Kourou, French Guyana               |                         |
| DIAMETER   | m             | 11                                  |                         | 11                                  |                         |
| <b>FREQUENCY STD</b>   |               |                                     |                         |                                     |                         |
| STANDARD TYPE  | Name          | Rubidium                            |                         | Rubidium                            |                         |
| STANDARD MFG   | Name          | Rhode and Schwarz                   |                         | Rhode and Schwarz                   |                         |
| STABILITY AT:  |               | <b>Allan Variance</b>               | <b>Drift</b>            | <b>Allan Variance</b>               | <b>Drift</b>            |
| 1 - SECOND   | $\Delta f/f$  | $5 \times 10^{-12}$                 | (1)                     | $\pm 5 \times 10^{-12}$             | (1)                     |
| 1 - HOUR   | $\Delta f/f$  | (1)                                 | $\pm 1 \times 10^{-12}$ | (1)                                 | $\pm 1 \times 10^{-12}$ |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                                 | $\pm 5 \times 10^{-12}$ | (1)                                 | $\pm 5 \times 10^{-12}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)                                 | $\pm 5 \times 10^{-12}$ | (1)                                 | $\pm 5 \times 10^{-12}$ |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>                        | <b>100 MHz</b>          | <b>5 MHz</b>                        | <b>100 MHz</b>          |
| 1 Hz OFFSET  | dBc/Hz        | (1)                                 |                         | (1)                                 |                         |
| 10 Hz OFFSET   | dBc/Hz        | -102                                |                         | -102                                |                         |
| 100 Hz OFFSET  | dBc/Hz        | -136                                |                         | -136                                |                         |
| 1000 Hz OFFSET   | dBc/Hz        | -154                                |                         | -154                                |                         |
| REF FREQS AVAILABLE  | MHz           | 1, 5, 10                            |                         | 1, 5, 10                            |                         |
| MAX STA-TO-STA OFFSET  | Hz            | $1 \times 10^{-4}$ @ 5 MHz          |                         | $1 \times 10^{-4}$ @ 5 MHz          |                         |
|  |               |                                     |                         |                                     |                         |
|  |               |                                     |                         |                                     |                         |
|  |               |                                     |                         |                                     |                         |
| <b>TIMING SYSTEM</b>   |               |                                     |                         |                                     |                         |
| MASTER REFERENCE AGENCY  | Name          | USNO                                |                         | USNO                                |                         |
| REFERENCE TIME   | Name          | UTC                                 |                         | UTC                                 |                         |
| TIME CODE EPOCH  | Yr            | 1 January 1958                      |                         | 1 January 1958                      |                         |
| TIME CODES AVAILABLE   | CCSDS Codes   | (1)                                 |                         | (1)                                 |                         |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-3}$                  |                         | $1 \times 10^{-3}$                  |                         |
| TIME TRANSFER METHOD   | Name          | GPS                                 |                         | GPS                                 |                         |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 0.1$                           |                         | $\pm 0.1$                           |                         |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 50$                            |                         | $\pm 50$                            |                         |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 0.01$                          |                         | $\pm 0.01$                          |                         |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 100                                 |                         | 100                                 |                         |
| TIMING SIGNALS AVAILABLE   | pulse/s       | from $1 \times 10^{-3}$ to 100 days |                         | from $1 \times 10^{-3}$ to 100 days |                         |
|  |               |                                     |                         |                                     |                         |
|  |               |                                     |                         |                                     |                         |
|  |               |                                     |                         |                                     |                         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                                     |                         |                                     |                         |

**CCSDS HISTORICAL DOCUMENT**  
**CNES TRACKING SYSTEM**  
**GEOGRAPHICAL AND MECHANICAL**

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION      |                            |
|---|--------------------|----------------------------|----------------------------|
|   |                    | AUSSAGUEL                  | KOUROU                     |
| <b>GENERAL</b>  |                    |                            |                            |
| STATION DESIGNATION   | -                  | Aussaguel 11               | Kourou 11                  |
| LOCATION(S)   | -                  | Toulouse, France           | Kourou, French Guyana      |
| DIAMETER  | m                  | 11                         | 11                         |
| <b>GEOGRAPHICAL</b>   |                    |                            |                            |
| LOCATION, COUNTRY/STATE   | Name               | Aussaguel                  | Kourou                     |
| LOCATION, CITY  | Name               | Toulouse, France           | Kourou, French Guyana      |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 1, 29, 57 E                | 307, 21, 38 E              |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 43, 25, 43 N               | 5, 05, 55 N                |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| <b>MECHANICAL</b>   |                    |                            |                            |
| TYPE OF MOUNT   |                    |                            |                            |
| AZIMUTH LIMITATIONS   | -                  | Az - El                    | Az - El                    |
| TRACKING SPEED RANGE  | -                  | ± 349                      | ± 349                      |
| MAX TRACK ACCELERATION  | deg/s              | 0 - 15                     | 0 - 15                     |
| TYPE OF POINTING  | deg/s <sup>2</sup> | 20                         | 20                         |
| POINTING ACCURACY   | Type               | Autotrack, Manual, Predict | Autotrack, Manual, Predict |
| MIN TRANSMIT ELEV ANGLE   | deg                | 0.13                       | 0.13                       |
| MIN RECEIVE ELEV ANGLE  | deg                | 5                          | 5                          |
|   | deg                | 0 - 4                      | 0 - 8.1                    |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| <b>SUPPORT</b>  |                    |                            |                            |
| TRANSMIT FREQ BAND(S)   | GHz                | 2.025 - 2.11               | 2.025 - 2.11               |
| RECEIVE FREQ BAND(S)  | GHz                | 2.2 - 2.29                 | 2.2 - 2.29                 |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                        | (1)                        |
| MISSION CATEGORIES  | Cat                | A                          | A                          |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES |                    |                            |                            |

6445-4007

CCSDS HISTORICAL DOCUMENT  
**CRL TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION  |                        |
|---------------------------|--------------|------------------------|------------------------|
|                           |              | KASHIMA <sup>(2)</sup> | KASHIMA <sup>(2)</sup> |
| <b>GENERAL</b>            |              |                        |                        |
| STATION DESIGNATION       | -            | Kashima CS 10          | Kashima 11             |
| LOCATION(S)               | -            | Kashima, Japan         | Kashima, Japan         |
| DIAMETER                  | m            | 10                     | 11                     |
| <b>TRANSMIT</b>           |              |                        |                        |
| FREQUENCIES               | MHz          | 5900 - 6400            | Receive Only           |
| FREQUENCY RESOLUTION      | Hz           | (1)                    |                        |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | 0.01                   |                        |
| TRANSMIT POWER 1          | W            | 8.5 - 135              |                        |
| EIRP RANGE 1              | dBW          | 64 - 76                |                        |
| TRANSMIT POWER 2          | W            | None                   |                        |
| EIRP RANGE 2              | dBW          | None                   |                        |
| POLARIZATION              | -            | LCP                    |                        |
| ANTENNA GAIN              | dBi          | 54.7                   |                        |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.4                    |                        |
| ANTENNA ELLIPTICITY       | dB           | (1)                    |                        |
| RF FREQ SWEEP RANGE       | kHz          | (1)                    |                        |
| MIN FREQ SWEEP RATE       | Hz/s         | (1)                    |                        |
| MAX FREQ SWEEP RATE       | kHz/s        | (1)                    |                        |
| PROGRAMMED UPLINK FREQ    | Yes/No       | (1)                    |                        |
| <b>COMMAND</b>            |              |                        |                        |
| RF CARRIER MOD TYPE       | -            | PM                     | None                   |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.4                    |                        |
| SUBCARRIER FREQUENCY(S)   | Hz           | 16 000                 |                        |
| SUBCARRIER STEP SIZE      | Hz           | (1)                    |                        |
| SUBCARRIER FREQ STABILITY | ppm          | (1)                    |                        |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine                   |                        |
| SUBCARRIER MOD TYPE       | -            | (1)                    |                        |
| SUBCARRIER/BIT RATE LIMIT | -            | (1)                    |                        |
| BIT RATE RANGE            | b/s          | 125                    |                        |
| FORMATS AVAILABLE         | -            | NRZ - M                |                        |
|                           |              |                        |                        |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

**CCSDS HISTORICAL DOCUMENT**  
**CRL TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION  |                        |
|---|--------------|------------------------|------------------------|
|   |              | KASHIMA <sup>(2)</sup> | KASHIMA <sup>(2)</sup> |
| <b>GENERAL</b>  |              |                        |                        |
| STATION DESIGNATION   | -            | Kashima CS 10          | Kashima 11             |
| LOCATION(S)   | -            | Kashima, Japan         | Kashima, Japan         |
| DIAMETER  | m            | 10                     | 11                     |
| <b>RECEIVE</b>  |              |                        |                        |
| FREQUENCIES   | MHz          | 3700 - 4200            | 2200 - 2320            |
| FREQUENCY RESOLUTION  | Hz           | (1)                    | (1)                    |
| ANTENNA GAIN @ 45 deg   | dBi          | 53.5                   | (1)                    |
| SYS NOISE TEMP @ ZENITH   | K            | (1)                    | (1)                    |
| G/T @ 45 deg  | dB           | 32.9                   | 24                     |
| POLARIZATION  | -            | RCP                    | RCP or LCP             |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.37                   | (1)                    |
| ANTENNA ELLIPTICITY   | dB           | (1)                    | (1)                    |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | (1)                    | (1)                    |
| RCVR AGC DYNAMIC RANGE  | dB           | (1)                    | (1)                    |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | (1)                    | (1)                    |
| RCVR LOOP BANDWIDTHS  | Hz           | (1)                    | (1)                    |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | (1)                    | (1)                    |
| RCVR PLL ORDER(S)   | No.          | (1)                    | (1)                    |
| ACQ SWEEP RANGE   | kHz          | (1)                    | (1)                    |
| MIN ACQ SWEEP RATE  | Hz/s         | (1)                    | (1)                    |
| MAX ACQ SWEEP RATE  | kHz/s        | (1)                    | (1)                    |
| ACQ SWEEP STEP SIZE   | Hz           | (1)                    | (1)                    |
| PROGRAMMED L.O.   | Yes/No       | (1)                    | (1)                    |
|   |              |                        |                        |
|   |              |                        |                        |
|   |              |                        |                        |
| <b>TELEMETRY</b>  |              |                        |                        |
| MODULATION TYPE(S)  | -            | PM                     | None                   |
| MODULATION FORMAT(S)  | -            | Bi - $\phi$ - L        |                        |
| MOD INDEX RANGE   | Rad Pk       | 0.8                    |                        |
| SUBCARRIER FREQ RANGE   | kHz          | 256                    |                        |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                   |                        |
| SYMBOL RATE RANGE   | s/s          | 512                    |                        |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)                    |                        |
| ARRAYS WITH STATIONS  | -            | None                   |                        |
| CHANNEL DECODING  | Type         | (1)                    |                        |
| DATA FORMAT   | -            | (1)                    |                        |
|   |              |                        |                        |
|   |              |                        |                        |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                        |                        |

6445-4401

**CCSDS HISTORICAL DOCUMENT**  
**CRL TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION  |                            |
|---|--------------|------------------------|----------------------------|
|   |              | KASHIMA <sup>(2)</sup> | KASHIMA <sup>(2)</sup>     |
| <b>GENERAL</b>  |              |                        |                            |
| STATION DESIGNATION   | -            | Kashima CS 10          | Kashima 11                 |
| LOCATION(S)   | -            | Kashima, Japan         | Kashima, Japan             |
| DIAMETER  | m            | 10                     | 11                         |
| <b>FREQUENCIES</b>  |              |                        |                            |
| TRANSMIT FREQUENCIES  | MHz          | 5900 - 6400            | None                       |
| RECEIVE FREQUENCIES   | MHz          | 5100 - 5300            | 136 - 136.605, 2200 - 2320 |
| TURNAROUND FREQ RATIO   | -            | 1.56                   | (1)                        |
| <b>DOPPLER</b>  |              |                        |                            |
| COHERENT/NON-COHERENT   | -            | None                   | None                       |
| COUNTER RESOLUTION  | Cycles       |                        |                            |
| MAX DOPPLER FREQ SHIFT  | MHz          |                        |                            |
| DOPPLER BIAS FREQ   | MHz          |                        |                            |
| DRIFT   | $\Delta f/f$ |                        |                            |
| OUTPUT EQUATION   | -            |                        |                            |
| DIRECTION INDICATOR   | -            |                        |                            |
|   |              |                        |                            |
|   |              |                        |                            |
|   |              |                        |                            |
| <b>RANGING</b>  |              |                        |                            |
| COHERENT/NON-COHERENT   | -            | (1)                    |                            |
| RANGE CODE WAVEFORM   | Sin/Sq       | (1)                    |                            |
| EARTH STATION MOD INDEX   | Rad Pk       | 1                      |                            |
| RANGE CODE FREQ RATIO   | -            | (1)                    |                            |
| MAJOR CODE FREQ(S)  | kHz          | 500, 100, 20           |                            |
| MINOR CODE FREQ(S)  | kHz          | 100 - 0.01             |                            |
| MIN RECEIVED CARRIER SNR  | dB           | 64                     |                            |
| MIN REQ CODE PWR/No   | dB-Hz        | 51                     |                            |
| CODE INTEGRATION TIME   | s            | (1)                    |                            |
| ACQUISITION SEQUENCE  | -            | (1)                    |                            |
| RANGE DATA UNITS  | -            | (1)                    |                            |
| RANGE QUANTIZATION  | -            | (1)                    |                            |
| ACCURACY (STRONG SIGNAL)  | m            | (1)                    |                            |
| MAX UNAMBIGUOUS RANGE   | km           | (1)                    |                            |
| TRANSPONDER BW  | MHz          | (1)                    |                            |
|   |              |                        |                            |
|   |              |                        |                            |
|   |              |                        |                            |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                        |                            |

6445-4402

**CCSDS HISTORICAL DOCUMENT**  
**CRL TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS          | SUBNETWORK OR STATION     |                |                           |                |
|--|----------------|---------------------------|----------------|---------------------------|----------------|
|  |                | KASHIMA <sup>(2)</sup>    |                | KASHIMA <sup>(2)</sup>    |                |
| <b>GENERAL</b>   |                |                           |                |                           |                |
| STATION DESIGNATION  | -              | Kashima CS 10             |                | Kashima 11                |                |
| LOCATION(S)  | -              | Kashima, Japan            |                | Kashima, Japan            |                |
| DIAMETER   | m              | 10                        |                | 11                        |                |
| <b>FREQUENCY STD</b>   |                |                           |                |                           |                |
| Data Not Available   |                |                           |                |                           |                |
| STANDARD TYPE  | Name           |                           |                | (1)                       |                |
| STANDARD MFG   | Name           |                           |                | (1)                       |                |
| STABILITY AT:  |                | <b>Allan<br/>Variance</b> | <b>Drift</b>   | <b>Allan<br/>Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$   |                           |                | (1)                       | (1)            |
| 1 - HOUR   | $\Delta f/f$   |                           |                | (1)                       | (1)            |
| 1 - DAY (24 HOURS)   | $\Delta f/f$   |                           |                | (1)                       | (1)            |
| 1 - MONTH  | $\Delta f/f$   |                           |                | (1)                       | (1)            |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$  | <b>5 MHz</b>              | <b>100 MHz</b> | <b>5 MHz</b>              | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz         |                           |                | (1)                       | (1)            |
| 10 Hz OFFSET   | dBc/Hz         |                           |                | (1)                       | (1)            |
| 100 Hz OFFSET  | dBc/Hz         |                           |                | (1)                       | (1)            |
| 1000 Hz OFFSET   | dBc/Hz         |                           |                | (1)                       | (1)            |
| REF FREQS AVAILABLE  | MHz            |                           |                |                           |                |
| MAX STA-TO-STA OFFSET  | Hz             |                           |                |                           |                |
|  |                |                           |                |                           |                |
|  |                |                           |                |                           |                |
|  |                |                           |                |                           |                |
|  |                |                           |                |                           |                |
|  |                |                           |                |                           |                |
| <b>TIMING SYSTEM</b>   |                |                           |                |                           |                |
| Data Not Available   |                |                           |                |                           |                |
| MASTER REFERENCE AGENCY  | Name           |                           |                | (1)                       |                |
| REFERENCE TIME   | Name           |                           |                | (1)                       |                |
| TIME CODE EPOCH  | Yr             |                           |                | (1)                       |                |
| TIME CODES AVAILABLE   | CCSDS<br>Codes |                           |                | (1)                       |                |
| MAX TIME RESOLUTION  | s              |                           |                | (1)                       |                |
| TIME TRANSFER METHOD   | Name           |                           |                | (1)                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec     |                           |                | (1)                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec     |                           |                | (1)                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec     |                           |                | (1)                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec     |                           |                | (1)                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s        |                           |                | (1)                       |                |
|  |                |                           |                |                           |                |
|  |                |                           |                |                           |                |
|  |                |                           |                |                           |                |
|  |                |                           |                |                           |                |
|  |                |                           |                |                           |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |                |                           |                |                           |                |

CCSDS HISTORICAL DOCUMENT  
**CRL TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION  |                        |
|---|--------------------|------------------------|------------------------|
|   |                    | Kashima <sup>(2)</sup> | KASHIMA <sup>(2)</sup> |
| <b>GENERAL</b>  |                    |                        |                        |
| STATION DESIGNATION   | -                  | Kashima CS 10          | Kashima 11             |
| LOCATION(S)   | -                  | Kashima, Japan         | Kashima, Japan         |
| DIAMETER  | m                  | 10                     | 11                     |
| <b>GEOGRAPHICAL</b>   |                    |                        |                        |
| LOCATION, COUNTRY/STATE   | Name               | Japan                  | Japan                  |
| LOCATION, CITY  | Name               | Kashima                | Kashima                |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 140, 40, 00 E          | 140, 39, 38            |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 35, 57, 12 N           | 35, 57, 11             |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
| <b>MECHANICAL</b>   |                    |                        |                        |
| TYPE OF MOUNT   | -                  | Az - El                | Az - El                |
| AZIMUTH LIMITATIONS   | -                  | 125 - 195, 185 - 245   | ± 360                  |
| TRACKING SPEED RANGE  | deg/s              | 0.005 - 0.1            | 0 - 5                  |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 0.1                    | 2.5                    |
| TYPE OF POINTING  | Type               | Autotrack, Predict     | Predict                |
| POINTING ACCURACY   | deg                | (1)                    | ± 0.005                |
| MIN TRANSMIT ELEV ANGLE   | deg                | - 1                    | (1)                    |
| MIN RECEIVE ELEV ANGLE  | deg                | - 1                    | -2                     |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
| <b>SUPPORT</b>  |                    |                        |                        |
| TRANSMIT FREQ BAND(S)   | GHz                | 5.9 - 6.4              | Receive Only           |
| RECEIVE FREQ BAND(S)  | GHz                | 5.1 - 5.3              | 0.136, 2.2 - 2.3       |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                    | (1)                    |
| MISSION CATEGORIES  | Cat                | A                      | A                      |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                        |                        |

6445-4404

CCSDS HISTORICAL DOCUMENT  
**CRL TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |                   |
|---|--------------|-----------------------|-------------------|
|   |              | KASHIMA(2)            | KASHIMA(2)        |
| <b>GENERAL</b>  |              |                       |                   |
| STATION DESIGNATION   | -            | Kashima BS 13         | Kashima 26        |
| LOCATION(S)   | -            | Kashima, Japan        | Kashima, Japan    |
| DIAMETER  | m            | 13                    | 26                |
| <b>TRANSMIT</b>   |              |                       |                   |
| FREQUENCIES   | MHz          | 14 000 - 14 500       | Receive VLBI Only |
| FREQUENCY RESOLUTION  | Hz           | (1)                   |                   |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | 1                     |                   |
| TRANSMIT POWER 1  | W            | 0.5 - 2 K             |                   |
| EIRP RANGE 1  | dBW          | 60 - 96.2             |                   |
| TRANSMIT POWER 2  | W            | None                  |                   |
| EIRP RANGE 2  | dBW          | None                  |                   |
| POLARIZATION  | -            | LIN                   |                   |
| ANTENNA GAIN  | dBi          | 63.2                  |                   |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.1                   |                   |
| ANTENNA ELLIPTICITY   | dB           | (1)                   |                   |
| RF FREQ SWEEP RANGE   | kHz          | (1)                   |                   |
| MIN FREQ SWEEP RATE   | Hz/s         | (1)                   |                   |
| MAX FREQ SWEEP RATE   | kHz/s        | (1)                   |                   |
| PROGRAMMED UPLINK FREQ  | Yes/No       | (1)                   |                   |
| <b>COMMAND</b>  |              |                       |                   |
| RF CARRIER MOD TYPE   | -            | None                  |                   |
| RF CARRIER MOD INDEX RNG  | Rad Pk       |                       |                   |
| SUBCARRIER FREQUENCY(S)   | Hz           |                       |                   |
| SUBCARRIER STEP SIZE  | Hz           |                       |                   |
| SUBCARRIER FREQ STABILITY   | ppm          |                       |                   |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                       |                   |
| SUBCARRIER MOD TYPE   | -            |                       |                   |
| SUBCARRIER/BIT RATE LIMIT   | -            |                       |                   |
| BIT RATE RANGE  | b/s          |                       |                   |
| FORMATS AVAILABLE   | -            |                       |                   |
|   |              |                       |                   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |                   |

6445-4410

CCSDS HISTORICAL DOCUMENT  
**CRL TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION  |  |   |
|---|--------------|------------------------|--|---|
|   |              | KASHIMA <sup>(2)</sup> |  | KASHIMA <sup>(2)</sup>                                  |
| <b>GENERAL</b>  |              |                        |  |   |
| STATION DESIGNATION   | -            | Kashima BS 13          |  | Kashima 26  |
| LOCATION(S)   | -            | Kashima, Japan         |  | Kashima, Japan  |
| DIAMETER  | m            | 13                     |  | 26  |
| <b>RECEIVE</b>  |              | VLBI Only              |  |   |
| FREQUENCIES   | MHz          | 11 700 - 12 200        |  | 2200 - 2320      8180 - 8600                            |
| FREQUENCY RESOLUTION  | Hz           | (1)                    |  | (1)      (1)  |
| ANTENNA GAIN @ 45 deg   | dBi          | 62.2                   |  | 52.8      64.5  |
| SYS NOISE TEMP @ ZENITH   | K            | (1)                    |  | (1)      (1)  |
| G/T @ 45 deg  | dB           | 33.5                   |  | 30.5      41.2  |
| POLARIZATION  | -            | LIN                    |  | RCP      RCP or LCP                                     |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.12                   |  | 0.29      0.079   |
| ANTENNA ELLIPTICITY   | dB           | (1)                    |  | (1)      (1)  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | (1)                    |  | $1 \times 10^{-8}$ @ 10 sec $1 \times 10^{-8}$ @ 10 sec |
| RCVR AGC DYNAMIC RANGE  | dB           | (1)                    |  | (1)      (1)  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | (1)                    |  | (1)      (1)  |
| RCVR LOOP BANDWIDTHS  | Hz           | (1)                    |  | Open Loop      Open Loop                                |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | (1)                    |  | (1)      (1)  |
| RCVR PLL ORDER(S)   | No.          | (1)                    |  | (1)      (1)  |
| ACQ SWEEP RANGE   | kHz          | (1)                    |  | (1)      (1)  |
| MIN ACQ SWEEP RATE  | Hz/s         | (1)                    |  | (1)      (1)  |
| MAX ACQ SWEEP RATE  | kHz/s        | (1)                    |  | (1)      (1)  |
| ACQ SWEEP STEP SIZE   | Hz           | (1)                    |  | (1)      (1)  |
| PROGRAMMED L.O.   | Yes/No       | (1)                    |  | (1)      (1)  |
| <b>TELEMETRY</b>  |              | None                   |  |   |
| MODULATION TYPE(S)  | -            | PM                     |  |   |
| MODULATION FORMAT(S)  | -            | Bi - $\phi$ - L        |  |   |
| MOD INDEX RANGE   | Rad Pk       | 0.8                    |  |   |
| SUBCARRIER FREQ RANGE   | kHz          | 256                    |  |   |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                   |  |   |
| SYMBOL RATE RANGE   | s/s          | 512                    |  |   |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)                    |  |   |
| ARRAYS WITH STATIONS  | -            | None                   |  |   |
| CHANNEL DECODING  | Type         | (1)                    |  |   |
| DATA FORMAT   | -            | (1)                    |  |   |
|   |              |                        |  |   |
|   |              |                        |  |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                        |  |   |

6445-4411

**CCSDS HISTORICAL DOCUMENT**  
**CRL TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |                          |
|---|--------------|-----------------------|--------------------------|
|   |              | KASHIMA(2)            | KASHIMA(2)               |
| <b>GENERAL</b>  |              |                       |                          |
| STATION DESIGNATION   | -            | Kashima BS 13         | Kashima 26               |
| LOCATION(S)   | -            | Kashima, Japan        | Kashima, Japan           |
| DIAMETER  | m            | 13                    | 26                       |
| <b>FREQUENCIES</b>  |              |                       |                          |
| TRANSMIT FREQUENCIES  | MHz          | 14 000 - 14 500       | None                     |
| RECEIVE FREQUENCIES   | MHz          | 11 700 - 12 200       | 2200 - 2300, 8180 - 8600 |
| TURNAROUND FREQ RATIO   | -            | 1.2                   | 240 / 221                |
| <b>DOPPLER</b>  |              |                       |                          |
| COHERENT/NON-COHERENT   | -            | None                  | None, VLBI Only          |
| COUNTER RESOLUTION  | Cycles       |                       |                          |
| MAX DOPPLER FREQ SHIFT  | MHz          |                       |                          |
| DOPPLER BIAS FREQ   | MHz          |                       |                          |
| DRIFT   | $\Delta f/f$ |                       |                          |
| OUTPUT EQUATION   | -            |                       |                          |
| DIRECTION INDICATOR   | -            |                       |                          |
|   |              |                       |                          |
|   |              |                       |                          |
|   |              |                       |                          |
| <b>RANGING</b>  |              |                       |                          |
| COHERENT/NON-COHERENT   | -            | Non - Coherent        | None, VLBI Only          |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine                  |                          |
| EARTH STATION MOD INDEX   | Rad Pk       | 1                     |                          |
| RANGE CODE FREQ RATIO   | -            | (1)                   |                          |
| MAJOR CODE FREQ(S)  | kHz          | 100, 20               |                          |
| MINOR CODE FREQ(S)  | kHz          | (1)                   |                          |
| MIN RECEIVED CARRIER SNR  | dB           | (1)                   |                          |
| MIN REQ CODE PWR/No   | dB-Hz        | (1)                   |                          |
| CODE INTEGRATION TIME   | s            | (1)                   |                          |
| ACQUISITION SEQUENCE  | -            | (1)                   |                          |
| RANGE DATA UNITS  | -            | (1)                   |                          |
| RANGE QUANTIZATION  | -            | (1)                   |                          |
| ACCURACY (STRONG SIGNAL)  | m            | (1)                   |                          |
| MAX UNAMBIGUOUS RANGE   | km           | (1)                   |                          |
| TRANSPONDER BW  | MHz          | (1)                   |                          |
|   |              |                       |                          |
|   |              |                       |                          |
|   |              |                       |                          |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |                          |
| 6445-4412   |              |                       |                          |

**CCSDS HISTORICAL DOCUMENT**  
**CRL TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION  |                |                        |                         |
|--|---------------|------------------------|----------------|------------------------|-------------------------|
|  |               | KASHIMA <sup>(2)</sup> |                | KASHIMA <sup>(2)</sup> |                         |
| <b>GENERAL</b>   |               |                        |                |                        |                         |
| STATION DESIGNATION  | -             | Kashima BS 13          |                | Kashima 26             |                         |
| LOCATION(S)  | -             | Kashima, Japan         |                | Kashima, Japan         |                         |
| DIAMETER   | m             | 13                     |                | 26                     |                         |
| <b>FREQUENCY STD</b>   |               |                        |                |                        |                         |
| Data Not Available   |               |                        |                |                        |                         |
| STANDARD TYPE  | Name          |                        |                | Hydrogen Maser         |                         |
| STANDARD MFG   | Name          |                        |                | Anritsu Co.            |                         |
| STABILITY AT:  |               | <b>Allan Variance</b>  | <b>Drift</b>   | <b>Allan Variance</b>  | <b>Drift</b>            |
| 1 - SECOND   | $\Delta f/f$  |                        |                | $1 \times 10^{-13}$    | (1)                     |
| 1 - HOUR   | $\Delta f/f$  |                        |                | (1)                    | $\pm 1 \times 10^{-15}$ |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  |                        |                | (1)                    | $\pm 1 \times 10^{-14}$ |
| 1 - MONTH  | $\Delta f/f$  |                        |                | (1)                    | (1)                     |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>           | <b>100 MHz</b> | <b>5 MHz</b>           | <b>100 MHz</b>          |
| 1 Hz OFFSET  | dBc/Hz        |                        |                |                        |                         |
| 10 Hz OFFSET   | dBc/Hz        |                        |                |                        |                         |
| 100 Hz OFFSET  | dBc/Hz        |                        |                |                        |                         |
| 1000 Hz OFFSET   | dBc/Hz        |                        |                |                        |                         |
| REF FREQS AVAILABLE  | MHz           |                        |                | 10                     |                         |
| MAX STA-TO-STA OFFSET  | Hz            |                        |                |                        |                         |
|  |               |                        |                |                        |                         |
|  |               |                        |                |                        |                         |
|  |               |                        |                |                        |                         |
|  |               |                        |                |                        |                         |
| <b>TIMING SYSTEM</b>   |               |                        |                |                        |                         |
| Data Not Available   |               |                        |                |                        |                         |
| MASTER REFERENCE AGENCY  | Name          |                        |                | Cesium Beam            |                         |
| REFERENCE TIME   | Name          |                        |                | DCRL or USNO           |                         |
| REFERENCE TIME   | Name          |                        |                | UTC                    |                         |
| TIME CODE EPOCH  | Yr            |                        |                | (1)                    |                         |
| TIME CODES AVAILABLE   | CCSDS Codes   |                        |                | (1)                    |                         |
| MAX TIME RESOLUTION  | s             |                        |                | (1)                    |                         |
| TIME TRANSFER METHOD   | Name          |                        |                | GPS                    |                         |
| MAX TRANS ERROR REF  | $\mu$ -sec    |                        |                | 1                      |                         |
| MAX OFFSET FROM REF  | $\mu$ -sec    |                        |                | 5                      |                         |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    |                        |                | (1)                    |                         |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    |                        |                | (1)                    |                         |
| TIMING SIGNALS AVAILABLE   | pulse/s       |                        |                | (1)                    |                         |
|  |               |                        |                |                        |                         |
|  |               |                        |                |                        |                         |
|  |               |                        |                |                        |                         |
|  |               |                        |                |                        |                         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                        |                |                        |                         |

CCSDS HISTORICAL DOCUMENT  
**CRL TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS                  | UNITS              | SUBNETWORK OR STATION  |                        |
|----------------------------------|--------------------|------------------------|------------------------|
|                                  |                    | Kashima <sup>(2)</sup> | KASHIMA <sup>(2)</sup> |
| <b>GENERAL</b>                   |                    |                        |                        |
| STATION DESIGNATION              | -                  | Kashima BS 13          | Kashima 26             |
| LOCATION(S)                      | -                  | Kashima, Japan         | Kashima, Japan         |
| DIAMETER                         | m                  | 13                     | 26                     |
| <b>GEOGRAPHICAL</b>              |                    |                        |                        |
| LOCATION, COUNTRY/STATE          | Name               | Japan                  | Japan                  |
| LOCATION, CITY                   | Name               | Kashima                | Kashima                |
| LONGITUDE (site 1/site 2/site 3) | d, m, s            | 140, 39, 57 E          | 140, 39, 58            |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 35, 57, 11 N           | 35, 57, 03             |
|                                  |                    |                        |                        |
|                                  |                    |                        |                        |
|                                  |                    |                        |                        |
|                                  |                    |                        |                        |
| <b>MECHANICAL</b>                |                    |                        |                        |
| TYPE OF MOUNT                    | -                  | Az - El                | Az - El                |
| AZIMUTH LIMITATIONS              | -                  | ± 185                  | ± 355                  |
| TRACKING SPEED RANGE             | deg/s              | 0 - 0.5                | 0 - 1                  |
| MAX TRACK ACCELERATION           | deg/s <sup>2</sup> | 1.1                    | 1                      |
| TYPE OF POINTING                 | Type               | Autotrack, Predict     | Predict                |
| POINTING ACCURACY                | deg                | ± 0.01                 | ± 0.001                |
| MIN TRANSMIT ELEV ANGLE          | deg                | - 1                    | No Transmit            |
| MIN RECEIVE ELEV ANGLE           | deg                | - 1                    | 5                      |
|                                  |                    |                        |                        |
|                                  |                    |                        |                        |
|                                  |                    |                        |                        |
|                                  |                    |                        |                        |
| <b>SUPPORT</b>                   |                    |                        |                        |
| TRANSMIT FREQ BAND(S)            | GHz                | 14 - 14.5              | Receive Only           |
| RECEIVE FREQ BAND(S)             | GHz                | 11.7 - 12.2            | 2.2 - 2.3, 8.2 - 8.6   |
| ACQ AID FREQ BAND(S)             | GHz                | (1)                    | (1)                    |
| MISSION CATEGORIES               | Cat                | A                      | VLBI Only              |
|                                  |                    |                        |                        |
|                                  |                    |                        |                        |
|                                  |                    |                        |                        |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS  
 4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES

6445-4414

CCSDS HISTORICAL DOCUMENT  
**CRL TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |  |
|---|--------------|-----------------------|--|
|   |              | KASHIMA(2)            |  |
| <b>GENERAL</b>  |              |                       |  |
| STATION DESIGNATION   | -            | Kashima 34            |  |
| LOCATION(S)   | -            | Kashima, Japan        |  |
| DIAMETER  | m            | 34                    |  |
| <b>TRANSMIT</b>   |              | Receive Only          |  |
| FREQUENCIES   | MHz          |                       |  |
| FREQUENCY RESOLUTION  | Hz           |                       |  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ |                       |  |
| TRANSMIT POWER 1  | W            |                       |  |
| EIRP RANGE 1  | dBW          |                       |  |
| TRANSMIT POWER 2  | W            |                       |  |
| EIRP RANGE 2  | dBW          |                       |  |
| POLARIZATION  | -            |                       |  |
| ANTENNA GAIN  | dBi          |                       |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          |                       |  |
| ANTENNA ELLIPTICITY   | dB           |                       |  |
| RF FREQ SWEEP RANGE   | kHz          |                       |  |
| MIN FREQ SWEEP RATE   | Hz/s         |                       |  |
| MAX FREQ SWEEP RATE   | kHz/s        |                       |  |
| PROGRAMMED UPLINK FREQ  | Yes/No       |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
| <b>COMMAND</b>  |              | None                  |  |
| RF CARRIER MOD TYPE   | -            |                       |  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       |                       |  |
| SUBCARRIER FREQUENCY(S)   | Hz           |                       |  |
| SUBCARRIER STEP SIZE  | Hz           |                       |  |
| SUBCARRIER FREQ STABILITY   | ppm          |                       |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                       |  |
| SUBCARRIER MOD TYPE   | -            |                       |  |
| SUBCARRIER/BIT RATE LIMIT   | -            |                       |  |
| BIT RATE RANGE  | b/s          |                       |  |
| FORMATS AVAILABLE   | -            |                       |  |
|   |              |                       |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                       |  |

6445-4405

CCSDS HISTORICAL DOCUMENT  
**CRL TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION  |             |
|---|--------------|------------------------|-------------|
|   |              | KASHIMA <sup>(2)</sup> |             |
| <b>GENERAL</b>  |              |                        |             |
| STATION DESIGNATION   | -            | Kashima 34             |             |
| LOCATION(S)   | -            | Kashima, Japan         |             |
| DIAMETER  | m            | 34                     |             |
| <b>RECEIVE</b>  |              |                        |             |
| FREQUENCIES   | MHz          | 2150 - 2350            | 8180 - 8600 |
| FREQUENCY RESOLUTION  | Hz           | (1)                    | (1)         |
| ANTENNA GAIN @ 45 deg   | dBi          | 56                     | 67          |
| SYS NOISE TEMP @ ZENITH   | K            | (1)                    | (1)         |
| G/T @ 45 deg  | dB           | 38                     | 50          |
| POLARIZATION  | -            | RCP or LCP             | RCP or LCP  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.27                   | 0.07        |
| ANTENNA ELLIPTICITY   | dB           | (1)                    | (1)         |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | (1)                    | (1)         |
| RCVR AGC DYNAMIC RANGE  | dB           | (1)                    | (1)         |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | (1)                    | (1)         |
| RCVR LOOP BANDWIDTHS  | Hz           | (1)                    | (1)         |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | (1)                    | (1)         |
| RCVR PLL ORDER(S)   | No.          | (1)                    | (1)         |
| ACQ SWEEP RANGE   | kHz          | (1)                    | (1)         |
| MIN ACQ SWEEP RATE  | Hz/s         | (1)                    | (1)         |
| MAX ACQ SWEEP RATE  | kHz/s        | (1)                    | (1)         |
| ACQ SWEEP STEP SIZE   | Hz           | (1)                    | (1)         |
| PROGRAMMED L.O.   | Yes/No       | (1)                    | (1)         |
|   |              |                        |             |
|   |              |                        |             |
|   |              |                        |             |
| <b>TELEMETRY</b>  |              |                        |             |
| MODULATION TYPE(S)  | -            | None                   |             |
| MODULATION FORMAT(S)  | -            |                        |             |
| MOD INDEX RANGE   | Rad Pk       |                        |             |
| SUBCARRIER FREQ RANGE   | kHz          |                        |             |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                        |             |
| SYMBOL RATE RANGE   | s/s          |                        |             |
| SUBCARRIER/SYM RATE LIMIT   | -            |                        |             |
| ARRAYS WITH STATIONS  | -            |                        |             |
| CHANNEL DECODING  | Type         |                        |             |
| DATA FORMAT   | -            |                        |             |
|   |              |                        |             |
|   |              |                        |             |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                        |             |

6445-4406

CCSDS HISTORICAL DOCUMENT  
**CRL TRACKING SYSTEM**  
RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION   |  |
|---|--------------|-------------------------|--|
|   |              | KASHIMA <sup>(2)</sup>  |  |
| <b>GENERAL</b>  |              |                         |  |
| STATION DESIGNATION   | -            | Kashima 34              |  |
| LOCATION(S)   | -            | Kashima, Japan          |  |
| DIAMETER  | m            | 34                      |  |
| <b>FREQUENCIES</b>  |              |                         |  |
| TRANSMIT FREQUENCIES  | MHz          | None                    |  |
| RECEIVE FREQUENCIES   | MHz          | 2150 - 2350, 8160 - 860 |  |
| TURNAROUND FREQ RATIO   | -            | (1)                     |  |
| <b>DOPPLER</b>  |              |                         |  |
| COHERENT/NON-COHERENT   | -            | None                    |  |
| COUNTER RESOLUTION  | Cycles       |                         |  |
| MAX DOPPLER FREQ SHIFT  | MHz          |                         |  |
| DOPPLER BIAS FREQ   | MHz          |                         |  |
| DRIFT   | $\Delta f/f$ |                         |  |
| OUTPUT EQUATION   | -            |                         |  |
| DIRECTION INDICATOR   | -            |                         |  |
|   |              |                         |  |
|   |              |                         |  |
|   |              |                         |  |
| <b>RANGING</b>  |              |                         |  |
| COHERENT/NON-COHERENT   | -            | None                    |  |
| RANGE CODE WAVEFORM   | Sin/Sq       |                         |  |
| EARTH STATION MOD INDEX   | Rad Pk       |                         |  |
| RANGE CODE FREQ RATIO   | -            |                         |  |
| MAJOR CODE FREQ(S)  | kHz          |                         |  |
| MINOR CODE FREQ(S)  | kHz          |                         |  |
| MIN RECEIVED CARRIER SNR  | dB           |                         |  |
| MIN REQ CODE PWR/No   | dB-Hz        |                         |  |
| CODE INTEGRATION TIME   | s            |                         |  |
| ACQUISITION SEQUENCE  | -            |                         |  |
| RANGE DATA UNITS  | -            |                         |  |
| RANGE QUANTIZATION  | -            |                         |  |
| ACCURACY (STRONG SIGNAL)  | m            |                         |  |
| MAX UNAMBIGUOUS RANGE   | km           |                         |  |
| TRANSPONDER BW  | MHz          |                         |  |
|   |              |                         |  |
|   |              |                         |  |
|   |              |                         |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                         |  |

6445-4407

**CCSDS HISTORICAL DOCUMENT**  
**CRL TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION      |                         |                       |                |
|--|---------------|----------------------------|-------------------------|-----------------------|----------------|
|  |               | KASHIMA <sup>(2)</sup>     |                         |                       |                |
| <b>GENERAL</b>   |               |                            |                         |                       |                |
| STATION DESIGNATION  | -             | Kashima 34                 |                         |                       |                |
| LOCATION(S)  | -             | Kashima, Japan             |                         |                       |                |
| DIAMETER   | m             | 34                         |                         |                       |                |
| <b>FREQUENCY STD</b>   |               |                            |                         |                       |                |
| STANDARD TYPE  | Name          | Hydrogen Maser             |                         |                       |                |
| STANDARD MFG   | Name          | Anritsu Co.                |                         |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b>      | <b>Drift</b>            | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $1 \times 10^{-13}$        | (1)                     |                       |                |
| 1 - HOUR   | $\Delta f/f$  | (1)                        | $\pm 3 \times 10^{-15}$ |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                        | $\pm 1 \times 10^{-14}$ |                       |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                        | (1)                     |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>               | <b>100 MHz</b>          | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                        | (1)                     |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | (1)                        | (1)                     |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | (1)                        | (1)                     |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | (1)                        | (1)                     |                       |                |
| REF FREQS AVAILABLE  | MHz           | 10                         |                         |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                        |                         |                       |                |
|  |               |                            |                         |                       |                |
|  |               |                            |                         |                       |                |
|  |               |                            |                         |                       |                |
|  |               |                            |                         |                       |                |
| <b>TIMING SYSTEM</b>   |               |                            |                         |                       |                |
| MASTER REFERENCE AGENCY  | Name          | Cesium Beam<br>CRL or USNO |                         |                       |                |
| REFERENCE TIME   | Name          | UTC                        |                         |                       |                |
| TIME CODE EPOCH  | Yr            | (1)                        |                         |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | (1)                        |                         |                       |                |
| MAX TIME RESOLUTION  | s             | (1)                        |                         |                       |                |
| TIME TRANSFER METHOD   | Name          | GPS                        |                         |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 1                          |                         |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | 5                          |                         |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | (1)                        |                         |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                        |                         |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | (1)                        |                         |                       |                |
|  |               |                            |                         |                       |                |
|  |               |                            |                         |                       |                |
|  |               |                            |                         |                       |                |
|  |               |                            |                         |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                            |                         |                       |                |

6445-4408

CCSDS HISTORICAL DOCUMENT  
**CRL TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION  |  |
|---|--------------------|------------------------|--|
|   |                    | KASHIMA <sup>(2)</sup> |  |
| <b>GENERAL</b>  |                    |                        |  |
| STATION DESIGNATION   | -                  | Kashima 34             |  |
| LOCATION(S)   | -                  | Kashima, Japan         |  |
| DIAMETER  | m                  | 34                     |  |
| <b>GEOGRAPHICAL</b>   |                    |                        |  |
| LOCATION, COUNTRY/STATE   | Name               | Japan                  |  |
| LOCATION, CITY  | Name               | Kashima                |  |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 140, 39, 48            |  |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 35, 57, 10             |  |
|   |                    |                        |  |
|   |                    |                        |  |
|   |                    |                        |  |
|   |                    |                        |  |
| <b>MECHANICAL</b>   |                    |                        |  |
| TYPE OF MOUNT   | -                  | Az - El                |  |
| AZIMUTH LIMITATIONS   | -                  | ± 359                  |  |
| TRACKING SPEED RANGE  | deg/s              | 0 - 1                  |  |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 1                      |  |
| TYPE OF POINTING  | Type               | Predict                |  |
| POINTING ACCURACY   | deg                | ± 0.002                |  |
| MIN TRANSMIT ELEV ANGLE   | deg                | (1)                    |  |
| MIN RECEIVE ELEV ANGLE  | deg                | 6.0                    |  |
|   |                    |                        |  |
|   |                    |                        |  |
|   |                    |                        |  |
|   |                    |                        |  |
|   |                    |                        |  |
| <b>SUPPORT</b>  |                    |                        |  |
| TRANSMIT FREQ BAND(S)   | GHz                | Receive Only           |  |
| RECEIVE FREQ BAND(S)  | GHz                | 0.3 - 43 (10 Bands)    |  |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                    |  |
| MISSION CATEGORIES  | Cat                | VLBI, Radio Astron     |  |
|   |                    |                        |  |
|   |                    |                        |  |
|   |                    |                        |  |
|   |                    |                        |  |
|   |                    |                        |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES |                    |                        |  |

6445-4409



CCSDS HISTORICAL DOCUMENT  
**CSA SATELLITE CONTROL STATIONS**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                                   |   |
|---|--------------|---|---|
|   |              | SASKATOON   | St-HUBERT   |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | Saskatoon   | St-Hubert   |
| LOCATION(S)   | -            | Saskatchewan, Canada                                    | Québec, Canada  |
| DIAMETER  | m            | 10  | 10  |
| <b>RECEIVE</b>  |              |   |   |
| FREQUENCIES   | MHz          | 2200 - 2300   | 2200 - 2300   |
| FREQUENCY RESOLUTION  | Hz           | 1000  | 1000  |
| ANTENNA GAIN  | dBi          | 40  | 40  |
| SYS NOISE TEMP @ 5°   | K            | 100   | 100   |
| G/T @ 5°  | dB           | 20  | 20  |
| POLARIZATION  | -            | RHCP, LHCP  | RHCP, LHCP  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.92  | 0.92  |
| ANTENNA ELLIPTICITY   | dB           | 1.5   | 1.5   |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $5 \times 10^{-5}$                                      | $5 \times 10^{-5}$                                      |
| RCVR AGC DYNAMIC RANGE  | dB           | 100   | 100   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -150  | -150  |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 100, 300, 1000, 3000, 10 000                        | 30, 100, 300, 1000, 3000, 10 000                        |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt   | Adapt   |
| RCVR PLL ORDER(S)   | No.          | 2   | 2   |
| ACQ SWEEP RANGE   | kHz          | $\pm 250$   | $\pm 250$   |
| MIN ACQ SWEEP RATE  | Hz/s         | 167   | 167   |
| MAX ACQ SWEEP RATE  | kHz/s        | 16 667  | 16 667  |
| ACQ SWEEP STEP SIZE   | Hz           | Factor of 10 Multiplier                                 | Factor of 10 Multiplier                                 |
| PROGRAMMED L.O.   | Yes/No       | Yes   | Yes   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| <b>TELEMETRY</b>  |              |   |   |
| MODULATION TYPE(S)  | -            | PM  | PM  |
| MODULATION FORMAT(S)  | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S; DIM - M, S; RZ    | NRZ - L, M, S; Bi - $\phi$ - L, M, S; DIM - M, S; RZ    |
| MOD INDEX RANGE   | Rad Pk       | 0 - 2.8   | 0 - 2.8   |
| SUBCARRIER FREQ RANGE   | kHz          | 1024 (Fixed)  | 1024 (Fixed)  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine  | Sine  |
| SYMBOL RATE RANGE   | s/s          | 0 - 32 kbps on 1.024 MHz S/C<br>0 - 1.5 Mbps on Carrier | 0 - 32 kbps on 1.024 MHz S/C<br>0 - 1.5 Mbps on Carrier |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)   | (1)   |
| ARRAYS WITH STATIONS  | -            | None  | None  |
| CHANNEL DECODING  | Type         | None  | None  |
| DATA FORMAT   | -            | TDM   | TDM   |
|   |              |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |   |   |

6445-4790

CCSDS HISTORICAL DOCUMENT  
**CSA SATELLITE CONTROL STATIONS**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION  |  |
|--------------------------|--------------|--|--|
|                          |              | SASKATOON  | St-HUBERT  |
| <b>GENERAL</b>           |              |  |  |
| STATION DESIGNATION      | -            | Saskatoon  | St-Hubert  |
| LOCATION(S)              | -            | Saskatchewan, Canada   | Québec, Canada   |
| DIAMETER                 | m            | 10   | 10   |
| <b>FREQUENCIES</b>       |              |  |  |
| TRANSMIT FREQUENCIES     | MHz          | 2025 - 2120  | 2025 - 2120  |
| RECEIVE FREQUENCIES      | MHz          | 2200 - 2300  | 2200 - 2300  |
| TURNAROUND FREQ RATIO    | -            | 240 / 221  | 240 / 221  |
| <b>DOPPLER</b>           |              |  |  |
| COHERENT/NON-COHERENT    | -            | Either   | Either   |
| COUNTER RESOLUTION       | Cycles       | 0.01   | 0.01   |
| MAX DOPPLER FREQ SHIFT   | MHz          | 0.2  | 0.2  |
| DOPPLER BIAS FREQ        | MHz          | None   | None   |
| DRIFT (24 HOURS)         | $\Delta f/f$ | $1 \times 10^{-9}$   | $1 \times 10^{-9}$   |
| OUTPUT EQUATION          | -            | $\frac{1000}{4} (f_{\text{bias}} \pm f_{\text{xmt}} \times \text{Turnaround Ratio} - f_{\text{rcv}})$                  | $\frac{1000}{4} (f_{\text{bias}} \pm f_{\text{xmt}} \times \text{Turnaround Ratio} - f_{\text{rcv}})$                  |
| DIRECTION INDICATOR      | -            | $+\Delta f = -\Delta r$  | $+\Delta f = -\Delta r$  |
| <b>RANGING</b>           |              |  |  |
| COHERENT/NON-COHERENT    | -            | Both   | Both   |
| RANGE CODE WAVEFORM      | Sin/Sq       | Sine   | Sine   |
| EARTH STATION MOD INDEX  | Rad Pk       | 0 - 0.5  | 0 - 0.5  |
| RANGE CODE FREQ RATIO    | -            | 5  | 5  |
| MAJOR CODE FREQ(S)       | kHz          | 500  | 500  |
| MINOR CODE FREQ(S)       | kHz          | 100, 20, 4, 0.8, 0.16, 0.032, 0.008, 0.002 <sup>(4)</sup><br>400, 20, 4, 0.8, 0.16, 0.032, 0.008, 0.002 <sup>(5)</sup> | 100, 20, 4, 0.8, 0.16, 0.032, 0.008, 0.002 <sup>(4)</sup><br>400, 20, 4, 0.8, 0.16, 0.032, 0.008, 0.002 <sup>(5)</sup> |
| MIN RECEIVED CARRIER SNR | dB           | 7  | 7  |
| MIN REQ CODE PWR/No      | dB-Hz        | 35   | 35   |
| CODE INTEGRATION TIME    | s            | 1  | 1  |
| ACQUISITION SEQUENCE     | -            | Sequential, Major Tone First   | Sequential, Major Tone First   |
| RANGE DATA UNITS         | -            | Nanoseconds  | Nanoseconds  |
| RANGE QUANTIZATION       | -            | 1 ns   | 1 ns   |
| ACCURACY (STRONG SIGNAL) | m            | < 6  | < 6  |
| MAX UNAMBIGUOUS RANGE    | km           | 75 000   | 75 000   |
| TRANSPONDER BW           | MHz          | 1  | 1  |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS  
 4. TONES BELOW 4 KHz ARE MOD ON 4 KHz TONE      5. TONES BELOW 400 KHz ARE MOD ON 400 KHz TONE

CCSDS HISTORICAL DOCUMENT  
**CSA SATELLITE CONTROL STATIONS**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                      |                       |                      |
|--|---------------|-----------------------|----------------------|-----------------------|----------------------|
|  |               | SASKATOON             |                      | St-HUBERT             |                      |
| <b>GENERAL</b>   |               |                       |                      |                       |                      |
| STATION DESIGNATION  | -             | Saskatoon             |                      | St-Hubert             |                      |
| LOCATION(S)  | -             | Saskatchewan, Canada  |                      | Québec, Canada        |                      |
| DIAMETER   | m             | 10                    |                      | 10                    |                      |
| <b>FREQUENCY STD</b>   |               |                       |                      |                       |                      |
| STANDARD TYPE  | Name          | Rubidium              |                      | Rubidium              |                      |
| STANDARD MFG   | Name          | TRAK 8812             |                      | TRAK 8812             |                      |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Drift</b>         | <b>Allan Variance</b> | <b>Drift</b>         |
| 1 - SECOND   | $\Delta f/f$  | $5 \times 10^{-12}$   | (1)                  | $5 \times 10^{-12}$   | (1)                  |
| 1 - HOUR   | $\Delta f/f$  | $1 \times 10^{-12}$   | (1)                  | $1 \times 10^{-12}$   | (1)                  |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                   | $< 1 \times 10^{-9}$ | (1)                   | $< 1 \times 10^{-9}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)                   | (1)                  | (1)                   | (1)                  |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b>       | <b>5 MHz</b>          | <b>100 MHz</b>       |
| 1 Hz OFFSET  | dBc/Hz        | (1)                   | (1)                  | (1)                   | (1)                  |
| 10 Hz OFFSET   | dBc/Hz        | (1)                   | (1)                  | (1)                   | (1)                  |
| 100 Hz OFFSET  | dBc/Hz        | (1)                   | (1)                  | (1)                   | (1)                  |
| 1000 Hz OFFSET   | dBc/Hz        | (1)                   | (1)                  | (1)                   | (1)                  |
| REF FREQS AVAILABLE  | MHz           | 10                    |                      | 10                    |                      |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                   |                      | (1)                   |                      |
| <b>TIMING SYSTEM</b>   |               |                       |                      |                       |                      |
| MASTER REFERENCE AGENCY  | Name          | GPS                   |                      | GPS                   |                      |
| REFERENCE TIME   | Name          | UTC                   |                      | UTC                   |                      |
| TIME CODE EPOCH  | Yr            | 1 January 1958        |                      | 1 January 1958        |                      |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG A                |                      | IRIG A                |                      |
| MAX TIME RESOLUTION  | s             | 0.0000001             |                      | 0.0000001             |                      |
| TIME TRANSFER METHOD   | Name          | GPS                   |                      | GPS                   |                      |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 0.25                  |                      | 0.25                  |                      |
| MAX OFFSET FROM REF  | $\mu$ -sec    | 1                     |                      | 1                     |                      |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | None                  |                      | None                  |                      |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | None                  |                      | None                  |                      |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 10 K                  |                      | 10 K                  |                      |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                      |                       |                      |

CCSDS HISTORICAL DOCUMENT  
**CSA SATELLITE CONTROL STATIONS**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS                  | UNITS              | SUBNETWORK OR STATION       |                             |
|----------------------------------|--------------------|-----------------------------|-----------------------------|
|                                  |                    | SASKATOON                   | St-HUBERT                   |
| <b>GENERAL</b>                   |                    |                             |                             |
| STATION DESIGNATION              | -                  | Saskatoon                   | St-Hubert                   |
| LOCATION(S)                      | -                  | Saskatchewan, Canada        | Québec, Canada              |
| DIAMETER                         | m                  | 10                          | 10                          |
| <b>GEOGRAPHICAL</b>              |                    |                             |                             |
| LOCATION, COUNTRY/STATE          | Name               | Saskatchewan, Canada        | Québec, Canada              |
| LOCATION, CITY                   | Name               | Saskatoon                   | St-Hubert                   |
| LONGITUDE (site 1/site 2/site 3) | d, m, s            | 253 22 26.87                | 286 36 11.7                 |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | + 52 08 21.93861            | + 45 31 7.809               |
|                                  |                    |                             |                             |
|                                  |                    |                             |                             |
|                                  |                    |                             |                             |
|                                  |                    |                             |                             |
| <b>MECHANICAL</b>                |                    |                             |                             |
| TYPE OF MOUNT                    | -                  | Az - El                     | Az - El                     |
| AZIMUTH LIMITATIONS              | -                  | ± 270° (Max)                | ± 270° (Max)                |
| TRACKING SPEED RANGE             | deg/s              | El = 5, Az = 10             | El = 5, Az = 10             |
| MAX TRACK ACCELERATION           | deg/s <sup>2</sup> | El = 2.5, Az = 5            | El = 2.5, Az = 5            |
| TYPE OF POINTING                 | Type               | Autotrack, Manual, Predicts | Autotrack, Manual, Predicts |
| POINTING ACCURACY                | deg                | < 0.1                       | < 0.1                       |
| MIN TRANSMIT ELEV ANGLE          | deg                | 5                           | 5                           |
| MIN RECEIVE ELEV ANGLE           | deg                | Horizon                     | ≤ 5 (Az Dependant)          |
|                                  |                    |                             |                             |
|                                  |                    |                             |                             |
|                                  |                    |                             |                             |
|                                  |                    |                             |                             |
|                                  |                    |                             |                             |
| <b>SUPPORT</b>                   |                    |                             |                             |
| TRANSMIT FREQ BAND(S)            | GHz                | 2.025 - 2.12                | 2.025 - 2.12                |
| RECEIVE FREQ BAND(S)             | GHz                | 2.2 - 2.3                   | 2.2 - 2.3                   |
| ACQ AID FREQ BAND(S)             | GHz                | None                        | None                        |
| MISSION CATEGORIES               | Cat                | A                           | A                           |
|                                  |                    |                             |                             |
|                                  |                    |                             |                             |
|                                  |                    |                             |                             |
|                                  |                    |                             |                             |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS  
 4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES

6445-4793

CCSDS HISTORICAL DOCUMENT  
**CSIR TRACKING SYSTEM**  
EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |                               |
|---|--------------|-----------------------|-------------------------------|
|   |              | BREDASDORP            | BREDASDORP                    |
| <b>GENERAL</b>  |              |                       |                               |
| STATION DESIGNATION   | -            | SGS OTB               | OTB-MS2 (Overberg Test Range) |
| LOCATION(S)   | -            | South Africa          | South Africa                  |
| DIAMETER  | m            | 2                     | 4.6                           |
| <b>TRANSMIT</b>   |              |                       |                               |
| FREQUENCIES   | MHz          | 2025 - 2120           | (1)                           |
| FREQUENCY RESOLUTION  | Hz           | (1)                   | (1)                           |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | (1)                   | (1)                           |
| TRANSMIT POWER 1  | W            | 50                    | (1)                           |
| EIRP RANGE 1  | dBW          | 0 - 46                | (1)                           |
| TRANSMIT POWER 2  | W            | (1)                   | (1)                           |
| EIRP RANGE 2  | dBW          | (1)                   | (1)                           |
| POLARIZATION  | -            | RCP / LCP Selectable  | (1)                           |
| ANTENNA GAIN  | dBi          | 29.5                  | (1)                           |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 4.2                   | (1)                           |
| ANTENNA ELLIPTICITY   | dB           | 0.5                   | (1)                           |
| RF FREQ SWEEP RANGE   | kHz          | (1)                   | (1)                           |
| MIN FREQ SWEEP RATE   | Hz/s         | (1)                   | (1)                           |
| MAX FREQ SWEEP RATE   | kHz/s        | (1)                   | (1)                           |
| PROGRAMMED UPLINK FREQ  | Yes/No       | (1)                   | (1)                           |
|   |              |                       |                               |
|   |              |                       |                               |
|   |              |                       |                               |
|   |              |                       |                               |
|   |              |                       |                               |
|   |              |                       |                               |
|   |              |                       |                               |
|   |              |                       |                               |
|   |              |                       |                               |
| <b>COMMAND</b>  |              |                       |                               |
| RF CARRIER MOD TYPE   | -            | (1)                   | (1)                           |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | (1)                   | (1)                           |
| SUBCARRIER FREQUENCY(S)   | Hz           | (1)                   | (1)                           |
| SUBCARRIER STEP SIZE  | Hz           | (1)                   | (1)                           |
| SUBCARRIER FREQ STABILITY   | ppm          | (1)                   | (1)                           |
| SUBCARRIER WAVEFORM   | Sin/Sq       | (1)                   | (1)                           |
| SUBCARRIER MOD TYPE   | -            | (1)                   | (1)                           |
| SUBCARRIER/BIT RATE LIMIT   | -            | (1)                   | (1)                           |
| BIT RATE RANGE  | b/s          | (1)                   | (1)                           |
| FORMATS AVAILABLE   | -            | (1)                   | (1)                           |
|   |              |                       |                               |
|   |              |                       |                               |
|   |              |                       |                               |
|   |              |                       |                               |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                       |                               |

6445-3097

**CCSDS HISTORICAL DOCUMENT**  
**CSIR TRACKING SYSTEM**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION   |   |
|--|--------------|---|---|
|  |              | BREDASDORP  | BREDASDORP  |
| <b>GENERAL</b>   |              |   |   |
| STATION DESIGNATION  | -            | SGS OTB   | OTB-MS2 (Overberg Test Range)                           |
| LOCATION(S)  | -            | South Africa  | South Africa  |
| DIAMETER   | m            | 2   | 4.6   |
| <b>RECEIVE</b>   |              |   |   |
| FREQUENCIES  | MHz          | 2200 - 2300   | 2188 - 2475   |
| FREQUENCY RESOLUTION   | Hz           | 100 000   | 100   |
| ANTENNA GAIN @ 45 deg  | dBi          | 29.5 @ S-BAND   | 37.5 @ 2300 MHz   |
| SYS NOISE TEMP @ ZENITH  | K            | 250   | 257   |
| G/T @ 45 deg   | dB           | 5.6   | 12.4 @ 2300 MHz   |
| POLARIZATION   | -            | RCP / LCP Simultaneous  | RCP / LCP Simultaneous                                  |
| ANTENNA BEAMWIDTH (-3 dB)  | deg          | 4.2   | 2   |
| ANTENNA ELLIPTICITY  | dB           | 2   | 1.5   |
| L.O. REF FREQ STAB @ 1 Hr  | $\Delta f/f$ | $5 \times 10^{-7}$  | $5 \times 10^{-7}$                                      |
| RCVR AGC DYNAMIC RANGE   | dB           | 80  | 80  |
| RCVR THRESHOLD @ 2 Blo Hz  | dBm          | -146 in 2 Blo = 30 Hz   | -146 in 2 Blo = 30 Hz                                   |
| RCVR LOOP BANDWIDTHS   | Hz           | 30, 100, 300, 1 K, 10 K, 100 K  | 30, 100, 300, 1 K, 10 K, 100 K                          |
| RCVR LOOP TYPE (ADAPT, FIX)  | -            | Adapt   | Adapt   |
| RCVR PLL ORDER(S)  | No.          | 2   | 2   |
| ACQ SWEEP RANGE  | kHz          | $\pm 5, \pm 50, \pm 250$  | $\pm 5, \pm 50, \pm 250$                                |
| MIN ACQ SWEEP RATE   | Hz/s         | 1000  | 1000  |
| MAX ACQ SWEEP RATE   | kHz/s        | 100   | 100   |
| ACQ SWEEP STEP SIZE  | Hz           | 1000  | 1   |
| PROGRAMMED L.O.  | Yes/No       | Yes   | Yes   |
|  |              |   |   |
|  |              |   |   |
|  |              |   |   |
|  |              |   |   |
| <b>TELEMETRY</b>   |              |   |   |
| MODULATION TYPE(S)   | -            | PCM / FM, PCM / BPSK, PCM / PM  | PCM / FM, PCM / BPSK                                    |
| MODULATION FORMAT(S)   | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S; DM-M / S, M <sup>2</sup> -M / S | NRZ - L, M, S; Bi - $\phi$ - L, M, S; RZ; DM-M, S; RNRZ |
| MOD INDEX RANGE  | Rad Pk       | 0.1 - 2   | 2.5   |
| SUBCARRIER FREQ RANGE  | kHz          | (1)   | 0.1 - 2   |
| SUBCARRIER WAVEFORM  | Sin/Sq       | (1)   | (1)   |
| SYMBOL RATE RANGE  | s/s          | (1)   | (1)   |
| SUBCARRIER/SYM RATE LIMIT  | -            | (1)   | (1)   |
| ARRAYS WITH STATIONS   | -            | (1)   | (1)   |
| CHANNEL DECODING   | Type         | (1)   | (1)   |
| DATA FORMAT  | -            | (1)   | (1)   |
|  |              |   | (1)   |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |   |   |

6445-3098

CCSDS HISTORICAL DOCUMENT  
**CSIR TRACKING SYSTEM**  
RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |                               |
|---|--------------|-----------------------|-------------------------------|
|   |              | BREDASDORP            | BREDASDORP                    |
| <b>GENERAL</b>  |              |                       |                               |
| STATION DESIGNATION   | -            | SGS OTB               | OTB-MS2 (Overberg Test Range) |
| LOCATION(S)   | -            | South Africa          | South Africa                  |
| DIAMETER  | m            | 2                     | 4.6                           |
| <b>FREQUENCIES</b>  |              |                       |                               |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120           | (1)                           |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300           | 2188 - 2475                   |
| TURNAROUND FREQ RATIO   | -            | 210 / 230             | (1)                           |
| <b>DOPPLER</b>  |              |                       |                               |
| COHERENT/NON-COHERENT   | -            | Non - Coherent        | (1)                           |
| COUNTER RESOLUTION  | Cycles       | 0.1                   | (1)                           |
| MAX DOPPLER FREQ SHIFT  | MHz          | ± 150                 | (1)                           |
| DOPPLER BIAS FREQ   | MHz          | 625                   | (1)                           |
| DRIFT   | $\Delta f/f$ | (1)                   | (1)                           |
| OUTPUT EQUATION   | -            | (1)                   | (1)                           |
| DIRECTION INDICATOR   | -            | (1)                   | (1)                           |
| <b>RANGING</b>  |              |                       |                               |
| COHERENT/NON-COHERENT   | -            | (1)                   | (1)                           |
| RANGE CODE WAVEFORM   | Sin/Sq       | (1)                   | (1)                           |
| EARTH STATION MOD INDEX   | Rad Pk       | (1)                   | (1)                           |
| RANGE CODE FREQ RATIO   | -            | (1)                   | (1)                           |
| MAJOR CODE FREQ(S)  | kHz          | (1)                   | (1)                           |
| MINOR CODE FREQ(S)  | kHz          | (1)                   | (1)                           |
| MIN RECEIVED CARRIER SNR  | dB           | (1)                   | (1)                           |
| MIN REQ CODE PWR/No   | dB-Hz        | (1)                   | (1)                           |
| CODE INTEGRATION TIME   | s            | (1)                   | (1)                           |
| ACQUISITION SEQUENCE  | -            | (1)                   | (1)                           |
| RANGE DATA UNITS  | -            | (1)                   | (1)                           |
| RANGE QUANTIZATION  | -            | (1)                   | (1)                           |
| ACCURACY (STRONG SIGNAL)  | m            | (1)                   | (1)                           |
| MAX UNAMBIGUOUS RANGE   | km           | (1)                   | (1)                           |
| TRANSPONDER BW  | MHz          | (1)                   | (1)                           |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |                               |

6445-3099

**CCSDS HISTORICAL DOCUMENT**  
**CSIR TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION       |                            |                                   |                     |
|--|---------------|-----------------------------|----------------------------|-----------------------------------|---------------------|
|  |               | BREDASDORP                  |                            | BREDASDORP                        |                     |
| <b>GENERAL</b>   |               |                             |                            |                                   |                     |
| STATION DESIGNATION  | -             | SGS OTB                     |                            | OTB-MS2 (Overberg Test Range)     |                     |
| LOCATION(S)  | -             | South Africa                |                            | South Africa                      |                     |
| DIAMETER   | m             | 2                           |                            | 4.6                               |                     |
| <b>FREQUENCY STD</b>   |               |                             |                            |                                   |                     |
| STANDARD TYPE  | Name          | X-Tal VCO                   |                            | Cesium Beam                       |                     |
| STANDARD MFG   | Name          | TRAK Model FE-1050A         |                            | OSA 3210                          |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>       | <b>Drift</b>               | <b>Allan Variance</b>             | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | (1)                         | <5 Parts per $10^{10}$ (5) | (1)                               | $3 \times 10^{-11}$ |
| 1 - HOUR   | $\Delta f/f$  | (1)                         | (1)                        | (1)                               | (1)                 |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                         | (1)                        | (1)                               | $2 \times 10^{-12}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)                         | (1)                        | (1)                               | $3 \times 10^{-13}$ |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>                | <b>100 MHz</b>             | <b>5 MHz</b>                      | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | (1)                         | (1)                        | (1)                               | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | -130                        | (1)                        | -120                              | (1)                 |
| 100 Hz OFFSET  | dBc/Hz        | -140                        | (1)                        | -140                              | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz        | -160                        | (1)                        | -140                              | (1)                 |
| REF FREQS AVAILABLE  | MHz           | 0.1, 1, 5, 10               |                            | 5                                 |                     |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                         |                            | (1)                               |                     |
| <b>TIMING SYSTEM</b>   |               |                             |                            |                                   |                     |
| MASTER REFERENCE AGENCY  | Name          | CSIR GPS                    |                            | CSIR GPS                          |                     |
| REFERENCE TIME   | Name          | UTC                         |                            | UTC                               |                     |
| TIME CODE EPOCH  | Yr            | 1958                        |                            | 1958                              |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG-B                      |                            | IRIG-A-B                          |                     |
| MAX TIME RESOLUTION  | s             | 0.001                       |                            | 0.0001                            |                     |
| TIME TRANSFER METHOD   | Name          | GPS                         |                            | GPS                               |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 2.5                         |                            | 2.5                               |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 25$                    |                            | $\pm 16$                          |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 2.5                         |                            | 2.5                               |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                         |                            | (1)                               |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | $1 \times 10^{-3}$ to 1 ppm |                            | 1, 10, 100, 1 K, 100 K, 1 M, 10 M |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY    5. 0 - 50 deg <sup>c</sup> 6445-4000 |               |                             |                            |                                   |                     |

CCSDS HISTORICAL DOCUMENT  
**CSIR TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS  | UNITS              | SUBNETWORK OR STATION      |                               |
|--|--------------------|----------------------------|-------------------------------|
|  |                    | BREDASDORP                 | BREDASDORP                    |
| <b>GENERAL</b>   |                    |                            |                               |
| STATION DESIGNATION  | -                  | SGS OTB                    | OTB-MS2 (Overberg Test Range) |
| LOCATION(S)  | -                  | South Africa               | South Africa                  |
| DIAMETER   | m                  | 2                          | 4.6                           |
| <b>GEOGRAPHICAL</b>  |                    |                            |                               |
| LOCATION, COUNTRY/STATE  | Name               | South Africa               | South Africa                  |
| LOCATION, CITY   | Name               | BREDASDORP                 | Bredasdorp                    |
| LONGITUDE (site 1/site 2/site 3)   | d, m, s            | 20, 13, 36 E               | 20, 13, 14                    |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 34, 36, 56 S               | -34, 37, 12                   |
|  |                    |                            |                               |
|  |                    |                            |                               |
|  |                    |                            |                               |
|  |                    |                            |                               |
| <b>MECHANICAL</b>  |                    |                            |                               |
| TYPE OF MOUNT  | -                  | Az / El                    | Az / El                       |
| AZIMUTH LIMITATIONS  | -                  | None                       | ± 360                         |
| TRACKING SPEED RANGE   | deg/s              | 30                         | 30                            |
| MAX TRACK ACCELERATION   | deg/s <sup>2</sup> | 60                         | 65                            |
| TYPE OF POINTING   | Type               | Manual, Autotrack, Predict | Manual, Autotrack, Computer   |
| POINTING ACCURACY  | deg                | 0.022                      | 0.2                           |
| MIN TRANSMIT ELEV ANGLE  | deg                | 3.0                        | (1)                           |
| MIN RECEIVE ELEV ANGLE   | deg                | None                       | -1                            |
|  |                    |                            |                               |
|  |                    |                            |                               |
|  |                    |                            |                               |
|  |                    |                            |                               |
|  |                    |                            |                               |
| <b>SUPPORT</b>   |                    |                            |                               |
| TRANSMIT FREQ BAND(S)  | GHz                | 2.025 - 2.12               | (1)                           |
| RECEIVE FREQ BAND(S)   | GHz                | 2.2 - 2.3                  | 2.188 - 2.475                 |
| ACQ AID FREQ BAND(S)   | GHz                | (1)                        | (1)                           |
| MISSION CATEGORIES   | Cat                | A                          | A                             |
|  |                    |                            |                               |
|  |                    |                            |                               |
|  |                    |                            |                               |
|  |                    |                            |                               |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETTIC COORDINATES |                    |                            |                               |

6445-4001

**CCSDS HISTORICAL DOCUMENT**  
**CSIR TRACKING SYSTEM**  
EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |   |
|---|--------------|-----------------------|---|
|   |              | BREDASDORP            | HARTEBEESTHOEK                              |
| <b>GENERAL</b>  |              |                       |   |
| STATION DESIGNATION   | -            | OTB-L2 MOBILE SYSTEM  | HBK (Hartebeesthoek)                        |
| LOCATION(S)   | -            | South Africa          | South Africa                                |
| DIAMETER  | m            | 4.6                   | 6.1   |
| <b>TRANSMIT</b>   |              |                       | CNES Equipment                              |
| FREQUENCIES   | MHz          | (1)                   | 2000 - 2100                                 |
| FREQUENCY RESOLUTION  | Hz           | (1)                   | 10  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | (1)                   | $3 \times 10^{-5}$ @ 1 sec                  |
| TRANSMIT POWER 1  | W            | (1)                   | 10 000                                      |
| EIRP RANGE 1  | dBW          | (1)                   | 0 - 77                                      |
| TRANSMIT POWER 2  | W            | (1)                   | 2 - 300                                     |
| EIRP RANGE 2  | dBW          | (1)                   | 48 - 71                                     |
| POLARIZATION  | -            | (1)                   | RCP / LCP                                   |
| ANTENNA GAIN  | dBi          | (1)                   | 39  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | (1)                   | 1.7   |
| ANTENNA ELLIPTICITY   | dB           | (1)                   | 0.5   |
| RF FREQ SWEEP RANGE   | kHz          | (1)                   | $\pm 150$                                   |
| MIN FREQ SWEEP RATE   | Hz/s         | (1)                   | 1000  |
| MAX FREQ SWEEP RATE   | kHz/s        | (1)                   | 100   |
| PROGRAMMED UPLINK FREQ  | Yes/No       | (1)                   | Yes   |
|   |              |                       |   |
|   |              |                       |   |
|   |              |                       |   |
|   |              |                       |   |
|   |              |                       |   |
|   |              |                       |   |
|   |              |                       |   |
|   |              |                       |   |
|   |              |                       |   |
| <b>COMMAND</b>  |              |                       | CNES Equipment                              |
| RF CARRIER MOD TYPE   | -            | (1)                   | PM  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | (1)                   | 0 - 2                                       |
| SUBCARRIER FREQUENCY(S)   | Hz           | (1)                   | 2000, 4000, 8000, 16 000                    |
| SUBCARRIER STEP SIZE  | Hz           | (1)                   | Not Adjustable                              |
| SUBCARRIER FREQ STABILITY   | ppm          | (1)                   | 51 @ 1 year                                 |
| SUBCARRIER WAVEFORM   | Sin/Sq       | (1)                   | Sine  |
| SUBCARRIER MOD TYPE   | -            | (1)                   | PSK   |
| SUBCARRIER/BIT RATE LIMIT   | -            | (1)                   | $\leq 256$ , Coh $\pm 10$ deg               |
| BIT RATE RANGE  | b/s          | (1)                   | $2000 / 2^{\eta}$ ; $\eta = 0, 1, \dots .8$ |
| FORMATS AVAILABLE   | -            | (1)                   | NRZ - L, M; Bi - $\phi$ - L, M              |
|   |              |                       |   |
|   |              |                       |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                       |   |

**CCSDS HISTORICAL DOCUMENT**  
**CSIR TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                                  |                      |
|---|--------------|--|----------------------|
|   |              | BREDASDORP   | HARTEBEESTHOEK       |
| <b>GENERAL</b>  |              |  |                      |
| STATION DESIGNATION   | -            | OTB-L2 MOBILE SYSTEM                                   | HBK (Hartebeesthoek) |
| LOCATION(S)   | -            | South Africa   | South Africa         |
| DIAMETER  | m            | 4.6  | 6.1                  |
| <b>RECEIVE</b>  |              |  |                      |
| FREQUENCIES   | MHz          | 2188 - 2475  | None                 |
| FREQUENCY RESOLUTION  | Hz           | 100  |                      |
| ANTENNA GAIN @ 45 deg   | dBi          | 37.5 @ 2300 MHz  |                      |
| SYS NOISE TEMP @ ZENITH   | K            | 257  |                      |
| G/T @ 45 deg  | dB           | 12.4 @ 2300 MHz  |                      |
| POLARIZATION  | -            | RCP / LCP Simultaneous                                 |                      |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 2  |                      |
| ANTENNA ELLIPTICITY   | dB           | 1.5  |                      |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $5 \times 10^{-7}$                                     |                      |
| RCVR AGC DYNAMIC RANGE  | dB           | 80   |                      |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -146 in 2 Blo = 30 Hz                                  |                      |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 100, 300, 1 K, 10 K, 100 K                         |                      |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt  |                      |
| RCVR PLL ORDER(S)   | No.          | 2  |                      |
| ACQ SWEEP RANGE   | kHz          | $\pm 5, \pm 50, \pm 250$                               |                      |
| MIN ACQ SWEEP RATE  | Hz/s         | 1000   |                      |
| MAX ACQ SWEEP RATE  | kHz/s        | 100  |                      |
| ACQ SWEEP STEP SIZE   | Hz           | 1  |                      |
| PROGRAMMED L.O.   | Yes/No       | Yes  |                      |
|   |              |  |                      |
|   |              |  |                      |
|   |              |  |                      |
|   |              |  |                      |
| <b>TELEMETRY</b>  |              |  |                      |
| MODULATION TYPE(S)  | -            | PCM / FM, PCM / BPSK                                   | None                 |
| MODULATION FORMAT(S)  | -            | NRZ - L, M, S; Bi- $\phi$ - L, M, S; RZ; DM-M, S; RNRZ |                      |
| MOD INDEX RANGE   | Rad Pk       | 2.5  |                      |
| SUBCARRIER FREQ RANGE   | kHz          | 0.1 - 2  |                      |
| SUBCARRIER WAVEFORM   | Sin/Sq       | (1)  |                      |
| SYMBOL RATE RANGE   | s/s          | (1)  |                      |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)  |                      |
| ARRAYS WITH STATIONS  | -            | (1)  |                      |
| CHANNEL DECODING  | Type         | (1)  |                      |
| DATA FORMAT   | -            | (1)  |                      |
|   |              | (1)  |                      |
|   |              |  |                      |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |  |                      |

ATSC-290

CCSDS HISTORICAL DOCUMENT  
**CSIR TRACKING SYSTEM**  
RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |   |
|---|--------------|-----------------------|---|
|   |              | BREDASDORP            | HARTEBEESTHOEK                                  |
| <b>GENERAL</b>  |              |                       |   |
| STATION DESIGNATION   | -            | OTB-MS2 MOBILE SYSTEM | HBK (Hartebeesthoek)                            |
| LOCATION(S)   | -            | South Africa          | South Africa                                    |
| DIAMETER  | m            | 4.6                   | 6.1   |
| <b>FREQUENCIES</b>  |              |                       |   |
| TRANSMIT FREQUENCIES  | MHz          | (1)                   | 2000 - 2100                                     |
| RECEIVE FREQUENCIES   | MHz          | 2188 - 2475           | None  |
| TURNAROUND FREQ RATIO   | -            | (1)                   | 221 / 240                                       |
| <b>DOPPLER</b>  |              |                       |   |
| CNES Equipment  |              |                       |   |
| COHERENT/NON-COHERENT   | -            | (1)                   | Either  |
| COUNTER RESOLUTION  | Cycles       | (1)                   | 0.1   |
| MAX DOPPLER FREQ SHIFT  | MHz          | (1)                   | ± 0.15  |
| DOPPLER BIAS FREQ   | MHz          | (1)                   | 60  |
| DRIFT   | $\Delta f/f$ | (1)                   | $5 \times 10^{-11}$                             |
| OUTPUT EQUATION   | -            | (1)                   | Bias freq + (240 / 221) ( $f_{up}$ ) (-2 v / c) |
| DIRECTION INDICATOR   | -            | (1)                   | + $\Delta f = -\Delta r$                        |
| <b>RANGING</b>  |              |                       |   |
| CNES Equipment  |              |                       |   |
| COHERENT/NON-COHERENT   | -            | (1)                   | Either  |
| RANGE CODE WAVEFORM   | Sin/Sq       | (1)                   | Sine  |
| EARTH STATION MOD INDEX   | Rad Pk       | (1)                   | Major ≤ 1.5; Minor ≤ 1                          |
| RANGE CODE FREQ RATIO   | -            | (1)                   | 5:1; 4:1  |
| MAJOR CODE FREQ(S)  | kHz          | (1)                   | 100   |
| MINOR CODE FREQ(S)  | kHz          | (1)                   | 20, 16 (0.8, 0.16, 0.032, 0.008 on 16 kHz)      |
| MIN RECEIVED CARRIER SNR  | dB           | (1)                   | -20 @ IF BW = 500 kHz                           |
| MIN REQ CODE PWR/No   | dB-Hz        | (1)                   | Major ≥ 25; Minor ≥ 20                          |
| CODE INTEGRATION TIME   | s            | (1)                   | 0.5 - 5   |
| ACQUISITION SEQUENCE  | -            | (1)                   | Sequential, Major Tone First                    |
| RANGE DATA UNITS  | -            | (1)                   | Nanoseconds                                     |
| RANGE QUANTIZATION  | -            | (1)                   | 2 ns  |
| ACCURACY (STRONG SIGNAL)  | m            | (1)                   | 15  |
| MAX UNAMBIGUOUS RANGE   | km           | (1)                   | 18 750  |
| TRANSPONDER BW  | MHz          | (1)                   | ≥ 0.3   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |   |
| ATSC-291  |              |                       |   |

## CSIR TRACKING SYSTEM

## FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS   | UNITS         | SUBNETWORK OR STATION             |                     |                                       |                        |
|---|---------------|-----------------------------------|---------------------|---------------------------------------|------------------------|
|   |               | BREDASDORP                        |                     | HARTEBEESTHOEK                        |                        |
| <b>GENERAL</b>  |               |                                   |                     |                                       |                        |
| STATION DESIGNATION   | -             | OTB-L2 MOBILE SYSTEM              |                     | HBK (Hartebeesthoek)                  |                        |
| LOCATION(S)   | -             | South Africa                      |                     | South Africa                          |                        |
| DIAMETER  | m             | 4.6                               |                     | 6.1                                   |                        |
| <b>FREQUENCY STD</b>  |               |                                   |                     |                                       |                        |
| STANDARD TYPE   | Name          | Rubidium Oscillator               |                     | Rubidium Oscillator                   |                        |
| STANDARD MFG  | Name          | DATUM 9150-720                    |                     | Hewlett Packard, Model 5065A          |                        |
| STABILITY AT:   |               | <b>Allan Variance</b>             | <b>Drift</b>        | <b>Allan Variance</b>                 | <b>Drift</b>           |
| 1 - SECOND  | $\Delta f/f$  | (1)                               | (1)                 | (1)                                   | $1 \times 10^{-11}$    |
| 100 - SECONDS   | $\Delta f/f$  | (1)                               | $1 \times 10^{-12}$ | (1)                                   | (1)                    |
| 1 - HOUR  | $\Delta f/f$  | (1)                               | (1)                 | (1)                                   | $2.8 \times 10^{-11}$  |
| 1 - DAY (24 HOURS)  | $\Delta f/f$  | (1)                               | (1)                 | (1)                                   | $2.63 \times 10^{-11}$ |
| 1 - MONTH   | $\Delta f/f$  | (1)                               | $4 \times 10^{-11}$ | (1)                                   | $3 \times 10^{-12}$    |
| REF FREQS PHASE NOISE   | $S_{\phi}(f)$ | <b>5 MHz</b>                      | <b>100 MHz</b>      | <b>5 MHz</b>                          | <b>100 MHz</b>         |
| 1 Hz OFFSET   | dBc/Hz        | (1)                               | (1)                 | (1)                                   | (1)                    |
| 10 Hz OFFSET  | dBc/Hz        | (1)                               | (1)                 | (1)                                   | (1)                    |
| 100 Hz OFFSET   | dBc/Hz        | (1)                               | (1)                 | (1)                                   | (1)                    |
| 1000 Hz OFFSET  | dBc/Hz        | (1)                               | (1)                 | (1)                                   | (1)                    |
| REF FREQS AVAILABLE   | MHz           | 10                                |                     | 0.1, 1, 5, 10                         |                        |
| MAX STA-TO-STA OFFSET   | Hz            | (1)                               |                     | $1 \times 10^{-4}$ @ 5 MHz With Other |                        |
|   |               |                                   |                     | CNES 2 GHz Stations                   |                        |
|   |               |                                   |                     |                                       |                        |
|   |               |                                   |                     |                                       |                        |
| <b>TIMING SYSTEM</b>  |               |                                   |                     |                                       |                        |
| MASTER REFERENCE AGENCY   | Name          | GPS                               |                     | USNO                                  |                        |
| REFERENCE TIME  | Name          | UTC                               |                     | UTC                                   |                        |
| TIME CODE EPOCH   | Yr            | 1958                              |                     | 1958                                  |                        |
| TIME CODES AVAILABLE  | CCSDS Codes   | IRIG-A-B                          |                     | NASA - 36, IRIG - A & B               |                        |
| MAX TIME RESOLUTION   | s             | 0.0001                            |                     | 0.001                                 |                        |
| TIME TRANSFER METHOD  | Name          | GPS                               |                     | GPS                                   |                        |
| MAX TRANS ERROR REF   | $\mu$ -sec    | 2.5                               |                     | 2.5                                   |                        |
| MAX OFFSET FROM REF   | $\mu$ -sec    | $\pm 16$                          |                     | $\pm 25$                              |                        |
| MAX OFFSET MEAS ERROR   | $\mu$ -sec    | 2.5                               |                     | 2.5                                   |                        |
| MAX STA-TO-STA OFFSET   | $\mu$ -sec    | (1)                               |                     | 100 With Other CNES 2 GHz Stations    |                        |
| TIMING SIGNALS AVAILABLE  | pulse/s       | 1, 10, 100, 1 K, 100 K, 1 M, 10 M |                     | from $1 \times 10^{-3}$ to 100 days   |                        |
|   |               |                                   |                     |                                       |                        |
|   |               |                                   |                     |                                       |                        |
|   |               |                                   |                     |                                       |                        |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY      5. $0 - 50 \text{ deg}^{\text{C}}$ ATSC-292 |               |                                   |                     |                                       |                        |

CCSDS HISTORICAL DOCUMENT  
**CSIR TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS                  | UNITS              | SUBNETWORK OR STATION       |                         |
|----------------------------------|--------------------|-----------------------------|-------------------------|
|                                  |                    | BREDASDORP                  | HARTEBEESTHOEK          |
| <b>GENERAL</b>                   |                    |                             |                         |
| STATION DESIGNATION              | -                  | OTB-L2 MOBILE SYSTEM        | HBK (Hartebeesthoek)    |
| LOCATION(S)                      | -                  | South Africa                | South Africa            |
| DIAMETER                         | m                  | 4.6                         | 6.1                     |
| <b>GEOGRAPHICAL</b>              |                    |                             |                         |
| LOCATION, COUNTRY/STATE          | Name               | South Africa                | South Africa            |
| LOCATION, CITY                   | Name               | Bredasdorp                  | Hartebeesthoek          |
| LONGITUDE (site 1/site 2/site 3) | d, m, s            | Location Varies             | 27, 42, 44 E            |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | Location Varies             | 25, 53, 12 S            |
|                                  |                    |                             |                         |
|                                  |                    |                             |                         |
|                                  |                    |                             |                         |
|                                  |                    |                             |                         |
| <b>MECHANICAL</b>                |                    |                             |                         |
| TYPE OF MOUNT                    | -                  | Az / El                     | X, Y                    |
| AZIMUTH LIMITATIONS              | -                  | ± 360                       | 6 deg East and West     |
| TRACKING SPEED RANGE             | deg/s              | 30                          | 5                       |
| MAX TRACK ACCELERATION           | deg/s <sup>2</sup> | 65                          | 5                       |
| TYPE OF POINTING                 | Type               | Manual, Autotrack, Computer | Slaved, Predict, Manual |
| POINTING ACCURACY                | deg                | 0.2                         | 0.4                     |
| MIN TRANSMIT ELEV ANGLE          | deg                | (1)                         | 5 - 6                   |
| MIN RECEIVE ELEV ANGLE           | deg                | -1                          | None                    |
|                                  |                    |                             |                         |
|                                  |                    |                             |                         |
|                                  |                    |                             |                         |
|                                  |                    |                             |                         |
| <b>SUPPORT</b>                   |                    |                             |                         |
| TRANSMIT FREQ BAND(S)            | GHz                | (1)                         | 2 - 2.4                 |
| RECEIVE FREQ BAND(S)             | GHz                | 2.188 - 2.475               | None                    |
| ACQ AID FREQ BAND(S)             | GHz                | (1)                         | None                    |
| MISSION CATEGORIES               | Cat                | A                           | A                       |
|                                  |                    |                             |                         |
|                                  |                    |                             |                         |
|                                  |                    |                             |                         |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS  
 4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES

CCSDS HISTORICAL DOCUMENT  
**CSIR TRACKING SYSTEM**  
EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS                        | UNITS  | SUBNETWORK OR STATION       |                |
|--|--|-----------------------------|----------------|
|  |  | BREDASDORP                  | HARTEBEESTHOEK |
| <b>GENERAL</b>                         |  |                             |                |
| STATION DESIGNATION                    | -  | SGS OTB                     | Hartebeesthoek |
| LOCATION(S)                            | -  | South Africa                | South Africa   |
| DIAMETER                               | m  | 10                          | 10             |
| <b>TRANSMIT</b>                        |  |                             | None           |
| FREQUENCIES                            | MHz  | 2025 - 2120                 |                |
| FREQUENCY RESOLUTION                   | Hz   | (1)                         |                |
| RF FREQ STABILITY @ 1 Hr               | $\Delta f/f$                                 | (1)                         |                |
| TRANSMIT POWER 1                       | W  | 50                          |                |
| EIRP RANGE 1                           | dBW  | 0 - 60                      |                |
| TRANSMIT POWER 2                       | W  | (1)                         |                |
| EIRP RANGE 2                           | dBW  | (1)                         |                |
| POLARIZATION                           | -  | RCP / LCP Selectable        |                |
| ANTENNA GAIN                           | dBi  | 43.2                        |                |
| ANTENNA BEAMWIDTH (-3 dB)              | deg  | 0.9                         |                |
| ANTENNA ELLIPTICITY                    | dB   | 0.5                         |                |
| RF FREQ SWEEP RANGE                    | kHz  | (1)                         |                |
| MIN FREQ SWEEP RATE                    | Hz/s   | (1)                         |                |
| MAX FREQ SWEEP RATE                    | kHz/s  | (1)                         |                |
| PROGRAMMED UPLINK FREQ                 | Yes/No                                       | (1)                         |                |
|  |  |                             |                |
|  |  |                             |                |
|  |  |                             |                |
|  |  |                             |                |
|  |  |                             |                |
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|  |  |                             |                |
|  |  |                             |                |
|  |  |                             |                |
|  |  |                             |                |
| <b>COMMAND</b>                         |  |                             | None           |
| RF CARRIER MOD TYPE                    | -  | (1)                         |                |
| RF CARRIER MOD INDEX RNG               | Rad Pk                                       | (1)                         |                |
| SUBCARRIER FREQUENCY(S)                | Hz   | (1)                         |                |
| SUBCARRIER STEP SIZE                   | Hz   | (1)                         |                |
| SUBCARRIER FREQ STABILITY              | ppm  | (1)                         |                |
| SUBCARRIER WAVEFORM                    | Sin/Sq                                       | (1)                         |                |
| SUBCARRIER MOD TYPE                    | -  | (1)                         |                |
| SUBCARRIER/BIT RATE LIMIT              | -  | (1)                         |                |
| BIT RATE RANGE                         | b/s  | (1)                         |                |
| FORMATS AVAILABLE                      | -  | (1)                         |                |
|  |  |                             |                |
|  |  |                             |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE | 2. SOME LIMITATIONS APPLY TO THIS CAPABILITY | 3. NOT RECOMMENDED BY CCSDS |                |

6445-5016

**CCSDS HISTORICAL DOCUMENT**  
**CSIR TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION   |   |
|-----------------------------|--------------|---|---|
|                             |              | BREDASDORP  | HARTEBEESTHOEK  |
| <b>GENERAL</b>              |              |   |   |
| STATION DESIGNATION         | -            | SGS OTB   | Hartebeesthoek  |
| LOCATION(S)                 | -            | South Africa  | South Africa  |
| DIAMETER                    | m            | 10  | 10  |
| <b>RECEIVE</b>              |              |   |   |
| FREQUENCIES                 | MHz          | 2200 - 2300, 7950 - 8550  | 1650 - 1750   2200 - 2300                                 |
| FREQUENCY RESOLUTION        | Hz           | 100 000   | 50 000   50 000   |
| ANTENNA GAIN @ 45 deg       | dBi          | 43.2 @ S-BAND, 55.5 @ X-BAND  | 42.5   44.5   |
| SYS NOISE TEMP @ ZENITH     | K            | 245   | 245   (1)   |
| G/T @ 45 deg                | dB           | 19.9@ S-BAND, 32.4 @ X-BAND   | 17.5   20.5   |
| POLARIZATION                | -            | RCP / LCP Simultaneous  | RCP or LCP Simultaneous                                   |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.9 @ S-BAND, 0.26 @ X-BAND   | 1   |
| ANTENNA ELLIPTICITY         | dB           | 1.5   | 1.5   |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $5 \times 10^{-7}$  | $5 \times 10^{-7}$  |
| RCVR AGC DYNAMIC RANGE      | dB           | 80  | 80  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -146 in 2 Blo = 30 Hz   | -146 in 2 Blo = 30 Hz                                     |
| RCVR C/N @ 2 Blo Hz BW      | -            | $\geq 15$ for 2 Blo $\geq 3$ kHz and $\geq 18$ for 2 Blo $\leq 1$ kHz | 30, 100, 300, 1 K, 10 K, 100 K                            |
| RCVR LOOP BANDWIDTHS        | Hz           | 30, 100, 300, 1 K, 10 K, 100 K  | Adaptive  |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | X-Tal, VCO, VCXO  | 2   |
| RCVR PLL ORDER(S)           | No.          | 2   | $\pm 5, \pm 50, \pm 250$                                  |
| ACQ SWEEP RANGE             | kHz          | $\pm 5, \pm 50, \pm 250$  | 1000  |
| MIN ACQ SWEEP RATE          | Hz/s         | 1000  | 100   |
| MAX ACQ SWEEP RATE          | kHz/s        | 100   | 1   |
| ACQ SWEEP STEP SIZE         | Hz           | 1000  | Yes   |
| PROGRAMMED L.O.             | Yes/No       | Yes   |   |
|                             |              |   |   |
|                             |              |   |   |
|                             |              |   |   |
| <b>TELEMETRY</b>            |              |   |   |
| MODULATION TYPE(S)          | -            | PCM / FM, PCM / BPSK, PCM / PM  | PCM / PM, PCM / PSK / PM                                  |
| MODULATION FORMAT(S)        | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S; DM-M / S, M <sup>2</sup> -M / S | NRZ - L, M, S; Bi - $\phi$ - L, M, S; DBi - $\phi$ - M, S |
| MOD INDEX RANGE             | Rad Pk       | 0.1 - 2   | 0.1 - 2   |
| SUBCARRIER FREQ RANGE       | kHz          | (1)   | 0.1 - 500   |
| SUBCARRIER WAVEFORM         | Sin/Sq       | (1)   | Sine or Square  |
| SYMBOL RATE RANGE           | s/s          | (1)   | 8 - 50 000  |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)   | $\leq 1024$   |
| ARRAYS WITH STATIONS        | -            | (1)   | None  |
| CHANNEL DECODING            | Type         | (1)   | None  |
| DATA FORMAT                 | -            | (1)   | Nascom Blocks   |
|                             |              |   |   |
|                             |              |   |   |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

**CCSDS HISTORICAL DOCUMENT**  
**CSIR TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION    |   |
|--|--------------|--------------------------|---|
|  |              | BREDASDORP               | HARTEBEESTHOEK                                  |
| <b>GENERAL</b>   |              |                          |   |
| STATION DESIGNATION  | -            | SGS OTB                  | Hartebeesthoek                                  |
| LOCATION(S)  | -            | South Africa             | South Africa                                    |
| DIAMETER   | m            | 10                       | 10  |
| <b>FREQUENCIES</b>   |              |                          |   |
| TRANSMIT FREQUENCIES   | MHz          | 2025 - 2120              | None  |
| RECEIVE FREQUENCIES  | MHz          | 2200 - 2300, 7950 - 8550 | 1650 - 1750, 2200 - 2300, 8000 - 8400           |
| TURNAROUND FREQ RATIO  | -            | 210 / 230                | 221 / 240                                       |
| <b>DOPPLER</b>   |              |                          |   |
| COHERENT/NON-COHERENT  | -            | Non - Coherent           | CNES Equipment<br>Either                        |
| COUNTER RESOLUTION   | Cycles       | 0.1                      | 0.1   |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 150                    | ± 0.15  |
| DOPPLER BIAS FREQ  | MHz          | 625                      | 60  |
| DRIFT  | $\Delta f/f$ | (1)                      | $5 \times 10^{-11}$                             |
| OUTPUT EQUATION  | -            | (1)                      | Bias Freq + (240 / 221) ( $f_{up}$ ) (-2 v / c) |
| DIRECTION INDICATOR  | -            | (1)                      | + $\Delta f = -\Delta r$                        |
|  |              |                          |   |
|  |              |                          |   |
|  |              |                          |   |
| <b>RANGING</b>   |              |                          |   |
| COHERENT/NON-COHERENT  | -            | (1)                      | CNES Equipment<br>Either                        |
| RANGE CODE WAVEFORM  | Sin/Sq       | (1)                      | Sine  |
| EARTH STATION MOD INDEX  | Rad Pk       | (1)                      | Major ≤ 1.5; Minor ≤ 1                          |
| RANGE CODE FREQ RATIO  | -            | (1)                      | 5:1; 4:1  |
| MAJOR CODE FREQ(S)   | kHz          | (1)                      | 100   |
| MINOR CODE FREQ(S)   | kHz          | (1)                      | 20, 16 (0.8, 0.16, 0.032, 0.0008 on 16 kHz)     |
| MIN RECEIVED CARRIER SNR   | dB           | (1)                      | -20 @ IF BW = 500 kHz                           |
| MIN REQ CODE PWR/No  | dB-Hz        | (1)                      | Major ≥ 25; Minor ≥ 20                          |
| CODE INTEGRATION TIME  | s            | (1)                      | 0.5 - 5   |
| ACQUISITION SEQUENCE   | -            | (1)                      | Sequential, Major Tone First                    |
| RANGE DATA UNITS   | -            | (1)                      | Nanoseconds                                     |
| RANGE QUANTIZATION   | -            | (1)                      | 2 ns  |
| ACCURACY (STRONG SIGNAL)   | m            | (1)                      | 15  |
| MAX UNAMBIGUOUS RANGE  | km           | (1)                      | 18 750  |
| TRANSPONDER BW   | MHz          | (1)                      | ≥ 0.3   |
|  |              |                          |   |
|  |              |                          |   |
|  |              |                          |   |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |                          |   |

6445-5018

**CSIR TRACKING SYSTEM**

FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS   | UNITS         | SUBNETWORK OR STATION       |                            |   |                        |
|---|---------------|-----------------------------|----------------------------|---|------------------------|
|   |               | BREDASDORP                  |                            | HARTEBEESTHOEK  |                        |
| <b>GENERAL</b>  |               |                             |                            |   |                        |
| STATION DESIGNATION   | -             | SGS OTB                     |                            | Hartebeesthoek  |                        |
| LOCATION(S)   | -             | South Africa                |                            | South Africa  |                        |
| DIAMETER  | m             | 10                          |                            | 10  |                        |
| <b>FREQUENCY STD</b>  |               |                             |                            |   |                        |
| STANDARD TYPE   | Name          | X-Tal VCO                   |                            | Rubidium Oscillator   |                        |
| STANDARD MFG  | Name          | TRAK Model FE-1050A         |                            | Hewlett Packard Model 5065A   |                        |
| STABILITY AT:   |               | <b>Allan Variance</b>       | <b>Drift</b>               | <b>Allan Variance</b>   | <b>Drift</b>           |
| 1 - SECOND  | $\Delta f/f$  | (1)                         | <5 Parts per $10^{10}$ (5) |   |                        |
| 1 - HOUR  | $\Delta f/f$  | (1)                         | (1)                        |   |                        |
| 1 - DAY (24 HOURS)  | $\Delta f/f$  | (1)                         | (1)                        |   |                        |
| 1 - MONTH   | $\Delta f/f$  | (1)                         | (1)                        |   |                        |
| REF FREQS PHASE NOISE   | $S_{\phi}(f)$ |                             |                            |   |                        |
| 1 Hz OFFSET   | dBc/Hz        | <b>5 MHz</b>                | <b>100 MHz</b>             | <b>5 MHz</b>  | <b>100 MHz</b>         |
| 10 Hz OFFSET  | dBc/Hz        | (1)                         | (1)                        | (1)   | $1 \times 10^{-11}$    |
| 100 Hz OFFSET   | dBc/Hz        | -130                        | (1)                        | (1)   | $2.8 \times 10^{-11}$  |
| 1000 Hz OFFSET  | dBc/Hz        | -140                        | (1)                        | (1)   | $2.63 \times 10^{-11}$ |
| REF FREQS AVAILABLE   | MHz           | -160                        | (1)                        | (1)   | $3 \times 10^{-12}$    |
| MAX STA-TO-STA OFFSET   | Hz            | 0.1, 1, 5, 10<br>(1)        |                            | 0.1, 1, 5, 10<br>$1 \times 10^{-4}$ @ 5 MHz With Other<br>CNES 2 GHz Stations |                        |
| <b>TIMING SYSTEM</b>  |               |                             |                            |   |                        |
| MASTER REFERENCE AGENCY   | Name          | CSIR GPS                    |                            | USNO  |                        |
| REFERENCE TIME  | Name          | UTC                         |                            | UTC   |                        |
| TIME CODE EPOCH   | Yr            | 1958                        |                            | 1958  |                        |
| TIME CODES AVAILABLE  | CCSDS Codes   | IRIG-B                      |                            | NASA - 36, IRIG - A & B   |                        |
| MAX TIME RESOLUTION   | s             | 0.001                       |                            | 0.001   |                        |
| TIME TRANSFER METHOD  | Name          | GPS                         |                            | GPS   |                        |
| MAX TRANS ERROR REF   | $\mu$ -sec    | 2.5                         |                            | 2.5   |                        |
| MAX OFFSET FROM REF   | $\mu$ -sec    | $\pm 25$                    |                            | $\pm 25$  |                        |
| MAX OFFSET MEAS ERROR   | $\mu$ -sec    | 2.5                         |                            | 2.5   |                        |
| MAX STA-TO-STA OFFSET   | $\mu$ -sec    | (1)                         |                            | 100 With Other CNES 2 GHz Stations  |                        |
| TIMING SIGNALS AVAILABLE  | pulse/s       | $1 \times 10^{-3}$ to 1 ppm |                            | from $1 \times 10^{-3}$ to 100 days   |                        |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> <p>4. MEASURED BY THE AGENCY      5. 0 - 50 deg<sup>c</sup>      6445-5019</p> |               |                             |                            |   |                        |

CCSDS HISTORICAL DOCUMENT  
**CSIR TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS                  | UNITS              | SUBNETWORK OR STATION      |                                |
|----------------------------------|--------------------|----------------------------|--------------------------------|
|                                  |                    | BREDASDORP                 | HARTEBEESTHOEK                 |
| <b>GENERAL</b>                   |                    |                            |                                |
| STATION DESIGNATION              | -                  | SGS OTB                    | Hartebeesthoek                 |
| LOCATION(S)                      | -                  | South Africa               | South Africa                   |
| DIAMETER                         | m                  | 10                         | 10                             |
| <b>GEOGRAPHICAL</b>              |                    |                            |                                |
| LOCATION, COUNTRY/STATE          | Name               | South Africa               | South Africa                   |
| LOCATION, CITY                   | Name               | BREDASDORP                 | Hartebeesthoek                 |
| LONGITUDE (site 1/site 2/site 3) | d, m, s            | 20, 13, 36 E               | 27, 42, 25.13 E                |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 34, 36, 57 S               | 25, 53, 10.98 S                |
|                                  |                    |                            |                                |
|                                  |                    |                            |                                |
|                                  |                    |                            |                                |
|                                  |                    |                            |                                |
| <b>MECHANICAL</b>                |                    |                            |                                |
| TYPE OF MOUNT                    | -                  | Az / El 3.5 deg 3rd Axis   | Az, El; 7 deg Z - Axis         |
| AZIMUTH LIMITATIONS              | -                  | None                       | None                           |
| TRACKING SPEED RANGE             | deg/s              | ≥ 15                       | Az: 15; El: 5                  |
| MAX TRACK ACCELERATION           | deg/s <sup>2</sup> | ≥ 20                       | 10                             |
| TYPE OF POINTING                 | Type               | Manual, Autotrack, Predict | Autotrack, Predict, Manual     |
| POINTING ACCURACY                | deg                | 0.005                      | 0.01                           |
| MIN TRANSMIT ELEV ANGLE          | deg                | 3.0                        | None                           |
| MIN RECEIVE ELEV ANGLE           | deg                | None                       | 0.1 - 2                        |
|                                  |                    |                            |                                |
|                                  |                    |                            |                                |
|                                  |                    |                            |                                |
|                                  |                    |                            |                                |
|                                  |                    |                            |                                |
| <b>SUPPORT</b>                   |                    |                            |                                |
| TRANSMIT FREQ BAND(S)            | GHz                | 2.025 - 2.12               | None                           |
| RECEIVE FREQ BAND(S)             | GHz                | 2.2 - 2.3, 7.95 - 8.55     | 1.65 - 1.75, 2.2 - 2.3, 8, 8.4 |
| ACQ AID FREQ BAND(S)             | GHz                | (1)                        | None                           |
| MISSION CATEGORIES               | Cat                | A                          | A                              |
|                                  |                    |                            |                                |
|                                  |                    |                            |                                |
|                                  |                    |                            |                                |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS  
 4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES

CCSDS HISTORICAL DOCUMENT  
**CSIR TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |  |
|---|--------------|-----------------------|--|
|   |              | HARTEBEESTHOEK        |  |
| <b>GENERAL</b>  |              |                       |  |
| STATION DESIGNATION   | -            | HBK (Hartebeesthoek)  |  |
| LOCATION(S)   | -            | South Africa          |  |
| DIAMETER  | m            | 12                    |  |
| <b>TRANSMIT</b>   |              | None                  |  |
| FREQUENCIES   | MHz          |                       |  |
| FREQUENCY RESOLUTION  | Hz           |                       |  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ |                       |  |
| TRANSMIT POWER 1  | W            |                       |  |
| EIRP RANGE 1  | dBW          |                       |  |
| TRANSMIT POWER 2  | W            |                       |  |
| EIRP RANGE 2  | dBW          |                       |  |
| POLARIZATION  | -            |                       |  |
| ANTENNA GAIN  | dBi          |                       |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          |                       |  |
| ANTENNA ELLIPTICITY   | dB           |                       |  |
| RF FREQ SWEEP RANGE   | kHz          |                       |  |
| MIN FREQ SWEEP RATE   | Hz/s         |                       |  |
| MAX FREQ SWEEP RATE   | kHz/s        |                       |  |
| PROGRAMMED UPLINK FREQ  | Yes/No       |                       |  |
|   |              |                       |  |
|   |              |                       |  |
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|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
| <b>COMMAND</b>  |              | None                  |  |
| RF CARRIER MOD TYPE   | -            |                       |  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       |                       |  |
| SUBCARRIER FREQUENCY(S)   | Hz           |                       |  |
| SUBCARRIER STEP SIZE  | Hz           |                       |  |
| SUBCARRIER FREQ STABILITY   | ppm          |                       |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                       |  |
| SUBCARRIER MOD TYPE   | -            |                       |  |
| SUBCARRIER/BIT RATE LIMIT   | -            |                       |  |
| BIT RATE RANGE  | b/s          |                       |  |
| FORMATS AVAILABLE   | -            |                       |  |
|   |              |                       |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE                      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY                      3. NOT RECOMMENDED BY CCSDS |              |                       |  |
| 6445-4002   |              |                       |  |

CCSDS HISTORICAL DOCUMENT  
**CSIR TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION   |             |
|-----------------------------|--------------|---|-------------|
|                             |              | HARTEBEESTHOEK  |             |
| <b>GENERAL</b>              |              |   |             |
| STATION DESIGNATION         | -            | HBK (Hartebeesthoek)  |             |
| LOCATION(S)                 | -            | South Africa  |             |
| DIAMETER                    | m            | 12  |             |
| <b>RECEIVE</b>              |              |   |             |
| FREQUENCIES                 | MHz          | 1650 - 1750   | 2200 - 2300 |
| FREQUENCY RESOLUTION        | Hz           | 50 000  | (1)         |
| ANTENNA GAIN @ 45 deg       | dBi          | 46.1  | (1)         |
| SYS NOISE TEMP @ ZENITH     | K            | 245   | (1)         |
| G/T @ 45 deg                | dB           | 22.1  | (1)         |
| POLARIZATION                | -            | RCP / LCP Simultaneous  |             |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.75  |             |
| ANTENNA ELLIPTICITY         | dB           | 1.5   |             |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $5 \times 10^{-7}$  |             |
| RCVR AGC DYNAMIC RANGE      | dB           | 80  |             |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -146 in 2 Blo = 30 Hz   |             |
| RCVR LOOP BANDWIDTHS        | Hz           | 30, 100, 300, 1 K, 10 K, 100 K  |             |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt   |             |
| RCVR PLL ORDER(S)           | No.          | 2   |             |
| ACQ SWEEP RANGE             | kHz          | $\pm 5, \pm 50, \pm 250$  |             |
| MIN ACQ SWEEP RATE          | Hz/s         | 1000  |             |
| MAX ACQ SWEEP RATE          | kHz/s        | 100   |             |
| ACQ SWEEP STEP SIZE         | Hz           | 1   |             |
| PROGRAMMED L.O.             | Yes/No       | Yes   |             |
|                             |              |   |             |
|                             |              |   |             |
|                             |              |   |             |
|                             |              |   |             |
| <b>TELEMETRY</b>            |              |   |             |
| MODULATION TYPE(S)          | -            | PCM / PM; FM / FM; PCM / FM; PM - Analog                                |             |
| MODULATION FORMAT(S)        | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S; DM - M, S; DBi - $\phi$ - L, M, S |             |
| MOD INDEX RANGE             | Rad Pk       | 0.1 - 2   |             |
| SUBCARRIER FREQ RANGE       | kHz          | 0.1 - 500   |             |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine or Square  |             |
| SYMBOL RATE RANGE           | s/s          | None  |             |
| SUBCARRIER/SYM RATE LIMIT   | -            | None  |             |
| ARRAYS WITH STATIONS        | -            |   |             |
| CHANNEL DECODING            | Type         | None  |             |
| DATA FORMAT                 | -            | None  |             |
|                             |              |   |             |
|                             |              |   |             |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-4003

**CCSDS HISTORICAL DOCUMENT**  
**CSIR TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION                           |  |
|--|--------------|---|--|
|  |              | Hartebeesthoek                                  |  |
| <b>GENERAL</b>   |              |   |  |
| STATION DESIGNATION  | -            | HBK (Hartebeesthoek)                            |  |
| LOCATION(S)  | -            | South Africa                                    |  |
| DIAMETER   | m            | 12  |  |
| <b>FREQUENCIES</b>   |              |   |  |
| TRANSMIT FREQUENCIES   | MHz          | None  |  |
| RECEIVE FREQUENCIES  | MHz          | 1650 - 1750, 2200 - 2300                        |  |
| TURNAROUND FREQ RATIO  | -            | 221 / 240                                       |  |
| <b>DOPPLER</b>   |              |   |  |
|  |              | CNES Equipment                                  |  |
| COHERENT/NON-COHERENT  | -            | Either  |  |
| COUNTER RESOLUTION   | Cycles       | 0.1   |  |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 0.15  |  |
| DOPPLER BIAS FREQ  | MHz          | 60  |  |
| DRIFT  | $\Delta f/f$ | $5 \times 10^{-11}$                             |  |
| OUTPUT EQUATION  | -            | Bias freq + (240 / 221) ( $f_{up}$ ) (-2 v / c) |  |
| DIRECTION INDICATOR  | -            | + $\Delta f = -\Delta r$                        |  |
| <b>RANGING</b>   |              |   |  |
|  |              | CNES Equipment                                  |  |
| COHERENT/NON-COHERENT  | -            | Either  |  |
| RANGE CODE WAVEFORM  | Sin/Sq       | Sine  |  |
| EARTH STATION MOD INDEX  | Rad Pk       | Major ≤ 1.5; Minor ≤ 1                          |  |
| RANGE CODE FREQ RATIO  | -            | 5:1; 4:1  |  |
| MAJOR CODE FREQ(S)   | kHz          | 100   |  |
| MINOR CODE FREQ(S)   | kHz          | 20, 16 (0.8, 0.16, 0.032, 0.008 on 16 kHz)      |  |
| MIN RECEIVED CARRIER SNR   | dB           | -20 @ IF BW = 500 kHz                           |  |
| MIN REQ CODE PWR/No  | dB-Hz        | Major ≥ 25; Minor ≥ 20                          |  |
| CODE INTEGRATION TIME  | s            | 0.5 - 5   |  |
| ACQUISITION SEQUENCE   | -            | Sequential, Major Tone First                    |  |
| RANGE DATA UNITS   | -            | Nanoseconds                                     |  |
| RANGE QUANTIZATION   | -            | 2 ns  |  |
| ACCURACY (STRONG SIGNAL)   | m            | 15  |  |
| MAX UNAMBIGUOUS RANGE  | km           | 18 750  |  |
| TRANSPONDER BW   | MHz          | ≥ 0.3   |  |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |   |  |

6445-4004

**CCSDS HISTORICAL DOCUMENT**  
**CSIR TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION  |                       |                       |                |
|--|---------------|--|-----------------------|-----------------------|----------------|
|  |               | HARTEBEESTHOEK   |                       |                       |                |
| <b>GENERAL</b>   |               |  |                       |                       |                |
| STATION DESIGNATION  | -             | HBK (Hartebeesthoek)   |                       |                       |                |
| LOCATION(S)  | -             | South Africa   |                       |                       |                |
| DIAMETER   | m             | 12   |                       |                       |                |
| <b>FREQUENCY STD</b>   |               |  |                       |                       |                |
| STANDARD TYPE  | Name          | Rubidium Oscillator (Backup Unit)                            |                       |                       |                |
| STANDARD MFG   | Name          | Rhode and Scharz, Model XSRM                                 |                       |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b>  | <b>Drift</b>          | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | (1)  | $1 \times 10^{-11}$   |                       |                |
| 1 - HOUR   | $\Delta f/f$  | (1)  | $3.2 \times 10^{-11}$ |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)  | $5 \times 10^{-11}$   |                       |                |
| 1 - MONTH  | $\Delta f/f$  | (1)  | $3 \times 10^{-12}$   |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>   | <b>100 MHz</b>        | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)  | (1)                   |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | (1)  | (1)                   |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | (1)  | (1)                   |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | (1)  | (1)                   |                       |                |
| REF FREQS AVAILABLE  | MHz           | 0.1, 1, 5, 10  |                       |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | $1 \times 10^{-4}$ @ 5 MHz With Other<br>CNES 2 GHz Stations |                       |                       |                |
|  |               |  |                       |                       |                |
|  |               |  |                       |                       |                |
|  |               |  |                       |                       |                |
| <b>TIMING SYSTEM</b>   |               |  |                       |                       |                |
| MASTER REFERENCE AGENCY  | Name          | USNO   |                       |                       |                |
| REFERENCE TIME   | Name          | UTC  |                       |                       |                |
| TIME CODE EPOCH  | Yr            | 1958   |                       |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | NASA - 36, IRIG - A & B                                      |                       |                       |                |
| MAX TIME RESOLUTION  | s             | 0.001  |                       |                       |                |
| TIME TRANSFER METHOD   | Name          | GPS  |                       |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 2.5  |                       |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 25$   |                       |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 2.5  |                       |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 100 With Other CNES 2 GHz Stations                           |                       |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | from $1 \times 10^{-3}$ to 100 days                          |                       |                       |                |
|  |               |  |                       |                       |                |
|  |               |  |                       |                       |                |
|  |               |  |                       |                       |                |
|  |               |  |                       |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |  |                       |                       |                |

