AVOID VERBAL ORDERS

HUGHES
AIRCRAFT COMPANY

TO	SYSTEM ENGINEERING/PROGRAM MGNT	SOURCE CODE	LOC.	BLDG.	M/S	PHONE
FROM	MGN DATA BANK	SOURCE CODE	LOC.	BLDG.	M/S	PHONE
SUBJECT	SPACECRAFT SYSTEM & SUBSYSTEM DESIGN BOOK UPDATE				DATE 11 / 10 / 87	

The following sections of the Spacecraft System and Subsystem Design Book from Martin Marietta have either been replace or updated:

VRM-2-280: Telemetry Measurements and Data Formats

VRM-2-290: Command Structure and Assignments

VRM-2-300: Telecommunications System Requirements

VRM-2-3717: Functional Requirements, S/X-Band Antenna Subsystem

VRM-2-170: Functional Accuracies and System Capabilities

VRM-SE-020-075: Spacecraft Flight System Parameters Report

Paula Tavares
SIGNATURE

VRM-SE-001-002
Exhibit II
Contract JPL 956700

Revision: Final
May 1987

VENUS RADAR MAPPER
FULL SCALE DEVELOPMENT

SPACECRAFT SYSTEM AND SUBSYSTEM DESIGN BOOK
TELEMETRY MEASUREMENTS AND DATA FORMATS

VRM-2-280

PREPARED BY: L. Feinstein

CONTRACTOR APPROVAL:

D. W. Marquet, Manager
Systems Engineering

W. E. Dorroh, Manager
Telecommunication and
Information Systems

H. Grotheer, Manager
Software

C. D. Brown
Program Manager

JPL APPROVAL:

J. P. Slonski
Spacecraft System Engineer

G. L. Parker
Spacecraft Manager

MARTIN MARIETTA AEROSPACE
Denver Aerospace
NASA Space Systems
P.O. Box 179, Denver, Colorado 80201

MARTIN MARIETTA

SPECIFICATION **CHANGE NOTICE**

DATE March 1988

CONTRACT NO. JPL 956700 UNIFORM CONTROL NO. See below

CHANGE CLASSIFICATION I and II

PRELIMINARY ☐ FINAL ☒

CHANGE NOTICE NO. 1 CHANGE NOTICE NO. REVISION Basic

DOCUMENT NO. VRM-2-280 REVISION Final

DOCUMENT TITLE VRM Full Scale Development Spacecraft System and Subsystem Design Book
Telemetry Measurements and Data Formats

DOCUMENT DATE May 1987

AUTHORITY FOR CHANGE:
EH 0833, EH 0873, EG 0897 Sup A, EH 0970

REASON FOR CHANGE:

Document update Per Approved Engineering

INCORPORATION INSTRUCTIONS: File this page directly behind the title page.

Remove and Replace Pages: iv, vii, 7, 8, 14, 26, 28, 31, 33, 34, 35, 36, 37, 63, 64, 65, 67, 68, 72, 102, 103, 104, 109, 110, 111, 112, 120, 121, 122, 123, 124, 125, 126, 127, 135, 146, 147, 148, 149, 151, 152, 162, 163, 166, 167, 168, 170, 171, 172, 175, 185, 186, 189, 190, 191, 196, 227, ia

Add pages: 111A and 120A

MARTIN MARIETTA

SPECIFICATION **CHANGE NOTICE**

DATE 25 May 88

CONTRACT NO. 956700 UNIFORM CONTROL NO. N/A

CHANGE CLASSIFICATION N/A

PRELIMINARY ☐ FINAL ☒

CHANGE NOTICE NO. Eratta to SCN 1 Dated March 1988 CHANGE NOTICE NO. REVISION Basic

DOCUMENT NO. VRM-2-280 REVISION Final

DOCUMENT TITLE Venus Radar Mapper Full Scale Development Spacecraft System and Subsystem Design Book Telemetry Measurements and Data Formats

DOCUMENT DATE MAY 1987

AUTHORITY FOR CHANGE: N/A

REASON FOR CHANGE: This is an eratta Change to the subject document for the purpose of correcting a typographical error.

INCORPORATION INSTRUCTIONS:

Remove and replace page 227. Add page ib. File this page directly behind the title page.

MARTIN MARIETTA | SPECIFICATION CHANGE LOG

Document Number VRM-2-280

Document Title Spacecraft System and Subsystem Design Book Telemetry Measurements and Data Formats

Chg. No.	Change Date	Pages Affected	Authority Reference	Remarks
Revision	Feb. 1985	All	EG0026, EG0075 EG0078, EG0089	Revision: Draft Feb. 1985
SCN 1	6 May 85	i, 89, 107, 122, 123, 126, 127 replaced; 107a added	EG0121	
SCN 2	5 Sep. 85	i, 49, 50, 51, 52, 53, 55, 56, 57, 86, 87, 88, 89, 90, 107, 122, 123, 54, 135, 136, 181, 182, 183; 56a added	EG0221, EG0164, EG0166	
Revision	Dec 1985	All	EG0232, EG0236 EG0268, EG0297 EG0309 Sup A, EG0324, EG0338 EG0340	Revision: Draft Dec 1985
SCN 1	12 Dec 86	i, iii, vii, 2, 6, 8-10, 13-16, 18, 21, 28, 48-68, 70, 75, 76, 78-85, 89, 90, 92-100 102-124, 127, 129-139, 141, 148-153, 177, (Cont.)	EH0309 Sup B, EH0343, EG0410, EH0453 Sup A, EH0458, EH0489, EH0490, EH0494, EH0497 Sup A, EH0497, EH0523, EG0524, EH0529, EH0531, EH0532, EH0533, EH0539 Sup A, EH0568, EH0574, EH0633	

MARTIN MARIETTA

SPECIFICATION CHANGE LOG

Document Number VRM-2-280

Document Title Spacecraft System and Subsystem Design Book Telemetry Measurements and Data Formats

Chg. No.	Change Date	Pages Affected	Remarks	Authority Reference
SCN 1 (Cont.)		196, 197, 198, 203, 205 replaced 10a, 104a, 108a-108d, 193a-193h, ia, added		
Revision	May 87		Revision: Final May 1987 The margins of this specification have not been marked with change bars due to the extensiveness of the changes.	EH0599 Sup A, EH0634, EH0634 Sup A, EG0643, EH0730, EH0739, EH0744, EH0772, EH0803, JPL ltr 86-132 dated 8 May 1986
SCN 1	Mar 1988	ia, iv, vii, 7, 8, 14, 26, 28, 31, 33, 34, 35, 36, 37, 63, 64, 65, 67, 68, 72, 102, 103, 104, 109, 110, 111, 112, 120 - 127, 135, 146 - 149, 151, 152, 162, 163, 166, 167, 168, 170, 171, 172, 175, 185, 186, 189, 190, 191, 196, 227, replaced 111a and 120a added		EH0833, EH0873, EG0897 Sup A, EH0970

MARTIN MARIETTA

SPECIFICATION **CHANGE LOG**

Document Number VRM-2-280

Document Title Venus Radar Mapper Full Scale Development Spacecraft System and Subsystem Design Book Telemetry Measurements and Data Formats.

Chg. No.	Change Date	Pages Affected	Authority Reference	Remarks
SCN 1 Eratta	25 May 88	227 Replaced	N/A	

FOREWORD

This document is submitted in accordance with the requirements of JPL Contract 956700, Exhibit II, Contract Plans and Documentation, dated 1 October 1983, Contract Data Requirements List, Data Requirement SE001, Line Item 002.

TABLE OF CONTENTS

TABLE OF CONTENTS (cont)

TABLE OF CONTENTS (cont)

TABLE OF CONTENTS (cont)

LIST OF FIGURES

TABLE OF CONTENTS (cont)

LIST OF TABLES

1.0 INTRODUCTION

1.1 Purpose

The purpose of this document is to define and establish the VRM telemetry measurements and data formats.

1.2 Scope

This document provides functional requirements and descriptions of the telemetry format structure characteristics for engineering, science, and playback data.

2.0 APPLICABLE DOCUMENTS

The following documents of the exact issue shown or of the latest VRM project approved issue form a part of this plan to the extent specified herein. In the event of conflict between documents referenced herein and the detail content of this document, the detail requirements herein shall be considered superseding (except in the case of VRM-SE-002-006 and VRM-SE-003-009). The documentation requirements of these applicable documents are limited to those required by the Data Procurement Document (DPD), Exhibit II of Contract 956700 entitled Plans and Documentation (1 October 1983).

2.1 Contractor Prepared Documents

VRM-2-100, VRM S/C System Specification, applies to this document. Requirements of other VRM level 2 documents may also be applicable. It is the responsibility of the user to adequately acquaint himself with the organization and pertinent contents of the level 2 documents, as well as with the material contained herein.

Document Number	Document Title	Paragraph Where Referenced
VRM-2-100	VRM S/C System Specification	3.4.4
VRM-2-300	VRM Telecommunications System Requirements	3.4.4
VRM-2-310	VRM Flight Software Requirements	3.5
VRM-SE-002-006	SCS/RS Interface Requirements Document	3.5.1
VRM-SE-003-009	SCS/RS Interface Control Document	3.5.1

3.0 TELEMETRY SYSTEM FUNCTIONAL REQUIREMENTS

3.1 General

The MGN S/C shall contain hardware and software to perform the telemetry functional requirements as defined in this document.

The data flow block diagram, depicted in Figure 1, shows the functional flow of all MGN telemetry data.

3.1.1 Engineering Subsystem

The VRM S/C and science subsystems consist of the following:

Subsystem Name	Mnemonic Designation	Subsystem Number
Structure Subsystem	MECH (STRU)	01
Radio Frequency Subsystem	TCS (RFS)	02
Power Subsystem	EPS (Power/Pyro)	04
Command and Data Subsystem	CDDS (CDS)	06
Attitude and Articulation Control Subsystem	AACS	07
Cabling Subsystem	EPS (Cabling)	09
Propulsion and Pyro Subsystem	PPS	10
Temperature Control Subsystem	MECH (TEMP)	11
Mechanical Devices Subsystem	MECH (DEV)	12
Data Memory Subsystem	CDDS (DMS)	16
S/X-Band Antenna Subsystem	TCS (SXAS)	17
Radar System	RS	23

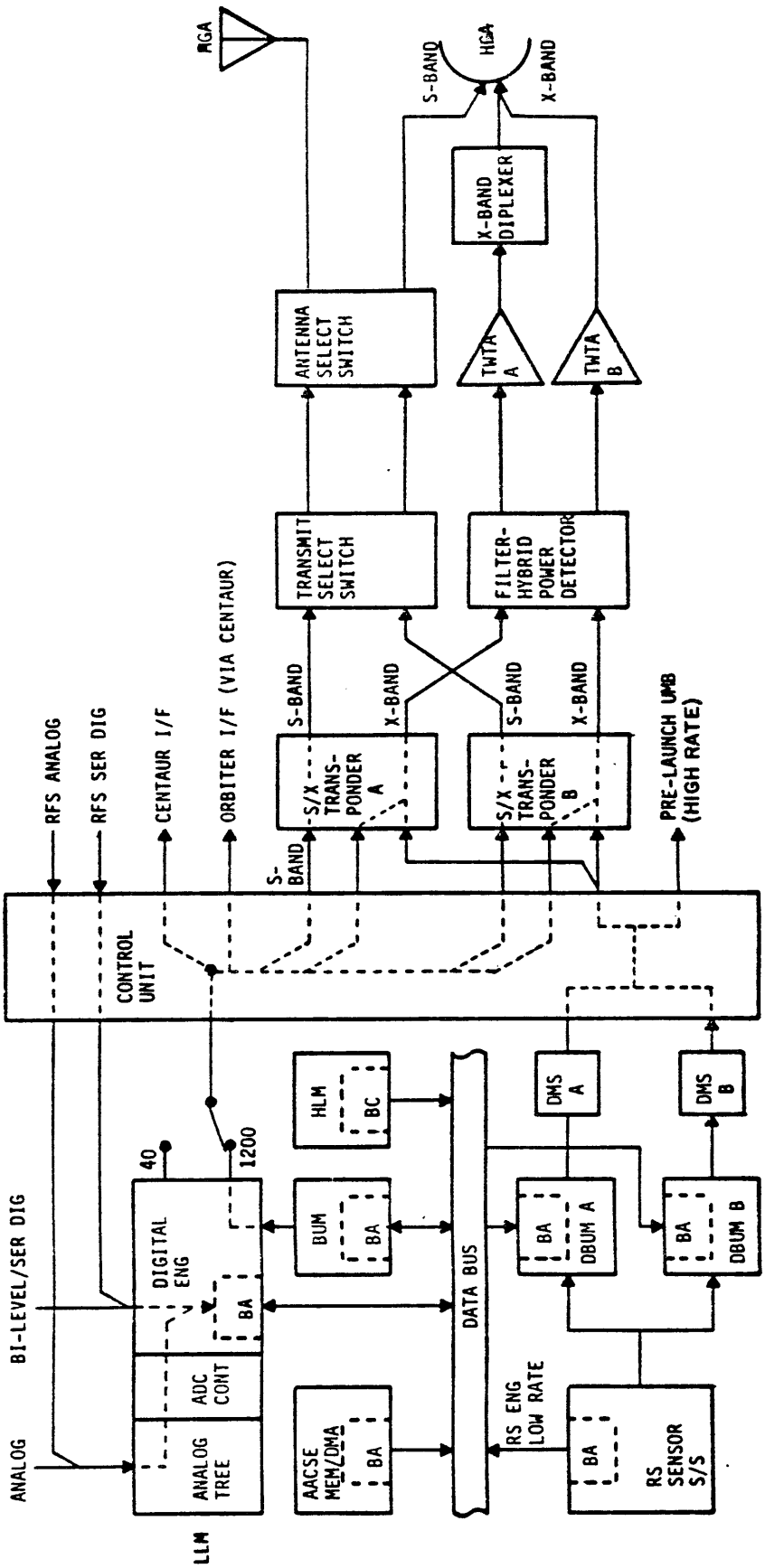


FIGURE 1: TELEMETRY FLOW

3.1.2 Document Conventions

Within this document, the following conventions are followed:

a. All numbers shall be decimal (base 10) unless otherwise indicated.

b. The left most bit in any group of bits shall be the most significant bit (MSB) and shall be assigned bit number 1. The right most bit in any group of bits is the least significant bit (LSB) and shall be assigned bit "N". Unless otherwise indicated, all data shall be transferred MSB first.

3.2 Data Management

The spacecraft shall process the following types of data:

a. Engineering

b. Memory Read Out

c. High-Rate Science (HRS)

d. Playback (PB)

3.2.1 Spacecraft Engineering Data (SED) Frame

Engineering data are those measurements required to monitor the executing sequence, the status and performance of engineering subsystems, and the Radar System critical parameters without prior knowledge of previous state. Redundant measurements for selected critical parameters shall be permitted. These measurements are formatted into a Spacecraft Engineering Data Frame for transmission to Earth via S- or X-band.

The priority in selecting engineering telemetry measurements for inclusion in the engineering frame is listed below. This order of priorities shall be used in the assignment of measurements to the downlink telemetry frames.

a. Measurements necessary for flight operations or safety, such as S/C pointing, fault identification, and state vector for sequence verification.

    1) Measurements that give positive indication of onboard status and actions (both hardware and software).

    2) Measurements required for selecting between alternate modes of operation or redundant elements.

b. Measurements of subsystem parameters directly affecting spacecraft system performance.

c. Measurements necessary to evaluate the performance of subsystems not previously flown.

d. Measurements necessary to evaluate the performance of a subsystem previously flown.

3.2.2 Memory Readout Data

Memory readout data is the data derived from the memories of the command and data subsystem (CDS) and attitude and articulation control subsystem (AACS).

3.2.3 Radar System Data

Radar System data comprises the SAR/Altimeter Burst (SAB) frame and the Radar Composite Data (RCD) frame.

3.2.3.1 SAR/Altimeter Burst (SAB) Frame

A complete radar frame, called a SAR/Altimeter Burst Frame, shall contain a header followed by a burst of SAR data and an optional altimeter data field. These frames are sent to the CDS at 790.08 Kbps.

3.2.3.2 Radar Composite Data (RCD) Frame

The CDS reformats the SAB and SED into Radar Composite Data (RCD) frames, each containing engineering data or filler bits (40 bits) embedded after the header (96 bits), followed by 6584 bits of SAB frame data. The RCDs are sent to the DMS at a rate of 806.4 Kbps (120 frames per second)

3.2.4 Recorded Engineering Data (RED) Frame

A Recorded Engineering Data (RED) Frame contains the same information as the SED, with 4320 bits of added filler to make it compatible with a recording rate of 7.68 Kbps.

3.2.5 Playback (PB) Data

The capability shall exist for DMS playback (RCD or RED) via X-band at a rate of either 268.8 Kbps or 115.2 Kbps. Playback is independent of real-time engineering transmission.

3.3 Data Acquisition

All data generated by engineering or science subsystems shall be initially routed to the CDS for conditioning and processing before being sent to the Shuttle Orbiter and IUS (via the CU), the telecommunication subsystem (TCS), and/or the data memory subsystem (DMS).

3.3.1 Analog Engineering Measurement Resolution

Each temperature and (0-3) volt analog engineering measurement converted to a digital number within the CDS shall result in an 8-bit word with a data number (DN) ranging from 0 to 255. Therefore, each measurement digitized by the CDS shall have a maximum resolution of 1/256 (0.39%).

3.3.2 Analog Engineering Measurement Accuracy

The accuracy with which the CDS shall convert each temperature and (0-3 volt) analog engineering measurement into an 8-bit digital number shall be as specified below:

a. Standard Range Temperature Measurement (-78 deg. C to +100 deg. C):
$\pm$ 3% (of full scale) $\pm$ 1/2 DN

b. Electrostatic Discharge Protected Temperature Measurement (-102 deg. C to +74 deg. C): $\pm$ 4% (of full scale) $\pm$ 1/2 DN

c. Other Temperature Measurements (special ranges):
$\pm$ 5% (of full scale) $\pm$ 1/2 DN

d. Other Analog Measurements:
$\pm$ 1% (of full scale) $\pm$ 1/2 DN

3.4 Data Transmission

The spacecraft shall be capable of data transmission under one or more of the following basic modes:

a. To the Shuttle Orbiter (via IUS) for downlink by the Shuttle Orbiter.

b. To the IUS for downlink by the Shuttle Orbiter (with concatenated Shuttle Orbiter and IUS data).

c. To the IUS for downlink by the IUS (with concatenated IUS data via GSTDN).

d. To the NASA Deep Space Network.

- Via a low-rate channel over S-band or X-band.
- Via a high-rate channel over X-band.

3.4.1 STS Attached Phase

The spacecraft data shall be provided via a hardline to both: (1) the IUS at 1.2 kb/s for inclusion in the IUS/Shuttle Orbiter data stream and (2) the Shuttle Orbiter at 1.2 kb/s. The S/C data stream shall be from the CDS via the CU and shall not be convolutionally coded.

3.4.2 STS Detached Phase

During this phase the spacecraft shall send data at 1200 b/s to the IUS for transmission to GSTDN. This transmission shall be uncoded.

3.4.3 Low-Rate Channel

The low-rate channel shall function on S-band and/or X-band, and shall contain the SED frame (at 1200/40 b/s) exclusively. The low-rate channel shall employ a constraint length = 7, rate = 1/2 convolutional code. It shall be possible to transmit the SED on S-band or X-band, simultaneously with any other data on the high-rate channel. However, the 40 b/s data rate shall be used only during emergency operation, cruise, or when warranted by link margins.

3.4.4 High-Rate Channel

The high-rate channel shall be the primary mode of radar system science data transmission during the mission. This channel shall contain high-rate DMS playback data at 268.8/115.2 kb/s, and shall operate on X-band only.

The telemetry rates and modes available on the high rate channel shall be as specified in Paragraph 3.7 herein.

All data on the high-rate channel shall employ a constraint length = 7, rate = 1/2 convolutional code. Transition density requirements shall be met in order to permit ground decoding as specified in VRM-2-300, Telecommunications and VRM-2-100, System Specification.

3.5 Data Processing

The spacecraft shall contain a number of on-board computers, peripheral processors and analog or digital interfaces. Collectively these computers, processors, and interfaces shall be defined as the spacecraft data system.

Each of the on-board processors shall be assigned dedicated functions described in the following paragraphs and in VRM-2-310, Software Requirements.

3.5.1 Radar System Processor Telemetry Functions

This section is provided for information only. The authoritative documents for Radar System requirements are ICD VRM-SE-003-009 and IRD VRM-SE-002-006.

Except for selected system temperature measurements processed by the CDS, the radar system is responsible for its data collection, analog to digital (A/D) conversion, processing, formatting, and buffering. The instrument telemetry data shall be output under control of the CDS.

General radar system telemetry data requirements shall include the following items:

a. The sensor subsystem shall supply measurements of critical functions in the radar and status messages of the radar state to the CDS for transmitting to the ground as radar engineering telemetry. The user bus reply lines of the DSB shall be used to transfer this data. The radar engineering telemetry shall provide all the required information to determine, without prior knowledge, the state of all mode control, power and redundancy switches in the radar, as well as the analog values of parameters critical to the radar performance. The effective data rate is 180 bits per second. The maximum transmission link bit error rate shall be less than 1×10^{-3}, where the link is defined as from the spacecraft through the DSN telemetry system.

b. The sensor subsystem shall transfer the radar data stream to the CDS via the CDS high rate data interface to be recorded for later transmission to the ground. The total bit error in transferring data from the sensor subsystem to the input of the DSN's ground-based tape recorders shall be less than 1×10^{-3}. The total effective data rate from the sensor subsystem to the flight tape recorder shall be 790.08 kb/s.

c. Within the 120 bit RS allocation, the 24-frame RS data format is asynchronous with the 91-frame SED telemetry format.

