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Ground Network Tracking and Acquisition Data Handbook

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Ground Network Tracking and Acquisition Data Handbook

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The contents have been revised and supersede *Tracking and Acquisition Handbook for the Spaceflight Tracking and Data Network*, STDN No. 724, dated March 1990, Revision 5 and all changes thereto. Destroy all previously issued documents.

Goddard Space Flight Center
Greenbelt, Maryland

Preface

This document is under the configuration management of the Goddard Space Flight Center (GSFC) Ground Network (Code 453) Configuration Control Board (CCB).

Proposed changes to this document shall be submitted to the Code 453 CCB along with supportive material justifying the proposed change.

This document may be changed by Documentation Change Notice (DCN) or by complete revision.

Questions concerning this document and proposed changes shall be addressed to:

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Greenbelt, Maryland 20771

Change Information Page

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Section 1. Introduction

1.1 Purpose and Scope

This handbook specifies acquisition and tracking data exchanged between the Ground Network (GN) tracking and acquisition systems and the Flight Dynamics Facility (FDF) or other providers. It includes acquisition data and tracking data, both high-speed and low-speed, along with formats, program applications, data reduction algorithms, and station characteristics. Both real-time and recorded data are addressed.

1.2 Management Responsibility

Goddard Space Flight Center (GSFC) Code 453 is the designated authority exercising management responsibility for maintenance of this document.

1.3 References

a. *Ground Network User's Guide*, 453-GNUG, Revision 2, May 2007.

b. *System Specification for the S-Band Tracking Processing System*, STDN 203.34, September 2005.

c. NASA Directory of Station Locations (NDOSL), http://fdf.gsfc.nasa.gov/prod_center/

d. Mission Station Information System (MSIS), https://msis.gsfc.nasa.gov/

e. *NASA Communications Operating Procedures (NASCOP)*, Volume 1,452-006.

f. *Digital Data/ Source/Destination and Format Codes Handbook for the NISN/Nascom Ground Network*, GSFC-NISN-COM-99-0001.

1.4 Corrections and Improvements

1.4.1

Revisions to this document are prepared and published on an as-required basis. Interim changes, additions, and/or deletions are made by Documentation Change Notice (DCN).

1.4.2

Corrections and/or improvement recommendations are solicited and should be submitted to the Code 453 Ground Network Project Manager.

Section 2. GN Tracking Systems

2.1 Ground Network Overview

The Ground Network consists of NASA-owned and commercial facilities.

a. Alaska Ground Station (AGS), Alaska, USA
b. Alaska Satellite Facility (ASF), Alaska, USA
c. DataLynx, various sites
d. Hartebeesthoek (HBK), South Africa
e. Merritt Island (MIL)/Ponce de Leon (PDL) Florida, USA
f. McMurdo Ground Station (MGS), Antarctica
g. Santiago (AGO), Chile
h. Svalbard Ground Station (SGS) Norway
i. Wallops Ground Station (WGS), Virginia, USA
j. Universal Space Network (USN), various sites

2.2 GN Antenna Systems

2.2.1 General

The support functions that can be performed with the GN antenna systems include tracking, telemetry, command, air-ground voice, and television capabilities. Technical capabilities of the GN antennas are described in *Ground Network User's Guide*, 453-GNUG. Detailed antenna characteristics are also available on-line from the Mission Station Information System (MSIS). (http://msis.gsfc.nasa.gov/)

2.2.2 System Equipment and Capabilities

2.2.2.1 Angle Tracking (9-m antenna)

The S-band systems employ monopulse autotrack principles to generate error signals for application to the antenna servo/computer system and thereby maintain the antenna pointed toward the spacecraft transmitted signal. To aid in initial acquisition, a program (computer-controlled) mode is also available. The program mode uses orbital prediction data to generate angle data for the antenna. Antenna angle readings are compared with predicted angles, and corresponding error signals are generated. In addition, the 9-m initial acquisition of the spacecraft Radio Frequency (RF) signal may be facilitated by means of a small, wider beamwidth acquisition parabolic antenna, mounted at the edge of the 9-m antennas. Other antenna operating modes include manual position and velocity, slave, and manual program. The X-Y mounts are capable of tracking through zenith but have a gimbal restriction keyhole near the horizon. This restriction is generally oriented north to south on 9-m antennas. Antenna coverage patterns are further restricted at most stations by the surrounding terrain.

2.2.2.2 Range and Range Rate Measurement

a. General. The 9-m GN S-band Ranging Equipment (MIL and AGO), operating in conjunction with the Multifunction Receivers (MFR) and S-band Exciters (SBE), provides precision range and Doppler measurements for a variety of spacecraft. For vehicles carrying an S-band phase-locked transponder, the ranging equipment will provide unambiguous range data to distances greater than 500,000 km and nondestructive Doppler data for carrier Doppler frequencies up to ±230 kHz. The ranging system employs sinusoidal modulation and extremely-narrow-band processing techniques to provide high- accuracy range data with low received-signal strength.

b. Range Measurement. Range measurement is performed using a hybrid ranging technique that employs sidetones and a pseudorandom binary-encoded Ambiguity Resolving Code (ARC). The available ranging tones are: 500, 100, 20, and 4 kHz; and 800, 160, 40, and 10 Hz. Any one of the three highest available tones may be selected as the major tone used to obtain range data resolution. During ranging operations, the selected major tone is transmitted continuously, and the lower tones are sequentially applied to resolve range ambiguities. For transmission, the 800-Hz tone is complemented on the high side of the 4 kHz and thus becomes 4.8 kHz. The three lowest tones are transmitted via a double-sideband-suppressed carrier, using the 4-kHz tone as a subcarrier. This action eliminates the modulation components close to the carrier which could degrade carrier acquisition and tracking. The lowest sidetone (10 Hz) gives an ambiguity interval of 0.1 sec (approximately 15,000 km). An ARC having a length of 1023 bits is biphase modulated on the 4-kHz tone. The code bit rate of 160/sec gives a code period of 639,375 seconds, corresponding to an unambiguous range of approximately 958,000 km. However, the range word readout size of 32 bits limits the maximum range readout to 644,000 km. Ranging signal delay is measured with a time increment size of 1 nsec, corresponding to an approximate range increment size of 0.15 m. The 32-bit wide range values are output ten times a second strobed by the 10 pps timing interrupt. Each range value output corresponds to the instantaneous phase delay of the major range tone, ±25 nsec.

c. Doppler Measurement. The Doppler is originally generated as an arbitrarily biased Doppler signal from the MFR, which is mixed together with reference signals from the exciter, MFR synthesizer, and from the system frequency standard to provide an output Doppler signal with a 70-MHz bias. This output-bias-plus-Doppler signal is translated to a 1.0-MHz bias frequency and then tracked by a PLL, which acts as a phase data multiplier. The resultant bias-plus-multiplied-Doppler signal is then translated to a new bias frequency at two phases separated by 90 degrees. The two phases of this 60-MHz ±57.5-kHz data signal are then employed in a high-speed counter for readout and display. The two different phases allow digitizing in 1/4-cycle increments. This 1/4-cycle incrementing, coupled with the prior multiplication by 250, provides an overall resolution (increment size) of 0.001 cycle of the input data and provides a nondestructive on-time readout of the instantaneous accumulated count. This provides nondestructive Doppler data with a uniform 0.1-sec sampling interval. Doppler counts can be continuously accumulated for 150 minutes at the maximum Doppler.

d. Rate-aided Tracking. Rate-aided tracking permits use of a narrow bandwidth, range-tone tracking Phase-lock Loop (PLL) with severe signal dynamics. A rate-aid signal is synthesized from the extracted Doppler- plus-bias signal with a fractional error of 1 part in 176,000 or less. As a result, the PLL bandwidth can be very narrow to minimize noise error in the output range data without incurring excessive lag error for range acceleration magnitudes of 150 m/sec^2 or less.

2.2.3 System Configuration

Both AGO and MILA have S-band Tracking Processor Systems (STPSs) for assembling and transmitting metric tracking data and controlling and pointing its associated antenna. Figure 2-1 illustrates a typical 9-meter RER configuration.

2.3 C-band Systems

2.3.1 General

The GN C-band radar tracking systems are amplitude-comparison, monopulse instrumentation systems which measure range, azimuth, and elevation of spacecraft. Included in this discussion are non-GN C-band radars which provide special tracking support for National Aeronautics and Space Administration (NASA) launches.

2.3.2 System Equipment and Capabilities

2.3.2.1 FPS-16 Radar

The FPS-16 radar has a 3.6-m diameter parabolic antenna mounted on an az-el pedestal. The antenna reflector surface consists of wire mesh panels supported by radial trusses. The antenna has a four-horn monopulse feed, supported on a tetrapod, located at the focal point of the antenna reflector.

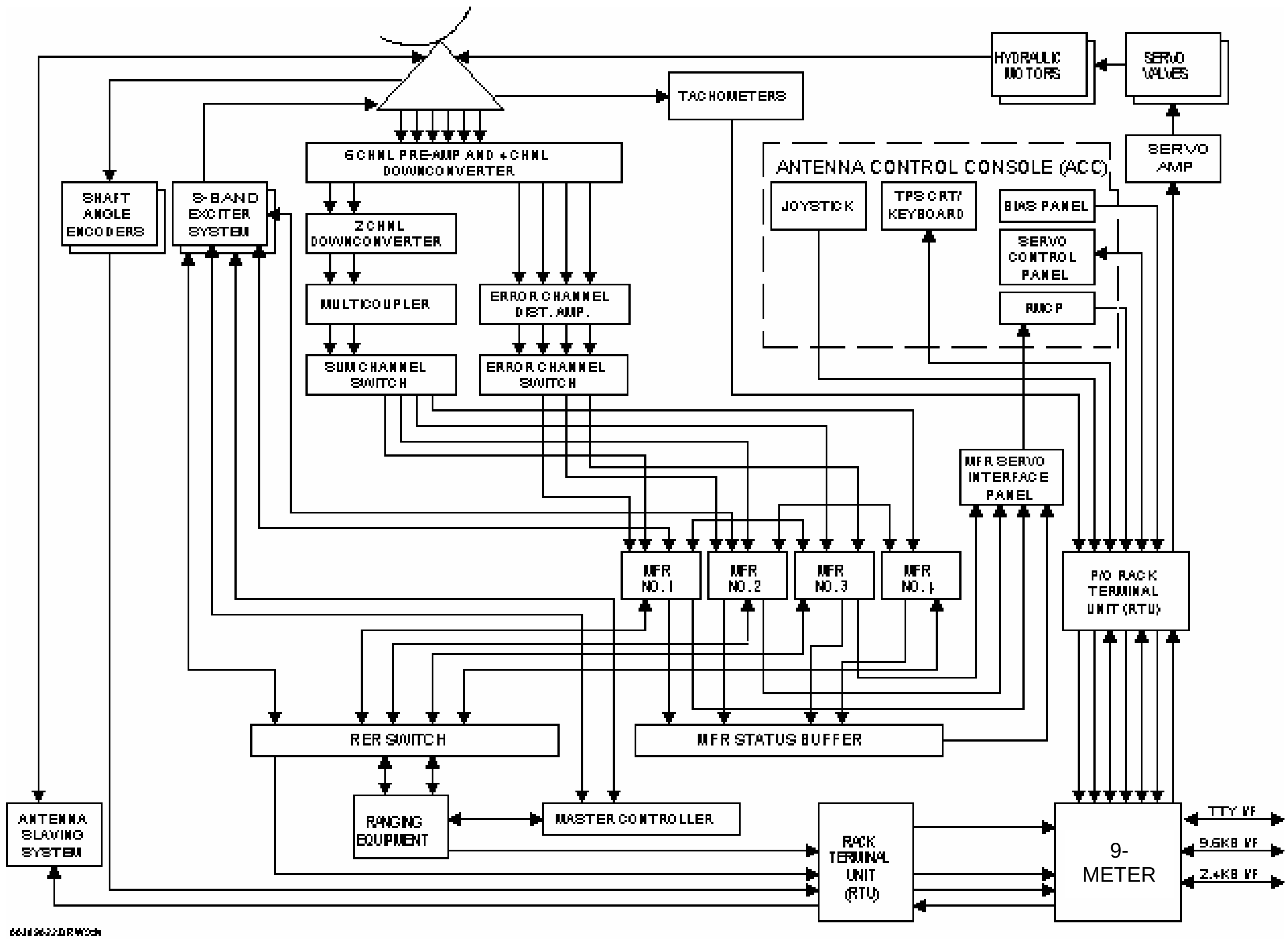


Figure 2-1. Typical 9-meter-RER Station Configuration

2.3.2.2 MIPIR Systems

The FPQ-6, FPQ-14, FPQ-19, and TPQ-18 radars are all classified as Missile Precision Instrumentation Radars (MIPIR) and utilize the same basic electronics configuration. A MIPIR is second generation to the FPS-16 radar and offers several major improvements such as tracking capability to greater distances, greater angle track precision, and rapid detection and lock-on of target. The antenna is an aluminum, parabolic, Cassegrain feed system with a solid surface and a diameter of 8.8 meters mounted on an az-el pedestal. The MIPIR was originally designed in two versions, the FPQ-6 in which the electronic equipment is housed within permanent buildings, and the TPQ-18 housed in modular shelters to enhance transportability of the system. Subsequent changes have resulted in additional configurations and designations as follows: (1) The FPQ-14 offers all FPQ-6 improvements and is computer integrated with the on-axis system; (2) The FPQ-19 is a former TPQ-18 that has been relocated to a permanent building.

2.3.2.3 FPQ-15 and TPQ-18 (M) Radars

The FPQ-15 and TPQ-18 (M) radars are functionally similar to the FPQ-14 radar but utilize a NIKE Target Tracking Radar (TTR) pedestal.

2.3.2.4 CAPRI and HAIR

The Compact All-purpose Range Instrument (CAPRI) radar evolved from the MIPIR and was designed to fill the specialized needs for range instrumentation radars. The standard CAPRI was delivered with a 12-ft antenna but could be delivered with any size pedestal/antenna configuration. The MTLC is equipped with a 16-ft antenna while the HAIR (VDHC) is equipped with the TPQ-18/FPQ-6 antenna. The transmitter power on both of these systems is 1 MW.

2.3.2.5 The Advanced Research Project Agency, Lincoln C-band Observable Radar (ALCOR)

ALCOR is a high-power, narrowbeam, coherent, and chirped C- band monopulse system capable of simultaneous skin and beacon tracking. It provides azimuth, elevation, range, and range rate data. It has a range accuracy of 0.5 m in narrowband mode, 0.1 m in wideband mode, and an angle accuracy of 0.005 degree. ALCOR has a 12.2-m diameter parabolic antenna with a gain of 54 dB and a beamwidth of 0.3 degree. The peak power output of the ALCOR radar is 4 MW, with an average power of 10 kW.

2.3.3 Radar Characteristics

2.3.3.1

There is some variance in the characteristics of the individual radars even though they have the same model designator. For example, a significant variance in the AN/FPS-16 models is the different antenna size which results in different gain and beamwidth characteristics. Also, some systems have 3.0 MW transmitters in place of the 1.0 MW transmitters. Each of the radars is similar in that the receive systems employ low-noise receivers or parametric amplifiers with a noise figure of about 3.5 dB, they all have digital designate capability, and all are operated in the 5400- to 5900-MHz band. (The AN/FPS-16 1.0 MW transmitter operates in the range of 5450 to

5825 MHz; the MIPIR from 5400 to 5900 MHz.) Detailed and up-to-date antenna characteristics are available on-line from the Mission Station Information System (MSIS). (http://msis.gsfc.nasa.gov/)

2.3.3.2

The radars are precision monopulse tracking systems designed specifically for missile range instrumentation. The MIPIRs have greater range tracking capability due to greater antenna size and radiated power. The maximum tracking rate for either system is 20,000 yd/sec. The antenna tracking rates are listed in Table 2-1

Table 2-1. C-band Radar Slew Capabilities

Radar	Azimuth	Elevation
FPS-16 (3.7-m antenna)	750 mils/sec	400 mils/sec
FPS-16 (4.9-m antenna)	800 mils/sec	450 mils/sec
FPQ-6	500 mils/sec	500 mils/sec
TPQ-18	500 mils/sec	500 mils/sec
FPQ-14	5 deg/sec	2.5 deg/sec
ALCOR	10 deg/sec	10 deg/sec
FPQ-15	10 deg/sec	10 deg/sec
FPQ-13	5 deg/sec	2.5 deg/sec

2.3.4 Other Radar Systems

2.3.4.1 General

Although not operating at the C-band frequencies, the ALTAIR and TRADEX systems provide data that is similar to and used in the same manner as that of the C-band radars. These two systems are therefore included in this section.

2.3.4.2 ALTAIR

The ALTAIR system was designed and developed to gather coherent data on reentry vehicles and satellites at very high frequency (VHF) and ultra-high frequency (UHF) frequencies. A general purpose computer within the radar provides real-time control of waveform, PRF, range and angle tracking, maintenance of multiple track files, and recording of target measurements. The 150 foot diameter antenna employs a focal-point VHF feed and a Cassegrainian UHF feed in conjunction with a frequency selective subreflector, giving a monopulse tracking capability at either frequency.

2.3.4.3 TRADEX

The TRADEX system can operate at L-band or S-band. Angle tracking capability exists at L-band only, while range track is possible at either L- or S-band. The system utilizes both uniform train and burst waveforms exhibiting large bandwidth, long pulse duration, and variable burst subpulse spacing to achieve high range and velocity resolution. Also, a Sigma 5 computer provides real-time control of tracking functions, waveform selection and multiplexing, data recording, and system test and calibration.

2.3.4.4 Configuration and Allocation

The NDOSL (http://fdf.gsfc.nasa.gov/prod_center/) provides radar allocation and station ID information.

2.4 Ranging Equipment

2.4.1 General

Ranging data is provided by various stations by means of STDN Ranging Equipment (SRE) or Receiver-exciter Ranging (RER). The RER equipment is used with Unified S-band (USB) system only, whereas the SRE may be configured for S-band. A station may have one or both of these systems as described in the following paragraphs.

2.4.2 SRE

2.4.2.1 General

SRE ranging in S-band (see Figure 2-2) can be provided by AGO. The Major Range Tone (MRT) frequencies available are 500, 100, and 20 kHz. The MRT is the highest frequency tone used in ranging support and is uplinked continuously. Of these, the 100-kHz and 20-kHz tones can also be used as the Minor Tone (MT), along with 4 kHz, 800 Hz, 160 Hz, 40 Hz, 10 Hz, and the Ambiguity Resolving Code (ARC).

2.4.2.2 S-Band

SRE ranging in S-band only is available at AGO. The configuration is as shown in Figure 2-2, with the 7-m antenna being used for uplink and the 12-m antenna being used for downlink.

2.4.3 RER

The RER configuration, as shown in Figure 2-3, is used with USB systems only. This type of ranging is available from AGO and MIL. The RER utilizes the same MRTs and MTs as the SRE.

2-9

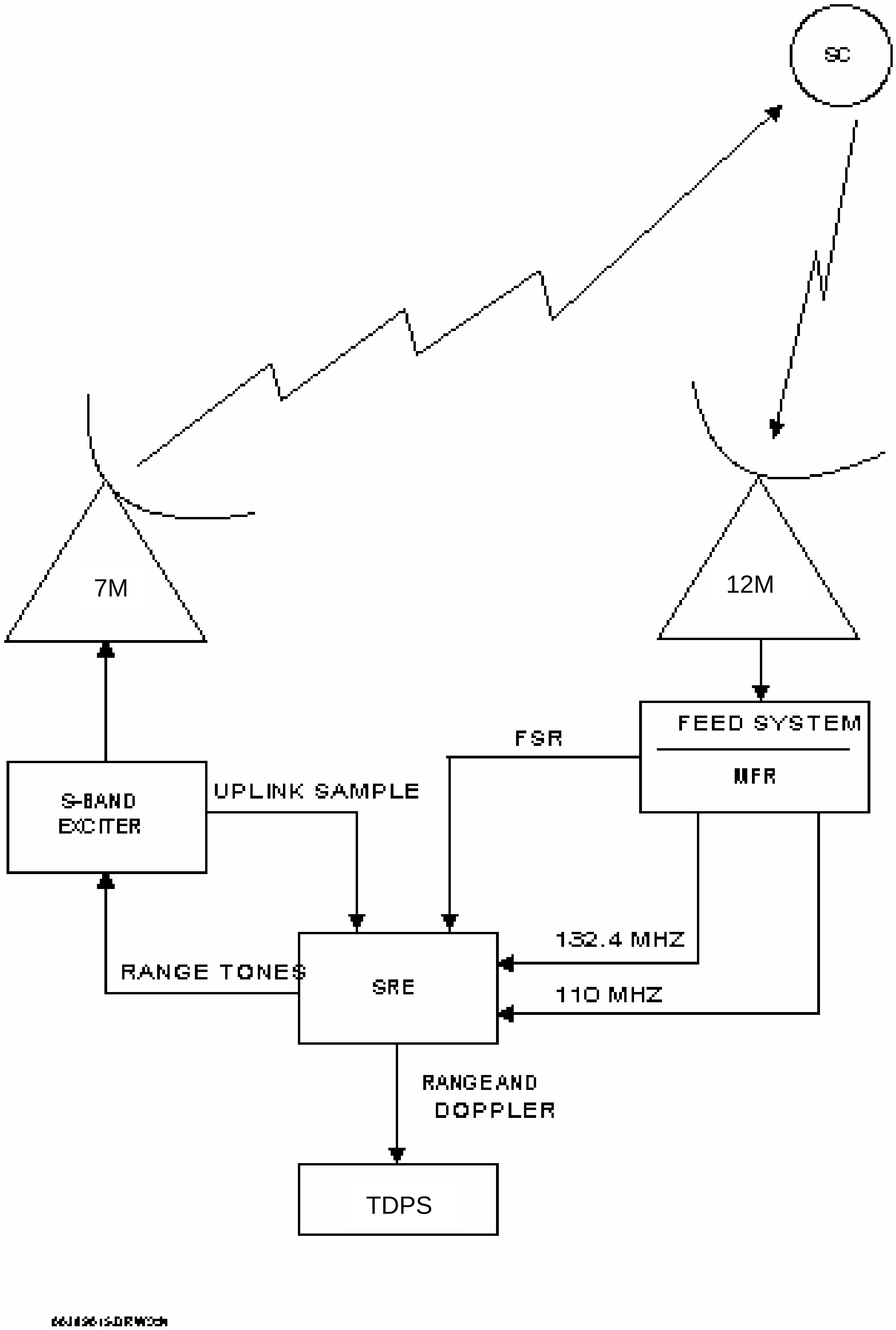


Figure 2-2. SRE Configuration, S-band

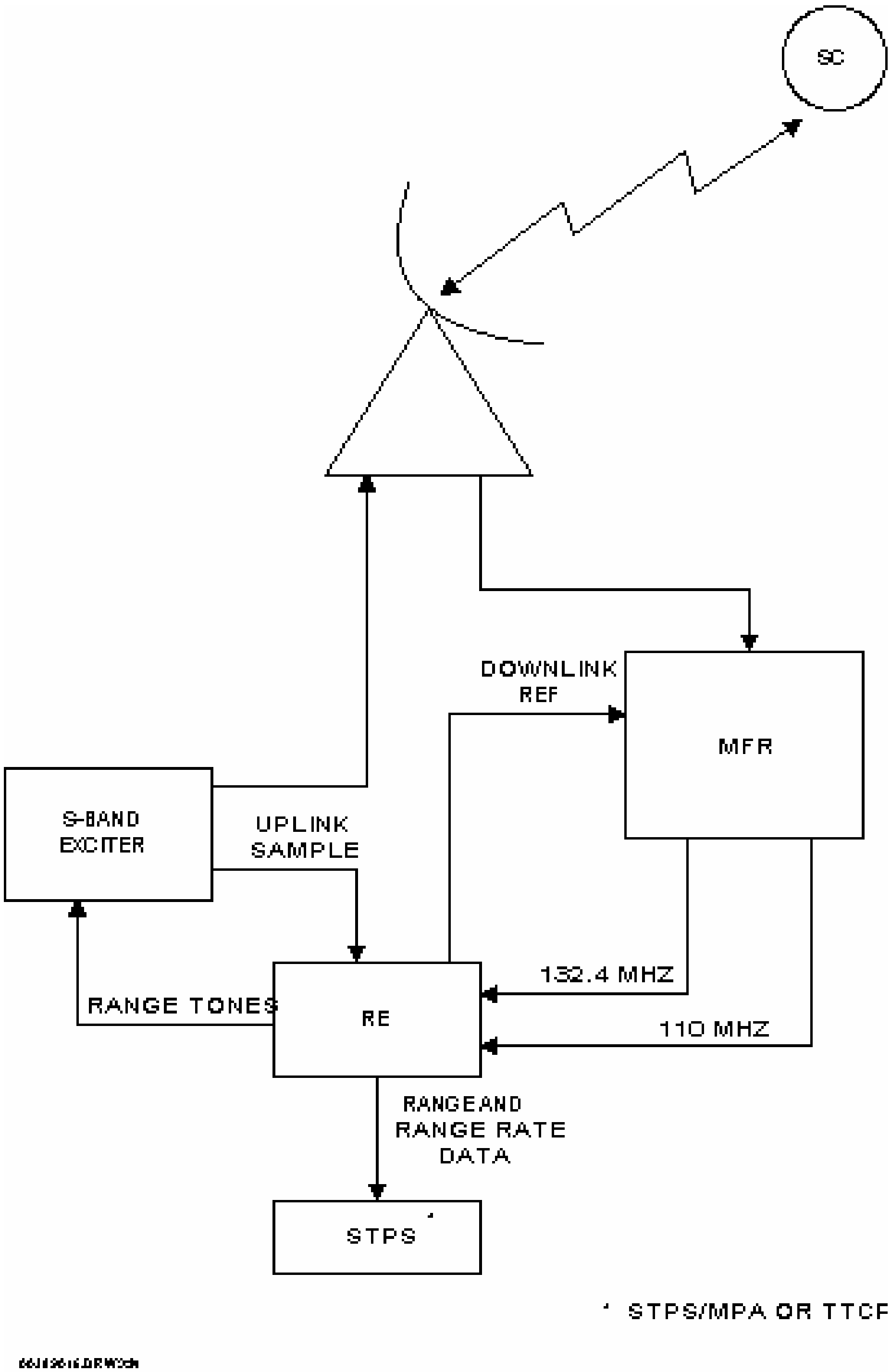


Figure 2-3. RER Configuration

Section 3. Spacecraft Acquisition Data

3.1 General

This section defines acquisition data formats used by the GN stations. Station processing capabilities are tabulated in Table 3-1.

Table 3-1. GN Station Acquisition Data Format Processing Capabilities

Station	IIRV	INP	IRV	TLE	LTAS
AGO	X	X		X	
AGS	X			X	
ASF	X			X	
DataLynx	X			X	
HBK				X	
MGS	X	*		X	
MIL	X	x		X	X
SGS	X			X	
USN	X	X		X	
WGS	X	X		X	X

* INP capability July 2007

3.2 Acquisition Data Formats

3.2.1 General Overview

Acquisition data formats consist of IRV, IIRV, EPV, INP, and Two Line Element (TLE) Message. Acquisition data is available in both low- and high-speed formats. The standard symbol definitions used in the low-speed format descriptions are listed in Table 3-2. In the figures and tables provided for the explanations of formats, all uppercase letters (except CAN and DEL) are fixed characters and are printed as they appear. Lowercase letters are variables which are defined in the tables.

Table 3-2. TTY Symbol Definitions

Symbol	Definition
<	Carriage return
o	Line feed
_	Space
DEL	Delete (ASCII)
CAN	Cancel (ASCII)
-	Figures shift (Baudot)
¯	Letters shift (Baudot)
$	Numeral
-	Sign of parameter

3.2.1.1 Interrange Vector Message

a. An IRV contains the position and velocity of a spacecraft at a given time in rotating geocentric coordinates. Checksums are provided for each of the position and velocity components and for the epoch time. In computing these checksums, 0 through 9 have face value; the ampersand (&), used to denote a positive sign, has a value of zero; and the minus (-), used to denote a negative sign, has a value of 1.

b. The IRV may be transmitted in either five-level format or eight-level TTY code (see Figures 3-1 and 3-2). If the eight-level format is converted to five-level code, the format will convert to that shown for the five-level format; however, if the five-level format is converted to eight-level format, each figure shift will be converted to a cancel code and each letter shift will be converted to a delete code. Refer to Table 3-3 for IRV message body description.

c. IRVs/IIRVs may be used to compute pointing angle information for any known antenna location. IRVs/IIRVs are not usually restricted to a specific pass but may be used over a limited period of time which is determined by the orbit of the satellite.

3.2.1.2 Improved Interrange Vector Message

a. The IIRV was implemented on the networks in 1978. The means of transmission may be either low-speed 110-baud teletype or high-speed Nascom blocked format. The IIRV is coded in American Standard Code for Information Interchange (ASCII). Although no parity checks are made on individual characters at Goddard Space Flight Center (GSFC), parity may be required for message switching between Nascom and other communications networks.

b. All data fields are right justified, with leading zeros added as needed. A positive sign (+) is indicated by an ASCII space, and a negative sign is indicated by a minus (-). The IIRV format is also used for intercenter exchange of acquisition data in Nascom 4800-bit blocks. Refer to paragraph 3.2.2.2 for further details.

c. In addition to containing the spacecraft position and velocity vectors for the given epoch time, the IIRV also contains information about the type of vector as well as additional spacecraft parameters. See Figure 3-3 for the IIRV message body format and refer to Table 3-3 for IIRV message body explanation.

Line 1: < < ≡ ≡ (optional message text)

Line 2: ↓ I R S T C S a a a < < ≡ ≡ ↑

Line 3: t Ø s s s s Δ m m Δ d d Δ n n n n Δ v < < ≡ ≡ ↑

Line 4: s x x x x x x x x x x Δ c c Δ s y y y y y y y y y y Δ c c Δ
s z z z z z z z z z z Δ c c ≡ ≡ ↑

Line 5: s x x x x x x x Δ c c Δ s y y y y y y y Δ c c Δ s z z z z z z z
Δ c c Δ h h m m s s s Δ c c < < ≡ ≡ ↓

Line 6: I R E D < < ≡ ≡ ↑

KEY:
↑ = figures.
↓ = letters.
Δ = space.
< = carriage return.
≡ = line feed.

Figure 3-1. IRV Message Body, Five-level (Baudot) Format

Line 1: _ _ _ _ _ < < ≡ ≡ (optional message text)
D
E
Line 2: L I R S T C S a a a < < ≡ ≡
C
A
Line 3: N t Ø s s s s Δ m m Δ d d Δ n n n n Δ v < < ≡ ≡
C
A
Line 4: N s x x x x x x x x x x Δ c c Δ s y y y y y y y y y y Δ c c Δ
s z z z z z z z z z z Δ c c < < ≡ ≡
C
A
Line 5: N s x x x x x x x Δ c c Δ s y y y y y y y Δ c c Δ s z z z z z z z
Δ c c Δ h h m m s s s Δ c c < < ≡ ≡

Line 6: I R E D < < ≡ ≡

KEY:
D
E = ASCII delete code.
L
C
A = ASCII cancel code.
N
Δ = ASCII space.
< = carriage return.
≡ = line feed.

Figure 3-2. IRV Message Body, Eight-level (ASCII) Format

Table 3-3. IRV Message Body Explanation (1 of 2)

Line	Characters	Explanation
1	-------------	Optional message text
2	IRSTCS	Start of message (fixed)
	aaa	Range address. Up to three characters indicating addressee: D = DSN P = PMR S = STDN W = WTR E = ETR Z = WLP A = CSTC K = KMR
3	t	Vector type: 1 = nominal 2 = in flight 3 = powered flight 4 = simulated
	Ø	Always zero (fixed)
	ssss	Satellite SIC
	mm	Month of year
	dd	Day of month
	nnnn	Sequence number
	v	VID.
4	s	Sign of X component
	xxxxxxxxxx	X component in feet
	cc	Checksum for X component
	s	Sign of Y component
	yyyyyyyyyy	Y component in feet
	cc	Checksum for Y component
	s	Sign of Z component
	zzzzzzzzzz	Z component in feet
	cc	Checksum for Z component. Digits 0 through 9 have face value, the - (minus) sign has a value of 1, and the & (ampersand) sign and spaces have values of 0.

Table 3-3. IRV Message Body Explanation (2 of 2)

Line	Characters	Explanation
5	s	Sign of X-velocity component
	ẋ ẋ ẋ ẋ ẋ ẋ ẋ	X-velocity component in 1/100 ft/second
	cc	Checksum for X component
	s	Sign of Y-velocity component
	ẏ ẏ ẏ ẏ ẏ ẏ ẏ	Y-velocity component in 1/100 ft/second
	cc	Checksum for Y component
	s	Sign of Z-velocity component
	ż ż ż ż ż ż ż	Z-velocity component in 1/100 ft/second
	cc	Checksum for Z component (see definition in line 4)
	hhmmsss	Epoch time of IRV in hours, minutes, seconds, and 1/10 seconds
	cc	Checksum of time word (see definition in line 4)
6	IRED	End of message (fixed)

```
Line 1:  _ _ _ _ _ < < ≡ ≡  (optional message text)

Line 2:  G I I R V a r r r r < < ≡ ≡

                 s s s s
                 i i i i
Line 3:  v s 1 c c c c c b b n n n d o y h h m m s s s s s c c c < < ≡ ≡
Line 4:  s x x x x x x x x x x x x s y y y y y y y y y y y y s z z z z z z z z z z z z
            c c c < < ≡ ≡

Line 5:  s ẋ ẋ ẋ ẋ ẋ ẋ ẋ ẋ ẋ ẋ ẋ ẋ  s ẏ ẏ ẏ ẏ ẏ ẏ ẏ ẏ ẏ ẏ ẏ ẏ  s ż ż ż ż ż ż ż ż ż ż ż ż

            c c c < < ≡ ≡
Line 6:  m m m m m m m m a a a a a k k k s r r r r r r c c c < < ≡ ≡

Line 7:  I T E R M _ o o o o < < ≡ ≡

         KEY:    <   Carriage Return
                 ≡   Line Feed
                 Δ   ASCII Space
```

Figure 3-3. IIRV Message Body Format

Table 3-4. IIRV ASCII TTY Message Body Explanation (1 of 2)

Line	Characters	Explanation
1	_ _ _ _	Optional message text.
2	GIIRV	Start of message (fixed).
	a	Alphabetic character indicating originator of message: ASCII space = GSFC Z = WLP E = ETR L = JPL W = WTR J = JSC P = PMR A = CSTC K = KMR C = CNES
	rrrr	Destination routing indicator. Specifies the site for which the message was generated. If for more than one station, this field should contain "MANY."
3	v	Vector type: 1 = Free flight (routine on-orbit) 2 = Forced (special orbit update) 3 = Spare 4 = Maneuver ignition 5 = Maneuver cutoff 6 = Reentry 7 = Powered flight 8 = Stationary 9 = Spare
	s	Source of data: 1 = Nominal/planning 2 = Real-time 3 = Off-line 4 = Off-line/mean NOTE Nominal/planning sets cannot be sent to WSGT from the NCC.
	1	Fixed one (1)
	c	Coordinate system: 1 = Geocentric True-of-Date Rotating 2 = Geocentric mean of 1950.0 (B1950.0). 3 = Heliocentric B1950.0. 4 = Reserved for JPL use (non-GSFC). 5 = Reserved for JPL use (non-GSFC). 6 = Geocentric mean of 2000.0 (J2000.0). 7 = Heliocentric J2000.0.
	sic (4 chars)	SIC
	bb	Body number/VID (01-99).
	nnn	Counter incremented for each vector in a set of vector data on a per-station per-transmission basis.
	doy	Day of year (001 = January 1).
	hhmmsssss	Vector epoch in UTC with resolution to nearest millisecond. (The implied decimal point is three places from the right).
	ccc	Checksum of the decimal equivalent of the preceding characters on Line 3: 0 through 9 = face value. Minus (-) = 1. ASCII Space = 0.

Table 3-4. IIRV ASCII TTY Message Body Explanation (2 of 2)

Line	Characters	Explanation
4	s	Sign character:ASCII Space = positive Minus sign = negative
	xxxxxxxxxxxx	X component of position (meters)
	yyyyyyyyyyyy	Y component of position (meters)
	zzzzzzzzzzzz	Z component of position (meters)
	ccc	Checksum of the decimal equivalent of the preceding characters on Line 4: 0 through 9 = face value Minus (-) = 1 ASCII Space = 0
5	s	Sign character (same as above)
	$\underline{\dot{x}}\,\underline{\dot{x}}\,\underline{\dot{x}}\,\underline{\dot{x}}\,\underline{\dot{x}}\,\underline{\dot{x}}\,\underline{\dot{x}}\,\underline{\dot{x}}\,\underline{\dot{x}}\,\underline{\dot{x}}\,\underline{\dot{x}}\,\underline{\dot{x}}$	X-component of velocity
	$\underline{\dot{y}}\,\underline{\dot{y}}\,\underline{\dot{y}}\,\underline{\dot{y}}\,\underline{\dot{y}}\,\underline{\dot{y}}\,\underline{\dot{y}}\,\underline{\dot{y}}\,\underline{\dot{y}}\,\underline{\dot{y}}\,\underline{\dot{y}}\,\underline{\dot{y}}$	Y-component of velocity
	$\underline{\dot{z}}\,\underline{\dot{z}}\,\underline{\dot{z}}\,\underline{\dot{z}}\,\underline{\dot{z}}\,\underline{\dot{z}}\,\underline{\dot{z}}\,\underline{\dot{z}}\,\underline{\dot{z}}\,\underline{\dot{z}}\,\underline{\dot{z}}\,\underline{\dot{z}}$	Z-component of velocity NOTE All velocity components are in meters/second with resolution to the nearest millimeter/second. The implied decimal point is three places from the right.
	ccc	Checksum of the decimal equivalent of the preceding characters on Line 5: 0 through 9 = face value Minus (-) = 1 ASCII Space = 0
6	mmmmmmmm	Mass of spacecraft in kilograms with resolution to 1/10 of a kilogram. The implied decimal point is one place from the right. Contains all zeros when not used.
	aaaaa	Average spacecraft cross-sectional area in square meters with resolution to the nearest hundredth of a square meter. The implied decimal point is two places from the right. Contains all zeros when not used.
	kkkk	Dimensionless drag coefficient. The implied decimal point is two places from the right. Contains all zeros when not used.
	s	Sign character for coefficient of solar reflectivity ASCII Space = positive Minus Sign = negative
	rrrrrrr	Dimensionless Solar Reflectivity coefficient. The implied decimal point is six places from the right. Contains all zeros when not used.
	ccc	Checksum of the decimal equivalent of the preceding characters on Line 6: 0 through 9 = face value Minus (-) = 1 ASCII Space = 0
7	ITERM	End of message (fixed)
	oooo	Originator routing indicator

3.2.1.3 Extended Precision Vector Message

a. General. The Extended Precision Vector (EPV) message described in this paragraph is the official version of the EPV along with the blocking structure for use with the Nascom 4800-bit block. The inclusion of the EPV in the document does not commit any entity that interfaces with the GSFC Code 450 to use it. Commitment for its use will be by individual Interface Control Documents (ICD) with specific Code 450 organizations. These ICDs should reference this document for the basic structure of the EPV message only and should identify each specific parameter options that is to be exercised. Additional specifics are as follow:

1. The EPV message format is intended to meet high-accuracy orbit propagation requirements. This has been achieved by increasing the precision of the state vector position and velocity components and by including additional force modeling parameters. The means of transmission may be either low-speed 110-band teletype or high-speed Nascom blocked format. The EPV is coded in ASCII. Although no parity checks are made on individual characters at GSFC, parity may be required for message switching between Nascom and other communications networks.

2. All data fields are right justified, with leading zeros added as needed. A positive sign (+) is indicated by an ASCII space, and a negative sign is indicated by a minus (-). The EPV format is also used for intercenter exchange of acquisition data in Nascom 4800-bit blocks. Refer to paragraph 3.2.2.2 for further details.

3. See Figure 3-4 for the EPV TTY message body format, and refer to Table 3-5 for the EPV message body explanation.

b. EPV Message Structure and Protocol.

1. Block Format. The block format used is defined in Figure 3-5. The block is segmented into six distinct parts: network control header, user header 1, time field, user header 2, data field, and error control field.