6445-4005

CCSDS HISTORICAL DOCUMENT  
**CSIR TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION       |  |
|---|--------------------|-----------------------------|--|
|   |                    | HARTEBEESTHOEK              |  |
| <b>GENERAL</b>  |                    |                             |  |
| STATION DESIGNATION   | -                  | HBK (Hartebeesthoek)        |  |
| LOCATION(S)   | -                  | South Africa                |  |
| DIAMETER  | m                  | 12                          |  |
| <b>GEOGRAPHICAL</b>   |                    |                             |  |
| LOCATION, COUNTRY/STATE   | Name               | South Africa                |  |
| LOCATION, CITY  | Name               | Hartebeesthoek              |  |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 27, 42, 27.93 E             |  |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 25, 53, 9.16 S              |  |
|   |                    |                             |  |
|   |                    |                             |  |
|   |                    |                             |  |
|   |                    |                             |  |
| <b>MECHANICAL</b>   |                    |                             |  |
| TYPE OF MOUNT   | -                  | X, Y                        |  |
| AZIMUTH LIMITATIONS   | -                  | 8 deg North and South       |  |
| TRACKING SPEED RANGE  | deg/s              | 10                          |  |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 5                           |  |
| TYPE OF POINTING  | Type               | Autotrack, Predicts, Manual |  |
| POINTING ACCURACY   | deg                | 0.01                        |  |
| MIN TRANSMIT ELEV ANGLE   | deg                | None                        |  |
| MIN RECEIVE ELEV ANGLE  | deg                | 1.5 - 8                     |  |
|   |                    |                             |  |
|   |                    |                             |  |
|   |                    |                             |  |
|   |                    |                             |  |
|   |                    |                             |  |
| <b>SUPPORT</b>  |                    |                             |  |
| TRANSMIT FREQ BAND(S)   | GHz                | None                        |  |
| RECEIVE FREQ BAND(S)  | GHz                | 1.65 - 1.75, 2.2 - 2.3      |  |
| ACQ AID FREQ BAND(S)  | GHz                | 2.2 - 2.3                   |  |
| MISSION CATEGORIES  | Cat                | A                           |  |
|   |                    |                             |  |
|   |                    |                             |  |
|   |                    |                             |  |
|   |                    |                             |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                             |  |

6445-4006



CCSDS HISTORICAL DOCUMENT  
**CSIRO TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS  | UNITS      | SUBNETWORK OR STATION     |  |
|--|------------|---------------------------|--|
|  |            | PARKES                    |  |
| <b>GENERAL</b>   |            |                           |  |
| STATION DESIGNATION  | -          | DSS 49                    |  |
| LOCATION(S)  | -          | Parkes, Australia, N.S.W. |  |
| DIAMETER   | m          | 64                        |  |
| <b>RECEIVE</b>   |            |                           |  |
|  |            | Open-Loop Downconverter   |  |
| FREQUENCIES  | MHz        | 2.29 - 2.3                |  |
| FREQUENCY RESOLUTION   | Hz         | (4)                       |  |
| ANTENNA GAIN @ 45 deg  | dBi        | 61.7                      |  |
| SYS NOISE TEMP @ ZENITH  | K          | 18                        |  |
| G/T @ 45 deg   | dB         | 49                        |  |
| POLARIZATION   | -          | RCP or LCP                |  |
| ANTENNA BEAMWIDTH (-3 dB)  | deg        | 0.12                      |  |
| ANTENNA ELLIPTICITY  | dB         | 1                         |  |
| L.O. REF FREQ STAB @ 1 Hr  | $\Delta/f$ | $1 \times 10^{-11}$       |  |
| RCVR AGC DYNAMIC RANGE   | dB         | > 100                     |  |
| RCVR THRESHOLD @ 2 Blo Hz  | dBm        | (4)                       |  |
| RCVR LOOP BANDWIDTHS   | Hz         | (4)                       |  |
| RCVR LOOP TYPE (ADAPT, FIX)  | -          | (4)                       |  |
| RCVR PLL ORDER(S)  | No.        | (4)                       |  |
| ACQ SWEEP RANGE  | kHz        | (4)                       |  |
| MIN ACQ SWEEP RATE   | Hz/s       | (4)                       |  |
| MAX ACQ SWEEP RATE   | kHz/s      | (4)                       |  |
| ACQ SWEEP STEP SIZE  | Hz         | (4)                       |  |
| PROGRAMMED L.O.  | Yes/No     | (4)                       |  |
|  |            |                           |  |
|  |            |                           |  |
|  |            |                           |  |
|  |            |                           |  |
| <b>TELEMETRY</b>   |            |                           |  |
|  |            | None                      |  |
| MODULATION TYPE(S)   | -          |                           |  |
| MODULATION FORMAT(S)   | -          |                           |  |
| MOD INDEX RANGE  | Rad Pk     |                           |  |
| SUBCARRIER FREQ RANGE  | kHz        |                           |  |
| SUBCARRIER WAVEFORM  | Sin/Sq     |                           |  |
| SYMBOL RATE RANGE  | s/s        |                           |  |
| SUBCARRIER/SYM RATE LIMIT  | -          |                           |  |
| ARRAYS WITH STATIONS   | -          |                           |  |
| CHANNEL DECODING   | Type       |                           |  |
| DATA FORMAT  | -          |                           |  |
|  |            |                           |  |
|  |            |                           |  |
|  |            |                           |  |
|  |            |                           |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. OLR (LNA-DOWNCONVERTER) OTHER EQUIPMENT SUPPLIED BY USER |            |                           |  |

6445-4487

CCSDS HISTORICAL DOCUMENT  
**CSIRO TRACKING SYSTEM**  
RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION     |  |
|---|--------------|---------------------------|--|
|   |              | PARKES                    |  |
| <b>GENERAL</b>  |              |                           |  |
| STATION DESIGNATION   | -            | DSS 49                    |  |
| LOCATION(S)   | -            | Parkes, Australia, N.S.W. |  |
| DIAMETER  | m            | 64                        |  |
| <b>FREQUENCIES</b>  |              |                           |  |
| TRANSMIT FREQUENCIES  | MHz          | None                      |  |
| RECEIVE FREQUENCIES   | MHz          | 2290 - 2300               |  |
| TURNAROUND FREQ RATIO   | -            | None                      |  |
| <b>DOPPLER</b>  |              |                           |  |
| COHERENT/NON-COHERENT   | -            | None                      |  |
| COUNTER RESOLUTION  | Cycles       |                           |  |
| MAX DOPPLER FREQ SHIFT  | MHz          |                           |  |
| DOPPLER BIAS FREQ   | MHz          |                           |  |
| DRIFT   | $\Delta f/f$ |                           |  |
| OUTPUT EQUATION   | -            |                           |  |
| DIRECTION INDICATOR   | -            |                           |  |
|   |              |                           |  |
|   |              |                           |  |
|   |              |                           |  |
| <b>RANGING</b>  |              |                           |  |
| COHERENT/NON-COHERENT   | -            | None                      |  |
| RANGE CODE WAVEFORM   | Sin/Sq       |                           |  |
| EARTH STATION MOD INDEX   | Rad Pk       |                           |  |
| RANGE CODE FREQ RATIO   | -            |                           |  |
| MAJOR CODE FREQ(S)  | kHz          |                           |  |
| MINOR CODE FREQ(S)  | kHz          |                           |  |
| MIN RECEIVED CARRIER SNR  | dB           |                           |  |
| MIN REQ CODE PWR/No   | dB-Hz        |                           |  |
| CODE INTEGRATION TIME   | s            |                           |  |
| ACQUISITION SEQUENCE  | -            |                           |  |
| RANGE DATA UNITS  | -            |                           |  |
| RANGE QUANTIZATION  | -            |                           |  |
| ACCURACY (STRONG SIGNAL)  | m            |                           |  |
| MAX UNAMBIGUOUS RANGE   | km           |                           |  |
| TRANSPONDER BW  | MHz          |                           |  |
|   |              |                           |  |
|   |              |                           |  |
|   |              |                           |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                           |  |

6445-4488

**CCSDS HISTORICAL DOCUMENT**  
**CSIRO TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION               |                |                       |                |
|--|---------------|-------------------------------------|----------------|-----------------------|----------------|
|  |               | PARKES                              |                |                       |                |
| <b>GENERAL</b>   |               |                                     |                |                       |                |
| STATION DESIGNATION  | -             | DSS 49                              |                |                       |                |
| LOCATION(S)  | -             | Parkes, Australia, N.S.W.           |                |                       |                |
| DIAMETER   | m             | 64                                  |                |                       |                |
| <b>FREQUENCY STD</b>   |               |                                     |                |                       |                |
| STANDARD TYPE  | Name          | Hydrogen Maser                      |                |                       |                |
| STANDARD MFG   | Name          | SAO VLG-11 / VLG 10                 |                |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b>               | <b>Drift</b>   | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $2 \times 10^{-13}$                 | (1)            |                       |                |
| 1 - HOUR   | $\Delta f/f$  | $1.5 \times 10^{-15}$               | (1)            |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | $5 \times 10^{-15}$                 | (1)            |                       |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                                 | (1)            |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>                        | <b>100 MHz</b> | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | -111.9                              | -84.8          |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | -114.7                              | -90.7          |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | -116.1                              | -88.7          |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | -138.7                              | -112.1         |                       |                |
| REF FREQS AVAILABLE  | MHz           | 10                                  |                |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | $9 \times 10^{-13}$                 |                |                       |                |
|  |               |                                     |                |                       |                |
|  |               |                                     |                |                       |                |
|  |               |                                     |                |                       |                |
|  |               |                                     |                |                       |                |
| <b>TIMING SYSTEM</b>   |               |                                     |                |                       |                |
| MASTER REFERENCE AGENCY  | Name          | NIST                                |                |                       |                |
| REFERENCE TIME   | Name          | UTL                                 |                |                       |                |
| TIME CODE EPOCH  | Yr            | 1 January 1958                      |                |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | ASCII Serial 42-bit BCD, 36-bit Bin |                |                       |                |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-3}$                  |                |                       |                |
| TIME TRANSFER METHOD   | Name          | GPS                                 |                |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 20$                            |                |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 20$                            |                |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 0.1$                           |                |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 10                                  |                |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 100, 1 K                     |                |                       |                |
|  |               |                                     |                |                       |                |
|  |               |                                     |                |                       |                |
|  |               |                                     |                |                       |                |
|  |               |                                     |                |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                                     |                |                       |                |

6445-4489



**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
**EARTH-TO-SPACE LINK CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |                        |
|---|--------------|-----------------------|------------------------|
|   |              | OBERPFAFFENHOFEN      | NEUSTRELITZ            |
| <b>GENERAL</b>  |              |                       |                        |
| STATION DESIGNATION   | -            | DFD - AVHHR           | S/X Band Groundstation |
| LOCATION(S)   | -            | Oberpfaffenhofen      | Neustrelitz, Germany   |
| DIAMETER  | m            | 2.4                   | 7.3                    |
| <b>TRANSMIT</b>   |              |                       |                        |
|   |              | None                  | No Transmitter         |
| FREQUENCIES   | MHz          |                       |                        |
| FREQUENCY RESOLUTION  | Hz           |                       |                        |
| RF FREQ STABILITY @ 1 HR  | $\Delta f/f$ |                       |                        |
| TRANSMIT POWER 1  | W            |                       |                        |
| EIRP RANGE 1  | dBW          |                       |                        |
| TRANSMIT POWER 2  | W            |                       |                        |
| EIRP RANGE 2  | dBW          |                       |                        |
| POLARIZATION  | -            |                       |                        |
| ANTENNA GAIN  | dBi          |                       |                        |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          |                       |                        |
| ANTENNA ELLIPTICITY   | dB           |                       |                        |
| RF FREQ SWEEP RANGE   | kHz          |                       |                        |
| MIN FREQ SWEEP RATE   | Hz/s         |                       |                        |
| MAX FREQ SWEEP RATE   | kHz/s        |                       |                        |
| PROGRAMMED UPLINK FREQ  | Yes/No       |                       |                        |
|   |              |                       |                        |
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|   |              |                       |                        |
| <b>COMMAND</b>  |              |                       |                        |
|   |              | None                  | No Command             |
| RF CARRIER MOD TYPE   | -            |                       |                        |
| RF CARRIER MOD INDEX RNG  | Rad Pk       |                       |                        |
| SUBCARRIER FREQUENCY(S)   | Hz           |                       |                        |
| SUBCARRIER STEP SIZE  | Hz           |                       |                        |
| SUBCARRIER FREQ STABILITY   | ppm          |                       |                        |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                       |                        |
| SUBCARRIER MOD TYPE   | -            |                       |                        |
| SUBCARRIER/BIT RATE LIMIT   | -            |                       |                        |
| BIT RATE RANGE  | b/s          |                       |                        |
| FORMATS AVAILABLE   | -            |                       |                        |
|   |              |                       |                        |
|   |              |                       |                        |
|   |              |                       |                        |
|   |              |                       |                        |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE     2. SOME LIMITATIONS APPLY TO THIS CAPABILITY     3. NOT RECOMMENDED BY CCSDS |              |                       |                        |

6445-4476

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION        |                         |                       |
|--|--------------|------------------------------|-------------------------|-----------------------|
|  |              | OBERPFAFFENHOFEN             | NEUSTRELITZ             |                       |
| <b>GENERAL</b>   |              |                              |                         |                       |
| STATION DESIGNATION  | -            | DFD - AVHHR                  | S/X Band Ground Station |                       |
| LOCATION(S)  | -            | Oberpfaffenhofen             | Neustrelitz, Germany    |                       |
| DIAMETER   | m            | 2.4                          | 7.3                     |                       |
| <b>RECEIVE</b>   |              |                              |                         |                       |
| FREQUENCIES  | MHz          | 1650 - 1755 MHz              | 1670 - 1720             | 2200 - 2400           |
| FREQUENCY RESOLUTION   | Hz           | 1000 Hz                      | 100 kHz                 | 100 kHz               |
| ANTENNA GAIN @ 45 deg  | dBi          | 30.2                         | 37 dB                   | 39.8 dB               |
| SYS NOISE TEMP @ ZENITH  | K            | (1)                          | 175 K                   | 170 K                 |
| G/T @ 45 deg   | dB           | (1)                          | 12 dB/K                 | 17 dB/K               |
| POLARIZATION   | -            | RHC                          | RHC, LHC                | RHC, LHC              |
| ANTENNA BEAMWIDTH (-3 dB)  | deg          | 5                            | 1.66                    | 1.26                  |
| ANTENNA ELLIPTICITY  | dB           | (1)                          | (1)                     | (1)                   |
| L.O. REF FREQ STAB @ 1 Hr  | $\Delta f/f$ | (1)                          | 10                      | 10                    |
| RCVR AGC DYNAMIC RANGE   | dB           | (1)                          | Approx 60               | Approx 60             |
| RCVR THRESHOLD @ 2 Blo Hz  | dBm          | (1)                          | -157 in 2 Blo = 3 Hz    | -157 in 2 Blo = 3 Hz  |
| RCVR LOOP BANDWIDTHS   | Hz           | (1)                          | 3 - 3000                | 3 - 3000              |
| RCVR LOOP TYPE (ADAPT, FIX)  | -            | (1)                          | Adapt                   | Adapt                 |
| RCVR PLL ORDER(S)  | No.          | (1)                          | 2                       | 2                     |
| ACQ SWEEP RANGE  | kHz          | (1)                          | $\pm 75$ to $\pm 250$   | $\pm 75$ to $\pm 250$ |
| MIN ACQ SWEEP RATE   | Hz/s         | (1)                          | Approx 1                | Approx 1              |
| MAX ACQ SWEEP RATE   | kHz/s        | (1)                          | Approx 0.1              | Approx 0.1            |
| ACQ SWEEP STEP SIZE  | Hz           | (1)                          | (1)                     | (1)                   |
| PROGRAMMED L.O.  | Yes/No       | (1)                          | Yes                     | Yes                   |
| <b>TELEMETRY</b>   |              |                              |                         |                       |
| MODULATION TYPE(S)   | -            | Specific for NOAA Satellites | PSK, PM, FM, QPSK       |                       |
| MODULATION FORMAT(S)   | -            | (1)                          | NRZ, Bi - $\phi$        |                       |
| MOD INDEX RANGE  | Rad Pk       | (1)                          | (1)                     |                       |
| SUBCARRIER FREQ RANGE  | kHz          | (1)                          | (1)                     |                       |
| SUBCARRIER WAVEFORM  | Sin/Sq       | (1)                          | (1)                     |                       |
| SYMBOL RATE RANGE  | s/s          | (1)                          | Up to 5 Mbps            |                       |
| SUBCARRIER/SYM RATE LIMIT  | -            | (1)                          | (1)                     |                       |
| ARRAYS WITH STATIONS   | -            | None                         | (1)                     |                       |
| CHANNEL CODING   | Type         | (1)                          | (1)                     |                       |
| DATA FORMAT  | -            | (1)                          | (1)                     |                       |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |                              |                         |                       |

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**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |                                       |
|---|--------------|-----------------------|---------------------------------------|
|   |              | OBERPFAFFENHOFEN      | NEUSTRELITZ                           |
| <b>GENERAL</b>  |              |                       |                                       |
| STATION DESIGNATION   | -            | DFD - AVHHR           | S/X Band Groundstation                |
| LOCATION(S)   | -            | Oberpfaffenhofen      | Neustrelitz                           |
| DIAMETER  | m            | 2.4                   | 7.3                                   |
| <b>FREQUENCIES</b>  |              |                       |                                       |
| TRANSMIT FREQUENCIES  | MHz          | None                  | None                                  |
| RECEIVE FREQUENCIES   | MHz          | 1650 - 1755           | 1670 - 1720, 2200 - 2400, 8025 - 8400 |
| TURNAROUND FREQ RATIO   | -            | None                  | None                                  |
| <b>DOPPLER</b>  |              |                       |                                       |
| COHERENT/NON-COHERENT   | -            | None                  | None                                  |
| COUNTER RESOLUTION  | Cycles       |                       |                                       |
| MAX DOPPLER FREQ SHIFT  | MHz          |                       |                                       |
| DOPPLER BIAS FREQ   | MHz          |                       |                                       |
| DRIFT   | $\Delta f/f$ |                       |                                       |
| OUTPUT EQUATION   | -            |                       |                                       |
| DIRECTION INDICATOR   | -            |                       |                                       |
|   |              |                       |                                       |
|   |              |                       |                                       |
|   |              |                       |                                       |
| <b>RANGING</b>  |              |                       |                                       |
| COHERENT/NON-COHERENT   | -            | None                  | None                                  |
| RANGE CODE WAVEFORM   | Sin/Sq       |                       |                                       |
| EARTH STATION MOD INDEX   | Rad Pk       |                       |                                       |
| RANGE CODE FREQ RATIO   | -            |                       |                                       |
| MAJOR CODE FREQ(S)  | kHz          |                       |                                       |
| MINOR CODE FREQ(S)  | kHz          |                       |                                       |
| MIN RECEIVED CARRIER SNR  | dB           |                       |                                       |
| MIN REQ CODE PWR/No   | dB-Hz        |                       |                                       |
| CODE INTEGRATION TIME   | s            |                       |                                       |
| ACQUISITION SEQUENCE  | -            |                       |                                       |
| RANGE DATA UNITS  | -            |                       |                                       |
| RANGE QUANTIZATION  | -            |                       |                                       |
| ACCURACY (STRONG SIGNAL)  | m            |                       |                                       |
| MAX UNAMBIGUOUS RANGE   | km           |                       |                                       |
| TRANSPONDER BW  | MHz          |                       |                                       |
|   |              |                       |                                       |
|   |              |                       |                                       |
|   |              |                       |                                       |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |                                       |

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**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                |                        |                |
|--|---------------|-----------------------|----------------|------------------------|----------------|
|  |               | OBERPFAFFENHOFEN      |                | NEUSTRELITZ            |                |
| <b>GENERAL</b>   |               |                       |                |                        |                |
| STATION DESIGNATION  | -             | DFD-AVHRR             |                | S/X Band Groundstation |                |
| LOCATION(S)  | -             | Oberpfaffenhofen      |                | Neustrelitz, Germany   |                |
| DIAMETER   | m             | 2.4                   |                | 7.3                    |                |
| <b>FREQUENCY STD</b>   |               |                       |                |                        |                |
|  |               | No Frequency Std.     |                | None                   |                |
| STANDARD TYPE  | Name          |                       |                |                        |                |
| STANDARD MFG   | Name          |                       |                |                        |                |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Drift</b>   | <b>Allan Variance</b>  | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  |                       |                |                        |                |
| 1 - HOUR   | $\Delta f/f$  |                       |                |                        |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  |                       |                |                        |                |
| 1 - MONTH  | $\Delta f/f$  |                       |                |                        |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b> | <b>5 MHz</b>           | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        |                       |                |                        |                |
| 10 Hz OFFSET   | dBc/Hz        |                       |                |                        |                |
| 100 Hz OFFSET  | dBc/Hz        |                       |                |                        |                |
| 1000 Hz OFFSET   | dBc/Hz        |                       |                |                        |                |
| REF FREQS AVAILABLE  | MHz           |                       |                |                        |                |
| MAX STA-TO-STA OFFSET  | Hz            |                       |                |                        |                |
|  |               |                       |                |                        |                |
|  |               |                       |                |                        |                |
|  |               |                       |                |                        |                |
| <b>TIMING SYSTEM</b>   |               |                       |                |                        |                |
|  |               | None                  |                |                        |                |
| MASTER REFERENCE AGENCY  | Name          | PTB                   |                |                        |                |
| REFERENCE TIME   | Name          | UTC                   |                |                        |                |
| TIME CODE EPOCH  | Yr            | 1 January 1958        |                |                        |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | (1)                   |                |                        |                |
| MAX TIME RESOLUTION  | s             | 1                     |                |                        |                |
| TIME TRANSFER METHOD   | Name          | DCF 77                |                |                        |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 1                     |                |                        |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | 1                     |                |                        |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | (1)                   |                |                        |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                   |                |                        |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                     |                |                        |                |
|  |               |                       |                |                        |                |
|  |               |                       |                |                        |                |
|  |               |                       |                |                        |                |
|  |               |                       |                |                        |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                |                        |                |

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CCSDS HISTORICAL DOCUMENT  
**DLR TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS                  | UNITS              | SUBNETWORK OR STATION |   |
|----------------------------------|--------------------|-----------------------|---|
|                                  |                    | OBERPFAFFENHOFEN      | NEUSTRELITZ                                       |
| <b>GENERAL</b>                   |                    |                       |   |
| STATION DESIGNATION              | -                  | DFD-AVHHR             | S/X Band Groundstation                            |
| LOCATION(S)                      | -                  | Oberpfaffenhofen      | Neustrelitz, Germany                              |
| DIAMETER                         | m                  | 2.4                   | 7.3   |
| <b>GEOGRAPHICAL</b>              |                    |                       |   |
| LOCATION, COUNTRY/STATE          | Name               | Germany               | Germany   |
| LOCATION, CITY                   | Name               | Oberpfaffenhofen      | Neustrelitz                                       |
| LONGITUDE (site 1/site 2/site 3) | d, m, s            | 11, 18, 00 E          | 13, 4, 19 E                                       |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 48, 5, 6 N            | 53, 19, 47 N                                      |
|                                  |                    |                       |   |
|                                  |                    |                       |   |
|                                  |                    |                       |   |
|                                  |                    |                       |   |
|                                  |                    |                       |   |
| <b>MECHANICAL</b>                |                    |                       |   |
| TYPE OF MOUNT                    | -                  | (1)                   | Azimuth / Elevation / Third Axis                  |
| AZIMUTH LIMITATIONS              | -                  | No Limits             | ± 365   |
| TRACKING SPEED RANGE             | deg/s              | 6 / s                 | Az; 15 / s, El; 7/s, Third Axis; 1 / s            |
| MAX TRACK ACCELERATION           | deg/s <sup>2</sup> | (1)                   | Az; 10 / s <sup>2</sup> , El; 10 / s <sup>2</sup> |
| TYPE OF POINTING                 | Type               | Program               | Autotrack, Programtrack                           |
| POINTING ACCURACY                | deg                | 0.5                   | 0.03  |
| MIN TRANSMIT ELEV ANGLE          | deg                | (1)                   | (1)   |
| MIN RECEIVE ELEV ANGLE           | deg                | 0                     | 2   |
|                                  |                    |                       |   |
|                                  |                    |                       |   |
|                                  |                    |                       |   |
|                                  |                    |                       |   |
|                                  |                    |                       |   |
| <b>SUPPORT</b>                   |                    |                       |   |
| TRANSMIT FREQ BAND(S)            | GHz                | (1)                   | (1)   |
| RECEIVE FREQ BAND(S)             | GHz                | 1.65 - 1.755          | 1.67 - 1.72, 2.2 - 2.4                            |
| ACQ AID FREQ BAND(S)             | GHz                | (1)                   | (1)   |
| MISSION CATEGORIES               | Cat                | A                     | A   |
|                                  |                    |                       |   |
|                                  |                    |                       |   |
|                                  |                    |                       |   |
|                                  |                    |                       |   |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS  
 4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
**EARTH-TO-SPACE LINK CHARACTERISTICS**

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION |  |
|---------------------------|--------------|-----------------------|--|
|                           |              | LIBREVILLE            |  |
| <b>GENERAL</b>            |              |                       |  |
| STATION DESIGNATION       | -            | TRS                   |  |
| LOCATION(S)               | -            | Libreville / Gabun    |  |
| DIAMETER                  | m            | 8                     |  |
| <b>TRANSMIT</b>           |              | None                  |  |
| FREQUENCIES               | MHz          |                       |  |
| FREQUENCY RESOLUTION      | Hz           |                       |  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ |                       |  |
| TRANSMIT POWER 1          | W            |                       |  |
| EIRP RANGE 1              | dBW          |                       |  |
| TRANSMIT POWER 2          | W            |                       |  |
| EIRP RANGE 2              | dBW          |                       |  |
| POLARIZATION              | -            |                       |  |
| ANTENNA GAIN              | dBi          |                       |  |
| ANTENNA BEAMWIDTH (-3 dB) | deg          |                       |  |
| ANTENNA ELLIPTICITY       | dB           |                       |  |
| RF FREQ SWEEP RANGE       | kHz          |                       |  |
| MIN FREQ SWEEP RATE       | Hz/s         |                       |  |
| MAX FREQ SWEEP RATE       | kHz/s        |                       |  |
| PROGRAMMED UPLINK FREQ    | Yes/No       |                       |  |
|                           |              |                       |  |
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|                           |              |                       |  |
|                           |              |                       |  |
| <b>COMMAND</b>            |              | None                  |  |
| RF CARRIER MOD TYPE       | -            |                       |  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       |                       |  |
| SUBCARRIER FREQUENCY(S)   | Hz           |                       |  |
| SUBCARRIER STEP SIZE      | Hz           |                       |  |
| SUBCARRIER FREQ STABILITY | ppm          |                       |  |
| SUBCARRIER WAVEFORM       | Sin/Sq       |                       |  |
| SUBCARRIER MOD TYPE       | -            |                       |  |
| SUBCARRIER/BIT RATE LIMIT | -            |                       |  |
| BIT RATE RANGE            | b/s          |                       |  |
| FORMATS AVAILABLE         | -            |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

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**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                        |             |
|---|--------------|--|-------------|
|   |              | LIBREVILLE                                   |             |
| <b>GENERAL</b>  |              |  |             |
| STATION DESIGNATION   | -            | TRS  |             |
| LOCATION(S)   | -            | Libreville / Gabun                           |             |
| DIAMETER  | m            | 8  |             |
| <b>RECEIVE</b>  |              |  |             |
| FREQUENCIES   | MHz          | 1700 - 2300                                  | 8000 - 8400 |
| FREQUENCY RESOLUTION  | Hz           | (1)  | 200 000     |
| ANTENNA GAIN @ 45 deg   | dBi          | (1)  | 53.7        |
| SYS NOISE TEMP @ ZENITH   | K            | (1)  | (1)         |
| G/T @ 45 deg  | dB           | (1)  | (1)         |
| POLARIZATION  | -            | (1)  | RHC, LHC    |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | (1)  | 0.33        |
| ANTENNA ELLIPTICITY   | dB           | (1)  | (1)         |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | (1)  | (1)         |
| RCVR AGC DYNAMIC RANGE  | dB           | (1)  | (1)         |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | (1)  | (1)         |
| RCVR LOOP BANDWIDTHS  | Hz           | (1)  | (1)         |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | (1)  | (1)         |
| RCVR PLL ORDER(S)   | No.          | (1)  | (1)         |
| ACQ SWEEP RANGE   | kHz          | (1)  | (1)         |
| MIN ACQ SWEEP RATE  | Hz/s         | (1)  | (1)         |
| MAX ACQ SWEEP RATE  | kHz/s        | (1)  | (1)         |
| ACQ SWEEP STEP SIZE   | Hz           | (1)  | (1)         |
| PROGRAMMED L.O.   | Yes/No       | Only Used for Autotracking                   | (1)         |
|   |              |  |             |
|   |              |  |             |
|   |              |  |             |
|   |              |  |             |
| <b>TELEMETRY</b>  |              |  |             |
| MODULATION TYPE(S)  | -            | QPSK, UQPSK                                  |             |
| MODULATION FORMAT(S)  | -            | Specific for ERS-1, ERS-2, JERS, Landsat - 5 |             |
| MOD INDEX RANGE   | Rad Pk       | ↓<br>↓<br>↓<br>↓<br>↓                        |             |
| SUBCARRIER FREQ RANGE   | kHz          |  |             |
| SUBCARRIER WAVEFORM   | Sin/Sq       |  |             |
| SYMBOL RATE RANGE   | s/s          |  |             |
| SUBCARRIER/SYM RATE LIMIT   | -            |  |             |
| ARRAYS WITH STATIONS  | -            | None   |             |
| CHANNEL DECODING  | Type         | (1)  |             |
| DATA FORMAT   | -            | (1)  |             |
|   |              |  |             |
|   |              |  |             |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |  |             |

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CCSDS HISTORICAL DOCUMENT  
**DLR TRACKING SYSTEM**  
RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION    |  |
|---|--------------|--------------------------|--|
|   |              | LIBREVILLE               |  |
| <b>GENERAL</b>  |              |                          |  |
| STATION DESIGNATION   | -            | TRS                      |  |
| LOCATION(S)   | -            | Libreville / Gaburn      |  |
| DIAMETER  | m            | 8                        |  |
| <b>FREQUENCIES</b>  |              |                          |  |
| TRANSMIT FREQUENCIES  | MHz          |                          |  |
| RECEIVE FREQUENCIES   | MHz          | 1700 - 2300, 8000 - 8400 |  |
| TURNAROUND FREQ RATIO   | -            |                          |  |
| <b>DOPPLER</b>  |              |                          |  |
|   |              | None                     |  |
| COHERENT/NON-COHERENT   | -            |                          |  |
| COUNTER RESOLUTION  | Cycles       |                          |  |
| MAX DOPPLER FREQ SHIFT  | MHz          |                          |  |
| DOPPLER BIAS FREQ   | MHz          |                          |  |
| DRIFT   | $\Delta f/f$ |                          |  |
| OUTPUT EQUATION   | -            |                          |  |
| DIRECTION INDICATOR   | -            |                          |  |
|   |              |                          |  |
|   |              |                          |  |
|   |              |                          |  |
| <b>RANGING</b>  |              |                          |  |
|   |              | None                     |  |
| COHERENT/NON-COHERENT   | -            |                          |  |
| RANGE CODE WAVEFORM   | Sin/Sq       |                          |  |
| EARTH STATION MOD INDEX   | Rad Pk       |                          |  |
| RANGE CODE FREQ RATIO   | -            |                          |  |
| MAJOR CODE FREQ(S)  | kHz          |                          |  |
| MINOR CODE FREQ(S)  | kHz          |                          |  |
| MIN RECEIVED CARRIER SNR  | dB           |                          |  |
| MIN REQ CODE PWR/No   | dB-Hz        |                          |  |
| CODE INTEGRATION TIME   | s            |                          |  |
| ACQUISITION SEQUENCE  | -            |                          |  |
| RANGE DATA UNITS  | -            |                          |  |
| RANGE QUANTIZATION  | -            |                          |  |
| ACCURACY (STRONG SIGNAL)  | m            |                          |  |
| MAX UNAMBIGUOUS RANGE   | km           |                          |  |
| TRANSPONDER BW  | MHz          |                          |  |
|   |              |                          |  |
|   |              |                          |  |
|   |              |                          |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                          |  |

6445-4883

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                |                       |                |
|--|---------------|-----------------------|----------------|-----------------------|----------------|
|  |               | LIBREVILLE            |                |                       |                |
| <b>GENERAL</b>   |               |                       |                |                       |                |
| STATION DESIGNATION  | -             | TRS                   |                |                       |                |
| LOCATION(S)  | -             | Libreville / Gabun    |                |                       |                |
| DIAMETER   | m             | 8                     |                |                       |                |
| <b>FREQUENCY STD</b>   |               |                       |                |                       |                |
| No Frequency Std.  |               |                       |                |                       |                |
| STANDARD TYPE  | Name          |                       |                |                       |                |
| STANDARD MFG   | Name          |                       |                |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Drift</b>   | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | (1)                   | (1)            |                       |                |
| 1 - HOUR   | $\Delta f/f$  | (1)                   | (1)            |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                   | (1)            |                       |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                   | (1)            |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b> | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                   | (1)            |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | (1)                   | (1)            |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | (1)                   | (1)            |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | (1)                   | (1)            |                       |                |
| REF FREQS AVAILABLE  | MHz           |                       |                |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
| <b>TIMING SYSTEM</b>   |               |                       |                |                       |                |
| MASTER REFERENCE AGENCY  | Name          | USNO                  |                |                       |                |
| REFERENCE TIME   | Name          | UTC                   |                |                       |                |
| TIME CODE EPOCH  | Yr            | 1 January 1958        |                |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG; A, IRIG; B      |                |                       |                |
| MAX TIME RESOLUTION  | s             | $10^{-4}, 10^{-3}$    |                |                       |                |
| TIME TRANSFER METHOD   | Name          | GPS                   |                |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 300$             |                |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 300$             |                |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 1                     |                |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                   |                |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                     |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                |                       |                |

6445-4484

CCSDS HISTORICAL DOCUMENT  
**DLR TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION   |  |
|---|--------------------|-------------------------|--|
|   |                    | LIBREVILLE              |  |
| <b>GENERAL</b>  |                    |                         |  |
| STATION DESIGNATION   | -                  | TRS                     |  |
| LOCATION(S)   | -                  | Libreville / Gabun      |  |
| DIAMETER  | m                  | 8                       |  |
| <b>GEOGRAPHICAL</b>   |                    |                         |  |
| LOCATION, COUNTRY/STATE   | Name               | Gabun / Africa          |  |
| LOCATION, CITY  | Name               | Libreville              |  |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 9, 40, 12               |  |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 0 21 11                 |  |
|   |                    |                         |  |
|   |                    |                         |  |
|   |                    |                         |  |
|   |                    |                         |  |
| <b>MECHANICAL</b>   |                    |                         |  |
| TYPE OF MOUNT   | -                  | Az - El                 |  |
| AZIMUTH LIMITATIONS   | -                  | - 360 deg + 360 deg     |  |
| TRACKING SPEED RANGE  | deg/s              | 15                      |  |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 15                      |  |
| TYPE OF POINTING  | Type               | Autotrack, Programtrack |  |
| POINTING ACCURACY   | deg                | < 0.05                  |  |
| MIN TRANSMIT ELEV ANGLE   | deg                | (1)                     |  |
| MIN RECEIVE ELEV ANGLE  | deg                | 0                       |  |
|   |                    |                         |  |
|   |                    |                         |  |
|   |                    |                         |  |
|   |                    |                         |  |
|   |                    |                         |  |
| <b>SUPPORT</b>  |                    |                         |  |
| TRANSMIT FREQ BAND(S)   | GHz                | (1)                     |  |
| RECEIVE FREQ BAND(S)  | GHz                | 1.7 - 2.3, 8 - 8.4      |  |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                     |  |
| MISSION CATEGORIES  | Cat                | A                       |  |
|   |                    |                         |  |
|   |                    |                         |  |
|   |                    |                         |  |
|   |                    |                         |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES |                    |                         |  |

6445-4485

CCSDS HISTORICAL DOCUMENT  
**DLR TRACKING SYSTEM**  
EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION |  |
|---------------------------|--------------|-----------------------|--|
|                           |              | O'HIGGINS             |  |
| <b>GENERAL</b>            |              |                       |  |
| STATION DESIGNATION       | -            | GARS                  |  |
| LOCATION(S)               | -            | O'Higgins             |  |
| DIAMETER                  | m            | 9                     |  |
| <b>TRANSMIT</b>           |              | None                  |  |
| FREQUENCIES               | MHz          |                       |  |
| FREQUENCY RESOLUTION      | Hz           |                       |  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ |                       |  |
| TRANSMIT POWER 1          | W            |                       |  |
| EIRP RANGE 1              | dBW          |                       |  |
| TRANSMIT POWER 2          | W            |                       |  |
| EIRP RANGE 2              | dBW          |                       |  |
| POLARIZATION              | -            |                       |  |
| ANTENNA GAIN              | dBi          |                       |  |
| ANTENNA BEAMWIDTH (-3 dB) | deg          |                       |  |
| ANTENNA ELLIPTICITY       | dB           |                       |  |
| RF FREQ SWEEP RANGE       | kHz          |                       |  |
| MIN FREQ SWEEP RATE       | Hz/s         |                       |  |
| MAX FREQ SWEEP RATE       | kHz/s        |                       |  |
| PROGRAMMED UPLINK FREQ    | Yes/No       |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |
| <b>COMMAND</b>            |              | None                  |  |
| RF CARRIER MOD TYPE       | -            |                       |  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       |                       |  |
| SUBCARRIER FREQUENCY(S)   | Hz           |                       |  |
| SUBCARRIER STEP SIZE      | Hz           |                       |  |
| SUBCARRIER FREQ STABILITY | ppm          |                       |  |
| SUBCARRIER WAVEFORM       | Sin/Sq       |                       |  |
| SUBCARRIER MOD TYPE       | -            |                       |  |
| SUBCARRIER/BIT RATE LIMIT | -            |                       |  |
| BIT RATE RANGE            | b/s          |                       |  |
| FORMATS AVAILABLE         | -            |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |
|                           |              |                       |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE     2. SOME LIMITATIONS APPLY TO THIS CAPABILITY     3. NOT RECOMMENDED BY CCSDS

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION          |             |                                   |
|---|--------------|--------------------------------|-------------|-----------------------------------|
|   |              | O'HIGGINS                      |             | O'HIGGINS                         |
| <b>GENERAL</b>  |              |                                |             |                                   |
| STATION DESIGNATION   | -            | GARS                           |             | GARS                              |
| LOCATION(S)   | -            | O'Higgins                      |             | O'Higgins                         |
| DIAMETER  | m            | 9                              |             | 9                                 |
| <b>RECEIVE</b>  |              |                                |             |                                   |
| FREQUENCIES   | MHz          | 1650 - 1750                    | 2200 - 2300 | 8025 - 8500                       |
| FREQUENCY RESOLUTION  | Hz           | (1)                            | (1)         | (1)                               |
| ANTENNA GAIN @ 45 deg   | dBi          | 34.2                           | (1)         | (1)                               |
| SYS NOISE TEMP @ ZENITH   | K            | (1)                            | (1)         | (1)                               |
| G/T @ 45 deg  | dB/K         | (1)                            | 20.5        | 31.1                              |
| POLARIZATION  | -            | RCP or LCP                     | RCP or LCP  | RCP                               |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | (1)                            | (1)         | (1)                               |
| ANTENNA ELLIPTICITY   | dB           | (1)                            | (1)         | (1)                               |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | (1)                            | (1)         | (1)                               |
| RCVR AGC DYNAMIC RANGE  | dB           | (1)                            | (1)         | (1)                               |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | (1)                            | (1)         | (1)                               |
| RCVR LOOP BANDWIDTHS  | Hz           | (1)                            | (1)         | (1)                               |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | (1)                            | (1)         | (1)                               |
| RCVR PLL ORDER(S)   | No.          | (1)                            | (1)         | (1)                               |
| ACQ SWEEP RANGE   | kHz          | (1)                            | (1)         | (1)                               |
| MIN ACQ SWEEP RATE  | Hz/s         | (1)                            | (1)         | (1)                               |
| MAX ACQ SWEEP RATE  | kHz/s        | (1)                            | (1)         | (1)                               |
| ACQ SWEEP STEP SIZE   | Hz           | (1)                            | (1)         | (1)                               |
| PROGRAMMED L.O.   | Yes/No       | (1)                            | (1)         | (1)                               |
| <b>TELEMETRY</b>  |              |                                |             |                                   |
| MODULATION TYPE(S)  | -            |                                |             | QPSK, UQPSK                       |
| MODULATION FORMAT(S)  | -            |                                |             |                                   |
| MOD INDEX RANGE   | Rad Pk       | } Specific for NOAA Satellites |             | } Specific for ERS-1, ERS-2, JERS |
| SUBCARRIER FREQ RANGE   | kHz          |                                |             |                                   |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                                |             |                                   |
| SYMBOL RATE RANGE   | s/s          |                                |             |                                   |
| SUBCARRIER/SYM RATE LIMIT   | -            |                                |             |                                   |
| ARRAYS WITH STATIONS  | -            |                                |             |                                   |
| CHANNEL DECODING  | Type         |                                |             |                                   |
| DATA FORMAT   | -            |                                |             |                                   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                                |             |                                   |

6445-4627

CCSDS HISTORICAL DOCUMENT  
**DLR TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                 |  |
|---|--------------|---------------------------------------|--|
|   |              | O'HIGGINS                             |  |
| <b>GENERAL</b>  |              |                                       |  |
| STATION DESIGNATION   | -            | GARS                                  |  |
| LOCATION(S)   | -            | O'Higgins                             |  |
| DIAMETER  | m            | 9                                     |  |
| <b>FREQUENCIES</b>  |              |                                       |  |
| TRANSMIT FREQUENCIES  | MHz          | (1)                                   |  |
| RECEIVE FREQUENCIES   | MHz          | 1650 - 1750, 2000 - 2400, 8000 - 8600 |  |
| TURNAROUND FREQ RATIO   | -            | (1)                                   |  |
| <b>DOPPLER</b>  |              |                                       |  |
|   |              | None                                  |  |
| COHERENT/NON-COHERENT   | -            |                                       |  |
| COUNTER RESOLUTION  | Cycles       |                                       |  |
| MAX DOPPLER FREQ SHIFT  | MHz          |                                       |  |
| DOPPLER BIAS FREQ   | MHz          |                                       |  |
| DRIFT   | $\Delta f/f$ |                                       |  |
| OUTPUT EQUATION   | -            |                                       |  |
| DIRECTION INDICATOR   | -            |                                       |  |
|   |              |                                       |  |
|   |              |                                       |  |
|   |              |                                       |  |
| <b>RANGING</b>  |              |                                       |  |
|   |              | None                                  |  |
| COHERENT/NON-COHERENT   | -            |                                       |  |
| RANGE CODE WAVEFORM   | Sin/Sq       |                                       |  |
| EARTH STATION MOD INDEX   | Rad Pk       |                                       |  |
| RANGE CODE FREQ RATIO   | -            |                                       |  |
| MAJOR CODE FREQ(S)  | kHz          |                                       |  |
| MINOR CODE FREQ(S)  | kHz          |                                       |  |
| MIN RECEIVED CARRIER SNR  | dB           |                                       |  |
| MIN REQ CODE PWR/No   | dB-Hz        |                                       |  |
| CODE INTEGRATION TIME   | s            |                                       |  |
| ACQUISITION SEQUENCE  | -            |                                       |  |
| RANGE DATA UNITS  | -            |                                       |  |
| RANGE QUANTIZATION  | -            |                                       |  |
| ACCURACY (STRONG SIGNAL)  | m            |                                       |  |
| MAX UNAMBIGUOUS RANGE   | km           |                                       |  |
| TRANSPONDER BW  | MHz          |                                       |  |
|   |              |                                       |  |
|   |              |                                       |  |
|   |              |                                       |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                                       |  |

6445-4628

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                |                       |                |
|--|---------------|-----------------------|----------------|-----------------------|----------------|
|  |               | O'HIGGINS             |                |                       |                |
| <b>GENERAL</b>   |               |                       |                |                       |                |
| STATION DESIGNATION  | -             | GARS                  |                |                       |                |
| LOCATION(S)  | -             | O'Higgins             |                |                       |                |
| DIAMETER   | m             | 9                     |                |                       |                |
| <b>FREQUENCY STD</b>   |               |                       |                |                       |                |
| STANDARD TYPE  | Name          | H-Maser               | Cesium         |                       |                |
| STANDARD MFG   | Name          | Oscilloquartz         | HP             |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Drift</b>   | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $3 \times 10^{-13}$   | (1)            |                       |                |
| 1 - HOUR   | $\Delta f/f$  | $3 \times 10^{-14}$   | (1)            |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | $3 \times 10^{-15}$   | (1)            |                       |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                   | (1)            |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b> | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                   | (1)            |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | (1)                   | (1)            |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | (1)                   | (1)            |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | (1)                   | (1)            |                       |                |
| REF FREQS AVAILABLE  | MHz           | (1)                   |                |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                   |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
| <b>TIMING SYSTEM</b>   |               |                       |                |                       |                |
| MASTER REFERENCE AGENCY  | Name          | USNO                  |                |                       |                |
| REFERENCE TIME   | Name          | UTC                   |                |                       |                |
| TIME CODE EPOCH  | Yr            | 1 JANUARY 1958        |                |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG - A, IRIG - B    |                |                       |                |
| MAX TIME RESOLUTION  | s             | $10^{-4}, 10^{-3}$    |                |                       |                |
| TIME TRANSFER METHOD   | Name          | GPS                   |                |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 300$             |                |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 300$             |                |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 1                     |                |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                   |                |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                     |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                |                       |                |

**CCSDS HISTORICAL DOCUMENT  
DLR TRACKING SYSTEM  
GEOGRAPHICAL AND MECHANICAL**

| CHARACTERISTICS                  | UNITS              | SUBNETWORK OR STATION                |  |
|----------------------------------|--------------------|--------------------------------------|--|
|                                  |                    | O'HIGGINS                            |  |
| <b>GENERAL</b>                   |                    |                                      |  |
| STATION DESIGNATION              | -                  | GARS                                 |  |
| LOCATION(S)                      | -                  | O'Higgins                            |  |
| DIAMETER                         | m                  | 9                                    |  |
| <b>GEOGRAPHICAL</b>              |                    |                                      |  |
| LOCATION, COUNTRY/STATE          | Name               | Antarctica                           |  |
| LOCATION, CITY                   | Name               | O'Higgins                            |  |
| LONGITUDE (site 1/site 2/site 3) | d, m, s            | 57 54 03 W                           |  |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 63 19 16 S                           |  |
|                                  |                    |                                      |  |
|                                  |                    |                                      |  |
|                                  |                    |                                      |  |
|                                  |                    |                                      |  |
|                                  |                    |                                      |  |
| <b>MECHANICAL</b>                |                    |                                      |  |
| TYPE OF MOUNT                    | -                  | Two Axis, Tilting                    |  |
| AZIMUTH LIMITATIONS              | -                  | - 270, + 270                         |  |
| TRACKING SPEED RANGE             | deg/s              | 11/s <sup>2</sup> , 5/s <sup>2</sup> |  |
| MAX TRACK ACCELERATION           | deg/s <sup>2</sup> | 7/s <sup>2</sup> , 5/s <sup>2</sup>  |  |
| TYPE OF POINTING                 | Type               | Program and Autotrack                |  |
| POINTING ACCURACY                | deg                | ~ 0.05                               |  |
| MIN TRANSMIT ELEV ANGLE          | deg                | (1)                                  |  |
| MIN RECEIVE ELEV ANGLE           | deg                | 0                                    |  |
|                                  |                    |                                      |  |
|                                  |                    |                                      |  |
|                                  |                    |                                      |  |
|                                  |                    |                                      |  |
|                                  |                    |                                      |  |
| <b>SUPPORT</b>                   |                    |                                      |  |
| TRANSMIT FREQ BAND(S)            | GHz                | (1)                                  |  |
| RECEIVE FREQ BAND(S)             | GHz                | 1.65 - 1.75, 2.2 - 2.3, 8 - 8.5      |  |
| ACQ AID FREQ BAND(S)             | GHz                | (1)                                  |  |
| MISSION CATEGORIES               | Cat                | A, VLBI                              |  |
|                                  |                    |                                      |  |
|                                  |                    |                                      |  |
|                                  |                    |                                      |  |
|                                  |                    |                                      |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE     2. SOME LIMITATIONS APPLY TO THIS CAPABILITY     3. NOT RECOMMENDED BY CCSDS  
4. BASED UPON GEOCENTRIC COORDINATES     5. BASED UPON GEODETTIC COORDINATES

CCSDS HISTORICAL DOCUMENT  
**DLR TRACKING SYSTEM**  
EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION                        |  |
|---------------------------|--------------|--|--|
|                           |              | LEOP - KU STATION                            |  |
| <b>GENERAL</b>            |              |  |  |
| STATION DESIGNATION       | -            | LEOP - KU                                    |  |
| LOCATION(S)               | -            | Weilheim, Germany                            |  |
| DIAMETER                  | m            | 11.1   |  |
| <b>TRANSMIT</b>           |              |  |  |
| FREQUENCIES               | MHz          | 13 750 - 14 500                              |  |
| FREQUENCY RESOLUTION      | Hz           | (1)  |  |
| RF FREQUENCY STABILITY    | $\Delta f/f$ | $1 \times 10^{-5}$ @ 10 sec                  |  |
| TRANSMIT POWER 1          | W            | 2000   |  |
| EIRP RANGE 1              | dBW          | 60 - 90                                      |  |
| TRANSMIT POWER 2          | W            | None   |  |
| EIRP RANGE 2              | dBW          | None   |  |
| POLARIZATION              | -            | RCP or LCP or LIN X or Y                     |  |
| ANTENNA GAIN              | dBi          | 58.8   |  |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.13   |  |
| ANTENNA ELLIPTICITY       | dB           | 2  |  |
| RF FREQ SWEEP RANGE       | kHz          | $\pm 10$ to $\pm 140$                        |  |
| MIN FREQ SWEEP RATE       | Hz/s         | 1000   |  |
| MAX FREQ SWEEP RATE       | kHz/s        | 30   |  |
| PROGRAMMED UPLINK FREQ    | Yes/No       | Yes  |  |
|                           |              |  |  |
|                           |              |  |  |
|                           |              |  |  |
|                           |              |  |  |
|                           |              |  |  |
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| <b>COMMAND</b>            |              |  |  |
| RF CARRIER MOD TYPE       | -            | PM or FM                                     |  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | $\pm 1.5$ , < 400 kHz                        |  |
| SUBCARRIER FREQUENCY(S)   | Hz           | 8000 or 16 000                               |  |
| SUBCARRIER STEP SIZE      | Hz           | (1)  |  |
| SUBCARRIER FREQ STABILITY | ppm          | $1 \times 10^{-5}$ @ 10 sec                  |  |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine   |  |
| SUBCARRIER MOD TYPE       | -            | PCM / PSK, PCM / FSK                         |  |
| SUBCARRIER/BIT RATE LIMIT | -            | $2^m$ ; $m = 2, 3, 4, \dots, 11$             |  |
| BIT RATE RANGE            | b/s          | $4000 / 2^\eta$ , $\eta = 0, 1, 2, \dots, 9$ |  |
| FORMATS AVAILABLE         | -            | NRZ - L, M, S; Bi- $\phi$ - L, M, S          |  |
|                           |              |  |  |
|                           |              |  |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                 |  |
|---|--------------|---------------------------------------|--|
|   |              | LEOP - KU STATION                     |  |
| <b>GENERAL</b>  |              |                                       |  |
| STATION DESIGNATION   | -            | LEOP - KU                             |  |
| LOCATION(S)   | -            | Weilheim, Germany                     |  |
| DIAMETER  | m            | 11.1                                  |  |
| <b>RECEIVE</b>  |              |                                       |  |
| FREQUENCIES   | MHz          | 10 700 - 12 750                       |  |
| FREQUENCY RESOLUTION  | Hz           | 1                                     |  |
| ANTENNA GAIN @ 45 deg   | dBi          | 60.53 @ 11.725 GHz                    |  |
| SYS NOISE TEMP @ ZENITH   | K            | 200                                   |  |
| G/T @ 45 deg  | dB           | 37.5                                  |  |
| POLARIZATION  | -            | RCP and LCP or LIN X and Y            |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.16                                  |  |
| ANTENNA ELLIPTICITY   | dB           | 2                                     |  |
| L.O. REF FREQ STAB @ 1 hr   | $\Delta f/f$ | $1 \times 10^{-5}$ @ 10 sec           |  |
| RCVR AGC DYNAMIC RANGE  | dB           | 60                                    |  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -140 in 2 Blo = 125 Hz                |  |
| RCVR LOOP BANDWIDTHS  | Hz           | 125, 250, 500, 1000 $\pm$ 10% (2 BLO) |  |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                                 |  |
| RCVR PLL ORDER(S)   | No.          | 2                                     |  |
| ACQ SWEEP RANGE   | kHz          | $\pm$ 10 to $\pm$ 300                 |  |
| MIN ACQ SWEEP RATE  | Hz/s         | 1500 @ 125 2 BLO                      |  |
| MAX ACQ SWEEP RATE  | kHz/s        | 100 @ 1000 2 BLO                      |  |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                            |  |
| PROGRAMMED L.O.   | Yes/No       | Yes                                   |  |
|   |              |                                       |  |
|   |              |                                       |  |
|   |              |                                       |  |
|   |              |                                       |  |
| <b>TELEMETRY</b>  |              |                                       |  |
| MODULATION TYPE(S)  | -            | PCM / PSK / PM, PCM / PM              |  |
| MODULATION FORMAT(S)  | -            | NRZ - L, SP - L                       |  |
| MOD INDEX RANGE   | Rad Pk       | 0.5 - 1                               |  |
| SUBCARRIER FREQ RANGE   | kHz          | 1.024 - 128                           |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                                  |  |
| SYMBOL RATE RANGE   | s/s          | 160 - 18 000                          |  |
| SUBCARRIER/SYM RATE LIMIT   | -            | None                                  |  |
| ARRAYS WITH STATIONS  | -            | None                                  |  |
| CHANNEL DECODING  | Type         | (1)                                   |  |
| DATA FORMAT   | -            | (1)                                   |  |
|   |              |                                       |  |
|   |              |                                       |  |
|   |              |                                       |  |
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| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                                       |  |

6445-4026

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION                                       |  |
|--------------------------|--------------|---|--|
|                          |              | LEOP - KU STATION   |  |
| <b>GENERAL</b>           |              |   |  |
| STATION DESIGNATION      | -            | LEOP - KU   |  |
| LOCATION(S)              | -            | Weilheim, Germany   |  |
| DIAMETER                 | m            | 11.1  |  |
| <b>FREQUENCIES</b>       |              |   |  |
| TRANSMIT FREQUENCIES     | MHz          | 13 750 - 14 500   |  |
| RECEIVE FREQUENCIES      | MHz          | 10 700 - 12 750   |  |
| TURNAROUND FREQ RATIO    | -            | (1)   |  |
| <b>DOPPLER</b>           |              |   |  |
| COHERENT/NON-COHERENT    | -            | Either  |  |
| COUNTER RESOLUTION       | Cycles       | 0.001   |  |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 0.15  |  |
| DOPPLER BIAS FREQ        | MHz          | 0.1 - 1.0 in 50 kHz Steps                                   |  |
| DRIFT                    | $\Delta f/f$ | $8 \times 10^{-12}$ @ 1 min                                 |  |
| OUTPUT EQUATION          | -            | $(N_{\eta} + 1 - N_{\eta}) (0.1 + T_{\eta} + 1 - T_{\eta})$ |  |
| DIRECTION INDICATOR      | -            | ± $\Delta f = -\Delta r$                                    |  |
|                          |              |   |  |
|                          |              |   |  |
|                          |              |   |  |
|                          |              |   |  |
| <b>RANGING</b>           |              |   |  |
| COHERENT/NON-COHERENT    | -            | Either  |  |
| RANGE CODE WAVEFORM      | Sin/Sq       | Sine  |  |
| EARTH STATION MOD INDEX  | Rad Pk       | 0.1 - 1.5   |  |
| RANGE CODE FREQ RATIO    | -            | 5:1, 4:1  |  |
| MAJOR CODE FREQ(S)       | kHz          | 27 779.606  |  |
| MINOR CODE FREQ(S)       | kHz          | 22 223.685 - 23 334.869                                     |  |
| MIN RECEIVED CARRIER SNR | dB           | 12  |  |
| MIN REQ CODE PWR/No      | dB-Hz        | Major = 22, Minor = 16                                      |  |
| CODE INTEGRATION TIME    | s            | 1.5   |  |
| ACQUISITION SEQUENCE     | -            | Major Code First, then Minor Codes                          |  |
| RANGE DATA UNITS         | -            | Nanoseconds   |  |
| RANGE QUANTIZATION       | -            | 1 ns  |  |
| ACCURACY (STRONG SIGNAL) | m            | 2   |  |
| MAX UNAMBIGUOUS RANGE    | km           | 7500  |  |
| TRANSPONDER BW           | MHz          | 0.1   |  |
|                          |              |   |  |
|                          |              |   |  |
|                          |              |   |  |
|                          |              |   |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                       |                       |                |
|--|---------------|-----------------------|-----------------------|-----------------------|----------------|
|  |               | LEOP - KU STATION     |                       |                       |                |
| <b>GENERAL</b>   |               |                       |                       |                       |                |
| STATION DESIGNATION  | -             | LEOP - KU             |                       |                       |                |
| LOCATION(S)  | -             | Weilheim, Germany     |                       |                       |                |
| DIAMETER   | m             | 11.1                  |                       |                       |                |
| <b>FREQUENCY STD</b>   |               |                       |                       |                       |                |
| STANDARD TYPE  | Name          | Cesium                | GPS - Rubidium        | Hydrogen - Maser      |                |
| STANDARD MFG   | Name          | Oscilloquartz         | Efratom               | KVARZ                 |                |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Allan Variance</b> | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $3 \times 10^{-11}$   | $1 \times 10^{-11}$   | $4 \times 10^{-13}$   |                |
| 1 - HOUR   | $\Delta f/f$  | (1)                   | $< 2 \times 10^{-12}$ | $2 \times 10^{-14}$   |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | $3 \times 10^{-13}$   | $< 2 \times 10^{-12}$ | $5 \times 10^{-15}$   |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                   | (1)                   | (1)                   |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>5 MHz</b>          | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                   | (1)                   | (1)                   |                |
| 10 Hz OFFSET   | dBc/Hz        | -125                  | -125                  | -130                  |                |
| 100 Hz OFFSET  | dBc/Hz        | -140                  | -155                  | -140                  |                |
| 1000 Hz OFFSET   | dBc/Hz        | -140                  | -155                  | -150                  |                |
| REF FREQS AVAILABLE  | MHz           | 1, 5, 10              |                       | 5, 100                |                |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                   |                       | (1)                   |                |
|  |               |                       |                       |                       |                |
|  |               |                       |                       |                       |                |
|  |               |                       |                       |                       |                |
| <b>TIMING SYSTEM</b>   |               |                       |                       |                       |                |
| MASTER REFERENCE AGENCY  | Name          | USNO                  |                       | USNO                  |                |
| REFERENCE TIME   | Name          | UTC                   |                       | UTC                   |                |
| TIME CODE EPOCH  | Yr            | 1 January 1958        |                       | 1 January 1958        |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | (1)                   |                       | (1)                   |                |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$    |                       | $1 \times 10^{-6}$    |                |
| TIME TRANSFER METHOD   | Name          | GPS                   |                       | GPS                   |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 0.1$             |                       | $\pm 0.1$             |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 20$              |                       | $\pm 20$              |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 0.01                  |                       | 0.01                  |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                   |                       | (1)                   |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                     |                       | 1                     |                |
|  |               |                       |                       |                       |                |
|  |               |                       |                       |                       |                |
|  |               |                       |                       |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                       |                       |                |

CCSDS HISTORICAL DOCUMENT  
**DLR TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS                  | UNITS              | SUBNETWORK OR STATION         |  |
|----------------------------------|--------------------|-------------------------------|--|
|                                  |                    | LEOP - KU STATION             |  |
| <b>GENERAL</b>                   |                    |                               |  |
| STATION DESIGNATION              | -                  | LEOP - KU                     |  |
| LOCATION(S)                      | -                  | Weilheim, Germany             |  |
| DIAMETER                         | m                  | 11.1                          |  |
| <b>GEOGRAPHICAL</b>              |                    |                               |  |
| LOCATION, COUNTRY/STATE          | Name               | Germany                       |  |
| LOCATION, CITY                   | Name               | Weilheim                      |  |
| LONGITUDE (site 1/site 2/site 3) | d, m, s            | 10, 05, 7.2                   |  |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 47, 52, 52.3                  |  |
|                                  |                    |                               |  |
|                                  |                    |                               |  |
|                                  |                    |                               |  |
|                                  |                    |                               |  |
|                                  |                    |                               |  |
| <b>MECHANICAL</b>                |                    |                               |  |
| TYPE OF MOUNT                    | -                  | Az - El                       |  |
| AZIMUTH LIMITATIONS              | deg                | ± 160                         |  |
| TRACKING SPEED RANGE             | deg/s              | Az = 15, El = 6               |  |
| MAX TRACK ACCELERATION           | deg/s <sup>2</sup> | Az = 6, El = 3                |  |
| TYPE OF POINTING                 | Type               | Monopulse, Autotrack, Program |  |
| POINTING ACCURACY                | deg                | 0.037                         |  |
| MIN TRANSMIT ELEV ANGLE          | deg                | 0                             |  |
| MIN RECEIVE ELEV ANGLE           | deg                | 0                             |  |
|                                  |                    |                               |  |
|                                  |                    |                               |  |
|                                  |                    |                               |  |
|                                  |                    |                               |  |
|                                  |                    |                               |  |
|                                  |                    |                               |  |
| <b>SUPPORT</b>                   |                    |                               |  |
| TRANSMIT FREQ BAND(S)            | GHz                | 13.75 - 14.5                  |  |
| RECEIVE FREQ BAND(S)             | GHz                | 10.7 - 12.75                  |  |
| ACQ AID FREQ BAND(S)             | GHz                | None                          |  |
| MISSION CATEGORIES               | Cat                | A                             |  |
|                                  |                    |                               |  |
|                                  |                    |                               |  |
|                                  |                    |                               |  |
|                                  |                    |                               |  |
|                                  |                    |                               |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS  
 4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES

CCSDS HISTORICAL DOCUMENT  
**DLR TRACKING SYSTEM**  
EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                        |  |
|---|--------------|--|--|
|   |              | 15-METER 1 STATION                           | 15-METER 2 STATION                           |
| <b>GENERAL</b>  |              |  |  |
| STATION DESIGNATION   | -            | 15 m 1                                       | 15 m 2                                       |
| LOCATION(S)   | -            | Weilheim, Germany                            | Weilheim, Germany                            |
| DIAMETER  | m            | 15   | 15   |
| <b>TRANSMIT</b>   |              |  |  |
| FREQUENCIES   | MHz          | 2025 - 2120                                  | 2025 - 2120                                  |
| FREQUENCY RESOLUTION  | Hz           | 3.2  | 3.2  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $1 \times 10^{-5}$ @ 10 sec                  | $1 \times 10^{-5}$ @ 10 sec                  |
| TRANSMIT POWER 1  | W            | 2 - 2000                                     | 2 - 2000                                     |
| EIRP RANGE 1  | dBW          | 50 - 80                                      | 50 - 80                                      |
| TRANSMIT POWER 2  | W            | 2 - 200                                      | 2 - 200                                      |
| EIRP RANGE 2  | dBW          | 50 - 70                                      | 50 - 70                                      |
| POLARIZATION  | -            | RCP or LCP                                   | RCP or LCP                                   |
| ANTENNA GAIN  | dBi          | 46.4   | 47.2   |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.66   | 0.66   |
| ANTENNA ELLIPTICITY   | dB           | 1  | 1  |
| RF FREQ SWEEP RANGE   | kHz          | $\pm 1, \pm 10, \pm 50, \pm 100, \pm 150$    | $\pm 1, \pm 10, \pm 50, \pm 100, \pm 150$    |
| MIN FREQ SWEEP RATE   | Hz/s         | 500  | 500  |
| MAX FREQ SWEEP RATE   | kHz/s        | 50   | 50   |
| PROGRAMMED UPLINK FREQ  | Yes/No       | Yes  | Yes  |
| <b>COMMAND</b>  |              |  |  |
| RF CARRIER MOD TYPE   | -            | PM   | PM   |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.01 - 3                                     | 0.01 - 3                                     |
| SUBCARRIER FREQUENCY(S)   | Hz           | 8000 or 16 000                               | 8000 or 16 000                               |
| SUBCARRIER STEP SIZE  | Hz           | (1)  | (1)  |
| SUBCARRIER FREQ STABILITY   | ppm          | $1 \times 10^{-5}$ @ 10 sec                  | $1 \times 10^{-5}$ @ 10 sec                  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine   | Sine   |
| SUBCARRIER MOD TYPE   | -            | PCM / PSK                                    | PCM / PSK                                    |
| SUBCARRIER/BIT RATE LIMIT   | -            | $2^m$ ; $m = 2, 3, 4, \dots, 11$             | $2^m$ ; $m = 2, 3, 4, \dots, 11$             |
| BIT RATE RANGE  | b/s          | $4000 / 2^\eta$ ; $\eta = 0, 1, 2, \dots, 9$ | $4000 / 2^\eta$ ; $\eta = 0, 1, 2, \dots, 9$ |
| FORMATS AVAILABLE   | -            | NRZ - L                                      | NRZ - L                                      |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE     2. SOME LIMITATIONS APPLY TO THIS CAPABILITY     3. NOT RECOMMENDED BY CCSDS |              |  |  |

6445-4019

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION          |                                |
|-----------------------------|--------------|--------------------------------|--------------------------------|
|                             |              | 15-METER 1 STATION             | 15-METER 2 STATION             |
| <b>GENERAL</b>              |              |                                |                                |
| STATION DESIGNATION         | -            | 15 m 1                         | 15 m 2                         |
| LOCATION(S)                 | -            | Weilheim                       | Weilheim                       |
| DIAMETER                    | m            | 15                             | 15                             |
| <b>RECEIVE</b>              |              |                                |                                |
| FREQUENCIES                 | MHz          | 2200 - 2300                    | 2200 - 2300                    |
| FREQUENCY RESOLUTION        | Hz           | 1                              | 1                              |
| ANTENNA GAIN @ 45 deg       | dBi          | 47.8 @ 2250 MHz                | 48.3 @ 2250 MHz                |
| SYS NOISE TEMP @ ZENITH     | K            | 90                             | 100                            |
| G/T @ 45 deg                | dB           | 26.9                           | 29                             |
| POLARIZATION                | -            | Any                            | RCP and LCP or LIN X and Y     |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.62                           | 0.62                           |
| ANTENNA ELLIPTICITY         | dB           | 1                              | 1                              |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $1 \times 10^{-5}$ @ 10 sec    | $1 \times 10^{-5}$ @ 10 sec    |
| RCVR AGC DYNAMIC RANGE      | dB           | 59                             | 59                             |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -150 in 2 Blo = 30 Hz          | -150 in 2 Blo = 30 Hz          |
| RCVR LOOP BANDWIDTHS        | Hz           | 30, 100, 300, 1 K              | 30, 100, 300, 1 K              |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                          | Adapt                          |
| RCVR PLL ORDER(S)           | No.          | 2                              | 2                              |
| ACQ SWEEP RANGE             | kHz          | 10, 50, 150                    | 10, 50, 150                    |
| MIN ACQ SWEEP RATE          | Hz/s         | 6                              | 56                             |
| MAX ACQ SWEEP RATE          | kHz/s        | 62.5                           | 62.5                           |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous                     | Continuous                     |
| PROGRAMMED L.O.             | Yes/No       | Yes                            | Yes                            |
|                             |              |                                |                                |
|                             |              |                                |                                |
|                             |              |                                |                                |
| <b>TELEMETRY</b>            |              |                                |                                |
| MODULATION TYPE(S)          | -            | PCM / PSK / PM, PCM / PM       | PCM / PSK / PM, PCM / PM       |
| MODULATION FORMAT(S)        | -            | NRZ - L, M, S, DM, Bi - $\phi$ | NRZ - L, M, S, DM, Bi - $\phi$ |
| MOD INDEX RANGE             | Rad Pk       | 0 - 2.5                        | 0 - 2.5                        |
| SUBCARRIER FREQ RANGE       | kHz          | 1 - 4000                       | 1 - 4000                       |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine or Square                 | Sine or Square                 |
| SYMBOL RATE RANGE           | s/s          | 10 - 1 250 000                 | 10 - 1 250 000                 |
| SUBCARRIER/SYM RATE LIMIT   | -            | None                           | None                           |
| ARRAYS WITH STATIONS        | -            | None                           | None                           |
| CHANNEL DECODING            | Type         | (1)                            | (1)                            |
| DATA FORMAT                 | -            | (1)                            | (1)                            |
|                             |              |                                |                                |
|                             |              |                                |                                |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-4020

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACK SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION                     |   |
|--|--------------|---|---|
|  |              | 15-METER 1 STATION                        | 15-METER 2 STATION  |
| <b>GENERAL</b>   |              |   |   |
| STATION DESIGNATION  | -            | 15 m 1                                    | 15 m 2  |
| LOCATION(S)  | -            | Weilheim, Germany                         | Weilheim, Germany   |
| DIAMETER   | m            | 15  | 15  |
| <b>FREQUENCIES</b>   |              |   |   |
| TRANSMIT FREQUENCIES   | MHz          | 2025 - 2120                               | 2025 - 2150   |
| RECEIVE FREQUENCIES  | MHz          | 2200 - 2300                               | 2200 - 2300   |
| TURNAROUND FREQ RATIO  | -            | 240 / 221                                 | 240 / 221   |
| <b>DOPPLER</b>   |              |   |   |
| COHERENT/NON-COHERENT  | -            | Either                                    | Either  |
| COUNTER RESOLUTION   | Cycles       | 0.001                                     | 5 ns  |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 0.15                                    | 0.15  |
| DOPPLER BIAS FREQ  | MHz          | 0   | 0.1 - 1.0 in 50 kHz Steps                                 |
| DRIFT  | $\Delta f/f$ | $8 \times 10^{-12}$ @ 1 min               | $8 \times 10^{-12}$ @ 1 min                               |
| OUTPUT EQUATION  | -            | $\pm f_d$                                 | $(N_{\eta+1} - N_{\eta}) - (0.1 + T_{\eta+1} - T_{\eta})$ |
| DIRECTION INDICATOR  | -            | $+ \Delta f = -\Delta r$                  |   |
|  |              |   |   |
|  |              |   |   |
|  |              |   |   |
|  |              |   |   |
|  |              |   |   |
| <b>RANGING</b>   |              |   |   |
| COHERENT/NON-COHERENT  | -            | Either                                    | Either  |
| RANGE CODE WAVEFORM  | Sin/Sq       | Sine                                      | Sine / PRN  |
| EARTH STATION MOD INDEX  | Rad Pk       | 0.1 - 1.5                                 | 0.01 - 1.5  |
| RANGE CODE FREQ RATIO  | -            | 5:1, 4:1                                  | 5:1, 4:1  |
| MAJOR CODE FREQ(S)   | kHz          | 100                                       | 100 - 3000 in 0.1 Hz Steps                                |
| MINOR CODE FREQ(S)   | kHz          | 20, 16 (0.8, 0.16, 0.32, 0.008 on 16 kHz) | Minor Codes $\eta = 0 \dots 20$                           |
| MIN RECEIVED CARRIER SNR   | dB-Hz        | 12.2                                      | 12.2  |
| MIN REQ CODE PWR/No  | s            | Major = 22, Minor = 13                    | -10   |
| CODE INTEGRATION TIME  | -            | 8   | 0.5 - 100   |
| ACQUISITION SEQUENCE   |              | Major Code First, then Minor Codes        | Major Code First, then Different Code Length              |
| RANGE DATA UNITS   | -            | Nanoseconds                               | Nanoseconds   |
| RANGE QUANTIZATION   | -            | 1 ns                                      | 1 ns  |
| ACCURACY (STRONG SIGNAL)   | m            | 0.15                                      | 0.5   |
| MAX UNAMBIGUOUS RANGE  | km           | 18 750                                    | 3 000 000   |
| TRANSPONDER BW   | MHz          | 0.3                                       | 2 * Major Code Frequency                                  |
|  |              |   |   |
|  |              |   |   |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |   |   |

6445-4021

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                          |                       |                |
|--|---------------|-----------------------|--------------------------|-----------------------|----------------|
|  |               | 15-METER 1 STATION    |                          |                       |                |
| <b>GENERAL</b>   |               |                       |                          |                       |                |
| STATION DESIGNATION  | -             | 15 m 1                |                          |                       |                |
| LOCATION(S)  | -             | Weilheim, Germany     |                          |                       |                |
| DIAMETER   | m             | 15 (2)                |                          |                       |                |
| <b>FREQUENCY STD</b>   |               |                       |                          |                       |                |
| STANDARD TYPE  | Name          | Cesium                | GPS-Rubidium             | Hydrogen-Maser        |                |
| STANDARD MFG   | Name          | Oscilloquartz         | Efratom                  | KVARZ                 |                |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Allan Variance</b>    | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $3 \times 10^{-11}$   | $1 \times 10^{-11}$      | $4 \times 10^{-13}$   |                |
| 1 - HOUR   | $\Delta f/f$  | (1)                   | $< 2 \times 10^{-12}$    | $2 \times 10^{-14}$   |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | $3 \times 10^{-13}$   | $\leq 2 \times 10^{-12}$ | $5 \times 10^{-15}$   |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                   | (1)                      | (1)                   |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>5 MHz</b>             | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                   | (1)                      | (1)                   |                |
| 10 Hz OFFSET   | dBc/Hz        | -125                  | -125                     | -130                  |                |
| 100 Hz OFFSET  | dBc/Hz        | -140                  | -155                     | -140                  |                |
| 1000 Hz OFFSET   | dBc/Hz        | -140                  | -155                     | -150                  |                |
| REF FREQS AVAILABLE  | MHz           | 1, 5, 10              |                          | 5, 100                |                |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                   |                          | (1)                   |                |
|  |               |                       |                          |                       |                |
|  |               |                       |                          |                       |                |
|  |               |                       |                          |                       |                |
| <b>TIMING SYSTEM</b>   |               |                       |                          |                       |                |
| MASTER REFERENCE AGENCY  | Name          | USNO                  |                          | USNO                  |                |
| REFERENCE TIME   | Name          | UTC                   |                          | UTC                   |                |
| TIME CODE EPOCH  | Yr            | 1 January 1958        |                          | 1 January 1958        |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | (1)                   |                          | (1)                   |                |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$    |                          | $1 \times 10^{-8}$    |                |
| TIME TRANSFER METHOD   | Name          | GPS                   |                          | GPS                   |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 0.1$             |                          | $\pm 0.1$             |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 20$              |                          | $\pm 20$              |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 0.01                  |                          | 0.01                  |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                   |                          | (1)                   |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                     |                          | 1                     |                |
|  |               |                       |                          |                       |                |
|  |               |                       |                          |                       |                |
|  |               |                       |                          |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                          |                       |                |

CCSDS HISTORICAL DOCUMENT  
**DLR TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION         |                               |
|---|--------------------|-------------------------------|-------------------------------|
|   |                    | 15-METER 1 STATION            | 15-METER 2 STATION            |
| <b>GENERAL</b>  |                    |                               |                               |
| STATION DESIGNATION   | -                  | 15 m 1                        | 15 m 2                        |
| LOCATION(S)   | -                  | Weilheim, Germany             | Weilheim, Germany             |
| DIAMETER  | m                  | 15                            | 15                            |
| <b>GEOGRAPHICAL</b>   |                    |                               |                               |
| LOCATION, COUNTRY/STATE   | Name               | Germany                       | Germany                       |
| LOCATION, CITY  | Name               | Weilheim                      | Weilheim                      |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 11, 05, 7.2                   | 11, 05, 1.2                   |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 47, 52, 48.2                  | 47, 52, 52.3                  |
|   |                    |                               |                               |
|   |                    |                               |                               |
|   |                    |                               |                               |
|   |                    |                               |                               |
| <b>MECHANICAL</b>   |                    |                               |                               |
| TYPE OF MOUNT   | -                  | Az - El                       | Az - El                       |
| AZIMUTH LIMITATIONS   | -                  | None                          | None                          |
| TRACKING SPEED RANGE  | deg/s              | Az = 15, El = 6               | Az = 15, El = 6               |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | Az = 6, El = 3                | Az = 6, El = 3                |
| TYPE OF POINTING  | Type               | Monopulse, Autotrack, Program | Monopulse, Autotrack, Program |
| POINTING ACCURACY   | deg                | 0.005                         | 0.005                         |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5                             | 2                             |
| MIN RECEIVE ELEV ANGLE  | deg                | 5                             | 2                             |
|   |                    |                               |                               |
|   |                    |                               |                               |
|   |                    |                               |                               |
|   |                    |                               |                               |
| <b>SUPPORT</b>  |                    |                               |                               |
| TRANSMIT FREQ BAND(S)   | GHz                | 2                             | 2                             |
| RECEIVE FREQ BAND(S)  | GHz                | 2                             | 2                             |
| ACQ AID FREQ BAND(S)  | GHz                | None                          | None                          |
| MISSION CATEGORIES  | Cat                | A                             | A                             |
|   |                    |                               |                               |
|   |                    |                               |                               |
|   |                    |                               |                               |
|   |                    |                               |                               |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                               |                               |

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION           |  |
|---------------------------|--------------|---------------------------------|--|
|                           |              | 30-METER STATION                |  |
| <b>GENERAL</b>            |              |                                 |  |
| STATION DESIGNATION       | -            | 30 m                            |  |
| LOCATION(S)               | -            | Weilheim, Germany               |  |
| DIAMETER                  | m            | 30                              |  |
| <b>TRANSMIT</b>           |              |                                 |  |
| FREQUENCIES               | MHz          | 2025 - 2120                     |  |
| FREQUENCY RESOLUTION      | Hz           | 12                              |  |
| RF FREQUENCY STABILITY    | $\Delta f/f$ | $\pm 1 \times 10^{-5}$ @ 10 sec |  |
| TRANSMIT POWER 1          | W            | 1860 - 14 800                   |  |
| EIRP RANGE 1              | dBW          | 85 - 94                         |  |
| TRANSMIT POWER 2          | W            | None                            |  |
| EIRP RANGE 2              | dBW          | None                            |  |
| POLARIZATION              | -            | RCP or LCP, or LIN              |  |
| ANTENNA GAIN              | dBi          | 52.3 @ 2115 MHz                 |  |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.33                            |  |
| ANTENNA ELLIPTICITY       | dB           | (1)                             |  |
| RF FREQ SWEEP RANGE       | kHz          | $\pm 500$                       |  |
| MIN FREQ SWEEP RATE       | Hz/s         | 1                               |  |
| MAX FREQ SWEEP RATE       | kHz/s        | 100                             |  |
| PROGRAMMED UPLINK FREQ    | Yes/No       | Yes                             |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
| <b>COMMAND</b>            |              |                                 |  |
| RF CARRIER MOD TYPE       | -            | PM                              |  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0 - 1.5                         |  |
| SUBCARRIER FREQUENCY(S)   | Hz           | 100 - 100 000                   |  |
| SUBCARRIER STEP SIZE      | Hz           | 0.01                            |  |
| SUBCARRIER FREQ STABILITY | ppm          | $1 \times 10^{-5}$ @ 10 sec     |  |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine or Square                  |  |
| SUBCARRIER MOD TYPE       | -            | PCM / PSK                       |  |
| SUBCARRIER/BIT RATE LIMIT | -            | 1, 2, 3, ... .4095              |  |
| BIT RATE RANGE            | b/s          | 1 - 2000                        |  |
| FORMATS AVAILABLE         | -            | NRZ - L; Bi - $\phi$ - L        |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-4744

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS  | SUBNETWORK OR STATION               |                                     |                                     |
|--|--------|-------------------------------------|-------------------------------------|-------------------------------------|
|  |        | 30-METER STATION                    |                                     |                                     |
| <b>GENERAL</b>   |        |                                     |                                     |                                     |
| STATION DESIGNATION  | -      | 30 m                                |                                     |                                     |
| LOCATION(S)  | -      | Weilheim, Germany                   |                                     |                                     |
| DIAMETER   | m      | 30                                  |                                     |                                     |
| <b>RECEIVE</b>   |        |                                     |                                     |                                     |
| FREQUENCIES  | MHz    | 2290 - 2300                         | 8400 - 8440                         | 5875 ± 50                           |
| FREQUENCY RESOLUTION   | Hz     | 48 x 10 <sup>-6</sup>               | 48 x 10 <sup>-6</sup>               | 48 x 10 <sup>-6</sup>               |
| ANTENNA GAIN 45 deg  | dBi    | 53                                  | 63                                  | (1)                                 |
| SYS NOISE TEMP @ ZENITH  | K      | 80                                  | 35                                  | (1)                                 |
| G/T @ 45 deg   | dB/K   | 33.5                                | 49                                  | (1)                                 |
| POLARIZATION   | -      | RCP or LCP, LIN                     | RCP or LCP, LIN                     | RCP or LCP                          |
| ANTENNA BEAMWIDTH (-3 dB)  | deg    | 0.3                                 | 0.08                                | (1)                                 |
| ANTENNA ELLIPTICITY  | dB     | (1)                                 | (1)                                 | (1)                                 |
| L.O. REF FREQ STAB @ 1 hr  | Δf/f   | 10 <sup>-5</sup> @ 10 sec           | 10 <sup>-5</sup> @ 10 sec           | 10 <sup>-5</sup> @ 10 sec           |
| RCVR AGC DYNAMIC RANGE   | dB     | 90                                  | 90                                  | 90                                  |
| RCVR THRESHOLD @ 2 Blo Hz  | dBm    | -161 in 2 Blo = 3 Hz                | -160 in 2 Blo = 3 Hz                | (1)                                 |
| RCVR LOOP BANDWIDTHS   | Hz     | 3, 12, 48, 152                      | 3, 12, 48, 152                      | 1, 2, 4, 8. . . .1024               |
| RCVR LOOP TYPE (ADAPT, FIX)  | -      | Adapt                               | Adapt                               | Adapt                               |
| RCVR PLL ORDER(S)  | No.    | 2                                   | 2                                   | 2                                   |
| ACQ SWEEP RANGE  | kHz    | ± 370                               | ± 370                               | ± 1000                              |
| MIN ACQ SWEEP RATE   | Hz/s   | 48 x 10 <sup>-6</sup>               | 48 x 10 <sup>-6</sup>               | 0.1                                 |
| MAX ACQ SWEEP RATE   | kHz/s  | 480                                 | 480                                 | 100                                 |
| ACQ SWEEP STEP SIZE  | Hz     | 48 x 10 <sup>-6</sup>               | 48 x 10 <sup>-6</sup>               | < 0.02                              |
| PROGRAMMED L.O.  | Yes/No | No                                  | No                                  | Yes                                 |
| <b>TELEMETRY</b>   |        |                                     |                                     |                                     |
| MODULATION TYPE(S)   | -      | PCM / PSK / PM, PCM / PM            | PCM / PSK / PM, PCM / PM            | PCM / PSK / PM, PCM / PM            |
| MODULATION FORMAT(S)   | -      | NRZ - L, M, S; Bi - φ - L, M, S; DM | NRZ - L, M, S; Bi - φ - L, M, S; DM | NRZ - L, M, S; Bi - φ - L, M, S; DM |
| MOD INDEX RANGE  | Rad Pk | 0.1 - 1.25                          | 0.1 - 1.25                          | 0.1 - 1.25                          |
| SUBCARRIER FREQ RANGE  | kHz    | 0.512 - 1000                        | 0.512 - 1000                        | 0.512 - 1000                        |
| SUBCARRIER WAVEFORM  | Sin/Sq | Sine or Square                      | Sine or Square                      | Sine or Square                      |
| SYMBOL RATE RANGE  | s/s    | 4.7 - 100 000                       | 4.7 - 100 000                       | 4.7 - 100 000                       |
| SUBCARRIER/SYM RATE LIMIT  | -      | None                                | None                                | None                                |
| ARRAYS WITH STATIONS   | -      | None                                | None                                | None                                |
| CHANNEL DECODING   |        | (1)                                 | (1)                                 | (1)                                 |
| DATA FORMAT  |        | (1)                                 | (1)                                 | (1)                                 |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> |        |                                     |                                     |                                     |

6445-4014

CCSDS HISTORICAL DOCUMENT  
**DLR TRACK SYSTEM**  
RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION   |  |
|--------------------------|--------------|---|--|
|                          |              | 30-METER STATION  |  |
| <b>GENERAL</b>           |              |   |  |
| STATION DESIGNATION      | -            | 30 m  |  |
| LOCATION(S)              | -            | Weilheim, Germany   |  |
| DIAMETER                 | m            | 30  |  |
| <b>FREQUENCIES</b>       |              |   |  |
| TRANSMIT FREQUENCIES     | MHz          | 2110 - 2120   |  |
| RECEIVE FREQUENCIES      | MHz          | 2240 - 2300   |  |
| TURNAROUND FREQ RATIO    | -            | 1 - 880 / 1 - 221   |  |
| <b>DOPPLER</b>           |              |   |  |
| COHERENT/NON-COHERENT    | -            | Either  |  |
| COUNTER RESOLUTION       | Cycles       | 5 ns  |  |
| MAX DOPPLER FREQ SHIFT   | MHz          | 0.05 - 1  |  |
| DOPPLER BIAS FREQ        | MHz          | 0.1 - 1 in 50 kHz Steps   |  |
| DRIFT                    | $\Delta f/f$ | $8 \times 10^{-12}$ @ 1 min                                       |  |
| OUTPUT EQUATION          | -            | Doppler Count + Time Fraction                                     |  |
| DIRECTION INDICATOR      | -            | $\pm \Delta f = -\Delta r$  |  |
|                          |              |   |  |
|                          |              |   |  |
|                          |              |   |  |
| <b>RANGING</b>           |              |   |  |
| COHERENT/NON-COHERENT    | -            | Coherent  |  |
| RANGE CODE WAVEFORM      | Sin/Sq       | Sine PRN  |  |
| EARTH STATION MOD INDEX  | Rad Pk       | 0.01 - 1.5  |  |
| RANGE CODE FREQ RATIO    | -            | 2:1   |  |
| MAJOR CODE FREQ(S)       | kHz          | 100 - 3000 in 0.1 Hz Steps  |  |
| MINOR CODE FREQ(S)       | kHz          | Minor Codes $h = 0 \dots 20$ Code Length $2^h$ / Major Code Freq. |  |
| MIN RECEIVED CARRIER SNR | dB           | 11  |  |
| MIN REQ CODE PWR/No      | dB-Hz        | -10   |  |
| CODE INTEGRATION TIME    | s            | 0.5 - 1000  |  |
| ACQUISITION SEQUENCE     | -            | Sine then PRN   |  |
| RANGE DATA UNITS         | -            | Nanoseconds   |  |
| RANGE QUANTIZATION       | -            | 1 ns  |  |
| ACCURACY (STRONG SIGNAL) | m            | 0.5   |  |
| MAX UNAMBIGUOUS RANGE    | km           | 3 000 000   |  |
| TRANSPONDER BW           | MHz          | 2 + Major Code Frequency  |  |
|                          |              |   |  |
|                          |              |   |  |
|                          |              |   |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

6445-4746

**CCSDS HISTORICAL DOCUMENT**  
**DLR TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                       |                       |                |
|--|---------------|-----------------------|-----------------------|-----------------------|----------------|
|  |               | 30-METER STATION      |                       |                       |                |
| <b>GENERAL</b>   |               |                       |                       |                       |                |
| STATION DESIGNATION  | -             | 30 m                  |                       |                       |                |
| LOCATION(S)  | -             | Weilheim, Germany     |                       |                       |                |
| DIAMETER   | m             | 30                    |                       |                       |                |
| <b>FREQUENCY STD</b>   |               |                       |                       |                       |                |
| STANDARD TYPE  | Name          | Cesium                | GPS-Rubidium          | Hydrogen-Maser        |                |
| STANDARD MFG   | Name          | Oscilloquartz         | Efratom               | KVARZ                 |                |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Allan Variance</b> | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $3 \times 10^{-11}$   | $1 \times 10^{-11}$   | $4 \times 10^{-13}$   |                |
| 1 - HOUR   | $\Delta f/f$  | (1)                   | $< 2 \times 10^{-12}$ | $2 \times 10^{-14}$   |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | $3 \times 10^{-13}$   | $< 2 \times 10^{-12}$ | $5 \times 10^{-15}$   |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                   | (1)                   | (1)                   |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>5 MHz</b>          | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                   | (1)                   | (1)                   |                |
| 10 Hz OFFSET   | dBc/Hz        | - 125                 | - 125                 | -130                  |                |
| 100 Hz OFFSET  | dBc/Hz        | - 140                 | - 155                 | -140                  |                |
| 1000 Hz OFFSET   | dBc/Hz        | - 140                 | - 155                 | -150                  |                |
| REF FREQS AVAILABLE  | MHz           | 1, 5, 10              |                       | 5, 100                |                |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                   |                       | (1)                   |                |
|  |               |                       |                       |                       |                |
|  |               |                       |                       |                       |                |
|  |               |                       |                       |                       |                |
| <b>TIMING SYSTEM</b>   |               |                       |                       |                       |                |
| MASTER REFERENCE AGENCY  | Name          | USNO                  |                       | USNO                  |                |
| REFERENCE TIME   | Name          | UTC                   |                       | UTC                   |                |
| TIME CODE EPOCH  | Yr            | 1 January 1958        |                       | 1 January 1958        |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | (1)                   |                       | (1)                   |                |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$    |                       | $1 \times 10^{-6}$    |                |
| TIME TRANSFER METHOD   | Name          | GPS                   |                       | GPS                   |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 0.1$             |                       | $\pm 0.1$             |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 2$               |                       | $\pm 2$               |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 0.01                  |                       | 0.01                  |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                   |                       | (1)                   |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                     |                       | 1                     |                |
|  |               |                       |                       |                       |                |
|  |               |                       |                       |                       |                |
|  |               |                       |                       |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                       |                       |                |

CCSDS HISTORICAL DOCUMENT  
**DLR TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION |  |
|---|--------------------|-----------------------|--|
|   |                    | 30-METER STATION      |  |
| <b>GENERAL</b>  |                    |                       |  |
| STATION DESIGNATION   | -                  | 30 m                  |  |
| LOCATION(S)   | -                  | Weilheim, Germany     |  |
| DIAMETER  | m                  | 30                    |  |
| <b>GEOGRAPHICAL</b>   |                    |                       |  |
| LOCATION, COUNTRY/STATE   | Name               | Germany               |  |
| LOCATION, CITY  | Name               | Weilheim              |  |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 11, 04, 41.6          |  |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 47, 52, 52.3          |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
| <b>MECHANICAL</b>   |                    |                       |  |
| TYPE OF MOUNT   | -                  | Az - El               |  |
| AZIMUTH LIMITATIONS   | -                  | ± 270                 |  |
| TRACKING SPEED RANGE  | deg/s              | Az = 1.5, El = 1      |  |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | Az = 1.5, El = 1      |  |
| TYPE OF POINTING  | Type               | Monopulse, Autotrack  |  |
| POINTING ACCURACY   | deg                | 0.001                 |  |
| MIN TRANSMIT ELEV ANGLE   | deg                | 8                     |  |
| MIN RECEIVE ELEV ANGLE  | deg                | 3                     |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
| <b>SUPPORT</b>  |                    |                       |  |
| TRANSMIT FREQ BAND(S)   | GHz                | 2                     |  |
| RECEIVE FREQ BAND(S)  | GHz                | 2, 5, 8               |  |
| ACQ AID FREQ BAND(S)  | GHz                | None                  |  |
| MISSION CATEGORIES  | Cat                | B                     |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
|   |                    |                       |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES |                    |                       |  |

6445-4047

**CCSDS HISTORICAL DOCUMENT**  
**DRA TRACKING SYSTEM**  
**EARTH-TO-SPACE LINK CHARACTERISTICS**

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION |                |
|---------------------------|--------------|-----------------------|----------------|
|                           |              | LASHAM                | LASHAM         |
| <b>GENERAL</b>            |              |                       |                |
| STATION DESIGNATION       | -            | Lasham                | Lasham         |
| LOCATION(S)               | -            | England               | England        |
| DIAMETER                  | m            | 2.4 (Tracking)        | 3.6 (Tracking) |
| <b>TRANSMIT</b>           |              | None                  | None           |
| FREQUENCIES               | MHz          |                       |                |
| FREQUENCY RESOLUTION      | Hz           |                       |                |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ |                       |                |
| TRANSMIT POWER 1          | W            |                       |                |
| EIRP RANGE 1              | dBW          |                       |                |
| TRANSMIT POWER 2          | W            |                       |                |
| EIRP RANGE 2              | dBW          |                       |                |
| POLARIZATION              | -            |                       |                |
| ANTENNA GAIN              | dBi          |                       |                |
| ANTENNA BEAMWIDTH (-3 dB) | deg          |                       |                |
| ANTENNA ELLIPTICITY       | dB           |                       |                |
| RF FREQ SWEEP RANGE       | kHz          |                       |                |
| MIN FREQ SWEEP RATE       | Hz/s         |                       |                |
| MAX FREQ SWEEP RATE       | kHz/s        |                       |                |
| PROGRAMMED UPLINK FREQ    | Yes/No       |                       |                |
|                           |              |                       |                |
|                           |              |                       |                |
|                           |              |                       |                |
|                           |              |                       |                |
|                           |              |                       |                |
| <b>COMMAND</b>            |              | None                  | None           |
| RF CARRIER MOD TYPE       | -            |                       |                |
| RF CARRIER MOD INDEX RNG  | Rad Pk       |                       |                |
| SUBCARRIER FREQUENCY(S)   | Hz           |                       |                |
| SUBCARRIER STEP SIZE      | Hz           |                       |                |
| SUBCARRIER FREQ STABILITY | ppm          |                       |                |
| SUBCARRIER WAVEFORM       | Sin/Sq       |                       |                |
| SUBCARRIER MOD TYPE       | -            |                       |                |
| SUBCARRIER/BIT RATE LIMIT | -            |                       |                |
| BIT RATE RANGE            | b/s          |                       |                |
| FORMATS AVAILABLE         | -            |                       |                |
|                           |              |                       |                |
|                           |              |                       |                |
|                           |              |                       |                |
|                           |              |                       |                |

1. CAPABILITY OR DATA IS NOT AVAILABLE     2. SOME LIMITATIONS APPLY TO THIS CAPABILITY     3. NOT RECOMMENDED BY CCSDS

6445-4739

**CCSDS HISTORICAL DOCUMENT**  
**DRA TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                |                                      |
|-----------------------------|--------------|--------------------------------------|--------------------------------------|
|                             |              | LASHAM                               | LASHAM                               |
| <b>GENERAL</b>              |              |                                      |                                      |
| STATION DESIGNATION         | -            | Lasham                               | Lasham                               |
| LOCATION(S)                 | -            | England                              | England                              |
| DIAMETER                    | m            | 2.4 (Tracking)                       | 3.6 (Tracking)                       |
| <b>RECEIVE</b>              |              |                                      |                                      |
| FREQUENCIES                 | MHz          | 1540 - 1720                          | 1540 - 1720                          |
| FREQUENCY RESOLUTION        | Hz           | 10                                   | 10                                   |
| ANTENNA GAIN @ 45 deg       | dBi          | 29.2                                 | 34                                   |
| SYS NOISE TEMP @ ZENITH     | K            | 88                                   | 40                                   |
| G/T @ 45 deg                | dB           | 7.1                                  | 27.6                                 |
| POLARIZATION                | -            | RCP or LCP                           | RCP or LCP                           |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 4.9                                  | 3.6                                  |
| ANTENNA ELLIPTICITY         | dB           | (1)                                  | (1)                                  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 50$                             | $\pm 50$                             |
| RCVR AGC DYNAMIC RANGE      | dB           | Threshold to -10 dBm                 | Threshold to -10 dBm                 |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -150 in 2 Blo = 30 Hz                | -154 in 2 Blo = 30 Hz                |
| RCVR LOOP BANDWIDTHS        | Hz           | 30, 100, 300, 1 K, 3 K, 10 K         | 30, 100, 300, 1 K, 3 K, 10 K         |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                                | Adapt                                |
| RCVR PLL ORDER(S)           | No.          | 2                                    | 2                                    |
| ACQ SWEEP RANGE             | kHz          | $\pm 100$ to $\pm 250$               | $\pm 100$ to $\pm 250$               |
| MIN ACQ SWEEP RATE          | Hz/s         | 0                                    | 0                                    |
| MAX ACQ SWEEP RATE          | kHz/s        | 250                                  | 250                                  |
| ACQ SWEEP STEP SIZE         | Hz           | 100                                  | 100                                  |
| PROGRAMMED L.O.             | Yes/No       | Yes                                  | Yes                                  |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
| <b>TELEMETRY</b>            |              |                                      |                                      |
| MODULATION TYPE(S)          | -            | PM / FM / AM; BPSK, PSK, FSK         | PM / FM / AM; BPSK, PSK, FSK         |
| MODULATION FORMAT(S)        | -            | Bi - $\phi$ - L, M, S; NRZ - L, M, S | Bi - $\phi$ - L, M, S; NRZ - L, M, S |
| MOD INDEX RANGE             | Rad Pk       | 2 - 8                                | 2 - 8                                |
| SUBCARRIER FREQ RANGE       | kHz          | (1)                                  | (1)                                  |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine                                 | Sine                                 |
| SYMBOL RATE RANGE           | s/s          | (1)                                  | (1)                                  |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)                                  | (1)                                  |
| ARRAYS WITH STATIONS        | -            | (1)                                  | (1)                                  |
| CHANNEL DECODING            | Type         | (1)                                  | (1)                                  |
| DATA FORMAT                 | -            | (1)                                  | (1)                                  |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-2163

**CCSDS HISTORICAL DOCUMENT**  
**DRA TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |         |
|---|--------------|-----------------------|---------|
|   |              | LASHAM                | LASHAM  |
| <b>GENERAL</b>  |              |                       |         |
| STATION DESIGNATION   | -            | Lasham                | Lasham  |
| LOCATION(S)   | -            | England               | England |
| DIAMETER  | m            | 2.4                   | 3.6     |
| <b>FREQUENCIES</b>  |              |                       |         |
| TRANSMIT FREQUENCIES  | MHz          | (1)                   | (1)     |
| RECEIVE FREQUENCIES   | MHz          | (1)                   | (1)     |
| TURNAROUND FREQ RATIO   | -            | (1)                   | (1)     |
| <b>DOPPLER</b>  |              |                       |         |
| COHERENT/NON-COHERENT   | -            | None                  | None    |
| COUNTER RESOLUTION  | Cycles       |                       |         |
| MAX DOPPLER FREQ SHIFT  | MHz          |                       |         |
| DOPPLER BIAS FREQ   | MHz          |                       |         |
| DRIFT   | $\Delta f/f$ |                       |         |
| OUTPUT EQUATION   | -            |                       |         |
| DIRECTION INDICATOR   | -            |                       |         |
|   |              |                       |         |
|   |              |                       |         |
|   |              |                       |         |
| <b>RANGING</b>  |              |                       |         |
| COHERENT/NON-COHERENT   | -            | None                  | None    |
| RANGE CODE WAVEFORM   | Sin/Sq       |                       |         |
| EARTH STATION MOD INDEX   | Rad Pk       |                       |         |
| RANGE CODE FREQ RATIO   | -            |                       |         |
| MAJOR CODE FREQ(S)  | kHz          |                       |         |
| MINOR CODE FREQ(S)  | kHz          |                       |         |
| MIN RECEIVED CARRIER SNR  | dB           |                       |         |
| MIN REQ CODE PWR/No   | dB-Hz        |                       |         |
| CODE INTEGRATION TIME   | s            |                       |         |
| ACQUISITION SEQUENCE  | -            |                       |         |
| RANGE DATA UNITS  | -            |                       |         |
| RANGE QUANTIZATION  | -            |                       |         |
| ACCURACY (STRONG SIGNAL)  | m            |                       |         |
| MAX UNAMBIGUOUS RANGE   | km           |                       |         |
| TRANSPONDER BW  | MHz          |                       |         |
|   |              |                       |         |
|   |              |                       |         |
|   |              |                       |         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |         |

6445-4741

**CCSDS HISTORICAL DOCUMENT**  
**DRA TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                |                       |                |
|--|---------------|-----------------------|----------------|-----------------------|----------------|
|  |               | LASHAM                |                | LASHAM                |                |
| <b>GENERAL</b>   |               |                       |                |                       |                |
| STATION DESIGNATION  | -             | Lasham                |                | Lasham                |                |
| LOCATION(S)  | -             | England               |                | England               |                |
| DIAMETER   | m             | 2.4                   |                | 3.6                   |                |
| <b>FREQUENCY STD</b>   |               |                       |                |                       |                |
| STANDARD TYPE  | Name          | (1)                   |                | (1)                   |                |
| STANDARD MFG   | Name          | (1)                   |                | (1)                   |                |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Drift</b>   | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | (1)                   | (1)            | (1)                   | (1)            |
| 1 - HOUR   | $\Delta f/f$  | (1)                   | (1)            | (1)                   | (1)            |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                   | (1)            | (1)                   | (1)            |
| 1 - MONTH  | $\Delta f/f$  | (1)                   | (1)            | (1)                   | (1)            |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b> | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                   | (1)            | (1)                   | (1)            |
| 10 Hz OFFSET   | dBc/Hz        | (1)                   | (1)            | (1)                   | (1)            |
| 100 Hz OFFSET  | dBc/Hz        | (1)                   | (1)            | (1)                   | (1)            |
| 1000 Hz OFFSET   | dBc/Hz        | (1)                   | (1)            | (1)                   | (1)            |
| REF FREQS AVAILABLE  | MHz           | (1)                   |                | (1)                   |                |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                   |                | (1)                   |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
| <b>TIMING SYSTEM</b>   |               |                       |                |                       |                |
| MASTER REFERENCE AGENCY  | Name          | GPS                   |                | GPS                   |                |
| REFERENCE TIME   | Name          | UTC                   |                | UTC                   |                |
| TIME CODE EPOCH  | Yr            | (1)                   |                | (1)                   |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG - B, NASA - 36   |                | IRIG - B, NASA - 36   |                |
| MAX TIME RESOLUTION  | s             | 1 pps                 |                | 1 pps                 |                |
| TIME TRANSFER METHOD   | Name          | GPS                   |                | GPS                   |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 2$ in 10 sec     |                | $\pm 2$ in 10 sec     |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | < 1                   |                | < 1                   |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | < 1                   |                | < 1                   |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                   |                | (1)                   |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 60                 |                | 1, 60                 |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                |                       |                |

**CCSDS HISTORICAL DOCUMENT**  
**DRA TRACKING SYSTEM**  
**GEOGRAPHICAL AND MECHANICAL**

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION        |                |
|---|--------------------|------------------------------|----------------|
|   |                    | LASHAM                       | LASHAM         |
| <b>GENERAL</b>  |                    |                              |                |
| STATION DESIGNATION   | -                  | Lasham                       | Lasham         |
| LOCATION(S)   | -                  | England                      | England        |
| DIAMETER  | m                  | 2.4 (Tracking)               | 3.6 (Tracking) |
| <b>GEOGRAPHICAL</b>   |                    |                              |                |
| LOCATION, COUNTRY/STATE   | Name               | Hampshire                    | Hampshire      |
| LOCATION, CITY  | Name               | Basingstoke                  | Basingstoke    |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 358, 58, 34 E                | 358, 58, 36 E  |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 51, 11, 14 N                 | 51, 11, 07 N   |
| <b>MECHANICAL</b>   |                    |                              |                |
| TYPE OF MOUNT   | -                  | El over Az                   | El over Az     |
| AZIMUTH LIMITATIONS   | -                  | + 410 to -410                | + 380 to -380  |
| TRACKING SPEED RANGE  | deg/s              | 0 - 21                       | 0 - 15         |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 22                           | 15             |
| TYPE OF POINTING  | Type               | Manual / Autotrack / Program | Program Track  |
| POINTING ACCURACY   | deg                | 0.25                         | 0.02           |
| MIN TRANSMIT ELEV ANGLE   | deg                | (1)                          | (1)            |
| MIN RECEIVE ELEV ANGLE  | deg                | 0                            | + 1            |
| <b>SUPPORT</b>  |                    |                              |                |
| TRANSMIT FREQ BAND(S)   | GHz                | (1)                          | None           |
| RECEIVE FREQ BAND(S)  | GHz                | 1.544 - 1.72                 | 1.54 - 1.75    |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                          | None           |
| MISSION CATEGORIES  | Cat                | A                            | A              |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                              |                |

6445-2158

CCSDS HISTORICAL DOCUMENT  
**DRA TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION |                        |
|---------------------------|--------------|-----------------------|------------------------|
|                           |              | LASHAM                | LASHAM                 |
| <b>GENERAL</b>            |              |                       |                        |
| STATION DESIGNATION       | -            | Lasham                | Lasham                 |
| LOCATION(S)               | -            | England               | England                |
| DIAMETER                  | m            | 4.6 (Tracking)        | 12.2 (Tracking)        |
| <b>TRANSMIT</b>           |              | None                  |                        |
| FREQUENCIES               | MHz          |                       | 2093.75                |
| FREQUENCY RESOLUTION      | Hz           |                       | 1                      |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ |                       | 0.0001                 |
| TRANSMIT POWER 1          | W            |                       | 0.00025 - 4            |
| EIRP RANGE 1              | dBW          |                       | + 10 to + 52           |
| TRANSMIT POWER 2          | W            |                       | None                   |
| EIRP RANGE 2              | dBW          |                       | None                   |
| POLARIZATION              | -            |                       | Circular               |
| ANTENNA GAIN              | dBi          |                       | 46                     |
| ANTENNA BEAMWIDTH (-3 dB) | deg          |                       | 1                      |
| ANTENNA ELLIPTICITY       | dB           |                       | (1)                    |
| RF FREQ SWEEP RANGE       | kHz          |                       | $\pm 130$              |
| MIN FREQ SWEEP RATE       | Hz/s         |                       | 22.5                   |
| MAX FREQ SWEEP RATE       | kHz/s        |                       | 65                     |
| PROGRAMMED UPLINK FREQ    | Yes/No       |                       | Yes                    |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
| <b>COMMAND</b>            |              | None                  |                        |
| RF CARRIER MOD TYPE       | -            |                       | PSK                    |
| RF CARRIER MOD INDEX RNG  | Rad Pk       |                       | 1.1                    |
| SUBCARRIER FREQUENCY(S)   | Hz           |                       | 8000                   |
| SUBCARRIER STEP SIZE      | Hz           |                       | 1                      |
| SUBCARRIER FREQ STABILITY | ppm          |                       | 0.001                  |
| SUBCARRIER WAVEFORM       | Sin/Sq       |                       | Sine                   |
| SUBCARRIER MOD TYPE       | -            |                       | NRZ - L                |
| SUBCARRIER/BIT RATE LIMIT | -            |                       | 125 B / S              |
| BIT RATE RANGE            | b/s          |                       | Fixed                  |
| FORMATS AVAILABLE         | -            |                       | ESA Standard Telemetry |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |
|                           |              |                       |                        |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

6445-2155

**CCSDS HISTORICAL DOCUMENT**  
**DRA TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                |                                      |
|---|--------------|--------------------------------------|--------------------------------------|
|   |              | LASHAM                               | LASHAM                               |
| <b>GENERAL</b>  |              |                                      |                                      |
| STATION DESIGNATION   | -            | Lasham                               | Lasham                               |
| LOCATION(S)   | -            | England                              | England                              |
| DIAMETER  | m            | 4.6 (Tracking)                       | 12.2 (Tracking)                      |
| <b>RECEIVE</b>  |              |                                      |                                      |
| FREQUENCIES   | MHz          | 1544 - 1720                          | 1500 - 2100                          |
| FREQUENCY RESOLUTION  | Hz           | 10                                   | 10                                   |
| ANTENNA GAIN @ 45 deg   | dBi          | 30                                   | 46                                   |
| SYS NOISE TEMP @ ZENITH   | K            | 190                                  | 100                                  |
| G/T @ 45 deg  | dB           | 12.4                                 | 13.8                                 |
| POLARIZATION  | -            | RCP or LCP                           | RCP or LCP                           |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 4.9                                  | 0.9                                  |
| ANTENNA ELLIPTICITY   | dB           | (1)                                  | (1)                                  |
| L.O. REF FREQ STAB @ 1 hr   | $\Delta f/f$ | $\pm 50$                             | $\pm 50$                             |
| RCVR AGC DYNAMIC RANGE  | dB           | Threshold to -10 dBm                 | Threshold to -10 dBm                 |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -147 in 2 Blo = 30 Hz                | -150 in 2 Blo = 30 Hz                |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 100, 300, 1 K, 3 K, 10 K         | 30, 100, 300, 1 K, 3 K, 10 K         |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                                | Adapt                                |
| RCVR PLL ORDER(S)   | No.          | 2                                    | 2                                    |
| ACQ SWEEP RANGE   | kHz          | $\pm 100$ to $\pm 250$               | $\pm 100$ to $\pm 250$               |
| MIN ACQ SWEEP RATE  | Hz/s         | 0                                    | 0                                    |
| MAX ACQ SWEEP RATE  | kHz/s        | 250                                  | 250                                  |
| ACQ SWEEP STEP SIZE   | Hz           | 100                                  | 100                                  |
| PROGRAMMED L.O.   | Yes/No       | Yes                                  | Yes                                  |
|   |              |                                      |                                      |
|   |              |                                      |                                      |
|   |              |                                      |                                      |
| <b>TELEMETRY</b>  |              |                                      |                                      |
| MODULATION TYPE(S)  | -            | PM / FM / AM; BPSK, PSK, FSK         | PM / FM / AM; BPSK, PSK, FSK         |
| MODULATION FORMAT(S)  | -            | Bi - $\phi$ - L, M, S; NRZ - L, M, S | Bi - $\phi$ - L, M, S; NRZ - L, M, S |
| MOD INDEX RANGE   | Rad Pk       | 2 - 8                                | 2 - 8                                |
| SUBCARRIER FREQ RANGE   | kHz          | (1)                                  | (1)                                  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                                 | Sine                                 |
| SYMBOL RATE RANGE   | s/s          | (1)                                  | (1)                                  |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)                                  | (1)                                  |
| ARRAYS WITH STATIONS  | -            | (1)                                  | (1)                                  |
| CHANNEL DECODING  | Type         | (1)                                  | (1)                                  |
| DATA FORMAT   | -            | (1)                                  | (1)                                  |
|   |              |                                      |                                      |
|   |              |                                      |                                      |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                                      |                                      |

6445-2162

**CCSDS HISTORICAL DOCUMENT**  
**DRA TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |         |
|---|--------------|-----------------------|---------|
|   |              | LASHAM                | LASHAM  |
| <b>GENERAL</b>  |              |                       |         |
| STATION DESIGNATION   | -            | Lasham                | Lasham  |
| LOCATION(S)   | -            | England               | England |
| DIAMETER  | m            | 4.6                   | 12.2    |
| <b>FREQUENCIES</b>  |              |                       |         |
| TRANSMIT FREQUENCIES  | MHz          | (1)                   | (1)     |
| RECEIVE FREQUENCIES   | MHz          | (1)                   | (1)     |
| TURNAROUND FREQ RATIO   | -            | (1)                   | (1)     |
| <b>DOPPLER</b>  |              |                       |         |
| COHERENT/NON-COHERENT   | -            | None                  | None    |
| COUNTER RESOLUTION  | Cycles       |                       |         |
| MAX DOPPLER FREQ SHIFT  | MHz          |                       |         |
| DOPPLER BIAS FREQ   | MHz          |                       |         |
| DRIFT   | $\Delta f/f$ |                       |         |
| OUTPUT EQUATION   | -            |                       |         |
| DIRECTION INDICATOR   | -            |                       |         |
|   |              |                       |         |
|   |              |                       |         |
|   |              |                       |         |
| <b>RANGING</b>  |              |                       |         |
| COHERENT/NON-COHERENT   | -            | None                  | None    |
| RANGE CODE WAVEFORM   | Sin/Sq       |                       |         |
| EARTH STATION MOD INDEX   | Rad Pk       |                       |         |
| RANGE CODE FREQ RATIO   | -            |                       |         |
| MAJOR CODE FREQ(S)  | kHz          |                       |         |
| MINOR CODE FREQ(S)  | kHz          |                       |         |
| MIN RECEIVED CARRIER SNR  | dB           |                       |         |
| MIN REQ CODE PWR/No   | dB-Hz        |                       |         |
| CODE INTEGRATION TIME   | s            |                       |         |
| ACQUISITION SEQUENCE  | -            |                       |         |
| RANGE DATA UNITS  | -            |                       |         |
| RANGE QUANTIZATION  | -            |                       |         |
| ACCURACY (STRONG SIGNAL)  | m            |                       |         |
| MAX UNAMBIGUOUS RANGE   | km           |                       |         |
| TRANSPONDER BW  | MHz          |                       |         |
|   |              |                       |         |
|   |              |                       |         |
|   |              |                       |         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |         |

6445-2161

**CCSDS HISTORICAL DOCUMENT**  
**DRA TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                |                       |                |
|--|---------------|-----------------------|----------------|-----------------------|----------------|
|  |               | LASHAM                |                | LASHAM                |                |
| <b>GENERAL</b>   |               |                       |                |                       |                |
| STATION DESIGNATION  | -             | Lasham                |                | Lasham                |                |
| LOCATION(S)  | -             | England               |                | England               |                |
| DIAMETER   | m             | 4.6                   |                | 12.2                  |                |
| <b>FREQUENCY STD</b>   |               |                       |                |                       |                |
| STANDARD TYPE  | Name          | (1)                   |                | (1)                   |                |
| STANDARD MFG   | Name          | (1)                   |                | (1)                   |                |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Drift</b>   | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | (1)                   | (1)            | (1)                   | (1)            |
| 1 - HOUR   | $\Delta f/f$  | (1)                   | (1)            | (1)                   | (1)            |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                   | (1)            | (1)                   | (1)            |
| 1 - MONTH  | $\Delta f/f$  | (1)                   | (1)            | (1)                   | (1)            |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b> | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                   | (1)            | (1)                   | (1)            |
| 10 Hz OFFSET   | dBc/Hz        | (1)                   | (1)            | (1)                   | (1)            |
| 100 Hz OFFSET  | dBc/Hz        | (1)                   | (1)            | (1)                   | (1)            |
| 1000 Hz OFFSET   | dBc/Hz        | (1)                   | (1)            | (1)                   | (1)            |
| REF FREQS AVAILABLE  | MHz           | (1)                   |                | (1)                   |                |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                   |                | (1)                   |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
| <b>TIMING SYSTEM</b>   |               |                       |                |                       |                |
| MASTER REFERENCE AGENCY  | Name          | GPS                   |                | GPS                   |                |
| REFERENCE TIME   | Name          | UTC                   |                | UTC                   |                |
| TIME CODE EPOCH  | Yr            | (1)                   |                | (1)                   |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG - B, NASA - 36   |                | IRIG - B, NASA - 36   |                |
| MAX TIME RESOLUTION  | s             | 1 pps                 |                | 1 pps                 |                |
| TIME TRANSFER METHOD   | Name          | GPS                   |                | GPS                   |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 2$ in 10 sec     |                | $\pm 2$ in 10 sec     |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | < 1                   |                | < 1                   |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | < 1                   |                | < 1                   |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                   |                | (1)                   |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 60                 |                | 1, 60                 |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                |                       |                |