3.5.2 AACS Processor Telemetry Functions

Except for selected subsystem measurements processed by the CDS, the AACS shall be responsible for its data collection, A/D conversion, processing, formatting and buffering. The AACS data shall be output under control of the CDS from a buffer area in AACS memory. The data in this buffer will be updated once each minor frame (2/3 seconds), prior to RTI 7 for fixed telemetry, and prior to RTI 5 for variable packet telemetry. The data contained in the buffer will include engineering data, fixed telemetry, and

variable packet telemetry. Engineering data shall be of sufficient rate, resolution, and content to unambiguously define pointing angles and rates with respect to inertial space. AACS shall prepare telemetry blocks at a speed compatible with the 1200 bps (2/3 sec. frame period) engineering telemetry rate. Low rate engineering (40 bps) is generated from this data by CDS, which samples only every 30th high rate frame prepared by AACS, for use in compiling the snapshot engineering frame (ref. para. 3.1.7.1.1).

Fixed telemetry data shall consist of AACS housekeeping measurements, and shall be of sufficient rate, resolution, and content to unambiguously define the AACS hardware and software operating configuration, to identify major software parameters, and to adequately diagnose subsystem anomalies.

An intermediate buffer shall be provided for Fixed Packet telemetry processing such that 10 integer and 39 floating point data items may be stored during RTI 0 of minor frames 0, 13, 26, 39, 52, 65 and 78. Measurements are then extracted from this buffer for placement into the SED telemetry frame. This provides the ability to freeze related parameters within a 13-deck cycle (8-2/3 seconds at 1200 bps)), thus permitting a time correlation of the stored data items.

For the contents of the intermediate buffer, refer to Table A2.2.7.f.

The Trickle Telemetry slot in the AACS Fixed Packet shall contain selected stored measurements (ref. Table A2.2.7.c). These measurements shall be identified by the Trickle ID measurement in the AACS Fixed Packet. The Trickle ID is an integer uplinked via the 7TRKL command and associated with a specific set of Trickle measurements. It will be changed each time the measurements selected for Trickle telemetry are changed. The Trickle measurements shall be displayed consecutively, 2 bytes per minor frame starting with minor frame 1, and continuing until all measurements have been displayed. Minor frame 0 shall always contain the address of the measurement in minor frame 1. Readout of a trickle block shall always begin at minor frame 0 with the address of the first measurement in the block.

The star calibration measurements (ref. Table A2.2.7.d) shall be accessed for telemetry using memory readout (MRO). The starting address for these measurements shall uniquely identify them as star calibration data, thus allowing ground decommutation and processing.

The memory compare telemetry table (ref. Table A2.2.7.e) provides a logical grouping of measurements that will be downlinked via MRO for processing by the ground using the memory analysis function (a byte-for-byte comparison). No byte-wise decommutation is required.

Selection of variable packet telemetry data as a function of telemetry format is done by CDS. AACS shall have all such data available at fixed addresses and at all times. When meaningful data is unavailable for some telemetry items, as determined by AACS configuration, AACS shall provide zeroes in these locations.

3.5.3 CDS Processor Telemetry Functions

3.5.3.1 General

The CDS shall be responsible for the A/D conversion of all analog measurements, sampling digital and bit level measurements attached to the CDS; collection, conversion, buffering, formatting CDS telemetry data; collecting and formatting other subsystem data into telemetry frames for transmission to the DMS and/or to Earth as specified in Paragraph 3.8.

The CDS shall output sufficient information such that detailed bit-level ground simulation of on-board events are not required for spacecraft sequencing or ground analysis of on-board activity.

3.5.3.2 Command Accountability

The following requirements shall apply to command transmission both from the ground to the spacecraft (uplink) and from the CDS to the other subsystems (on-board).

3.5.3.2.1 Uplink Command Accountability

a. The following information about the last message received at the CDS shall be inserted into the downlink at least once every 60 2/3 seconds:

   1. Message number
   2. Message type
   3. Number of frames in message
   4. Presence or absence of start word error
   5. Acceptance or rejection or message.

b. In spacecraft system test, an echo of each uplink command bit shall be sent from the CDS to the CDS support equipment.

c. Separate 8-bit counters for each function described below shall be downlinked at least once every 60 2/3 seconds:

   1. Uplink messages received and accepted (1 counter for each message type)

2. Uplink messages received and rejected
3. Command frames detected in error
4. Data frames corrected
5. Uncorrectable data frames
6. DAC rejected because of elapsed time
7. DAC rejected because of invalid message number
8. DAC rejected because of occupied buffer slot
9. CDU lock changes.

d. The active/inactive status of each DAC buffer slot shall be indicated in the downlink at least once every 60 2/3 seconds.

e. The most recently commanded state of CDS critical controller registers and critical enable relays shall be placed in the downlink at least once every 60 2/3 seconds.

f. A list of messages found missing by the CDS from the last message sequence shall be downlinked at least once every 60 2/3 seconds, or upon receipt of the terminator message of the message sequence.

3.5.3.2.2 Spacecraft (On-board) Command Accountability

Spacecraft command accountability shall consist of:

1. Periodic readout counters for each of the following:

   a. Number of commands issued from stored CDS sequences
   b. Number of Real Time Commands
   c. Number of commands resulting from interactive requests from other spacecraft subsystems (i.e., error correction routines and alarms)
   d. Number of power code commands
   e. Heart beat

   NOTE: Counters must count commands as they are issued by the CDS.

2. Identification of executing sequence elements.

3. Buffers for downlink transmission of the latest 7 CCs and DCs, and the latest 16 BCs (one buffer for CCs and DCs, and one buffer for BCs).

   Each entry in the BC queue consists of five bytes of bus command data. For BCs and BCIs this is: the least significant byte of the RIM, the code for the recipient of the command, the least significant byte of the

recipient address, and two bytes of the bus command data. For BCAs and BCAIs this is: the special AACS bus command ID code, the least significant byte of the recipient address, two bytes of the bus command data, and the least significant byte of the RIM.

3.5.4 Data Forms

Data shall be presented to the CDS in either analog or digital form. Digital data may consist of discrete event pulses, bi-levels, or serial Non-Return to Zero (NRZ) data; except for data provided to the CDS over the data bus which shall be serial Return to Zero (RZ), and data sent to the CDS from the RS via the high speed interfaces. Analog data shall consist of variable voltages. All analog engineering data shall be consistent with the ranges specified in Paragraph 3.3 for the appropriate transducer. Data presented to the DMS shall be in the form of serial NRZ data, MSB first.

Data presented to the CDS as analog voltages shall be converted to 8-bit digital words with leading zeros where the data does not fill all 8 bits.

All status data shall represent absolute value (rather than change to previous value).

3.6 Data Storage

Data storage (DMS) shall be provided by two digital tape recorders each with a capacity of 1.8×10^9 bits.

In order to simplify the ground tape management tasks associated with the S/C tape recorders, all recording and playback of the RCD shall occur in the same tape direction (First In, First Out). The data from the tape recorder shall appear to the ground as if it were a normal, real-time data stream (e.g., no backwards data). However, RCD playback shall be interrupted by Star Cal recording and playback. RED and Star Cal recording and playback shall not adhere to the First In, First Out philosophy.

3.6.1 Data Recording

The DMS shall be capable of recording at any of the following data rates on command from the CDS.

a. 806.4 kb/s

b. 7.68 kb/s

3.6.2 Data Playback

The DMS shall be capable of playing back data to the CU at any of the following rates on command from the CDS:.

a. 268.8 kb/s

b. 115.2 kb/s

3.7 Telemetry Modes

Telemetry modes, for the purpose of this document, shall be defined as the possible combinations of Real-Time, Playback, and Record formats. Only those telemetry modes that are foreseen as being nominal mission configurations are discussed here, although virtually all combinations are possible.

Table 1 shows the telemetry formats, data rates, and Format Identification (FID) that compose the modes.

3.7.1 Real-Time Telemetry Modes

3.7.1.1 Spacecraft Engineering Data (SED)

A Spacecraft Engineering Data Frame is formed from measurements collected from the engineering subsystems. These frames are transmitted in real time simultaneously over an S-band and an X-band telemetry channel at 1200 bps (nominal), or at 40 bps. The SED is described in detail in Paragraph 3.8.3. The 1200 bps SED frame shall be used during launch operations (when the spacecraft data is being included in the Shuttle or IUS data stream and during non-mapping orbital operations.

It shall be possible to transmit at 40 bps every 30th frame of the 1200 bps engineering. This 40 bps transmission shall be known as "snapshot" engineering. The capability to transmit the snapshot data over the S-band link shall be available using real time commands from the ground, and shall exist simultaneously with any other data transmitted on the X-band link. The capability shall also exist to transmit snapshot engineering at 40 bps over the X-band link when link margins warrant.

Engineering data shall be downlinked at 40 bps during interplanetary cruise. During emergency operation, the 40 bps downlink shall consist of alternate "1"s and "0"s.

All data transmitted directly from the spacecraft shall be convolutionally encoded, and all data transmitted via the IUS umbilical shall be uncoded.

TABLE 1 VRM TELEMETRY FORMATS

A: Real Time Telemetry Formats

Format	Data Rate	FID R/T ID Bits 1-5	FID MRO Bit 6	FID REC ID Bits 12-16	Ref. Para.	Remarks
Spacecraft Engineering Data (SED):					3.8.3	
Orbital	1200 bps	00001	0	000XX*		
Cruise, Emergency, End of Mission (Snapshot)	40 bps	11101	0	000XX*		
Orbital W/MRO	1200 bps	00001	1	000XX*	A2.3	Source Add = 4K RAM for DED, 4K RAM+3 for Flood Mode, other for other memory
Snapshot W/MRO	40 bps	11101	1	000XX*	A2.3	
DMS Playback:						
RED PB	115.2 Kbps or 268.8 Kbps	00000	0 or 1	00010		
RCD PB		00000	0 or 1	00011		

*00 = Not Formatting
10 = RED Formatting
11 = RCD Formatting

B: Delayed Telemetry Formats

Recorded Data:						
RED	7.68 Kbps	00000	0 or 1	00010	3.8.4	
RCD	806.4 Kbps	00000	0 or 1	00011	3.8.5	
RAM Buffer:					3.7.2.2	
DED					A2.2.10.2	GV161, E-0357, E-0685: DED EN ≠ 0 (Enabled) DED EN = 0 (Disabled)
Flood Mode					A2.2.10.3	

3.7.1.2 Spacecraft Engineering Data With Memory Readout

Memory readout (MRO) shall be accomplished by replacing five of the seven variable area data packets in the SED frame with either CDS memory readout data, CDS 4K RAM, or attitude and articulation control subsystem (AACS) memory data.

3.7.1.3 Spacecraft Engineering Data With DMS Playback

The capability exists to playback recorded data (either Recorded Engineering Data or Radar Composite Data, as described below) via X-band, simultaneously with transmission of the Spacecraft Engineering Data via X- or S-band.

During interplanetary cruise, Recorded Engineering Data (RED) will be played back at 115.2 Kbps via X-band while 1200 bps SED is transmitted via S-band.

During mapping phase, Radar Composite Data (RCD) shall be played back at 268.8 Kbps or 115.2 Kbps via X-band, while 1200 bps SED is transmitted via S-band (during most of the mission) or 40 bps SED is transmitted via X-band (at end of mission when link margins worsen).

All data transmitted from the spacecraft during cruise or orbital operations shall be convolutionally encoded.

3.7.2 Delayed Telemetry Modes

During non-Earth pointing periods when real-time telemetering of spacecraft data is not possible (star cal, maneuvers, and mapping) two methods exist by which data can be stored for delayed transmission to Earth.

3.7.2.1 Recorded Data

Two types of data can be recorded by the DMS for later playback to Earth, Recorded Engineering Data (RED) and Radar Composite Data (RCD).

3.7.2.1.1 Recorded Engineering Data (RED)

A Recorded Engineering Data Frame contains the same information as the SED, but with 4320 bits of added filler data to make it compatible with a recording rate of 7.68 Kbps. A detailed description of the RED is given in Paragraph 3.8.4.

3.7.2.1.2 Radar Composite Data (RCD)

Radar Composite Data consists of a SAR Altimeter Burst (SAB) interleaved with a Spacecraft Engineering Data (SED) Frame.

A complete radar frame, called a SAR/Altimeter Burst (SAB) Frame, will contain a header followed by a burst of SAR data and an optional Altimeter data field.

SAR/Altimeter Burst frames are output by the Radar System at an effective data rate of 790.08 Kbps and sent to the CDS DBUM. The DBUM reformats the SAB and SED into Radar Composite Data (RCD) frames, each containing engineering data (40 bits) embedded after the header, followed by 6584 bits of asynchronous SAB frame data. The RCDs are sent to the tape recorder at a rate of 806.4 Kbps (120 frames per second).

A detailed description of the SAB and RCD is given in Paragraph 3.8.5.

3.7.2.2 CDS RAM Buffer

The CDS shall provide a RAM buffer of 4096 byte capacity, located in the DBUM, for the purpose of storing engineering telemetry data (delayed engineering data) or AACS Flood Mode telemetry, at the discretion of the MOS. DED collection shall be disabled when the buffer is filled, to prevent overwriting stored data.

The contents of the buffer shall be accessed by the ground via the Memory Readout mode as described below.

The collection of delayed engineering data is described in Paragraph A2.2.10.2 and AACS Flood Mode Telemetry is described in Paragraph A2.2.10.3.

3.8 Telemetry Data Formats

3.8.1 General

The MGN telemetry frames shall be structured in accordance with the NASA Planetary Data Standards; specifically,

a. All frame lengths shall be multiples of 16 bits.

b. All data subsets within the frame shall be multiples of 8 bits. Unused bits shall be zero filled with the data portion right justified within the field.

c. The frame synchronization code shall be 32 bits.

d. Convolutional Code (K = 7, R = 1/2) shall be used.

In an attempt to retain flexibility to change bit rate allocations among the various VRM subsystems, a generalized concept of specifying the format contained within the frame is being used. This concept separately documents each subsystem allocation in the frame. Each of these allocations is then concatenated to create the resultant frame as seen in the downlink telemetry

stream. All spacecraft and ground software shall be designed to easily accommodate changes to allocations and position in the downlink telemetry frame.

3.8.2 Header

The first 96 bits of each telemetry frame except KPR shall consist of those necessary fields which enable frame synchronization, identification and decommutation of the received data. The format of the header is shown in Figure 2 and described in greater detail in Table 2. The individual fields are described in Paragraphs 3.8.2.1 through 3.8.2.3. The KPR exception is described in Paragraph 3.8.5.

FRAME SYNCHRONIZATION-CODE	FORMAT IDENTIFICATION	SPACECRAFT CLOCK
(FSC)	(FID)	(SCLK)
32	16	48

FIGURE 2: HEADER

TABLE 2: HEADER FORMAT

Data Description	Bits Frame	Offset to Data Start	Paragraph
Frame Synchronization Code	32	0	3.8.2.1
Format Identification	16	32	3.8.2.2
Spacecraft Clock	48	48	3.8.2.3

3.8.2.1 Frame Synchronization Code (FSC)

The frame synchronization code shall be composed of 32 bits with the following pattern:

MSB
(Binary) 0000 0011 1001 0001 0101 1110 1101 0011
(Hexadecimal) 03915ED3

3.8.2.2 Format Identification (FID)

Each telemetry frame shall contain a format identification word which identifies the data being processed and transmitted from the spacecraft. All data within the frame shall be completely and unambiguously identifiable by the format identification, the S/C clock, and the pre-established frame commutation sequence, with the exception of MRO readouts (including DED, Flood Mode, and Star Cal) and AACS Trickle telemetry.

The data output concurrently with the change of the FID shall be immediately valid.

The structure of the FID is shown in Figure 3 and described in greater detail in Table 3.

3.8.2.2.1 Real-Time Identifier (R/T)

Bits 1 through 5 shall indicate the real-time downlink rate and format, as shown in Table 1. On all data being placed into the DMS, this field shall read zero. The real-time identifier shall be permitted to change during every minor frame when the MOD10 and MOD8 counts are zero.

Real-time Identifier	Memory Readout	Commutation Map Identifier	Map Sequence Number	Record Identifier
5	1	2	3	5

FIGURE 3: FORMAT IDENTIFICATION

TABLE 3: FORMAT IDENTIFICATION

Data Description	Bits Allocated	Offset to Data Start	Paragraph
Real-time identifier	5	0	3.8.2.2.1
Memory Readout	1	5	3.8.2.2.2
Commutation Map Identifier	2	6	3.8.2.2.3
Map Sequence Number	3	8	3.8.2.2.4
Record Identifier	5	11	3.8.2.2.5

3.8.2.2.2 Memory Readout (MRO)

Bit 6 of the FID shall identify the fact that memory readout data has replaced the first 5 variable engineering packets.

0 = Variable engineering is present
1 = Memory readout data is present

The MRO bit shall be set to 1 whenever MRO data is being telemetered. The MRO bit shall be set 3 minor frames after requested, and reset to 0 after the last 22-byte MRO block has been telemetered.

3.8.2.2.3 Commutation Map Identifier (CMI)

Bits 7 and 8 shall identify the commutation map currently being used to sample the S/C engineering subsystem variable packet data. The assignment of these bits shall be as shown in Table 4.

The actual assignment of the mission phase commutation maps shall be to one of the four available map allocations. The commutation map shall identify the variable engineering packets, their timing relationships, and their placement into the engineering format. The details of these commutation maps are found in Paragraph A2.2.11.2.2

In the event that any on-board detected anomaly occurs which is permitted to cause automatic changing of commutation maps, the change shall be to map 0.

The CMI shall change only concurrently with the start of a major frame (MOD 91 = 0).

TABLE 4: COMMUTATION MAP IDENTIFIER (CMI) ASSIGNMENT

Bits 7,8	Commutation Map Identifier
00	0*
01	1
10	2
11	3

*This CMI shall be used for any on-board detected anomaly which causes an automatic CMI change.

3.8.2.2.4 Map Sequence Number (MSN)

Bits 9 through 11 shall indicate the Map Sequence Number. The MSN shall represent the decommutation map to be used on the ground when decommutating telemetry, and, when used in conjunction with the CMI, shall unambiguously identify the telemetry format. The MSN shall be changed by ground command whenever the telemetry content in either the fixed or variable packet areas is changed (also by ground command), and shall be permanently allocated to the decommutation map associated with the new telemetry. Note that selecting a new CMI (i.e., reallocating the variable packet areas for different mission phases) does not require a change of MSN; however changing the telemetry content of any of the VP formats (ref. para. A2.2.11.2.2) will necessitate a change of MSN. The MSN shall change only concurrently with the start of a major frame (MOD 91=0).

3.8.2.2.5 Record Identifier (REC)

Bits 12 through 16 shall indicate the rate and format of data being placed onto the DMS, as shown in Table 1. In the event there is no data being placed on the tape recorder, this field will contain all zeros. The Record Identifier shall be permitted to change during every minor frame when the MOD10 and MOD8 counts are zero.

3.8.2.3 Spacecraft Clock (SCLK)

Each spacecraft telemetry frame shall contain a S/C time field. The SCLK shall have the characteristic that it can be directly used to determine time, identify all measurements, and to correlate events to within the time resolution of the S/C clock.

The SCLK shall mark the first bit of the frame synchronization code time and shall represent the time interval in which the CDS collected the instrument data contained within the frame. The SCLK is shown in Figure 4 and is described in Paragraphs 3.8.2.3.1 through 3.8.2.3.4.

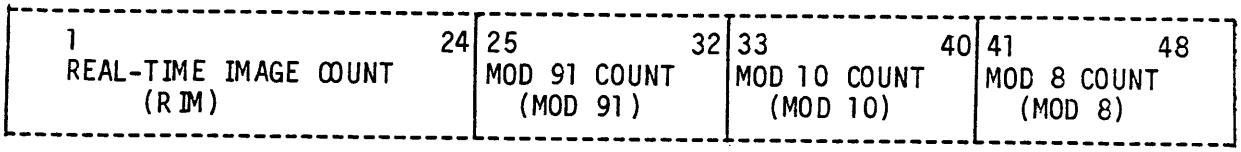


FIGURE 4: SPACECRAFT CLOCK (SCLK)

3.8.2.3.1 Real-Time Image Count (RIM)

This field is a 24 bit counter which shall be incremented each 60-2/3s. The least significant byte (LSB) shall increment by 1 each time the Mod 91 count rolls over from 90 to 0.

The middle byte shall increment by 1 when the LSB rolls over from 255 to 0, and the most significant byte shall increment by 1 when the middle byte rolls over from 255 to 0.

This clock shall keep unambiguous account of time for 32 years. The starting value of the counter shall be initialized at launch and shall not be reset after launch except from the ground after an interruption of power to the CDS memories. The SCLK shall not roll-over until attaining the value 16777215.

3.8.2.3.2 Mod 91 Count (MOD91)

The MOD91 counter is an 8 bit counter which shall be incremented once every 2/3s. This field shall range in value from 0 through 90, and shall increment by one every 1200 bps SED minor frame.

Telemetry mode changes shall occur synchronously with the (1) roll over of the MOD91 count from 90 to 0 and (2) incrementing the RIM by 1.

3.8.2.3.3 Mod 10 Count (MOD10)

The MOD10 counter is an 8 bit counter which shall be incremented once each 66-2/3 msec. This field shall range from 0 through 9, with the change to zero synchronous to the incrementing of the MOD91 count. This field shall increment by 1 for each frame transmitted or recorded at a telemetry rate greater than 7.68 kb/s. The MOD10 field is synonymous with the Real-Time Interrupt (RTI) in the CDS.