2. Network Control Header.

   (a) The Nascom synchronization field, bits 1 through 24, is a 24-bit binary field with the following structure:

   First bit transmitted 011000100111011000100111 Last bit transmitted

   (b) The source field, bits 25 through 32, is an 8-bit field that describes the data source. Nascom assigns these codes (refer to NASA Communications Operating Procedures [NASCOP]).

   (c) The destination field, bits 33 through 40, is an 8-bit binary field that describes the data destination. Nascom assigns these codes (refer to NASCOP).

   (d) The sequence number field, bits 41 through 43, is a 3-bit field that identifies the sequence in which blocks were transmitted from a source. The range of this cyclic counter is 1 through 7.

Line 1: m t m e s s g i d s m c < < ≡ ≡

Line 2: G E P V a r r r r < < ≡ ≡

Line 3: v s o c e s i d c b b n n n y y y y d o y h h m m s s s s s s u t l u t c c c c < < ≡ ≡

Line 4: s x x x x x x x x x x x x x x x x x s y y y y y y y y y y y y y y y y y s
z z z z z z z z z z z z z z z z z c c c < < ≡ ≡

Line 5: s ẋ ẋ ẋ ẋ ẋ ẋ ẋ ẋ ẋ ẋ ẋ ẋ ẋ s ẏ ẏ ẏ ẏ ẏ ẏ ẏ ẏ ẏ ẏ ẏ ẏ ẏ s ż ż ż ż ż ż ż ż ż ż ż ż ż c c c < <

Line 6: s o s c s e m i m a j o r a x i s s s o s c e c c e n t r i c s o s c i n c l i n a t n c c c < < ≡ ≡

Line 7: s o s c l o n a s n o d e s o s c a r g p e r i a p s o s c m e a n a n o m l
g r a v i t a t i o n a l p a r m c c c < < ≡ ≡

Line 8: m a s s m m m m d c s a r e a c s b d s d s c a l e p s c s a r e a s c s u b r f
s f l x i g m g a i c c c < < ≡ ≡

Line 9: _
_ < < ≡ ≡

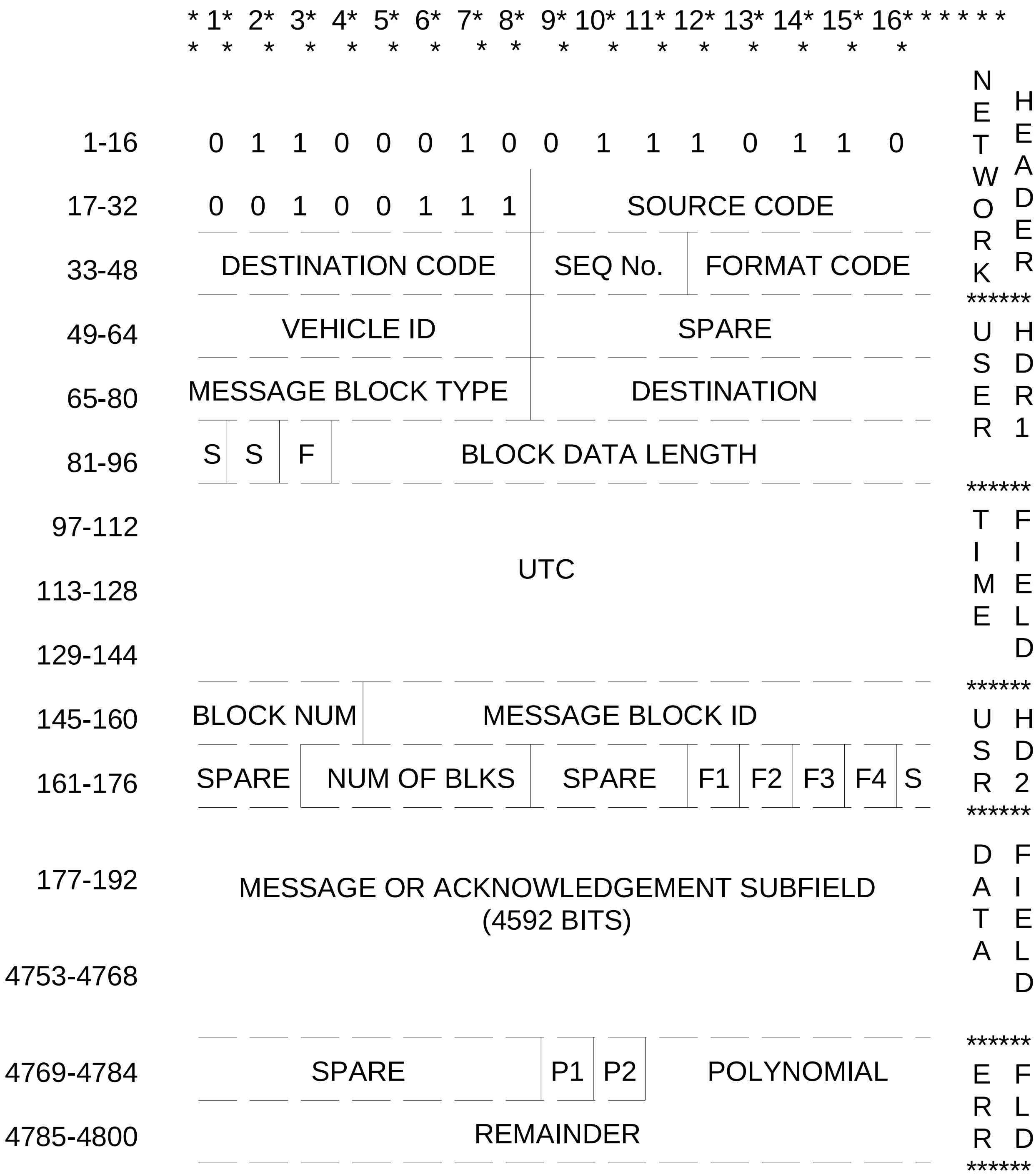
Line 10: _
_ < < ≡ ≡

Line 11: _
_ < < ≡ ≡

Line 12: I T E R M 0 0 0 0 < <

KEY:
< = Carriage Return
≡ = Line Feed
Δ = ASCII Space

Figure 3-4. EPV TTY Message Body Format



A0389024.DRW:X:N

Figure 3-5. 4800-bit Block EPV Format

Table 3-5. EPV Message Body Explanation (1 of 5)

Line	Characters	Explanation
1	MT	Message type (= 03).
	MESSGID	Message ID. A unique seven-character number used to reference this message.
	S	Source (= 0).
	MC	Message class code: 20 =Routine on-orbit or stationary vector. 25 =Maneuver sequence vector or high-priority on-orbit or stationary vector.
	CRCR	Two carriage returns.
	LFLF	Two line feeds.
2	GEPV	EPV message identifier.
	A	Alphabetic character indicating originator of message: G = GSFC Z = WLP E = ETR L = JPL W = WTR J = JSC P = PMR A = AFSTC K = KMR C = CNES
	RRRR	Destination routing indicator. Specifies the site for which the message was generated. If the message is for more than one station, this field contains "MANY"
	CRCR	Two carriage returns
	LFLF	Two line feeds
3	V	Vector type: 1 = Routine on-orbit 2 = Special on-orbit update 3 = Spare 4 = Maneuver ignition 5 = Maneuver cutoff 6 = Reentry 7 = Powered flight 8 = Stationary 9 = Spare
	S	Data type: 1 = Nominal/planning 2 = Real-time
	O	Origin of coordinate system and reference plane: 1 = Geocentric, Earth equator 2 = Heliocentric, Earth equator 3 = Heliocentric, eclipic 4 = Selenocentric, Earth equator 5 = Selenocentric, Moon equator 6 through 9 = Spares
	C	Coordinate system: 1 = Greenwich true-of-date rotating 2 = Greenwich true-of-date nonrotating 3 = Mean-of-1950.0 (B1950.0) 4 = Mean-of-2000.0 (J2000.0) 5 = True-of-date (B1950.0) 6 = True-of-date (J2000.0) 7 = Selenographic. 8 and 9 = Spares.
	E	Types of elements only. 1 = Cartesian elements only 2 = Osculating elements only 3 = Both Cartesian and osculating elements
	SIDC	SIC
	BB	Body number of vehicle ID

Table 3-5. EPV Message Body Explanation (2 of 5)

Line	Characters	Explanation
3 (cont)	NNN	Counter incremented for each vector in a set of vector data on a pre-station, per-transmission basis. For JSC, each mission is treated as a single transmission.
	YYYY	Year.
	DOY	Day of Year.
	HHMMSSSSSS	Vector epoch in UTC with resolution to the nearest tenth of a millisecond. The millisecond. The implied decimal point is four places from the right.
	S	Sign character: ASCII space = positive Minus sign = negative
	UT1UTC	UT1 = UTC timing coefficient at epoch with resolution to the nearest microsecond. The implied decimal point is six places from the right. This field will contain all zeros when not used
	CCC	Checksum of the decimal equivalents of each of the preceding characters on line 2: 0 through 9 = face value Minus (-) = 1 ASCII space = 0
	CRCR	Two carriage returns
	LFLF	Two line feeds
4	S	Sign character: ASCII space = positive Minus sign = negative NOTE All position components are in kilometers with resolution to the nearest tenth of a millimeter. The implied decimal point is seven places from the right. These fields will contain all zeros when not used.
	XXXXXXXXXXXXXXXXX	X component of position
	S	Sign character: ASCII space = positive Minus sign= negative
	YYYYYYYYYYYYYYYYY	Y component of position
	S	Sign character: ASCII space = positive Minus sign = negative
	ZZZZZZZZZZZZZZZZZ	Z component of position
	CCC	Checksum. This is the sum of the decimal equivalents of all the preceding characters on line 3: 0 through 9 = face value Minus (-) = 1 ASCII Space = 0
	CRCR	Two carriage returns
	LFLF	Two line feeds
5	S	Sign character: ASCII space = positive Minus sign = negative NOTE All velocity components are in kilometers/second with resolution to the nearest tenth of a micron/second. The implied decimal point is ten places from the right. These fields will contain all zeros when not used.
	$\dot{\underline{x}}\dot{\underline{x}}\dot{\underline{x}}\dot{\underline{x}}\dot{\underline{x}}\dot{\underline{x}}\dot{\underline{x}}\dot{\underline{x}}\dot{\underline{x}}\dot{\underline{x}}\dot{\underline{x}}\dot{\underline{x}}\dot{\underline{x}}$	X component of velocity.
	S	Sign character ASCII space = positive Minus sign = negative
	$\dot{\underline{y}}\dot{\underline{y}}\dot{\underline{y}}\dot{\underline{y}}\dot{\underline{y}}\dot{\underline{y}}\dot{\underline{y}}\dot{\underline{y}}\dot{\underline{y}}\dot{\underline{y}}\dot{\underline{y}}\dot{\underline{y}}\dot{\underline{y}}$	Y component of velocity
	S	Sign character: ASCII space = positive Minus sign = negative
	$\dot{\underline{z}}\dot{\underline{z}}\dot{\underline{z}}\dot{\underline{z}}\dot{\underline{z}}\dot{\underline{z}}\dot{\underline{z}}\dot{\underline{z}}\dot{\underline{z}}\dot{\underline{z}}\dot{\underline{z}}\dot{\underline{z}}\dot{\underline{z}}$	Z component of velocity

Table 3-5. EPV Message Body Explanation (3 of 5)

Line	Characters	Explanation
5 (cont)	CCC	Checksum. This is the sum of the decimal equivalents of all the preceding characters on line 4: 0 through 9 = face value Minus (-) = 1 ASCII space = 0
	CRCR	Two carriage returns
	LFLF	Two line feeds
6	S	Sign character: ASCII space = positive Minus sign = negative
	OSCSEMIMAJORAXISS	Osculating semimajor axis
	S	Sign character: ASCII space = positive Minus sign = negative
	OSCECCENTRIC	Osculating eccentricity
	S	Sign character: ASCII space = positive Minus sign = negative
	OSCINCLINATN	Osculating inclination
		The semimajor axis is in kilometers with resolution to the nearest tenth of a millimeter. The implied decimal point is seven places from the right. The eccentricity is dimensionless with resolution to the nearest 10-10. The implied decimal point is ten places from the right. The inclination is in degrees with resolution to the nearest 10-9 degrees. The implied decimal point is nine places from the right. These fields will contain all zeros when not used.
	CCC	Checksum. This is the sum of the decimal equivalents of all the preceding characters on line 5. 0 through 9 = face value Minus (-) = 1 ASCII Space = 0
	CRCR	Two carriage returns
	LFLF	Two line feeds
7	S	Sign character: ASCII space = positive Minus sign = negative
	OSCLONASNODE	Osculating longitude of the ascending node.
	S	Sign character: ASCII space = positive Minus sign = negative
	OSCARGPERIAP	Osculating argument of periapse
	S	Sign character ASCII space = positive Minus sign = negative
	OSCMEANANOML	Osculating mean anomaly
		The longitude of the ascending node, the argument of perigee, and the mean anomaly are in degrees with resolution to the nearest 10^{-9} degrees. The implied decimal point is nine places from the right. These fields will contain all zeros when not used.
	GRAVITATIONALPARM	Gravitational parameter corresponding to Cartesian and osculating elements in units of kilometers^3/second^2 with resolution to the nearest 10^{-5} kilometers^3/second^2. The implied decimal point is five places from the right. This field will contain all zeros when not used.
	CCC	Checksum. This is the sum of the decimal equivalents of all the preceding characters on line 6: 0 through 9 = face value Minus (-) = 1 ASCII space = 0
	CRCR	Two carriage returns.
	LFLF	Two line feeds.

Table 3-5. EPV Message Body Explanation (4 of 5)

Line	Characters	Explanation
8	MASSMMMM	Spacecraft mass in kilograms with resolution to the nearest tenth of a kilogram. The implied decimal point is one place from the right. This field will contain all zeros when not used.
	DCSAREA	Spacecraft reference cross-sectional area for drag calculations in square meters with resolution to the nearest hundredth of a square meter. The implied decimal point is two places from the right. This field will contain all zeros when not used.
	CSBD	Dimensionless drag coefficient, C_D. The implied decimal point is three places from the right. This field will contain all zeros when not used.
	S	Sign character: ASCII space = positive Minus sign = negative
	DSCALEP	Dimensionless drag scaling parameter, d. The effective drag coefficient is given by C_D (1 + d). The implied decimal point is five places from the right. This field will contain all zeros when not used.
	SCSAREA	Spacecraft reference cross-sectional area for solar radiation force calculations in square meters with resolution to the nearest hundredth of a square meter. The implied decimal point is two places from the right. This field will contain all zeros when not used.
	S	Sign character: ASCII space = positive Minus sign = negative
	CSUBR	Dimensionless solar reflectivity coefficient, 1 + n, where n is the surface reflectivity of the spacecraft. The implied decimal point is four places from the right. This field will contain all zeros when not used.
	F	Solar activity paramater: 1 = Exospheric temperature 2 = $F_{10.7}$ solar flux. NOTE This field will contain a zero when not used.
	SFLX	Exospheric temperature, T_c, at epoch in units of degrees Kelvin with resolution to the nearest unit or of $F_{10.7}$ solar flux at epoch in units of 10^{-22} Watts/meter^2/Hertz with resolution to the nearest tenth of a unit. The implied decimal place for the $F_{10.7}$ solar flux is one place from the right. This field will contain all zeros when not used.
	I	Geomagnetic activity index type: 1 = Kp 2 = Ap NOTE This field will contain a zero when not used.
	GMGAI	Dimensionless geomagnetic activity index, Kp or Ap, at epoch. The implied decimal point is two places from the right. This field will contain all zeros when not used.
	CCC	Checksum. This is the sum of the decimal equivalents of all the preceding characters on line 7: 0 through 9 = face value Minus (-) = 1 ASCII space = 0
	CRCR	Two carriage returns.
	LRLR	Two line feeds.
9	---	Optional 60-byte free-text line for additional information related to the state vector contained in the EPV message. This field will contain all ASCII blanks when not used.
	CRCR	Two carriage returns
	LFLF	Two line feeds
10	---	Optional 60-byte free-text line for additional information related to the state vector contained in the EPV message. This field will contain all ASCII blanks when not used.
	CRCR	Two carriage returns
	LFLF	Two line feeds
11	---	Optional 60-byte free-text line for additional information related to the state vector contained in the EPV message. This field will contain all ASCII blanks when not used.
	CRCR	Two carriage returns
	LFLF	Two line feeds

Table 3-5. EPV Message Body Explanation (5 of 5)

Line	Characters	Explanation
12	ITERM	End of message.
	0000	Originator routing indicator.
	CRCR	Two carriage returns.
	LFLF	Two line feeds.
	---	Fill data (311_8).

(e) The Nascom format field, bits 44 through 48, is a 5-bit field used to identify the type of data block. The EPV message must have a binary 01011 code in this field.

3. User Header 1.

(a) The Vehicle ID (VID) field, bits 49 through 56, is an 8-bit field that contains a code identifying the spacecraft to which the message block is related.

(b) The spare field, bits 57 through 64, is an 8-bit field that contains an all 1's pattern.

(c) The message block type field, bits 65 through 72, is an 8-bit field that contains a code that defines the specific type of data contained in the block. The EPV message must have a binary 10001100 code in this field.

(d) The destination code field, bits 73 through 80 is an 8-bit field that is reserved for a destination code that identifies the recipient of the data block and contains the same value as bits 33 through 40.

(e) Bits 81 and 82 are spare bits and are not used.

(f) Bit 83 is set to a binary 1, for the full block flag, to indicate that the block data field is completely used, or it is set to a binary 0 to indicate that the data field is less than full.

(g) The block data length binary field, bits 84 through 96, is a 13-bit field that contains the length, in bits, of user header 2 plus the data portion of the block. If the block is full, this field must contain the binary equivalent of 4624 bits.

4. Time Field. The use of the time field, bits 97 through 144, is optional. If used, it contains NASA PB4 time (refer to X-814-77-64). NCC-generated blocks must always contain a time code in this field. If this field does not contain a PB4 time code, it must be set to all binary 1's.

5. User Header 2.

(a) The message block number, bits 145 through 148, is a 4-bit field that contains an incrementing binary counter associated with a unique block ID to place blocks in the proper sequence in a multiblock group. The block count always starts at 1 and increments by 1 for each subsequent block in a multiblock group. A block count of 1 indicates that this block is the only block of a single-block message or the first block of a multiblock message. The maximum allowable value in this field is 15.

(b) The message block ID field, bits 149 through 160, is a 12-bit field that is used to define a unique message. The message block ID starts with an initial value of 1 and increments by 1 for successive messages. Message block ID assignment is controlled by the message originator. It should not be expected that sequential messages received at a destination will have sequential message block IDs.

(c) Bit 161 and 162 contain zeros.

(d) The number of blocks binary field, bits 163 through 166, is a 4-bit field that contains the number blocks constituting the message. The maximum number of blocks per message is 15. The number in this field must be the same in all blocks of a message.

(e) Bits 167 through 171 contain zeros.

(f) Message Block Flags.

(1) Five 1-bit flags, bits 172 through 176, are included in the header. These flags must be used to signify an acknowledge request, retransmitted block, acknowledgment enclosed, last block, and one spare bit. A flag set means that the bit equals a binary 1.

(2) The acknowledge request flag (F1), bit 172, is set to any message that requires an acknowledgment. The acknowledgment request flag will not be set in an acknowledgment message. An acknowledgment must be sent to the originator on receipt of a completed message having the acknowledgment request flag set. The FDF waits for the acknowledgment of one message before transmitting the next message. The acknowledge request flag is only valid in the first block of a multiblock group.

(3) The retransmitted block flag (F2), bit 173, is set in any retransmitted blocks. The original block number and ID are not altered by retransmission.

(4) The acknowledgment enclosed flag (F3), bit 174, is set whenever bits 177 through 208 contain an acknowledgment.

(5) The last block indicator (F4), bit 175, must be set in the last block of a message and must be 0 in all preceding blocks.

(6) Bit 176 is zero.

6. Message Block Data Field. The message block data field, bits 177 through 4768, consists of either the message subfield of 4592 bits or the acknowledgment subfield of 144 bits.

7. Message Subfield. This field consists of 574 8-bit bytes (4592 bits). Each byte contains an ASCII character. ASCII characters have the parity bit (bit 2^7) set to a zero. The parity bit occurs first in serial transmissions. For example, a message type of 02 (ASCII) appears as follows:

```
Bit 177                Bit 192
↓                            ↓
0 0 1 1 0 0 0 0 0 0 1 1 0 0 1 0
↑                            ↑
Parity                  Parity
```

First bit in serial transmission

8. Acknowledgment Subfield.

   (a) Bytes 23 through 26 are a duplication of bytes 19 through 22 of the last block of the message being acknowledged. This encompasses the data field previously described as follows:

      (1) Block Number.

      (2) Message block ID.

      (3) Spare.

      (4) Number of blocks.

      (5) Spare.

      (6) Block flags.

   (b) Bytes 27 through 33 contain ASCII spaces. Bytes 34 through 40 contain a SUPIDEN code of Z9999ZZ.

9. Error Control Field.

   (a) Bits 4769 through 4776 are spares.

   (b) Bits 4777 and 4778 are used to indicate the detection of errors in a decoded block.

   (c) Bits 4779 through 4800 contain a 22-bit polynomial remainder.

c. EPV Acknowledgment Protocol. On receipt of a complete EPV message requiring an acknowledgment, the receiver will transmit an acknowledgment to the originator in the next block transmission opportunity. The acknowledgment will repeat bytes 19 through 22 of the last block of the message being acknowledged and will always be sent in a separate, standalone message. The acknowledgment block will be an octal message block type (bits 65 to 72) of 113 (4B hexadecimal) for acknowledgments generated by the recipient. If a message is received with flag bit 2 (retransmitted message) set to a 1 and an acknowledgment required (flag bit 1 set to a 1), the receiver will acknowledge receipt of this message in the same manner as previously described. It is the receiver's responsibility to determine if this message has alreay been processed (i.e., same message block ID and source code). If so, the second copy of the message should not be processed.

d. EPV Acknowledgment Message. The format shown in Table 3-6 will be used for the transmission of an EPV message acknowledgment.

e. EPV Retransmission Protocol. On failure to receive an acknowledgment within 5 seconds of transmission of the last block of an EPV message, the originator will set the retransmitted block flag (F2) in each block of the message and retransmit the entire message. The first block of the retransmitted EPV message will be transmitted at the next transmission opportunity after any pending acknowledgment. The originator will retransmit all blocks of the EPV message in the order of ascending block sequence number. Retransmitted blocks will retain their original block number, block ID, and type. Failure to receive an acknowledgment for the first retransmission within 5 seconds will result in a second retransmission. Failure to receive an acknowledgment to the second retransmission within 5 seconds will result in an error indication being sent to the responsible operator and the termination of transmission for that particular SUPIDEN and EPV message.

f. EPVs may be used to compute pointing angle information for any known antenna location. EPVs are not usually restricted to a specific pass but may be used over a limited period of time which is determined by the orbit of the satellite.

Table 3-6. EPV Acknowledgment Message

Item Number	Number of Bytes	Data Item	Range of Values
1	4	Acknowledgment SUBFIELD	Bytes 19-22 from acknowledged message
2	7	Spare	ASCII spaces
3	7	SUPIDEN	Z9999ZZ

3.2.1.4 Internet Predict Message

a. The INP message contains predicted pointing data for a specific satellite pass and for a specific antenna. The INP body message is preceded by a Nascom header and followed by a Nascom trailer. The INP always contains angle information (see Figures 3-6 and 3-7 and refer to Table 3-7) and may include range information (see Figures 3-8 and 3-9 and refer to Table 3-7) and frequency information (see Figure 3-10.)

b. The INP must contain at least six data points (and not have more than 50 data points) which have the correct checksum calculations. In computing the checksums, 0 through 9 have face value, the ampersand (&), denoting a positive sign, has a value of 10; the minus (-), denoting a negative sign, has a value of 11.

c. The standard INP contains 30 points; however, 6 to 50 points are acceptable. The number of dynamic points is a function of request-zero or three and pass geometry-zero to three. The maximum angular difference between successive points should not exceed 5 degrees in the referenced coordinate system of the INP. If the Y axis exceeds plus or minus 79 degrees (keyhole), the 5-degree requirement can be disregarded. Each INP contains between 0 and 3 pre-acquisition of signal (AOS) and post-loss of signal (LOS) points (i.e., the elevation at the beginning and end of the message may be negative). For long passes, additional INPs are acceptable if the start time of the continued INP is greater than 30 minutes later than the AOS time of the original INP.

d. INPs are issued as Ground Elapsed Time (GET) or Greenwich Mean Time (GMT). An INP generated for GET time generates the points for time elapsed since liftoff with the time for liftoff being considered 000 days, 00 hours, 00 minutes, 00 seconds. INPs generated pre-mission are GET INPs. INPs generated GMT are real-time. GET INP messages are not regenerated unless the liftoff slips more than 30 days.

```
Line 1:      ↑$↓INP↑$∆↓SET∆a↑nnnn,∆↓MIS∆↑ssss,∆SC∆↑vv,∆↓CH∆↑cc,∆↓STA∆r↑ii<<≡↓

Line 2:      SC∆XMT∆↑ffff.ffffff,↓SC∆RCV∆↑gggg.gggggg,↓STA∆XMT∆↑hh.hhhhhh,
             ↓RG∆MOD∆↑rrrrrr<<≡≡↓

Line 3:      eee∆↑yy,ddd,hhmmss∆∆∆↓RTLT∆↑rr:tt:vv.v<<≡↓

Line 4:      fff∆↑yy,ddd,hhmmss∆∆∆↓RTLT∆↑rr:tt:vv.v<<≡≡↓

Line 5:      ∆∆ttt∆∆∆aaaaa∆∆∆bbbbb∆∆↓CK<<≡↑

Line 6 to
Line n-1:    hhmmss∆aaaaa∆bbbbb∆cc<<≡↑

Line n:      hhmmss∆aaaaa∆bbbbb∆cc<<≡≡↑

Line n+1:    $↓END↑$∆↓SET∆a↑nnnn,∆↓MIS_↑ssss,∆↓SC∆↑vv,∆↓CH∆↑cc,∆↓S TA∆r↑ii<<≡↓

     KEY:
             ↑ = Figures
             ↓ = Letters
             ∆ = Space
             ≡ = Line Feed
             < = Carriage Return
```

Figure 3-6. Five-level Coded INP Format with Angles Only

```
Line 1:     $ I N P $ ∆ S E T ∆ a n n n n , ∆ M I S ∆ s s s s , ∆ S C ∆ v v , ∆ C H ∆ c c, ∆ S T A ∆ r i i < < ≡

Line 2:     S C ∆ X M T ∆ f f f f . f f f f f f , S C ∆ R C V ∆ g g g g . g g g g g g , S T A ∆ X M T ∆ h h . h h h h h h ,
            R G ∆ MO D ∆ r r r r r r < < ≡ ≡

Line 3:     e e e ∆ y y , d d d , h h m m s s ∆ ∆ ∆ R T L T ∆ r r : t t : v v .v < < ≡

Line 4:     f f f ∆ y y , d d d , h h m m s s ∆ ∆ ∆ R T L T ∆ r r : t t : v v . v < < ≡ ≡

Line 5:     ∆ ∆ t t t ∆ ∆ ∆ a a a a a ∆ ∆ ∆ b b b b b ∆ ∆  CK < < ≡

                                                                 C
Line 6 to                                                        A
Line n-1:   h h m m s s ∆ a a a a ∆ b b b b b ∆ c c < < ≡ N

                                                                    C
                                                                    A
Line n:     h h m m s s ∆ a a a a a ∆ b b b b b ∆ c c < < ≡ ≡ N

                                                                                                        D
                                                                                                        E
Line n+1: $ E N D $ ∆ S E T ∆ a n n n n , ∆ M I S ∆ s s s s , ∆ S C ∆ v v , ∆ C H ∆ c c , ∆ S T A ∆ r i i < < ≡ L
```

```
KEY:   C
       A  = Cancel
       N

       ∆  = ASCII Space

       <  = Carriage Return

       ≡  Line Feed

       D
       E  = Delete
       L
```

NOTE

This is the format when the INP is generated directly in eight level. When converted from an original five-level INP into eight level, the up and down arrows in the five-level format (see Figure 3-4) will appear in their corresponding positions in the eight-level format as follows:

```
        C       D
↑  =    A   ↓ = E
   =    N       L
```

Figure 3-7. Eight-level Coded (ASCII) INP Format with Angles Only

Table 3-7. Explanation of INP Format (1 of 4)

Line	Characters		Explanation
	Fixed	Variable	
1	INP SET MIS SC CH	 a nnnn ssss vv cc	Start of message SET Alphabetic character specifying generator of data: a. G = FDF/RLT f. W = WTR b. S = FDF/NON-RLT g. P = PMR c. J = JSC h. K = KMR d. L = JPL i. Z = WLP e. E = ETR Predict set number (message sequence number), consisting of four alphanumeric characters and necessary upper and lower case teletype shift characters Mission SIC, consisting of four numeric characters. Cannot be all zeros Spacecraft VID, consisting of two numeric characters (refer to appendix D). Cannot be 00 Channel Channel identification number 01-99 is now defined as: Trajectory Identification Number 01-19 =ON ORBIT - SOURCE OR DESTINATION OF DATA where: 01 = premission nominal (source) 02 = real time (source) 03 = offline (source) 00 = not used 20-79 = launch trajectory variations 80-99 = entry and landing
	STA		Alphabetic character indicating the range for which the message is generated: a. A = CSTC e. P = PMR b. D = DSN f. S = STDN c. E = ETR g. W = WTR d. K = KMR h. Z = WLP Station identification, consisting of two numeric characters. Refer to Appendix C or NDOSL (http://fdf.gsfc.nasa.gov/prod_center/)
2	SC XMT SC RCV STA XMT RG.MOD	 ffff.ffffff gggg.gggggg hh.hhhhhh rrrrrr	Spacecraft transmit Spacecraft transmit frequency in MHz Spacecraft receive Spacecraft receive frquency in MHz Station transmit Station transmission frequency in MHz Range modules (ambiguities) Number of range modules subtracted from the range value

Table 3-7. Explanation of INP Format (2 of 4)

Line	Characters: Fixed	Characters: Variable	Explanation
3		eee	Three alphabetic characters identifying the event used as the start of the message. Valid entries are: AOS: Usually indicates horizon break. SOP: (Start of Predicts); Indicates that the start of the INP does not correspond to a particular event. EMG: (Emergence); Time of spacecraft coming out of occultation with a celestial body CON: (Continuation); Used when message follows another INP which contains data points previous to these (see Note). Used by DOD radars only
	NOTE STDN TDPS-equipped stations cannot process continuation INPs. The TDPS stops processing at the last point in any message and will not automatically process any continuation received. Operator action is required to begin processing of continuation INP.		
	RTLT	yy,ddd,hhmmss rr:tt:vv.v	UTC of the event described in eee field. (ddd) cannot be all zeros Round trip light time Round trip light time at time specified by yy,ddd,hhmmss field in hours, minutes, seconds, and tenths of seconds
4	 RTLT	fff yy,ddd,hhmmss rr:tt:vv.v	Three alphabetic characters identifying the event used as the end of message. Valid entries are: LOS: Loss of signal due to spacecraft going below station horizon EOP: End of predicts indicates that the end of INP does not correspond to a particular event OCC: Occultation predicts end due to spacecraft going behind a celestial body TBC: Indicates that predicts to be continued in another INP (see Note for line 3). Used by DOD radars only UTC of the event described in fff field. ddd cannot be all zeros Round trip light time Round trip light time at time specified by yy,ddd,hhmmss field in hours, minutes, seconds, and tenths of seconds
5		ttt	NOTE Line 5 entries are column headers for lines 6 through n. The range and Doppler information is optional and may not appear on all INPs. See Figure 3-8 for sample INP with Doppler frequency fields. Indicates GET or GMT

Table 3-7. Explanation of INP Format (3 of 4)

Line	Characters		Explanation
	Fixed	**Variable**	
		aaaaa	Up to five alphanumeric characters indicating the coordinate system for angle 1. Valid entries are: a. Eight-level AZI X30 D E L X85 D E L b. Five-level AZI X ↑ 30 ↓ X ↑ 85 ↓ NOTE These entries must correspond respectively to the entries selected for aaaaa field.
	CK		Checksum NOTE See Figure 3-8 for example of Doppler frequency fields
	R		Range
		rrrr	Up to four alphabetic characters with appropriate upper and lower case shift indicating the units for range field. Valid entries are: a. KMS _ (kilometers). b. KYD _ (kiloyards). c. NMI _ (nautical miles). d. MCS _ (microseconds).
		D1 DOP	D1 = predicted one-way Doppler frequency measured at the Doppler extractor. R1 = one-way Doppler frequency measured at the receiver Voltage-controlled Oscillator (VCO). S1 = one-way Doppler at S-band.
		D2 DOP	D2 = predicted two-way Doppler frequency measured at the Doppler extractor. R2 = two-way Doppler frequency measured at the receiver VCO. S2 = two-way Doppler frequency at S-band.
		D3XXX	D3 = three-way Doppler frequency. XXX is the station transmitting to the spacecraft. R3 = three-way Doppler frequency at the receiver VCO. XXX is the station transmitting to the spacecraft. S3 = three-way Doppler frequency at S-band. XXX is the station transmitting to the spacecraft.
		tx vco	Doppler frequency of the uplink Signal at the transmitter VCO. NOTE Doppler frequencies in Hertz.

Table 3-7. Explanation of INP Format (4 of 4)

Line	Characters		Explanation
	Fixed	Variable	
6 through n		hhmmss	Six numeric characters specifying the UTC hours, minutes, and seconds of the point.
		aaaaa	Angle 1 value in 1/100 degree. For X85 and X30, the first character is the sign of the angle where & (ampersand) indicates positive, - (minus) indicates negative. For azimuth, signs are not required, zeros are used to fill unused character positions; i.e., 8.46 deg az = 00846, + 7.31 deg x = &0731
		bbbbb	Angle 2 value in 1/100 degree. For ELE, Y85, and Y30, the first character is the sign of the angle where & (ampersand) indicates positive, - (minus) indicates negative. Zeros are used to fill unused character positions; i.e., 7.31 deg Y or EL = &0731
		cc	Checksum computed on digits in the aaaaa and bbbbb fields. 0 through 9 carry face value, (&) = 10 and (-) = 11
		rrrrrrr	One-way range in 1/10 units specified in column header (line 5)
		ddddddddd	For D1, D2 and D3 actual Doppler frequency measured at Doppler extractor. For R1, R2, and R3 readings assume a leading 2 before the MSD for S1, S2, and S3
		fffffffff	Frequency measurement assumes a leading 1 NOTE All Doppler frequency measurements are in hundredths of Hertz with the decimal point assumed between the second and third digits from the right. The MSD is in megahertz
n+1	END		End of message. (The rest of line n + 1 is a repetition of line 1.)

Line 1: ↑ $ ↓ I N P ↑ $ Δ ↓ S E T Δ a ↑ n n n n , Δ ↓ M I S Δ ↑ s s s s , Δ ↓ S C Δ ↑ v v , Δ ↓ C H Δ ↑ cc , Δ ↓ S T A Δ r ↑ i i < < ≡ ↓

Line 2: S C Δ X M T Δ ↑ f f f f . f f f f f f , ↓ S C Δ ↑ R C V Δ g g g g . g g g g g g , ↓ S T A Δ X M T Δ ↑ h h . h h h h h h ↓ , R G Δ M O D Δ ↑ r r r r r r < < ≡ ≡ ↓

Line 3: e e e Δ ↑ y y , d d d , h h m m s s Δ Δ Δ ↓ R T L T Δ ↑ r r : t t : v v . v < < ≡ ↓

Line 4: f f f ↑ y y , d d d , h h m m s s Δ Δ Δ ↓ R TL T Δ ↑ r r : t t : v v . v < < ≡ ≡ ↓

Line 5: Δ Δ t t t Δ Δ Δ a a a a a Δ Δ Δ b b b b b Δ Δ ↓ C K Δ Δ R ↑ . ↓ r r r r < < ≡ ↑

Line 6 to Line n-1: h h m m s s Δ a a a a a Δ b b b b b Δ c c Δ r r r r r r r < < ≡ ↑

Line n: h h m m s s Δ a a a a a Δ b b b b b Δ c c Δ r r r r r r r < < ≡ ≡ ↑

Line n+1: $ ↓ E N D ↑ $ Δ ↓ S E T Δ a ↑ n n n n , Δ ↓ M I S Δ ↑ s s s s , Δ ↓ S C v ↑ v v , Δ ↓ C H Δ ↑ c c , Δ ↓ S T A Δ r ↑ i i < < ≡ ↓

KEY:

↑ = Figures

↓ = Letters

Δ = Line Feed

≡ = Line Feed

< = Carriage Return

Figure 3-8. Five-level Coded INP Format with Range

```
Line 1:     $INP$_SET_annnnn,_MIS_ssss,_SC_vv,_CH_cc,_STA_rii<<≡

Line 2:     SC_XMT_ffff.ffffff,SC_RCV_gggg.gggggg,STA_XMT_hh.hhhhhh,RG_MOD_
            rrrrrr<<≡≡

Line 3:     eee_yy,ddd,hhmmss___RTLT_rr:tt:vv.v<<≡

Line 4:     fff↑yy,ddd,hhmmss___RTLT_rr:tt:vv.v<<≡≡

Line 5:     __ttt___aaaaa___bbbbb__CK__R.rrrr<<≡
                                                   C
Line 6 to                                          A
Line n-1:   hhmmss_aaaaa_bbbbb_cc_rrrrrrr<<≡N
                                                     C
                                                     A
Line n:     hhmmss_aaa aa_bbbbb_cc_rrrrrrr<<≡≡ N
                                                                        D
                                                                        E
Line n+1: $END$_SET_annnn,_MIS_ssss,_SC_vv,_CH_cc,_STA_rii<<≡ L
```

KEY:

```
C
A = Cancel
N

Δ = Space
≡ = Line Feed
< = Carriage Return

D
E = Delete
L
```

NOTE

This is the format when the INP is generated directly in eight level. When converted from an original five-level INP into eight level, the up and down arrows in the five-level format (see Figure 3-6) will appear in the corresponding positions in the eight-level format as follows:

```
    C        D
↑ = A    ↓ = E
    N        L
```

Figure 3-9. Eight-level Coded INP Format with Range

```
Line 5:     ΔΔtttΔΔΔaaaaaaΔΔbbbbbbΔΔ↓CK__R↑,↓rrrrΔΔΔD↑1.↓DOPΔΔΔΔ
            D↑2.↓DOPΔΔΔΔD↑3.↓XXXXXΔΔΔΔTX↑.↓VCO<<≡↑
Line 6 to
Line N:     hhmmssΔaaaaaaΔbbbbbbΔccΔrrrrrrrΔdddddddddΔdddddddddΔdddddddddΔ
            ffffffff<<≡↑
```

Figure 3-10. Five-level INP Format with Doppler Frequency Field

3.2.1.5 Two Line Element Message

The US Strategic Command (USSTRATCOM) Element/Bulletin contains the classical orbital elements for an orbiting object. The orbital elements are contained in a two-line (also referred to as a two-card) element message. This message is sent via the five-level TTY code (see Figure 3-11 and refer to Table 3-8) from USSTRATCOM. Where required, GSFC can convert this to eight-level.