**CCSDS HISTORICAL DOCUMENT**  
**DRA TRACKING SYSTEM**  
**GEOGRAPHICAL AND MECHANICAL**

| CHARACTERISTICS                  | UNITS              | SUBNETWORK OR STATION     |                    |
|----------------------------------|--------------------|---------------------------|--------------------|
|                                  |                    | LASHAM                    | LASHAM             |
| <b>GENERAL</b>                   |                    |                           |                    |
| STATION DESIGNATION              | -                  | Lasham                    | Lasham             |
| LOCATION(S)                      | -                  | England                   | England            |
| DIAMETER                         | m                  | 4.6 (Sarsat Tracking)     | 12.2 (Tracking)    |
| <b>GEOGRAPHICAL</b>              |                    |                           |                    |
| LOCATION, COUNTRY/STATE          | Name               | Hampshire                 | Hampshire          |
| LOCATION, CITY                   | Name               | Basingstoke               | Basingstoke        |
| LONGITUDE (site 1/site 2/site 3) | d, m, s            | 358, 58, 33 E             | 358, 58, 28 E      |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 51, 11, 07 N              | 51, 11, 01 N       |
|                                  |                    |                           |                    |
|                                  |                    |                           |                    |
|                                  |                    |                           |                    |
|                                  |                    |                           |                    |
| <b>MECHANICAL</b>                |                    |                           |                    |
| TYPE OF MOUNT                    | -                  | El over Az                | Non-Orthogonal     |
| AZIMUTH LIMITATIONS              | -                  | + 270 to -270             | + 250 to -271      |
| TRACKING SPEED RANGE             | deg/s              | 0 - 18                    | 0 - 10             |
| MAX TRACK ACCELERATION           | deg/s <sup>2</sup> | 15                        | 5                  |
| TYPE OF POINTING                 | Type               | Program                   | Manual or Computer |
| POINTING ACCURACY                | deg                | 0.25                      | 0.001              |
| MIN TRANSMIT ELEV ANGLE          | deg                | (1)                       | 0                  |
| MIN RECEIVE ELEV ANGLE           | deg                | 0                         | 0                  |
|                                  |                    |                           |                    |
|                                  |                    |                           |                    |
|                                  |                    |                           |                    |
|                                  |                    |                           |                    |
| <b>SUPPORT</b>                   |                    |                           |                    |
| TRANSMIT FREQ BAND(S)            | GHz                | (1)                       | 2.09375            |
| RECEIVE FREQ BAND(S)             | GHz                | 1.544 - 1.72              | 1.5 - 2.3          |
| ACQ AID FREQ BAND(S)             | GHz                | (1)                       | None               |
| MISSION CATEGORIES               | Cat                | A                         | A                  |
|                                  |                    | (Cospas-Sarsat Dedicated) |                    |
|                                  |                    |                           |                    |
|                                  |                    |                           |                    |
|                                  |                    |                           |                    |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS  
4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES

6445-2157

CCSDS HISTORICAL DOCUMENT  
**ESA ESTRACK**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS           | SUBNETWORK OR STATION                         |   |
|---|-----------------|---|---|
|   |                 | KIRUNA  | KOUROU  |
| <b>GENERAL</b>  |                 |   |   |
| STATION DESIGNATION   | -               | Kiruna  | Kourou  |
| LOCATION(S)   | -               | Kiruna, Sweden                                | Kourou, French Guiana                         |
| DIAMETER  | m               | 15  | 15  |
| <b>TRANSMIT</b>   |                 |   |   |
| FREQUENCIES   | MHz             | 2025 - 2120                                   | 2025 - 2120                                   |
| FREQUENCY RESOLUTION  | Hz              | 10  | 10  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$    | $3 \times 10^{-6}$                            | $3 \times 10^{-6}$                            |
| TRANSMIT POWER 1  | W               | 300   | 400   |
| EIRP RANGE 1  | dBW             | 71  | 73  |
| TRANSMIT POWER 2  | W               | None  | 2000  |
| EIRP RANGE 2  | dBW             | None  | 80  |
| POLARIZATION  | -               | RCP or LCP                                    | RCP or LCP                                    |
| ANTENNA GAIN  | dB <sub>i</sub> | 46  | 47.4  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg             | 0.7   | 0.7   |
| ANTENNA ELLIPTICITY   | dB              | 1   | 1   |
| RF FREQ SWEEP RANGE   | kHz             | 0.1 - 100                                     | 0.1 - 100                                     |
| MIN FREQ SWEEP RATE   | Hz/s            | 10  | 10  |
| MAX FREQ SWEEP RATE   | kHz/s           | 100   | 100   |
| PROGRAMMED UPLINK FREQ  | Yes/No          | No  | No  |
| <b>COMMAND</b>  |                 |   |   |
| RF CARRIER MOD TYPE   | -               | PM  | PM  |
| RF CARRIER MOD INDEX RNG  | Rad Pk          | 0.1 - 1.4                                     | 0.1 - 1.4                                     |
| SUBCARRIER FREQUENCY(S)   | Hz              | 8000, 16 000                                  | 8000 - 16 000                                 |
| SUBCARRIER STEP SIZE  | Hz              | (1)   | (1)   |
| SUBCARRIER FREQ STABILITY   | ppm             | $3 \times 10^{-6}$                            | $3 \times 10^{-6}$                            |
| SUBCARRIER WAVEFORM   | Sin/Sq          | Sine  | Sine  |
| SUBCARRIER MOD TYPE   | -               | PSK   | PSK   |
| SUBCARRIER/BIT RATE LIMIT   | -               | > 8; Coh $\pm$ 6 deg                          | > 8; Coh $\pm$ 6 deg                          |
| BIT RATE RANGE  | b/s             | 4000 <sup>1</sup> ; $\eta = 0, 1, 2, \dots 9$ | 4000 <sup>1</sup> ; $\eta = 0, 1, 2, \dots 9$ |
| FORMATS AVAILABLE   | -               | NRZ - L; Bi - $\phi$ - L                      | NRZ - L; Bi - $\phi$ - L                      |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |                 |   |   |

6445-3083

**CCSDS HISTORICAL DOCUMENT**  
**ESA ESTRACK**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                  |                                  |                                    |                                  |
|---|--------------|--|----------------------------------|------------------------------------|----------------------------------|
|   |              | KIRUNA                                 |                                  | KOUROU                             |                                  |
| <b>GENERAL</b>  |              |  |                                  |                                    |                                  |
| STATION DESIGNATION   | -            | Kiruna                                 |                                  | Kourou                             |                                  |
| LOCATION(S)   | -            | Kiruna, Sweden                         |                                  | Kourou, French Guiana              |                                  |
| DIAMETER  | m            | 15                                     |                                  | 15                                 |                                  |
| <b>RECEIVE</b>  |              |  |                                  |                                    |                                  |
| FREQUENCIES   | MHz          | 2200 - 2300                            | 8025 - 8500                      | 2200 - 2300                        | 8025 - 8500                      |
| FREQUENCY RESOLUTION  | Hz           | 150                                    | 150                              | 150                                | 150                              |
| ANTENNA GAIN @ 45 deg   | dBi          | 48.6                                   | 57.7                             | 49.4                               | 59.8                             |
| SYS NOISE TEMP @ ZENITH   | K            | 93                                     | 208                              | 85                                 | 144                              |
| G/T @ ZENITH  | dB           | 28.9                                   | 34.5                             | 30.1                               | 38.2                             |
| POLARIZATION  | -            | RCP and LCP                            | RCP or LCP                       | RCP and LCP                        | RCP and LCP                      |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.65                                   | 0.18                             | 0.65                               | 0.18                             |
| ANTENNA ELLIPTICITY   | dB           | 1                                      | 1                                | 1                                  | 1                                |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $3 \times 10^{-6}$                     | $3 \times 10^{-6}$               | $3 \times 10^{-6}$                 | $3 \times 10^{-6}$               |
| RCVR AGC DYNAMIC RANGE  | dB           | 75                                     | 40                               | 70                                 | 70                               |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -150 in 2 Blo = 30 Hz                  | -146 in 2 Blo = 30 Hz            | -150 in 2 Blo = 30 Hz              | -148 in 2 Blo = 30 Hz            |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 100, 300, 1 K                      | (1)                              | 30, 100, 300, 1 K                  | 30, 100, 300, 1 K                |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Fix                                    | Fix                              | Fix                                | Fix                              |
| RCVR PLL ORDER(S)   | No.          | 2                                      | 2                                | 2                                  | 2                                |
| ACQ SWEEP RANGE   | kHz          | $\pm 5, \pm 15, \pm 50, \pm 150$       | $\pm 5, \pm 15, \pm 50, \pm 150$ | $\pm 5, \pm 15, \pm 50, \pm 150$   | $\pm 5, \pm 15, \pm 50, \pm 150$ |
| MIN ACQ SWEEP RATE  | Hz/s         | 150                                    | 80                               | 150                                | 80                               |
| MAX ACQ SWEEP RATE  | kHz/s        | 1500                                   | 80                               | 1500                               | 80                               |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                             | Continuous                       | Continuous                         | Continuous                       |
| PROGRAMMED L.O.   | Yes/No       | No                                     | No                               | No                                 | No                               |
|   |              |  |                                  |                                    |                                  |
|   |              |  |                                  |                                    |                                  |
|   |              |  |                                  |                                    |                                  |
|   |              |  |                                  |                                    |                                  |
| <b>TELEMETRY</b>  |              |  |                                  |                                    |                                  |
| MODULATION TYPE(S)  | -            | PM                                     | (U)QPSK                          | PM, BPSK, (U)QPSK                  |                                  |
| MODULATION FORMAT(S)  | -            | PSK; NRZ - L, M,<br>Bi - $\phi$ - L, M | NRZ-L                            | NRZ - L, M; Bi - $\phi$ - L        |                                  |
| MOD INDEX RANGE   | Rad Pk       | $\leq 1.5$                             | (1)                              | $\leq 1.5$                         |                                  |
| SUBCARRIER FREQ RANGE   | kHz          | 65.536 Only                            | (1)                              | 2 - 1000                           |                                  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine or Square                         | (1)                              | Sine or Square                     |                                  |
| SYMBOL RATE RANGE   | s/s          | 2000 Only                              | QPSK Only, 8<br>750 000 & 15 000 | 1 200 000 (PM), 32 000 - 4 096 000 |                                  |
| SUBCARRIER/SYM RATE LIMIT   | -            | 65.536 / 2000                          | (1)                              | 40 - 1024                          |                                  |
| ARRAYS WITH STATIONS  | -            | None                                   | None                             | None                               |                                  |
| CHANNEL DECODING  | Type         | None                                   | None                             | CCSDS R/S Conv, Concat             |                                  |
| DATA FORMAT   | -            | TDM                                    | TDM                              | CCSDS Xfer Frame / VC Service      |                                  |
|   |              |  |                                  |                                    |                                  |
|   |              |  |                                  |                                    |                                  |
|   |              |  |                                  |                                    |                                  |
|   |              |  |                                  |                                    |                                  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |  |                                  |                                    |                                  |

6445-3084

**ESA ESTRACK**

RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |                     |                       |                     |
|---|--------------|-----------------------|---------------------|-----------------------|---------------------|
|   |              | KIRUNA                |                     | KOUROU                |                     |
| <b>GENERAL</b>  |              |                       |                     |                       |                     |
| STATION DESIGNATION   | -            | Kiruna                |                     | Kourou                |                     |
| LOCATION(S)   | -            | Kiruna, Sweden        |                     | Kourou, French Guiana |                     |
| DIAMETER  | m            | 15                    |                     | 15                    |                     |
| <b>FREQUENCIES</b>  |              |                       |                     |                       |                     |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120           | 2025 - 2120         | 2025 - 2120           | 2025 - 2120         |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300           | 8025 - 8500         | 2200 - 2300           | 8025 - 8500         |
| TURNAROUND FREQ RATIO   | -            | 240 / 221             | 880 / 221           | 240 / 221             | 880 / 221           |
| <b>DOPPLER</b>  |              |                       |                     |                       |                     |
| COHERENT/NON-COHERENT   | -            | Coherent              | Coherent            | Coherent              | Coherent            |
| COUNTER RESOLUTION  | Cycles       | < 10 <sup>-3</sup>    | < 10 <sup>-3</sup>  | < 10 <sup>-3</sup>    | < 10 <sup>-3</sup>  |
| MAX DOPPLER FREQ SHIFT  | MHz          | 3                     | 3                   | 3                     | 3                   |
| DOPPLER BIAS FREQ   | MHz          | 0.05 - 3              | 0.05 - 3            | 0.05 - 3              | 0.05 - 3            |
| DRIFT   | $\Delta f/f$ | < 10 <sup>-11</sup>   | < 10 <sup>-11</sup> | < 10 <sup>-11</sup>   | < 10 <sup>-12</sup> |
| OUTPUT EQUATION   | -            | (1)                   | (1)                 | (1)                   | (1)                 |
| DIRECTION INDICATOR   | -            | (1)                   | (1)                 | (1)                   | (1)                 |
| <b>RANGING</b>  |              |                       |                     |                       |                     |
| COHERENT/NON-COHERENT   | -            | Either                |                     | Either                |                     |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine / PRN            |                     | Sine / PRN            |                     |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.1 - 1.2             |                     | 0.1 - 1.2             |                     |
| RANGE CODE FREQ RATIO   | -            | (1)                   |                     | (1)                   |                     |
| MAJOR CODE FREQ(S)  | kHz          | 100 - 1500            |                     | 100 - 1500            |                     |
| MINOR CODE FREQ(S)  | kHz          | PRN Code              |                     | PRN Code              |                     |
| MIN RECEIVED CARRIER SNR  | dB           | 10                    |                     | 10                    |                     |
| MIN REQ CODE PWR/No   | dB-Hz        | -10                   |                     | -10                   |                     |
| CODE INTEGRATION TIME   | s            | Any                   |                     | Any                   |                     |
| ACQUISITION SEQUENCE  | -            | Sine then Sine / PRN  |                     | Sine then Sine / PRN  |                     |
| RANGE DATA UNITS  | -            | Nanoseconds           |                     | Nanosecond            |                     |
| RANGE QUANTIZATION  | -            | 2 ns                  |                     | 2 ns                  |                     |
| ACCURACY (STRONG SIGNAL)  | m            | 0.15                  |                     | 0.15                  |                     |
| MAX UNAMBIGUOUS RANGE   | km           | 500 000               |                     | 500 000               |                     |
| TRANSPONDER BW  | MHz          | 0.2 - 3               |                     | 0.2 - 3               |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |                     |                       |                     |

6445-3085

**ESA ESTRACK**

FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS   | UNITS         | SUBNETWORK OR STATION |                     |                       |                     |
|---|---------------|-----------------------|---------------------|-----------------------|---------------------|
|   |               | KIRUNA                |                     | KOUROU                |                     |
| <b>GENERAL</b>  |               |                       |                     |                       |                     |
| STATION DESIGNATION   | -             | Kiruna                |                     | Kourou                |                     |
| LOCATION(S)   | -             | Kiruna, Sweden        |                     | Kourou, French Guiana |                     |
| DIAMETER  | m             | 15                    |                     | 15                    |                     |
| <b>FREQUENCY STD</b>  |               |                       |                     |                       |                     |
| STANDARD TYPE   | Name          | Cesium                |                     | Cesium                |                     |
| STANDARD MFG  | Name          | Oscilloquartz 3210    |                     | Oscilloquartz 3210    |                     |
| STABILITY AT:   |               | <b>Allan Variance</b> | <b>Drift</b>        | <b>Allan Variance</b> | <b>Drift</b>        |
| 1 - SECOND  | $\Delta f/f$  | $1 \times 10^{-11}$   | (1)                 | $1 \times 10^{-11}$   | (1)                 |
| 1 - HOUR  | $\Delta f/f$  | $1 \times 10^{-12}$   | (1)                 | $1 \times 10^{-12}$   | (1)                 |
| 1 - DAY (24 HOURS)  | $\Delta f/f$  | $1 \times 10^{-13}$   | (1)                 | $3 \times 10^{-13}$   | (1)                 |
| 1 - MONTH   | $\Delta f/f$  | (1)                   | $3 \times 10^{-12}$ | (1)                   | $3 \times 10^{-12}$ |
| REF FREQS PHASE NOISE   | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b>      | <b>5 MHz</b>          | <b>100 MHz</b>      |
| 1 Hz OFFSET   | dBc/Hz        | $N / A^1$             | (1)                 | (1)                   | (1)                 |
| 10 Hz OFFSET  | dBc/Hz        | -120                  | (1)                 | -120                  | (1)                 |
| 100 Hz OFFSET   | dBc/Hz        | -140                  | (1)                 | -140                  | (1)                 |
| 1000 Hz OFFSET  | dBc/Hz        | -140                  | (1)                 | -140                  | (1)                 |
| REF FREQS AVAILABLE   | MHz           | 5                     |                     | 5                     |                     |
| MAX STA-TO-STA OFFSET   | Hz            | $3 \times 10^{-12}$   |                     | $3 \times 10^{-12}$   |                     |
| <b>TIMING SYSTEM</b>  |               |                       |                     |                       |                     |
| MASTER REFERENCE AGENCY   | Name          | USNO                  |                     | USNO                  |                     |
| REFERENCE TIME  | Name          | UTC                   |                     | UTC                   |                     |
| TIME CODE EPOCH   | Yr            | 1 January 1958        |                     | 1 January 1958        |                     |
| TIME CODES AVAILABLE  | CCSDS Codes   | CDS                   |                     | CDS                   |                     |
| MAX TIME RESOLUTION   | s             | $1 \times 10^{-6}$    |                     | $1 \times 10^{-6}$    |                     |
| TIME TRANSFER METHOD  | Name          | GPS                   |                     | GPS                   |                     |
| MAX TRANS ERROR REF   | $\mu$ -sec    | $\pm 5$               |                     | $\pm 5$               |                     |
| MAX OFFSET FROM REF   | $\mu$ -sec    | $\pm 50$              |                     | $\pm 50$              |                     |
| MAX OFFSET MEAS ERROR   | $\mu$ -sec    | 0.05                  |                     | 0.05                  |                     |
| MAX STA-TO-STA OFFSET   | $\mu$ -sec    | 100                   |                     | 100                   |                     |
| TIMING SIGNALS AVAILABLE  | pulse/s       | 1                     |                     | 1                     |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY<br>4. MEASURED BY THE AGENCY |               |                       |                     |                       |                     |

CCSDS HISTORICAL DOCUMENT  
**ESA ESTRACK**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS                        | UNITS  | SUBNETWORK OR STATION              |                                    |
|--|--|------------------------------------|------------------------------------|
|  |  | KIRUNA                             | KOUROU                             |
| <b>GENERAL</b>                         |  |                                    |                                    |
| STATION DESIGNATION                    | -  | Kiruna                             | Kourou                             |
| LOCATION(S)                            | -  | Kiruna, Sweden                     | Kourou, French Guiana              |
| DIAMETER                               | m  | 15                                 | 15                                 |
| <b>GEOGRAPHICAL</b>                    |  |                                    |                                    |
| LOCATION, COUNTRY/STATE                | Name   | Sweden                             | French Guiana                      |
| LOCATION, CITY                         | Name   | Kiruna                             | Kourou                             |
| LONGITUDE (site 1/site 2/site 3)       | d, m, s                                      | 20, 57, 51.48 E                    | 307, 11, 43.44 E                   |
| LATITUDE (site 1/site 2/site 3)        | d, m, s                                      | 67, 51, 25.56 N                    | 5, 15, 5.04 N                      |
|  |  |                                    |                                    |
|  |  |                                    |                                    |
|  |  |                                    |                                    |
|  |  |                                    |                                    |
| <b>MECHANICAL</b>                      |  |                                    |                                    |
| TYPE OF MOUNT                          | -  | Elevation over Azimuth             | Elevation over Azimuth             |
| AZIMUTH LIMITATIONS                    | -  | 0 - 720                            | 0 - 720                            |
| TRACKING SPEED RANGE                   | deg/s  | 15 Az / 5 EI                       | 15 Az / 5 EI                       |
| MAX TRACK ACCELERATION                 | deg/s <sup>2</sup>                           | 7.5 Az / 2.5 EI                    | 7.5 Az / 2.5 EI                    |
| TYPE OF POINTING                       | Type   | Autotrack, Programtrack and Manual | Autotrack, Programtrack and Manual |
| POINTING ACCURACY                      | deg  | 0.05                               | 0.05                               |
| MIN TRANSMIT ELEV ANGLE                | deg  | 5                                  | 5                                  |
| MIN RECEIVE ELEV ANGLE                 | deg  | 5                                  | 5                                  |
|  |  |                                    |                                    |
|  |  |                                    |                                    |
|  |  |                                    |                                    |
|  |  |                                    |                                    |
|  |  |                                    |                                    |
| <b>SUPPORT</b>                         |  |                                    |                                    |
| TRANSMIT FREQ BAND(S)                  | GHz  | 2.025 - 2.12                       | 2.025 - 2.12                       |
| RECEIVE FREQ BAND(S)                   | GHz  | 2.2 - 2.3, 8.025 - 8.5             | 2.2 - 2.3, 8.025 - 8.5             |
| ACQ AID FREQ BAND(S)                   | GHz  | (1)                                | (1)                                |
| MISSION CATEGORIES                     | Cat  | A & B                              | A & B                              |
|  |  |                                    |                                    |
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|  |  |                                    |                                    |
|  |  |                                    |                                    |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE | 2. SOME LIMITATIONS APPLY TO THIS CAPABILITY | 3. NOT RECOMMENDED BY CCSDS        |                                    |
| 4. BASED UPON GEOCENTRIC COORDINATES   | 5. BASED UPON GEODETIC COORDINATES           |                                    |                                    |

**ESA ESTRACK**

EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION                         |   |
|---------------------------|--------------|---|---|
|                           |              | PERTH   | REDU  |
| <b>GENERAL</b>            |              |   |   |
| STATION DESIGNATION       | -            | Perth   | Redu  |
| LOCATION(S)               | -            | Perth, Australia                              | Redu, Belgium                                 |
| DIAMETER                  | m            | 15  | 15  |
| <b>TRANSMIT</b>           |              |   |   |
| FREQUENCIES               | MHz          | 2025 - 2120                                   | 2025 - 2120                                   |
| FREQUENCY RESOLUTION      | Hz           | 10  | 10  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $3 \times 10^{-6}$                            | $3 \times 10^{-6}$                            |
| TRANSMIT POWER 1          | W            | 400   | 300   |
| EIRP RANGE 1              | dBW          | 72  | 73  |
| TRANSMIT POWER 2          | W            | 2000  | None  |
| EIRP RANGE 2              | dBW          | 79  | None  |
| POLARIZATION              | -            | RCP or LCP                                    | RCP or LCP                                    |
| ANTENNA GAIN              | dBi          | 46.3  | 48.4  |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.7   | 0.7   |
| ANTENNA ELLIPTICITY       | dB           | 1   | 1   |
| RF FREQ SWEEP RANGE       | kHz          | 0.1 - 100                                     | 0.1 - 100                                     |
| MIN FREQ SWEEP RATE       | Hz/s         | 10  | 10  |
| MAX FREQ SWEEP RATE       | kHz/s        | 100   | 100   |
| PROGRAMMED UPLINK FREQ    | Yes/No       | No  | No  |
|                           |              |   |   |
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|                           |              |   |   |
| <b>COMMAND</b>            |              |   |   |
| RF CARRIER MOD TYPE       | -            | PM  | PM  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.1 - 1.4                                     | 0.1 - 1.4                                     |
| SUBCARRIER FREQUENCY(S)   | Hz           | 8000 - 16 000                                 | 8000, 16 000                                  |
| SUBCARRIER STEP SIZE      | Hz           | (1)   | (1)   |
| SUBCARRIER FREQ STABILITY | ppm          | $3 \times 10^{-6}$                            | $3 \times 10^{-6}$                            |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine  | Sine  |
| SUBCARRIER MOD TYPE       | -            | PSK   | PSK   |
| SUBCARRIER/BIT RATE LIMIT | -            | > 8; Coh $\pm$ 6 deg                          | > 8; Coh $\pm$ 6 deg                          |
| BIT RATE RANGE            | b/s          | 4000 <sup>1</sup> ; $\eta = 0, 1, 2, \dots 9$ | 4000 <sup>1</sup> ; $\eta = 0, 1, 2, \dots 9$ |
| FORMATS AVAILABLE         | -            | NRZ - L; Bi - $\phi$ - L                      | NRZ - L; Bi - $\phi$ - L                      |
|                           |              |   |   |
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1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

**CCSDS HISTORICAL DOCUMENT**  
**ESA ESTRACK**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION              |                                  |                                  |
|---|--------------|------------------------------------|----------------------------------|----------------------------------|
|   |              | PERTH                              |                                  | REDU                             |
| <b>GENERAL</b>  |              |                                    |                                  |                                  |
| STATION DESIGNATION   | -            | Perth                              |                                  | Redu                             |
| LOCATION(S)   | -            | Perth, Australia                   |                                  | Redu, Belgium                    |
| DIAMETER  | m            | 15                                 |                                  | 15                               |
| <b>RECEIVE</b>  |              |                                    |                                  |                                  |
| FREQUENCIES   | MHz          | 2200 - 2300                        | 8025 - 8500                      | 2200 - 2300                      |
| FREQUENCY RESOLUTION  | Hz           | 150                                | 150                              | 150                              |
| ANTENNA GAIN @ 45 deg   | dBi          | 47.6                               | 59                               | 49.4                             |
| SYS NOISE TEMP @ ZENITH   | K            | 87                                 | 120                              | 85                               |
| G/T @ ZENITH  | dB           | 28.2                               | 38.2                             | 30.1                             |
| POLARIZATION  | -            | RCP and LCP                        | RCP and LCP                      | RCP and LCP                      |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.65                               | 0.18                             | 0.65                             |
| ANTENNA ELLIPTICITY   | dB           | 1                                  | 1                                | 1                                |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $3 \times 10^{-6}$                 | $3 \times 10^{-6}$               | $3 \times 10^{-6}$               |
| RCVR AGC DYNAMIC RANGE  | dB           | 70                                 | 70                               | 70                               |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -150 in 2 Blo = 30 Hz              | -149 in 2 Blo = 30 Hz            | -155 in 2 Blo = 30 Hz            |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 100, 300, 1 K                  | 30, 100, 300, 1 K                | 30, 100, 300, 1 K                |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Fix                                | Fix                              | Fix                              |
| RCVR PLL ORDER(S)   | No.          | 2                                  | 2                                | 2                                |
| ACQ SWEEP RANGE   | kHz          | $\pm 5, \pm 15, \pm 50, \pm 150$   | $\pm 5, \pm 15, \pm 50, \pm 150$ | $\pm 5, \pm 15, \pm 50, \pm 150$ |
| MIN ACQ SWEEP RATE  | Hz/s         | 150                                | 80                               | 150                              |
| MAX ACQ SWEEP RATE  | kHz/s        | 1500                               | 80                               | 1500                             |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                         | Continuous                       | Continuous                       |
| PROGRAMMED L.O.   | Yes/No       | No                                 | No                               | No                               |
|   |              |                                    |                                  |                                  |
|   |              |                                    |                                  |                                  |
|   |              |                                    |                                  |                                  |
|   |              |                                    |                                  |                                  |
| <b>TELEMETRY</b>  |              |                                    |                                  |                                  |
| MODULATION TYPE(S)  | -            | PM, BPSK, (U) QPSK                 |                                  | PM                               |
| MODULATION FORMAT(S)  | -            | NRZ - L, M; Bi - $\phi$ - L, M     |                                  | NRZ - L, M; Bi - $\phi$ - L      |
| MOD INDEX RANGE   | Rad Pk       | $< = 1.5$                          |                                  | $< = 1.5$                        |
| SUBCARRIER FREQ RANGE   | kHz          | 2 - 1000                           |                                  | 2 - 1000                         |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine or Square                     |                                  | Sine or Square                   |
| SYMBOL RATE RANGE   | s/s          | 1 200 000 (PM), 32 000 - 4 096 000 |                                  | 40 - 1 200 000                   |
| SUBCARRIER/SYM RATE LIMIT   | -            | 40 - 1024                          |                                  | 40 - 1024                        |
| ARRAYS WITH STATIONS  | -            | None                               |                                  | None                             |
| CHANNEL DECODING  | TYPE         | CCSDS R/S Conv. Concat.            |                                  | CCSDS R/S Conv. Concat           |
| DATA FORMAT   | -            | CCSDS Xfer Frame / VC Service      |                                  | CCSDS Xfer Frame / VC Service    |
|   |              |                                    |                                  |                                  |
|   |              |                                    |                                  |                                  |
|   |              |                                    |                                  |                                  |
|   |              |                                    |                                  |                                  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                                    |                                  |                                  |

6445-3089

**ESA ESTRACK**

RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |              |                      |
|---|--------------|-----------------------|--------------|----------------------|
|   |              | PERTH                 |              | REDU                 |
| <b>GENERAL</b>  |              |                       |              |                      |
| STATION DESIGNATION   | -            | Perth                 |              | Redu                 |
| LOCATION(S)   | -            | Perth, Australia      |              | Redu, Belgium        |
| DIAMETER  | m            | 15                    |              | 15                   |
| <b>FREQUENCIES</b>  |              |                       |              |                      |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120           | 2025 - 2120  | 2025 - 2120          |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300           | 8025 - 8500  | 2200 - 2300          |
| TURNAROUND FREQ RATIO   | -            | 240 / 221             | 880 / 221    | 240 / 221            |
| <b>DOPPLER</b>  |              |                       |              |                      |
| COHERENT/NON-COHERENT   | -            | Coherent              | Coherent     | Coherent             |
| COUNTER RESOLUTION  | Cycles       | $< 10^{-3}$           | $< 10^{-3}$  | $< 10^{-3}$          |
| MAX DOPPLER FREQ SHIFT  | MHz          | 3                     | 3            | 3                    |
| DOPPLER BIAS FREQ   | MHz          | 0.05 - 3              | 0.05 - 3     | 0.05 - 3             |
| DRIFT   | $\Delta f/f$ | $< 10^{-11}$          | $< 10^{-12}$ | $< 10^{-11}$         |
| OUTPUT EQUATION   | -            | (1)                   | (1)          | (1)                  |
| DIRECTION INDICATOR   | -            | (1)                   | (1)          | (1)                  |
| <b>RANGING</b>  |              |                       |              |                      |
| COHERENT/NON-COHERENT   | -            | Either                |              | Either               |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine / PRN            |              | Sine / PRN           |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.1 - 1.2             |              | 0.1 - 1.2            |
| RANGE CODE FREQ RATIO   | -            | (1)                   |              | (1)                  |
| MAJOR CODE FREQ(S)  | kHz          | 100 - 1500            |              | 100 - 1500           |
| MINOR CODE FREQ(S)  | kHz          | PRN Code              |              | PRN Code             |
| MIN RECEIVED CARRIER SNR  | dB           | 10                    |              | 10                   |
| MIN REQ CODE PWR/No   | dB-Hz        | -10                   |              | -10                  |
| CODE INTEGRATION TIME   | s            | Any                   |              | Any                  |
| ACQUISITION SEQUENCE  | -            | Sine then Sine / PRN  |              | Sine then Sine / PRN |
| RANGE DATA UNITS  | -            | Nanosecond            |              | Nanosecond           |
| RANGE QUANTIZATION  | -            | 2 ns                  |              | 2 ns                 |
| ACCURACY (STRONG SIGNAL)  | m            | 0.15                  |              | 0.15                 |
| MAX UNAMBIGUOUS RANGE   | km           | 500 000               |              | 500 000              |
| TRANSPONDER BW  | MHz          | 0.2 - 3               |              | 0.2 - 3              |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |              |                      |

6445-3090

**ESA ESTRACK**

FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                     |                       |                     |
|--|---------------|-----------------------|---------------------|-----------------------|---------------------|
|  |               | PERTH                 |                     | REDU                  |                     |
| <b>GENERAL</b>   |               |                       |                     |                       |                     |
| STATION DESIGNATION  | -             | Perth                 |                     | Redu                  |                     |
| LOCATION(S)  | -             | Perth, Australia      |                     | Redu, Belgium         |                     |
| DIAMETER   | m             | 15                    |                     | 15                    |                     |
| <b>FREQUENCY STD</b>   |               |                       |                     |                       |                     |
| STANDARD TYPE  | Name          | Cesium                |                     | Cesium                |                     |
| STANDARD MFG   | Name          | Oscilloquartz 3210    |                     | Oscilloquartz 3210    |                     |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Drift</b>        | <b>Allan Variance</b> | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | $1 \times 10^{-11}$   | (1)                 | $1 \times 10^{-11}$   | (1)                 |
| 1 - HOUR   | $\Delta f/f$  | $1 \times 10^{-12}$   | (1)                 | $1 \times 10^{-12}$   | (1)                 |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | $3 \times 10^{-13}$   | (1)                 | $1 \times 10^{-13}$   | (1)                 |
| 1 - MONTH  | $\Delta f/f$  | (1)                   | $3 \times 10^{-12}$ | (1)                   | $3 \times 10^{-12}$ |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b>      | <b>5 MHz</b>          | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dB/Hz         | (1)                   | (1)                 | (1)                   | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | -120                  | (1)                 | -120                  | (1)                 |
| 100 Hz OFFSET  | dBc/Hz        | -140                  | (1)                 | -140                  | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz        | -140                  | (1)                 | -140                  | (1)                 |
| REF FREQS AVAILABLE  | MHz           | 5                     |                     | 5                     |                     |
| MAX STA-TO-STA OFFSET  | Hz            | $3 \times 10^{-12}$   |                     | $3 \times 10^{-12}$   |                     |
|  |               |                       |                     |                       |                     |
|  |               |                       |                     |                       |                     |
|  |               |                       |                     |                       |                     |
| <b>TIMING SYSTEM</b>   |               |                       |                     |                       |                     |
| MASTER REFERENCE AGENCY  | Name          | USNO                  |                     | USNO                  |                     |
| REFERENCE TIME   | Name          | UTC                   |                     | UTC                   |                     |
| TIME CODE EPOCH  | Yr            | 1 January 1958        |                     | 1 January 1958        |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | CDS                   |                     | CDS                   |                     |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$    |                     | $1 \times 10^{-6}$    |                     |
| TIME TRANSFER METHOD   | Name          | GPS                   |                     | GPS                   |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 5$               |                     | $\pm 5$               |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 50$              |                     | $\pm 50$              |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 0.05                  |                     | 0.05                  |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 100                   |                     | 100                   |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                     |                     | 1                     |                     |
|  |               |                       |                     |                       |                     |
|  |               |                       |                     |                       |                     |
|  |               |                       |                     |                       |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                     |                       |                     |

**ESA ESTRACK**

GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION              |                                    |
|---|--------------------|------------------------------------|------------------------------------|
|   |                    | PERTH                              | REDU                               |
| <b>GENERAL</b>  |                    |                                    |                                    |
| STATION DESIGNATION   | -                  | Perth                              | Redu                               |
| LOCATION(S)   | -                  | Perth, Australia                   | Redu, Belgium                      |
| DIAMETER  | m                  | 15                                 | 15                                 |
| <b>GEOGRAPHICAL</b>   |                    |                                    |                                    |
| LOCATION, COUNTRY/STATE   | Name               | Australia                          | Belgium                            |
| LOCATION, CITY  | Name               | Perth                              | Redu                               |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 115, 53, 6.36 E                    | 5, 08, 25.8 E                      |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 31, 48, 9 S                        | 50, 01, 00 N                       |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
| <b>MECHANICAL</b>   |                    |                                    |                                    |
| TYPE OF MOUNT   | -                  | Elevation over Azimuth             | Elevation over Azimuth             |
| AZIMUTH LIMITATIONS   | -                  | 0 - 720                            | 0 - 720                            |
| TRACKING SPEED RANGE  | deg/s              | 15 Az / 5 EI                       | 5                                  |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 7.5 Az / 2.5 EI                    | 2.5                                |
| TYPE OF POINTING  | Type               | Autotrack, Programtrack and Manual | Autotrack, Programtrack and Manual |
| POINTING ACCURACY   | deg                | 0.05                               | 0.05                               |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5                                  | 5                                  |
| MIN RECEIVE ELEV ANGLE  | deg                | 5                                  | 5                                  |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
| <b>SUPPORT</b>  |                    |                                    |                                    |
| TRANSMIT FREQ BAND(S)   | GHz                | 2.025 - 2.12                       | 2.025 - 2.12                       |
| RECEIVE FREQ BAND(S)  | GHz                | 2.2 - 2.3, 8.025 - 8.5             | 2.2 - 2.3                          |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                                | (1)                                |
| MISSION CATEGORIES  | Cat                | A & B                              | A & B                              |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                                    |                                    |

6445-3092

CCSDS HISTORICAL DOCUMENT  
**ESA ESTRACK**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION                     |   |
|---------------------------|--------------|---|---|
|                           |              | VILLAFRANCA                               | VILLAFRANCA                               |
| <b>GENERAL</b>            |              |   |   |
| STATION DESIGNATION       | -            | Vilspa-1                                  | Vilspa-2                                  |
| LOCATION(S)               | -            | Villafranca, Spain                        | Villafranca, Spain                        |
| DIAMETER                  | m            | 15  | 15  |
| <b>TRANSMIT</b>           |              |   |   |
| FREQUENCIES               | MHz          | 2025 - 2120                               | 2025 - 2120                               |
| FREQUENCY RESOLUTION      | Hz           | 10  | 10  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $3 \times 10^{-6}$                        | $3 \times 10^{-6}$                        |
| TRANSMIT POWER 1          | W            | 300                                       | 400                                       |
| EIRP RANGE 1              | dBW          | 73  | 72  |
| TRANSMIT POWER 2          | W            | None                                      | 2000                                      |
| EIRP RANGE 2              | dBW          | None                                      | 79  |
| POLARIZATION              | -            | RCP or LCP                                | RCP or LCP                                |
| ANTENNA GAIN              | dBi          | 48.4                                      | 46.2                                      |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.7                                       | 0.7                                       |
| ANTENNA ELLIPTICITY       | dB           | 1   | 1   |
| RF FREQ SWEEP RANGE       | kHz          | 0.1 - 100                                 | 0.1 - 100                                 |
| MIN FREQ SWEEP RATE       | Hz/s         | 10  | 10  |
| MAX FREQ SWEEP RATE       | kHz/s        | 100                                       | 100                                       |
| PROGRAMMED UPLINK FREQ    | Yes/No       | No  | No  |
|                           |              |   |   |
|                           |              |   |   |
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|                           |              |   |   |
|                           |              |   |   |
| <b>COMMAND</b>            |              |   |   |
| RF CARRIER MOD TYPE       | -            | PM  | PM  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.1 - 1.4                                 | 0.1 - 1.4                                 |
| SUBCARRIER FREQUENCY(S)   | Hz           | 8000, 16 000                              | 8000, 16 000                              |
| SUBCARRIER STEP SIZE      | Hz           | (1)                                       | (1)                                       |
| SUBCARRIER FREQ STABILITY | ppm          | $3 \times 10^{-6}$                        | $3 \times 10^{-6}$                        |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine                                      | Sine                                      |
| SUBCARRIER MOD TYPE       | -            | PSK                                       | PSK                                       |
| SUBCARRIER/BIT RATE LIMIT | -            | > 8; Coh $\pm$ 6 deg                      | > 8; Coh $\pm$ 6 deg                      |
| BIT RATE RANGE            | b/s          | $4000^{\eta}$ ; $\eta = 0, 1, 2, \dots 9$ | $4000^{\eta}$ ; $\eta = 0, 1, 2, \dots 9$ |
| FORMATS AVAILABLE         | -            | NRZ - L; Bi - $\phi$ - L                  | NRZ - L; Bi - $\phi$ - L                  |
|                           |              |   |   |
|                           |              |   |   |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-3093

CCSDS HISTORICAL DOCUMENT  
**ESA ESTRACK**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION            |                                  |
|---|--------------|----------------------------------|----------------------------------|
|   |              | VILLAFRANCA                      | VILLAFRANCA                      |
| <b>GENERAL</b>  |              |                                  |                                  |
| STATION DESIGNATION   | -            | Vilspa-1                         | Vilspa-2                         |
| LOCATION(S)   | -            | Villafranca, Spain               | Villafranca, Spain               |
| DIAMETER  | m            | 15                               | 15                               |
| <b>RECEIVE</b>  |              |                                  |                                  |
| FREQUENCIES   | MHz          | 2200 - 2300                      | 2200 - 2300                      |
| FREQUENCY RESOLUTION  | Hz           | 150                              | 150                              |
| ANTENNA GAIN @ 45 deg   | dBi          | 49.4                             | 47.6                             |
| SYS NOISE TEMP @ ZENITH   | K            | 85                               | 72                               |
| G/T @ ZENITH  | dB/K         | 30.1                             | 29                               |
| POLARIZATION  | -            | RCP and LCP                      | RCP and LCP                      |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.65                             | 0.65                             |
| ANTENNA ELLIPTICITY   | dB           | 1                                | 1                                |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $3 \times 10^{-6}$               | $3 \times 10^{-6}$               |
| RCVR AGC DYNAMIC RANGE  | dB           | 70                               | 70                               |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -154 in 2 Blo = 30 Hz            | -155 in 2 Blo = 30 Hz            |
| RCVR LOOP BANDWIDTHS  | Hz           | 30,100, 300 1 K                  | 30, 100, 300, 1 K                |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Fix                              | Fix                              |
| RCVR PLL ORDER(S)   | No.          | 2                                | 2                                |
| ACQ SWEEP RANGE   | kHz          | $\pm 5, \pm 15, \pm 50, \pm 150$ | $\pm 5, \pm 15, \pm 50, \pm 150$ |
| MIN ACQ SWEEP RATE  | Hz/s         | 150                              | 150                              |
| MAX ACQ SWEEP RATE  | kHz/s        | 1500                             | 1500                             |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                       | Continuous                       |
| PROGRAMMED L.O.   | Yes/No       | No                               | No                               |
|   |              |                                  |                                  |
|   |              |                                  |                                  |
|   |              |                                  |                                  |
|   |              |                                  |                                  |
| <b>TELEMETRY</b>  |              |                                  |                                  |
| MODULATION TYPE(S)  | -            | PM                               | PM                               |
| MODULATION FORMAT(S)  | -            | NRZ - L, M; Bi - $\phi$ - L, M   | NRZ - L, M; Bi - $\phi$ - L      |
| MOD INDEX RANGE   | Rad Pk       | 0.1 - 1.4                        | $\leq 1.5$                       |
| SUBCARRIER FREQ RANGE   | kHz          | 8000, 16 000                     | 2 - 1000                         |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine or Square                   | Sine or Square                   |
| SYMBOL RATE RANGE   | s/s          | 40 - 1 200 000                   | 40 - 1 200 000                   |
| SUBCARRIER/SYM RATE LIMIT   | -            | 40 - 1024                        | 40 - 1024                        |
| ARRAYS WITH STATIONS  | -            | None                             | None                             |
| CHANNEL DECODING  | Type         | CCSDS R/S Conv. Concat           | CCSDS R/S Conv. Concat           |
| DATA FORMAT   | -            | CCSDS Xfer Frame / VC Service    | CCSDS Xfer Frame / VC Service    |
|   |              |                                  |                                  |
|   |              |                                  |                                  |
|   |              |                                  |                                  |
|   |              |                                  |                                  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                                  |                                  |

6445-3094

**ESA ESTRACK**

RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |                      |
|---|--------------|-----------------------|----------------------|
|   |              | VILLAFRANCA           | VILLAFRANCA          |
| <b>GENERAL</b>  |              |                       |                      |
| STATION DESIGNATION   | -            | Vilspa-1              | Vilspa-2             |
| LOCATION(S)   | -            | Villafranca, Spain    | Villafranca, Spain   |
| DIAMETER  | m            | 15                    | 15                   |
| <b>FREQUENCIES</b>  |              |                       |                      |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120           | 2025 - 2120          |
| RECEIVE FREQUENCIES   | MHz          | 8025 - 8500           | 2200 - 2300          |
| TURNAROUND FREQ RATIO   | -            | 240 / 221             | 240 / 221            |
| <b>DOPPLER</b>  |              |                       |                      |
| COHERENT/NON-COHERENT   | -            | Coherent              | Coherent             |
| COUNTER RESOLUTION  | Cycles       | $< 10^{-3}$           | $< 10^{-3}$          |
| MAX DOPPLER FREQ SHIFT  | MHz          | 3                     | 3                    |
| DOPPLER BIAS FREQ   | MHz          | 0.05 - 3              | 0.05 - 3             |
| DRIFT   | $\Delta f/f$ | $< 10^{-11}$          | $< 10^{-11}$         |
| OUTPUT EQUATION   | -            | (1)                   | (1)                  |
| DIRECTION INDICATOR   | -            | (1)                   | (1)                  |
|   |              |                       |                      |
|   |              |                       |                      |
|   |              |                       |                      |
| <b>RANGING</b>  |              |                       |                      |
| COHERENT/NON-COHERENT   | -            | Either                | Either               |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine/PRN              | Sine / PRN           |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.1 - 1.2             | 0.1 - 1.2            |
| RANGE CODE FREQ RATIO   | -            | (1)                   | (1)                  |
| MAJOR CODE FREQ(S)  | kHz          | 100 - 1500            | 100 - 1500           |
| MINOR CODE FREQ(S)  | kHz          | PRN Code              | PRN Code             |
| MIN RECEIVED CARRIER SNR  | dB           | 10                    | 10                   |
| MIN REQ CODE PWR/No   | dB-Hz        | -10                   | -10                  |
| CODE INTEGRATION TIME   | s            | Any                   | Any                  |
| ACQUISITION SEQUENCE  | -            | Sine then Sine / PRN  | Sine then Sine / PRN |
| RANGE DATA UNITS  | -            | Nanoseconds           | Nanosecond           |
| RANGE QUANTIZATION  | -            | 2 ns                  | 2 ns                 |
| ACCURACY (STRONG SIGNAL)  | m            | 0.15                  | 0.15                 |
| MAX UNAMBIGUOUS RANGE   | km           | 500 000               | 500 000              |
| TRANSPONDER BW  | MHz          | 0.2 - 3               | 0.2 - 3              |
|   |              |                       |                      |
|   |              |                       |                      |
|   |              |                       |                      |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |                      |
| 6445-3095   |              |                       |                      |

**ESA ESTRACK**

FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS   | UNITS         | SUBNETWORK OR STATION |                     |                       |                     |
|---|---------------|-----------------------|---------------------|-----------------------|---------------------|
|   |               | VILLAFRANCA           |                     | VILLAFRANCA           |                     |
| <b>GENERAL</b>  |               |                       |                     |                       |                     |
| STATION DESIGNATION   | -             | Vilspa-2              |                     | Vilspa-2              |                     |
| LOCATION(S)   | -             | Villafranca, Spain    |                     | Villafranca, Spain    |                     |
| DIAMETER  | m             | 15                    |                     | 15                    |                     |
| <b>FREQUENCY STD</b>  |               |                       |                     |                       |                     |
| STANDARD TYPE   | Name          | Cesium                |                     | Cesium                |                     |
| STANDARD MFG  | Name          | Oscilloquartz 3210    |                     | Oscilloquartz 3210    |                     |
| STABILITY AT:   |               | <b>Allan Variance</b> | <b>Drift</b>        | <b>Allan Variance</b> | <b>Drift</b>        |
| 1 - SECOND  | $\Delta f/f$  | $1 \times 10^{-11}$   | (1)                 | $1 \times 10^{-11}$   | (1)                 |
| 1 - HOUR  | $\Delta f/f$  | $1 \times 10^{-12}$   | (1)                 | $1 \times 10^{-12}$   | (1)                 |
| 1 - DAY (24 HOURS)  | $\Delta f/f$  | $1 \times 10^{-13}$   | (1)                 | $1 \times 10^{-13}$   | (1)                 |
| 1 - MONTH   | $\Delta f/f$  | (1)                   | $3 \times 10^{-12}$ | (1)                   | $3 \times 10^{-12}$ |
| REF FREQS PHASE NOISE   | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b>      | <b>5 MHz</b>          | <b>100 MHz</b>      |
| 1 Hz OFFSET   | dBc/Hz        | (1)                   | (1)                 | (1)                   | (1)                 |
| 10 Hz OFFSET  | dBc/Hz        | -120                  | (1)                 | -120                  | (1)                 |
| 100 Hz OFFSET   | dBc/Hz        | -140                  | (1)                 | -140                  | (1)                 |
| 1000 Hz OFFSET  | dBc/Hz        | -140                  | (1)                 | -140                  | (1)                 |
| REF FREQS AVAILABLE   | MHz           | 5                     |                     | 5                     |                     |
| MAX STA-TO-STA OFFSET   | Hz            | $3 \times 10^{-12}$   |                     | $3 \times 10^{-12}$   |                     |
| <b>TIMING SYSTEM</b>  |               |                       |                     |                       |                     |
| MASTER REFERENCE AGENCY   | Name          | USNO                  |                     | USNO                  |                     |
| REFERENCE TIME  | Name          | UTC                   |                     | UTC                   |                     |
| TIME CODE EPOCH   | Yr            | 1 January 1958        |                     | 1 January 1958        |                     |
| TIME CODES AVAILABLE  | CCSDS Codes   | CDS                   |                     | CDS                   |                     |
| MAX TIME RESOLUTION   | s             | $1 \times 10^{-6}$    |                     | $1 \times 10^{-6}$    |                     |
| TIME TRANSFER METHOD  | Name          | GPS                   |                     | GPS                   |                     |
| MAX TRANS ERROR REF   | $\mu$ -sec    | $\pm 5$               |                     | $\pm 5$               |                     |
| MAX OFFSET FROM REF   | $\mu$ -sec    | $\pm 50$              |                     | $\pm 50$              |                     |
| MAX OFFSET MEAS ERROR   | $\mu$ -sec    | 0.05                  |                     | 0.05                  |                     |
| MAX STA-TO-STA OFFSET   | $\mu$ -sec    | 100                   |                     | 100                   |                     |
| TIMING SIGNALS AVAILABLE  | pulse/s       | 1                     |                     | 1                     |                     |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> <p>4. MEASURED BY THE AGENCY</p> |               |                       |                     |                       |                     |

**ESA ESTRACK**

GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION              |                                    |
|---|--------------------|------------------------------------|------------------------------------|
|   |                    | VILLAGRANCA                        | VILLAGRANCA                        |
| <b>GENERAL</b>  |                    |                                    |                                    |
| STATION DESIGNATION   | -                  | Vilspa-1                           | Vilspa-2                           |
| LOCATION(S)   | -                  | Villafranca, Spain                 | Villafranca, Spain                 |
| DIAMETER  | m                  | 15                                 | 15                                 |
| <b>GEOGRAPHICAL</b>   |                    |                                    |                                    |
| LOCATION, COUNTRY/STATE   | Name               | Spain                              | Spain                              |
| LOCATION, CITY  | Name               | Villafranca                        | Villafranca                        |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 356, 2, 52.8 E                     | 356, 2, 52.8 E                     |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 40, 26, 48 N                       | 40, 26, 48 N                       |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
| <b>MECHANICAL</b>   |                    |                                    |                                    |
| TYPE OF MOUNT   | -                  | Elevation over Azimuth             | Elevation over Azimuth             |
| AZIMUTH LIMITATIONS   | -                  | 0 - 720                            | 0 - 720                            |
| TRACKING SPEED RANGE  | deg/s              | 5                                  | 15 Az / 5 EI                       |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 2.5                                | 7.5 Az / 2.5 EI                    |
| TYPE OF POINTING  | Type               | Autotrack, Programtrack and Manual | Autotrack, Programtrack and Manual |
| POINTING ACCURACY   | deg                | 0.05                               | 0.05                               |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5                                  | 5                                  |
| MIN RECEIVE ELEV ANGLE  | deg                | 5                                  | 5                                  |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
| <b>SUPPORT</b>  |                    |                                    |                                    |
| TRANSMIT FREQ BAND(S)   | GHz                | 2.025 - 2.12                       | 2.025 - 2.12                       |
| RECEIVE FREQ BAND(S)  | GHz                | 2.2 - 2.3                          | 2.2 - 2.3                          |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                                | (1)                                |
| MISSION CATEGORIES  | Cat                | A & B                              | A & B                              |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
|   |                    |                                    |                                    |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                                    |                                    |

6445-3097

CCSDS HISTORICAL DOCUMENT  
**ESA ESTRACK**  
EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION                      |  |
|---------------------------|--------------|--|--|
|                           |              | PERTH                                      |  |
| <b>GENERAL</b>            |              |  |  |
| STATION DESIGNATION       | -            | Perth                                      |  |
| LOCATION(S)               | -            | Perth, Australia                           |  |
| DIAMETER                  | m            | 32   |  |
| <b>TRANSMIT</b>           |              |  |  |
| FREQUENCIES               | MHz          | 2025 - 2120                                |  |
| FREQUENCY RESOLUTION      | Hz           | 10   |  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $3 \times 10^{-6}$                         |  |
| TRANSMIT POWER 1          | W            | 20 000                                     |  |
| EIRP RANGE 1              | dBW          | 97   |  |
| TRANSMIT POWER 2          | W            | 2000                                       |  |
| EIRP RANGE 2              | dBW          | 87   |  |
| POLARIZATION              | -            | RCP or LCP                                 |  |
| ANTENNA GAIN              | dBi          | 54   |  |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.3  |  |
| ANTENNA ELLIPTICITY       | dB           | 1  |  |
| RF FREQ SWEEP RANGE       | kHz          | 0.1 - 100                                  |  |
| MIN FREQ SWEEP RATE       | Hz/s         | 10   |  |
| MAX FREQ SWEEP RATE       | kHz/s        | 100  |  |
| PROGRAMMED UPLINK FREQ    | Yes/No       | No   |  |
|                           |              |  |  |
|                           |              |  |  |
|                           |              |  |  |
|                           |              |  |  |
|                           |              |  |  |
|                           |              |  |  |
|                           |              |  |  |
|                           |              |  |  |
|                           |              |  |  |
| <b>COMMAND</b>            |              |  |  |
| RF CARRIER MOD TYPE       | -            | PM   |  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.1 - 1.4                                  |  |
| SUBCARRIER FREQUENCY(S)   | Hz           | 8000 - 16 000                              |  |
| SUBCARRIER STEP SIZE      | Hz           | (1)  |  |
| SUBCARRIER FREQ STABILITY | ppm          | $3 \times 10^{-6}$                         |  |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine                                       |  |
| SUBCARRIER MOD TYPE       | -            | PSK  |  |
| SUBCARRIER/BIT RATE LIMIT | -            | > 8; Coh $\pm$ 6 deg                       |  |
| BIT RATE RANGE            | b/s          | 4000 <sup>η</sup> ; η = 0, 1, 2, . . . . 9 |  |
| FORMATS AVAILABLE         | -            | NRZ - L; SP - L                            |  |
|                           |              |  |  |
|                           |              |  |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

CCSDS HISTORICAL DOCUMENT  
**ESA ESTRACK**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                        |                          |
|---|--------------|--|--------------------------|
|   |              | PERTH  |                          |
| <b>GENERAL</b>  |              |  |                          |
| STATION DESIGNATION   | -            | Perth  |                          |
| LOCATION(S)   | -            | Perth, Australia                             |                          |
| DIAMETER  | m            | 32   |                          |
| <b>RECEIVE</b>  |              |  |                          |
| FREQUENCIES   | MHz          | 2200 - 2300                                  | 8400 - 8500              |
| FREQUENCY RESOLUTION  | Hz           | 150  | 150                      |
| ANTENNA GAIN @ 45 deg   | dBi          | 56.3   | 68.3                     |
| SYS NOISE TEMP @ ZENITH   | K            | 75   | 65                       |
| G/T @ 10 deg  | dB           | 37.5   | 50.1                     |
| POLARIZATION  | -            | RCP and LCP                                  | RCP and LCP              |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.3  | 0.08                     |
| ANTENNA ELLIPTICITY   | dB           | 1  | 1                        |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $3 \times 10^{-6}$                           | $3 \times 10^{-6}$       |
| RCVR AGC DYNAMIC RANGE  | dB           | 70   | 70                       |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -150 in 2 Blo = 30 Hz                        | -150 in 2 Blo = 30 Hz    |
| RCVR LOOP BANDWIDTHS  | Hz           | 0.3 - 3000                                   | 0.3 - 3000               |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Fix  | Fix                      |
| RCVR PLL ORDER(S)   | No.          | 2  | 2                        |
| ACQ SWEEP RANGE   | kHz          | $\pm 5, \pm 15, \pm 150$                     | $\pm 5, \pm 15, \pm 150$ |
| MIN ACQ SWEEP RATE  | Hz/s         | 150  | 80                       |
| MAX ACQ SWEEP RATE  | kHz/s        | 1500   | 80                       |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                                   | Continuous               |
| PROGRAMMED L.O.   | Yes/No       | No   | No                       |
|   |              |  |                          |
|   |              |  |                          |
|   |              |  |                          |
|   |              |  |                          |
| <b>TELEMETRY</b>  |              |  |                          |
| MODULATION TYPE(S)  | -            | PM, BSPK (U), QPSK                           |                          |
| MODULATION FORMAT(S)  | -            | NRZ - L, M; SP-L                             |                          |
| MOD INDEX RANGE   | Rad Pk       | $\leq 1.5$                                   |                          |
| SUBCARRIER FREQ RANGE   | kHz          | 2 - 1000                                     |                          |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine or Square                               |                          |
| SYMBOL RATE RANGE   | s/s          | 10 - 1 200 000 (PM), 32 000 - 4 096 000 BPSK |                          |
| SUBCARRIER/SYM RATE LIMIT   | -            | 40 - 1024                                    |                          |
| ARRAYS WITH STATIONS  | -            | None   |                          |
| CHANNEL DECODING  | -            | (1)  |                          |
| DATA FORMAT   | -            | (1)  |                          |
|   |              |  |                          |
|   |              |  |                          |
|   |              |  |                          |
|   |              |  |                          |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |  |                          |

6445-5169

CCSDS HISTORICAL DOCUMENT  
**ESA ESTRACK**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |              |
|---|--------------|-----------------------|--------------|
|   |              | PERTH                 |              |
| <b>GENERAL</b>  |              |                       |              |
| STATION DESIGNATION   | -            | Perth                 |              |
| LOCATION(S)   | -            | Perth, Australia      |              |
| DIAMETER  | m            | 32                    |              |
| <b>FREQUENCIES</b>  |              |                       |              |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120           | 2025 - 2120  |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300           | 8025 - 8500  |
| TURNAROUND FREQ RATIO   | -            | 240 / 221             | 880 / 221    |
| <b>DOPPLER</b>  |              |                       |              |
| COHERENT/NON-COHERENT   | -            | Coherent              | Coherent     |
| COUNTER RESOLUTION  | Cycles       | $< 10^{-3}$           | $< 10^{-3}$  |
| MAX DOPPLER FREQ SHIFT  | MHz          | 3                     | 3            |
| DOPPLER BIAS FREQ   | MHz          | 0.05 - 3              | 0.05 - 3     |
| DRIFT   | $\Delta f/f$ | $< 10^{-11}$          | $< 10^{-12}$ |
| OUTPUT EQUATION   | -            | (1)                   | (1)          |
| DIRECTION INDICATOR   | -            |                       |              |
|   |              |                       |              |
|   |              |                       |              |
|   |              |                       |              |
| <b>RANGING</b>  |              |                       |              |
| COHERENT/NON-COHERENT   | -            | Either                |              |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine / PRN            |              |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.1 - 1.2             |              |
| RANGE CODE FREQ RATIO   | -            | (1)                   |              |
| MAJOR CODE FREQ(S)  | kHz          | 100 - 1500            |              |
| MINOR CODE FREQ(S)  | kHz          | PRN Code              |              |
| MIN RECEIVED CARRIER SNR  | dB           | 10                    |              |
| MIN REQ CODE PWR/No   | dB-Hz        | -10                   |              |
| CODE INTEGRATION TIME   | s            | Any                   |              |
| ACQUISITION SEQUENCE  | -            | Sine then Sine / PRN  |              |
| RANGE DATA UNITS  | -            | Nanosecond            |              |
| RANGE QUANTIZATION  | -            | 2 ns                  |              |
| ACCURACY (STRONG SIGNAL)  | m            | 0.15                  |              |
| MAX UNAMBIGUOUS RANGE   | km           | 500 000               |              |
| TRANSPONDER BW  | MHz          | 0.2 - 3               |              |
|   |              |                       |              |
|   |              |                       |              |
|   |              |                       |              |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |              |

6445-5170

**ESA ESTRACK**

FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                     |
|--|---------------|-----------------------|---------------------|
|  |               | PERTH                 |                     |
| <b>GENERAL</b>   |               |                       |                     |
| STATION DESIGNATION  | -             | Perth                 |                     |
| LOCATION(S)  | -             | Perth, Australia      |                     |
| DIAMETER   | m             | 32                    |                     |
| <b>FREQUENCY STD</b>   |               |                       |                     |
| STANDARD TYPE  | Name          | Cesium                |                     |
| STANDARD MFG   | Name          |                       |                     |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | $1 \times 10^{-11}$   |                     |
| 1 - HOUR   | $\Delta f/f$  | $1 \times 10^{-12}$   |                     |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | $3 \times 10^{-13}$   |                     |
| 1 - MONTH  | $\Delta f/f$  |                       | $3 \times 10^{-12}$ |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ |                       | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        |                       |                     |
| 10 Hz OFFSET   | dBc/Hz        | -120                  |                     |
| 100 Hz OFFSET  | dBc/Hz        | -140                  |                     |
| 1000 Hz OFFSET   | dBc/Hz        | -140                  |                     |
| REF FREQS AVAILABLE  | MHz           | 5                     |                     |
| MAX STA-TO-STA OFFSET  | Hz            | $3 \times 10^{-12}$   |                     |
|  |               |                       |                     |
|  |               |                       |                     |
|  |               |                       |                     |
| <b>TIMING SYSTEM</b>   |               |                       |                     |
| MASTER REFERENCE AGENCY  | Name          | USNO                  |                     |
| REFERENCE TIME   | Name          | UTC                   |                     |
| TIME CODE EPOCH  | Yr            | 1 January 1958        |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | CDS                   |                     |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$    |                     |
| TIME TRANSFER METHOD   | Name          | GPS                   |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 5$               |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 50$              |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 0.05                  |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 100                   |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                     |                     |
|  |               |                       |                     |
|  |               |                       |                     |
|  |               |                       |                     |
|  |               |                       |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                     |

6445-5171

CCSDS HISTORICAL DOCUMENT  
**ESA ESTRACK**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION    |  |
|---|--------------------|--------------------------|--|
|   |                    | PERTH                    |  |
| <b>GENERAL</b>  |                    |                          |  |
| STATION DESIGNATION   | -                  | Perth                    |  |
| LOCATION(S)   | -                  | Perth, Australia         |  |
| DIAMETER  | m                  | 32                       |  |
| <b>GEOGRAPHICAL</b>   |                    |                          |  |
| LOCATION, COUNTRY/STATE   | Name               | Australia                |  |
| LOCATION, CITY  | Name               | Perth                    |  |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 115.8851 E (TBD)         |  |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 31.8025 S (TBD)          |  |
|   |                    |                          |  |
|   |                    |                          |  |
|   |                    |                          |  |
|   |                    |                          |  |
| <b>MECHANICAL</b>   |                    |                          |  |
| TYPE OF MOUNT   | -                  | Elevation over Azimuth   |  |
| AZIMUTH LIMITATIONS   | -                  | 0 - 360                  |  |
| TRACKING SPEED RANGE  | deg/s              | 0.4                      |  |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 0.4                      |  |
| TYPE OF POINTING  | Type               | Programtrack and Manual  |  |
| POINTING ACCURACY   | deg                | 0.008 (TBD)              |  |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5                        |  |
| MIN RECEIVE ELEV ANGLE  | deg                | 5                        |  |
|   |                    |                          |  |
|   |                    |                          |  |
|   |                    |                          |  |
|   |                    |                          |  |
|   |                    |                          |  |
| <b>SUPPORT</b>  |                    |                          |  |
| TRANSMIT FREQ BAND(S)   | GHz                | 2025 - 2120              |  |
| RECEIVE FREQ BAND(S)  | GHz                | 2200 - 2300, 8400 - 8500 |  |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                      |  |
| MISSION CATEGORIES  | Cat                | A and B                  |  |
|   |                    |                          |  |
|   |                    |                          |  |
|   |                    |                          |  |
|   |                    |                          |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                          |  |



**CCSDS HISTORICAL DOCUMENT**  
**EUTELSAT TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION       |                             |
|---|--------------|-----------------------------|-----------------------------|
|   |              | RAMBOUILLET                 | SINTRA                      |
| <b>GENERAL</b>  |              |                             |                             |
| STATION DESIGNATION   | -            | TR2                         | TS1                         |
| LOCATION(S)   | -            | Rambouillet, France         | Sintra, Portugal            |
| DIAMETER  | m            | 3.7 (1)                     | 3.7 (1)                     |
| <b>RECEIVE</b>  |              |                             |                             |
| FREQUENCIES   | MHz          | 10 950 - 11 700             | 10 950 - 11 700             |
| FREQUENCY RESOLUTION  | Hz           | 1000                        | 1000                        |
| ANTENNA GAIN @ 45 deg   | dBi          | 52.8                        | 52.8 - 50.5                 |
| SYS NOISE TEMP @ ZENITH   | K            | < 220                       | < 220 - < 135               |
| G/T @ 45 deg  | dB           | 29.7                        | 29.7 - 28.7                 |
| POLARIZATION  | -            | LIN                         | LIN                         |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.35                        | 0.35 - 0.44                 |
| ANTENNA ELLIPTICITY   | dB           | (1)                         | (1)                         |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 2 \cdot 10^{-8}$ Month | $\pm 2 \cdot 10^{-8}$ Month |
| RCVR AGC DYNAMIC RANGE  | dB           | 100                         | 100                         |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -136 in 2 Blo = 300 Hz      | -136 in 2 Blo = 300 Hz      |
| RCVR LOOP BANDWIDTHS  | Hz           | 300, 1000                   | 300, 1000                   |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                       | Adapt                       |
| RCVR PLL ORDER(S)   | No.          | 2                           | 2                           |
| ACQ SWEEP RANGE   | kHz          | 30, 60, 120                 | 0.30, 60, 120               |
| MIN ACQ SWEEP RATE  | Hz/s         | 10                          | 10                          |
| MAX ACQ SWEEP RATE  | kHz/s        | 100                         | 100                         |
| ACQ SWEEP STEP SIZE   | Hz           | (1)                         | (1)                         |
| PROGRAMMED L.O.   | Yes/No       | Yes                         | Yes                         |
|   |              |                             |                             |
|   |              |                             |                             |
|   |              |                             |                             |
| <b>TELEMETRY</b>  |              |                             |                             |
| MODULATION TYPE(S)  | -            | BPSK - PM                   | BPSK - PM                   |
| MODULATION FORMAT(S)  | -            | NRZ - L, Bi - $\phi$ - L    | NRZ - L, Bi - $\phi$ - L    |
| MOD INDEX RANGE   | Rad Pk       | 0.3 - 1.5                   | 0.3 - 1.5                   |
| SUBCARRIER FREQ RANGE   | kHz          | 32 768                      | 32 768                      |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                        | Sine                        |
| SYMBOL RATE RANGE   | s/s          | 1                           | 1                           |
| SUBCARRIER/SYM RATE LIMIT   | -            | 2 - 1024                    | 2 - 1024                    |
| ARRAYS WITH STATIONS  | -            | (1)                         | (1)                         |
| CHANNEL DECODING  | Type         | (1)                         | (1)                         |
| DATA FORMAT   | -            | (1)                         | (1)                         |
|   |              |                             |                             |
|   |              |                             |                             |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                             |                             |

6445-4266

**CCSDS HISTORICAL DOCUMENT**  
**EUTELSAT TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION           |  |
|--|--------------|---------------------------------|--|
|  |              | RAMBOUILLET                     | SINTRA                                       |
| <b>GENERAL</b>   |              |                                 |  |
| STATION DESIGNATION  | -            | TR2                             | TS1  |
| LOCATION(S)  | -            | Rambouillet, France             | Sintra, Portugal                             |
| DIAMETER   | m            | 3.7 (1)                         | 3.7 (1)                                      |
| <b>FREQUENCIES</b>   |              |                                 |  |
| TRANSMIT FREQUENCIES   | MHz          | 14 000 - 14 500                 | 14 000 - 14 500                              |
| RECEIVE FREQUENCIES  | MHz          | 10 950 - 11 700                 | 10 950 - 11 700                              |
| TURNAROUND FREQ RATIO  | -            | (1)                             | (1)  |
| <b>DOPPLER</b>   |              |                                 |  |
| COHERENT/NON-COHERENT  | -            | None                            | (1)  |
| COUNTER RESOLUTION   | Cycles       |                                 | (1)  |
| MAX DOPPLER FREQ SHIFT   | MHz          |                                 | (1)  |
| DOPPLER BIAS FREQ  | MHz          |                                 | (1)  |
| DRIFT  | $\Delta f/f$ |                                 | (1)  |
| OUTPUT EQUATION  | -            |                                 | (1)  |
| DIRECTION INDICATOR  | -            |                                 | (1)  |
|  |              |                                 |  |
|  |              |                                 |  |
|  |              |                                 |  |
| <b>RANGING</b>   |              |                                 |  |
| COHERENT/NON-COHERENT  | -            | Coherent                        | Coherent                                     |
| RANGE CODE WAVEFORM  | Sin/Sq       | Sine (Tones)                    | Sine (Tones)                                 |
| EARTH STATION MOD INDEX  | Rad Pk       | 1 and 0.6                       | 1 and 0.6                                    |
| RANGE CODE FREQ RATIO  | -            | 4 and 5                         | 4 and 5                                      |
| MAJOR CODE FREQ(S)   | kHz          | 100                             | 100  |
| MINOR CODE FREQ(S)   | kHz          | 20.16, 16.8, 16, 16,032, 16.008 | 20, 16, 16.8, 16.16, 16.032, 16.008          |
| MIN RECEIVED CARRIER SNR   | dB           | 10                              | 10   |
| MIN REQ CODE PWR/No  | dB-Hz        | 722 dB-Hz Major Tone            | > 22 dB-Hz or > 13 dB-Hz for Awgravity Resol |
| CODE INTEGRATION TIME  | s            | (1)                             | (1)  |
| ACQUISITION SEQUENCE   | -            | (1)                             | (1)  |
| RANGE DATA UNITS   | -            | 2-Way Propag Delay              | 2-Way Propag Delay                           |
| RANGE QUANTIZATION   | -            | 1 $\mu$ s                       | 1 $\mu$ s                                    |
| ACCURACY (STRONG SIGNAL)   | m            | 1.5                             | 1.5  |
| MAX UNAMBIGUOUS RANGE  | km           | 18 750                          | 18 750                                       |
| TRANSPONDER BW   | MHz          | (1)                             | (1)  |
|  |              |                                 |  |
|  |              |                                 |  |
|  |              |                                 |  |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> |              |                                 |  |

6445-4267

**CCSDS HISTORICAL DOCUMENT**  
**EUTELSAT TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                    |
|--|---------------|-----------------------|--------------------|
|  |               | RAMBOUILLET           | SINTRA             |
| <b>GENERAL</b>   |               |                       |                    |
| STATION DESIGNATION  | -             | TR2                   | TS1                |
| LOCATION(S)  | -             | Rambouillet, France   | Sintra, Portugal   |
| DIAMETER   | m             | 3.7 (1)               | 3.7 (1)            |
| <b>FREQUENCY STD</b>   |               |                       |                    |
| STANDARD TYPE  | Name          | (1)                   | (1)                |
| STANDARD MFG   | Name          | (1)                   | (1)                |
| STABILITY AT:  |               | (1)                   | (1)                |
| 1 - SECOND   | $\Delta f/f$  | (1)                   | (1)                |
| 1 - HOUR   | $\Delta f/f$  | (1)                   | (1)                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | $5 \cdot 10^{-10}$    | $5 \cdot 10^{-10}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)                   | (1)                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | (1)                   | (1)                |
| 1 Hz OFFSET  | dBc/Hz        | (1)                   | (1)                |
| 10 Hz OFFSET   | dBc/Hz        | (1)                   | (1)                |
| 100 Hz OFFSET  | dBc/Hz        | (1)                   | (1)                |
| 1000 Hz OFFSET   | dBc/Hz        | (1)                   | (1)                |
| REF FREQS AVAILABLE  | MHz           | 5                     | 5                  |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                   | (1)                |
|  |               |                       |                    |
|  |               |                       |                    |
|  |               |                       |                    |
| <b>TIMING SYSTEM</b>   |               |                       |                    |
| MASTER REFERENCE AGENCY  | Name          | (1)                   | (1)                |
| REFERENCE TIME   | Name          | MSF - DCF 77          | MSF - DCF 77       |
| TIME CODE EPOCH  | Yr            | (1)                   | (1)                |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG - B              | IRIG - B           |
| MAX TIME RESOLUTION  | s             | $10^{-3}$             | $10^{-3}$          |
| TIME TRANSFER METHOD   | Name          | LORAN                 | LORAN              |
| MAX TRANS ERROR REF  | $\mu$ -sec    | (1)                   | (1)                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | (1)                   | (1)                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | (1)                   | (1)                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                   | (1)                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | (1)                   | (1)                |
|  |               |                       |                    |
|  |               |                       |                    |
|  |               |                       |                    |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                    |

**CCSDS HISTORICAL DOCUMENT**  
**EUTELSAT TRACKING SYSTEM**  
**GEOGRAPHICAL AND MECHANICAL**

| CHARACTERISTICS                  | UNITS              | SUBNETWORK OR STATION    |                                |
|----------------------------------|--------------------|--------------------------|--------------------------------|
|                                  |                    | RAMBOUILLET              | SINTRA                         |
| <b>GENERAL</b>                   |                    |                          |                                |
| STATION DESIGNATION              | -                  | TR2                      | TS1                            |
| LOCATION(S)                      | -                  | Rambouillet, France      | Sintra, Portugal               |
| DIAMETER                         | m                  | 3.7 (1)                  | 3.7 (1)                        |
| <b>GEOGRAPHICAL</b>              |                    |                          |                                |
| LOCATION, COUNTRY/STATE          | Name               | France                   | Portugal                       |
| LOCATION, CITY                   | Name               | Rambouillet              | Sintra                         |
| LONGITUDE (site 1/site 2/site 3) | d, m, s            | 01 47 00 E               | 9 16 46 W                      |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 48 32 57 N               | 38 52 13 N                     |
| ALTITUDE                         |                    | 164 m                    | 197 m                          |
| <b>MECHANICAL</b>                |                    |                          |                                |
| TYPE OF MOUNT                    | -                  | Az - El                  | El - Az                        |
| AZIMUTH LIMITATIONS              | -                  | 120 deg                  | 120 deg                        |
| TRACKING SPEED RANGE             | deg/s              | 0.05                     | 0.05                           |
| MAX TRACK ACCELERATION           | deg/s <sup>2</sup> | (1)                      | (1)                            |
| TYPE OF POINTING                 | Type               | Step, Prediction, Manual | Step Tracking, Predict, Manual |
| POINTING ACCURACY                | deg                | 0.05                     | 0.05                           |
| MIN TRANSMIT ELEV ANGLE          | deg                | 5                        | 5                              |
| MIN RECEIVE ELEV ANGLE           | deg                | 0                        | 0                              |
| <b>SUPPORT</b>                   |                    |                          |                                |
| TRANSMIT FREQ BAND(S)            | GHz                | 14 - 14.5                | 14 - 14.5                      |
| RECEIVE FREQ BAND(S)             | GHz                | 10.95 - 11.7             | 10.95 - 11.7                   |
| ACQ AID FREQ BAND(S)             | GHz                | (1)                      | (1)                            |
| MISSION CATEGORIES               | Cat                | A                        | A                              |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS  
4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETTIC COORDINATES

**CCSDS HISTORICAL DOCUMENT**  
**EUTELSAT TRACKING SYSTEM**  
**EARTH-TO-SPACE LINK CHARACTERISTICS**

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION       |                             |
|---------------------------|--------------|-----------------------------|-----------------------------|
|                           |              | RAMBOUILLET                 | SINTRA                      |
| <b>GENERAL</b>            |              |                             |                             |
| STATION DESIGNATION       | -            | TR3 - TR6                   | TS2 - TS6                   |
| LOCATION(S)               | -            | Rambouillet, France         | Sintra Portugal             |
| DIAMETER                  | m            | 4.57 (4)                    | 4.57 (5)                    |
| <b>TRANSMIT</b>           |              |                             |                             |
| FREQUENCIES               | MHz          | 14 000 - 14 500             | 14 000 - 14 500             |
| FREQUENCY RESOLUTION      | Hz           | 1000                        | 1000                        |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $\pm 2 \cdot 10^{-8}$ Month | $\pm 2 \cdot 10^{-8}$ Month |
| TRANSMIT POWER 1          | W            | (1)                         | (1)                         |
| EIRP RANGE 1              | dBW          | 68 - 71                     | 68 (71 Max) 67 (69.5 Max)   |
| TRANSMIT POWER 2          | W            | None                        | (1)                         |
| EIRP RANGE 2              | dBW          | None                        | (1)                         |
| POLARIZATION              | -            | LIN X - Y                   | LIN (X - Y)                 |
| ANTENNA GAIN              | dBi          | 54.4                        | 54.4 - 52.4                 |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.28                        | 0.28 - 0.34                 |
| ANTENNA ELLIPTICITY       | dB           | (1)                         | (1)                         |
| RF FREQ SWEEP RANGE       | kHz          | (1)                         | (1)                         |
| MIN FREQ SWEEP RATE       | Hz/s         | (1)                         | (1)                         |
| MAX FREQ SWEEP RATE       | kHz/s        | (1)                         | (1)                         |
| PROGRAMMED UPLINK FREQ    | Yes/No       | Yes                         | Yes                         |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
|                           |              |                             |                             |
| <b>COMMAND</b>            |              |                             |                             |
| RF CARRIER MOD TYPE       | -            | PM                          | PM                          |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.1 - 2                     | 0.1 - 2                     |
| SUBCARRIER FREQUENCY(S)   | Hz           | 100 - 20 000                | 100 - 20 000                |
| SUBCARRIER STEP SIZE      | Hz           | 0.1                         | 0.1                         |
| SUBCARRIER FREQ STABILITY | ppm          | 50                          | 50                          |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine                        | Sine                        |
| SUBCARRIER MOD TYPE       | -            | PSK                         | PSK                         |
| SUBCARRIER/BIT RATE LIMIT | -            | 4 - 1024                    | 4 - 1024                    |
| BIT RATE RANGE            | b/s          | $\geq 7$                    | $\geq 7$                    |
| FORMATS AVAILABLE         | -            | ESA - PSS - 45              | ESA - PSS - 45              |
|                           |              |                             |                             |
|                           |              |                             |                             |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-4260

**CCSDS HISTORICAL DOCUMENT**  
**EUTELSAT TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION    |                          |
|---|--------------|--------------------------|--------------------------|
|   |              | RAMBOUILLET              | SINTRA                   |
| <b>GENERAL</b>  |              |                          |                          |
| STATION DESIGNATION   | -            | TR3 - TR6                | TS2 - TS6                |
| LOCATION(S)   | -            | Rambouillet, France      | Sintra, Portugal         |
| DIAMETER  | m            | 4.57 (4)                 | 4.57 (5)                 |
| <b>RECEIVE</b>  |              |                          |                          |
| FREQUENCIES   | MHz          | 10 950 - 11 700          | 10 950 - 11 700          |
| FREQUENCY RESOLUTION  | Hz           | 1000                     | 1000                     |
| ANTENNA GAIN @ 45 deg   | dBi          | 52.8                     | 52.8 - 50.5              |
| SYS NOISE TEMP @ ZENITH   | K            | < 220                    | < 220 - < 135            |
| G/T @ 45 deg  | dB           | 29.7                     | 29.7 - 28.7              |
| POLARIZATION  | -            | LIN                      | LIN                      |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.35                     | 0.35 - 0.44              |
| ANTENNA ELLIPTICITY   | dB           | (1)                      | (1)                      |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 2 - 10^{-8}$ Month  | $\pm 2 - 10^{-8}$ Month  |
| RCVR AGC DYNAMIC RANGE  | dB           | 100                      | 100                      |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -136 in 2 Blo = 300 Hz   | -136 in 2 BLo = 300 Hz   |
| RCVR LOOP BANDWIDTHS  | Hz           | 300, 1000                | 300, 1000                |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                    | Adapt                    |
| RCVR PLL ORDER(S)   | No.          | 2                        | 2                        |
| ACQ SWEEP RANGE   | kHz          | 30, 60, 120              | 0.30, 60, 120            |
| MIN ACQ SWEEP RATE  | Hz/s         | 10                       | 10 kHz                   |
| MAX ACQ SWEEP RATE  | kHz/s        | 100                      | 100                      |
| ACQ SWEEP STEP SIZE   | Hz           | (1)                      | (1)                      |
| PROGRAMMED L.O.   | Yes/No       | Yes                      | Yes                      |
|   |              |                          |                          |
|   |              |                          |                          |
|   |              |                          |                          |
| <b>TELEMETRY</b>  |              |                          |                          |
| MODULATION TYPE(S)  | -            | BPSK - PM                | BPSK - PM                |
| MODULATION FORMAT(S)  | -            | NRZ - L, Bi - $\phi$ - L | NRZ - L, Bi - $\phi$ - L |
| MOD INDEX RANGE   | Rad Pk       | 0.3 - 1.5                | 0.3 - 1.5                |
| SUBCARRIER FREQ RANGE   | kHz          | 32 768                   | 32 768                   |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                     | Sine                     |
| SYMBOL RATE RANGE   | s/s          | 1                        | 1                        |
| SUBCARRIER/SYM RATE LIMIT   | -            | 2 - 1024                 | 2 - 1024                 |
| ARRAYS WITH STATIONS  | -            | (1)                      | (1)                      |
| CHANNEL DECODING  | Type         | (1)                      | (1)                      |
| DATA FORMAT   | -            | (1)                      | (1)                      |
|   |              |                          |                          |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                          |                          |

6445-4261

**CCSDS HISTORICAL DOCUMENT**  
**EUTELSAT TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION           |  |
|---|--------------|---------------------------------|--|
|   |              | RAMBOUILLET                     | SINTRA                                       |
| <b>GENERAL</b>  |              |                                 |  |
| STATION DESIGNATION   | -            | TR3 - TR6                       | TS2 - TS6                                    |
| LOCATION(S)   | -            | Rambouillet, France             | Sintra, Portugal                             |
| DIAMETER  | m            | 4.57 (4)                        | 4.57 (5)                                     |
| <b>FREQUENCIES</b>  |              |                                 |  |
| TRANSMIT FREQUENCIES  | MHz          | 14 000 - 14 500                 | 14 000 - 14 500                              |
| RECEIVE FREQUENCIES   | MHz          | 10 950 - 11 700                 | 10 950 - 11 700                              |
| TURNAROUND FREQ RATIO   | -            | (1)                             | (1)  |
| <b>DOPPLER</b>  |              |                                 |  |
| COHERENT/NON-COHERENT   | -            | None                            | (1)  |
| COUNTER RESOLUTION  | Cycles       |                                 | (1)  |
| MAX DOPPLER FREQ SHIFT  | MHz          |                                 | (1)  |
| DOPPLER BIAS FREQ   | MHz          |                                 | (1)  |
| DRIFT   | $\Delta f/f$ |                                 | (1)  |
| OUTPUT EQUATION   | -            |                                 | (1)  |
| DIRECTION INDICATOR   | -            |                                 | (1)  |
|   |              |                                 |  |
|   |              |                                 |  |
|   |              |                                 |  |
| <b>RANGING</b>  |              |                                 |  |
| COHERENT/NON-COHERENT   | -            | Coherent                        | Coherent                                     |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine (Tones)                    | Sine (Tones)                                 |
| EARTH STATION MOD INDEX   | Rad Pk       | 1 and 0.6                       | 1 and 0.6                                    |
| RANGE CODE FREQ RATIO   | -            | 4 and 5                         | 4 and 5                                      |
| MAJOR CODE FREQ(S)  | kHz          | 100                             | 100  |
| MINOR CODE FREQ(S)  | kHz          | 20.16, 16.8, 16, 16,032, 16.008 | 20, 16, 16.8, 16.16, 16.032, 16.008          |
| MIN RECEIVED CARRIER SNR  | dB           | 10                              | 10   |
| MIN REQ CODE PWR/No   | dB-Hz        | 722 dB-Hz Major Tone            | > 22 dB-Hz or > 13 dB-Hz for Awgravity Resol |
| CODE INTEGRATION TIME   | s            | (1)                             | (1)  |
| ACQUISITION SEQUENCE  | -            | (1)                             | (1)  |
| RANGE DATA UNITS  | -            | 2-Way Propag Delay              | 2-Way Propag Delay                           |
| RANGE QUANTIZATION  | -            | 1 $\mu$ s                       | 1 $\mu$ s                                    |
| ACCURACY (STRONG SIGNAL)  | m            | 1.5                             | 1.5  |
| MAX UNAMBIGUOUS RANGE   | km           | 18 750                          | 18 750                                       |
| TRANSPONDER BW  | MHz          | (1)                             | (1)  |
|   |              |                                 |  |
|   |              |                                 |  |
|   |              |                                 |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                                 |  |
| 6445-4262   |              |                                 |  |

**CCSDS HISTORICAL DOCUMENT**  
**EUTELSAT TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS              | SUBNETWORK OR STATION |                       |
|--|--------------------|-----------------------|-----------------------|
|  |                    | RAMBOUILLET           | SINTRA                |
| <b>GENERAL</b>   |                    |                       |                       |
| STATION DESIGNATION  | -                  | TR3 - TR6             | TS2 - TS6             |
| LOCATION(S)  | -                  | Rambouillet, France   | Sintra, Portugal      |
| DIAMETER   | m                  | 4.57 (4)              | 4.57 (5)              |
| <b>FREQUENCY STD</b>   |                    |                       |                       |
| STANDARD TYPE  | Name               | (1)                   | (1)                   |
| STANDARD MFG   | Name               | (1)                   | (1)                   |
| STABILITY AT:  |                    | (1)                   | (1)                   |
| 1 - SECOND   | $\Delta f/f$       | (1)                   | (1)                   |
| 1 - HOUR   | $\Delta f/f$       | (1)                   | (1)                   |
| 1 - DAY (24 HOURS)   | $\Delta f/f$       | 5 - 10 <sup>-10</sup> | 5 - 10 <sup>-10</sup> |
| 1 - MONTH  | $\Delta f/f$       | (1)                   | (1)                   |
| REF FREQS PHASE NOISE  | S <sub>φ</sub> (f) | (1)                   | (1)                   |
| 1 Hz OFFSET  | dBc/Hz             | (1)                   | (1)                   |
| 10 Hz OFFSET   | dBc/Hz             | (1)                   | (1)                   |
| 100 Hz OFFSET  | dBc/Hz             | (1)                   | (1)                   |
| 1000 Hz OFFSET   | dBc/Hz             | (1)                   | (1)                   |
| REF FREQS AVAILABLE  | MHz                | 5                     | 5                     |
| MAX STA-TO-STA OFFSET  | Hz                 | (1)                   | (1)                   |
|  |                    |                       |                       |
|  |                    |                       |                       |
|  |                    |                       |                       |
| <b>TIMING SYSTEM</b>   |                    |                       |                       |
| MASTER REFERENCE AGENCY  | Name               | (1)                   | (1)                   |
| REFERENCE TIME   | Name               | MSF - DCF 77          | MSF - DCF 77          |
| TIME CODE EPOCH  | Yr                 | (1)                   | (1)                   |
| TIME CODES AVAILABLE   | CCSDS Codes        | IRIG - B              | IRIG - B              |
| MAX TIME RESOLUTION  | s                  | 10 <sup>-3</sup>      | 10 <sup>-3</sup>      |
| TIME TRANSFER METHOD   | Name               | LORAN                 | LORAN                 |
| MAX TRANS ERROR REF  | μ-sec              | (1)                   | (1)                   |
| MAX OFFSET FROM REF  | μ-sec              | (1)                   | (1)                   |
| MAX OFFSET MEAS ERROR  | μ-sec              | (1)                   | (1)                   |
| MAX STA-TO-STA OFFSET  | μ-sec              | (1)                   | (1)                   |
| TIMING SIGNALS AVAILABLE   | pulse/s            | (1)                   | (1)                   |
|  |                    | (1)                   | (1)                   |
|  |                    |                       |                       |
|  |                    |                       |                       |
|  |                    |                       |                       |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |                    |                       |                       |

**CCSDS HISTORICAL DOCUMENT**  
**EUTELSAT TRACKING SYSTEM**  
**GEOGRAPHICAL AND MECHANICAL**

| CHARACTERISTICS  | UNITS              | SUBNETWORK OR STATION    |                                |
|--|--------------------|--------------------------|--------------------------------|
|  |                    | RAMBOUILLET              | SINTRA                         |
| <b>GENERAL</b>   |                    |                          |                                |
| STATION DESIGNATION  | -                  | TR3 - TR6                | TS2 - TS6                      |
| LOCATION(S)  | -                  | Rambouillet, France      | Sintra, Portugal               |
| DIAMETER   | m                  | 4.57 (4)                 | 4.57 (5)                       |
| <b>GEOGRAPHICAL</b>  |                    |                          |                                |
| LOCATION, COUNTRY/STAT   | Name               | France                   | Portugal                       |
| LOCATION, CITY   | Name               | Rambouillet              | Sintra                         |
| LONGITUDE (site 1/site 2/site 3)   | d, m, s            | 01 47 00 E               | 9 16 46 W                      |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 48 32 57 N               | 38 52 13 N                     |
| ALTITUDE   | -                  | 164 m                    | 197 m                          |
| <b>MECHANICAL</b>  |                    |                          |                                |
| TYPE OF MOUNT  | -                  | Az - El                  | El - Az                        |
| AZIMUTH LIMITATIONS  | -                  | 120 deg                  | 120 deg                        |
| TRACKING SPEED RANGE   | deg/s              | 0.05                     | 0.05                           |
| MAX TRACK ACCELERATION   | deg/s <sup>2</sup> | (1)                      | (1)                            |
| TYPE OF POINTING   | Type               | Step, Prediction, Manual | Step Tracking, Predict, Manual |
| POINTING ACCURACY  | deg                | 0.05                     | 0.05                           |
| MIN TRANSMIT ELEV ANGLE  | deg                | 5                        | 5                              |
| MIN RECEIVE ELEV ANGLE   | deg                | 0                        | 0                              |
| <b>SUPPORT</b>   |                    |                          |                                |
| TRANSMIT FREQ BAND(S)  | GHz                | 14 - 14.5                | 14 - 14.5                      |
| RECEIVE FREQ BAND(S)   | GHz                | 10.95 - 11.7             | 10.95 - 11.7                   |
| ACQ AID FREQ BAND(S)   | GHz                | (1)                      | (1)                            |
| MISSION CATEGORIES   | Cat                | A                        | A                              |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETTIC COORDINATES |                    |                          |                                |

6445-4264

CCSDS HISTORICAL DOCUMENT  
**EUTELSAT TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION       |  |
|---|--------------|-----------------------------|--|
|   |              | SINTRA                      |  |
| <b>GENERAL</b>  |              |                             |  |
| STATION DESIGNATION   | -            | TSU                         |  |
| LOCATION(S)   | -            | Sintra, Portugal            |  |
| DIAMETER  | m            | 7.3 (1)                     |  |
| <b>TRANSMIT</b>   |              |                             |  |
| FREQUENCIES   | MHz          | 2080 - 2095                 |  |
| FREQUENCY RESOLUTION  | Hz           | 160                         |  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $\pm 2 \cdot 10^{-8}$ Month |  |
| TRANSMIT POWER 1  | W            | (1)                         |  |
| EIRP RANGE 1  | dBW          | 61 (63 Max)                 |  |
| TRANSMIT POWER 2  | W            | (1)                         |  |
| EIRP RANGE 2  | dBW          | (1)                         |  |
| POLARIZATION  | -            | LIN, RCP, LCP               |  |
| ANTENNA GAIN  | dBi          | $\geq 39$                   |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 1.3                         |  |
| ANTENNA ELLIPTICITY   | dB           | 1 Max                       |  |
| RF FREQ SWEEP RANGE   | kHz          | 10, 50, 100                 |  |
| MIN FREQ SWEEP RATE   | Hz/s         | 10 kHz                      |  |
| MAX FREQ SWEEP RATE   | kHz/s        | 100                         |  |
| PROGRAMMED UPLINK FREQ  | Yes/No       | Yes                         |  |
|   |              |                             |  |
|   |              |                             |  |
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|   |              |                             |  |
| <b>COMMAND</b>  |              |                             |  |
| RF CARRIER MOD TYPE   | -            | PM                          |  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.1 - 2                     |  |
| SUBCARRIER FREQUENCY(S)   | Hz           | 100 - 20 000                |  |
| SUBCARRIER STEP SIZE  | Hz           | 0.1                         |  |
| SUBCARRIER FREQ STABILITY   | ppm          | 50                          |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                        |  |
| SUBCARRIER MOD TYPE   | -            | PSK                         |  |
| SUBCARRIER/BIT RATE LIMIT   | -            | 4 - 1024                    |  |
| BIT RATE RANGE  | b/s          | $\geq 7$                    |  |
| FORMATS AVAILABLE   | -            | ESA PSS - 45                |  |
|   |              |                             |  |
|   |              |                             |  |
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|   |              |                             |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                             |  |

**CCSDS HISTORICAL DOCUMENT**  
**EUTELSAT TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION       |  |
|---|--------------|-----------------------------|--|
|   |              | SINTRA                      |  |
| <b>GENERAL</b>  |              |                             |  |
| STATION DESIGNATION   | -            | TSU                         |  |
| LOCATION(S)   | -            | Sintra, Portugal            |  |
| DIAMETER  | m            | 7.3 (1)                     |  |
| <b>RECEIVE</b>  |              |                             |  |
| FREQUENCIES   | MHz          | 2260 - 2275                 |  |
| FREQUENCY RESOLUTION  | Hz           | 320                         |  |
| ANTENNA GAIN @ 45 deg   | dBi          | ≥ 39                        |  |
| SYS NOISE TEMP @ ZENITH   | K            | 158                         |  |
| G/T @ 45 deg  | dB           | 17                          |  |
| POLARIZATION  | -            | LHC, RHC                    |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 1.2                         |  |
| ANTENNA ELLIPTICITY   | dB           | (1)                         |  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 2 \cdot 10^{-8}$ Month |  |
| RCVR AGC DYNAMIC RANGE  | dB           | 100                         |  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -136 in 2 BLo = 300 Hz      |  |
| RCVR LOOP BANDWIDTHS  | Hz           | 300, 1000                   |  |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                       |  |
| RCVR PLL ORDER(S)   | No.          | 2                           |  |
| ACQ SWEEP RANGE   | kHz          | 0.30, 60, 120               |  |
| MIN ACQ SWEEP RATE  | Hz/s         | 10 kHz/s                    |  |
| MAX ACQ SWEEP RATE  | kHz/s        | 100                         |  |
| ACQ SWEEP STEP SIZE   | Hz           | (1)                         |  |
| PROGRAMMED L.O.   | Yes/No       | Yes                         |  |
|   |              |                             |  |
|   |              |                             |  |
|   |              |                             |  |
|   |              |                             |  |
| <b>TELEMETRY</b>  |              |                             |  |
| MODULATION TYPE(S)  | -            | BPSK - PM                   |  |
| MODULATION FORMAT(S)  | -            | NRZ - L, Bi - $\phi$ - L    |  |
| MOD INDEX RANGE   | Rad Pk       | 0.3 - 1.5                   |  |
| SUBCARRIER FREQ RANGE   | kHz          | 32 768                      |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                        |  |
| SYMBOL RATE RANGE   | s/s          | 2 - 1024                    |  |
| SUBCARRIER/SYM RATE LIMIT   | -            | 1                           |  |
| ARRAYS WITH STATIONS  | -            | (1)                         |  |
| CHANNEL DECODING  | Type         | (1)                         |  |
| DATA FORMAT   | -            | (1)                         |  |
|   |              |                             |  |
|   |              |                             |  |
|   |              |                             |  |
|   |              |                             |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                             |  |

6445-5034

CCSDS HISTORICAL DOCUMENT  
**EUTELSAT TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |  |
|---|--------------|-----------------------|--|
|   |              | SINTRA                |  |
| <b>GENERAL</b>  |              |                       |  |
| STATION DESIGNATION   | -            | TSU                   |  |
| LOCATION(S)   | -            | Sintra, Portugal      |  |
| DIAMETER  | m            | 7.3                   |  |
| <b>FREQUENCIES</b>  |              |                       |  |
| TRANSMIT FREQUENCIES  | MHz          | 1400 - 1450           |  |
| RECEIVE FREQUENCIES   | MHz          | 1095 - 1170           |  |
| TURNAROUND FREQ RATIO   | -            | (1)                   |  |
| <b>DOPPLER</b>  |              |                       |  |
|   |              | None                  |  |
| COHERENT/NON-COHERENT   | -            |                       |  |
| COUNTER RESOLUTION  | Cycles       |                       |  |
| MAX DOPPLER FREQ SHIFT  | MHz          |                       |  |
| DOPPLER BIAS FREQ   | MHz          |                       |  |
| DRIFT   | $\Delta f/f$ |                       |  |
| OUTPUT EQUATION   | -            |                       |  |
| DIRECTION INDICATOR   | -            |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
| <b>RANGING</b>  |              |                       |  |
|   |              | None                  |  |
| COHERENT/NON-COHERENT   | -            |                       |  |
| RANGE CODE WAVEFORM   | Sin/Sq       |                       |  |
| EARTH STATION MOD INDEX   | Rad Pk       |                       |  |
| RANGE CODE FREQ RATIO   | -            |                       |  |
| MAJOR CODE FREQ(S)  | kHz          |                       |  |
| MINOR CODE FREQ(S)  | kHz          |                       |  |
| MIN RECEIVED CARRIER SNR  | dB           |                       |  |
| MIN REQ CODE PWR/No   | dB-Hz        |                       |  |
| CODE INTEGRATION TIME   | s            |                       |  |
| ACQUISITION SEQUENCE  | -            |                       |  |
| RANGE DATA UNITS  | -            |                       |  |
| RANGE QUANTIZATION  | -            |                       |  |
| ACCURACY (STRONG SIGNAL)  | m            |                       |  |
| MAX UNAMBIGUOUS RANGE   | km           |                       |  |
| TRANSPONDER BW  | MHz          |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |  |

6445-5035

**CCSDS HISTORICAL DOCUMENT**  
**EUTELSAT TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |  |
|--|---------------|-----------------------|--|
|  |               | SINTRA                |  |
| <b>GENERAL</b>   |               |                       |  |
| STATION DESIGNATION  | -             | TSU                   |  |
| LOCATION(S)  | -             | Sintra, Portugal      |  |
| DIAMETER   | m             | 7.3 (1)               |  |
| <b>FREQUENCY STD</b>   |               |                       |  |
| STANDARD TYPE  | Name          | (1)                   |  |
| STANDARD MFG   | Name          | (1)                   |  |
| STABILITY AT:  |               | (1)                   |  |
| 1 - SECOND   | $\Delta f/f$  | (1)                   |  |
| 1 - HOUR   | $\Delta f/f$  | (1)                   |  |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | 5 - 10 <sup>-10</sup> |  |
| 1 - MONTH  | $\Delta f/f$  | (1)                   |  |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | (1)                   |  |
| 1 Hz OFFSET  | dBc/Hz        | (1)                   |  |
| 10 Hz OFFSET   | dBc/Hz        | (1)                   |  |
| 100 Hz OFFSET  | dBc/Hz        | (1)                   |  |
| 1000 Hz OFFSET   | dBc/Hz        | (1)                   |  |
| REF FREQS AVAILABLE  | MHz           | 5                     |  |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                   |  |
|  |               |                       |  |
|  |               |                       |  |
|  |               |                       |  |
|  |               |                       |  |
| <b>TIMING SYSTEM</b>   |               |                       |  |
| MASTER REFERENCE AGENCY  | Name          | (1)                   |  |
| REFERENCE TIME   | Name          | MSF - DCF 77          |  |
| TIME CODE EPOCH  | Yr            | (1)                   |  |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG - B              |  |
| MAX TIME RESOLUTION  | s             | 10 <sup>-3</sup>      |  |
| TIME TRANSFER METHOD   | Name          | LORAN                 |  |
| MAX TRANS ERROR REF  | $\mu$ -sec    | (1)                   |  |
| MAX OFFSET FROM REF  | $\mu$ -sec    | (1)                   |  |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | (1)                   |  |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                   |  |
| TIMING SIGNALS AVAILABLE   | pulse/s       | (1)                   |  |
|  |               |                       |  |
|  |               |                       |  |
|  |               |                       |  |
|  |               |                       |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |  |

CCSDS HISTORICAL DOCUMENT  
**EUTELSAT TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION      |  |
|---|--------------------|----------------------------|--|
|   |                    | SINTRA                     |  |
| <b>GENERAL</b>  |                    |                            |  |
| STATION DESIGNATION   | -                  | SNT - TSU                  |  |
| LOCATION(S)   | -                  | Sintra, Portugal           |  |
| DIAMETER  | m                  | 7.3 (1)                    |  |
| <b>GEOGRAPHICAL</b>   |                    |                            |  |
| LOCATION, COUNTRY/STATE   | Name               | Portugal                   |  |
| LOCATION, CITY  | Name               | Sintra                     |  |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 9 16 46 W                  |  |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 38 52 13 N                 |  |
| ALTITUDE  |                    | 197 m                      |  |
| <b>MECHANICAL</b>   |                    |                            |  |
| TYPE OF MOUNT   | -                  | EI - Az                    |  |
| AZIMUTH LIMITATIONS   | -                  | ± 90 deg                   |  |
| TRACKING SPEED RANGE  | deg/s              | 0.2                        |  |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 1.5                        |  |
| TYPE OF POINTING  | Type               | Autotrack, Predict, Manual |  |
| POINTING ACCURACY   | deg                | 0.05                       |  |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5                          |  |
| MIN RECEIVE ELEV ANGLE  | deg                | 0                          |  |
| <b>SUPPORT</b>  |                    |                            |  |
| TRANSMIT FREQ BAND(S)   | GHz                | 2.08 - 2.095               |  |
| RECEIVE FREQ BAND(S)  | GHz                | 2.26 - 2.275               |  |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                        |  |
| MISSION CATEGORIES  | Cat                | A                          |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                            |  |

6445-5037

CCSDS HISTORICAL DOCUMENT  
**INPE / DSA TRACK**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION   |  |
|---|--------------|-------------------------|--|
|   |              | DSA GROUND STATION ERDS |  |
| <b>GENERAL</b>  |              |                         |  |
| STATION DESIGNATION   | -            | DSA Ground Station ERDS |  |
| LOCATION(S)   | -            | Cachoeira Paulista      |  |
| DIAMETER  | m            | 3.6                     |  |
| <b>TRANSMIT</b>   |              | None                    |  |
| FREQUENCIES   | MHz          |                         |  |
| FREQUENCY RESOLUTION  | Hz           |                         |  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ |                         |  |
| TRANSMIT POWER 1  | W            |                         |  |
| EIRP RANGE 1  | dBW          |                         |  |
| TRANSMIT POWER 2  | W            |                         |  |
| EIRP RANGE 2  | dBW          |                         |  |
| POLARIZATION  | -            |                         |  |
| ANTENNA GAIN  | dBi          |                         |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          |                         |  |
| ANTENNA ELLIPTICITY   | dB           |                         |  |
| RF FREQ SWEEP RANGE   | kHz          |                         |  |
| MIN FREQ SWEEP RATE   | Hz/s         |                         |  |
| MAX FREQ SWEEP RATE   | kHz/s        |                         |  |
| PROGRAMMED UPLINK FREQ  | Yes/No       |                         |  |
|   |              |                         |  |
|   |              |                         |  |
|   |              |                         |  |
|   |              |                         |  |
|   |              |                         |  |
|   |              |                         |  |
|   |              |                         |  |
|   |              |                         |  |
| <b>COMMAND</b>  |              | None                    |  |
| RF CARRIER MOD TYPE   | -            |                         |  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       |                         |  |
| SUBCARRIER FREQUENCY(S)   | Hz           |                         |  |
| SUBCARRIER STEP SIZE  | Hz           |                         |  |
| SUBCARRIER FREQ STABILITY   | ppm          |                         |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                         |  |
| SUBCARRIER MOD TYPE   | -            |                         |  |
| SUBCARRIER/BIT RATE LIMIT   | -            |                         |  |
| BIT RATE RANGE  | b/s          |                         |  |
| FORMATS AVAILABLE   | -            |                         |  |
|   |              |                         |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                         |  |

6445-4831

**CCSDS HISTORICAL DOCUMENT**  
**INPE / DSA TRACK**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION            |  |
|--|--------------|----------------------------------|--|
|  |              | DSA GROUND STATION ERDS          |  |
| <b>GENERAL</b>   |              |                                  |  |
| STATION DESIGNATION  | -            | DSA Ground Station ERDS          |  |
| LOCATION(S)  | -            | Cachoeira Paulista               |  |
| DIAMETER   | m            | 3.6                              |  |
| <b>RECEIVE</b>   |              |                                  |  |
| FREQUENCIES  | MHz          | 1650 - 1750                      |  |
| FREQUENCY RESOLUTION   | Hz           | 12 500                           |  |
| ANTENNA GAIN @ 45 deg  | dBi          | 33.1                             |  |
| SYS NOISE TEMP @ ZENITH  | K            | (1)                              |  |
| G/T @ 45 deg   | dB           | (1)                              |  |
| POLARIZATION   | -            | RHC / LHC                        |  |
| ANTENNA BEAMWIDTH (-3 dB)  | deg          | 3                                |  |
| ANTENNA ELLIPTICITY  | dB           | (1)                              |  |
| L.O. REF FREQ STAB @ 1 Hr  | $\Delta f/f$ | $\pm 2 \times 10^6$ Per Year     |  |
| RCVR AGC DYNAMIC RANGE   | dB           | 115 dB min                       |  |
| RCVR THRESHOLD @ 2 Blo Hz  | dBm          | (1)                              |  |
| RCVR LOOP BANDWIDTHS   | Hz           | 30, 100, 300, 1000, 3000, $10^4$ |  |
| RCVR LOOP TYPE (ADAPT, FIX)  | -            | Adapt                            |  |
| RCVR PLL ORDER(S)  | No.          | (1)                              |  |
| ACQ SWEEP RANGE  | kHz          | $\pm 250$ min                    |  |
| MIN ACQ SWEEP RATE   | Hz/s         | 70                               |  |
| MAX ACQ SWEEP RATE   | kHz/s        | 5000                             |  |
| ACQ SWEEP STEP SIZE  | Hz           | Continuous                       |  |
| PROGRAMMED L.O.  | Yes/No       | No                               |  |
|  |              |                                  |  |
|  |              |                                  |  |
|  |              |                                  |  |
|  |              |                                  |  |
| <b>TELEMETRY</b>   |              |                                  |  |
| MODULATION TYPE(S)   | -            | PM                               |  |
| MODULATION FORMAT(S)   | -            | BPSK                             |  |
| MOD INDEX RANGE  | Rad Pk       | $2.35 \pm 0.12$ rad              |  |
| SUBCARRIER FREQ RANGE  | kHz          | None                             |  |
| SUBCARRIER WAVEFORM  | Sin/Sq       | None                             |  |
| SYMBOL RATE RANGE  | s/s          | None                             |  |
| SUBCARRIER/SYM RATE LIMIT  | -            | None                             |  |
| ARRAYS WITH STATIONS   | -            | None                             |  |
| CHANNEL DECODING   | Type         | None                             |  |
| DATA FORMAT  | -            | None                             |  |
|  |              |                                  |  |
|  |              |                                  |  |
|  |              |                                  |  |
|  |              |                                  |  |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |                                  |  |

6445-4832

**INPE / DSA TRACK**

RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION   |  |
|---|--------------|-------------------------|--|
|   |              | DSA GROUND STATION ERDS |  |
| <b>GENERAL</b>  |              |                         |  |
| STATION DESIGNATION   | -            | DSA Ground Station ERDS |  |
| LOCATION(S)   | -            | Cachoeira Paulista      |  |
| DIAMETER  | m            | 3.6                     |  |
| <b>FREQUENCIES</b>  |              |                         |  |
| TRANSMIT FREQUENCIES  | MHz          | None                    |  |
| RECEIVE FREQUENCIES   | MHz          | 1650 - 1750             |  |
| TURNAROUND FREQ RATIO   | -            | None                    |  |
| <b>DOPPLER</b>  |              |                         |  |
|   |              | None                    |  |
| COHERENT/NON-COHERENT   | -            |                         |  |
| COUNTER RESOLUTION  | Cycles       |                         |  |
| MAX DOPPLER FREQ SHIFT  | MHz          |                         |  |
| DOPPLER BIAS FREQ   | MHz          |                         |  |
| DRIFT   | $\Delta f/f$ |                         |  |
| OUTPUT EQUATION   | -            |                         |  |
| DIRECTION INDICATOR   | -            |                         |  |
| <b>RANGING</b>  |              |                         |  |
|   |              | None                    |  |
| COHERENT/NON-COHERENT   | -            |                         |  |
| RANGE CODE WAVEFORM   | Sin/Sq       |                         |  |
| EARTH STATION MOD INDEX   | Rad Pk       |                         |  |
| RANGE CODE FREQ RATIO   | -            |                         |  |
| MAJOR CODE FREQ(S)  | kHz          |                         |  |
| MINOR CODE FREQ(S)  | kHz          |                         |  |
| MIN RECEIVED CARRIER SNR  | dB           |                         |  |
| MIN REQ CODE PWR/ $N_0$   | dB-Hz        |                         |  |
| CODE INTEGRATION TIME   | s            |                         |  |
| ACQUISITION SEQUENCE  | -            |                         |  |
| RANGE DATA UNITS  | -            |                         |  |
| RANGE QUANTIZATION  | -            |                         |  |
| ACCURACY (STRONG SIGNAL)  | m            |                         |  |
| MAX UNAMBIGUOUS RANGE   | km           |                         |  |
| TRANSPONDER BW  | MHz          |                         |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                         |  |
| 6445-4833   |              |                         |  |

**INPE / DSA TRACK**

FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION   |                |                       |                |
|--|---------------|-------------------------|----------------|-----------------------|----------------|
|  |               | DSA GROUND STATION ERDS |                |                       |                |
| <b>GENERAL</b>   |               |                         |                |                       |                |
| STATION DESIGNATION  | -             | DSA Ground Station ERDS |                |                       |                |
| LOCATION(S)  | -             | Cachoeira Paulista      |                |                       |                |
| DIAMETER   | m             | 3.6                     |                |                       |                |
| <b>FREQUENCY STD</b>   |               |                         |                |                       |                |
| STANDARD TYPE  | Name          | Sat. Sync. Clock        |                |                       |                |
| STANDARD MFG   | Name          | Truetime/Kinometrics    |                |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b>   | <b>Drift</b>   | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | None                    |                |                       |                |
| 1 - HOUR   | $\Delta f/f$  | None                    |                |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | None                    |                |                       |                |
| 1 - MONTH  | $\Delta f/f$  | None                    |                |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>            | <b>100 MHz</b> | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | None                    |                |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | None                    |                |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | None                    |                |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | None                    |                |                       |                |
| REF FREQS AVAILABLE  | MHz           | None                    |                |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | None                    |                |                       |                |
|  |               |                         |                |                       |                |
|  |               |                         |                |                       |                |
|  |               |                         |                |                       |                |
| <b>TIMING SYSTEM</b>   |               |                         |                |                       |                |
| MASTER REFERENCE AGENCY  | Name          | None                    |                |                       |                |
| REFERENCE TIME   | Name          | UTC                     |                |                       |                |
| TIME CODE EPOCH  | Yr            | None                    |                |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG-B                  |                |                       |                |
| MAX TIME RESOLUTION  | s             | $10^{-3}$               |                |                       |                |
| TIME TRANSFER METHOD   | Name          | None                    |                |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | None                    |                |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | None                    |                |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | None                    |                |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | None                    |                |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1,1000                  |                |                       |                |
|  |               |                         |                |                       |                |
|  |               |                         |                |                       |                |
|  |               |                         |                |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                         |                |                       |                |

6445-4834

**INPE / DSA TRACK**

GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS                  | UNITS              | SUBNETWORK OR STATION   |  |
|----------------------------------|--------------------|-------------------------|--|
|                                  |                    | DSA GROUND STATION ERDS |  |
| <b>GENERAL</b>                   |                    |                         |  |
| STATION DESIGNATION              | -                  | DSA Ground Station ERDS |  |
| LOCATION(S)                      | -                  | Cachoeira Paulista      |  |
| DIAMETER                         | m                  | 3.6                     |  |
| <b>GEOGRAPHICAL</b>              |                    |                         |  |
| LOCATION, COUNTRY/STATE          | Name               | Brazil / SP             |  |
| LOCATION, CITY                   | Name               | Cachoeira Paulista      |  |
| LONGITUDE (site 1/site 2/site 3) | d, m, s            | 45, 00, 00 W            |  |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 22, 40, 55 S            |  |
|                                  |                    |                         |  |
|                                  |                    |                         |  |
|                                  |                    |                         |  |
|                                  |                    |                         |  |
| <b>MECHANICAL</b>                |                    |                         |  |
| TYPE OF MOUNT                    | -                  | Az - El                 |  |
| AZIMUTH LIMITATIONS              | -                  | ± 360                   |  |
| TRACKING SPEED RANGE             | deg/s              | Az = El = 0 - 15        |  |
| MAX TRACK ACCELERATION           | deg/s <sup>2</sup> | None                    |  |
| TYPE OF POINTING                 | Type               | Manual, Program         |  |
| POINTING ACCURACY                | deg                | 0.01                    |  |
| MIN TRANSMIT ELEV ANGLE          | deg                | None                    |  |
| MIN RECEIVE ELEV ANGLE           | deg                | 7                       |  |
|                                  |                    |                         |  |
|                                  |                    |                         |  |
|                                  |                    |                         |  |
|                                  |                    |                         |  |
|                                  |                    |                         |  |
| <b>SUPPORT</b>                   |                    |                         |  |
| TRANSMIT FREQ BAND(S)            | GHz                | None                    |  |
| RECEIVE FREQ BAND(S)             | GHz                | 1.65 - 1.75             |  |
| ACQ AID FREQ BAND(S)             | GHz                | None                    |  |
| MISSION CATEGORIES               | Cat                | A                       |  |
|                                  |                    |                         |  |
|                                  |                    |                         |  |
|                                  |                    |                         |  |
|                                  |                    |                         |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS  
 4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES

6445-4835

CCSDS HISTORICAL DOCUMENT

**INPE / DSA TRACK**

EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION                        |  |
|---------------------------|--------------|--|--|
|                           |              | ALCANTARA                                    | CUIABÁ                                       |
| <b>GENERAL</b>            |              |  |  |
| STATION DESIGNATION       | -            | Alcântara Ground Station - ETA               | Cuiabá Ground Stations - ETC                 |
| LOCATION(S)               | -            | Alcântara, Brazil                            | Cuiabá, Brazil                               |
| DIAMETER                  | m            | 11 (1)                                       | 11 (1)                                       |
| <b>TRANSMIT</b>           |              |  |  |
| FREQUENCIES               | MHz          | 2025 - 2120                                  | 2025 - 2120                                  |
| FREQUENCY RESOLUTION      | Hz           | 2  | 2  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $\pm 3 \times 10^{-5}$ @ 1 sec               | $\pm 3 \times 10^{-5}$ @ 1 sec               |
| TRANSMIT POWER 1          | W            | 2000   | 2000   |
| EIRP RANGE 1              | dBW          | 52 - 72                                      | 52 - 72                                      |
| TRANSMIT POWER 2          | W            | 50   | 50   |
| EIRP RANGE 2              | dBW          | 36 - 56                                      | 36 - 56                                      |
| POLARIZATION              | -            | RCP or LCP                                   | RCP or LCP                                   |
| ANTENNA GAIN              | dBi          | 44.6   | 44.6   |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.8  | 0.8  |
| ANTENNA ELLIPTICITY       | dB           | < 1  | < 1  |
| RF FREQ SWEEP RANGE       | kHz          | $\pm 100$                                    | $\pm 100$                                    |
| MIN FREQ SWEEP RATE       | Hz/s         | 80   | 80   |
| MAX FREQ SWEEP RATE       | kHz/s        | 50   | 50   |
| PROGRAMMED UPLINK FREQ    | Yes/No       | Yes  | Yes  |
|                           |              |  |  |
|                           |              |  |  |
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|                           |              |  |  |
| <b>COMMAND</b>            |              |  |  |
| RF CARRIER MOD TYPE       | -            | PM   | PM   |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.2 - 1.4                                    | 0.2 - 1.4                                    |
| SUBCARRIER FREQUENCY(S)   | Hz           | 8000 or 16 000                               | 8000 or 16 000                               |
| SUBCARRIER STEP SIZE      | Hz           | 8000   | 8000   |
| SUBCARRIER FREQ STABILITY | ppm          | $\pm 3 \times 10^{-5}$ @ 1 sec               | $\pm 3 \times 10^{-5}$ @ 1 sec               |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine   | Sine   |
| SUBCARRIER MOD TYPE       | -            | PCM, PSK                                     | PCM, PSK                                     |
| SUBCARRIER/BIT RATE LIMIT | -            | > 4  | > 4  |
| BIT RATE RANGE            | b/s          | 2000 / $2^\eta$ ; $\eta = 0, 1, 2, \dots, 9$ | 2000 / $2^\eta$ ; $\eta = 0, 1, 2, \dots, 9$ |
| FORMATS AVAILABLE         | -            | NRZ - L, M, S                                | NRZ - L, M, S                                |
|                           |              |  |  |
|                           |              |  |  |
|                           |              |  |  |
|                           |              |  |  |
|                           |              |  |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