3.8.2.3.4 Mod 8 Count (MOD8)

The MOD8 counter is an 8 bit counter which shall be incremented once each 8-1/3 ms. The field shall range from 0 through 7, with the change to 0 synchronous to the incrementing of the MOD10 count.

This field shall normally be zero in any frame being created at telemetry rates less than or equaling 115.2 kb/s. For those frames being routed to the DMS at rates exceeding 115.2 kb/s, the counter shall increment by one for each frame placed onto the DMS.

3.8.2.3.5 Spacecraft Clock Progression

The SCLK shall increment as shown in Table 5 for each of the various telemetry rates, except the KPR mode at 40 b/s. The KPR mode consists exclusively of alternate 1-0 data, i.e., no header; therefore, the SCLK progression of Table 5 does not apply to this mode. See 3.8.6 for additional detail.

TABLE 5: SPACECRAFT CLOCK (SCLK) PROGRESSION

Telemetry Rate (kb/s)	Real-Time	Record	RIM	MOD91	MOD10	MOD8
1.20	Yes	Yes*	i	0, 1,...,90	0	0
7.68	No	Yes	i	0, 1,...,90	0	0
806.4	No	Yes	i	0	0	0, 1,...7
			i	0	1	0, 1,...7
			.	.	.	.
			.	.	.	.
			.	.	.	.
			i	0	9	0, 1,...7
			i	1	0	0, 1,...7
			.	.	.	.
			.	.	.	.
			.	.	.	.
			i	1	9	0, 1,...7
			.	.	.	.
			.	.	.	.
			.	.	.	.
			i	90	0	0, 1,...7
			i	90	1	0, 1,...7
			.	.	.	.
			.	.	.	.
			.	.	.	.
			i	90	9	0, 1,...7

*Interleaved with RS data (at 790.08 kb/s) for the combined 806.4 kb/s record rate.

TABLE 5: SPACECRAFT CLOCK (SCLK) PROGRESSION (CONTINUED)

Telemetry Rate (kb/s)	Real-Time	Record	RIM (Modulo 30)	MOD91	MOD10	MOD8
0.040*	Yes	No	0	0, 30, 60, 90	0	0
			1	29, 59, 89	0	0
			2	28, 58, 88	0	0
			3	27, 57, 87	0	0
			4	26, 56, 86	0	0
			5	25, 55, 85	0	0
			6	24, 54, 84	0	0
			7	23, 53, 83	0	0
			8	22, 52, 82	0	0
			9	21, 51, 81	0	0
			10	20, 50, 80	0	0
			11	19, 49, 79	0	0
			12	18, 48, 78	0	0
			13	17, 47, 77	0	0
			14	16, 46, 76	0	0
			15	15, 45, 75	0	0
			16	14, 44, 74	0	0
			17	13, 43, 73	0	0
			18	12, 42, 72	0	0
			19	11, 41, 71	0	0
			20	10, 40, 70	0	0
			21	9, 39, 69	0	0
			22	8, 38, 68	0	0
			23	7, 37, 67	0	0
			24	6, 36, 66	0	0
			25	5, 35, 65	0	0
			26	4, 34, 64	0	0
			27	3, 33, 63	0	0
			28	2, 32, 62	0	0
			29	1, 31, 61	0	0
			0	0, 30, 60, 90	0	0
			.	.	.	.
			.	.	.	.
			.	.	.	.

*KPR mode exception described in 3.8.2.3.5.

3.8.3 Spacecraft Engineering Data (SED)

The SED frame shall be the carrier of S/C engineering data. The schematic of the SED frame is shown in Figure 5 and described in greater detail in Table 6.

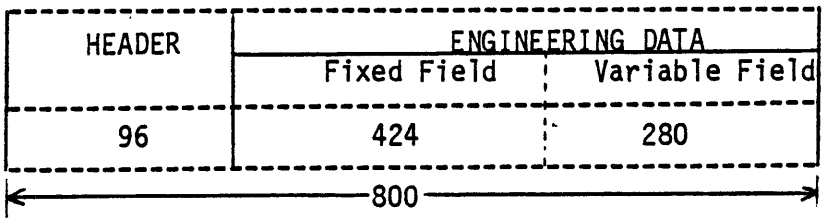


FIGURE 5: SED FRAME

TABLE 6: SED FORMAT

Data Description	Bits Frame	Bits sec 40	Bits sec 1200	Offset to Start of Data	Paragraph
Header	96	4.8	144	0	3.8.2
Engineering	704	35.2	1056	96	A2.2
	800	40	1200		
Frame Time (seconds) =		20	2/3		

3.8.3.1 Source

The SED frame shall exist in the downlink telemetry as a result of:

a. Being transmitted at a real-time rate of 1200 b/s or 40 b/s.

b. Being embedded at 1200 b/s with the RS frame, and being played back from the S/C tape recorder.

c. Being transmitted at 40 b/s over the S-band or X-band downlink concurrently with any other data being transmitted on the X-band link.

d. The 40 b/s SED frame, known as snapshot engineering, shall be used during cruise, and at end of mission, when link margins warrant.

3.8.3.2 Contents

Each engineering frame shall contain data of the following types:

a. Engineering subsystem analog, digital, and software measurements.

b. Spacecraft system level status measurements.

c. Selected radar system temperature measurements.

d. Radar system low rate engineering.

3.8.3.3 Spacecraft Clock Progression

The SCLK (see Paragraph 3.8.2.3) in successive SED frames shall increment as shown in Table 7. The table is organized by Subcommutation Index (SI) and data rate.

The expressions for computing the engineering SI shall be as shown in Table 7.

TABLE 7: SUBCOMMUTATION INDEX (SI) PROGRESSION

1200 b.s or 40 b/s snapshot of 1200 b/s*

SI	RIM	MOD91	MOD10	MOD8
0	i	0	0	0
1	i	1	0	0
2	i	2	0	0
.	.	.	.	.
.	.	.	.	
.	.	.	.	
90	i	90	0	0
		SI = MOD91		

*The SI expression and following table are valid for all telemetry modes (see Table 1).

3.8.3.4 SED Frame Characteristics

The 1200 bps real-time engineering data shall be as shown in Figure 6, and described in greater detail in Table 8.

The Format I.D. word for SED shall be as follows:
R/T ID: 00001
MRO: 0 or 1
REC ID: 000XX

RT FIXED							MEMORY READOUT						
HDR	HLM 1A	LLM 1A	HLM 1B	LLM 1B	AACS	RS	P1	P2	P3	P4	P5	P6	P7
96	40	48	40	48	128	120	40	40	40	40	40	40	40

<--800 BITS PER MINOR FRAME-->

FIGURE 6: REAL-TIME ENGINEERING FORMAT (1200 bps/40 bps)

TABLE 8: R/T ENGINEERING FORMAT

Data Description	Bits/ Frame	Bits/ Sec	Offset to Start of Data	Paragraph
Header	96	144	0	3.8.2
HLM 1A	40	60	96	A2.2.2
LLM 1A	48	72	136	A2.2.3
HLM 1B	40	60	184	A2.2.4
LLM 1B	48	72	224	A2.2.5
AACS	128	192	272	A2.2.6
RS	120	180	400	A2.2.7
P1	40	60	520	A2.2.8
P2	40	60	560	A2.2.8
P3	40	60	600	A2.2.8
P4	40	60	640	A2.2.8
P5	40	60	680	A2.2.8
P6	40	60	720	A2.2.8
P7	40	60	760	A2.2.8
	800	1200		

Frame Time = 2/3 second

3.8.3.5 SED Frame Characteristics, 40 BPS

The 40 b/s SED frame shall exist in real-time as a result of being collected at 1200 b/s but being transmitted at the 40 b/s rate. This mode shall be known as snapshot engineering.

As a result of this mode, every 30th engineering frame created at 1200 b/s shall be downlinked. The data contained within the 40 b/s engineering frame shall represent a snapshot of the engineering data contained within the SED frame. During CDS emergency operation, the 40 bps shall consist of alternate "1"s and "0"s.

The Format I.D. word for SED at 40 bps shall be as follows:

R/T ID: 11101
MRO: 0 or 1
REC ID: 000XX

3.8.3.6 Radar System Low Rate Engineering Data

The radar system low rate engineering data shall be interleaved into the real-time engineering frame, as shown in Figure A2.2.10 (see Appendix A). Since the RS major frame consists of 24 minor frames, which is not divisible into the SED major frame (which consist of 91 minor frames), the RS major frame is asynchronous with the SED major frame. This means that a given RS minor frame will not consistently appear in the same SED minor frame, and the RS Minor Frame ID must be used to identify the RS minor frame. The radar system shall require 120 bits of the frame, which shall be formatted as shown in Figure 7 (see Table A2.2.7, Engineering Measurements, for an explanation of the measurement codes). The telemetry block from each Telemetry and Command Unit (TCU) of the RS is dedicated to a specific CDS side (TCU-A telemetry block to CDS A, TCU-B telemetry block to CDS B). Therefore, only the powered TCU will output meaningful data, and switching to either the backup RS or the backup CDS alone will result in loss of RS engineering data.

The RS minor frames shall be numbered from 0 to 23, and identified by the 5 LSBs of the minor frame ID (ref. Figure 7). The MSB of the minor frame ID shall always be high, and the next 2 bits shall be zero.

3.8.4 Recorded Engineering Data (RED) Frame

The Recorded Engineering Data comprises the Spacecraft Engineering Data (SED) frame at 1200 bps, with modified header record ID (see Table 1) and added filler bits (zeros) to enable recording at 7.68 Kbps.

The RED shall be formatted as shown in Figure 8.

Header	Engineering Data		Filler (Zeros)
	Fixed	Variable	
96 Bits 144 bps	424 Bits 636 bps	280 Bits 420 bps	4320 Bits 6480 bps

← 1 Minor Frame (2/3 Sec) →
5120 Bits

FIGURE 8: RECORDED ENGINEERING DATA (RED) FORMAT

EACH ENTRY = 8 Bits

WORD NUMBER

MINOR FRAME NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	MINOR FRAME ID	S1-8	S9-16	S17-24	S25-32	S33-40	P17	P16	T2	V20	P11	P15	P13	I10	T6
1	MINOR FRAME ID	S41-45 (3 SPARE)	S46-50 (3 SPARE)	S51-56 (2 SPARE)	P19	P20	P18	P15	T3	V21	P12	V2	P17	I11	T7
2	MINOR FRAME ID	I1	I2	I4	I6	I26	I28	I30	I32	V4	P11	P16	V3	I12	T8
3	MINOR FRAME ID	I1	I3	I5	I7	I27	I29	I31	I33	V5	P12	V14	V15	I13	T9
4	MINOR FRAME ID	I8	P1	P3	P5	P7	P9	I34	T4	V20	P11	P15	P14	I14	T10
5	MINOR FRAME ID	I9	P2	P4	P6	P8	P10	I34	T5	V21	P12	V2	P16	I15	T11
6	MINOR FRAME ID	S1-8	S9-16	S17-24	S25-32	S33-40	P13	P14	T20	V6	P11	P16	V3	I16	T12
7	MINOR FRAME ID	S41-45 (3 SPARE)	S46-50 (3 SPARE)	S51-56 (2 SPARE)	P19	P20	P17	P15	T21	V7	P12	V16	V17	I17	V1
8	MINOR FRAME ID	I1	I2	I4	I6	I26	I28	I30	I32	V20	P11	P15	P13	I18	T1
9	MINOR FRAME ID	I1	I3	I5	I7	I27	I29	I31	I33	V21	P12	V2	P17	I19	T13
10	MINOR FRAME ID	I8	P1	P3	P5	P7	P9	P13	T22	V8	P11	P16	V3	I20	T14
11	MINOR FRAME ID	I9	P2	P4	P6	P8	P10	P14	T23	V9	P12	V14	V15	I21	T15
12	MINOR FRAME ID	S1-8	S9-16	S17-24	S25-32	S33-40	V22	I34	T2	V20	P11	P15	P14	I22	T16
13	MINOR FRAME ID	S41-45 (3 SPARE)	S46-50 (3 SPARE)	S51-56 (2 SPARE)	P19	P20	T30	I34	T3	V21	P12	V2	P16	I23	T17
14	MINOR FRAME ID	I1	I2	I4	I6	I26	I28	I30	I32	V10	P11	P16	V3	I24	T18
15	MINOR FRAME ID	I1	I3	I5	I7	I27	I29	I31	I33	V11	P12	V16	V17	I25	T19
16	MINOR FRAME ID	I8	P1	P3	P5	P7	P9	I34	T24	V20	P11	P15	P13	V12	V13
17	MINOR FRAME ID	I9	P2	P4	P6	P8	P10	I34	T25	V21	P12	V2	P17	V18	V19
18	MINOR FRAME ID	S1-8	S9-16	S17-24	S25-32	S33-40	P18	P17	T26	V12	P11	P16	V3	V1	V22
19	MINOR FRAME ID	S41-45 (3 SPARE)	S46-S50 (3 SPARE)	S51-56 (2 SPARE)	P19	P20	P13	P14	T27	V13	P12	V14	V15	T1	T30
20	MINOR FRAME ID	I1	I2	I4	I6	I26	I28	I30	I32	V20	P11	P15	P14	T2	T3
21	MINOR FRAME ID	I1	I3	I5	I7	I27	I29	I31	I33	V21	P12	V2	P18	V6	V7
22	MINOR FRAME ID	I8	P1	P3	P5	P7	P9	I34	T28	V18	P11	P16	V3	V8	V8
23	MINOR FRAME ID	I9	P2	P4	P6	P8	P10	I34	T29	V19	P12	V16	V17	V10	V11

EACH ENTRY = 8 Bits

FIGURE 7: RS TELEMETRY DATA - FORMAT OF CONTENTS

3.8.4.1 Source

The RED shall be recorded at 7.68 Kbps, and played back at either 115.2 Kbps or 268.8 Kbps.

3.8.4.2 Contents

The RED shall contain the same data types as the SED as described in Paragraph 3.8.3.2.

3.8.4.3 Spacecraft Clock Progression

The SCLK in successive RED frames shall increment as described in Paragraph 3.8.3.3.

3.8.4.4 RED Frame Characteristics

The RED Frame Characteristics shall be identical to the SED Frame Characteristics described in Paragraph 3.8.3.4, with an additional 4320 bits of zero fill, as shown in Figure 8.

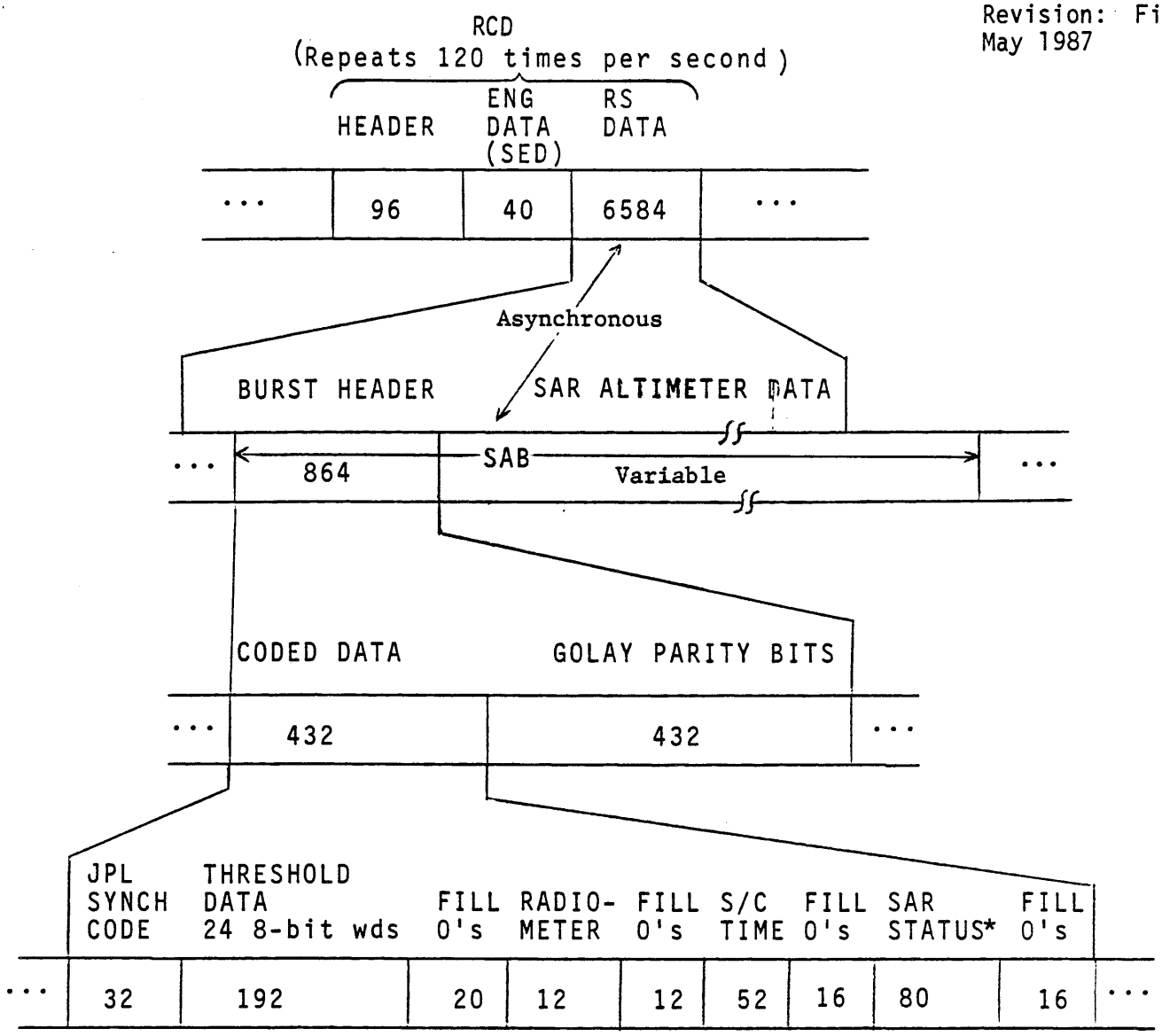
The Format I.D. word for RED shall be as follows:

R/T ID: 00000
MRO: 0 or 1
REC ID: 00010

3.8.5 Radar Composite Data (RCD) Frame

A Radar Composite Data Frame is formatted in the CDS DBUM every sub-RTI (8-1/3 ms) during SAR operation. The RCD consists of 96 bits of header (ref. Paragraph 3.8.2), 40 bits of Spacecraft Engineering Data or zero fill (ref. Paragraph 3.8.3), which is transferred to the DBUM at 40 bytes per RTI, and 6584 bits of SAR Altimeter Burst (SAB) data (ref. Paragraph 3.8.5.2 below) for a total of 6720 bits every sub-RTI. Since sub-RTIs repeat 120 times per second, the effective data rate of an RCD is 806.4 Kbps. This is recorded on the DMS during mapping.

The RCD is shown in Figure 9. Table 9 shows the contents of the SAR status field, including fields necessary for frame synchronizing SAB data. A description of how the SAR Altimeter Burst and Spacecraft Engineering Data are assembled into the RCD follows. A detailed description of all items in the SAR status field, including conversions to engineering units, is given in the MOS-Radar System Interface Requirements Document, JPL PD 630-204.



* Ref. Table 9

FIGURE 9: RADAR DATA STREAM FORMAT

TABLE 9: SAR STATUS FIELD

ITEM	NO. OF BITS	NAME	DESCRIPTION (ALL ITEMS MSB FIRST)
1	1	-	Leading zero fill bit
2	8	SAR fine resolution	Determines location of SAR range gate within a SAR IPP, counted in 0.885 usec units [half the resolution clock frequency]
3	7	PRF code	Selects desired PRF
4	8	SAR coarse resolution	Determines the no. of transmitted SAR pulses before reception of first echo
5	8	Range gate length	Selects length of data collection window within an IPP, counted in 0.885 usec units [half the resolution clock frequency]
6	11	SAR transmit pulses	Determines the no. of pulses transmitted in a SAR burst
7	9	Altimeter coarse resolution	Determines the no. of altimeter clock counts 66.86 usec units between end of altimeter burst and enabling of altimeter data window
8	15	Burst period	Selects length of burst cycle from cycle start, to the following cycle start, measured in 66.86 usec units [15 kHz altimeter clock]
9	3	Receiver gain - altimeter	Sets attenuation of receiver gain for altimeter burst from 0 to 28 dB [in 4-dB steps]
10	3	Receiver gain - SAR	Sets attenuation of receiver gain during radiometer function from 0 to 28 dB [in 4-dB steps]
11	3	Receiver gain - radiometer	Sets attenuation of receiver gain during radiometer function from 0 to 28 dB [in 4-dB steps]

(cont)

TABLE 9: SAR STATUS FIELD (concl)

ITEM	NO. OF BITS	NAME	DESCRIPTION (ALL ITEMS MSB FIRST)
12	2	Altimeter skip factor	Determines presence of altimetr burst in a burst cycle. [Range: every burst -- every fourth burst]
13	1	Radiometer source	Determines whether the receiver is protected (for calibration) or switched to antenna during radiometer mode
14	1	Altimeter data set flag	Flag set high if an altimeter burst is present in the current burst cycle

3.8.5.1 SAR Altimeter Burst (SAB) Frame

The SAR Altimeter Burst Frame consists of a burst header (864 bits, Golay coded, byte aligned) and a variable length data field consisting of SAR data (16 kb to 701.9 kb) and optional, non-variable altimeter data (0 or 18.12 kb), for a total length of 17248 bits minimum and 720896 bits maximum (ref. Figure 10). During operation, the radar data consists of a continuous stream of SABs.