SOM (((((Δ ↓ ↓ ↓ ↓ ↓ ↓ < < ≡

Line 1: ↑ 1 Δ s s s s s ↓ c Δ ↑ i i l l l v v v ↓ Δ ↑ y y d d d . d d d d d d d d Δ s ↑ .
ṁ ṁ ṁ ṁ ṁ ṁ ṁ ṁ
Δ ↑ S m̈ m̈ m̈ m̈ m̈ - m Δ S↑ d d d d d - d Δ ↑ e Δ n n n n c ↓ ↓ ↓ ↓ < <

Line 2: ↑ 2 Δ ↑ s s s s s Δ ↑ i i i . i i i i Δ r r r . r r r r Δ e e e e e e e Δ ↑ p p p . p p p p Δ
a a a . a a a a

Δ r r . r r r r r r r r n n n n n c

Key:
(= Parenthesis
Δ = Space
↓ = Letters
↑ = Figures
< = Carriage Return
≡ = Line feed

Figure 3-11. USSTRATCOM Two-line Orbital Element Format

Table 3-8. Explanation of USSTRATCOM Two-line Orbital Element Format

Line	Characters	Explanation
SOM	(((((	Fixed (start of message code)
1	sssss	Satellite number
	c	Classification U = unclassified C = confidential S = secret
	iillllvvv	International Designator ii = launch year ill = launch number of year vvv = piece of launch
	yy	Epoch year of message
	ddd.dddddddd	Epoch day and fraction of day
	S.mmmmmmmm	First time derivative of the mean motion or ballistic coefficient (depending on ephemeris type). Revolutions per day 2 or meters 2 per kilogram. S = minus sign if appropriate plus signs are not used.
	S.mmmmm-m	Second time derivative of mean motion. Revolutions per day 3. Decimal point assumed between S and first m. S = minus sign if applicable. This field will be blank if not applicable.
	S.ddddd-d	BSTAR drag term if GP4 general pertubations theory was used; otherwise, this field will be radiation pressure coefficient. S = minus sign if applicable.
	e	Ephemeris type: Specifies ephemeris theory used to produce the elements. 0 = mean inertial, 1 = osculating inertial.
	nnnn	Element number
	c	Checksum: Modulo 10
2	sssss	Satellite number.
	iii.iiii	Inclination in degrees.
	rrr.rrrr	Right ascension of ascending node in degrees.
	eeeeeee	Eccentricity (decimal assumed at beginning of field).
	ppp.pppp	Argument of perigee in degrees.
	aaa.aaaa	Mean anomaly in degrees.
	rr.rrrrrrrr	Mean motion (revolutions per day).
	nnnnn	Revolution number at epoch.
	c	Checksum: modulo 10.

3.2.2 Acquisition Data Transmission

3.2.2.1 General

Acquisition data is transmitted by the FDF or JSC to GN ground stations via NISN. This data is generated in eight-level ASCII teletype format by FDF. The acquisition data is implanted into 4800-bit blocks by a Conversion Device (CD) and transmitted to the Tracking Data System (TDS) where it is converted to eight-level ASCII teletype format and sent to the tracking sites and range stations. Projects also send acquistion data via FTP and e-mail.

3.2.2.2 4800 Bit Block

Vectors are exchanged between NASA centers and external agencies. The vectors are formatted as IIRVs or EPVs and transmitted in 4800-bit blocks. The packing into blocks for IIRVs is illustrated in Figures 3-12 and 3-13; unique IIRV packing will be controlled by ICDs. The packing into blocks for EPVs is illustrated in Figures 3-14 and 3-15.

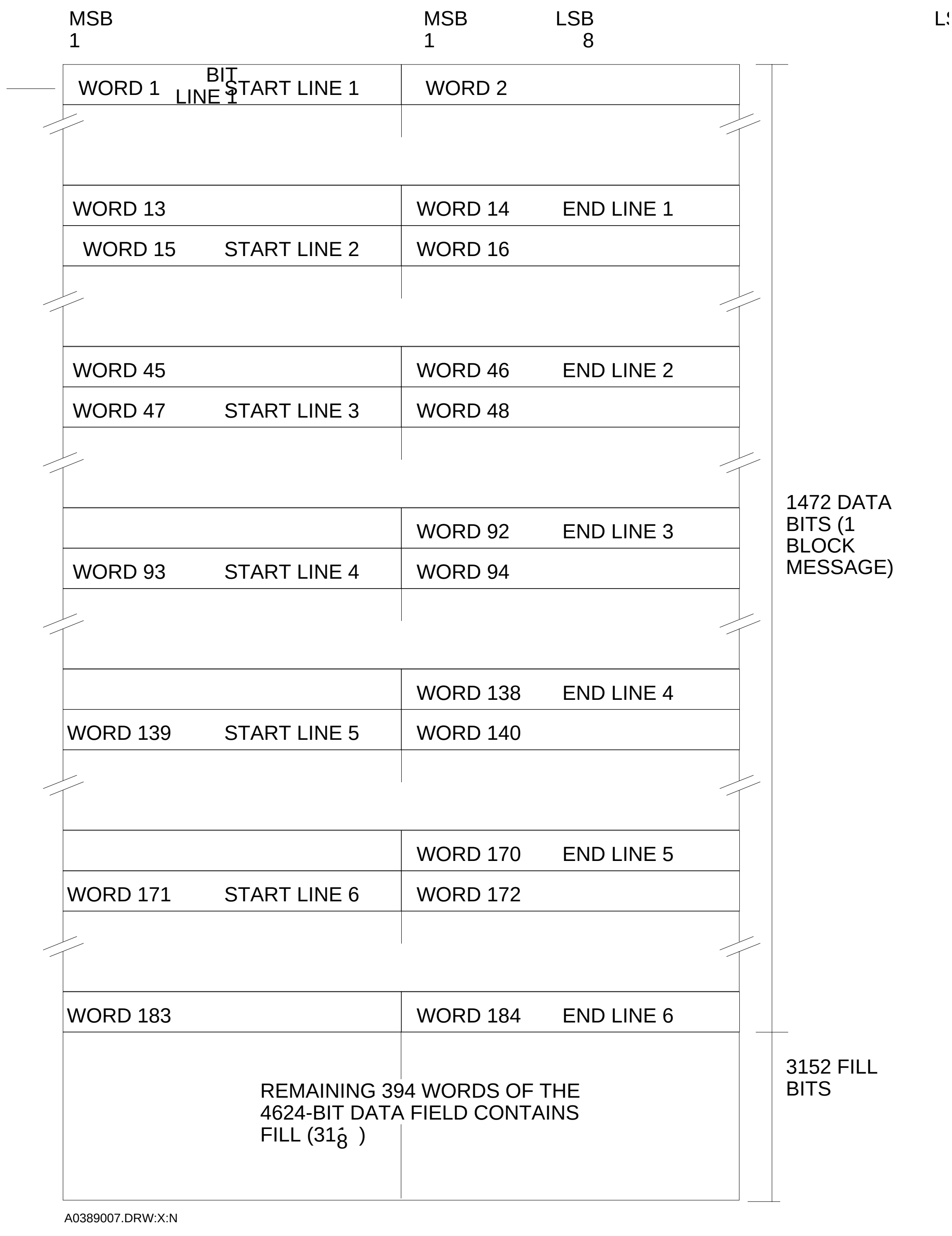


Figure 3-12. Illustration of IIRV Data Words Packed into the Data Field of the 4800-bit Block Format

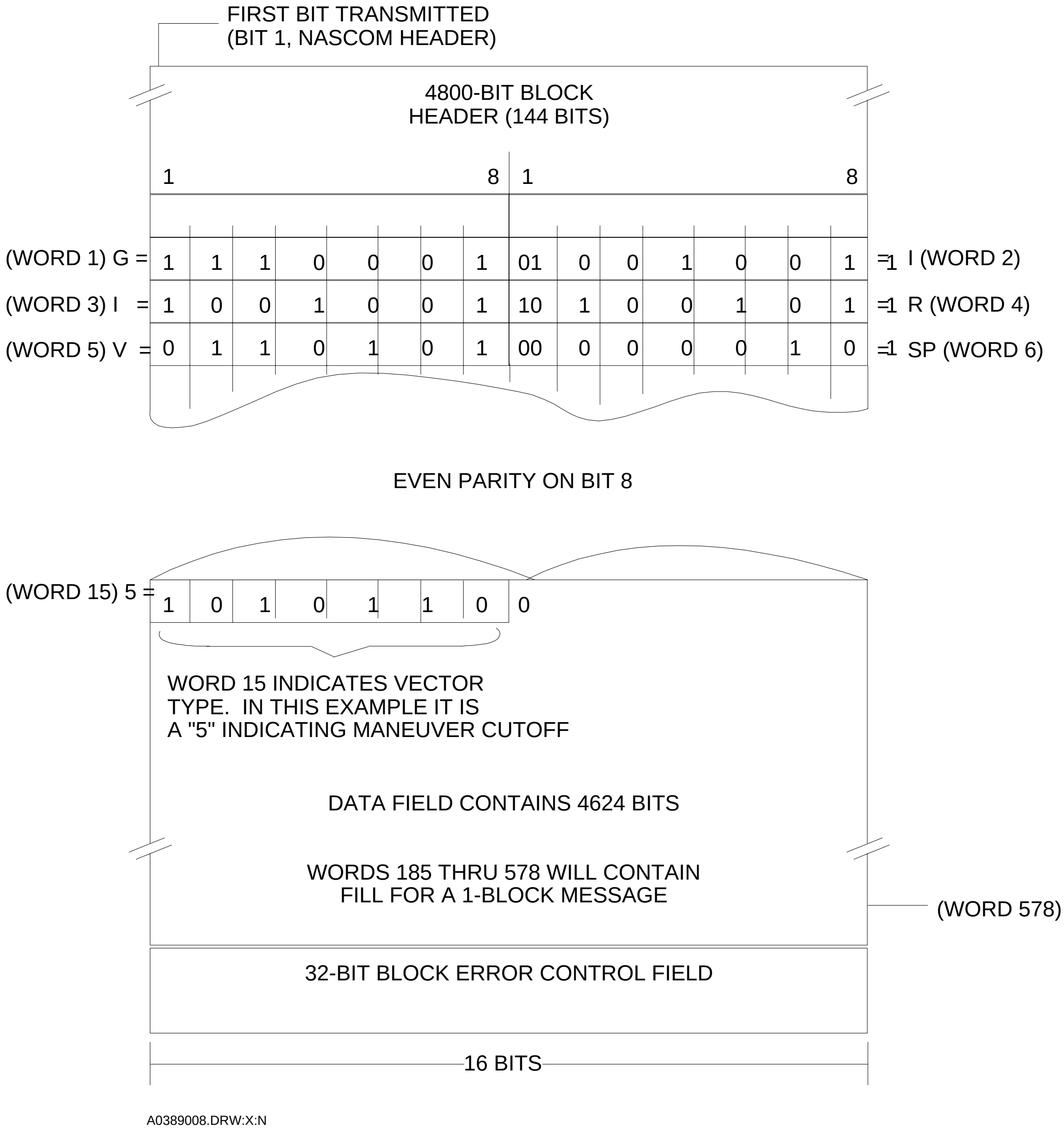


Figure 3-13. Illustration of IIRV ASCII Characters Packed into the 4800-bit Block

Figure 3-14. Illustration of EPV Data Words Packed Into the Data Field of the 4800-bit Block Format

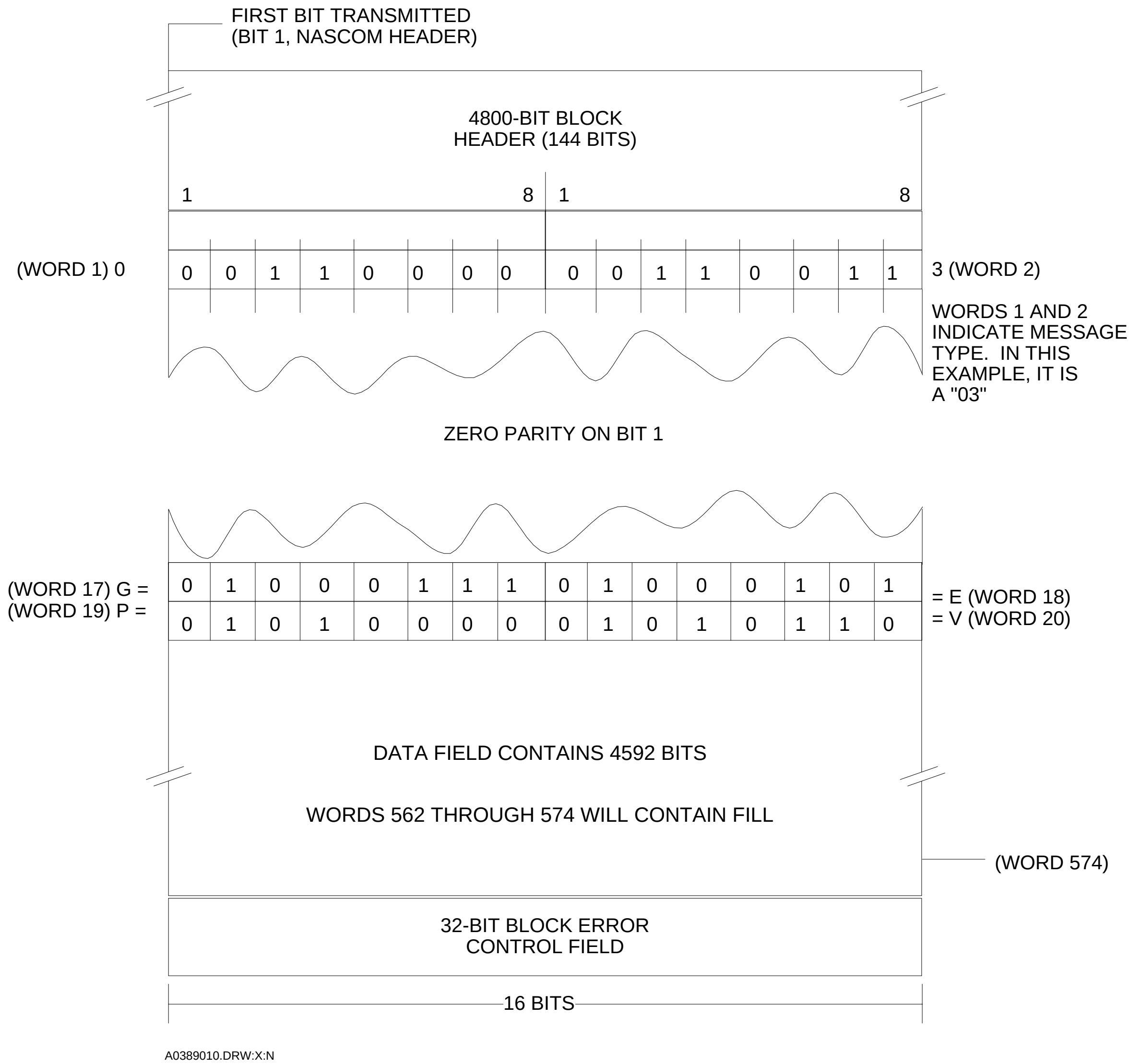


Figure 3-15. Illustration of EPV ASCII Characters Packed into the 4800-bit Block

3.2.3 Acquisition Data Processing

GN sites use STPS, TTCP, and MPA for acquisition data processing. Reception of data is handled as follows (refer to the current tracking Software Support Instruction (SSI) for current version of operational software being used):

a. STPS.

1. The on-site STPS systems automatically receive and store acquisition data.

2. The STPS can accept Interrange Vector (IRV), Improved Interrange Vector (IIRV), and Internet Predict (INP) messages.

3. When the STPS is on, and the Update acq function is not being performed, the following apply:

(a) Any incoming acquisition message whose epoch or first-point time is more than 24 hours old from the current Universal Time Coordinated (UTC) will not be written to the disk. An operator message will list the acquisition message received but not saved.

(b) All disk-resident acquisition data whose epoch or first-point time is less than 24 hours old from current UTC is tagged for deletion and removed from the availability listing when new acquisition messages of the same type (IIRV, IRV, or INP) and identical Support Identification Code/Vehicle Identification Code (SIC/VID) and VS (CH) fields are received.

(c) All disk-resident acquisition data whose epoch or first-point time is less than 30 minutes (plus or minus) of the epoch or first-point time of the incoming acquisition data is tagged for deletion and removed from the availability listing by the incoming data, providing the SIC/VID and VS (CH) fields are identical.

(d) If the INP Time Check Override (ITOR) function is selected, all INPs regardless of epoch time or first-point are accepted and automatic purging is deactivated.

b. TTCP.

1. The TTCP can receive and hold one IIRV message, as follows:

(a) The TTCP determines the geometric validity of the message and writes the message to the disk.

(b) The existing message is deleted and replaced by the incoming message.

c. MPA. The MPA can accept IRV, IIRV, and INP messages.

3.2.4 LTAS

High-speed acquisition data is utilized by some stations for launch and Shuttle landing support. The Launch Trajectory Acquisition System (LTAS) replaced the Launch Trajectory Data System (LTDS) in 1978.

Although originally adopted only as an acquisition data source for STDN, expanded support has mandated LTAS format for some tracking data requirements. Therefore, in that respect, it may be considered as dual function. The Central Computer Complex (CCC) can use almost any type of tracking data to generate LTAS, but the WLP Impact Prediction (IP) must have 2.4-kb/sec Minimum Delay Data Format (MDDF) data as an input. FDF, MIL, WPS, and the WLP radar can receive and process LTAS data. The 2.4-kb/sec LTAS data is transmitted Least Significant Bit (LSB) first and is composed of 240-bit blocks containing smoothed, best source, E, F, and G data. In addition, 16 of the 240 bits contain a pattern which allows the onstation processors at LTAS-equipped stations to synchronize on the incoming LTAS data and use it as an acquisition source. See Figure 3-16, and refer to Table 3-9 for an explanation of the format. The LTAS has three standard operational configurations as follows:

a. Cape Canaveral Launches. The CCC at Cape Canaveral receives real-time RADAR tracking data from the Eastern Test Range (ETR) and GN, and converts it to LTAS format for transmission to the WLP, and MIL tracking stations and to Flight Dynamics Facility (FDF).

b. Space Shuttle Landings.

    1. Edwards AFB Landings. The CCC receives real-time radar tracking data from the WTR, Pacific Missile Test Center (PMTC), and Air Force Satellite Test Center (AFFTC), and converts it to LTAS format for transmission to the west coast tracking stations and to FDF.

    2. Cape Kennedy Landings. ETR and WTR radars transmit real-time tracking data to CCC where it is converted to LTAS and transmitted to the MIL tracking station and to the FDF.

c. Ariane Launches. The WLP C-band transmits 2.4-kb/sec MDDF data to the IP system which converts it to LTAS format for transmission to GSFC and to Kourou, French Guiana. .

Table 3-9. Explanation of Launch Trajectory Acquisition System 2400-b/sec Format (1 of 3)*

Bit No.	Description
1-13	Satellite ID Code (binary)
14-17	Vehicle ID Code (binary)
18-26	Day of year (binary)
27-30	Format type (binary) = 0000 for LTAS
31-34	Time of Day - Tenths of seconds (binary - LSB = 0.1 sec)
35-51	Time of Day - Seconds (binary - LSB = 1.0 sec)
52-60	Site ID (refer to appendix C, table C-2)
61-87	E-position component (meters)
88	Sign for E (0 = positive) (1 = negative. When negative, bits 61-87 will be 2's complement.)
89-90	PSC (Position Scale Code: value by which all position components should be multiplied if the field length is exceeded): 00 - x 1 01 - x 10 10 - x 10^3 11 - x 10^{10}
91-117	F-position component (meters)
118	Sign for F (0 = positive) (1 = negative. When negative, bits 91-117 will be 2's complement.)

Table 3-9. Explanation of Launch Trajectory Acquisition System 2400-b/sec Format (2 of 3)*

Bit No.	Description
119-120	00 - x 1 01 - x 10 (All other scales are invalid)
*30 bits = 1 word; bit No. 1 = first bit transmitted.	
121-147	G-position component (meters)
148	Sign for G (0 = positive) (1 = negative. When negative, bits 121-147 will be 2's complement.)
149	Optical Track Bit (OTB) (always = 0)
150	PTF (Plus Time Flag) (1 = using plus time)
151-164	F-velocity component (meters/second)
165	Sign for F 0 = positive (1 = negative. When negative, bits 151-164 will be 2's complement.)
166-179	E-velocity component (meters/second)
180	Sign for E 0 = positive (1 = negative. When negative, bits 166-179 will be 2's complement.)
181	L liftoff 1 = liftoff has occurred
182	P plunge mode 1 = plunge
183-184	P/W (Pulse Width) 00 - 1.0 µsec 01 - 2.4 µsec 10 - 5.0 µsec 11 - 10.0 µsec
185	RFI (Refraction correction) (0 = out)(1 = in)
186	DI (Droop) (0 = out) (1 = in)
187	PO (Paramp) (0 = off) (1 = on)
188	RO (Radiation) (0 = off) (1 = on)
189	LO (0 = Single LO) (1 = Dual LO)
190	B/S (Beacon/Skin) (0 = skin) (1 = beacon)
191	T (Track bit) (0 = off) (1 = on)
192	Q (Quality bit) (0 = bad) (1 = good)
NOTE When LTAS is generated by the BDA IP, bit 191 signifies the Angle bit (A) and bit 192 signifies the Range bit (R).	
193-195	Mode (Bit No. 193 194 195) 0 0 0 = manual 1 0 0 = autotrack 0 1 0 = computer drive 1 1 0 = on-axis orbital 0 0 1 = on-axis powered flight 1 0 1 = on-axis coast 0 1 1 = autotrack coast
196-209	G-velocity component (meters/second)

Table 3-9. Explanation of Launch Trajectory Acquisition System 2400-b/sec Format (3 of 3)*

Bit No.	Description
210	Sign for G (0 = positive) (1 = negative. When negative bits 196-209 will be 2's complement.)
211-217	Checksum (see Note)
218-224	Spares.
225-240	Sync bits. Bits 225-240 will have the following patterns: 0-0-0-1-1-0-1-0-0-0-0-1-1-0-1- 0 on one message and 0-0-0-1-1-0-1-0-0-0-0-0-0-1-0-1 on the next.

NOTE

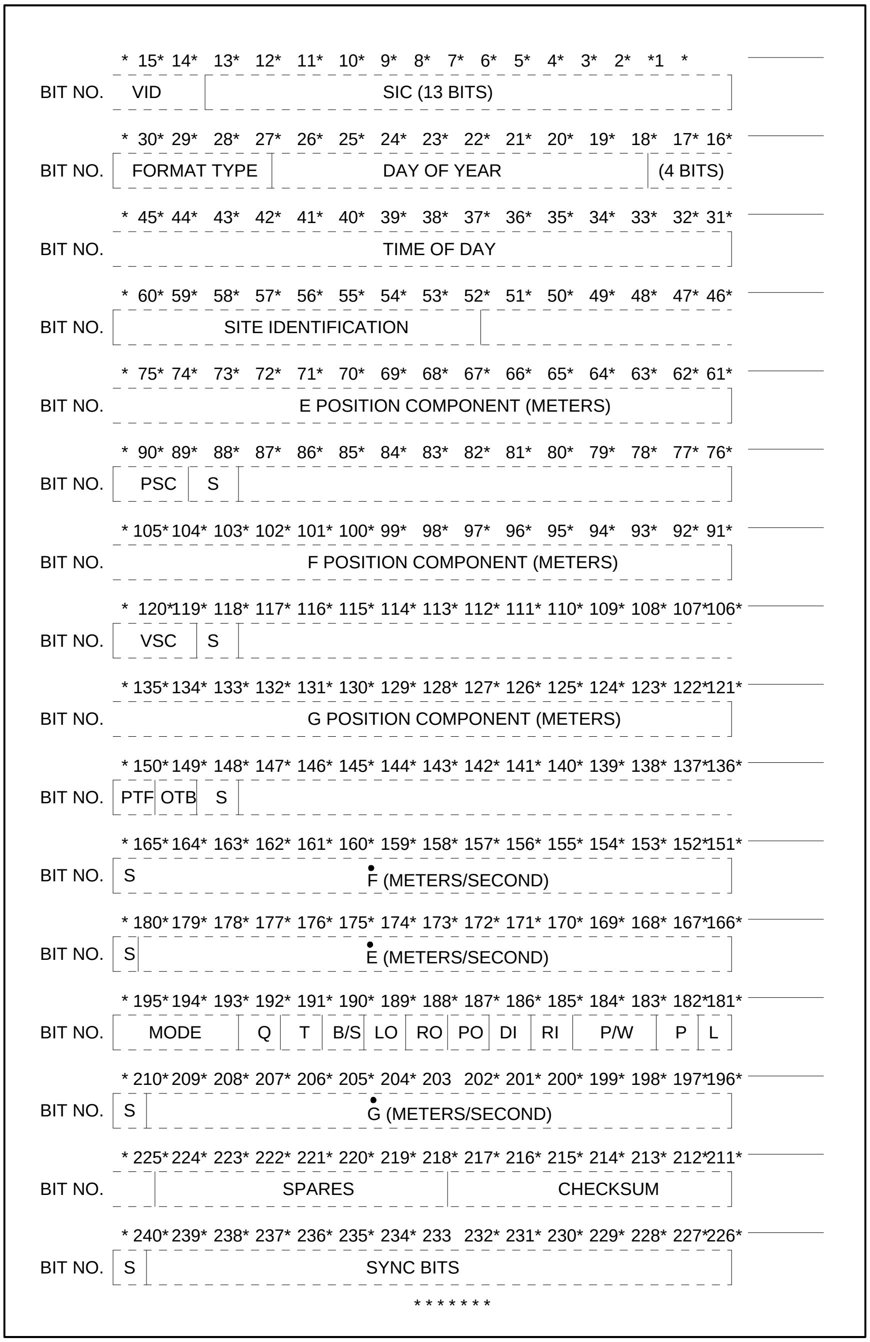
LTAS 2400-b/sec checksum algorithm:

a. The first 210 data bits are treated as fourteen words of 15 bits each. These words are summed, treating them as positive integers, in an accumulator capable of handling a 19-bit positive integer sum.

b. This sum is split up into three parts: the most significant 7 bits, the next most significant 6 bits, and the least significant 6 bits, and these three words are summed, treating them as positive integers, in an accumulator capable of handling an 8-bit positive integer sum.

c. The least significant 7 bits of these sums become the checksum.

*30 bits = 1 word; bit No. 1 = first bit transmitted.



A0389013.DRW:X:N

Figure 3-16. Launch Trajectory Acquisition System 2400-b/sec Data Format

3.3 Slaving Systems

3.3.1 Intrasite Slaving System

3.3.1.1

The Intrasite Slaving System (ISS), composed of slaving switch panels and a slaving junction box, provides a flexible method of slaving one onstation antenna to another. It allows any automatic-tracking type antenna to operate as a leader to drive one or more antennas without affecting the accuracy of the leader or introducing instabilities into the servo systems of either the leader or the slaved antennas.

3.3.1.2

Figure 3-17 illustrates the basic leader-to-slave configuration of the ISS. A slaving system synchro Control Transformer (CT) is mounted on each axis of those types of antennas which are slaves/leaders, and on each of the slave-only antennas. A slaving system synchro-transmitter (TX or CX) is also mounted on each axis of the automatic-tracking (leader) type antennas.

3.3.1.3

All leader and slave systems are interfaced through the slaving junction box. Each slave system also has a slaving switch panel to indicate the availability of leader-type angles. The slaving switch panel has indicators and controls for each of the interfaced systems. An indicator for the associated system will light on the leader system's slaving switch panel when the leader system is being used as a slave source. The upper portion of a split-screen Pushbutton Indicator (PBI) will light on the slave systems slaving switch panel for each leader system that is ready to be used as a slave source. To slave to the desired leader, press the split-screen PBI for the appropriate system. The lower portion of the split-screen PBI will light to indicate that the slave system is indeed slaved to the desired leader. The slaving capabilities of the GN stations with ISS are listed in Table 3-10.

Table 3-10. ISS Slaving Capabilities

Station	Antenna
AGO	12-m * 12-m TDPS* 9-m S-Band* 9-m STPS* 11-m RX/TX * 7-m L-Band RX SATAN TX 7-m RX/TX
MIL	9-m S-band No. 1* 9-m S-band No. 2* TELTRAC, 18 element STPS 1 and 2*
WPS**	STPS 1 and 2* S-band 7.3-m 1 and 2 Rx S-band 6-m TX 9-m S-band*

* These systems can be leaders in the slaving configuration. The others can only be followers.
** WLP indicates Wallops Island tracking radars, WPS indicates Wallops Island orbital tracking (TM/ranging).

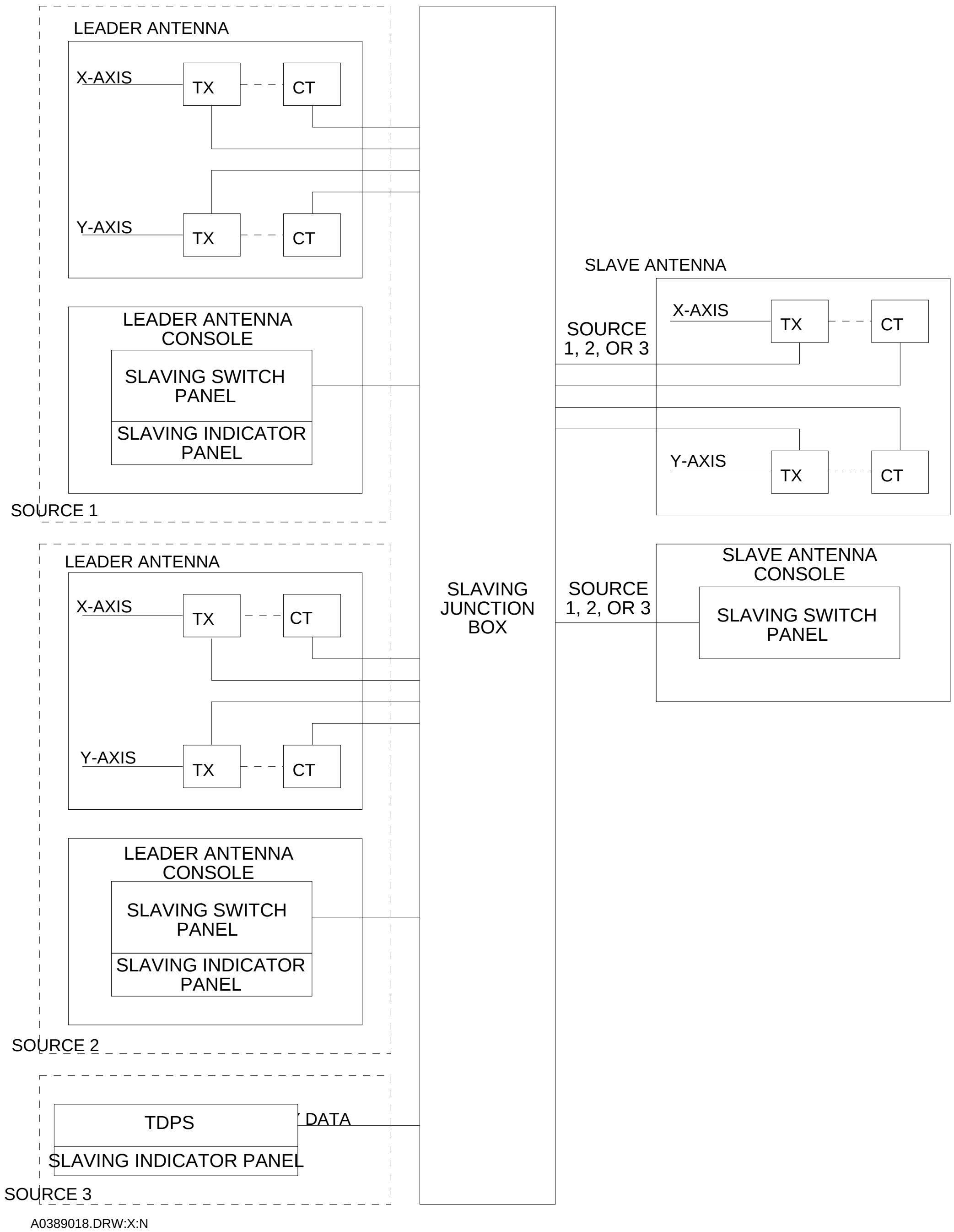


Figure 3-17. Intrasite Slaving System Block Diagram

Section 4. Tracking Data Formats and Reduction Algorithms

4.1 General

This section describes the low- and high-speed tracking data formats transmitted by the GN stations and, where pertinent, from other networks. Applicable reduction algorithms are also given. Appendix E delineates the format applicable to each tracker with references to the paragraph numbers in this section.

4.2 Low-speed Tracking Data Formats

4.2.1 General

This paragraph describes the formats used for transmission of low-speed tracking data which is sent from the station via FTP (post-pass) or teletype circuits. Definitions of the various teletype code symbols are the same as those for acquisition data and are presented in Table 3-2.

Tracking data is sent in eight-level ASCII teletype format by tracking sites and range stations to the NISN Tracking Data System (TDS). The TDS implants the TTY-received tracking data into 4800-bit blocks. This tracking data is transmitted in that 4800-bit block format to a NISN Conversion Device (CD) for Internet Protocol/User Datagram Protocol (IP/UDP) encapsulation and transmission to the FDF or JSC.

4.2.2 Universal Tracking Data Format

4.2.2.1 Introduction

The Universal Tracking Data Format (UTDF) is used by all systems configured with a TDF, or else a STPS, ITCP, & MPA. The means of transmission is FTP (post-pass) from the TDF UTDF files and TRS systems may be via either a low-speed 110-baud TTY circuit or a high-speed 9.6-kb/sec circuit, depending on mission requirements. One sample of data contains 75 bytes and is the same for both low- and high-speed transmission. Table 4-1 describes the contents of a data sample, and Table 4-2 describes the system-unique modes required for bytes 49 and 50.

4.2.2.2 TTY Transmission

UTDF data transmitted via teletype from the TPS is at a sample rate of one sample per 10 seconds. When this Low-sample Rate (LSR) data is required by JSC or FDF, NISN packs the data into 4800-bit blocks for transmission. This procedure is discussed in paragraph 4.3.3.

4.2.2.3 FTP Transmission

UTDF data transmitted post-pass via FTP is sent in files consisting of only the 75-byte UTDF frames. No larger block is used.

Table 4-1. Universal Tracking Data Format (1 of 3)

Byte	Format	Description
1	$0D_{(16)}$	Fixed
2	$0A_{(16)}$	Fixed
3	$01_{(16)}$	Fixed
4 to 5	ASCII	Tracking data router: 4141 = AA = GSFC 4444 = DD = GSFC 4646 = FF = GSFC/France (CNES) 4848 = HH = GSFC/Japan 4949 = II = GSFC/Germany (ESRO) 4A4A = JJ = GSFC/JSC
6	Binary	Last two digits of current year
7 to 8	Binary	SIC
9 to 10	Binary	VID
11 to 14	Binary	Seconds of year
15 to 18	Binary	Microseconds of second
19 to 22	FOC	Angle 1; X or az
23 to 26	FOC	Angle 2; Y or el (Angle 2 byte/bit format is the same as for bytes 19-22.)
NOTE For bytes 19-22/23-26, convert angle data to decimal form. Angle data is given in fractions of a circle. To express raw angle in degrees, multiply decimal angle by $8.381903173 \times 10^{-8}$ (360 degrees divided by 2^{32}). When the STPS is initialized as WPS S08 or S37, these bytes will read zero.		
27 to 32	Binary	RTLT in 1/256 nsec (MSB = 524288 ns; LSB = 0.00390625 ns)
33 to 38	Binary	Bias Doppler, counts of: 240 MHz + 1000 $f_{d'}$ LSB = 1 count
39 to 40	Binary	AGC (an integer: $\frac{-150 \text{ AGC}}{8192} - 50 = \text{dBm}$) Note: AGC field not used by systems with TDF
41 to 44	Binary	Transmit frequency information in 10's of Hz
45	Discrete	MSD = antenna size (xmit) as follows: $0_{(16)}$ = less than 1 m $1_{(16)}$ = 3.9 m $2_{(16)}$ = 4.3 m $3_{(16)}$ = 9 m $4_{(16)}$ = 12 m $5_{(16)}$ = 26 m $6_{(16)}$ = TDRSS ground antenna $7_{(16)}$ = 6 m $8_{(16)}$ = 7.3 m $9_{(16)}$ = 8.0 m $A_{(16)}$ through $F_{(16)}$ = spares

Table 4-1. Universal Tracking Data Format (2 of 3)

Byte	Format	Description
45 (cont)		LSD = antenna geometry (xmit) as follows: $0_{(16)}$ = az-el $1_{(16)}$ = X-Y(+X-south) $2_{(16)}$ = X-Y(+X-east) $3_{(16)}$ = RA-DEC $4_{(16)}$ = HR-DEC $5_{(16)}$ through $F_{(16)}$ = spares
46	Binary	Pad ID (xmit) Link ID (refer to Appendix C)
		NOTE If S-band and 3 way, zeros are output. If S-band and 2 way, good data is output. If VHF and 3 way, zeros are output. If VHF and 2 way, byte 45 is 0 and 46 is pad ID.
47	Discrete	Antenna size (rcv; refer to byte 45)
48	Binary	Pad ID (rcv refer to byte 46)
		NOTE If VHF, byte 47 is 0 and 48 is pad ID. If S-band, good data is output.
49-50	Discrete	Mode-system unique (refer to Table 4-2)
51	Discrete	Data validity by bit: 8 = (MSB) sidelobe (1 = sidelobe) 7 = destruct $\dot{R}$ (1 = destruct) 6 = refraction correction to R, $\underline{\dot{R}}$ (1 = corrected) 5 = refraction correction to angles (1 = corrected) 4 = angle data correction (1 = corrected) 3 = angle valid (1 = valid) 2 = $\underline{\dot{R}}$ valid (1 = valid) 1 = (LSB) R valid (1 = valid)
52	Discrete	MSD= frequency band, as follows: $1_{(16)}$ = VHF $2_{(16)}$ = UHF $3_{(16)}$ = S-band $4_{(16)}$ = C-band $5_{(16)}$ = X-band $6_{(16)}$ = Ku-band $7_{(16)}$ = visible $8_{(16)}$ = S-band uplink/Ku-band downlink $9_{(16)}$ through $F_{(16)}$ = spares

Table 4-1. Universal Tracking Data Format (3 of 3)

Byte	Format	Description
52 (cont)	Discrete	LSD = data transmission type, as follows: $0_{(16)}$ = test $1_{(16)}$ = spare $2_{(16)}$ = simulated $3_{(16)}$ = resubmit $4_{(16)}$ = RT (real time) $5_{(16)}$ = PB (playback) $6_{(16)}$ through $F_{(16)}$ = spares
53 to 54	Discrete	MSD = tracker type: Byte 53, bits 8 through 5: $0_{(16)}$ = C-band pulse track $1_{(16)}$ = SRE (S-band and VHF) or RER $2_{(16)}$ = X-Y angles only (data acquisition antenna) $3_{(16)}$ = Spare $4_{(16)}$ = SGLS (AFSCF S-band trackers) $5_{(16)}$ = Spare $6_{(16)}$ = TDRSS $7_{(16)}$ = STGT/WSGTU $8_{(16)}$ = TDRSS TT&C $9_{(16)}$ through $F_{(16)}$ = spares Byte 53, bit 4: 1 = last frame of data (not used by systems with TDF) Byte 53, bits 3 through 1 and eight bits of byte 54: 11 bits for transmission rate (positive indicates the binary seconds between samples up to a maximum of 1023; negative indicates the 2's complement of the number of samples per second).
55 to 72	Spare	
73	$04_{(16)}$	Fixed.
74	$0F_{(16)}$	Fixed.
75	$0F_{(16)}$	Fixed.

Table 4-2. System-unique Modes

System	Bits	Description
C-band	1 (LSB)	0 = beacon, 1 = skin
	2	0
	4,3	00 = autotrack
		01 = program track
		10 = manual
		11 = slaved
	16 to 5	Rest spares
NOTE If for WPS S08 or S37, will always read slaved. If GRT S55 or S57, will always read slaved and angles valid bit will be set when in steptrack mode.		
SRE	1 (LSB)	0 = coherent
		1 = noncoherent
	2	0 = secondary, 1 = primary
	4,3	See C-band
	6,5	00 = not used
		01 = 1-way
		10 = 2-way
		11 = 3-way
	8,7	01 = lowest sidetone 10 Hz
	10, 9	00 = not used
		01 = major tone 20 kHz
		10 = major tone 100 kHz
		11 = major tone 500 kHz
	13 to 11	Autotrack MFR, 1 to 6 (binary) (0 = unknown)
		(MFR not applicable for TDF-equipped systems)
	16 to 14	Range MFR, 1 to 4 (binary) (0 = unknown)
		(MFR not applicable for TDF-equipped systems)
SRE - VHF	2,1	Not used
	4,3	See C-band
	6,5	Not used
	10,7	See SRE

4.2.2.4 Data Reduction Algorithms

The following processes are used to convert UTDF to the decimal form of data, whether transmitted via FTP, TTY or 9.6-kb/sec circuits:

a. Observed Angles. To process, convert angle data to decimal form. To express angle data in degrees, multiply by $8.381903173 \times 10^{-8}$.