6445-4471

**CCSDS HISTORICAL DOCUMENT**  
**INPE / DSA TRACK**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                |                                      |
|-----------------------------|--------------|--------------------------------------|--------------------------------------|
|                             |              | ALCANTARA                            | CUIABÁ                               |
| <b>GENERAL</b>              |              |                                      |                                      |
| STATION DESIGNATION         | -            | Alcântara Ground Station - ETA       | Cuiabá Ground Stations - ETC         |
| LOCATION(S)                 | -            | Alcântara, Brazil                    | Cuiabá, Brazil                       |
| DIAMETER                    | m            | 11 (1)                               | 11 (1)                               |
| <b>RECEIVE</b>              |              |                                      |                                      |
| FREQUENCIES                 | MHz          | 2200 - 2300                          | 2200 - 2300                          |
| FREQUENCY RESOLUTION        | Hz           | 12 500                               | 12 500                               |
| ANTENNA GAIN @ 45 deg       | dBi          | 44                                   | 45                                   |
| SYS NOISE TEMP @ ZENITH     | K            | 160                                  | 150                                  |
| G/T @ 45 deg                | dB           | 22                                   | 23                                   |
| POLARIZATION                | -            | RCP and LCP and LIN                  | RCP and LCP and LIN                  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.8                                  | 0.8                                  |
| ANTENNA ELLIPTICITY         | dB           | 1                                    | 1                                    |
| L.O. REF FREQ STAB @ 1 Hr   | Af/f         | $\pm 3 \times 10^{-5}$ @ 1 sec       | $\pm 3 \times 10^{-5}$ @ 1 sec       |
| RCVR AGC DYNAMIC RANGE      | $\Delta f/f$ | 110                                  | 110                                  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -147.8 in 2 Blo = 30 Hz              | -148 in 2 Blo = 30 Hz                |
| RCVR LOOP BANDWIDTHS        | Hz           | 30, 100, 300, 1 K, 3 K               | 30, 100, 300, 1 K, 3 K               |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                                | Adapt                                |
| RCVR PLL ORDER(S)           | No.          | 2                                    | 2                                    |
| ACQ SWEEP RANGE             | kHz          | $\pm 250$                            | $\pm 250$                            |
| MIN ACQ SWEEP RATE          | Hz/s         | 70                                   | 70                                   |
| MAX ACQ SWEEP RATE          | kHz/s        | 350                                  | 350                                  |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous                           | Continuous                           |
| PROGRAMMED L.O.             | Yes/No       | No                                   | No                                   |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
| <b>TELEMETRY</b>            |              |                                      |                                      |
| MODULATION TYPE(S)          | -            | PM                                   | PM                                   |
| MODULATION FORMAT(S)        | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S | NRZ - L, M, S; Bi - $\phi$ - L, M, S |
| MOD INDEX RANGE             | Rad Pk       | $\leq 1.4$                           | $\leq 1.4$                           |
| SUBCARRIER FREQ RANGE       | kHz          | 0.1 - 1000                           | 0.1 - 1000                           |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Square                               | Square                               |
| SYMBOL RATE RANGE           | s/s          | 32 - 10 000                          | 32 - 10 000                          |
| SUBCARRIER/SYM RATE LIMIT   | -            | 2 - 512                              | 2 - 512                              |
| ARRAYS WITH STATIONS        | -            | None                                 | None                                 |
| CHANNEL DECODING            | Type         | None                                 | None                                 |
| DATA FORMAT                 | -            | (1)                                  | (1)                                  |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

6445-4472

**CCSDS HISTORICAL DOCUMENT**  
**INPE / DSA TRACK**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION             |                                   |
|---|--------------|-----------------------------------|-----------------------------------|
|   |              | ALCANTARA                         | CUIABÁ                            |
| <b>GENERAL</b>  |              |                                   |                                   |
| STATION DESIGNATION   | -            | Alcântara Ground Station - ETA    | Cuiabá Ground Stations - ETC      |
| LOCATION(S)   | -            | Alcântara, Brazil                 | Cuiabá, Brazil                    |
| DIAMETER  | m            | 11 (1)                            | 11 (1)                            |
| <b>FREQUENCIES</b>  |              |                                   |                                   |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120                       | 2025 - 2120                       |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300                       | 2200 - 2300                       |
| TURNAROUND FREQ RATIO   | -            | 240 / 221                         | 240 / 221                         |
| <b>DOPPLER</b>  |              |                                   |                                   |
| COHERENT/NON-COHERENT   | -            | None                              | None                              |
| COUNTER RESOLUTION  | Cycles       |                                   |                                   |
| MAX DOPPLER FREQ SHIFT  | MHz          |                                   |                                   |
| DOPPLER BIAS FREQ   | MHz          |                                   |                                   |
| DRIFT   | $\Delta f/f$ |                                   |                                   |
| OUTPUT EQUATION   | -            |                                   |                                   |
| DIRECTION INDICATOR   | -            |                                   |                                   |
|   |              |                                   |                                   |
|   |              |                                   |                                   |
|   |              |                                   |                                   |
| <b>RANGING</b>  |              |                                   |                                   |
| COHERENT/NON-COHERENT   | -            | Either                            | Either                            |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine                              | Sine                              |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.2 - 1.4                         | 0.2 - 1.4                         |
| RANGE CODE FREQ RATIO   | -            | 5:1; 4:1                          | 5:1; 4:1                          |
| MAJOR CODE FREQ(S)  | kHz          | 100, 20                           | 100, 20                           |
| MINOR CODE FREQ(S)  | kHz          | 0.8, 0.16, 0.032, 0.008 on 16 kHz | 0.8, 0.16, 0.032, 0.008 on 16 kHz |
| MIN RECEIVED CARRIER SNR  | dB           | 12                                | 12                                |
| MIN REQ CODE PWR/No   | dB-Hz        | Major = 22, Minor = 13            | Major = 22, Minor = 13            |
| CODE INTEGRATION TIME   | s            | 4                                 | 4                                 |
| ACQUISITION SEQUENCE  | -            | Sequence Major Tone First         | Sequence Major Tone First         |
| RANGE DATA UNITS  | -            | Nanoseconds                       | Nanoseconds                       |
| RANGE QUANTIZATION  | -            | 10 ns                             | 10 ns                             |
| ACCURACY (STRONG SIGNAL)  | m            | $\pm 3$                           | $\pm 3$                           |
| MAX UNAMBIGUOUS RANGE   | km           | 18 750                            | 18 750                            |
| TRANSPONDER BW  | MHz          | $\geq 0.3$                        | $\geq 0.3$                        |
|   |              |                                   |                                   |
|   |              |                                   |                                   |
|   |              |                                   |                                   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                                   |                                   |
| 6445-4473   |              |                                   |                                   |

**INPE / DSA TRACK**

FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION          |                |                              |                |
|--|---------------|--------------------------------|----------------|------------------------------|----------------|
|  |               | ALCANTARA                      |                | CUIABÁ                       |                |
| <b>GENERAL</b>   |               |                                |                |                              |                |
| STATION DESIGNATION  | -             | Alcântara Ground Station - ETA |                | Cuiabá Ground Stations - ETC |                |
| LOCATION(S)  | -             | Alcântara, Brazil              |                | Cuiabá, Brazil               |                |
| DIAMETER   | m             | 11 (1)                         |                | 11 (1)                       |                |
| <b>FREQUENCY STD</b>   |               |                                |                |                              |                |
| STANDARD TYPE  | Name          | Cesium Beam                    |                | Cesium Beam                  |                |
| STANDARD MFG   | Name          | OSA 3210                       |                | OSA 3210                     |                |
| STABILITY AT:  |               | <b>Allan Variance</b>          | <b>Drift</b>   | <b>Allan Variance</b>        | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $3 \times 10^{-11}$            |                | $3 \times 10^{-11}$          |                |
| 1 - HOUR   | $\Delta f/f$  | $2 \times 10^{-12}$            |                | $2 \times 10^{-12}$          |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | $5 \times 10^{-13}$            |                | $5 \times 10^{-13}$          |                |
| 1 - MONTH  | $\Delta f/f$  | $3 \times 10^{-13}$            |                | $3 \times 10^{-13}$          |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>                   | <b>100 MHz</b> | <b>5 MHz</b>                 | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | -80                            |                | -80                          |                |
| 10 Hz OFFSET   | dBc/Hz        | -120                           |                | -120                         |                |
| 100 Hz OFFSET  | dBc/Hz        | -140                           |                | -140                         |                |
| 1000 Hz OFFSET   | dBc/Hz        | -140                           |                | -140                         |                |
| REF FREQS AVAILABLE  | MHz           | 1, 5, 10                       |                | 1, 5, 10                     |                |
| MAX STA-TO-STA OFFSET  | Hz            | $\pm 3 \times 10^{-12}$        |                | $\pm 3 \times 10^{-12}$      |                |
|  |               |                                |                |                              |                |
|  |               |                                |                |                              |                |
|  |               |                                |                |                              |                |
| <b>TIMING SYSTEM</b>   |               |                                |                |                              |                |
| MASTER REFERENCE AGENCY  | Name          | Observatório Nacional          |                | Observatório Nacional        |                |
| REFERENCE TIME   | Name          | UTC                            |                | UTC                          |                |
| TIME CODE EPOCH  | Yr            | 1 January 1972                 |                | 1 January 1972               |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG - B                       |                | IRIG - B                     |                |
| MAX TIME RESOLUTION  | s             | $10^{-3}$                      |                | $10^{-3}$                    |                |
| TIME TRANSFER METHOD   | Name          | Portable Clock, TV , GPS       |                | Portable Clock, TV , GPS     |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 21                             |                | 21                           |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | 10                             |                | 10                           |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 40                             |                | 40                           |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 100                            |                | 100                          |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                              |                | 1                            |                |
|  |               |                                |                |                              |                |
|  |               |                                |                |                              |                |
|  |               |                                |                |                              |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                                |                |                              |                |

**CCSDS HISTORICAL DOCUMENT**  
**INPE / DSA TRACK**  
**GEOGRAPHICAL AND MECHANICAL**

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION          |                              |
|---|--------------------|--------------------------------|------------------------------|
|   |                    | ALCANTARA                      | CUIABÁ                       |
| <b>GENERAL</b>  |                    |                                |                              |
| STATION DESIGNATION   | -                  | Alcântara Ground Station - ETA | Cuiabá Ground Stations - ETC |
| LOCATION(S)   | -                  | Alcântara, Brazil / MA         | Cuiabá, Brazil / MT          |
| DIAMETER  | m                  | 11 (1)                         | 11 (1)                       |
| <b>GEOGRAPHICAL</b>   |                    |                                |                              |
| LOCATION, COUNTRY/STATE   | Name               | Alcântara, Brazil / MA         | Cuiabá, Brazil / MT          |
| LOCATION, CITY  | Name               | Alcântara                      | Cuiabá                       |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 44, 24, 15 W                   | 56, 04, 11 W                 |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 2, 20, 18 S                    | 15, 33, 18 S                 |
| <b>MECHANICAL</b>   |                    |                                |                              |
| TYPE OF MOUNT   | -                  | Az / El                        | Az / El                      |
| AZIMUTH LIMITATIONS   | -                  | ± 360                          | ± 360                        |
| TRACKING SPEED RANGE  | deg/s              | Az = 0 - 21; El = 0 - 5        | Az = 0 - 21; El = 0 - 5      |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 10                             | 10                           |
| TYPE OF POINTING  | Type               | Manual, Predict, Autotrack     | Manual, Predict, Autotrack   |
| POINTING ACCURACY   | deg                | 0.05                           | 0.05                         |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5                              | 5                            |
| MIN RECEIVE ELEV ANGLE  | deg                | 2                              | 3                            |
| <b>SUPPORT</b>  |                    |                                |                              |
| TRANSMIT FREQ BAND(S)   | GHz                | 2                              | 2                            |
| RECEIVE FREQ BAND(S)  | GHz                | 2                              | 2                            |
| ACQ AID FREQ BAND(S)  | GHz                | None                           | 2                            |
| MISSION CATEGORIES  | Cat                | A                              | A                            |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES |                    |                                |                              |

6445-4475

**CCSDS HISTORICAL DOCUMENT**  
**ISAS TRACKING SYSTEM**  
**EARTH-TO-SPACE LINK CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION    |  |
|---|--------------|--------------------------|--|
|   |              | USUDA                    |  |
| <b>GENERAL</b>  |              |                          |  |
| STATION DESIGNATION   | -            | UDSC                     |  |
| LOCATION(S)   | -            | Usuda, Japan             |  |
| DIAMETER  | m            | 64                       |  |
| <b>TRANSMIT</b>   |              |                          |  |
| FREQUENCIES   | MHz          | 2076 - 2086, 2110 - 2120 |  |
| FREQUENCY RESOLUTION  | Hz           | 1                        |  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $1 \times 10^{-11}$      |  |
| TRANSMIT POWER 1  | W            | 200, 2000, 20 000        |  |
| EIRP RANGE 1  | dBW          | 83.5, 93.5, 103.5        |  |
| TRANSMIT POWER 2  | W            | None                     |  |
| EIRP RANGE 2  | dBW          | None                     |  |
| POLARIZATION  | -            | RCP or LCP               |  |
| ANTENNA GAIN  | dBi          | 61.4                     |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.13                     |  |
| ANTENNA ELLIPTICITY   | dB           | (1)                      |  |
| RF FREQ SWEEP RANGE   | kHz          | $\pm 300$                |  |
| MIN FREQ SWEEP RATE   | Hz/s         | 0.1                      |  |
| MAX FREQ SWEEP RATE   | kHz/s        | 30                       |  |
| PROGRAMMED UPLINK FREQ  | Yes/No       | Yes                      |  |
|   |              |                          |  |
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| <b>COMMAND</b>  |              |                          |  |
| RF CARRIER MOD TYPE   | -            | PM                       |  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0 - 2                    |  |
| SUBCARRIER FREQUENCY(S)   | Hz           | 100 - 16 384             |  |
| SUBCARRIER STEP SIZE  | Hz           | 1                        |  |
| SUBCARRIER FREQ STABILITY   | ppm          | 10                       |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine or Square           |  |
| SUBCARRIER MOD TYPE   | -            | PSK                      |  |
| SUBCARRIER/BIT RATE LIMIT   | -            | 2 - 256                  |  |
| BIT RATE RANGE  | b/s          | 1 - 8197                 |  |
| FORMATS AVAILABLE   | -            | NRZ - L                  |  |
|   |              |                          |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                          |  |

**CCSDS HISTORICAL DOCUMENT**  
**ISAS TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                         |                         |
|---|--------------|---|-------------------------|
|   |              | USUDA   |                         |
| <b>GENERAL</b>  |              |   |                         |
| STATION DESIGNATION   | -            | UDSC  |                         |
| LOCATION(S)   | -            | USUDA, Japan                                  |                         |
| DIAMETER  | m            | 64  |                         |
| <b>RECEIVE</b>  |              |   |                         |
| FREQUENCIES   | MHz          | 2200 - 2300                                   | 8400 - 8500             |
| FREQUENCY RESOLUTION  | Hz           | 1   | 1                       |
| ANTENNA GAIN @ 45 deg   | dBi          | 61.6  | 70.5                    |
| SYS NOISE TEMP @ ZENITH   | K            | 75  | 81                      |
| G/T @ 90 deg  | dB/K         | 42.8  | 51.4                    |
| POLARIZATION  | -            | RCP or LCP                                    | RCP or LCP              |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.13  | 0.04                    |
| ANTENNA ELLIPTICITY   | dB           | (1)   | (1)                     |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $1 \times 10^{-11}$                           | $1 \times 10^{-11}$     |
| RCVR AGC DYNAMIC RANGE  | dB           | 80  | 80                      |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -165 in 2 Blo = 3 Hz                          | -160 in 2 Blo = 3 Hz    |
| RCVR LOOP BANDWIDTHS  | Hz           | 3, 10, 30, 100, 300, 1K                       | 3, 10, 30, 100, 300, 1K |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt   | Adapt                   |
| RCVR PLL ORDER(S)   | No.          | 2   | 2                       |
| ACQ SWEEP RANGE   | kHz          | 999   | 999                     |
| MIN ACQ SWEEP RATE  | Hz/s         | 0.1   | 0.1                     |
| MAX ACQ SWEEP RATE  | kHz/s        | 99.9  | 99.9                    |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                                    | Continuous              |
| PROGRAMMED L.O.   | Yes/No       | Yes   | Yes                     |
|   |              |   |                         |
|   |              |   |                         |
|   |              |   |                         |
|   |              |   |                         |
| <b>TELEMETRY</b>  |              |   |                         |
| MODULATION TYPE(S)  | -            | PCM / PSK / PM; PCM / PM (Bi - $\phi$ - only) |                         |
| MODULATION FORMAT(S)  | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S          |                         |
| MOD INDEX RANGE   | Rad Pk       | 0.2 - 1.3                                     |                         |
| SUBCARRIER FREQ RANGE   | kHz          | 0.1 - 999                                     |                         |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine or Square                                |                         |
| SYMBOL RATE RANGE   | s/s          | 5 - 600 000                                   |                         |
| SUBCARRIER/SYM RATE LIMIT   | -            | 4 - 1000                                      |                         |
| ARRAYS WITH STATIONS  | -            | None  |                         |
| CHANNEL DECODING  | Type         | Convolutional (k = 7, R = 1/2 and 1/3)        |                         |
| DATA FORMAT   | -            | TDM   |                         |
|   |              |   |                         |
|   |              |   |                         |
|   |              |   |                         |
|   |              |   |                         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |   |                         |

6445-4161

**CCSDS HISTORICAL DOCUMENT**  
**ISAS TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION              |                             |
|---|--------------|------------------------------------|-----------------------------|
|   |              | USUDA                              |                             |
| <b>GENERAL</b>  |              |                                    |                             |
| STATION DESIGNATION   | -            | UDSC                               |                             |
| LOCATION(S)   | -            | Usuda, Japan                       |                             |
| DIAMETER  | m            | 64                                 |                             |
| <b>FREQUENCIES</b>  |              |                                    |                             |
| TRANSMIT FREQUENCIES  | MHz          | 2076 - 2086,<br>2110 - 2120        | 2076 - 2086,<br>2110 - 2120 |
| RECEIVE FREQUENCIES   | MHz          | 2259 - 2300                        | 8400 - 8500                 |
| TURNAROUND FREQ RATIO   | -            | 240 / 221                          | 900 / 221: 800 / 221        |
| <b>DOPPLER</b>  |              |                                    |                             |
| COHERENT/NON-COHERENT   | -            | Either                             | Either                      |
| COUNTER RESOLUTION  | Cycles       | 0.01                               | 0.01                        |
| MAX DOPPLER FREQ SHIFT  | MHz          | $\pm 0.45$                         | $\pm 1.7$                   |
| DOPPLER BIAS FREQ   | MHz          | 5                                  | 5                           |
| DRIFT   | $\Delta f/f$ | $< 1 \times 10^{-11}$              | $< 1 \times 10^{-11}$       |
| OUTPUT EQUATION   | -            | Bias Frequency $\pm f_d$           | Bias Frequency $\pm f_d$    |
| DIRECTION INDICATOR   | -            | $+ \Delta f = -\Delta r$           | $+ \Delta f = -\Delta r$    |
| <b>RANGING</b>  |              |                                    |                             |
| COHERENT/NON-COHERENT   | -            | Coherent Only                      | None                        |
| RANGE CODE WAVEFORM   | Sin/Sq       | Filtered Square                    |                             |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.2 - 1.5                          |                             |
| RANGE CODE FREQ RATIO   | -            | 2:1                                |                             |
| MAJOR CODE FREQ(S)  | kHz          | fxmt $2^{\eta}$ ; $\eta = 11 - 14$ |                             |
| MINOR CODE FREQ(S)  | kHz          | fxmt $2^{\eta}$ ; $\eta = 12 - 31$ |                             |
| MIN RECEIVED CARRIER SNR  | dB           | (1)                                |                             |
| MIN REQ CODE PWR/ $N_0$   | dB-Hz        | 6                                  |                             |
| CODE INTEGRATION TIME   | s            | 1 - 9999                           |                             |
| ACQUISITION SEQUENCE  | -            | Major Code First                   |                             |
| RANGE DATA UNITS  | -            | Nanoseconds                        |                             |
| RANGE QUANTIZATION  | -            | 1 ns                               |                             |
| ACCURACY (STRONG SIGNAL)  | m            | 1 (bias) + 2 (ran)                 |                             |
| MAX UNAMBIGUOUS RANGE   | km           | 149 000                            |                             |
| TRANSPONDER BW  | MHz          | 3                                  |                             |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                                    |                             |

6445-4162

**CCSDS HISTORICAL DOCUMENT**  
**ISAS TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                |                       |                |
|--|---------------|-----------------------|----------------|-----------------------|----------------|
|  |               | USUDA                 |                |                       |                |
| <b>GENERAL</b>   |               |                       |                |                       |                |
| STATION DESIGNATION  | -             | UDSC                  |                |                       |                |
| LOCATION(S)  | -             | Usuda, Japan          |                |                       |                |
| DIAMETER   | m             | 64                    |                |                       |                |
| <b>FREQUENCY STD</b>   |               |                       |                |                       |                |
| STANDARD TYPE  | Name          | Hydrogen Maser        |                |                       |                |
| STANDARD MFG   | Name          | Anritsu               |                |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Drift</b>   | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $3 \times 10^{-13}$   |                |                       |                |
| 1 - HOUR   | $\Delta f/f$  | $1 \times 10^{-14}$   |                |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                   |                |                       |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                   |                |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b> | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                   |                |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | -135                  |                |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | -140                  |                |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | -148                  |                |                       |                |
| REF FREQS AVAILABLE  | MHz           | 5, 10                 |                |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                   |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
| <b>TIMING SYSTEM</b>   |               |                       |                |                       |                |
| MASTER REFERENCE AGENCY  | Name          | TOYOCOM               |                |                       |                |
| REFERENCE TIME   | Name          | UTC                   |                |                       |                |
| TIME CODE EPOCH  | Yr            | 0000                  |                |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | None                  |                |                       |                |
| MAX TIME RESOLUTION  | s             | 1                     |                |                       |                |
| TIME TRANSFER METHOD   | Name          | LORAN                 |                |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 1                     |                |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | (1)                   |                |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | (1)                   |                |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                   |                |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | (1)                   |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
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|  |               |                       |                |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                |                       |                |

**CCSDS HISTORICAL DOCUMENT**  
**ISAS TRACKING SYSTEM**  
**GEOGRAPHICAL AND MECHANICAL**

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION      |  |
|---|--------------------|----------------------------|--|
|   |                    | UDSC                       |  |
| <b>GENERAL</b>  |                    |                            |  |
| STATION DESIGNATION   | -                  | UDSC                       |  |
| LOCATION(S)   | -                  | Usuda, Japan               |  |
| DIAMETER  | m                  | 64                         |  |
| <b>GEOGRAPHICAL</b>   |                    |                            |  |
| LOCATION, COUNTRY/STATE   | Name               | Usuda                      |  |
| LOCATION, CITY  | Name               | Japan                      |  |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 138, 21, 45.670 E          |  |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 36, 7, 56.937 N            |  |
|   |                    |                            |  |
|   |                    |                            |  |
|   |                    |                            |  |
|   |                    |                            |  |
| <b>MECHANICAL</b>   |                    |                            |  |
| TYPE OF MOUNT   | -                  | Az - El                    |  |
| AZIMUTH LIMITATIONS   | -                  | ± 270                      |  |
| TRACKING SPEED RANGE  | deg/s              | 0.5                        |  |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 0.5                        |  |
| TYPE OF POINTING  | Type               | Autotrack, Manual, Predict |  |
| POINTING ACCURACY   | deg                | 0.001                      |  |
| MIN TRANSMIT ELEV ANGLE   | deg                | 13                         |  |
| MIN RECEIVE ELEV ANGLE  | deg                | 7.5                        |  |
|   |                    |                            |  |
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| <b>SUPPORT</b>  |                    |                            |  |
| TRANSMIT FREQ BAND(S)   | GHz                | 2.07 - 2.12                |  |
| RECEIVE FREQ BAND(S)  | GHz                | 2.2 - 2.3, 8.4 - 8.5       |  |
| ACQ AID FREQ BAND(S)  | GHz                | 2.11 - 2.13, 8.4 - 8.5     |  |
| MISSION CATEGORIES  | Cat                | A <sup>(2)</sup> and B     |  |
|   |                    |                            |  |
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| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES |                    |                            |  |

6445-4164

CCSDS HISTORICAL DOCUMENT  
**ISRO ISTRAC**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS           | SUBNETWORK OR STATION                       |                      |
|---------------------------|-----------------|---|----------------------|
|                           |                 | PORT BLAIR                                  | THIRUVANANTH A PURAM |
| <b>GENERAL</b>            |                 |   |                      |
| STATION DESIGNATION       | -               | Port Blair                                  | Thiruvananth A Puram |
| LOCATION(S)               | -               | Port Blair, India                           | Thiruvananth, India  |
| DIAMETER                  | m               | 8   | 8                    |
| <b>TRANSMIT</b>           |                 |   | No Transmitter       |
| FREQUENCIES               | MHz             | 2025 - 2110                                 |                      |
| FREQUENCY RESOLUTION      | Hz              | 100   |                      |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$    | $2 \times 10^{-11}$                         |                      |
| TRANSMIT POWER 1          | W               | 2000  |                      |
| EIRP RANGE 1              | dBW             | 63 - 73                                     |                      |
| TRANSMIT POWER 2          | W               | 2000  |                      |
| EIRP RANGE 2              | dBW             | 63 - 73                                     |                      |
| POLARIZATION              | -               | RCP or LCP                                  |                      |
| ANTENNA GAIN              | dB <sub>i</sub> | 41.5  |                      |
| ANTENNA BEAMWIDTH (-3 dB) | deg             | 1.35  |                      |
| ANTENNA ELLIPTICITY       | dB              | (1)   |                      |
| RF FREQ SWEEP RANGE       | kHz             | $\pm 25, \pm 75, \pm 125, \pm 175, \pm 250$ |                      |
| MIN FREQ SWEEP RATE       | Hz/s            | 500   |                      |
| MAX FREQ SWEEP RATE       | kHz/s           | 100   |                      |
| PROGRAMMED UPLINK FREQ    | Yes/No          | Yes   |                      |
|                           |                 |   |                      |
|                           |                 |   |                      |
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|                           |                 |   |                      |
|                           |                 |   |                      |
| <b>COMMAND</b>            |                 |   | None                 |
| RF CARRIER MOD TYPE       | -               | PM  |                      |
| RF CARRIER MOD INDEX RNG  | Rad Pk          | 0.1 - 2                                     |                      |
| SUBCARRIER FREQUENCY(S)   | Hz              | 3125; 5555 (FSK); 70 000 (FM)               |                      |
| SUBCARRIER STEP SIZE      | Hz              | Continuous                                  |                      |
| SUBCARRIER FREQ STABILITY | ppm             | 1000  |                      |
| SUBCARRIER WAVEFORM       | Sin/Sq          | Sine  |                      |
| SUBCARRIER MOD TYPE       | -               | FSK, FM                                     |                      |
| SUBCARRIER/BIT RATE LIMIT | -               | (1)   |                      |
| BIT RATE RANGE            | b/s             | 100   |                      |
| FORMATS AVAILABLE         | -               | NRZ - L                                     |                      |
|                           |                 |   |                      |
|                           |                 |   |                      |
|                           |                 |   |                      |

1. CAPABILITY OR DATA IS NOT AVAILABLE     2. SOME LIMITATIONS APPLY TO THIS CAPABILITY     3. NOT RECOMMENDED BY CCSDS

6445-4430

CCSDS HISTORICAL DOCUMENT  
**ISRO ISTRAC**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                |                                      |
|---|--------------|--------------------------------------|--------------------------------------|
|   |              | PORT BLAIR                           | THIRUVANANTH A PURAM                 |
| <b>GENERAL</b>  |              |                                      |                                      |
| STATION DESIGNATION   | -            | Port Blair                           | Thiruvananth A Puram                 |
| LOCATION(S)   | -            | Port Blair, India                    | Thiruvananth, India                  |
| DIAMETER  | m            | 8                                    | 8                                    |
| <b>RECEIVE</b>  |              |                                      |                                      |
| FREQUENCIES   | MHz          | 2200 - 2290                          | 2200 - 2290                          |
| FREQUENCY RESOLUTION  | Hz           | 1000                                 | 1000                                 |
| ANTENNA GAIN @ 45 deg   | dBi          | 42                                   | 42                                   |
| SYS NOISE TEMP @ ZENITH   | K            | 250                                  | 280                                  |
| G/T @ 45 deg  | dB           | 18                                   | 17.5                                 |
| POLARIZATION  | -            | RCP and LCP and LIN                  | RCP and LCP and LIN                  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 1.21                                 | 1.21                                 |
| ANTENNA ELLIPTICITY   | dB           | (1)                                  | (1)                                  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $2 \times 10^{-11}$                  | $2 \times 10^{-10}$                  |
| RCVR AGC DYNAMIC RANGE  | dB           | 120                                  | 120                                  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -150 in 2 Blo = 10 Hz                | -150 in 2 Blo = 10 Hz                |
| RCVR LOOP BANDWIDTHS  | Hz           | 10, 30, 100, 300, 1 K, 3 K           | 10, 30, 100, 300, 1 K, 3 K           |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                                | Adapt                                |
| RCVR PLL ORDER(S)   | No.          | 2                                    | 2                                    |
| ACQ SWEEP RANGE   | kHz          | $\pm 150$                            | $\pm 150$                            |
| MIN ACQ SWEEP RATE  | Hz/s         | 20                                   | 20                                   |
| MAX ACQ SWEEP RATE  | kHz/s        | 100                                  | 100                                  |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                           | Continuous                           |
| PROGRAMMED L.O.   | Yes/No       | Yes                                  | Yes                                  |
|   |              |                                      |                                      |
|   |              |                                      |                                      |
|   |              |                                      |                                      |
|   |              |                                      |                                      |
| <b>TELEMETRY</b>  |              |                                      |                                      |
| MODULATION TYPE(S)  | -            | PM, FM                               | PM, FM                               |
| MODULATION FORMAT(S)  | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S | NRZ - L, M, S; Bi - $\phi$ - L, M, S |
| MOD INDEX RANGE   | Rad Pk       | 0.1 - 2                              | 0.1 - 2                              |
| SUBCARRIER FREQ RANGE   | kHz          | 1 - 10 000                           | 1 - 10 000                           |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                                 | Sine                                 |
| SYMBOL RATE RANGE   | s/s          | 20 - 2 000 000                       | 20 - 2 000 000                       |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)                                  | (1)                                  |
| ARRAYS WITH STATIONS  | -            | None                                 | None                                 |
| CHANNEL DECODING  | Type         | (1)                                  | (1)                                  |
| DATA FORMAT   | -            | (1)                                  | (1)                                  |
|   |              |                                      |                                      |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                                      |                                      |

6445-4431

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION                          |                      |
|--------------------------|--------------|--|----------------------|
|                          |              | PORT BLAIR                                     | THIRUVANANTH A PURAM |
| <b>GENERAL</b>           |              |  |                      |
| STATION DESIGNATION      | -            | Port Blair                                     | Thiruvananth A Puram |
| LOCATION(S)              | -            | Port Blair, India                              | Thiruvananth, India  |
| DIAMETER                 | m            | 8  | 8                    |
| <b>FREQUENCIES</b>       |              |  |                      |
| TRANSMIT FREQUENCIES     | MHz          | 2025 - 2110                                    |                      |
| RECEIVE FREQUENCIES      | MHz          | 2200 - 2290                                    |                      |
| TURNAROUND FREQ RATIO    | -            | 240 / 221                                      |                      |
| <b>DOPPLER</b>           |              |  |                      |
| Not Available            |              |  |                      |
| COHERENT/NON-COHERENT    | -            | Either   |                      |
| COUNTER RESOLUTION       | Cycles       | 0.01   |                      |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 0.25   |                      |
| DOPPLER BIAS FREQ        | MHz          | 50   |                      |
| DRIFT                    | $\Delta f/f$ | $1 \times 10^{-11} / \text{day}$               |                      |
| OUTPUT EQUATION          | -            | $(\text{Bias Freq} \pm f_d) / \text{SR}^{(4)}$ |                      |
| DIRECTION INDICATOR      | -            | $+ \Delta f = - \Delta r$                      |                      |
|                          |              |  |                      |
|                          |              |  |                      |
|                          |              |  |                      |
| <b>RANGING</b>           |              |  |                      |
| Not Available            |              |  |                      |
| COHERENT/NON-COHERENT    | -            | Either   |                      |
| RANGE CODE WAVEFORM      | Sin/Sq       | Sine   |                      |
| EARTH STATION MOD INDEX  | Rad Pk       | 0.1 - 2  |                      |
| RANGE CODE FREQ RATIO    | -            | 4:1; 5:1                                       |                      |
| MAJOR CODE FREQ(S)       | kHz          | 500, 100, 20                                   |                      |
| MINOR CODE FREQ(S)       | kHz          | 100, 20, 4, (0.8, 0.16, 0.032, 0.008 on 4 kHz) |                      |
| MIN RECEIVED CARRIER SNR | dB           | 10   |                      |
| MIN REQ CODE PWR/No      | dB-Hz        | Major = 27, Minor = 16                         |                      |
| CODE INTEGRATION TIME    | s            | 0.125, 0.250, 1                                |                      |
| ACQUISITION SEQUENCE     | -            | Seq; Major Code First                          |                      |
| RANGE DATA UNITS         | -            | Nanoseconds                                    |                      |
| RANGE QUANTIZATION       | -            | 1 ns   |                      |
| ACCURACY (STRONG SIGNAL) | m            | 2 @ 50 dB                                      |                      |
| MAX UNAMBIGUOUS RANGE    | km           | 18 735   |                      |
| TRANSPONDER BW           | MHz          | (1)  |                      |
|                          |              |  |                      |
|                          |              |  |                      |
|                          |              |  |                      |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS  
 4. SR = SAMPLE RATE

FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS   | UNITS         | SUBNETWORK OR STATION |                         |                       |                         |
|---|---------------|-----------------------|-------------------------|-----------------------|-------------------------|
|   |               | PORT BLAIR            |                         | THIRUVANANTH A PURAM  |                         |
| <b>GENERAL</b>  |               |                       |                         |                       |                         |
| STATION DESIGNATION   | -             | Port Blair            |                         | Thiruvananth A Puram  |                         |
| LOCATION(S)   | -             | Port Blair, India     |                         | Thiruvananth, India   |                         |
| DIAMETER  | m             | 8                     |                         | 8                     |                         |
| <b>FREQUENCY STD</b>  |               |                       |                         |                       |                         |
| STANDARD TYPE   | Name          | Quartz Oscillator     |                         | Quartz Oscillator     |                         |
| STANDARD MFG  | Name          | Oscilloquartz 2210    |                         | Oscilloquartz 2210    |                         |
| STABILITY AT:   |               | <b>Allan Variance</b> | <b>Drift</b>            | <b>Allan Variance</b> | <b>Drift</b>            |
| 1 - SECOND  | $\Delta f/f$  | $5 \times 10^{-13}$   | (1)                     | (1)                   | $\pm 1 \times 10^{-12}$ |
| 1 - HOUR  | $\Delta f/f$  | (1)                   | (1)                     | (1)                   | (1)                     |
| 1 - DAY (24 HOURS)  | $\Delta f/f$  | (1)                   | $\pm 2 \times 10^{-11}$ | (1)                   | $\pm 2 \times 10^{-11}$ |
| 1 - MONTH   | $\Delta f/f$  | (1)                   | $\pm 1 \times 10^{-9}$  | (1)                   | (1)                     |
| REF FREQS PHASE NOISE   | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b>          | <b>5 MHz</b>          | <b>100 MHz</b>          |
| 1 Hz OFFSET   | dBc/Hz        | (1)                   | (1)                     | (1)                   | (1)                     |
| 10 Hz OFFSET  | dBc/Hz        | - 138                 | (1)                     | -140                  | (1)                     |
| 100 Hz OFFSET   | dBc/Hz        | - 150                 | (1)                     | -150                  | (1)                     |
| 1000 Hz OFFSET  | dBc/Hz        | - 150                 | (1)                     | -150                  | (1)                     |
| REF FREQS AVAILABLE   | MHz           | 1, 5, 10              |                         | 1, 5, 10              |                         |
| MAX STA-TO-STA OFFSET   | Hz            | $4 \times 10^{-11}$   |                         | $2 \times 10^{-10}$   |                         |
| <b>TIMING SYSTEM</b>  |               |                       |                         |                       |                         |
| MASTER REFERENCE AGENCY   | Name          | GPS                   |                         | NPL, New Delhi        |                         |
| REFERENCE TIME  | Name          | UTC                   |                         | UTC                   |                         |
| TIME CODE EPOCH   | Yr            | 1 January 1958        |                         | 1 January 1958        |                         |
| TIME CODES AVAILABLE  | CCSDS Codes   | IRIG - B              |                         | IRIG - B              |                         |
| MAX TIME RESOLUTION   | s             | 0.001                 |                         | 0.001                 |                         |
| TIME TRANSFER METHOD  | Name          | GPS                   |                         | High Frequency        |                         |
| MAX TRANS ERROR REF   | $\mu$ -sec    | 100                   |                         | 1000 - 3000           |                         |
| MAX OFFSET FROM REF   | $\mu$ -sec    | 20                    |                         | 3000                  |                         |
| MAX OFFSET MEAS ERROR   | $\mu$ -sec    | 10                    |                         | 10                    |                         |
| MAX STA-TO-STA OFFSET   | $\mu$ -sec    | $\pm 50$              |                         | 3000                  |                         |
| TIMING SIGNALS AVAILABLE  | pulse/s       | 0.001, 0.01, 0.1, 1   |                         | 1, 10, 100, 1000      |                         |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> <p>4. MEASURED BY THE AGENCY</p> |               |                       |                         |                       |                         |

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION      |                            |
|---|--------------------|----------------------------|----------------------------|
|   |                    | PORT BLAIR                 | THIRUVANANTH A PURAM       |
| <b>GENERAL</b>  |                    |                            |                            |
| STATION DESIGNATION   | -                  | Port Blair                 | Thiruvananth A Puram       |
| LOCATION(S)   | -                  | Port Blair, India          | Thiruvananth, India        |
| DIAMETER  | m                  | 8                          | 8                          |
| <b>GEOGRAPHICAL</b>   |                    |                            |                            |
| LOCATION, COUNTRY/STATE   | Name               | India                      | India                      |
| LOCATION, CITY  | Name               | Camicobar                  | Trivandrum                 |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 92, 44, 06                 | 76, 34, 12                 |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 11, 38, 45                 | 8, 17, 24                  |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| <b>MECHANICAL</b>   |                    |                            |                            |
| TYPE OF MOUNT   | -                  | Az - El                    | Az - El                    |
| AZIMUTH LIMITATIONS   | -                  | ± 360                      | ± 360                      |
| TRACKING SPEED RANGE  | deg/s              | 9                          | 9                          |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 3                          | 3                          |
| TYPE OF POINTING  | Type               | Autotrack, Manual, Predict | Autotrack, Manual, Predict |
| POINTING ACCURACY   | deg                | 0.12                       | 0.12                       |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5                          | No Transmitter             |
| MIN RECEIVE ELEV ANGLE  | deg                | 2                          | 2                          |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| <b>SUPPORT</b>  |                    |                            |                            |
| TRANSMIT FREQ BAND(S)   | GHz                | 2.025 - 2.11               | None                       |
| RECEIVE FREQ BAND(S)  | GHz                | 2.2 - 2.29                 | 2.2 - 2.29                 |
| ACQ AID FREQ BAND(S)  | GHz                | 2.2 - 2.29                 | 2.2 - 2.29                 |
| MISSION CATEGORIES  | Cat                | A                          | A                          |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                            |                            |

6445-4434

CCSDS HISTORICAL DOCUMENT  
**ISRO ISTRAC**  
EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                       |  |
|---|--------------|---|--|
|   |              | BANGALORE                                   | LUCKNOW  |
| <b>GENERAL</b>  |              |   |  |
| STATION DESIGNATION   | -            | Bangalore                                   | Lucknow  |
| LOCATION(S)   | -            | Bangalore, India                            | Lucknow, India   |
| DIAMETER  | m            | 10 (2)                                      | 10   |
| <b>TRANSMIT</b>   |              |   |  |
| FREQUENCIES   | MHz          | 2025 - 2110                                 | 2025 - 2110  |
| FREQUENCY RESOLUTION  | Hz           | 100   | 100  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $2 \times 10^{-11}$                         | $2 \times 10^{-11}$  |
| TRANSMIT POWER 1  | W            | 2000  | 2000   |
| EIRP RANGE 1  | dBW          | 64 - 74                                     | 64 - 74  |
| TRANSMIT POWER 2  | W            | 2000  | 2000   |
| EIRP RANGE 2  | dBW          | 64 - 74                                     | 64 - 74  |
| POLARIZATION  | -            | RCP or LCP                                  | RCP or LCP   |
| ANTENNA GAIN  | dBi          | 43  | 43   |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.95  | 0.95   |
| ANTENNA ELLIPTICITY   | dB           | (1)   | (1)  |
| RF FREQ SWEEP RANGE   | kHz          | $\pm 25, \pm 75, \pm 125, \pm 175, \pm 250$ | $\pm 25, \pm 75, \pm 125, \pm 175, \pm 250$                                  |
| MIN FREQ SWEEP RATE   | Hz/s         | 500   | 500  |
| MAX FREQ SWEEP RATE   | kHz/s        | 100   | 100  |
| PROGRAMMED UPLINK FREQ  | Yes/No       | Yes   | Yes  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
| <b>COMMAND</b>  |              |   |  |
| RF CARRIER MOD TYPE   | -            | PM  | PM   |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.1 - 2                                     | 0.1 - 2  |
| SUBCARRIER FREQUENCY(S)   | Hz           | 3125; 5555 (FSK); 70 000 (FM)               | 3125 <sup>(2)</sup> , 5555 (FSK) <sup>(2)</sup> ; 70 000 (FM) <sup>(2)</sup> |
| SUBCARRIER STEP SIZE  | Hz           | Continuous                                  | Continuous   |
| SUBCARRIER FREQ STABILITY   | ppm          | 1000  | 1000   |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine  | Sine   |
| SUBCARRIER MOD TYPE   | -            | FSK, FM                                     | FSK, FM  |
| SUBCARRIER/BIT RATE LIMIT   | -            | (1)   | (1)  |
| BIT RATE RANGE  | b/s          | 100   | 100  |
| FORMATS AVAILABLE   | -            | NRZ - L                                     | NRZ - L  |
|   |              |   |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |   |  |

6445-4415

CCSDS HISTORICAL DOCUMENT  
**ISRO ISTRAC**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                |                                      |
|---|--------------|--------------------------------------|--------------------------------------|
|   |              | BANGALORE                            | LUCKNOW                              |
| <b>GENERAL</b>  |              |                                      |                                      |
| STATION DESIGNATION   | -            | Bangalore                            | Lucknow                              |
| LOCATION(S)   | -            | Bangalore, India                     | Lucknow, India                       |
| DIAMETER  | m            | 10 (2)                               | 10                                   |
| <b>RECEIVE</b>  |              |                                      |                                      |
| FREQUENCIES   | MHz          | 2200 - 2290                          | 2200 - 2290                          |
| FREQUENCY RESOLUTION  | Hz           | 1000                                 | 1000                                 |
| ANTENNA GAIN @ 45 deg   | dBi          | 43.5                                 | 43.5                                 |
| SYS NOISE TEMP @ ZENITH   | K            | 250                                  | 250                                  |
| G/T @ 45 deg  | dB           | 19.5                                 | 19.5                                 |
| POLARIZATION  | -            | RCP and LCP and LIN                  | RCP and LCP and LIN                  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.85                                 | 0.85                                 |
| ANTENNA ELLIPTICITY   | dB           | (1)                                  | (1)                                  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $2 \times 10^{-11}$                  | $2 \times 10^{-11}$                  |
| RCVR AGC DYNAMIC RANGE  | dB           | 120                                  | 120                                  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -150 in 2 Blo = 10 Hz                | -150 in 2 Blo = 10 Hz                |
| RCVR LOOP BANDWIDTHS  | Hz           | 10, 30, 100, 300, 1 K, 3 K           | 10, 30, 100, 300, 1 K, 3 K           |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                                | Adapt                                |
| RCVR PLL ORDER(S)   | No.          | 2                                    | 2                                    |
| ACQ SWEEP RANGE   | kHz          | $\pm 150$                            | $\pm 150$                            |
| MIN ACQ SWEEP RATE  | Hz/s         | 20                                   | 20                                   |
| MAX ACQ SWEEP RATE  | kHz/s        | 100                                  | 100                                  |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                           | Continuous                           |
| PROGRAMMED L.O.   | Yes/No       | Yes                                  | Yes                                  |
|   |              |                                      |                                      |
|   |              |                                      |                                      |
|   |              |                                      |                                      |
| <b>TELEMETRY</b>  |              |                                      |                                      |
| MODULATION TYPE(S)  | -            | PM, FM                               | PM, FM                               |
| MODULATION FORMAT(S)  | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S | NRZ - L, M, S; Bi - $\phi$ - L, M, S |
| MOD INDEX RANGE   | Rad Pk       | 0.1 - 2                              | 0.1 - 2                              |
| SUBCARRIER FREQ RANGE   | kHz          | 1 - 10 000                           | 1 - 10 000                           |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                                 | Sine                                 |
| SYMBOL RATE RANGE   | s/s          | 20 - 2 000 000                       | 20 - 2 000 000                       |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)                                  | (1)                                  |
| ARRAYS WITH STATIONS  | -            | None                                 | None                                 |
| CHANNEL DECODING  | Type         | (1)                                  | (1)                                  |
| DATA FORMAT   | -            | (1)                                  | (1)                                  |
|   |              |                                      |                                      |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                                      |                                      |

6445-4416

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                          |  |
|---|--------------|--|--|
|   |              | BANGALORE                                      | LUCKNOW  |
| <b>GENERAL</b>  |              |  |  |
| STATION DESIGNATION   | -            | Bangalore                                      | Lucknow  |
| LOCATION(S)   | -            | Bangalore, India                               | Lucknow, India                                 |
| DIAMETER  | m            | 10 (2)   | 10   |
| <b>FREQUENCIES</b>  |              |  |  |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2110                                    | 2025 - 2110                                    |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2290                                    | 2200 - 2290                                    |
| TURNAROUND FREQ RATIO   | -            | 240 / 221                                      | 240 / 221                                      |
| <b>DOPPLER</b>  |              |  |  |
| COHERENT/NON-COHERENT   | -            | Either   | Either   |
| COUNTER RESOLUTION  | Cycles       | 0.01   | 0.01   |
| MAX DOPPLER FREQ SHIFT  | MHz          | ± 0.25   | ± 0.25   |
| DOPPLER BIAS FREQ   | MHz          | 50   | 50   |
| DRIFT   | $\Delta f/f$ | $1 \times 10^{-11} / \text{day}$               | $1 \times 10^{-11} / \text{day}$               |
| OUTPUT EQUATION   | -            | $(\text{Bias Freq} \pm f_d) / \text{SR}^{(4)}$ | $(\text{Bias Freq} \pm f_d) / \text{SR}^{(4)}$ |
| DIRECTION INDICATOR   | -            | + $\Delta f = -\Delta r$                       | + $\Delta f = -\Delta r$                       |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
| <b>RANGING</b>  |              |  |  |
| COHERENT/NON-COHERENT   | -            | Either   | Either   |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine   | Sine   |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.1 - 2  | 0.1 - 2  |
| RANGE CODE FREQ RATIO   | -            | 4:1; 5:1                                       | 4:1; 5:1                                       |
| MAJOR CODE FREQ(S)  | kHz          | 500, 100, 20                                   | 500, 100, 20                                   |
| MINOR CODE FREQ(S)  | kHz          | 100, 20, 4, (0.8, 0.16, 0.032, 0.008 on 4 kHz) | 100, 20, 4, (0.8, 0.16, 0.032, 0.008 on 4 kHz) |
| MIN RECEIVED CARRIER SNR  | dB           | 10   | 10   |
| MIN REQ CODE PWR/No   | dB-Hz        | Major = 27, Minor = 16                         | Major = 27, Minor = 16                         |
| CODE INTEGRATION TIME   | s            | 0.125, 0.25, 1                                 | 0.125, 0.25, 1                                 |
| ACQUISITION SEQUENCE  | -            | Seq; Major Code First                          | Seq; Major Code First                          |
| RANGE DATA UNITS  | -            | Nanoseconds                                    | Nanoseconds                                    |
| RANGE QUANTIZATION  | -            | 1 ns   | 1 ns   |
| ACCURACY (STRONG SIGNAL)  | m            | 2 @ 50 dB                                      | 2 @ 50 dB                                      |
| MAX UNAMBIGUOUS RANGE   | km           | 18 735   | 18 735   |
| TRANSPONDER BW  | MHz          | (1)  | (1)  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |  |  |
| 4. SR = SAMPLE RATE   |              |  |  |
| 6445-4417   |              |  |  |

FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS   | UNITS         | SUBNETWORK OR STATION |                         |                       |                         |
|---|---------------|-----------------------|-------------------------|-----------------------|-------------------------|
|   |               | BANGALORE             |                         | LUCKNOW               |                         |
| <b>GENERAL</b>  |               |                       |                         |                       |                         |
| STATION DESIGNATION   | -             | Bangalore             |                         | Lucknow               |                         |
| LOCATION(S)   | -             | Bangalore, India      |                         | Lucknow, India        |                         |
| DIAMETER  | m             | 10 (2)                |                         | 10                    |                         |
| <b>FREQUENCY STD</b>  |               |                       |                         |                       |                         |
| STANDARD TYPE   | Name          | Quartz Oscillator     |                         | Quartz Oscillator     |                         |
| STANDARD MFG  | Name          | Oscilloquartz 2210    |                         | Oscilloquartz 2210    |                         |
| STABILITY AT:   |               | <b>Allan Variance</b> | <b>Drift</b>            | <b>Allan Variance</b> | <b>Drift</b>            |
| 1 - SECOND  | $\Delta f/f$  | $5 \times 10^{-13}$   | (1)                     | $5 \times 10^{-13}$   | (1)                     |
| 1 - HOUR  | $\Delta f/f$  | (1)                   | (1)                     | (1)                   | (1)                     |
| 1 - DAY (24 HOURS)  | $\Delta f/f$  | (1)                   | $\pm 2 \times 10^{-11}$ | (1)                   | $\pm 2 \times 10^{-11}$ |
| 1 - MONTH   | $\Delta f/f$  | (1)                   | $\pm 1 \times 10^{-9}$  | (1)                   | $\pm 1 \times 10^{-9}$  |
| REF FREQS PHASE NOISE   | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b>          | <b>5 MHz</b>          | <b>100 MHz</b>          |
| 1 Hz OFFSET   | dBc/Hz        | (1)                   | (1)                     | (1)                   | (1)                     |
| 10 Hz OFFSET  | dBc/Hz        | - 138                 | (1)                     | -138                  | (1)                     |
| 100 Hz OFFSET   | dBc/Hz        | - 150                 | (1)                     | -150                  | (1)                     |
| 1000 Hz OFFSET  | dBc/Hz        | - 150                 | (1)                     | -150                  | (1)                     |
| REF FREQS AVAILABLE   | MHz           | 1, 5, 10              |                         | 1, 5, 10              |                         |
| MAX STA-TO-STA OFFSET   | Hz            | $4 \times 10^{-11}$   |                         | $4 \times 10^{-11}$   |                         |
| <b>TIMING SYSTEM</b>  |               |                       |                         |                       |                         |
| MASTER REFERENCE AGENCY   | Name          | GPS                   |                         | GPS                   |                         |
| REFERENCE TIME  | Name          | UTC                   |                         | UTC                   |                         |
| TIME CODE EPOCH   | Yr            | 1 January 1958        |                         | 1 January 1958        |                         |
| TIME CODES AVAILABLE  | CCSDS Codes   | IRIG - B              |                         | IRIG - B              |                         |
| MAX TIME RESOLUTION   | s             | 0.001                 |                         | 0.001                 |                         |
| TIME TRANSFER METHOD  | Name          | GPS                   |                         | GPS                   |                         |
| MAX TRANS ERROR REF   | $\mu$ -sec    | 100                   |                         | 100                   |                         |
| MAX OFFSET FROM REF   | $\mu$ -sec    | 20                    |                         | 20                    |                         |
| MAX OFFSET MEAS ERROR   | $\mu$ -sec    | 10                    |                         | 10                    |                         |
| MAX STA-TO-STA OFFSET   | $\mu$ -sec    | $\pm 50$              |                         | $\pm 50$              |                         |
| TIMING SIGNALS AVAILABLE  | pulse/s       | 0.001, 0.01, 0.1, 1   |                         | 0.001, 0.01, 0.1, 1   |                         |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> <p>4. MEASURED BY THE AGENCY</p> |               |                       |                         |                       |                         |

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION      |                            |
|---|--------------------|----------------------------|----------------------------|
|   |                    | BANGALORE                  | LUCKNOW                    |
| <b>GENERAL</b>  |                    |                            |                            |
| STATION DESIGNATION   | -                  | Bangalore                  | Lucknow                    |
| LOCATION(S)   | -                  | Bangalore, India           | Lucknow, India             |
| DIAMETER  | m                  | 10 (2)                     | 10                         |
| <b>GEOGRAPHICAL</b>   |                    |                            |                            |
| LOCATION, COUNTRY/STATE   | Name               | India                      | India                      |
| LOCATION, CITY  | Name               | Bangalore                  | Lucknow                    |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 77, 30, 36                 | 80, 57, 25.2               |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 13, 2, 2.4                 | 26, 54, 46.8               |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| <b>MECHANICAL</b>   |                    |                            |                            |
| TYPE OF MOUNT   | -                  | Az - El                    | Az - El                    |
| AZIMUTH LIMITATIONS   | -                  | ± 360                      | ± 360                      |
| TRACKING SPEED RANGE  | deg/s <sup>2</sup> | 9                          | 9                          |
| MAX TRACK ACCELERATION  | deg/s              | 3                          | 3                          |
| TYPE OF POINTING  | Type               | Autotrack, Manual, Predict | Autotrack, Manual, Predict |
| POINTING ACCURACY   | deg                | 0.1                        | 0.1                        |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5                          | 5                          |
| MIN RECEIVE ELEV ANGLE  | deg                | 2                          | 2                          |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| <b>SUPPORT</b>  |                    |                            |                            |
| TRANSMIT FREQ BAND(S)   | GHz                | 2.025 - 2.11               | 2.025 - 2.11               |
| RECEIVE FREQ BAND(S)  | GHz                | 2.2 - 2.29                 | 2.2 - 2.29                 |
| ACQ AID FREQ BAND(S)  | GHz                | 2.2 - 2.29                 | 2.2 - 2.29                 |
| MISSION CATEGORIES  | Cat                | A                          | A                          |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                            |                            |

**CCSDS HISTORICAL DOCUMENT**  
**ISRO ISTRAC**  
**EARTH-TO-SPACE LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION  |  |
|--|--------------|--|--|
|  |              | MAURITIUS  |  |
| <b>GENERAL</b>   |              |  |  |
| STATION DESIGNATION  | -            | Mauritius  |  |
| LOCATION(S)  | -            | Bigara, Mauritius  |  |
| DIAMETER   | m            | 10   |  |
| <b>TRANSMIT</b>  |              |  |  |
| FREQUENCIES  | MHz          | 2025 - 2100  |  |
| FREQUENCY RESOLUTION   | Hz           | 100  |  |
| RF FREQ STABILITY @ 1 Hr   | $\Delta f/f$ | $2 \times 10^{-11}$  |  |
| TRANSMIT POWER 1   | W            | 2000   |  |
| EIRP RANGE 1   | dBW          | 64 - 74  |  |
| TRANSMIT POWER 2   | W            | 2000   |  |
| EIRP RANGE 2   | dBW          | 64 - 74  |  |
| POLARIZATION   | -            | RCP or LCP   |  |
| ANTENNA GAIN   | dBi          | 43   |  |
| ANTENNA BEAMWIDTH (-3 dB)  | deg          | 0.95   |  |
| ANTENNA ELLIPTICITY  | dB           | (1)  |  |
| RF FREQ SWEEP RANGE  | kHz          | $\pm 25, \pm 75, \pm 125, \pm 175, \pm 250$                  |  |
| MIN FREQ SWEEP RATE  | Hz/s         | 500  |  |
| MAX FREQ SWEEP RATE  | kHz/s        | 100  |  |
| PROGRAMMED UPLINK FREQ   | Yes/No       | Yes  |  |
|  |              |  |  |
|  |              |  |  |
|  |              |  |  |
|  |              |  |  |
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|  |              |  |  |
|  |              |  |  |
|  |              |  |  |
| <b>COMMAND</b>   |              |  |  |
| RF CARRIER MOD TYPE  | -            | PM   |  |
| RF CARRIER MOD INDEX RNG   | Rad Pk       | 0.1 - 2  |  |
| SUBCARRIER FREQUENCY(S)  | Hz           | 3125; 5555 (FSK) <sup>(2)</sup> ; 70 000 (FM) <sup>(2)</sup> |  |
| SUBCARRIER STEP SIZE   | Hz           | Continuous   |  |
| SUBCARRIER FREQ STABILITY  | ppm          | 1000   |  |
| SUBCARRIER WAVEFORM  | Sin/Sq       | Sine   |  |
| SUBCARRIER MOD TYPE  | -            | FSK, FM  |  |
| SUBCARRIER/BIT RATE LIMIT  | -            | (1)  |  |
| BIT RATE RANGE   | b/s          | 100  |  |
| FORMATS AVAILABLE  | -            | NRZ - L  |  |
|  |              |  |  |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> |              |  |  |

6445-4420

CCSDS HISTORICAL DOCUMENT  
**ISRO ISTRAC**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                |  |
|---|--------------|--------------------------------------|--|
|   |              | MAURITIUS                            |  |
| <b>GENERAL</b>  |              |                                      |  |
| STATION DESIGNATION   | -            | Mauritius                            |  |
| LOCATION(S)   | -            | Bigara, Mauritius                    |  |
| DIAMETER  | m            | 10                                   |  |
| <b>RECEIVE</b>  |              |                                      |  |
| FREQUENCIES   | MHz          | 2200 - 2290                          |  |
| FREQUENCY RESOLUTION  | Hz           | 1000                                 |  |
| ANTENNA GAIN @ 45 deg   | dBi          | 43.5                                 |  |
| SYS NOISE TEMP @ ZENITH   | K            | 250                                  |  |
| G/T @ 45 deg  | dB           | 19.5                                 |  |
| POLARIZATION  | -            | RCP and LCP and LIN                  |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.85                                 |  |
| ANTENNA ELLIPTICITY   | dB           | (1)                                  |  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $2 \times 10^{-5}$                   |  |
| RCVR AGC DYNAMIC RANGE  | dB           | 120                                  |  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -150 in 2 Blo = 10 Hz                |  |
| RCVR LOOP BANDWIDTHS  | Hz           | 10, 30, 100, 300, 1 K, 3 K           |  |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                                |  |
| RCVR PLL ORDER(S)   | No.          | 2                                    |  |
| ACQ SWEEP RANGE   | kHz          | $\pm 150$                            |  |
| MIN ACQ SWEEP RATE  | Hz/s         | 20                                   |  |
| MAX ACQ SWEEP RATE  | kHz/s        | 100                                  |  |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                           |  |
| PROGRAMMED L.O.   | Yes/No       | Yes                                  |  |
|   |              |                                      |  |
|   |              |                                      |  |
|   |              |                                      |  |
|   |              |                                      |  |
| <b>TELEMETRY</b>  |              |                                      |  |
| MODULATION TYPE(S)  | -            | PM, FM                               |  |
| MODULATION FORMAT(S)  | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S |  |
| MOD INDEX RANGE   | Rad Pk       | 0.1 - 2                              |  |
| SUBCARRIER FREQ RANGE   | kHz          | 1 - 10 000                           |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                                 |  |
| SYMBOL RATE RANGE   | s/s          | 20 - 2 000 000                       |  |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)                                  |  |
| ARRAYS WITH STATIONS  | -            | None                                 |  |
| CHANNEL DECODING  | Type         | (1)                                  |  |
| DATA FORMAT   | -            | (1)                                  |  |
|   |              |                                      |  |
|   |              |                                      |  |
|   |              |                                      |  |
|   |              |                                      |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                                      |  |

6445-4421

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION                          |  |
|--------------------------|--------------|--|--|
|                          |              | MAURITIUS                                      |  |
| <b>GENERAL</b>           |              |  |  |
| STATION DESIGNATION      | -            | Mauritius                                      |  |
| LOCATION(S)              | -            | Bigara, Mauritius                              |  |
| DIAMETER                 | m            | 10   |  |
| <b>FREQUENCIES</b>       |              |  |  |
| TRANSMIT FREQUENCIES     | MHz          | 2025 - 2110                                    |  |
| RECEIVE FREQUENCIES      | MHz          | 2200 - 2290                                    |  |
| TURNAROUND FREQ RATIO    | -            | 240 / 221                                      |  |
| <b>DOPPLER</b>           |              |  |  |
| COHERENT/NON-COHERENT    | -            | Either   |  |
| COUNTER RESOLUTION       | Cycles       | 0.01   |  |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 0.25   |  |
| DOPPLER BIAS FREQ        | MHz          | 50   |  |
| DRIFT                    | $\Delta f/f$ | $1 \times 10^{-11} / \text{Day}$               |  |
| OUTPUT EQUATION          | -            | $(\text{Bias Freq} \pm f_D) / SR^{(4)}$        |  |
| DIRECTION INDICATOR      | -            | $+ \Delta f = -\Delta r$                       |  |
|                          |              |  |  |
|                          |              |  |  |
|                          |              |  |  |
| <b>RANGING</b>           |              |  |  |
| COHERENT/NON-COHERENT    | -            | Either   |  |
| RANGE CODE WAVEFORM      | Sin/Sq       | Sine   |  |
| EARTH STATION MOD INDEX  | Rad Pk       | 0.1 - 2  |  |
| RANGE CODE FREQ RATIO    | -            | 4:1; 5:1                                       |  |
| MAJOR CODE FREQ(S)       | kHz          | 500, 100, 20                                   |  |
| MINOR CODE FREQ(S)       | kHz          | 100, 20, 4, (0.8, 0.16, 0.032, 0.008 on 4 kHz) |  |
| MIN RECEIVED CARRIER SNR | dB           | 10   |  |
| MIN REQ CODE PWR/No      | dB-Hz        | Major = 27, Minor - 16                         |  |
| CODE INTEGRATION TIME    | s            | 0.125, 0.25, 1                                 |  |
| ACQUISITION SEQUENCE     | -            | Seq; Major Code First                          |  |
| RANGE DATA UNITS         | -            | Nanoseconds                                    |  |
| RANGE QUANTIZATION       | -            | 1 ns   |  |
| ACCURACY (STRONG SIGNAL) | m            | 2 @ 50 dB                                      |  |
| MAX UNAMBIGUOUS RANGE    | km           | 18 735   |  |
| TRANSPONDER BW           | MHz          | (1)  |  |
|                          |              |  |  |
|                          |              |  |  |
|                          |              |  |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

4. SR = SAMPLE RATE

FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS   | UNITS         | SUBNETWORK OR STATION |                         |                       |                |
|---|---------------|-----------------------|-------------------------|-----------------------|----------------|
|   |               | MAURITIUS             |                         |                       |                |
| <b>GENERAL</b>  |               |                       |                         |                       |                |
| STATION DESIGNATION   | -             | Mauritius             |                         |                       |                |
| LOCATION(S)   | -             | Bigara, Mautitius     |                         |                       |                |
| DIAMETER  | m             | 10                    |                         |                       |                |
| <b>FREQUENCY STD</b>  |               |                       |                         |                       |                |
| STANDARD TYPE   | Name          | Quartz Oscillator     |                         |                       |                |
| STANDARD MFG  | Name          | Oscilloquartz 2210    |                         |                       |                |
| STABILITY AT:   |               | <b>Allan Variance</b> | <b>Drift</b>            | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND  | $\Delta f/f$  | $5 \times 10^{-13}$   | (1)                     |                       |                |
| 1 - HOUR  | $\Delta f/f$  | (1)                   | (1)                     |                       |                |
| 1 - DAY (24 HOURS)  | $\Delta f/f$  | (1)                   | $\pm 2 \times 10^{-11}$ |                       |                |
| 1 - MONTH   | $\Delta f/f$  | (1)                   | $\pm 1 \times 10^{-9}$  |                       |                |
| REF FREQS PHASE NOISE   | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b>          | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET   | dBc/Hz        | (1)                   | (1)                     |                       |                |
| 10 Hz OFFSET  | dBc/Hz        | -138                  | (1)                     |                       |                |
| 100 Hz OFFSET   | dBc/Hz        | -150                  | (1)                     |                       |                |
| 1000 Hz OFFSET  | dBc/Hz        | -150                  | (1)                     |                       |                |
| REF FREQS AVAILABLE   | MHz           | 1, 5, 10              |                         |                       |                |
| MAX STA-TO-STA OFFSET   | Hz            | $4 \times 10^{-11}$   |                         |                       |                |
| <b>TIMING SYSTEM</b>  |               |                       |                         |                       |                |
| MASTER REFERENCE AGENCY   | Name          | GPS                   |                         |                       |                |
| REFERENCE TIME  | Name          | UTC                   |                         |                       |                |
| TIME CODE EPOCH   | Yr            | 1 January 1958        |                         |                       |                |
| TIME CODES AVAILABLE  | CCSDS Codes   | IRIG - B              |                         |                       |                |
| MAX TIME RESOLUTION   | s             | 0.001                 |                         |                       |                |
| TIME TRANSFER METHOD  | Name          | GPS                   |                         |                       |                |
| MAX TRANS ERROR REF   | $\mu$ -sec    | 100                   |                         |                       |                |
| MAX OFFSET FROM REF   | $\mu$ -sec    | 20                    |                         |                       |                |
| MAX OFFSET MEAS ERROR   | $\mu$ -sec    | 10                    |                         |                       |                |
| MAX STA-TO-STA OFFSET   | $\mu$ -sec    | $\pm 50$              |                         |                       |                |
| TIMING SIGNALS AVAILABLE  | pulse/s       | 0.001, 0.01, 0.1, 1   |                         |                       |                |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> <p>4. MEASURED BY THE AGENCY</p> |               |                       |                         |                       |                |

CCSDS HISTORICAL DOCUMENT  
**ISRO ISTRAC**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS  | UNITS              | SUBNETWORK OR STATION      |  |
|--|--------------------|----------------------------|--|
|  |                    | MAURITIUS                  |  |
| <b>GENERAL</b>   |                    |                            |  |
| STATION DESIGNATION  | -                  | Mauritius                  |  |
| LOCATION(S)  | -                  | Bigara, Mauritius, India   |  |
| DIAMETER   | m                  | 10                         |  |
| <b>GEOGRAPHICAL</b>  |                    |                            |  |
| LOCATION, COUNTRY/STATE  | Name               | Mauritius, India           |  |
| LOCATION, CITY   | Name               | Bigara                     |  |
| LONGITUDE (site 1/site 2/site 3)   | d, m, s            | 57, 31, 8.4                |  |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | -20, 20, 42                |  |
|  |                    |                            |  |
|  |                    |                            |  |
|  |                    |                            |  |
|  |                    |                            |  |
| <b>MECHANICAL</b>  |                    |                            |  |
| TYPE OF MOUNT  | -                  | Az - El                    |  |
| AZIMUTH LIMITATIONS  | -                  | ± 360                      |  |
| TRACKING SPEED RANGE   | deg/s              | 9                          |  |
| MAX TRACK ACCELERATION   | deg/s <sup>2</sup> | 3                          |  |
| TYPE OF POINTING   | Type               | Autotrack, Manual, Predict |  |
| POINTING ACCURACY  | deg                | 0.1                        |  |
| MIN TRANSMIT ELEV ANGLE  | deg                | 5                          |  |
| MIN RECEIVE ELEV ANGLE   | deg                | 2                          |  |
|  |                    |                            |  |
|  |                    |                            |  |
|  |                    |                            |  |
|  |                    |                            |  |
|  |                    |                            |  |
| <b>SUPPORT</b>   |                    |                            |  |
| TRANSMIT FREQ BAND(S)  | GHz                | 2.025 - 2.11               |  |
| RECEIVE FREQ BAND(S)   | GHz                | 2.2 - 2.29                 |  |
| ACQ AID FREQ BAND(S)   | GHz                | 2.2 - 2.29                 |  |
| MISSION CATEGORIES   | Cat                | A                          |  |
|  |                    |                            |  |
|  |                    |                            |  |
|  |                    |                            |  |
|  |                    |                            |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETTIC COORDINATES |                    |                            |  |

6445-4424

CCSDS HISTORICAL DOCUMENT  
**ISRO ISTRAC**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION                       |   |
|---------------------------|--------------|---|---|
|                           |              | SHAR  | SHAR  |
| <b>GENERAL</b>            |              |   |   |
| STATION DESIGNATION       | -            | SHAR -1                                     | SHAR - 2                                    |
| LOCATION(S)               | -            | Sriharikota, India                          | Sriharikota, India                          |
| DIAMETER                  | m            | 10  | 10  |
| <b>TRANSMIT</b>           |              |   |   |
| FREQUENCIES               | MHz          | 2025 - 2110                                 | 2025 - 2110                                 |
| FREQUENCY RESOLUTION      | Hz           | 100   | 100   |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $2 \times 10^{-11}$                         | $2 \times 10^{-11}$                         |
| TRANSMIT POWER 1          | W            | 2000  | 1000  |
| EIRP RANGE 1              | dBW          | 64 - 74                                     | 61 - 71                                     |
| TRANSMIT POWER 2          | W            | 1000  | None  |
| EIRP RANGE 2              | dBW          | 61 - 71                                     | None  |
| POLARIZATION              | -            | RCP or LCP                                  | RCP or LCP                                  |
| ANTENNA GAIN              | dBi          | 43  | 43  |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.95  | 0.95  |
| ANTENNA ELLIPTICITY       | dB           | (1)   | (1)   |
| RF FREQ SWEEP RANGE       | kHz          | $\pm 25, \pm 75, \pm 125, \pm 175, \pm 250$ | $\pm 25, \pm 75, \pm 125, \pm 175, \pm 250$ |
| MIN FREQ SWEEP RATE       | Hz/s         | 500   | 500   |
| MAX FREQ SWEEP RATE       | kHz/s        | 100   | 100   |
| PROGRAMMED UPLINK FREQ    | Yes/No       | (1)   | (1)   |
|                           |              |   |   |
|                           |              |   |   |
|                           |              |   |   |
|                           |              |   |   |
|                           |              |   |   |
|                           |              |   |   |
|                           |              |   |   |
|                           |              |   |   |
|                           |              |   |   |
| <b>COMMAND</b>            |              |   |   |
| RF CARRIER MOD TYPE       | -            | PM  | PM  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.1 - 2                                     | 0.1 - 2                                     |
| SUBCARRIER FREQUENCY(S)   | Hz           | 3125, 5555 (FSK); 70 000 (FM)               | 3125, 5555 (FSK); 70 000 (FM)               |
| SUBCARRIER STEP SIZE      | Hz           | Continuous                                  | Continuous                                  |
| SUBCARRIER FREQ STABILITY | ppm          | 1000  | 1000  |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine  | Sine  |
| SUBCARRIER MOD TYPE       | -            | FSK, FM                                     | FSK, FM                                     |
| SUBCARRIER/BIT RATE LIMIT | -            | (1)   | (1)   |
| BIT RATE RANGE            | b/s          | 100   | 100   |
| FORMATS AVAILABLE         | -            | NRZ - L                                     | NRZ - L                                     |
|                           |              |   |   |
|                           |              |   |   |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

**CCSDS HISTORICAL DOCUMENT**  
**ISRO ISTRAC**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION                |                                      |
|--|--------------|--------------------------------------|--------------------------------------|
|  |              | SHAR                                 | SHAR                                 |
| <b>GENERAL</b>   |              |                                      |                                      |
| STATION DESIGNATION  | -            | SHAR - 1                             | SHAR - 2                             |
| LOCATION(S)  | -            | Sriharikota, India                   | Sriharikota, India                   |
| DIAMETER   | m            | 10                                   | 10                                   |
| <b>RECEIVE</b>   |              |                                      |                                      |
| FREQUENCIES  | MHz          | 2200 - 2290                          | 2200 - 2290                          |
| FREQUENCY RESOLUTION   | Hz           | 1000                                 | 1000                                 |
| ANTENNA GAIN @ 45 deg  | dBi          | 43.5                                 | 43.5                                 |
| SYS NOISE TEMP @ ZENITH  | K            | 250                                  | 250                                  |
| G/T @ 45 deg   | dB           | 19.5                                 | 19.5                                 |
| POLARIZATION   | -            | RCP and LCP                          | RCP and LCP and LIN                  |
| ANTENNA BEAMWIDTH (-3 dB)  | deg          | 0.85                                 | 0.85                                 |
| ANTENNA ELLIPTICITY  | dB           | (1)                                  | (1)                                  |
| L.O. REF FREQ STAB @ 1 Hr  | $\Delta f/f$ | $2 \times 10^{-5}$                   | $2 \times 10^{-5}$                   |
| RCVR AGC DYNAMIC RANGE   | dB           | 120                                  | 120                                  |
| RCVR THRESHOLD @ 2 Blo Hz  | dBm          | -150 in 2 Blo = 10 Hz                | -150 in 2 Blo = 10 Hz                |
| RCVR LOOP BANDWIDTHS   | Hz           | 10, 30, 100, 300, 1 K, 3 K           | 10, 30, 100, 300, 1 K, 3 K           |
| RCVR LOOP TYPE (ADAPT, FIX)  | -            | Adapt                                | Adapt                                |
| RCVR PLL ORDER(S)  | No.          | 2                                    | 2                                    |
| ACQ SWEEP RANGE  | kHz          | $\pm 150$                            | $\pm 150$                            |
| MIN ACQ SWEEP RATE   | Hz/s         | 20                                   | 20                                   |
| MAX ACQ SWEEP RATE   | kHz/s        | 100                                  | 100                                  |
| ACQ SWEEP STEP SIZE  | Hz           | Continuous                           | Continuous                           |
| PROGRAMMED L.O.  | Yes/No       | Yes                                  | Yes                                  |
|  |              |                                      |                                      |
|  |              |                                      |                                      |
|  |              |                                      |                                      |
| <b>TELEMETRY</b>   |              |                                      |                                      |
| MODULATION TYPE(S)   | -            | PM, FM                               | PM, FM                               |
| MODULATION FORMAT(S)   | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S | NRZ - L, M, S; Bi - $\phi$ - L, M, S |
| MOD INDEX RANGE  | Rad Pk       | 0.1 - 2                              | 0.1 - 2                              |
| SUBCARRIER FREQ RANGE  | kHz          | 1 - 10 000                           | 1 - 10 000                           |
| SUBCARRIER WAVEFORM  | Sin/Sq       | Sine                                 | Sine                                 |
| SYMBOL RATE RANGE  | s/s          | 20 - 2 000 000                       | 20 - 2 000 000                       |
| SUBCARRIER/SYM RATE LIMIT  | -            | (1)                                  | (1)                                  |
| ARRAYS WITH STATIONS   | -            | None                                 | None                                 |
| CHANNEL DECODING   | Type         | (1)                                  | (1)                                  |
| DATA FORMAT  | -            | (1)                                  | (1)                                  |
|  |              |                                      |                                      |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |                                      |                                      |

6445-4426

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION                          |  |
|--------------------------|--------------|--|--|
|                          |              | SHAR   | SHAR   |
| <b>GENERAL</b>           |              |  |  |
| STATION DESIGNATION      | -            | SHAR - 1                                       | SHAR - 2                                       |
| LOCATION(S)              | -            | Sriharikota, India                             | Sriharikota, India                             |
| DIAMETER                 | m            | 10   | 10   |
| <b>FREQUENCIES</b>       |              |  |  |
| TRANSMIT FREQUENCIES     | MHz          | 2025 - 2110                                    | 2025 - 2110                                    |
| RECEIVE FREQUENCIES      | MHz          | 2200 - 2290                                    | 2200 - 2290                                    |
| TURNAROUND FREQ RATIO    | -            | 240 / 221                                      | 240 / 221                                      |
| <b>DOPPLER</b>           |              |  |  |
| COHERENT/NON-COHERENT    | -            | Either   | Either   |
| COUNTER RESOLUTION       | Cycles       | 0.01   | 0.01   |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 0.25   | ± 0.25   |
| DOPPLER BIAS FREQ        | MHz          | 50   | 50   |
| DRIFT                    | $\Delta f/f$ | $1 \times 10^{-11}$                            | $1 \times 10^{-11}$                            |
| OUTPUT EQUATION          | -            | $(\text{Bias Freq} \pm f_d) / SR^{(4)}$        | $(\text{Bias Freq} \pm f_d) / SR^{(4)}$        |
| DIRECTION INDICATOR      | -            | $+ \Delta f = -\Delta r$                       | $+ \Delta f = -\Delta r$                       |
|                          |              |  |  |
|                          |              |  |  |
|                          |              |  |  |
| <b>RANGING</b>           |              |  |  |
| COHERENT/NON-COHERENT    | -            | Either   | Either   |
| RANGE CODE WAVEFORM      | Sin/Sq       | Sine   | Sine   |
| EARTH STATION MOD INDEX  | Rad Pk       | 0.1 - 2  | 0.1 - 2  |
| RANGE CODE FREQ RATIO    | -            | 4:1; 5:1                                       | 4:1; 5:1                                       |
| MAJOR CODE FREQ(S)       | kHz          | 500, 100, 20                                   | 500, 100, 20                                   |
| MINOR CODE FREQ(S)       | kHz          | 100, 20, 4, (0.8, 0.16, 0.032, 0.008 on 4 kHz) | 100, 20, 4, (0.8, 0.16, 0.032, 0.008 on 4 kHz) |
| MIN RECEIVED CARRIER SNR | dB           | 10   | 10   |
| MIN REQ CODE PWR/No      | dB-Hz        | Major = 27, Minor = 16                         | Major = 27, Minor = 16                         |
| CODE INTEGRATION TIME    | s            | 0.125, 0.25, 1                                 | 0.125, 0.25, 1                                 |
| ACQUISITION SEQUENCE     | -            | Seq; Major Code First                          | Seq; Major Code First                          |
| RANGE DATA UNITS         | -            | Nanoseconds                                    | Nanoseconds                                    |
| RANGE QUANTIZATION       | -            | 1 ns   | 1 ns   |
| ACCURACY (STRONG SIGNAL) | m            | 2 @ 50 dB                                      | 2 @ 50 dB                                      |
| MAX UNAMBIGUOUS RANGE    | km           | 18 735   | 18 735   |
| TRANSPONDER BW           | MHz          | (1)  | (1)  |
|                          |              |  |  |
|                          |              |  |  |
|                          |              |  |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

4. SR = SAMPLE RATE

**ISRO ISTRAC**

FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                         |                       |                         |
|--|---------------|-----------------------|-------------------------|-----------------------|-------------------------|
|  |               | SHAR                  |                         | SHAR                  |                         |
| <b>GENERAL</b>   |               |                       |                         |                       |                         |
| STATION DESIGNATION  | -             | SHAR - 1              |                         | SHAR - 2              |                         |
| LOCATION(S)  | -             | Sriharikota, India    |                         | Sriharikota, India    |                         |
| DIAMETER   | m             | 10                    |                         | 10                    |                         |
| <b>FREQUENCY STD</b>   |               |                       |                         |                       |                         |
| STANDARD TYPE  | Name          | Quartz Oscillator     |                         | Quartz Oscillator     |                         |
| STANDARD MFG   | Name          | Oscilloquartz 2210    |                         | Oscilloquartz 2210    |                         |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Drift</b>            | <b>Allan Variance</b> | <b>Drift</b>            |
| 1 - SECOND   | $\Delta f/f$  | $5 \times 10^{-13}$   | (1)                     | $5 \times 10^{-13}$   | (1)                     |
| 1 - HOUR   | $\Delta f/f$  | (1)                   | (1)                     | (1)                   | (1)                     |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                   | $\pm 2 \times 10^{-11}$ | (1)                   | $\pm 2 \times 10^{-11}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)                   | $\pm 1 \times 10^{-9}$  | (1)                   | $\pm 1 \times 10^{-9}$  |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b>          | <b>5 MHz</b>          | <b>100 MHz</b>          |
| 1 Hz OFFSET  | dBc/Hz        | (1)                   | (1)                     | (1)                   | (1)                     |
| 10 Hz OFFSET   | dBc/Hz        | -138                  | (1)                     | -138                  | (1)                     |
| 100 Hz OFFSET  | dBc/Hz        | -150                  | (1)                     | -150                  | (1)                     |
| 1000 Hz OFFSET   | dBc/Hz        | -150                  | (1)                     | -150                  | (1)                     |
| REF FREQS AVAILABLE  | MHz           | 1, 5, 10              |                         | 1, 5, 10              |                         |
| MAX STA-TO-STA OFFSET  | Hz            | $4 \times 10^{-11}$   |                         | $4 \times 10^{-11}$   |                         |
|  |               |                       |                         |                       |                         |
|  |               |                       |                         |                       |                         |
|  |               |                       |                         |                       |                         |
| <b>TIMING SYSTEM</b>   |               |                       |                         |                       |                         |
| MASTER REFERENCE AGENCY  | Name          | GPS                   |                         | GPS                   |                         |
| REFERENCE TIME   | Name          | UTC                   |                         | UTC                   |                         |
| TIME CODE EPOCH  | Yr            | 1 January 1958        |                         | 1 January 1958        |                         |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG - B              |                         | IRIG - B              |                         |
| MAX TIME RESOLUTION  | s             | 0.001                 |                         | 0.001                 |                         |
| TIME TRANSFER METHOD   | Name          | GPS                   |                         | GPS                   |                         |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 100                   |                         | 100                   |                         |
| MAX OFFSET FROM REF  | $\mu$ -sec    | 20                    |                         | 20                    |                         |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 10                    |                         | 10                    |                         |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 50$              |                         | $\pm 50$              |                         |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 0.001, 0.01, 0.1, 1   |                         | 0.001, 0.01, 0.1, 1   |                         |
|  |               |                       |                         |                       |                         |
|  |               |                       |                         |                       |                         |
|  |               |                       |                         |                       |                         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                         |                       |                         |



**CCSDS HISTORICAL DOCUMENT**  
**NASA DEEP SPACE NETWORK**  
**EARTH-TO-SPACE LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS           | SUBNETWORK OR STATION          |  |   |
|--|-----------------|--------------------------------|--|---|
|  |                 | 9M STATIONS                    |  | 11M SUBNETWORK                            |
| <b>GENERAL</b>   |                 |                                |  |   |
| STATION DESIGNATION  | -               | DSS 17                         |  | DSS 23, DSS 33, DSS 53                    |
| LOCATION(S)  | -               | CA, USA                        |  | USA, Australia, Spain                     |
| DIAMETER   | m               | 9                              |  | 11  |
| <b>TRANSMIT</b>  |                 |                                |  |   |
| FREQUENCIES  | MHz             | 2025 - 2120                    |  | 7145 - 7190   15 250 - 15 350             |
| FREQUENCY RESOLUTION   | Hz              | 100                            |  | 0.001   0.001                             |
| RF FREQ STABILITY @ 1 Hr   | $\Delta f/f$    | $1 \times 10^{-14}$            |  | $1 \times 10^{-14}$   $1 \times 10^{-14}$ |
| TRANSMIT POWER 1   | W               | 200 - 20 K                     |  | 0.000005 - 5   0.000005 - 0.5             |
| EIRP RANGE 1   | dBW             | 65 - 85                        |  | 2.2 - 62.2   9.2 - 59.2                   |
| TRANSMIT POWER 2   | W               | 16                             |  | None   (1)                                |
| EIRP RANGE 2   | dBW             | 49.5                           |  | None   (1)                                |
| POLARIZATION   | -               | RCP or LCP                     |  | RCP or LCP   RCP or LCP                   |
| ANTENNA GAIN   | dB <sub>i</sub> | 43                             |  | 55.2   62.2                               |
| ANTENNA BEAMWIDTH (-3 dB)  | deg             | 1.1                            |  | 0.23   0.11                               |
| ANTENNA ELLIPTICITY  | dB              | 1                              |  | (1)   (1)                                 |
| RF FREQ SWEEP RANGE  | kHz             | $\pm 15, \pm 300$              |  | $\pm 600$   $\pm 1000$                    |
| MIN FREQ SWEEP RATE  | Hz/s            | 1.25                           |  | 0.01   0.01                               |
| MAX FREQ SWEEP RATE  | kHz/s           | 800                            |  | 10   10                                   |
| PROGRAMMED UPLINK FREQ   | Yes/No          | No                             |  | Yes   Yes                                 |
|  |                 |                                |  |   |
|  |                 |                                |  |   |
|  |                 |                                |  |   |
|  |                 |                                |  |   |
|  |                 |                                |  |   |
| <b>COMMAND</b>   |                 |                                |  |   |
| RF CARRIER MOD TYPE  | -               | PM                             |  | None                                      |
| RF CARRIER MOD INDEX RNG   | Rad Pk          | 0.3 - 1.57                     |  |   |
| SUBCARRIER FREQUENCY(S)  | Hz              | 100 - 16 000                   |  |   |
| SUBCARRIER STEP SIZE   | Hz              | 0.1                            |  |   |
| SUBCARRIER FREQ STABILITY  | ppm             | $\pm 0.1$ (1 sec)              |  |   |
| SUBCARRIER WAVEFORM  | Sin/Sq          | Sine or Square                 |  |   |
| SUBCARRIER MOD TYPE  | -               | PSK, FSK                       |  |   |
| SUBCARRIER/BIT RATE LIMIT  | -               | $> = 8$ ; Coherent $\pm 6$ deg |  |   |
| BIT RATE RANGE   | b/s             | 1 - 2000                       |  |   |
| FORMATS AVAILABLE  | -               | NRZ - L; Bi - $\phi$ - L       |  |   |
|  |                 |                                |  |   |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |                 |                                |  |   |

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION  |  |  |
|---|--------------|--|--|--|
|   |              | 9M STATIONS  |  | 11M SUBNETWORK   |
| <b>GENERAL</b>  |              |  |  |  |
| STATION DESIGNATION   | -            | DSS 17   |  | DSS 23, DSS 33, DSS 53                                 |
| LOCATION(S)   | -            | USA  |  | USA, Australia, Spain                                  |
| DIAMETER  | m            | 9  |  | 11   |
| <b>RECEIVE</b>  |              |  |  |  |
|   |              | MFR Receiver   |  | Scientific Atlanta                                     |
| FREQUENCIES   | MHz          | 2200 - 2300  |  | 8020 - 8500      14 000 - 15 350                       |
| FREQUENCY RESOLUTION  | Hz           | 10 000   |  | 0.001              0.001                               |
| ANTENNA GAIN @ 45 deg   | dBi          | 43.8   |  | 57.3                62.5                               |
| SYS NOISE TEMP @ ZENITH   | K            | 125  |  | 158                 209                                |
| G/T @ 45 deg  | dB           | 22.8   |  | 35.3                39.3                               |
| POLARIZATION  | -            | RCP and LCP  |  | RCP or LCP      RCP or LCP                             |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 1  |  | 0.21                0.12                               |
| ANTENNA ELLIPTICITY   | dB           | (1)  |  | (1)                  (1)                               |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $3 \times 10^{-13}$  |  | $\pm 1 \times 10^{-14}$ $\pm 1 \times 10^{-14}$        |
| RCVR AGC DYNAMIC RANGE  | dB           | 120  |  | 120                 120                                |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -158 in 2 Blo = 10 Hz  |  | -142.8 in 2 Blo = 100 Hz      -141.4 in 2 Blo = 100 Hz |
| RCVR LOOP BANDWIDTHS  | Hz           | 10, 30, 100, 300, 1 K, 3 K   |  | 100, 1 K, 10 K      100, 1 K, 10 K                     |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Fix  |  | Adapt                Adapt                             |
| RCVR PLL ORDER(S)   | No.          | 2, 3   |  | 2                     2, Costas                        |
| ACQ SWEEP RANGE   | kHz          | $\pm 15, \pm 300$  |  | $\pm 400$ $\pm 800$                                    |
| MIN ACQ SWEEP RATE  | Hz/s         | 2.5  |  | (1)                    (1)                             |
| MAX ACQ SWEEP RATE  | kHz/s        | 600  |  | (1)                    (1)                             |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous   |  | 0.01                 0.01                              |
| PROGRAMMED L.O.   | Yes/No       | No   |  | Yes                    Yes                             |
|   |              |  |  |  |
|   |              |  |  |  |
|   |              |  |  |  |
|   |              |  |  |  |
| <b>TELEMETRY</b>  |              |  |  |  |
|   |              |  |  | None                Hi Rate VLBI Only                  |
| MODULATION TYPE(S)  | -            | PCM / PSK / PM; PCM / PM; FM                                       |  |  |
| MODULATION FORMAT(S)  | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S, IRIG                         |  |  |
| MOD INDEX RANGE   | Rad Pk       | 0.02 - 1.56 (Square): 0.05 - 3 (Sine)                              |  |  |
| SUBCARRIER FREQ RANGE   | kHz          | 10 - 2000  |  |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine or Square   |  |  |
| SYMBOL RATE RANGE   | s/s          | 4 - 6 600 000 <sup>(2)</sup>                                       |  |  |
| SUBCARRIER/SYM RATE LIMIT   | -            | 1.5 - 1000 <sup>(2)</sup>  |  |  |
| ARRAYS WITH STATIONS  | -            | None   |  |  |
| CHANNEL DECODING  | Type         | CCSDS R/S, Conv., Concat<br>Conv (r - 1/2, 1/3, 1/4, 1/6 k = 3-15) |  |  |
| DATA FORMAT   | -            | CCSDS Transfer Frame   |  |  |
|   |              |  |  |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |  |  |  |

6445-4350

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION  |  |   |
|---|--------------|--|--|---|
|   |              | 9M STATION   |  | 11M SUBNETWORK  |
| <b>GENERAL</b>  |              |  |  |   |
| STATION DESIGNATION   | -            | DSS 17   |  | DSS 23, DSS 33, DSS 53                                |
| LOCATION(S)   | -            | USA  |  | USA, Australia, Spain                                 |
| DIAMETER  | m            | 9  |  | 11  |
| <b>FREQUENCIES</b>  |              |  |  |   |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120  |  | 7145 - 7235   15 250 - 15 350                         |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300  |  | 8025 - 8500   14 000 - 15 350                         |
| TURNAROUND FREQ RATIO   | -            | 240 / 221  |  | -   -   |
| <b>DOPPLER</b>  |              |  |  |   |
| COHERENT/NON-COHERENT   | -            | Coherent or Non-Coherent   |  | Coherent   Coherent                                   |
| COUNTER RESOLUTION  | Cycles       | 0.001  |  | 0.001   0.001   |
| MAX DOPPLER FREQ SHIFT  | MHz          | + 0.23 to - 0.23   |  | + 0.6 to - 0.6 <sup>4</sup>   + 1 to - 1 <sup>4</sup> |
| DOPPLER BIAS FREQ   | MHz          | 0.24   |  | 0   0   |
| DRIFT   | $\Delta f/f$ | $4 \times 10^{-11}$ @ 0.1 sec  |  | $5 \times 10^{-14}$   $5 \times 10^{-14}$             |
| OUTPUT EQUATION   | -            | $\frac{1000}{4} (f_{bias} \pm f_{xmit} \times \text{Turn-Around Ratio} - f_{rcv})$ |  | (1)   (1)   |
| DIRECTION INDICATOR   | -            | + $\Delta f = -\Delta r$   |  | (1)   (1)   |
| <b>RANGING</b>  |              |  |  |   |
| COHERENT/NON-COHERENT   | -            | 2 - 3-Way Coherent   |  | None  |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine   |  |   |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.2 - 1.5 on Carrier; 0.3 - 1.2 on 1.7 MHz Subcarrier                              |  |   |
| RANGE CODE FREQ RATIO   | -            | 5:1  |  |   |
| MAJOR CODE FREQ(S)  | kHz          | 500, 100, 20   |  |   |
| MINOR CODE FREQ(S)  | kHz          | 100, 20, 4 on Carr or 1.7 MHz Subc;<br>0.8, 0.16, 0.04, 0.01 on 4 kHz Tone         |  |   |
| MIN RECEIVED CARRIER SNR  | dB           | 10   |  |   |
| MIN REQ CODE PWR/No   | dB-Hz        | + 12   |  |   |
| CODE INTEGRATION TIME   | s            | Max of 32 for Major Range Code   |  |   |
| ACQUISITION SEQUENCE  | -            | Major Code + Sequence Minor Tones  |  |   |
| RANGE DATA UNITS  | -            | Nanoseconds  |  |   |
| RANGE QUANTIZATION  | -            | 1 ns   |  |   |
| ACCURACY (STRONG SIGNAL)  | m            | 6 m - 20 kHz Tone; 1.5 m - 100 kHz Tone;<br>0.6 m - 500 kHz Tone                   |  |   |
| MAX UNAMBIGUOUS RANGE   | km           | 644 000  |  |   |
| TRANSPONDER BW  | MHz          | > 1.6  |  |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |  |  |   |

6445-4351

**NASA DEEP SPACE NETWORK**

FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION          |                |                                      |                |
|--|---------------|--------------------------------|----------------|--------------------------------------|----------------|
|  |               | 9M STATION                     |                | 11M SUBNETWORK                       |                |
| <b>GENERAL</b>   |               |                                |                |                                      |                |
| STATION DESIGNATION  | -             | DSS 17                         |                | DSS 23, DSS 33, DSS 53               |                |
| LOCATION(S)  | -             | USA                            |                | USA, Australia, Spain                |                |
| DIAMETER   | m             | 9                              |                | 11                                   |                |
| <b>FREQUENCY STD</b>   |               |                                |                |                                      |                |
| STANDARD TYPE  | Name          | Hydrogen Maser                 |                | Hydrogen Maser                       |                |
| STANDARD MFG   | Name          | SAO VLG-11 / VLG-10            |                | SAO VLG-11 / VLG-10                  |                |
| STABILITY AT:  |               | <b>Allan Deviation</b>         |                | <b>Allan Deviation</b>               |                |
| 1 - SECOND   | $\Delta f/f$  | $2 \times 10^{-12}$            |                | $1 \times 10^{-12}$                  |                |
| 1 - HOUR   | $\Delta f/f$  | $5 \times 10^{-15}$            |                | $1 \times 10^{-14}$                  |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | $1 \times 10^{-14}$            |                | $1 \times 10^{-14}$                  |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                            |                | $1 \times 10^{-13}$                  |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>                   | <b>100 MHz</b> | <b>5 MHz</b>                         | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                            | (1)            | (1)                                  | (1)            |
| 10 Hz OFFSET   | dBc/Hz        | -129                           | (1)            | -129                                 | -100           |
| 100 Hz OFFSET  | dBc/Hz        | -141                           | (1)            | -139                                 | -113           |
| 1000 Hz OFFSET   | dBc/Hz        | -141                           | (1)            | -139                                 | -113           |
| REF FREQS AVAILABLE  | MHz           | 5                              |                | 5                                    |                |
| MAX STA-TO-STA OFFSET  | Hz            | Coherent to SPC 10             |                | $\pm 3 \times 10^{-13}$              |                |
| <b>TIMING SYSTEM</b>   |               |                                |                |                                      |                |
| MASTER REFERENCE AGENCY  | Name          | NIST                           |                | NIST                                 |                |
| REFERENCE TIME   | Name          | UTC                            |                | UTC                                  |                |
| TIME CODE EPOCH  | Yr            | 1 January 1958                 |                | 1 January 1958                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | NASA 36-bit Serial, 42-bit BCD |                | ASCII Serial, 42-bit BCD, 36-bit BIN |                |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-3}$             |                | $1 \times 10^{-3}$                   |                |
| TIME TRANSFER METHOD   | Name          | Coherent to SPC 10             |                | GPS Common View                      |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 25$                       |                | $\pm 5$                              |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 5$                        |                | $\pm 20$                             |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 0.1$                      |                | $\pm 0.1$                            |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 5$                        |                | 10                                   |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 100, 1 K, 10 K, 100 K   |                | 1, 10, 100, 1 K                      |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                                |                |                                      |                |

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION        |                                       |
|---|--------------------|------------------------------|---------------------------------------|
|   |                    | 9M STATION                   | 11M SUBNETWORK                        |
| <b>GENERAL</b>  |                    |                              |                                       |
| STATION DESIGNATION   | -                  | DSS 17                       | DSS 23, DSS 33, DSS 53                |
| LOCATION(S)   | -                  | USA                          | USA, Australia, Spain                 |
| DIAMETER  | m                  | 9                            | 11                                    |
| <b>GEOGRAPHICAL</b>   |                    |                              |                                       |
| LOCATION, COUNTRY/STATE   | Name               | California, USA              | USA, Australia, Spain                 |
| LOCATION, CITY  | Name               | Goldstone                    | Goldstone, Canberra, Madrid           |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 243, 07, 35                  | 243, 07, 38; 148, 58, 59; 355, 45, 01 |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 35, 20 32                    | 35, 20, 22; -35, 24, 02; 40, 25, 38   |
| REFERENCE FRAME   | Name               | ITRF 93                      | ITRF 93                               |
| EPOCH   | Date               | 1993                         | 1993                                  |
| HEIGHT (site 1/site 2/site 3)   | m-msl              | 938                          | 946, 685, 827                         |
| <b>MECHANICAL</b>   |                    |                              |                                       |
| TYPE OF MOUNT   | -                  | X - Y                        | Az - El                               |
| AZIMUTH LIMITATIONS   | -                  | Keyhole N, S                 | Tilt Axis (No Keyhole)                |
| TRACKING SPEED RANGE  | deg/s              | 0.002 - 3                    | 15 (Az); 5 (El)                       |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 5                            | 7.5 (Az); 5 (El)                      |
| TYPE OF POINTING  | Type               | Autotrack, Predicts          | Autotrack, Predicts                   |
| POINTING ACCURACY   | deg                | 0.025 (x); 0.015 (y)         | ± 0.01                                |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5.5                          | 5                                     |
| MIN RECEIVE ELEV ANGLE  | deg                | Local Horizon                | 5                                     |
| <b>SUPPORT</b>  |                    |                              |                                       |
| TRANSMIT FREQ BAND(S)   | GHz                | 2 (A&B)                      | 7 (A); 15 (A)                         |
| RECEIVE FREQ BAND(S)  | GHz                | 2 (A&B)                      | 8 (A); 14 - 15 (A)                    |
| ACQ AID FREQ BAND(S)  | GHz                | 2 (A&B)                      | None                                  |
| MISSION CATEGORIES  | Cat                | A & Limited B <sup>(2)</sup> | A, Space VLBI Only                    |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES |                    |                              |                                       |

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION          |                                |
|---------------------------|--------------|--------------------------------|--------------------------------|
|                           |              | 26M SUBNETWORK                 | 34M HSB STATION                |
| <b>GENERAL</b>            |              |                                |                                |
| STATION DESIGNATION       | -            | DSS 16, DSS 46, DSS 66         | DSS 27                         |
| LOCATION(S)               | -            | USA, Australia, Spain          | USA                            |
| DIAMETER                  | m            | 26                             | 34                             |
| <b>TRANSMIT</b>           |              |                                |                                |
| FREQUENCIES               | MHz          | 2025 - 2120                    | 2025 - 2120                    |
| FREQUENCY RESOLUTION      | Hz           | 100                            | 100                            |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $1 \times 10^{-14}$            | $2 \times 10^{-13}$            |
| TRANSMIT POWER 1          | W            | 16 200 - 20 K                  | 50 - 200                       |
| EIRP RANGE 1              | dBW          | 60.5, 73.5 - 93.5              | 71 - 77                        |
| TRANSMIT POWER 2          | W            | 200 - 20 K <sup>(2)</sup>      | None                           |
| EIRP RANGE 2              | dBW          | 73.5 - 93.5                    | None                           |
| POLARIZATION              | -            | RCP or LCP                     | RCP or LCP                     |
| ANTENNA GAIN              | dBi          | 51.5                           | 54.9                           |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.39                           | 0.39                           |
| ANTENNA ELLIPTICITY       | dB           | $1 \pm 0.4$                    | $1 \pm 0.4$                    |
| RF FREQ SWEEP RANGE       | kHz          | $\pm 15$ to $\pm 300$          | $\pm 15$ to $\pm 300$          |
| MIN FREQ SWEEP RATE       | Hz/s         | 1.25                           | 1.25                           |
| MAX FREQ SWEEP RATE       | kHz/s        | 800                            | 600                            |
| PROGRAMMED UPLINK FREQ    | Yes/No       | No                             | No                             |
|                           |              |                                |                                |
|                           |              |                                |                                |
|                           |              |                                |                                |
|                           |              |                                |                                |
|                           |              |                                |                                |
|                           |              |                                |                                |
|                           |              |                                |                                |
|                           |              |                                |                                |
|                           |              |                                |                                |
|                           |              |                                |                                |
|                           |              |                                |                                |
| <b>COMMAND</b>            |              |                                |                                |
| RF CARRIER MOD TYPE       | -            | PM                             | PM                             |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.3 - 1.57                     | 0.3 - 1.57                     |
| SUBCARRIER FREQUENCY(S)   | Hz           | 100 - 16 000                   | 100 - 16 000                   |
| SUBCARRIER STEP SIZE      | Hz           | 0.1                            | 0.1                            |
| SUBCARRIER FREQ STABILITY | ppm          | $\pm 0.1$ (1 sec)              | $\pm 0.1$ (1 sec)              |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine or Square                 | Sine or Square                 |
| SUBCARRIER MOD TYPE       | -            | PSK, FSK                       | PSK, FSK                       |
| SUBCARRIER/BIT RATE LIMIT | -            | $> = 8$ ; Coherent $\pm 6$ deg | $> = 8$ ; Coherent $\pm 6$ deg |
| BIT RATE RANGE            | b/s          | 1 - 2000                       | 1 - 2000                       |
| FORMATS AVAILABLE         | -            | NRZ - L, Bi - $\phi$ - L       | NRZ - L, Bi - $\phi$ - L       |
|                           |              |                                |                                |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-4334

**CCSDS HISTORICAL DOCUMENT**  
**NASA DEEP SPACE NETWORK**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION  |  |
|--|--------------|--|--|
|  |              | 26M SUBNETWORK   | 34M HSB STATION  |
| <b>GENERAL</b>   |              |  |  |
| STATION DESIGNATION  | -            | DSS 16, DSS 46, DSS 66   | DSS 27   |
| LOCATION(S)  | -            | USA, Australia, Spain  | USA  |
| DIAMETER   | m            | 26   | 34   |
| <b>RECEIVE</b>   |              |  |  |
|  |              | MFR Receiver   | MFR Receiver   |
| FREQUENCIES  | MHz          | 2200 - 2300  | 2200 - 2300  |
| FREQUENCY RESOLUTION   | Hz           | 10 000   | 10 000   |
| ANTENNA GAIN @ 45 deg  | dBi          | 52.5   | 54.9   |
| SYS NOISE TEMP @ ZENITH  | K            | 122  | 103  |
| G/T @ 45 deg   | dB           | 31.6   | 34.8   |
| POLARIZATION   | -            | RCP and LCP  | RCP and LCP  |
| ANTENNA BEAMWIDTH (-3 dB)  | deg          | 0.36   | 0.36   |
| ANTENNA ELLIPTICITY  | dB           | 0.6  | 0.6  |
| L.O. REF FREQ STAB @ 1 Hr  | $\Delta f/f$ | $2 \times 10^{-13}$  | $\pm 2 \times 10^{-13}$  |
| RCVR AGC DYNAMIC RANGE   | dB           | 120  | 120  |
| RCVR THRESHOLD @ 2 Blo Hz  | dBm          | -158 in 2 Blo = 10 Hz  | -158 in 2 Blo = 10 Hz  |
| RCVR LOOP BANDWIDTHS   | Hz           | 10, 30, 100, 300, 1 K, 3 K   | 10, 30, 100, 300, 1 K, 3 K   |
| RCVR LOOP TYPE (ADAPT, FIX)  | -            | Fix  | Fix  |
| RCVR PLL ORDER(S)  | No.          | 2, 3   | 2, 3   |
| ACQ SWEEP RANGE  | kHz          | $\pm 15, \pm 300$  | $\pm 15, \pm 300$  |
| MIN ACQ SWEEP RATE   | Hz/s         | 2.5  | 2.5  |
| MAX ACQ SWEEP RATE   | kHz/s        | 600  | 600  |
| ACQ SWEEP STEP SIZE  | Hz           | Continuous   | Continuous   |
| PROGRAMMED L.O.  | Yes/No       | No   | No   |
|  |              |  |  |
|  |              |  |  |
|  |              |  |  |
|  |              |  |  |
| <b>TELEMETRY</b>   |              |  |  |
| MODULATION TYPE(S)   | -            | PCM / PSK / PM; PCM / PM; FM                                       | PCM / PSK / PM; PCM / PM; FM                                       |
| MODULATION FORMAT(S)   | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S; IRIG                         | NRZ - L, M, S; Bi - $\phi$ - L, M, S; IRIG                         |
| MOD INDEX RANGE  | Rad Pk       | 0.2 - 1.56 (Square), 0.05 - 3.0 (Sine)                             | 0.2 - 1.56 (Square), 0.05 - 3.0 (Sine)                             |
| SUBCARRIER FREQ RANGE  | kHz          | 10 - 2000  | 10 - 2000  |
| SUBCARRIER WAVEFORM  | Sin/Sq       | Sine or Square   | Sine or Square   |
| SYMBOL RATE RANGE  | s/s          | 8 - 2 200 000 <sup>(2)</sup>                                       | 8 - 2 200 000 <sup>(2)</sup>                                       |
| SUBCARRIER/SYM RATE LIMIT  | -            | 5 - 10 000 <sup>(2)</sup>  | 5 - 10 000 <sup>(2)</sup>  |
| ARRAYS WITH STATIONS   | -            | None   | None   |
| CHANNEL DECODING   | Type         | CCSDR R/S, Conv., Concat<br>Conv (r - 1/2, 1/3, 1/4, 1/6 k = 3-15) | CCSDR R/S, Conv., Concat<br>Conv (r - 1/2, 1/3, 1/4, 1/6 k = 3-15) |
| DATA FORMAT  | -            | CCSDS Transfer Frame   | CCSDS Transfer Frame   |
|  |              |  |  |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |  |  |

6445-4335

**CCSDS HISTORICAL DOCUMENT**  
**NASA DEEP SPACE NETWORK**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION  |  |
|--|--------------|--|--|
|  |              | 26M SUBNETWORK   | 34M HSB STATION  |
| <b>GENERAL</b>   |              |  |  |
| STATION DESIGNATION  | -            | DSS 16, DSS 46, DSS 66   | DSS 27   |
| LOCATION(S)  | -            | USA, Australia, Spain  | USA  |
| DIAMETER   | m            | 26   | 34   |
| <b>FREQUENCIES</b>   |              |  |  |
| TRANSMIT FREQUENCIES   | MHz          | 2025 - 2120  | 2025 - 2120  |
| RECEIVE FREQUENCIES  | MHz          | 2200 - 2300  | 2200 - 2300  |
| TURNAROUND FREQ RATIO  | -            | 240 / 221  | 240 / 221  |
| <b>DOPPLER</b>   |              |  |  |
| COHERENT/NON-COHERENT  | -            | 1-Way, 2-Way / 3-Way Coherent and Non-Coherent                                     | 1-Way, 2-Way / 3-Way Coherent and Non-Coherent                                     |
| COUNTER RESOLUTION   | Cycles       | 0.001  | 0.001  |
| MAX DOPPLER FREQ SHIFT   | MHz          | + 0.23 to -0.23  | + 0.23 to -0.23  |
| DOPPLER BIAS FREQ  | MHz          | 0.24   | 0.24   |
| DRIFT  | $\Delta f/f$ | $4 \times 10^{-11}$ @ 0.1 sec  | $4 \times 10^{-11}$ @ 0.1 sec  |
| OUTPUT EQUATION  | -            | $\frac{1000}{4} (f_{bias} \pm f_{xmit} \times \text{Turn Around Ratio} - f_{rcv})$ | $\frac{1000}{4} (f_{bias} \pm f_{xmit} \times \text{Turn Around Ratio} - f_{rcv})$ |
| DIRECTION INDICATOR  | -            | + $\Delta f = -\Delta r$   | + $\Delta f = -\Delta r$   |
|  |              |  |  |
|  |              |  |  |
|  |              |  |  |
| <b>RANGING</b>   |              |  |  |
|  |              | Tone Ranging Only  | Tone Ranging Only  |
| COHERENT/NON-COHERENT  | -            | 2 - 3-Way Coherent and Non-Coherent  | 2 - 3-Way Coherent   |
| RANGE CODE WAVEFORM  | Sin/Sq       | Sine (See 34M HEF for Square)  | Sine (See 34M HEF for Square)  |
| EARTH STATION MOD INDEX  | Rad Pk       | 0.2 - 1.5 on Carrier; 0.3 - 1.2 on 1.7 MHz Subcarrier                              | 0.2 - 1.5 on Carrier   |
| RANGE CODE FREQ RATIO  | -            | 5:1  | 5:1  |
| MAJOR CODE FREQ(S)   | kHz          | 500, 100, 20   | 500, 100, 20   |
| MINOR CODE FREQ(S)   | kHz          | 100, 20, 4 on Carrier or 1.7 MHz Subcarrier; 0.8, 0.16, 0.04, 0.01 on 4 kHz Tone   | 100, 20, 4 on Carrier; 0.8, 0.16, 0.04, 0.01 on 4 kHz Tone                         |
| MIN RECEIVED CARRIER SNR   | dB           | 10   | 10   |
| MIN REQ CODE PWR/No  | dB-Hz        | + 12   | + 12   |
| CODE INTEGRATION TIME  | s            | Max. of 32 for Major Range Code  | Max. of 32 for Major Range Code  |
| ACQUISITION SEQUENCE   | -            | Major Code + Sequence Minor Tones  | Major Code + Sequence Minor Tones  |
| RANGE DATA UNITS   | -            | Nanoseconds  | Nanoseconds  |
| RANGE QUANTIZATION   | -            | 1 ns   | 1 ns   |
| ACCURACY (STRONG SIGNAL)   | m            | 6 m - 20 kHz Tone; 1.5 - 100 kHz Tone; 0.6 - 500 kHz Tone                          | 6 m - 20 kHz Tone; 1.5 - 100 kHz Tone; 0.6 - 500 kHz Tone                          |
| MAX UNAMBIGUOUS RANGE  | km           | 644 000  | 644 000  |
| TRANSPONDER BW   | MHz          | > 1.6  | > 1.6  |
|  |              |  |  |
|  |              |  |  |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> |              |  |  |

6445-4336

**CCSDS HISTORICAL DOCUMENT**  
**NASA DEEP SPACE NETWORK**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION          |                |                                      |                |
|---|--------------------|--------------------------------|----------------|--------------------------------------|----------------|
|   |                    | 26M SUBNETWORK                 |                | 34M HSB STATION                      |                |
| <b>GENERAL</b>  |                    |                                |                |                                      |                |
| STATION DESIGNATION   | -                  | DSS 16, DSS 46, DSS 66         |                | DSS 27                               |                |
| LOCATION(S)   | -                  | USA, Australia, Spain          |                | USA                                  |                |
| DIAMETER  | m                  | 26                             |                | 34                                   |                |
| <b>FREQUENCY STD</b>  |                    |                                |                |                                      |                |
| STANDARD TYPE   | Name               | Hydrogen Maser                 |                | Cesium Beam                          |                |
| STANDARD MFG  | Name               | SAO VLG-11 / VLG-10            |                | HP 54061A                            |                |
| STABILITY AT:   |                    | <b>Allan Deviation</b>         |                | <b>Allan Deviation</b>               |                |
| 1 - SECOND  | $\Delta f/f$       | 2 x 10 <sup>-12</sup>          |                | 5 x 10 <sup>-12</sup>                |                |
| 1 - HOUR  | $\Delta f/f$       | 5 x 10 <sup>-15</sup>          |                | 2 x 10 <sup>-13</sup>                |                |
| 1 - DAY (24 HOURS)  | $\Delta f/f$       | 1 x 10 <sup>-14</sup>          |                | 5 x 10 <sup>-14</sup>                |                |
| 1 - MONTH   | $\Delta f/f$       | (1)                            |                | (1)                                  |                |
| REF FREQS PHASE NOISE   | S <sub>φ</sub> (f) | <b>5 MHz</b>                   | <b>100 MHz</b> | <b>5 MHz</b>                         | <b>100 MHz</b> |
| 1 Hz OFFSET   | dBc/Hz             | (1)                            | (1)            | (1)                                  | (1)            |
| 10 Hz OFFSET  | dBc/Hz             | -129                           | (1)            | -129                                 | (1)            |
| 100 Hz OFFSET   | dBc/Hz             | -141                           | (1)            | -139                                 | (1)            |
| 1000 Hz OFFSET  | dBc/Hz             | -141                           | (1)            | -139                                 | (1)            |
| REF FREQS AVAILABLE   | MHz                | 5                              |                | 5, 10                                |                |
| MAX STA-TO-STA OFFSET   | Hz                 | Coherent to SPC 10, 40, 60     |                | ± 1x 10 <sup>-3</sup>                |                |
| <b>TIMING SYSTEM</b>  |                    |                                |                |                                      |                |
| MASTER REFERENCE AGENCY   | Name               | NIST                           |                | NIST                                 |                |
| REFERENCE TIME  | Name               | UTC                            |                | UTC                                  |                |
| TIME CODE EPOCH   | Yr                 | 1 January 1958                 |                | 1 January 1958                       |                |
| TIME CODES AVAILABLE  | CCSDS Codes        | 36-bit NASA Serial, 42-bit BCD |                | ASCII Serial, 42-bit BCD, 36-bit BIN |                |
| MAX TIME RESOLUTION   | s                  | 1 x 10 <sup>-3</sup>           |                | 1 x 10 <sup>-3</sup>                 |                |
| TIME TRANSFER METHOD  | Name               | GPS Common View                |                | Coherent to SPC 10, 40, 60           |                |
| MAX TRANS ERROR REF   | μ-sec              | ± 25                           |                | ± 0.5                                |                |
| MAX OFFSET FROM REF   | μ-sec              | ± 25                           |                | ± 20                                 |                |
| MAX OFFSET MEAS ERROR   | μ-sec              | ± 0.1                          |                | ± 0.2                                |                |
| MAX STA-TO-STA OFFSET   | μ-sec              | ± 5                            |                | ± 0.1                                |                |
| TIMING SIGNALS AVAILABLE  | pulse/s            | 1, 10, 100, 1K, 10 K, 100 K    |                | 1, 10, 100, 1K                       |                |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> <p>4. MEASURED BY THE AGENCY</p> |                    |                                |                |                                      |                |

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION                 |  |
|---|--------------------|---------------------------------------|--|
|   |                    | 26M SUBNETWORK                        | 34M HSB STATION                              |
| <b>GENERAL</b>  |                    |                                       |  |
| STATION DESIGNATION   | -                  | DSS 16, DSS 46, DSS 66                | DSS 27                                       |
| LOCATION(S)   | -                  | USA, Australia, Spain                 | USA  |
| DIAMETER  | m                  | 26                                    | 34   |
| <b>GEOGRAPHICAL</b>   |                    |                                       |  |
| LOCATION, COUNTRY/STATE   | Name               | USA, Australia, Spain                 | USA  |
| LOCATION, CITY  | Name               | Goldstone, Canberra, Madrid           | Goldstone                                    |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 243, 07, 35; 148, 58, 59; 355, 44, 55 | 243, 13, 24                                  |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 35, 20, 30; -35, 24, 18; 40, 25, 48   | 35, 14, 18                                   |
| REFERENCE FRAME   | Name               | ITRF 93                               | ITRF 93                                      |
| EPOCH   | Date               | 1993                                  | 1993   |
| HEIGHT (site 1/site 2/site 3)   | m-msl              | 945, 678, 855                         | 1053   |
| <b>MECHANICAL</b>   |                    |                                       |  |
| TYPE OF MOUNT   | -                  | X - Y                                 | Az - El                                      |
| AZIMUTH LIMITATIONS   | -                  | Keyhole, E, W                         | Keyhole, Zenith                              |
| TRACKING SPEED RANGE  | deg/s              | 0.002 - 3                             | 0.0001 - 3 (Az); 0.0001 - 2 (El)             |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 5                                     | 1 (Az); 0.5 (El)                             |
| TYPE OF POINTING  | Type               | Autotrack, Predicts                   | Predicts                                     |
| POINTING ACCURACY   | deg                | 0.025 (X), 0.015 (Y)                  | 0.008  |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5.5                                   | 10   |
| MIN RECEIVE ELEV ANGLE  | deg                | Local Horizon                         | 6  |
| <b>SUPPORT</b>  |                    |                                       |  |
| TRANSMIT FREQ BAND(S)   | GHz                | 2 (A & B)                             | 2 (A & B)                                    |
| RECEIVE FREQ BAND(S)  | GHz                | 2 (A & B)                             | 2 (A & B)                                    |
| ACQ AID FREQ BAND(S)  | GHz                | 2.2 - 2.3 (A & B), 8.2 - 8.5 (B)      | 2.29 - 2.3 (B), 8.2 - 8.5 (B) <sup>(2)</sup> |
| MISSION CATEGORIES  | Cat                | A & B                                 | A & B  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES |                    |                                       |  |