Burst Header	Variable SAR Data	Altimeter Data
864 Bits	16384 to 701904 Bits	0 or 18128 Bits

FIGURE 10: SAR ALTIMETER BURST (SAB) FRAME

The SABs shall be transferred into the CDS DBUM in groups of 6584 bits, once each sub-RTI (8-1/3 ms). This results in an effective data rate of 790.080 Kbps. The bit transfer is asynchronous, i.e., it need not start with the burst header, but can be any contiguous group of 6584 bits (823 bytes). The SAB may consist of any of the data combinations shown in Table 10. At no time will the SAB contain radar and/or altimeter data from one burst and data from a second burst with no header between them, nor will it ever be of the form: zero fill + header or data. The bit transfer for a given sub-RTI continues where the previous sub-RTI transfer ended.

The length (n) of the SAB (distance between the start of burst headers) is determined as follows:

$$n \text{ (in bytes)} = 108 + (2048-NP)\ (256-RGL) + a\ (2265)$$

NP = No. of Pulses Code (Item 6 of Table 9)
RGL = Range gate length code (Item 5 of Table 9)
a = Alt data set flag code (Item 14 of Table 9.) This will be 1 or 0.

TABLE 10: SAB DATA COMBINATIONS

1.	Burst Header* + Radar Data*
2.	Radar Data*
3.	Radar Data* + Altimeter Data*
4.	Altimeter Data*
5.	Radar Data* + Zero Fill
6.	Altimeter Data* + Zero Fill
7.	Zero Fill only
8.	Altimeter Data* + Burst Header** + Radar Data**
9.	Radar Data* + Burst Header** + Radar Data**
10.	Altimeter Data* + Burst Header** (see Note 1)
11.	Radar Data* + Burst Header** (see Note 1)

* From one burst
** From next burst
Note 1: This may be all or part of the burst header, as the burst header can be split between 823-byte transfers.

3.8.5.2 Spacecraft Engineering Data (SED) Transfer

The 100 byte SED buffer is transferred from the BUM to the DBUM in groups of 40 bits per sub-RTI (8-1/3 ms). This transfer continues for 2-1/2 RTIs (20 sub-RTIs), until 100 bytes of SED have been transferred. Filler bits (zeros) are transferred for the remaining 7-1/2 RTIs of each minor frame, also at a rate of 40 filler bits per sub-RTI. Thus, at the end of each minor frame (2/3 second), a total of 800 bits of engineering data and 2400 bits of zero filler will have been transferred to the DBUM. The effective data rate of the

SED is therefore 1200 bps (800 bits per minor frame). The RCD SCLK increments 1 sub-RTI for each 40 bits of transferred SED. The SED commutation strategy is shown in Table 11.

The Format I.D. word for SED interleaved into the RCD shall be as follows:

R/T ID: 00000
MRO: 0 or 1
REC ID: 00011

TABLE 11: INTERLEAVED SED COMMUTATION STRATEGY

RIM	mf	RTI		Sub-RTI 0	1	2	3	4	5	6	7
XXX	X	0	SED BYTES	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40
XXX	X	1	SED BYTES	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76-80
XXX	X	2	SED BYTES	81-85	86-90	91-95	96-100	ZERO s			
XXX	X	3-10	SED BYTES	ZERO s							

3.8.5.3 RCD Formatting

The CDS DBUM formats one RCD frame each sub-RTI. It does this by taking a 96-bit header, followed by the 40 bits of SED or filler (ref. paragraph 3.8.5.2) and the 6584 bits of SAB data (ref. paragraph 3.8.5.1) for a total of 6720 bits each sub-RTI. This is sent to the DMS for recording at an effective rate of 806.4 Kbps.

3.8.6 Power-On Reset

A Power-On Reset (POR) occurs whenever the CDS has experienced a temporary loss of AC power (such as during inverter switchover). Upon restoration of power, the CDS will transmit an SED frame consisting of alternate 1-0 data at 40 bps, until it autonomously recovers from the loss via pre-programmed POR reset software, at which time normal telemetry at 1200 bps will be restored. Recovery time is approximately 2 seconds. If the spacecraft is in Standard Engineering Mode, CDS Spacecraft Safing, requested as a result of POR recovery, will set the telemetry rate to 40 bps after an additional 8 seconds.

3.8.7 Keep Alive Power-On Reset

A Keep Alive Power-On Reset (KAPOR) occurs whenever the CDS has experienced both a temporary loss of AC power and a loss of Memory Keep Alive (MKA) power. Upon restoration of AC power, the CDS will transmit an SED frame consisting of alternate 1-0 data at 40 bps. Owing to memory loss, complete recovery from a KAPOR requires that the ground re-establishes memory contents, reinstates CDS configuration, and releases the KAPOR lockout of the CDS. This recovery sequences restarts the SED frame in the normal mode at 1200 bps. It should be noted that a POR is present whenever a KAPOR occurs; however, a KAPOR does not invoke CDS spacecraft safing.

THIS PAGE INTENTIONALLY LEFT BLANK

VRM-2-280

APPENDIX A

TELEMETRY FRAME FORMAT

COMPONENTS

A1.0 SCOPE

This document establishes the VRM spacecraft requirement for telemetry measurements.

A2.0 TELEMETRY FRAME FORMAT COMPONENTS

A2.1 General

The following paragraphs contain the structure and contents of the elements comprising the various data formats found in paragraph 3.8.

A2.2 Engineering Data

The engineering data shall contain a fixed area and a variable area allocation for measurement sampling. The fixed allocation shall be invarient under all the VRM mission phases.

The variable area allocation shall accommodate the various mission phase sampling requirements including anomaly investigations, special tests, spacecraft system test, and performance monitoring. The engineering data shall be allocated as shown in Figure A2.2.1 and described in greater detail in Table A2.2.1.

(100 LEVEL DECK - LESS HEADER)

HLM 1A DATA	LLM 1A DATA	HLM 1B DATA	LLM 1B DATA	AACS DATA	RS DATA	P1	P2	P3	P4	P5	P6	P7
40	48	40	48	128	120	40	40	40	40	40	40	40

FIGURE A2.2.1: ENGINEERING DATA

A2.2.1 Measurement Position Identification

In order to assign measurements to the engineering data allocation, it is necessary to describe the structure and placement of measurements on the structure. The description must support the ability to command commutation map changes and to identify measurement position within the structure. Within the fixed area and variable area, the structure location shall be as described in the following paragraphs.

A2.2.1.1 Fixed-Area Allocation

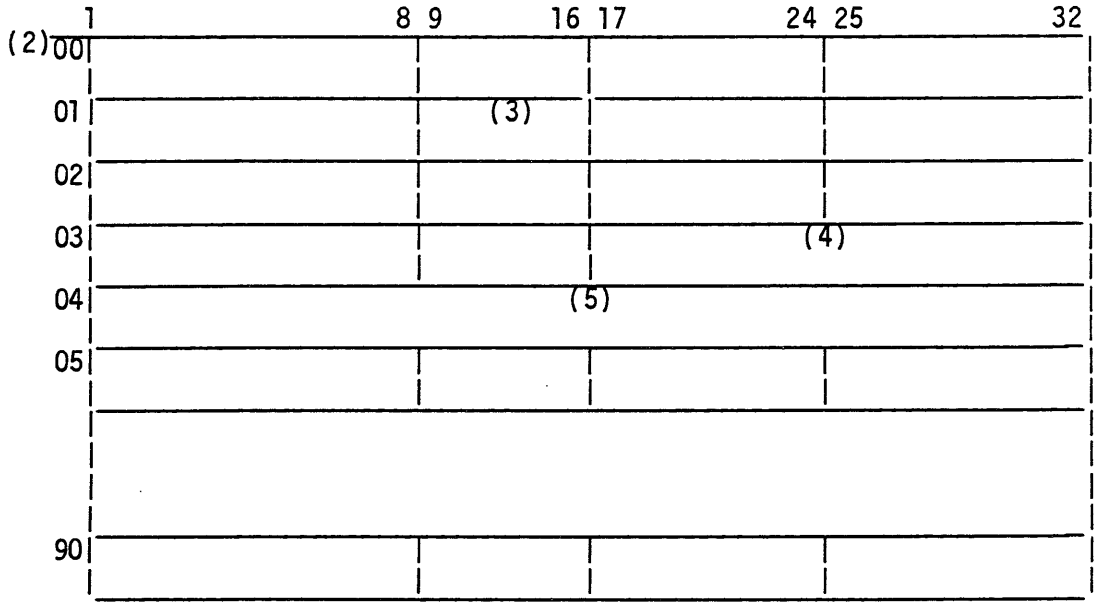
Using the example in Figure A2.2.2 from HLM1A, the resulting structure and rules for creating the structure identifiers are highlighted.

The rules and legal values for creating the identifiers are shown in Table A2.2.2.

TABLE A2.2.1: ENGINEERING DATA

Data Description	Bits / Frame	Offset to Data Start	Paragraph
High Level Module (HLM) 1A Data	40	0	A2.2.2
Low Level Module (LLM) 1A Data	48	40	A2.2.3
HLM 1B Data	40	88	A2.2.4
LLM 1B Data	48	128	A2.2.5
AACS Data	128	176	A2.2.6
Radar System Data	120	304	A2.2.7
Packet-1	40	424	A2.2.8
Packet-2	40	464	A2.2.8
Packet-3	40	504	A2.2.8
Packet-4	40	544	A2.2.8
Packet-5	40	584	A2.2.8
Packet-6	40	624	A2.2.8
Packet-7	40	664	A2.2.8

HLM-1A N1F(1)



NOTES: (1) THIS SUBCOM (N1F) IS OF LENGTH 91 ("N"), IS THE FIRST SUBCOM OF THIS TYPE IN HLM1A ("1"), AND IS FOUR BYTES WIDE.

(2) THIS IDENTIFIES THE SUBCOM POSITION.

(3) A MEASUREMENT IN THIS POSITION IS IDENTIFIED AS HLM1A N1F01 2.

(4) A MEASUREMENT IN THIS POSITION IS IDENTIFIED AS HLM1A N1F03 3. THE MEASUREMENT CONSISTS OF 16 BITS.

(5) A MEASUREMENT IN THIS POSITION IS IDENTIFIED AS HLM1A N1F04 1. THE MEASUREMENT CONSISTS OF 32 BITS.

FIGURE A2.2.2: FIXED STRUCTURE/POSITION IDENTIFIERS

TABLE A2.2.2: FIXED AREA STRUCTURE/POSITION IDENTIFIERS

Item	Item Identifier	Contents	Meaning	Comments
1.	Module ID	AACS HLM1A HLM1B LLM1A LLM1B RS		Identifies the module which creates the fixed area packet.
2.	Commutation Deck Length	Z S T N	One Seven Thirteen Ninety One	Indicates the repetition cycle of the data; e.g., every "n"th frame.
3.	Number of Commutation Deck of this Type	$1 \leq m \leq M$		Sequential number of commutator deck length and width (items 2 and 4).
4.	Commutation Deck Width	S D F	Single Byte Double Byte Four Byte	Width of Structure
5.	Position in Commutator Deck	See Comments		Item 2 — Maximum Value Z — 0 S — 6 T — 12 N — 90
6.	Measurement Characteristic	1 2 3 4	First Byte Second Byte Third Byte Fourth Byte	In multiple byte subcoms, this indicates the position of the measurement in the subcom. Measurements consisting of more than one byte are identified by the position of the most significant byte.

A2.2.1.2 Variable-Area Allocation

Using the example in Figure A2.2.3 for a typical AACS variable area packet, the resulting structure and the rules for creating the structure/position identifiers are highlighted.

The rules and allowed values for creating the identifiers are shown in Table A2.2.3.

PACKET

AACS-V09S(1)

1	2(2)	3	4	5

POSITION

NOTES: (1) THE ILLUSTRATED 5 BYTE PACKET IS THE NINTH ("09") VARIABLE ("V") PACKET FROM "AACS". EACH MEASUREMENT IS NOMINALLY ONE BYTE ("S").

(2) A MEASUREMENT IS PLACED IN POSITION "2" OF THE VARIABLE PACKET

(a) TO IDENTIFY A SINGLE BYTE ASSIGNMENT IN THIS LOCATION, THE POSITION IDENTIFIER IS AACS-V09S2F.

(b) TO IDENTIFY A TWO BYTE ASSIGNMENT IN THIS LOCATION, THE POSITION IDENTIFIER IS AACS-V09S2D.

(c) TO IDENTIFY ONE HALF OF A TWO BYTE ASSIGNMENT IN THIS LOCATION, THE POSITION IDENTIFIER IS
AACS-V09S2L (LEFT BYTE) OR
AACS-V09S2R (RIGHT BYTE)

FIGURE A2.2.3: VARIABLE PACKET STRUCTURE/POSITION IDENTIFIERS

TABLE A2.2.3 VARIABLE PACKET STRUCTURE/POSITION IDENTIFIERS

Item	Item Identifier	Contents	Meaning	Comments
1.	Module ID	AACS LLM 1A LLM 1B RS (LLM Meas. Only)		Identifies the module which creates the variable area packet.
2.	Variable Packet	V	Variable packet of length 5	Used to differentiate between fixed area and variable area packets.
3.	Packet Number	$01 \leq n \leq 15$		Identifies the specific packet within the module of interest
4.	Width	S	Single Byte	
	Description stops here if desire is to just identify packet. To identify a specific position, the remaining items are used.			
5.	Packet Position	$1 \leq$ positions ≤ 5		Position within packet.
6.	Measurement Characteristic	F	1 byte measurement	
		D	2 byte measurement	Packet position 4
		L	Left byte	Left byte of 2 byte measurement assigned to specific packet position.
		R	Right byte	Right byte of 2 byte measurement assigned to specific packet position.

A2.2.2 High Level Module 1A Data Packet

The fixed area allocation for HLM 1A shall contain those measurements created within or sampled by HLM 1A.

The structure associated with the HLM 1A data shall be as shown in Figure A2.2.4 (refer to Paragraph A2.2.1.1 for the interpretation of the identifiers shown in the figure).

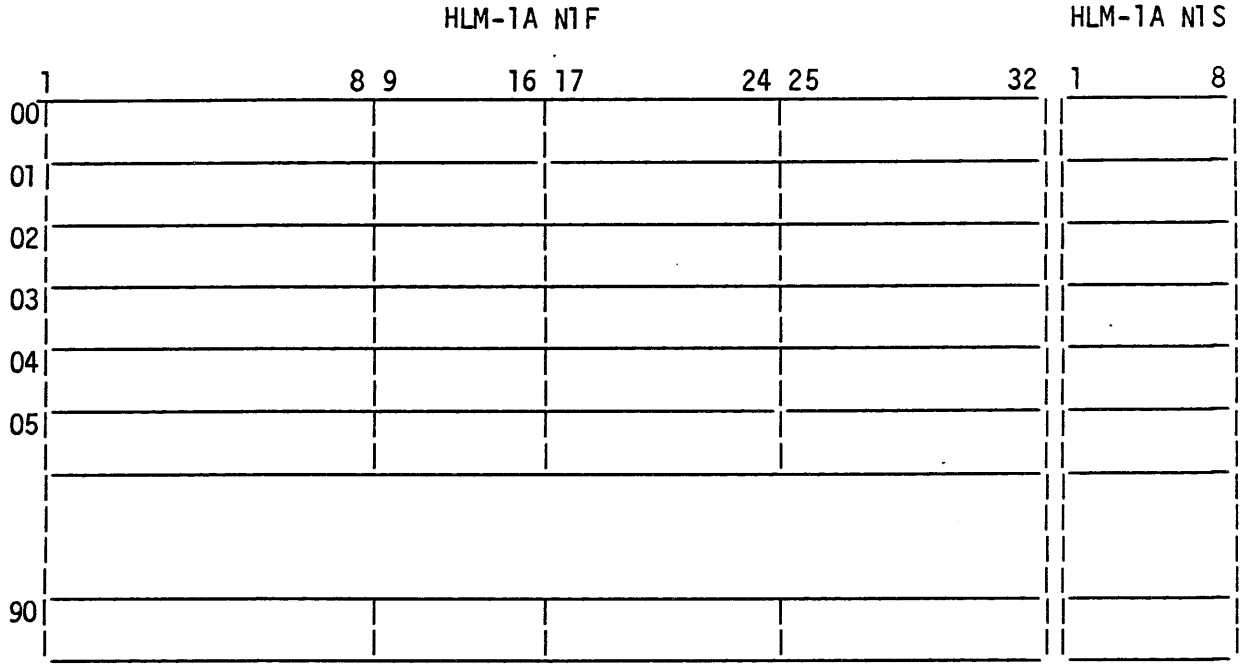


FIGURE A2.2.4: HLM 1A DATA PACKET

A2.2.3 Low Level Module 1A Data Packet

The fixed area allocation for LLM 1A shall contain those measurements created within or sampled by LLM 1A.

The structure associated with LLM 1A data shall be as shown by Figure A2.2.5 (refer to Paragraph A2.2.1.1 for the interpretation of the identifiers shown on the figure).

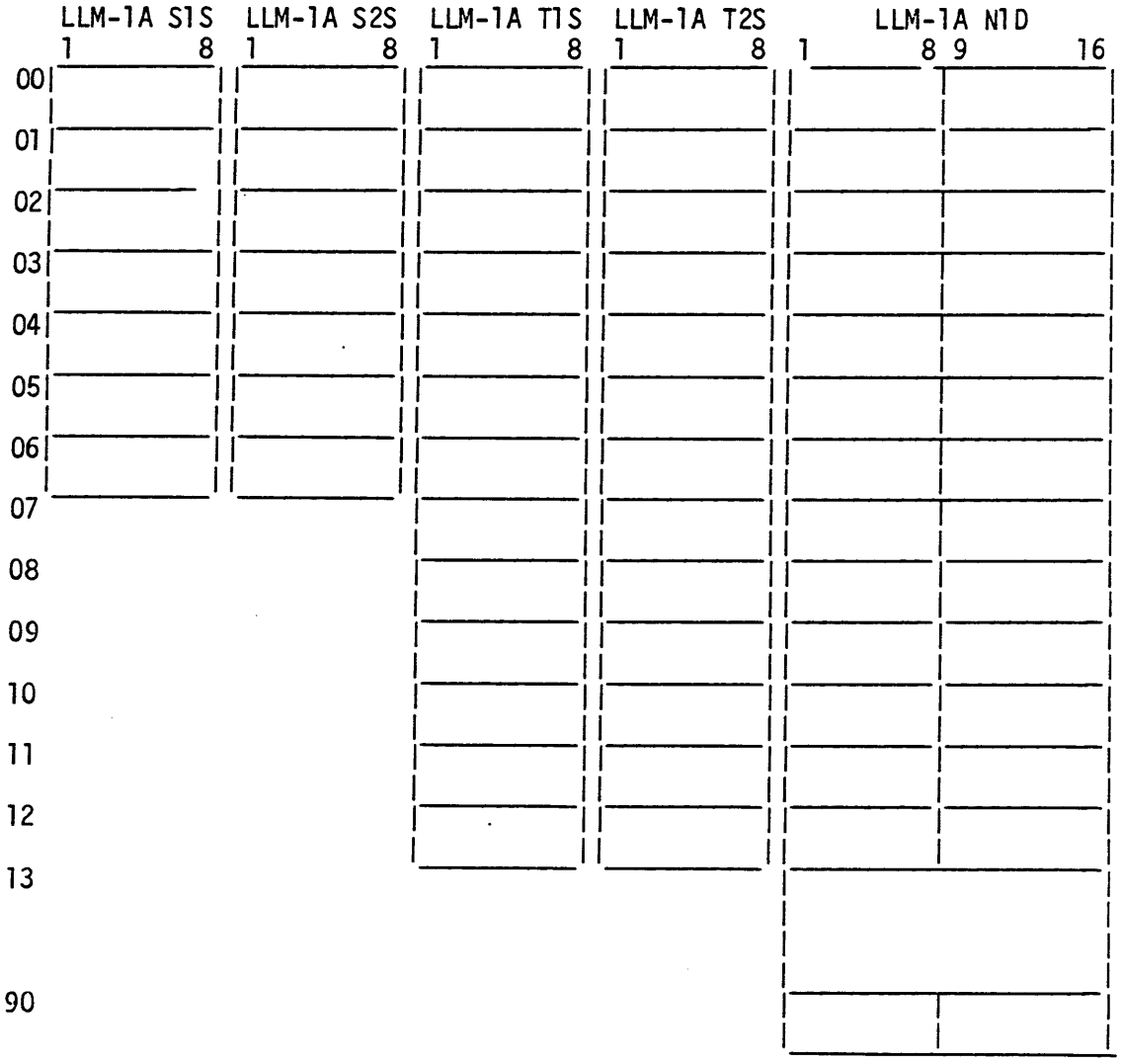


FIGURE A2.2.5: LLM 1A DATA PACKET

A2.2.4 High Level Module 1B Data Packet

The fixed area allocation for HLM 1B shall contain those measurements created within or sampled by HLM 1B.

The structure associated with HLM 1B data shall be as shown by Figure A2.2.6 (refer to Paragraph A2.2.1.1 for the interpretation of the identifiers shown on the figure).