NOTE

For X-Y angles only, subtract 360 degrees whenever the converted value exceeds 180 degrees.

b. Observed Range. The observed measurement is Round Trip Light Time (RTLT) in units of 1/256 nsec and is time-tagged at receive time. To process, convert range data to decimal form. In units of length, the range is $R(T) = (c/512)\,10^{-9}\,R_r(T)$

where: c = speed of light in units of length/sec

R_r = raw range value in decimal form

c. Observed Range Rate. The Doppler measurement is the cumulative cycle count of the Doppler frequency plus a 240-MHz bias frequency. It is time tagged at the time of cycle counter reading. To process, convert Doppler data to decimal form. The observed average range rate is:

$$\dot{R}(T_0) = \frac{-c}{2f_T KM}\left[\frac{N(T_0)-N(T_{-1})}{T_0 - T_{-1}} - 2.4 \times 10^8\right] \text{ (units, same as "c")}$$

where: c = speed of light.

f_T = transmit frequency in Hertz.

K = 240/221 for S-band, or 1 for VHF, 880/749 for X-band.

M = 1000 for S-band and VHF, 250 for X-band.

N = cumulative Doppler-plus-bias counter reading

T_0, T_{-1} = time of present and previous Doppler count, respectively

4.2.3 USSTRATCOM B3 Type 2 Radar Data Format

The USSTRATCOM B3 Type 2 data format consists of FPQ-6 radar data originating at WPS and transmitted to USSTRATCOM in real-time via NISN. The USSTRATCOM B3 Type 2 format is illustrated in Figure 4-1 and described in Table 4-3.

```
(NASCOM TTY HEADER)
BT (CR/CR/LF/LF)
UNCLAS (CR/CR/LF/LF)
) ) U n n n i 2 t t t v v v v v d d d h h m m s s 0 0 0 x e e e e e e 0 a a a a a a a 0 r r r r r r r 2 0 c $ $
```

Figure 4-1. USSTRATCOM B3 Type 2 Radar Data Format

Table 4-3. Explanation of USSTRATCOM B3 Type-2 Radar Data Format

Character Number	Character	Explanation
	BT	(Break)
	CR/CR/LF/LF	(2 carriage returns and 2 line feeds)
	UNCLAS	Unclassified message
	CR/CR/LF/LF	(2 carriage returns and 2 line feeds)
1-2	))	Start of message (fixed)
3	U	Unclassified (fixed)
4-6	nnn	000 to 999 = message number; assigned sequentially to observation messages by the reporting station
7	i	Report indicator: 3 = First line 4 = Body line 5 = Last line 8 = Data off track
8	2	Observation type = AZ/EL/R (fixed)
9-11	ttt	Station number: 439 = WLPS FPQ-6
12-16	vvvvv	Satellite number; NORAD classification number.
17-28	dddhhmmss000	Time of observation: DDD = day of year HH = hour of day MM = minutes SS = seconds 000 = fractional part of seconds (fixed)
29-36	xeeeeee0	Elevation: X = sign EEEEEE = elevation in degrees. Decimal point implied between second and third digits from left 0 = weight indicator (fixed)
37-44	aaaaaaa	Azimuth: AAAAAAA = azimuth in degrees. Decimal point implied between third and fourth digits from the left 0 = weight indicator (fixed)
45-53	rrrrrrr20	Range: RRRRRRR = range in kilometers. Decimal point implied between the fourth and fifth digit from the left 2 = exponent (fixed at 2, indicates position of decimal point) 0 = weight indicator (fixed)
54	c	Checksum; sum (Modulo 10) of characters 4 through 53
55-56	$$	End of message

4.2.4 46-character Radar Data Format

4.2.4.1 General

The 46-character C-band format is illustrated in Figure 4-2 and described in Table 4-4. Each line of data is preceded by a line feed and two figure shifts or cancel codes and is followed by a carriage return. Each line is transmitted in the sequence indicated by the character (second column of Table 4-4). The azimuth, elevation, and range data are in octal form with the most significant character transmitted first. This data is transmitted to JSC for Shuttle support. It is packed into 4800-bit blocks at NISN prior to transmission, as illustrated in Figure 4-3.

```
RR↓< ≡                                (start of message)

  ≡↑↑v s s z d h h m m s s a a a a a a a a e e e e e e e e r r r r r r r r d o y s i c c m <
  ≡↑# ↓                               (end of message)

Key:  ↓ = letter shift (5 level) or delete code (8 level)
      < = carriage return
      ≡ = line feed
      ↑ = figure shift (5 level) or cancel code (8 level)
      # = pound sign
```

Figure 4-2. C-band 46-character Radar Data Format

Table 4-4. Explanation of Radar 46-character Format

Number	Characters	Explanation
(SOM)	RR	Low-speed data router where: RR = DD for GSFC only = JJ for JSC and GSFC = KK for GRTS/JSC/ETR = II for GSFC/Germany
	↓	Letter shift (5 level) or delete (8 level)
	<	Carriage return
	≡	Line feed
	↓	Letter shift (5 level) or delete (8 level)
1	≡	Line feed
2 to 3	--	Figure shifts (5 level) or cancel (8 level)
4	v	Vehicle ID (0 to 9)
5 to 6	ss	Station ID (refer to appendix C)
7	z	RADAR ID (0 to 9)
8	d	Data validity (0 = invalid/2 = valid)
9	h	Time (UTC) hours (tens)
10	h	hours (units)
11	m	minutes (tens)
12	m	minutes (units)
13	s	seconds (tens)
14	s	seconds (units)
15 to 21	aaaaaaa	Azimuth angle where: 15 = (0 to 1) 16 to 21 = (0-7) LSB = 0.0006866455 deg
22 to 28	eeeeeee	Elevation angle where: 22 = (0 to 1) 23 to 28 = (0 to 7) LSB = 0.0006866455 deg
29 to 37	rrrrrrrrr	Range where: 29 = (0-1) 30 to 37 = (0-7) LSB = 1.7859375 meters
38 to 40	doy	UTC day of year (000 to 366)
41 to 44	sicc	Support ID code (0000 to 9999)
45	m	Mode where: 1 = beacon 2 = skin 3 = test 4 = last frame
46	CR	Carriage return
(EOM)	≡	Line feed
	↑	Figure shift (5 level) or cancel (8 level)
	#	Pound sign
	↓	Letter shift (5 level) or delete (8 level)

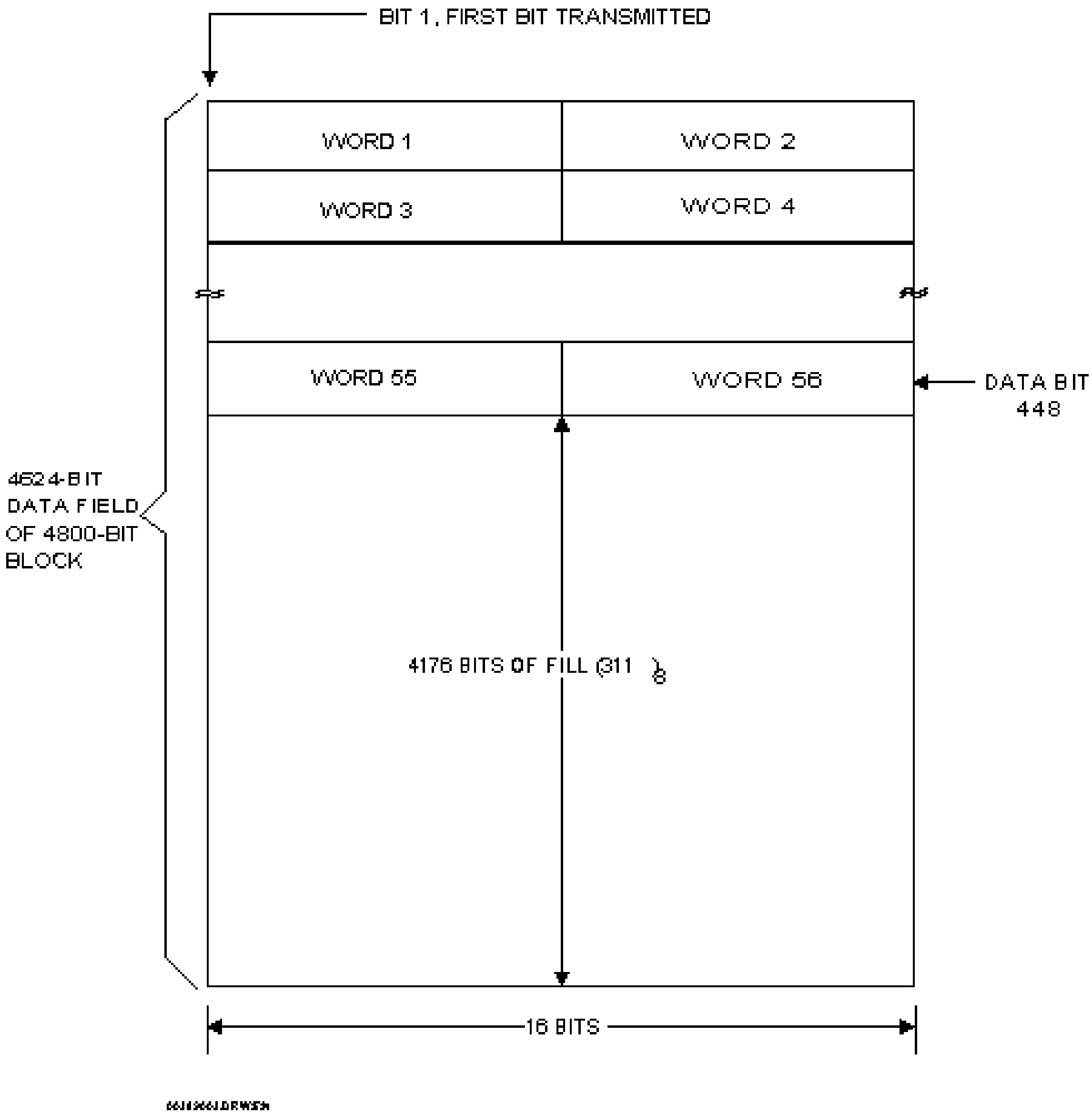


Figure 4-3. Packing of 46-character C-band LSR Data

4.2.4.2 DOD C-band Trackers

The DOD C-band trackers are capable of correcting data for tropospheric and ionospheric refraction upon request. The onstation refraction corrections are documented in STDN No. 601 (mission Network Operations Support Plan [NOSP]). STDN stations do not apply a refraction correction. Transponder delay is always applied onstation.

4.2.4.3 Data Reduction Algorithm

Appropriate conversions are noted in the format description.

4.3 High-speed Tracking Data Formats

4.3.1 General

This paragraph describes the types of high-speed tracking data formats transmitted from the GN. LTAS, which is also used as a tracking data format, is described in paragraph 3.2.4. Refer to appendix E for station format transmission capabilities.

This data is sent in 240-bit blocks by launch-support tracking sites to the NISN TDS. The TDS implants the received high-speed tracking data into 4800-bit blocks. This tracking data is transmitted in that 4800-bit block format to a NISN CD for IP/UDP encapsulation and transmission to the FDF or JSC.

4.3.2 Minimum Delay Data Format

4.3.2.1 General

The MDDF transmit capability exists at WGS and MIL S-band and on the WGS radar. Each frame of data contains 240 bits. See Figure 4-4 for MDDF format, and refer to Table 4-5 for an explanation of the format.

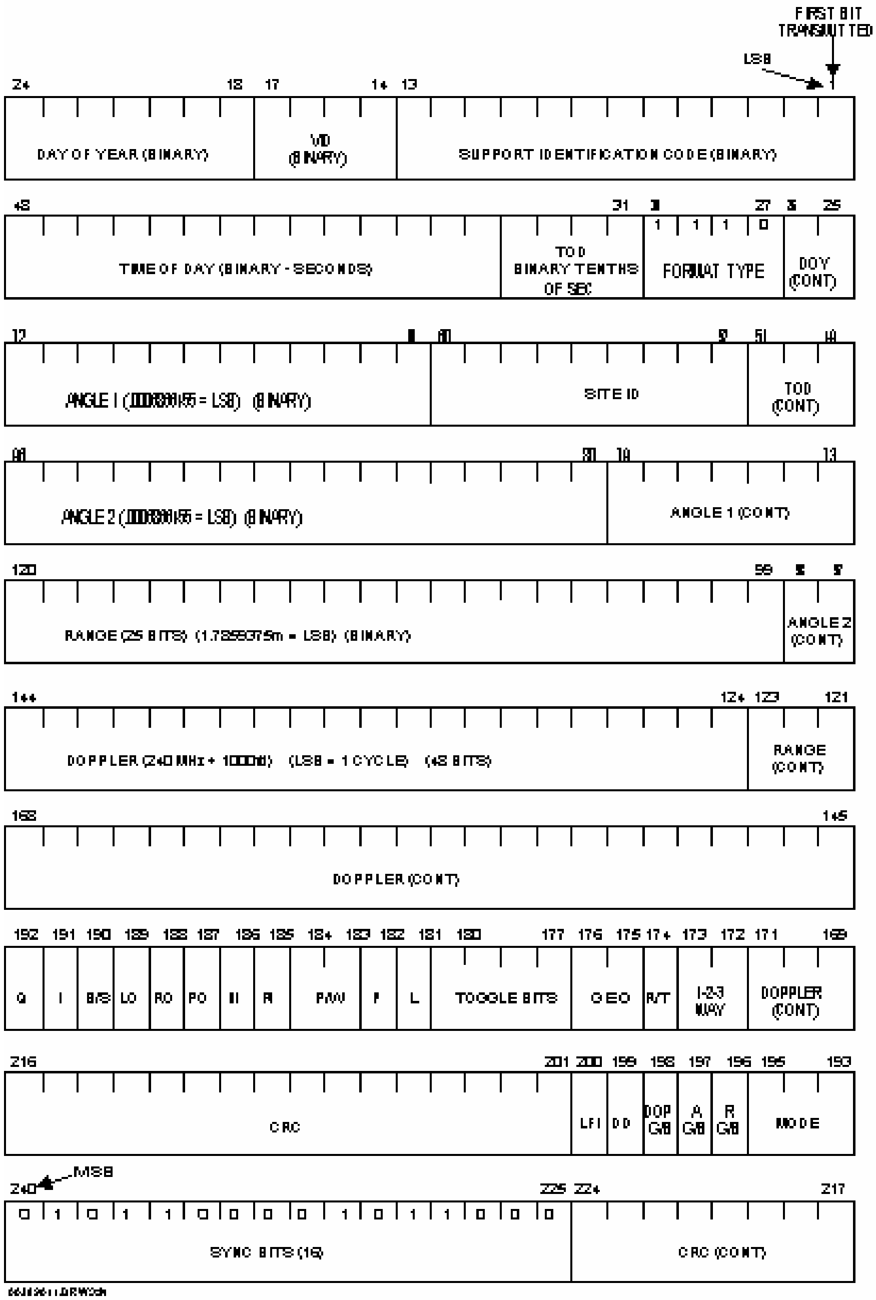


Figure 4-4. MDDF Format

Table 4-5. Explanation of MDDF Format (1 of 2)

Bit	Description
1-13	SIC (binary)
14-17	VID (binary)
18-26	Day of year (binary)
27-30	Format type (binary) $\frac{27}{0}\ \frac{28}{1}\ \frac{29}{1}\ \frac{30}{1}$
31-34	Time of day (binary-tenths of seconds) $\frac{\text{BIT}}{\text{VALUE}} = \frac{31}{0.1}\ \frac{32}{0.2}\ \frac{33}{0.4}\ \frac{34}{0.8}$
35-51	Time of day (binary-seconds) $\frac{\text{BIT}}{\text{VALUE}} = \frac{35}{1}\ \frac{36}{2}\ \frac{51}{65536}$
52-60	Site ID (Refer to Appendix C, Table C-2)
	NOTE To decode the angle fields (bits 61-79/80-98), convert to decimal and multiply by the granularity (0.0006866455 degree). If the result is between 180 and 360 degrees, the angle is negative (except for the azimuth reading on az-el trackers) and can be determined by subtracting 360 degrees from the result.
61-79	Angle 1 (X or azimuth) (LSB = 0.0006866455) (binary)
80-98	Angle 2 (Y or elevation) (LSB = 0.0006866455) (binary)
99-123	Range (LSB = 1.7859375 m) (binary)
124-171	Doppler (counts of 240 MHz + 1000 f_d) (LSB = 1 cycle)*
172-173	One-, two-, or three-way data: 172 173 0 0 = 1-way 1 0 = 2-way 1 1 = 3-way
174	R/T (real/test) 1 = real data
175-176	Geo (antenna geometry): 175 176 0 0 = az-el 1 0 = (X-Y) (+X = south) 1 1 = (X-Y) (+X = east)
177-180	Toggle bits: 177 178 179 180 On one frame: 1 0 1 1 On next frame: 0 1 0 0
181	L (liftoff); 1 = liftoff has occurred
182	P (plunge mode); 1 = plunge
183-184	P/W (Pulse width): 183 184 0 0 = 1.0 m sec 1 0 = 2.4 m sec 0 1 = 5.0 m sec (0.25 sec for WFC radars) 1 1 = 10.0 m sec (0.5 sec for WFC radars)

Table 4-5. Explanation of MDDF Format (2 of 2)

Bit	Description
185	RI (refraction correction) 0 = out, 1 = in
186	DI (droop) 0 = out, 1 = in
187	PO (paramp) 0 = off, 1 = on
188	RO (radiation) 0 = off, 1 = on
189	LO 0 = single LO, 1 = dual LO
190	B/S (beacon/skin) 0 = skin, 1 = beacon
191*	T (track bit) 0 = off, 1 = on
192**	Q (quality bit) 0 = bad, 1 = good
193-195	Mode: 193 194 195
	0 0 0 = manual
	1 0 0 = autotrack
	0 1 0 = computer drive
	1 1 0 = on-axis orbital
	0 0 1 = on-axis powered flight
	1 0 1 = on-axis coast
	0 1 1 = autotrack coast
196	R (range) 1 = range good, 0 = range bad
197	A (angles) 1 = angles good, 0 = angles bad
198	DOP (Doppler) 1 = Doppler good, 0 = Doppler bad
199	DD (destruct Doppler) 1 = destruct Doppler
200	LFI (last frame indicator) 1 = last frame
201-224	Cyclic Redundancy Code (CRC)***
225-240	Sync bits will have the following pattern: 0-0-0-1-1-0-1-0-0-0-0-1-1-0-1-0

* The on-track bit (No. 191) is present under the following conditions (or equivalent):

a. All three servos are in auto mode; i.e., have no designation/acquisition source (including manual) selected.

b. Radiation ON.

c. ADRAN/DIRAM range verified.

d. Angle control ADRAN/DIRAM (not autotrack).

e. ADRAN/DIRAM not coast.

** Q-bit ON corresponds to a 6-dB or greater signal-to-noise ratio plus a valid on-track bit (bit 191).

***The TRACQ Program (SCAN Control No. 13-601.X) does not generate a CRC Code for MDDF data. Zeros are output in these positions.

4.3.2.2 Cyclic Redundancy Code

a. A Cyclic Redundancy Code (CRC), formerly called a polynomial error code, is used to protect the data in the MDDF. The data that is to be protected is used to create a polynomial D(X), which is then divided by a known polynomial G(X) of degree 22. The remainder polynomial from this division is then used to determine the 22-bit CRC.

b. The polynomials used have coefficients in F_2, the field with two elements. The following truth tables summarize the necessary facts about F_2:

Addition Table

	0	1
0	0	1
1	1	0

Multiplication Table

	0	1
0	0	0
1	0	1

$F_2 = 0,1$

For example; $F(X) = X^2 + X + 1$ and $G(X) = X^2 + 1$ are two polynomials with coefficients in F_2. Performing the indicated operations on the coefficients in F_2, the following is found:

$$F(X) + G(X) = X \text{ and } F(X); G(X) = X^4 + X^3 + X + 1$$

c. As a simple example of CRCs, consider a data block of eight bits to have three-bit CRC, and generating the polynomial $G(X) = X^3 + X + 1$. Suppose the following eight-bit serial data stream was to be sent:

```
+---------------> 10011110
|
+-------  First bit transmitted
```

d. Generate D(X) = X10 + X7 + X6+ X5 + X4, where the coefficients are the data bits in transmitted order, and the leading power of X is 8 + 3 - 1 = 10. Doing the division, the following is found:

$$X^{10} + X^7 + X^6 + X^5 + X^4 = (X^7 + X^5 + X)(X^3 + X + 1) + (X^2 + X).$$

$R(X) = X^2 + X$ and the CRC is 110 (the coefficients).

e. The eleven bits transmitted are:

```
 ------------------> 10011110      110
|                    Data)        (CRC)
 ------------------  First bit sent
```

f. Computer implementation of this division is as follows:

1. Append three zeros to the data to get the correct polynomial: 10011110000.

2. From left to right, exclusive OR the 4-bit pattern for G(X) at each successive 1:

```
10011110000
1011
  101110000
  1011
      10000
      1011
        110
```

Since an LSB transmit of the data is used, a small change in the algorithm is necessary.

3. By bit flipping the pattern for G(X), D(X) and working right to left, the correct CRC is generated in a form that is directly transmitted as follows:

```
00001111001
       1101
000011101
     1101
00001
 1101
011
```

with a transmitted CRC of 110 (transmitting LSB first).

g. Bits 201 through 224 are the CRC in the MDDF. A 22-bit CRC is used, and the two additional bits are flags that could be used by intervening hardware decoders to indicate that the CRC did not check. Initially, they are zeros.

4.3.3 High-speed Universal Tracking Data Format

4.3.3.1 General

High Sample Rate (HSR) tracking data is available from GN trackers. The means of transmission is either FTP (post-pass) or a high-speed 9.6-kb/sec circuit. Its transmission by NISN utilizes the 4800-bit block structure shown in Figure 4-5 and defined in Table 4-6. Each block is segmented into five distinct fields as shown in Figure 4-5. These fields contain the following:

a. Network Control Header, Bytes 1 through 6. Used to identify the start and type of message of each 4800-bit data block.

b. User Header, Bytes 7 through 12. Contains the information required by the user to route and process the data contained in the block. Note that bits 65-72 (refer to Table 4-6) define the type of tracker and the type of UTDF (LSR or HSR) data.

c. Time Field, Bytes 13 through 18. This field is set to logical ones in TDRS data. This is an optional NASA entry-binary time code (reception time of first bit in the data field bit 145).

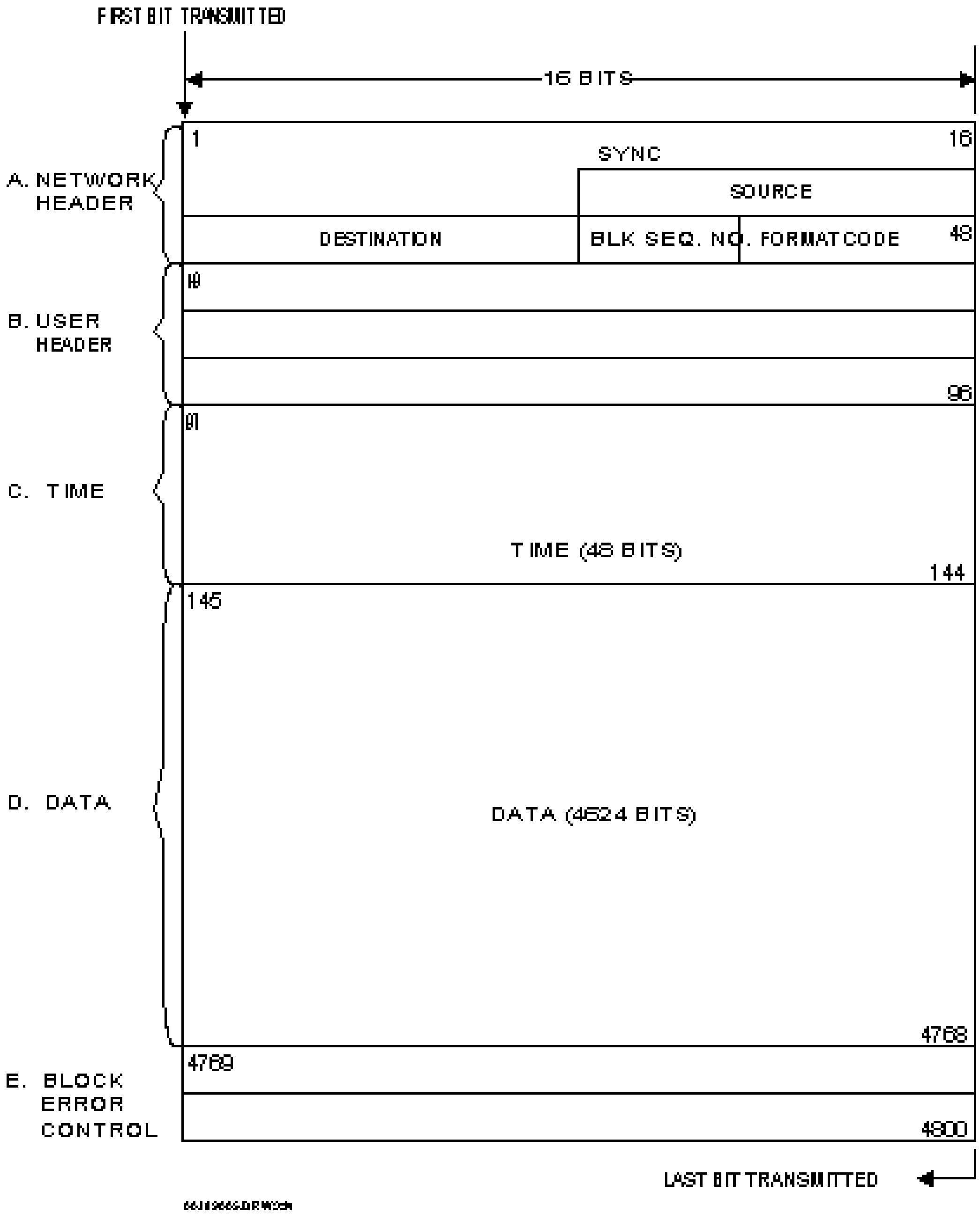


Figure 4-5. 4800-bit Data Block Structure

Table 4-6. 4800-bit Block Structure, Tracking Data (1 of 2)

Bit Number	Description
	Network Header
1 to 24	Synchronizaton: A bit pattern identifying beginning of block sync pattern = 011 000 100 111 011 000 100 111 (30473047 octal) (627627 hex)
25 to 32	Source: Geographic source of the data (note)
33 to 40	Destination: Geographic destination of the data (note)
41 to 43	Block Sequence Number: Identifies the sequence in which the source transmits the block. Set to 0 in DSN format.
44 to 47	Format Code: Identifies general type of data C-band = 0110 TDPS = 1110 tracking data TDRSS = 0101 TDPS UPDATE DATA = 0001
48	Block Size: 1 = 4800 bit block/0 = 1200 bit block
	User Header
	NOTE 1. This header field varies depending on user requirements. Two user headers will be detailed; the user header transmitted by STDN and the user header transmitted by TDRSS. 2. Refer to *Digital Data Source/Destination and Format Code Handbook for the NISN Nascom Message Switching System*, GSFC-NISN-COM-99-001 , or *NASA Communications Operating Procedures*, Volume 1, 452-006 for these codes. NISN controls these documents.
	STDN User Header
49 to 56	Source Circuit ID: Identifies, by circuit, the geographic source of the data (refer to Table 4-7). If a DSN rate of 1 sample/sec, 1/10 sec, or 1/60 sec is selected, this field is overwritten with 001 octal.
57 to 60	Source Circuit Sequence No. Sequence number assigned on a circuit basis.
61	Spare
62 to 64	Block Sequence No. Same information as Block Sequence No. in the Network Header. This number is repeated here because the Network Header Block Sequence Number will be overwritten when the data is retransmitted from GSFC to JSC. Set to 0 when DSN sample rate is used.
65 to 72	Message Type: 251 octal = S-band HSR tracking data. (A9 hex) 106 octal = MDDF tracking data (46 hex) 211 octal = S-band LSR tracking data. (89 hex) 367 octal = S-band LSR (TTY) tracking data (F7 hex) 370 octal = C-band 46 character tracking data. (F8 hex) 360 octal = TDRSS user and TT&C tracking data (hex F0)
73 to 80	Destination: Geographic destination of the block. Same as destination in Network Header.
81 and 82	Spares
83	Full Block Flag: Set = 0 if fill pattern contained in the data field. Fill pattern = 311 octal.
84 to 96	Data Length: Binary count of number of actual data bits in the block. Fill bits not included. When using STDN rate of 10:1 or DSN rate of 1:1, this should be 4200. When using DSN rate of 1:10 or 1:60, it should be 600.

Table 4-6. 4800-bit Block Structure, Tracking Data (2 of 2)

Bit Number	Description
TDRSS User Header	
49 to 52	Block Sequence No.: Block sequence number within a message
53 to 64	Message Identity: 4095
65 to 71	Fixed at 0001111
72 to 75	Message Type. Fixed at 0001
76 to 80	Protocol Control Flags
81 and 82	Spares
83	Full Block Flag. (No fill data.)
84 to 96	Message Field Size: The number of data bits in the data field, excluding fill data (600 for sample rates of 1/10 sec and 1/60 sec, and 4200 for sample rates of 1/10 sec and 1/sec)
Time Field	
97 to 144	TDRSS Data: Time field set to logical ones STDN/NASA: This is an optional binary time code that indicates the time of reception of the first data bits (bit 145). DSN: Tracking Data Processor System (TDPS) tracking data transmitted to JPL contains a time tag in a modified PB4 format:
NOTE In the Parallel Binary Time format, PB1 is to milliseconds resolution and PB4 to microseconds. The modified PB4 format merely sets all microsecond bits to zero, in effect changing the PB4 value to the PB1 resolution.	
97 to 98	Parity, set to zero.
99 to 107	Day of year, binary.
108 to 134	Milliseconds of day.
135 to 144	Microseconds, set to zero.
NOTE UTDF sample rate selection determines the contents of this field. A rate of 10:1 sec sets field to zeros. Other rates insert the PB4 format.	
Data Field	
145 to 4768	Tracking Data. From 1 to 7 UTDF frames of data at a 10/sec, 1/sec, 1/10 sec, or 1/60 sec sample rate. If less than 7 frames of data in the data field then a FILL data pattern (311 octal) will be inserted following the data. Bits 4345 through 4400 and Bits 4641 through 4768 will always contain fill data. Bits 4401 through 4640 will contain Tracking Residuals and Time if HSR data, and transmitting station is GDS, RID, or NBE, and sample rate is other than 10/sec; if sample rate is 10/sec then these bits will contain fill data also. (The data field is transmitted sequentially in 8-bit with the most significant byte transmitted first. STDN transmits the LSB of each byte first, while TDRSS transmits the MSB of each byte first. See Figure 4-7 for layout of packing of HSR data.)
	Block Error Control. This field set to 1's for TDRSS
4769 to 4776	STDN. Spare.
4777	STDN Polynomial Status Flag. Indicates the polynomial check passed/failed at GSFC.
4778	STDN Polynomial Status Flag. Indicates the polynomial check passed/failed at JSC.
4779 to 4800	Polynomial Reminder. This results from encoding the block at the source.

d. Data Field, Bytes 19 through 596, GSTDN/JPL. The data field contains from one to seven tracking data samples (refer to Table 4-1 for description of a sample). If the 9.6 kb/sec circuits are being utilized for transmission of LSR data (refer to paragraph 4.2.2), the sample rate will be 1/10 sec. If HSR data is being transmitted, the sample rate may be 10/sec, 1/sec, 1/10 sec, or 1/60 sec. The portion of the data field between the end of the last tracking data sample and the first bit of the error control field is filled by a fixed pattern of 311 octal.

e. Data Field, Bytes 550 through 579, JPL/DSN 26-m Subnet Only. If HSR data and sample rate is 1/sec, 1/10 sec, or 1/60 sec, these bytes contain Tracking Data Residuals (O-Cs) and Time. If sample rate is 10/sec, these bytes will contain fill data (octal 311).

f. Error Control Field, Bytes 597 through 600. This field is set to logical ones for TDRSS data. NASA uses this field to determine whether bit errors occurred during the transmission of the block.

4.3.3.2 Construction of 4800-bit Block

Regardless of whether UTDF is LSR (refer to paragraph 4.2.2) or HSR (refer to paragraph 4.3.3), when transmitted on 9.6-kb/sec circuits, it is first packed into 4800-bit blocks. Each data sample (shown in Figure 4-6) is packed into a data field as shown in Figure 4-7. This data field will contain up to 7 samples of 75 bytes each, plus fill, plus tracking residuals (JPL only), and when complete, will become that portion of the block labeled DATA in Figure 4-5. The remainder of the block structure is as outlined in the preceding paragraph. The 4800 bit block is transmitted sequentially in 8-bit with the MSB of each byte first, except for the synchronization bits and the source circuit ID bits. TDRSS transmits the MSB of each byte first. See Figure 4-7 for a layout of the packing of the HSR data.

4.3.3.3 Data Reduction

UTDF transmitted on the 9.6-kb/sec lines is converted to decimal form in the same manner as teletype transmission. The algorithms used in this process are discussed in paragraph 4.2.2.4.

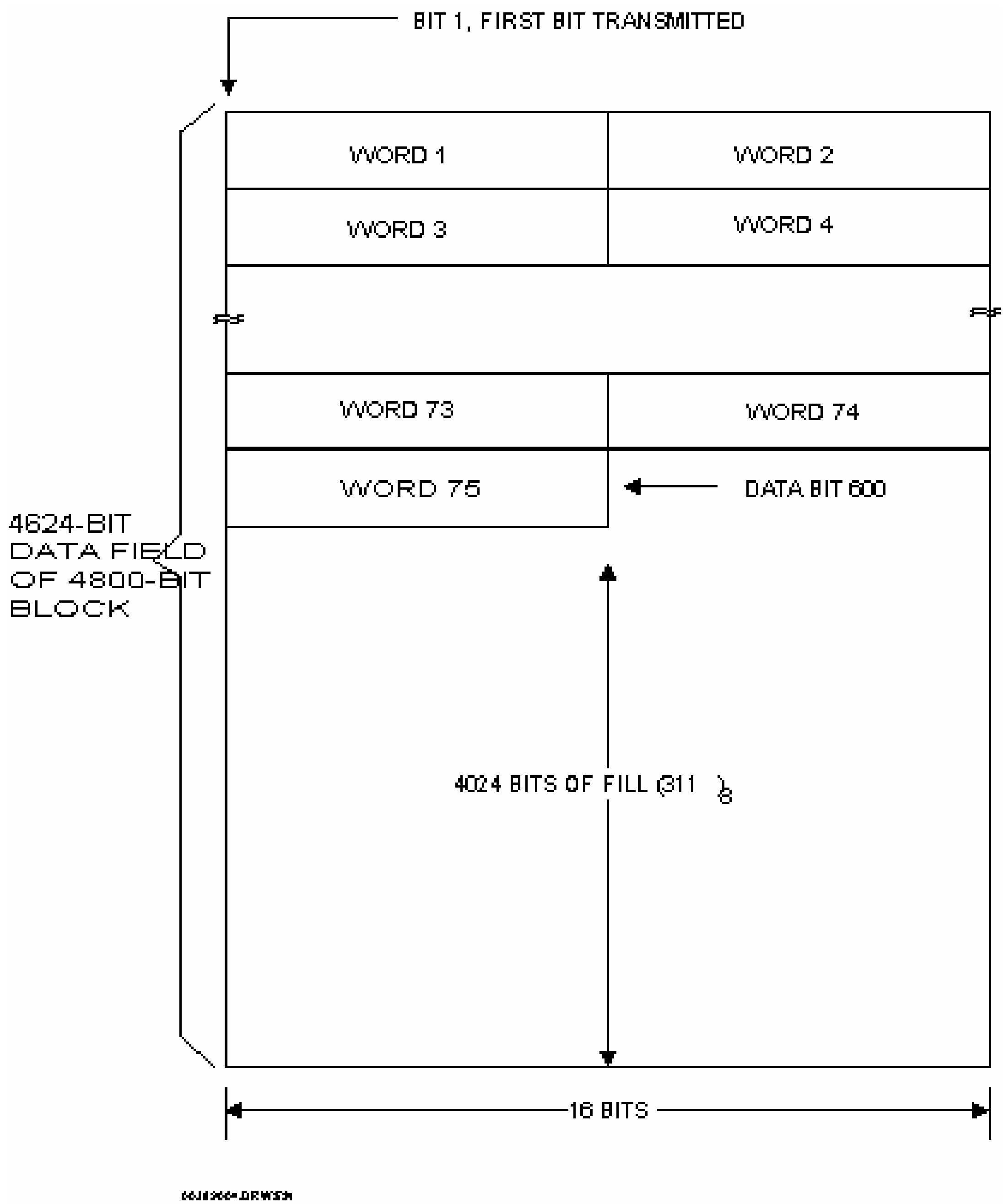


Figure 4-6. Packing of LSR Data Sample (Universal Format)

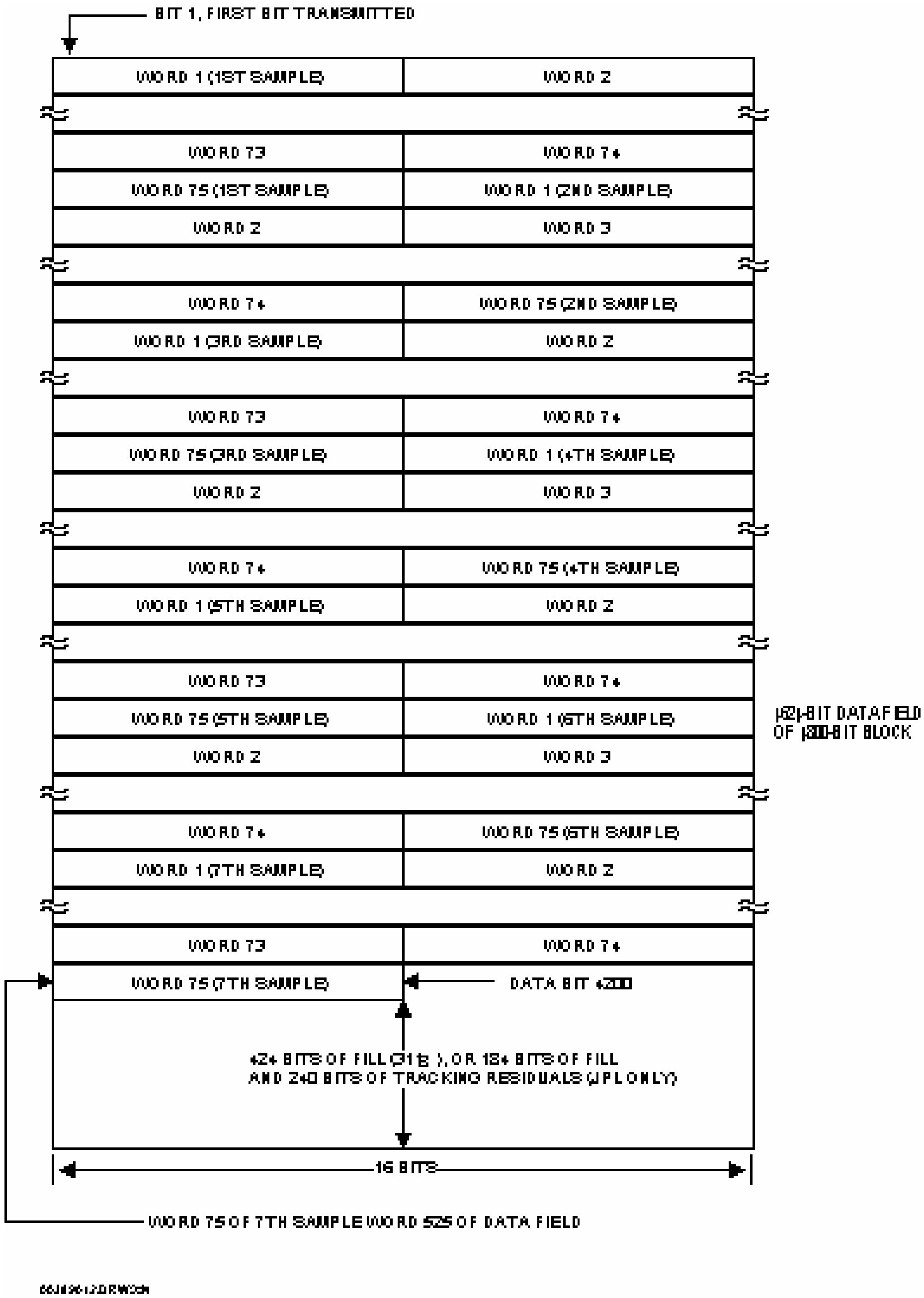


Figure 4-7. Packing of HSR Data Field (Universal Format)

Table 4-7. Source Circuit ID Codes (Octal)

GN Site	Line 1	Line 2	Line 3	9.6 kb/sec Track
SPARE	030	031	032	NA
AGO	040	041	042	NA
SPARE	064	065	066	067
MIL	004	005	006	007
PDL	110	NA	NA	NA
SOCC	134	135	136	NA
VANS	NA	NA	NA	151
WSSH	220	NA	NA	NA
SPARE	153	154	NA	NA
GSFC Interfaces				
TTY/4.8 (Track)	377			
FDF	377			
NCC	377			
POCC	377			
NOTE For GSFC interfaces with source circuit codes of 377, the source circuit sequence number will always contain all ones.				