6445-4338

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION          |                            |                                |
|---------------------------|--------------|--------------------------------|----------------------------|--------------------------------|
|                           |              | 34M BWG-1 STATIONS             |                            | 34M BWG-2 STATION              |
| <b>GENERAL</b>            |              | OPERATIONAL 6-95, 4-96, 10-97  |                            |                                |
| STATION DESIGNATION       | -            | DSS 24, DSS 34, DSS 54         |                            | DSS 25                         |
| LOCATION(S)               | -            | USA, Australia, Spain          |                            | USA                            |
| DIAMETER                  | m            | 34                             |                            | 34                             |
| <b>TRANSMIT</b>           |              |                                |                            |                                |
| FREQUENCIES               | MHz          | 2025 - 2120                    | 7145 - 7190 <sup>(4)</sup> | 7145 - 7190                    |
| FREQUENCY RESOLUTION      | Hz           | $9.6 \times 10^{-5}$           | $1.6 \times 10^{-5}$       | $4 \times 10^{-12}$            |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $1 \times 10^{-14}$            | $2 \times 10^{-15}$        | $2 \times 10^{-15}$            |
| TRANSMIT POWER 1          | W            | 200 - 20 K                     | 50 - 4 K                   | 50 - 4 K                       |
| EIRP RANGE 1              | dBW          | 76.2 - 98.5                    | 88 - 105                   | 88 - 105                       |
| TRANSMIT POWER 2          | W            | None                           | None                       | None                           |
| EIRP RANGE 2              | dBW          | None                           | None                       | None                           |
| POLARIZATION              | -            | RCP or LCP                     | RCP or LCP                 | RCP or LCP                     |
| ANTENNA GAIN              | dBi          | 56.2                           | 68.1                       | 68.1                           |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.26                           | 0.074                      | 0.074                          |
| ANTENNA ELLIPTICITY       | dB           | 1                              | 1                          | 1                              |
| RF FREQ SWEEP RANGE       | kHz          | 300                            | 1000                       | 1000                           |
| MIN FREQ SWEEP RATE       | Hz/s         | $1 \times 10^{-6}$             | $1 \times 10^{-6}$         | $41 \times 10^{-6}$            |
| MAX FREQ SWEEP RATE       | kHz/s        | $\pm 3.1$                      | $\pm 12.1$                 | $\pm 12.1$                     |
| PROGRAMMED UPLINK FREQ    | Yes/No       | Yes                            | Yes                        | Yes                            |
|                           |              |                                |                            |                                |
|                           |              |                                |                            |                                |
|                           |              |                                |                            |                                |
|                           |              |                                |                            |                                |
|                           |              |                                |                            |                                |
|                           |              |                                |                            |                                |
|                           |              |                                |                            |                                |
|                           |              |                                |                            |                                |
|                           |              |                                |                            |                                |
| <b>COMMAND</b>            |              |                                |                            |                                |
| RF CARRIER MOD TYPE       | -            | PM                             |                            | PM                             |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.3 - 1.57                     |                            | 0.3 - 1.57                     |
| SUBCARRIER FREQUENCY(S)   | Hz           | 100 - 16 000                   |                            | 100 - 16 000                   |
| SUBCARRIER STEP SIZE      | Hz           | 0.1                            |                            | 0.1                            |
| SUBCARRIER FREQ STABILITY | ppm          | $\pm 0.1$ (1 sec)              |                            | $\pm 0.1$ (sec)                |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine or Square                 |                            | Sine or Square                 |
| SUBCARRIER MOD TYPE       | -            | PSK, FSK                       |                            | PSK, FSK                       |
| SUBCARRIER/BIT RATE LIMIT | -            | $> = 8$ ; Coherent $\pm 6$ deg |                            | $> = 8$ ; Coherent $\pm 6$ deg |
| BIT RATE RANGE            | b/s          | 1 - 2000                       |                            | 1 - 2000                       |
| FORMATS AVAILABLE         | -            | NRZ - L, Bi - $\phi$ - L       |                            | NRZ - L, Bi - $\phi$ - L       |
|                           |              |                                |                            |                                |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS  
4. DSS 34 AND DSS 54 ONLY

**CCSDS HISTORICAL DOCUMENT**  
**NASA DEEP SPACE NETWORK**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION  |                       |  |                                |
|-----------------------------|--------------|--|-----------------------|--|--------------------------------|
|                             |              | 34M BWG-1 STATIONS   |                       | 34M BWG-2 STATION  |                                |
| <b>GENERAL</b>              |              | OPERATIONAL 6-95, 4-96, 10-97                                      |                       | OPERATIONAL 10-96  |                                |
| STATION DESIGNATION         | -            | DSS 24, DSS 34, DSS 54   |                       | DSS 25   |                                |
| LOCATION(S)                 | -            | USA, Australia, Spain  |                       | USA  |                                |
| DIAMETER                    | m            | 34   |                       | 34   |                                |
| <b>RECEIVE</b>              |              | Block V Receiver   |                       | Block V Receiver   |                                |
| FREQUENCIES                 | MHz          | 2200 - 2300  | 8400 - 8500           | 8400 - 8500  | 31 800 - 32 300 <sup>(2)</sup> |
| FREQUENCY RESOLUTION        | Hz           | 0.00015  | 0.00015               | 0.00015  | 0.00015                        |
| ANTENNA GAIN @ 45 deg       | dBi          | 56.7   | 68.1                  | 68.2   | 78.6                           |
| SYS NOISE TEMP @ ZENITH     | K            | 30.2   | 25.4                  | 25.2   | 48.7                           |
| G/T @ 45 deg                | dB           | 41.7   | 53.9                  | 54.2   | 61.7                           |
| POLARIZATION                | -            | RCP or LCP   | RCP or LCP            | RCP and LCP  | RCP or LCP                     |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.24   | 0.063                 | 0.063  | 0.017                          |
| ANTENNA ELLIPTICITY         | dB           | 1  | 0.8                   | 0.8  | 0.8                            |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 0.002$  | $\pm 0.002$           | $\pm 0.002$  | $\pm 0.002$                    |
| RCVR AGC DYNAMIC RANGE      | dB           | 125  | 125                   | 125  | 125                            |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -164 in 2 Blo = 10 Hz  | -165 in 2 Blo = 10 Hz | -165 in 2 Blo = 10 Hz  | -162 in 2 Blo = 10 Hz          |
| RCVR LOOP BANDWIDTHS        | Hz           | Continuous (0.1 - 200)   |                       | Continuous (0.1 - 200)   |                                |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Fix  |                       | Fix  |                                |
| RCVR PLL ORDER(S)           | No.          | 1, 2, 3  |                       | 1, 2, 3  |                                |
| ACQ SWEEP RANGE             | kHz          | FFT - Variable, 1 Hz to Full Band                                  |                       | FFT - Variable, 1 Hz to Full Band                                  |                                |
| MIN ACQ SWEEP RATE          | Hz/s         | Variable Integration Time  |                       | Variable Integration Time  |                                |
| MAX ACQ SWEEP RATE          | kHz/s        | Variable integration Time  |                       | Variable integration Time  |                                |
| ACQ SWEEP STEP SIZE         | Hz           | FFT ( $2^{17}$ Points)   |                       | FFT ( $2^{17}$ Points)   |                                |
| PROGRAMMED L.O.             | Yes/No       | Yes  |                       | Yes  |                                |
|                             |              |  |                       |  |                                |
|                             |              |  |                       |  |                                |
|                             |              |  |                       |  |                                |
|                             |              |  |                       |  |                                |
| <b>TELEMETRY</b>            |              |  |                       |  |                                |
| MODULATION TYPE(S)          | -            | PCM / PSK / PM; PCM / PM   |                       | PCM / PSK / PM; PCM / PM   |                                |
| MODULATION FORMAT(S)        | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S                               |                       | NRZ - L, M, S; Bi - $\phi$ - L, M, S                               |                                |
| MOD INDEX RANGE             | Rad Pk       | 0.17 - 1.57  |                       | 0.17 - 1.57  |                                |
| SUBCARRIER FREQ RANGE       | kHz          | 1 - 2000   |                       | 1 - 2000   |                                |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine or Square   |                       | Sine or Square   |                                |
| SYMBOL RATE RANGE           | s/s          | 8 - 2 200 000 <sup>(2)</sup>                                       |                       | 8 - 2 200 000 <sup>(2)</sup>                                       |                                |
| SUBCARRIER/SYM RATE LIMIT   | -            | $> 1.5^{(2)}$  |                       | $> 1.5^{(2)}$  |                                |
| ARRAYS WITH STATIONS        | -            | 34M HEF, 34M STD, 34M BWG, 70M                                     |                       | 34M HEF, 34M BWG, 70M  |                                |
| CHANNEL DECODING            | Type         | CCSDR R/S, Conv., Concat<br>Conv (r - 1/2, 1/3, 1/4, 1/6 k = 3-15) |                       | CCSDR R/S, Conv., Concat<br>Conv (r - 1/2, 1/3, 1/4, 1/6 k = 3-15) |                                |
| DATA FORMAT                 | -            | CCSDS Transfer Frame   |                       | CCSDS Transfer Frame   |                                |
|                             |              |  |                       |  |                                |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-4340

**CCSDS HISTORICAL DOCUMENT**  
**NASA DEEP SPACE NETWORK**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS  | SUBNETWORK OR STATION   |   |
|---|--------|---|---|
|   |        | 34M BWG-1 STATIONS  | 34M BWG-2 STATION   |
| <b>GENERAL</b>  |        | OPERATIONAL 6-95, 4-96, 10-97   |   |
| STATION DESIGNATION   | -      | DSS 24, DSS 34, DSS 54  |   |
| LOCATION(S)   | -      | USA, Australia, Spain   |   |
| DIAMETER  | m      | 34  |   |
| <b>FREQUENCIES</b>  |        | DSS 24  | DSS 34, DSS 54  |
| TRANSMIT FREQUENCIES  | MHz    | 2025 - 2120   | 2025 - 2120, 7145 - 7190  |
| RECEIVE FREQUENCIES   | MHz    | 2200 - 2300, 8400 - 8500  | 2200 - 2300, 8400 - 8500  |
| TURNAROUND FREQ RATIO   | -      | 240 / 221, 880 / 221  | 240 / 221; 880 / 221,<br>240 / 479, 880 / 749                                   |
| <b>DOPPLER</b>  |        |   |   |
| COHERENT/NON-COHERENT   | -      | 1-Way, 2-Way / 3-Way Coherent and Non-Coherent                                  |   |
| COUNTER RESOLUTION  | Cycles | 2 <sup>-10</sup>  |   |
| MAX DOPPLER FREQ SHIFT  | MHz    | ± 33  |   |
| DOPPLER BIAS FREQ   | MHz    | ± 1   |   |
| DRIFT   | Δf/f   | < 3 x 10 <sup>-14</sup> @ 12 hrs.   |   |
| OUTPUT EQUATION   | -      | (f <sub>xmit</sub> x Turn-Around Ratio - f <sub>rcv</sub> ) + f <sub>bias</sub> | (f <sub>xmit</sub> x Turn-Around Ratio - f <sub>rcv</sub> ) + f <sub>bias</sub> |
| DIRECTION INDICATOR   | -      | + Δf = + Δr   |   |
|   |        |   |   |
|   |        |   |   |
|   |        |   |   |
| <b>RANGING</b>  |        |   |   |
| COHERENT/NON-COHERENT   | -      | 2 - 3-Way Coherent  |   |
| RANGE CODE WAVEFORM   | Sin/Sq | Square  |   |
| EARTH STATION MOD INDEX   | Rad Pk | 0.1 - 1.6   |   |
| RANGE CODE FREQ RATIO   | -      | 2:1   |   |
| MAJOR CODE FREQ(S)  | kHz    | ~1 MHz to 16 kHz in Steps of 2  |   |
| MINOR CODE FREQ(S)  | kHz    | f (Major Code) / 2 to ~1 Hz in Steps of 2<br>16 kHz and Below on Major Code     | f (Major Code) / 2 to ~1 Hz in Steps of 2<br>16 kHz and Below on Major Code     |
| MIN RECEIVED CARRIER SNR  | dB     | 10  |   |
| MIN REQ CODE PWR/No   | dB-Hz  | -10   |   |
| CODE INTEGRATION TIME   | s      | Depending on Pr / No & Desired Accuracy   |   |
| ACQUISITION SEQUENCE  | -      | Sequential; Major Code First  |   |
| RANGE DATA UNITS  | -      | 1 RU ~ 0.95 ns  |   |
| RANGE QUANTIZATION  | -      | 1 RU  |   |
| ACCURACY (STRONG SIGNAL)  | m      | 2 (S), 1 (X)  |   |
| MAX UNAMBIGUOUS RANGE   | km     | 152 000   |   |
| TRANSPONDER BW  | MHz    | > 3.3   |   |
|   |        |   |   |
|   |        |   |   |
|   |        |   |   |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br/> 4. NOT AVAILABLE UNTIL 2001</p> |        |   |   |

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                |                |                                      |                |
|--|---------------|--------------------------------------|----------------|--------------------------------------|----------------|
|  |               | 34M BWG-1 STATIONS                   |                | 34M BWG-2 STATION                    |                |
| <b>GENERAL</b>   |               | OPERATIONAL 6-95, 4-96, 10-97        |                | OPERATIONAL 10-96                    |                |
| STATION DESIGNATION  | -             | DSS 24, DSS 34, DSS 54               |                | DSS 25                               |                |
| LOCATION(S)  | -             | USA, Australia, Spain                |                | USA                                  |                |
| DIAMETER   | m             | 34                                   |                | 34                                   |                |
| <b>FREQUENCY STD</b>   |               |                                      |                |                                      |                |
| STANDARD TYPE  | Name          | Hydrogen Maser                       |                | Hydrogen Maser                       |                |
| STANDARD MFG   | Name          | SAO VLG-11 / VLG-10                  |                | SAO VLG-11 / VLG-10                  |                |
| STABILITY AT:  |               | <b>Allan Deviation</b>               |                | <b>Allan Deviation</b>               |                |
| 1 - SECOND   | $\Delta f/f$  | 2 x 10 <sup>-13</sup>                |                | 2 x 10 <sup>-13</sup>                |                |
| 1 - HOUR   | $\Delta f/f$  | 5 x 10 <sup>-15</sup>                |                | 5 x 10 <sup>-15</sup>                |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | 1 x 10 <sup>-14</sup>                |                | 1 x 10 <sup>-14</sup>                |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                                  |                | (1)                                  |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>                         | <b>100 MHz</b> | <b>5 MHz</b>                         | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        |                                      | (1)            |                                      | (1)            |
| 10 Hz OFFSET   | dBc/Hz        |                                      | -103           |                                      | -103           |
| 100 Hz OFFSET  | dBc/Hz        |                                      | -115           |                                      | -115           |
| 1000 Hz OFFSET   | dBc/Hz        |                                      | -115           |                                      | -115           |
| REF FREQS AVAILABLE  | MHz           | 100                                  |                | 100                                  |                |
| MAX STA-TO-STA OFFSET  | Hz            | Coherent to SPC 10, 40, 60           |                | Coherent to SPC 10                   |                |
|  |               |                                      |                |                                      |                |
|  |               |                                      |                |                                      |                |
|  |               |                                      |                |                                      |                |
| <b>TIMING SYSTEM</b>   |               |                                      |                |                                      |                |
| MASTER REFERENCE AGENCY  | Name          | NIST                                 |                | NIST                                 |                |
| REFERENCE TIME   | Name          | UTC                                  |                | UTC                                  |                |
| TIME CODE EPOCH  | Yr            | 1 January 1958                       |                | 1 January 1958                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | ASCII Serial, 42-bit BCD, 36-bit BIN |                | ASCII Serial, 42-bit BCD, 36-bit BIN |                |
| MAX TIME RESOLUTION  | s             | 1 x 10 <sup>-3</sup>                 |                | 1 x 10 <sup>-3</sup>                 |                |
| TIME TRANSFER METHOD   | Name          | Coherent to SPC 10, 40, 60           |                | Coherent to SPC 10                   |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 0.02$                           |                | $\pm 0.02$                           |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 20$                             |                | $\pm 20$                             |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 0.1$                            |                | $\pm 0.1$                            |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 0.1$                            |                | $\pm 0.1$                            |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 100, 1 K                      |                | 1, 10, 100, 1 K                      |                |
|  |               |                                      |                |                                      |                |
|  |               |                                      |                |                                      |                |
|  |               |                                      |                |                                      |                |
|  |               |                                      |                |                                      |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                                      |                |                                      |                |

6445-4341

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION                     |                                       |
|---|--------------------|---|---------------------------------------|
|   |                    | 34M BWG-1 STATIONS                        | 34M BWG-2 STATION                     |
| <b>GENERAL</b>  |                    | OPERATIONAL 6-95, 4-96, 10-97             | OPERATIONAL 10-96                     |
| STATION DESIGNATION   | -                  | DSS 24, DSS 34, DSS 54                    | DSS 25                                |
| LOCATION(S)   | -                  | USA, Australia, Spain                     | USA                                   |
| DIAMETER  | m                  | 34  | 34                                    |
| <b>GEOGRAPHICAL</b>   |                    |   |                                       |
| LOCATION, COUNTRY/STATE   | Name               | USA, Australia, Spain                     | USA, Australia, Spain                 |
| LOCATION, CITY  | Name               | Goldstone, Canberra, Madrid               | Goldstone, Canberra, Madrid           |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 243, 07, 30.7; 148, 58, 55; 355, 44, 50   | 243, 07, 29                           |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 35, 20, 23.6; -35, 23, 54.5; 40, 25, 27.2 | 35, 20, 15                            |
| REFERENCE FRAME   | Name               | ITRF 93                                   | ITRF 93                               |
| EPOCH   | Date               | 1993                                      | 1993                                  |
| HEIGHT (site 1/site 2/site 3)   | m-msl              | 952, 661, 824                             | 961                                   |
|   |                    |   |                                       |
|   |                    |   |                                       |
| <b>MECHANICAL</b>   |                    |   |                                       |
| TYPE OF MOUNT   | -                  | Az - El                                   | Az - El                               |
| AZIMUTH LIMITATIONS   | -                  | Keyhole Zenith                            | Keyhole Zenith                        |
| TRACKING SPEED RANGE  | deg/s              | 0.8                                       | 0.8                                   |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 0.4                                       | 0.4                                   |
| TYPE OF POINTING  | Type               | Conscan, Predicts                         | Conscan, Predicts                     |
| POINTING ACCURACY   | deg                | 0.006                                     | 0.006                                 |
| MIN TRANSMIT ELEV ANGLE   | deg                | 6.5                                       | 10                                    |
| MIN RECEIVE ELEV ANGLE  | deg                | 6   | 6                                     |
|   |                    |   |                                       |
|   |                    |   |                                       |
|   |                    |   |                                       |
|   |                    |   |                                       |
| <b>SUPPORT</b>  |                    |   |                                       |
| TRANSMIT FREQ BAND(S)   | GHz                | 2 (A&B)                                   | 7 (B)                                 |
| RECEIVE FREQ BAND(S)  | GHz                | 2 (A&B)                                   | 2 (A&B); 8 (B); 32 (B) <sup>(6)</sup> |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                                       | (1)                                   |
| MISSION CATEGORIES  | Cat                | A & B                                     | A & B                                 |
|   |                    |   |                                       |
|   |                    |   |                                       |
|   |                    |   |                                       |
|   |                    |   |                                       |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES      6. DSS 25 ONLY |                    |   |                                       |

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION                    |                                |
|---------------------------|--------------|--|--------------------------------|
|                           |              | 34M STD SUBNETWORK<br>Closed 4-98, 12-98 | 34M BWG-3 STATION              |
| <b>GENERAL</b>            |              |  | OPERATIONAL 10-99              |
| STATION DESIGNATION       | -            | DSS 42, 61                               | DSS 26                         |
| LOCATION(S)               | -            | Australia, Spain                         | USA                            |
| DIAMETER                  | m            | 34                                       | 34                             |
| <b>TRANSMIT</b>           |              |  |                                |
| FREQUENCIES               | MHz          | 2025 - 2120                              | 7145 - 7190                    |
| FREQUENCY RESOLUTION      | Hz           | $9.6 \times 10^{-5}$                     | $4 \times 10^{-12}$            |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $5 \times 10^{-8}$                       | $2 \times 10^{-15}$            |
| TRANSMIT POWER 1          | W            | 200 - 20 K                               | 50 - 4 K                       |
| EIRP RANGE 1              | dBW          | 78 - 98                                  | 88 - 105                       |
| TRANSMIT POWER 2          | W            | None                                     | None                           |
| EIRP RANGE 2              | dBW          | None                                     | None                           |
| POLARIZATION              | -            | RCP or LCP                               | RCP or LCP                     |
| ANTENNA GAIN              | dBi          | 55.2                                     | 68.1                           |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.31                                     | 0.074                          |
| ANTENNA ELLIPTICITY       | dB           | 2.2                                      | 1                              |
| RF FREQ SWEEP RANGE       | kHz          | $\pm 4800$                               | 1000                           |
| MIN FREQ SWEEP RATE       | Hz/s         | $1 \times 10^{-6}$                       | $41 \times 10^{-6}$            |
| MAX FREQ SWEEP RATE       | kHz/s        | 9600                                     | $\pm 12.1$                     |
| PROGRAMMED UPLINK FREQ    | Yes/No       | Yes                                      | Yes                            |
|                           |              |  |                                |
|                           |              |  |                                |
|                           |              |  |                                |
|                           |              |  |                                |
|                           |              |  |                                |
|                           |              |  |                                |
| <b>COMMAND</b>            |              |  |                                |
| RF CARRIER MOD TYPE       | -            | PM                                       | PM                             |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.3 - 1.57                               | 0.3 - 1.57                     |
| SUBCARRIER FREQUENCY(S)   | Hz           | 100 - 16 000                             | 100 - 16 000                   |
| SUBCARRIER STEP SIZE      | Hz           | 0.1                                      | 0.1                            |
| SUBCARRIER FREQ STABILITY | ppm          | $\pm 0.1$ (1 sec)                        | $\pm 0.1$ (sec)                |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine or Square                           | Sine or Square                 |
| SUBCARRIER MOD TYPE       | -            | PSK, FSK                                 | PSK, FSK                       |
| SUBCARRIER/BIT RATE LIMIT | -            | $> = 8$ ; Coherent $\pm 6$ deg           | $> = 8$ ; Coherent $\pm 6$ deg |
| BIT RATE RANGE            | b/s          | 1 - 2000                                 | 1 - 2000                       |
| FORMATS AVAILABLE         | -            | NRZ - L; Bi - $\phi$ - L                 | NRZ - L, Bi - $\phi$ - L       |
|                           |              |  |                                |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-4344

**CCSDS HISTORICAL DOCUMENT**  
**NASA DEEP SPACE NETWORK**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION  |  |
|---|--------------|--|--|
|   |              | 34M STD SUBNETWORK<br>Closed 4-98, 12-98                             | 34M BWG-3 STATION  |
| <b>GENERAL</b>  |              | OPERATIONAL 10-99  |  |
| STATION DESIGNATION   | -            | DSS 42, 61   |  |
| LOCATION(S)   | -            | Australia, Spain   |  |
| DIAMETER  | m            | 34   |  |
| <b>RECEIVE</b>  |              | Block III Receiver   |  |
| FREQUENCIES   | MHz          | 2200 - 2300  | 8400 - 8500  |
| FREQUENCY RESOLUTION  | Hz           | 9.6  | 9.6  |
| ANTENNA GAIN @ 45 deg   | dBi          | 56.2   | 66.2   |
| SYS NOISE TEMP @ ZENITH   | K            | 21.5 <sup>(4)</sup> / 110 <sup>(5)</sup>                             | 25.4   |
| G/T @ 45 deg  | dB           | 42.8 <sup>(4)</sup> / 35.7 <sup>(5)</sup>                            | 52.2   |
| POLARIZATION  | -            | RCP or LCP   | RCP or LCP   |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.27   | 0.075  |
| ANTENNA ELLIPTICITY   | dB           | 0.6  | 0.8  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 0.002$  | $\pm 0.002$  |
| RCVR AGC DYNAMIC RANGE  | dB           | 125  | 125  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -161 in 2 Blo = 10.8 Hz  | -160 in 2 Blo = 10.8 Hz  |
| RCVR LOOP BANDWIDTHS  | Hz           | 10.8, 43.2, 45, 136.8, 180, 770                                      | Continuous (0.1 - 200)   |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt  | Fix  |
| RCVR PLL ORDER(S)   | No.          | 2  | 1, 2, 3  |
| ACQ SWEEP RANGE   | kHz          | 0.5N or 2N (N - 1, 2, 3, n) Same                                     | FFT - Variable, 1 Hz to Full Band                                  |
| MIN ACQ SWEEP RATE  | Hz/s         | Variable Integration Time  | Variable Integration Time  |
| MAX ACQ SWEEP RATE  | kHz/s        | Variable Integration Time  | Variable integration Time  |
| ACQ SWEEP STEP SIZE   | Hz           | 500 or 2000  | FFT (2 <sup>17</sup> Points)                                       |
| PROGRAMMED L.O.   | Yes/No       | Yes  | Yes  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
| <b>TELEMETRY</b>  |              |  |  |
| MODULATION TYPE(S)  | -            | PCM / PSK / PM; PCM / PM   | PCM / PSK / PM; PCM / PM   |
| MODULATION FORMAT(S)  | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S                                 | NRZ - L, M, S; Bi - $\phi$ - L, M, S                               |
| MOD INDEX RANGE   | Rad Pk       | 0.2 - 1.4  | 0.17 - 1.57  |
| SUBCARRIER FREQ RANGE   | kHz          | 10 - 2000  | 1 - 2000   |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine or Square   | Sine or Square   |
| SYMBOL RATE RANGE   | s/s          | 8 - 1 300 000  | 8 - 2 200 000 <sup>(2)</sup>                                       |
| SUBCARRIER/SYM RATE LIMIT   | -            | 1.5 - 1000 <sup>(2)</sup>  | > 1.5 <sup>(2)</sup>   |
| ARRAYS WITH STATIONS  | -            | 34M HEF, 34M BWG, 70M  | 34M HEF, 34M BWG, 70M  |
| CHANNEL DECODING  | Type         | CCSDS R/S, Conv., Concat<br>Conv (r - 1/2, 1/3, 1/4, 1/6 k = 3 - 15) | CCSDR R/S, Conv., Concat<br>Conv (r - 1/2, 1/3, 1/4, 1/6 k = 3-15) |
| DATA FORMAT   | -            | CCSDS Transfer Frame   | CCSDS Transfer Frame   |
|   |              |  |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. VALID FOR FREQUENCY BAND 2270-2300      5. VALID FOR FREQUENCY BAND 2200-2270 |              |  |  |

6445-4345

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS  | SUBNETWORK OR STATION   |   |
|---|--------|---|---|
|   |        | 34M STD SUBNETWORK<br>Closed 4-98, 12-98  | 34M BWG-3 STATION   |
| <b>GENERAL</b>  |        |   | OPERATIONAL 10-99   |
| STATION DESIGNATION   | -      | DSS 42, 61  |   |
| LOCATION(S)   | -      | Australia, Spain  |   |
| DIAMETER  | m      | 34  |   |
| <b>FREQUENCIES</b>  |        |   |   |
| TRANSMIT FREQUENCIES  | MHz    | 2025 - 2120   | 7145 - 7190   |
| RECEIVE FREQUENCIES   | MHz    | 2200 - 2300   | 8400 - 8500   |
| TURNAROUND FREQ RATIO   | -      | 240 / 221   | 880 / 749   |
| <b>DOPPLER</b>  |        |   |   |
| COHERENT/NON-COHERENT   | -      | Coherent or Non-Coherent  | 1-Way, 2-Way / 3-Way Coherent and Non-Coherent                                  |
| COUNTER RESOLUTION  | Cycles | 0.00156   | 2 <sup>-10</sup>  |
| MAX DOPPLER FREQ SHIFT  | MHz    | +6 to -0.5  | ±33   |
| DOPPLER BIAS FREQ   | MHz    | ±1  | ±1  |
| DRIFT   | Δf/f   | < 8 x 10 <sup>-14</sup> @ 12 Hrs  | < 3 x 10 <sup>-14</sup> @ 12 hrs.   |
| OUTPUT EQUATION   | -      | (f <sub>xmit</sub> x Turn-Around Ratio - f <sub>rcv</sub> ) + f <sub>bias</sub> | (f <sub>xmit</sub> x Turn-Around Ratio - f <sub>rcv</sub> ) + f <sub>bias</sub> |
| DIRECTION INDICATOR   | -      | + Δf = + Δr   | + Δf = + Δr   |
|   |        |   |   |
|   |        |   |   |
|   |        |   |   |
| <b>RANGING</b>  |        |   |   |
| COHERENT/NON-COHERENT   | -      | 2 - 3-Way Coherent  | 2 - 3-Way Coherent  |
| RANGE CODE WAVEFORM   | Sin/Sq | Square  | Square  |
| EARTH STATION MOD INDEX   | Rad Pk | 0.1 - 1.6   | 0.1 - 1.6   |
| RANGE CODE FREQ RATIO   | -      | 2:1   | 2:1   |
| MAJOR CODE FREQ(S)  | kHz    | ~1 MHz to 16 kHz in Steps of 2  | ~1 MHz to 16 kHz in Steps of 2  |
| MINOR CODE FREQ(S)  | kHz    | f (Major Code) / 2 to ~1 Hz in Steps of 2<br>16 kHz and Below on Major Code     | f (Major Code) / 2 to ~1 Hz in Steps of 2<br>16 kHz and Below on 1 Major Code   |
| MIN RECEIVED CARRIER SNR  | dB     | 10  | 10  |
| MIN REQ CODE PWR/No   | dB-Hz  | -15   | -15   |
| CODE INTEGRATION TIME   | s      | Depending on Pr / No and Desired Accuracy                                       | Depending on Pr / No and Desired Accuracy                                       |
| ACQUISITION SEQUENCE  | -      | Sequential; Major Code First  | Sequential; Major Code First  |
| RANGE DATA UNITS  | -      | 1 RU ~ 0.95 ns  | 1 RU ~ 0.95 ns  |
| RANGE QUANTIZATION  | -      | 1 RU  | 1 RU  |
| ACCURACY (STRONG SIGNAL)  | m      | 2 (S), 1 (X)  | 2 (S), 1 (X)  |
| MAX UNAMBIGUOUS RANGE   | km     | 305 000   | 305 000   |
| TRANSPONDER BW  | MHz    | > 3.3   | > 3.3   |
|   |        |   |   |
|   |        |   |   |
|   |        |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |        |   |   |

6445-4346

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS          | UNITS         | SUBNETWORK OR STATION                    |               |                                      |                |
|--------------------------|---------------|--|---------------|--------------------------------------|----------------|
|                          |               | 34M STD SUBNETWORK<br>Closed 4-98, 12-98 |               | 34M BWG-3 STATION                    |                |
| <b>GENERAL</b>           |               |  |               |                                      |                |
| STATION DESIGNATION      | -             | DSS 42, 61                               |               | DSS 26                               |                |
| LOCATION(S)              | -             | Australia, Spain                         |               | USA                                  |                |
| DIAMETER                 | m             | 34                                       |               | 34                                   |                |
| <b>FREQUENCY STD</b>     |               |  |               |                                      |                |
| STANDARD TYPE            | Name          | Hydrogen Maser                           |               | Hydrogen Maser                       |                |
| STANDARD MFG             | Name          | SAO / VLG-10; VLG-11                     |               | SAO / VLG-11; VLG-10                 |                |
| STABILITY AT:            |               | <b>Allan Deviation</b>                   |               | <b>Allan Deviation</b>               |                |
| 1 - SECOND               | $\Delta f/f$  | $1 \times 10^{-12}$                      |               | $1 \times 10^{-13}$                  |                |
| 1 - HOUR                 | $\Delta f/f$  | $1 \times 10^{-14}$                      |               | $1 \times 10^{-15}$                  |                |
| 1 - DAY (24 HOURS)       | $\Delta f/f$  | $1 \times 10^{-14}$                      |               | $1 \times 10^{-14}$                  |                |
| 1 - MONTH                | $\Delta f/f$  | $1 \times 10^{-13}$                      |               | (1)                                  |                |
| REF FREQS PHASE NOISE    | $S_{\phi}(f)$ | <b>5 MHz</b>                             | <b>50 MHz</b> | <b>5 MHz</b>                         | <b>100 MHz</b> |
| 1 Hz OFFSET              | dBc/Hz        | (1)                                      | (1)           |                                      | (1)            |
| 10 Hz OFFSET             | dBc/Hz        | -126                                     | -106          |                                      | -103           |
| 100 Hz OFFSET            | dBc/Hz        | -139                                     | -119          |                                      | -115           |
| 1000 Hz OFFSET           | dBc/Hz        | -139                                     | -119          |                                      | -115           |
| REF FREQS AVAILABLE      | MHz           | 5, 50                                    |               | 100                                  |                |
| MAX STA-TO-STA OFFSET    | Hz            | Coherent to SPC 40, 60                   |               | Coherent to SPC 10                   |                |
|                          |               |  |               |                                      |                |
|                          |               |  |               |                                      |                |
|                          |               |  |               |                                      |                |
| <b>TIMING SYSTEM</b>     |               |  |               |                                      |                |
| MASTER REFERENCE AGENCY  | Name          | NIST                                     |               | NIST                                 |                |
| REFERENCE TIME           | Name          | UTC                                      |               | UTC                                  |                |
| TIME CODE EPOCH          | Yr            | 1 January 1958                           |               | 1 January 1958                       |                |
| TIME CODES AVAILABLE     | CCSDS Codes   | ASCII Serial, 42-bit BCD, 36-bit BIN     |               | ASCII Serial, 42-bit BCD, 36-bit BIN |                |
| MAX TIME RESOLUTION      | s             | $1 \times 10^{-3}$                       |               | $1 \times 10^{-3}$                   |                |
| TIME TRANSFER METHOD     | Name          | Coherent to SPC 40, 60                   |               | Coherent to SPC 10                   |                |
| MAX TRANS ERROR REF      | $\mu$ -sec    | $\pm 0.02$                               |               | $\pm 0.02$                           |                |
| MAX OFFSET FROM REF      | $\mu$ -sec    | $\pm 20$                                 |               | $\pm 20$                             |                |
| MAX OFFSET MEAS ERROR    | $\mu$ -sec    | $\pm 0.1$                                |               | $\pm 0.1$                            |                |
| MAX STA-TO-STA OFFSET    | $\mu$ -sec    | $\pm 0.1$                                |               | $\pm 0.1$                            |                |
| TIMING SIGNALS AVAILABLE | pulse/s       | 1, 10, 100, 1 K                          |               | 1, 10, 100, 1 K                      |                |
|                          |               |  |               |                                      |                |
|                          |               |  |               |                                      |                |
|                          |               |  |               |                                      |                |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS  
 4. MEASURED BY THE AGENCY 6445-4347

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS                        | UNITS  | SUBNETWORK OR STATION                    |                                       |
|--|--|--|---------------------------------------|
|  |  | 34M STD SUBNETWORK<br>Closed 4-98, 12-98 | 34M BWG-3 STATION                     |
| <b>GENERAL</b>                         |  |  | OPERATIONAL 10-99                     |
| STATION DESIGNATION                    | -  | DSS 42, 61                               | DSS 26                                |
| LOCATION(S)                            | -  | Australia, Spain                         | USA                                   |
| DIAMETER                               | m  | 34                                       | 34                                    |
| <b>GEOGRAPHICAL</b>                    |  |  |                                       |
| LOCATION, COUNTRY/STATE                | Name   | Australia, Spain                         | USA, Australia, Spain                 |
| LOCATION, CITY                         | Name   | Canberra, Madrid                         | Goldstone, Canberra, Madrid           |
| LONGITUDE (site 1/site 2/site 3)       | d, m, s                                      | 148, 58, 52.5; 355, 45, 03.5             | 243, 07, 37                           |
| LATITUDE (site 1/site 2/site 3)        | d, m, s                                      | -35, 24, 02.4; 40, 25, 43.5              | 35, 20, 08                            |
| REFERENCE FRAME                        | Name   | ITRF 93                                  | ITRF 93                               |
| EPOCH                                  | Date   | 1993                                     | 1993                                  |
| HEIGHT (site 1/site 2/site 3)          | m-msl  | 675, 841                                 | 970                                   |
|  |  |  |                                       |
|  |  |  |                                       |
| <b>MECHANICAL</b>                      |  |  |                                       |
| TYPE OF MOUNT                          | -  | Ha-Dec                                   | Az - El                               |
| AZIMUTH LIMITATIONS                    | -  | Keyhole S (42), N (61)                   | Keyhole Zenith                        |
| TRACKING SPEED RANGE                   | deg/s  | 0.001 - 0.25                             | 0.8                                   |
| MAX TRACK ACCELERATION                 | deg/s <sup>2</sup>                           | 0.25                                     | 0.4                                   |
| TYPE OF POINTING                       | Type   | Conscan, Predicts                        | Conscan, Predicts                     |
| POINTING ACCURACY                      | deg  | 0.02                                     | 0.006                                 |
| MIN TRANSMIT ELEV ANGLE                | deg  | 5  | 10                                    |
| MIN RECEIVE ELEV ANGLE                 | deg  | Local Horizon                            | 6                                     |
|  |  |  |                                       |
|  |  |  |                                       |
|  |  |  |                                       |
|  |  |  |                                       |
| <b>SUPPORT</b>                         |  |  |                                       |
| TRANSMIT FREQ BAND(S)                  | GHz  | 2 (A&B)                                  | 7 (B)                                 |
| RECEIVE FREQ BAND(S)                   | GHz  | 2 (A&B), 8 (A&B)                         | 2 (A&B), 8 (B), 32 (B) <sup>(6)</sup> |
| ACQ AID FREQ BAND(S)                   | GHz  | (1)                                      | (1)                                   |
| MISSION CATEGORIES                     | Cat  | A & B                                    | A & B                                 |
|  |  |  |                                       |
|  |  |  |                                       |
|  |  |  |                                       |
|  |  |  |                                       |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE | 2. SOME LIMITATIONS APPLY TO THIS CAPABILITY | 3. NOT RECOMMENDED BY CCSDS              |                                       |
| 4. BASED UPON GEOCENTRIC COORDINATES   | 5. BASED UPON GEODETIC COORDINATES           |  | 6445-4348                             |

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION           |  |
|---------------------------|--------------|---------------------------------|--|
|                           |              | 34M HEF SUBNETWORK              | 70M SUBNETWORK   |
| <b>GENERAL</b>            |              |                                 |  |
| STATION DESIGNATION       | -            | DSS 15, DSS 45, DSS 65          | DSS 14, DSS 43, DSS 63                                 |
| LOCATION(S)               | -            | USA, Australia, Spain           | USA, Australia, Spain                                  |
| DIAMETER                  | m            | 34                              | 70   |
| <b>TRANSMIT</b>           |              |                                 |  |
| FREQUENCIES               | MHz          | 7145 - 7190                     | 2090 - 2094; 2110 - 2120                               |
| FREQUENCY RESOLUTION      | Hz           | $4 \times 10^{-12}$             | $4 \times 10^{-12}$                                    |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $2 \times 10^{-15}$             | $2 \times 10^{-15}$                                    |
| TRANSMIT POWER 1          | W            | 200 - 20 K                      | 200 - 20 K (2110 - 2120)                               |
| EIRP RANGE 1              | dBW          | 90 - 110                        | 85.5 - 105.5   |
| TRANSMIT POWER 2          | W            | None                            | 5 K - 400 K (2090 - 2094 <sup>(4)</sup> , 2110 - 2120) |
| EIRP RANGE 2              | dBW          | None                            | 99.5 - 118.5   |
| POLARIZATION              | -            | RCP or LCP                      | RCP or LCP   |
| ANTENNA GAIN              | dBi          | 67.1                            | 62.7   |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.074                           | 0.119  |
| ANTENNA ELLIPTICITY       | dB           | 1                               | 1  |
| RF FREQ SWEEP RANGE       | kHz          | 1000                            | 300  |
| MIN FREQ SWEEP RATE       | Hz/s         | $41 \times 10^{-6}$             | $41 \times 10^{-6}$                                    |
| MAX FREQ SWEEP RATE       | kHz/s        | $\pm 12.1$                      | 3.1  |
| PROGRAMMED UPLINK FREQ    | Yes/No       | Yes                             | Yes  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
|                           |              |                                 |  |
| <b>COMMAND</b>            |              |                                 |  |
| RF CARRIER MOD TYPE       | -            | PM                              | PM   |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | 0.3 - 1.57                      | 0.3 - 1.57   |
| SUBCARRIER FREQUENCY(S)   | Hz           | 100 - 16 000                    | 100 - 16 000   |
| SUBCARRIER STEP SIZE      | Hz           | 0.1                             | 0.1  |
| SUBCARRIER FREQ STABILITY | ppm          | $\pm 0.1$ (1 sec)               | $\pm 0.1$ (1 sec)                                      |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine or Square                  | Sine or Square   |
| SUBCARRIER MOD TYPE       | -            | PSK, FSK                        | PSK  |
| SUBCARRIER/BIT RATE LIMIT | -            | $\geq 8$ ; Coherent $\pm 6$ deg | $\geq 8$ ; Coherent $\pm 6$ deg                        |
| BIT RATE RANGE            | b/s          | 1 - 2000                        | 1 - 2000   |
| FORMATS AVAILABLE         | -            | NRZ - L, Bi - $\phi$ - L        | NRZ - L, Bi - $\phi$ - L                               |
|                           |              |                                 |  |
|                           |              |                                 |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

4. TRANSMIT POWER 5K - 150K OVER 2190-2094 BAND

**CCSDS HISTORICAL DOCUMENT**  
**NASA DEEP SPACE NETWORK**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION  |                       |   |                       |
|--|--------------|--|-----------------------|---|-----------------------|
|  |              | 34M HEF SUBNETWORK   |                       | 70M SUBNETWORK  |                       |
| <b>GENERAL</b>   |              |  |                       |   |                       |
| STATION DESIGNATION  | -            | DSS 15, DSS 45, DSS 65   |                       | DSS 14, DSS 43, DSS 63  |                       |
| LOCATION(S)  | -            | USA, Australia, Spain  |                       | USA, Australia, Spain   |                       |
| DIAMETER   | m            | 34   |                       | 70  |                       |
| <b>RECEIVE</b>   |              |  |                       |   |                       |
|  |              | Block V Receiver   |                       | Block V Receiver  |                       |
| FREQUENCIES  | MHz          | 2200 - 2300  | 8400 - 8500           | 2270 - 2300   | 8400 - 8500           |
| FREQUENCY RESOLUTION   | Hz           | 0.00015  | 0.00015               | 0.00015   | 0.00015               |
| ANTENNA GAIN @ 45 deg  | dBi          | 56   | 68.2                  | 63.3  | 74.1                  |
| SYS NOISE TEMP @ ZENITH  | K            | 40.6   | 20.6                  | 15.2 <sup>(4)</sup>   | 20.6                  |
| G/T @ 45 deg   | dB           | 39.9   | 55.1                  | 51.2  | 60.7                  |
| POLARIZATION   | -            | RCP or LCP   | RCP or LCP            | RCP and LCP   | RCP and LCP           |
| ANTENNA BEAMWIDTH (-3 dB)  | deg          | 0.24   | 0.063                 | 0.108   | 0.031                 |
| ANTENNA ELLIPTICITY  | dB           | 1  | 0.8                   | 1   | 0.8                   |
| L.O. REF FREQ STAB @ 1 Hr  | $\Delta f/f$ | $2 \times 10^{-15}$  | $2 \times 10^{-15}$   | $2 \times 10^{-15}$   | $2 \times 10^{-15}$   |
| RCVR AGC DYNAMIC RANGE   | dB           | 125  | 125                   | 120   | 125                   |
| RCVR THRESHOLD @ 2 Blo Hz  | dBm          | -162 in 2 Blo = 10 Hz  | -165 in 2 Blo = 10 Hz | -167 in 2 Blo = 10 Hz   | -165 in 2 Blo = 10 Hz |
| RCVR LOOP BANDWIDTHS   | Hz           | Continuous (0.1 - 200)   |                       | Continuous (0.1 - 200)  |                       |
| RCVR LOOP TYPE (ADAPT, FIX)  | -            | Fix  |                       | Fix   |                       |
| RCVR PLL ORDER(S)  | No.          | 1, 2, 3  |                       | 1, 2, 3   |                       |
| ACQ SWEEP RANGE  | kHz          | FFT - Variable, 1 Hz to Full Band                                  |                       | FFT - Variable, 1 Hz to Full Band                             |                       |
| MIN ACQ SWEEP RATE   | Hz/s         | No Sweep, Use FFT  |                       | Variable Integration Time                                     |                       |
| MAX ACQ SWEEP RATE   | kHz/s        | No Sweep, Use FFT  |                       | Variable Integration Time                                     |                       |
| ACQ SWEEP STEP SIZE  | Hz           | FFT ( $2^{17}$ Points)   |                       | FFT ( $2^{17}$ Points)  |                       |
| PROGRAMMED L.O.  | Yes/No       | Yes  |                       | Yes   |                       |
|  |              |  |                       |   |                       |
|  |              |  |                       |   |                       |
|  |              |  |                       |   |                       |
|  |              |  |                       |   |                       |
| <b>TELEMETRY</b>   |              |  |                       |   |                       |
| MODULATION TYPE(S)   | -            | PCM / PSK / PM; PCM / PM   |                       | PCM / PSK / PM; PCM / PM                                      |                       |
| MODULATION FORMAT(S)   | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S                               |                       | NRZ - L, M, S; Bi - $\phi$ - L, M, S                          |                       |
| MOD INDEX RANGE  | Rad Pk       | 0.17 - 1.57  |                       | 0.17 - 1.57   |                       |
| SUBCARRIER FREQ RANGE  | kHz          | 0 - 2000   |                       | 1 - 2000  |                       |
| SUBCARRIER WAVEFORM  | Sin/Sq       | Sine or Square   |                       | Sine or Square  |                       |
| SYMBOL RATE RANGE  | s/s          | 8 - 2 200 000 <sup>(2)</sup>                                       |                       | 8 - 2 200 000 <sup>(2)</sup>                                  |                       |
| SUBCARRIER/SYM RATE LIMIT  | -            | $> 1.5^{(2)}$  |                       | $> 1.5^{(2)}$   |                       |
| ARRAYS WITH STATIONS   | -            | 34M STD, 34M BWG, 70M  |                       | 34M STD, 34M HEF, 34M BWG, 70M                                |                       |
| CHANNEL DECODING   | Type         | CCSDR R/S, Conv., Concat<br>Conv (r - 1/2, 1/3, 1/4, 1/6 k = 3-15) |                       | CCSDS R/S, Conv., Concat<br>Conv (r-1/2,1/3,1/4,1/6 k = 3-15) |                       |
| DATA FORMAT  | -            | CCSDS Transfer Frame   |                       | CCSDS Transfer Frame  |                       |
|  |              |  |                       |   |                       |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. GTS ONLY |              |  |                       |   |                       |

6445-4355

**CCSDS HISTORICAL DOCUMENT**  
**NASA DEEP SPACE NETWORK**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION   |   |
|--|--------------|---|---|
|  |              | 34M HEF SUBNETWORK  | 70M SUBNETWORK  |
| <b>GENERAL</b>   |              |   |   |
| STATION DESIGNATION  | -            | DSS 15, DSS 45, DSS 65  | DSS 14, DSS 43, DSS 63  |
| LOCATION(S)  | -            | USA, Australia, Spain   | USA, Australia, Spain   |
| DIAMETER   | m            | 34  | 70  |
| <b>FREQUENCIES</b>   |              |   |   |
| TRANSMIT FREQUENCIES   | MHz          | 7145 - 7190   | 2090 - 2094, 2110 - 2120  |
| RECEIVE FREQUENCIES  | MHz          | 2200 - 2300, 8400 - 8500  | 2200 - 2300, 8400 - 8500  |
| TURNAROUND FREQ RATIO  | -            | 240 / 749, 880 / 749  | 240 / 221, 880 / 221  |
| <b>DOPPLER</b>   |              |   |   |
| COHERENT/NON-COHERENT  | -            | 1-Way, 2-Way / 3-Way Coherent and Non-Coherent                              | 1-Way, 2-Way / 3-Way Coherent and Non-Coherent                              |
| COUNTER RESOLUTION   | Cycles       | $2^{-10}$   | $2 \times 10^{-10}$   |
| MAX DOPPLER FREQ SHIFT   | MHz          | $\pm 33$  | $\pm 33$  |
| DOPPLER BIAS FREQ  | MHz          | $\pm 1$   | $\pm 1$   |
| DRIFT  | $\Delta f/f$ | $< 8 \times 10^{-14}$ @ 12 hrs.   | $< 3 \times 10^{-14}$ @ 12 hrs  |
| OUTPUT EQUATION  | -            | $(f_{rcv} - f_{xmit} \times \text{Turn-Around Ratio}) + f_{bias}$           | $(f_{xmit} \times \text{Turn-Around Ratio} - f_{rcv}) + f_{bias}$           |
| DIRECTION INDICATOR  | -            | $+ \Delta f = + \Delta r$   | $+ \Delta f = + \Delta r$   |
| <b>RANGING</b>   |              |   |   |
| COHERENT/NON-COHERENT  | -            | 2 - 3-Way Coherent  | 2 - 3-Way Coherent  |
| RANGE CODE WAVEFORM  | Sin/Sq       | Square  | Square  |
| EARTH STATION MOD INDEX  | Rad Pk       | 0.1 - 1.6   | 0.1 - 1.6   |
| RANGE CODE FREQ RATIO  | -            | 2:1   | 2:1   |
| MAJOR CODE FREQ(S)   | kHz          | ~1 MHz to 16 kHz in Steps of 2  | ~1 MHz to 16 kHz in Steps of 2  |
| MINOR CODE FREQ(S)   | kHz          | f (Major Code) / 2 to -1 Hz in Steps of 2<br>16 kHz and Below on Major Code | f (Major Code) / 2 to -1 Hz in Steps of 2<br>16 kHz and Below on Major Code |
| MIN RECEIVED CARRIER SNR   | dB           | 10  | 10  |
| MIN REQ CODE PWR/No  | dB-Hz        | -15   | -10   |
| CODE INTEGRATION TIME  | s            | Depending on Pr / No and Desired Accuracy                                   | Depending on Pr / No and Desired Accuracy                                   |
| ACQUISITION SEQUENCE   | -            | Sequential; Major Code First  | Sequential; Major Code First  |
| RANGE DATA UNITS   | -            | 1 RU ~ 0.95 ns  | 1 RU ~ 0.95 ns  |
| RANGE QUANTIZATION   | -            | 1 RU  | 1 RU  |
| ACCURACY (STRONG SIGNAL)   | m            | 2 (S), 1 (X)  | 2 (S), 1 (X)  |
| MAX UNAMBIGUOUS RANGE  | km           | 305 000   | 305 000   |
| TRANSPONDER BW   | MHz          | > 3.3   | > 3.3   |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> |              |   |   |

6445-4356

**CCSDS HISTORICAL DOCUMENT**  
**NASA DEEP SPACE NETWORK**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS   | UNITS         | SUBNETWORK OR STATION                |                |                                      |                |
|---|---------------|--------------------------------------|----------------|--------------------------------------|----------------|
|   |               | 34M HEF SUBNETWORK                   |                | 70M SUBNETWORK                       |                |
| <b>GENERAL</b>  |               |                                      |                |                                      |                |
| STATION DESIGNATION   | -             | DSS 15, DSS 45, DSS 65               |                | DSS 14, DSS 43, DSS 63               |                |
| LOCATION(S)   | -             | USA, Australia, Spain                |                | USA, Australia, Spain                |                |
| DIAMETER  | m             | 34                                   |                | 70                                   |                |
| <b>FREQUENCY STD</b>  |               |                                      |                |                                      |                |
| STANDARD TYPE   | Name          | Hydrogen Maser                       |                | Hydrogen Maser                       |                |
| STANDARD MFG  | Name          | SAO VLG-11 / VLG-10                  |                | SAO VLG - 11 / VLG - 10              |                |
| STABILITY AT:   |               | <b>Allan Deviation</b>               |                | <b>Allan Deviation</b>               |                |
| 1 - SECOND  | $\Delta f/f$  | $2 \times 10^{-13}$                  |                | $2 \times 10^{-13}$                  |                |
| 1 - HOUR  | $\Delta f/f$  | $1.5 \times 10^{-15}$                |                | $1.5 \times 10^{-15}$                |                |
| 1 - DAY (24 HOURS)  | $\Delta f/f$  | $4 \times 10^{-15}$                  |                | $5 \times 10^{-15}$                  |                |
| 1 - MONTH   | $\Delta f/f$  | (1)                                  |                | (1)                                  |                |
| REF FREQS PHASE NOISE   | $S_{\phi}(f)$ | <b>5 MHz</b>                         | <b>100 MHz</b> | <b>5 MHz</b>                         | <b>100 MHz</b> |
| 1 Hz OFFSET   | dBc/Hz        | (1)                                  | (1)            | (1)                                  | (1)            |
| 10 Hz OFFSET  | dBc/Hz        | (1)                                  | -103           | (1)                                  | -103           |
| 100 Hz OFFSET   | dBc/Hz        | (1)                                  | -115           | (1)                                  | -115           |
| 1000 Hz OFFSET  | dBc/Hz        | (1)                                  | -115           | (1)                                  | -115           |
| REF FREQS AVAILABLE   | MHz           | 100                                  |                | 100                                  |                |
| MAX STA-TO-STA OFFSET   | Hz            | Coherent to SPC 10, 40, 60           |                | Coherent to SPC 10, 40, 60           |                |
|   |               |                                      |                |                                      |                |
|   |               |                                      |                |                                      |                |
|   |               |                                      |                |                                      |                |
| <b>TIMING SYSTEM</b>  |               |                                      |                |                                      |                |
| MASTER REFERENCE AGENCY   | Name          | NIST                                 |                | NIST                                 |                |
| REFERENCE TIME  | Name          | UTC                                  |                | UTC                                  |                |
| TIME CODE EPOCH   | Yr            | 1 January 1958                       |                | 1 January 1958                       |                |
| TIME CODES AVAILABLE  | CCSDS Codes   | ASCII Serial, 42-bit BCD, 36-bit BIN |                | ASCII Serial, 42-bit BCD, 36-bit BIN |                |
| MAX TIME RESOLUTION   | s             | $1 \times 10^{-3}$                   |                | $1 \times 10^{-3}$                   |                |
| TIME TRANSFER METHOD  | Name          | Coherent to SPC 10, 40, 60           |                | Coherent to SPC 10, 40, 60           |                |
| MAX TRANS ERROR REF   | $\mu$ -sec    | $\pm 20$                             |                | $\pm 20$                             |                |
| MAX OFFSET FROM REF   | $\mu$ -sec    | $\pm 20$                             |                | $\pm 21$                             |                |
| MAX OFFSET MEAS ERROR   | $\mu$ -sec    | $\pm 0.1$                            |                | $\pm 0.1$                            |                |
| MAX STA-TO-STA OFFSET   | $\mu$ -sec    | $\pm 0.1$                            |                | 10                                   |                |
| TIMING SIGNALS AVAILABLE  | pulse/s       | 1, 10, 100, 1K                       |                | 1, 10, 100, 1K                       |                |
|   |               |                                      |                |                                      |                |
|   |               |                                      |                |                                      |                |
|   |               |                                      |                |                                      |                |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> <p>4. MEASURED BY THE AGENCY</p> |               |                                      |                |                                      |                |

CCSDS HISTORICAL DOCUMENT  
**NASA DEEP SPACE NETWORK**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION                 |                                       |
|---|--------------------|---------------------------------------|---------------------------------------|
|   |                    | 34M HEF SUBNETWORK                    | 70M SUBNETWORK                        |
| <b>GENERAL</b>  |                    |                                       |                                       |
| STATION DESIGNATION   | -                  | DSS 15, DSS 45, DSS 65                | DSS 14, DSS 43, DSS 63                |
| LOCATION(S)   | -                  | USA, Australia, Spain                 | USA, Australia, Spain                 |
| DIAMETER  | m                  | 34                                    | 70                                    |
| <b>GEOGRAPHICAL</b>   |                    |                                       |                                       |
| LOCATION, COUNTRY/STATE   | Name               | USA, Australia, Spain                 | USA, Australia, Spain                 |
| LOCATION, CITY  | Name               | Goldstone, Canberra, Madrid           | Goldstone, Canberra, Madrid           |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 243, 06, 46; 148, 58, 40; 355, 44, 55 | 243, 06, 38; 148, 58, 53; 355, 45, 07 |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 35, 25, 19; -35, 23, 54; 40, 25, 38   | 35, 25, 33; -35, 24, 09; 40, 25, 52   |
| REFERENCE FRAME   | Name               | ITRF 93                               | ITRF 93                               |
| EPOCH   | Date               | 1993                                  | 1993                                  |
| HEIGHT (site 1/site 2/site 3)   | m-msl              | 974, 675, 835                         | 1002, 690, 866                        |
| <b>MECHANICAL</b>   |                    |                                       |                                       |
| TYPE OF MOUNT   | -                  | Az - El                               | Az - El                               |
| AZIMUTH LIMITATIONS   | -                  | Keyhole Zenith                        | Keyhole, Zenith                       |
| TRACKING SPEED RANGE  | deg/s              | 0.001 - 0.4                           | 0.0001 - 0.25                         |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 0.4                                   | 0.2                                   |
| TYPE OF POINTING  | Type               | Conscan, Predicts                     | Conscan, Predicts                     |
| POINTING ACCURACY   | deg                | 0.01                                  | 0.005                                 |
| MIN TRANSMIT ELEV ANGLE   | deg                | 10.4, 10.5, 10.3                      | 6 (Low Power); 10.2 (High Power)      |
| MIN RECEIVE ELEV ANGLE  | deg                | 6                                     | 6                                     |
| <b>SUPPORT</b>  |                    |                                       |                                       |
| TRANSMIT FREQ BAND(S)   | GHz                | 7 (B)                                 | 2 (B)                                 |
| RECEIVE FREQ BAND(S)  | GHz                | 2 (A&B), 8 (B)                        | 2 (A&B), 8 (B)                        |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                                   | (1)                                   |
| MISSION CATEGORIES  | Cat                | A & B                                 | A & B                                 |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                                       |                                       |

6445-4358

**CCSDS HISTORICAL DOCUMENT**  
**NASA / GSFC TRACKING SYSTEM**  
**EARTH-TO-SPACE LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION             |                              |
|--|--------------|-----------------------------------|------------------------------|
|  |              | BERMUDA                           | MERRITT ISLAND               |
| <b>GENERAL</b>   |              |                                   |                              |
| STATION DESIGNATION  | -            | Bermuda (BDA)                     | Merritt Island (MIL)         |
| LOCATION(S)  | -            | Bermuda                           | Titusville, Fl. USA          |
| DIAMETER   | m            | 9 (2)                             | 9 (2)                        |
| <b>TRANSMIT</b>  |              |                                   |                              |
| FREQUENCIES  | MHz          | 2025 - 2120                       | 2025 - 2120                  |
| FREQUENCY RESOLUTION   | Hz           | 100                               | 100                          |
| RF FREQ STABILITY @ 1 Hr   | $\Delta f/f$ | 1 PPM                             | $\pm 5 \times 10^{-12}$      |
| TRANSMIT POWER 1   | W            | 10 000                            | 10 000                       |
| EIRP RANGE 1   | dBW          | 83                                | 83                           |
| TRANSMIT POWER 2   | W            | None                              | 200                          |
| EIRP RANGE 2   | dBW          | None                              | 63                           |
| POLARIZATION   | -            | RCP or LCP                        | RCP or LCP                   |
| ANTENNA GAIN   | dBi          | 44                                | 44                           |
| ANTENNA BEAMWIDTH (-3 dB)  | deg          | 1                                 | 1                            |
| ANTENNA ELLIPTICITY  | dB           | (1)                               | (1)                          |
| RF FREQ SWEEP RANGE  | kHz          | 600 $\pm$ 300                     | 600                          |
| MIN FREQ SWEEP RATE  | Hz/s         | 500                               | 500                          |
| MAX FREQ SWEEP RATE  | kHz/s        | 600                               | 600                          |
| PROGRAMMED UPLINK FREQ   | Yes/No       | (1)                               | No                           |
|  |              |                                   |                              |
|  |              |                                   |                              |
|  |              |                                   |                              |
|  |              |                                   |                              |
|  |              |                                   |                              |
|  |              |                                   |                              |
|  |              |                                   |                              |
| <b>COMMAND</b>   |              |                                   |                              |
| RF CARRIER MOD TYPE  | -            | PM                                | PM, FM, PSK                  |
| RF CARRIER MOD INDEX RNG   | Rad Pk       | 1 - 3                             | 1 - 3 (PM), 1 MHz (FM)       |
| SUBCARRIER FREQUENCY(S)  | Hz           | 2 K, 4 K, 8 K, 16 K               | 2 K, 4 K, 8 K, 16 K          |
| SUBCARRIER STEP SIZE   | Hz           | 2 K, 4 K, 8 K, 16 K               | (1)                          |
| SUBCARRIER FREQ STABILITY  | ppm          | 2 PPM                             | $\pm 5 \times 10^{-12}$      |
| SUBCARRIER WAVEFORM  | Sin/Sq       | Sine                              | Sine                         |
| SUBCARRIER MOD TYPE  | -            | PM                                | PM                           |
| SUBCARRIER/BIT RATE LIMIT  | -            | Subcarrier / 2 ( $2^{1.7}$ )      | Subcarrier / 2 ( $2^{1.7}$ ) |
| BIT RATE RANGE   | b/s          | 125, 250, 500, 1 K, 2 K, 4 K, 8 K | 8 K                          |
| FORMATS AVAILABLE  | -            | PSK, PSK Summed                   | PSK, PSK Summed              |
|  |              |                                   |                              |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |                                   |                              |

6445-4170

CCSDS HISTORICAL DOCUMENT  
**NASA / GSFC TRACKING NETWORK**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION  |  |
|---|--------------|--|--|
|   |              | BERMUDA  | MERRITT ISLAND   |
| <b>GENERAL</b>  |              |  |  |
| STATION DESIGNATION   | -            | Bermuda (BDA)  | Merritt Island (MIL)   |
| LOCATION(S)   | -            | Bermuda  | Titusville, Fl. USA  |
| DIAMETER  | m            | 9 (2)  | 9 (2)  |
| <b>RECEIVE</b>  |              |  |  |
| FREQUENCIES   | MHz          | 2200 - 2300  | 2200 - 2300  |
| FREQUENCY RESOLUTION  | Hz           | 100  | 10 K   |
| ANTENNA GAIN @ 45 deg   | dBi          | 44   | 44   |
| SYS NOISE TEMP @ ZENITH   | K            | 100  | 100  |
| G/T @ 45 deg  | dB           | 24   | 24   |
| POLARIZATION  | -            | RCP and LCP  | RCP and LCP  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 1  | 1  |
| ANTENNA ELLIPTICITY   | dB           | (1)  | (1)  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | 1 PPM  | $\pm 5 \times 10^{-12}$  |
| RCVR AGC DYNAMIC RANGE  | dB           | (1)  | -25 dBm to Threshold   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -154 in 2 Blo = 30 Hz  | -160 in 2 Blo = 10 Hz  |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 600, 300, 1 K, 3 K   | 10, 30, 100, 300, 1 K, 3 K   |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt  | Adapt  |
| RCVR PLL ORDER(S)   | No.          | 2  | 2  |
| ACQ SWEEP RANGE   | kHz          | 600 $\pm$ 300  | 0.6 - 400  |
| MIN ACQ SWEEP RATE  | Hz/s         | 5  | 15   |
| MAX ACQ SWEEP RATE  | kHz/s        | 50   | 100  |
| ACQ SWEEP STEP SIZE   | Hz           | Ramped   | Analog   |
| PROGRAMMED L.O.   | Yes/No       | (1)  | No   |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
| <b>TELEMETRY</b>  |              |  |  |
| MODULATION TYPE(S)  | -            | PCM / PSK / PM, PCM / PSK / FM,<br>PSK / FM, PCM / FM, PCM / PM, FM / FM,<br>PCM / PPDM / FM / PM, PDM / FM / FM | PCM / PSK / PM, PCM / PSK / FM,<br>PSK / FM, PCM / FM, PCM / FM, FM / FM         |
| MODULATION FORMAT(S)  | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S; DBi - $\phi$ - M, S;<br>DM - M, DM - S, RZ                                 | NRZ - L, M, S; Bi - $\phi$ - L, M, S; DBi - $\phi$ - M, S;<br>DM - M, DM - S, RZ |
| MOD INDEX RANGE   | Rad Pk       | 3  | (1)  |
| SUBCARRIER FREQ RANGE   | kHz          | 1 - 2000   | 1 - 2000   |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine or Square   | Sine or Square   |
| SYMBOL RATE RANGE   | s/s          | 0 - 2000   | 0 - 2000   |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)  | Subcarrier / BW < 1000   |
| ARRAYS WITH STATIONS  | -            | (1)  | (1)  |
| CHANNEL DECODING  | Type         | (1)  | (1)  |
| DATA FORMAT   | -            | (1)  | (1)  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |  |  |

6445-4171

**CCSDS HISTORICAL DOCUMENT**  
**NASA / GSFC TRACKING NETWORK**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION  |   |
|--|--------------|--|---|
|  |              | BERMUDA  | MERRITT ISLAND  |
| <b>GENERAL</b>   |              |  |   |
| STATION DESIGNATION  | -            | Bermuda (BDA)  | Merritt Island (MIL)  |
| LOCATION(S)  | -            | Bermuda  | Titusville, Fl. USA   |
| DIAMETER   | m            | 9 (2)  | 9 (2)   |
| <b>RECEIVE</b>   |              |  |   |
| FREQUENCIES  | MHz          | 2200 - 2300  | 2200 - 2300   |
| FREQUENCY RESOLUTION   | Hz           | 100  | 10 K  |
| ANTENNA GAIN @ 45 deg  | dBi          | 44   | 44  |
| SYS NOISE TEMP @ ZENITH  | K            | 100  | 100   |
| G/T @ 45 deg   | dB           | 24   | 24  |
| POLARIZATION   | -            | RCP and LCP  | RCP and LCP   |
| ANTENNA BEAMWIDTH (-3 dB)  | deg          | 1  | 1   |
| ANTENNA ELLIPTICITY  | dB           | (1)  | (1)   |
| L.O. REF FREQ STAB @ 1 Hr  | $\Delta f/f$ | 1 PPM  | $\pm 5 \times 10^{-12}$   |
| RCVR AGC DYNAMIC RANGE   | dB           | (1)  | -25 dBm to Threshold  |
| RCVR THRESHOLD @ 2 Blo Hz  | dBm          | -154 in 2 Blo = 30 Hz  | -160 in 2 Blo = 10 Hz   |
| RCVR LOOP BANDWIDTHS   | Hz           | 30, 600, 300, 1 K, 3 K   | 10, 30, 100, 300, 1 K, 3 K  |
| RCVR LOOP TYPE (ADAPT, FIX)  | -            | Adapt  | Adapt   |
| RCVR PLL ORDER(S)  | No.          | 2  | 2   |
| ACQ SWEEP RANGE  | kHz          | 600 $\pm$ 300  | 0.6 - 400   |
| MIN ACQ SWEEP RATE   | Hz/s         | 5  | 15  |
| MAX ACQ SWEEP RATE   | kHz/s        | 50   | 100   |
| ACQ SWEEP STEP SIZE  | Hz           | Ramped   | Analog  |
| PROGRAMMED L.O.  | Yes/No       | (1)  | No  |
|  |              |  |   |
|  |              |  |   |
|  |              |  |   |
|  |              |  |   |
| <b>TELEMETRY</b>   |              |  |   |
| MODULATION TYPE(S)   | -            | PCM / PSK / PM, PCM / PSK / FM, PSK / FM, PCM / FM, PCM / PM, FM / FM, PCM / PPDM / FM / PM, PDM / FM / FM | PCM / PSK / PM, PCM / PSK / FM, PSK / FM, PCM / FM, PCM / FM, FM / FM         |
| MODULATION FORMAT(S)   | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S; DBi - $\phi$ - M, S; DM - M, DM - S, RZ                              | NRZ - L, M, S; Bi - $\phi$ - L, M, S; DBi - $\phi$ - M, S; DM - M, DM - S, RZ |
| MOD INDEX RANGE  | Rad Pk       | 3  | (1)   |
| SUBCARRIER FREQ RANGE  | kHz          | 1 - 2000   | 1 - 2000  |
| SUBCARRIER WAVEFORM  | Sin/Sq       | Sine or Square   | Sine or Square  |
| SYMBOL RATE RANGE  | s/s          | 0 - 2000   | 0 - 2000  |
| SUBCARRIER/SYM RATE LIMIT  | -            | (1)  | Subcarrier / BW < 1000  |
| ARRAYS WITH STATIONS   | -            | (1)  | (1)   |
| CHANNEL DECODING   | Type         | (1)  | (1)   |
| DATA FORMAT  | -            | (1)  | (1)   |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |  |   |

6445-4171

CCSDS HISTORICAL DOCUMENT  
**NASA / GSFC TRACKING NETWORK**  
RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                        |  |
|---|--------------|--|--|
|   |              | BERMUDA                                      | MERRITT ISLAND                               |
| <b>GENERAL</b>  |              |  |  |
| STATION DESIGNATION   | -            | Bermuda (BDA)                                | Merritt Island (MIL)                         |
| LOCATION(S)   | -            | Bermuda                                      | Titusville, Fl. USA                          |
| DIAMETER  | m            | 9 (2)  | 9 (2)  |
| <b>FREQUENCIES</b>  |              |  |  |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120                                  | 2025 - 2120                                  |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300                                  | 2200 - 2300                                  |
| TURNAROUND FREQ RATIO   | -            | 240 / 221                                    | 240 / 221                                    |
| <b>DOPPLER</b>  |              |  |  |
| COHERENT/NON-COHERENT   | -            | Both Coherent and Non-Coherent               | Both Coherent and Non-Coherent               |
| COUNTER RESOLUTION  | Cycles       | 0.001  | 0.001  |
| MAX DOPPLER FREQ SHIFT  | MHz          | ± 0.23                                       | ± 0.23                                       |
| DOPPLER BIAS FREQ   | MHz          | 60   | 240  |
| DRIFT   | $\Delta f/f$ | (1)  | (1)  |
| OUTPUT EQUATION   | -            | (1)  | (1)  |
| DIRECTION INDICATOR   | -            | (1)  | (1)  |
| <b>RANGING</b>  |              |  |  |
| COHERENT/NON-COHERENT   | -            | Coherent                                     | Coherent                                     |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine   | Sine   |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.2 - 1.5                                    | 0.2 - 1.5                                    |
| RANGE CODE FREQ RATIO   | -            | (1)  | 5:1, 4:1                                     |
| MAJOR CODE FREQ(S)  | kHz          | 500, 100, 10                                 | 500, 100, 20                                 |
| MINOR CODE FREQ(S)  | kHz          | 100, 20, 4 (0.8, 0.16, 0.04, 0.01.4) 4       | 100, 20, 4 (0.8, 0.16, 0.04, 0.01.4) 4       |
| MIN RECEIVED CARRIER SNR  | dB           | (1)  | (1)  |
| MIN REQ CODE PWR/No   | dB-Hz        | (1)  | 10   |
| CODE INTEGRATION TIME   | s            | 15, 25, 75                                   | 15, 25, 75                                   |
| ACQUISITION SEQUENCE  | -            | Major Tone, then High to Low for Minor Tones | Major Tone, then High to Low for Minor Tones |
| RANGE DATA UNITS  | -            | Nanosecond                                   | Nanosecond                                   |
| RANGE QUANTIZATION  | -            | 32 bits                                      | 32 bits                                      |
| ACCURACY (STRONG SIGNAL)  | m            | 1  | 1  |
| MAX UNAMBIGUOUS RANGE   | km           | 644 000 (One Way)                            | 644 000 (One Way)                            |
| TRANSPONDER BW  | MHz          | (1)  | x2 Major Tone                                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |  |  |

6445-4172

**CCSDS HISTORICAL DOCUMENT**  
**NASA / GSFC TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                |  |                |
|--|---------------|-----------------------|----------------|--|----------------|
|  |               | BERMUDA               |                | MERRITT ISLAND                                 |                |
| <b>GENERAL</b>   |               |                       |                |  |                |
| STATION DESIGNATION  | -             | Bermuda (BDA)         |                | Merritt Island (MIL)                           |                |
| LOCATION(S)  | -             | Bermuda               |                | Titusville, Fl. USA                            |                |
| DIAMETER   | m             | 9 (2)                 |                | 9 (2)  |                |
| <b>FREQUENCY STD</b>   |               |                       |                |  |                |
| STANDARD TYPE  | Name          | (1)                   |                | Cesium 5061A/B                                 |                |
| STANDARD MFG   | Name          | (1)                   |                | H.P.   |                |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Drift</b>   | <b>Allan Variance</b>                          | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | (1)                   |                | $+ 1 \times 10^{-11}$                          |                |
| 1 - HOUR   | $\Delta f/f$  | (1)                   |                | (1)  |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                   |                | (1)  |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                   |                | (1)  |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b> | <b>5 MHz</b>                                   | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                   |                | (1)  |                |
| 10 Hz OFFSET   | dBc/Hz        | (1)                   |                | (1)  |                |
| 100 Hz OFFSET  | dBc/Hz        | (1)                   |                | (1)  |                |
| 1000 Hz OFFSET   | dBc/Hz        | (1)                   |                | (1)  |                |
| REF FREQS AVAILABLE  | MHz           | (1)                   |                | 0.1, 1.5                                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                   |                | (1)  |                |
|  |               |                       |                |  |                |
|  |               |                       |                |  |                |
|  |               |                       |                |  |                |
| <b>TIMING SYSTEM</b>   |               |                       |                |  |                |
| MASTER REFERENCE AGENCY  | Name          | (1)                   |                | USNO   |                |
| REFERENCE TIME   | Name          | (1)                   |                | (1)  |                |
| TIME CODE EPOCH  | Yr            | (1)                   |                | (1)  |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | (1)                   |                | NASA 36, 2 & 20-BIT MOD/DC BCD, SDT & IRIG - B |                |
| MAX TIME RESOLUTION  | s             | (1)                   |                | 50 msec  |                |
| TIME TRANSFER METHOD   | Name          | (1)                   |                | LORAN - C                                      |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | (1)                   |                | (1)  |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | (1)                   |                | 10   |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | (1)                   |                | (1)  |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                   |                | (1)  |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | (1)                   |                | 1, 10, 100, 1 K, 10 K, 100, 1M                 |                |
|  |               |                       |                |  |                |
|  |               |                       |                |  |                |
|  |               |                       |                |  |                |
|  |               |                       |                |  |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                |  |                |

6445-4173

CCSDS HISTORICAL DOCUMENT  
**NASA / GSFC TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS  | UNITS              | SUBNETWORK OR STATION     |               |                           |               |
|--|--------------------|---------------------------|---------------|---------------------------|---------------|
|  |                    | BERMUDA                   |               | MERRITT ISLAND            |               |
| <b>GENERAL</b>   |                    |                           |               |                           |               |
| STATION DESIGNATION  | -                  | Bermuda (BDA)             |               | Merritt Island (MIL)      |               |
| LOCATION(S)  | -                  | Bermuda                   |               | Titusville, Fl. USA       |               |
| DIAMETER   | m                  | 9 (2)                     |               | 9 (2)                     |               |
| <b>GEOGRAPHICAL</b>  |                    |                           |               |                           |               |
| LOCATION, COUNTRY/STATE  | Name               | Bermuda                   |               | Florida, USA              |               |
| LOCATION, CITY   | Name               | (1)                       |               | Titusville                |               |
| LONGITUDE (site 1/site 2/site 3)   | d, m, s            | 295, 20, 31.0             | 295, 20, 27.8 | 279, 18, 25.3             | 279, 18, 23.1 |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 32, 21, 04.4              | 32, 21, 04.1  | 28, 30, 28.3              | 28, 30, 27.3  |
|  |                    |                           |               |                           |               |
|  |                    |                           |               |                           |               |
|  |                    |                           |               |                           |               |
|  |                    |                           |               |                           |               |
| <b>MECHANICAL</b>  |                    |                           |               |                           |               |
| TYPE OF MOUNT  | -                  | X - Y                     |               | X - Y                     |               |
| AZIMUTH LIMITATIONS  | -                  | Keyhole E, W              |               | Keyhole E, W              |               |
| TRACKING SPEED RANGE   | deg/s              | 0.002 - 4                 |               | 0.002 - 4                 |               |
| MAX TRACK ACCELERATION   | deg/s <sup>2</sup> | 5                         |               | 5                         |               |
| TYPE OF POINTING   | Type               | Autotrack, Predict, Slave |               | Autotrack, Predict, Slave |               |
| POINTING ACCURACY  | deg                | 0.015                     |               | 0.015                     |               |
| MIN TRANSMIT ELEV ANGLE  | deg                | No Restrictions           |               | No Restrictions           |               |
| MIN RECEIVE ELEV ANGLE   | deg                | No Restrictions           |               | No Restrictions           |               |
|  |                    |                           |               |                           |               |
|  |                    |                           |               |                           |               |
|  |                    |                           |               |                           |               |
|  |                    |                           |               |                           |               |
| <b>SUPPORT</b>   |                    |                           |               |                           |               |
| TRANSMIT FREQ BAND(S)  | GHz                | 2                         |               | 2.025 - 2.12              |               |
| RECEIVE FREQ BAND(S)   | GHz                | 2                         |               | 2.2 - 2.3                 |               |
| ACQ AID FREQ BAND(S)   | GHz                | (1)                       |               | (1)                       |               |
| MISSION CATEGORIES   | Cat                | A                         |               | A                         |               |
|  |                    |                           |               |                           |               |
|  |                    |                           |               |                           |               |
|  |                    |                           |               |                           |               |
|  |                    |                           |               |                           |               |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETTIC COORDINATES |                    |                           |               |                           |               |



CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                     |   |
|-----------------------------|--------------|---|---|
|                             |              | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS |
| <b>GENERAL</b>              |              |   |   |
| STATION DESIGNATION         | -            | Mobile 8-Foot No. 1                       | Mobile 8-Foot No. 2                       |
| LOCATION(S)                 | -            | Location Varies                           | Location Varies                           |
| DIAMETER                    | m            | 2.4                                       | 2.4                                       |
| <b>RECEIVE</b>              |              |   |   |
| FREQUENCIES                 | MHz          | 1435 - 1535, 1670 - 1720, 2200 - 2400     | 1435 - 1535, 1670 - 1720, 2200 - 2400     |
| FREQUENCY RESOLUTION        | Hz           | 50 000                                    | 50 000                                    |
| ANTENNA GAIN @ 45 deg       | dBi          | 28.8 (L1), 30.0 (L2), 32.5 (S)            | 28.8 (L1), 30.0 (L2), 32.5 (S)            |
| SYS NOISE TEMP @ ZENITH     | K            | 350, 350, 350                             | 350, 350, 350                             |
| G/T @ 45 deg                | dB           | 3.3 (L1), 4.5 (L2), 7.0 (S)               | 3.3 (L1), 4.5 (L2), 7.0 (S)               |
| POLARIZATION                | -            | RHC, LHC                                  | RHC, LHC                                  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 5.1 (L), 3.9 (S)                          | 5.1 (L), 3.9 (S)                          |
| ANTENNA ELLIPTICITY         | dB           | (1)                                       | (1)                                       |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-3}$                    | $\pm 1 \times 10^{-3}$                    |
| RCVR AGC DYNAMIC RANGE      | dB           | 130                                       | 130                                       |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | 30, 100, 300, 1 K, 3 K                    | 30, 100, 300, 1 K, 3 K                    |
| RCVR LOOP BANDWIDTHS        | Hz           | -144 in 2 Blo = 30 Hz                     | -144 in 2 Blo = 30 Hz                     |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                                     | Adapt                                     |
| RCVR PLL ORDER(S)           | No.          | 2   | 2   |
| ACQ SWEEP RANGE             | kHz          | $\pm 250$                                 | $\pm 250$                                 |
| MIN ACQ SWEEP RATE          | Hz/s         | Depends on Loop BW                        | Depends on Loop BW                        |
| MAX ACQ SWEEP RATE          | kHz/s        | Depends on BW                             | Depends on BW                             |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous                                | Continuous                                |
| PROGRAMMED L.O.             | Yes/No       | No  | No  |
|                             |              |   |   |
|                             |              |   |   |
|                             |              |   |   |
| <b>TELEMETRY</b>            |              |   |   |
| MODULATION TYPE(S)          | -            | BPSK, PM, FM, AM                          | BPSK, PM, FM, AM                          |
| MODULATION FORMAT(S)        | -            | All IRIG's                                | All IRIG's                                |
| MOD INDEX RANGE             | Rad Pk       | 0.2 - 2.8                                 | 0.2 - 2.8                                 |
| SUBCARRIER FREQ RANGE       | kHz          | 1 - 2000                                  | 1 - 2000                                  |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine                                      | Sine                                      |
| SYMBOL RATE RANGE           | s/s          | 4 - 4 000 000                             | 4 - 4 000 000                             |
| SUBCARRIER/SYM RATE LIMIT   | -            | > 1.5                                     | > 1.5                                     |
| ARRAYS WITH STATIONS        | -            | None                                      | None                                      |
| CHANNEL DECODING            | Type         | (1)                                       | (1)                                       |
| DATA FORMAT                 | -            | (1)                                       | (1)                                       |
|                             |              |   |   |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

6445-4551

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                     |   |
|---|--------------|---|---|
|   |              | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | Mobile 8-Foot No. 1                       | Mobile 8-Foot No. 2                       |
| LOCATION(S)   | -            | Location Varies                           | Location Varies                           |
| DIAMETER  | m            | 2.4                                       | 2.4                                       |
| <b>FREQUENCIES</b>  |              |   |   |
| TRANSMIT FREQUENCIES  | MHz          | (1)                                       | (1)                                       |
| RECEIVE FREQUENCIES   | MHz          | 1435 - 1535, 1670 - 1720, 2200 - 2400     | 1435 - 1535, 1670 - 1720, 2200 - 2400     |
| TURNAROUND FREQ RATIO   | -            |   |   |
| <b>DOPPLER</b>  |              |   |   |
|   |              | (1)                                       | (1)                                       |
| COHERENT/NON-COHERENT   | -            |   |   |
| COUNTER RESOLUTION  | Cycles       |   |   |
| MAX DOPPLER FREQ SHIFT  | MHz          |   |   |
| DOPPLER BIAS FREQ   | MHz          |   |   |
| DRIFT   | $\Delta f/f$ |   |   |
| OUTPUT EQUATION   | -            |   |   |
| DIRECTION INDICATOR   | -            |   |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| <b>RANGING</b>  |              |   |   |
|   |              | (1)                                       | (1)                                       |
| COHERENT/NON-COHERENT   | -            |   |   |
| RANGE CODE WAVEFORM   | Sin/Sq       |   |   |
| EARTH STATION MOD INDEX   | Rad Pk       |   |   |
| RANGE CODE FREQ RATIO   | -            |   |   |
| MAJOR CODE FREQ(S)  | kHz          |   |   |
| MINOR CODE FREQ(S)  | kHz          |   |   |
| MIN RECEIVED CARRIER SNR  | dB           |   |   |
| MIN REQ CODE PWR/No   | dB-Hz        |   |   |
| CODE INTEGRATION TIME   | s            |   |   |
| ACQUISITION SEQUENCE  | -            |   |   |
| RANGE DATA UNITS  | -            |   |   |
| RANGE QUANTIZATION  | -            |   |   |
| ACCURACY (STRONG SIGNAL)  | m            |   |   |
| MAX UNAMBIGUOUS RANGE   | km           |   |   |
| TRANSPONDER BW  | MHz          |   |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |   |   |

6445-4552

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                                 |                     |   |                     |
|--|---------------|---|---------------------|---|---------------------|
|  |               | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS             |                     | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS             |                     |
| <b>GENERAL</b>   |               |   |                     |   |                     |
| STATION DESIGNATION  | -             | Mobile 8-Foot No. 1                                   |                     | Mobile 8-Foot No. 2                                   |                     |
| LOCATION(S)  | -             | Location Varies                                       |                     | Location Varies                                       |                     |
| DIAMETER   | m             | 2.4   |                     | 2.4   |                     |
| <b>FREQUENCY STD</b>   |               |   |                     |   |                     |
| STANDARD TYPE  | Name          | Crystal Oscillator                                    |                     | Crystal Oscillator                                    |                     |
| STANDARD MFG   | Name          | Datum 9390  |                     | Datum 9390  |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>                                 | <b>Drift</b>        | <b>Allan Variance</b>                                 | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - HOUR   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)   | $2 \times 10^{-12}$ | (1)   | $2 \times 10^{-12}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)   | $8 \times 10^{-9}$  | (1)   | $8 \times 10^{-9}$  |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>  | <b>100 MHz</b>      | <b>5 MHz</b>  | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | (1)   | (1)                 | (1)   | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | -125  | (1)                 | -125  | (1)                 |
| 100 Hz OFFSET  | dBc/Hz        | -155  | (1)                 | -155  | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz        | -155  | (1)                 | -155  | (1)                 |
| REF FREQS AVAILABLE  | MHz           | 0.000001, 0.00001, 0.001, 5, 10                       |                     | 0.000001, 0.00001, 0.001, 5, 10                       |                     |
| MAX STA-TO-STA OFFSET  | Hz            | (1)   |                     | (1)   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
| <b>TIMING SYSTEM</b>   |               |   |                     |   |                     |
| MASTER REFERENCE AGENCY  | Name          | GPS   |                     | GPS   |                     |
| REFERENCE TIME   | Name          | GPS   |                     | GPS   |                     |
| TIME CODE EPOCH  | Yr            | GPS   |                     | GPS   |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$                                    |                     | $1 \times 10^{-6}$                                    |                     |
| TIME TRANSFER METHOD   | Name          | GPS   |                     | GPS   |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 1000, 1 000 000, 5, 000 000                    |                     | 1, 10, 1000, 1 000 000, 5, 000 000                    |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |   |                     |   |                     |

6445-4553

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION                     |   |
|---|--------------------|---|---|
|   |                    | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS |
| <b>GENERAL</b>  |                    |   |   |
| STATION DESIGNATION   | -                  | Mobile 8-Foot No. 1                       | Mobile 8-Foot No. 2                       |
| LOCATION(S)   | -                  | Location Varies                           | Location Varies                           |
| DIAMETER  | m                  | 2.4                                       | 2.4                                       |
| <b>GEOGRAPHICAL</b>   |                    |   |   |
| LOCATION, COUNTRY/STATE   | Name               | Location Varies                           | Location Varies                           |
| LOCATION, CITY  | Name               | Location Varies                           | Location Varies                           |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | Location Varies                           | Location Varies                           |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | Location Varies                           | Location Varies                           |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
| <b>MECHANICAL</b>   |                    |   |   |
| TYPE OF MOUNT   | -                  | Ei - Az                                   | Ei - Az                                   |
| AZIMUTH LIMITATIONS   | -                  | Keyhole Zenith                            | Keyhole Zenith                            |
| TRACKING SPEED RANGE  | deg/s              | 0.01 - 20                                 | 0.01 - 20                                 |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 20  | 20  |
| TYPE OF POINTING  | Type               | Autotrack / Slave                         | Autotrack / Slave                         |
| POINTING ACCURACY   | deg                | 0.25                                      | 0.25                                      |
| MIN TRANSMIT ELEV ANGLE   | deg                | (1)                                       | (1)                                       |
| MIN RECEIVE ELEV ANGLE  | deg                | - 8                                       | - 8                                       |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
| <b>SUPPORT</b>  |                    |   |   |
| TRANSMIT FREQ BAND(S)   | GHz                | None                                      | None                                      |
| RECEIVE FREQ BAND(S)  | GHz                | 1.435 - 1.535, 1.67 - 1.72, 2.2 - 2.4     | 1.435 - 1.535, 1.67 - 1.72, 2.2 - 2.4     |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                                       | (1)                                       |
| MISSION CATEGORIES  | Cat                | A   | A   |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |   |   |

6445-4554

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                  |  |
|---|--------------|--|--|
|   |              | WALLOPS FLIGHT FACILITY MOBILE SYSTEMS | WALLOPS FLIGHT FACILITY MOBILE SYSTEMS   |
| <b>GENERAL</b>  |              |  |  |
| STATION DESIGNATION   | -            | Mobile 10-Foot No. 1                   | Mobile 10-Foot No. 2   |
| LOCATION(S)   | -            | Location Varies                        | Currently Thule, Greenland   |
| DIAMETER  | m            | 3                                      | 3  |
| <b>TRANSMIT</b>   |              | None                                   |  |
| FREQUENCIES   | MHz          |  | 2025 - 2120  |
| FREQUENCY RESOLUTION  | Hz           |  | 100  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ |  | $\pm 1$ Per °C Per 24 hrs  |
| TRANSMIT POWER 1  | W            |  | 200  |
| EIRP RANGE 1  | dBW          |  | 4.2  |
| TRANSMIT POWER 2  | W            |  | None   |
| EIRP RANGE 2  | dBW          |  | None   |
| POLARIZATION  | -            |  | RHC, LHC   |
| ANTENNA GAIN  | dBi          |  | 33.7   |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          |  | 3.37   |
| ANTENNA ELLIPTICITY   | dB           |  | (1)  |
| RF FREQ SWEEP RANGE   | kHz          |  | $\pm 900$  |
| MIN FREQ SWEEP RATE   | Hz/s         |  | 1  |
| MAX FREQ SWEEP RATE   | kHz/s        |  | 12   |
| PROGRAMMED UPLINK FREQ  | Yes/No       |  | (1)  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
| <b>COMMAND</b>  |              | None                                   |  |
| RF CARRIER MOD TYPE   | -            |  | PM, FM, PSK  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       |  | Rate DC-10 MHz; Dev 0 - 1.5 rad (PM); Rate 20 Hz - 12 MHz;<br>Dev 50 kHz - 50 MHz (FM); Rate DC-150 MHz;<br>Dev 90 deg PSK |
| SUBCARRIER FREQUENCY(S)   | Hz           |  | 16 000   |
| SUBCARRIER STEP SIZE  | Hz           |  | (1)  |
| SUBCARRIER FREQ STABILITY   | ppm          |  | $\pm 1$  |
| SUBCARRIER WAVEFORM   | Sin/Sq       |  | Sine, Square   |
| SUBCARRIER MOD TYPE   | -            |  | BPSK   |
| SUBCARRIER/BIT RATE LIMIT   | -            |  | > 8  |
| BIT RATE RANGE  | b/s          |  | 125, 250, 500, 1 K, 2 K  |
| FORMATS AVAILABLE   | -            |  | NRZ - L, M, S; Bi - $\phi$ - L, M, S   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |  |  |

6445-4526

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                     |   |
|-----------------------------|--------------|---|---|
|                             |              | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS |
| <b>GENERAL</b>              |              |   |   |
| STATION DESIGNATION         | -            | Mobile 10-Foot No. 1                      | Mobile 10-Foot No. 2                      |
| LOCATION(S)                 | -            | Location Varies                           | Currently Thule, Greenland                |
| DIAMETER                    | m            | 3   | 3   |
| <b>RECEIVE</b>              |              |   |   |
| FREQUENCIES                 | MHz          | 1435 - 1535, 1670 - 1720, 2200 - 2400     |   |
| FREQUENCY RESOLUTION        | Hz           | 50 000                                    |   |
| ANTENNA GAIN @ 45 deg       | dBi          | 34.4 (S)                                  |   |
| SYS NOISE TEMP @ ZENITH     | K            | 435                                       |   |
| G/T @ 45 deg                | dB           | 8.0 (S)                                   |   |
| POLARIZATION                | -            | RHC, LHC                                  |   |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 3.1 (S)                                   |   |
| ANTENNA ELLIPTICITY         | dB           | (1)                                       |   |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-3}$                    |   |
| RCVR AGC DYNAMIC RANGE      | dB           | 130                                       |   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | 30, 100, 300, 1 K, 3 K                    |   |
| RCVR LOOP BANDWIDTHS        | Hz           | -144 in 2 Blo = 30 Hz                     |   |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                                     |   |
| RCVR PLL ORDER(S)           | No.          | 2   |   |
| ACQ SWEEP RANGE             | kHz          | $\pm 250$                                 |   |
| MIN ACQ SWEEP RATE          | Hz/s         | Depends on Loop BW                        |   |
| MAX ACQ SWEEP RATE          | kHz/s        | Depends on Loop BW                        |   |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous                                |   |
| PROGRAMMED L.O.             | Yes/No       | No  |   |
|                             |              |   |   |
|                             |              |   |   |
|                             |              |   |   |
| <b>TELEMETRY</b>            |              |   |   |
| MODULATION TYPE(S)          | -            | BPSK, PM, FM, AM                          |   |
| MODULATION FORMAT(S)        | -            | All IRIG's                                |   |
| MOD INDEX RANGE             | Rad Pk       | 0.2 - 2.8                                 |   |
| SUBCARRIER FREQ RANGE       | kHz          | 1 - 2000                                  |   |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine                                      |   |
| SYMBOL RATE RANGE           | s/s          | 4 - 4 000 000                             |   |
| SUBCARRIER/SYM RATE LIMIT   | -            | > 1.5                                     |   |
| ARRAYS WITH STATIONS        | -            | None                                      |   |
| CHANNEL DECODING            | Type         | (1)                                       |   |
| DATA FORMAT                 | -            | (1)                                       |   |
|                             |              |   |   |
|                             |              |   |   |
|                             |              |   |   |
|                             |              | None                                      |   |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

6445-4527

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                     |   |
|---|--------------|---|---|
|   |              | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS   |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | Mobile 10-Foot No. 1                      | Mobile 10-Foot No. 2  |
| LOCATION(S)   | -            | Location Varies                           | Currently Thule Greenland   |
| DIAMETER  | m            | 3   | 3   |
| <b>FREQUENCIES</b>  |              |   |   |
| TRANSMIT FREQUENCIES  | MHz          | (1)                                       | 2025 - 2120   |
| RECEIVE FREQUENCIES   | MHz          | 1435 - 1535, 1670 - 1720, 2200 - 2400     | (1)   |
| TURNAROUND FREQ RATIO   | -            |   |   |
| <b>DOPPLER</b>  |              |   |   |
| COHERENT/NON-COHERENT   | -            | None                                      | Coherent & Non-Coherent 2-Way with USAF Antenna   |
| COUNTER RESOLUTION  | Cycles       |   | 0.01  |
| MAX DOPPLER FREQ SHIFT  | MHz          |   | ± 250   |
| DOPPLER BIAS FREQ   | MHz          |   | 0.240   |
| DRIFT   | $\Delta f/f$ |   | $4 \times 10^{-11}$ @ 0.1 sec   |
| OUTPUT EQUATION   | -            |   | $1000 [f \text{ (transmit)} \times (240 / 221) - f \text{ (receive)}] + f \text{ (bias)}$ |
| DIRECTION INDICATOR   | -            |   | $+ \Delta f = -\Delta r$  |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| <b>RANGING</b>  |              |   |   |
| COHERENT/NON-COHERENT   | -            | None                                      | None  |
| RANGE CODE WAVEFORM   | Sin/Sq       |   |   |
| EARTH STATION MOD INDEX   | Rad Pk       |   |   |
| RANGE CODE FREQ RATIO   | -            |   |   |
| MAJOR CODE FREQ(S)  | kHz          |   |   |
| MINOR CODE FREQ(S)  | kHz          |   |   |
| MIN RECEIVED CARRIER SNR  | dB           |   |   |
| MIN REQ CODE PWR/No   | dB-Hz        |   |   |
| CODE INTEGRATION TIME   | s            |   |   |
| ACQUISITION SEQUENCE  | -            |   |   |
| RANGE DATA UNITS  | -            |   |   |
| RANGE QUANTIZATION  | -            |   |   |
| ACCURACY (STRONG SIGNAL)  | m            |   |   |
| MAX UNAMBIGUOUS RANGE   | km           |   |   |
| TRANSPONDER BW  | MHz          |   |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |   |   |

6445-4528

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS          | SUBNETWORK OR STATION                                    |                     |  |                     |
|--|----------------|--|---------------------|--|---------------------|
|  |                | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS                |                     | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS                |                     |
| <b>GENERAL</b>   |                |  |                     |  |                     |
| STATION DESIGNATION  | -              | Mobile 10-Foot No. 1                                     |                     | Mobile 10-Foot No. 2                                     |                     |
| LOCATION(S)  | -              | Location Varies  |                     | Location Varies  |                     |
| DIAMETER   | m              | 3  |                     | 3  |                     |
| <b>FREQUENCY STD</b>   |                |  |                     |  |                     |
| STANDARD TYPE  | Name           | Crystal Oscillator                                       |                     | Crystal Oscillator                                       |                     |
| STANDARD MFG   | Name           | Datum 9390   |                     | Datum 9390   |                     |
| STABILITY AT:  |                | <b>Allan<br/>Variance</b>                                | <b>Drift</b>        | <b>Allan<br/>Variance</b>                                | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$   | (1)  | $1 \times 10^{-11}$ | (1)  | $1 \times 10^{-11}$ |
| 1 - HOUR   | $\Delta f/f$   | (1)  | $1 \times 10^{-11}$ | (1)  | $1 \times 10^{-11}$ |
| 1 - DAY (24 HOURS)   | $\Delta f/f$   | (1)  | $2 \times 10^{-12}$ | (1)  | $2 \times 10^{-12}$ |
| 1 - MONTH  | $\Delta f/f$   | (1)  | $8 \times 10^{-11}$ | (1)  | $8 \times 10^{-9}$  |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$  | <b>5 MHz</b>   | <b>100 MHz</b>      | <b>5 MHz</b>   | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz         | (1)  | (1)                 | (1)  | (1)                 |
| 10 Hz OFFSET   | dBc/Hz         | -125   | (1)                 | -125   | (1)                 |
| 100 Hz OFFSET  | dBc/Hz         | -155   | (1)                 | -155   | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz         | -155   | (1)                 | -155   | (1)                 |
| REF FREQS AVAILABLE  | MHz            | 0.000001, 0.00001, 0.001, 5, 10                          |                     | 0.000001, 0.00001, 0.001, 5, 10                          |                     |
| MAX STA-TO-STA OFFSET  | Hz             | (1)  |                     | (1)  |                     |
|  |                |  |                     |  |                     |
|  |                |  |                     |  |                     |
|  |                |  |                     |  |                     |
| <b>TIMING SYSTEM</b>   |                |  |                     |  |                     |
| MASTER REFERENCE AGENCY  | Name           | GPS  |                     | GPS  |                     |
| REFERENCE TIME   | Name           | GPS  |                     | GPS  |                     |
| TIME CODE EPOCH  | Yr             | GPS  |                     | GPS  |                     |
| TIME CODES AVAILABLE   | CCSDS<br>Codes | IRIG A, B, G, H; NASA 28, 36;<br>1 pps; 10 pps; 1000 pps |                     | IRIG A, B, G, H; NASA 28, 36;<br>1 pps; 10 pps; 1000 pps |                     |
| MAX TIME RESOLUTION  | s              | $1 \times 10^{-6}$                                       |                     | $1 \times 10^{-6}$                                       |                     |
| TIME TRANSFER METHOD   | Name           | GPS  |                     | GPS  |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec     | $\pm 10$   |                     | $\pm 10$   |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec     | $\pm 10$   |                     | $\pm 10$   |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec     | $\pm 10$   |                     | $\pm 10$   |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec     | $\pm 10$   |                     | $\pm 10$   |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s        | 1, 10, 1000, 1 000 000, 5, 000 000                       |                     | 1, 10, 1000, 1 000 000, 5, 000 000                       |                     |
|  |                |  |                     |  |                     |
|  |                |  |                     |  |                     |
|  |                |  |                     |  |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |                |  |                     |  |                     |

6445-4529

**CCSDS HISTORICAL DOCUMENT**  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
**GEOGRAPHICAL AND MECHANICAL**

| CHARACTERISTICS  | UNITS              | SUBNETWORK OR STATION                     |   |
|--|--------------------|---|---|
|  |                    | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS |
| <b>GENERAL</b>   |                    |   |   |
| STATION DESIGNATION  | -                  | Mobile 10-Foot No. 1                      | Mobile 10-Foot No. 2                      |
| LOCATION(S)  | -                  | Location Varies                           | Currently Thule, Greenland                |
| DIAMETER   | m                  | 3   | 3   |
| <b>GEOGRAPHICAL</b>  |                    |   |   |
| LOCATION, COUNTRY/STATE  | Name               | Location Varies                           | Location Varies                           |
| LOCATION, CITY   | Name               | Location Varies                           | Location Varies                           |
| LONGITUDE (site 1/site 2/site 3)   | d, m, s            | Location Varies                           | Location Varies                           |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | Location Varies                           | Location Varies                           |
|  |                    |   |   |
|  |                    |   |   |
|  |                    |   |   |
| <b>MECHANICAL</b>  |                    |   |   |
| TYPE OF MOUNT  | -                  | Az - El                                   | Az - El                                   |
| AZIMUTH LIMITATIONS  | -                  | Keyhole Zenith                            | Keyhole Zenith                            |
| TRACKING SPEED RANGE   | deg/s              | 0.01 - 20                                 | 0.01 - 20                                 |
| MAX TRACK ACCELERATION   | deg/s <sup>2</sup> | 20  | 20  |
| TYPE OF POINTING   | Type               | Autotrack / Slave                         | Autotrack / Slave                         |
| POINTING ACCURACY  | deg                | 0.25                                      | 0.25                                      |
| MIN TRANSMIT ELEV ANGLE  | deg                | (1)                                       | (1)                                       |
| MIN RECEIVE ELEV ANGLE   | deg                | - 8                                       | - 8                                       |
|  |                    |   |   |
|  |                    |   |   |
|  |                    |   |   |
|  |                    |   |   |
| <b>SUPPORT</b>   |                    |   |   |
| TRANSMIT FREQ BAND(S)  | GHz                | None                                      | 2.025 - 2.12                              |
| RECEIVE FREQ BAND(S)   | GHz                | 1.435 - 1.535, 1.67 - 1.72, 2.2 - 2.4     | None                                      |
| ACQ AID FREQ BAND(S)   | GHz                | (1)                                       | (1)                                       |
| MISSION CATEGORIES   | Cat                | A   | A   |
|  |                    |   |   |
|  |                    |   |   |
|  |                    |   |   |
|  |                    |   |   |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br/> 4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES</p> |                    |   |   |

6445-4530



CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                     |   |
|---|--------------|---|---|
|   |              | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | Mobile 18-Foot No. 1                      | Mobile 20-Foot No. 1                      |
| LOCATION(S)   | -            | Location Varies                           | Location Varies                           |
| DIAMETER  | m            | 5.5                                       | 6.1                                       |
| <b>RECEIVE</b>  |              |   |   |
| FREQUENCIES   | MHz          | 1435 - 1535, 1670 - 1720, 2200 - 2300     | 1435 - 1535, 1670 - 1720, 2200 - 2400     |
| FREQUENCY RESOLUTION  | Hz           | 50 000                                    | 50 000                                    |
| ANTENNA GAIN @ 45 deg   | dBi          | 34.9 (L1), 37.1 (L2), 39.5 (S)            | 35.8 (L1), 38.0 (L2), 40.5 (S)            |
| SYS NOISE TEMP @ ZENITH   | K            | 350, 350, 310                             | 350, 350, 316                             |
| G/T @ 45 deg  | dB           | 9.4 (L1), 11.6 (L2), 14.6 (S)             | 10.3 (L1), 12.5 (L2), 15.5 (S)            |
| POLARIZATION  | -            | RHC, LHC                                  | RHC, LHC                                  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 2.25 (L), 1.7 (S)                         | 2.03 (L), 1.53 (S)                        |
| ANTENNA ELLIPTICITY   | dB           | (1)                                       | (1)                                       |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-3}$                    | $\pm 1 \times 10^{-3}$                    |
| RCVR AGC DYNAMIC RANGE  | dB           | 130                                       | 130                                       |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | 30, 100, 300 1 K, 3 K                     | 30, 100, 300 1 K, 3 K                     |
| RCVR LOOP BANDWIDTHS  | Hz           | -144 in 2 Blo = 30 Hz                     | -144 in 2 Blo = 30 Hz                     |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                                     | Adapt                                     |
| RCVR PLL ORDER(S)   | No.          | 2   | 2   |
| ACQ SWEEP RANGE   | kHz          | $\pm 250$                                 | $\pm 250$                                 |
| MIN ACQ SWEEP RATE  | Hz/s         | Depends on Loop BW                        | Depends on Loop BW                        |
| MAX ACQ SWEEP RATE  | kHz/s        | Depends on Loop BW                        | Depends on Loop BW                        |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                                | Continuous                                |
| PROGRAMMED L.O.   | Yes/No       | No  | No  |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| <b>TELEMETRY</b>  |              |   |   |
| MODULATION TYPE(S)  | -            | BPSR, PM, FM, AM                          | BPSR, PM, FM, AM                          |
| MODULATION FORMAT(S)  | -            | All IRIG's                                | All IRIG's                                |
| MOD INDEX RANGE   | Rad Pk       | 0.2 - 1.4                                 | 0.2 - 2.8                                 |
| SUBCARRIER FREQ RANGE   | kHz          | 1 - 2000                                  | 1 - 2000                                  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                                      | Sine                                      |
| SYMBOL RATE RANGE   | s/s          | 4 - 4 000 000                             | 4 - 4 000 000                             |
| SUBCARRIER/SYM RATE LIMIT   | -            | > 1.5                                     | > 1.5                                     |
| ARRAYS WITH STATIONS  | -            | None                                      | None                                      |
| CHANNEL DECODING  | Type         | (1)                                       | (1)                                       |
| DATA FORMAT   | -            | (1)                                       | (1)                                       |
|   |              |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |   |   |

6445-4566

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                     |   |
|---|--------------|---|---|
|   |              | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | Mobile 18-Foot No. 1                      | Mobile 20-Foot No. 1                      |
| LOCATION(S)   | -            | Location Varies                           | Location Varies                           |
| DIAMETER  | m            | 5.5                                       | 6.1                                       |
| <b>FREQUENCIES</b>  |              |   |   |
| TRANSMIT FREQUENCIES  | MHz          | None                                      | None                                      |
| RECEIVE FREQUENCIES   | MHz          | 1435 - 1535, 1670 - 1720, 2200 - 2300     | 1435 - 1535, 1670 - 1720, 2200 - 2300     |
| TURNAROUND FREQ RATIO   | -            | (1)                                       | (1)                                       |
| <b>DOPPLER</b>  |              |   |   |
| COHERENT/NON-COHERENT   | -            | None                                      | None                                      |
| COUNTER RESOLUTION  | Cycles       |   |   |
| MAX DOPPLER FREQ SHIFT  | MHz          |   |   |
| DOPPLER BIAS FREQ   | MHz          |   |   |
| DRIFT   | $\Delta f/f$ |   |   |
| OUTPUT EQUATION   | -            |   |   |
| DIRECTION INDICATOR   | -            |   |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| <b>RANGING</b>  |              |   |   |
| COHERENT/NON-COHERENT   | -            | None                                      | None                                      |
| RANGE CODE WAVEFORM   | Sin/Sq       |   |   |
| EARTH STATION MOD INDEX   | Rad Pk       |   |   |
| RANGE CODE FREQ RATIO   | -            |   |   |
| MAJOR CODE FREQ(S)  | kHz          |   |   |
| MINOR CODE FREQ(S)  | kHz          |   |   |
| MIN RECEIVED CARRIER SNR  | dB           |   |   |
| MIN REQ CODE PWR/No   | dB-Hz        |   |   |
| CODE INTEGRATION TIME   | s            |   |   |
| ACQUISITION SEQUENCE  | -            |   |   |
| RANGE DATA UNITS  | -            |   |   |
| RANGE QUANTIZATION  | -            |   |   |
| ACCURACY (STRONG SIGNAL)  | m            |   |   |
| MAX UNAMBIGUOUS RANGE   | km           |   |   |
| TRANSPONDER BW  | MHz          |   |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |   |   |

6445-4567

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                                 |                     |   |                     |
|--|---------------|---|---------------------|---|---------------------|
|  |               | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS             |                     | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS             |                     |
| <b>GENERAL</b>   |               |   |                     |   |                     |
| STATION DESIGNATION  | -             | Mobile 18-Foot No. 1                                  |                     | Mobile 20-Foot No. 1                                  |                     |
| LOCATION(S)  | -             | Location Varies                                       |                     | Location Varies                                       |                     |
| DIAMETER   | m             | 5.5   |                     | 6.1   |                     |
| <b>FREQUENCY STD</b>   |               |   |                     |   |                     |
| STANDARD TYPE  | Name          | Crystal Oscillator                                    |                     | Crystal Oscillator                                    |                     |
| STANDARD MFG   | Name          | Datum 9390  |                     | Datum 9390  |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>                                 | <b>Drift</b>        | <b>Allan Variance</b>                                 | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - HOUR   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)   | $2 \times 10^{-12}$ | (1)   | $2 \times 10^{-12}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)   | $8 \times 10^{-9}$  | (1)   | $8 \times 10^{-9}$  |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>  | <b>100 MHz</b>      | <b>5 MHz</b>  | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | (1)   | (1)                 | (1)   | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | -125  | (1)                 | -125  | (1)                 |
| 100 Hz OFFSET  | dBc/Hz        | -155  | (1)                 | -155  | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz        | -155  | (1)                 | -155  | (1)                 |
| REF FREQS AVAILABLE  | MHz           | 0.000001, 0.00001, 0.001, 5, 10                       |                     | 0.000001, 0.00001, 0.001, 5, 10                       |                     |
| MAX STA-TO-STA OFFSET  | Hz            | (1)   |                     | (1)   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
| <b>TIMING SYSTEM</b>   |               |   |                     |   |                     |
| MASTER REFERENCE AGENCY  | Name          | GPS   |                     | GPS   |                     |
| REFERENCE TIME   | Name          | GPS   |                     | GPS   |                     |
| TIME CODE EPOCH  | Yr            | GPS   |                     | GPS   |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$                                    |                     | $1 \times 10^{-6}$                                    |                     |
| TIME TRANSFER METHOD   | Name          | GPS   |                     | GPS   |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 1000, 1 000 000, 5 000 000                     |                     | 1, 10, 1000, 1 000 000, 5, 000 000                    |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |   |                     |   |                     |

6445-4568

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION                     |   |
|---|--------------------|---|---|
|   |                    | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS | WALLOPS FLIGHT FACILITY<br>MOBILE SYSTEMS |
| <b>GENERAL</b>  |                    |   |   |
| STATION DESIGNATION   | -                  | Mobile 18-Foot No. 1                      | Mobile 20-Foot No. 1                      |
| LOCATION(S)   | -                  | Location Varies                           | Location Varies                           |
| DIAMETER  | m                  | 5.5                                       | 6.1                                       |
| <b>GEOGRAPHICAL</b>   |                    |   |   |
| LOCATION, COUNTRY/STATE   | Name               | Location Varies                           | Location Varies                           |
| LOCATION, CITY  | Name               | Location Varies                           | Location Varies                           |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | Location Varies                           | Location Varies                           |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | Location Varies                           | Location Varies                           |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
| <b>MECHANICAL</b>   |                    |   |   |
| TYPE OF MOUNT   | -                  | EI - Az                                   | EI - Az                                   |
| AZIMUTH LIMITATIONS   | -                  | Keyhole Zenith                            | Keyhole Zenith                            |
| TRACKING SPEED RANGE  | deg/s              | 0.01 - 15                                 | 0.01 - 20                                 |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 15  | 20  |
| TYPE OF POINTING  | Type               | Autotrack, Program, Slave                 | Autotrack, Program, Slave                 |
| POINTING ACCURACY   | deg                | 0.1                                       | 0.1                                       |
| MIN TRANSMIT ELEV ANGLE   | deg                | (1)                                       | (1)                                       |
| MIN RECEIVE ELEV ANGLE  | deg                | - 8                                       | - 8                                       |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
| <b>SUPPORT</b>  |                    |   |   |
| TRANSMIT FREQ BAND(S)   | GHz                | None                                      | None                                      |
| RECEIVE FREQ BAND(S)  | GHz                | 1.435 - 1.535, 1.67 - 1.72, 2.2 - 2.3     | 1.435 - 1.535, 1.67 - 1.72, 2.2 - 2.3     |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                                       | (1)                                       |
| MISSION CATEGORIES  | Cat                | A   | A   |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
|   |                    |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |   |   |

6445-4569

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION  |  |
|---|--------------|--|--|
|   |              | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS)  | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS)  |
| <b>GENERAL</b>  |              |  |  |
| STATION DESIGNATION   | -            | TOTS #1  | TOTS #2  |
| LOCATION(S)   | -            | Poker Flat Research Range, AK  | Poker Flat Research Range, AK  |
| DIAMETER  | m            | 8  | 8  |
| <b>TRANSMIT</b>   |              |  |  |
| FREQUENCIES   | MHz          | 2025 - 2120  | 2025 - 2120  |
| FREQUENCY RESOLUTION  | Hz           | 100  | 100  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $\pm 1$ Per °C Per 24 hrs  | $\pm 1$ Per °C Per 24 hrs  |
| TRANSMIT POWER 1  | W            | 200  | 200  |
| EIRP RANGE 1  | dBW          | 62   | 62   |
| TRANSMIT POWER 2  | W            | None   | None   |
| EIRP RANGE 2  | dBW          | None   | None   |
| POLARIZATION  | -            | RHC, LHC   | RHC, LHC   |
| ANTENNA GAIN  | dBi          | 42.1   | 42.1   |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 1.27   | 1.27   |
| ANTENNA ELLIPTICITY   | dB           | (1)  | (1)  |
| RF FREQ SWEEP RANGE   | kHz          | $\pm 900$  | $\pm 900$  |
| MIN FREQ SWEEP RATE   | Hz/s         | 1  | 1  |
| MAX FREQ SWEEP RATE   | kHz/s        | 12   | 12   |
| PROGRAMMED UPLINK FREQ  | Yes/No       | (1)  | (1)  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
|   |              |  |  |
| <b>COMMAND</b>  |              |  |  |
| RF CARRIER MOD TYPE   | -            | PM, FM, PSK  | PM, FM, PSK  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | Rate DC - 10 MHz, Dev 0 - 1.5 rad (PM)<br>Rate 20 Hz - 12 MHz, Dev 50 KHz - 50 MHz (FM)<br>Rate DC - 150 MHz, Dev 90 deg (PSK) | Rate DC - 10 MHz, Dev 0 - 1.5 rad (PM)<br>Rate 20 Hz - 12 MHz, Dev 50 KHz - 50 MHz (FM)<br>Rate DC - 150 MHz, Dev 90 deg (PSK) |
| SUBCARRIER FREQUENCY(S)   | Hz           | 1000 - 2 000 000   | 1000 - 2 000 000   |
| SUBCARRIER STEP SIZE  | Hz           | (1)  | (1)  |
| SUBCARRIER FREQ STABILITY   | ppm          | $\pm 1$  | $\pm 1$  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine, Square   | Sine, Square   |
| SUBCARRIER MOD TYPE   | -            | BPSK   | BPSK   |
| SUBCARRIER/BIT RATE LIMIT   | -            | > 8  | > 8  |
| BIT RATE RANGE  | b/s          | < 32 000   | < 32 000   |
| FORMATS AVAILABLE   | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S   | NRZ - L, M, S; Bi - $\phi$ - L, M, S   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |  |  |