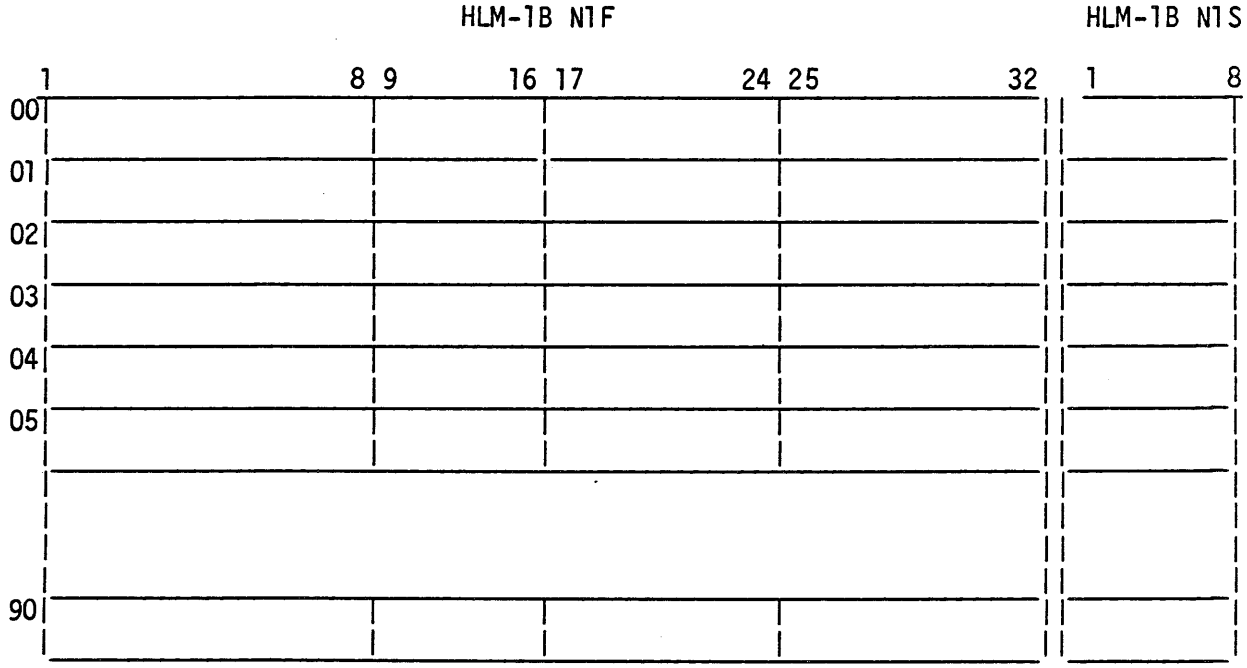


FIGURE A2.2.6: HLM 1B DATA PACKET

A2.2.5 Low Level Module 1B Data Packet

The fixed area allocation for LLM 1B shall contain those measurements created within or sampled by LLM 1B.

The structure associated with LLM 1B data shall be as shown by Figure A2.2.7 (refer to Paragraph A2.2.1.1 for the interpretation of the identifiers shown on the figure).

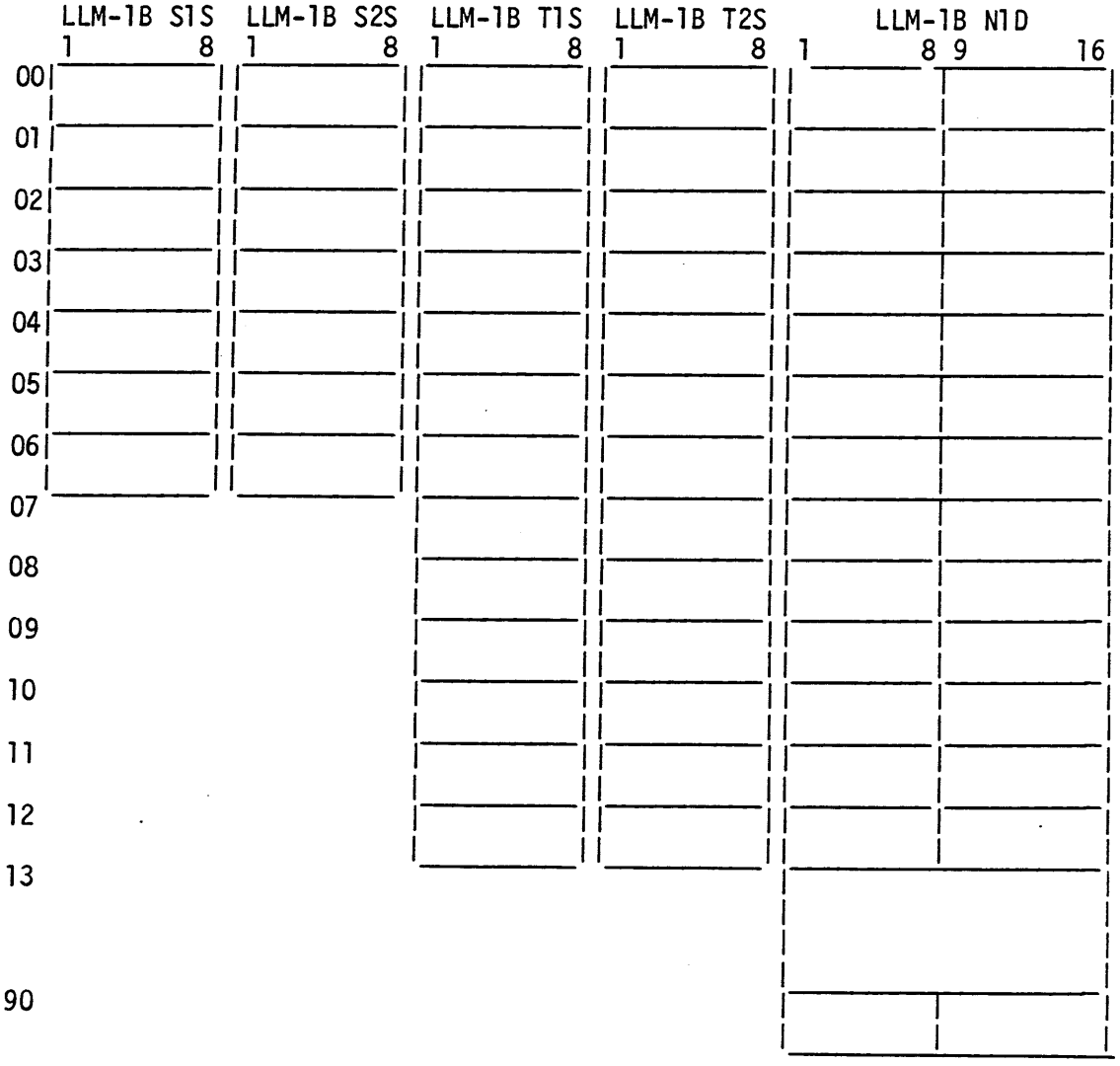


FIGURE A2.2.7: LLM 1B DATA PACKET

A2.2.6 Attitude and Articulation Control Subsystem Data Packet

The fixed area allocation for the AACS shall contain those measurements created within or sampled by AACS.

The structure associated with AACS data shall be as shown by Figure A2.2.8 (refer to Paragraph A2.2.1.1 for the interpretation of the identifiers shown on the figure).

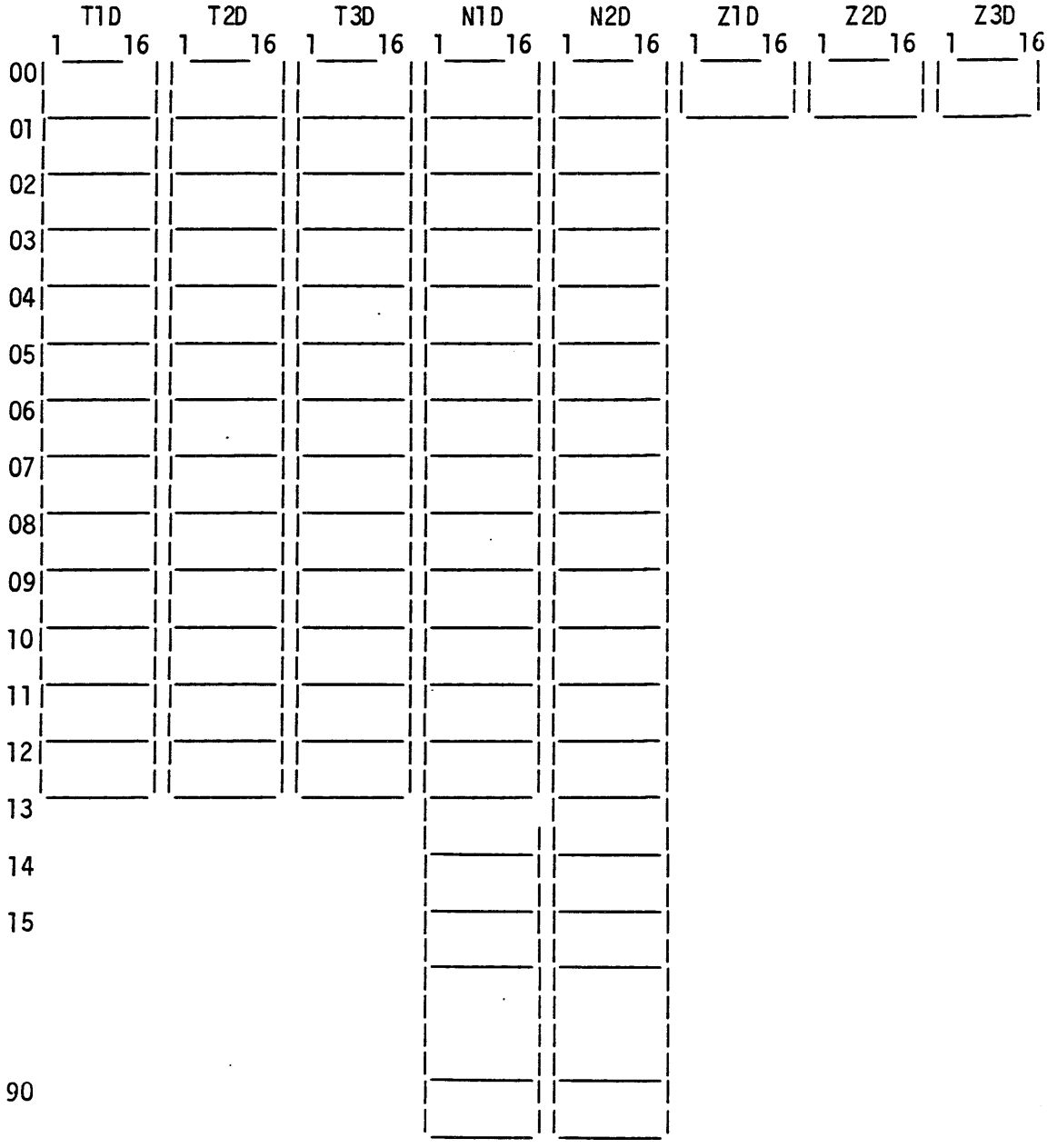


FIGURE A2.2.8 AACS DATA PACKET

A2.2.7 Radar System Data Packet

The fixed area allocation for the Radar System shall contain engineering measurements generated within the Radar System, and formatted as described in Paragraph 3.8.3.6. RS minor frames are numbered from 0 to 23, and the RS major frame is asynchronous with the 91 Frame SED Format.

A2.2.8 Variable Area Packets

The variable area packets shall be identical in structure within each of the CDS and AACS computer modules. These packets shall accommodate the various mission phase differences in measurement sampling requirements.

The structure associated with each packet shall be as shown in Figure A2.2.9 (refer to Paragraph A2.2.1.2 for the interpretation of the identifiers shown in the figure).

In any variable packet it shall be prohibited to create subcommutators within any position of the packet. There shall be no restriction as to the measurements which may be assigned to these packets.

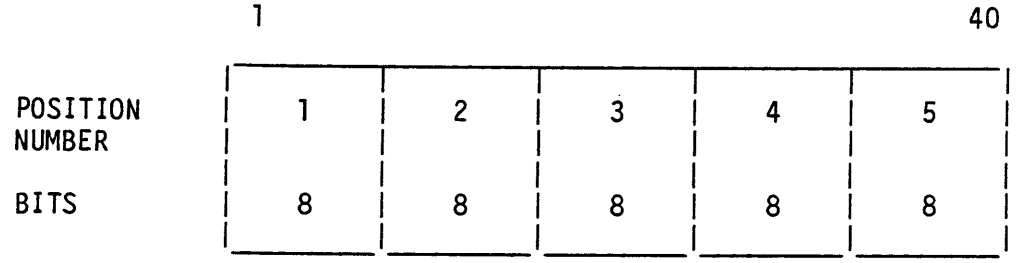


FIGURE A2.2.9: VARIABLE PACKET

A2.2.9 Measurement Sampling Times

The measurements placed into the engineering packet shall be sampled as specified in the succeeding paragraphs.

A2.2.9.1 Fixed-Area Measurement Timing: CDS

Data sampled by a CDS high level module shall be sampled as specified in A2.2.9.1.1. Data sampled by a CDS low level module shall be sampled as specified in A2.2.9.1.2.

A2.2.9.1.1 CDS High Level Module Sampling

Within the CDS, the data subcommutated into the HLM area of an engineering frame shall have been sampled during the MOD91 = 89 of the RIM previous to the RIM contained in the header.

A2.2.9.1.2 CDS Low Level Module Sampling

Within the CDS, most software measurements subcommutated into the LLM area of an engineering frame shall have been sampled during the MOD91 = 89 of the RIM previous to the RIM contained in the header (30 bytes are sampled in real time). Hardware measurements (Analog, Digital, and Temperature) shall be sampled as shown in Table A2.2.4.

TABLE A2.2.4: CDS FIXED AREA MEASUREMENT SAMPLING TIME (MILLISECONDS OFFSET PRIOR TO SCLK)

		Subcommutation Deck					
Telemetry Mode	Rate b/s	S1S	S2S	T1S	T2S	N1D Left Byte	N1D Right Byte
SED	1200	646-2/3	580	446-2/3	380	246-2/3	180

A2.2.9.2 Variable Packet Measurement Timing: CDS

Within any CDS module creating variable area packets, the sample time relationship shown in Table A2.2.5 shall be maintained.

TABLE A2.2.5: CDS VARIABLE PACKET MEASUREMENT SAMPLING TIME (MILLISECONDS OFFSET PRIOR TO SCLK)

Packet (1) Timing Position	Position Within Packet				
	1	2	3	4	5
A	666-2/3	533-1/3	400	266-2/3	133-1/3
B	633-1/3	500	366-2/3	233-1/3	100
C	600	466-2/3	333-1/3	200	66-2/3
D	566-2/3	433-1/3	300	166-2/3	33-1/3
E	653-1/3	520	386-2/3	253-1/3	120
F	606-2/3	473-1/3	340	206-2/3	73-1/3
G	586-2/3	453-1/3	320	186-2/3	53-1/3
H	540	406-2/3	273-1/3	140	6-2/3
I	460	440	426-2/3	420	413-1/3

(1) In creating an engineering map, any of the packets within a module may be assigned to the packet timing position A, B, C, D, E, F, G, H, or I.

A2.2.9.3 Measurement Timing: AACS

Within the AACS, the data sampling shall occur prior to RTI 7 for fixed telemetry, and prior to RTI 5 for variable telemetry.

A2.2.10 S/C Special Sampling Modes

A2.2.10.1 Single Identifier (SID) Mode

In order to assist in the investigation of spacecraft anomalies, it shall be possible to replace all of the variable engineering data with a single measurement. The measurement will be placed in all five positions of all seven packets, overriding all other variable packet formats and allowing the measurement to be sampled up to 35 times per minor frame.

SID mode is not identified in the telemetry header. It shall be necessary to create a new commutation map to overwrite the existing map in order to initiate SID mode.

A2.2.10.2 Delayed Engineering Data (DED)

The Delayed Engineering Data (DED) mode permits the collection of data during non-Earth point spacecraft operations, and provides a quick-look at this data as soon as Earth-pointing is re-established.

Upon command to enable DED collection (6ASSB, GV161), the CDS shall extract a selected portion of the engineering telemetry from the engineering high rate buffer and store this data into the 4096-byte RAM buffer for downlink transmission (quick-look) when commanded by the MOS (usually following star calibration maneuvers and mapping passes). The collected DED Measurements shall be a subset of the data which may be stored on the DMS.

The RAM buffer shall be filled in approximately 61 minutes (determined by allowing for a 43-minute mapping period, two 6-minute turns, and a 6-minute spare time period) after which DED collection shall cease until re-enabled by the MOS. DED collection may be stopped prior to completely filling the buffer at MOS discretion. In this case, old data shall exist in the remainder of the buffer. Downlinking shall be accomplished via the Memory Readout mode, which overlays five of the seven variable packets in the downlink telemetry format with RAM data.

The selected DED shall be limited to data needed to verify MGN performance or to quickly identify a vehicle anomaly, and shall include AACS, thermal, power, DMS, fault detection, and SAR data. The RAM buffer contents, format, addresses, and sample times for DED are shown in Table A2.2.6.a.

The DED shall be collected at three different sampling rates, or groups. Group 0 is the Radar System major frame collection done once per mapping pass, with a collection delay time specified by uplink command (6ASSB, GV73, GV74). This delay time shall be stored in the 4K RAM buffer at the end of the Group 0 collection. Group 1 measurements are sampled once every 60-2/3 seconds. Group 2 measurements are sampled once every 242-2/3 seconds. The index for each group shows where the current data collection has stopped (it points to the next byte to be filled). In the event that data coallection has been terminated prior to filling the 4K RAM buffer, the indexes shall be used to distinguish current data from old data.

The DED measurements are sampled from the 100-byte engineering buffer in groups of contiguous bytes, called an extraction. Each measurement in an extraction shall have the same sampling period as the other measurements in that extraction. The Radar System major frame, which requires only one extraction, is an exception to this rule.

The extraction location within the 100-byte engineering buffer (numbered from 0 to 99), the number of minor frames from collection start for each extraction and length (number of bytes) of each extraction shall be as shown in Table A2.2.6.b. This table is included for information only and is not required for interpretation of the DED.

DED collection shall start on minor frame 0 following MOS DED enable. This start time (D) shall be included in the first 3 bytes of the DED 4K RAM buffer format. The actual time of each extraction shall be referenced to this DED collection start time.

A2.2.10.3 AACS Flood Mode

The AACS shall have the capability to accumulate data to facilitate in-flight problem resolution, system calibration, and/or ground test. The accumulation, management, and downlinking of this data (as described below) shall constitute AACS Flood Mode.

During each odd RTI (1, 3, 5, 7, and 9), the AACS shall access eight 16-bit data words from CPU memory and load these words into 1 slot of a 5 slot X 8-word buffer, so that at the end of one minor telemetry frame (2/3 second), the buffer will contain 40 data words (80 bytes). An additional 2-byte counter, located at the end of the 40 data words, shall be incremented once per minor frame in a circular manner, starting from zero at flight software activation. The format of this counter shall be a 2's complement signed integer. The accumulation of data shall be a continuous process, with the data from the current minor frame overwriting the stored data from the previous minor frame. The data selected to be accessed for use during Flood Mode may be changed at the discretion of MOS and AACS.

Upon ground command, the CDS shall access the 82 bytes in the AACS buffer during RTI 4, and transfer the data to the 4K RAM buffer in CDS starting at address "4K RAM Buffer + 3" (to distinguish Flood Mode from DED). This process may continue, at the discretion of the MOS, for as long as 33 seconds, which will fill the 4K RAM buffer.

The data stored in the 4K RAM buffer shall be downlinked to the ground for analysis, via the 5 variable packets of the telemetry format, operating in the Memory Readout mode.

The option to utilize AACS Flood Mode shall rest with the MOS.

Table A2.2.6.a 4K RAM BUFFER CONTENTS, DED

Contents	Address (4K RAM = 0)	Sample Time (Minor Frames)
DED Collection Start Time (D)	0	mf 0 after enable (6ASSB, GV161 not 0)
Group 0 Index	3	Every mf in which a Group 0 extraction occurs
RS Minor Frame X*	5	D+GV73,74 +0
RS Minor Frame X*	20	D+GV73,74 +1
RS Minor Frame X*	35	D+GV73,74 +2
RS Minor Frame X*	50	D+GV73,74 +3
RS Minor Frame X*	65	D+GV73,74 +4
RS Minor Frame X*	80	D+GV73,74 +5
RS Minor Frame X*	95	D+GV73,74 +6
RS Minor Frame X*	110	D+GV73,74 +7
RS Minor Frame X*	125	D+GV73,74 +8
RS Minor Frame X*	140	D+GV73,74 +9
RS Minor Frame X*	155	D+GV73,74 +10
RS Minor Frame X*	170	D+GV73,74 +11
RS Minor Frame X*	185	D+GV73,74 +12
RS Minor Frame X*	200	D+GV73,74 +13
RS Minor Frame X*	215	D+GV73,74 +14
RS Minor Frame X*	230	D+GV73,74 +15
RS Minor Frame X*	245	D+GV73,74 +16
RS Minor Frame X*	260	D+GV73,74 +17
RS Minor Frame X*	275	D+GV73,74 +18
RS Minor Frame X*	290	D+GV73,74 +19
RS Minor Frame X*	305	D+GV73,74 +20
RS Minor Frame X*	320	D+GV73,74 +21
RS Minor Frame X*	335	D+GV73,74 +22
RS Minor Frame X*	350	D+GV73,74 +23
RS Collection Delay (mf)	365	D

* X = RS frame number. Because the RS frame is asynchronous with the telemetry major frame, the RS frame number must be obtained from the RS minor frame I.D.