Section 5. Computer Program Applications

5.1 General

This section gives a general description of the onstation computer programs which process acquisition data (described in Section 3) and transmit tracking data (described in Section 4).

5.2 Tracking and Acquisition Programs

5.2.1 S-band Tracking Processor System

5.2.1.1

The STPS has been designed as a real-time control system and a data processing system for the NASA antenna systems in the GN. The heart of the system consists of two Central Processor Unit (CPU) cards located in a Multibus chassis which are programmed to accomplish the necessary control and data handling functions in real time. The STPS processes acquisition data, controls and monitors the S-band antenna, and records, formats, and transmits tracking data. The STPS interfaces with various antenna systems, the Antenna Control Console (ACC), the Multi-function Receivers (MFR), the Ranging Equipment (RE), the station timing system, and station communications equipment. See Figure 5-1 for a typical STPS configuration. The STPS has three functions. First, it monitors the antenna through incoming data from the Interface to the Antenna Control Console (IACC). Second, the system assists in acquiring and tracking a spacecraft by use of IRV, IIRV, INP, MDDF and LTAS data. The system maintains a data base on disk of IRVs, IIRVs and INPs and integrates and interpolates the respective data to predict the position of a spacecraft. The STPS can then position the antenna to the predicted position through the IACC. Third, the STPS transmits tracking data for a spacecraft over 9.6 kb/sec, 2.4 kb/sec, and TTY data lines.

5.2.1.2

The STPS operational software provides the following functions via two modes of operation, Online and Offline. The Online mode provides all functions required to perform a real time support and perform look angle generation. The Offline mode is used to perform functions which require a full text display at the operators terminal such as site-unique and support-unique files editing and manipulation, playback and resubmit operations, slew tests, and look angle generation when outputting to the Cathod Ray Tube (CRT). All functions available in the Online mode are also available in the Offline mode.

a. Data acquisition from the antenna and range equipment via the IACC.

b. Output antenna drive signals.

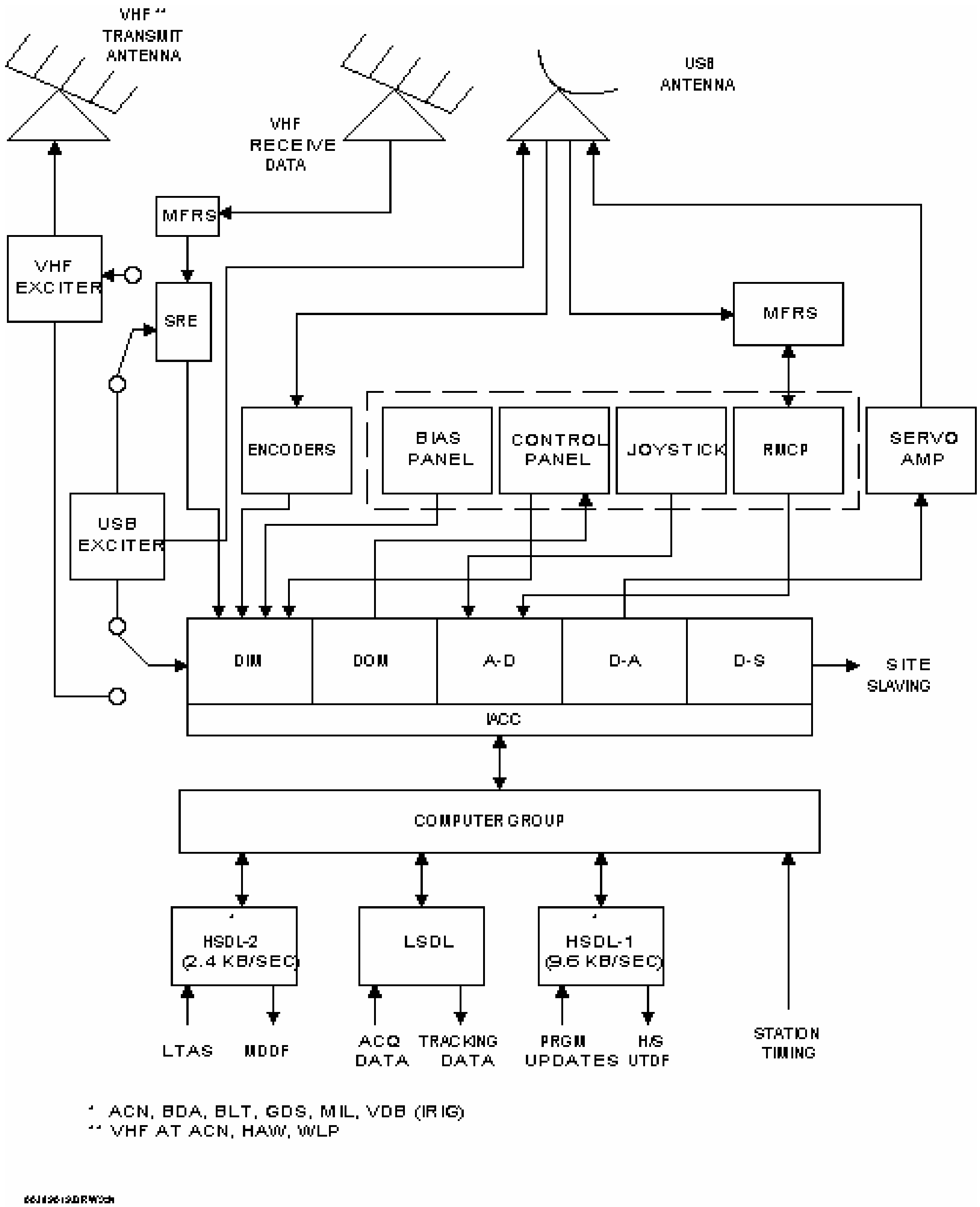


Figure 5-1. Typical USB TPS Configuration

c. Format, output, and log tracking data.

d. Generate spacecraft position predict data.

e. Update CRT display.

f. Drive digital to synchro bus.

g. Receive, store, and retrieve system disk-resident acquisition data.

h. Look angle generation.

i. Playbacks.

j. Log tape delogs.

k. Acquisition data file management.

l. Site file updata and display.

5.2.2 Metric Pointing Assembly

The Metric Pointing Assembly (MPA) is part of the Deep Space Communications Complex (DSCC) Tracking Subsystem (DTK). The MPA performs the tracking and antenna pointing functions for the GN antennas. The MPA consists of two Modcomp 9735 computers, the MPA Controller (MPC) and the MPA Realtime Computer (MPR). The MPC performs the monitor and control functions (directives, displays, etc.). The MPC is also used for local control. The MPR performs the realtime functions (device control, data type generation, etc.) and is connected to the servo subsystem and Receiver Exciter Ranging (RER) equipment. The MPR also receives LTAS data and sends MDDF data to non-DSN users.

5.2.3 Tracking, Telemetry, and Command Processor

5.2.3.1

The TTCP has been designed as a real-time control system and a data processing system for the 4.6 and 10-m antenna systems located at the RGRT station in Canberra. The heart of the system consists of a 80386DX Personal Computer (PC) which is programmed to accomplish the necessary control and data handling functions in real time. The TTCP processes acquisition data, controls and monitors the 10-m S-band antenna and the 4.6-m ku-band antenna, formats and transmits lowspeed UTDF tracking data, and receives control from and sends status to the OMCS. The TTCP interfaces with the antenna systems, the MFR, the RE, the exciter, the station timing system, station communications equipment, and the OMCS. See Figure ____ for a typical TTCP configuration. The TTCP has three functions. First, it monitors the antennas through incoming asynchronous data from the antenna controllers. Second, the system assists in acquiring and tracking a spacecraft by use of IIRV data. The system maintains on disk one IIRV and processes the data to predict the position of the TDRS F1 spacecraft. The TTCP can then position the antenna to the predicted position through the respective antenna controllers. Third, the TTCP transmits tracking data for the TDRS F1 spacecraft over TTY data lines.

5.2.3.2

The TTCP operational software has two modes of operation, Local and Remote. The Local mode allows all functions required to perform a real-time support to be operated from the TTCP. The Remote mode allows all functions required to perform a real-time support to be operated from the OMCS. An IIRV can be entered from the front panel when in Remote mode, but none of the other functions can be used locally. When in Local mode, status is sent to the OMCS, but commands are ignored. The TTCP provides the following:

a. Data acquisition from the antenna and range equipment.

b. Output antenna drive signals.

c. Format and output lowspeed UTDF tracking data.

d. Generate spacecraft position predict data.

e. Update CRT display.

f. Receive, store, and retrieve one disk-resident IIRV acquisition data message.

g. Antenna parameters file update and display.

5.3 Data Correction System Applicability

5.3.1 TPS S-band (Angle Data Correction)

The TPS software contains algorithms to correct tracking data angles for mount misalignment and other system errors. The following equations are used:

a. $X = A_1 - A_2 \sin X \sec Y + A_3 \tan Y - A_4 \sec Y + A_5 \tan Y \sin X - A_6 \tan Y \cos X$

b. $Y = A_7 - A_8 \cos X \sin Y + A_5 \cos X + A_6 \sin X$

where:

ΔX = X-angle correction to be subtracted from X-angle observations
ΔY = Y-angle correction to be subtracted from Y-angle observations
X = X-angle value.
Y = Y-angle value.

A_1 = X-angle encoder bias less tilt (eastward for 9-meter, southward for 26-meter antenna configurations) of upward normal to plane or base of antenna. This coefficient is also referred to as X-angle encoder bias.

A_2 = elevation deflection associated with X-direction (structural sag minus feed droop). This coefficient is also referred to as X-angle structural deflection.

A_3 = Y-axis to X-axis lack of orthogonality.

A_4 = RF-axis to Y-axis lack of orthogonality. This coefficient is also referred to as RF-axis misalignment.

A_5 = tilt of end of X-axis upward (north end for 9-meter, east end for 26-meter antenna configurations).

A_6 = tilt of end (north end for 9-meter, east end for 26-meter antenna configurations) of X-axis (eastward for 9-meter, southward for 26-meter antenna configurations). This coefficient is also referred to as rotation.

A_7 = Y-angle encoder bias less RF-axis to X-axis lack of orthogonality. This coefficient is also referred to as Y-angle encoder bias.

A_8 = elevation deflection associated with Y-direction (structural sag minus feed droop). This coefficient is also referred to as Y-angle structural deflection.

5.3.2 RTPS Computer System

The RTPS program provides the following corrections to the FPQ-6 raw data:

a. Azimuth and elevation servo lag corrections, if selected, are computed in track mode and whenever AGC data is available. The corrections are computed and stored in cells ATC and ETC, respectively, using equations:

1. ATC = COAØ + VA • VRVA

2. ETC = COBØ + VE • VRVE

where:

VA, VE = azimuth and elevation servo error voltages
COAØ, COBØ = nonvariable linear-fit coefficients of azimuth and elevation lag
VRVA, VRVE = azimuth and elevation lag linear-fit coefficients which are tabular functions of AGC

NOTE

These optional dynamic corrections subsequently are added into cells ATT and ETT, respectively, which hold running sums of the dynamic and static error corrections as they are applied.

b. The first static error correction is for null shift. The null shift correction compensates for RF axis shift, which is a function of receiver frequency. Null shifts are combined with the lag corrections into cells ATT and ETT. At present, these cells contain 0's; therefore, the null shift correction has no effect on the input data.

c. Next the program corrects for elevation encoder nonlinearity resulting from encoder bias and eccentricity. The correction is computed and added to cell ETT with the equation:

$$ETT = ETT + ES + EBIAS + ELINB + K_7 \sin(ES + EBIAS + EPHAZ)$$

where:

ES = Raw elevation encoder value
EBIAS = Elevation encoder bias
K_7 = Elevation encoder nonlinearity amplitude
EPHAZ = Phase angle between elevation position and elevation linearity

ELINB = Elevation linearity position bias

d. Elevation is then corrected for antenna droop with the equation:

$ETT = ETT + K_0 \cos ETT$

where:

K_0 = Antenna droop angle at 0 degrees elevation.

e. From the corrected elevation angle computed above, the program performs a secant correction to computer azimuth error. Then it corrects for azimuth encoder nonlinearity and for nonorthogonality relative to the elevation axis. The three equations used for these corrections are:

1. $ATT = ATT \dfrac{1}{\cos ETT}$

2. $ATT = ATT + AS + ABIAS + ALINB + K_6 \sin(AS + ABIAS + APHAZ)$

3. $ATT = ATT + K_1 \tan ETT$

where:

AS	=	Raw azimuth encoder value
ABIAS	=	Azimuth encoder bias
K_6	=	Azimuth encoder nonlinearity amplitude
APHAZ	=	Phase angle between azimuth position and azimuth linearity
K_1	=	Angle between the true Z axis and the Z axis of the radar where, looking in the direction of 0 degrees azimuth, positive direction is to the right
ALINB	=	Azimuth linearity position bias

f. Finally, azimuth and elevation are corrected for pedestal misalignment, or leveling error, with the equations:

1. $ATT = ATT + K_2 \sin(ATT + K_3) \tan ETT$

2. $ETT = ETT + K_2 \cos(ATT + K_3)$

where:

K_2 represents the expression $\sqrt{P^2 + R^2}$
K_3 represents the expression tan $-1_{R/P}$

and where:

P = pedestal pitch at 0 degrees azimuth
R = pedestal roll at 0 degrees azimuth

g. After all corrections are made, the corrected azimuth and elevation are loaded into cells AZ and EL for program use.

5.4 Masking

The acquisition and tracking programs contain limits beyond which the antenna may not move. These limits are categorized as follows:

a. Hardware Limits. These are limits imposed by the mechanical design of the antenna. If these limits were to be exceeded, the antenna would crash into itself. The antenna servo system automatically turns off when this limit is reached.

b. Terrain Limits. Terrain limits are imposed by the contour of the nearby terrain. If these limits were to be exceeded, the antenna would be attempting to track through hills and mountains.

c. Restricted Zone Limits. The radiation into certain areas might interfere with private life in these areas.

5.5 System Applicability

The TDPS computer program contain masking which takes all three types of limiting into consideration. Radiation restrictions may be fulfilled by adjustment of mechanical limit switches.

Section 6. Magnetic Tape Record Formats and Usage

6.1 Introduction

The tape formats described are intended to be applicable for the various systems currently being developed. An identical drive is being used on the STPS and RTPS systems. The model F880 Cipher drive and the Ciprico Tapemaster A multibus controller were chosen for the systems. The Cipher drive supports 100/50/25 IPS and 3200/1600 BPI. The Cipher drive has a high density for the application. This switch, in combination with the speed select bit in the Tapemaster setup, defines the speed/density used. The software for the application selects the lower speed. Table 6-1 defines the possible combinations.

Table 6-1. Speed and Density Combinations

Speed (IPS)	Density	
	High (3200)	Low (1600)
Low	25	25
High	50	100

6.2 Tape Block Formats and Tape Operation

6.2.1

The application software currently defines five different tape block types (refer to Appendix F). To simplify controller driver software, all block types are the same size. The current block size is 32000 bytes. If all bytes are not used, the block is padded to the full block size.

6.2.2

Support for multiple logging sessions is provided by writing one filemark at the end of the logging session.

6.2.3

Any data that may not always be valid is provided with a status bit to flag whether or not it is currently valid in the block. All other data is always updated for each block.

6.3 Tape Block Types

6.3.1 Tape Block Type 1: Dynamic System Status Tape (RTPS or STPS)

Tape block type 1 is used to record data that is changing on a regular basis, such as stream data. This block is different from the rest of the other block types in one case. The size of this block is 1200 bytes versus 12000. This is to allow 10 samples of data per second. However, ten blocks are collected and written to tape as if they were a single block. Space is available in this block to support unique raw data for the different systems. Refer to paragraph F.1 of Appendix F.

6.3.2 Tape Block Type 2 (RTPS or STPS)

Tape block type 2 is mainly used to log input and output acquisition messages. This block would normally be written to the tape when new data is available. Refer to paragraph F.2 of Appendix F.

6.3.3 Tape Block Type 3 (RTPS or STPS)

Tape block type 3 is used to log less common acquisition data messages. These include Brouwer, EPV, and digital synchro messages. At this time, block type 3 is used in the STPS system only. This block would normally be written to tape when new data is available. Refer to paragraph F.3 of Appendix F.

6.3.4 Tape Block Type 4 (RTPS)

Tape block type 4 is used to record ASCII-based system configuration and control messages provided by the Work Station. This block is used currently by the RTPS only. This block would normally be written to the tape when new data is available. Refer to paragraph F.4 of Appendix F.

6.3.5 Tape Block Type 5 (STPS)

Tape block type 5 is used to log raw UTDF Nascom blocks. This block is currently only used on the STPS system. This block would normally be written to the tape when new data is available. Refer to paragraph F.5 of Appendix F.

Appendix A.
Determination of the Local Topocentric Vector at a Tracking Station

Appendix A. Determination of the Local Topocentric Vector at a Tracking Station

A.1

The local topocentric vector from a tracking station to a space vehicle has components along axis defined as follows:

a. The Z-axis is toward the local zenith, aligned with the direction of a plumb bob.

b. The Y-axis is in the north direction and the X-axis is in the east direction, both in a plane defined by a spirit level.

A.2

The inertial geocentric vector to the spacecraft is given in a true-of-date equinox and equator system whose coordinate axes are defined by:

a. The Z-axis is directed toward the north celestial pole.

b. The X-axis is the vernal equinox.

c. The Y-axis is 90 degrees E of the X-axis in the plane of the celestial equator.

A.3

The coordinates of every tracking station are given in an earth-fixed geocentric equatorial system in which:

a. The X-axis is in the equator through the point of zero longitude.

b. The Y-axis is in the equator through the point of +90 degrees longitude.

c. The Z-axis is through the north pole.

A.4

Given:

$\bar{R}s$ = coordinates of a station in the earth-fixed equatorial system

$\bar{R}(t)$ = coordinates of a space vehicle in the inertial true-of-date equinox and equatorial system

Let:

Σ = eastward deflection of the vertical
η = northward deflection of the vertical
W_e = rotation rate of the earth
t_o = epoch; i.e., a reference time
t = time of an observation
λ_o = GHA at time to (GHA = Greenwich hour angle of the vernal equinox)

A.5

Form $\bar{R}_T$, where:

$\bar{R}_T$ = local topocentric position vector of the space vehicle

A.6

Form λ, where:

$$\lambda = \lambda_o + W_e (t - t_o)$$

A.7

Form sines and cosines of spherical coordinates of a station as follows:

$$\sin\phi_S = \frac{Z_S}{R_S} \qquad \cos\phi_S = \frac{\sqrt{X_S^2 + Y_S^2}}{R_S}$$

$$\sin\lambda_S = \frac{Y_S}{\sqrt{X_S^2 + Y_S^2}} \qquad \cos\lambda_S = \frac{Y_S}{\sqrt{X_S^2 + Y_S^2}}$$

where:

$$\begin{bmatrix} X_S \\ Y_S \\ Z_S \end{bmatrix} = \bar{R}_S$$

and:

$$R_S = \text{magnitude } \bar{R}_S$$

A.8

Form matrices for required transformations:

$$M_\Sigma = \begin{bmatrix} 1 & 0 & \eta \\ 0 & 1 & \Sigma \\ -\eta & -\Sigma & 1 \end{bmatrix}$$

$$M_{\phi_S} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \sin\phi_S & \cos\phi_S \\ 0 & -\cos\phi_S & -\sin\phi_S \end{bmatrix}$$

$$M_{\lambda_S} = \begin{bmatrix} \cos\lambda_S & \sin\lambda_S & 0 \\ -\sin\lambda_S & \sin\lambda_S & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$M_{\lambda} = \begin{bmatrix} \cos\lambda_S & \sin\lambda_S & 0 \\ -\sin\lambda_S & \sin\lambda_S & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

A.9

Then:

$$\bar{R}_T = M_\Sigma \, M_{\phi_S} \, M_{\lambda_S} \, (M_\lambda \, \bar{R} - \bar{R}_S \qquad \text{(A-1)}$$

where:

$\bar{R}_T$ is the local (east, north, up) topocentric position vector of the space vehicle;

for example:

$\bar{R}_T = (X_T, Y_T, Z_T)$

T is such that the direction cosine ℓ is given by:

$\ell = X_T/R_T$

$\sin E_L = Z_T/R_T$

$\bar{R}_T$ is the magnitude of $\bar{R}_T$

A.10

Note that (A-1) may be written:

$$R_T = M_\Sigma \, M_{\phi_S} \, M_{\lambda_S} \, M_\lambda \, (R - M_\lambda \, T \, \bar{R}_S) \qquad \text{(A-2)}$$

where:

$M_{\phi_S} \, M_{\lambda_S} \, M_\lambda$ is the transpose of the matrix ϕ (discussed in the Network Computing and Analysis Division *DEBTAP Mathematics Manual*).

$\bar{R} - M_\lambda \, T\bar{R}_S$ (normalized) is the unit vector L.

NOTE

The DEBTAP computer program has no provisions for deflection of the vertical, which means a tacit assumption that:

$$\Sigma = \eta = 0$$

M_Σ becomes the identity matrix and can be removed from (A-1) and (A-2), enabling complete agreement with the DEBTAP algorithms.A.11

The local topocentric unit vector in the direction from station to space vehicle, L_T, is formed by normalizing $\bar{R}_T$; i.e.,

$$\bar{L}T = \frac{\bar{R}_T}{R_T}$$

where:

R_T is the length of R_T.

Appendix B.
Antenna Angular Relations

Appendix B. Antenna Angular Relations

B.1 General

B.1.1

Denote the S-band 26-meter (85-ft) and the rotated 9-meter (30-ft) angles by X_{85} and Y_{85}, the nonrotated S-band 9-meter (30-ft) (also applicable for the 9-meter with +X south orientations) and the Data Acquisition 26-meter and 12-meter (40-ft) angles by X_{30} and Y_{30}; azimuth and elevation angles by AZ and EL; hour angle and declination by HA and DEC. Referring to Figure B-1, these angles are defined as follows:

$-X_{85}$ is angle ACF

Y_{85} is angle FOR

X_{30} is angle AOB

Y_{30} is angle BOR

AZ is angle EOD

EL is angle ROD

L is the cosine of angle ROC

M is the cosine of angle ROE

-HA is angle AOB when = 0

DEC is angle BOR when = 0

where ϕ is the geodetic latitude of the station.

B.1.2

In Figure B-1 the unit vector in the direction OR can be expressed by:

$$\begin{bmatrix} L \\ M \\ \sqrt{L^2 - M^2} \end{bmatrix} = \begin{bmatrix} \sin X_{30} \cos Y_{30} \\ \sin Y_{30} \\ \cos X_{30} \cos Y_{30} \end{bmatrix}$$

$$= \begin{bmatrix} \sin Y_{85} \\ -\sin X_{85} \cos Y_{85} \\ \cos X_{85} \cos Y_{85} \end{bmatrix}$$

$$= \begin{bmatrix} \sin AZ \cos EL \\ \cos AZ \cos EL \\ \sin EL \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\phi & -\sin\phi \\ 0 & \sin\phi & \cos\phi \end{bmatrix} X \begin{bmatrix} -\cos DEC \sin HA \\ \sin DEC \\ \cos DEC \cos HA \end{bmatrix}$$

B.1.3
From these vectors, trigonometric identities establish the relationship between all combinations of pairs of angular coordinates and direction cosines.

B.1.4
To eliminate the ambiguity of quadrant determination for AZ and HA, use the following equation:

$$\tan A = \frac{\text{numerator}}{\text{denominator}}$$

where:

Numerator	Denominator	Quadrant
≥0	>0	$0^o \leq A < 90^o$
>0	0	$A = 90^o$
≥0	<0	$90^o < A \leq 180^o$
<0	<0	$180^o < A < 270^o$
<0	0	$A = 270^o$
<0	>0	$270^o < Z < 360^o$

B.2 Equations

The following 10 sets of equations define the relationships of pairs of angles (or direction cosines):

a. Equation B-1.

AZ, EL ⟷ X_{30}, Y_{30}

$$\sin Y_{30} = \cos EL \cos AZ$$

$$\tan X_{30} = \cot EL \sin AZ$$

$$\sin EL = \cos Y_{30} \cos X_{30}$$

$$\tan AZ = \frac{\sin X_{30}}{\tan Y_{30}}$$

b. Equation B-2.

AZ, EL ⟷ X_{85}, Y_{85}

$$\sin Y_{85} = \cos EL \sin AZ$$

$$\tan X_{85} = -\cot EL \cos AZ$$

$$\sin EL = \cos Y_{85} \cos X_{85}$$

$$\tan AZ = \frac{\tan Y_{85}}{(-\sin X_{85})}$$

c. Equation B-3.

$$AZ, EL \longleftrightarrow HA, DEC$$

$$\sin DEC = \cos \phi \cos EL \cos AZ + \sin \phi \sin EL$$

$$\tan HA = \frac{-\cos EL \sin AZ}{\cos \phi \sin EL - \sin \phi \cos EL \cos AZ}$$

$$\sin EL = \sin \phi \sin DEC + \cos \phi \cos DEC \cos HA$$

$$\tan AZ = \frac{-\cos DEC \sin HA}{\cos \phi \sin DEC - \sin \phi \cos DEC \cos HA}$$

d. Equation B-4.

$$AZ, EL \longleftrightarrow L, M$$

$$L = \sin AZ \cos EL$$

$$M = \cos AZ \cos EL$$

$$\tan AZ = \frac{L}{M}$$

$$\sin EL = \sqrt{1-L^2-M^2}$$

e. Equation B-5.

$$X_{30}, Y_{30} \longleftrightarrow X_{85}, Y_{85}$$

$$\sin Y_{85} = \cos Y_{30} \sin X_{30}$$

$$\tan X_{85} = \frac{-\tan Y_{30}}{\cos X_{30}}$$

$$\sin Y_{30} = -\cos Y_{85} \sin X_{85}$$

$$\tan X_{30} = \frac{\tan Y_{85}}{\cos X_{85}}$$

f. Equation B-6.

$$X_{30}, Y_{30} \longleftrightarrow HA, DEC$$

$$\sin DEC = \sin Y_{30} \cos \phi + \cos Y_{30} \cos X_{30} \sin \phi$$

$$\tan HA = \frac{-\cos Y_{30} \sin X_{30}}{\cos Y_{30} \cos X_{30} \cos \phi - \sin Y_{30} \sin \phi}$$

$$\sin Y_{30} = \cos \phi \sin DEC - \sin \phi \cos DEC \cos HA$$

$$\tan X_{30} = \frac{-\cos DEC \sin HA}{\sin \phi \sin DEC + \cos \phi \cos DEC \cos HA}$$

g. Equation B-7.

$X_{30}, Y_{30} \longleftrightarrow L, M$

$$L = \sin X_{30} \cos Y_{30}$$

$$M = \sin Y_{30}$$

$$\tan X_{30} = \frac{L}{\sqrt{1-L^2-M^2}}$$

$$\sin Y_{30} = M$$

h. Equation B-8.

$X_{85}, Y_{85} \longleftrightarrow HR, DEC$

$$\sin DEC = \cos Y_{85} \sin (\phi - X_{85})$$

$$\tan HA = \frac{-\sin Y_{85}}{\cos Y_{85} \cos (\phi - X_{85})}$$

$$\sin Y_{85} = -\cos DEC \sin HA$$

$$\tan X_{85} = \frac{\sin \phi \cos DEC \cos HA - \cos \phi \sin DEC}{\cos \phi \cos DEC \cos HA + \sin \phi \sin DEC}$$

i. Equation B-9.

$X_{85}, Y_{85} \longleftrightarrow L, M$

$$L = \sin Y_{85}$$

$$M = -\sin X_{85} \cos Y_{85}$$

$$\tan X_{30} = \frac{M}{\sqrt{1-L^2-M^2}}$$

$$\sin Y_{85} = L$$

j. Equation B-10.

$HA, DEC \longleftrightarrow L, M$

$$L = -\cos DEC \sin HA$$

$$M = \cos \phi \sin DEC - \sin \phi \cos DEC \cos HA$$

$$\sin DEC = M \cos \phi + \sqrt{1-L^2-M^2} \sin \phi$$

$$\tan HA = \frac{L}{M \sin \phi - \sqrt{1-L^2-M^2} \cos \phi}$$

B.3 System Orientations

Figures B-2 and B-3 show the relationship of Az - El to X - Y coordinates for the different system orientations used in the STDN.

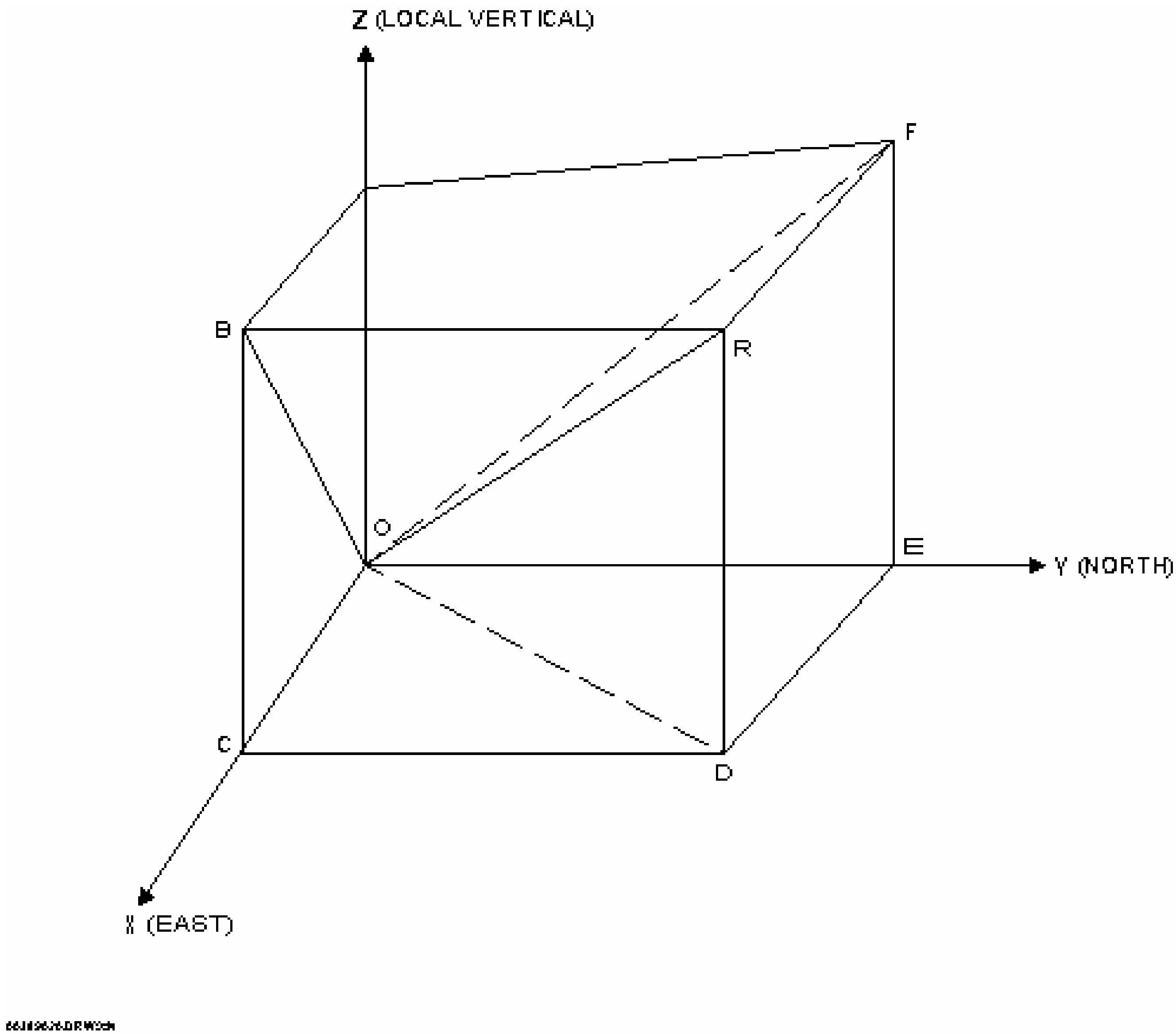
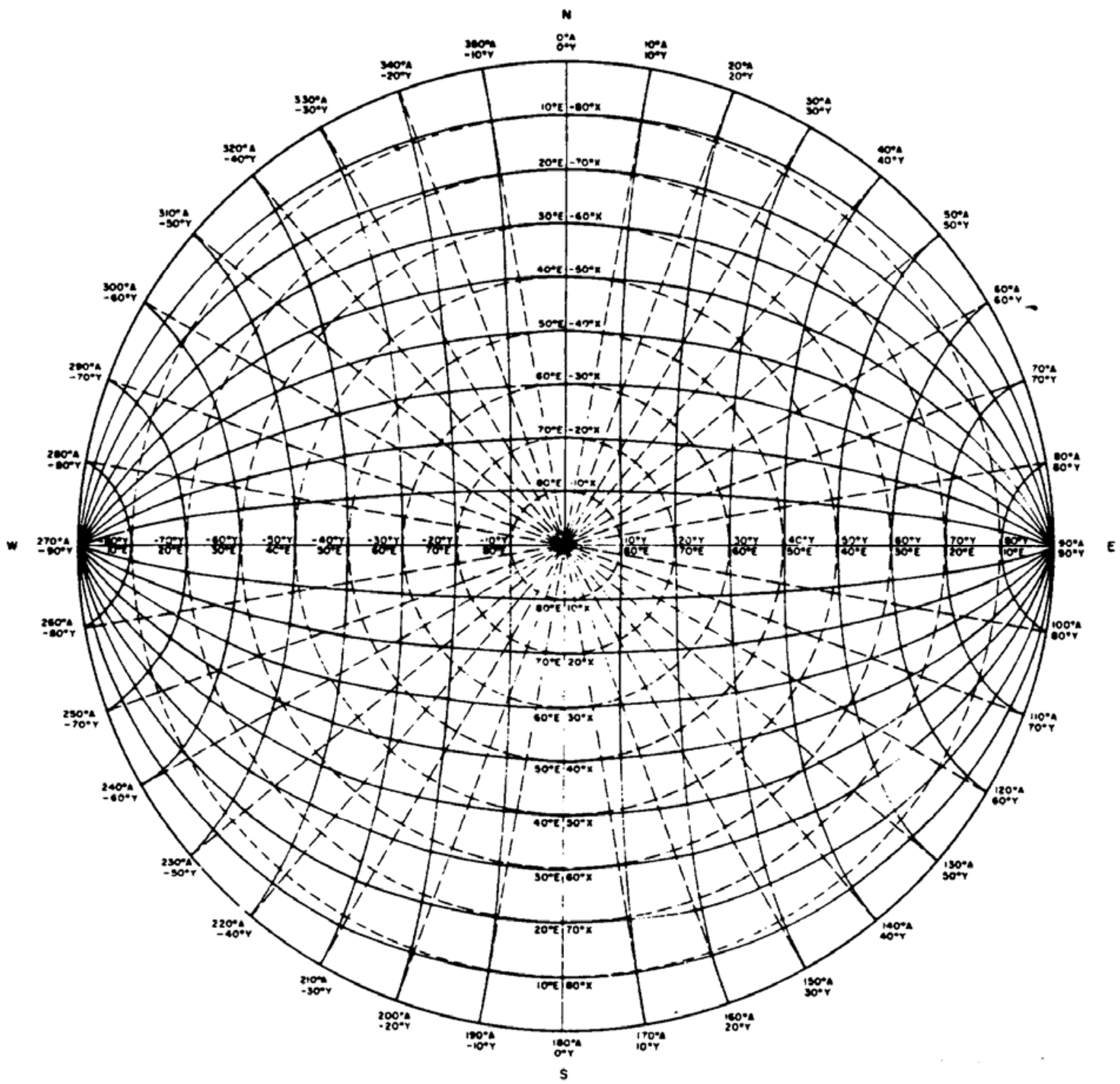


Figure B-1. Topocentric Cartesian Coordinates at a Station



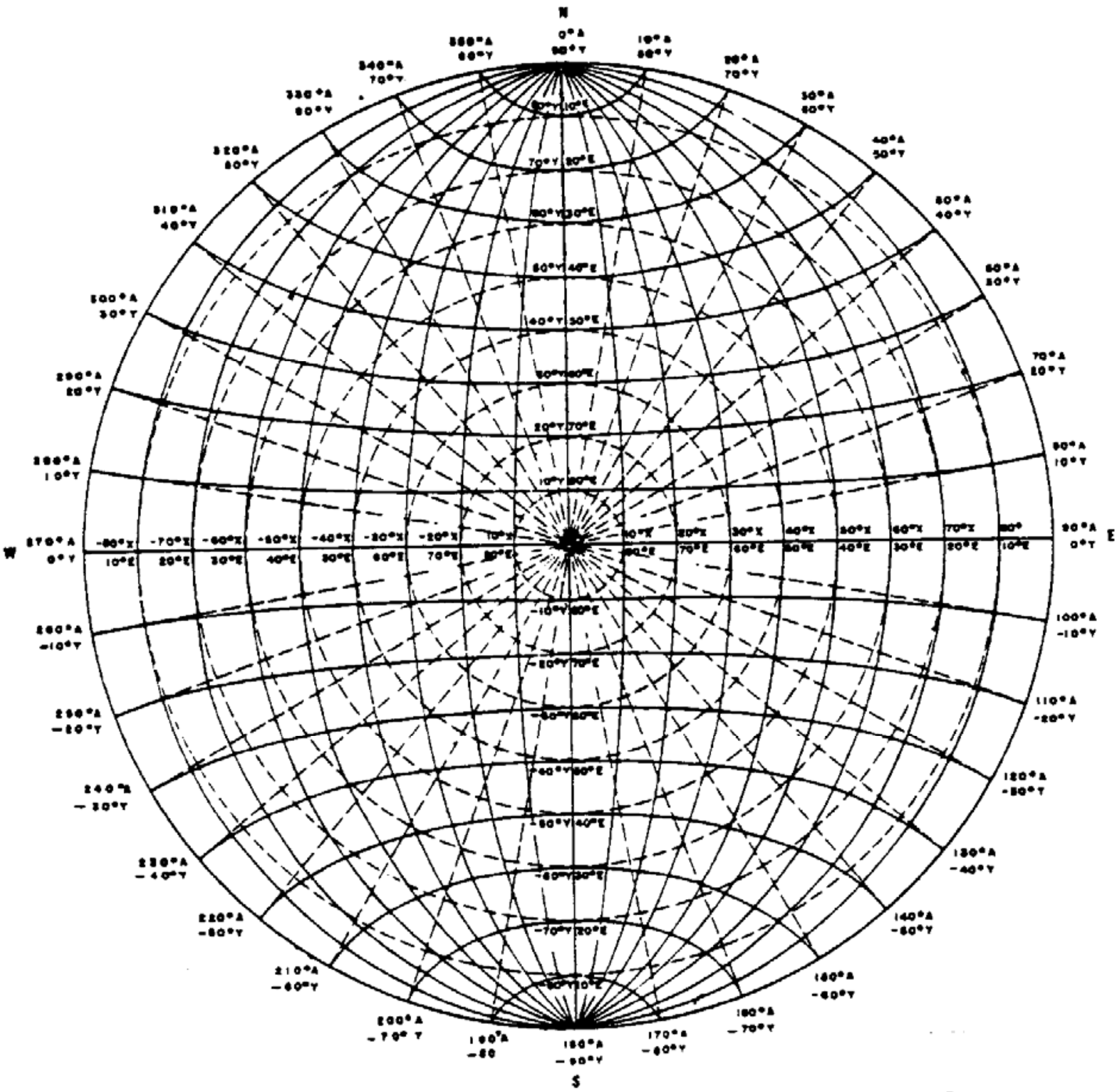
NOTE:

X AND Y ARE 0° AT ZENITH, WITH INCREASING -X ANGLES TO THE NORTH, AND INCREASING +X ANGLES TO THE SOUTH. Y IS MEASURED WITH INCREASING + ANGLES TO THE EAST, AND INCREASING - ANGLES TO THE WEST

LEGEND:

A = AZIMUTH - - - - - - - -
E = ELEVATION - - - - - -
X = X (LOWER) AXIS___
Y = Y (UPPER) AXIS___

Figure B-2. Relationship of az-el to X-Y Coordinates for 9- and 26-m Systems with +X South Orientation



LEGEND:

A = AZIMUTH - - -
E = ELEVATION - - -
X = X (LOWER) AXIS___
Y = Y (UPPER) AXIS___

Figure B-3. Relationship of az-el to X-Y Coordinates for 9-m Systems with +X East Orientation

Appendix C.
Station/Tracker ID

Appendix C. Station/Tracker ID

Appendix C provides a means of identifying stations and their data and a cross-reference for station names, equipment, and numbers. It contains the following tables:

a. Table C-1, External Station IDs (Low-speed Data). (Refer to Table 14 NASA Directory of Station Locations (NDOSL), http://fdf.gsfc.nasa.gov/prod_center/.

b. Table C-2, External Station IDs (2.4-kb High-speed Data).

c. Table C-3, Station Acronym/ID/Tracker Cross-Reference (Refer to Table 12 NASA Directory of Station Locations (NDOSL), http://fdf.gsfc.nasa.gov/prod_center/.