6445-4491

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                         |   |
|---|--------------|---|---|
|   |              | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS) | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS) |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | TOTS #1                                       | TOTS #2                                       |
| LOCATION(S)   | -            | Poker Flat Research Range, AK                 | Poker Flat Research Range, AK                 |
| DIAMETER  | m            | 8   | 8   |
| <b>RECEIVE</b>  |              |   |   |
| FREQUENCIES   | MHz          | 2200 - 2400                                   | 2200 - 2400                                   |
| FREQUENCY RESOLUTION  | Hz           | 50 000  | 50 000  |
| ANTENNA GAIN @ 45 deg   | dBi          | 42.8  | 42.8  |
| SYS NOISE TEMP @ ZENITH   | K            | 150   | 150   |
| G/T @ 45 deg  | dB           | 21  | 21  |
| POLARIZATION  | -            | RHC, LHC                                      | RHC, LHC                                      |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 1.14  | 1.14  |
| ANTENNA ELLIPTICITY   | dB           | (1)   | (1)   |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-3}$                        | $\pm 1 \times 10^{-3}$                        |
| RCVR AGC DYNAMIC RANGE  | dB           | 130   | 130   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | 30, 100, 300, 1 K, 3 K                        | 30, 100, 300, 1 K, 3 K                        |
| RCVR LOOP BANDWIDTHS  | Hz           | -148 in 2 Blo = 30 Hz                         | -148 in 2 Blo = 30 Hz                         |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt   | Adapt   |
| RCVR PLL ORDER(S)   | No.          | 2   | 2   |
| ACQ SWEEP RANGE   | kHz          | $\pm 250$                                     | $\pm 250$                                     |
| MIN ACQ SWEEP RATE  | Hz/s         | Depends on Loop BW                            | Depends on Loop BW                            |
| MAX ACQ SWEEP RATE  | kHz/s        | Depends on Loop BW                            | Depends on Loop BW                            |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                                    | Continuous                                    |
| PROGRAMMED L.O.   | Yes/No       | No  | No  |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| <b>TELEMETRY</b>  |              |   |   |
| MODULATION TYPE(S)  | -            | BPSK, PM, FM, AM                              | BPSK, PM, FM, AM                              |
| MODULATION FORMAT(S)  | -            | All IRIG's                                    | All IRIG's                                    |
| MOD INDEX RANGE   | Rad Pk       | 0.2 - 2.8                                     | 0.2 - 2.8                                     |
| SUBCARRIER FREQ RANGE   | kHz          | 1 - 2000                                      | 1 - 2000                                      |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine  | Sine  |
| SYMBOL RATE RANGE   | s/s          | 4 - 4 000 000                                 | 4 - 4 000 000                                 |
| SUBCARRIER/SYM RATE LIMIT   | -            | > 1.5   | > 1.5   |
| ARRAYS WITH STATIONS  | -            | None  | None  |
| CHANNEL DECODING  | Type         | (1)   | (1)   |
| DATA FORMAT   | -            | (1)   | (1)   |
|   |              |   |   |
|   |              |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |   |   |

6445-4492

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION   |   |
|--|--------------|---|---|
|  |              | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS)   | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS)   |
| <b>GENERAL</b>   |              |   |   |
| STATION DESIGNATION  | -            | TOTS #1   | TOTS #2   |
| LOCATION(S)  | -            | Poker Flat Research Range, AK   | Poker Flat Research Range, AK   |
| DIAMETER   | m            | 8   | 8   |
| <b>FREQUENCIES</b>   |              |   |   |
| TRANSMIT FREQUENCIES   | MHz          | 2025 - 2120   | 2025 - 2120   |
| RECEIVE FREQUENCIES  | MHz          | 2200 - 2400   | 2200 - 2400   |
| TURNAROUND FREQ RATIO  | -            | 240 / 221   | 240 / 221   |
| <b>DOPPLER</b>   |              |   |   |
| COHERENT/NON-COHERENT  | -            | Coherent and Non-Coherent 2-Way   | Coherent and Non-Coherent 2-Way   |
| COUNTER RESOLUTION   | Cycles       | 0.001   | 0.001   |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 0.25  | ± 0.25  |
| DOPPLER BIAS FREQ  | MHz          | 0.24  | 0.24  |
| DRIFT  | $\Delta f/f$ | $4 \times 10^{-11}$ @ 0.1 sec   | $4 \times 10^{-11}$ @ 0.1 sec   |
| OUTPUT EQUATION  | -            | $1000 [f \text{ (transmit)} \times (240 / 221) - f \text{ (receive)}] + f \text{ (bias)}$ | $1000 [f \text{ (transmit)} \times (240 / 221) - f \text{ (receive)}] + f \text{ (bias)}$ |
| DIRECTION INDICATOR  | -            | $+ \Delta f = -\Delta r$  | $+ \Delta f = -\Delta r$  |
| <b>RANGING</b>   |              |   |   |
| COHERENT/NON-COHERENT  | -            | PR Digital  | PR Digital  |
| RANGE CODE WAVEFORM  | Sin/Sq       | Square  | Square  |
| EARTH STATION MOD INDEX  | Rad Pk       | 1.5   | 1.5   |
| RANGE CODE FREQ RATIO  | -            | (1)   | (1)   |
| MAJOR CODE FREQ(S)   | kHz          | 16  | 16  |
| MINOR CODE FREQ(S)   | kHz          | 16  | 16  |
| MIN RECEIVED CARRIER SNR   | dB           | 10  | 10  |
| MIN REQ CODE PWR/No  | dB-Hz        | 15  | 15  |
| CODE INTEGRATION TIME  | s            | (1)   | (1)   |
| ACQUISITION SEQUENCE   | -            | Automatic   | Automatic   |
| RANGE DATA UNITS   | -            | Nanoseconds   | Nanoseconds   |
| RANGE QUANTIZATION   | -            | Nanoseconds   | Nanoseconds   |
| ACCURACY (STRONG SIGNAL)   | m            | PR Digital 1.5 (RSS)  | PR Digital 1.5 (RSS)  |
| MAX UNAMBIGUOUS RANGE  | km           | 5 000 000   | 5 000 000   |
| TRANSPONDER BW   | MHz          | < 0.8   | < 0.8   |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |   |   |

6445-4493

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                                    |                     |  |                     |
|--|---------------|--|---------------------|--|---------------------|
|  |               | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS)            |                     | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS)            |                     |
| <b>GENERAL</b>   |               |  |                     |  |                     |
| STATION DESIGNATION  | -             | TOTS #1  |                     | TOTS #2  |                     |
| LOCATION(S)  | -             | Poker Flat Research Range, AK                            |                     | Poker Flat Research Range, AK                            |                     |
| DIAMETER   | m             | 8  |                     | 8  |                     |
| <b>FREQUENCY STD</b>   |               |  |                     |  |                     |
| STANDARD TYPE  | Name          | Rubidium Oscillator                                      |                     | Rubidium Oscillator                                      |                     |
| STANDARD MFG   | Name          | Datum 9390   |                     | Datum 9390   |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>                                    | <b>Drift</b>        | <b>Allan Variance</b>                                    | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | (1)  | $1 \times 10^{-11}$ | (1)  | $1 \times 10^{-11}$ |
| 1 - HOUR   | $\Delta f/f$  | (1)  | $1 \times 10^{-11}$ | (1)  | $1 \times 10^{-11}$ |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)  | $2 \times 10^{-12}$ | (1)  | $2 \times 10^{-12}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)  | $8 \times 10^{-9}$  | (1)  | $8 \times 10^{-9}$  |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>   | <b>100 MHz</b>      | <b>5 MHz</b>   | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | (1)  | (1)                 | (1)  | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | -125   | (1)                 | (1)  | -125                |
| 100 Hz OFFSET  | dBc/Hz        | -155   | (1)                 | (1)  | -155                |
| 1000 Hz OFFSET   | dBc/Hz        | -155   | (1)                 | (1)  | -155                |
| REF FREQS AVAILABLE  | MHz           | 0.000001, 0.00001, 0.001, 5, 10                          |                     | 0.000001, 0.00001, 0.001, 5, 10                          |                     |
| MAX STA-TO-STA OFFSET  | Hz            | (1)  |                     | (1)  |                     |
|  |               |  |                     |  |                     |
|  |               |  |                     |  |                     |
|  |               |  |                     |  |                     |
| <b>TIMING SYSTEM</b>   |               |  |                     |  |                     |
| MASTER REFERENCE AGENCY  | Name          | GPS  |                     | GPS  |                     |
| REFERENCE TIME   | Name          | GPS  |                     | GPS  |                     |
| TIME CODE EPOCH  | Yr            | GPS  |                     | GPS  |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG A, B, G, H; NASA 28, 36;<br>1 pps; 10 pps; 1000 pps |                     | IRIG A, B, G, H; NASA 28, 36;<br>1 pps; 10 pps; 1000 pps |                     |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$                                       |                     | $1 \times 10^{-6}$                                       |                     |
| TIME TRANSFER METHOD   | Name          | GPS  |                     | GPS  |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$   |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$   |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$   |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$   |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 1000, 1 000 000, 5 000 000                        |                     | 1, 10, 1000, 1 000 000, 5 000 000                        |                     |
|  |               |  |                     |  |                     |
|  |               |  |                     |  |                     |
|  |               |  |                     |  |                     |
|  |               |  |                     |  |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |  |                     |  |                     |

6445-4494

**CCSDS HISTORICAL DOCUMENT**  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
**GEOGRAPHICAL AND MECHANICAL**

| CHARACTERISTICS                        | UNITS              | SUBNETWORK OR STATION                        |  |
|--|--------------------|--|--|
|  |                    | TRANSPORTABLE ORBITAL TRACKING SYSTEM (TOTS) | TRANSPORTABLE ORBITAL TRACKING SYSTEM (TOTS) |
| <b>GENERAL</b>                         |                    |  |  |
| STATION DESIGNATION                    | -                  | TOTS #1                                      | TOTS #2                                      |
| LOCATION(S)                            | -                  | Poker Flat Research Range, AK                | Poker Flat Research Range, AK                |
| DIAMETER                               | m                  | 8  | 8  |
| <b>GEOGRAPHICAL</b>                    |                    |  |  |
| LOCATION, COUNTRY/STATE                | Name               | USA / Alaska                                 | USA / Alaska                                 |
| LOCATION, CITY                         | Name               | Chatanika, AK                                | Chatanika, AK                                |
| LONGITUDE (site 1/site 2/site 3)       | d, m, s            | 147 27 33 W                                  | 147 27 42 W                                  |
| LATITUDE (site 1/site 2/site 3)        | d, m, s            | 65 07 02 N                                   | 65 07 02 N                                   |
|  |                    |  |  |
|  |                    |  |  |
|  |                    |  |  |
|  |                    |  |  |
|  |                    |  |  |
| <b>MECHANICAL</b>                      |                    |  |  |
| TYPE OF MOUNT                          | -                  | EI - Az                                      | EI - Az                                      |
| AZIMUTH LIMITATIONS                    | -                  | Keyhole Zenith                               | Keyhole Zenith                               |
| TRACKING SPEED RANGE                   | deg/s              | 0.001 - 20                                   | 0.001 - 20                                   |
| MAX TRACK ACCELERATION                 | deg/s <sup>2</sup> | 20   | 20   |
| TYPE OF POINTING                       | Type               | Autotrack, Program, Slave                    | Autotrack, Program, Slave                    |
| POINTING ACCURACY                      | deg                | 0.05   | 0.05   |
| MIN TRANSMIT ELEV ANGLE                | deg                | 0  | 0  |
| MIN RECEIVE ELEV ANGLE                 | deg                | - 8  | - 8  |
|  |                    |  |  |
|  |                    |  |  |
|  |                    |  |  |
|  |                    |  |  |
|  |                    |  |  |
|  |                    |  |  |
| <b>SUPPORT</b>                         |                    |  |  |
| TRANSMIT FREQ BAND(S)                  | GHz                | 2.025 - 2.12 (A)                             | 2.025 - 2.12 (A)                             |
| RECEIVE FREQ BAND(S)                   | GHz                | 2.2 - 2.4 (A)                                | 2.2 - 2.4 (A)                                |
| ACQ AID FREQ BAND(S)                   | GHz                | 2 - 2.4 (A)                                  | 2 - 2.4 (A)                                  |
| MISSION CATEGORIES                     | Cat                | A  | A  |
|  |                    |  |  |
|  |                    |  |  |
|  |                    |  |  |
|  |                    |  |  |
|  |                    |  |  |
|  |                    |  |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE |                    | 2. SOME LIMITATIONS APPLY TO THIS CAPABILITY | 3. NOT RECOMMENDED BY CCSDS                  |
| 4. BASED UPON GEOCENTRIC COORDINATES   |                    | 5. BASED UPON GEODETIC COORDINATES           |  |

6445-4495



CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                         |   |
|---|--------------|---|---|
|   |              | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS) | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS) |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | TOTS #3                                       | TOTS Pad                                      |
| LOCATION(S)   | -            | Wallops Island, VA                            | Andoya, Norway                                |
| DIAMETER  | m            | 8   |   |
| <b>RECEIVE</b>  |              |   |   |
| FREQUENCIES   | MHz          | 2200 - 2400                                   |   |
| FREQUENCY RESOLUTION  | Hz           | 50 000  |   |
| ANTENNA GAIN @ 45 deg   | dBi          | 42.8  |   |
| SYS NOISE TEMP @ ZENITH   | K            | 150   |   |
| G/T @ 45 deg  | dB           | 21  |   |
| POLARIZATION  | -            | RHC, LHC                                      |   |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 1.14  |   |
| ANTENNA ELLIPTICITY   | dB           | (1)   |   |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-3}$                        |   |
| RCVR AGC DYNAMIC RANGE  | dB           | 130   |   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | 30, 100, 300, 1 K, 3 K                        |   |
| RCVR LOOP BANDWIDTHS  | Hz           | -148 in 2 Blo = 30 Hz                         |   |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt   |   |
| RCVR PLL ORDER(S)   | No.          | 2   |   |
| ACQ SWEEP RANGE   | kHz          | $\pm 250$                                     |   |
| MIN ACQ SWEEP RATE  | Hz/s         | Depends on Loop BW                            |   |
| MAX ACQ SWEEP RATE  | kHz/s        | Depends on Loop BW                            |   |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                                    |   |
| PROGRAMMED L.O.   | Yes/No       | No  |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| <b>TELEMETRY</b>  |              |   |   |
| MODULATION TYPE(S)  | -            | BPSK, PM, FM, AM                              |   |
| MODULATION FORMAT(S)  | -            | All IRIG's                                    |   |
| MOD INDEX RANGE   | Rad Pk       | 0.2 - 2.8                                     |   |
| SUBCARRIER FREQ RANGE   | kHz          | 1 - 2000                                      |   |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine  |   |
| SYMBOL RATE RANGE   | s/s          | 4 - 4 000 000                                 |   |
| SUBCARRIER/SYM RATE LIMIT   | -            | > 1.5   |   |
| ARRAYS WITH STATIONS  | -            | None  |   |
| CHANNEL DECODING  | Type         | (1)   |   |
| DATA FORMAT   | -            | (1)   |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |   |   |

6445-4502

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                                      |   |
|---|--------------|--|---|
|   |              | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS)              | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS) |
| <b>GENERAL</b>  |              |  |   |
| STATION DESIGNATION   | -            | TOTS #3  | TOTS Pad                                      |
| LOCATION(S)   | -            | Wallops Island, VA   | Andoya, Norway                                |
| DIAMETER  | m            | 8  |   |
| <b>FREQUENCIES</b>  |              |  |   |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120  |   |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2400  |   |
| TURNAROUND FREQ RATIO   | -            | 240 / 221  |   |
| <b>DOPPLER</b>  |              |  |   |
| COHERENT/NON-COHERENT   | -            | Coherent and Non-Coherent 2-Way                            |   |
| COUNTER RESOLUTION  | Cycles       | 0.001  |   |
| MAX DOPPLER FREQ SHIFT  | MHz          | ± 0.25   |   |
| DOPPLER BIAS FREQ   | MHz          | 0.24   |   |
| DRIFT   | $\Delta f/f$ | $4 \times 10^{-11}$ @ 0.1 sec                              |   |
| OUTPUT EQUATION   | -            | 1000 [f (transmit) x (240 / 221) - f (receive)] + f (bias) |   |
| DIRECTION INDICATOR   | -            | + $\Delta f = -\Delta r$                                   |   |
| <b>RANGING</b>  |              |  |   |
| COHERENT/NON-COHERENT   | -            | PR Digital   |   |
| RANGE CODE WAVEFORM   | Sin/Sq       | Square   |   |
| EARTH STATION MOD INDEX   | Rad Pk       | 1.5  |   |
| RANGE CODE FREQ RATIO   | -            | (1)  |   |
| MAJOR CODE FREQ(S)  | kHz          | 16   |   |
| MINOR CODE FREQ(S)  | kHz          | 16   |   |
| MIN RECEIVED CARRIER SNR  | dB           | 10   |   |
| MIN REQ CODE PWR/No   | dB-Hz        | 15   |   |
| CODE INTEGRATION TIME   | s            | (1)  |   |
| ACQUISITION SEQUENCE  | -            | Automatic  |   |
| RANGE DATA UNITS  | -            | Nanoseconds  |   |
| RANGE QUANTIZATION  | -            | Nanoseconds  |   |
| ACCURACY (STRONG SIGNAL)  | m            | PR Digital 1.5 (RSS)                                       |   |
| MAX UNAMBIGUOUS RANGE   | km           | 5 000 000  |   |
| TRANSPONDER BW  | MHz          | < 0.8  |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |  |   |

6445-4503

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                                 |                     |   |                |
|--|---------------|---|---------------------|---|----------------|
|  |               | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS)         |                     | TRANSPORTABLE ORBITAL TRACKING STATION (TOTS) |                |
| <b>GENERAL</b>   |               |   |                     |   |                |
| STATION DESIGNATION  | -             | TOTS #3   |                     | TOTS Pad                                      |                |
| LOCATION(S)  | -             | Wallops Island, VA                                    |                     | Andoyo, Norway                                |                |
| DIAMETER   | m             | 8   |                     |   |                |
| <b>FREQUENCY STD</b>   |               |   |                     |   |                |
| STANDARD TYPE  | Name          | Rubidium Oscillator                                   |                     |   |                |
| STANDARD MFG   | Name          | Datum 9390  |                     |   |                |
| STABILITY AT:  |               | <b>Allan Variance</b>                                 | <b>Drift</b>        | <b>Allan Variance</b>                         | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ |   |                |
| 1 - HOUR   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ |   |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)   | $2 \times 10^{-12}$ |   |                |
| 1 - MONTH  | $\Delta f/f$  | (1)   | $8 \times 10^{-9}$  |   |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>  | <b>100 MHz</b>      | <b>5 MHz</b>                                  | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)   | (1)                 |   |                |
| 10 Hz OFFSET   | dBc/Hz        | -125  | (1)                 |   |                |
| 100 Hz OFFSET  | dBc/Hz        | -155  | (1)                 |   |                |
| 1000 Hz OFFSET   | dBc/Hz        | -155  | (1)                 |   |                |
| REF FREQS AVAILABLE  | MHz           | 0.0000001, 0.00001, 0.001, 5, 10                      |                     |   |                |
| MAX STA-TO-STA OFFSET  | Hz            | (1)   |                     |   |                |
|  |               |   |                     |   |                |
|  |               |   |                     |   |                |
|  |               |   |                     |   |                |
| <b>TIMING SYSTEM</b>   |               |   |                     |   |                |
| MASTER REFERENCE AGENCY  | Name          | GPS   |                     |   |                |
| REFERENCE TIME   | Name          | GPS   |                     |   |                |
| TIME CODE EPOCH  | Yr            | GPS   |                     |   |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     |   |                |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$                                    |                     |   |                |
| TIME TRANSFER METHOD   | Name          | GPS   |                     |   |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 10$  |                     |   |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 10$  |                     |   |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$  |                     |   |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$  |                     |   |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 1000, 1 000 000, 5 000 000                     |                     |   |                |
|  |               |   |                     |   |                |
|  |               |   |                     |   |                |
|  |               |   |                     |   |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |   |                     |   |                |

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS                  | UNITS              | SUBNETWORK OR STATION                        |  |
|----------------------------------|--------------------|--|--|
|                                  |                    | TRANSPORTABLE ORBITAL TRACKING SYSTEM (TOTS) | TRANSPORTABLE ORBITAL TRACKING SYSTEM (TOTS) |
| <b>GENERAL</b>                   |                    |  |  |
| STATION DESIGNATION              | -                  | TOTS #3                                      | TOTS Pad                                     |
| LOCATION(S)                      | -                  | Wallops Island, VA                           | Andoya, Norway                               |
| DIAMETER                         | m                  | 8  |  |
| <b>GEOGRAPHICAL</b>              |                    |  |  |
| LOCATION, COUNTRY/STATE          | Name               | USA / Virginia                               | Norway                                       |
| LOCATION, CITY                   | Name               | Wallops Island, VA                           | Andoya, Norway                               |
| LONGITUDE (site 1/site 2/site 3) | d, m, s            | 77 28 25 W                                   | 343 56 15 W                                  |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 37 55 11 N                                   | 69 18 01 N                                   |
|                                  |                    |  |  |
|                                  |                    |  |  |
|                                  |                    |  |  |
|                                  |                    |  |  |
| <b>MECHANICAL</b>                |                    |  |  |
| TYPE OF MOUNT                    | -                  | EI - Az                                      |  |
| AZIMUTH LIMITATIONS              | -                  | Keyhole Zenith                               |  |
| TRACKING SPEED RANGE             | deg/s              | 0.001 - 20                                   |  |
| MAX TRACK ACCELERATION           | deg/s <sup>2</sup> | 20   |  |
| TYPE OF POINTING                 | Type               | Autotrack, Prgoram, Slave                    |  |
| POINTING ACCURACY                | deg                | 0.05   |  |
| MIN TRANSMIT ELEV ANGLE          | deg                | 0  |  |
| MIN RECEIVE ELEV ANGLE           | deg                | - 8  |  |
|                                  |                    |  |  |
|                                  |                    |  |  |
|                                  |                    |  |  |
|                                  |                    |  |  |
| <b>SUPPORT</b>                   |                    |  |  |
| TRANSMIT FREQ BAND(S)            | GHz                | 2.025 - 2.12 (A)                             |  |
| RECEIVE FREQ BAND(S)             | GHz                | 2.2 - 2.4 (A)                                |  |
| ACQ AID FREQ BAND(S)             | GHz                | 2 - 2.4 (A)                                  |  |
| MISSION CATEGORIES               | Cat                | A  |  |
|                                  |                    |  |  |
|                                  |                    |  |  |
|                                  |                    |  |  |
|                                  |                    |  |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS  
 4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES

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CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS                        | UNITS        | SUBNETWORK OR STATION                        |                         |
|--|--------------|--|-------------------------|
|  |              | POKER FLAT RESEARCH RANGE                    | WALLOPS FLIGHT FACILITY |
| <b>GENERAL</b>                         |              |  |                         |
| STATION DESIGNATION                    | -            | AK 2.4                                       | MET                     |
| LOCATION(S)                            | -            | Poker Flat Research Range, AK                | Wallops Island, VA      |
| DIAMETER                               | m            | 2.4  | 2.4                     |
| <b>TRANSMIT</b>                        |              | None   | None                    |
| FREQUENCIES                            | MHz          |  |                         |
| FREQUENCY RESOLUTION                   | Hz           |  |                         |
| RF FREQ STABILITY @ 1 Hr               | $\Delta f/f$ |  |                         |
| TRANSMIT POWER 1                       | W            |  |                         |
| EIRP RANGE 1                           | dBW          |  |                         |
| TRANSMIT POWER 2                       | W            |  |                         |
| EIRP RANGE 2                           | dBW          |  |                         |
| POLARIZATION                           | -            |  |                         |
| ANTENNA GAIN                           | dBi          |  |                         |
| ANTENNA BEAMWIDTH (-3 dB)              | deg          |  |                         |
| ANTENNA ELLIPTICITY                    | dB           |  |                         |
| RF FREQ SWEEP RANGE                    | kHz          |  |                         |
| MIN FREQ SWEEP RATE                    | Hz/s         |  |                         |
| MAX FREQ SWEEP RATE                    | kHz/s        |  |                         |
| PROGRAMMED UPLINK FREQ                 | Yes/No       |  |                         |
|  |              |  |                         |
|  |              |  |                         |
|  |              |  |                         |
|  |              |  |                         |
|  |              |  |                         |
|  |              |  |                         |
|  |              |  |                         |
| <b>COMMAND</b>                         |              | None   | None                    |
| RF CARRIER MOD TYPE                    | -            |  |                         |
| RF CARRIER MOD INDEX RNG               | Rad Pk       |  |                         |
| SUBCARRIER FREQUENCY(S)                | Hz           |  |                         |
| SUBCARRIER STEP SIZE                   | Hz           |  |                         |
| SUBCARRIER FREQ STABILITY              | ppm          |  |                         |
| SUBCARRIER WAVEFORM                    | Sin/Sq       |  |                         |
| SUBCARRIER MOD TYPE                    | -            |  |                         |
| SUBCARRIER/BIT RATE LIMIT              | -            |  |                         |
| BIT RATE RANGE                         | b/s          |  |                         |
| FORMATS AVAILABLE                      | -            |  |                         |
|  |              |  |                         |
|  |              |  |                         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE |              | 2. SOME LIMITATIONS APPLY TO THIS CAPABILITY |                         |
|  |              | 3. NOT RECOMMENDED BY CCSDS                  |                         |

6445-4580

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION         |                                       |
|-----------------------------|--------------|-------------------------------|---------------------------------------|
|                             |              | POKER FLAT RESEARCH RANGE     | WALLOPS FLIGHT FACILITY               |
| <b>GENERAL</b>              |              |                               |                                       |
| STATION DESIGNATION         | -            | AK 2.4                        | MET                                   |
| LOCATION(S)                 | -            | Poker Flat Research Range, AK | Wallops Island, VA                    |
| DIAMETER                    | m            | 2.4                           | 2.4                                   |
| <b>RECEIVE</b>              |              |                               |                                       |
| FREQUENCIES                 | MHz          | 2200 - 2300                   | 1435 - 1535, 1670 - 1720, 2200 - 2400 |
| FREQUENCY RESOLUTION        | Hz           | 25 000                        | 10 000                                |
| ANTENNA GAIN @ 45 deg       | dBi          | 32.5                          | 28.8 (L1), 30.0 (L2), 32.5 (S)        |
| SYS NOISE TEMP @ ZENITH     | K            | 350                           | 350, 350, 350                         |
| G/T @ 45 deg                | dB           | 7                             | 3.3 (L1), 4.5 (L2), 7.0 (S)           |
| POLARIZATION                | -            | RHC, LHC                      | RHC, LHC                              |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 3.9                           | 5.1 (L), 3.9 (S)                      |
| ANTENNA ELLIPTICITY         | dB           | (1)                           | (1)                                   |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-3}$        | $\pm 1 \times 10^{-3}$                |
| RCVR AGC DYNAMIC RANGE      | dB           | 130                           | 130                                   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -144 in 2 Blo = 30 Hz         | -144 in 2 Blo = 30 Hz                 |
| RCVR LOOP BANDWIDTHS        | Hz           | 30, 100, 300, 1 K, 3 K        | 30, 100, 300, 1 K, 3 K                |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                         | Adapt                                 |
| RCVR PLL ORDER(S)           | No.          | 2                             | 2                                     |
| ACQ SWEEP RANGE             | kHz          | $\pm 250$                     | $\pm 250$                             |
| MIN ACQ SWEEP RATE          | Hz/s         | Depends on Loop BW            | Depends on Loop BW                    |
| MAX ACQ SWEEP RATE          | kHz/s        | Depends on Loop BW            | Depends on Loop BW                    |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous                    | Continuous                            |
| PROGRAMMED L.O.             | Yes/No       | No                            | No                                    |
|                             |              |                               |                                       |
|                             |              |                               |                                       |
|                             |              |                               |                                       |
| <b>TELEMETRY</b>            |              |                               |                                       |
| MODULATION TYPE(S)          | -            | BPSK, PM, FM, AM              | PM, FM, AM                            |
| MODULATION FORMAT(S)        | -            | All IRIG's                    | All IRIG's                            |
| MOD INDEX RANGE             | Rad Pk       | 0.2 - 2.8                     | 0.2 - 1.4                             |
| SUBCARRIER FREQ RANGE       | kHz          | 1 - 2000                      | 1 - 2000                              |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine                          | Sine                                  |
| SYMBOL RATE RANGE           | s/s          | 4 - 4 000 000                 | 4 - 6 600 000                         |
| SUBCARRIER/SYM RATE LIMIT   | -            | > 1.5                         | > 1.5                                 |
| ARRAYS WITH STATIONS        | -            | None                          | None                                  |
| CHANNEL DECODING            | Type         | (1)                           | (1)                                   |
| DATA FORMAT                 | -            | (1)                           | (1)                                   |
|                             |              |                               |                                       |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

6445-4581

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION         |                                       |
|---|--------------|-------------------------------|---------------------------------------|
|   |              | POKER FLAT RESEARCH RANGE     | WALLOPS FLIGHT FACILITY               |
| <b>GENERAL</b>  |              |                               |                                       |
| STATION DESIGNATION   | -            | AK 2.4                        | MET                                   |
| LOCATION(S)   | -            | Poker Flat Research Range, AK | Wallops Island, VA                    |
| DIAMETER  | m            | 2.4                           | 2.4                                   |
| <b>FREQUENCIES</b>  |              |                               |                                       |
| TRANSMIT FREQUENCIES  | MHz          | None                          | None                                  |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300                   | 1435 - 1535, 1670 - 1720, 2200 - 2400 |
| TURNAROUND FREQ RATIO   | -            | (1)                           | (1)                                   |
| <b>DOPPLER</b>  |              |                               |                                       |
| COHERENT/NON-COHERENT   | -            | None                          | None                                  |
| COUNTER RESOLUTION  | Cycles       |                               |                                       |
| MAX DOPPLER FREQ SHIFT  | MHz          |                               |                                       |
| DOPPLER BIAS FREQ   | MHz          |                               |                                       |
| DRIFT   | $\Delta f/f$ |                               |                                       |
| OUTPUT EQUATION   | -            |                               |                                       |
| DIRECTION INDICATOR   | -            |                               |                                       |
|   |              |                               |                                       |
|   |              |                               |                                       |
|   |              |                               |                                       |
| <b>RANGING</b>  |              |                               |                                       |
| COHERENT/NON-COHERENT   | -            | None                          | None                                  |
| RANGE CODE WAVEFORM   | Sin/Sq       |                               |                                       |
| EARTH STATION MOD INDEX   | Rad Pk       |                               |                                       |
| RANGE CODE FREQ RATIO   | -            |                               |                                       |
| MAJOR CODE FREQ(S)  | kHz          |                               |                                       |
| MINOR CODE FREQ(S)  | kHz          |                               |                                       |
| MIN RECEIVED CARRIER SNR  | dB           |                               |                                       |
| MIN REQ CODE PWR/No   | dB-Hz        |                               |                                       |
| CODE INTEGRATION TIME   | s            |                               |                                       |
| ACQUISITION SEQUENCE  | -            |                               |                                       |
| RANGE DATA UNITS  | -            |                               |                                       |
| RANGE QUANTIZATION  | -            |                               |                                       |
| ACCURACY (STRONG SIGNAL)  | m            |                               |                                       |
| MAX UNAMBIGUOUS RANGE   | km           |                               |                                       |
| TRANSPONDER BW  | MHz          |                               |                                       |
|   |              |                               |                                       |
|   |              |                               |                                       |
|   |              |                               |                                       |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                               |                                       |

6445-4582

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                                 |                     |   |                     |
|--|---------------|---|---------------------|---|---------------------|
|  |               | POKER FLAT RESEARCH RANGE                             |                     | WALLOPS FLIGHT FACILITY                               |                     |
| <b>GENERAL</b>   |               |   |                     |   |                     |
| STATION DESIGNATION  | -             | AK 2.4  |                     | MET   |                     |
| LOCATION(S)  | -             | Poker Flat Research Range, AK                         |                     | Wallops Island, VA                                    |                     |
| DIAMETER   | m             | 2.4   |                     | 2.4   |                     |
| <b>FREQUENCY STD</b>   |               |   |                     |   |                     |
| STANDARD TYPE  | Name          | Crystal Oscillator                                    |                     | Cesium Beam   |                     |
| STANDARD MFG   | Name          | Datum 9390  |                     | HP5061A   |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>                                 | <b>Drift</b>        | <b>Allan Variance</b>                                 | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - HOUR   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $3 \times 10^{-13}$ |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)   | $2 \times 10^{-12}$ | (1)   | $3 \times 10^{-13}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)   | $8 \times 10^{-9}$  | (1)   | $3 \times 10^{-13}$ |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>  | <b>100 MHz</b>      | <b>5 MHz</b>  | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | (1)   | (1)                 | (1)   | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | -125  | (1)                 | -120  | (1)                 |
| 100 Hz OFFSET  | dBc/Hz        | -155  | (1)                 | -125  | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz        | -155  | (1)                 | -140  | (1)                 |
| REF FREQS AVAILABLE  | MHz           | 0.000001, 0.00001, 0.001, 5, 10                       |                     | 1,5   |                     |
| MAX STA-TO-STA OFFSET  | Hz            | (1)   |                     | $\pm 5 \times 10^{-12}$                               |                     |
| <b>TIMING SYSTEM</b>   |               |   |                     |   |                     |
| MASTER REFERENCE AGENCY  | Name          | GPS   |                     | USNO  |                     |
| REFERENCE TIME   | Name          | GPS   |                     | UTC   |                     |
| TIME CODE EPOCH  | Yr            | GPS   |                     | 1972  |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$                                    |                     | $1 \times 10^{-6}$                                    |                     |
| TIME TRANSFER METHOD   | Name          | GPS   |                     | GPS   |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 1000, 1 000 000, 5 000 000                     |                     | 1, 10, 1000, 1 000 000, 5, 000 000                    |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |   |                     |   |                     |

6445-4583

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION         |                                       |
|---|--------------------|-------------------------------|---------------------------------------|
|   |                    | POKER FLAT RESEARCH RANGE     | WALLOPS FLIGHT FACILITY               |
| <b>GENERAL</b>  |                    |                               |                                       |
| STATION DESIGNATION   | -                  | AK 2.4                        | MET                                   |
| LOCATION(S)   | -                  | Poker Flat Research Range, AK | Wallops Island, VA                    |
| DIAMETER  | m                  | 2.4                           | 2.4                                   |
| <b>GEOGRAPHICAL</b>   |                    |                               |                                       |
| LOCATION, COUNTRY/STATE   | Name               | USA / Alaska                  | USA / Virginia                        |
| LOCATION, CITY  | Name               | Chatanika, AK                 | Wallops Island, VA                    |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 147, 27, 46 W                 | 75 28 32 W                            |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 65, 07, 00 N                  | 37 55 42 N                            |
|   |                    |                               |                                       |
|   |                    |                               |                                       |
|   |                    |                               |                                       |
|   |                    |                               |                                       |
| <b>MECHANICAL</b>   |                    |                               |                                       |
| TYPE OF MOUNT   | -                  | EI - Az                       | EI - Az                               |
| AZIMUTH LIMITATIONS   | -                  | Keyhole Zenith                | Keyhole Zeinith                       |
| TRACKING SPEED RANGE  | deg/s              | 0.01 - 20                     | 0.01 - 20                             |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 20                            | 20                                    |
| TYPE OF POINTING  | Type               | Autotrack, Slave              | Autotrack, Program, Slave             |
| POINTING ACCURACY   | deg                | 0.1                           | 0.1                                   |
| MIN TRANSMIT ELEV ANGLE   | deg                | (1)                           | (1)                                   |
| MIN RECEIVE ELEV ANGLE  | deg                | - 8                           | 0                                     |
|   |                    |                               |                                       |
|   |                    |                               |                                       |
|   |                    |                               |                                       |
|   |                    |                               |                                       |
| <b>SUPPORT</b>  |                    |                               |                                       |
| TRANSMIT FREQ BAND(S)   | GHz                | None                          | None                                  |
| RECEIVE FREQ BAND(S)  | GHz                | 2.2 - 2.3                     | 1.435 - 1.535, 1.67 - 1.72, 2.2 - 2.4 |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                           | (1)                                   |
| MISSION CATEGORIES  | Cat                | A                             | A                                     |
|   |                    |                               |                                       |
|   |                    |                               |                                       |
|   |                    |                               |                                       |
|   |                    |                               |                                       |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                               |                                       |

6445-4584

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION   |                               |
|---|--------------|-------------------------|-------------------------------|
|   |              | WALLOPS FLIGHT FACILITY | POKER FLAT RESEARCH RANGE     |
| <b>GENERAL</b>  |              |                         |                               |
| STATION DESIGNATION   | -            | TM                      | AK 4.9                        |
| LOCATION(S)   | -            | Wallops Island, VA      | Poker Flat Research Range, AK |
| DIAMETER  | m            | 2.4                     | 4.9                           |
| <b>TRANSMIT</b>   |              |                         |                               |
|   |              | None                    | None                          |
| FREQUENCIES   | MHz          |                         |                               |
| FREQUENCY RESOLUTION  | Hz           |                         |                               |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ |                         |                               |
| TRANSMIT POWER 1  | W            |                         |                               |
| EIRP RANGE 1  | dBW          |                         |                               |
| TRANSMIT POWER 2  | W            |                         |                               |
| EIRP RANGE 2  | dBW          |                         |                               |
| POLARIZATION  | -            |                         |                               |
| ANTENNA GAIN  | dBi          |                         |                               |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          |                         |                               |
| ANTENNA ELLIPTICITY   | dB           |                         |                               |
| RF FREQ SWEEP RANGE   | kHz          |                         |                               |
| MIN FREQ SWEEP RATE   | Hz/s         |                         |                               |
| MAX FREQ SWEEP RATE   | kHz/s        |                         |                               |
| PROGRAMMED UPLINK FREQ  | Yes/No       |                         |                               |
|   |              |                         |                               |
|   |              |                         |                               |
|   |              |                         |                               |
|   |              |                         |                               |
|   |              |                         |                               |
|   |              |                         |                               |
|   |              |                         |                               |
|   |              |                         |                               |
|   |              |                         |                               |
| <b>COMMAND</b>  |              |                         |                               |
|   |              | None                    | None                          |
| RF CARRIER MOD TYPE   | -            |                         |                               |
| RF CARRIER MOD INDEX RNG  | Rad Pk       |                         |                               |
| SUBCARRIER FREQUENCY(S)   | Hz           |                         |                               |
| SUBCARRIER STEP SIZE  | Hz           |                         |                               |
| SUBCARRIER FREQ STABILITY   | ppm          |                         |                               |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                         |                               |
| SUBCARRIER MOD TYPE   | -            |                         |                               |
| SUBCARRIER/BIT RATE LIMIT   | -            |                         |                               |
| BIT RATE RANGE  | b/s          |                         |                               |
| FORMATS AVAILABLE   | -            |                         |                               |
|   |              |                         |                               |
|   |              |                         |                               |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE 2. SOME LIMITATIONS APPLY TO THIS CAPABILITY 3. NOT RECOMMENDED BY CCSDS |              |                         |                               |

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                 |                                       |
|---|--------------|---------------------------------------|---------------------------------------|
|   |              | WALLOPS FLIGHT FACILITY               | POKER FLAT RESEARCH RANGE             |
| <b>GENERAL</b>  |              |                                       |                                       |
| STATION DESIGNATION   | -            | TM                                    | AK 4.9                                |
| LOCATION(S)   | -            | Wallops Island, VA                    | Poker Flat Research Range, AK         |
| DIAMETER  | m            | 2.4                                   | 4.9                                   |
| <b>RECEIVE</b>  |              |                                       |                                       |
| FREQUENCIES   | MHz          | 1435 - 1535, 1670 - 1720, 2200 - 2400 | 1435 - 1535, 1670 - 1720, 2200 - 2300 |
| FREQUENCY RESOLUTION  | Hz           | 10 000                                | 25 000                                |
| ANTENNA GAIN @ 45 deg   | dBi          | 28.8 (L1), 30.0 (L2), 32.5 (S)        | 34.0 (L1), 36.2 (L2), 38.6 (S)        |
| SYS NOISE TEMP @ ZENITH   | K            | 350, 350, 350                         | 400, 415, 460                         |
| G/T @ 45 deg  | dB           | 3.3 (L1), 4.5 (L2), 7.0 (S)           | 8.0 (L1), 10.0 (L2), 12.0 (S)         |
| POLARIZATION  | -            | RHC, LHC                              | RHC, LHC                              |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 5.1 (L), 3.9 (S)                      | 2.5 (L), 1.9 (S)                      |
| ANTENNA ELLIPTICITY   | dB           | (1)                                   | (1)                                   |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-3}$                | $\pm 1 \times 10^{-3}$                |
| RCVR AGC DYNAMIC RANGE  | dB           | 130                                   | 130                                   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -144 in 2 Blo = 30 Hz                 | -144 in 2 Blo = 30 Hz                 |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 100, 300, 1 K, 3 K                | 30, 100, 300, 1 K, 3 K                |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                                 | Adapt                                 |
| RCVR PLL ORDER(S)   | No.          | 2                                     | 2                                     |
| ACQ SWEEP RANGE   | kHz          | $\pm 250$                             | $\pm 250$                             |
| MIN ACQ SWEEP RATE  | Hz/s         | Depends on Loop BW                    | Depends on Loop BW                    |
| MAX ACQ SWEEP RATE  | kHz/s        | Depends on Loop BW                    | Depends on Loop BW                    |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                            | Continuous                            |
| PROGRAMMED L.O.   | Yes/No       | No                                    | No                                    |
|   |              |                                       |                                       |
|   |              |                                       |                                       |
|   |              |                                       |                                       |
|   |              |                                       |                                       |
| <b>TELEMETRY</b>  |              |                                       |                                       |
| MODULATION TYPE(S)  | -            | PM, FM, AM                            | BPSK, PM, FM, AM                      |
| MODULATION FORMAT(S)  | -            | All IRIG's                            | All IRIG's                            |
| MOD INDEX RANGE   | Rad Pk       | 0.2 - 1.4                             | 0.2 - 2.8                             |
| SUBCARRIER FREQ RANGE   | kHz          | 1 - 2000                              | 1 - 2000                              |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                                  | Sine (S)                              |
| SYMBOL RATE RANGE   | s/s          | 4 - 6 600 000                         | 4 - 4 000 000                         |
| SUBCARRIER/SYM RATE LIMIT   | -            | > 1.5                                 | > 1.5                                 |
| ARRAYS WITH STATIONS  | -            | None                                  | None                                  |
| CHANNEL DECODING  | Type         | (1)                                   | (1)                                   |
| DATA FORMAT   | -            | (1)                                   | (1)                                   |
|   |              |                                       |                                       |
|   |              |                                       |                                       |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                                       |                                       |

6445-4522

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                 |                                       |
|---|--------------|---------------------------------------|---------------------------------------|
|   |              | WALLOPS FLIGHT FACILITY               | POKER FLAT RESEARCH RANGE             |
| <b>GENERAL</b>  |              |                                       |                                       |
| STATION DESIGNATION   | -            | TM                                    | AK 4.9                                |
| LOCATION(S)   | -            | Wallops Island, VA                    | Poker Flat Research Range, AK         |
| DIAMETER  | m            | 2.4                                   | 4.9                                   |
| <b>FREQUENCIES</b>  |              |                                       |                                       |
| TRANSMIT FREQUENCIES  | MHz          | None                                  | None                                  |
| RECEIVE FREQUENCIES   | MHz          | 1435 - 1535, 1670 - 1720, 2200 - 2400 | 1435 - 1535, 1670 - 1720, 2200 - 2400 |
| TURNAROUND FREQ RATIO   | -            | (1)                                   | (1)                                   |
| <b>DOPPLER</b>  |              |                                       |                                       |
| COHERENT/NON-COHERENT   | -            | None                                  | None                                  |
| COUNTER RESOLUTION  | Cycles       |                                       |                                       |
| MAX DOPPLER FREQ SHIFT  | MHz          |                                       |                                       |
| DOPPLER BIAS FREQ   | MHz          |                                       |                                       |
| DRIFT   | -            |                                       |                                       |
| OUTPUT EQUATION   | $\Delta f/f$ |                                       |                                       |
| DIRECTION INDICATOR   | -            |                                       |                                       |
|   |              |                                       |                                       |
|   |              |                                       |                                       |
|   |              |                                       |                                       |
| <b>RANGING</b>  |              |                                       |                                       |
| COHERENT/NON-COHERENT   | -            | None                                  | None                                  |
| RANGE CODE WAVEFORM   | Sin/Sq       |                                       |                                       |
| EARTH STATION MOD INDEX   | Rad Pk       |                                       |                                       |
| RANGE CODE FREQ RATIO   | -            |                                       |                                       |
| MAJOR CODE FREQ(S)  | kHz          |                                       |                                       |
| MINOR CODE FREQ(S)  | kHz          |                                       |                                       |
| MIN RECEIVED CARRIER SNR  | dB           |                                       |                                       |
| MIN REQ CODE PWR/No   | dB-Hz        |                                       |                                       |
| CODE INTEGRATION TIME   | s            |                                       |                                       |
| ACQUISITION SEQUENCE  | -            |                                       |                                       |
| RANGE DATA UNITS  | -            |                                       |                                       |
| RANGE QUANTIZATION  | -            |                                       |                                       |
| ACCURACY (STRONG SIGNAL)  | m            |                                       |                                       |
| MAX UNAMBIGUOUS RANGE   | km           |                                       |                                       |
| TRANSPONDER BW  | MHz          |                                       |                                       |
|   |              |                                       |                                       |
|   |              |                                       |                                       |
|   |              |                                       |                                       |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                                       |                                       |

6445-4523

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                                 |                     |   |                     |
|--|---------------|---|---------------------|---|---------------------|
|  |               | WALLOPS FLIGHT FACILITY                               |                     | POKER FLAT RESEARCH RANGE                             |                     |
| <b>GENERAL</b>   |               |   |                     |   |                     |
| STATION DESIGNATION  | -             | TM  |                     | AK 4.9  |                     |
| LOCATION(S)  | -             | Wallops Island, VA                                    |                     | Poker Flat Research Range, AK                         |                     |
| DIAMETER   | m             | 2.4   |                     | 4.9   |                     |
| <b>FREQUENCY STD</b>   |               |   |                     |   |                     |
| STANDARD TYPE  | Name          | Cesium Beam   |                     | Crystal Oscillator                                    |                     |
| STANDARD MFG   | Name          | HP5061A   |                     | Datum 9390  |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>                                 | <b>Drift</b>        | <b>Allan Variance</b>                                 | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - HOUR   | $\Delta f/f$  | (1)   | $3 \times 10^{-13}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)   | $3 \times 10^{-13}$ | (1)   | $2 \times 10^{-12}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)   | $3 \times 10^{-13}$ | (1)   | $8 \times 10^{-9}$  |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>  | <b>100 MHz</b>      | <b>5 MHz</b>  | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | (1)   | (1)                 | (1)   | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | -120  | (1)                 | -125  | (1)                 |
| 100 Hz OFFSET  | dBc/Hz        | -125  | (1)                 | -155  | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz        | -140  | (1)                 | -155  | (1)                 |
| REF FREQS AVAILABLE  | MHz           | 1,5   |                     | 0.0000001, 0.00001, 0.001, 5, 10                      |                     |
| MAX STA-TO-STA OFFSET  | Hz            | $\pm 5 \times 10^{-12}$                               |                     | (1)   |                     |
| <b>TIMING SYSTEM</b>   |               |   |                     |   |                     |
| MASTER REFERENCE AGENCY  | Name          | USNO  |                     | GPS   |                     |
| REFERENCE TIME   | Name          | UTC   |                     | GPS   |                     |
| TIME CODE EPOCH  | Yr            | 1972  |                     | GPS   |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$                                    |                     | $1 \times 10^{-6}$                                    |                     |
| TIME TRANSFER METHOD   | Name          | GPS   |                     | GPS   |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 1000, 1 000 000, 5 000 000                     |                     | 1, 10, 1000, 1 000 000, 5 000 000                     |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |   |                     |   |                     |

6445-4524

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS   | SUBNETWORK OR STATION                 |                                       |
|---|---------|---------------------------------------|---------------------------------------|
|   |         | WALLOPS FLIGHT FACILITY               | POKER FLAT RESEARCH RANGE             |
| <b>GENERAL</b>  |         |                                       |                                       |
| STATION DESIGNATION   | -       | TM                                    | AK 4.9                                |
| LOCATION(S)   | -       | Wallops Island, VA                    | Poker Flat Research Range, AK         |
| DIAMETER  | m       | 2.4                                   | 4.9                                   |
| <b>GEOGRAPHICAL</b>   |         |                                       |                                       |
| LOCATION, COUNTRY/STATE   | Name    | USA / Virginia                        | USA / Alaska                          |
| LOCATION, CITY  | Name    | Wallops Island, VA                    | Chatanika, AK                         |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s | 75 28 33 W                            | 147 27 46 W                           |
| LATITUDE (site 1/site 2/site 3)   | d, m, s | 37 55 41 N                            | 65 07 00 N                            |
|   |         |                                       |                                       |
|   |         |                                       |                                       |
|   |         |                                       |                                       |
| <b>MECHANICAL</b>   |         |                                       |                                       |
| TYPE OF MOUNT   | -       | El - Az                               | Az - El with Train                    |
| AZIMUTH LIMITATIONS   | -       | Keyhole Zenith                        | Keyhole Zenith                        |
| TRACKING SPEED RANGE  | deg/s   | 0.01 - 20                             | 0.05 - 15                             |
| MAX TRACK ACCELERATION  | deg/s   | 20                                    | 15                                    |
| TYPE OF POINTING  | Type    | Autotrack, Program, Slave             | Autotrack, Slave                      |
| POINTING ACCURACY   | deg     | 0.1                                   | 0.1                                   |
| MIN TRANSMIT ELEV ANGLE   | deg     | (1)                                   | (1)                                   |
| MIN RECEIVE ELEV ANGLE  | deg     | 0                                     | - 8                                   |
|   |         |                                       |                                       |
|   |         |                                       |                                       |
|   |         |                                       |                                       |
| <b>SUPPORT</b>  |         |                                       |                                       |
| TRANSMIT FREQ BAND(S)   | GHz     | None                                  | None                                  |
| RECEIVE FREQ BAND(S)  | GHz     | 1.435 - 1.535, 1.67 - 1.72, 2.2 - 2.4 | 1.435 - 1.535, 1.67 - 1.72, 2.3 - 2.4 |
| ACQ AID FREQ BAND(S)  | GHz     | (1)                                   | (1)                                   |
| MISSION CATEGORIES  | Cat     | A                                     | A                                     |
|   |         |                                       |                                       |
|   |         |                                       |                                       |
|   |         |                                       |                                       |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |         |                                       |                                       |

6445-4525



CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION   |                         |
|---|--------------|-------------------------|-------------------------|
|   |              | WALLOPS FLIGHT FACILITY | WALLOPS FLIGHT FACILITY |
| <b>GENERAL</b>  |              |                         |                         |
| STATION DESIGNATION   | -            | Wallops 6-Meter         | METEOSAT                |
| LOCATION(S)   | -            | Wallops Island, VA      | Wallops Island, VA      |
| DIAMETER  | m            | 6                       | 7.3                     |
| <b>RECEIVE</b>  |              |                         |                         |
|   |              | None                    |                         |
| FREQUENCIES   | MHz          |                         | 1685 - 1710             |
| FREQUENCY RESOLUTION  | Hz           |                         | 10 000                  |
| ANTENNA GAIN @ 45 deg   | dBi          |                         | 39                      |
| SYS NOISE TEMP @ ZENITH   | K            |                         | 500                     |
| G/T @ 45 deg  | dB           |                         | 12                      |
| POLARIZATION  | -            |                         | RHC, LHC                |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          |                         | 1.7                     |
| ANTENNA ELLIPTICITY   | dB           |                         | (1)                     |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ |                         | $\pm 1 \times 10^{-3}$  |
| RCVR AGC DYNAMIC RANGE  | dB           |                         | 130                     |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          |                         | -143 in 2 Blo = 30 Hz   |
| RCVR LOOP BANDWIDTHS  | Hz           |                         | 30, 100, 300, 1K, 3 K   |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            |                         | Adapt                   |
| RCVR PLL ORDER(S)   | No.          |                         | 2                       |
| ACQ SWEEP RANGE   | kHz          |                         | $\pm 250$               |
| MIN ACQ SWEEP RATE  | Hz/s         |                         | Depends on Loop BW      |
| MAX ACQ SWEEP RATE  | kHz/s        |                         | Depends on Loop BW      |
| ACQ SWEEP STEP SIZE   | Hz           |                         | Continuous              |
| PROGRAMMED L.O.   | Yes/No       |                         | No                      |
|   |              |                         |                         |
|   |              |                         |                         |
|   |              |                         |                         |
|   |              |                         |                         |
| <b>TELEMETRY</b>  |              |                         |                         |
|   |              | None                    |                         |
| MODULATION TYPE(S)  | -            |                         | PM, FM, AM              |
| MODULATION FORMAT(S)  | -            |                         | All IRIG's              |
| MOD INDEX RANGE   | Rad Pk       |                         | 0.2 - 1.4               |
| SUBCARRIER FREQ RANGE   | kHz          |                         | 1 - 2000                |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                         | Sine                    |
| SYMBOL RATE RANGE   | s/s          |                         | 4 - 6 600 000           |
| SUBCARRIER/SYM RATE LIMIT   | -            |                         | > 1.5                   |
| ARRAYS WITH STATIONS  | -            |                         | None                    |
| CHANNEL DECODING  | Type         |                         | (1)                     |
| DATA FORMAT   | -            |                         | (1)                     |
|   |              |                         |                         |
|   |              |                         |                         |
|   |              |                         |                         |
|   |              |                         |                         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                         |                         |

6445-4561

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION   |                         |
|---|--------------|-------------------------|-------------------------|
|   |              | WALLOPS FLIGHT FACILITY | WALLOPS FLIGHT FACILITY |
| <b>GENERAL</b>  |              |                         |                         |
| STATION DESIGNATION   | -            | Wallops 6-Meter         | METEOSAT                |
| LOCATION(S)   | -            | Wallops Island, VA      | Wallops Island, VA      |
| DIAMETER  | m            | 6                       | 7.3                     |
| <b>FREQUENCIES</b>  |              |                         |                         |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120             | None                    |
| RECEIVE FREQUENCIES   | MHz          | (1)                     |                         |
| TURNAROUND FREQ RATIO   | -            | (1)                     |                         |
| <b>DOPPLER</b>  |              |                         |                         |
| COHERENT/NON-COHERENT   | -            | None                    |                         |
| COUNTER RESOLUTION  | Cycles       |                         |                         |
| MAX DOPPLER FREQ SHIFT  | MHz          |                         |                         |
| DOPPLER BIAS FREQ   | MHz          |                         |                         |
| DRIFT   | $\Delta f/f$ |                         |                         |
| OUTPUT EQUATION   | -            |                         |                         |
| DIRECTION INDICATOR   | -            |                         |                         |
|   |              |                         |                         |
|   |              |                         |                         |
|   |              |                         |                         |
| <b>RANGING</b>  |              |                         |                         |
| COHERENT/NON-COHERENT   | -            | None                    | None                    |
| RANGE CODE WAVEFORM   | Sin/Sq       |                         |                         |
| EARTH STATION MOD INDEX   | Rad Pk       |                         |                         |
| RANGE CODE FREQ RATIO   | -            |                         |                         |
| MAJOR CODE FREQ(S)  | kHz          |                         |                         |
| MINOR CODE FREQ(S)  | kHz          |                         |                         |
| MIN RECEIVED CARRIER SNR  | dB           |                         |                         |
| MIN REQ CODE PWR/No   | dB-Hz        |                         |                         |
| CODE INTEGRATION TIME   | s            |                         |                         |
| ACQUISITION SEQUENCE  | -            |                         |                         |
| RANGE DATA UNITS  | -            |                         |                         |
| RANGE QUANTIZATION  | -            |                         |                         |
| ACCURACY (STRONG SIGNAL)  | m            |                         |                         |
| MAX UNAMBIGUOUS RANGE   | km           |                         |                         |
| TRANSPONDER BW  | MHz          |                         |                         |
|   |              |                         |                         |
|   |              |                         |                         |
|   |              |                         |                         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                         |                         |

6445-4562

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS   | UNITS         | SUBNETWORK OR STATION                                 |                     |   |                     |
|---|---------------|---|---------------------|---|---------------------|
|   |               | WALLOPS FLIGHT FACILITY                               |                     | WALLOPS FLIGHT FACILITY                               |                     |
| <b>GENERAL</b>  |               |   |                     |   |                     |
| STATION DESIGNATION   | -             | Wallops 6-Meter                                       |                     | METEOSAT  |                     |
| LOCATION(S)   | -             | Wallops Island, VA                                    |                     | Wallops Island, VA                                    |                     |
| DIAMETER  | m             | 6   |                     | 7.3   |                     |
| <b>FREQUENCY STD</b>  |               |   |                     |   |                     |
| STANDARD TYPE   | Name          | Cesium Beam   |                     | Cesium Beam   |                     |
| STANDARD MFG  | Name          | HP5061A   |                     | HP5061A   |                     |
| STABILITY AT:   |               | <b>Allan Variance</b>                                 | <b>Drift</b>        | <b>Allan Variance</b>                                 | <b>Drift</b>        |
| 1 - SECOND  | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - HOUR  | $\Delta f/f$  | (1)   | $3 \times 10^{-13}$ | (1)   | $3 \times 10^{-13}$ |
| 1 - DAY (24 HOURS)  | $\Delta f/f$  | (1)   | $3 \times 10^{-13}$ | (1)   | $3 \times 10^{-13}$ |
| 1 - MONTH   | $\Delta f/f$  | (1)   | $3 \times 10^{-13}$ | (1)   | $3 \times 10^{-13}$ |
| REF FREQS PHASE NOISE   | $S_{\phi}(f)$ | <b>5 MHz</b>  | <b>100 MHz</b>      | <b>5 MHz</b>  | <b>100 MHz</b>      |
| 1 Hz OFFSET   | dBc/Hz        | (1)   | (1)                 | (1)   | (1)                 |
| 10 Hz OFFSET  | dBc/Hz        | -120  | (1)                 | -120  | (1)                 |
| 100 Hz OFFSET   | dBc/Hz        | -125  | (1)                 | -125  | (1)                 |
| 1000 Hz OFFSET  | dBc/Hz        | -140  | (1)                 | -140  | (1)                 |
| REF FREQS AVAILABLE   | MHz           | 1, 5  |                     | 1, 5  |                     |
| MAX STA-TO-STA OFFSET   | Hz            | $\pm 5 \times 10^{-12}$                               |                     | $\pm 5 \times 10^{-12}$                               |                     |
| <b>TIMING SYSTEM</b>  |               |   |                     |   |                     |
| MASTER REFERENCE AGENCY   | Name          | USNO  |                     | USNO  |                     |
| REFERENCE TIME  | Name          | UTC   |                     | UTC   |                     |
| TIME CODE EPOCH   | Yr            | 1972  |                     | 1972  |                     |
| TIME CODES AVAILABLE  | CCSDS Codes   | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     |
| MAX TIME RESOLUTION   | s             | $1 \times 10^{-6}$                                    |                     | $1 \times 10^{-6}$                                    |                     |
| TIME TRANSFER METHOD  | Name          | GPS   |                     | GPS   |                     |
| MAX TRANS ERROR REF   | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET FROM REF   | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET MEAS ERROR   | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX STA-TO-STA OFFSET   | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| TIMING SIGNALS AVAILABLE  | pulse/s       | 1, 10, 1000, 1 000 000, 5 000 000                     |                     | 1, 10, 1000, 1 000 000, 5, 000 000                    |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |               |   |                     |   |                     |
| 4. MEASURED BY THE AGENCY <span style="float: right;">6445-4563</span>  |               |   |                     |   |                     |

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS   | SUBNETWORK OR STATION   |                         |
|---|---------|-------------------------|-------------------------|
|   |         | WALLOPS FLIGHT FACILITY | WALLOPS FLIGHT FACILITY |
| <b>GENERAL</b>  |         |                         |                         |
| STATION DESIGNATION   | -       | Wallops 6-Meter         | METEOSAT                |
| LOCATION(S)   | -       | Wallops Island, VA      | Wallops Island, VA      |
| DIAMETER  | m       | 6                       | 7.3                     |
| <b>GEOGRAPHICAL</b>   |         |                         |                         |
| LOCATION, COUNTRY/STATE   | Name    | USA / Virginia          | USA / Virginia          |
| LOCATION, CITY  | Name    | Wallops Island, VA      | Wallops Island, VA      |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s | 75 28 33 W              | 75 28 35 W              |
| LATITUDE (site 1/site 2/site 3)   | d, m, s | 37 55 39 N              | 37 55 36 N              |
|   |         |                         |                         |
|   |         |                         |                         |
|   |         |                         |                         |
|   |         |                         |                         |
| <b>MECHANICAL</b>   |         |                         |                         |
| TYPE OF MOUNT   | -       | EI - Az                 | Stationary              |
| AZIMUTH LIMITATIONS   | -       | Keyhole Zenith          | (1)                     |
| TRACKING SPEED RANGE  | deg/s   | 0.002 - 10              | (1)                     |
| MAX TRACK ACCELERATION  | deg/s   | 5                       | (1)                     |
| TYPE OF POINTING  | Type    | Predicts, Slave         | Stationary              |
| POINTING ACCURACY   | deg     | 0.25                    | 1                       |
| MIN TRANSMIT ELEV ANGLE   | deg     | 0                       | 0                       |
| MIN RECEIVE ELEV ANGLE  | deg     | (1)                     | (1)                     |
|   |         |                         |                         |
|   |         |                         |                         |
|   |         |                         |                         |
|   |         |                         |                         |
| <b>SUPPORT</b>  |         |                         |                         |
| TRANSMIT FREQ BAND(S)   | GHz     | 2.025 - 2.12            | None                    |
| RECEIVE FREQ BAND(S)  | GHz     | None                    | 1.685 - 1.71            |
| ACQ AID FREQ BAND(S)  | GHz     | (1)                     | (1)                     |
| MISSION CATEGORIES  | Cat     | A                       | A                       |
|   |         |                         |                         |
|   |         |                         |                         |
|   |         |                         |                         |
|   |         |                         |                         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |         |                         |                         |

6445-4564



CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                 |                                       |
|-----------------------------|--------------|---------------------------------------|---------------------------------------|
|                             |              | WALLOPS FLIGHT FACILITY               | WALLOPS FLIGHT FACILITY               |
| <b>GENERAL</b>              |              |                                       |                                       |
| STATION DESIGNATION         | -            | MG - North                            | MG - South                            |
| LOCATION(S)                 | -            | Wallops Island, VA                    | Wallops Island, VA                    |
| DIAMETER                    | m            | 7.3                                   | 7.3                                   |
| <b>RECEIVE</b>              |              |                                       |                                       |
| FREQUENCIES                 | MHz          | 1435 - 1535, 1670 - 1720, 2200 - 2400 | 1435 - 1535, 1670 - 1720, 2200 - 2400 |
| FREQUENCY RESOLUTION        | Hz           | 25 000                                | 25 000                                |
| ANTENNA GAIN @ 45 deg       | dBi          | 37.5 (L1), 39.6 (L2), 42.0 (S)        | 37.5 (L1), 39.6 (L2), 42.0 (S)        |
| SYS NOISE TEMP @ ZENITH     | K            | 446, 510, 446                         | 440, 510, 445                         |
| G/T @ 45 deg                | dB           | 11 (L1), 12.5 (L2), 15.5 (S)          | 11 (L1), 12.5 (L2), 15.5 (S)          |
| POLARIZATION                | -            | RHC, LHC                              | RHC, LHC                              |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 1.69 (L), 1.28 (S)                    | 1.69 (L), 1.28 (S)                    |
| ANTENNA ELLIPTICITY         | dB           | (1)                                   | (1)                                   |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-3}$                | $\pm 1 \times 10^{-3}$                |
| RCVR AGC DYNAMIC RANGE      | dB           | 130                                   | 130                                   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | - 143 in 2 Blo = 30 Hz                | 30, 100, 300, 1 K, 3 K                |
| RCVR LOOP BANDWIDTHS        | Hz           | 30, 100, 300, 1 K, 3 K                | -143 in 2 Blo = 30 Hz                 |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                                 | Adapt                                 |
| RCVR PLL ORDER(S)           | No.          | 2                                     | 2                                     |
| ACQ SWEEP RANGE             | kHz          | $\pm 250$                             | $\pm 250$                             |
| MIN ACQ SWEEP RATE          | Hz/s         | Depends on Loop BW                    | Depends on Loop BW                    |
| MAX ACQ SWEEP RATE          | kHz/s        | Depends on Loop BW                    | Depends on Loop BW                    |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous                            | Continuous                            |
| PROGRAMMED L.O.             | Yes/No       | No                                    | No                                    |
|                             |              |                                       |                                       |
|                             |              |                                       |                                       |
|                             |              |                                       |                                       |
| <b>TELEMETRY</b>            |              |                                       |                                       |
| MODULATION TYPE(S)          | -            | PM, FM, AM                            | PM, FM, AM                            |
| MODULATION FORMAT(S)        | -            | All IRIG's                            | All IRIG's                            |
| MOD INDEX RANGE             | Rad Pk       | 0.2 - 2.8                             | 0.2 - 2.8                             |
| SUBCARRIER FREQ RANGE       | kHz          | 1 - 2000                              | 1 - 2000                              |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine                                  | Sine                                  |
| SYMBOL RATE RANGE           | s/s          | 4 - 6 600 000                         | 4 - 6 600 000                         |
| SUBCARRIER/SYM RATE LIMIT   | -            | > 1.5                                 | > 1.5                                 |
| ARRAYS WITH STATIONS        | -            | None                                  | None                                  |
| CHANNEL DECODING            | Type         | (1)                                   | (1)                                   |
| DATA FORMAT                 | -            | (1)                                   | (1)                                   |
|                             |              |                                       |                                       |
|                             |              |                                       |                                       |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-4497

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION  |  |
|---|--------------|--|--|
|   |              | WALLOPS FLIGHT FACILITY  | WALLOPS FLIGHT FACILITY  |
| <b>GENERAL</b>  |              |  |  |
| STATION DESIGNATION   | -            | MG - North   | MG - South   |
| LOCATION(S)   | -            | Wallops Island, VA   | Wallops Island, VA   |
| DIAMETER  | m            | 7.3  | 7.3  |
| <b>FREQUENCIES</b>  |              |  |  |
| TRANSMIT FREQUENCIES  | MHz          | (1)  | None   |
| RECEIVE FREQUENCIES   | MHz          | 1435 - 1535, 1670 - 1720, 2200 - 2400  | 1435 - 1535, 1670 - 1720, 2200 - 2400  |
| TURNAROUND FREQ RATIO   | -            | (1)  | (1)  |
| <b>DOPPLER</b>  |              |  |  |
| COHERENT/NON-COHERENT   | -            | Coherent and Non-Coherent 2-Way (with 6-meter)   | Coherent and Non-Coherent 2-Way (with 6-meter)   |
| COUNTER RESOLUTION  | Cycles       | 0.001  | 0.001  |
| MAX DOPPLER FREQ SHIFT  | MHz          | ± 0.25   | ± 0.25   |
| DOPPLER BIAS FREQ   | MHz          | 0.24   | 0.24   |
| DRIFT   | $\Delta f/f$ | $4 \times 10^{-11}$ @ 0.1 sec  | $4 \times 10^{-11}$ @ 0.1 sec  |
| OUTPUT EQUATION   | -            | $1000 [f (xmit) \times (240 / 221) - f (receive)] + f (bias)$                          | $1000 [f (xmit) \times (240 / 221) - f (receive)] + f (bias)$                          |
| DIRECTION INDICATOR   | -            | $+ \Delta f = -\Delta r$   | $+ \Delta f = -\Delta r$   |
| <b>RANGING</b>  |              |  |  |
| COHERENT/NON-COHERENT   | -            | 2-Way Coherent and Non-Coherent  | 2-Way Coherent / Non-Coherent  |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine   | Sine   |
| EARTH STATION MOD INDEX   | Rad Pk       | PM, 0.2 - 1.5 on Carrier; 0.3 - 1.2 on 1.7 MHz Subcarrier                              | PM, 0.2 - 1.5 on Carrier; 0.3 - 1.2 on 1.7 MHz Subcarrier                              |
| RANGE CODE FREQ RATIO   | -            | 5:1, 4:1   | 5:1, 4:1   |
| MAJOR CODE FREQ(S)  | kHz          | 500, 100, 20   | 500, 100, 20   |
| MINOR CODE FREQ(S)  | kHz          | 100, 20, 4 on Carrier or 1.7 MHz Range Subcarrier; 0.8, 0.16, 0.04, 0.01 on 4 kHz Tone | 100, 20, 4 on Carrier or 1.7 MHz Range Subcarrier; 0.8, 0.16, 0.04, 0.01 on 4 kHz Tone |
| MIN RECEIVED CARRIER SNR  | dB           | 10   | 10   |
| MIN REQ CODE PWR/No   | dB-Hz        | 15   | 15   |
| CODE INTEGRATION TIME   | s            | (1)  | (1)  |
| ACQUISITION SEQUENCE  | -            | Automatic / Manual   | Automatic / Manual   |
| RANGE DATA UNITS  | -            | Nanoseconds  | Nanoseconds  |
| RANGE QUANTIZATION  | -            | Nanoseconds  | Nanoseconds  |
| ACCURACY (STRONG SIGNAL)  | m            | 1 (RSS)  | 1 (RSS)  |
| MAX UNAMBIGUOUS RANGE   | km           | 644 000  | 644 000  |
| TRANSPONDER BW  | MHz          | < 0.8  | < 0.8  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |  |  |

6445-4498

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                                    |                     |  |                     |
|--|---------------|--|---------------------|--|---------------------|
|  |               | WALLOPS FLIGHT FACILITY                                  |                     | WALLOPS FLIGHT FACILITY                                  |                     |
| <b>GENERAL</b>   |               |  |                     |  |                     |
| STATION DESIGNATION  | -             | MG - North   |                     | MG - South   |                     |
| LOCATION(S)  | -             | Wallops Island, VA                                       |                     | Wallops Island, VA                                       |                     |
| DIAMETER   | m             | 7.3  |                     | 7.3  |                     |
| <b>FREQUENCY STD</b>   |               |  |                     |  |                     |
| STANDARD TYPE  | Name          | Cesium Beam  |                     | Cesium Beam  |                     |
| STANDARD MFG   | Name          | HP5016A  |                     | HP5061A  |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>                                    | <b>Drift</b>        | <b>Allan Variance</b>                                    | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | (1)  | $1 \times 10^{-11}$ | (1)  | $1 \times 10^{-11}$ |
| 1 - HOUR   | $\Delta f/f$  | (1)  | $3 \times 10^{-13}$ | (1)  | $3 \times 10^{-13}$ |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)  | $3 \times 10^{-13}$ | (1)  | $3 \times 10^{-13}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)  | $3 \times 10^{-13}$ | (1)  | $3 \times 10^{-13}$ |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>   | <b>100 MHz</b>      | <b>5 MHz</b>   | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | (1)  | (1)                 | (1)  | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | -120   | (1)                 | -120   | (1)                 |
| 100 Hz OFFSET  | dBc/Hz        | -125   | (1)                 | -125   | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz        | -140   | (1)                 | -140   | (1)                 |
| REF FREQS AVAILABLE  | MHz           | 1, 5   |                     | 1, 5   |                     |
| MAX STA-TO-STA OFFSET  | Hz            | $\pm 5 \times 10^{-12}$                                  |                     | $\pm 5 \times 10^{-12}$                                  |                     |
| <b>TIMING SYSTEM</b>   |               |  |                     |  |                     |
| MASTER REFERENCE AGENCY  | Name          | USNO   |                     | USNO   |                     |
| REFERENCE TIME   | Name          | UTC  |                     | UTC  |                     |
| TIME CODE EPOCH  | Yr            | 1972   |                     | 1972   |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG A, B, G, H; NASA 28, 36;<br>1 pps; 10 pps; 1000 pps |                     | IRIG A, B, G, H; NASA 28, 36;<br>1 pps; 10 pps; 1000 pps |                     |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$                                       |                     | $1 \times 10^{-6}$                                       |                     |
| TIME TRANSFER METHOD   | Name          | GPS  |                     | GPS  |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$   |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$   |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$   |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$   |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 1000, 1 000 000, 5 000 000                        |                     | 1, 10, 1000, 1 000 000, 5 000 000                        |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |  |                     |  |                     |

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION                 |                                       |
|---|--------------------|---------------------------------------|---------------------------------------|
|   |                    | WALLOPS FLIGHT FACILITY               | WALLOPS FLIGHT FACILITY               |
| <b>GENERAL</b>  |                    |                                       |                                       |
| STATION DESIGNATION   | -                  | MG - North                            | MG - South                            |
| LOCATION(S)   | -                  | Wallops Island, VA                    | Wallops Island, VA                    |
| DIAMETER  | m                  | 7.3                                   | 7.3                                   |
| <b>GEOGRAPHICAL</b>   |                    |                                       |                                       |
| LOCATION, COUNTRY/STATE   | Name               | USA / Virginia                        | USA / Virginia                        |
| LOCATION, CITY  | Name               | Wallops Island, VA                    | Wallops Island, VA                    |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 75 28 27 W                            | 75 28 28 W                            |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 37 55 42 N                            | 37 55 41 N                            |
|   |                    |                                       |                                       |
|   |                    |                                       |                                       |
|   |                    |                                       |                                       |
| <b>MECHANICAL</b>   |                    |                                       |                                       |
| TYPE OF MOUNT   | -                  | EI - Az                               | EI - Az                               |
| AZIMUTH LIMITATIONS   | -                  | Keyhole Zenith                        | Keyhole Zenith                        |
| TRACKING SPEED RANGE  | deg/s              | 0.002 - 20                            | 0.002 - 20                            |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 20                                    | 20                                    |
| TYPE OF POINTING  | Type               | Autotrack, Program, Slave             | Autotrack, Program, Slave             |
| POINTING ACCURACY   | deg                | 0.05                                  | 0.05                                  |
| MIN TRANSMIT ELEV ANGLE   | deg                | (1)                                   | (1)                                   |
| MIN RECEIVE ELEV ANGLE  | deg                | 3                                     | 3                                     |
|   |                    |                                       |                                       |
|   |                    |                                       |                                       |
|   |                    |                                       |                                       |
|   |                    |                                       |                                       |
| <b>SUPPORT</b>  |                    |                                       |                                       |
| TRANSMIT FREQ BAND(S)   | GHz                | None                                  | None                                  |
| RECEIVE FREQ BAND(S)  | GHz                | 1.435 - 1.535, 1.67 - 1.72, 2.2 - 2.4 | 1.435 - 1.535, 1.67 - 1.72, 2.2 - 2.4 |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                                   | (1)                                   |
| MISSION CATEGORIES  | Cat                | A                                     | A                                     |
|   |                    |                                       |                                       |
|   |                    |                                       |                                       |
|   |                    |                                       |                                       |
|   |                    |                                       |                                       |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                                       |                                       |

6445-4500

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION     |                               |
|---|--------------|---------------------------|-------------------------------|
|   |              | WHITE SANDS MISSILE RANGE | POKER FLAT RESEARCH RANGE     |
| <b>GENERAL</b>  |              |                           |                               |
| STATION DESIGNATION   | -            | Redstone System 1         | Redstone System 2             |
| LOCATION(S)   | -            | White Sands, NM           | Poker Flat Research Range, AK |
| DIAMETER  | m            | 9                         | 9                             |
| <b>TRANSMIT</b>   |              | None                      | None                          |
| FREQUENCIES   | MHz          |                           |                               |
| FREQUENCY RESOLUTION  | Hz           |                           |                               |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ |                           |                               |
| TRANSMIT POWER 1  | W            |                           |                               |
| EIRP RANGE 1  | dBW          |                           |                               |
| TRANSMIT POWER 2  | W            |                           |                               |
| EIRP RANGE 2  | dBW          |                           |                               |
| POLARIZATION  | -            |                           |                               |
| ANTENNA GAIN  | dBi          |                           |                               |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          |                           |                               |
| ANTENNA ELLIPTICITY   | dB           |                           |                               |
| RF FREQ SWEEP RANGE   | kHz          |                           |                               |
| MIN FREQ SWEEP RATE   | Hz/s         |                           |                               |
| MAX FREQ SWEEP RATE   | kHz/s        |                           |                               |
| PROGRAMMED UPLINK FREQ  | Yes/No       |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
| <b>COMMAND</b>  |              | None                      | None                          |
| RF CARRIER MOD TYPE   | -            |                           |                               |
| RF CARRIER MOD INDEX RNG  | Rad Pk       |                           |                               |
| SUBCARRIER FREQUENCY(S)   | Hz           |                           |                               |
| SUBCARRIER STEP SIZE  | Hz           |                           |                               |
| SUBCARRIER FREQ STABILITY   | ppm          |                           |                               |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                           |                               |
| SUBCARRIER MOD TYPE   | -            |                           |                               |
| SUBCARRIER/BIT RATE LIMIT   | -            |                           |                               |
| BIT RATE RANGE  | b/s          |                           |                               |
| FORMATS AVAILABLE   | -            |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                           |                               |

6445-4516

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION     |                               |
|-----------------------------|--------------|---------------------------|-------------------------------|
|                             |              | WHITE SANDS MISSILE RANGE | POKER FLAT RESEARCH RANGE     |
| <b>GENERAL</b>              |              |                           |                               |
| STATION DESIGNATION         | -            | Redstone System 1         | Redstone System 2             |
| LOCATION(S)                 | -            | White Sands, NM           | Poker Flat Research Range, AK |
| DIAMETER                    | m            | 9                         | 9                             |
| <b>RECEIVE</b>              |              |                           |                               |
| FREQUENCIES                 | MHz          | 2200 - 2400               | 2200 - 2400                   |
| FREQUENCY RESOLUTION        | Hz           | 25 000                    | 25 000                        |
| ANTENNA GAIN @ 45 deg       | dBi          | 44                        | 44                            |
| SYS NOISE TEMP @ ZENITH     | K            | 160                       | 160                           |
| G/T @ 45 deg                | dB           | 22                        | 22                            |
| POLARIZATION                | -            | RHC, LHC                  | RHC, LHC                      |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 1.04                      | 1.04                          |
| ANTENNA ELLIPTICITY         | dB           | (1)                       | (1)                           |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-3}$    | $\pm 1 \times 10^{-3}$        |
| RCVR AGC DYNAMIC RANGE      | dB           | 130                       | 130                           |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -148 in 2 Blo = 30 Hz     | -148 in 2 Blo = 30 Hz         |
| RCVR LOOP BANDWIDTHS        | Hz           | 30, 100, 300, 1 K, 3 K    | 30, 100, 300, 1 K, 3 K        |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                     | Adapt                         |
| RCVR PLL ORDER(S)           | No.          | 2                         | 2                             |
| ACQ SWEEP RANGE             | kHz          | $\pm 250$                 | $\pm 250$                     |
| MIN ACQ SWEEP RATE          | Hz/s         | Depends on Loop BW        | Depends on Loop BW            |
| MAX ACQ SWEEP RATE          | kHz/s        | Depends on Loop BW        | Depends on Loop BW            |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous                | Continuous                    |
| PROGRAMMED L.O.             | Yes/No       | No                        | No                            |
|                             |              |                           |                               |
|                             |              |                           |                               |
|                             |              |                           |                               |
| <b>TELEMETRY</b>            |              |                           |                               |
| MODULATION TYPE(S)          | -            | BPSK, PM, FM, AM          | BPSK, PM, FM, AM              |
| MODULATION FORMAT(S)        | -            | All IRIG's                | All IRIG's                    |
| MOD INDEX RANGE             | Rad Pk       | 0.2 - 2.8                 | 0.2 - 2.8                     |
| SUBCARRIER FREQ RANGE       | kHz          | 1 - 2000                  | 1 - 2000                      |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine                      | Sine                          |
| SYMBOL RATE RANGE           | s/s          | 4 - 4 000 000             | 4 - 4 000 000                 |
| SUBCARRIER/SYM RATE LIMIT   | -            | > 1.5                     | > 1.5                         |
| ARRAYS WITH STATIONS        | -            | None                      | None                          |
| CHANNEL DECODING            | Type         | (1)                       | (1)                           |
| DATA FORMAT                 | -            | (1)                       | (1)                           |
|                             |              |                           |                               |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

6445-4517

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION     |                               |
|---|--------------|---------------------------|-------------------------------|
|   |              | WHITE SANDS MISSILE RANGE | POKER FLAT RESEARCH RANGE     |
| <b>GENERAL</b>  |              |                           |                               |
| STATION DESIGNATION   | -            | Redstone System 1         | Redstone System 2             |
| LOCATION(S)   | -            | White Sands, NM           | Poker Flat Research Range, AK |
| DIAMETER  | m            | 9                         | 9                             |
| <b>FREQUENCIES</b>  |              |                           |                               |
| TRANSMIT FREQUENCIES  | MHz          | None                      | None                          |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2400               | 2200 - 2400                   |
| TURNAROUND FREQ RATIO   | -            | (1)                       | (1)                           |
| <b>DOPPLER</b>  |              |                           |                               |
| COHERENT/NON-COHERENT   | -            | None                      | None                          |
| COUNTER RESOLUTION  | Cycles       |                           |                               |
| MAX DOPPLER FREQ SHIFT  | MHz          |                           |                               |
| DOPPLER BIAS FREQ   | MHz          |                           |                               |
| DRIFT   | $\Delta f/f$ |                           |                               |
| OUTPUT EQUATION   | -            |                           |                               |
| DIRECTION INDICATOR   | -            |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
| <b>RANGING</b>  |              |                           |                               |
| COHERENT/NON-COHERENT   | -            | None                      | None                          |
| RANGE CODE WAVEFORM   | Sin/Sq       |                           |                               |
| EARTH STATION MOD INDEX   | Rad Pk       |                           |                               |
| RANGE CODE FREQ RATIO   | -            |                           |                               |
| MAJOR CODE FREQ(S)  | kHz          |                           |                               |
| MINOR CODE FREQ(S)  | kHz          |                           |                               |
| MIN RECEIVED CARRIER SNR  | dB           |                           |                               |
| MIN REQ CODE PWR/No   | dB-Hz        |                           |                               |
| CODE INTEGRATION TIME   | s            |                           |                               |
| ACQUISITION SEQUENCE  | -            |                           |                               |
| RANGE DATA UNITS  | -            |                           |                               |
| RANGE QUANTIZATION  | -            |                           |                               |
| ACCURACY (STRONG SIGNAL)  | m            |                           |                               |
| MAX UNAMBIGUOUS RANGE   | km           |                           |                               |
| TRANSPONDER BW  | MHz          |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
|   |              |                           |                               |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                           |                               |

6445-4518

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                                 |                     |   |                     |
|--|---------------|---|---------------------|---|---------------------|
|  |               | WHITE SANDS MISSILE RANGE                             |                     | POKER FLAT RESEARCH RANGE                             |                     |
| <b>GENERAL</b>   |               |   |                     |   |                     |
| STATION DESIGNATION  | -             | Redstone System 1                                     |                     | Redstone System 2                                     |                     |
| LOCATION(S)  | -             | White Sands, NM                                       |                     | Poker Flat Research Range, AK                         |                     |
| DIAMETER   | m             | 9   |                     | 9   |                     |
| <b>FREQUENCY STD</b>   |               |   |                     |   |                     |
| STANDARD TYPE  | Name          | Crystal Oscillator                                    |                     | Crystal Oscillator                                    |                     |
| STANDARD MFG   | Name          | Datum 9390  |                     | Datum 9390  |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>                                 | <b>Drift</b>        | <b>Allan Variance</b>                                 | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - HOUR   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)   | $2 \times 10^{-12}$ | (1)   | $2 \times 10^{-12}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)   | $8 \times 10^{-9}$  | (1)   | $8 \times 10^{-9}$  |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>  | <b>100 MHz</b>      | <b>5 MHz</b>  | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | (1)   | (1)                 | (1)   | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | -125  | (1)                 | -125  | (1)                 |
| 100 Hz OFFSET  | dBc/Hz        | -155  | (1)                 | -155  | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz        | -155  | (1)                 | -155  | (1)                 |
| REF FREQS AVAILABLE  | MHz           | 0.000001, 0.00001, 0.001, 5, 10                       |                     | 0.000001, 0.00001, 0.001, 5, 10                       |                     |
| MAX STA-TO-STA OFFSET  | Hz            | (1)   |                     | (1)   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
| <b>TIMING SYSTEM</b>   |               |   |                     |   |                     |
| MASTER REFERENCE AGENCY  | Name          | USNO  |                     | GPS   |                     |
| REFERENCE TIME   | Name          | UTC   |                     | GPS   |                     |
| TIME CODE EPOCH  | Yr            | 1972  |                     | GPS   |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     |
| MAX TIME RESOLUTION  | s             | (1)   |                     | $1 \times 10^{-6}$                                    |                     |
| TIME TRANSFER METHOD   | Name          | GPS   |                     | GPS   |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 1000, 1 000 000, 5 000 000                     |                     | 1, 10, 1000, 1 000 000, 5 000 000                     |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |   |                     |   |                     |

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION     |                               |
|---|--------------------|---------------------------|-------------------------------|
|   |                    | WHITE SANDS MISSILE RANGE | POKER FLAT RESEARCH RANGE     |
| <b>GENERAL</b>  |                    |                           |                               |
| STATION DESIGNATION   | -                  | Redstone System 1         | Redstone System 2             |
| LOCATION(S)   | -                  | White Sands, NM           | Poker Flat Research Range, AK |
| DIAMETER  | m                  | 9                         | 9                             |
| <b>GEOGRAPHICAL</b>   |                    |                           |                               |
| LOCATION, COUNTRY/STATE   | Name               | USA / New Mexico          | USA / Alaska                  |
| LOCATION, CITY  | Name               | White Sands, NM           | Chatanika, AK                 |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 106, 19, 26.4 W           | 147, 27, 23 W                 |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 32, 24, 18 N              | 65, 07, 04 N                  |
|   |                    |                           |                               |
|   |                    |                           |                               |
|   |                    |                           |                               |
|   |                    |                           |                               |
| <b>MECHANICAL</b>   |                    |                           |                               |
| TYPE OF MOUNT   | -                  | EI - Az                   | EI - Az                       |
| AZIMUTH LIMITATIONS   | -                  | Keyhole Zenith            | Keyhole Zenith                |
| TRACKING SPEED RANGE  | deg/s              | 0.002 - 30                | 0.002 - 30                    |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 75                        | 20                            |
| TYPE OF POINTING  | Type               | Autotrack, Slave          | Autotrack, Slave              |
| POINTING ACCURACY   | deg                | 0.1                       | 0.1                           |
| MIN TRANSMIT ELEV ANGLE   | deg                | (1)                       | (1)                           |
| MIN RECEIVE ELEV ANGLE  | deg                | 0                         | - 8                           |
|   |                    |                           |                               |
|   |                    |                           |                               |
|   |                    |                           |                               |
|   |                    |                           |                               |
| <b>SUPPORT</b>  |                    |                           |                               |
| TRANSMIT FREQ BAND(S)   | GHz                | None                      | None                          |
| RECEIVE FREQ BAND(S)  | GHz                | 2.2 - 2.4                 | 2.2 - 2.4                     |
| ACQ AID FREQ BAND(S)  | GHz                | 2.2 - 2.4                 | 2.2 - 2.4                     |
| MISSION CATEGORIES  | Cat                | A                         | A                             |
|   |                    |                           |                               |
|   |                    |                           |                               |
|   |                    |                           |                               |
|   |                    |                           |                               |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                           |                               |

6445-4520



CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION      |   |
|---|--------------|----------------------------|---|
|   |              | WALLOPS FLIGHT FACILITY    | ALASKA SAR FACILITY                       |
| <b>GENERAL</b>  |              |                            |   |
| STATION DESIGNATION   | -            | Wallops 9-Meter            | ASF 10                                    |
| LOCATION(S)   | -            | Wallops Island, VA         | Fairbanks, AK                             |
| DIAMETER  | m            | 9                          | 10  |
| <b>RECEIVE</b>  |              |                            |   |
| FREQUENCIES   | MHz          | 2200 - 2300                | 2200 - 2400, 8025 - 8400                  |
| FREQUENCY RESOLUTION  | Hz           | 10 000                     | 50 000                                    |
| ANTENNA GAIN @ 45 deg   | dBi          | 44                         | 45 (S), 56 (X)                            |
| SYS NOISE TEMP @ ZENITH   | K            | 200                        | 245, 225                                  |
| G/T @ 45 deg  | dB           | 24                         | 21.1 (S), 32.5 (X)                        |
| POLARIZATION  | -            | RHC, LHC                   | RHC, LHC                                  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 1.04                       | 0.91 (S), 0.26 (X)                        |
| ANTENNA ELLIPTICITY   | dB           | (1)                        | (1)                                       |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-3}$     | $\pm 1 \times 10^{-3}$                    |
| RCVR AGC DYNAMIC RANGE  | dB           | 136                        | 130                                       |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -152 in 2 Blo = 10 Hz      | -146 in 2 Blo = 30 Hz                     |
| RCVR LOOP BANDWIDTHS  | Hz           | 10, 30, 100, 300, 1 K, 3 K | 30, 100, 300, 1 K, 3 K                    |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                      | Adapt                                     |
| RCVR PLL ORDER(S)   | No.          | 2                          | 2   |
| ACQ SWEEP RANGE   | kHz          | $\pm 15, \pm 300$          | $\pm 250$                                 |
| MIN ACQ SWEEP RATE  | Hz/s         | Depends on Loop BW         | Depends on Loop BW                        |
| MAX ACQ SWEEP RATE  | kHz/s        | Depends on Loop BW         | Depends on Loop BW                        |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                 | Continuous                                |
| PROGRAMMED L.O.   | Yes/No       | No                         | No  |
|   |              |                            |   |
|   |              |                            |   |
|   |              |                            |   |
| <b>TELEMETRY</b>  |              |                            |   |
| MODULATION TYPE(S)  | -            | PM, FM, AM                 | BPSK, PM, FM, AM (S); QPSK (X)            |
| MODULATION FORMAT(S)  | -            | All IRIG's                 | NRZ - L, SAR Data (X)                     |
| MOD INDEX RANGE   | Rad Pk       | 0.2 - 1.4                  | 0.2 - 2.8                                 |
| SUBCARRIER FREQ RANGE   | kHz          | 1 - 2000                   | 1 - 4000 (S); 60 M, 105 M (X)             |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                       | Sine(s)                                   |
| SYMBOL RATE RANGE   | s/s          | 4 - 10 000 000             | 10 - 4 000 000 (S); 60 M, 85 M, 105 M (X) |
| SUBCARRIER/SYM RATE LIMIT   | -            | > 1.5                      | > 1.5                                     |
| ARRAYS WITH STATIONS  | -            | None                       | None                                      |
| CHANNEL DECODING  | Type         | (1)                        | (1)                                       |
| DATA FORMAT   | -            | (1)                        | (1)                                       |
|   |              |                            |   |
|   |              |                            |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                            |   |

6445-4512

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION  |                          |
|---|--------------|--|--------------------------|
|   |              | WALLOPS FLIGHT FACILITY  | ALASKA SAR FACILITY      |
| <b>GENERAL</b>  |              |  |                          |
| STATION DESIGNATION   | -            | Wallops 9-Meter  | ASF 10                   |
| LOCATION(S)   | -            | Wallops Island, VA   | Fairbanks, AK            |
| DIAMETER  | m            | 9  | 10                       |
| <b>FREQUENCIES</b>  |              |  |                          |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120  | None                     |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300  | 2200 - 2400, 8025 - 8400 |
| TURNAROUND FREQ RATIO   | -            | 240 - 221  | (1)                      |
| <b>DOPPLER</b>  |              |  |                          |
| COHERENT/NON-COHERENT   | -            | Coherent & Non-Coherent 2 - Way  | None                     |
| COUNTER RESOLUTION  | Cycles       | 0.001  |                          |
| MAX DOPPLER FREQ SHIFT  | MHz          | ± 0.25   |                          |
| DOPPLER BIAS FREQ   | MHz          | 0.24   |                          |
| DRIFT   | $\Delta f/f$ | $4 \times 10^{-11}$ @ 0.1 sec  |                          |
| OUTPUT EQUATION   | -            | $1000 [ f (xmit) \times (240 / 221) - f (receive) ] + f (bias)$                        |                          |
| DIRECTION INDICATOR   | -            | $+ \Delta f = -\Delta r$   |                          |
|   |              |  |                          |
|   |              |  |                          |
|   |              |  |                          |
| <b>RANGING</b>  |              |  |                          |
| COHERENT/NON-COHERENT   | -            | 2 - Way Coherent & Non-Coherent  | None                     |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine   |                          |
| EARTH STATION MOD INDEX   | Rad Pk       | P.M, 0.2 - 1.5 on Carrier; 0.3 - 1.2 on 1.7 MHz Subcarrier                             |                          |
| RANGE CODE FREQ RATIO   | -            | 5:1, 4:1   |                          |
| MAJOR CODE FREQ(S)  | kHz          | 500, 100, 20   |                          |
| MINOR CODE FREQ(S)  | kHz          | 100, 20, 4 on Carrier or 1.7 MHz Range Subcarrier; 0.8, 0.16, 0.04, 0.01 on 4 kHz Tone |                          |
| MIN RECEIVED CARRIER SNR  | dB           | 10   |                          |
| MIN REQ CODE PWR/No   | dB-Hz        | 15   |                          |
| CODE INTEGRATION TIME   | s            | (1)  |                          |
| ACQUISITION SEQUENCE  | -            | Automatic / Manual   |                          |
| RANGE DATA UNITS  | -            | Nanoseconds  |                          |
| RANGE QUANTIZATION  | -            | Nanoseconds  |                          |
| ACCURACY (STRONG SIGNAL)  | m            | 1 (RSS)  |                          |
| MAX UNAMBIGUOUS RANGE   | km           | 644 000  |                          |
| TRANSPONDER BW  | MHz          | < 0.8  |                          |
|   |              |  |                          |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |  |                          |
| 6445-4513   |              |  |                          |

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                                    |                     |                                   |                |
|--|---------------|--|---------------------|-----------------------------------|----------------|
|  |               | WALLOPS FLIGHT FACILITY                                  |                     | ALASKA SAR FACILITY               |                |
| <b>GENERAL</b>   |               |  |                     |                                   |                |
| STATION DESIGNATION  | -             | Wallops 9-Meter  |                     | ASF 10                            |                |
| LOCATION(S)  | -             | Wallops Island, VA                                       |                     | Fairbanks, AK                     |                |
| DIAMETER   | m             | 9  |                     | 10                                |                |
| <b>FREQUENCY STD</b>   |               |  |                     |                                   |                |
| STANDARD TYPE  | Name          | Cesium Beam  |                     | (1)                               |                |
| STANDARD MFG   | Name          | HP5061A  |                     | (1)                               |                |
| STABILITY AT:  |               | <b>Allan Variance</b>                                    | <b>Drift</b>        | <b>Allan Variance</b>             | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | (1)  | $1 \times 10^{-11}$ | (1)                               | (1)            |
| 1 - HOUR   | $\Delta f/f$  | (1)  | $3 \times 10^{-13}$ | (1)                               | (1)            |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)  | $3 \times 10^{-13}$ | (1)                               | (1)            |
| 1 - MONTH  | $\Delta f/f$  | (1)  | $3 \times 10^{-13}$ | (1)                               | (1)            |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>   | <b>100 MHz</b>      | <b>5 MHz</b>                      | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)  | (1)                 | (1)                               | (1)            |
| 10 Hz OFFSET   | dBc/Hz        | -120   | (1)                 | (1)                               | (1)            |
| 100 Hz OFFSET  | dBc/Hz        | -125   | (1)                 | (1)                               | (1)            |
| 1000 Hz OFFSET   | dBc/Hz        | -140   | (1)                 | (1)                               | (1)            |
| REF FREQS AVAILABLE  | MHz           | 1, 5   |                     | (1)                               |                |
| MAX STA-TO-STA OFFSET  | Hz            | $\pm 5 \times 10^{-12}$                                  |                     | (1)                               |                |
| <b>TIMING SYSTEM</b>   |               |  |                     |                                   |                |
| MASTER REFERENCE AGENCY  | Name          | USNO   |                     | USNO                              |                |
| REFERENCE TIME   | Name          | UTC  |                     | UTC                               |                |
| TIME CODE EPOCH  | Yr            | 1972   |                     | 1993                              |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG A, B, G, H; NASA 28, 36;<br>1 pps; 10 pps; 1000 pps |                     | IRIG B                            |                |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$                                       |                     | $1 \times 10^{-6}$                |                |
| TIME TRANSFER METHOD   | Name          | GPS  |                     | NESS / GOES                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$                          |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$                          |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$                          |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$                          |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 1000, 1 000 000, 5, 000 000                       |                     | 1, 10, 1000, 1 000 000, 5 000 000 |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |  |                     |                                   |                |

6445-4514

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS                        | UNITS  | SUBNETWORK OR STATION       |                           |
|--|--|-----------------------------|---------------------------|
|  |  | WALLOPS FLIGHT FACILITY     | ALASKA SAR FACILITY       |
| <b>GENERAL</b>                         |  |                             |                           |
| STATION DESIGNATION                    | -  | Wallops 9-Meter             | ASF 10                    |
| LOCATION(S)                            | -  | Wallops Island, VA          | Fairbanks, AK             |
| DIAMETER                               | m  | 9                           | 10                        |
| <b>GEOGRAPHICAL</b>                    |  |                             |                           |
| LOCATION, COUNTRY/STATE                | Name   | USA / Virginia              | USA / Alaska              |
| LOCATION, CITY                         | Name   | Wallops Island, VA          | Fairbanks, AK             |
| LONGITUDE (site 1/site 2/site 3)       | d, m, s                                      | 75 28 30 W                  | 147 50 50 W               |
| LATITUDE (site 1/site 2/site 3)        | d, m, s                                      | 37 55 39 N                  | 64 51 36 N                |
|  |  |                             |                           |
|  |  |                             |                           |
|  |  |                             |                           |
| <b>MECHANICAL</b>                      |  |                             |                           |
| TYPE OF MOUNT                          | -  | X - Y, N - S                | EI - Az with Tilt         |
| AZIMUTH LIMITATIONS                    | -  | Keyhole E, W                | Tilt Axis (No Keyhole)    |
| TRACKING SPEED RANGE                   | deg/s  | 0.002 - 4                   | 0 - 5.7 (EI), 0 - 15 (Az) |
| MAX TRACK ACCELERATION                 | deg/s <sup>2</sup>                           | 5                           | 10 (EI), 20 (Az)          |
| TYPE OF POINTING                       | Type   | Autotrack, Program, Slave   | Autotrack, Program, Slave |
| POINTING ACCURACY                      | deg  | 0.1                         | 0.04                      |
| MIN TRANSMIT ELEV ANGLE                | deg  | 0                           | (1)                       |
| MIN RECEIVE ELEV ANGLE                 | deg  | 0                           | 1                         |
|  |  |                             |                           |
|  |  |                             |                           |
|  |  |                             |                           |
|  |  |                             |                           |
| <b>SUPPORT</b>                         |  |                             |                           |
| TRANSMIT FREQ BAND(S)                  | GHz  | 2.025 - 2.12                | None                      |
| RECEIVE FREQ BAND(S)                   | GHz  | 2.2 - 2.3                   | 2.2 - 2.4, 8.025 - 8.4    |
| ACQ AID FREQ BAND(S)                   | GHz  | 2.2 - 2.3                   | (1)                       |
| MISSION CATEGORIES                     | Cat  | A                           | A                         |
|  |  |                             |                           |
|  |  |                             |                           |
|  |  |                             |                           |
|  |  |                             |                           |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE | 2. SOME LIMITATIONS APPLY TO THIS CAPABILITY | 3. NOT RECOMMENDED BY CCSDS |                           |
| 4. BASED UPON GEOCENTRIC COORDINATES   | 5. BASED UPON GEODETTIC COORDINATES          |                             |                           |

6445-4515



CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                           |  |
|-----------------------------|--------------|---|--|
|                             |              | McMURDO   | ALASKA SAR FACILITY                      |
| <b>GENERAL</b>              |              |   |  |
| STATION DESIGNATION         | -            | McMurdo   | 11-Meter System 1                        |
| LOCATION(S)                 | -            | McMurdo Station, Antarctica                     | Fairbanks, AK                            |
| DIAMETER                    | m            | 10  | 11.3                                     |
| <b>RECEIVE</b>              |              |   |  |
| FREQUENCIES                 | MHz          | 2200 - 2400, 8025 - 8400                        | 2200 - 2400, 8000 - 9000                 |
| FREQUENCY RESOLUTION        | Hz           | 50 000  | 25 000                                   |
| ANTENNA GAIN @ 45 deg       | dBi          | 45 (S), 56 (X)                                  | 45.8 (S), 56.8 (X)                       |
| SYS NOISE TEMP @ ZENITH     | K            | 245, 225  | 190, 150                                 |
| G/T @ 45 deg                | dB           | 21.1 (S), 32.5 (X)                              | 23 (S), 35 (X)                           |
| POLARIZATION                | -            | RHC, LHC  | RHC, LHC                                 |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.91 (S), 0.26 (X)                              | 0.85 (S), 0.23 (X)                       |
| ANTENNA ELLIPTICITY         | dB           | (1)   | (1)                                      |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-3}$                          | $\pm 1 \times 10^{-3}$                   |
| RCVR AGC DYNAMIC RANGE      | dB           | 130   | 130                                      |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -161 in 2 Blo = 30 Hz                           | -147 in 2 Blo = 30 Hz                    |
| RCVR LOOP BANDWIDTHS        | Hz           | 30, 100, 300, 1 K, 3 K                          | 30, 100, 300, 1 K, 3 K                   |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt   | Adapt                                    |
| RCVR PLL ORDER(S)           | No.          | 2   | 2  |
| ACQ SWEEP RANGE             | kHz          | $\pm 250$                                       | $\pm 250$                                |
| MIN ACQ SWEEP RATE          | Hz/s         | Depends on Loop BW                              | Depends on Loop BW                       |
| MAX ACQ SWEEP RATE          | kHz/s        | Depends on Loop BW                              | Depends on Loop BW                       |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous                                      | Continuous                               |
| PROGRAMMED L.O.             | Yes/No       | No  | No                                       |
|                             |              |   |  |
|                             |              |   |  |
|                             |              |   |  |
| <b>TELEMETRY</b>            |              |   |  |
| MODULATION TYPE(S)          | -            | BPSK, PM, FM, AM (S); QSPK (X)                  | BPSK, PM, FM, AM (S); QSPK (X)           |
| MODULATION FORMAT(S)        | -            | All IRIG's SAR Data (X)                         | All IRIG's, SAR Data (X)                 |
| MOD INDEX RANGE             | Rad Pk       | 0.2 - 2.8                                       | 0.2 - 2.8                                |
| SUBCARRIER FREQ RANGE       | kHz          | 1 - 4000 (S); 60 M, 85 M, 105 M (X)             | 1 - 2000 (S); 6 M, 85 M, 105 M (X)       |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine (S)  | Sine(s)                                  |
| SYMBOL RATE RANGE           | s/s          | 10 - 4 000 000 (S); 85 000 000, 105 000 000 (X) | 10 - 15M (S); 6 M, 60 M, 85 M, 105 M (X) |
| SUBCARRIER/SYM RATE LIMIT   | -            | > 1.5   | > 1.5                                    |
| ARRAYS WITH STATIONS        | -            | None  | None                                     |
| CHANNEL DECODING            | Type         | (1)   | (1)                                      |
| DATA FORMAT                 | -            | (1)   | (1)                                      |
|                             |              |   |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-4576

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION       |                          |
|---|--------------|-----------------------------|--------------------------|
|   |              | McMURDO                     | ALASKA SAR FACILITY      |
| <b>GENERAL</b>  |              |                             |                          |
| STATION DESIGNATION   | -            | McMurdo                     | 11-Meter System 1        |
| LOCATION(S)   | -            | McMurdo Station, Antarctica | Fairbanks, AK            |
| DIAMETER  | m            | 10                          | 11.3                     |
| <b>FREQUENCIES</b>  |              |                             |                          |
| TRANSMIT FREQUENCIES  | MHz          | None                        | None                     |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2400, 8000 - 9000    | 2200 - 2400, 8000 - 9000 |
| TURNAROUND FREQ RATIO   | -            | (1)                         | (1)                      |
| <b>DOPPLER</b>  |              |                             |                          |
| COHERENT/NON-COHERENT   | -            | None                        | None                     |
| COUNTER RESOLUTION  | Cycles       |                             |                          |
| MAX DOPPLER FREQ SHIFT  | MHz          |                             |                          |
| DOPPLER BIAS FREQ   | MHz          |                             |                          |
| DRIFT   | $\Delta f/f$ |                             |                          |
| OUTPUT EQUATION   | -            |                             |                          |
| DIRECTION INDICATOR   | -            |                             |                          |
|   |              |                             |                          |
|   |              |                             |                          |
|   |              |                             |                          |
| <b>RANGING</b>  |              |                             |                          |
| COHERENT/NON-COHERENT   | -            | None                        | None                     |
| RANGE CODE WAVEFORM   | Sin/Sq       |                             |                          |
| EARTH STATION MOD INDEX   | Rad Pk       |                             |                          |
| RANGE CODE FREQ RATIO   | -            |                             |                          |
| MAJOR CODE FREQ(S)  | kHz          |                             |                          |
| MINOR CODE FREQ(S)  | kHz          |                             |                          |
| MIN RECEIVED CARRIER SNR  | dB           |                             |                          |
| MIN REQ CODE PWR/No   | dB-Hz        |                             |                          |
| CODE INTEGRATION TIME   | s            |                             |                          |
| ACQUISITION SEQUENCE  | -            |                             |                          |
| RANGE DATA UNITS  | -            |                             |                          |
| RANGE QUANTIZATION  | -            |                             |                          |
| ACCURACY (STRONG SIGNAL)  | m            |                             |                          |
| MAX UNAMBIGUOUS RANGE   | km           |                             |                          |
| TRANSPONDER BW  | MHz          |                             |                          |
|   |              |                             |                          |
|   |              |                             |                          |
|   |              |                             |                          |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                             |                          |

6445-4577

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                                 |                     |   |                     |
|--|---------------|---|---------------------|---|---------------------|
|  |               | McMURDO   |                     | ALASKA SAR FACILITY                                   |                     |
| <b>GENERAL</b>   |               |   |                     |   |                     |
| STATION DESIGNATION  | -             | McMurdo   |                     | 11-Meter System 1                                     |                     |
| LOCATION(S)  | -             | McMurdo Station, Antarctica                           |                     | Fairbanks, AK   |                     |
| DIAMETER   | m             | 10  |                     | 11.3  |                     |
| <b>FREQUENCY STD</b>   |               |   |                     |   |                     |
| STANDARD TYPE  | Name          | Cesium Beam   |                     | Crystal Oscillator                                    |                     |
| STANDARD MFG   | Name          | HP5061A   |                     | Datum 9390  |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>                                 | <b>Drift</b>        | <b>Allan Variance</b>                                 | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - HOUR   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)   | $2 \times 10^{-12}$ | (1)   | $2 \times 10^{-12}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)   | $8 \times 10^{-9}$  | (1)   | $8 \times 10^{-9}$  |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>  | <b>100 MHz</b>      | <b>5 MHz</b>  | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | (1)   | (1)                 | (1)   | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | -125  | (1)                 | -125  | (1)                 |
| 100 Hz OFFSET  | dBc/Hz        | -155  | (1)                 | -155  | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz        | -155  | (1)                 | -155  | (1)                 |
| REF FREQS AVAILABLE  | MHz           | 0.000001, 0.00001, 0.001, 5, 10                       |                     | 0.000001, 0.00001, 0.001, 5, 10                       |                     |
| MAX STA-TO-STA OFFSET  | Hz            | (1)   |                     | (1)   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
| <b>TIMING SYSTEM</b>   |               |   |                     |   |                     |
| MASTER REFERENCE AGENCY  | Name          | GPS   |                     | GPS   |                     |
| REFERENCE TIME   | Name          | GPS   |                     | GPS   |                     |
| TIME CODE EPOCH  | Yr            | GPS   |                     | GPS   |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$                                    |                     | $1 \times 10^{-6}$                                    |                     |
| TIME TRANSFER METHOD   | Name          | GPS   |                     | GPS   |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 1000, 1 000 000, 5 000 000                     |                     | 1, 10, 1000, 1 000 000, 5, 000 000                    |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |   |                     |   |                     |

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS  | UNITS   | SUBNETWORK OR STATION       |                           |
|--|---------|-----------------------------|---------------------------|
|  |         | McMURDO                     | ALASKA SAR FACILITY       |
| <b>GENERAL</b>   |         |                             |                           |
| STATION DESIGNATION  | -       | McMurdo                     | 11-Meter System 1         |
| LOCATION(S)  | -       | McMurdo Station, Antarctica | Fairbanks, AK             |
| DIAMETER   | m       | 10                          | 11.3                      |
| <b>GEOGRAPHICAL</b>  |         |                             |                           |
| LOCATION, COUNTRY/STATE  | Name    | Antarctica                  | USA / Alaska              |
| LOCATION, CITY   | Name    | McMurdo Station             | Fairbanks, AK             |
| LONGITUDE (site 1/site 2/site 3)   | d, m, s | 193 19 59 W                 | 147 51 27 W               |
| LATITUDE (site 1/site 2/site 3)  | d, m, s | -77 50 21 N                 | 64 51 31 N                |
| <b>MECHANICAL</b>  |         |                             |                           |
| TYPE OF MOUNT  | -       | EI - Az with Train          | EI - Az with Train        |
| AZIMUTH LIMITATIONS  | -       | Train Axis (No Keyhole)     | Tilt Axis (No Keyhole)    |
| TRACKING SPEED RANGE   | deg/s   | 0 - 10 (EI), 0 - 17 (Az)    | 0.004 - 15                |
| MAX TRACK ACCELERATION   | deg/s   | 10 (EI), 17 (Az)            | 15                        |
| TYPE OF POINTING   | Type    | Autotrack, Program, Slave   | Autotrack, Program, Slave |
| POINTING ACCURACY  | deg     | 0.04                        | 0.05                      |
| MIN TRANSMIT ELEV ANGLE  | deg     | (1)                         | (1)                       |
| MIN RECEIVE ELEV ANGLE   | deg     | 1                           | 1                         |
| <b>SUPPORT</b>   |         |                             |                           |
| TRANSMIT FREQ BAND(S)  | GHz     | None                        | None                      |
| RECEIVE FREQ BAND(S)   | GHz     | 2.2 - 2.4, 8.025 - 8.4      | 2.2 - 2.4, 8 - 9          |
| ACQ AID FREQ BAND(S)   | GHz     | (1)                         | (1)                       |
| MISSION CATEGORIES   | Cat     | A                           | A                         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE     2. SOME LIMITATIONS APPLY TO THIS CAPABILITY     3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES     5. BASED UPON GEODETIC COORDINATES |         |                             |                           |

6445-4579

**CCSDS HISTORICAL DOCUMENT**  
**NASA WALLOPS FLIGHT TRACKING SYSTEM**  
**EARTH-TO-SPACE LINK CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION   |   |
|---|--------------|---|---|
|   |              | WALLOPS FLIGHT FACILITY   | NORWAY  |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | 11-Meter System 2   | 11-Meter System 3   |
| LOCATION(S)   | -            | Wallops Island, VA  | Longyearbyen, Norway  |
| DIAMETER  | m            | 11.3  | 11.28 (Operational ~1/98)   |
| <b>TRANSMIT</b>   |              |   |   |
| FREQUENCIES   | MHz          | 2025 - 2120   | 2025 - 2120   |
| FREQUENCY RESOLUTION  | Hz           | 100   | 100   |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $\pm 1$ Per °C 2 hrs  | $\pm 1$ Per °C 24 hrs   |
| TRANSMIT POWER 1  | W            | 200   | 200   |
| EIRP RANGE 1  | dBW          | 66  | 66  |
| TRANSMIT POWER 2  | W            | None  | None  |
| EIRP RANGE 2  | dBW          | None  | None  |
| POLARIZATION  | -            | RHC, LHC  | RHC / LHC   |
| ANTENNA GAIN  | dBi          | 44.8  | 44.8  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.95  | 0.95  |
| ANTENNA ELLIPTICITY   | dB           | (1)   | -1  |
| RF FREQ SWEEP RANGE   | kHz          | $\pm 900$   | $\pm 900$   |
| MIN FREQ SWEEP RATE   | Hz/s         | 1   | 1   |
| MAX FREQ SWEEP RATE   | kHz/s        | 12  | 12  |
| PROGRAMMED UPLINK FREQ  | Yes/No       | (1)   | (1)   |
| <b>COMMAND</b>  |              |   |   |
| RF CARRIER MOD TYPE   | -            | PM, FM, PSK   | PM, FM, PSK   |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | Rate DC - 10 MHz, Dev 0 - 1.5 rad (PM)<br>Rate 20 Hz - 12 MHz,<br>Dev 50 kHz - 50 MHz (FM)<br>Rate DC - 150 MHz, Dev 90 deg (PSK) | Rate DC - 10 MHz, Dev 0 - 1.5 rad (PM)<br>Rate 20 Hz - 12 MHz,<br>Dev 50 kHz - 50 MHz (FM)<br>Rate DC - 150 MHz, Dev 90 deg (PSK) |
| SUBCARRIER FREQUENCY(S)   | Hz           | 1000 - 2 000 000  | 1000 - 2 000 000  |
| SUBCARRIER STEP SIZE  | Hz           | 0.1   | 0.1   |
| SUBCARRIER FREQ STABILITY   | ppm          | $\pm 1$   | $\pm 1$   |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine, Square  | Sine, Square  |
| SUBCARRIER MOD TYPE   | -            | BPSK  | BPSK  |
| SUBCARRIER/BIT RATE LIMIT   | -            | > 8   | > 8   |
| BIT RATE RANGE  | b/s          | < 32 000  | < 32 000  |
| FORMATS AVAILABLE   | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S  | NRZ - L, M, S; Bi - $\phi$ - L, M, S  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |   |   |

6445-4506

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                               |   |
|---|--------------|---|---|
|   |              | WALLOPS FLIGHT FACILITY                             | NORWAY  |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | 11-Meter System 2                                   | 11-Meter System 3                                   |
| LOCATION(S)   | -            | Wallops Island, VA                                  | Longyearbyen, Norway                                |
| DIAMETER  | m            | 11.3  | 11.28 (Operational ~1/98)                           |
| <b>RECEIVE</b>  |              |   |   |
| FREQUENCIES   | MHz          | 2200 - 2400, 8000 - 9000                            | 2200 - 2400, 8000 - 9000                            |
| FREQUENCY RESOLUTION  | Hz           | 25 000  | 25 000  |
| ANTENNA GAIN @ 45 deg   | dBi          | 45.8 (S), 56.8 (X)                                  | 45.8 (S), 57.64 (X)                                 |
| SYS NOISE TEMP @ ZENITH   | K            | 190, 150  | 190 (S), 92 (X)                                     |
| G/T @ 45 deg  | dB           | 23 (S), 35 (X)                                      | 23 (S), 35 (X)                                      |
| POLARIZATION  | -            | RHC, LHC  | RHC / LHC   |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.85 (S), 0.23 (X)                                  | 0.85 (S), 0.23 (X)                                  |
| ANTENNA ELLIPTICITY   | dB           | (1)   | (1)   |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-3}$                              | $\pm 1 \times 10^{-3}$                              |
| RCVR AGC DYNAMIC RANGE  | dB           | 130   | 130   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -147 in 2 Blo = 30 Hz                               | -147 in 2 Blo = 30 Hz                               |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 100, 300, 1 K, 3 K                              | 30, 100, 300, 1 K, 3 K                              |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt   | Adapt   |
| RCVR PLL ORDER(S)   | No.          | 2   | 2   |
| ACQ SWEEP RANGE   | kHz          | $\pm 250$   | $\pm 250$   |
| MIN ACQ SWEEP RATE  | Hz/s         | Depends on Loop BW                                  | Depends on Loop BW                                  |
| MAX ACQ SWEEP RATE  | kHz/s        | Depends on Loop BW                                  | Depends on Loop BW                                  |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous  | Continuous  |
| PROGRAMMED L.O.   | Yes/No       | No  | No  |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| <b>TELEMETRY</b>  |              |   |   |
| MODULATION TYPE(S)  | -            | BPSK, PM, FM, AM (S); QPSK (X)                      | BPSK, PM, FM, AM (S); QPSK (X)                      |
| MODULATION FORMAT(S)  | -            | All IRIG's, SAR Data (X)                            | All IRIG's  |
| MOD INDEX RANGE   | Rad Pk       | 0.2 - 2.8   | 0.2 - 2.8   |
| SUBCARRIER FREQ RANGE   | kHz          | 1 - 2000 (S); 6 M - 105 M (X) <sup>(2)</sup>        | 1 - 2000 (S); 6 M - 150 M (X) <sup>(2)</sup>        |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine (S)  | Sine (S)  |
| SYMBOL RATE RANGE   | s/s          | 10 - 15 000 000 (S); 6 M - 105 M (X) <sup>(2)</sup> | 10 - 15 000 000 (S); 6 M - 300 M (X) <sup>(2)</sup> |
| SUBCARRIER/SYM RATE LIMIT   | -            | > 1.5   | > 1.5   |
| ARRAYS WITH STATIONS  | -            | None  | None  |
| CHANNEL DECODING  | Type         | (1)   | (1)   |
| DATA FORMAT   | -            | (1)   | (1)   |
|   |              |   | (1)   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |   |   |