(cont)

Table A2.2.6.a 4K RAM BUFFER CONTENTS, DED (cont)

Contents	Address (4K RAM = 0)	Sample Time (Minor Frames)
Group 1 Index	367	Every mf in which a Group 1 extraction occurs
E-1021	367+Y*(48)+2	D+Y*(91)+0
E-1072	367+Y*(48)+4	D+Y*(91)+0
E-1028	367+Y*(48)+6	D+Y*(91)+0
E-1029	367+Y*(48)+8	D+Y*(91)+0
E-1033	367+Y*(48)+10	D+Y*(91)+0
SPARE	367+Y*(48)+14	D+Y*(91)+0
E-1030	367+Y*(48)+15	D+Y*(91)+0
E-0190	367+Y*(48)+17	D+Y*(91)+1
E-0251	367+Y*(48)+18	D+Y*(91)+1
E-0186	367+Y*(48)+19	D+Y*(91)+1
E-0188	367+Y*(48)+20	D+Y*(91)+1
E-0010	367+Y*(48)+21	D+Y*(91)+1
E-0945	367+Y*(48)+22	D+Y*(91)+1
E-1022	367+Y*(48)+23	D+Y*(91)+1
E-1023	367+Y*(48)+25	D+Y*(91)+1
E-1024	367+Y*(48)+27	D+Y*(91)+9
E-0254	367+Y*(48)+29	D+Y*(91)+5
E-0193	367+Y*(48)+30	D+Y*(91)+5
E-0189	367+Y*(48)+31	D+Y*(91)+5
E-0157	367+Y*(48)+32	D+Y*(91)+5
E-0011	367+Y*(48)+33	D+Y*(91)+5
E-0206	367+Y*(48)+34	D+Y*(91)+8
E-0180	367+Y*(48)+35	D+Y*(91)+8
E-0102	367+Y*(48)+36	D+Y*(91)+8
E-0087	367+Y*(48)+37	D+Y*(91)+8
E-1028	367+Y*(48)+38	D+Y*(91)+39
E-1029	367+Y*(48)+40	D+Y*(91)+39
E-1030	367+Y*(48)+42	D+Y*(91)+39
E-1022	367+Y*(48)+44	D+Y*(91)+40
E-1023	367+Y*(48)+46	D+Y*(91)+40
E-1024	367+Y*(48)+48	D+Y*(91)+40

* Y = 0 through 60, and represents the total number of times this group will be sampled during the maximum DED collection period.

(cont)

Table A2.2.6.a 4K RAM BUFFER CONTENTS, DED (concl)

Contents	Address (4K RAM = 0)	Sample Time (Minor Frames)
Group 2 Index	3297	Every mf in which a Group 2 extraction occurs
E-1087	3297+Z*(25)+2	D+Z*(364)+8
E-1071	3297+Z*(25)+4	D+Z*(364)+8
E-0951	3297+Z*(25)+6	D+Z*(364)+12
E-0196	3297+Z*(25)+7	D+Z*(364)+12
E-0002	3297+Z*(25)+8	D+Z*(364)+12
E-0006	3297+Z*(25)+9	D+Z*(364)+12
E-0952	3297+Z*(25)+10	D+Z*(364)+12
SPARE	3297+Z*(25)+11	D+Z*(364)+12
E-1010	3297+Z*(25)+12	D+Z*(364)+12
E-0003	3297+Z*(25)+13	D+Z*(364)+12
E-0092	3297+Z*(25)+14	D+Z*(364)+20
E-0178	3297+Z*(25)+15	D+Z*(364)+20
E-0345	3297+Z*(25)+16	D+Z*(364)+43
E-0176	3297+Z*(25)+19	D+Z*(364)+46
E-0162	3297+Z*(25)+20	D+Z*(364)+46
E-0028	3297+Z*(25)+21	D+Z*(364)+47
E-0170	3297+Z*(25)+22	D+Z*(364)+47
E-0953	3297+Z*(25)+23	D+Z*(364)+57
E-0022	3297+Z*(25)+24	D+Z*(364)+57
E-0184	3297+Z*(25)+25	D+Z*(364)+65
E-0171	3297+Z*(25)+26	D+Z*(364)+65

* Z = 0 through 14, and represents the total number of times this group will be sampled during the maximum DED collection period.

Table A2.2.6.b DED Extraction Areas

EXTRACTION NUMBER	LOC (0-99)	EXTRACTION LENGTH (BYTES) (1-100)	SAMPLING GROUP (0-2)	MINOR FRAMES FROM COLLECTION START (0-5096)	DESCRIPTION
1	50	15	0	*	RS
2	38	2	1	00	AACS
3	42	6	1	00	AACS
4	90	7	1	00	Var. Packet
5	17	6	1	01	LLM1A
6	34	6	1	01	AACS
7	28	5	1	05	LLM1B
8	19	4	1	08	LLM1A
9	44	4	1	39	AACS
10	95	2	1	39	Var. Packet
11	34	6	1	40	AACS
12	40	4	2	08	AACS
13	19	4	2	12	LLM1A
14	30	4	2	12	LLM1B
15	21	2	2	20	LLM1A
16	12	3	2	43	HLM1A
17	21	2	2	46	LLM1A
18	32	2	2	47	LLM1B
19	21	2	2	57	LLM1A
20	21	2	2	65	LLM1A

* Variable. Selected via uplink command (GV73, GV74).

A2.2.11 Engineering Measurements and Formats

This section identifies the VRM engineering measurements, variable packet engineering formats, and commutator position assignments of each measurement within the engineering formats.

A2.2.11.1 Engineering Measurement Detailed Data

Table A2.2.7 provides detailed data for each engineering measurement. This data includes measurement engineering number, title, identification (treeswitch or other identification, as appropriate), engineering unit range, number of bits, and type (analog/temperature/digital/software).

The table headings are as follows: NUMBER refers to engineering number. This number will nominally be of the form E-X_1 X_2 X_3 X_4. Exceptions to this are AACS Trickle Telemetry, of the form T-X_1 X_2 X_3 X_4, and Radar System telemetry, of the form R-$X_1X_2X_3X_4$. Furthermore, the Radar System number is broken down as follows:

X_1: 0 = "A" Unit, 1 = "B" Unit, 2 = T&C bilevel telemetry (A or B)

X_2: 1 - TCU, 2 = PTU, 3 = RDU, 4 = TXU, 5 = ONU, 6 = RXU, 7 = BPU, 8 = DFU, 9 = PDU

X_3X_4 0-49 = bilevel, 50-59 = voltage, 60-69 = current, 70-79 = temperature, 80-89 = power

MEASUREMENT TITLE is the name of the measurement. ENGINEERING RANGE refers to the engineering range of the measurement, with degrees given in Celsius for temperature measurements. TREE POS refers to the CDS hardware A or B side treeswitch position. COMM POS refers to the position in the engineering commutator, and therefore the frequency of sampling, of engineering measurements. NO. OF BITS indicates how many bits the measurement contains. FLAGS refers to 2 flags, with the first flag (F, V, or B) referring to whether the measurement is in the fixed commutator area only, the variable commutator area only, or both. The second flag (A, T, D, or S) denotes whether the measurement is an analog measurement, a temperature measurement, a digital measurement, or a software measurement.

Digital and software bit definitions are shown in Table A2.2.9.

TABLE A2.2.7 ENGINEERING MEASUREMENTS

SUBSYSTEM: STRUCTURES AND THERMAL CONTROL

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0000	Bay 1 TEMP	-78/100°C	T1A 5A	LLM1A N1D16 1	8	FT
E-0001	Bay 2 TEMP	-78/100°C	T1B 5A	LLM1B N1D26 2	8	FT
E-0002	Bay 3 TEMP	-78/100°C	T1A 6B	LLM1A N1D12 1	8	FT
E-0003	Bay 4 TEMP	-78/100°C	T1B 7E	LLM1B N1D12 2	8	FT
E-0004	Bay 5 TEMP	-78/100°C	T1A 7E	LLM1A N1D16 2	8	FT
E-0006	Bay 7 TEMP	-78/100°C	T1A 6E	LLM1A N1D12 2	8	FT
E-0007	Bay 8 TEMP	-78/100°C	T1B 6B	LLM1B N1D17 2	8	FT
E-0008	Bay 9 TEMP	-78/100°C	T1B 7A	LLM1B N1D17 1	8	FT
E-0009	Bay 10 TEMP	-78/100°C	T1A 7A	LLM1A N1D00 1	8	FT
E-0010	RS Sensor Structure Temp 1	-78/100°C	T1A 7B	LLM1A N1D01 1	8	FT
E-0011	RS Sensor Structure Temp 2	-78/100°C	T1B 7B	LLM1B N1D05 1	8	FT
E-0012	ALTA Temp	-190/161°C	T1B 54	LLM1B N1D20 1	8	FT
E-0013	Multilayer Temp 1	-190/161°C	T1A 58	LLM1A N1D03 2	8	FT
E-0014	Multilayer Temp 2	-190/161°C	T1B 59	LLM1B N1D14 1	8	FT
E-0015	Multilayer Temp 3	-190/161°C	T1A 54	LLM1A N1D07 1	8	FT
E-0016	Louver Cover Temp 1	-102/74°C	T1B 7D	LLM1B N1D42 1	8	FT
E-0017	Louver Cover Temp 2	-102/74°C	T1A 78	LLM1A N1D69 2	8	FT
E-0018	Louver Cover Temp 3	-102/74°C	T1B 73	LLM1B N1D82 2	8	FT
E-0019	Propellant Equipment Plate Temp 1	-78/100°C	T1A 5D	LLM1A N1D54 2	8	FT
E-0020	Propellant Tank Temp 1	-78/100°C	T1A 74	LLM1A N1D44 2	8	FT
E-0021	Pressurant Tank Temp 1	-78/100°C	T1B 64	LLM1B N1D57 2	8	FT
E-0022	Propellant Line Temp 1	-78/100°C	T1A 69	LLM1A N1D57 2	8	FT
E-0023	Propellant Line Temp 2	-78/100°C	T1B 69	LLM1B N1D58 1	8	FT
E-0024	Propellant Equipment Plate Temp 2	-78/100°C	T1B 6C	LLM1B N1D66 1	8	FT

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: STRUCTURES AND THERMAL CONTROL (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0025	SRM Temp 1	-78/100°C	T1B 6D	LLM1B N1D58 2	8	FT
E-0026	SRM Temp 2	-78/100°C	T1A 6C	LLM1A N1D58 2	8	FT
E-0027	SRM Temp 3	-78/100°C	T1B 74	LLM1B N1D14 2	8	FT
E-0028	REM 1 Temp 1	-78/100°C	T1B 53	LLM1B N1D47 1	8	FT
E-0029	REM 2 Temp 1	-78/100°C	T1B 78	LLM1B N1D52 2	8	FT
E-0030	REM 1 Temp 2	-78/100°C	T1A 62	LLM1A N1D52 2	8	FT
E-0031	REM 2 Temp 2	-78/100°C	T1A 55	LLM1A N1D53 1	8	FT
E-0032	Bay 6 Temp	-78/100°C	T1B 6E	LLM1B N1D44 2	8	FT
E-0033	Propellant Tank Temp 2	-78/100°C	TIB 61	LLM1B N1D53 1	8	FT
E-0034	Propellant Tank Temp 3	-78/100°C	TIA 6D	LLM1A N1D52 1	8	FT
E-0035	Pressurant Tank Temp 2	-78/100°C	TIA 61	LLM1A N1D53 2	8	FT
E-0036	Propellant Line Temp 3	-78/100°C	TIA 51	LLM1A N1D54 1	8	FT
E-0037	REM 3 Temp 1	-78/100°C	TIA 73	LLM1A N1D81 2	8	FT
E-0038	REM 3 Temp 2	-78/100°C	TIB 71	LLM1B N1D54 1	8	FT
E-0039	REM 4 Temp 1	-78/100°C	TIA 7D	LLM1A N1D26 2	8	FT
E-0040	REM 4 Temp 2	-78/100°C	TIB 62	LLM1B N1D81 2	8	FT
E-0041	Coax Temp Zone 2	-78/100°C	T1A 57	LLM1A N1D31 1	8	FT
E-0042	Coax Temp Zone 3	-78/100°C	T1B 57	LLM1B N1D02 1	8	FT
E-0043	Coax Temp Zone 4	-78/100°C	T1B 76	LLM1B N1D03 2	8	FT
E-0044	Coax Temp Zone 5	-78/100°C	T1B 5E	LLM1B N1D31 1	8	FT
E-0045	Coax Temp Zone 6	-78/100°C	T1B 77	LLM1B N1D40 2	8	FT
E-0046	Coax Temp Zone 7	-78/100°C	T1A 67	LLM1A N1D33 2	8	FT
E-0151/8*	Solar Panel Deployment Lock				1	FD

* Bi-Level, A-side. See Table A2.2.9, BI-level Word 1, for word content.

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: TELECOMMUNICATIONS

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0051	TCS Status Word 1(A)*		T1A 0A	LLM1A N1D73 1	8	FD
E-0052	TCS Status Word 1(B)*		T1B 0A	LLM1B N1D73 1	8	FD
E-0053	TCS Status Word 2(A)*		T1A 0B	LLM1A N1D59 2	8	FD
E-0054	TCS Status Word 2(B)*		T1B 0B	LLM1B N1D59 2	8	FD
E-0055	TCS Status Word 3A*		T1A 08	LLM1A T1S11 1	8	FD
E-0056	TCS Status Word 3A*		T1B 08	LLM1B T1S11 1	8	FD
E-0057	Receiver A Static Phase Error	-200/+200 kHz	T1A 1B	LLM1A T1S04 1	8	FA
E-0058	Receiver A Static Phase Error	-200/+200 kHz	T1B 41	LLM1B T1S01 1	8	FA
E-0059	Receiver B Static Phase Error	-200/+200 kHz	T1B 2D	LLM1B T2S09 1	8	FA
E-0060	Receiver B Static Phase Error	-200/+200 kHz	T1A 19	LLM1A T2S09 1	8	FA
E-0061	Receiver A Power Supply Voltage	0/+10 Vdc	T1A 17	LLM1A N1D78 1	8	FA
E-0062	Receiver B Power Supply Voltage	0/+10 Vdc	T1B 17	LLM1B N1D78 1	8	FA
E-0063	Receiver A AGC	-70/-155 dBm	T1A 33	LLM1A S1S04 1	8	FA
E-0064	Receiver A AGC	-70/-155 dBm	T1B 3D	LLM1B S2S04 1	8	FA
E-0065	Receiver B AGC	-70/-155 dBm	T1B 26	LLM1B S1S04 1	8	FA
E-0066	Receiver B AGC	-70/-155 dBm	T1A 46	LLM1A S2S04 1	8	FA
E-0067	S-Band Xmitter A Output RF Monitor	+32.3/+39.1 dBm	T1A 24	LLM1A T1S10 1	8	FA
E-0068	S-Band Xmitter A Output RF Monitor	+32.3/+39.1 dBm	T1B 21	LLM1B T2S07 1	8	FA
E-0069	S-Band Xmitter B Output RF Monitor	+30.9/+37.8 dBm	T1B 46	LLM1B T1S04 1	8	FA
E-0070	S-Band Xmitter B Output RF Monitor	+30.9/+37.8 dBm	T1A 1E	LLM1A T1S06 1	8	FA

*See Table A2.2.9 for contents.

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: TELECOMMUNICATIONS (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0071	TWTA A Helix Current	0/2 ma	T1A 47	LLM1A T2S04 1	8	FA
E-0072	TWTA A Helix Current	0/2 ma	T1B 36	LLM1B T2S06 1	8	FA
E-0073	TWTA B Helix Current	0/2 ma	T1B 24	LLM1B T1S09 1	8	FA
E-0074	TWTA B Helix Current	0/2 ma	T1A 22	LLM1A T2S06 1	8	FA
E-0075	TWTA A Output RF Monitor (WAP)	+36/+43.7 dBm	T1A 2D	LLM1A T1S05 1	8	FA
E-0076	TWTA A Output RF Monitor (WAP)	+36/+43.7 dBm	T1B 2A	LLM1B T1S07 1	8	FA
E-0077	TWTA B Output RF Monitor (WAP)	+36/+44 dBm	T1B 4C	LLM1B T2S11 1	8	FA
E-0078	TWTA B Output RF Monitor (WAP)	+36/+44 dBm	T1A 21	LLM1A T2S07 1	8	FA
E-0079	TWTA A Heater Current	1.32 Amp	T1A 2A	LLM1A T1S09 1	8	FA
E-0080	TWTA A Heater Current	1.32 Amp	T1B 1A	LLM1B T1S06 1	8	FA
E-0081	TWTA B Heater Current	1.32 Amp	T1B 1B	LLM1B T2S04 1	8	FA
E-0082	TWTA B Heater Current	1.32 Amp	T1A 1A	LLM1A T1S07 1	8	FA
E-0083	X-Band Exciter Output RF Monitor	+1/+16 dBm	T1A 38	LLM1A T2S11 1	8	FA
E-0084	X-Band Exciter Output RF Monitor	+1/+16 dBm	T1B 1C	LLM1B T2S02 1	8	FA
E-0085	Receiver A VCO Temp	-78/100°C	T1A 5B	LLM1A N1D70 1	8	FT
E-0086	Receiver B VCO Temp	-78/100°C	T1B 5B	LLM1B N1D70 1	8	FT
E-0087	S-Band Xmitter A Temp	-78/100°C	T1A 6A	LLM1A N1D08 2	8	FT
E-0088	S-Band Xmitter B Temp	-78/100°C	T1B 6A	LLM1B N1D71 2	8	FT
E-0089	WAP A Temp	-78/100°C	T1A 65	LLM1A N1D82 2	8	FT
E-0090	WAP B Temp	-78/100°C	T1B 65	LLM1B N1D69 2	8	FT
E-0091	X-Band Filter-Hybrid Temp	-78/100°C	T1A 64	LLM1A N1D71 1	8	FT
E-0092	X-Band TWT A Temp	-78/100°C	T1A 68	LLM1A N1D20 1	8	FT
E-0093	X-Band TWT B Temp	-78/100°C	T1B 68	LLM1B N1D70 2	8	FT

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: TELECOMMUNICATIONS (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0094	Auxiliary Oscillator A Temp	-78/100°C	T1A 76	LLM1A N1D71 2	8	FT
E-0095	Auxiliary Oscillator B Temp	-78/100°C	T1B 67	LLM1B N1D68 1	8	FT
E-0096	X/S DC LO Voltage Drive	+2/+15 dBm	T1B 1D	LLM1B S1S00 1	8	FA
E-0097	X/S DC Temp	-78/100°C	T1A 5E	LLM1A N1D00 2	8	FT
E-0098	HGA S-Band Feed Horn Temp	-190/161°C	T1B 75	LLM1B N1D13 1	8	FT
E-0099	HGA X-Band Feed Horn Temp	-190/161°C	T1B 58	LLM1B N1D13 2	8	FT
E-0100	HGA Reflector Temp	-190/161°C	T1A 75	LLM1A N1D13 1	8	FT
E-0101	TWTA A EPC Temp	-40/75°C	T1B 1E	LLM1B N1D69 1	8	FA
E-0102	TWTA A EPC Temp	-40/75°C	T1A 26	LLM1A N1D08 1	8	FA
E-0103	TWTA B EPC Temp	-40/75°C	T1A 27	LLM1A N1D79 2	8	FA
E-0104	TWTA B EPC Temp	-40/75°C	T1B 22	LLM1B N1D79 2	8	FA
E-0105	LGA Temp	-153/204°C	T1A 53	LLM1A N1D14 2	8	FT
E-0106	MGA Temp	-153/204°C	T1B 52	LLM1B N1D65 2	8	FT
E-0107	TCS Status Word 3B*		T1A 09	LLM1A T2S10 1	8	FD
E-0108	TCS Status Word 3B*		T1B 09	LLM1B T2S10 1	8	FD

*See Table A2.2.9 for contents.

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ELECTRICAL POWER

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0151	Bi-Level Word 1 *		T1A 00	LLM1A N1D85 2	8	BD
E-0152	Bi-Level Word 2 **		T1B 00	LLM1B N1D72 2	8	BD
E-0151/1	SPARE				1	BD
E-0152/1	PSU Pyro Unshort Ind.**				1	BD
E-0151/2	Battery 1 Cell Fail Det. C/O Enable*				1	BD
E-0152/2	Battery 2 Cell Fail Det. C/O Enable**				1	BD
E-0151/3	Battery 1 Float/Reconnect*				1	BD
E-0152/3	Battery 2 Float/Reconnect**				1	BD
E-0151/4	PSU Pyro Arm Ind.*				1	BD
E-0152/4	DC Bus U/V Sensor Enable**				1	BD
E-0151/5	Battery 1 Disconnect*				1	BD
E-0152/5	Battery 2 Disconnect**				1	BD
E-0151/6	Battery 1 Overtemp C/O Enable*				1	BD
E-0152/6	Battery 2 Overtemp C/O Enable**				1	BD
E-0151/7	Battery 1 Recond. L/V Det. Enable*				1	BD
E-0152/7	Battery 2 Recond. L/V Det. Enable**				1	BD
E-0153	Bi-Level Word 3 *		T1A 01	LLM1A N1D02 1	8	BD
E-0154	Bi-Level Word 4 **		T1B 01	LLM1B N1D85 2	8	BD

* Bi-Level, A side. See Table A2.2.9 for Bi-Level word content.
** Bi-Level, B side. See Table A2.2.9 for Bi-Level word content.