Table C-1. External Station IDs (Low-speed Data) (Example from NDOSL)

ESN NUMBER	STDN CODE	ESN NUMBER	STDN CODE	ESN NUMBER	STDN CODE
2	KMRF	27	D27D	56	LBVS
3	ANPC	27	ULA4	57	RTKS
3	MA2C	28	GD28	58	HTSS
3	VDB3	28	KIXS	59	TTSS
4	CALY	29	AG1S	60	GTSS
4	WPSA	29	WH6F	61	DS61
5	NHSS	30	SG1S	61	HOLF
5	WPSS	30	WH9F	62	HBK3
6	BLKQ	31	DAKS	63	DS63
6	VT2S	32	ULAE	63	FTHF
7	WHSF	33	ATLS	63	HB33
7	WPS8	34	DS34	64	GILE
8	VTSS	34	KA2S	64	GT2S
8	WP2S	35	HT2S	64	WAPS
9	BANF	36	JSCJ	65	DS65
9	FR2F	37	NH2S	66	CN4F
9	WHSK	37	WP3S	66	DS66
10	WH2K	38	PDLS	67	CALC
11	WH3K	39	EAFF	67	KGLQ
12	DS12	39	SF1S	68	GLAS

Table C-2. External Station IDs (2.4-kb/sec High-speed Data) (1 of 3)

ID HEX	ID Binary	Format (Note)	Station	Location
001	0 0000 0001	0	0.14 (PATQ)	
		4	UCS-1	Merritt Island/Contraves
002	0 0000 0010	0	0.13 (PA2Q)	
		4	UCS-2	Merritt Island/Contraves
003	0 0000 0011	4	UCS-3	CCAFS/Contraves
005	0 0000 0101	4	UCS-5	Merritt Island/Contraves
006	0 0000 0110	4	UCS-6	Merritt Island/Contraves
007	0 0000 0111	4	UCS-7	Merritt Island/Contraves
008	0 0000 1000	4	UCS-8	CCAFS/Contraves
009	0 0000 1001	4	UCS-9	CCAFS/Contraves
00A	0 0000 1010	4	PAFB IGOR	PAFB/Contraves
00B	0 0000 1011	4	CB ROTI	Cocoa Beach/Contraves
00C	0 0000 1100	4	MB ROTI	Melbourne Beach/Contraves
010	0 0001 0000	4	UCS-10	CCAFS/Contraves
011	0 0001 0001		RTCS ADASP	CCAFS
012	0 0001 0010	-	RTCS FAITH	CCAFS
		4	UCS-12	CCAFS/Contraves
013	0 0001 0011	0+3	CCC	CCAFS/CCC-CYBER 860
014	0 0001 0100	0	1.16 (CNVF)	CCAFS FPS-16
015	0 0001 0101	0	1.17 (CN3F)	CCAFS MCB-17
017	0 0001 0111	4	UCS-17	Merritt Island/Contraves
018	0 0001 1000	4	UCS-18	Merritt Island/Contraves
019	0 0001 1001	4	UCS-19.2	CCAFS/Contrav
020	0 0010 0000	4	UCS-20	CCAFS/Contraves
021	0 0010 0001	4	UCS-21	CCAFS/Contraves
022	0 0010 0010	4	UCS-22	CCAFS/Contraves
023	0 0010 0011	4	UCS-23	CCAFS/Contraves
024	0 0010 0100	0	19.17 (MIMF)	MILA, FL (MCB-17)
		4	UCS-24	CCAFS/Contraves
025	0 0010 0101	4	UCS-25	CCAFS/Contraves
		0	2.17	Jupiter, FL (MCB-17)
026	0 0010 0110	4	UCS-26	CCAFS/Contraves
027	0 0010 0111	4	HRT	Merritt Island/Contraves
028	0 0010 1000	4	DSIF-71	CCAFS/Contraves
		0	JDI	FPQ-14

Table C-2. External Station IDs (2.4-kb/sec High-speed Data) (2 of 3)

ID HEX	ID Binary	Format (Note)	Station	Location
029	0 0010 1001	4	CPX16 (RAMP)	CCAFS/Contraves
02B	0 0010 1011	0	JDI	15-m az-el
02D	0 0010 1101	0	JDI	24-m az-el
040	0 0100 0000	-	KMR	Kwajalein alcor
051	0 0101 0001	0	Bretagne No. 1	French Guiana, SA, French radar
052	0 0101 0010	0	Bretagne No. 2	French Guiana, SA, French radar
053	0 0101 0011	0	Adour No. 1	French Guiana, SA, French radar
054	0 0101 0100	0	Adour No. 2	French Guiana, SA, French radar
055	0 0101 0101	0	NATAL	French Guiana, SA, French radar
056	0 0101 0110	0	Kourou TLM	French Guiana, SA.
058	0 0101 1000	0	ITEK	Malabar, FL, telescope
066	0 0110 0110	-	MPS-36	Merritt Island
091	0 1001 0001	0	91.14 (ANTQ)	Antigua FPQ-14
092	0 1001 0010	0	91TLM-TAA8A	Antigua TLM
0A1	0 1010 0001	4	D38LO	CCAFS/Contraves
0A2	0 1010 0010	4	U73R95	CCAFS/Contraves
0A3	0 1010 0011	4	THEO 1.3	CCAFS/Contraves
100	1 0000 0000	0	EGL (EG2F)	Eglin FPS-85
118	1 0001 1000	0	CCC MOTHER	CCASFS/Contraves
120	1 0010 0000	0	ASC MOTHER	ASC (12.18 VAN)/Contraves
122	1 0010 0010	4	Cont 12.2	ASC (Gannett Hill)/Contraves
		4	UCS-1.75	PAFB/Contraves
126	1 0010 0110	4	Cont 12.4	ASC (Cotar Hill)/Contraves
127	1 0010 0111	4	Cont 12.3	ASC (12.15)/Contraves
130	1 0011 0000	-	PMRF	Point Mugu, CA 4440, FPS-16
131	1 0011 0001	-	FPS-16, Ser #3	Pt. Mugu, CA
132	1 0011 0010	-	PM2F	Point Mugu, CA, 4445 FPS-16
133	1 0011 0011	-	PM3F	Point Mugu, CA, 4446 FPS-16V
135	1 0011 0101	-	MPS-36	PPT

Table C-2. External Station IDs (2.4-kb/sec High-speed Data) (3 of 3)

ID HEX	ID Binary	Format (Note)	Station	Location
151	1 0101 0001	14	86.18 (WLPQ)	Wallops FPQ-6
152	1 0101 0010	14	86.16B (WL2F)	Wallops FPS-16V (Airport)
153	1 0101 0011	14	86.16 (WLPF)	Wallops FPS-16 (Island)
154	1 0101 0100	14	WPSA	Wallops 9-m S-band (E-W)
161	1 0110 0001	IRIG	KPTQ	Kaena Pt., HA, FPQ-14
162	1 0110 0010	IRIG	PPTQ	Pt. Pillar, CA, FPQ-6
168	1 0110 1000	13	FTHF	Ft Huachuca, AZ, FPS-16
169	1 0110 1001	13	R123 (HOLF)	Holloman AFB, NM, FPS-16
				S-band (E-W)
173	1 0111 0011	IRIG	SN7 (SNIF)	San Nicolas Island FPS-16.2
174	1 0111 0100	IRIG	SN13 (SN2F)	San Nicolas Island FPS-16.3
175	1 0111 0101	IRIG	SN15 (SN3F)	San Nicolas Island FPS-16.4
		4	UCS-1.75	Patrick AFB, FL/Contraves
176	1 0111 0110	IRIG	R34 (FRCF)	Dryden Flight Test Center FPS-16
177	1 0111 0111	IRIG	R38 (EAFF)	Edwards AFB, CA, FPS-16.1
179	1 0111 1001	13	1.1 (MTLF)	Ft Huachuca, AZ, Capri (Mt. Lemon)
180	1 1000 0000	13	R127 (WH6F)	Stallion, NM FPS-16
181	1 1000 0001	13	12.6 (FT2F)	Ft. Huachuca, AZ, FPS-16 (Scott Pk)
182	1 1000 0010	13	R124 (WH9F)	Phillips Hill, NM, FPS-16
183	1 1000 0011	13	R125 (TULF)	Wilde Site, NM, FPS-16
191	1 1001 0001	0	19.14 (MLAQ)	MILA FPQ-14
192	1 1001 0010	0	M13Z	MILA
193	1 1001 0011	14	MIL3 (ANT1)	MILA 9-m S-band (N-S)
194	1 1001 0100	14	MILA (ANT2)	MILA 9-m S-band (E-W)
195	1 1001 0101	0	TEL IV (TAA24)	MILA

NOTE

Format 0	Equal	LTAS data to GN stations from CCC.
	Equal	ETR radar E, F, and G format to CCC.
Format 3	Equal	Multiplexed, multi-object format output from CCC.
Format 4	Equal	Contraves site optical data format to CCC (Mother sites also convert this data and transmit a zero format to CCC).
Format 13	Equal	White Sands radar azimuth/elevation/range format to CCC.
Format 14	Equal	MDDF data to CCC and other users.

Table C-3. Station Acronym/ID/Tracker Cross-reference (Example from NDOSL)

```
STDN   NASA
CODE NUMBER                          EQUIPMENT
----------- -----------------------------------------------
Alamo Peak

ALAY     1707 Tlm S-bd 7.3m TAS az-el


Alice Springs

ALSJ     0204 BRT 2-ft manual az-el


Am Samoa

AMSJ     0205 BRT 2-ft manual az-el


Anderson Peak

ANPC     0623 Camera DMI TV az-el


Antigua

AN3S     1704 S-bd 10m az-el
AN8S     1705 S-bd 24m az-el
ANTQ     4087 C-bd FPQ-14 8.8m az-el on-axis


Arequipa

AREL     7907 Laser-SAO


AscensioN Island

ASNS     1726 S-bd 4m az-el


Ascension Island

AC2J     0208 BRT 2-ft manual az-el
ACN3     1306 USB 9m X-Y n-s
ACNJ     0207 BRT 2-ft manual az-el
AS2Q     4765 C-bd TPQ-11 8.8m, az-el
ASCQ     4045 C-bd FPQ-15 8.5m az-el on-axis
```

Appendix D.
Vehicle Identification Assignment Conventions

Appendix D. Vehicle Identification Assignment Conventions

D.1 Nonshuttle

D.1.1

The VID number is assigned prior to launch. For unmanned missions, the mated launch vehicle is numbered sequentially starting with the Spacecraft (SC) or top most stage.

D.1.2

Spacecraft VID always equals 1. Other VIDs are as follows:

Launch Vehicle Type	Stage No.	VID No.
Two-stage	2nd	2
Three-stage	3rd	2
	2nd	3

NOTE

In case of a multiple launch, the launch vehicle will use the same Satellite Identification Code (SIC) as the designated primary payload. The secondary payload will use a distinct SIC, and a VID of 1.

D.2 Shuttle

The Shuttle Orbiter, Solid Rocket Boosters (SRB), Interim Upper Stage (IUS), Shuttle Upper Stage (SUS), and external tank use a SIC and VID distinct from the payload SIC and VID:

a. External tank = 2

b. SRB (left) = 3.

c. SRB (right) = 4.

d. Orbiter = 5.

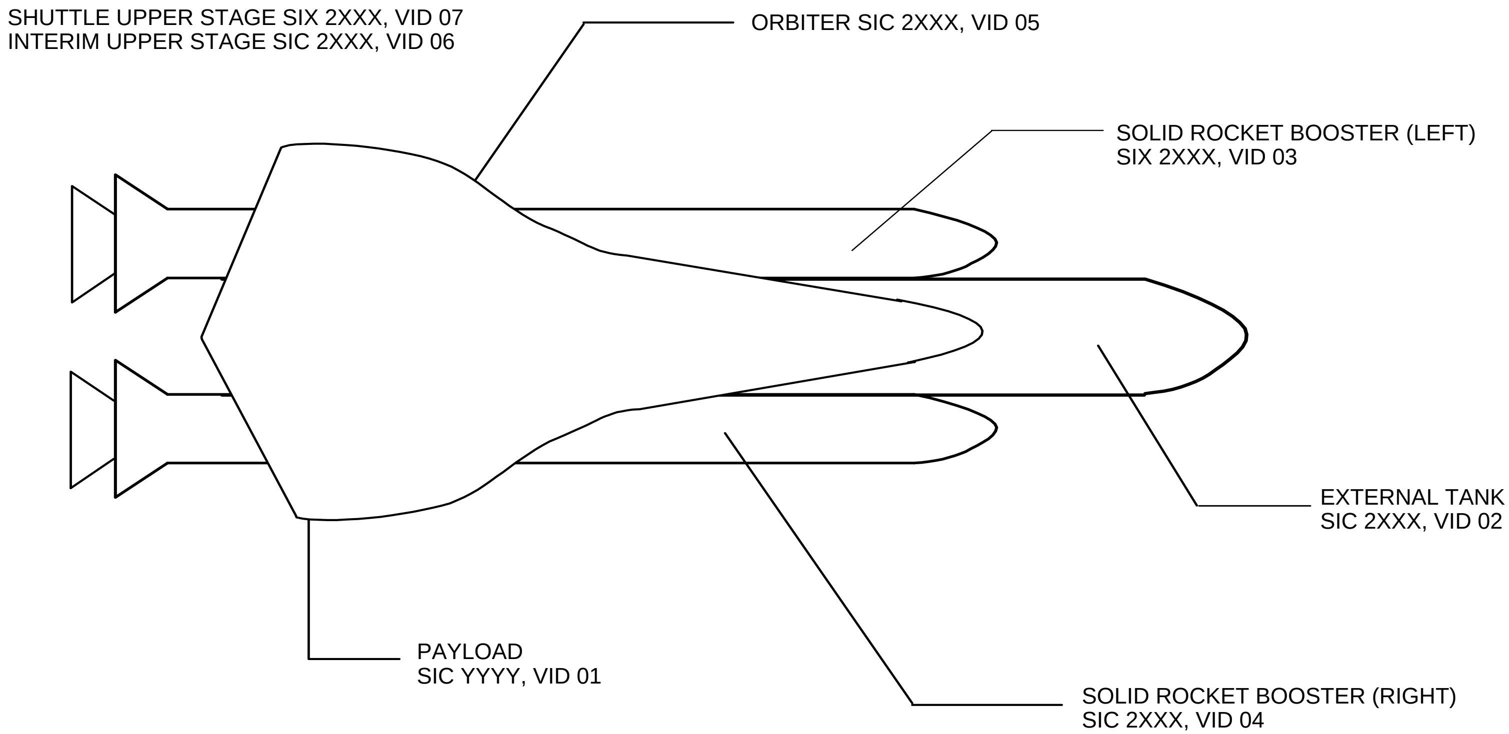
e. Interim Upper Stage = 6.

f. Shuttle Upper Stage = 7.

g. See Figure D-1 for an example of the Shuttle VID.

NOTE

For SN applications, Vehicle Body Number is referred to as "VIC" (Vehicle Identification Code), whereas the GN refers to Vehicle Body Number as "VID" (Vehicle ID). VID in SN applications is not limited to Vehicle Body Number. Refer to the *Support Identification Code Dictionary*, CSOC-GSFC-DICT-002184.



A0389006.DRW:X:N

Figure D-1. Example of Shuttle SIC and VID Assignments

Appendix E.
Tracking Data Format Capabilities

Appendix E. Tracking Data Format Capabilities

Appendix E (Table E-1) provides a quick reference for the types of tracking data provided by the stations. The listing is presented in the numerical sequence of the tracker ID. Contact the GN station for current information concerning tracking capabilities.

Table E-1. Tracking Data Format Capabilities (1 of 4)

Format and Paragraph References						
Low-speed				High-speed		
UTDF 4.2.2	**Radar 46-character 4.2.4**	**Tracker Acronym**	**Tracker ID**	**MDDF 4.3.2**	**UTDF 4.3.3**	**LTAS 3.2.4**
X		VDB3	S03(1)		X	X(2)
		CALY	W04			
X		WPSA	S04	X	X	X
		WPSS	S05			
		NHSS	A05			
		VT2S	A06			
	X	WHSF	W07			
X		WPS8	S07			
X		WP2S	S08			
		VTSS	A08			
X		WHSK	T09			
X		WH2K	T10			
		WH3K	T11			
	X	HAWF	P12			
X		AG3V	S13		X	
	X	MTLF	W14			
		GB2Y	E15			
		MTLS	W15			
	X	PM3F	P18			
	X	PMRF	P23			

Table E-1. Tracking Data Format Capabilities (2 of 4)

Format and Paragraph References						
Low-speed			**High-speed**			
UTDF 4.2.2	**Radar 46-character 4.2.4**	**Tracker Acronym**	**Tracker ID**	**MDDF 4.3.2**	**UTDF 4.3.3**	**LTAS 3.2.4**
X		GWM3	S24		X	
		MLRL	M25			
		AMEY	S26			
X		ULA4	N27		X	
	X	WH6F	W29			
	X	WH9F	W30			
X		ULAE	S32		X	
X		HA2Y	S34			
X		WP3S	S37		X	
		PDLS	S38			
		EAFF	W39			X
X		MILA	S40	X	X	X(2)
		FRCF	W43			X
		TIDD	D43			
		WLPE	N44			
	X	FT2F	W44			
		PPTY	W45			
X		CAN8	D46	X	X	X(2)
	X	PPTQ	W46			X
		CALF	W47			X
		CALT	W48			
		CA2F	W49			X
X		SEYS	A50			
	X	PPTF	W50			
	X	GTKQ	E51			X
		WL2F	Z52	X		X
		WLPF	Z53	X		X
X		AG03	S54		X	
	X	PM4F	P54			
		FORF	S55			

Table E-1. Tracking Data Format Capabilities (3 of 4)

Format and Paragraph References						
Low-speed			**High-speed**			
UTDF 4.2.2	**Radar 46-character 4.2.4**	**Tracker Acronym**	**Tracker ID**	**MDDF 4.3.2**	**UTDF 4.3.3**	**LTAS 3.2.4**
		EG2F	A56			
		GILE	N56			
		HTSS	A58			
		TTSS	A59			
		GTSS	A60			
	X	HOLF	W61			
		ATMY	W62			
		MADD	D63			
	X	FTHF	W63			
		GT2S	A64			
		CNVF	E65			X
X		RID8	D66	X	X	X(2)
		CN3F	E66			X
X		AG04	S67		X	
	X	KPTQ	P68			X
		KASR	S68			
	X	KMRQ	P69			X
	X	ASCQ	E70			X
	X	MLAQ	E71			X
X		MIL3	S71	X	X	X(2)
X		ACNZ	S72		X	
		ASCF	E75			X
X		UL23	S79		X	
	X	WLPQ	Z86	X		
X		DFRS	S89		X	
X		UL33	S90		X	
		SYNC	W90			
	X	ANTQ	E91		X	X
		KRUF	M92			

Table E-1. Tracking Data Format Capabilities (4 of 4)

Format and Paragraph References						
Low-speed			High-speed			
UTDF 4.2.2	**Radar 46-character 4.2.4**	**Tracker Acronym**	**Tracker ID**	**MDDF 4.3.2**	**UTDF 4.3.3**	**LTAS 3.2.4**
		KM2F	P92			
X		ACNY	S93			
X		TULF	W93			
		SN3F	P96		X	
		SN2F	P97			X
		SNIF	P98			X

NOTE
1. VDB3 also has IRIG capabilities (4.3.4).
2. Input only.

Appendix F.
Status Tape Block Types

Appendix F. Contents

Appendix F. Status Tape Block Types

F.1 Dynamic System Status Tape: Block Type 1

F.1.1 RTPS

F.1.1.1 Overview

Each tape block type 1 contains an array of 10 records.

BYTE 0

DESCRIPTION	TAPE BLOCK 1 RECORD 0

BYTE 704G6

DESCRIPTION	TAPE BLOCK 1 RECORD 1

BYTE 1408

DESCRIPTION	TAPE BLOCK 1 RECORD 2

BYTE 2112

DESCRIPTION	TAPE BLOCK 1 RECORD 3

BYTE 2816

DESCRIPTION	TAPE BLOCK 1 RECORD 4

BYTE 3520

DESCRIPTION	TAPE BLOCK 1 RECORD 5

BYTE 4224

DESCRIPTION	TAPE BLOCK 1 RECORD 6

BYTE 4728

DESCRIPTION	TAPE BLOCK 1 RECORD 7

BYTE 5432

DESCRIPTION	TAPE BLOCK 1 RECORD 8

BYTE 6136

DESCRIPTION	TAPE BLOCK 1 RECORD 9

BYTES 6840 - 11999

DESCRIPTION	SPARE

F.1.1.2 Record description

BYTE 0

DESCRIPTION		TAPE BLOCK SEQUENCE COUNT													
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 2

DESCRIPTION		TAPE BLOCK TYPE					
7	6	5	4	3	2	1	0

Dynamic System Status 1

BYTE 3

DESCRIPTION	SYSTEM ID						
7	6	5	4	3	2	1	0
1 = RTPS			2 = STPS				

BYTE 4

DESCRIPTION	ANTENNA GEO						
7	6	5	4	3	2	1	0
1 = AZ EL			2 = X Y			3 = X Y PRIME	

BYTE 5

DESCRIPTION	VALID RECORD						
7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID			

BYTE 6

DESCRIPTION	REAL TIME = DAY OF YEAR														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

DESCRIPTION	REAL TIME = MILLISECS OF DAY														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

DESCRIPTION	REAL TIME = MICROSECS OF MILLISECS														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

DESCRIPTION	REAL TIME = YEAR														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 16

DESCRIPTION	SIMULATED TIME = DAY OF YEAR														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

DESCRIPTION	SIMULATED TIME = MILLISECS OF DAY														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

DESCRIPTION	SIMULATED TIME = MICROSECS OF MILLISECS														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

DESCRIPTION	SIMULATED TIME = YEAR														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 26

DESCRIPTION	LIFTOFF TIME = DAY OF YEAR														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

DESCRIPTION	LIFTOFF TIME = MILLISECS OF DAY														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

DESCRIPTION	LIFTOFF TIME = MICROSECS OF MILLISECS														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

DESCRIPTION	LIFTOFF TIME = YEAR														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 36

DESCRIPTION				SYSTEM RUN TIME = DAY OF YEAR											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

DESCRIPTION				SYSTEM RUN TIME = MILLISECS OF DAY											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

DESCRIPTION				SYSTEM RUN TIME = MICROSECS OF MILLISECS											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

DESCRIPTION				SYSTEM RUN TIME = YEAR											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 46

DESCRIPTION				CURRENT DESIGNATE SOURCE			
7	6	5	4	3	2	1	0

Value	Source		Value		Source		Value	Source
1	IRV A		2		OTE A		3	LRV A
4	IIRV A		5		NORAD A		6	MDDF A
7	LTAS A		8		INP A		9	MANUAL TABLE
10	IRV B		11		OTE B		12	LRV B
13	IIRV B		14		NORAD B		15	MDDF B
16	LTAS B		17		INP B		18	BROUWER A
19	BROUWER B		20		EPV A		21	EPV B

BYTE 47

DESCRIPTION				VALID AVAILABLE DESIGINATE SOURCES = BROUWER MEAN A			
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 48

DESCRIPTION				VALID AVAILABLE DESIGINATE SOURCES = BROUWER MEAN B			
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 49

DESCRIPTION				SPARE (RESERVED FOR STPS)			
7	6	5	4	3	2	1	0

BYTE 50

DESCRIPTION				VALID AVAILABLE DESIGINATE SOURCES = EXTENDED PRECISION VECTORS A			
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 51

DESCRIPTION				VALID AVAILABLE DESIGINATE SOURCES = EXTENDED PRECISION VECTORS B			
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 52

DESCRIPTION	SPARE (RESERVED FOR STPS)						
7	6	5	4	3	2	1	0

BYTE 53

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = IIRV A						
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 54

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = IIRV B						
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 55

DESCRIPTION	SPARE (RESERVED FOR STPS)						
7	6	5	4	3	2	1	0

BYTE 56

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = INP A						
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 57

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = INP B						
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 58

DESCRIPTION	SPARE (RESERVED FOR STPS)						
7	6	5	4	3	2	1	0

BYTE 59

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = IRV A						
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 60

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = IRV B						
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 61

DESCRIPTION	SPARE (RESERVED FOR STPS)						
7	6	5	4	3	2	1	0

BYTE 62

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = LRV A						
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 63

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = LRV B						
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 64

DESCRIPTION	SPARE (RESERVED FOR STPS)						
7	6	5	4	3	2	1	0

BYTE 65

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = LTAS A						
7	6	5	4	3	2	1	0
1 = AVAILABLE	0 = NOT AVAILABLE						

BYTE 66

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = LTAS B						
7	6	5	4	3	2	1	0
1 = AVAILABLE	0 = NOT AVAILABLE						

BYTE 67

DESCRIPTION	SPARE (RESERVED FOR STPS)						
7	6	5	4	3	2	1	0

BYTE 68

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = MANUAL TABLE						
7	6	5	4	3	2	1	0
1 = AVAILABLE	0 = NOT AVAILABLE						

BYTE 69

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = MDDF A						
7	6	5	4	3	2	1	0
1 = AVAILABLE	0 = NOT AVAILABLE						

BYTE 70

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = MDDF B						
7	6	5	4	3	2	1	0
1 = AVAILABLE	0 = NOT AVAILABLE						

BYTE 71

DESCRIPTION	SPARE (RESERVED FOR STPS)						
7	6	5	4	3	2	1	0

BYTE 72

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES = NORAD A						
7	6	5	4	3	2	1	0
1 = AVAILABLE	0 = NOT AVAILABLE						

BYTE 73

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES (SPARE)						
7	6	5	4	3	2	1	0

BYTE 79

DESCRIPTION	VALID MESSAGE BIT FLAGS														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

Bit set to 1 = Message Valid in this record.

INPUT

BIT	**Message type**		**BIT**	**Message type**
5	MDDF A		6	LTAS A
14	MDDF B		15	LTAS B

OUTPUT

BIT	**Message type**		**BIT**	**Message type**		**BIT**	**Message type**
21	MDDF A		22	MDDF B		23	LTAS A
24	LTAS B		25	NORAD		26	46CHAR
28	IRV A		29	IRV B			

BYTE 83

DESCRIPTION	OUTPUT ENABLE STATUS FLAGS						
7	6	5	4	3	2	1	0

Bit set to 1 = output enabled for this message type.

BIT	**Message type**		**BIT**	**Message type**
0	MDDF		1	LTAS
2	46CHAR		3	NORAD

BYTE 84

DESCRIPTION	INPUT MDDF A MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see MDDF description for format)

BYTE 114

DESCRIPTION	INPUT MDDF B MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see MDDF description for format)

BYTE 144

DESCRIPTION	INPUT LTAS A MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see LTAS description for format)

BYTE 174

DESCRIPTION	INPUT LTAS B MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see LTAS description for format)

BYTE 204

DESCRIPTION	OUTPUT MDDF A MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see MDDF description for format)

BYTE 234

DESCRIPTION	OUTPUT MDDF B MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see MDDF description for format)

BYTE 264

DESCRIPTION	OUTPUT LTAS A MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see LTAS description for format)

BYTE 294

DESCRIPTION	OUTPUT LTAS B MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see LTAS description for format)

BYTES 324 - 398

DESCRIPTION	SPARE (RESERVED FOR STPS)						
7	6	5	4	3	2	1	0

BYTE 399

DESCRIPTION	46 CHAR OUTPUT MESSAGE						
7	6	5	4	3	2	1	0

Up to 56 bytes
(see 46 CHAR description for format)

BYTE 455

DESCRIPTION	NORAD TYPE 2 B3 OUTPUT MESSAGE						
7	6	5	4	3	2	1	0

Up to 59 bytes
(see NORAD TYPE 2 B3 description for format)

BYTE 514

DESCRIPTION	TIME BIAS = DAY OF YEAR														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 516

DESCRIPTION	TIME BIAS = MILLISECS OF DAY														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

BYTE 520

DESCRIPTION	TIME BIAS = MICROSECS OF MILLISECS														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 522

DESCRIPTION				TIME BIAS = YEAR											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 524

DESCRIPTION				ANGLE 1 BIAS (AZ, or X, or X') UNITS = RADIANS											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 532

DESCRIPTION				ANGLE 2 BIAS (EL, or Y, or Y') UNITS = RADIANS											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 540

DESCRIPTION				RANGE BIAS UNITS = METERS											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 548

DESCRIPTION				CURRENT RANGE UNITS = METERS											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 556

DESCRIPTION				CURRENT ANGLE 1 (AZ, or X, or X') UNITS = RADIANS											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 564

DESCRIPTION				CURRENT ANGLE 2 (EL, or Y, or Y') UNITS = RADIANS											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 572

DESCRIPTION				CURRENT TIME TAG = DAY OF YEAR											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

DESCRIPTION				CURRENT TIME TAG = MILLISECS OF DAY											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

DESCRIPTION				CURRENT TIME TAG = MICROSECS OF MILLISECS											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

DESCRIPTION				CURRENT TIME TAG = YEAR											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 582

DESCRIPTION				CURRENT DOPPLER UNITS = HZ											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 590

DESCRIPTION				TRANSMIT FREQ. FOR DOPPLER CALC UNITS = HZ											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 598

DESCRIPTION				DESIGNATE RANGE UNITS = METERS											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 606

DESCRIPTION				DESIGNATE ANGLE 1 (AZ, or X, or X') UNITS = RADIANS											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 614

DESCRIPTION				DESIGNATE ANGLE 2 (EL, or Y, or Y') UNITS = RADIANS											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 622

DESCRIPTION				DESIGNATE TIME = DAY OF YEAR											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

DESCRIPTION				DESIGNATE TIME = MILLISECS OF DAY											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

DESCRIPTION				DESIGNATE TIME = MICROSECS OF MILLISECS											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

DESCRIPTION				DESIGNATE TIME = YEAR											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 632

DESCRIPTION				COMPUTED DOPPLER UNITS = HZ											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTES 640 - 689

DESCRIPTION				SPARE (RESERVED FOR STPS)			
7	6	5	4	3	2	1	0

BYTES 690 - 1199 = SYSTEM UNIQUE DATA/VARIABLES UNIQUE TO EACH SYSTEM

BYTE 690

DESCRIPTION				TRACK STATUS			
7	6	5	4	3	2	1	0
0 = NOT ON TRACK				1 = ON TRACK			

BYTE 691

DESCRIPTION				JOYSTICK ACTIVE			
7	6	5	4	3	2	1	0
1 = ON		0 = OFF					

BYTE 692

DESCRIPTION				RAW RADAR STATUS 0											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BIT	Function		BIT	Function
15	pulsewidth lsb		10	synchro
14	bandwidth msb		9	designate mode
13	bandwidth lsb		8	acquisition mode
12	prf 640		0 - 7	spare
11	prf 160			

BYTE 694

DESCRIPTION	RAW RADAR STATUS 1														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BIT	Function
12 - 15	spare
11	radiation on
10	lo sngl dual
9	paramp on
8	skin beacon
7	valid angle track
6	ang man dig
5	rng man dig
4	src3 designate
3	src2 designate
2	angle coast on
1	agc on
0	pulsewidth msb

BYTE 696

DESCRIPTION	RAW RADAR STATUS 2														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BIT	Function
4 - 15	spare
3	operate test
2	range verified
1	valid range lock number status bit
0	spare

BYTE 698

DESCRIPTION	AZ ERROR														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

12 bits (0 - 11 valid)

BYTE 700

DESCRIPTION	EL ERROR														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

12 bits (0 - 11 valid)

BYTE 702

DESCRIPTION	AGC														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

12 bits (0 - 11 valid)

BYTE 704

DESCRIPTION	START OF NEXT RECORD OR SPARE						
7	6	5	4	3	2	1	0

F.1.2 STPS

F.1.2.1 Overview

The size of each tape block type 1 record is 1200 bytes.
An array of 10 records are in each tape block type 1.

BYTE 0

DESCRIPTION	TAPE BLOCK 1 RECORD 0

BYTE 1200

DESCRIPTION	TAPE BLOCK 1 RECORD 1

BYTE 2400

DESCRIPTION	TAPE BLOCK 1 RECORD 2

BYTE 3600

DESCRIPTION	TAPE BLOCK 1 RECORD 3

BYTE 4800

DESCRIPTION	TAPE BLOCK 1 RECORD 4

BYTE 6000

DESCRIPTION	TAPE BLOCK 1 RECORD 5

BYTE 7200

DESCRIPTION	TAPE BLOCK 1 RECORD 6

BYTE 8400

DESCRIPTION	TAPE BLOCK 1 RECORD 7

BYTE 9600

DESCRIPTION	TAPE BLOCK 1 RECORD 8

BYTE 10800

DESCRIPTION	TAPE BLOCK 1 RECORD 9

F.1.2.2 Record description

BYTE 0

DESCRIPTION		TAPE BLOCK SEQUENCE COUNT													
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 2

DESCRIPTION		TAPE BLOCK TYPE					
7	6	5	4	3	2	1	0

1 = Dynamic System Status

BYTE 3

DESCRIPTION		SYSTEM ID					
7	6	5	4	3	2	1	0
1 = RTPS		2 = STPS		3 = DSTPS			

BYTE 4

DESCRIPTION		ANTENNA GEO					
7	6	5	4	3	2	1	0
1 = AZ EL		2 = X Y		3 = X Y PRIME			

BYTE 5

DESCRIPTION				VALID RECORD			
7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID			

BYTE 6

DESCRIPTION				REAL TIME											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTE 16

DESCRIPTION				SIMULATED TIME											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTE 26

DESCRIPTION				LIFTOFF TIME											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTES 36 - 45

DESCRIPTION	SYSTEM RUN TIME														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTE 46

DESCRIPTION	CURRENT DESIGNATE SOURCE						
7	6	5	4	3	2	1	0

Value	Source	Value	Source	Value	Source
1	IRV A	2	OTE A	3	LRV A
4	IIRV A	5	NORAD A	6	MDDF A
7	LTAS A	8	INP A	9	MANUAL TABLE
10	IRV B	11	OTE B	12	LRV B
13	IIRV B	14	NORAD B	15	MDDF B
16	LTAS B	17	INP B	18	BROUWER A
19	BROUWER B	20	EPV A	21	EPV B

BYTE 47

DESCRIPTION	SPARE						
7	6	5	4	3	2	1	0

BYTE 48

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES BROUWER MEAN A						
7	6	5	4	3	2	1	0
1 = AVAILABLE	0 = NOT AVAILABLE						

BYTE 49

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES BROUWER MEAN B						
7	6	5	4	3	2	1	0
1 = AVAILABLE	0 = NOT AVAILABLE						

BYTE 50

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES BROUWER MEAN C						
7	6	5	4	3	2	1	0
1 = AVAILABLE	0 = NOT AVAILABLE						

BYTE 51

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES EXTENDED PRECISION VECTORS A						
7	6	5	4	3	2	1	0
1 = AVAILABLE	0 = NOT AVAILABLE						

BYTE 52

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES

				EXTENDED PRECISION VECTORS B			
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 53

DESCRIPTION				VALID AVAILABLE DESIGINATE SOURCES EXTENDED PRECISION VECTORS C			
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 54

DESCRIPTION				VALID AVAILABLE DESIGINATE SOURCES IIRV A			
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 55

DESCRIPTION				VALID AVAILABLE DESIGINATE SOURCES IIRV B			
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 56

DESCRIPTION				VALID AVAILABLE DESIGINATE SOURCES IIRV C			
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 57

DESCRIPTION				VALID AVAILABLE DESIGINATE SOURCES INP A			
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 58

DESCRIPTION				VALID AVAILABLE DESIGINATE SOURCES INP B			
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 59

DESCRIPTION				VALID AVAILABLE DESIGINATE SOURCES INP C			
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 60

DESCRIPTION				VALID AVAILABLE DESIGINATE SOURCES IRV A			
7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 61

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES IRV B

7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 62

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES IRV C

7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 63

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES LRV A

7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 64

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES LRV B

7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 65

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES LRV C

7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 66

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES LTAS A

7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 67

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES LTAS B

7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 68

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES LTAS C

7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 69

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES MANUAL TABLE

7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 70

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES MDDF A

7	6	5	4	3	2	1	0

1 = AVAILABLE	0 = NOT AVAILABLE

BYTE 71

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES MDDF B

7	6	5	4	3	2	1	0

1 = AVAILABLE	0 = NOT AVAILABLE

BYTE 72

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES MDDF C

7	6	5	4	3	2	1	0

1 = AVAILABLE	0 = NOT AVAILABLE

BYTE 73

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES NORAD A

7	6	5	4	3	2	1	0

1 = AVAILABLE	0 = NOT AVAILABLE

BYTE 74

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES NORAD B

7	6	5	4	3	2	1	0

1 = AVAILABLE	0 = NOT AVAILABLE

BYTE 75

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES NORAD C

7	6	5	4	3	2	1	0

1 = AVAILABLE	0 = NOT AVAILABLE

BYTE 76

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES OTE A

7	6	5	4	3	2	1	0

1 = AVAILABLE	0 = NOT AVAILABLE

BYTE 77

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES OTE B

7	6	5	4	3	2	1	0

1 = AVAILABLE	0 = NOT AVAILABLE

BYTE 78

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES SLEW

7	6	5	4	3	2	1	0

1 = AVAILABLE	0 = NOT AVAILABLE

BYTE 79

DESCRIPTION	VALID AVAILABLE DESIGINATE SOURCES STAR A

7	6	5	4	3	2	1	0
1 = AVAILABLE				0 = NOT AVAILABLE			

BYTE 80

DESCRIPTION	OUTPUT ENABLE STATUS FLAGS														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

Bit set to 1 = message valid in this record.

INPUT

BIT	Message type	BIT	Message type
5	MDDF A	6	LTAS A
14	MDDF B	15	LTAS B

OUTPUT

BIT	Message type	BIT	Message type	BIT	Message type
21	MDDF A	22	MDDF B	23	LTAS A
24	LTAS B	25	NORAD	26	46CHAR
27	UTDF	28	IRV A	29	IRV B

BYTE 84

DESCRIPTION	OUTPUT ENABLE STATUS FLAGS						
7	6	5	4	3	2	1	0

Bit set to 1 = output enabled for this message type.