6445-4507

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION   |  |
|---|--------------|---|--|
|   |              | WALLOPS FLIGHT FACILITY   | NORWAY   |
| <b>GENERAL</b>  |              |   |  |
| STATION DESIGNATION   | -            | 11-Meter System 2   | 11-Meter System 3  |
| LOCATION(S)   | -            | Wallops Island, VA  | Longyearbyen, Norway   |
| DIAMETER  | m            | 11.3  | 11.28 (Operational ~1/98)  |
| <b>FREQUENCIES</b>  |              |   |  |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120   | 2025 - 2120  |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2400, 8000 - 9000  | 2200 - 2400, 8000 - 9000   |
| TURNAROUND FREQ RATIO   | -            | 240 / 221   | 240 / 221  |
| <b>DOPPLER</b>  |              |   |  |
| COHERENT/NON-COHERENT   | -            | Coherent and Non-Coherent 2-Way   | Coherent and Non-Coherent 2-Way                                      |
| COUNTER RESOLUTION  | Cycles       | 0.001   | 0.001  |
| MAX DOPPLER FREQ SHIFT  | MHz          | ± 0.25  | ± 0.25   |
| DOPPLER BIAS FREQ   | MHz          | 0.24  | 0.24   |
| DRIFT   | $\Delta f/f$ | $4 \times 10^{-11}$ @ 0.1 sec   | $4 \times 10^{-11}$ @ 0.1 sec  |
| OUTPUT EQUATION   | -            | $1000 [f (\text{transmit}) \times (240 / 221) - f (\text{receive})] + f (\text{bias})$            | $1000 [f (\text{transmit}) \times (240 / 221)$                       |
| DIRECTION INDICATOR   | -            | $+ \Delta f = - \Delta r$   | $- f (\text{receive})] + f (\text{bias})$                            |
|   |              |   | $+ \Delta f = - \Delta r$  |
|   |              |   |  |
|   |              |   |  |
| <b>RANGING</b>  |              |   |  |
| COHERENT/NON-COHERENT   | -            | Coherent and Non-Coherent; PR Digital 2-Way   | Coherent and Non-Coherent; PR Digital 2-Way                          |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine / Digital  | Sine / Digital   |
| EARTH STATION MOD INDEX   | Rad Pk       | PM, 0.2 - 1.5 on Carrier; 0.3 - 12 on 1.7 MHz Subcarrier; PR Digital                              | PM, 0.2 - 1.5 on Carrier; 0.3 - 12 on 1.7 MHz Subcarrier; PR Digital |
| RANGE CODE FREQ RATIO   | -            | (1)   | (1)  |
| MAJOR CODE FREQ(S)  | kHz          | 500, 100, 20 / PR   | 500, 100, 20; PR   |
| MINOR CODE FREQ(S)  | kHz          | 100, 20, 4 on Carrier or 1.7 MHz Range Subcarrier; 0.8, 0.16, 0.04, 0.01 on 4 kHz Tone; 16 kHz PR |  |
| MIN RECEIVED CARRIER SNR  | dB           | 10  | 10   |
| MIN REQ CODE PWR/No   | dB-Hz        | 15  | 15   |
| CODE INTEGRATION TIME   | s            | (1)   | (1)  |
| ACQUISITION SEQUENCE  | -            | Automatic   | Automatic  |
| RANGE DATA UNITS  | -            | Nanoseconds   | Nanoseconds  |
| RANGE QUANTIZATION  | -            | Nanoseconds   | Nanoseconds  |
| ACCURACY (STRONG SIGNAL)  | m            | 1 (RSS); PR Digital 1.5 (RSS)   | 1 (RSS); PR Digital 1.5 (RSS)  |
| MAX UNAMBIGUOUS RANGE   | km           | 5 000 000   | 5 000 000  |
| TRANSPONDER BW  | MHz          | < 0.8   | < 0.8  |
|   |              |   |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |   |  |

6445-4508

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                                 |                     |   |                     |
|--|---------------|---|---------------------|---|---------------------|
|  |               | WALLOPS FLIGHT FACILITY                               |                     | NORWAY  |                     |
| <b>GENERAL</b>   |               |   |                     |   |                     |
| STATION DESIGNATION  | -             | 11-Meter System 2                                     |                     | 11-Meter System 3                                     |                     |
| LOCATION(S)  | -             | Wallops Island, VA                                    |                     | Longyearbyen, Norway                                  |                     |
| DIAMETER   | m             | 11.3  |                     | 11.28 (Operational ~1/98)                             |                     |
| <b>FREQUENCY STD</b>   |               |   |                     |   |                     |
| STANDARD TYPE  | Name          | Rubidium Oscillator                                   |                     | Rubidium Oscillator                                   |                     |
| STANDARD MFG   | Name          | Datum 9390  |                     | Datum 9390  |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>                                 | <b>Drift</b>        | <b>Allan Variance</b>                                 | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - HOUR   | $\Delta f/f$  | (1)   | $3 \times 10^{-11}$ | (1)   | $3 \times 10^{-11}$ |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)   | $2 \times 10^{-12}$ | (1)   | $2 \times 10^{-12}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)   | $8 \times 10^{-9}$  | (1)   | $8 \times 10^{-9}$  |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>  | <b>100 MHz</b>      | <b>5 MHz</b>  | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | (1)   | (1)                 | (1)   | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | -125  | (1)                 | -125  | (1)                 |
| 100 Hz OFFSET  | dBc/Hz        | -155  | (1)                 | -155  | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz        | -155  | (1)                 | -155  | (1)                 |
| REF FREQS AVAILABLE  | MHz           | 0.0000001, 0.00001, 0.001, 5, 10                      |                     | 0.0000001, 0.00001, 0.001, 5, 10                      |                     |
| MAX STA-TO-STA OFFSET  | Hz            | (1)   |                     | (1)   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
| <b>TIMING SYSTEM</b>   |               |   |                     |   |                     |
| MASTER REFERENCE AGENCY  | Name          | GPS   |                     | GPS   |                     |
| REFERENCE TIME   | Name          | GPS   |                     | GPS   |                     |
| TIME CODE EPOCH  | Yr            | GPS   |                     | GPS   |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     | IRIG A, B, G, H; NASA 28, 36; 1 pps; 10 pps; 1000 pps |                     |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$                                    |                     | $1 \times 10^{-6}$                                    |                     |
| TIME TRANSFER METHOD   | Name          | GPS   |                     | GPS   |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 1000, 1 000 000, 5 000 000                     |                     | 1, 10, 1000, 1 000 000, 5 000 000                     |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
|  |               |   |                     |   |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |   |                     |   |                     |

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS   | SUBNETWORK OR STATION     |                           |
|---|---------|---------------------------|---------------------------|
|   |         | WALLOPS FLIGHT FACILITY   | NORWAY                    |
| <b>GENERAL</b>  |         |                           |                           |
| STATION DESIGNATION   | -       | 11-Meter System 2         | 11-Meter System 3         |
| LOCATION(S)   | -       | Wallops Island, VA        | Longyearbyen, Norway      |
| DIAMETER  | m       | 11.3                      | 11.28 (Operational ~1/98) |
| <b>GEOGRAPHICAL</b>   |         |                           |                           |
| LOCATION, COUNTRY/STATE   | Name    | USA / Virginia            | Norway                    |
| LOCATION, CITY  | Name    | Wallops Island, VA        | Longyearbyen, Norway      |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s | 75 28 35 W                | Exact Site Undetermined   |
| LATITUDE (site 1/site 2/site 3)   | d, m, s | 37 55 30 N                | Exact Site Undetermined   |
|   |         |                           |                           |
|   |         |                           |                           |
|   |         |                           |                           |
|   |         |                           |                           |
| <b>MECHANICAL</b>   |         |                           |                           |
| TYPE OF MOUNT   | -       | Az - El with Train        | Az - El with Train        |
| AZIMUTH LIMITATIONS   | -       | Train Axis - No Keyhole   | Train Axis - No Keyhole   |
| TRACKING SPEED RANGE  | deg/s   | 0.004 - 15                | 0.004 - 15                |
| MAX TRACK ACCELERATION  | deg/s   | 15                        | 15                        |
| TYPE OF POINTING  | Type    | Autotrack, Program, Slave | Autotrack, Program, Slave |
| POINTING ACCURACY   | deg     | 0.05                      | 0.05                      |
| MIN TRANSMIT ELEV ANGLE   | deg     | 5                         | 5                         |
| MIN RECEIVE ELEV ANGLE  | deg     | 3                         | 3                         |
|   |         |                           |                           |
|   |         |                           |                           |
|   |         |                           |                           |
|   |         |                           |                           |
| <b>SUPPORT</b>  |         |                           |                           |
| TRANSMIT FREQ BAND(S)   | GHz     | 2.025 - 2.12              | 2.025 - 2.12              |
| RECEIVE FREQ BAND(S)  | GHz     | 2.2 - 2.4, 8 - 9          | 2.2 - 2.4, 8 - 9          |
| ACQ AID FREQ BAND(S)  | GHz     | (1)                       | (1)                       |
| MISSION CATEGORIES  | Cat     | A                         | A                         |
|   |         |                           |                           |
|   |         |                           |                           |
|   |         |                           |                           |
|   |         |                           |                           |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES |         |                           |                           |

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS           | UNITS        | SUBNETWORK OR STATION   |                         |
|---------------------------|--------------|---|-------------------------|
|                           |              | ALASKA  | WALLOPS FLIGHT FACILITY |
| <b>GENERAL</b>            |              |   |                         |
| STATION DESIGNATION       | -            | 11-Meter System 4   | ADAS                    |
| LOCATION(S)               | -            |   | Wallops Island, VA      |
| DIAMETER                  | m            | 11.28 (Operational ~1/98)   | 18                      |
| <b>TRANSMIT</b>           |              |   |                         |
| FREQUENCIES               | MHz          | 2025 - 2120   | None                    |
| FREQUENCY RESOLUTION      | Hz           | 100   |                         |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | $\pm 1$ Per °C 24 hrs   |                         |
| TRANSMIT POWER 1          | W            | 200   |                         |
| EIRP RANGE 1              | dBW          | 66  |                         |
| TRANSMIT POWER 2          | W            | None  |                         |
| EIRP RANGE 2              | dBW          | None  |                         |
| POLARIZATION              | -            | RHC / LHC   |                         |
| ANTENNA GAIN              | dBi          | 44.8  |                         |
| ANTENNA BEAMWIDTH (-3 dB) | deg          | 0.95  |                         |
| ANTENNA ELLIPTICITY       | dB           | -1  |                         |
| RF FREQ SWEEP RANGE       | kHz          | $\pm 900$   |                         |
| MIN FREQ SWEEP RATE       | Hz/s         | 1   |                         |
| MAX FREQ SWEEP RATE       | kHz/s        | 12  |                         |
| PROGRAMMED UPLINK FREQ    | Yes/No       | (1)   |                         |
|                           |              |   |                         |
|                           |              |   |                         |
|                           |              |   |                         |
|                           |              |   |                         |
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|                           |              |   |                         |
|                           |              |   |                         |
|                           |              |   |                         |
|                           |              |   |                         |
|                           |              |   |                         |
|                           |              |   |                         |
| <b>COMMAND</b>            |              |   |                         |
| RF CARRIER MOD TYPE       | -            | PM, FM, PSK   | None                    |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | Rate DC - 10 MHz, Dev 0 - 1.5 rad (PM)<br>Rate 20 Hz - 12 MHz,<br>Dev 50 kHz - 50 MHz (FM)<br>Rate DC - 150 MHz, Dev 90 deg (PSK) |                         |
| SUBCARRIER FREQUENCY(S)   | Hz           | 1000 - 2 000 000  |                         |
| SUBCARRIER STEP SIZE      | Hz           | 0.1   |                         |
| SUBCARRIER FREQ STABILITY | ppm          | $\pm 1$   |                         |
| SUBCARRIER WAVEFORM       | Sin/Sq       | Sine, Square  |                         |
| SUBCARRIER MOD TYPE       | -            | BPSK  |                         |
| SUBCARRIER/BIT RATE LIMIT | -            | $> 8$   |                         |
| BIT RATE RANGE            | b/s          | $< 32 000$  |                         |
| FORMATS AVAILABLE         | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S  |                         |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                                    |                                       |
|-----------------------------|--------------|--|---------------------------------------|
|                             |              | ALASKA   | WALLOPS FLIGHT FACILITY               |
| <b>GENERAL</b>              |              |  |                                       |
| STATION DESIGNATION         | -            | 11-Meter System 4  | ADAS                                  |
| LOCATION(S)                 | -            |  | Wallops Island, VA                    |
| DIAMETER                    | m            | 11.28 (Operational ~1/98)                                | 18                                    |
| <b>RECEIVE</b>              |              |  |                                       |
| FREQUENCIES                 | MHz          | 2200 - 2400, 8000 - 9000                                 | 1435 - 1535, 1670 - 1720, 2200 - 2400 |
| FREQUENCY RESOLUTION        | Hz           | 25 000   | 10 000                                |
| ANTENNA GAIN @ 70 deg       | dBi          | 45.8 (S), 57.64 (X)                                      | 45.8 (L1), 47.5 (L2), 50.1 (S)        |
| SYS NOISE TEMP @ 70 deg     | K            | 190 (S), 92 (X)  | 182, 204, 229                         |
| G/T @ 70 deg                | dB/K         | 23 (S), 35 (X)   | 23.2 (L1), 24.4 (L2), 26.5 (S)        |
| POLARIZATION                | -            | RHC / LHC  | RHC, LHC                              |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.85 (S), 0.23 (X)                                       | 0.68 (L), 0.51 (S)                    |
| ANTENNA ELLIPTICITY         | dB           | (1)  | (1)                                   |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-3}$                                   | $\pm 1 \times 10^{-3}$                |
| RCVR AGC DYNAMIC RANGE      | dB           | 130  | 136                                   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -147 in 2 Blo = 30 Hz                                    | -152 in 2 Blo = 10 Hz                 |
| RCVR LOOP BANDWIDTHS        | Hz           | 30, 100, 300, 1 K, 3 K                                   | 10, 30, 100, 300, 1K, 3 K             |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt  | Adapt                                 |
| RCVR PLL ORDER(S)           | No.          | 2  | 2                                     |
| ACQ SWEEP RANGE             | kHz          | $\pm 250$  | $\pm 15, \pm 300$                     |
| MIN ACQ SWEEP RATE          | Hz/s         | Depends on Loop BW                                       | Depends on Loop BW                    |
| MAX ACQ SWEEP RATE          | kHz/s        | Depends on Loop BW                                       | Depends on Loop BW                    |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous   | Continuous                            |
| PROGRAMMED L.O.             | Yes/No       | No   | No                                    |
|                             |              |  |                                       |
|                             |              |  |                                       |
|                             |              |  |                                       |
|                             |              |  |                                       |
| <b>TELEMETRY</b>            |              |  |                                       |
| MODULATION TYPE(S)          | -            | BPSK, PM, FM, AM (S); QPSK (X)                           | PM, FM, AM                            |
| MODULATION FORMAT(S)        | -            | All IRIG's   | All IRIG's                            |
| MOD INDEX RANGE             | Rad Pk       | 0.2 - 2.8  | 0.2 - 1.4                             |
| SUBCARRIER FREQ RANGE       | kHz          | 1 - 2000 (S); 6 M - 150 M (X) <sup>(2)</sup><br>Sine (S) | 1 - 2000<br>Sine                      |
| SUBCARRIER WAVEFORM         | Sin/Sq       | 10 - 15 000 000 (S); 6 M - 300 M (X) <sup>(2)</sup>      | 4 - 10 000 000                        |
| SYMBOL RATE RANGE           | s/s          | > 1.5  | > 1.5                                 |
| SUBCARRIER/SYM RATE LIMIT   | -            | None   | None                                  |
| ARRAYS WITH STATIONS        | -            |  | (1)                                   |
| CHANNEL DECODING            | Type         | (1)  | (1)                                   |
| DATA FORMAT                 | -            | (1)  |                                       |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-5313

**CCSDS HISTORICAL DOCUMENT**  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION   |                                       |
|--------------------------|--------------|---|---------------------------------------|
|                          |              | ALASKA  | WALLOPS FLIGHT FACILITY               |
| <b>GENERAL</b>           |              |   |                                       |
| STATION DESIGNATION      | -            | 11- Meter System 4  | ADAS                                  |
| LOCATION(S)              | -            |   | Wallops Island, VA                    |
| DIAMETER                 | m            | 11.28 (Operational ~1/98)   | 18                                    |
| <b>FREQUENCIES</b>       |              |   |                                       |
| TRANSMIT FREQUENCIES     | MHz          | 2025 - 2120   | None                                  |
| RECEIVE FREQUENCIES      | MHz          | 2200 - 2400, 8000 - 9000  | 1435 - 1535, 1670 - 1720, 2200 - 2400 |
| TURNAROUND FREQ RATIO    | -            | 240 / 221   |                                       |
| <b>DOPPLER</b>           |              |   |                                       |
| COHERENT/NON-COHERENT    | -            | Coherent and Non-Coherent 2-Way   | None                                  |
| COUNTER RESOLUTION       | Cycles       | 0.001   |                                       |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 0.25  |                                       |
| DOPPLER BIAS FREQ        | MHz          | 0.24  |                                       |
| DRIFT                    | $\Delta f/f$ | $4 \times 10^{-11}$ @ 0.1 sec   |                                       |
| OUTPUT EQUATION          | -            | $1000 [f (\text{transmit}) \times (240 / 221) - f (\text{receive})] + f (\text{bias})$            |                                       |
| DIRECTION INDICATOR      | -            | $+ \Delta f = - \Delta r$   |                                       |
|                          |              |   |                                       |
|                          |              |   |                                       |
| <b>RANGING</b>           |              |   |                                       |
| COHERENT/NON-COHERENT    | -            | Coherent and Non-Coherent; PR Digital 2-Way   | None                                  |
| RANGE CODE WAVEFORM      | Sin/Sq       | Sine / Digital  |                                       |
| EARTH STATION MOD INDEX  | Rad Pk       | PM, 0.2 - 1.5 on Carrier; 0.3 - 12 on 1.7 MHz Subcarrier; PR Digital                              |                                       |
| RANGE CODE FREQ RATIO    | -            | (1)   |                                       |
| MAJOR CODE FREQ(S)       | kHz          | 500, 100, 20; PR  |                                       |
| MINOR CODE FREQ(S)       | kHz          | 100, 20, 4 on Carrier or 1.7 MHz Range Subcarrier; 0.8, 0.16, 0.04, 0.01 on 4 kHz Tone; 16 kHz PR |                                       |
| MIN RECEIVED CARRIER SNR | dB           | 10  |                                       |
| MIN REQ CODE PWR/No      | dB-Hz        | 15  |                                       |
| CODE INTEGRATION TIME    | s            | (1)   |                                       |
| ACQUISITION SEQUENCE     | -            | Automatic   |                                       |
| RANGE DATA UNITS         | -            | Nanoseconds   |                                       |
| RANGE QUANTIZATION       | -            | Nanoseconds   |                                       |
| ACCURACY (STRONG SIGNAL) | m            | 1 (RSS); PR Digital 1.5 (RSS)   |                                       |
| MAX UNAMBIGUOUS RANGE    | km           | 5 000 000   |                                       |
| TRANSPONDER BW           | MHz          | < 0.8   |                                       |
|                          |              |   |                                       |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

6445-5314

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION                                    |                     |  |                     |
|--|---------------|--|---------------------|--|---------------------|
|  |               | ALASKA   |                     | WALLOPS FLIGHT FACILITY                                  |                     |
| <b>GENERAL</b>   |               |  |                     |  |                     |
| STATION DESIGNATION  | -             | 11-Meter System 4  |                     | ADAS   |                     |
| LOCATION(S)  | -             |  |                     | Wallops Island, VA                                       |                     |
| DIAMETER   | m             | 11.28 (Operational ~1/98)                                |                     | 18   |                     |
| <b>FREQUENCY STD</b>   |               |  |                     |  |                     |
| STANDARD TYPE  | Name          | Rubidium Oscillator                                      |                     | Cesium Beam  |                     |
| STANDARD MFG   | Name          | Datum 9390   |                     | HP5061A  |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>                                    | <b>Drift</b>        | <b>Allan Variance</b>                                    | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | (1)  | $1 \times 10^{-11}$ | (1)  | $1 \times 10^{-11}$ |
| 1 - HOUR   | $\Delta f/f$  | (1)  | $3 \times 10^{-11}$ | (1)  | $3 \times 10^{-13}$ |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)  | $2 \times 10^{-12}$ | (1)  | $3 \times 10^{-13}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)  | $8 \times 10^{-9}$  | (1)  | $3 \times 10^{-13}$ |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>   | <b>100 MHz</b>      | <b>5 MHz</b>   | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | (1)  | (1)                 | (1)  | (1)                 |
| 10 Hz OFFSET   | dBc/Hz        | -125   | (1)                 | -120   | (1)                 |
| 100 Hz OFFSET  | dBc/Hz        | -155   | (1)                 | -125   | (1)                 |
| 1000 Hz OFFSET   | dBc/Hz        | -155   | (1)                 | -140   | (1)                 |
| REF FREQS AVAILABLE  | MHz           | 0.0000001, 0.00001, 0.001, 5, 10                         |                     | 1, 5   |                     |
| MAX STA-TO-STA OFFSET  | Hz            | (1)  |                     | $\pm 5 \times 10^{-12}$                                  |                     |
| <b>TIMING SYSTEM</b>   |               |  |                     |  |                     |
| MASTER REFERENCE AGENCY  | Name          | GPS  |                     | USNO   |                     |
| REFERENCE TIME   | Name          | GPS  |                     | UTC  |                     |
| TIME CODE EPOCH  | Yr            | GPS  |                     | 1972   |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | IRIG A, B, G, H; NASA 28, 36;<br>1 pps; 10 pps; 1000 pps |                     | IRIG A, B, G, H; NASA 28, 36;<br>1 pps; 10 pps; 1000 pps |                     |
| MAX TIME RESOLUTION  | s             | $1 \times 10^{-6}$                                       |                     | $1 \times 10^{-6}$                                       |                     |
| TIME TRANSFER METHOD   | Name          | GPS  |                     | GPS  |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$   |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$   |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$   |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$   |                     | $\pm 10$   |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 1000, 1 000 000, 5, 000 000                       |                     | 1, 10, 1000, 1 000 000, 5, 000 000                       |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |  |                     |  |                     |

CCSDS HISTORICAL DOCUMENT  
**NASA WALLOPS FLIGHT FACILITY TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS   | SUBNETWORK OR STATION     |                                       |
|---|---------|---------------------------|---------------------------------------|
|   |         | ALASKA                    | WALLOPS FLIGHT FACILITY               |
| <b>GENERAL</b>  |         |                           |                                       |
| STATION DESIGNATION   | -       | 11-Meter System 4         | ADAS                                  |
| LOCATION(S)   | -       |                           | Wallops Island, VA                    |
| DIAMETER  | m       | 11.28 (Operational ~1/98) | 18                                    |
| <b>GEOGRAPHICAL</b>   |         |                           |                                       |
| LOCATION, COUNTRY/STATE   | Name    | USA / Alaska              | USA / Virginia                        |
| LOCATION, CITY  | Name    |                           | Wallops Island, VA                    |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s | Exact Site Undetermined   | 75 28 35 W                            |
| LATITUDE (site 1/site 2/site 3)   | d, m, s | Exact Site Undetermined   | 37 55 36 N                            |
|   |         |                           |                                       |
|   |         |                           |                                       |
|   |         |                           |                                       |
|   |         |                           |                                       |
| <b>MECHANICAL</b>   |         |                           |                                       |
| TYPE OF MOUNT   | -       | EI - Az                   | EI - Az                               |
| AZIMUTH LIMITATIONS   | -       | Keyhole Zenith            | Keyhole Zenith                        |
| TRACKING SPEED RANGE  | deg/s   | 0.004 - 15                | 0.002 - 6                             |
| MAX TRACK ACCELERATION  | deg/s   | 15                        | 8                                     |
| TYPE OF POINTING  | Type    | Autotrack, Program, Slave | Autotrack, Program, Slave             |
| POINTING ACCURACY   | deg     | 0.05                      | 0.25                                  |
| MIN TRANSMIT ELEV ANGLE   | deg     | 5                         | (1)                                   |
| MIN RECEIVE ELEV ANGLE  | deg     | 3                         | 5                                     |
|   |         |                           |                                       |
|   |         |                           |                                       |
|   |         |                           |                                       |
|   |         |                           |                                       |
|   |         |                           |                                       |
| <b>SUPPORT</b>  |         |                           |                                       |
| TRANSMIT FREQ BAND(S)   | GHz     | 2.025 - 2.12              | None                                  |
| RECEIVE FREQ BAND(S)  | GHz     | 2.2 - 2.4, 8 - 9          | 1.435 - 1.535, 1.67 - 1.72, 2.2 - 2.4 |
| ACQ AID FREQ BAND(S)  | GHz     | (1)                       | (1)                                   |
| MISSION CATEGORIES  | Cat     | A                         | A                                     |
|   |         |                           |                                       |
|   |         |                           |                                       |
|   |         |                           |                                       |
|   |         |                           |                                       |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES |         |                           |                                       |



CCSDS HISTORICAL DOCUMENT  
**NASDA TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                |                                      |
|-----------------------------|--------------|--------------------------------------|--------------------------------------|
|                             |              | KATSUURA                             | MASUDA                               |
| <b>GENERAL</b>              |              |                                      |                                      |
| STATION DESIGNATION         | -            | Katsuura No. 2                       | Masuda No. 2                         |
| LOCATION(S)                 | -            | Katsuura, Japan                      | Tanegashima, Japan                   |
| DIAMETER                    | m            | 13                                   | 13                                   |
| <b>RECEIVE</b>              |              |                                      |                                      |
| FREQUENCIES                 | MHz          | 2200 - 2300                          | 2200 - 2300                          |
| FREQUENCY RESOLUTION        | Hz           | 10 000                               | 10 000                               |
| ANTENNA GAIN @ 45 deg       | dBi          | 45.3                                 | 46.8                                 |
| SYS NOISE TEMP @ ZENITH     | K            | 170 @ 5 deg                          | 210 @ 5 deg                          |
| G/T @ 45 deg                | dB           | 23 @ 5 deg                           | 22 @ 5 deg                           |
| POLARIZATION                | -            | RCP and LCP (Diversity)              | RCP and LCP (Diversity)              |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.8                                  | 0.72                                 |
| ANTENNA ELLIPTICITY         | dB           | (1)                                  | (1)                                  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $1 \times 10^{-5}$ @ 1 sec           | $1 \times 10^{-5}$ @ 1 sec           |
| RCVR AGC DYNAMIC RANGE      | dB           | 90                                   | 100                                  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -142 in 2 Blo = 100 Hz               | -141 in 2 Blo = 100 Hz               |
| RCVR LOOP BANDWIDTHS        | Hz           | 100, 300, 1 K                        | 100, 300, 1 K                        |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                                | Adapt                                |
| RCVR PLL ORDER(S)           | No.          | 2                                    | 2                                    |
| ACQ SWEEP RANGE             | kHz          | $\pm 30, \pm 200$                    | $\pm 30, \pm 200$                    |
| MIN ACQ SWEEP RATE          | Hz/s         | 15 000                               | 15 000                               |
| MAX ACQ SWEEP RATE          | kHz/s        | 20                                   | 20                                   |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous                           | Continuous                           |
| PROGRAMMED L.O.             | Yes/No       | Yes                                  | Yes                                  |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
| <b>TELEMETRY</b>            |              |                                      |                                      |
| MODULATION TYPE(S)          | -            | PCM / PSK / PM, PCM / PM             | PCM / PSK / PM, PCM / PM             |
| MODULATION FORMAT(S)        | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S | NRZ - L, M, S; Bi - $\phi$ - L, M, S |
| MOD INDEX RANGE             | Rad Pk       | 0 - 1.5                              | 0 - 1.5                              |
| SUBCARRIER FREQ RANGE       | kHz          | 0.1 - 2000                           | 0.1 - 2000                           |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine                                 | Sine                                 |
| SYMBOL RATE RANGE           | s/s          | 100 - 1 000 000                      | 100 - 1 000 000                      |
| SUBCARRIER/SYM RATE LIMIT   | -            | 4:1 - 1000:1                         | 1:1 - 1000:1                         |
| ARRAYS WITH STATIONS        | -            | None                                 | None                                 |
| CHANNEL DECODING            | Type         | (1)                                  | (1)                                  |
| DATA FORMAT                 | -            | (1)                                  | (1)                                  |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-4108

**CCSDS HISTORICAL DOCUMENT**  
**NASDA TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION                               |   |
|--|--------------|---|---|
|  |              | KATSUURA  | MASUDA  |
| <b>GENERAL</b>   |              |   |   |
| STATION DESIGNATION  | -            | Katsuura No. 2                                      | Masuda No. 2  |
| LOCATION(S)  | -            | Katsuura, Japan                                     | Tanegashima, Japan                                  |
| DIAMETER   | m            | 13  | 13  |
| <b>FREQUENCIES</b>   |              |   |   |
| TRANSMIT FREQUENCIES   | MHz          | 2025 - 2120   | 2025 - 2120   |
| RECEIVE FREQUENCIES  | MHz          | 2200 - 2300   | 2200 - 2300   |
| TURNAROUND FREQ RATIO  | -            | 240 / 221   | 240 / 221   |
| <b>DOPPLER</b>   |              |   |   |
| COHERENT/NON-COHERENT  | -            | Either  | None  |
| COUNTER RESOLUTION   | Cycles       | 0.0018  |   |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 0.15  |   |
| DOPPLER BIAS FREQ  | MHz          | 0.7   |   |
| DRIFT  | $\Delta f/f$ | $1 \times 10^{-11}$ @ 1 sec                         |   |
| OUTPUT EQUATION  | -            | Bias Freq $\pm 1.3 f_d$                             |   |
| DIRECTION INDICATOR  | -            | $+\Delta f = -\Delta r$                             |   |
|  |              |   |   |
|  |              |   |   |
|  |              |   |   |
| <b>RANGING</b>   |              |   |   |
| COHERENT/NON-COHERENT  | -            | Either  | Either  |
| RANGE CODE WAVEFORM  | Sin/Sq       | Sine  | Sine  |
| EARTH STATION MOD INDEX  | Rad Pk       | 0.7 - 1.5   | 0 - 2   |
| RANGE CODE FREQ RATIO  | -            | 5:1, 4:1  | 5:1, 4:1  |
| MAJOR CODE FREQ(S)   | kHz          | 500, 100  | 500, 100  |
| MINOR CODE FREQ(S)   | kHz          | 100, 20, 4, (0.8, 0.16, 0.04, 0.01, 0.008 on 4 kHz) | 100, 20, 4, (0.8, 0.16, 0.04, 0.01, 0.008 on 4 kHz) |
| MIN RECEIVED CARRIER SNR   | dB           | 25  | (1)   |
| MIN REQ CODE PWR/No  | dB-Hz        | 25  | (1)   |
| CODE INTEGRATION TIME  | s            | 5   | 5   |
| ACQUISITION SEQUENCE   | -            | Seq; Major Code First                               | Seq; Major Code First                               |
| RANGE DATA UNITS   | -            | Nanoseconds   | Meters  |
| RANGE QUANTIZATION   | -            | 1 ns  | 0.3 Meters  |
| ACCURACY (STRONG SIGNAL)   | m            | 10  | 10  |
| MAX UNAMBIGUOUS RANGE  | km           | 75 000  | 75 000  |
| TRANSPONDER BW   | MHz          | ≥ 1.5   | ≥ 1.3   |
|  |              |   |   |
|  |              |   |   |
|  |              |   |   |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> |              |   |   |

6445-4109

**CCSDS HISTORICAL DOCUMENT**  
**NASDA TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                |                       |                |
|--|---------------|-----------------------|----------------|-----------------------|----------------|
|  |               | KATSUURA              |                | MASUDA                |                |
| <b>GENERAL</b>   |               |                       |                |                       |                |
| STATION DESIGNATION  | -             | Katsuura No. 2        |                | Masuda No. 2          |                |
| LOCATION(S)  | -             | Katsuura, Japan       |                | Tanegashima, Japan    |                |
| DIAMETER   | m             | 13                    |                | 13                    |                |
| <b>FREQUENCY STD</b>   |               |                       |                |                       |                |
| STANDARD TYPE  | Name          | Cesium                |                | Cesium                |                |
| STANDARD MFG   | Name          | Toyocom               |                | Model 12AT35 II       |                |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Drift</b>   | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $7 \times 10^{-12}$   |                | $5 \times 10^{-12}$   |                |
| 1 - HOUR   | $\Delta f/f$  | (1)                   |                | $5 \times 10^{-13}$   |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                   |                | (1)                   |                |
| 1 - MONTH  | $\Delta f/f$  | $3 \times 10^{-12}$   |                | (1)                   |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b> | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | -108                  |                | N / A                 |                |
| 10 Hz OFFSET   | dBc/Hz        | -140                  |                | -120                  |                |
| 100 Hz OFFSET  | dBc/Hz        | -150                  |                | -126                  |                |
| 1000 Hz OFFSET   | dBc/Hz        | -157                  |                | -140                  |                |
| REF FREQS AVAILABLE  | MHz           | 5                     |                | 1, 5                  |                |
| MAX STA-TO-STA OFFSET  | Hz            | $1 \times 10^{-3}$    |                | $1 \times 10^{-3}$    |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
| <b>TIMING SYSTEM</b>   |               |                       |                |                       |                |
| MASTER REFERENCE AGENCY  | Name          | USNO                  |                | USNO                  |                |
| REFERENCE TIME   | Name          | UTC                   |                | UTC                   |                |
| TIME CODE EPOCH  | Yr            | (1)                   |                | (1)                   |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | (1)                   |                | (1)                   |                |
| MAX TIME RESOLUTION  | s             | (1)                   |                | (1)                   |                |
| TIME TRANSFER METHOD   | Name          | GPS                   |                | Cesium                |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 20$              |                | $\pm 20$              |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 100$             |                | $\pm 100$             |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$              |                | $\pm 10$              |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$              |                | $\pm 10$              |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                     |                | 1                     |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                |                       |                |

**CCSDS HISTORICAL DOCUMENT**  
**NASDA TRACKING SYSTEM**  
**GEOGRAPHICAL AND MECHANICAL**

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION      |                            |
|---|--------------------|----------------------------|----------------------------|
|   |                    | KATSUURA                   | MASUDA                     |
| <b>GENERAL</b>  |                    |                            |                            |
| STATION DESIGNATION   | -                  | Katsuura No. 2             | Masuda No. 2               |
| LOCATION(S)   | -                  | Japan                      | Japan                      |
| DIAMETER  | m                  | 13 (1)                     | 13 (1)                     |
| <b>GEOGRAPHICAL</b>   |                    |                            |                            |
| LOCATION, COUNTRY/STATE   | Name               | Katsuura, Japan            | Tanegashima, Japan         |
| LOCATION, CITY  | Name               | Katsuura                   | Tanegashima                |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 140, 18, 11                | 131, 01, 12                |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 35, 12, 09                 | 30, 33, 06                 |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| <b>MECHANICAL</b>   |                    |                            |                            |
| TYPE OF MOUNT   | -                  | Az - El                    | Az - El                    |
| AZIMUTH LIMITATIONS   | -                  | ± 190 (Ref S)              | ± 190 (Ref S)              |
| TRACKING SPEED RANGE  | deg/s              | Az = El = 0 - 2            | Az = El = 0 - 2            |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | Az = El = 0 - 2            | Az = El = 0 - 2            |
| TYPE OF POINTING  | Type               | Autotrack, Manual, Predict | Autotrack, Manual, Predict |
| POINTING ACCURACY   | deg                | 0.05 rms                   | 0.05 rms                   |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5                          | 5                          |
| MIN RECEIVE ELEV ANGLE  | deg                | 1                          | 0                          |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| <b>SUPPORT</b>  |                    |                            |                            |
| TRANSMIT FREQ BAND(S)   | GHz                | 2 (A)                      | 2 (A)                      |
| RECEIVE FREQ BAND(S)  | GHz                | 2 (A)                      | 2 (A)                      |
| ACQ AID FREQ BAND(S)  | GHz                | None                       | None                       |
| MISSION CATEGORIES  | Cat                | A                          | A                          |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                            |                            |

6445-4144



**CCSDS HISTORICAL DOCUMENT**  
**NASDA TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                |                                      |
|-----------------------------|--------------|--------------------------------------|--------------------------------------|
|                             |              | KATSUURA                             | MASUDA                               |
| <b>GENERAL</b>              |              |                                      |                                      |
| STATION DESIGNATION         | -            | Katsuura No. 1                       | Masuda No. 1                         |
| LOCATION(S)                 | -            | Katsuura, Japan                      | Tanegashima, Japan                   |
| DIAMETER                    | m            | 18                                   | 18                                   |
| <b>RECEIVE</b>              |              |                                      |                                      |
| FREQUENCIES                 | MHz          | 2200 - 2300                          | 2200 - 2300                          |
| FREQUENCY RESOLUTION        | Hz           | 10 000                               | 10 000                               |
| ANTENNA GAIN @ 45 deg       | dBi          | 47.7                                 | 49.8                                 |
| SYS NOISE TEMP @ ZENITH     | K            | 235 @ 5 deg                          | 190 @ 5 deg                          |
| G/T @ 45 deg                | dB           | 24 @ 5 deg                           | 26 @ 5 deg                           |
| POLARIZATION                | -            | RCP and LCP (Diversity)              | RCP and LCP (Diversity)              |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.6                                  | 0.52                                 |
| ANTENNA ELLIPTICITY         | dB           | (1)                                  | (1)                                  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $1 \times 10^{-5}$ @ 1 sec           | $1 \times 10^{-5}$ @ 1 sec           |
| RCVR AGC DYNAMIC RANGE      | dB           | 90                                   | 100                                  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -141 in 2 Blo = 100 Hz               | -142 in 2 Blo = 100 Hz               |
| RCVR LOOP BANDWIDTHS        | Hz           | 100, 300, 1 K                        | 100, 300, 1 K                        |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                                | Adapt                                |
| RCVR PLL ORDER(S)           | No.          | 2                                    | 2                                    |
| ACQ SWEEP RANGE             | kHz          | $\pm 30, \pm 200$                    | $\pm 30, \pm 200$                    |
| MIN ACQ SWEEP RATE          | Hz/s         | 15 000                               | 15 000                               |
| MAX ACQ SWEEP RATE          | kHz/s        | 30                                   | 30                                   |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous                           | Continuous                           |
| PROGRAMMED L.O.             | Yes/No       | Yes                                  | Yes                                  |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
| <b>TELEMETRY</b>            |              |                                      |                                      |
| MODULATION TYPE(S)          | -            | PCM / PSK / PM; PCM / PM             | PCM / PSK / PM; PCM / PM             |
| MODULATION FORMAT(S)        | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S | NRZ - L, M, S; Bi - $\phi$ - L, M, S |
| MOD INDEX RANGE             | Rad Pk       | 0 - 1.5                              | 0 - 1.5                              |
| SUBCARRIER FREQ RANGE       | kHz          | 0.1 - 2000                           | 0.1 - 2000                           |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine                                 | Sine                                 |
| SYMBOL RATE RANGE           | s/s          | 100 - 1 000 000                      | 100 - 1 000 000                      |
| SUBCARRIER/SYM RATE LIMIT   | -            | 4:1 - 1000:1                         | 1:1 - 1000:1                         |
| ARRAYS WITH STATIONS        | -            | None                                 | None                                 |
| CHANNEL DECODING            | Type         | (1)                                  | (1)                                  |
| DATA FORMAT                 | -            | (1)                                  | (1)                                  |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-4116

CCSDS HISTORICAL DOCUMENT  
**NASDA TRACKING SYSTEM**  
RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                               |   |
|---|--------------|---|---|
|   |              | KATSUURA  | MASUDA  |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | Katsuura No. 1                                      | Masuda No. 1  |
| LOCATION(S)   | -            | Katsuura, Japan                                     | Tanegashima, Japan                                  |
| DIAMETER  | m            | 18  | 18  |
| <b>FREQUENCIES</b>  |              |   |   |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120   | 2025 - 2120   |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300   | 2200 - 2300   |
| TURNAROUND FREQ RATIO   | -            | 240 / 221   | 240 / 221   |
| <b>DOPPLER</b>  |              |   |   |
| COHERENT/NON-COHERENT   | -            | Either  | Either  |
| COUNTER RESOLUTION  | Cycles       | 0.0018  | 0.0018  |
| MAX DOPPLER FREQ SHIFT  | MHz          | ± 0.15  | ± 0.15  |
| DOPPLER BIAS FREQ   | MHz          | 0.7   | 0.7   |
| DRIFT   | $\Delta f/f$ | $1 \times 10^{-11}$ @ 1 sec                         | $1 \times 10^{-11}$ @ 1 sec                         |
| OUTPUT EQUATION   | -            | Bias Freq ± 1.3 $f_d$                               | Bias Freq ± 1.3 $f_d$                               |
| DIRECTION INDICATOR   | -            | + $\Delta f = -\Delta r$                            | + $\Delta f = -\Delta r$                            |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| <b>RANGING</b>  |              |   |   |
| COHERENT/NON-COHERENT   | -            | Either  | Either  |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine  | Sine  |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.7 - 1.5   | 0 - 2   |
| RANGE CODE FREQ RATIO   | -            | 5:1, 4:1  | 5:1, 4:1  |
| MAJOR CODE FREQ(S)  | kHz          | 500, 100  | 500, 100  |
| MINOR CODE FREQ(S)  | kHz          | 100, 20, 4, (0.8, 0.16, 0.04, 0.01, 0.008 on 4 kHz) | 100, 20, 4, (0.8, 0.16, 0.04, 0.01, 0.008 on 4 kHz) |
| MIN RECEIVED CARRIER SNR  | dB           | 25  | 25  |
| MIN REQ CODE PWR/No   | dB-Hz        | 25  | 25  |
| CODE INTEGRATION TIME   | s            | 5   | 5   |
| ACQUISITION SEQUENCE  | -            | Seq; Major Code First                               | Seq; Major Code First                               |
| RANGE DATA UNITS  | -            | Nanoseconds   | Nanoseconds   |
| RANGE QUANTIZATION  | -            | 1 ns  | 1 ns  |
| ACCURACY (STRONG SIGNAL)  | m            | 1   | 1   |
| MAX UNAMBIGUOUS RANGE   | km           | 75 000  | 75 000  |
| TRANSPONDER BW  | MHz          | ≥ 1.5   | ≥ 1.5   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |   |   |

6445-4117

**CCSDS HISTORICAL DOCUMENT**  
**NASDA TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION |                |                       |                |
|--|---------------|-----------------------|----------------|-----------------------|----------------|
|  |               | KATSUURA              |                | MASUDA                |                |
| <b>GENERAL</b>   |               |                       |                |                       |                |
| STATION DESIGNATION  | -             | Katsuura No. 1        |                | Masuda No. 1          |                |
| LOCATION(S)  | -             | Katsuura, Japan       |                | Tanegashima, Japan    |                |
| DIAMETER   | m             | 18                    |                | 18                    |                |
| <b>FREQUENCY STD</b>   |               |                       |                |                       |                |
| STANDARD TYPE  | Name          | Cesium                |                | Cesium                |                |
| STANDARD MFG   | Name          | Toyocom               |                | Model 12AT35 II       |                |
| STABILITY AT:  |               | <b>Allan Variance</b> | <b>Drift</b>   | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $7 \times 10^{-12}$   |                | $5 \times 10^{-12}$   |                |
| 1 - HOUR   | $\Delta f/f$  | (1)                   |                | $5 \times 10^{-13}$   |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                   |                | (1)                   |                |
| 1 - MONTH  | $\Delta f/f$  | $3 \times 10^{-12}$   |                | (1)                   |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>          | <b>100 MHz</b> | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | -108                  |                | (1)                   |                |
| 10 Hz OFFSET   | dBc/Hz        | -140                  |                | -120                  |                |
| 100 Hz OFFSET  | dBc/Hz        | -150                  |                | -126                  |                |
| 1000 Hz OFFSET   | dBc/Hz        | -157                  |                | -140                  |                |
| REF FREQS AVAILABLE  | MHz           | 5                     |                | 1, 5                  |                |
| MAX STA-TO-STA OFFSET  | Hz            | $1 \times 10^{-3}$    |                | $1 \times 10^{-3}$    |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
| <b>TIMING SYSTEM</b>   |               |                       |                |                       |                |
| MASTER REFERENCE AGENCY  | Name          | USNO                  |                | USNO                  |                |
| REFERENCE TIME   | Name          | UTC                   |                | UTC                   |                |
| TIME CODE EPOCH  | Yr            | (1)                   |                | (1)                   |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | (1)                   |                | (1)                   |                |
| MAX TIME RESOLUTION  | s             | (1)                   |                | (1)                   |                |
| TIME TRANSFER METHOD   | Name          | GPS                   |                | Cesium                |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 20$              |                | $\pm 20$              |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 100$             |                | $\pm 100$             |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$              |                | $\pm 10$              |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$              |                | $\pm 10$              |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                     |                | 1                     |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
|  |               |                       |                |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                       |                |                       |                |

6445-4118

CCSDS HISTORICAL DOCUMENT  
**NASDA TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION      |                            |
|---|--------------------|----------------------------|----------------------------|
|   |                    | KATSUURA                   | MASUDA                     |
| <b>GENERAL</b>  |                    |                            |                            |
| STATION DESIGNATION   | -                  | Katsuura No. 1             | Masuda No. 1               |
| LOCATION(S)   | -                  | Japan                      | Japan                      |
| DIAMETER  | m                  | 18 (1)                     | 18 (1)                     |
| <b>GEOGRAPHICAL</b>   |                    |                            |                            |
| LOCATION, COUNTRY/STATE   | Name               | Katsuura, Japan            | Tanegashima, Japan         |
| LOCATION, CITY  | Name               | Katsuura                   | Tanegashima                |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 140, 18, 08                | 131, 01, 02                |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 35, 12, 27                 | 30, 33, 07                 |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| <b>MECHANICAL</b>   |                    |                            |                            |
| TYPE OF MOUNT   | -                  | X - Y                      | Az - El                    |
| AZIMUTH LIMITATIONS   | -                  | Keyhole E, W               | ± 270 (Ref W)              |
| TRACKING SPEED RANGE  | deg/s              | X = Y = 0 - 2              | Az = El = 0 - 2.5          |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | X = Y = 0 - 2              | Az = El = 0 - 2.5          |
| TYPE OF POINTING  | Type               | Autotrack, Manual, Predict | Autotrack, Manual, Predict |
| POINTING ACCURACY   | deg                | 0.05 rms                   | 0.05 rms                   |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5                          | 5                          |
| MIN RECEIVE ELEV ANGLE  | deg                | 0                          | 0                          |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| <b>SUPPORT</b>  |                    |                            |                            |
| TRANSMIT FREQ BAND(S)   | GHz                | 2 (A)                      | 2 (A)                      |
| RECEIVE FREQ BAND(S)  | GHz                | 2 (A)                      | 2 (A)                      |
| ACQ AID FREQ BAND(S)  | GHz                | 2 (A)                      | 2 (A)                      |
| MISSION CATEGORIES  | Cat                | A                          | A                          |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
|   |                    |                            |                            |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES |                    |                            |                            |

6445-4122



**CCSDS HISTORICAL DOCUMENT**  
**NASDA TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                |                                      |
|-----------------------------|--------------|--------------------------------------|--------------------------------------|
|                             |              | OKINAWA                              | OKINAWA                              |
| <b>GENERAL</b>              |              |                                      |                                      |
| STATION DESIGNATION         | -            | Okinawa No. 1                        | Okinawa No. 2                        |
| LOCATION(S)                 | -            | Okinawa, Japan                       | Okinawa, Japan                       |
| DIAMETER                    | m            | 18                                   | 18                                   |
| <b>RECEIVE</b>              |              |                                      |                                      |
| FREQUENCIES                 | MHz          | 2200 - 2300                          | 2200 - 2300                          |
| FREQUENCY RESOLUTION        | Hz           | 10 000                               | 10 000                               |
| ANTENNA GAIN @ 45 deg       | dBi          | 48                                   | 47                                   |
| SYS NOISE TEMP @ ZENITH     | K            | 200 @ 5 deg                          | 200                                  |
| G/T @ 45 deg                | dB           | 25 @ 5 deg                           | 24                                   |
| POLARIZATION                | -            | RCP and LCP (Diversity)              | RCP and LCP (Diversity)              |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.6                                  | 0.6                                  |
| ANTENNA ELLIPTICITY         | dB           | (1)                                  | (1)                                  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $1 \times 10^{-5}$ @ 1 sec           | $1 \times 10^{-5}$ @ 1 sec           |
| RCVR AGC DYNAMIC RANGE      | dB           | 90                                   | 90                                   |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -141 in 2 Blo = 100 Hz               | -141 in 2 Blo = 100 Hz               |
| RCVR LOOP BANDWIDTHS        | Hz           | 100, 300, 1 K                        | 100, 300, 1 K                        |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                                | Adapt                                |
| RCVR PLL ORDER(S)           | No.          | 2                                    | 2                                    |
| ACQ SWEEP RANGE             | kHz          | $\pm 30, \pm 200$                    | $\pm 30, \pm 200$                    |
| MIN ACQ SWEEP RATE          | Hz/s         | 15 000                               | 15 000                               |
| MAX ACQ SWEEP RATE          | kHz/s        | 30                                   | 20                                   |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous                           | Continuous                           |
| PROGRAMMED L.O.             | Yes/No       | Yes                                  | Yes                                  |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |
| <b>TELEMETRY</b>            |              |                                      |                                      |
| MODULATION TYPE(S)          | -            | PCM / PSK / PM; PCM / PM             | PCM / PSK / PM; PCM / PM             |
| MODULATION FORMAT(S)        | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S | NRZ - L, M, S; Bi - $\phi$ - L, M, S |
| MOD INDEX RANGE             | Rad Pk       | 0 - 1.5                              | 0 - 1.5                              |
| SUBCARRIER FREQ RANGE       | kHz          | 0.1 - 2000                           | 0.1 - 2000                           |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Sine                                 | Sine                                 |
| SYMBOL RATE RANGE           | s/s          | 100 - 1 000 000                      | 100 - 1 000 000                      |
| SUBCARRIER/SYM RATE LIMIT   | -            | 1:1 - 1000:1                         | 1:1 - 1000:1                         |
| ARRAYS WITH STATIONS        | -            | None                                 | None                                 |
| CHANNEL DECODING            | Type         | (1)                                  | (1)                                  |
| DATA FORMAT                 | -            | (1)                                  | (1)                                  |
|                             |              |                                      |                                      |
|                             |              |                                      |                                      |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-4112

**CCSDS HISTORICAL DOCUMENT**  
**NASDA TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION                               |   |
|--------------------------|--------------|---|---|
|                          |              | OKINAWA   | OKINAWA   |
| <b>GENERAL</b>           |              |   |   |
| STATION DESIGNATION      | -            | Okinawa No. 1                                       | Okinawa No. 2                                       |
| LOCATION(S)              | -            | Okinawa, Japan                                      | Okinawa, Japan                                      |
| DIAMETER                 | m            | 18  | 18  |
| <b>FREQUENCIES</b>       |              |   |   |
| TRANSMIT FREQUENCIES     | MHz          | 2025 - 2120   | 2025 - 2120   |
| RECEIVE FREQUENCIES      | MHz          | 2200 - 2300   | 2200 - 2300   |
| TURNAROUND FREQ RATIO    | -            | 240 / 221   | 240 / 221   |
| <b>DOPPLER</b>           |              |   |   |
| COHERENT/NON-COHERENT    | -            | Either  | None  |
| COUNTER RESOLUTION       | Cycles       | 0.0018  |   |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 0.15  |   |
| DOPPLER BIAS FREQ        | MHz          | 0.7   |   |
| DRIFT                    | $\Delta f/f$ | $1 \times 10^{-11}$ @ 1 sec                         |   |
| OUTPUT EQUATION          | -            | Bias Freq $\pm 1.3 f_d$                             |   |
| DIRECTION INDICATOR      | -            | $+\Delta f = -\Delta r$                             |   |
|                          |              |   |   |
|                          |              |   |   |
|                          |              |   |   |
| <b>RANGING</b>           |              |   |   |
| COHERENT/NON-COHERENT    | -            | Either  | Non - Coherent Only                                 |
| RANGE CODE WAVEFORM      | Sin/Sq       | Sine  | Sine  |
| EARTH STATION MOD INDEX  | Rad Pk       | 0.7 - 1.5   | 0 - 2   |
| RANGE CODE FREQ RATIO    | -            | 5:1, 4:1  | 5:1, 4:1  |
| MAJOR CODE FREQ(S)       | kHz          | 500, 100  | 500, 100  |
| MINOR CODE FREQ(S)       | kHz          | 100, 20, 4, (0.8, 0.16, 0.04, 0.01, 0.008 on 4 kHz) | 100, 20, 4, (0.8, 0.16, 0.04, 0.01, 0.008 on 4 kHz) |
| MIN RECEIVED CARRIER SNR | dB           | 25  | (1)   |
| MIN REQ CODE PWR/No      | dB-Hz        | 25  | (1)   |
| CODE INTEGRATION TIME    | s            | 5   | 5   |
| ACQUISITION SEQUENCE     | -            | Seq; Major Code First                               | Seq; Major Code First                               |
| RANGE DATA UNITS         | -            | Nanoseconds   | Nanoseconds   |
| RANGE QUANTIZATION       | -            | 1 ns  | 1 ns  |
| ACCURACY (STRONG SIGNAL) | m            | 1   | 10  |
| MAX UNAMBIGUOUS RANGE    | km           | 75 000  | 75 000  |
| TRANSPONDER BW           | MHz          | ≥ 1.5   | ≥ 0.3   |
|                          |              |   |   |
|                          |              |   |   |
|                          |              |   |   |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS

6445-4113

CCSDS HISTORICAL DOCUMENT  
**NASDA TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION   |                |                       |                |
|--|---------------|-------------------------|----------------|-----------------------|----------------|
|  |               | OKINAWA                 |                |                       |                |
| <b>GENERAL</b>   |               |                         |                |                       |                |
| STATION DESIGNATION  | -             | Okinawa No. 1 and No. 2 |                |                       |                |
| LOCATION(S)  | -             | Okinawa, Japan          |                |                       |                |
| DIAMETER   | m             | 18                      |                |                       |                |
| <b>FREQUENCY STD</b>   |               |                         |                |                       |                |
| STANDARD TYPE  | Name          | Rubidium                |                |                       |                |
| STANDARD MFG   | Name          | HP 5065 A               |                |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b>   | <b>Drift</b>   | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $5 \times 10^{-12}$     |                |                       |                |
| 1 - HOUR   | $\Delta f/f$  | $5 \times 10^{-13}$     |                |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                     |                |                       |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                     |                |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>            | <b>100 MHz</b> | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                     |                |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | -120                    |                |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | -126                    |                |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | -140                    |                |                       |                |
| REF FREQS AVAILABLE  | MHz           | 1, 5                    |                |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | $1 \times 100^{-3}$     |                |                       |                |
|  |               |                         |                |                       |                |
|  |               |                         |                |                       |                |
|  |               |                         |                |                       |                |
|  |               |                         |                |                       |                |
| <b>TIMING SYSTEM</b>   |               |                         |                |                       |                |
| MASTER REFERENCE AGENCY  | Name          | USNO                    |                |                       |                |
| REFERENCE TIME   | Name          | UTC                     |                |                       |                |
| TIME CODE EPOCH  | Yr            | (1)                     |                |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | (1)                     |                |                       |                |
| MAX TIME RESOLUTION  | s             | (1)                     |                |                       |                |
| TIME TRANSFER METHOD   | Name          | LORAN - C               |                |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | $\pm 20$                |                |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 100$               |                |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | $\pm 10$                |                |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | $\pm 10$                |                |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                       |                |                       |                |
|  |               |                         |                |                       |                |
|  |               |                         |                |                       |                |
|  |               |                         |                |                       |                |
|  |               |                         |                |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                         |                |                       |                |

6445-4114

**CCSDS HISTORICAL DOCUMENT**  
**NASDA TRACKING SYSTEM**  
**GEOGRAPHICAL AND MECHANICAL**

| CHARACTERISTICS                  | UNITS              | SUBNETWORK OR STATION      |                            |
|----------------------------------|--------------------|----------------------------|----------------------------|
|                                  |                    | OKINAWA                    | OKINAWA                    |
| <b>GENERAL</b>                   |                    |                            |                            |
| STATION DESIGNATION              | -                  | Okinawa No. 1              | Okinawa No. 2              |
| LOCATION(S)                      | -                  | Japan                      | Japan                      |
| DIAMETER                         | m                  | 18 (1)                     | 18 (1)                     |
| <b>GEOGRAPHICAL</b>              |                    |                            |                            |
| LOCATION, COUNTRY/STATE          | Name               | Okinawa, Japan             | Okinawa, Japan             |
| LOCATION, CITY                   | Name               | Okinawa                    | Okinawa                    |
| LONGITUDE (site 1/site 2/site 3) | d, m, s            | 127, 54, 13                | 127, 54, 19                |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 26, 29, 40                 | 26, 29, 45                 |
|                                  |                    |                            |                            |
|                                  |                    |                            |                            |
|                                  |                    |                            |                            |
|                                  |                    |                            |                            |
| <b>MECHANICAL</b>                |                    |                            |                            |
| TYPE OF MOUNT                    | -                  | X - Y                      | Az - El                    |
| AZIMUTH LIMITATIONS              | -                  | Keyhole E, W               | ± 270 (Ref W)              |
| TRACKING SPEED RANGE             | deg/s              | X = Y = 0 - 2              | Az = El = 0 - 2            |
| MAX TRACK ACCELERATION           | deg/s <sup>2</sup> | X = Y = 0 - 2              | Az = El = 0 - 2            |
| TYPE OF POINTING                 | Type               | Autotrack, Manual, Predict | Autotrack, Manual, Predict |
| POINTING ACCURACY                | deg                | 0.05 rms                   | 0.05 rms                   |
| MIN TRANSMIT ELEV ANGLE          | deg                | 5                          | 5                          |
| MIN RECEIVE ELEV ANGLE           | deg                | 0                          | 0                          |
|                                  |                    |                            |                            |
|                                  |                    |                            |                            |
|                                  |                    |                            |                            |
|                                  |                    |                            |                            |
|                                  |                    |                            |                            |
| <b>SUPPORT</b>                   |                    |                            |                            |
| TRANSMIT FREQ BAND(S)            | GHz                | 2 (A)                      | 2 (A)                      |
| RECEIVE FREQ BAND(S)             | GHz                | 2 (A)                      | 2 (A)                      |
| ACQ AID FREQ BAND(S)             | GHz                | 2 (A)                      | None                       |
| MISSION CATEGORIES               | Cat                | A                          | A                          |
|                                  |                    |                            |                            |
|                                  |                    |                            |                            |
|                                  |                    |                            |                            |
|                                  |                    |                            |                            |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS  
4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES



CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |  |
|---|--------------|-----------------------|--|
|   |              | FAIRBANKS CDA         |  |
| <b>GENERAL</b>  |              |                       |  |
| STATION DESIGNATION   | -            | Fairbanks CDA Station |  |
| LOCATION(S)   | -            | Fairbanks, Alaska     |  |
| DIAMETER  | m            | 4                     |  |
| <b>RECEIVE</b>  |              | None                  |  |
| FREQUENCIES   | MHz          |                       |  |
| FREQUENCY RESOLUTION  | Hz           |                       |  |
| ANTENNA GAIN @ 45 deg   | dBi          |                       |  |
| SYS NOISE TEMP @ ZENITH   | K            |                       |  |
| G/T @ 45 deg  | dB           |                       |  |
| POLARIZATION  | -            |                       |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          |                       |  |
| ANTENNA ELLIPTICITY   | dB           |                       |  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ |                       |  |
| RCVR AGC DYNAMIC RANGE  | dB           |                       |  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          |                       |  |
| RCVR LOOP BANDWIDTHS  | Hz           |                       |  |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            |                       |  |
| RCVR PLL ORDER(S)   | No.          |                       |  |
| ACQ SWEEP RANGE   | kHz          |                       |  |
| MIN ACQ SWEEP RATE  | Hz/s         |                       |  |
| MAX ACQ SWEEP RATE  | kHz/s        |                       |  |
| ACQ SWEEP STEP SIZE   | Hz           |                       |  |
| PROGRAMMED L.O.   | Yes/No       |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
| <b>TELEMETRY</b>  |              | None                  |  |
| MODULATION TYPE(S)  | -            |                       |  |
| MODULATION FORMAT(S)  | -            |                       |  |
| MOD INDEX RANGE   | Rad Pk       |                       |  |
| SUBCARRIER FREQ RANGE   | kHz          |                       |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                       |  |
| SYMBOL RATE RANGE   | s/s          |                       |  |
| SUBCARRIER/SYM RATE LIMIT   | -            |                       |  |
| ARRAYS WITH STATIONS  | -            |                       |  |
| CHANNEL DECODING  | Type         |                       |  |
| DATA FORMAT   | -            |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                       |  |

6445-4612

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |  |
|---|--------------|-----------------------|--|
|   |              | FAIRBANKS CDA         |  |
| <b>GENERAL</b>  |              |                       |  |
| STATION DESIGNATION   | -            | Fairbanks CDA Station |  |
| LOCATION(S)   | -            | Fairbanks, Alaska     |  |
| DIAMETER  | m            | 4                     |  |
| <b>FREQUENCIES</b>  |              |                       |  |
| TRANSMIT FREQUENCIES  | MHz          | 2020 - 2120           |  |
| RECEIVE FREQUENCIES   | MHz          | None                  |  |
| TURNAROUND FREQ RATIO   | -            | None                  |  |
| <b>DOPPLER</b>  |              |                       |  |
| COHERENT/NON-COHERENT   | -            | None                  |  |
| COUNTER RESOLUTION  | Cycles       |                       |  |
| MAX DOPPLER FREQ SHIFT  | MHz          |                       |  |
| DOPPLER BIAS FREQ   | MHz          |                       |  |
| DRIFT   | $\Delta f/f$ |                       |  |
| OUTPUT EQUATION   | -            |                       |  |
| DIRECTION INDICATOR   | -            |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
| <b>RANGING</b>  |              |                       |  |
| COHERENT/NON-COHERENT   | -            | None                  |  |
| RANGE CODE WAVEFORM   | Sin/Sq       |                       |  |
| EARTH STATION MOD INDEX   | Rad Pk       |                       |  |
| RANGE CODE FREQ RATIO   | -            |                       |  |
| MAJOR CODE FREQ(S)  | kHz          |                       |  |
| MINOR CODE FREQ(S)  | kHz          |                       |  |
| MIN RECEIVED CARRIER SNR  | dB           |                       |  |
| MIN REQ CODE PWR/No   | dB-Hz        |                       |  |
| CODE INTEGRATION TIME   | s            |                       |  |
| ACQUISITION SEQUENCE  | -            |                       |  |
| RANGE DATA UNITS  | -            |                       |  |
| RANGE QUANTIZATION  | -            |                       |  |
| ACCURACY (STRONG SIGNAL)  | m            |                       |  |
| MAX UNAMBIGUOUS RANGE   | km           |                       |  |
| TRANSPONDER BW  | MHz          |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |  |

6445-4613

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING NETWORK**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION    |                |                       |                |
|--|---------------|--------------------------|----------------|-----------------------|----------------|
|  |               | FAIRBANKS CDA            |                |                       |                |
| <b>GENERAL</b>   |               |                          |                |                       |                |
| STATION DESIGNATION  | -             | Fairbanks CDA Station    |                |                       |                |
| LOCATION(S)  | -             | Fairbanks, Alaska        |                |                       |                |
| DIAMETER   | m             | 4                        |                |                       |                |
| <b>FREQUENCY STD</b>   |               |                          |                |                       |                |
| STANDARD TYPE  | Name          | Cesium Beam              |                |                       |                |
| STANDARD MFG   | Name          | HP5061 B                 |                |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b>    | <b>Drift</b>   | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $5.6 \times 10^{-11}$    | (1)            |                       |                |
| 1 - HOUR   | $\Delta f/f$  | (1)                      | (1)            |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                      | (1)            |                       |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                      | (1)            |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>             | <b>100 MHz</b> | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | -48                      | (1)            |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | -82                      | (1)            |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | -120                     | (1)            |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | -125                     | (1)            |                       |                |
| REF FREQS AVAILABLE  | MHz           | 0.1, 1, 5, 10            |                |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                      |                |                       |                |
|  |               |                          |                |                       |                |
|  |               |                          |                |                       |                |
|  |               |                          |                |                       |                |
|  |               |                          |                |                       |                |
| <b>TIMING SYSTEM</b>   |               |                          |                |                       |                |
| MASTER REFERENCE AGENCY  | Name          | USNO                     |                |                       |                |
| REFERENCE TIME   | Name          | UTC                      |                |                       |                |
| TIME CODE EPOCH  | Yr            | (1)                      |                |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | NASA 36-bit Serial, IRIG |                |                       |                |
| MAX TIME RESOLUTION  | s             | (1)                      |                |                       |                |
| TIME TRANSFER METHOD   | Name          | GPS                      |                |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 0.1                      |                |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | 10                       |                |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 10                       |                |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 10                       |                |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 100, 1 K          |                |                       |                |
|  |               |                          |                |                       |                |
|  |               |                          |                |                       |                |
|  |               |                          |                |                       |                |
|  |               |                          |                |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                          |                |                       |                |





CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |  |
|---|--------------|-----------------------|--|
|   |              | WALLOPS CDA           |  |
| <b>GENERAL</b>  |              |                       |  |
| STATION DESIGNATION   | -            | Wallops CDA Station   |  |
| LOCATION(S)   | -            | Wallops, VA           |  |
| DIAMETER  | m            | 4                     |  |
| <b>RECEIVE</b>  |              |                       |  |
|   |              | None                  |  |
| FREQUENCIES   | MHz          |                       |  |
| FREQUENCY RESOLUTION  | Hz           |                       |  |
| ANTENNA GAIN @ 45 deg   | dBi          |                       |  |
| SYS NOISE TEMP @ ZENITH   | K            |                       |  |
| G/T @ 45 deg  | dB           |                       |  |
| POLARIZATION  | -            |                       |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          |                       |  |
| ANTENNA ELLIPTICITY   | dB           |                       |  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ |                       |  |
| RCVR AGC DYNAMIC RANGE  | dB           |                       |  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          |                       |  |
| RCVR LOOP BANDWIDTHS  | Hz           |                       |  |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            |                       |  |
| RCVR PLL ORDER(S)   | No.          |                       |  |
| ACQ SWEEP RANGE   | kHz          |                       |  |
| MIN ACQ SWEEP RATE  | Hz/s         |                       |  |
| MAX ACQ SWEEP RATE  | kHz/s        |                       |  |
| ACQ SWEEP STEP SIZE   | Hz           |                       |  |
| PROGRAMMED L.O.   | Yes/No       |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
| <b>TELEMETRY</b>  |              |                       |  |
|   |              | None                  |  |
| MODULATION TYPE(S)  | -            |                       |  |
| MODULATION FORMAT(S)  | -            |                       |  |
| MOD INDEX RANGE   | Rad Pk       |                       |  |
| SUBCARRIER FREQ RANGE   | kHz          |                       |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                       |  |
| SYMBOL RATE RANGE   | s/s          |                       |  |
| SUBCARRIER/SYM RATE LIMIT   | -            |                       |  |
| ARRAYS WITH STATIONS  | -            |                       |  |
| CHANNEL DECODING  | Type         |                       |  |
| DATA FORMAT   | -            |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                       |  |

6445-4622

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |  |
|---|--------------|-----------------------|--|
|   |              | WALLOPS CDA           |  |
| <b>GENERAL</b>  |              |                       |  |
| STATION DESIGNATION   | -            | Wallops CDA Station   |  |
| LOCATION(S)   | -            | Wallops, VA           |  |
| DIAMETER  | m            | 4                     |  |
| <b>FREQUENCIES</b>  |              |                       |  |
| TRANSMIT FREQUENCIES  | MHz          | 2020 - 2120           |  |
| RECEIVE FREQUENCIES   | MHz          | None                  |  |
| TURNAROUND FREQ RATIO   | -            | None                  |  |
| <b>DOPPLER</b>  |              |                       |  |
| COHERENT/NON-COHERENT   | -            | None                  |  |
| COUNTER RESOLUTION  | Cycles       |                       |  |
| MAX DOPPLER FREQ SHIFT  | MHz          |                       |  |
| DOPPLER BIAS FREQ   | MHz          |                       |  |
| DRIFT   | $\Delta f/f$ |                       |  |
| OUTPUT EQUATION   | -            |                       |  |
| DIRECTION INDICATOR   | -            |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
| <b>RANGING</b>  |              |                       |  |
| COHERENT/NON-COHERENT   | -            | None                  |  |
| RANGE CODE WAVEFORM   | Sin/Sq       |                       |  |
| EARTH STATION MOD INDEX   | Rad Pk       |                       |  |
| RANGE CODE FREQ RATIO   | -            |                       |  |
| MAJOR CODE FREQ(S)  | kHz          |                       |  |
| MINOR CODE FREQ(S)  | kHz          |                       |  |
| MIN RECEIVED CARRIER SNR  | dB           |                       |  |
| MIN REQ CODE PWR/No   | dB-Hz        |                       |  |
| CODE INTEGRATION TIME   | s            |                       |  |
| ACQUISITION SEQUENCE  | -            |                       |  |
| RANGE DATA UNITS  | -            |                       |  |
| RANGE QUANTIZATION  | -            |                       |  |
| ACCURACY (STRONG SIGNAL)  | m            |                       |  |
| MAX UNAMBIGUOUS RANGE   | km           |                       |  |
| TRANSPONDER BW  | MHz          |                       |  |
|   |              |                       |  |
|   |              |                       |  |
|   |              |                       |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                       |  |

6445-4623

**CCSDS HISTORICAL DOCUMENT**  
**NOAA - NESDIS TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION    |                |                       |                |
|--|---------------|--------------------------|----------------|-----------------------|----------------|
|  |               | WALLOPS CDA              |                |                       |                |
| <b>GENERAL</b>   |               |                          |                |                       |                |
| STATION DESIGNATION  | -             | Wallops CDA Station      |                |                       |                |
| LOCATION(S)  | -             | Wallops, VA              |                |                       |                |
| DIAMETER   | m             | 4                        |                |                       |                |
| <b>FREQUENCY STD</b>   |               |                          |                |                       |                |
| STANDARD TYPE  | Name          | Cesium Beam              |                |                       |                |
| STANDARD MFG   | Name          | HP5061B                  |                |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b>    | <b>Drift</b>   | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $5.6 \times 10^{-11}$    | (1)            |                       |                |
| 1 - HOUR   | $\Delta f/f$  | (1)                      | (1)            |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                      | (1)            |                       |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                      | (1)            |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>             | <b>100 MHz</b> | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | -48                      | (1)            |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | -82                      | (1)            |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | -120                     | (1)            |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | -125                     | (1)            |                       |                |
| REF FREQS AVAILABLE  | MHz           | 10, 5, 1 0.1             |                |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                      |                |                       |                |
|  |               |                          |                |                       |                |
|  |               |                          |                |                       |                |
|  |               |                          |                |                       |                |
|  |               |                          |                |                       |                |
| <b>TIMING SYSTEM</b>   |               |                          |                |                       |                |
| MASTER REFERENCE AGENCY  | Name          | USNO                     |                |                       |                |
| REFERENCE TIME   | Name          | UTC                      |                |                       |                |
| TIME CODE EPOCH  | Yr            | (1)                      |                |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | NASA 36-bit Serial, IRIG |                |                       |                |
| MAX TIME RESOLUTION  | s             | (1)                      |                |                       |                |
| TIME TRANSFER METHOD   | Name          | GPS                      |                |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 0.1                      |                |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | 10                       |                |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 10                       |                |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 10                       |                |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 100, 1 K          |                |                       |                |
|  |               |                          |                |                       |                |
|  |               |                          |                |                       |                |
|  |               |                          |                |                       |                |
|  |               |                          |                |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                          |                |                       |                |



CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION          |                        |  |
|---|--------------|--------------------------------|------------------------|--|
|   |              | FAIRBANKS                      | FAIRBANKS              |  |
| <b>GENERAL</b>  |              |                                |                        |  |
| STATION DESIGNATION   | -            | Fairbanks CDA Station          | Fairbanks CDA Station  |  |
| LOCATION(S)   | -            | Fairbanks, Alaska, USA         | Fairbanks, Alaska, USA |  |
| DIAMETER  | m            | 6                              | 12                     |  |
| <b>TRANSMIT</b>   |              |                                |                        |  |
| FREQUENCIES   | MHz          | 2025 - 2120                    | No Transmitter         |  |
| FREQUENCY RESOLUTION  | Hz           | 100                            |                        |  |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | 1 / deg C / 24 hrs             |                        |  |
| TRANSMIT POWER 1  | W            | (1)                            |                        |  |
| EIRP RANGE 1  | dBW          | 82                             |                        |  |
| TRANSMIT POWER 2  | W            | (1)                            |                        |  |
| EIRP RANGE 2  | dBW          | 51                             |                        |  |
| POLARIZATION  | -            | RCP or LCP                     |                        |  |
| ANTENNA GAIN  | dBi          | 39                             |                        |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 1.7                            |                        |  |
| ANTENNA ELLIPTICITY   | dB           | (1)                            |                        |  |
| RF FREQ SWEEP RANGE   | kHz          | $\pm 15, \pm 300$              |                        |  |
| MIN FREQ SWEEP RATE   | Hz/s         | 500                            |                        |  |
| MAX FREQ SWEEP RATE   | kHz/s        | 600                            |                        |  |
| PROGRAMMED UPLINK FREQ  | Yes/No       | (1)                            |                        |  |
| <b>COMMAND</b>  |              |                                |                        |  |
| RF CARRIER MOD TYPE   | -            | PM, FM                         | None                   |  |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | PM = 0 - 1 Rad, FM = 0 - 1 MHz |                        |  |
| SUBCARRIER FREQUENCY(S)   | Hz           | 70 000                         |                        |  |
| SUBCARRIER STEP SIZE  | Hz           | (1)                            |                        |  |
| SUBCARRIER FREQ STABILITY   | ppm          | (1)                            |                        |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                           |                        |  |
| SUBCARRIER MOD TYPE   | -            | PSK AM, FSK / AM               |                        |  |
| SUBCARRIER/BIT RATE LIMIT   | -            | (1)                            |                        |  |
| BIT RATE RANGE  | b/s          | (1)                            |                        |  |
| FORMATS AVAILABLE   | -            | (1)                            |                        |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                                |                        |  |

6445-4604

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION           |  |   |
|---|--------------|---------------------------------|--|---|
|   |              | FAIRBANKS                       |  | FAIRBANKS   |
| <b>GENERAL</b>  |              |                                 |  |   |
| STATION DESIGNATION   | -            | Fairbanks CDA Station           |  | Fairbanks CDA Station   |
| LOCATION(S)   | -            | Fairbanks, Alaska, USA          |  | Fairbanks, Alaska, USA  |
| DIAMETER  | m            | 6                               |  | 12  |
| <b>RECEIVE</b>  |              |                                 |  |   |
| FREQUENCIES   | MHz          | 2200 - 2300                     |  | 1690 - 1710      2200 - 2300                                    |
| FREQUENCY RESOLUTION  | Hz           | 10 000                          |  | 10 000      10 000  |
| ANTENNA GAIN @ 45 deg   | dBi          | 40.5                            |  | 43.7      48  |
| SYS NOISE TEMP @ ZENITH   | K            | 76                              |  | 186      302  |
| G/T @ 45 deg  | dB           | 21.7                            |  | 21      23.2  |
| POLARIZATION  | -            | RCR or LCP                      |  | LIN      LIN  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 1.6                             |  | 1      0.8  |
| ANTENNA ELLIPTICITY   | dB           | (1)                             |  | (1)      (1)  |
| L.O. REF FREQ STAB @ 1 hr   | $\Delta f/f$ | $5 \times 10^{-9} / \text{day}$ |  | $5 \times 10^{-9} / \text{day}$ $5 \times 10^{-9} / \text{day}$ |
| RCVR AGC DYNAMIC RANGE  | dB           | 120                             |  | 120      120  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -151 in 2 Blo = 30 Hz           |  | -147 in 2 Blo = 30 Hz      -145 in 2 Blo = 30 Hz                |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 100, 300, 1 K, 3 K          |  | 30, 100, 300, 1 K, 3 K      30, 100, 300, 1 K, 3 K              |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | (1)                             |  | (1)      (1)  |
| RCVR PLL ORDER(S)   | No.          | (1)                             |  | (1)      (1)  |
| ACQ SWEEP RANGE   | kHz          | $\pm 0.1$ to 200                |  | $\pm 0.1$ to 200 $\pm 0.1$ to 200                               |
| MIN ACQ SWEEP RATE  | Hz/s         | 5                               |  | 5      5  |
| MAX ACQ SWEEP RATE  | kHz/s        | 0.5                             |  | 0.5      0.5  |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                      |  | Continuous      Continuous                                      |
| PROGRAMMED L.O.   | Yes/No       | Yes                             |  | Yes      Yes  |
| <b>TELEMETRY</b>  |              |                                 |  |   |
| MODULATION TYPE(S)  | -            | PM, FM                          |  | PM, FM  |
| MODULATION FORMAT(S)  | -            | NRZ, RZ, Bi - $\phi$            |  | NRZ, RZ, Bi - $\phi$  |
| MOD INDEX RANGE   | Rad Pk       | (1)                             |  | (1)   |
| SUBCARRIER FREQ RANGE   | kHz          | (1)                             |  | (1)   |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                            |  | Sine  |
| SYMBOL RATE RANGE   | s/s          | (1)                             |  | (1)   |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)                             |  | (1)   |
| ARRAYS WITH STATIONS  | -            | None                            |  | None  |
| CHANNEL DECODING  | Type         | (1)                             |  | (1)   |
| DATA FORMAT   | -            | (1)                             |  | (1)   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                                 |  |   |

6445-4605

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION  |                          |
|--------------------------|--------------|------------------------|--------------------------|
|                          |              | FAIRBANKS              | FAIRBANKS                |
| <b>GENERAL</b>           |              |                        |                          |
| STATION DESIGNATION      | -            | Fairbanks CDA Station  | Fairbanks CDA Station    |
| LOCATION(S)              | -            | Fairbanks, Alaska, USA | Fairbanks, Alaska, USA   |
| DIAMETER                 | m            | 6                      | 12                       |
| <b>FREQUENCIES</b>       |              |                        |                          |
| TRANSMIT FREQUENCIES     | MHz          | 2025 - 2120            | None                     |
| RECEIVE FREQUENCIES      | MHz          | 2200 - 2300            | 1690 - 1710, 2200 - 2300 |
| TURNAROUND FREQ RATIO    | -            | (1)                    | (1)                      |
| <b>DOPPLER</b>           |              |                        |                          |
| COHERENT/NON-COHERENT    | -            | (1)                    | (1)                      |
| COUNTER RESOLUTION       | Cycles       | (1)                    | (1)                      |
| MAX DOPPLER FREQ SHIFT   | MHz          | (1)                    | (1)                      |
| DOPPLER BIAS FREQ        | MHz          | (1)                    | (1)                      |
| DRIFT                    | $\Delta f/f$ | (1)                    | (1)                      |
| OUTPUT EQUATION          | -            | (1)                    | (1)                      |
| DIRECTION INDICATOR      | -            | (1)                    | (1)                      |
| <b>RANGING</b>           |              |                        |                          |
| COHERENT/NON-COHERENT    | -            | (1)                    | (1)                      |
| RANGE CODE WAVEFORM      | Sin/Sq       | (1)                    | (1)                      |
| EARTH STATION MOD INDEX  | Rad Pk       | (1)                    | (1)                      |
| RANGE CODE FREQ RATIO    | -            | (1)                    | (1)                      |
| MAJOR CODE FREQ(S)       | kHz          | (1)                    | (1)                      |
| MINOR CODE FREQ(S)       | kHz          | (1)                    | (1)                      |
| MIN RECEIVED CARRIER SNR | dB           | (1)                    | (1)                      |
| MIN REQ CODE PWR/No      | dB-Hz        | (1)                    | (1)                      |
| CODE INTEGRATION TIME    | s            | (1)                    | (1)                      |
| ACQUISITION SEQUENCE     | -            | (1)                    | (1)                      |
| RANGE DATA UNITS         | -            | (1)                    | (1)                      |
| RANGE QUANTIZATION       | -            | (1)                    | (1)                      |
| ACCURACY (STRONG SIGNAL) | m            | (1)                    | (1)                      |
| MAX UNAMBIGUOUS RANGE    | km           | (1)                    | (1)                      |
| TRANSPONDER BW           | MHz          | (1)                    | (1)                      |
|                          |              |                        |                          |
|                          |              |                        |                          |
|                          |              |                        |                          |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

6445-4606

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION        |                         |                              |                         |
|--|---------------|------------------------------|-------------------------|------------------------------|-------------------------|
|  |               | FAIRBANKS                    |                         | FAIRBANKS                    |                         |
| <b>GENERAL</b>   |               |                              |                         |                              |                         |
| STATION DESIGNATION  | -             | Fairbanks - 6 m              |                         | Fairbanks - 13 m             |                         |
| LOCATION(S)  | -             | Fairbanks, Alaska, USA       |                         | Fairbanks, Alaska, USA       |                         |
| DIAMETER   | m             | 6                            |                         | 12                           |                         |
| <b>FREQUENCY STD</b>   |               |                              |                         |                              |                         |
| STANDARD TYPE  | Name          | Cesium                       |                         | Cesium                       |                         |
| STANDARD MFG   | Name          | HP - 5061 B                  |                         | HP - 5061 B                  |                         |
| STABILITY AT:  |               | <b>Allan Variance</b>        | <b>Drift</b>            | <b>Allan Variance</b>        | <b>Drift</b>            |
| 1 - SECOND   | $\Delta f/f$  | $5.6 \times 10^{-11}$        | (1)                     | $5.6 \times 10^{-11}$        | (1)                     |
| 1 - HOUR   | $\Delta f/f$  | (1)                          | (1)                     | (1)                          | (1)                     |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                          | (1)                     | (1)                          | (1)                     |
| 1 - MONTH  | $\Delta f/f$  | (1)                          | $\pm 5 \times 10^{-12}$ | (1)                          | $\pm 5 \times 10^{-12}$ |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>                 | <b>100 MHz</b>          | <b>5 MHz</b>                 | <b>100 MHz</b>          |
| 1 Hz OFFSET  | dBc/Hz        | (1)                          | (1)                     | (1)                          | (1)                     |
| 10 Hz OFFSET   | dBc/Hz        | - 82                         | (1)                     | - 82                         | (1)                     |
| 100 Hz OFFSET  | dBc/Hz        | - 120                        | (1)                     | - 120                        | (1)                     |
| 1000 Hz OFFSET   | dBc/Hz        | - 125                        | (1)                     | - 125                        | (1)                     |
| REF FREQS AVAILABLE  | MHz           | 0.1, 1, 5, 10                |                         | 0.1, 1, 5, 10                |                         |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                          |                         | (1)                          |                         |
|  |               |                              |                         |                              |                         |
|  |               |                              |                         |                              |                         |
|  |               |                              |                         |                              |                         |
| <b>TIMING SYSTEM</b>   |               |                              |                         |                              |                         |
| MASTER REFERENCE AGENCY  | Name          | USNO                         |                         | USNO                         |                         |
| REFERENCE TIME   | Name          | UTC                          |                         | UTC                          |                         |
| TIME CODE EPOCH  | Yr            | (1)                          |                         | (1)                          |                         |
| TIME CODES AVAILABLE   | CCSDS Codes   | NASA 36-bit Serial, IRIG     |                         | NASA 36-bit Serial, IRIG     |                         |
| MAX TIME RESOLUTION  | s             | (1)                          |                         | (1)                          |                         |
| TIME TRANSFER METHOD   | Name          | GPS                          |                         | GPS                          |                         |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 0.1                          |                         | 0.1                          |                         |
| MAX OFFSET FROM REF  | $\mu$ -sec    | 10                           |                         | 10                           |                         |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 10                           |                         | 10                           |                         |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 10                           |                         | 10                           |                         |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 100, 1 K, 10 K, 100 K |                         | 1, 10, 100, 1 K, 10 K, 100 K |                         |
|  |               |                              |                         |                              |                         |
|  |               |                              |                         |                              |                         |
|  |               |                              |                         |                              |                         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                              |                         |                              |                         |

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION  |                        |
|---|--------------------|------------------------|------------------------|
|   |                    | FAIRBANKS              | FAIRBANKS              |
| <b>GENERAL</b>  |                    |                        |                        |
| STATION DESIGNATION   | -                  | Fairbanks CDA Station  | Fairbanks CDA Station  |
| LOCATION(S)   | -                  | Fairbanks, Alaska, USA | Fairbanks, Alaska, USA |
| DIAMETER  | m                  | 6                      | 12                     |
| <b>GEOGRAPHICAL</b>   |                    |                        |                        |
| LOCATION, COUNTRY/STATE   | Name               | USA / Alaska           | USA / Alaska           |
| LOCATION, CITY  | Name               | Fairbanks              | Fairbanks              |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 148, 28, 56.804        | 148, 28, 45.222        |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 64, 58, 20.312         | 64, 58, 35.391         |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
| <b>MECHANICAL</b>   |                    |                        |                        |
| TYPE OF MOUNT   | -                  | Az - El                | X - Y                  |
| AZIMUTH LIMITATIONS   | -                  | 3600                   | (1)                    |
| TRACKING SPEED RANGE  | deg/s              | 4                      | 4                      |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 5                      | 5                      |
| TYPE OF POINTING  | Type               | (1)                    | (1)                    |
| POINTING ACCURACY   | deg                | 0.01                   | 0.01                   |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5                      | (1)                    |
| MIN RECEIVE ELEV ANGLE  | deg                | 5                      | 5                      |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
| <b>SUPPORT</b>  |                    |                        |                        |
| TRANSMIT FREQ BAND(S)   | GHz                | 2.025 - 2.12           | None                   |
| RECEIVE FREQ BAND(S)  | GHz                | 2.2 - 2.3              | 1.69 - 1.71, 2.2 - 2.3 |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                    | (1)                    |
| MISSION CATEGORIES  | Cat                | A                      | A                      |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                        |                        |

6445-4608

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 EARTH-TO-SPACE LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION        |                        |      |
|---|--------------|------------------------------|------------------------|------|
|   |              | WALLOPS CDA                  | FAIRBANKS              |      |
| <b>GENERAL</b>  |              |                              |                        |      |
| STATION DESIGNATION   | -            | Wallops CDA Station          | Fairbanks CDA Station  |      |
| LOCATION(S)   | -            | Wallops, VA                  | Fairbanks, Alaska, USA |      |
| DIAMETER  | m            | 14.2                         | 26                     |      |
| <b>TRANSMIT</b>   |              |                              |                        |      |
| FREQUENCIES   | MHz          | 2020 - 2120                  | None                   |      |
| FREQUENCY RESOLUTION  | Hz           | 100 000                      |                        |      |
| RF FREQ STABILITY @ 1 Hr  | $\Delta f/f$ | (1)                          |                        |      |
| TRANSMIT POWER 1  | W            | 16 - 1800                    |                        |      |
| EIRP RANGE 1  | dBW          | 58.8 - 79.8                  |                        |      |
| TRANSMIT POWER 2  | W            | None                         |                        |      |
| EIRP RANGE 2  | dBW          | None                         |                        |      |
| POLARIZATION  | -            | RCP                          |                        |      |
| ANTENNA GAIN  | dBi          | 46.8                         |                        |      |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.76                         |                        |      |
| ANTENNA ELLIPTICITY   | dB           | (1)                          |                        |      |
| RF FREQ SWEEP RANGE   | kHz          | (1)                          |                        |      |
| MIN FREQ SWEEP RATE   | Hz/s         | (1)                          |                        |      |
| MAX FREQ SWEEP RATE   | kHz/s        | (1)                          |                        |      |
| PROGRAMMED UPLINK FREQ  | Yes/No       | (1)                          |                        |      |
| <b>COMMAND</b>  |              |                              |                        |      |
| RF CARRIER MOD TYPE   | -            | PM, FM                       |                        | None |
| RF CARRIER MOD INDEX RNG  | Rad Pk       | PMEO - 1 rad, FM = 0 - 1 MHz |                        |      |
| SUBCARRIER FREQUENCY(S)   | Hz           | 70 000                       |                        |      |
| SUBCARRIER STEP SIZE  | Hz           | (1)                          |                        |      |
| SUBCARRIER FREQ STABILITY   | ppm          | (1)                          |                        |      |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                         |                        |      |
| SUBCARRIER MOD TYPE   | -            | PSK / AM, FSK / AM           |                        |      |
| SUBCARRIER/BIT RATE LIMIT   | -            | (1)                          |                        |      |
| BIT RATE RANGE  | b/s          | (1)                          |                        |      |
| FORMATS AVAILABLE   | -            | (1)                          |                        |      |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                              |                        |      |

6445-4616

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION           |                                 |                                 |                                 |
|---|--------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
|   |              | WALLOPS CDA                     |                                 | FAIRBANKS                       |                                 |
| <b>GENERAL</b>  |              |                                 |                                 |                                 |                                 |
| STATION DESIGNATION   | -            | WALLOPS CDA Station             |                                 | Fairbanks CDA Station           |                                 |
| LOCATION(S)   | -            | Wallops, VA                     |                                 | Fairbanks, Alaska, USA          |                                 |
| DIAMETER  | m            | 14.2                            |                                 | 26                              |                                 |
| <b>RECEIVE</b>  |              |                                 |                                 |                                 |                                 |
| FREQUENCIES   | MHz          | 1670 - 1710                     | 2200 - 2300                     | 1690 - 1710                     | 2200 - 2300                     |
| FREQUENCY RESOLUTION  | Hz           | 10 000                          | 10 000                          | 10 000                          | 10 000                          |
| ANTENNA GAIN @ 45 deg   | dBi          | 44.1                            | 46.6                            | 49.6                            | 51.8                            |
| SYS NOISE TEMP @ ZENITH   | K            | 144                             | 165                             | 182                             | 190                             |
| G/T @ 45 deg  | dB           | 22.5                            | 24.4                            | 27                              | 29                              |
| POLARIZATION  | -            | RCP - LCP                       | RCP - LCP                       | LIN                             | LIN                             |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.91                            | 0.68                            | 0.6                             | 0.3                             |
| ANTENNA ELLIPTICITY   | dB           | (1)                             | (1)                             | (1)                             | (1)                             |
| L.O. REF FREQ STAB @1 hr  | $\Delta f/f$ | $5 \times 10^{-9} / \text{Day}$ | $5 \times 10^{-9} / \text{Day}$ | $5 \times 10^{-9} / \text{day}$ | $5 \times 10^{-9} / \text{day}$ |
| RCVR AGC DYNAMIC RANGE  | dB           | 120                             | 120                             | 120                             | 120                             |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -148 in 2 Blo = 30 Hz           | -147 in 2 Blo = 30 Hz           | -147 in 2 Blo = 30 Hz           | -147 in 2 Blo = 30 Hz           |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 100, 300, 1 K, 3 K          | 30, 100, 300, 1 K, 3 K          | 30, 100, 300, 1 K, 3 K          | 30, 100, 300, 1 K, 3 K          |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                           | Adapt                           | (1)                             | (1)                             |
| RCVR PLL ORDER(S)   | No.          | 2                               | 2                               | (1)                             | (1)                             |
| ACQ SWEEP RANGE   | kHz          | $\pm 300$                       | $\pm 300$                       | Continuous                      | Continuous                      |
| MIN ACQ SWEEP RATE  | Hz/s         | 5                               | 5                               | 5                               | 5                               |
| MAX ACQ SWEEP RATE  | kHz/s        | 0.5                             | 0.5                             | 0.5                             | 0.5                             |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                      | Continuous                      | (1)                             | (1)                             |
| PROGRAMMED L.O.   | Yes/No       | Yes                             | Yes                             | Yes                             | Yes                             |
| <b>TELEMETRY</b>  |              |                                 |                                 |                                 |                                 |
| MODULATION TYPE(S)  | -            | PM, FM                          |                                 | PM, FM                          | PM, FM                          |
| MODULATION FORMAT(S)  | -            | Bi - $\phi$                     |                                 | NRZ, RZ, Bi - $\phi$            | NRZ, RZ, Bi - $\phi$            |
| MOD INDEX RANGE   | Rad Pk       | 1.169                           |                                 | (1)                             | 0 - 1                           |
| SUBCARRIER FREQ RANGE   | kHz          | (1)                             |                                 | (1)                             | (1)                             |
| SUBCARRIER WAVEFORM   | Sin/Sq       | (1)                             |                                 | Sine                            | Sine                            |
| SYMBOL RATE RANGE   | s/s          | 8320                            |                                 | (1)                             | (1)                             |
| SUBCARRIER/SYM RATE LIMIT   | -            | (1)                             |                                 | (1)                             | (1)                             |
| ARRAYS WITH STATIONS  | -            | None                            |                                 | None                            | None                            |
| CHANNEL DECODING  | Type         | (1)                             |                                 | (1)                             | (1)                             |
| DATA FORMAT   | -            | (1)                             |                                 | (1)                             | (1)                             |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                                 |                                 |                                 |                                 |

6445-4617

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION    |                          |
|---|--------------|--------------------------|--------------------------|
|   |              | WALLOPS CDA              | FAIRBANKS                |
| <b>GENERAL</b>  |              |                          |                          |
| STATION DESIGNATION   | -            | Wallops CDA Station      | Fairbanks CDA Station    |
| LOCATION(S)   | -            | Wallops, VA              | Fairbanks, Alaska, USA   |
| DIAMETER  | m            | 14.2                     | 26                       |
| <b>FREQUENCIES</b>  |              |                          |                          |
| TRANSMIT FREQUENCIES  | MHz          | 2020 - 2120              | None                     |
| RECEIVE FREQUENCIES   | MHz          | 1670 - 1710, 2200 - 2300 | 1690 - 1710, 2200 - 2300 |
| TURNAROUND FREQ RATIO   | -            | None                     | (1)                      |
| <b>DOPPLER</b>  |              |                          |                          |
| COHERENT/NON-COHERENT   | -            | None                     | None                     |
| COUNTER RESOLUTION  | Cycles       |                          |                          |
| MAX DOPPLER FREQ SHIFT  | MHz          |                          |                          |
| DOPPLER BIAS FREQ   | MHz          |                          |                          |
| DRIFT   | $\Delta f/f$ |                          |                          |
| OUTPUT EQUATION   | -            |                          |                          |
| DIRECTION INDICATOR   | -            |                          |                          |
|   |              |                          |                          |
|   |              |                          |                          |
|   |              |                          |                          |
| <b>RANGING</b>  |              |                          |                          |
| COHERENT/NON-COHERENT   | -            | None                     | None                     |
| RANGE CODE WAVEFORM   | Sin/Sq       |                          |                          |
| EARTH STATION MOD INDEX   | Rad Pk       |                          |                          |
| RANGE CODE FREQ RATIO   | -            |                          |                          |
| MAJOR CODE FREQ(S)  | kHz          |                          |                          |
| MINOR CODE FREQ(S)  | kHz          |                          |                          |
| MIN RECEIVED CARRIER SNR  | dB           |                          |                          |
| MIN REQ CODE PWR/No   | dB-Hz        |                          |                          |
| CODE INTEGRATION TIME   | s            |                          |                          |
| ACQUISITION SEQUENCE  | -            |                          |                          |
| RANGE DATA UNITS  | -            |                          |                          |
| RANGE QUANTIZATION  | -            |                          |                          |
| ACCURACY (STRONG SIGNAL)  | m            |                          |                          |
| MAX UNAMBIGUOUS RANGE   | km           |                          |                          |
| TRANSPONDER BW  | MHz          |                          |                          |
|   |              |                          |                          |
|   |              |                          |                          |
|   |              |                          |                          |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                          |                          |

6445-4618

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION    |                |                              |                         |
|--|---------------|--------------------------|----------------|------------------------------|-------------------------|
|  |               | WALLOPS CDA              |                | FAIRBANKS                    |                         |
| <b>GENERAL</b>   |               |                          |                |                              |                         |
| STATION DESIGNATION  | -             | Wallops CDA Station      |                | Fairbanks CDA Station        |                         |
| LOCATION(S)  | -             | Wallops, VA              |                | Fairbanks, Alaska, USA       |                         |
| DIAMETER   | m             | All Antennas             |                | All Antennas                 |                         |
| <b>FREQUENCY STD</b>   |               |                          |                |                              |                         |
| STANDARD TYPE  | Name          | Cesium Beam              |                | Cesium                       |                         |
| STANDARD MFG   | Name          | HP5061B                  |                | HP - 5061 B                  |                         |
| STABILITY AT:  |               | <b>Allan Variance</b>    | <b>Drift</b>   | <b>Allan Variance</b>        | <b>Drift</b>            |
| 1 - SECOND   | $\Delta f/f$  | $5.6 \times 10^{-11}$    | (1)            | $5.6 \times 10^{-11}$        | (1)                     |
| 1 - HOUR   | $\Delta f/f$  | (1)                      | (1)            | (1)                          | (1)                     |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                      | (1)            | (1)                          | (1)                     |
| 1 - MONTH  | $\Delta f/f$  | (1)                      | (1)            | (1)                          | $\pm 5 \times 10^{-12}$ |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>             | <b>100 MHz</b> | <b>5 MHz</b>                 | <b>100 MHz</b>          |
| 1 Hz OFFSET  | dBc/Hz        | -48                      | (1)            | (1)                          | (1)                     |
| 10 Hz OFFSET   | dBc/Hz        | -82                      | (1)            | - 82                         | (1)                     |
| 100 Hz OFFSET  | dBc/Hz        | -120                     | (1)            | - 120                        | (1)                     |
| 1000 Hz OFFSET   | dBc/Hz        | -125                     | (1)            | - 125                        | (1)                     |
| REF FREQS AVAILABLE  | MHz           | 10, 5, 1, 0.1            |                | 0.001, 0.01, 0.1, 1, 5       |                         |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                      |                | (1)                          |                         |
|  |               |                          |                |                              |                         |
|  |               |                          |                |                              |                         |
|  |               |                          |                |                              |                         |
| <b>TIMING SYSTEM</b>   |               |                          |                |                              |                         |
| MASTER REFERENCE AGENCY  | Name          | USNO                     |                | USNO                         |                         |
| REFERENCE TIME   | Name          | UTC                      |                | UTC                          |                         |
| TIME CODE EPOCH  | Yr            | (1)                      |                | (1)                          |                         |
| TIME CODES AVAILABLE   | CCSDS Codes   | NASA 36-bit Serial, IRIG |                | NASA 36-bit Serial, IRIG     |                         |
| MAX TIME RESOLUTION  | s             | (1)                      |                | (1)                          |                         |
| TIME TRANSFER METHOD   | Name          | GPS                      |                | GPS                          |                         |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 0.1                      |                | 0.1                          |                         |
| MAX OFFSET FROM REF  | $\mu$ -sec    | 10                       |                | 10                           |                         |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 10                       |                | 10                           |                         |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 10                       |                | 10                           |                         |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 100, 1 K          |                | 1, 10, 100, 1 K, 10 K, 100 K |                         |
|  |               |                          |                |                              |                         |
|  |               |                          |                |                              |                         |
|  |               |                          |                |                              |                         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                          |                |                              |                         |

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION  |                        |
|---|--------------------|------------------------|------------------------|
|   |                    | WALLOPS CDA            | FAIRBANKS              |
| <b>GENERAL</b>  |                    |                        |                        |
| STATION DESIGNATION   | -                  | Wallops CDA Station    | Fairbanks CDA Station  |
| LOCATION(S)   | -                  | Wallops, VA            | Fairbanks, Alaska, USA |
| DIAMETER  | m                  | 14.2                   | 26                     |
| <b>GEOGRAPHICAL</b>   |                    |                        |                        |
| LOCATION, COUNTRY/STATE   | Name               | USA / VA               | USA / Alaska           |
| LOCATION, CITY  | Name               | Wallops                | Fairbanks              |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | 75 27 36.227           | 148 28 56.803          |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | 37 56 48.389           | 64 58 36.176           |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
| <b>MECHANICAL</b>   |                    |                        |                        |
| TYPE OF MOUNT   | -                  | X - Y                  | X - Y                  |
| AZIMUTH LIMITATIONS   | -                  | (1)                    | (1)                    |
| TRACKING SPEED RANGE  | deg/s              | 4                      | 4                      |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 5                      | 5                      |
| TYPE OF POINTING  | Type               | (1)                    | (1)                    |
| POINTING ACCURACY   | deg                | 0.015                  | 0.01                   |
| MIN TRANSMIT ELEV ANGLE   | deg                | 5                      | (1)                    |
| MIN RECEIVE ELEV ANGLE  | deg                | 5                      | 5                      |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
| <b>SUPPORT</b>  |                    |                        |                        |
| TRANSMIT FREQ BAND(S)   | GHz                | 2.02 - 2.12            | None                   |
| RECEIVE FREQ BAND(S)  | GHz                | 1.67 - 1.71, 2.2 - 2.3 | 1.67 - 1.71, 2.2 - 2.3 |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                    | (1)                    |
| MISSION CATEGORIES  | Cat                | A                      | A                      |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES      5. BASED UPON GEODETIC COORDINATES |                    |                        |                        |



CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION  |                          |                          |
|---|--------------|------------------------|--------------------------|--------------------------|
|   |              | FAIRBANKS              |                          | WALLOPS CDA              |
| <b>GENERAL</b>  |              |                        |                          |                          |
| STATION DESIGNATION   | -            | Fairbanks CDA Station  |                          | WALLOPS CDA Station      |
| LOCATION(S)   | -            | Fairbanks, Alaska, USA |                          | Wallops, VA              |
| DIAMETER  | m            | 26 VLBI                |                          | 26                       |
| <b>RECEIVE</b>  |              |                        |                          |                          |
| FREQUENCIES   | MHz          | 8180 - 8980            | 1670 - 1710              | 2200 - 2300              |
| FREQUENCY RESOLUTION  | Hz           | 10 000                 | 10 000                   | 10 000                   |
| ANTENNA GAIN @ 45 deg   | dBi          | 63                     | 43.7                     | 48.8                     |
| SYS NOISE TEMP @ ZENITH   | K            | 50                     | 353                      | 307                      |
| G/T @ 45 deg  | dB/K         | 46                     | 18.2                     | 23.9                     |
| POLARIZATION  | -            | RCP                    | RCP - LCP                | RCP - LCP                |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.085                  | 0.54                     | 0.34                     |
| ANTENNA ELLIPTICITY   | dB           | (1)                    | (1)                      | (1)                      |
| L.O. REF FREQ STAB @ 1 hr   | $\Delta f/f$ | $1 \times 10^{-8}$     | $5 \times 10^{-9}$ / Day | $5 \times 10^{-9}$ / Day |
| RCVR AGC DYNAMIC RANGE  | dB           | (1)                    | 120                      | 120                      |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | (1)                    | -144 in 2 Blo = 30 Hz    | -145 in 2 Blo = 30 Hz    |
| RCVR LOOP BANDWIDTHS  | Hz           | (1)                    | 30, 100, 300, 1 K, 3 K   | 30, 100, 300, 1 K, 3 K   |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | (1)                    | Adapt                    | Adapt                    |
| RCVR PLL ORDER(S)   | No.          | (1)                    | 2                        | 2                        |
| ACQ SWEEP RANGE   | kHz          | (1)                    | $\pm 300$                | $\pm 300$                |
| MIN ACQ SWEEP RATE  | Hz/s         | (1)                    | 5                        | 5                        |
| MAX ACQ SWEEP RATE  | kHz/s        | (1)                    | 0.5                      | 0.5                      |
| ACQ SWEEP STEP SIZE   | Hz           | (1)                    | Continuous               | Continuous               |
| PROGRAMMED L.O.   | Yes/No       | No                     | Yes                      | Yes                      |
|   |              |                        |                          |                          |
|   |              |                        |                          |                          |
|   |              |                        |                          |                          |
|   |              |                        |                          |                          |
| <b>TELEMETRY</b>  |              |                        |                          |                          |
| MODULATION TYPE(S)  | -            | None                   |                          | PM, FM                   |
| MODULATION FORMAT(S)  | -            |                        |                          | Bi - $\phi$              |
| MOD INDEX RANGE   | Rad Pk       |                        |                          | 1.169                    |
| SUBCARRIER FREQ RANGE   | kHz          |                        |                          | (1)                      |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                        |                          | (1)                      |
| SYMBOL RATE RANGE   | s/s          |                        |                          | 8320                     |
| SUBCARRIER/SYM RATE LIMIT   | -            |                        |                          | (1)                      |
| ARRAYS WITH STATIONS  | -            |                        |                          | None                     |
| CHANNEL DECODING  | Type         |                        |                          | (1)                      |
| DATA FORMAT   | -            |                        |                          | (1)                      |
|   |              |                        |                          |                          |
|   |              |                        |                          |                          |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                        |                          |                          |

6445-4600

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION  |                          |
|---|--------------|------------------------|--------------------------|
|   |              | FAIRBANKS              | WALLOPS CDA              |
| <b>GENERAL</b>  |              |                        |                          |
| STATION DESIGNATION   | -            | Fairbanks CDA Station  | Wallops CDA Station      |
| LOCATION(S)   | -            | Fairbanks, Alaska, USA | Wallops, VA              |
| DIAMETER  | m            | 26 VLBI                | 26                       |
| <b>FREQUENCIES</b>  |              |                        |                          |
| TRANSMIT FREQUENCIES  | MHz          | None                   | (1)                      |
| RECEIVE FREQUENCIES   | MHz          | 8180 - 8980            | 1670 - 1710, 2200 - 2300 |
| TURNAROUND FREQ RATIO   | -            | (1)                    | None                     |
| <b>DOPPLER</b>  |              |                        |                          |
| COHERENT/NON-COHERENT   | -            | None                   | None                     |
| COUNTER RESOLUTION  | Cycles       |                        |                          |
| MAX DOPPLER FREQ SHIFT  | MHz          |                        |                          |
| DOPPLER BIAS FREQ   | MHz          |                        |                          |
| DRIFT   | $\Delta f/f$ |                        |                          |
| OUTPUT EQUATION   | -            |                        |                          |
| DIRECTION INDICATOR   | -            |                        |                          |
|   |              |                        |                          |
|   |              |                        |                          |
|   |              |                        |                          |
| <b>RANGING</b>  |              |                        |                          |
| COHERENT/NON-COHERENT   | -            | None                   | None                     |
| RANGE CODE WAVEFORM   | Sin/Sq       |                        |                          |
| EARTH STATION MOD INDEX   | Rad Pk       |                        |                          |
| RANGE CODE FREQ RATIO   | -            |                        |                          |
| MAJOR CODE FREQ(S)  | kHz          |                        |                          |
| MINOR CODE FREQ(S)  | kHz          |                        |                          |
| MIN RECEIVED CARRIER SNR  | dB           |                        |                          |
| MIN REQ CODE PWR/No   | dB-Hz        |                        |                          |
| CODE INTEGRATION TIME   | s            |                        |                          |
| ACQUISITION SEQUENCE  | -            |                        |                          |
| RANGE DATA UNITS  | -            |                        |                          |
| RANGE QUANTIZATION  | -            |                        |                          |
| ACCURACY (STRONG SIGNAL)  | m            |                        |                          |
| MAX UNAMBIGUOUS RANGE   | km           |                        |                          |
| TRANSPONDER BW  | MHz          |                        |                          |
|   |              |                        |                          |
|   |              |                        |                          |
|   |              |                        |                          |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                        |                          |

6445-4601

**CCSDS HISTORICAL DOCUMENT**  
**NOAA - NESDIS TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION        |                         |                              |                         |
|--|---------------|------------------------------|-------------------------|------------------------------|-------------------------|
|  |               | FAIRBANKS                    |                         | WALLOPS CDA                  |                         |
| <b>GENERAL</b>   |               |                              |                         |                              |                         |
| STATION DESIGNATION  | -             | Fairbanks CDA Station        |                         | Wallops CDA Station          |                         |
| LOCATION(S)  | -             | Fairbanks, Alaska, USA       |                         | Wallops, Va                  |                         |
| DIAMETER   | m             | 26 VLBI                      |                         | 26                           |                         |
| <b>FREQUENCY STD</b>   |               |                              |                         |                              |                         |
| STANDARD TYPE  | Name          | Rubidium                     |                         | Rubidium                     |                         |
| STANDARD MFG   | Name          | HP - 5065 A                  |                         | HP - 5065 A                  |                         |
| STABILITY AT:  |               | <b>Allan Variance</b>        | <b>Drift</b>            | <b>Allan Variance</b>        | <b>Drift</b>            |
| 1 - SECOND   | $\Delta f/f$  | $5.6 \times 10^{-11}$        | (1)                     | $5.6 \times 10^{-11}$        | (1)                     |
| 1 - HOUR   | $\Delta f/f$  | (1)                          | (1)                     | (1)                          | (1)                     |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                          | (1)                     | (1)                          | (1)                     |
| 1 - MONTH  | $\Delta f/f$  | (1)                          | $\pm 5 \times 10^{-12}$ | (1)                          | $\pm 5 \times 10^{-12}$ |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>                 | <b>100 MHz</b>          | <b>5 MHz</b>                 | <b>100 MHz</b>          |
| 1 Hz OFFSET  | dBc/Hz        | (1)                          | (1)                     | (1)                          | (1)                     |
| 10 Hz OFFSET   | dBc/Hz        | - 82                         | (1)                     | - 82                         | (1)                     |
| 100 Hz OFFSET  | dBc/Hz        | - 120                        | (1)                     | - 120                        | (1)                     |
| 1000 Hz OFFSET   | dBc/Hz        | - 125                        | (1)                     | - 125                        | (1)                     |
| REF FREQS AVAILABLE  | MHz           | 0.001, 0.01, 0.1, 1, 5       |                         | 0.001, 0.01, 0.1, 1, 5       |                         |
| MAX STA-TO-STA OFFSET  | Hz            | (1)                          |                         | (1)                          |                         |
|  |               |                              |                         |                              |                         |
|  |               |                              |                         |                              |                         |
|  |               |                              |                         |                              |                         |
|  |               |                              |                         |                              |                         |
| <b>TIMING SYSTEM</b>   |               |                              |                         |                              |                         |
| MASTER REFERENCE AGENCY  | Name          | USNO                         |                         | USNO                         |                         |
| REFERENCE TIME   | Name          | UTC                          |                         | UTC                          |                         |
| TIME CODE EPOCH  | Yr            | (1)                          |                         | (1)                          |                         |
| TIME CODES AVAILABLE   | CCSDS Codes   | NASA 36-bit Serial, IRIG     |                         | NASA 36-bit Serial, IRIG     |                         |
| MAX TIME RESOLUTION  | s             | (1)                          |                         | (1)                          |                         |
| TIME TRANSFER METHOD   | Name          | GPS                          |                         | GPS                          |                         |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 0.1                          |                         | 0.1                          |                         |
| MAX OFFSET FROM REF  | $\mu$ -sec    | 10                           |                         | 10                           |                         |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 10                           |                         | 10                           |                         |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | 10                           |                         | 10                           |                         |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1, 10, 100, 1 K, 10 K, 100 K |                         | 1, 10, 100, 1 K, 10 K, 100 K |                         |
|  |               |                              |                         |                              |                         |
|  |               |                              |                         |                              |                         |
|  |               |                              |                         |                              |                         |
|  |               |                              |                         |                              |                         |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                              |                         |                              |                         |

CCSDS HISTORICAL DOCUMENT  
**NOAA - NESDIS TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS   | UNITS              | SUBNETWORK OR STATION  |                        |
|---|--------------------|------------------------|------------------------|
|   |                    | FAIRBANKS              | WALLOPS CDA            |
| <b>GENERAL</b>  |                    |                        |                        |
| STATION DESIGNATION   | -                  | Fairbanks CDA Station  | Wallops CDA Station    |
| LOCATION(S)   | -                  | Fairbanks, Alaska, USA | Wallops, VA            |
| DIAMETER  | m                  | 26 VLBI                | 26                     |
| <b>GEOGRAPHICAL</b>   |                    |                        |                        |
| LOCATION, COUNTRY/STATE   | Name               | USA / Alaska           | USA / VA               |
| LOCATION, CITY  | Name               | Fairbanks              | Wallops                |
| LONGITUDE (site 1/site 2/site 3)  | d, m, s            | (1)                    | 75 27 31.309           |
| LATITUDE (site 1/site 2/site 3)   | d, m, s            | (1)                    | 37 56 48.079           |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
| <b>MECHANICAL</b>   |                    |                        |                        |
| TYPE OF MOUNT   | -                  | X - Y                  | X - Y                  |
| AZIMUTH LIMITATIONS   | -                  | (1)                    | (1)                    |
| TRACKING SPEED RANGE  | deg/s              | 4                      | 3                      |
| MAX TRACK ACCELERATION  | deg/s <sup>2</sup> | 5                      | 5                      |
| TYPE OF POINTING  | Type               | (1)                    | (1)                    |
| POINTING ACCURACY   | deg                | 0.001                  | 0.01                   |
| MIN TRANSMIT ELEV ANGLE   | deg                | (1)                    | 5                      |
| MIN RECEIVE ELEV ANGLE  | deg                | 5                      | 5                      |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
| <b>SUPPORT</b>  |                    |                        |                        |
| TRANSMIT FREQ BAND(S)   | GHz                | None                   | 2.02 - 2.12            |
| RECEIVE FREQ BAND(S)  | GHz                | 8.18 - 8.98            | 1.67 - 1.71, 2.2 - 2.3 |
| ACQ AID FREQ BAND(S)  | GHz                | (1)                    | (1)                    |
| MISSION CATEGORIES  | Cat                | A                      | A                      |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
|   |                    |                        |                        |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES |                    |                        |                        |

6445-4603



**CCSDS HISTORICAL DOCUMENT**  
**RSA TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                  |              |
|-----------------------------|--------------|--|--------------|
|                             |              | ECDSC - 25                             | ECDSC - 32   |
| <b>GENERAL</b>              |              |  |              |
| STATION DESIGNATION         | -            | ECDSC A - 25                           | ECDSC A - 32 |
| LOCATION(S)                 | -            | Russia                                 | Russia       |
| DIAMETER                    | m            | 25                                     | 32           |
| <b>RECEIVE</b>              |              |  |              |
| FREQUENCIES                 | MHz          | None                                   |              |
| FREQUENCY RESOLUTION        | Hz           | 5870 - 5890                            | 920 - 935    |
| ANTENNA GAIN @ 45 deg       | dBi          | 0.01                                   | 0.01         |
| SYS NOISE TEMP @ ZENITH     | K            | 62                                     | 46.5         |
| G/T @ 45 deg                | dB           | 110                                    | 100          |
| POLARIZATION                | -            | 41.5                                   | 26.5         |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | LCP                                    | RCP          |
| ANTENNA ELLIPTICITY         | dB           | 0.11                                   | 0.7          |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | -3                                     | -3           |
| RCVR AGC DYNAMIC RANGE      | dB           | $\pm 1 \times 10^{-14} / 1 \text{ hr}$ |              |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | 80                                     |              |
| RCVR LOOP BANDWIDTHS        | Hz           | -168 in 2 Blo = 1 Hz                   |              |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | 1 - 100                                |              |
| RCVR PLL ORDER(S)           | No.          | Adapt                                  |              |
| ACQ SWEEP RANGE             | kHz          | 3                                      |              |
| MIN ACQ SWEEP RATE          | Hz/s         | $\pm 60$                               |              |
| MAX ACQ SWEEP RATE          | kHz/s        | 1                                      |              |
| ACQ SWEEP STEP SIZE         | Hz           | 10                                     |              |
| PROGRAMMED L.O.             | Yes/No       | Continuous                             |              |
|                             |              | Yes                                    |              |
|                             |              |  |              |
|                             |              |  |              |
|                             |              |  |              |
|                             |              |  |              |
| <b>TELEMETRY</b>            |              |  |              |
| MODULATION TYPE(S)          | -            | None                                   |              |
| MODULATION FORMAT(S)        | -            | PM                                     |              |
| MOD INDEX RANGE             | Rad Pk       | NRZ-L, Bi - $\phi$ - L                 |              |
| SUBCARRIER FREQ RANGE       | kHz          | 0 - 2.1 or 0 - 2.6                     |              |
| SUBCARRIER WAVEFORM         | Sin/Sq       | 1.024                                  |              |
| SYMBOL RATE RANGE           | s/s          | Square                                 |              |
| SUBCARRIER/SYM RATE LIMIT   | -            | 1 - 131072                             |              |
| ARRAYS WITH STATIONS        | -            | $\geq 8$                               |              |
| CHANNEL DECODING            | Type         | None                                   |              |
| DATA FORMAT                 | -            | R = 1/2, K = 6                         |              |
|                             |              | NRZ-L, Bi - $\phi$ - L                 |              |
|                             |              |  |              |
|                             |              |  |              |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS