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ELECTRICAL POWER (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0153/2	V/T Level 7-8*				1	BD
E-0154/2	V/T Level 7-8**				1	BD
E-0153/4	EPS Pyro Amps 1A Status* (Pyro Events Mod 2)				1	BD
E-0154/4	EPS Pyro Amps 1B Status** (Pyro Events Mod 2)				1	BD
E-0153/6	PSU 1A Enable Relays A Status*				1	BD
E-0154/6	PSU 1B Enable Relays B Status**					
E-0156	Shunt Regulator Total Input Current	0-50 Amp	T1A 18	LLM1A T1S02 1	8	FA
E-0157	Shunt Regulator Total Input Current	0-50 Amp	T1B 18	LLM1B T2S05 1	8	FA
E-0158	Pyro Bank A Voltage	0-45 Vdc	T1A 40	LLM1A N1D43 2	8	FA
E-0159	Pyro Bank A Voltage	0-45 Vdc	T1B 40	LLM1B N1D43 2	8	FA
E-0160	Pyro Bank B Voltage	0-45 Vdc	T1A 2B	LLM1A N1D07 2	8	FA
E-0161	Pyro Bank B Voltage	0-45 Vdc	T1B 2B	LLM1B N1D07 2	8	FA
E-0162	Solar Panel No. 1 (+X) Temp 1	-190/161°C	T1A 59	LLM1A N1D46 2	8	FT
E-0163	Solar Panel No. 1 (+X) Temp 2	-190/161°C	T1B 55	LLM1B N1D33 2	8	FT
E-0164	Solar Panel No. 2 (-X) Temp 1	-190/161°C	T1A 5C	LLM1A N1D84 1	8	FT
E-0165	Solar Panel No. 2 (-X) Temp 2	-190/161°C	T1B 5D	LLM1B N1D84 1	8	FT
E-0166	Main PRU Bus Voltage	0-36 Vdc	T1A 1D	LLM1A T1S03 1	8	FA
E-0167	Main PRU Bus Voltage	0-36 Vdc	T1B 31	LLM1B T1S03 1	8	FA
E-0168	NOT ASSIGNED					
E-0169	NOT ASSIGNED					

* Bi-Level, A side. See Table A2.2.9 for Bi-Level word content.
** Bi-Level, B side. See Table A2.2.9 for Bi-Level word content.

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ELECTRICAL POWER (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0170	Battery 2 Cell Voltage Imbalance	-1.5/+1.5 Vdc	T1B 32	LLM1B N1D47 2	8	FA
E-0171	Battery 1 Cell Voltage Imbalance	-1.5/+1.5 Vdc	T1A 30	LLM1A N1D65 2	8	FA
E-0172	Inverter AC Bus Voltage	35-55 Vac	T1A 3D	LLM1A T2S03 1	8	FA
E-0173	Inverter AC Bus Voltage	35-55 Vac	T1B 3C	LLM1B T2S03 1	8	FA
E-0174	Battery 1 Voltage	0-36 Vdc	T1A 3E	LLM1A T2S05 1	8	FA
E-0175	Battery 2 Voltage	0-36 Vdc	T1B 3B	LLM1B T1S10 1	8	FA
E-0176	Battery 1 Temp 1	-15/56°C	T1A 50	LLM1A N1D46 1	8	FT
E-0177	Battery 1 Temp 2	-15/56°C	T1B 50	LLM1B N1D20 2	8	FT
E-0178	Battery 2 Temp 1	-15/56°C	T1A 60	LLM1A N1D20 2	8	FT
E-0179	Battery 2 Temp 2	-15/56°C	T1B 60	LLM1B N1D44 1	8	FT
E-0180	Main Bus Voltage	0-36 Vdc	T1A 36	LLM1A T2S08 1	8	FA
E-0181	Main Bus Voltage	0-36 Vdc	T1B 33	LLM1B T2S08 1	8	FA
E-0182	Shunt Regulator 1 Temp	-78/100°C	T1A 66	LLM1A N1D78 2	8	FT
E-0183	Shunt Regulator 2 Temp	-78/100°C	T1B 66	LLM1B N1D03 1	8	FT
E-0184	Shunt Radiator 1 (-Y) Temp	-201/243.5°C	T1A 52	LLM1A N1D65 1	8	FT
E-0185	Shunt Radiator 2 (+Y) Temp	-201/243.5°C	T1B 51	LLM1B N1D00 1	8	FT
E-0186	Unregulated Main Bus Load Current	0-50 Amp	T1A 23	LLM1A T1S01 1	8	FA
E-0187	Unregulated Main Bus Load Current	0-50 Amp	T1B 23	LLM1B T1S02 1	8	FA
E-0188	Solar Panel No. 1 (+X) Current	0-30 Amp	T1A 2C	LLM1A T2S01 1	8	FA
E-0189	Solar Panel No. 2 (-X) Current	0-30 Amp	T1B 30	LLM1B T1S05 1	8	FA
E-0190	Battery 1 Current	-40 to +40 Amp	T1A 37	LLM1A S1S01 1	8	FA
E-0191	Battery 1 Current	-40 to +40 Amp	T1B 19	LLM1B S1S02 1	8	FA
E-0192	Battery 2 Current	-40 to +40 Amp	T1A 3A	LLM1A S2S02 1	8	FA
E-0193	Battery 2 Current	-40 to +40 Amp	T1B 37	LLM1B S2S05 1	8	FA

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ELECTRICAL POWER (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0194	Battery 2 Voltage	0-36 VDC	T1A 41	LLM1A T1S00 1	8	FA
E-0195	Battery 1 Voltage	0-36VDC	T1B 42	LLM1B T1S00 1	8	FA
E-0196	PRU Input Current	0-18 Amp	T1A 31	LLM1A T2S12 1	8	FA
E-0197	PRU Input Current	0-18 Amp	T1B 44	LLM1B T1S08 1	8	FA
E-0198	Standby PRU Bus Voltage	0-36 VDC	T1A 49	LLM1A T2S02 1	8	FA
E-0199	Standby PRU Bus Voltage	0-36 VDC	T1B 47	LLM1B T2S01 1	8	FA
E-0200	Inverter Main to Standby*	0 or 3 VDC	T1A 4A	LLM1A N1D33 1	8	FA
E-0201	Inverter Main to Standby*	0 or 3 VDC	T1B 48	LLM1B N1D33 1	8	FA
E-0202	Load Shed Relay Tripped**	0 or 1.5 VDC	T1A 4C	LLM1A N1D30 1	8	FA
E-0203	Load Shed Relay Tripped**	0 or 1.5 VDC	T1B 49	LLM1B N1D30 1	8	FA
E-0204	Solar Panel No. 1 (+X) Current	0-30 Amp	T1B 3A	LLM1B T2S00 1	8	FA
E-0205	Solar Panel No. 2 (-X) Current	0-30 Amp	T1A 3B	LLM1A T2S00 1	8	FA
E-0206	Heater Current	0-40 Amp	T1A 3C	LLM1A T1S08 1	8	FA
E-0207	Battery 1 Charge Current	0-10 Amp	T1A 34	LLM1A S1S03 1	8	FA
E-0208	Battery 1 Charge Current	0-10 Amp	T1B 34	LLM1B S1S03 1	8	FA
E-0209	Battery 2 Charge Current	0-10 Amp	T1A 4D	LLM1A S2S05 1	8	FA
E-0210	Battery 2 Charge Current	0-10 Amp	T1B 4A	LLM1B S2S03 1	8	FA

* Bi-Level, loaded on analog channel; 0 = Main, 3 = Standby
**Bi-Level, loaded on analog channel; 0 = Not Tripped, 1.5 = Tripped

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0153/1	CDS 4.8 KHz Test/A (Inhibited/Enabled)**				1	FD
E-0154/1	CDS 4.8 KHz Test/B (Inhibited/Enabled)***				1	FD
E-0251	DMS A Status Data****		T1A 0C	LLM1A S2S01 1	8	FD
E-0252	DMS A Status Data*****		T1B 0C	LLM1B S2S01 1	8	FD
E-0253	DMS B Status Data****		T1A 0D	LLM1A S1S05 1	8	FD
E-0254	DMS B Status Data*****		T1B 0D	LLM1B S1S05 1	8	FD
E-0255	DMS A DC Motor Current	0-438 ma	T1A 35	LLM1A S2S03 1	8	FA
E-0256	DMS A DC Motor Current	0-438 ma	T1B 35	LLM1B S2S00 1	8	FA
E-0257	DMS B DC Motor Current	0-438 ma	T1B 25	LLM1B S1S06 1	8	FA
E-0258	DMS B DC Motor Current	0-438 ma	T1A 25	LLM1A S2S06 1	8	FA
E-0259	HLM1A Last BC Rim Count		H1A 00	HLM1A N1F00 1	24	F S
E-0260	HLM1A Last BC Mod91		H1A 00	HLM1A N1F00 4	8	F S
E-0261	HLM1A BC Buffer Entry 1A		H1A 00	HLM1A N1F01 1	32	F S
E-0262	HLM1A BC Buffer Entry 2A		H1A 00	HLM1A N1F02 1	32	F S
E-0263	HLM1A BC Buffer Entry 3A		H1A 00	HLM1A N1F03 1	32	F S
E-0264	HLM1A BC Buffer Entry 4A		H1A 00	HLM1A N1F04 1	32	F S
E-0265	HLM1A BC Buffer Entry 5A		H1A 00	HLM1A N1F05 1	32	F S
E-0266	HLM1A BC Buffer Entry 6A		H1A 00	HLM1A N1F06 1	32	F S
E-0267	HLM1A BC Buffer Entry 7A		H1A 00	HLM1A N1F07 1	32	F S
E-0268	HLM1A BC Buffer Entry 8A		H1A 00	HLM1A N1F08 1	32	F S
E-0269	HLM1A BC Buffer Entry 9A		H1A 00	HLM1A N1F09 1	32	F S

* See Table A2.2.9 for contents.
** Bi-Level, A side. See Table A2.2.9 for word content.
*** Bi-Level, B side. See Table A2.2.9 for word content.
**** Serial-Digital Word, A side. See Table A2.2.9 for word content.
***** Serial-Digital Word, B side. See TAble A2.2.9 for word content.