BIT	Message type	BIT	Message type
0	MDDF	1	LTAS
2	46 CHAR	3	NORAD
4	UTDF		

BYTE 85

DESCRIPTION	SPARE						
7	6	5	4	3	2	1	0

BYTE 86

DESCRIPTION	INPUT MDDF A MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see MDDF description for format)

BYTE 116

DESCRIPTION	INPUT MDDF B MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see MDDF description for format)

BYTE 146

DESCRIPTION	INPUT LTAS A MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see LTAS description for format)

BYTE 176

DESCRIPTION	INPUT LTAS B MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see LTAS description for format)

BYTE 206

DESCRIPTION	OUTPUT MDDF A MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see MDDF description for format)

BYTE 236

DESCRIPTION	OUTPUT MDDF B MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see MDDF description for format)

BYTE 266

DESCRIPTION	OUTPUT LTAS A MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see LTAS description for format)

BYTE 296

DESCRIPTION	OUTPUT LTAS B MESSAGE						
7	6	5	4	3	2	1	0

Up to 30 bytes
(see LTAS description for format)

BYTE 326

DESCRIPTION	OUTPUT UTDF MESSAGE						
7	6	5	4	3	2	1	0

Up to 75 bytes
(see UTDF description for format)

BYTE 401

DESCRIPTION	SPARE						
7	6	5	4	3	2	1	0

BYTE 402

DESCRIPTION	46 CHAR OUTPUT MESSAGE						
7	6	5	4	3	2	1	0

Up to 56 bytes
(see 46 CHAR description for format)

BYTE 458

DESCRIPTION	NORAD TYPE 2 B3 OUTPUT MESSAGE						
7	6	5	4	3	2	1	0

Up to 59 bytes
(see NORAD TYPE 2 B3 description for format)

BYTE 517

DESCRIPTION		SPARE					
7	6	5	4	3	2	1	0

BYTE 518

DESCRIPTION		TIME BIAS													
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTE 528

DESCRIPTION				ANGLE 1 BIAS (AZ ,X ,X') UNITS = radians											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 536

DESCRIPTION				ANGLE 2 BIAS (EL, Y, Y') UNITS = radians											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 544

DESCRIPTION				RANGE BIAS UNITS = meters											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 552

DESCRIPTION				CURRENT RANGE UNITS = meters											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 560

DESCRIPTION				CURRENT ANGLE 1 (AZ ,X ,X') UNITS = radians											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 568

DESCRIPTION				CURRENT ANGLE 2 (EL, Y, Y') UNITS = radians											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 576

DESCRIPTION				CURRENT TIME TAG											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTE 586

DESCRIPTION				CURRENT DOPPLER UNITS = HZ											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 594

DESCRIPTION				TRANSMIT FREQ. FOR DOPPLER CALC UNITS = HZ											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 602

DESCRIPTION				DESIGNATE RANGE UNITS = meters											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 610

DESCRIPTION	DESIGNATE ANGLE 1 (AZ ,X ,X') UNITS = radians														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 618

DESCRIPTION	DESIGNATE ANGLE 2 (EL, Y, Y') UNITS = radians														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 626

DESCRIPTION	DESIGNATE TIME														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTE 636

DESCRIPTION	COMPUTED DOPPLER UNITS = HZ														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 644

DESCRIPTION	DIGITAL SYNCHRO (DS) GEO						
7	6	5	4	3	2	1	0

UNKNOWN VALUE

BYTE 645

DESCRIPTION	DIGITAL SYNCHRO MODE						
7	6	5	4	3	2	1	0

VALUE	**DESCRIPTION**
0	LOCAL ANTENNA
1	PROGRAM A
2	PROGRAM B
3	DS PROGRAM

BYTE 646

DESCRIPTION	DIGITAL SYNCHRO ACQ. SOURCE FOR D S PROG						
7	6	5	4	3	2	1	0

UNKNOWN VALUE

BYTE 647

DESCRIPTION	DIGITAL SYNCHRO ANGLE DATA CORRECTION						
7	6	5	4	3	2	1	0

UNKNOWN VALUE

BYTE 648

DESCRIPTION	DIGITAL SYNCHRO MASKING						
7	6	5	4	3	2	1	0

UNKNOWN VALUE

BYTE 649

DESCRIPTION	DIGITAL SYNCHRO PARALLAX CORRECTION						
7	6	5	4	3	2	1	0

UNKNOWN VALUE

BYTE 650

DESCRIPTION	DIGITAL SYNCHRO RUNWAY CAMERAS						
7	6	5	4	3	2	1	0

UNKNOWN VALUE

BYTE 651

DESCRIPTION	DIGITAL SYNCHRO USED FOR PDL						
7	6	5	4	3	2	1	0

UNKNOWN VALUE

BYTE 652

DESCRIPTION	DIGITAL SYNCHRO TIME BIAS														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTE 662

DESCRIPTION	DIGITAL SYNCHRO ANGLE 1 BIAS (AZ ,X ,X')														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 670

DESCRIPTION	DIGITAL SYNCHRO ANGLE 2 BIAS (EL, Y, Y')														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 678

DESCRIPTION	DIGITAL SYNCHRO DESIGNATE ANGLE 1 (AZ ,X ,X')														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTE 686

DESCRIPTION	DIGITAL SYNCHRO DESIGNATE ANGLE 2 (EL, Y, Y')														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

DOUBLE

BYTES 694 - 1199

DESCRIPTION	SYSTEM UNIQUE DATA VARIABLES UNIQUE TO EACH SYSTEM

BYTE 694

DESCRIPTION	RAW INPUT # 0														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-1 address 3FF0100

BIT	DESCRIPTION
15	Scan Mode
14	Scan Hold
13	spare
12	MFR D ID
11	MFR C ID
10	MFR B ID
9	MFR A ID
8	spare
7	spare
6	spare
5	spare
4	X Encoder data valid
3	X Encoder sign
2	X Encoder 90 deg.
1	X Encoder 45 deg.
0	X Encoder 22.5 deg.

BYTE 696

DESCRIPTION				RAW INPUT # 1											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-1 address 3FF0102

BIT	DESCRIPTION
15	X Encoder 11.25 Deg
14	X Encoder 5.675 Deg
13	X Encoder 2.8125 Deg
12	X Encoder 1.40625 Deg
11	X Encoder 0.703125 Deg
10	X Encoder 0.3515625 Deg
9	X Encoder 0.1757812 Deg
8	X Encoder 0.0878906 Deg
7	X Encoder 0.0439453 Deg
6	X Encoder 0.0219727 Deg
5	X Encoder 0.0109863 Deg
4	X Encoder 0.0054932 Deg
3	X Encoder 0.0027466 Deg
2	X Encoder 0.0013733 Deg
1	X Encoder 0.0006867 Deg
0	X Encoder 0.0003434 Deg

BYTE 698

DESCRIPTION				RAW INPUT # 2											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-1 address 3FF0104

BIT	DESCRIPTION
15	VHF/S-band (WPS 18M only)
14	Transmit Antenna Link (WPS 18M only)
13	Normal / Backup (WPS 18M only)
12	Data Available (WPS 18M only)
11	Spare (WPS 18M - J2 Coherency)
10	Receive Antenna Link (WPS 18M only)
9	Spare
8	Spare
7	Spare
6	Spare
5	Spare
4	Y Encoder Data Valid
3	Y Encoder Sign
2	Y Encoder 90 Deg
1	Y Encoder 45 Deg
0	Y Encoder 22.5 Deg

BYTE 700

DESCRIPTION				RAW INPUT # 3											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-1 address 3FF0106

BIT	**DESCRIPTION**
15	Y Encoder 11.25 Deg
14	Y Encoder 5.675 Deg
13	Y Encoder 2.8125 Deg
12	Y Encoder 1.40625 Deg
11	Y Encoder 0.703125 Deg
10	Y Encoder 0.3515625 Deg
9	Y Encoder 0.1757812 Deg
8	Y Encoder 0.0878906 Deg
7	Y Encoder 0.0439453 Deg
6	Y Encoder 0.0219727 Deg
5	Y Encoder 0.0109863 Deg
4	Y Encoder 0.0054932 Deg
3	Y Encoder 0.0027466 Deg
2	Y Encoder 0.0013733 Deg
1	Y Encoder 0.0006867 Deg
0	Y Encoder 0.0003434 Deg

BYTE 702

DESCRIPTION				RAW INPUT # 4											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-1 address 3FF0108

BIT	**DESCRIPTION**
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 704

DESCRIPTION	RAW INPUT # 5														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-2 address 3FF0200

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare
12	Spare
11	Spare
10	Spare
9	Spare
8	Spare
7	Spare
6	Spare
5	Add X-position bias
4	X-position bias sign
3	X-position bias 80 Deg
2	X-position bias 40 Deg
1	X-position bias 20 Deg
0	X-position bias 10 Deg

BYTE 706

DESCRIPTION	RAW INPUT # 6														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-2 address 3FF0202

BIT	DESCRIPTION
15	X-position bias 8 Deg
14	X-position bias 4 Deg
13	X-position bias 2 Deg
12	X-position bias 1 Deg
11	X-position bias 0.8 Deg
10	X-position bias 0.4 Deg
9	X-position bias 0.2 Deg
8	X-position bias 0.1 Deg
7	X-position bias 0.08 Deg
6	X-position bias 0.04 Deg
5	X-position bias 0.02 Deg
4	X-position bias 0.01 Deg
3	X-position bias 0.008 Deg
2	X-position bias 0.004 Deg
1	X-position bias 0.002 Deg
0	X-position bias 0.001 Deg

BYTE 708

DESCRIPTION				RAW INPUT # 7											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-2 address 3FF0204

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare
12	Spare
11	Spare
10	Spare
9	Spare
8	Spare
7	Spare
6	Spare
5	Add Y-position bias
4	Y-position bias sign
3	Y-position bias 80 Deg
2	Y-position bias 40 Deg
1	Y-position bias 20 Deg
0	Y-position bias 10 Deg

BYTE 710

DESCRIPTION				RAW INPUT # 8											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-2 address 3FF0206

BIT	DESCRIPTION
15	Y-position bias 8 Deg
14	Y-position bias 4 Deg
13	Y-position bias 2 Deg
12	Y-position bias 1 Deg
11	Y-position bias 0.8 Deg
10	Y-position bias 0.4 Deg
9	Y-position bias 0.2 Deg
8	Y-position bias 0.1 Deg
7	Y-position bias 0.08 Deg
6	Y-position bias 0.04 Deg
5	Y-position bias 0.02 Deg
4	Y-position bias 0.01 Deg
3	Y-position bias 0.008 Deg
2	Y-position bias 0.004 Deg
1	Y-position bias 0.002 Deg
0	Y-position bias 0.001 Deg

BYTE 712

DESCRIPTION				RAW INPUT # 9											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-2 address 3FF0208

BIT	DESCRIPTION
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 714

DESCRIPTION				RAW INPUT # 10											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-3 address 3FF0300

BIT	DESCRIPTION
15	Bump final limit (12M ONLY)
14	NW bump prelimit (12M ONLY)
13	SW bump prelimit (12M ONLY)
12	SE bump prelimit (12M ONLY)
11	NE bump prelimit (12M ONLY)
10	Stow mtr ovrld (12M ONLY)
9	Stow pin out (12M ONLY)
8	Stow pin in (12M ONLY)
7	Contour limit open (12M ONLY)
6	Emergency INTRLK open
5	dc power open
4	ac power open
3	ac power
2	BW K7
1	BW K1
0	Primary

BYTE 716

DESCRIPTION				RAW INPUT # 11											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-3 address 3FF0302

BIT	DESCRIPTION
15	Type 1
14	Coarse joystick
13	X release joystick
12	Prelimit override
11	Y release joystick
10	Spare
9	Spare
8	Auxiliary
7	Slave
6	Autotrack
5	Program A
4	Program B
3	Manual program
2	Manual position
1	Manual Velocity
0	Brake

BYTE 718

DESCRIPTION				RAW INPUT # 12											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-3 address 3FF0304

BIT	DESCRIPTION
15	X dirty filter (9M & WPS 26M ONLY)
14	X repln press LOW (9M & WPS 26M ONLY)
13	X control press LOW (9M & WPS 26M ONLY)
12	X HYD ON (9M & WPS 26M ONLY)
11	X final limit
10	minus X prelimit
9	plus X prelimit
8	X-axis disable
7	Spare
6	press LOW (12M & ULA 26M ONLY)
5	Hydraulics ON (12M & ULA 26M ONLY)
4	X-axis align (12M ONLY)
3	MFR LOCK STATUS
2	X hi temp (9M & WPS 26M ONLY)
1	X he ON (9M & WPS 26M ONLY)
0	X overheat (9M & WPS 26M ONLY)

BYTE 720

DESCRIPTION				RAW INPUT # 13											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-3 address 3FF0306

BIT	DESCRIPTION
15	Y dirty filter (9M & WPS 26M ONLY)
14	Y repln press LOW (9M & WPS 26M ONLY)
13	Y control press LOW (9M & WPS 26M ONLY)
12	Y HYD ON (9M & WPS 26M ONLY)
11	Y final limit
10	minus Y prelimit
9	plus Y prelimit
8	Y-axis disable
7	Spare
6	he ON (12M & ULA 26M ONLY)
5	overheat (12M & ULA 26M ONLY)
4	Y-axis align (12M ONLY)
3	Hydraulics level LOW (12M & ULA 26M ONLY)
2	Y hi temp (9M & WPS 26M ONLY)
1	Y he ON (9M & WPS 26M ONLY)
0	Y overheat (9M & WPS 26M ONLY)

BYTE 722

DESCRIPTION				RAW INPUT # 14											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-3 address 3FF0308

BIT	DESCRIPTION
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	Spare
6	dc brake fail (12M ONLY)
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 724

DESCRIPTION				RAW INPUT # 15											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-4 address 3FF0400

BIT	DESCRIPTION
15	Phase lock
14	FM track
13	136 Mhz (12M 14M 26M ONLY)
12	1500 (14M ONLY)
11	1700 (12M 14M 26M ONLY)
10	2200 (12M 14M 26M ONLY)
9	Acquisition (9M & ULA 26M ONLY)
8	Main (9M ONLY)
7	Auto-track system 3 selected
6	Auto-track system 2 selected
5	Auto-track system 1 selected
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 726

DESCRIPTION				RAW INPUT # 16											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-4 address 3FF0402

BIT	DESCRIPTION
15	Phase lock
14	FM track
13	136 Mhz (12M 14M 26M ONLY)
12	1500 (14M ONLY)
11	1700 (12M 14M 26M ONLY)
10	2200 (12M 14M 26M ONLY)
9	Acquisition (9M & ULA 26M ONLY)
8	Main (9M ONLY)
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 728

DESCRIPTION				RAW INPUT # 17											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-4 address 3FF0404

BIT	DESCRIPTION
15	Phase lock
14	FM track
13	136 Mhz (12M 14M 26M ONLY)
12	1500 (14M ONLY)
11	1700 (12M 14M 26M ONLY)
10	2200 (12M 14M 26M ONLY)
9	Acquisition (9M & ULA 26M ONLY)
8	Main (9M ONLY)
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 730

DESCRIPTION				RAW INPUT # 18											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-4 address 3FF0406

BIT	DESCRIPTION
15	80 Mhz VHF XMT (WLPS 18M ONLY)
14	40 Mhz VHF XMT (WLPS 18M ONLY)
13	20 Mhz VHF XMT (WLPS 18M ONLY)
12	10 Mhz VHF XMT (WLPS 18M ONLY)
11	8 Mhz VHF XMT (WLPS 18M ONLY)
10	4 Mhz VHF XMT (WLPS 18M ONLY)
9	2 Mhz VHF XMT (WLPS 18M ONLY)
8	1 Mhz VHF XMT (WLPS 18M ONLY)
7	800 khz VHF XMT (WLPS 18M ONLY)
6	400 khz VHF XMT (WLPS 18M ONLY)
5	200 khz VHF XMT (WLPS 18M ONLY)
4	100 khz VHF XMT (WLPS 18M ONLY)
3	80 khz VHF XMT (WLPS 18M ONLY)
2	40 khz VHF XMT (WLPS 18M ONLY)
1	20 khz VHF XMT (WLPS 18M ONLY)
0	10 khz VHF XMT (WLPS 18M ONLY)

BYTE 732

DESCRIPTION				RAW INPUT # 19											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-4 address 3FF0408

BIT	DESCRIPTION
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	Spare
6	Spare
5	Rcvr 6
4	Rcvr 5
3	Rcvr 4
2	Rcvr 3
1	Rcvr 2
0	Rcvr 1

BYTE 734

DESCRIPTION				RAW INPUT # 20											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-5 address 3FF0500

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare
12	CAI X sign
11	CAI X 80 Deg
10	CAI X 40 Deg
9	CAI X 20 Deg
8	CAI X 10 Deg
7	CAI X 8 Deg
6	CAI X 4 Deg
5	CAI X 2 Deg
4	CAI X 1 Deg
3	CAI X 0.8 Deg
2	CAI X 0.4 Deg
1	CAI X 0.2 Deg
0	CAI X 0.1 Deg

BYTE 736

DESCRIPTION	RAW INPUT # 21														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-5 address 3FF0502

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare
12	CAI Y sign
11	CAI Y 80 Deg
10	CAI Y 40 Deg
9	CAI Y 20 Deg
8	CAI Y 10 Deg
7	CAI Y 8 Deg
6	CAI Y 4 Deg
5	CAI Y 2 Deg
4	CAI Y 1 Deg
3	CAI Y 0.8 Deg
2	CAI Y 0.4 Deg
1	CAI Y 0.2 Deg
0	CAI Y 0.1 Deg

BYTE 738

DESCRIPTION	RAW INPUT # 22														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-5 address 3FF0504

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare
12	Spare
11	Spare
10	Spare
9	Spare
8	Spare
7	X Encoder Fault Code Bit 1
6	X Encoder Fault Code Bit 2
5	X Encoder Fault Code Bit 4
4	X Encoder Fault Code Bit 8
3	Y Encoder Fault Code Bit 1
2	Y Encoder Fault Code Bit 2
1	Y Encoder Fault Code Bit 4
0	Y Encoder Fault Code Bit 8

BYTE 740

DESCRIPTION				RAW INPUT # 23											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-5 address 3FF0506

BIT	DESCRIPTION
15	X-Minor Fault (14M ONLY)
14	Y-Minor Fault (14M ONLY)
13	X-Major Fault (14M ONLY)
12	Y-Major Fault (14M ONLY)
11	X-Rate Limit (14M ONLY)
10	Y-Rate Limit (14M ONLY)
9	X-Pre Limit (14M ONLY)
8	Y-Pre Limit (14M ONLY)
7	X-Brake Release (14M ONLY)
6	Y-Brake Release (14M ONLY)
5	X-Stowed (14M ONLY)
4	Y-Stowed (14M ONLY)
3	X-Unstowed (14M ONLY)
2	Y-Unstowed (14M ONLY)
1	Spare
0	Spare

BYTE 742

DESCRIPTION				RAW INPUT # 24											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-5 address 3FF0508

BIT	DESCRIPTION
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 744

DESCRIPTION				RAW INPUT # 25											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-6 address 3FF0600

BIT	DESCRIPTION
15	Exciter drive on
14	Exciter search out
13	Exciter Modulation on
12	Spare
11	Spare
10	Spare
9	Spare
8	Spare
7	Spare
6	System slave source
5	Range granularity (WLPS 18M - SRE J21)
4	Range granularity (WLPS 18M - SRE J21)
3	Spare (WLPS 18M - Modulation SRE J21)
2	SBE READT (WLPS 18M - Doppler SRE J21)
1	Range Acquired (WLPS 18M - SRE J21)
0	Range Data Available (WLPS 18M - SRE J21)

BYTE 746

DESCRIPTION				RAW INPUT # 26											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-6 address 3FF0602

BIT	DESCRIPTION
15	Range data 2 to the 31 (WLPS 18M - SRE J21)
14	Range data 2 to the 30 (WLPS 18M - SRE J21)
13	Range data 2 to the 29 (WLPS 18M - SRE J21)
12	Range data 2 to the 28 (WLPS 18M - SRE J21)
11	Range data 2 to the 27 (WLPS 18M - SRE J21)
10	Range data 2 to the 26 (WLPS 18M - SRE J21)
9	Range data 2 to the 25 (WLPS 18M - SRE J21)
8	Range data 2 to the 24 (WLPS 18M - SRE J21)
7	Range data 2 to the 23 (WLPS 18M - SRE J21)
6	Range data 2 to the 22 (WLPS 18M - SRE J21)
5	Range data 2 to the 21 (WLPS 18M - SRE J21)
4	Range data 2 to the 20 (WLPS 18M - SRE J21)
3	Range data 2 to the 19 (WLPS 18M - SRE J21)
2	Range data 2 to the 18 (WLPS 18M - SRE J21)
1	Range data 2 to the 17 (WLPS 18M - SRE J21)
0	Range data 2 to the 16 (WLPS 18M - SRE J21)

BYTE 748

DESCRIPTION				RAW INPUT # 27											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-6 address 3FF0604

BIT	DESCRIPTION
15	Range data 2 to the 15 (WLPS 18M - SRE J21)
14	Range data 2 to the 14 (WLPS 18M - SRE J21)
13	Range data 2 to the 13 (WLPS 18M - SRE J21)
12	Range data 2 to the 12 (WLPS 18M - SRE J21)
11	Range data 2 to the 11 (WLPS 18M - SRE J21)
10	Range data 2 to the 10 (WLPS 18M - SRE J21)
9	Range data 2 to the 9 (WLPS 18M - SRE J21)
8	Range data 2 to the 8 (WLPS 18M - SRE J21)
7	Range data 2 to the 7 (WLPS 18M - SRE J21)
6	Range data 2 to the 6 (WLPS 18M - SRE J21)
5	Range data 2 to the 5 (WLPS 18M - SRE J21)
4	Range data 2 to the 4 (WLPS 18M - SRE J21)
3	Range data 2 to the 3 (WLPS 18M - SRE J21)
2	Range data 2 to the 2 (WLPS 18M - SRE J21)
1	Range data 2 to the 1 (WLPS 18M - SRE J21)
0	Range data 2 to the 0 (WLPS 18M - SRE J21)

BYTE 750

DESCRIPTION				RAW INPUT # 28											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-6 address 3FF0606

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare
12	Spare
11	AUX 1 select
10	AUX 2 select
9	AUX 3 select
8	AUX 4 select
7	AUX 5 select
6	AUX 6 select
5	OTE A/B
4	OTE-A HOLD
3	OTE-A RESET
2	OTE-B HOLD
1	OTE-B RESET
0	Spare

BYTE 752

DESCRIPTION				RAW INPUT # 29											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-6 address 3FF0608

BIT	DESCRIPTION
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 754

DESCRIPTION				RAW INPUT # 30											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-7 address 3FF0700

BIT	DESCRIPTION
15	Selected VCO locked (WLPS 18M - SRE J21)
14	Doppler Loop Lock (WLPS 18M - SRE J21 VCO Change)
13	Spare
12	Spare
11	Spare
10	Spare
9	Doppler data 2 to the 41 (WLPS 18M - SRE J21)
8	Doppler data 2 to the 40 (WLPS 18M - SRE J21)
7	Doppler data 2 to the 39 (WLPS 18M - SRE J21)
6	Doppler data 2 to the 38 (WLPS 18M - SRE J21)
5	Doppler data 2 to the 37 (WLPS 18M - SRE J21)
4	Doppler data 2 to the 36 (WLPS 18M - SRE J21)
3	Doppler data 2 to the 35 (WLPS 18M - SRE J21)
2	Doppler data 2 to the 34 (WLPS 18M - SRE J21)
1	Doppler data 2 to the 33 (WLPS 18M - SRE J21)
0	Doppler data 2 to the 32 (WLPS 18M - SRE J21)

BYTE 756

DESCRIPTION				RAW INPUT # 31											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-7 address 3FF0702

BIT	DESCRIPTION
15	Doppler data 2 to the 31 (WLPS 18M - SRE J21)
14	Doppler data 2 to the 30 (WLPS 18M - SRE J21)
13	Doppler data 2 to the 29 (WLPS 18M - SRE J21)
12	Doppler data 2 to the 28 (WLPS 18M - SRE J21)
11	Doppler data 2 to the 27 (WLPS 18M - SRE J21)
10	Doppler data 2 to the 26 (WLPS 18M - SRE J21)
9	Doppler data 2 to the 25 (WLPS 18M - SRE J21)
8	Doppler data 2 to the 24 (WLPS 18M - SRE J21)
7	Doppler data 2 to the 23 (WLPS 18M - SRE J21)
6	Doppler data 2 to the 22 (WLPS 18M - SRE J21)
5	Doppler data 2 to the 21 (WLPS 18M - SRE J21)
4	Doppler data 2 to the 20 (WLPS 18M - SRE J21)
3	Doppler data 2 to the 19 (WLPS 18M - SRE J21)
2	Doppler data 2 to the 18 (WLPS 18M - SRE J21)
1	Doppler data 2 to the 17 (WLPS 18M - SRE J21)
0	Doppler data 2 to the 16 (WLPS 18M - SRE J21)

BYTE 758

DESCRIPTION				RAW INPUT # 32											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-7 address 3FF0704

BIT	DESCRIPTION
15	Doppler data 2 to the 15 (WLPS 18M - SRE J21)
14	Doppler data 2 to the 14 (WLPS 18M - SRE J21)
13	Doppler data 2 to the 13 (WLPS 18M - SRE J21)
12	Doppler data 2 to the 12 (WLPS 18M - SRE J21)
11	Doppler data 2 to the 11 (WLPS 18M - SRE J21)
10	Doppler data 2 to the 10 (WLPS 18M - SRE J21)
9	Doppler data 2 to the 9 (WLPS 18M - SRE J21)
8	Doppler data 2 to the 8 (WLPS 18M - SRE J21)
7	Doppler data 2 to the 7 (WLPS 18M - SRE J21)
6	Doppler data 2 to the 6 (WLPS 18M - SRE J21)
5	Doppler data 2 to the 5 (WLPS 18M - SRE J21)
4	Doppler data 2 to the 4 (WLPS 18M - SRE J21)
3	Doppler data 2 to the 3 (WLPS 18M - SRE J21)
2	Doppler data 2 to the 2 (WLPS 18M - SRE J21)
1	Doppler data 2 to the 1 (WLPS 18M - SRE J21)
0	Doppler data 2 to the 0 (WLPS 18M - SRE J21)

BYTE 760

DESCRIPTION				RAW INPUT # 33											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-7 address 3FF0706

BIT	**DESCRIPTION**
15	unassigned
14	unassigned
13	unassigned
12	unassigned
11	unassigned
10	unassigned
9	unassigned
8	unassigned
7	unassigned
6	unassigned
5	unassigned
4	unassigned
3	unassigned
2	unassigned
1	unassigned
0	unassigned

BYTE 762

DESCRIPTION				RAW INPUT # 34											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-7 address 3FF0708

BIT	**DESCRIPTION**
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	Spare
6	Spare
5	Narrow Loop Bandwidth (WLPS 18M Only)
4	Medium Loop Bandwidth (WLPS 18M Only)
3	Wide Loop Bandwidth (WLPS 18M Only)
2	Select PSK ON
1	SelectPM ON
0	SelectFM ON

BYTE 764

DESCRIPTION	RAW INPUT # 35														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-8 address 3FF0800

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare
12	Spare
11	Spare
10	Spare
9	Spare
8	100-MHz exciter frequency
7	80-MHz exciter frequency
6	40-MHz exciter frequency
5	20-MHz exciter frequency
4	10-MHz exciter frequency
3	8-MHz exciter frequency
2	4-MHz exciter frequency
1	2-MHz exciter frequency
0	1-MHz exciter frequency

BYTE 766

DESCRIPTION	RAW INPUT # 36														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-8 address 3FF0802

BIT	DESCRIPTION
15	800-kHz exciter frequency
14	400-kHz exciter frequency
13	200-kHz exciter frequency
12	100-kHz exciter frequency
11	80-kHz exciter frequency
10	40-kHz exciter frequency
9	20-kHz exciter frequency
8	10-kHz exciter frequency
7	8-kHz exciter frequency
6	4-kHz exciter frequency
5	2-kHz exciter frequency
4	1-kHz exciter frequency
3	800-Hz exciter frequency
2	400-Hz exciter frequency
1	200-Hz exciter frequency
0	100-Hz exciter frequency

BYTE 768

DESCRIPTION				RAW INPUT # 37											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-8 address 3FF0804

BIT	DESCRIPTION
15	Spare
14	Spare
13	Add time bias
12	Time bias sign
11	Spare
10	Spare
9	Time bias 20 hours
8	Time bias 10 hours
7	Time bias 8 hours
6	Time bias 4 hours
5	Time bias 2 hours
4	Time bias 1 hours
3	Spare
2	Time bias 40 minutes
1	Time bias 20 minutes
0	Time bias 10 minutes

BYTE 770

DESCRIPTION				RAW INPUT # 38											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-8 address 3FF0806

BIT	DESCRIPTION
15	Time bias 8 minutes
14	Time bias 4 minutes
13	Time bias 2 minutes
12	Time bias 1 minutes
11	Spare
10	Time bias 40 seconds
9	Time bias 20 seconds
8	Time bias 10 seconds
7	Time bias 8 seconds
6	Time bias 4 seconds
5	Time bias 2 seconds
4	Time bias 1 seconds
3	Time bias 0.8 seconds
2	Time bias 0.4 seconds
1	Time bias 0.2 seconds
0	Time bias 0.1 seconds

BYTE 772

DESCRIPTION				RAW INPUT # 39											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board IN-8 address 3FF0808

BIT	DESCRIPTION
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 774

DESCRIPTION				RAW INPUT # 40											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
X Tach 1
A/D scale factor 0.0003051758

BYTE 776

DESCRIPTION				RAW INPUT # 41											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
X Tach 2
A/D scale factor 0.0003051758

BYTE 778

DESCRIPTION				RAW INPUT # 42											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Y Tach 1
A/D scale factor 0.0003051758

BYTE 780

DESCRIPTION				RAW INPUT # 43											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Y Tach 2
A/D scale factor 0.0003051758

BYTE 782

DESCRIPTION				RAW INPUT # 44											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
X Joystick
A/D scale factor 0.0003051758

BYTE 784

DESCRIPTION				RAW INPUT # 45											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Y Joystick
A/D scale factor 0.0003051758

BYTE 786

DESCRIPTION				RAW INPUT # 46											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
X Slave Error
A/D scale factor 0.0003051758

BYTE 788

DESCRIPTION				RAW INPUT # 47											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Y Slave Error
A/D scale factor 0.0003051758

BYTE 790

DESCRIPTION				RAW INPUT # 48											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
X RCVR 1 Error Volts
A/D scale factor 0.0003051758

BYTE 792

DESCRIPTION				RAW INPUT # 49											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Y RCVR 1 Error Volts
A/D scale factor 0.0003051758

BYTE 794

DESCRIPTION				RAW INPUT # 50											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
X RCVR 2 Error Volts
A/D scale factor 0.0003051758

BYTE 796

DESCRIPTION				RAW INPUT # 51											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Y RCVR 2 Error Volts
A/D scale factor 0.0003051758

BYTE 798

DESCRIPTION				RAW INPUT # 52											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
X RCVR 3 Error Volts

A/D scale factor 0.0003051758

BYTE 800

DESCRIPTION				RAW INPUT # 53											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Y RCVR 3 Error Volts
A/D scale factor 0.0003051758

BYTE 802

DESCRIPTION				RAW INPUT # 54											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
RCVR 1 AGC (DBM)
A/D scale factor 0.0003051758

BYTE 804

DESCRIPTION				RAW INPUT # 55											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
RCVR 2 AGC (DBM)
A/D scale factor 0.0003051758

BYTE 806

DESCRIPTION				RAW INPUT # 56											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
RCVR 3 AGC (DBM)
A/D scale factor 0.0003051758

BYTE 808

DESCRIPTION				RAW INPUT # 57											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 810

DESCRIPTION				RAW INPUT # 58											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
+28 V DC

BYTE 812

DESCRIPTION				RAW INPUT # 59											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
-28 V DC

BYTE 814

DESCRIPTION				RAW INPUT # 60											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
+15 V DC (X Axis)

BYTE 816

DESCRIPTION				RAW INPUT # 61											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
-15 V DC (X Axis)

BYTE 818

DESCRIPTION				RAW INPUT # 62											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
+15 V DC (Y Axis)

BYTE 820

DESCRIPTION				RAW INPUT # 63											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
-15 V DC (Y Axis)

BYTE 822

DESCRIPTION				RAW INPUT # 64											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
+5 V DC LOGIC P/S

BYTE 824

DESCRIPTION				RAW INPUT # 65											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
+8 V DC LOGIC P/S

BYTE 826

DESCRIPTION				RAW INPUT # 66											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
+4 V DC LOGIC P/S

BYTE 828

DESCRIPTION				RAW INPUT # 67											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
-8 V DC LOGIC P/S

BYTE 830

DESCRIPTION				RAW INPUT # 68											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
X Yoke Pot FDBK

BYTE 832

DESCRIPTION				RAW INPUT # 69											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Y Yoke Pot FDBK

BYTE 834

DESCRIPTION				RAW INPUT # 70											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
X Servo value out

BYTE 836

DESCRIPTION				RAW INPUT # 71											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Y Servo value out

BYTE 838

DESCRIPTION				RAW INPUT # 72											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
A AGC MFR 1

BYTE 840

DESCRIPTION				RAW INPUT # 73											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
B AGC MFR 1

BYTE 842

DESCRIPTION				RAW INPUT # 74											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
A AGC MFR 2

BYTE 844

DESCRIPTION				RAW INPUT # 75											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
B AGC MFR 2

BYTE 846

DESCRIPTION				RAW INPUT # 76											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
A AGC MFR 3

BYTE 848

DESCRIPTION				RAW INPUT # 77											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
B AGC MFR 3

BYTE 850

DESCRIPTION				RAW INPUT # 78											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
A AGC MFR 3

BYTE 852

DESCRIPTION				RAW INPUT # 79											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 854

DESCRIPTION				RAW INPUT # 80											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 856

DESCRIPTION				RAW INPUT # 81											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 858

DESCRIPTION				RAW INPUT # 82											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 860

DESCRIPTION				RAW INPUT # 83											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 862

DESCRIPTION				RAW INPUT # 84											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 864

DESCRIPTION				RAW INPUT # 85											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 866

DESCRIPTION				RAW INPUT # 86											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 868

DESCRIPTION				RAW INPUT # 87											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 870

DESCRIPTION				RAW INPUT # 88											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 872

DESCRIPTION				RAW INPUT # 89											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 874

DESCRIPTION				RAW INPUT # 90											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 876

DESCRIPTION				RAW INPUT # 91											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 878

DESCRIPTION				RAW INPUT # 92											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 880

DESCRIPTION				RAW INPUT # 93											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 882

DESCRIPTION				RAW INPUT # 94											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 884

DESCRIPTION				RAW INPUT # 95											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 886

DESCRIPTION				RAW INPUT # 96											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 888

DESCRIPTION				RAW INPUT # 97											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input

Spare

BYTE 890

DESCRIPTION				RAW INPUT # 98											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 892

DESCRIPTION				RAW INPUT # 99											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 894

DESCRIPTION				RAW INPUT # 100											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 896

DESCRIPTION				RAW INPUT # 101											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 898

DESCRIPTION				RAW INPUT # 102											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 900

DESCRIPTION				RAW INPUT # 103											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Analog to Digital input
Spare

BYTE 902

DESCRIPTION				RAW OUTPUT # 0											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-1 address 3FF1100

BIT	DESCRIPTION
15	unassigned
14	Normal
13	Test
12	Computer ready
11	Computer run
10	Time bias ready
9	Default 1 frame / min indicator
8	Scan Ready
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 904

DESCRIPTION				RAW OUTPUT # 1											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-1 address 3FF1102

BIT	DESCRIPTION
15	Brake
14	Manual velocity
13	Manual position
12	Manual program
11	Program A
10	Program B
9	Auto track
8	Slave
7	D-S is az / el (MILA ONLY)
6	D-S ready
5	Stow
4	Coll tower
3	Spare
2	Program A -or- B ready
1	Program B ready
0	Program A ready

BYTE 906

DESCRIPTION				RAW OUTPUT # 2											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-1 address 3FF1104

BIT	DESCRIPTION
15	X HYD on
14	X disable on
13	Spare
12	Spare
11	Spare
10	Spare
9	Spare
8	Spare
7	Y HYD on
6	Y disable on
5	Spare
4	X-angle sign
3	X-angle 80 deg
2	X-angle 40 deg
1	X-angle 20 deg
0	X-angle 10 deg

BYTE 908

DESCRIPTION				RAW OUTPUT # 3											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-1 address 3FF1106

BIT	DESCRIPTION
15	X-angle 8 deg
14	X-angle 4 deg
13	X-angle 2 deg
12	X-angle 1 deg
11	X-angle 0.8 deg
10	X-angle 0.4 deg
9	X-angle 0.2 deg
8	X-angle 0.1 deg
7	X-angle 0.08 deg
6	X-angle 0.04 deg
5	X-angle 0.02 deg
4	X-angle 0.01 deg
3	X-angle 0.008 deg
2	X-angle 0.004 deg
1	X-angle 0.002 deg
0	X-angle 0.001 deg

BYTE 910

DESCRIPTION				RAW OUTPUT # 4											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-1 address 3FF1108

BIT	DESCRIPTION
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 912

DESCRIPTION				RAW OUTPUT # 5											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-2 address 3FF1200

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare
12	Spare
11	Spare
10	Spare
9	Spare
8	Spare
7	Spare
6	Spare
5	Spare
4	Y-angle sign
3	Y-angle 80 deg
2	Y-angle 40 deg
1	Y-angle 20 deg
0	Y-angle 10 deg

BYTE 914

DESCRIPTION				RAW OUTPUT # 6											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-2 address 3FF1202

BIT	DESCRIPTION
15	Y-angle 8 deg
14	Y-angle 4 deg
13	Y-angle 2 deg
12	Y-angle 1 deg
11	Y-angle 0.8 deg
10	Y-angle 0.4 deg
9	Y-angle 0.2 deg
8	Y-angle 0.1 deg
7	Y-angle 0.08 deg
6	Y-angle 0.04 deg
5	Y-angle 0.02 deg
4	Y-angle 0.01 deg
3	Y-angle 0.008 deg
2	Y-angle 0.004 deg
1	Y-angle 0.002 deg
0	Y-angle 0.001 deg

BYTE 916

DESCRIPTION				RAW OUTPUT # 7											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-2 address 3FF1204

BIT	DESCRIPTION
15	RCVR LOCK (VALID TRACK)
14	LSD on
13	HSD on
12	Range ready
11	Hydraulics on
10	Spare
9	Spare
8	Spare
7	CAI X or AZ sign
6	Spare
5	CAI AZ 200 deg
4	CAI AZ 100 deg
3	CAI X or AZ 80 deg
2	CAI X or AZ 40 deg
1	CAI X or AZ 20 deg
0	CAI X or AZ 10 deg

BYTE 918

DESCRIPTION				RAW OUTPUT # 8											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-2 address 3FF1206

BIT	DESCRIPTION
15	CAI X or AZ 8 deg
14	CAI X or AZ 4 deg
13	CAI X or AZ 2 deg
12	CAI X or AZ 1 deg
11	CAI X or AZ 0.8 deg
10	CAI X or AZ 0.4 deg
9	CAI X or AZ 0.2 deg
8	CAI X or AZ 0.1 deg
7	CAI X or AZ 0.08 deg
6	CAI X or AZ 0.04 deg
5	CAI X or AZ 0.02 deg
4	CAI X or AZ 0.01 deg
3	CAI X or AZ 0.008 deg
2	CAI X or AZ 0.004 deg
1	CAI X or AZ 0.002 deg
0	CAI X or AZ 0.001 deg

BYTE 920

DESCRIPTION				RAW OUTPUT # 9											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-2 address 3FF1208

BIT	DESCRIPTION
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 922

DESCRIPTION				RAW OUTPUT # 10											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-3 address 3FF1300

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare
12	Spare
11	Spare
10	Spare
9	Spare
8	Spare
7	CAI Y or EL sign
6	Spare
5	CAI EL 200 deg
4	CAI EL 100 deg
3	CAI Y or EL 80 deg
2	CAI Y or EL 40 deg
1	CAI Y or EL 20 deg
0	CAI Y or EL 10 deg

BYTE 924

DESCRIPTION				RAW OUTPUT # 11											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-3 address 3FF1302