6445-4737

**CCSDS HISTORICAL DOCUMENT**  
**RSA TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION |                                      |
|---|--------------|-----------------------|--------------------------------------|
|   |              | ECDSC - 25            | ECDSC - 32                           |
| <b>GENERAL</b>  |              |                       |                                      |
| STATION DESIGNATION   | -            | ECDSC A - 25          | ECDSC A - 32                         |
| LOCATION(S)   | -            | Russia                | Russia                               |
| DIAMETER  | m            | 25                    | 32                                   |
| <b>FREQUENCIES</b>  |              |                       |                                      |
| TRANSMIT FREQUENCIES  | MHz          | 772.275               | None                                 |
| RECEIVE FREQUENCIES   | MHz          | None                  | 5870 - 5890, 920 - 935               |
| TURNAROUND FREQ RATIO   | -            | None                  | (1)                                  |
| <b>DOPPLER</b>  |              |                       |                                      |
| COHERENT/NON-COHERENT   | -            | None                  | Coherent or Non-Coherent             |
| COUNTER RESOLUTION  | Cycles       |                       | 0.001                                |
| MAX DOPPLER FREQ SHIFT  | MHz          |                       | ± 0.8                                |
| DOPPLER BIAS FREQ   | MHz          |                       | + 0.8                                |
| DRIFT   | $\Delta f/f$ |                       | $1 \times 10^{-12}$ @ 1s             |
| OUTPUT EQUATION   | -            |                       | 1-Bias Freq + fd1                    |
| DIRECTION INDICATOR   | -            |                       | + $\Delta f = -\Delta r$             |
| <b>RANGING</b>  |              |                       |                                      |
| COHERENT/NON-COHERENT   | -            | None                  | Side Tone Ranging Only               |
| RANGE CODE WAVEFORM   | Sin/Sq       |                       | Coherent or Non-Coherent             |
| EARTH STATION MOD INDEX   | Rad Pk       |                       | Square                               |
| RANGE CODE FREQ RATIO   | -            |                       | 0 - 2.1 Carrier; 0 - 1.5 Subcarrier, |
| MAJOR CODE FREQ(S)  | kHz          |                       | 4:1                                  |
| MINOR CODE FREQ(S)  | kHz          |                       | 300; 30                              |
| MIN RECEIVED CARRIER SNR  | dB           |                       | $300 / 4^i, i = 1 - 5$               |
| MIN REQ CODE PWR/No   | dB-Hz        |                       | 17                                   |
| CODE INTEGRATION TIME   | s            |                       | (1)                                  |
| ACQUISITION SEQUENCE  | -            |                       | 10                                   |
| RANGE DATA UNITS  | -            |                       | Sequence Major Tone First            |
| RANGE QUANTIZATION  | -            |                       | (1)                                  |
| ACCURACY (STRONG SIGNAL)  | m            |                       | (1)                                  |
| MAX UNAMBIGUOUS RANGE   | km           |                       | 20 (rss), 100 (rss)                  |
| TRANSPONDER BW  | MHz          |                       | 512                                  |
|   |              |                       | 0.5                                  |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> <p>4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA</p> |              |                       |                                      |

**CCSDS HISTORICAL DOCUMENT**  
**RSA TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION   |                |                         |                |
|--|---------------|-------------------------|----------------|-------------------------|----------------|
|  |               | ECDSC - 25              |                | ECDSC - 32              |                |
| <b>GENERAL</b>   |               |                         |                |                         |                |
| STATION DESIGNATION  | -             | ECDSC A - 25            |                | ECDSC A - 32            |                |
| LOCATION(S)  | -             | Russia                  |                | Russia                  |                |
| DIAMETER   | m             | 25                      |                | 32                      |                |
| <b>FREQUENCY STD</b>   |               |                         |                |                         |                |
| STANDARD TYPE  | Name          | Hydrogen Maser          |                | Hydrogen Maser          |                |
| STANDARD MFG   | Name          | 40 - 101B               |                | 40 - 101B               |                |
| STABILITY AT:  |               | Allan Variance          |                | Allan Variance          |                |
| 1 - SECOND   | $\Delta f/f$  | $1 \times 10^{-12}$     |                | $1 \times 10^{-12}$     |                |
| 1 - HOUR   | $\Delta f/f$  | $5 \times 10^{-14}$     |                | $5 \times 10^{-14}$     |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | $3 \times 10^{-14}$     |                | $3 \times 10^{-14}$     |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                     |                | (1)                     |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>            | <b>100 MHz</b> | <b>5 MHz</b>            | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | (1)                     | (1)            | (1)                     | (1)            |
| 10 Hz OFFSET   | dBc/Hz        | -125                    | (1)            | -125                    | (1)            |
| 100 Hz OFFSET  | dBc/Hz        | -135                    | (1)            | -135                    | (1)            |
| 1000 Hz OFFSET   | dBc/Hz        | -140                    | (1)            | -140                    | (1)            |
| REF FREQS AVAILABLE  | MHz           | 5 MHz; 1 Hz             |                | 5 MHz; 1 Hz             |                |
| MAX STA-TO-STA OFFSET  | Hz            | $\pm 3 \times 10^{-12}$ |                | $\pm 3 \times 10^{-12}$ |                |
|  |               |                         |                |                         |                |
|  |               |                         |                |                         |                |
|  |               |                         |                |                         |                |
| <b>TIMING SYSTEM</b>   |               |                         |                |                         |                |
| MASTER REFERENCE AGENCY  | Name          | SSRTF                   |                | SSRTF                   |                |
| REFERENCE TIME   | Name          | Moscow Time             |                | Moscow Time             |                |
| TIME CODE EPOCH  | Yr            | (1)                     |                | (1)                     |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | Own Codes               |                | Own Codes               |                |
| MAX TIME RESOLUTION  | s             | (1)                     |                | (1)                     |                |
| TIME TRANSFER METHOD   | Name          | Planning GLONASS        |                | Planning GLONASS        |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | (1)                     |                | (1)                     |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | (1)                     |                | (1)                     |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | (1)                     |                | (1)                     |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | (1)                     |                | (1)                     |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                       |                | 1                       |                |
|  |               |                         |                |                         |                |
|  |               |                         |                |                         |                |
|  |               |                         |                |                         |                |
|  |               |                         |                |                         |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA    5. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA    6445-4683 |               |                         |                |                         |                |

CCSDS HISTORICAL DOCUMENT  
**RSA TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS  | UNITS              | SUBNETWORK OR STATION |                           |
|--|--------------------|-----------------------|---------------------------|
|  |                    | ECDSC - 25            | ECDSC - 32                |
| <b>GENERAL</b>   |                    |                       |                           |
| STATION DESIGNATION  | -                  | ECDSC A - 25          | ECDSC A - 32              |
| LOCATION(S)  | -                  | Russia                | Russia                    |
| DIAMETER   | m                  | 25                    | 32                        |
| <b>GEOGRAPHICAL</b>  |                    |                       |                           |
| LOCATION, COUNTRY/STATE  | Name               | Russia                | Russia                    |
| LOCATION, CITY   | Name               | Ussuriysk             | Ussuriysk                 |
| LONGITUDE (site 1/site 2/site 3)   | d, m, s            | 131 45 E              | 131 45 E                  |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 44 01 N               | 44 01 N                   |
|  |                    |                       |                           |
|  |                    |                       |                           |
|  |                    |                       |                           |
|  |                    |                       |                           |
| <b>MECHANICAL</b>  |                    |                       |                           |
| TYPE OF MOUNT  | -                  | Az - El               | Az - El                   |
| AZIMUTH LIMITATIONS  | -                  | ± 330                 | ± 330                     |
| TRACKING SPEED RANGE   | deg/s              | 0.16                  | 0.06                      |
| MAX TRACK ACCELERATION   | deg/s <sup>2</sup> | (1)                   | (1)                       |
| TYPE OF POINTING   | Type               | Predicts              | Predicts, Conscan         |
| POINTING ACCURACY  | deg                | (1)                   | 0.33                      |
| MIN TRANSMIT ELEV ANGLE  | deg                | 7                     | None                      |
| MIN RECEIVE ELEV ANGLE   | deg                | None                  | 7                         |
|  |                    |                       |                           |
|  |                    |                       |                           |
|  |                    |                       |                           |
|  |                    |                       |                           |
| <b>SUPPORT</b>   |                    |                       |                           |
| TRANSMIT FREQ BAND(S)  | GHz                | 0.772                 | None                      |
| RECEIVE FREQ BAND(S)   | GHz                | None                  | 0.92 - 0.935, 5.87 - 5.89 |
| ACQ AID FREQ BAND(S)   | GHz                | None                  | (1)                       |
| MISSION CATEGORIES   | Cat                | B                     | B                         |
|  |                    |                       |                           |
|  |                    |                       |                           |
|  |                    |                       |                           |
|  |                    |                       |                           |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES<br>6. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA |                    |                       |                           |

6445-4686



**CCSDS HISTORICAL DOCUMENT**  
**RSA TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION       |  |  |                         |                         |                         |
|-----------------------------|--------------|-----------------------------|--|--|-------------------------|-------------------------|-------------------------|
|                             |              | WCDSC - 32                  |  | ECDSC - 70                             |                         |                         |                         |
| <b>GENERAL</b>              |              |                             |  |  |                         |                         |                         |
| STATION DESIGNATION         | -            | WCDSC A - 32 <sup>(4)</sup> |  | ECDSC A - 70                           |                         |                         |                         |
| LOCATION(S)                 | -            | Ukraine                     |  | Russia                                 |                         |                         |                         |
| DIAMETER                    | m            | 32                          |  | 70                                     |                         |                         |                         |
| <b>RECEIVE</b>              |              | None                        |  |  |                         |                         |                         |
| FREQUENCIES                 | MHz          |                             |  | 8370 - 8530                            | 5870 - 5690             | 2200 - 2300             | 920 - 935               |
| FREQUENCY RESOLUTION        | Hz           |                             |  | 1                                      | 0.01                    | 10 000                  | 0.01                    |
| ANTENNA GAIN @ 45 deg       | dBi          |                             |  | 74                                     | 71                      | 61                      | 53                      |
| SYS NOISE TEMP @ ZENITH     | K            |                             |  | 35                                     | 25                      | 42                      | 45                      |
| G/T @ 45 deg                | dB           |                             |  | 58.2                                   | 56.5                    | 44.5                    | 36.3                    |
| POLARIZATION                | -            |                             |  | LCP                                    | LCP                     | LCP                     | RCP                     |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          |                             |  | 0.035                                  | 0.05                    | 0.13                    | 0.32                    |
| ANTENNA ELLIPTICITY         | dB           |                             |  | -3                                     |                         |                         |                         |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ |                             |  | $\pm 1 \times 10^{-14} / 1 \text{ hr}$ |                         |                         |                         |
| RCVR AGC DYNAMIC RANGE      | dB           |                             |  | 80                                     |                         |                         |                         |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          |                             |  | -173 in<br>2 Blo = 1 Hz                | -175 in<br>2 Blo = 1 Hz | -172 in<br>2 Blo = 1 Hz | -172 in<br>2 Blo = 1 Hz |
| RCVR LOOP BANDWIDTHS        | Hz           |                             |  | 1 - 100                                |                         |                         |                         |
| RCVR LOOP TYPE (ADAPT, FIX) | -            |                             |  | Adapt                                  |                         |                         |                         |
| RCVR PLL ORDER(S)           | No.          |                             |  | 3                                      |                         |                         |                         |
| ACQ SWEEP RANGE             | kHz          |                             |  | $\pm 60$                               |                         |                         |                         |
| MIN ACQ SWEEP RATE          | Hz/s         |                             |  | (1)                                    |                         |                         |                         |
| MAX ACQ SWEEP RATE          | kHz/s        |                             |  | (1)                                    |                         |                         |                         |
| ACQ SWEEP STEP SIZE         | Hz           |                             |  | Continuous                             |                         |                         |                         |
| PROGRAMMED L.O.             | Yes/No       |                             |  | Yes                                    |                         |                         |                         |
|                             |              |                             |  |  |                         |                         |                         |
|                             |              |                             |  |  |                         |                         |                         |
|                             |              |                             |  |  |                         |                         |                         |
|                             |              |                             |  |  |                         |                         |                         |
|                             |              |                             |  |  |                         |                         |                         |
|                             |              |                             |  |  |                         |                         |                         |
| <b>TELEMETRY</b>            |              | None                        |  |  |                         |                         |                         |
| MODULATION TYPE(S)          | -            |                             |  | PM                                     |                         |                         |                         |
| MODULATION FORMAT(S)        | -            |                             |  | NRZ-L, Bi - $\phi$ - L                 |                         |                         |                         |
| MOD INDEX RANGE             | Rad Pk       |                             |  | 2.1, 2.6                               |                         |                         |                         |
| SUBCARRIER FREQ RANGE       | kHz          |                             |  | 1 - 131                                |                         |                         |                         |
| SUBCARRIER WAVEFORM         | Sin/Sq       |                             |  | Square                                 |                         |                         |                         |
| SYMBOL RATE RANGE           | s/s          |                             |  | 1 - 262 144                            |                         |                         |                         |
| SUBCARRIER/SYM RATE LIMIT   | -            |                             |  | >8                                     |                         |                         |                         |
| ARRAYS WITH STATIONS        | -            |                             |  | None                                   |                         |                         |                         |
| CHANNEL DECODING            | Type         |                             |  | Conv ( $r = 1/2, k = 6$ )              |                         |                         |                         |
| DATA FORMAT                 | -            |                             |  | NRZ-L, Bi - $\phi$ - L                 |                         |                         |                         |
|                             |              |                             |  |  |                         |                         |                         |
|                             |              |                             |  |  |                         |                         |                         |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS  
4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA

**CCSDS HISTORICAL DOCUMENT**  
**RSA TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION       |  |  |  |
|--------------------------|--------------|-----------------------------|--|--|--|
|                          |              | WCDSC - 32                  |  | ECDSC - 70                                     |  |
| <b>GENERAL</b>           |              |                             |  |  |  |
| STATION DESIGNATION      | -            | WCDSC A - 32 <sup>(4)</sup> |  | ECDSC A - 70                                   |  |
| LOCATION(S)              | -            | Ukraine                     |  | Russia   |  |
| DIAMETER                 | m            | 32                          |  | 70   |  |
| <b>FREQUENCIES</b>       |              |                             |  |  |  |
| TRANSMIT FREQUENCIES     | MHz          | 5000 - 5025                 |  | 5000 - 5025, 772.275                           |  |
| RECEIVE FREQUENCIES      | MHz          | None                        |  | 8370 - 8530                                    | 5870 - 5890   2200 - 2300   920 - 935                              |
| TURNAROUND FREQ RATIO    | -            | None                        |  | 19456 / (17 x 681)<br>or<br>19456 / (17 x 105) | 800 / 681<br>or<br>800 / 105   None   126 / 681<br>or<br>126 / 105 |
| <b>DOPPLER</b>           |              |                             |  |  |  |
| COHERENT/NON-COHERENT    | -            | None                        |  | Coherent                                       |  |
| COUNTER RESOLUTION       | Cycles       |                             |  | 0.001  |  |
| MAX DOPPLER FREQ SHIFT   | MHz          |                             |  | ± 0.8  |  |
| DOPPLER BIAS FREQ        | MHz          |                             |  | + 0.8  |  |
| DRIFT                    | $\Delta f/f$ |                             |  | $1 \times 10^{-12}$ @ 1s                       |  |
| OUTPUT EQUATION          | -            |                             |  | 1 - Bias Freq + fd1                            |  |
| DIRECTION INDICATOR      | -            |                             |  | + $\Delta f = -\Delta r$                       |  |
| <b>RANGING</b>           |              |                             |  |  |  |
| COHERENT/NON-COHERENT    | -            | None                        |  | Side Tone Ranging Only                         |  |
| RANGE CODE WAVEFORM      | Sin/Sq       |                             |  | Coherent                                       |  |
| EARTH STATION MOD INDEX  | Rad Pk       |                             |  | Square   |  |
| RANGE CODE FREQ RATIO    | -            |                             |  | 0 - 2.1 Carrier, 0 - 1.5 Subcarrier            |  |
| MAJOR CODE FREQ(S)       | kHz          |                             |  | 4:1  |  |
| MINOR CODE FREQ(S)       | kHz          |                             |  | 300, 30  |  |
| MIN RECEIVED CARRIER SNR | dB           |                             |  | $300 / 4^i$ , $i = 1 - 5$                      |  |
| MIN REQ CODE PWR/No      | dB-Hz        |                             |  | 17   |  |
| CODE INTEGRATION TIME    | s            |                             |  | (1)  |  |
| ACQUISITION SEQUENCE     | -            |                             |  | 10   |  |
| RANGE DATA UNITS         | -            |                             |  | Sequence Major Tone First                      |  |
| RANGE QUANTIZATION       | -            |                             |  | (1)  |  |
| ACCURACY (STRONG SIGNAL) | m            |                             |  | (1)  |  |
| MAX UNAMBIGUOUS RANGE    | km           |                             |  | 20 (rss), 100 (rss)                            |  |
| TRANSPONDER BW           | MHz          |                             |  | 512  |  |
|                          |              |                             |  | 0.5  |  |

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4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA

**CCSDS HISTORICAL DOCUMENT**  
**RSA TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS   | UNITS         | SUBNETWORK OR STATION       |                |                         |                |
|---|---------------|-----------------------------|----------------|-------------------------|----------------|
|   |               | WCDSC - 32                  |                | ECDSC - 70              |                |
| <b>GENERAL</b>  |               |                             |                |                         |                |
| STATION DESIGNATION   | -             | WCDSC A - 32 <sup>(4)</sup> |                | ECDSC A - 70            |                |
| LOCATION(S)   | -             | Ukraine                     |                | Russia                  |                |
| DIAMETER  | m             | 32                          |                | 70                      |                |
| <b>FREQUENCY STD</b>  |               |                             |                |                         |                |
| STANDARD TYPE   | Name          | Hydrogen Maser              |                | Hydrogen Maser          |                |
| STANDARD MFG  | Name          | 40 - 101B                   |                | 40 - 101B               |                |
| STABILITY AT:   |               | Allan Variance              |                | Allan Variance          |                |
| 1 - SECOND  | $\Delta f/f$  | $1 \times 10^{-12}$         |                | $1 \times 10^{-12}$     |                |
| 1 - HOUR  | $\Delta f/f$  | $5 \times 10^{-14}$         |                | $5 \times 10^{-14}$     |                |
| 1 - DAY (24 HOURS)  | $\Delta f/f$  | $3 \times 10^{-14}$         |                | $3 \times 10^{-14}$     |                |
| 1 - MONTH   | $\Delta f/f$  | (1)                         |                | (1)                     |                |
| REF FREQS PHASE NOISE   | $S_{\phi}(f)$ | <b>5 MHz</b>                | <b>100 MHz</b> | <b>5 MHz</b>            | <b>100 MHz</b> |
| 1 Hz OFFSET   | dBc/Hz        | (1)                         | (1)            | (1)                     | (1)            |
| 10 Hz OFFSET  | dBc/Hz        | -125                        | (1)            | -125                    | (1)            |
| 100 Hz OFFSET   | dBc/Hz        | -135                        | (1)            | -135                    | (1)            |
| 1000 Hz OFFSET  | dBc/Hz        | -140                        | (1)            | -140                    | (1)            |
| REF FREQS AVAILABLE   | MHz           | 5 MHz, 1 Hz                 |                | 5 MHz, 1 Hz             |                |
| MAX STA-TO-STA OFFSET   | Hz            | $\pm 3 \times 10^{-12}$     |                | $\pm 3 \times 10^{-12}$ |                |
|   |               |                             |                |                         |                |
|   |               |                             |                |                         |                |
|   |               |                             |                |                         |                |
| <b>TIMING SYSTEM</b>  |               |                             |                |                         |                |
| MASTER REFERENCE AGENCY   | Name          | SSRTF                       |                | SSRTF                   |                |
| REFERENCE TIME  | Name          | Moscow Time                 |                | Moscow Time             |                |
| TIME CODE EPOCH   | Yr            | (1)                         |                | (1)                     |                |
| TIME CODES AVAILABLE  | CCSDS Codes   | Own Codes                   |                | Own Codes               |                |
| MAX TIME RESOLUTION   | s             | (1)                         |                | (1)                     |                |
| TIME TRANSFER METHOD  | Name          | Planning GLONASS            |                | Planning GLONASS        |                |
| MAX TRANS ERROR REF   | $\mu$ -sec    | (1)                         |                | (1)                     |                |
| MAX OFFSET FROM REF   | $\mu$ -sec    | (1)                         |                | (1)                     |                |
| MAX OFFSET MEAS ERROR   | $\mu$ -sec    | (1)                         |                | (1)                     |                |
| MAX STA-TO-STA OFFSET   | $\mu$ -sec    | (1)                         |                | (1)                     |                |
| TIMING SIGNALS AVAILABLE  | pulse/s       | 1                           |                | 1                       |                |
|   |               |                             |                |                         |                |
|   |               |                             |                |                         |                |
|   |               |                             |                |                         |                |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br/> 4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA</p> |               |                             |                |                         |                |

6445-4684

CCSDS HISTORICAL DOCUMENT  
**RSA TRACKING SYSTEM**  
 GEOGRAPHICAL AND MECHANICAL

| CHARACTERISTICS  | UNITS              | SUBNETWORK OR STATION       |                                     |
|--|--------------------|-----------------------------|-------------------------------------|
|  |                    | WCDSC - 32                  | ECDSC A - 70                        |
| <b>GENERAL</b>   |                    |                             |                                     |
| STATION DESIGNATION  | -                  | WCDSC A - 32 <sup>(6)</sup> | ECDSC A - 70                        |
| LOCATION(S)  | -                  | Ukraine                     | Russia                              |
| DIAMETER   | m                  | 32                          | 70                                  |
| <b>GEOGRAPHICAL</b>  |                    |                             |                                     |
| LOCATION, COUNTRY/STATE  | Name               | Ukraine                     | Russia                              |
| LOCATION, CITY   | Name               | Yevpatorija                 | Ussuriysk                           |
| LONGITUDE (site 1/site 2/site 3)   | d, m, s            | 33 11 E                     | 131 45 E                            |
| LATITUDE (site 1/site 2/site 3)  | d, m, s            | 45 11 N                     | 44 01 N                             |
|  |                    |                             |                                     |
|  |                    |                             |                                     |
|  |                    |                             |                                     |
|  |                    |                             |                                     |
| <b>MECHANICAL</b>  |                    |                             |                                     |
| TYPE OF MOUNT  | -                  | Az - El                     | Az - El                             |
| AZIMUTH LIMITATIONS  | -                  | ± 330                       | ± 270                               |
| TRACKING SPEED RANGE   | deg/s              | 0.16                        | 0.06                                |
| MAX TRACK ACCELERATION   | deg/s <sup>2</sup> | (1)                         | 0.05                                |
| TYPE OF POINTING   | Type               | Predicts                    | Predicts, Conscan                   |
| POINTING ACCURACY  | deg                | (1)                         | (1)                                 |
| MIN TRANSMIT ELEV ANGLE  | deg                | 7                           | 7                                   |
| MIN RECEIVE ELEV ANGLE   | deg                | -1                          | 5                                   |
|  |                    |                             |                                     |
|  |                    |                             |                                     |
|  |                    |                             |                                     |
|  |                    |                             |                                     |
| <b>SUPPORT</b>   |                    |                             |                                     |
| TRANSMIT FREQ BAND(S)  | GHz                | 5.0 - 5.025, 0.77275        | 5 - 5.025, 0.772                    |
| RECEIVE FREQ BAND(S)   | GHz                | None                        | 2.2 - 2.3, 5.87 - 5.89, 8.37 - 8.59 |
| ACQ AID FREQ BAND(S)   | GHz                | (1)                         | (1)                                 |
| MISSION CATEGORIES   | Cat                | B                           | B                                   |
|  |                    |                             |                                     |
|  |                    |                             |                                     |
|  |                    |                             |                                     |
|  |                    |                             |                                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. BASED UPON GEOCENTRIC COORDINATES    5. BASED UPON GEODETIC COORDINATES<br>6. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA |                    |                             |                                     |

6445-4685



**CCSDS HISTORICAL DOCUMENT**  
**RSA TRACKING SYSTEM**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION                  |  |
|-----------------------------|--------------|--|--|
|                             |              | WCDSC - 70                             | WCDSC - 70                             |
| <b>GENERAL</b>              |              |  |  |
| STATION DESIGNATION         | -            | WCDSC A - 70 <sup>4</sup>              |  |
| LOCATION(S)                 | -            | Ukraine                                |  |
| DIAMETER                    | m            | 70                                     |  |
| <b>RECEIVE</b>              |              |  |  |
| FREQUENCIES                 | MHz          | 8370 - 8530                            | 5870 - 5890                            |
| FREQUENCY RESOLUTION        | Hz           | 1                                      | 0.01                                   |
| ANTENNA GAIN @ 45 deg       | dBi          | 74                                     | 71                                     |
| SYS NOISE TEMP @ ZENITH     | K            | 35                                     | 25                                     |
| G/T @ 45 deg                | dB           | 58.2                                   | 56.5                                   |
| POLARIZATION                | -            | LCP                                    | LCP                                    |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.035                                  | 0.05                                   |
| ANTENNA ELLIPTICITY         | dB           | -3                                     | -3                                     |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | $\pm 1 \times 10^{-14} / 1 \text{ hr}$ | $\pm 1 \times 10^{-14} / 1 \text{ hr}$ |
| RCVR AGC DYNAMIC RANGE      | dB           | 80                                     | 80                                     |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -173 in 2 Blo = 1 Hz                   | -175 in 2 Blo = 1 Hz                   |
| RCVR LOOP BANDWIDTHS        | Hz           | 1 - 100                                |  |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                                  |  |
| RCVR PLL ORDER(S)           | No.          | 3                                      |  |
| ACQ SWEEP RANGE             | kHz          | $\pm 60$                               |  |
| MIN ACQ SWEEP RATE          | Hz/s         | 1                                      |  |
| MAX ACQ SWEEP RATE          | kHz/s        | 10                                     |  |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous                             |  |
| PROGRAMMED L.O.             | Yes/No       | Yes                                    |  |
|                             |              |  |  |
|                             |              |  |  |
|                             |              |  |  |
| <b>TELEMETRY</b>            |              |  |  |
| MODULATION TYPE(S)          | -            | PM                                     |  |
| MODULATION FORMAT(S)        | -            | NRZ-L, Bi - $\phi$ - L                 |  |
| MOD INDEX RANGE             | Rad Pk       | 2.1 (2.6)                              |  |
| SUBCARRIER FREQ RANGE       | kHz          | 1 - 131                                |  |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Square                                 |  |
| SYMBOL RATE RANGE           | s/s          | 1 - 262144                             |  |
| SUBCARRIER/SYM RATE LIMIT   | -            | >8                                     |  |
| ARRAYS WITH STATIONS        | -            | None                                   |  |
| CHANNEL DECODING            | Type         | Conv (r = 1/2, k = 6)                  |  |
| DATA FORMAT                 | -            | NRZ-L, Bi - $\phi$ - L                 |  |
|                             |              |  |  |
|                             |              |  |  |

1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS  
4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA

CCSDS HISTORICAL DOCUMENT  
**RSA TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS             | UNITS        | SUBNETWORK OR STATION     |                      |
|-----------------------------|--------------|---------------------------|----------------------|
|                             |              | WCDSC - 70                |                      |
| <b>GENERAL</b>              |              |                           |                      |
| STATION DESIGNATION         | -            | WCDSC A - 70 <sup>4</sup> |                      |
| LOCATION(S)                 | -            | Ukraine                   |                      |
| DIAMETER                    | m            | 70                        |                      |
| <b>RECEIVE</b>              |              |                           |                      |
| FREQUENCIES                 | MHz          | 2200 - 2300               | 920 - 935            |
| FREQUENCY RESOLUTION        | Hz           | 10 000                    | 0.1                  |
| ANTENNA GAIN @ 45 deg       | dBi          | 61                        | 53                   |
| SYS NOISE TEMP @ ZENITH     | K            | 42                        | 45                   |
| G/T @ 45 deg                | dB           | 44.5                      | 36.3                 |
| POLARIZATION                | -            | LCP                       | RCP                  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.13                      | 0.32                 |
| ANTENNA ELLIPTICITY         | dB           | -3                        | -3                   |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ |                           |                      |
| RCVR AGC DYNAMIC RANGE      | dB           |                           |                      |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -172 in 2 Blo = 1 Hz      | -172 in 2 Blo = 1 Hz |
| RCVR LOOP BANDWIDTHS        | Hz           | 1 - 100                   |                      |
| RCVR LOOP TYPE (ADAPT, FIX) | -            | Adapt                     |                      |
| RCVR PLL ORDER(S)           | No.          | 3                         |                      |
| ACQ SWEEP RANGE             | kHz          | $\pm 60$                  |                      |
| MIN ACQ SWEEP RATE          | Hz/s         | 1                         |                      |
| MAX ACQ SWEEP RATE          | kHz/s        | 10                        |                      |
| ACQ SWEEP STEP SIZE         | Hz           | Continuous                |                      |
| PROGRAMMED L.O.             | Yes/No       | Yes                       |                      |
|                             |              |                           |                      |
|                             |              |                           |                      |
|                             |              |                           |                      |
| <b>TELEMETRY</b>            |              |                           |                      |
| MODULATION TYPE(S)          | -            | PM                        |                      |
| MODULATION FORMAT(S)        | -            | NRZ-L, Bi - $\phi$ - L    |                      |
| MOD INDEX RANGE             | Rad Pk       | 2.1 (2.6)                 |                      |
| SUBCARRIER FREQ RANGE       | kHz          | 1 - 131                   |                      |
| SUBCARRIER WAVEFORM         | Sin/Sq       | Square                    |                      |
| SYMBOL RATE RANGE           | s/s          | 1 - 262144                |                      |
| SUBCARRIER/SYM RATE LIMIT   | -            | >8                        |                      |
| ARRAYS WITH STATIONS        | -            | None                      |                      |
| CHANNEL DECODING            | Type         | Conv (r = 1/2, k = 6)     |                      |
| DATA FORMAT                 | -            | NRZ-L, Bi - $\phi$ - L    |                      |
|                             |              |                           |                      |
|                             |              |                           |                      |

1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS  
4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA

**CCSDS HISTORICAL DOCUMENT**  
**RSA TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION                          |                              |
|--------------------------|--------------|--|------------------------------|
|                          |              | WCDSC - 70                                     | WCDSC - 70                   |
| <b>GENERAL</b>           |              |  |                              |
| STATION DESIGNATION      | -            | WCDSC A - 70 <sup>4</sup>                      |                              |
| LOCATION(S)              | -            | Ukraine  |                              |
| DIAMETER                 | m            | 70   |                              |
| <b>FREQUENCIES</b>       |              |  |                              |
| TRANSMIT FREQUENCIES     | MHz          | 5000 - 5025                                    | 772.275                      |
| RECEIVE FREQUENCIES      | MHz          | 8370 - 8530                                    | 5870 - 5890                  |
| TURNAROUND FREQ RATIO    | -            | 19456 / (17 x 681)<br>or<br>19456 / (17 x 105) | 800 / 681<br>or<br>800 / 105 |
| <b>DOPPLER</b>           |              |  |                              |
| COHERENT/NON-COHERENT    | -            | Coherent or Non-Coherent                       |                              |
| COUNTER RESOLUTION       | Cycles       | 0.001  |                              |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 0.8  |                              |
| DOPPLER BIAS FREQ        | MHz          | ± 0.8  |                              |
| DRIFT                    | $\Delta f/f$ | $1 \times 10^{-12}$ @ 1 s                      |                              |
| OUTPUT EQUATION          | -            | 1 - Bias freq + fdi                            |                              |
| DIRECTION INDICATOR      | -            | + $\Delta f = -\Delta r$                       |                              |
| <b>RANGING</b>           |              |  |                              |
|                          |              | Side Tone Ranging Only                         |                              |
| COHERENT/NON-COHERENT    | -            | Coherent or Non-Coherent                       |                              |
| RANGE CODE WAVEFORM      | Sin/Sq       | Square   |                              |
| EARTH STATION MOD INDEX  | Rad Pk       | 0-2.1 Carrier, 1.5 Subcarrier                  |                              |
| RANGE CODE FREQ RATIO    | -            | 4:1  |                              |
| MAJOR CODE FREQ(S)       | kHz          | 300, 30  |                              |
| MINOR CODE FREQ(S)       | kHz          | $300 / 4^i, i = 1 - 5$                         |                              |
| MIN RECEIVED CARRIER SNR | dB           | 17   |                              |
| MIN REQ CODE PWR/ $N_0$  | dB-Hz        | (1)  |                              |
| CODE INTEGRATION TIME    | s            | 10   |                              |
| ACQUISITION SEQUENCE     | -            | Sequence Major Tone First                      |                              |
| RANGE DATA UNITS         | -            | (1)  |                              |
| RANGE QUANTIZATION       | -            | (1)  |                              |
| ACCURACY (STRONG SIGNAL) | m            | 20 (RSS), 100 (RSS)                            |                              |
| MAX UNAMBIGUOUS RANGE    | km           | 512  |                              |
| TRANSPONDER BW           | MHz          | 0.5  |                              |

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4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA

**CCSDS HISTORICAL DOCUMENT**  
**RSA TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS          | UNITS        | SUBNETWORK OR STATION         |                              |
|--------------------------|--------------|-------------------------------|------------------------------|
|                          |              | WCDSC - 70                    |                              |
| <b>GENERAL</b>           |              |                               |                              |
| STATION DESIGNATION      | -            | WCDSC A - 70 <sup>4</sup>     |                              |
| LOCATION(S)              | -            | Ukraine                       |                              |
| DIAMETER                 | m            | 70                            |                              |
| <b>FREQUENCIES</b>       |              |                               |                              |
| TRANSMIT FREQUENCIES     | MHz          |                               |                              |
| RECEIVE FREQUENCIES      | MHz          | 2200 - 2300                   | 920 - 935                    |
| TURNAROUND FREQ RATIO    | -            |                               | 126 / 681<br>or<br>126 / 105 |
| <b>DOPPLER</b>           |              |                               |                              |
| COHERENT/NON-COHERENT    | -            | Coherent or Non-Coherent      |                              |
| COUNTER RESOLUTION       | Cycles       | 0.001                         |                              |
| MAX DOPPLER FREQ SHIFT   | MHz          | ± 0.8                         |                              |
| DOPPLER BIAS FREQ        | MHz          | ± 0.8                         |                              |
| DRIFT                    | $\Delta f/f$ | $1 \times 10^{-12}$ @ is      |                              |
| OUTPUT EQUATION          | -            | 1 - Bias freq + fdi           |                              |
| DIRECTION INDICATOR      | -            | + $\Delta f = -\Delta r$      |                              |
| <b>RANGING</b>           |              |                               |                              |
|                          |              | Side Tone Ranging Only        |                              |
| COHERENT/NON-COHERENT    | -            | Coherent or Non-Coherent      |                              |
| RANGE CODE WAVEFORM      | Sin/Sq       | Square                        |                              |
| EARTH STATION MOD INDEX  | Rad Pk       | 0-2.1 Carrier, 1.5 Subcarrier |                              |
| RANGE CODE FREQ RATIO    | -            | 4:1                           |                              |
| MAJOR CODE FREQ(S)       | kHz          | 300, 30                       |                              |
| MINOR CODE FREQ(S)       | kHz          | $300 / 4^i, i = 1 - 5$        |                              |
| MIN RECEIVED CARRIER SNR | dB           | 17                            |                              |
| MIN REQ CODE PWR/ $N_0$  | dB-Hz        | (1)                           |                              |
| CODE INTEGRATION TIME    | s            | 10                            |                              |
| ACQUISITION SEQUENCE     | -            | Sequence Major Tone First     |                              |
| RANGE DATA UNITS         | -            | (1)                           |                              |
| RANGE QUANTIZATION       | -            | (1)                           |                              |
| ACCURACY (STRONG SIGNAL) | m            | 20 (RSS), 100 (RSS)           |                              |
| MAX UNAMBIGUOUS RANGE    | km           | 512                           |                              |
| TRANSPONDER BW           | MHz          | 0.5                           |                              |

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4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA

**CCSDS HISTORICAL DOCUMENT**  
**RSA TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS   | UNITS         | SUBNETWORK OR STATION     |                |
|---|---------------|---------------------------|----------------|
|   |               | WCDSC - 70                |                |
| <b>GENERAL</b>  |               |                           |                |
| STATION DESIGNATION   | -             | WCDSC A - 70 <sup>4</sup> |                |
| LOCATION(S)   | -             | Ukraine                   |                |
| DIAMETER  | m             | 70                        |                |
| <b>FREQUENCY STD</b>  |               |                           |                |
| STANDARD TYPE   | Name          | Hydrogen Maser            |                |
| STANDARD MFG  | Name          | 40 - 101B                 |                |
| STABILITY AT:   |               | Allan Variance            |                |
| 1 - SECOND  | $\Delta f/f$  | $1 \times 10^{-12}$       |                |
| 1 - HOUR  | $\Delta f/f$  | $5 \times 10^{-14}$       |                |
| 1 - DAY (24 HOURS)  | $\Delta f/f$  | $3 \times 10^{-14}$       |                |
| 1 - MONTH   | $\Delta f/f$  | (1)                       |                |
| REF FREQS PHASE NOISE   | $S_{\phi}(f)$ | <b>5 MHz</b>              | <b>100 MHz</b> |
| 1 Hz OFFSET   | dBc/Hz        | (1)                       | (1)            |
| 10 Hz OFFSET  | dBc/Hz        | -125                      | (1)            |
| 100 Hz OFFSET   | dBc/Hz        | -135                      | (1)            |
| 1000 Hz OFFSET  | dBc/Hz        | -140                      | (1)            |
| REF FREQS AVAILABLE   | MHz           | 5 MHz, 1 Hz               |                |
| MAX STA-TO-STA OFFSET   | Hz            | $\pm 3 \times 10^{-12}$   |                |
|   |               |                           |                |
|   |               |                           |                |
|   |               |                           |                |
| <b>TIMING SYSTEM</b>  |               |                           |                |
| MASTER REFERENCE AGENCY   | Name          | SSRTF                     |                |
| REFERENCE TIME  | Name          | Moscow Time               |                |
| TIME CODE EPOCH   | Yr            | (1)                       |                |
| TIME CODES AVAILABLE  | CCSDS Codes   | Own Codes                 |                |
| MAX TIME RESOLUTION   | s             | (1)                       |                |
| TIME TRANSFER METHOD  | Name          | Planning GLONASS          |                |
| MAX TRANS ERROR REF   | $\mu$ -sec    | (1)                       |                |
| MAX OFFSET FROM REF   | $\mu$ -sec    | (1)                       |                |
| MAX OFFSET MEAS ERROR   | $\mu$ -sec    | (1)                       |                |
| MAX STA-TO-STA OFFSET   | $\mu$ -sec    | (1)                       |                |
| TIMING SIGNALS AVAILABLE  | pulse/s       | 1                         |                |
|   |               |                           |                |
|   |               |                           |                |
|   |               |                           |                |
|   |               |                           |                |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br/> 4. UNDER JOINT MANAGEMENT OF UKRAINE AND RUSSIA</p> |               |                           |                |

6445-4690





CCSDS HISTORICAL DOCUMENT  
**SSC TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION         |  |
|---|--------------|-------------------------------|--|
|   |              | KIRUNA                        |  |
| <b>GENERAL</b>  |              |                               |  |
| STATION DESIGNATION   | -            | Esrange Satellite Station ETX |  |
| LOCATION(S)   | -            | Kiruna, Sweden                |  |
| DIAMETER  | m            | 6.1                           |  |
| <b>RECEIVE</b>  |              | None                          |  |
| FREQUENCIES   | MHz          |                               |  |
| FREQUENCY RESOLUTION  | Hz           |                               |  |
| ANTENNA GAIN @ 45 deg   | dBi          |                               |  |
| SYS NOISE TEMP @ ZENITH   | K            |                               |  |
| G/T @ 45 deg  | dB           |                               |  |
| POLARIZATION  | -            |                               |  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          |                               |  |
| ANTENNA ELLIPTICITY   | dB           |                               |  |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ |                               |  |
| RCVR AGC DYNAMIC RANGE  | dB           |                               |  |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          |                               |  |
| RCVR LOOP BANDWIDTHS  | Hz           |                               |  |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            |                               |  |
| RCVR PLL ORDER(S)   | No.          |                               |  |
| ACQ SWEEP RANGE   | kHz          |                               |  |
| MIN ACQ SWEEP RATE  | Hz/s         |                               |  |
| MAX ACQ SWEEP RATE  | kHz/s        |                               |  |
| ACQ SWEEP STEP SIZE   | Hz           |                               |  |
| PROGRAMMED L.O.   | Yes/No       |                               |  |
|   |              |                               |  |
|   |              |                               |  |
|   |              |                               |  |
|   |              |                               |  |
| <b>TELEMETRY</b>  |              | None                          |  |
| MODULATION TYPE(S)  | -            |                               |  |
| MODULATION FORMAT(S)  | -            |                               |  |
| MOD INDEX RANGE   | Rad Pk       |                               |  |
| SUBCARRIER FREQ RANGE   | kHz          |                               |  |
| SUBCARRIER WAVEFORM   | Sin/Sq       |                               |  |
| SYMBOL RATE RANGE   | s/s          |                               |  |
| SUBCARRIER/SYM RATE LIMIT   | -            |                               |  |
| ARRAYS WITH STATIONS  | -            |                               |  |
| CHANNEL DECODING  | Type         |                               |  |
| DATA FORMAT   | -            |                               |  |
|   |              |                               |  |
|   |              |                               |  |
|   |              |                               |  |
|   |              |                               |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |                               |  |

6445-4178

CCSDS HISTORICAL DOCUMENT  
**SSC TRACKING SYSTEM**  
RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                       |  |
|---|--------------|---|--|
|   |              | KIRUNA                                      |  |
| <b>GENERAL</b>  |              |   |  |
| STATION DESIGNATION   | -            | Esrange Satellite Station ETX               |  |
| LOCATION(S)   | -            | Kiruna, Sweden                              |  |
| DIAMETER  | m            | 6.1   |  |
| <b>FREQUENCIES</b>  |              |   |  |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120                                 |  |
| RECEIVE FREQUENCIES   | MHz          | None  |  |
| TURNAROUND FREQ RATIO   | -            | 240 / 221                                   |  |
| <b>DOPPLER</b>  |              |   |  |
| None  |              |   |  |
| COHERENT/NON-COHERENT   | -            |   |  |
| COUNTER RESOLUTION  | Cycles       |   |  |
| MAX DOPPLER FREQ SHIFT  | MHz          |   |  |
| DOPPLER BIAS FREQ   | MHz          |   |  |
| DRIFT   | $\Delta f/f$ |   |  |
| OUTPUT EQUATION   | -            |   |  |
| DIRECTION INDICATOR   | -            |   |  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
| <b>RANGING</b>  |              |   |  |
| COHERENT/NON-COHERENT   | -            | Either                                      |  |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine  |  |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.1 - 1.5                                   |  |
| RANGE CODE FREQ RATIO   | -            | 5:1   |  |
| MAJOR CODE FREQ(S)  | kHz          | 100   |  |
| MINOR CODE FREQ(S)  | kHz          | 20, 16, (0.8, 0.16, 0.032, 0.008 on 16 kHz) |  |
| MIN RECEIVED CARRIER SNR  | dB           | 10  |  |
| MIN REQ CODE PWR/No   | dB-Hz        | 25  |  |
| CODE INTEGRATION TIME   | s            | 0.5 - 5                                     |  |
| ACQUISITION SEQUENCE  | -            | Sequence, Major Code First                  |  |
| RANGE DATA UNITS  | -            | Nanosecond                                  |  |
| RANGE QUANTIZATION  | -            | 2 ns  |  |
| ACCURACY (STRONG SIGNAL)  | m            | 15  |  |
| MAX UNAMBIGUOUS RANGE   | km           | 18 750                                      |  |
| TRANSPONDER BW  | MHz          | > 0.3                                       |  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |   |  |

6445-4179

**CCSDS HISTORICAL DOCUMENT**  
**SSC TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION        |                     |                       |                |
|--|---------------|------------------------------|---------------------|-----------------------|----------------|
|  |               | KIRUNA                       |                     |                       |                |
| <b>GENERAL</b>   |               |                              |                     |                       |                |
| STATION DESIGNATION  | -             | Esrang Satellite Station ETX |                     |                       |                |
| LOCATION(S)  | -             | Kiruna, Sweden               |                     |                       |                |
| DIAMETER   | m             | 6.1                          |                     |                       |                |
| <b>FREQUENCY STD</b>   |               |                              |                     |                       |                |
| STANDARD TYPE  | Name          | Low Noise BVA Quartz         |                     |                       |                |
| STANDARD MFG   | Name          | Oscillogvartz                |                     |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b>        | <b>Drift</b>        | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $1 \times 10^{-12}$          | (1)                 |                       |                |
| 1 - HOUR   | $\Delta f/f$  | (1)                          | (1)                 |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                          | $2 \times 10^{-11}$ |                       |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                          | $5 \times 10^{-10}$ |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>                 | <b>100 MHz</b>      | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | -115                         | None                |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | -140                         | None                |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | -150                         | None                |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | -155                         | None                |                       |                |
| REF FREQS AVAILABLE  | MHz           | 1, 5, 10                     |                     |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | None                         |                     |                       |                |
|  |               |                              |                     |                       |                |
|  |               |                              |                     |                       |                |
|  |               |                              |                     |                       |                |
| <b>TIMING SYSTEM</b>   |               |                              |                     |                       |                |
| MASTER REFERENCE AGENCY  | Name          | NIST                         |                     |                       |                |
| REFERENCE TIME   | Name          | UTC                          |                     |                       |                |
| TIME CODE EPOCH  | Yr            | 1 January 1958               |                     |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | None                         |                     |                       |                |
| MAX TIME RESOLUTION  | s             | None                         |                     |                       |                |
| TIME TRANSFER METHOD   | Name          | GPS                          |                     |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 1                            |                     |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 50$                     |                     |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 1                            |                     |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | None                         |                     |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                            |                     |                       |                |
|  |               |                              |                     |                       |                |
|  |               |                              |                     |                       |                |
|  |               |                              |                     |                       |                |
|  |               |                              |                     |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                              |                     |                       |                |

6445-4180





**CCSDS HISTORICAL DOCUMENT**  
**SSC TRACKING SYSTEM**  
SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                |             |                                      |                              |
|---|--------------|--------------------------------------|-------------|--------------------------------------|------------------------------|
|   |              | KIRUNA                               |             | KIRUNA                               |                              |
| <b>GENERAL</b>  |              |                                      |             |                                      |                              |
| STATION DESIGNATION   | -            | Esrange Satellite Station ELS        |             | Esrange Satellite Station ESX        |                              |
| LOCATION(S)   | -            | Kiruna, Sweden                       |             | Kiruna, Sweden                       |                              |
| DIAMETER  | m            | 9.1                                  |             | 9.1                                  |                              |
| <b>RECEIVE</b>  |              |                                      |             |                                      |                              |
| FREQUENCIES   | MHz          | 2200 - 2300                          | 8025 - 8400 | 2200 - 2300                          | 8025 - 8400                  |
| FREQUENCY RESOLUTION  | Hz           | 100 000                              | -           | 100 000                              | 100 000                      |
| ANTENNA GAIN @ 45 deg   | dBi          | 43                                   | 55          | 43                                   | 55                           |
| SYS NOISE TEMP @ ZENITH   | K            | 150                                  | 250         | 150                                  | 250                          |
| G/T @ 45 deg  | dB           | 21                                   | 31          | 21                                   | 31                           |
| POLARIZATION  | -            | RCP or LCP                           | RCP         | RCP or LCP                           | RCP                          |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.86                                 | 0.27        | 0.86                                 | 0.27                         |
| ANTENNA ELLIPTICITY   | dB           | 2                                    | 0.9         | 2                                    | 0.9                          |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | 10                                   | None        | 10                                   | 10                           |
| RCVR AGC DYNAMIC RANGE  | dB           | 120                                  | None        | 120                                  | 120                          |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -148 in 2 Blo = 30 Hz                | None        | -148 in 2 Blo = 30 Hz                | -146 in 2 Blo = 30 Hz        |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 100, 300, 1 K, 3 K, 10 K         | None        | 30, 100, 300, 1 K, 3 K, 10 K         | 30, 100, 300, 1 K, 3 K, 10 K |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                                | None        | Adapt                                | Adapt                        |
| RCVR PLL ORDER(S)   | No.          | 2                                    | None        | 2                                    | 2                            |
| ACQ SWEEP RANGE   | kHz          | $\pm 250$                            | None        | $\pm 250$                            | $\pm 250$                    |
| MIN ACQ SWEEP RATE  | Hz/s         | Determined by Rcvr Loop BW           |             | Determined by Rcvr Loop BW           |                              |
| MAX ACQ SWEEP RATE  | kHz/s        | Determined by Rcvr Loop BW           |             | Determined by Rcvr Loop BW           |                              |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                           |             | Continuous                           |                              |
| PROGRAMMED L.O.   | Yes/No       | No                                   |             | No                                   |                              |
|   |              |                                      |             |                                      |                              |
|   |              |                                      |             |                                      |                              |
|   |              |                                      |             |                                      |                              |
|   |              |                                      |             |                                      |                              |
| <b>TELEMETRY</b>  |              |                                      |             |                                      |                              |
| MODULATION TYPE(S)  | -            | PM, FM                               |             | PM, FM                               |                              |
| MODULATION FORMAT(S)  | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S |             | NRZ - L, M, S; Bi - $\phi$ - L, M, S |                              |
| MOD INDEX RANGE   | Rad Pk       | < 2.8                                |             | < 2.8                                |                              |
| SUBCARRIER FREQ RANGE   | kHz          | 0.5 - 10 000                         |             | 0.5 - 10 000                         |                              |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                                 |             | Sine                                 |                              |
| SYMBOL RATE RANGE   | s/s          | 1 - 5 000 000                        |             | 1 - 5 000 000                        |                              |
| SUBCARRIER/SYM RATE LIMIT   | -            | < 1000                               |             | < 1000                               |                              |
| ARRAYS WITH STATIONS  | -            | None                                 |             | None                                 |                              |
| CHANNEL DECODING  | Type         | None                                 |             | None                                 |                              |
| DATA FORMAT   | -            | None                                 |             | None                                 |                              |
|   |              |                                      |             |                                      |                              |
|   |              |                                      |             |                                      |                              |
|   |              |                                      |             |                                      |                              |
|   |              |                                      |             |                                      |                              |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                                      |             |                                      |                              |

6445-4177

**CCSDS HISTORICAL DOCUMENT**  
**SSC TRACKING SYSTEM**  
**RADIO METRIC CHARACTERISTICS**

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                       |   |
|---|--------------|---|---|
|   |              | KIRUNA                                      | KIRUNA                                      |
| <b>GENERAL</b>  |              |   |   |
| STATION DESIGNATION   | -            | Esrange Satellite Station ELS               | Esrange Satellite Station ESX               |
| LOCATION(S)   | -            | Kiruna, Sweden                              | Kiruna, Sweden                              |
| DIAMETER  | m            | 9.1   | 9.1   |
| <b>FREQUENCIES</b>  |              |   |   |
| TRANSMIT FREQUENCIES  | MHz          | None  | None  |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300, 8025 - 8400                    | 2200 - 2300, 8025 - 8400                    |
| TURNAROUND FREQ RATIO   | -            | 240 / 221                                   | 240 / 221                                   |
| <b>DOPPLER</b>  |              |   |   |
| COHERENT/NON-COHERENT   | -            | None  | None  |
| COUNTER RESOLUTION  | Cycles       |   |   |
| MAX DOPPLER FREQ SHIFT  | MHz          |   |   |
| DOPPLER BIAS FREQ   | MHz          |   |   |
| DRIFT   | $\Delta f/f$ |   |   |
| OUTPUT EQUATION   | -            |   |   |
| DIRECTION INDICATOR   | -            |   |   |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| <b>RANGING</b>  |              |   |   |
| COHERENT/NON-COHERENT   | -            | Either                                      | Either                                      |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine  | Sine  |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.1 - 1.5                                   | 0.1 - 1.5                                   |
| RANGE CODE FREQ RATIO   | -            | 5:1   | 5:1   |
| MAJOR CODE FREQ(S)  | kHz          | 100   | 100   |
| MINOR CODE FREQ(S)  | kHz          | 20, 16, (0.8, 0.16, 0.032, 0.008 on 16 kHz) | 20, 16, (0.8, 0.16, 0.032, 0.008 on 16 kHz) |
| MIN RECEIVED CARRIER SNR  | dB           | 10  | 10  |
| MIN REQ CODE PWR/No   | dB-Hz        | 25  | 25  |
| CODE INTEGRATION TIME   | s            | 0.5 - 5                                     | 0.5 - 5                                     |
| ACQUISITION SEQUENCE  | -            | Sequence, Major Code First                  | Sequence, Major Code First                  |
| RANGE DATA UNITS  | -            | Nanosecond                                  | Nanosecond                                  |
| RANGE QUANTIZATION  | -            | 2 ns  | 2 ns  |
| ACCURACY (STRONG SIGNAL)  | m            | 15  | 15  |
| MAX UNAMBIGUOUS RANGE   | km           | 18 750                                      | 18 750                                      |
| TRANSPONDER BW  | MHz          | > 0.3                                       | > 0.3                                       |
|   |              |   |   |
|   |              |   |   |
|   |              |   |   |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |   |   |

6445-4749

**CCSDS HISTORICAL DOCUMENT**  
**SSC TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION         |                     |                               |                     |
|--|---------------|-------------------------------|---------------------|-------------------------------|---------------------|
|  |               | KIRUNA                        |                     | KIRUNA                        |                     |
| <b>GENERAL</b>   |               |                               |                     |                               |                     |
| STATION DESIGNATION  | -             | Esrange Satellite Station ELS |                     | Esrange Satellite Station ESX |                     |
| LOCATION(S)  | -             | Kiruna, Sweden                |                     | Kiruna, Sweden                |                     |
| DIAMETER   | m             | 9.1                           |                     | 9.1                           |                     |
| <b>FREQUENCY STD</b>   |               |                               |                     |                               |                     |
| STANDARD TYPE  | Name          | Low Noise BVA Quartz          |                     | Low Noise BVA Quartz          |                     |
| STANDARD MFG   | Name          | Oscillogvartz                 |                     | Oscillogvartz                 |                     |
| STABILITY AT:  |               | <b>Allan Variance</b>         | <b>Drift</b>        | <b>Allan Variance</b>         | <b>Drift</b>        |
| 1 - SECOND   | $\Delta f/f$  | $1 \times 10^{-12}$           | (1)                 | $1 \times 10^{-12}$           | (1)                 |
| 1 - HOUR   | $\Delta f/f$  | (1)                           | (1)                 | (1)                           | (1)                 |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                           | $2 \times 10^{-11}$ | (1)                           | $2 \times 10^{-11}$ |
| 1 - MONTH  | $\Delta f/f$  | (1)                           | $5 \times 10^{-10}$ | (1)                           | $5 \times 10^{-10}$ |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>                  | <b>100 MHz</b>      | <b>5 MHz</b>                  | <b>100 MHz</b>      |
| 1 Hz OFFSET  | dBc/Hz        | -115                          | None                | -115                          | None                |
| 10 Hz OFFSET   | dBc/Hz        | -140                          | None                | -140                          | None                |
| 100 Hz OFFSET  | dBc/Hz        | -150                          | None                | -150                          | None                |
| 1000 Hz OFFSET   | dBc/Hz        | -155                          | None                | -155                          | None                |
| REF FREQS AVAILABLE  | MHz           | 1, 5, 10                      |                     | 1, 5, 10                      |                     |
| MAX STA-TO-STA OFFSET  | Hz            | None                          |                     | None                          |                     |
|  |               |                               |                     |                               |                     |
|  |               |                               |                     |                               |                     |
|  |               |                               |                     |                               |                     |
| <b>TIMING SYSTEM</b>   |               |                               |                     |                               |                     |
| MASTER REFERENCE AGENCY  | Name          | NIST                          |                     | NIST                          |                     |
| REFERENCE TIME   | Name          | UTC                           |                     | UTC                           |                     |
| TIME CODE EPOCH  | Yr            | 1 January 1958                |                     | 1 January 1958                |                     |
| TIME CODES AVAILABLE   | CCSDS Codes   | None                          |                     | None                          |                     |
| MAX TIME RESOLUTION  | s             | None                          |                     | None                          |                     |
| TIME TRANSFER METHOD   | Name          | GPS                           |                     | GPS                           |                     |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 1                             |                     | 1                             |                     |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 50$                      |                     | $\pm 50$                      |                     |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 1                             |                     | 1                             |                     |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | -                             |                     | -                             |                     |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                             |                     | 1                             |                     |
|  |               |                               |                     |                               |                     |
|  |               |                               |                     |                               |                     |
|  |               |                               |                     |                               |                     |
|  |               |                               |                     |                               |                     |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                               |                     |                               |                     |

6445-4750





CCSDS HISTORICAL DOCUMENT  
**SSC TRACKING SYSTEM**  
 SPACE-TO-EARTH LINK CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                |             |
|---|--------------|--------------------------------------|-------------|
|   |              | KIRUNA                               |             |
| <b>GENERAL</b>  |              |                                      |             |
| STATION DESIGNATION   | -            | Esrange Satellite Station ETX        |             |
| LOCATION(S)   | -            | Kiruna, Sweden                       |             |
| DIAMETER  | m            | 13                                   |             |
| <b>RECEIVE</b>  |              |                                      |             |
| FREQUENCIES   | MHz          | 2200 - 2300                          | 8025 - 8400 |
| FREQUENCY RESOLUTION  | Hz           | 100 000                              | 100 000     |
| ANTENNA GAIN @ 45 deg   | dBi          | 45.5                                 | 57.2        |
| SYS NOISE TEMP @ ZENITH   | K            | 144                                  | 230         |
| G/T @ 45 deg  | dB           | 23.9                                 | 33.6        |
| POLARIZATION  | -            | RCP or LCP                           | RCP or LCP  |
| ANTENNA BEAMWIDTH (-3 dB)   | deg          | 0.67                                 | 0.19        |
| ANTENNA ELLIPTICITY   | dB           | 1.5                                  | 1.5         |
| L.O. REF FREQ STAB @ 1 Hr   | $\Delta f/f$ | 10                                   | None        |
| RCVR AGC DYNAMIC RANGE  | dB           | 120                                  | None        |
| RCVR THRESHOLD @ 2 Blo Hz   | dBm          | -148 in 2 Blo = 30 Hz                | None        |
| RCVR LOOP BANDWIDTHS  | Hz           | 30, 100, 300, 1 K, 3 K, 10 K         | None        |
| RCVR LOOP TYPE (ADAPT, FIX)   | -            | Adapt                                | None        |
| RCVR PLL ORDER(S)   | No.          | 2                                    | None        |
| ACQ SWEEP RANGE   | kHz          | $\pm 250$                            | None        |
| MIN ACQ SWEEP RATE  | Hz/s         | Determined by Rcvr Loop BW           | None        |
| MAX ACQ SWEEP RATE  | kHz/s        | Determined by Rcvr Loop BW           | None        |
| ACQ SWEEP STEP SIZE   | Hz           | Continuous                           | None        |
| PROGRAMMED L.O.   | Yes/No       | No                                   | None        |
| <b>TELEMETRY</b>  |              |                                      |             |
| MODULATION TYPE(S)  | -            | PM, FM                               |             |
| MODULATION FORMAT(S)  | -            | NRZ - L, M, S; Bi - $\phi$ - L, M, S |             |
| MOD INDEX RANGE   | Rad Pk       | < 2.8                                |             |
| SUBCARRIER FREQ RANGE   | kHz          | 0.5 - 10 000                         |             |
| SUBCARRIER WAVEFORM   | Sin/Sq       | Sine                                 |             |
| SYMBOL RATE RANGE   | s/s          | 1 - 5 000 000                        |             |
| SUBCARRIER/SYM RATE LIMIT   | -            | < 1000                               |             |
| ARRAYS WITH STATIONS  | -            | None                                 |             |
| CHANNEL DECODING  | Type         | (1)                                  |             |
| DATA FORMAT   | -            | (1)                                  |             |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS |              |                                      |             |

6445-4178A

CCSDS HISTORICAL DOCUMENT  
**SSC TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                       |  |
|---|--------------|---|--|
|   |              | KIRUNA                                      |  |
| <b>GENERAL</b>  |              |   |  |
| STATION DESIGNATION   | -            | Esrange Satellite Station ETX               |  |
| LOCATION(S)   | -            | Kiruna, Sweden                              |  |
| DIAMETER  | m            | 13  |  |
| <b>FREQUENCIES</b>  |              |   |  |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120                                 |  |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300, 8025 - 8400                    |  |
| TURNAROUND FREQ RATIO   | -            | 240 / 221                                   |  |
| <b>DOPPLER</b>  |              |   |  |
|   |              | None  |  |
| COHERENT/NON-COHERENT   | -            |   |  |
| COUNTER RESOLUTION  | Cycles       |   |  |
| MAX DOPPLER FREQ SHIFT  | MHz          |   |  |
| DOPPLER BIAS FREQ   | MHz          |   |  |
| DRIFT   | $\Delta f/f$ |   |  |
| OUTPUT EQUATION   | -            |   |  |
| DIRECTION INDICATOR   | -            |   |  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
| <b>RANGING</b>  |              |   |  |
| COHERENT/NON-COHERENT   | -            | Either                                      |  |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine  |  |
| EARTH STATION MOD INDEX   | Rad Pk       | 0.1 - 1.5                                   |  |
| RANGE CODE FREQ RATIO   | -            | 5:1   |  |
| MAJOR CODE FREQ(S)  | kHz          | 100   |  |
| MINOR CODE FREQ(S)  | kHz          | 20, 16, (0.8, 0.16, 0.032, 0.008 on 16 kHz) |  |
| MIN RECEIVED CARRIER SNR  | dB           | 10  |  |
| MIN REQ CODE PWR/No   | dB-Hz        | 25  |  |
| CODE INTEGRATION TIME   | s            | 0.5 - 5                                     |  |
| ACQUISITION SEQUENCE  | -            | Sequence, Major Code First                  |  |
| RANGE DATA UNITS  | -            | Nanosecond                                  |  |
| RANGE QUANTIZATION  | -            | 2 ns  |  |
| ACCURACY (STRONG SIGNAL)  | m            | 15  |  |
| MAX UNAMBIGUOUS RANGE   | km           | 18 750                                      |  |
| TRANSPONDER BW  | MHz          | > 0.3                                       |  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
|   |              |   |  |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |   |  |

6445-4179A

**CCSDS HISTORICAL DOCUMENT**  
**SSC TRACKING SYSTEM**  
**FREQUENCY AND TIMING SYSTEM CHARACTERISTICS**

| CHARACTERISTICS  | UNITS         | SUBNETWORK OR STATION        |                     |                       |                |
|--|---------------|------------------------------|---------------------|-----------------------|----------------|
|  |               | KIRUNA                       |                     |                       |                |
| <b>GENERAL</b>   |               |                              |                     |                       |                |
| STATION DESIGNATION  | -             | Esrang Satellite Station ETX |                     |                       |                |
| LOCATION(S)  | -             | Kiruna, Sweden               |                     |                       |                |
| DIAMETER   | m             | 13                           |                     |                       |                |
| <b>FREQUENCY STD</b>   |               |                              |                     |                       |                |
| STANDARD TYPE  | Name          | Low Noise BVA Quartz         |                     |                       |                |
| STANDARD MFG   | Name          | Oscillogvartz                |                     |                       |                |
| STABILITY AT:  |               | <b>Allan Variance</b>        | <b>Drift</b>        | <b>Allan Variance</b> | <b>Drift</b>   |
| 1 - SECOND   | $\Delta f/f$  | $1 \times 10^{-12}$          | (1)                 |                       |                |
| 1 - HOUR   | $\Delta f/f$  | (1)                          | (1)                 |                       |                |
| 1 - DAY (24 HOURS)   | $\Delta f/f$  | (1)                          | $2 \times 10^{-11}$ |                       |                |
| 1 - MONTH  | $\Delta f/f$  | (1)                          | $5 \times 10^{-10}$ |                       |                |
| REF FREQS PHASE NOISE  | $S_{\phi}(f)$ | <b>5 MHz</b>                 | <b>100 MHz</b>      | <b>5 MHz</b>          | <b>100 MHz</b> |
| 1 Hz OFFSET  | dBc/Hz        | -115                         | None                |                       |                |
| 10 Hz OFFSET   | dBc/Hz        | -140                         | None                |                       |                |
| 100 Hz OFFSET  | dBc/Hz        | -150                         | None                |                       |                |
| 1000 Hz OFFSET   | dBc/Hz        | -155                         | None                |                       |                |
| REF FREQS AVAILABLE  | MHz           | 1, 5, 10                     |                     |                       |                |
| MAX STA-TO-STA OFFSET  | Hz            | None                         |                     |                       |                |
|  |               |                              |                     |                       |                |
|  |               |                              |                     |                       |                |
|  |               |                              |                     |                       |                |
| <b>TIMING SYSTEM</b>   |               |                              |                     |                       |                |
| MASTER REFERENCE AGENCY  | Name          | NIST                         |                     |                       |                |
| REFERENCE TIME   | Name          | UTC                          |                     |                       |                |
| TIME CODE EPOCH  | Yr            | 1 January 1958               |                     |                       |                |
| TIME CODES AVAILABLE   | CCSDS Codes   | None                         |                     |                       |                |
| MAX TIME RESOLUTION  | s             | None                         |                     |                       |                |
| TIME TRANSFER METHOD   | Name          | GPS                          |                     |                       |                |
| MAX TRANS ERROR REF  | $\mu$ -sec    | 1                            |                     |                       |                |
| MAX OFFSET FROM REF  | $\mu$ -sec    | $\pm 50$                     |                     |                       |                |
| MAX OFFSET MEAS ERROR  | $\mu$ -sec    | 1                            |                     |                       |                |
| MAX STA-TO-STA OFFSET  | $\mu$ -sec    | -                            |                     |                       |                |
| TIMING SIGNALS AVAILABLE   | pulse/s       | 1                            |                     |                       |                |
|  |               |                              |                     |                       |                |
|  |               |                              |                     |                       |                |
|  |               |                              |                     |                       |                |
|  |               |                              |                     |                       |                |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS<br>4. MEASURED BY THE AGENCY |               |                              |                     |                       |                |

6445-4180A





**CCSDS HISTORICAL DOCUMENT**  
**UdC TRACKING SYSTEM**  
**SPACE-TO-EARTH LINK CHARACTERISTICS**

| CHARACTERISTICS  | UNITS        | SUBNETWORK OR STATION                                 |  |  |
|--|--------------|---|--|--|
|  |              | SANTIAGO  |  | SANTIAGO   |
| <b>GENERAL</b>   |              |   |  |  |
| STATION DESIGNATION  | -            | Santiago (AGO)  |  | Santiago (AGO)   |
| LOCATION(S)  | -            | Santiago, Chile                                       |  | Santiago, Chile  |
| DIAMETER   | m            | 9   |  | 12   |
| <b>RECEIVE</b>   |              |   |  |  |
| FREQUENCIES  | MHz          | 2200 - 2300   |  | 2200 - 2300      8000 - 8900                             |
| FREQUENCY RESOLUTION   | Hz           | 100   |  | 100      (1)   |
| ANTENNA GAIN @ 45 deg  | dBi          | 44.5  |  | 46.9      58.2   |
| SYS NOISE TEMP @ ZENITH  | K            | 100   |  | 190.5      66  |
| G/T @ 45 deg   | dB           | 21.8  |  | 27 (RCP), 23 (LCP)      40                               |
| POLARIZATION   | -            | RCP or LCP  |  | RCP or LCP      RCP                                      |
| ANTENNA BEAMWIDTH (-3 dB)  | deg          | 1   |  | 0.75      0.2  |
| ANTENNA ELLIPTICITY  | dB           | (1)   |  | (1)      (1)   |
| L.O. REF FREQ STAB @ 1 Hr  | $\Delta f/f$ | $\pm 5 \times 10^{-6}$                                |  | $\pm 5 \times 10^{-6}$ $\pm 5 \times 10^{-6}$            |
| RCVR AGC DYNAMIC RANGE   | dB           | 120   |  | 120      (1)   |
| RCVR THRESHOLD @ 2 Blo Hz  | dBm          | -154 in 2 Blo = 10 Hz                                 |  | -152 in 1 Blo = 10 Hz      (1)                           |
| RCVR LOOP BANDWIDTHS   | Hz           | 10, 30, 100, 300, 1 K, 3 K                            |  | 10, 30, 100, 300, 1 K, 3K      10, 30, 100, 300, 1 K, 3K |
| RCVR LOOP TYPE (ADAPT, FIX)  | -            | Adapt   |  | (1)      (1)   |
| RCVR PLL ORDER(S)  | No.          | 2   |  | (1)      (1)   |
| ACQ SWEEP RANGE  | kHz          | $\pm 15, \pm 300$                                     |  | $\pm 15, \pm 300$ (1)                                    |
| MIN ACQ SWEEP RATE   | Hz/s         | 2.5   |  | 2.5      (1)   |
| MAX ACQ SWEEP RATE   | kHz/s        | 50  |  | 50      (1)  |
| ACQ SWEEP STEP SIZE  | Hz           | Continuous  |  | Continuous      Continuous                               |
| PROGRAMMED L.O.  | Yes/No       | No  |  | No      No   |
| <b>TELEMETRY</b>   |              |   |  |  |
| MODULATION TYPE(S)   | -            | PM, FM, AM, PSK                                       |  | PM, FM, AM, PSK  |
| MODULATION FORMAT(S)   | -            | NRZ - L, M, S; Bi - f - L, M, S; DM - M, S, RZ - M, S |  | NRZ - L, M, S; Bi - f - L, M, S; DM - M, S, RZ - M, S    |
| MOD INDEX RANGE  | Rad Pk       | 1.5   |  | 1.5  |
| SUBCARRIER FREQ RANGE  | kHz          | 1 - 2000  |  | 1 - 2000   |
| SUBCARRIER WAVEFORM  | Sin/Sq       | Sine  |  | Sine   |
| SYMBOL RATE RANGE  | s/s          | 0 - 2000  |  | 0 - 2000   |
| SUBCARRIER/SYM RATE LIMIT  | -            | 1000  |  | 1000   |
| ARRAYS WITH STATIONS   | -            | No  |  | No   |
| CHANNEL CODING   | Type         | (1)   |  | (1)  |
| DATA FORMAT  | -            | (1)   |  | (1)  |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE      2. SOME LIMITATIONS APPLY TO THIS CAPABILITY      3. NOT RECOMMENDED BY CCSDS</p> |              |   |  |  |

6445-4009

CCSDS HISTORICAL DOCUMENT  
**UdC TRACKING SYSTEM**  
 RADIO METRIC CHARACTERISTICS

| CHARACTERISTICS   | UNITS        | SUBNETWORK OR STATION                                 |                               |
|---|--------------|---|-------------------------------|
|   |              | SANTIAGO  | SANTIAGO                      |
| <b>GENERAL</b>  |              |   |                               |
| STATION DESIGNATION   | -            | Santiago (AGO)  | Santiago (AGO)                |
| LOCATION(S)   | -            | Santiago, Chile                                       | Santiago, Chile               |
| DIAMETER  | m            | 9   | 12                            |
| <b>FREQUENCIES</b>  |              |   |                               |
| TRANSMIT FREQUENCIES  | MHz          | 2025 - 2120   |                               |
| RECEIVE FREQUENCIES   | MHz          | 2200 - 2300   | 2200 - 2300                   |
| TURNAROUND FREQ RATIO   | -            | 221 / 240   | This Station is Downlink Only |
| <b>DOPPLER</b>  |              |   |                               |
| COHERENT/NON-COHERENT   | -            | Coherent and Non-Coherent                             | None                          |
| COUNTER RESOLUTION  | Cycles       | 0.0001  |                               |
| MAX DOPPLER FREQ SHIFT  | MHz          | 0.23  |                               |
| DOPPLER BIAS FREQ   | MHz          | 240   |                               |
| DRIFT   | $\Delta f/f$ | $< 8 \times 10^{-14}$ @ 12 Hz                         |                               |
| OUTPUT EQUATION   | -            | $240 \text{ MHz} \pm 1.0 f_d$                         |                               |
| DIRECTION INDICATOR   | -            | $+\Delta f = -\Delta r$                               |                               |
|   |              |   |                               |
|   |              |   |                               |
|   |              |   |                               |
| <b>RANGING</b>  |              |   |                               |
| COHERENT/NON-COHERENT   | -            | Coherent  | None                          |
| RANGE CODE WAVEFORM   | Sin/Sq       | Sine  |                               |
| EARTH STATION MOD INDEX   | Rad Pk       | 3   |                               |
| RANGE CODE FREQ RATIO   | -            | 5 & 4   |                               |
| MAJOR CODE FREQ(S)  | kHz          | 500, 100, 20  |                               |
| MINOR CODE FREQ(S)  | kHz          | 100, 20, 4 (0.8, 0.16, 0.04, 0.01 on 4 KHz) 4 kHz PRN |                               |
| MIN RECEIVED CARRIER SNR  | dB           | 6   |                               |
| MIN REQ CODE PWR/No   | dB-Hz        | 10  |                               |
| CODE INTEGRATION TIME   | s            | 0, 50, 800  |                               |
| ACQUISITION SEQUENCE  | -            | Autotrack, Manual                                     |                               |
| RANGE DATA UNITS  | -            | Nonoseconds   |                               |
| RANGE QUANTIZATION  | -            | 32 (Parallel Binery)                                  |                               |
| ACCURACY (STRONG SIGNAL)  | m            | 1.0 (for 500 kHz Major Code)                          |                               |
| MAX UNAMBIGUOUS RANGE   | km           | 644 000   |                               |
| TRANSPONDER BW  | MHz          | 5   |                               |
|   |              |   |                               |
|   |              |   |                               |
|   |              |   |                               |
| 1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS |              |   |                               |

6445-4010

**UdC TRACKING SYSTEM**

FREQUENCY AND TIMING SYSTEM CHARACTERISTICS

| CHARACTERISTICS   | UNITS         | SUBNETWORK OR STATION                                     |                     |   |                     |
|---|---------------|---|---------------------|---|---------------------|
|   |               | SANTIAGO  |                     | SANTIAGO  |                     |
| <b>GENERAL</b>  |               |   |                     |   |                     |
| STATION DESIGNATION   | -             | Santiago (AGO)  |                     | Santiago (AGO)  |                     |
| LOCATION(S)   | -             | Santiago, Chile   |                     | Santiago, Chile   |                     |
| DIAMETER  | m             | 9   |                     | 12  |                     |
| <b>FREQUENCY STD</b>  |               |   |                     |   |                     |
| STANDARD TYPE   | Name          | (1)   |                     | (1)   |                     |
| STANDARD MFG  | Name          | (1)   |                     | (1)   |                     |
| STABILITY AT:   |               | <b>Allan Variance</b>                                     | <b>Drift</b>        | <b>Allan Variance</b>                                     | <b>Drift</b>        |
| 1 - SECOND  | $\Delta f/f$  | (1)   | $1 \times 10^{-11}$ | (1)   | $1 \times 10^{-11}$ |
| 1 - HOUR  | $\Delta f/f$  | (1)   | (1)                 | (1)   | (1)                 |
| 1 - DAY (24 HOURS)  | $\Delta f/f$  | (1)   | (1)                 | (1)   | (1)                 |
| 1 - MONTH   | $\Delta f/f$  | (1)   | $5 \times 10^{-12}$ | (1)   | $5 \times 10^{-12}$ |
| REF FREQS PHASE NOISE   | $S_{\phi}(f)$ | <b>5 MHz</b>  | <b>100 MHz</b>      | <b>5 MHz</b>  | <b>100 MHz</b>      |
| 1 Hz OFFSET   | dBc/Hz        | (1)   | (1)                 | (1)   | (1)                 |
| 10 Hz OFFSET  | dBc/Hz        | (1)   | (1)                 | (1)   | (1)                 |
| 100 Hz OFFSET   | dBc/Hz        | (1)   | (1)                 | (1)   | (1)                 |
| 1000 Hz OFFSET  | dBc/Hz        | (1)   | (1)                 | (1)   | (1)                 |
| REF FREQS AVAILABLE   | MHz           | 0.1, 1, 5   |                     | 0.1, 1, 5   |                     |
| MAX STA-TO-STA OFFSET   | Hz            | (1)   |                     | (1)   |                     |
| <b>TIMING SYSTEM</b>  |               |   |                     |   |                     |
| MASTER REFERENCE AGENCY   | Name          | MIST/USNO   |                     | MIST/USNO   |                     |
| REFERENCE TIME  | Name          | UTC   |                     | UTC   |                     |
| TIME CODE EPOCH   | Yr            | 1 January 1958  |                     | 1 January 1958  |                     |
| TIME CODES AVAILABLE  | CCSDS Codes   | IRIG - A, IRIG - B, NASA 1/sec SDTC, PB1, PB4, SERIAL PB1 |                     | IRIG - A, IRIG - B, NASA 1/sec SDTC, PB1, PB4, SERIAL PB1 |                     |
| MAX TIME RESOLUTION   | s             | $1 \times 10^{-6}$  |                     | $1 \times 10^{-6}$  |                     |
| TIME TRANSFER METHOD  | Name          | GPS   |                     | GPS   |                     |
| MAX TRANS ERROR REF   | $\mu$ -sec    | $\pm 1$   |                     | $\pm 1$   |                     |
| MAX OFFSET FROM REF   | $\mu$ -sec    | $\pm 10$  |                     | $\pm 10$  |                     |
| MAX OFFSET MEAS ERROR   | $\mu$ -sec    | 0.2   |                     | 0.2   |                     |
| MAX STA-TO-STA OFFSET   | $\mu$ -sec    | (1)   |                     | (1)   |                     |
| TIMING SIGNALS AVAILABLE  | pulse/s       | 0.1, 1, 10, 1 K, 2.4 K, 10 K, 100 K                       |                     | 0.1, 1, 10, 1 K, 2.4 K, 10 K, 100 K                       |                     |
| <p>1. CAPABILITY OR DATA IS NOT AVAILABLE    2. SOME LIMITATIONS APPLY TO THIS CAPABILITY    3. NOT RECOMMENDED BY CCSDS</p> <p>4. MEASURED BY THE AGENCY</p> |               |   |                     |   |                     |



## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

**5.0 REPRESENTATIVES AND PUBLICATIONS**

Section 5 lists two important sources for additional information about CCSDS Agencies' earth stations: *Agency Representatives and Descriptive Publications*. As with all previous sections, these data are arranged alphabetically by agency. Because some CCSDS Agencies separate the responsibility for different portions of their earth station facilities, more than one page may be required to provide all necessary information. Users of this Report are cautioned to contact those persons, and use those documents, that relate to the specific earth stations in which they are interested.

Frequently, two *Agency Representatives* are listed as sources of additional information. When a reader is interested in determining under what conditions another agency's earth stations may be available for support of his mission, he should contact that person listed in the *Cross-Support Information* column. Conversely, should the reader be attempting to ascertain whether or not the other agency's earth stations are compatible with his spacecraft design, then he should contact the individual named in the *Technical Information* column.

In addition to the addresses for the respective agency representatives, Telephone and Facsimile (FAX) numbers have been provided. Generally, these numbers include the Country Code where the representative is located. Where available, Telex numbers are listed.

Titles and document identification numbers for published descriptions of CCSDS Agencies' earth stations can be found in the *References* portion of the information sheet. A short summary of the document's contents has been provided so that one can determine whether it is likely to contain the desired information. Readers should understand that these publications may be in the language of the Owner Agency's country and some language translation may be required.

**CCSDS HISTORICAL DOCUMENT  
CCRS RECEIVING STATIONS**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

**TECHNICAL  
INFORMATION**

Agency Name: Canada Centre for Remote Sensing (CCRS)  
Person's Name: T. Feehan  
Title: Head, Ground Systems Operations  
Street Address: 588 Booth Street  
Department Name: Ground Systems Operations Section  
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**REFERENCES:**

**PUBLICATION No. 1**

**PUBLICATION No. 2**

Title: \_\_\_\_\_  
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Document No. \_\_\_\_\_  
Published By: \_\_\_\_\_  
Publication Date: \_\_\_\_\_  
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**PUBLICATION No. 4**

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**CCSDS HISTORICAL DOCUMENT  
CLRC / RAL TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

**TECHNICAL  
INFORMATION**

Agency Name: Central Lab of the Research Council (CLRC)  
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44 1235 44 5848  
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p.h.mcpherson@rl.ac.uk

**REFERENCES:**

**PUBLICATION No. 1**

Title: The IRAS Ground Station and  
Operations Control Center at Chilton  
 \_\_\_\_\_  
 Document No. ISSN 0007 - 084X  
 Published By: British Interplanetary Society  
 Publication Date: January 1983  
 Summary: \_\_\_\_\_  
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**PUBLICATION No. 2**

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**PUBLICATION No. 3**

Title: \_\_\_\_\_  
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**PUBLICATION No. 4**

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**CCSDS HISTORICAL DOCUMENT  
CLTC TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

**TECHNICAL  
INFORMATION**

Agency Name: CLTC / TT&C  
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 FAX No. +86 10 62021638  
 Telex No. NIL  
 E Mail No. \_\_\_\_\_

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**CCSDS HISTORICAL DOCUMENT  
CNES TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

**TECHNICAL  
INFORMATION**

Agency Name: Centre National d'Etudes Spatiales (CNES)  
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**PUBLICATION No. 1**

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**CCSDS HISTORICAL DOCUMENT  
CRL TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

**TECHNICAL  
INFORMATION**

Agency Name: Communications Research Lab. (CRL)  
Person's Name: Dr. Takashi Iida  
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**CCSDS HISTORICAL DOCUMENT**  
**CSA SATELLITE CONTROL STATIONS**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

**TECHNICAL  
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**CCSDS HISTORICAL DOCUMENT  
CSIR TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
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**TECHNICAL  
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CCSDS HISTORICAL DOCUMENT  
CSIRO TRACKING SYSTEM

FOR INFORMATION PLEASE CONTACT:

CROSS-SUPPORT  
INFORMATION

TECHNICAL  
INFORMATION

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Australian Telescope National Facility  
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REFERENCES:

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**CCSDS HISTORICAL DOCUMENT  
DLR TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

**TECHNICAL  
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Agency Name: DLR  
Person's Name: Werner Schwarz  
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**REFERENCES:**

**PUBLICATION No. 1**

**PUBLICATION No. 2**

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**CCSDS HISTORICAL DOCUMENT  
DRA TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

**TECHNICAL  
INFORMATION**

Agency Name: \_\_\_\_\_  
Person's Name: \_\_\_\_\_  
Title: \_\_\_\_\_  
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Department Name: \_\_\_\_\_  
Department Code: \_\_\_\_\_  
Mail Stop (if any): \_\_\_\_\_  
City and ZIP Code: \_\_\_\_\_  
Country: \_\_\_\_\_  
Telephone No. \_\_\_\_\_  
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Defense Research Agency (DRA)  
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Tony Mills  
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**REFERENCES:**

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**CCSDS HISTORICAL DOCUMENT  
ESA TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

**TECHNICAL  
INFORMATION**

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**CCSDS HISTORICAL DOCUMENT  
INPE / DSA TRACK**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

**TECHNICAL  
INFORMATION**

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**REFERENCES:**

**PUBLICATION No. 1**

**PUBLICATION No. 2**

Title: CRC Facilities Manual  
Cuiabá Ground Station  
Document No. OPG-DG-002  
Published By: CRC  
Publication Date: September 1991  
Summary: Describes Cuiabá Ground Station

CRC Facilities Manual  
Alcãntera Ground Station  
OPG-DG-003  
CRC  
March 1992  
Describes Alcãntera Ground Station

**PUBLICATION No. 3**

**PUBLICATION No. 4**

Title: Ground Segment Communication  
Protocol Specifications  
Document No. A-EIF-0004  
Published By: MECB  
Publication Date: February 1993  
Summary: Describes Communication protocol between  
the Ground Stations and Control Center

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CCSDS HISTORICAL DOCUMENT  
**ISAS TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

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INFORMATION

TECHNICAL  
INFORMATION

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**CCSDS HISTORICAL DOCUMENT  
ISRO TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

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**CCSDS HISTORICAL DOCUMENT  
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**PUBLICATION No. 1**

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**CCSDS HISTORICAL DOCUMENT  
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**CCSDS HISTORICAL DOCUMENT  
NASA / GSFC TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

**TECHNICAL  
INFORMATION**

Agency Name: NASA/GSFC  
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**CCSDS HISTORICAL DOCUMENT  
NASA / GSFC TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

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INFORMATION**

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**CCSDS HISTORICAL DOCUMENT**  
**NASA / WALLOPS & NASA / MOBILE TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

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**CCSDS HISTORICAL DOCUMENT  
NASDA TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

**TECHNICAL  
INFORMATION**

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REFERENCES:

**PUBLICATION No. 1**

**PUBLICATION No. 2**

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CCSDS HISTORICAL DOCUMENT  
NOAA TRACKING SYSTEM

FOR INFORMATION PLEASE CONTACT:

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REFERENCES:

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CCSDS HISTORICAL DOCUMENT  
RSA TRACKING SYSTEM

FOR INFORMATION PLEASE CONTACT:

CROSS-SUPPORT  
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REFERENCES:

PUBLICATION No. 1

PUBLICATION No. 2

Title: Radio Communication Systems for  
For Interplanetary Spacecraft by  
Bakit'ko R.V., Vasil'ev M. B., Vimitskiy A.S. et al  
Document No. ISBN 5-25b-01054-g  
Published By: Moscow, Radio and Communications  
Publication Date: 1993  
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**CCSDS HISTORICAL DOCUMENT  
SSC TRACKING SYSTEM**

FOR INFORMATION PLEASE CONTACT:

**CROSS-SUPPORT  
INFORMATION**

**TECHNICAL  
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REFERENCES:

**PUBLICATION No. 1**

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CCSDS HISTORICAL DOCUMENT  
UdC TRACKING SYSTEM

FOR INFORMATION PLEASE CONTACT:

CROSS-SUPPORT  
INFORMATION

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REFERENCES:

PUBLICATION No. 1

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## Earth Stations

**6.0 TERMINOLOGY AND GLOSSARY**

It is an imperative resulting from the compact nature of this CCSDS Report that abbreviations and acronyms be used throughout the summary tables. It is equally essential that all users and contributors have a common, identical, understanding of all terminology, abbreviations, and acronyms contained in this document. Section 6 is intended to minimize misunderstandings by providing definitions for terminology, abbreviations, and acronyms found in this Report.

Section 6 provides a short definition for the *Terminology* used in each entry of every table. Entries are arranged, by section, in the order that a user will encounter the term when reading the Report from front to back. Definitions for the *General Information*, found in section 6.1.1, apply to the terms found at the column headings of all tables in Sections 4. This *General Information* is necessary to correlate the information for each earth station found in those two Sections.

*Electrical Characteristics* are described in Section 6.1.2. The latter Section is further subdivided into the several services provided by the RF and Modulation system on the *Earth-to-Space* and *Space-to-Earth* links. When using the tables, readers should ensure that they fully understand the definition for each item in which they are interested.

Section 6.2 contains the full name for the abbreviations and acronyms used throughout this Report. If a reader is uncertain as to the meaning any abbreviation or acronym, this Section should be consulted. Here, entries are arranged alphabetically.

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

## 6.1 TERMINOLOGY

This section contains definitions of the specific terms used in the 5 data sheets that are used to characterise an Earth station.

## 6.1.1 GENERAL INFORMATION

|                              |   |
|------------------------------|---|
| STATION DESIGNATION          | That name, given by the owner-agency, which identifies the specific earth station (station ID).                               |
| LOCATION, COUNTRY            | The country where the named earth station is located (name).  |
| LOCATION, CITY               | The nearest city of reasonable size to the named earth station (name).  |
| DIAMETER AND No. of ANTENNAS | The earth station antenna's diameter, expressed in meters, followed by the number of such antennas at the named location (m). |

## 6.1.2 ELECTRICAL CHARACTERISTICS

## EARTH-TO-SPACE

## 6.1.2.1 TRANSMIT SECTION

|                      |  |
|----------------------|--|
| FREQUENCIES          | The <b>range</b> of frequencies over which the named station can transmit a signal to a spacecraft at the stated EIRP (MHz).   |
| FREQUENCY RESOLUTION | The smallest increment with which the transmitted RF carrier's frequency can be adjusted in the specified band (Hz).   |
| RF FREQ STABILITY    | The maximum change in RF carrier frequency, expressed as a fraction of the nominal RF carrier frequency, that the earth-to-space link will vary due to system instabilities over a named period (e.g., 1 sec or 1 min.) (parts per million).   |
| EIRP RANGE 1         | The <b>range</b> of equivalent isotopically radiated powers over which the main earth-to-space link can be operated while maintaining the other characteristics shown in this table. This characteristic is the product of the power supplied to the antenna and the antenna's gain (dBW). |
| EIRP RANGE 2         | Same as the previous entry except that the specification pertains to an auxiliary, or an emergency transmitter (dBW).  |
| POLARIZATION         | The type and direction in which the electric field of the earth-to-space link can be polarized (use IEEE definitions).   |

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

|                     |   |
|---------------------|---|
| ANTENNA GAIN        | The increase in signal power, measured at the center of the specified transmitting band, which results from the directivity of the named antenna. This characteristic is expressed as a dB increase in power which is required at the input to a loss-free isotropic reference antenna to produce the same field strength or power flux density as the given antenna in its direction of maximum radiation (dBi). |
| BEAMWIDTH           | The planar angle between the two diametrically opposite rays, originating at the antenna and intersecting the points where the antenna's gain is 3 dB below the maximum boresight gain (deg).   |
| ANTENNA ELLIPTICITY | Peak-to-peak axial ratio, maximum, defined as the ratio of peak-to-trough received voltages with rotating linearly polarized source and circularly (elliptically) polarized receiving antenna. Ellipticity (db) = $20 \log (V1/V2)$ .   |
| FREQ SWEEP RANGE    | The <b>range</b> of frequencies over which the earth-to-space link can be swept during acquisition of the spacecraft receiver acquisition (kHz).  |
| MIN FREQ SWEEP RATE | The lowest rate at which the earth-to-space link can be swept in frequency during spacecraft receiver acquisition (Hz/s).   |
| MAX FREQ SWEEP RATE | The highest rate at which the earth-to-space link can be swept in frequency during spacecraft receiver acquisition (kHz/s).   |

## 6.1.2.2 COMMAND SECTION

|                      |  |
|----------------------|--|
| CARRIER MOD TYPE     | The type of RF carrier modulation such as phase, frequency, or amplitude.  |
| CARRIER MOD INDICES  | The <b>range</b> of RF carrier modulation indices over which the earth-to-space link may be operated when sending commands to the spacecraft (Rad-Pk, Hz, Percent, etc.).    |
| SUBCARRIER FREQ(S)   | The <b>range</b> of command subcarrier frequencies that the system can generate (kHz).   |
| SUBCARRIER STEP SIZE | The smallest increment with which the subcarrier frequency can be adjusted over the frequency range specified above (Hz).  |
| SUBCARRIER FREQ STAB | The change in subcarrier frequency, expressed as a fraction of the nominal subcarrier frequency, which results from instabilities in the command system (parts per million). |
| SUBCARRIER WAVEFORM  | The shape of the command subcarrier waveform [CCSDS recommends sine](e.g., sine, square).  |

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

|                         |   |
|-------------------------|---|
| SUBCARRIER MOD TYPE     | The method by which the command subcarrier is modulated by the data (FSK; PSK; Bi- $\phi$ -L, M; AM).             |
| SUBCARRIER/BIT RATE LIM | Any restrictions placed on the phase or frequency ratio relationship between the command data and its subcarrier. |
| BIT RATE (S)            | The <b>range</b> of command data rates over which the system is capable of operating (b/s).                       |
| FORMAT                  | The methods used to represent command data bits (e.g., NRZ-L, M; Bi- $\phi$ -L, M; etc.).                         |

## SPACE-TO-EARTH

## 6.1.2.3 RECEIVE SECTION

|                       |  |
|-----------------------|--|
| FREQUENCIES           | The <b>range</b> of frequencies over which the named station can receive a signal from a spacecraft with the stated G/T (MHz).   |
| FREQUENCY RESOLUTION  | The smallest increment with which the receiver's frequency can be adjusted within the specific band (Hz).  |
| G/T @ 45 deg          | The antenna's gain divided by the system's noise temperature, expressed in dB per degrees Kelvin, when the antenna is pointed at 45 deg. (dB/K).   |
| ANTENNA GAIN @ 45 deg | The increase in signal power, measured at the center of the specified receiving frequency band, which results from the directivity of the named antenna. This characteristic is expressed as a dB increase in the received signal power flux density which is required at the input to a loss-free isotropic reference antenna to product the same electrical signal level at its output terminals as the given antenna (dBi). |
| POLARIZATION          | The type and direction of the electric field with which the receiving equipment of the space-to-earth link can operate (RCP, LCP, LIN, etc).   |
| BEAMWIDTH             | The planar angle between two diametrically opposite rays, originating at the antenna and intersecting points where the antenna's gain is 3 dB below the maximum boresight gain (deg).  |
| ANTENNA ELLIPTICITY   | Peak-to-peak axial ratio, maximum, defied as the ratio of peak-to-trough received voltages with rotating linearly polarized source and circularly (elliptically) polarized receiving antenna. Ellipticity (db) = $20 \log (V1/V2)$ .   |

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

|                                       |   |
|---------------------------------------|---|
| L.O. REF FREQ STAB                    | The change in the receiver's local oscillator frequency, expressed as a fraction of the nominal local oscillator frequency, which results from system instabilities (parts per million).  |
| RCVR DYNAMIC RANGE                    | The <b>range</b> of received powers over which the receiver is capable of operating (dB).   |
| RCVR THRESHOLD in 2B <sub>lo</sub> Hz | That signal level producing a signal-to-noise ratio of 10 dB in the phase locked loop's bandwidth.  |
| RCVR LOOP BANDWIDTHS                  | The resultant phase locked bandwidth when the signal-to-noise ratio in the phase locked loop is 10 dB.  |
| RCVR LOOP TYPE (Adapt/Fix)            | The characteristic of the PLL to expand its bandwidth as the carrier power increases. This characteristic is created by having a limiter before the loop phase detector and is prevalent in the older, analog receivers. Newer, digital receivers are usually characterized with a fixed bandwidth that does not change with changing power levels. |
| RCVR PLL ORDER                        | The order of the loop is defined by the number of integrators in the feedback loop. The PLL built into the older analog receivers were typically 2 <sup>nd</sup> order PLL. The newer digital PLL are typically, 1 <sup>st</sup> , 2 <sup>nd</sup> , 3 <sup>rd</sup> or 4 <sup>th</sup> order PLLs.   |
| ACQ SWEEP RANGE                       | The range(s) of frequencies over which the receiver can be swept in order to acquire the space-to-earth link (kHz).   |
| MIN ACQ SWEEP RATE                    | The lowest rate at which the receiver can be swept in frequency during the space-to-earth link acquisition (Hz/s).  |
| MAX ACQ SWEEP RATE                    | The highest rate at which the receiver can be swept in frequency during the space-to-earth link acquisition (kHz/s).  |
| ACQ SWEEP STEP SIZE                   | The smallest frequency increment with which the receiver can be adjusted during the space-to-earth link acquisition process (Hz).   |
| PROGRAMMED L.O                        | A statement showing the existence of a device which continually adjusts the receiver's frequency so that the phase-locked loop's static phase error remains virtually constant over some time interval (Yes or No).   |

## 6.1.2.4 TELEMETRY SECTION

|                    |  |
|--------------------|--|
| MODULATION TYPE(s) | The <b>type(s)</b> of RF carrier modulation such as phase, frequency, or amplitude that the ground station is capable of receiving (PM, FM, AM, etc.). |
| MODULATION FORMAT  | The method used to represent data bits and control to the frequency spectrum (NRZ-L, M, S; Bi- $\phi$ -L, M, S; etc.).                                 |

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

|                      |  |
|----------------------|--|
| MOD INDEX RANGE      | The <b>range</b> of RF carrier modulation indices over which the space-to-earth link may be operated while receiving the signal at the named station (Rad-Pk).   |
| SUBCARR FREQ RANGE   | The <b>range</b> of telemetry subcarrier frequencies over which the receiving system will operated (kHz).  |
| SUBCARRIER WAVEFORM  | The shape of the telemetry subcarrier's waveform (e.g., sine, square).   |
| SYMBOL RATE RANGE    | The <b>range</b> of digital telemetry symbol rates, whether coded or uncoded, over which the receiving system will operate (sps).  |
| SUBCARR/SYM RATE LIM | Any restrictions placed on the phase or frequency relationship between the telemetry data and its subcarrier by the receiving equipment.   |
| ARRAYS WITH STATIONS | The names of stations with which the signal from this station may be combined in order to increase the antenna's effective aperture size (station Ids).  |
| CHANNEL DECODING     | The types and characteristics of the error-detecting, error-correcting codes for which the named Earth station maintains a decoding capability. For example the standard CCSDS Recommended code: Convolutional $R = 1/2$ , $k = 7$ concatenated with a Reed-Solomon 223/255 Block code would be written as CCSDS Conv. $R = 1/2$ , $k = 7$ ; R-S 223 / 255 Block.  |
| DATA FORMAT          | The names of the <i>Link Layer</i> Formats(s) on the transmitted telemetry data stream which the named Earth station can properly handle. For CCSDS Recommended formats, handling includes separation and routing of Virtual Channels. For example, an Earth station capable of handling CCSDS Transfer Frame and VCDU and the older Time Domain Multiplexed (TDM) formats would be written as: CCSDS Trans. Frame (6-Ch); CCSDS VCDU (16-Ch); TDM |

## RADIO METRIC CHARACTERISTICS

## 6.1.2.5 DOPPLER SECTION

|                    |   |
|--------------------|---|
| COHERENT/NON COHER | The spacecraft's RF modes in which the earth station's doppler extraction equipment can operate (e.g., coherent only, non-coherent only, either). |
| COUNTER RESOLUTION | The smallest increment measured by the doppler detection equipment. Generally, this characteristic is specified in Hz.                            |

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

|                     |   |
|---------------------|---|
| MAX DOPPLER FREQ    | The greatest doppler frequency shift at which the doppler detection equipment will operate properly (MHz).  |
| DOPPLER BIAS FREQ   | The frequency of a signal which has been added to the received doppler so as to avoid negative frequencies (MHz).   |
| DRIFT               | The maximum change in frequency, expressed as a fraction of the nominal doppler frequency, that is introduced by instabilities in the ground receiving equipment ( $f/f$ ). |
| OUTPUT EQUATION     | A short mathematical statement showing the relationship between the doppler frequency shift and the output from the doppler detection equipment.                            |
| DIRECTION INDICATOR | A short mathematical statement showing the relationship between a change in the doppler frequency shift and the change in the spacecraft's distance vector.                 |

## 6.1.2.6 RANGING SECTION

|                       |   |
|-----------------------|---|
| COHERENT/NON COHER    | The ability of the ranging equipment to operate with an RF carrier which has either been coherently generated by the spacecraft's radio system from the earth-to-space link (coherent); or which has been generated by an oscillator on the spacecraft that has no specific phase relationship to the earth-to-space link (non coherent). |
| RANGE CODE WAVEFORM   | The shape and type of the ranging code waveform (e.g., sine, square, pseudo noise, etc.).   |
| GND MOD INDEX         | The <b>range</b> of RF carrier modulation indices over which the earth-to-space link may be operated with the ranging code (Rad-Pk).  |
| RANGE CODE FREQ RATIO | The frequency ratio between adjacent range code components (ratio).   |
| MAJOR CODE FREQ(S)    | The set of highest frequency range code components, each of which may be individually selected, and which determine the precision of a given range measurement (kHz).   |
| MINOR CODE FREQ(S)    | The set of range code components which may be used during a given range measurement to resolve ambiguities resulting from the repetition rate of the major code component (kHz).  |
| MIN REC CARRIER SNR   | The minimum received carrier signal-to-noise ratio which is required to measure the range satisfactorily (dB).  |
| MIN CODE PWR/No       | The minimum received code power divided by the noise spectral density which is required to measure the range satisfactorily (db-Hz).  |

CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

**Earth Stations**

|                       |  |
|-----------------------|--|
| CODE INTEGRATION TIME | The range of times that the user may select to measure the phase of major and minor range code components (s).   |
| ACQUISITION SEQUENCE  | The method and order in which the phase of the received range code components are measured (example, sequential, major code first).  |
| RANGE DATA UNITS      | The measurement units, produced by the station's equipment in its ranging determination, which is provided to users of the raw data (e.g., meters, microseconds, nanoseconds, etc.). |
| RANGE QUANTIZATION    | The smallest increment of Range Data Units reported by the ranging equipment (see prior definition).   |
| ACCURACY (STRONG SIG) | The greatest accuracy with which the ranging equipment can measure distance at high signal-to-noise ratios while using the highest frequency range code (m).                         |
| MAX UNAMBIG RANGE     | The period of the lowest frequency code component multiplied by the speed of light (km)  |
| TRANSPONDER BW        | The minimum spacecraft transponder bandwidth which is required for the ranging system to provide the above stated accuracy (MHz).  |

**FREQUENCY AND TIMING SYSTEM**

6.1.2.7 **FREQUENCY STANDARD**

|               |   |
|---------------|---|
| STANDARD TYPE | The name of the element which provides the primary frequency reference (e.g., Hydrogen Maser, Cesium Beam, Rubidium Oscillator, etc.) |
| STANDARD MFG. | The manufacturer's name and model number, if the frequency standard is a commercially available item (name and number).               |
| STABILITY AT: |   |
| 1 - SECOND    | The Allan Variance and/or Drift over a 1 second time interval.  |
| 1 - HOUR      | The Allan Variance and/or Drift over a 1 hour time interval.  |
| 24 - HOURS    | The Allan Variance and/or Drift over a 24 hour time interval.   |
| 1 - MONTH     | The Allan Variance and/or Drift over a 1 month time interval.   |

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

REF. FREQ PHASE NOISE: The earth station Frequency and Timing system's reference frequency phase noise, measured at the named frequencies (5 Mhz / 100 Mhz) using a single side band system with a 1 Hz bandwidth (dB Hz) at the following offset frequencies from the carrier (dBc/Hz):

1 Hz Offset  
 10 Hz Offset  
 100 Hz Offset  
 1000 Hz Offset

REFERENCE FREQS. AVAIL. The set of reference frequencies, derived from the master frequency standard, which are available from the station's frequency and timing subsystem for external equipment interfacing (MHz).

MAX. STA.-TO-STA. OFFSET The maximum frequency offset permitted between two or more stations of an agency's network (Hz).

## 6.1.2.8 TIMING SYSTEM

MASTER REFERENCE AGENCY The name of the agency or bureau responsible for maintaining the master time reference to which the specified station is synchronized (name).

REFERENCE TIME The name of the time reference employed in the named station(s) (UTC, other).

TIME CODE EPOCH The reference, or beginning, year for the previously specified reference time (yr).

TIME CODES AVAILABLE The names of those codes, recommended by the CCSDS, which are available to users of, or supplied with data from, the named station(s).

MAX TIME RESOLUTION The highest resolution provided by the previously specified CCSDS Time Code(s) (s).

TIME TRANSFER METHOD The name of the method used to synchronize station's clock to the master time reference (GPS, LORAN, etc.).

MAX. TRANS. ERROR TO REF. The maximum permissible real offset between the station's clock and the master time reference at the conclusion of the station clock synchronization process ( $\hat{\epsilon}$ s).

MAX. OFFSET FROM REF. The maximum permissible real offset between the station's clock and the master time reference before re-synchronization of the station's clock is initiated ( $\hat{\epsilon}$ s).

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

|                          |   |
|--------------------------|---|
| MAX. OFFSET MEAS. ERROR  | The maximum permissible measurement error in establishing the real offset of the station's clock from the master time reference ( $\hat{\epsilon}_s$ ).               |
| MAX. STA.-TO-STA. OFFSET | The maximum permissible real offset between two clocks at different stations within an agency's network ( $\hat{\epsilon}_s$ ).                                       |
| TIMING SIGNALS AVAILABLE | The timing signals, derived from the station's clock, which are available from the station's frequency and timing subsystem for external equipment interfacing (sec). |

## 6.1.4 GEOGRAPHICAL &amp; MECHANICAL INFORMATION

|                            |  |
|----------------------------|--|
| LONGITUDE                  | The longitude of the earth station's antenna (deg., min., sec. East of the Greenwich Meridian).  |
| LATITUDE                   | The latitude of the earth station's antenna (deg., min., sec. North (+) or South (-) of the Equator).  |
| TYPE OF MOUNT              | Antenna mounting structure configuration, such as azimuth-elevation, hour angle-declination, X-Y, etc.   |
| AZIMUTH LIMITATIONS        | Physical constraints on the horizontal movement or pointing of the antenna, generally referenced to a specific direction (deg).  |
| TRACKING SPEED RANGE       | That range of speeds over which the antenna's beam remains pointed at a target within the specified accuracy (deg/s).  |
| MAX. TRACKING ACCELERATION | The maximum rate at which the antenna's mechanical structure can alter its tracking speed while remaining pointed at a target within the specified accuracy (deg/s <sup>2</sup> ). |
| TYPE OF POINTING           | The methods by which the antenna's beam can be directed toward a target such as autotrack, manual, predicts, etc.  |
| POINTING ACCURACY          | The nominal precision with which the antenna's beam can be directed toward a target (deg).   |
| MIN. TRANSMIT ELEV. ANGLE  | The lowest elevation angle usable for transmitting signals to a spacecraft. This limitation can result from either physical or policy constraints (deg).                           |
| MIN. RECEIVE ELEV. ANGLE   | The lowest elevation angle usable for receiving signals from a spacecraft. This limitation can result from either physical or policy constraints (deg).                            |
| TRANSMIT FREQUENCY BAND    | Those frequency bands and mission Category for which an earth-to-space link is available on the named antenna (GHz and Cat).   |

CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

Earth Stations

|                              |   |
|------------------------------|---|
| RECEIVE FREQUENCY BAND       | Those frequency bands and mission Category for which a space-to-earth link is available on the named antenna (GHz and Cat).   |
| ACQUISITION AID FREQ. BAND   | Those frequency bands and mission Category for which an auxiliary, wide beamwidth antenna is available for use in the initial signal acquisition (GHz and Cat.).  |
| MISSION CATEGORIES SUPPORTED | Those mission categories (A or B) which the named antenna can support. Category A Missions have a topocentric distance of less than $2 \times 10^6$ km. Category B Missions have a geocentric distance equal to, or greater than, $2 \times 10^6$ km. |

6.1.5 OTHER TERMS

|                     |   |
|---------------------|---|
| CATEGORY A MISSIONS | Those missions whose altitude above the earth is less than $2 \times 10^6$ km.  |
| CATEGORY B MISSIONS | Those missions whose altitude above the earth is equal to, or greater than, $2 \times 10^6$ km.   |
| LIBRATION POINT     | A point of equal potential gravitational fields between two or more large bodies such as the Sun and the Earth  |
| OCCUPIED BANDWIDTH  | (ITU/RR/147): "The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage $\cdot/2$ of the total mean power of a given emission." [Unless otherwise specified by the CCIR for the appropriate class of emission, the value of $\cdot/2$ should be taken as 0.5%."] |

## Earth Stations

## 6.2 GLOSSARY OF TERMS

|                     |   |
|---------------------|---|
| ACQ or Acq          | Acquisition   |
| AGC                 | Automatic Gain Control  |
| AM                  | Amplitude Modulation  |
| ASA                 | Austrian Space Agency   |
| ASO                 | Austrian Space Office   |
| BER                 | Bit Error Rate  |
| Bi- $\phi$ -L       | Bi-Phase-Level modulation   |
| Bi- $\phi$ -M       | Bi-Phase-Mark modulation  |
| Bi- $\phi$ -S       | Bi-Phase-Space modulation   |
| B <sub>LO</sub>     | Phase Locked Loop Bandwidth   |
| BPL                 | Station time code of CASO   |
| bps or b/s          | Bits Per Second   |
| BW                  | Bandwidth   |
| CASO                | China Shanx Astronomical Observatory  |
| CAST                | Chinese Academy of Space Technology   |
| Cat                 | Category  |
| Category A Missions | Those missions whose altitude above the Earth is less than $2 \times 10^6$ km.                  |
| Category B Missions | Those missions whose altitude above the Earth is equal to, or greater than, $2 \times 10^6$ km. |
| CCIR                | International Radio Consultative Committee  |
| CCRS                | Canadian Centre for Remote Sensors  |
| CDA                 | Command and Data Acquisition  |
| CCSDS               | Consultative Committee for Space Data Systems   |
| CLRC                | Central Laboratory of the Research Council  |
| CLTC                | China Satellite Launch Tracking and Control   |
| CNES                | Centre National D'Etudes Spatiales  |
| COHER or Coh        | Coherent  |
| CRC                 | Industry Canada / Communications Research Centre  |
| CRL                 | Communications Research Laboratory / Japan  |
| CSA                 | Canadian Space Agency / Canada  |
| CSIR                | Council for Science and Industrial Research / S. Africa   |
| CSIRO               | Commonwealth Scientific and Industrial Research Organization                                    |
| CTA                 | Cebtro Technico Aeroespacial / Brasil   |

## Earth Stations

## 6.2 GLOSSARY OF TERMS (Continued)

|                                |  |
|--------------------------------|--|
| dB                             | Decibel(s)   |
| dB <sub>i</sub>                | Decibel(s) relative to an isotropically radiated signal        |
| dB/K                           | Decibel(s) per degree Kelvin                                   |
| dB <sub>m</sub>                | Decibel(s) relative to one milliwatt                           |
| dBW                            | Decibel(s) relative to one Watt                                |
| DCT                            | Design Control Table [Link]                                    |
| deg                            | Degree   |
| DLR                            | Deutsche Forschungs-und Versuchsanstalt für Luft-und Raumfahrt |
| DNRZ                           | Differential Non-Return to Zero                                |
| DOC/CRC                        | Department of Communications, Communications Research Centre   |
| DRA                            | Defense Research Agency  |
| DRVID                          | Differenced Range vs. Integrated Doppler                       |
| DSN                            | Deep Space Network   |
| DSRI                           | Danish Space Research Institute / Denmark                      |
| E <sub>b</sub>                 | Energy per data bit  |
| E <sub>b</sub> /N <sub>0</sub> | Energy per data bit to Noise ratio in a 1 Hz bandwidth         |
| EES                            | Earth Exploration Service                                      |
| EIRP                           | Equivalent Isotropically Radiated Power                        |
| ELEV                           | Elevation  |
| E/S                            | Earth-to-Space   |
| ESA                            | European Space Agency  |
| EUTELSAT                       | European Telecommunications Satellite Organization / Europe    |
| exp                            | Exponent   |
| f or Freq                      | Frequency  |
| f <sub>c</sub>                 | RF carrier frequency   |
| f <sub>d</sub>                 | Doppler frequency shift  |
| f <sub>sc</sub>                | Subcarrier frequency   |
| FM                             | Frequency Modulation   |
| FN or Fn                       | Footnote   |
| FSK                            | Frequency Shift Keying   |
| GHz                            | Gigahertz  |
| GND                            | Ground   |
| GPS                            | Global Positioning System                                      |

## Earth Stations

## 6.2 GLOSSARY OF TERMS (Continued)

|            |   |
|------------|---|
| GSFC       | Goddard Space Flight Center   |
| G/T        | Antenna gain divided by the receiving system's noise temperature in degrees Kelvin (usually expressed in dB). |
| Hz         | Hertz   |
| IFRB       | International Frequency Registration Board  |
| IKI        | Institute of Space Research / Russian Federation  |
| INPE       | Instituto Nacional De Pesquisas Espaciais   |
| ISAS       | Institute of Space and Astronautical Science / Japan  |
| ISRO       | Indian Space Research Organization / India  |
| ITU        | International Telecommunication Union   |
| ITU/RR     | International Telecommunication Union Radio Regulations   |
| k          | Kilo (thousands)  |
| K          | Degrees Kelvin  |
| kb/s       | Kilobits Per Second   |
| KFKI       | Research Institute for Particle & Nuclear Physics / Hungary   |
| kHz        | Kilohertz   |
| km         | Kilometers  |
| Ku         | Ku-band (approximately 13 to 15 gigahertz)  |
| LCP        | Left Circular Polarization  |
| LIM or Lim | Limitation(s)   |
| LIN or Lin | Linear  |
| L.O. or LO | Local Oscillator  |
| M          | Mega (million)  |
| m          | Meter(s)  |
| MAX or Max | Maximum   |
| MHz        | Megahertz   |
| MIN or Min | Minimum   |
| MOC        | Ministry of Communications / Israel   |
| n          | Nano  |
| ns         | Nanosecond(s)   |
| NASA       | National Aeronautics and Space Administration   |
| NASDA      | National Space Development Agency of Japan  |
| NOAA       | National Oceanic and Atmospheric Administration / USA   |

## CCSDS RADIO FREQUENCY AND MODULATION SYSTEMS REPORT

## Earth Stations

## 6.2 GLOSSARY OF TERMS (Continued)

|                |   |
|----------------|---|
| NRZ            | Non-Return to Zero                            |
| NRZ-L          | Non-Return to Zero-Level                      |
| NRZ-M          | Non-Return to Zero-Mark                       |
| NRZ-S          | Non-Return to Zero-Space                      |
| OQPSK          | Offset Quadra-Phase Shift Keying [modulation] |
| $P_c$          | Carrier power                                 |
| PCM            | Pulse Code Modulation                         |
| PDF            | Probability Density Function                  |
| PFD            | Power Flux Density                            |
| $P_k$ or $p_k$ | Peak  |
| $P_{LL}$       | Phase Locked Loop                             |
| PM             | Phase Modulation                              |
| PN             | Pseudo Noise                                  |
| ppm            | Parts Per Million                             |
| PRN            | Pseudo Random Noise                           |
| PSK            | Phase Shift Keying                            |
| PWR            | Power   |
| QPSK           | Quadra-Phase Shift Keying [modulation]        |
| r              | Range   |
| Rad            | Radian  |
| RAL            | Rutherford Appleton Laboratory                |
| RCP            | Right Circular Polarization                   |
| RCVR or Rcvr   | Receiver                                      |
| Rec            | Receive                                       |
| REF or Ref     | Reference                                     |
| RF             | Radio Frequency                               |
| RFI            | Radio Frequency Interference                  |
| RLIN           | Rotatable Linear polarization                 |
| rms            | Root Mean Square                              |
| RSA            | Russian Space Agency                          |
| RSS            | Root Sum Square                               |
| s or sec       | Second(s)                                     |
| S/E            | Space-to-Earth                                |

## Earth Stations

## 6.2 GLOSSARY OF TERMS (Continued)

|                  |   |
|------------------|---|
| SEP              | Sun-Earth-Probe [angle]                         |
| seq              | Sequential                                      |
| SFDU             | Standard Formatted Data Unit (CCSDS)            |
| SFCG             | Space Frequency Coordination Group              |
| SIG or sig       | Signal  |
| SNR              | Signal-to-Noise Ratio                           |
| SP               | Split Phase                                     |
| SPO              | Belgian Science Policy Office / Belgium         |
| sps or s/s       | Symbols Per Second                              |
| SSC              | Swedish Space Corporation                       |
| SSRTF            | State Standard Reference for Time and Frequency |
| STA              | Station   |
| STAB             | Stability                                       |
| SUBCARR          | Subcarrier                                      |
| SYM or sym       | Symbol  |
| TBD              | To Be Determined                                |
| TDRSS            | Tracking and Data Relay Satellite System        |
| Trans or Tr      | Transmit  |
| TTC              | Tracking, Telemetry, and Command                |
| UdC              | University of Chile                             |
| USGS             | United States Geological Survey                 |
| UTC              | Universal Time Coordinated                      |
| VLBI             | Very Long Baseline Interferometry               |
| w/m <sup>2</sup> | Watts per square Meter                          |
| X-band           | Approximately 8000 megahertz                    |
| XMIT or Xmit     | Transmit  |
| yr               | Year  |
| Æ                | Delta (change or variation)                     |
| Ì                | Phase   |
| Ê                | Micro   |