BIT	DESCRIPTION
15	CAI Y or EL 8 deg
14	CAI Y or EL 4 deg
13	CAI Y or EL 2 deg
12	CAI Y or EL 1 deg
11	CAI Y or EL 0.8 deg
10	CAI Y or EL 0.4 deg
9	CAI Y or EL 0.2 deg
8	CAI Y or EL 0.1 deg
7	CAI Y or EL 0.08 deg
6	CAI Y or EL 0.04 deg
5	CAI Y or EL 0.02 deg
4	CAI Y or EL 0.01 deg
3	CAI Y or EL 0.008 deg
2	CAI Y or EL 0.004 deg
1	CAI Y or EL 0.002 deg
0	CAI Y or EL 0.001 deg

BYTE 926

DESCRIPTION				RAW OUTPUT # 12											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-3 address 3FF1304

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare
12	Spare
11	Spare
10	Spare
9	Spare
8	Spare
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 928

DESCRIPTION				RAW OUTPUT # 13											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-3 address 3FF1306

BIT	DESCRIPTION
15	Spare
14	Spare
13	PDL or CAM 1 AZ 200 deg
12	PDL or CAM 1 AZ 100 deg
11	PDL or CAM 1 AZ 80 deg
10	PDL or CAM 1 AZ 40 deg
9	PDL or CAM 1 AZ 20 deg
8	PDL or CAM 1 AZ 10 deg
7	PDL or CAM 1 AZ 8 deg
6	PDL or CAM 1 AZ 4 deg
5	PDL or CAM 1 AZ 2 deg
4	PDL or CAM 1 AZ 1 deg
3	PDL or CAM 1 AZ 0.8 deg
2	PDL or CAM 1 AZ 0.4 deg
1	PDL or CAM 1 AZ 0.2 deg
0	PDL or CAM 1 AZ 0.1 deg

BYTE 930

DESCRIPTION				RAW OUTPUT # 14											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-3 address 3FF1308

BIT	DESCRIPTION
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	unassigned
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 932

DESCRIPTION				RAW OUTPUT # 15											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-4 address 3FF1400

BIT	**DESCRIPTION**
15	PDL or CAM 1 EL sign
14	Spare
13	Spare
12	Spare
11	PDL or CAM 1 EL 80 deg
10	PDL or CAM 1 EL 40 deg
9	PDL or CAM 1 EL 20 deg
8	PDL or CAM 1 EL 10 deg
7	PDL or CAM 1 EL 8 deg
6	PDL or CAM 1 EL 4 deg
5	PDL or CAM 1 EL 2 deg
4	PDL or CAM 1 EL 1 deg
3	PDL or CAM 1 EL 0.8 deg
2	PDL or CAM 1 EL 0.4 deg
1	PDL or CAM 1 EL 0.2 deg
0	PDL or CAM 1 EL 0.1 deg

BYTE 934

DESCRIPTION				RAW OUTPUT # 16											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-4 address 3FF1402

BIT	**DESCRIPTION**
15	Spare
14	Spare
13	CAM 2 AZ 200 deg
12	CAM 2 AZ 100 deg
11	CAM 2 AZ 80 deg
10	CAM 2 AZ 40 deg
9	CAM 2 AZ 20 deg
8	CAM 2 AZ 10 deg
7	CAM 2 AZ 8 deg
6	CAM 2 AZ 4 deg
5	CAM 2 AZ 2 deg
4	CAM 2 AZ 1 deg
3	CAM 2 AZ 0.8 deg
2	CAM 2 AZ 0.4 deg
1	CAM 2 AZ 0.2 deg
0	CAM 2 AZ 0.1 deg

BYTE 936

DESCRIPTION				RAW OUTPUT # 17											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-4 address 3FF1404

BIT	DESCRIPTION
15	CAM 2 EL sign
14	Spare
13	Spare
12	Spare
11	CAM 2 EL 80 deg
10	CAM 2 EL 40 deg
9	CAM 2 EL 20 deg
8	CAM 2 EL 10 deg
7	CAM 2 EL 8 deg
6	CAM 2 EL 4 deg
5	CAM 2 EL 2 deg
4	CAM 2 EL 1 deg
3	CAM 2 EL 0.8 deg
2	CAM 2 EL 0.4 deg
1	CAM 2 EL 0.2 deg
0	CAM 2 EL 0.1 deg

BYTE 938

DESCRIPTION				RAW OUTPUT # 18											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-4 address 3FF1406

BIT	DESCRIPTION
15	AUX 1 READY
14	AUX 2 READY
13	AUX 3 READY
12	AUX 4 READY
11	AUX 5 READY
10	AUX 6 READY
9	OTE-A READY
8	D / O HOLD A
7	OTE-B READY
6	D / O HOLD B
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 940

DESCRIPTION				RAW OUTPUT # 19											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-4 address 3FF1408

BIT	DESCRIPTION
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 942

DESCRIPTION				RAW OUTPUT # 20											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-5 address 3FF1500

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare AZ 200 Deg
12	Spare AZ 100 Deg
11	Spare AZ 80 Deg
10	Spare AZ 40 Deg
9	Spare AZ 20 Deg
8	Spare AZ 10 Deg
7	Spare AZ 8 Deg
6	Spare AZ 4 Deg
5	Spare AZ 2 Deg
4	Spare AZ 1 Deg
3	Spare AZ 0.8 Deg
2	Spare AZ 0.4 Deg
1	Spare AZ 0.2 Deg
0	Spare AZ 0.1 Deg

BYTE 944

DESCRIPTION	RAW OUTPUT # 21														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-5 address 3FF1502

BIT	DESCRIPTION
15	Spare EL sign
14	Spare
13	Spare
12	Spare
11	Spare EL 80 Deg
10	Spare EL 40 Deg
9	Spare EL 20 Deg
8	Spare EL 10 Deg
7	Spare EL 8 Deg
6	Spare EL 4 Deg
5	Spare EL 2 Deg
4	Spare EL 1 Deg
3	Spare EL 0.8 Deg
2	Spare EL 0.4 Deg
1	Spare EL 0.2 Deg
0	Spare EL 0.1 Deg

BYTE 946

DESCRIPTION	RAW OUTPUT # 22														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-5 address 3FF1504

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare
12	Spare
11	Spare
10	Spare
9	Spare
8	Spare
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 948

DESCRIPTION				RAW OUTPUT # 23											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-5 address 3FF1506

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare
12	Spare
11	Spare
10	Spare
9	Spare
8	Spare
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 950

DESCRIPTION				RAW OUTPUT # 24											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-5 address 3FF1508

BIT	DESCRIPTION
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 952

DESCRIPTION				RAW OUTPUT # 25											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-6 address 3FF1600

BIT	DESCRIPTION
15	Spare
14	Spare
13	Spare
12	Spare
11	Spare
10	Spare
9	Spare
8	Spare
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 954

DESCRIPTION				RAW OUTPUT # 26											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-6 address 3FF1602

BIT	DESCRIPTION
15	not used
14	not used
13	not used
12	not used
11	not used
10	not used
9	not used
8	not used
7	Spare
6	Spare
5	Spare
4	Spare
3	Spare
2	Spare
1	Spare
0	Spare

BYTE 956

DESCRIPTION				RAW OUTPUT # 27											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-6 address 3FF1604

BIT	DESCRIPTION
15	not used
14	not used
13	X D/S 180 Deg (sign)
12	X D/S 90 Deg
11	X D/S 45 Deg
10	X D/S 22.5 Deg
9	X D/S 11.25 Deg
8	X D/S 5.625 Deg
7	X D/S 2.8125 Deg
6	X D/S 1.40625 Deg
5	X D/S 0.703125 Deg
4	X D/S 0.3515625 Deg
3	X D/S 0.1757812 Deg
2	X D/S 0.0878906 Deg
1	X D/S 0.0439453 Deg
0	X D/S 0.0219727 Deg

BYTE 958

DESCRIPTION				RAW OUTPUT # 28											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-6 address 3FF1606

BIT	DESCRIPTION
15	not used
14	not used
13	Y D/S 180 Deg (sign)
12	Y D/S 90 Deg
11	Y D/S 45 Deg
10	Y D/S 22.5 Deg
9	Y D/S 11.25 Deg
8	Y D/S 5.625 Deg
7	Y D/S 2.8125 Deg
6	Y D/S 1.40625 Deg
5	Y D/S 0.703125 Deg
4	Y D/S 0.3515625 Deg
3	Y D/S 0.1757812 Deg
2	Y D/S 0.0878906 Deg
1	Y D/S 0.0439453 Deg
0	Y D/S 0.0219727 Deg

BYTE 960

DESCRIPTION				RAW OUTPUT # 29											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

digital input output board OUT-6 address 3FF1608

BIT	DESCRIPTION
15	No Connection
14	No Connection
13	No Connection
12	No Connection
11	No Connection
10	No Connection
9	No Connection
8	No Connection
7	Not used
6	Not used
5	Not used
4	Not used
3	Not used
2	Not used
1	Not used
0	Not used

BYTE 962

DESCRIPTION				RAW OUTPUT # 30											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

X drive signal Digital to analog output
A/D scale factor 0.0003051758

BYTE 964

DESCRIPTION				RAW OUTPUT # 31											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Y drive signal Digital to analog output
A/D scale factor 0.0003051758

BYTE 966

DESCRIPTION				RAW OUTPUT # 32											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

X program error Digital to analog output
A/D scale factor 0.0003051758

BYTE 968

DESCRIPTION				RAW OUTPUT # 33											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Y program error Digital to analog output
A/D scale factor 0.0003051758

BYTE 970

DESCRIPTION				RAW OUTPUT # 34											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

X program error secondary Digital to analog output
A/D scale factor 0.0003051758

BYTE 972

DESCRIPTION				RAW OUTPUT # 35											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Y program error secondary Digital to analog output
A/D scale factor 0.0003051758

BYTE 974

DESCRIPTION				RAW OUTPUT # 36											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Spare Digital to analog output

BYTE 976

DESCRIPTION				RAW OUTPUT # 37											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Spare Digital to analog output

BYTE 978 - 1198

DESCRIPTION				SPARE (221)			
7	6	5	4	3	2	1	0

BYTE 1199

DESCRIPTION				DELOG USAGE			
7	6	5	4	3	2	1	0

NOTE: This byte is used by the delog software in the STPS

F.2 Static System Status Tape: Block Type 2

F.2.1 RTPS

F.2.1.1 Bytes 0 to 1719

The size of each tape block is 12000 bytes.

BYTE 0

DESCRIPTION	TAPE BLOCK SEQUENCE COUNT														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 2

DESCRIPTION	TAPE BLOCK TYPE						
7	6	5	4	3	2	1	0

Static System Status 2

BYTE 3

DESCRIPTION	SYSTEM ID						
7	6	5	4	3	2	1	0
1 = RTPS		2 = STPS			3 = DSTPS		

BYTE 4

DESCRIPTION	ANTENNA GEO						
7	6	5	4	3	2	1	0
1 = AZ EL		2 = X Y			3 = X Y PRIME		

BYTE 5

DESCRIPTION	VALID RECORD						
7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID			

BYTE 6

DESCRIPTION	REAL TIME														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTE 16

DESCRIPTION	VALID MESSAGE FLAGS														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

Bit set to 1 = message valid in this record.

INPUT

Bit	Msg Type	Bit	Msg Type
0	IRV A	1	OTE A
2	LRV A	3	IIRV A
4	NORAD A	5	MDDF A
6	LTAS A	7	INP A
8	MANUAL	9	IRV B
10	OTE B	11	LRV B
12	IIRV B	13	NORAD B
14	MDDF B	15	LTAS B
16	INP B	17	BROUWER A
18	BROUWER B	19	EPV A
20	EPV B		

OUTPUT

Bit	Msg Type	Bit	Msg Type
21	MDDF A	22	MDDF B
23	LTAS A	24	LTAS B
25	NORAD	26	46 CHAR
28	IRV A	29	IRV B

BYTE 20

DESCRIPTION	IRV A MESSAGE FROM OTE OUTPUT						
7	6	5	4	3	2	1	0

Up to 850 bytes
(see IRV description for format)

BYTE 870

DESCRIPTION	IRV B MESSAGE FROM OTE OUTPUT						
7	6	5	4	3	2	1	0

Up to 850 bytes
(see IRV description for format)

F.2.1.2 CURRENT ACQUISITION DATA MESSAGES

BYTE 1720

DESCRIPTION	IRV A						
7	6	5	4	3	2	1	0

Up to 850 bytes
(see IRV description for format)

BYTE 2530

DESCRIPTION	IRV B						
7	6	5	4	3	2	1	0

Up to 850 bytes
(see IRV description for format)

BYTE 3380

DESCRIPTION				IIRV A			
7	6	5	4	3	2	1	0

Up to 500 bytes
(see IIRV description for format)

BYTE 3880

DESCRIPTION				IIRV B			
7	6	5	4	3	2	1	0

Up to 500 bytes
(see IIRV description for format)

BYTE 4380

DESCRIPTION				INP A			
7	6	5	4	3	2	1	0

Up to 2500 bytes
(see INP description for format)

BYTE 6880

DESCRIPTION				INP B			
7	6	5	4	3	2	1	0

Up to 2500 bytes
(see INP description for format)

BYTE 9380

DESCRIPTION				NORAD A			
7	6	5	4	3	2	1	0

Up to 500 bytes
(see NORAD description for format)

BYTE 9880

DESCRIPTION				NORAD B			
7	6	5	4	3	2	1	0

Up to 500 bytes
(see NORAD description for format)

BYTE 10380

DESCRIPTION				LRV A			
7	6	5	4	3	2	1	0

Up to 500 bytes
IIRV derived from LTAS frame
(see IIRV description for format)

BYTE 10880

DESCRIPTION				LRV B			
7	6	5	4	3	2	1	0

Up to 500 bytes
IIRV derived from LTAS frame
(see IIRV description for format)

F.2.1.3 CPU STATUS

BYTE 11380

DESCRIPTION	MP PROGRAM NAME						
7	6	5	4	3	2	1	0

Up to 20 bytes of ASCII characters

BYTE 11400

DESCRIPTION	MP PROGRAM VERSION						
7	6	5	4	3	2	1	0

Up to 20 bytes of ASCII characters

BYTE 11420

DESCRIPTION	ORBITAL PROCESSOR PROGRAM NAME						
7	6	5	4	3	2	1	0

Up to 20 bytes of ASCII characters

BYTE 11440

DESCRIPTION	ORBITAL PROCESSOR PROGRAM VERSION						
7	6	5	4	3	2	1	0

Up to 20 bytes of ASCII characters

BYTE 11460

DESCRIPTION	MAIN PROCESSOR MEMORY STATUS						
7	6	5	4	3	2	1	0
1 = GOOD				0 = BAD			

BYTE 11461

DESCRIPTION	ORBITAL PROCESSOR MEMORY STATUS						
7	6	5	4	3	2	1	0
1 = GOOD				0 = BAD			

F.2.1.4 SYSTEM UNIQUE STATUS

BYTE 11462

DESCRIPTION	CDSG SWITCH STATES						
7	6	5	4	3	2	1	0

Switch 0 not recorded

BYTE 11463

DESCRIPTION	CDSG SWITCH STATES						
7	6	5	4	3	2	1	0

Switch 1 not recorded

BYTE 11464

DESCRIPTION	CDSG SWITCH STATES						
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 2 recorded (Select IRV A Designate Source)

BYTE 11465

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 3 recorded (Select OTE A Designate Source)

BYTE 11466

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 4 recorded (Select LRV A Designate Source)

BYTE 11467

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 5 recorded (Select IIRV A Designate Source)

BYTE 11468

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 6 recorded (Select NORAD A Designate Source)

BYTE 11469

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 7 recorded (Select MDDF A Designate Source)

BYTE 11470

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 8 recorded (Select LTAS A Designate Source)

BYTE 11471

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 9 recorded (Select INP A Designate Source)

BYTE 11472

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0

Switch 10 not recorded

BYTE 11473

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 11 recorded (Select MANUAL TABLE Designate Source)

BYTE 11474

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0

Switch 12 not recorded

BYTE 11475

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 13 recorded (Select IRV B Designate Source)

BYTE 11476

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 14 recorded (Select OTE B Designate Source)

BYTE 11477

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 15 recorded (Select LRV B Designate Source)

BYTE 11478

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 16 recorded (Select IIRV B Designate Source)

BYTE 11479

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 17 recorded (Select NORAD B Designate Source)

BYTE 11480

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 18 recorded (Select MDDF B Designate Source)

BYTE 11481

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 19 recorded (Select LTAS B Designate Source)

BYTE 11482

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 20 recorded (Select INP B Designate Source)

BYTE 11483 - 11492

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0

Switches 21 - 30 not recorded

BYTE 11493

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = SELECTED				0 = DESELECTED			

Switch 31 recorded (Select SLEW Designate Source)

BYTE 11494 - 11585

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0

Switches 32 - 123 not recorded

BYTE 11586

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = ON				0 = OFF			

Switch 124 recorded (SYSTEM STATUS)

BYTES 11587 - 11592

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0

Switches 125 - 130 not recorded

BYTE 11593

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = A				0 = B			

Switch 131 recorded (OTE SELECT Switch Position)

BYTE 11594

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0

Switch 132 not recorded

BYTE 11595

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = ON				0 = OFF			

Switch 133 recorded (NOR SPLINE)

BYTES 11596 - 11600

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0

Switches 134 - 138 not recorded

BYTE 11601

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = GMT SELECTED				0 = SIM SELECTED			

Switch 139 recorded (GMT Time or SIM Time Switch Position)

BYTE 11602

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0

Switch 140 not recorded

BYTE 11603

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0

Switch 141 not recorded

BYTE 11604

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = ON				0 = OFF			

Switch 142 recorded (High Speed DATA DOD)

BYTE 11605

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = ON				0 = OFF			

Switch 143 recorded (PLUNGE SELECT)

BYTE 11606

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0
1 = RECORD SELECTED				0 = PLAYBACK SELECTED			

Switch 144 recorded (RECORD / PLAYBACK MODE Switch Position)

BYTES 11607 - 11717

DESCRIPTION				CDSG SWITCH STATES			
7	6	5	4	3	2	1	0

Switches 145 - 255 not recorded

BYTE 11718

DESCRIPTION	SPARE (30) (RESERVED FOR STPS)						
7	6	5	4	3	2	1	0

30 bytes

BYTES 11748 - 11999

DESCRIPTION	SPARE						
7	6	5	4	3	2	1	0

F.2.2 STPS

F.2.2.1 Bytes 0 to 1719

The size of each tape block is 12000 bytes.

BYTE 0

DESCRIPTION	TAPE BLOCK SEQUENCE COUNT														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 2

DESCRIPTION	TAPE BLOCK TYPE						
7	6	5	4	3	2	1	0

Static System Status 2

BYTE 3

DESCRIPTION	SYSTEM ID						
7	6	5	4	3	2	1	0
1 = RTPS	2 = STPS	3 = DSTPS					

BYTE 4

DESCRIPTION	ANTENNA GEO						
7	6	5	4	3	2	1	0
1 = AZ EL	2 = X Y	3 = X Y PRIME					

BYTE 5

DESCRIPTION	VALID RECORD						
7	6	5	4	3	2	1	0
1 = VALID	0 = INVALID						

BYTE 6

DESCRIPTION	REAL TIME														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTE 16

DESCRIPTION	VALID MESSAGE FLAGS														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

Bit set to 1 = message valid in this record.

INPUT

Bit	Msg Type	Bit	Msg Type
0	IRV A	1	OTE A
2	LRV A	3	IIRV A
4	NORAD A	5	MDDF A
6	LTAS A	7	INP A
8	MANUAL	9	IRV B
10	OTE B	11	LRV B
12	IIRV B	13	NORAD B
14	MDDF B	15	LTAS B
16	INP B	17	BROUWER A
18	BROUWER B	19	EPV A
20	EPV B		

OUTPUT

Bit	Msg Type	Bit	Msg Type
21	MDDF A	22	MDDF B
23	LTAS A	24	LTAS B
25	NORAD	26	46 CHAR
27	UTDF	28	IRV A
29	IRV B		

BYTE 20

DESCRIPTION	IRV A MESSAGE FROM OTE OUTPUT						
7	6	5	4	3	2	1	0

Up to 850 bytes
(see IRV description for format)

BYTE 870

DESCRIPTION	IRV B MESSAGE FROM OTE OUTPUT						
7	6	5	4	3	2	1	0

Up to 850 bytes
(see IRV description for format)

F.2.2.2 CURRENT ACQUISITION DATA MESSAGES

BYTE 1720

DESCRIPTION	IRV A						
7	6	5	4	3	2	1	0

Up to 850 bytes
(see IRV description for format)

BYTE 2530

DESCRIPTION	IRV B						
7	6	5	4	3	2	1	0

Up to 850 bytes
(see IRV description for format)

BYTE 3380

DESCRIPTION	IIRV A						
7	6	5	4	3	2	1	0

Up to 500 bytes
(see IIRV description for format)

BYTE 3880

DESCRIPTION	IIRV B						
7	6	5	4	3	2	1	0

Up to 500 bytes
(see IIRV description for format)

BYTE 4380

DESCRIPTION	INP A						
7	6	5	4	3	2	1	0

Up to 2500 bytes
(see INP description for format)

BYTE 6880

DESCRIPTION	INP B						
7	6	5	4	3	2	1	0

Up to 2500 bytes
(see INP description for format)

BYTE 9380

DESCRIPTION	NORAD A						
7	6	5	4	3	2	1	0

Up to 500 bytes
(see NORAD description for format)

BYTE 9880

DESCRIPTION	NORAD B						
7	6	5	4	3	2	1	0

Up to 500 bytes
(see NORAD description for format)

BYTE 10380

DESCRIPTION	LRV A						
7	6	5	4	3	2	1	0

Up to 500 bytes
IIRV derived from LTAS frame
(see IIRV description for format)

BYTE 10880

DESCRIPTION	LRV B						
7	6	5	4	3	2	1	0

Up to 500 bytes
IIRV derived from LTAS frame
(see IIRV description for format)

F.2.2.3 CPU STATUS

BYTE 11380

DESCRIPTION				RTP PROGRAM NAME			
7	6	5	4	3	2	1	0

Up to 20 bytes of ASCII characters

BYTE 11400

DESCRIPTION				RTP PROGRAM VERSION			
7	6	5	4	3	2	1	0

Up to 20 bytes of ASCII characters

BYTE 11420

DESCRIPTION				ORBITAL PROCESSOR PROGRAM NAME			
7	6	5	4	3	2	1	0

Up to 20 bytes of ASCII characters

BYTE 11440

DESCRIPTION				ORBITAL PROCESSOR PROGRAM VERSION			
7	6	5	4	3	2	1	0

Up to 20 bytes of ASCII characters

BYTE 11460

DESCRIPTION				RTP MEMORY STATUS			
7	6	5	4	3	2	1	0
1 = GOOD				0 = BAD			

BYTE 11461

DESCRIPTION				ORBITAL PROCESSOR MEMORY STATUS			
7	6	5	4	3	2	1	0
1 = GOOD				0 = BAD			

F.2.2.4 SYSTEM UNIQUE STATUS

BYTE 11462 - 11517

DESCRIPTION				SPARE (256) (RESERVED FOR RTPS)			
7	6	5	4	3	2	1	0

BYTE 11518

DESCRIPTION				SUPPORT UNIQUE FILE NAME			
7	6	5	4	3	2	1	0

Up to 30 bytes of ASCII characters

BYTES 11548 - 11999

DESCRIPTION				SPARE			
7	6	5	4	3	2	1	0

F.3 Static System Status Tape: Block Type 3

F.3.1 RTPS

The size of each tape block is 12000 bytes.

BYTE 0

DESCRIPTION	TAPE BLOCK SEQUENCE COUNT														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 2

DESCRIPTION	TAPE BLOCK TYPE						
7	6	5	4	3	2	1	0

Static System Status 3

BYTE 3

DESCRIPTION	SYSTEM ID						
7	6	5	4	3	2	1	0
1 = RTPS		2 = STPS		3 = DSTPS			

BYTE 4

DESCRIPTION	ANTENNA GEO						
7	6	5	4	3	2	1	0
1 = AZ EL		2 = X Y		3 = X Y PRIME			

BYTE 5

DESCRIPTION	SPARE (RESERVED FOR STPS)						
7	6	5	4	3	2	1	0

BYTE 5

DESCRIPTION	REAL TIME														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTE 16

DESCRIPTION	VALID MESSAGE FLAGS														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

Bit set to 1 = message valid in this record.

BIT	**Message Type**
17	BROUWER A
18	BROUWER B
19	EPV A
20	EPV B

BYTES 20 - 2669

DESCRIPTION	SPARE (RESERVED FOR STPS)						
7	6	5	4	3	2	1	0

BYTE 2670

DESCRIPTION	BROUWER A						
7	6	5	4	3	2	1	0

Up to 850 bytes
(see BROUWER description for format)

BYTE 2520

DESCRIPTION	BROUWER B						
7	6	5	4	3	2	1	0

Up to 850 bytes
(see BROUWER description for format)

BYTES 3370 - 4219

DESCRIPTION	SPARE (850) (RESERVED FOR STPS)						
7	6	5	4	3	2	1	0

BYTE 4220

DESCRIPTION	EPV A						
7	6	5	4	3	2	1	0

(extended precision vector)
Up to 850 bytes
(see EPV description for format)

BYTE 5070

DESCRIPTION	EPV B						
7	6	5	4	3	2	1	0

(extended precision vector)
Up to 850 bytes
(see EPV description for format)

BYTES 5920 - 6769

DESCRIPTION	SPARE (850) (RESERVED FOR STPS)						
7	6	5	4	3	2	1	0

BYTES 6770 - 11999

DESCRIPTION	SPARE						
7	6	5	4	3	2	1	0

F.3.2 STPS

The size of each tape block is 12000 bytes.

BYTE 0

DESCRIPTION				TAPE BLOCK SEQUENCE COUNT											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 2

DESCRIPTION				TAPE BLOCK TYPE			
7	6	5	4	3	2	1	0

Static System Status 3

BYTE 3

DESCRIPTION				SYSTEM ID			
7	6	5	4	3	2	1	0
1 = RTPS		2 = STPS			3 = DSTPS		

BYTE 4

DESCRIPTION				ANTENNA GEO			
7	6	5	4	3	2	1	0
1 = AZ EL		2 = X Y			3 = X Y PRIME		

BYTE 5

DESCRIPTION				ANTENNA DS MODE			
7	6	5	4	3	2	1	0

BYTE 5

DESCRIPTION				REAL TIME											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTE 16

DESCRIPTION	VALID MESSAGE FLAGS														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

Bit set to 1 = message valid in this record.

BIT	**Message Type**
0	IRV DS
1	LRV DS
2	IIRV DS
4	NORAD DS
5	INP DS
6	BROUWER DS
7	EPV DS
17	BROUWER A
18	BROUWER B
19	EPV A
20	EPV B

BYTE 20

DESCRIPTION	IRV DS						
7	6	5	4	3	2	1	0

Up to 850 bytes
(see IRV description for format)

BYTE 870

DESCRIPTION	IIRV DS						
7	6	5	4	3	2	1	0

Up to 500 bytes
(see IIRV description for format)

BYTE 1370

DESCRIPTION	INP DS						
7	6	5	4	3	2	1	0

Up to 2500 bytes
(see INP description for format)

BYTE 1670

DESCRIPTION	NORAD DS						
7	6	5	4	3	2	1	0

Up to 500 bytes
(see NORAD description for format)

BYTE 2170

DESCRIPTION	LRV DS						
7	6	5	4	3	2	1	0

Up to 500 bytes
IIRV derived from LTAS frame
(see IIRV description for format)

BYTE 2670

DESCRIPTION				BROUWER A			
7	6	5	4	3	2	1	0

Up to 850 bytes
(see BROUWER description for format)

BYTE 2520

DESCRIPTION				BROUWER B			
7	6	5	4	3	2	1	0

Up to 850 bytes
(see BROUWER description for format)

BYTE 3370

DESCRIPTION				BROUWER DS			
7	6	5	4	3	2	1	0

Up to 850 bytes
(see BROUWER description for format)

BYTE 4220

DESCRIPTION				EPV A			
7	6	5	4	3	2	1	0

(extended precision vector)
Up to 850 bytes
(see EPV description for format)

BYTE 5070

DESCRIPTION				EPV B			
7	6	5	4	3	2	1	0

(extended precision vector)
Up to 850 bytes
(see EPV description for format)

BYTE 5920

DESCRIPTION				EPV DS			
7	6	5	4	3	2	1	0

(extended precision vector)
Up to 850 bytes
(see EPV description for format)

BYTES 6770 - 11999

DESCRIPTION				SPARE			
7	6	5	4	3	2	1	0

F.4 Static System Status Tape: Block Type 4 (RTPS)

The size of each tape block is 12000 bytes.

BYTE 0

DESCRIPTION	TAPE BLOCK SEQUENCE COUNT														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 2

DESCRIPTION	TAPE BLOCK TYPE						
7	6	5	4	3	2	1	0

Static System Status 4

BYTE 3

DESCRIPTION	SYSTEM ID						
7	6	5	4	3	2	1	0
1 = RTPS		2 = STPS		3 = DSTPS			

BYTE 4

DESCRIPTION	ANTENNA GEO						
7	6	5	4	3	2	1	0
1 = AZ EL		2 = X Y		3 = X Y PRIME			

BYTE 5

DESCRIPTION	SPARE						
7	6	5	4	3	2	1	0

BYTE 6

DESCRIPTION	REAL TIME														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTE 16

DESCRIPTION				VALID CALIBRATION FILE			
7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID			

BYTE 17

DESCRIPTION				CALIBRATION FILE			
7	6	5	4	3	2	1	0

Up to 1100 bytes of ASCII characters

BYTE 1117

DESCRIPTION				VALID SITE FILE			
7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID			

BYTE 1118

DESCRIPTION				SITE FILE			
7	6	5	4	3	2	1	0

Up to 4300 bytes of ASCII characters

BYTE 5418

DESCRIPTION				VALID MISSION FILE			
7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID			

BYTE 5419

DESCRIPTION				MISSION FILE			
7	6	5	4	3	2	1	0

Up to 500 bytes of ASCII characters

BYTES 5919 - 11999

DESCRIPTION				SPARE			
7	6	5	4	3	2	1	0

F.5 Static System Status Tape: Block Type 5 (STPS)

The size of each tape block is 12000 bytes.

BYTE 0

DESCRIPTION	TAPE BLOCK SEQUENCE COUNT														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BYTE 2

DESCRIPTION	TAPE BLOCK TYPE						
7	6	5	4	3	2	1	0

Static System Status 5

BYTE 3

DESCRIPTION	SYSTEM ID						
7	6	5	4	3	2	1	0
1 = RTPS		2 = STPS			3 = DSTPS		

BYTE 4

DESCRIPTION	ANTENNA GEO						
7	6	5	4	3	2	1	0
1 = AZ EL		2 = X Y			3 = X Y PRIME		

BYTE 5

DESCRIPTION	SPARE						
7	6	5	4	3	2	1	0

BYTE 6

DESCRIPTION	REAL TIME														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

day of year

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

millisecs of day

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

microsecs of millisecs

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

year

BYTE 16

DESCRIPTION	VALID RECORD #1														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID											

BYTE 18

DESCRIPTION	NASCOM BLOCK DATA #1						
7	6	5	4	3	2	1	0

600 bytes

BYTE 618

DESCRIPTION	VALID RECORD #2														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID											

BYTE 620

DESCRIPTION	NASCOM BLOCK DATA #2

7	6	5	4	3	2	1	0

600 bytes

BYTE 1220

DESCRIPTION	VALID RECORD #3														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID	0 = INVALID														

BYTE 1222

DESCRIPTION	NASCOM BLOCK DATA #3						
7	6	5	4	3	2	1	0

600 bytes

BYTE 1822

DESCRIPTION	VALID RECORD #4														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID	0 = INVALID														

BYTE 1824

DESCRIPTION	NASCOM BLOCK DATA #4						
7	6	5	4	3	2	1	0

600 bytes

BYTE 2424

DESCRIPTION	VALID RECORD #5														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID	0 = INVALID														

BYTE 2426

DESCRIPTION	NASCOM BLOCK DATA #5						
7	6	5	4	3	2	1	0

600 bytes

BYTE 3026

DESCRIPTION	VALID RECORD #7														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID	0 = INVALID														

BYTE 3028

DESCRIPTION	NASCOM BLOCK DATA #7						
7	6	5	4	3	2	1	0

600 bytes

BYTE 3628

DESCRIPTION	VALID RECORD #8														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID	0 = INVALID														

BYTE 3630

DESCRIPTION	NASCOM BLOCK DATA #8						
7	6	5	4	3	2	1	0

600 bytes

BYTE 4230

DESCRIPTION	VALID RECORD #9														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID											

BYTE 4232

DESCRIPTION	NASCOM BLOCK DATA #9						
7	6	5	4	3	2	1	0

600 bytes

BYTE 4832

DESCRIPTION	VALID RECORD #10														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID											

BYTE 4834

DESCRIPTION	NASCOM BLOCK DATA #10						
7	6	5	4	3	2	1	0

600 bytes

BYTE 5434

DESCRIPTION	VALID RECORD #11														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID											

BYTE 5436

DESCRIPTION	NASCOM BLOCK DATA #11						
7	6	5	4	3	2	1	0

600 bytes

BYTE 6036

DESCRIPTION	VALID RECORD #12														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID											

BYTE 6038

DESCRIPTION	NASCOM BLOCK DATA #12						
7	6	5	4	3	2	1	0

600 bytes

BYTE 6638

DESCRIPTION	VALID RECORD #13														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID											

BYTE 6640

DESCRIPTION	NASCOM BLOCK DATA #13						
7	6	5	4	3	2	1	0

600 bytes

BYTE 7240

DESCRIPTION	VALID RECORD #14														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID											

BYTE 7242

DESCRIPTION	NASCOM BLOCK DATA #14						
7	6	5	4	3	2	1	0

600 bytes

BYTE 7842

DESCRIPTION	VALID RECORD #15														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID											

BYTE 7844

DESCRIPTION	NASCOM BLOCK DATA #15						
7	6	5	4	3	2	1	0

600 bytes

BYTE 8444

DESCRIPTION	VALID RECORD #16														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 = VALID				0 = INVALID											

BYTE 8446

DESCRIPTION	NASCOM BLOCK DATA #16						
7	6	5	4	3	2	1	0

600 bytes

BYTES 9046 - 11999

DESCRIPTION	SPARE						
7	6	5	4	3	2	1	0

Abbreviations and Acronyms

ACN	Ascension Island
ACC	antenna control console
A-D	analog-to-digital
ADRAN	advanced digital range equipment
ADRS	Automatic Digital Recording System
AFETR	Air Force Eastern Test Range
AFFTC	Air Force Flight Test Center, Edwards Air Force Base
AFSTC	Air Force Satellite Test Center
AGO	Santiago, Chile, GN station
AGS	Alaska Ground Station
ALCOR	Advance Research Project Agency, Lincoln, C-band
ANT	Antigua Island, USAF ETR station 91
AOS	acquisition of signal
APP	antenna position programmer
ARC	ambiguity resolving code
ASC	Ascension Island (U.K.), USAF ETR station 12
ASCII	American Standard Code for Information Interchange
ASF	Alaska Satellite Facility
ATS	Application Technology Satellite
ATSR	Application Technology Satellite Range and Range Rate System
az-el	azimuth-elevation
BCD	binary-coded decimal
BOT	beginning of tape
CAI	command angle indicator
CCC	Central Computer Complex
CD	Conversion Device (NISN)
CNES	Centre National d'Etudes Spatiales
CPU	central processing unit

CRC	cyclic redundancy code
CRT	cathode ray tube
CSTC	Consolidated Space Test Center (Sunnyvale, CA)
CT	control transformer
D-A	digital-to-analog
DCN	documentation change notice
DFL	double precision floating point
DFM	double file mark
DFX	double precision fixed point
DIM	digital input multiplexer
DIRAM	digital range machine
DOD	Department of Defense
DOM	digital output multiplexer
D-S	digital-to-synchro
EAFB	Edwards Air Force Base, CA
EOF	end of file
EOM	end of message
EOT	end of transmission; end of tape
EPV	extended precision vector
ETR	Eastern Test Range, FL
FDF	Flight Dynamics Facility
FLT	floating point
FOC	fraction of circle
FXP	fixed point
GBI	Grand Bahama Island, USAF ETR station 3
GCE	ground control equipment
GDS	Goldstone, CA, DSN station
GET	ground elapsed time
GMT	Greenwich Mean Time
GN	Ground Network
GSFC	Goddard Space Flight Center, Greenbelt, MD

GTK	Grand Turk Island, USAF ETR station 7
GTR	ground transponder relay
HAW	Kokee Park, Kauai, HI
HBK	Hartebeesthoek, South Africa
HSDL	high-speed data link
HSR	high sample rate
Hz	Hertz - cycles per second
IACC	interface to antenna control console
ICD	interface control document
ID	identification
IF	intermediate frequency
IIRV	improved interrange vector
INP	internet prediction
I/O	input and/or output
IOIS	input/output interface subsystem
IP	impact prediction
IRV	interrange vector
ISS	intrasite slaving system
ITDR	INP time check override
IUS	interim upper stage
JPL	Jet Propulsion Laboratory, Pasadena, CA
JSC	Johnson Space Center, Houston, TX
kHz	kilohertz - thousands of cycles per second
KMR	Kwajalein Missile Range, Marshall Island
KPT	Kaena Point, HI, ground station
KSC	Kennedy Space Center, Cape Canaveral, FL
LAG	look angle generation
LCP	left-hand circular polarization
LOS	loss of signal
LSB	least significant bit
LSD	least significant digit; low-speed data

LSDL	low-speed data link
LSR	low sample rate
LTAS	launch trajectory acquisition system
LTC	local transport control
LTDS	launch trajectory data system
MA	multiple access
MDDF	minimum delay data format
MFR	multifunction receiver
MGS	McMurdo Ground Station
MHz	megahertz - millions of cycles per second
MIL	Merritt Island, FL, GN station
MLA	Merritt Island Launch Area
MRT	major range tone
MSB	most significant bit
MSD	most significant digit
MT	minor tone
MTC	magnetic tape control
MTU	magnetic tape unit
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications Network
NBE	Canberra, Australia, DSN station
NISN	NASA Integrated Services Network
NOAA	National Oceanic and Atmospheric Administration
NDOSL	NASA Directory of Station Locations
NOR	NORAD element or bulletin
NORAD	North American Air Defense Command
NOSP	Network Operations Support Plan
PBI	pushbutton indicator
PCA	point of closest approach
PDL	Ponce de Leon, FL, GN Station
PLL	phase-locked loop

PMTC	Pacific Missile Test Center
PN	pseudo-random noise
P/W	pulse width
R	range
$\dot{R}$	range rate
RAP	RCA assembly program
RARR	range and range rate
RCP	right-hand circular polarization
RER	receiver/exciter/ranging
RF	radio frequency
RID	Madrid, Spain, DSN station
RIS	Range Instrumentation Ship
RMCP	receive monitor control panel
RTLT	round trip light time
RTPS	Radar Tracking Processor System
RX	receiver
SA	single access
SBE	S-band exciter
SC	spacecraft
SCR	silicon-controlled rectifier
SCR/DE	subcarrier receiver/Doppler extractor
SFM	single file mark
SFX	single precision fixed point
SGS	Svalbard Ground Station
SIC	support identification code
SRB	solid rocket booster
SRE	STDN ranging equipment
SSI	software support instruction
SST	satellite-to-satellite tracking
STDN	Spaceflight Tracking and Data Network

STGT	Second TDRSS Ground Terminal
SUF	site-unique file
SUS	Shuttle upper stage
TDP	tracking data processor
TDS	Tracking Data System (NISN)
TDPS	Tracking Data Processor System
TDR	tracking data relay
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
TLM	telemetry
TRACQ	tracking and acquisition program
TTCP	tracking, telemetry, and command processor
TTY	teletype
TX	transmitter
ULA	Fairbanks, AK, NOAA station
USN	Universal Space Network
UTC	universal time coordinated
UTDF	universal tracking data format
VCO	voltage controller oscillator
VCU	VHF control unit
VDB	Vandenberg Air Force Base, CA, USAF WTR station
VHF	very high frequency
VID	vehicle indentification code
WFF	Wallops Flight Facility
WLP	Wallops Island, NASA tracking radar
WGS	Wallops Ground Station
WSGT	White Sands Ground Terminal
WSGTU	White Sands Ground Terminal Upgrade
WSSH	White Sands Space Harbour
WTR	Western Test Range
ZSB	zero-set bias