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0270	HLM1A BC Buffer Entry 10A		H1A 00	HLM1A N1F10 1	32	F S
E-0271	HLM1A BC Buffer Entry 11A		H1A 00	HLM1A N1F11 1	32	F S
E-0272	HLM1A BC Buffer Entry 12A		H1A 00	HLM1A N1F12 1	32	F S
E-0273	HLM1A BC Buffer Entry 13A		H1A 00	HLM1A N1F13 1	32	F S
E-0274	HLM1A BC Buffer Entry 14A		H1A 00	HLM1A N1F14 1	32	F S
E-0275	HLM1A BC Buffer Entry 15A		H1A 00	HLM1A N1F15 1	32	F S
E-0276	HLM1A BC Buffer Entry 16A		H1A 00	HLM1A N1F16 1	32	F S
E-0277	HLM1A Non-Buffered BC Counter		H1A 00	HLM1A N1F17 1	16	F S
E-0278	HLM1A Last Uplink Message		H1A 00	HLM1A N1F17 3	16	F S
E-0279	HLM1A S/S FC Counter		H1A 00	HLM1A N1F18 1	16	F S
E-0280	HLM1A S/S BC Counter		H1A 00	HLM1A N1F18 3	16	F S
E-0281	HLM1A F/P FC Counter		H1A 00	HLM1A N1F19 1	16	F S
E-0282	HLM1A F/P BC Counter		H1A 00	HLM1A N1F19 3	16	F S
E-0283	Unassigned					
E-0284	Unassigned					
E-0285	HLM1A LLM Bus Transactions Received		H1A 00	HLM1A N1F22 1	8	F S
E-0286	HLM1A DAC Error Counter		H1A 00	HLM1A N1F22 2	8	F S
E-0287	HLM1A Mem Copy/Tweak Error Counter		H1A 00	HLM1A N1F22 3	8	F S
E-0288	HLM1A BUM Error Limiter		H1A 00	HLM1A N1F22 4	8	F S
E-0289	HLM1A To LLMS Priviledged FC Counter		H1A 00	HLM1A N1F23 1	8	F S
E-0290	HLM1A To LLMS Total FC Counter		H1A 00	HLM1A N1F23 2	8	F S
E-0291	HLM1A Non-Priv CC/DC/Power Code Counter		H1A 00	HLM1A N1F23 3	8	F S
E-0292	HLM1A Priv CC/DC/Power Code Counter		H1A 00	HLM1A N1F23 4	8	F S
E-0293	HLM1A RS Commanding Enable		H1A 00	HLM1A N1F24 1	8	F S
E-0294	HLM1A PRF Command Message Counter		H1A 00	HLM1A N1F24 2	8	F S
E-0295	HLM1A RG Message Counter		H1A 00	HLM1A N1F24 3	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0296	HLM1A HB First Entry		H1A 00	HLM1A N1F24 4	8	F S
E-0297	HLM1A HB Entry Time		H1A 00	HLM1A N1F25 1	32	F S
E-0298	HLM1A FP Flags (S-X Band RF, TWTA RF/TWTA Thermal, Safing)		H1A 00	HLM1A N1F26 1	24	F S
E-0299	HLM1A GPV-39 AACS POR Counter		H1A 00	HLM1A N1F26 4	8	F S
E-0300	HLM1A CRC Bank A Registers 0-3		H1A 00	HLM1A N1F27 1	32	F S
E-0301	HLM1A CRC Bank A Registers 4-6		H1A 00	HLM1A N1F28 1	24	F S
E-0302	HLM1A GPV-47 (Spare)		H1A 00	HLM1A N1F28 4	8	F S
E-0303	HLM1A CRC Bank B Registers 0-3		H1A 00	HLM1A N1F29 1	32	F S
E-0304	HLM1A CRC Bank B Registers 4-7		H1A 00	HLM1A N1F30 1	32	F S
E-0305	HLM1A HCD Command Summary Word		H1A 00	HLM1A N1F31 1	8	F S
E-0306	HLM1A Messages Received and Accepted Counter		H1A 00	HLM1A N1F31 2	8	F S
E-0307	HLM1A Messages Received and Rejected Counter		H1A 00	HLM1A N1F31 3	8	F S
E-0308	HLM1A Command Frame Errors Detected Counter		H1A 00	HLM1A N1F31 4	8	F S
E-0309	HLM1A Data Frame Errors Corrected Counter		H1A 00	HLM1A N1F32 1	8	F S
E-0310	HLM1A Data Frame Errors Uncorrectable Counter		H1A 00	HLM1A N1F32 2	8	F S
E-0311	HLM1A Lock Changes Counter		H1A 00	HLM1A N1F32 3	8	F S
E-0312	HLM1A CRC Status Word		H1A 00	HLM1A N1F32 4	8	F S
E-0313	HLM1A Error Words IOSL 0-1-2		H1A 00	HLM1A N1F33 1	24	F S
E-0314	HLM1A Cmd Loss Response Counter		H1A 00	HLM1A N1F33 4	8	F S
E-0315	HLM1A BUM Error Words		H1A 00	HLM1A N1F34 1	32	F S
E-0316	HLM1A DBUM Error Words		H1A 00	HLM1A N1F35 1	16	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0317	HLM1A Flag Status		H1A 00	HLM1A N1F35 3	8	F S
E-0318	HLM1A Extended Background Processing Counter		H1A 00	HLM1A N1F35 4	8	F S
E-0319	HLM1A This CDS Op Mode		H1A 00	HLM1A N1F36 1	8	F S
E-0320	HLM1A This Safe Request Flag		H1A 00	HLM1A N1F36 2	8	F S
E-0321	HLM1A This Safe Enable		H1A 00	HLM1A N1F36 3	8	F S
E-0322	HLM1A This Effectual Down Flag		H1A 00	HLM1A N1F36 4	8	F S
E-0323	HLM1A This Clock Sync Error Count		H1A 00	HLM1A N1F37 1	8	F S
E-0324	HLM1A GPV-132 (Spare to Other HLM)		H1A 00	HLM1A N1F37 2	8	F S
E-0325	HLM1A GPV-133 (Spare to Other HLM)		H1A 00	HLM1A N1F37 3	8	F S
E-0326	HLM1A This Side Launch Mode Ready		H1A 00	HLM1A N1F37 4	8	F S
E-0327	HLM1A Out-of-Range Alert Code Counter		H1A 00	HLM1A N1F38 1	8	F S
E-0328	HLM1A Erroneous Alert Error Counter		H1A 00	HLM1A N1F38 2	8	F S
E-0329	HLM1A AACS Alert Code Received Counter		H1A 00	HLM1A N1F38 3	16	F S
E-0330	HLM1A Heartbeat Entry Counter		H1A 00	HLM1A N1F39 1	8	F S
E-0331	HLM1A Heartbeat Error Counter Accumulated		H1A 00	HLM1A N1F39 2	8	F S
E-0332	HLM1A Last AACS Alert Code		H1A 00	HLM1A N1F39 3	8	F S
E-0333	HLM1A AACS Alert Code Response Counter		H1A 00	HLM1A N1F39 4	8	F S
E-0334	HLM1A Command Loss Response Start Time		H1A 00	HLM1A N1F40 1	24	F S
E-0335	HLM1A Unassigned					
E-0336	HLM1A AACS Heartbeat Code		H1A 00	HLM1A N1F40 4	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0337	HLM1A Last PRF Time		H1A 00	HLM1A N1F41 1	24	F S
E-0338	HLM1A NOT ASSIGNED					
E-0339	HLM1A NOT ASSIGNED					
E-0340	HLM1A U/V Response Counter		H1A 00	HLM1A N1F41 4	8	F S
E-0341	HLM1A S/C F/P Monitor Enable (Priv.)		H1A 00	HLM1A N1F42 1	8	F S
E-0342	HLM1A S/C F/P Monitor Emergency O/T Enables		H1A 00	HLM1A N1F42 2	8	F S
E-0343	HLM1A Spare		H1A 00	HLM1A N1F42 3	8	F S
E-0344	HLM1A Spare		H1A 00	HLM1A N1F42 4	8	F S
E-0345	HLM1A S/C F/P Response Enables (Priv)		H1A 00	HLM1A N1F43 1	24	F S
E-0346	HLM1A CDS POR Response Counter		H1A 00	HLM1A N1F43 4	8	F S
E-0347	HLM1A F/P Condition (Requests) Enables		H1A 00	HLM1A N1F44 1	24	F S
E-0348	HLM1A RF Loss Response Counter		H1A 00	HLM1A N1F44 4	8	F S
E-0349	HLM1A F/P Response Inactive Enables		H1A 00	HLM1A N1F45 1	24	F S
E-0350	HLM1A Prime/Backup Status		H1A 00	HLM1A N1F45 4	8	F S
E-0351	HLM1A MOS F/P Response Enables (Non-Privileged)		H1A 00	HLM1A N1F46 1	24	F S
E-0352	HLM1A AACS Status		H1A 00	HLM1A N1F46 4	8	F S
E-0353	HLM1A MOS F/P Monitor Enable (Non-Privileged)		H1A 00	HLM1A N1F47 1	8	F S
E-0354	HLM1A MOS F/P Monitor Emergency O/T Enables		H1A 00	HLM1A N1F47 2	8	F S
E-0355	HLM1A Cmd Loss Reset Delta RIMS		H1A 00	HLM1A N1F47 3	16	F S
E-0356	HLM1A System Fault Status		H1A 00	HLM1A N1F48 1	24	F S
E-0357	HLM1A DED Collection Enable		H1A 00	HLM1A N1F48 4	8	F S
E-0358	HLM1A GV-117 (Spare to Other HLM)		H1A 00	HLM1A N1F20 1	8	F S
E-0359	HLM1A GV-118 (Spare to Other HLM)		H1A 00	HLM1A N1F20 2	8	F S
E-0360	HLM1A GV-119 (Spare to Other HLM)		H1A 00	HLM1A N1F20 3	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0361	HLM1A GV-120 (Spare to Other HLM)		H1A 00	HLM1A N1F20 4	8	F S
E-0362	HLM1A GV-121 (Spare to Other HLM)		H1A 00	HLM1A N1F21 1	8	F S
E-0363	HLM1A GV-122 (Spare to Other HLM)		H1A 00	HLM1A N1F21 2	8	F S
E-0364	HLM1A GV-123 (Spare to Other HLM)		H1A 00	HLM1A N1F21 3	8	F S
E-0365	HLM1A GV-124 (Spare to Other HLM)		H1A 00	HLM1A N1F21 4	8	F S
E-0366	HLM1A SYS Diagnostic MSG Queue Entry 1		H1A 00	HLM1A N1F49 1	16	F S
E-0367	HLM1A SYS Diagnostic MSG Queue Entry 2		H1A 00	HLM1A N1F49 3	16	F S
E-0368	HLM1A SYS Diagnostic MSG Queue Entry 3		H1A 00	HLM1A N1F50 1	16	F S
E-0369	HLM1A SYS Diagnostic MSG Queue Entry 4		H1A 00	HLM1A N1F50 3	16	F S
E-0370	HLM1A SYS Diagnostic MSG Queue Entry 5		H1A 00	HLM1A N1F51 1	16	F S
E-0371	HLM1A SYS Diagnostic MSG Queue Entry 6		H1A 00	HLM1A N1F51 3	16	F S
E-0372	HLM1A SYS Diagnostic MSG Queue Entry 7		H1A 00	HLM1A N1F52 1	16	F S
E-0373	HLM1A SYS Diagnostic MSG Queue Entry 8		H1A 00	HLM1A N1F52 3	16	F S
E-0374	HLM1A CDS Diagnostic MSG Queue Entry 1		H1A 00	HLM1A N1F53 1	16	F S
E-0375	HLM1A CDS Diagnostic MSG Queue Entry 2		H1A 00	HLM1A N1F53 3	16	F S
E-0376	HLM1A CDS Diagnostic MSG Queue Entry 3		H1A 00	HLM1A N1F54 1	16	F S
E-0377	HLM1A CDS Diagnostic MSG Queue Entry 4		H1A 00	HLM1A N1F54 3	16	F S
E-0378	HLM1A CDS Diagnostic MSG Queue Entry 5		H1A 00	HLM1A N1F55 1	16	F S
E-0379	HLM1A CDS Diagnostic MSG Queue Entry 6		H1A 00	HLM1A N1F55 3	16	F S
E-0380	HLM1A CDS Diagnostic MSG Queue Entry 7		H1A 00	HLM1A N1F56 1	16	F S
E-0381	HLM1A CDS Diagnostic MSG Queue Entry 8		H1A 00	HLM1A N1F56 3	16	F S
E-0382	HLM1A CAP/IAP Program State File		H1A 00	HLM1A N1F57 1	32	F S
E-0383	HLM1A F/P Program State File Entry 1		H1A 00	HLM1A N1F58 1	32	F S
E-0384	HLM1A F/P Program State File Entry 2		H1A 00	HLM1A N1F59 1	32	F S
E-0385	HLM1A F/P Program State File Entry 3		H1A 00	HLM1A N1F60 1	32	F S
E-0386	HLM1A F/P Program State File Entry 4		H1A 00	HLM1A N1F61 1	32	F S
E-0387	HLM1A F/P Program State File Entry 5		H1A 00	HLM1A N1F62 1	32	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0388	HLM1A F/P Program State File Entry 6		H1A 00	HLM1A N1F63 1	32	F S
E-0389	HLM1A F/P Program State File Entry 7		H1A 00	HLM1A N1F64 1	32	F S
E-0390	HLM1A F/P Program State File Entry 8		H1A 00	HLM1A N1F65 1	32	F S
E-0391	HLM1A SPARE		H1A 00	HLM1A N1F81 1	32	F S
E-0392	HLM1A SPARE		H1A 00	HLM1A N1F82 1	32	F S
E-0393	HLM1A S/S Program State File Entry 1		H1A 00	HLM1A N1F66 1	32	F S
E-0394	HLM1A S/S Program State File Entry 2		H1A 00	HLM1A N1F67 1	32	F S
E-0395	HLM1A S/S Program State File Entry 3		H1A 00	HLM1A N1F68 1	32	F S
E-0396	HLM1A S/S Program State File Entry 4		H1A 00	HLM1A N1F69 1	32	F S
E-0397	HLM1A S/S Program State File Entry 5		H1A 00	HLM1A N1F70 1	32	F S
E-0398	HLM1A S/S Program State File Entry 6		H1A 00	HLM1A N1F71 1	32	F S
E-0399	HLM1A S/S Program State File Entry 7		H1A 00	HLM1A N1F72 1	32	F S
E-0400	HLM1A S/S Program State File Entry 8		H1A 00	HLM1A N1F73 1	32	F S
E-0401	HLM1A S/S Program State File Entry 9		H1A 00	HLM1A N1F74 1	32	F S
E-0402	HLM1A S/S Program State File Entry 10		H1A 00	HLM1A N1F75 1	32	F S
E-0403	HLM1A S/S Program State File Entry 11		H1A 00	HLM1A N1F76 1	32	F S
E-0404	HLM1A S/S Program State File Entry 12		H1A 00	HLM1A N1F77 1	32	F S
E-0405	HLM1A S/S Program State File Entry 13		H1A 00	HLM1A N1F78 1	32	F S
E-0406	HLM1A S/S Program State File Entry 14		H1A 00	HLM1A N1F79 1	32	F S
E-0407	HLM1A S/S Program State File Entry 15		H1A 00	HLM1A N1F80 1	32	F S
E-0408	HLM1A SPARE		H1A 00	HLM1A N1F83 1	32	F S
E-0409	HLM1A SPARE		H1A 00	HLM1A N1F84 1	32	F S
E-0410	HLM1A SPARE		H1A 00	HLM1A N1F85 1	32	F S
E-0411	HLM1A SPARE		H1A 00	HLM1A N1F86 1	32	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0412	HLM1A Spare		H1A 00	HLM1A N1F87 1	32	F S
E-0413	HLM1A Spare		H1A 00	HLM1A N1F88 1	32	F S
E-0414	HLM1A Spare		H1A 00	HLM1A N1F89 1	32	F S
E-0415	HLM1A Spare		H1A 00	HLM1A N1F90 1	32	F S
E-0416	HLM1A Buffered BC Counter		H1A 00	HLM1A N1S00 1	8	F S
E-0417	HLM1A BC Buffer Entry 1B		H1A 00	HLM1A N1S01 1	8	F S
E-0418	HLM1A BC Buffer Entry 2B		H1A 00	HLM1A N1S02 1	8	F S
E-0419	HLM1A BC Buffer Entry 3B		H1A 00	HLM1A N1S03 1	8	F S
E-0420	HLM1A BC Buffer Entry 4B		H1A 00	HLM1A N1S04 1	8	F S
E-0421	HLM1A BC Buffer Entry 5B		H1A 00	HLM1A N1S05 1	8	F S
E-0422	HLM1A BC Buffer Entry 6B		H1A 00	HLM1A N1S06 1	8	F S
E-0423	HLM1A BC Buffer Entry 7B		H1A 00	HLM1A N1S07 1	8	F S
E-0424	HLM1A BC Buffer Entry 8B		H1A 00	HLM1A N1S08 1	8	F S
E-0425	HLM1A BC Buffer Entry 9B		H1A 00	HLM1A N1S09 1	8	F S
E-0426	HLM1A BC Buffer Entry 10B		H1A 00	HLM1A N1S10 1	8	F S
E-0427	HLM1A BC Buffer Entry 11B		H1A 00	HLM1A N1S11 1	8	F S
E-0428	HLM1A BC Buffer Entry 12B		H1A 00	HLM1A N1S12 1	8	F S
E-0429	HLM1A BC Buffer Entry 13B		H1A 00	HLM1A N1S13 1	8	F S
E-0430	HLM1A BC Buffer Entry 14B		H1A 00	HLM1A N1S14 1	8	F S
E-0431	HLM1A BC Buffer Entry 15B		H1A 00	HLM1A N1S15 1	8	F S
E-0432	HLM1A BC Buffer Entry 16B		H1A 00	HLM1A N1S16 1	8	F S
E-0433	HLM1A CAP FC Counter		H1A 00	HLM1A N1S17 1	8	F S
E-0434	HLM1A CAP BC Counter		H1A 00	HLM1A N1S18 1	8	F S
E-0435	HLM1A IAP FC Counter		H1A 00	HLM1A N1S19 1	8	F S
E-0436	HLM1A IAP BC Counter		H1A 00	HLM1A N1S20 1	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0437	HLM1A Spare		H1A 00	HLM1A N1S21 1	8	F S
E-0438	HLM1A Spare		H1A 00	HLM1A N1S22 1	8	F S
E-0439	HLM1A Spare		H1A 00	HLM1A N1S23 1	8	F S
E-0440	HLM1A Spare		H1A 00	HLM1A N1S24 1	8	F S
E-0441	HLM1A Uplink IAP Counter		H1A 00	HLM1A N1S25 1	8	F S
E-0442	HLM1A Uplink DAC Counter		H1A 00	HLM1A N1S26 1	8	F S
E-0443	HLM1A Uplink NML Counter		H1A 00	HLM1A N1S27 1	8	F S
E-0444	HLM1A Uplink IEX Counter		H1A 00	HLM1A N1S28 1	8	F S
E-0445	HLM1A Uplink MSD(P) Counter		H1A 00	HLM1A N1S29 1	8	F S
E-0446	HLM1A Uplink MSD(T) Counter		H1A 00	HLM1A N1S30 1	8	F S
E-0447	HLM1A Uplink NMSL Counter		H1A 00	HLM1A N1S31 1	8	F S
E-0448	HLM1A Uplink PMSL Counter		H1A 00	HLM1A N1S32 1	8	F S
E-0449	HLM1A Uplink CAP Counter		H1A 00	HLM1A N1S33 1	8	F S
E-0450	HLM1A Uplink NML/NMSL Address Error Counter		H1A 00	HLM1A N1S34 1	8	F S
E-0451	HLM1A Uplink MSL Error Counter		H1A 00	HLM1A N1S35 1	8	F S
E-0452	HLM1A Spare		H1A 00	HLM1A N1S36 1	8	F S
E-0453	HLM1A Spare		H1A 00	HLM1A N1S37 1	8	F S
E-0454	HLM1A Spare		H1A 00	HLM1A N1S38 1	8	F S
E-0455	HLM1A Spare		H1A 00	HLM1A N1S39 1	8	F S
E-0456	HLM1A Spare		H1A 00	HLM1A N1S40 1	8	F S
E-0457	HLM1A Spare		H1A 00	HLM1A N1S41 1	8	F S
E-0458	HLM1A Spare		H1A 00	HLM1A N1S42 1	8	F S
E-0459	HLM1A Spare		H1A 00	HLM1A N1S43 1	8	F S
E-0460	HLM1A Spare		H1A 00	HLM1A N1S44 1	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0461	HLM1A Spare		H1A 00	HLM1A N1S45 1	8	F S
E-0462	HLM1A Spare		H1A 00	HLM1A N1S46 1	8	F S
E-0463	HLM1A Spare		H1A 00	HLM1A N1S47 1	8	F S
E-0464	HLM1A Spare		H1A 00	HLM1A N1S48 1	8	F S
E-0465	HLM1A System Diagnostic Message Counter		H1A 00	HLM1A N1S49 1	8	F S
E-0466	HLM1A CDS Diagnostic Message Counter		H1A 00	HLM1A N1S50 1	8	F S
E-0467	HLM1A Mark FC Counter		H1A 00	HLM1A N1S51 1	8	F S
E-0468	HLM1A Spare		H1A 00	HLM1A N1S52 1	8	F S
E-0469	HLM1A Cap Start Link		H1A 00	HLM1A N1S53 1	8	F S
E-0470	HLM1A F/P Start Link		H1A 00	HLM1A N1S54 1	8	F S
E-0471	HLM1A IAP Start Link		H1A 00	HLM1A N1S55 1	8	F S
E-0472	HLM1A S/S Start Link		H1A 00	HLM1A N1S56 1	8	F S
E-0473	HLM1A Uplink NMSL/PMSL Sequence Number		H1A 00	HLM1A N1S57 1	8	F S
E-0474	HLM1A Uplink Checkstate		H1A 00	HLM1A N1S58 1	8	F S
E-0475	HLM1A Missing Message List 1		H1A 00	HLM1A N1S59 1	8	F S
E-0476	HLM1A Missing Message List 2		H1A 00	HLM1A N1S60 1	8	F S
E-0477	HLM1A Missing Message List 3		H1A 00	HLM1A N1S61 1	8	F S
E-0478	HLM1A Missing Message List 4		H1A 00	HLM1A N1S62 1	8	F S
E-0479	HLM1A Missing Message List 5		H1A 00	HLM1A N1S63 1	8	F S
E-0480	HLM1A Missing Message List 6		H1A 00	HLM1A N1S64 1	8	F S
E-0481	HLM1A Missing Message List 7		H1A 00	HLM1A N1S65 1	8	F S
E-0482	HLM1A Missing Message List 8		H1A 00	HLM1A N1S66 1	8	F S
E-0483	HLM1A Missing Message List 9		H1A 00	HLM1A N1S67 1	8	F S
E-0484	HLM1A Missing Message List 10		H1A 00	HLM1A N1S68 1	8	F S
E-0485	HLM1A Missing Message List 11		H1A 00	HLM1A N1S69 1	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0486	HLM1A Missing Message List 12		H1A 00	HLM1A N1S70 1	8	F S
E-0487	HLM1A Missing Message List 13		H1A 00	HLM1A N1S71 1	8	F S
E-0488	HLM1A Missing Message List 14		H1A 00	HLM1A N1S72 1	8	F S
E-0489	HLM1A Missing Message List 15		H1A 00	HLM1A N1S73 1	8	F S
E-0490	HLM1A Missing Message List 16		H1A 00	HLM1A N1S74 1	8	F S
E-0491	HLM1A Missing Message List 17		H1A 00	HLM1A N1S75 1	8	F S
E-0492	HLM1A Missing Message List 18		H1A 00	HLM1A N1S76 1	8	F S
E-0493	HLM1A Missing Message List 19		H1A 00	HLM1A N1S77 1	8	F S
E-0494	HLM1A Missing Message List 20		H1A 00	HLM1A N1S78 1	8	F S
E-0495	HLM1A Missing Message List 21		H1A 00	HLM1A N1S79 1	8	F S
E-0496	HLM1A Missing Message List 22		H1A 00	HLM1A N1S80 1	8	F S
E-0497	HLM1A Missing Message List 23		H1A 00	HLM1A N1S81 1	8	F S
E-0498	HLM1A Missing Message List 24		H1A 00	HLM1A N1S82 1	8	F S
E-0499	HLM1A Missing Message List 25		H1A 00	HLM1A N1S83 1	8	F S
E-0500	HLM1A Missing Message List 26		H1A 00	HLM1A N1S84 1	8	F S
E-0501	HLM1A Missing Message List 27		H1A 00	HLM1A N1S85 1	8	F S
E-0502	HLM1A Missing Message List 28		H1A 00	HLM1A N1S86 1	8	F S
E-0503	HLM1A Missing Message List 29		H1A 00	HLM1A N1S87 1	8	F S
E-0504	HLM1A Missing Message List 30		H1A 00	HLM1A N1S88 1	8	F S
E-0505	HLM1A Missing Message List 31		H1A 00	HLM1A N1S89 1	8	F S
E-0506	HLM1A Missing Message List 32		H1A 00	HLM1A N1S90 1	8	F S
E-0507	LLM1A Last CC/DC RIM Count MSB/ISB		L1A 80	LLM1A N1D19 1	16	F S
E-0507			L1A 81			
E-0508	LLM1A Last CC/DC RIM Count LSB		L1A 82	LLM1A N1D09 1	8	F S
E-0509	LLM1A Last CC/DC MOD91		L1A 83	LLM1A N1D09 2	8	F S
E-0510	LLM1A Last CC/DC MOD10		L1A 84	LLM1A N1D10 1	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0511	LLM1A Last CC/DC Pointer		L1A 85	LLM1A N1D10 2	8	F S
E-0512	LLM1A CC/DC Queue Entry 1		L1A 86	LLM1A N1D11 1	16	F S
E-0512			L1A 87			
E-0513	LLM1A CC/DC Queue Entry 2		L1A 88	LLM1A N1D17 1	16	F S
E-0513			L1A 89			
E-0514	LLM1A CC/DC Queue Entry 3		L1A 8A	LLM1A N1D21 1	16	F S
E-0514			L1A 8B			
E-0515	LLM1A CC/DC Queue Entry 4		L1A 8C	LLM1A N1D22 1	16	F S
E-0515			L1A 8D			
E-0516	LLM1A CC/DC Queue Entry 5		L1A 8E	LLM1A N1D23 1	16	F S
E-0516			L1A 8F			
E-0517	LLM1A CC/DC Queue Entry 6		L1A 90	LLM1A N1D24 1	16	F S
E-0517			L1A 91			
E-0518	LLM1A CC/DC Queue Entry 7		L1A 92	LLM1A N1D25 1	16	F S
E-0518			L1A 93			
E-0519	LLM1A Priv CC/DC Executed Counter		L1A 94	LLM1A N1D34 1	8	F S
E-0520	LLM1A Non-Priv CC/DC Executed Counter		L1A 95	LLM1A N1D34 2	8	F S
E-0521	LLM1A Priv CC/DC Queued Counter		L1A 96	LLM1A N1D35 1	8	F S
E-0522	LLM1A Non-Priv CC/DC/(Power Code) Queued Counter		L1A 97	LLM1A N1D35 2	8	F S
E-0523	LLM1A Temperature CC/DC Queued Counter		L1A 98	LLM1A N1D36 1	8	F S
E-0524	LLM1A AACS Power Codes Queued Counter		L1A A4	LLM1A N1D37 1	8	F S
E-0525	LLM1A AACS Power Codes Rejected Counter		L1A A5	LLM1A N1D37 2	8	F S
E-0526	LLM1A Pyro Event Counter		L1A FF	LLM1A N1D38 1	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0527	LLM1A Last Power Code Executed		L1A A6	LLM1A N1D38 2	8	F S
E-0528	LLM1A FCs Received Counter		L1A A9	LLM1A N1D47 1	8	F S
E-0529	LLM1A FCs Executed Counter		L1A AA	LLM1A N1D47 2	8	F S
E-0530	LLM1A Last Valid FC ID		L1A AB	LLM1A N1D48 1	8	F S
E-0531	LLM1A FCs Rejected Counter		L1A AC	LLM1A N1D48 2	8	F S
E-0532	LLM1A CVPS FC Counter		L1A AD	LLM1A N1D49 1	8	F S
E-0533	LLM1A Bus Transactions Sent Counter		L1A AE	LLM1A N1D49 2	8	F S
E-0534	LLM1A Change Packet Timing Counter		L1A AF	LLM1A N1D50 1	8	F S
E-0535	LLM1A TLM Menu Change Counter		L1A B0	LLM1A N1D50 2	8	F S
E-0536	LLM1A AACS Power Codes Received Counter		L1A A2	LLM1A N1D51 1	16	F S
E-0536			L1A A3			
E-0537	LLM1A DAC CC/DC Queued Counter		L1A 99	LLM1A N1D36 2	8	F S
E-0538	LLM1A Flag Status		L1A B4	LLM1A N1D60 1	8	F S
E-0539	LLM1A CDS Diagnostic Message Counter		L1A B7	LLM1A N1D60 2	8	F S
E-0540	LLM1A CDS Diagnostic MSG Queue Entry 1		L1A B8	LLM1A N1D61 1	16	F S
E-0540			L1A B9			
E-0541	LLM1A CDS Diagnostic Msg Queue Entry 2		L1A BA	LLM1A N1D62 1	16	F S
E-0541			L1A BB			
E-0542	LLM1A CDS Diagnostic Msg Queue Entry 3		L1A BC	LLM1A N1D63 1	16	F S
E-0542			L1A BD			
E-0543	LLM1A CDS Diagnostic Msg Queue Entry 4		L1A BE	LLM1A N1D64 1	16	F S
E-0543			L1A BF			
E-0544	Not Assigned					
E-0545	LLM1A System Diagnostic Message Counter		L1A C0	LLM1A N1D73 2	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0546	LLM1A Sys Diagnostic Msg Queue Entry 1		L1A C1	LLM1A N1D74 1	16	F S
E-0546			L1A C2			
E-0547	LLM1A Sys Diagnostic Msg Queue Entry 2		L1A C3	LLM1A N1D75 1	16	F S
E-0547			L1A C4			
E-0548	LLM1A Sys Diagnostic Msg Queue Entry 3		L1A C5	LLM1A N1D76 1	16	F S
E-0548			L1A C6			
E-0549	LLM1A Sys Diagnostic Msg Queue Entry 4		L1A C7	LLM1A N1D77 1	16	F S
E-0549			L1A C8			
E-0550	LLM1A Error Word-1 IOSL-0		L1A B5	LLM1A N1D86 1	8	F S
E-0551	LLM1A Error Word-2 IOSL-1		L1A B6	LLM1A N1D86 2	8	F S
E-0552	LLM1A DAC Map Part-1		L1A C9	LLM1A N1D87 1	16	F S
E-0552			L1A CA			
E-0553	LLM1A S/C Temperature Enable Status (Privileged)		L1A B2	LLM1A N1D55 1	8	F S
E-0554	LLM1A DAC Map Part-2		L1A CB	LLM1A N1D88 1	16	F S
E-0554			L1A CC			
E-0555	LLM1A MOS Temperature Enable Status (Non-Privileged)		L1A B3	LLM1A N1D55 2	8	F S
E-0556	LLM1A DACs Received Counter		L1A CD	LLM1A N1D89 1	8	F S
E-0557	LLM1A DACs Rejected Counter		L1A CE	LLM1A N1D89 2	8	F S
E-0558	LLM1A DAC BC Counter		L1A CF	LLM1A N1D90 1	8	F S
E-0559	LLM1A DAC Checksum Reject Counter		L1A D0	LLM1A N1D90 2	8	F S
E-0560	LLM1A DMS TIC Count Input A		L1A FB	LLM1A N1D67 1	16	F S
E-0560			LIA FC			
E-0561	LLM1A DMS TIC Count Input B		L1A FD	LLM1A N1D68 1	16	F S
E-0561			LIA FE			

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0562	LLM1A DMS FCs Executed A Counter		L1A 9A	LLM1A N1D28 1	8	F S
E-0563	LLM1A DMS FCs Executed B Counter		L1A 9B	LLM1A N1D28 2	8	F S
E-0564	LLM1A DMS FCs Rejected Counter		L1A 9C	LLM1A N1D58 1	8	F S
E-0565	SPARE		L1A 9D	LLM1A N1D59 1	8	F S
E-0566	LLM1A Last DMS Command A		L1A 9E	LLM1A N1D29 1	8	F S
E-0567	LLM1A Last DMS Command B		L1A 9F	LLM1A N1D29 2	8	F S
E-0568	LLM1A Memory Copy FC Counter		L1A A7	LLM1A N1D30 2	8	F S
E-0569	LLM1A Tweak FC Counter		L1A A8	LLM1A N1D31 2	8	F S
E-0570	LLM1A Checksum Result		L1A A0	LLM1A N1D32 1	8	F S
E-0571	LLM1A Checksum Counter		L1A A1	LLM1A N1D32 2	8	F S
E-0572	DAC Time Reject Counter		L1A D1	LLM1A N1D42 1	8	F S
E-0573	DAC Slot Reject Counter		L1A D2	LLM1A N1D42 2	8	F S
E-0574	DAC ID Reject Counter		L1A D3	LLM1A N1D18 2	8	F S
E-0575	Worst Case LLM RTI Utilization 0		L1A F1	LLM1A N1D40 2	8	F S
E-0576	Worst Case LLM RTI Utilization 1		L1A F2	LLM1A N1D43 1	8	F S
E-0577	Worst Case LLM RTI Utilization 2		L1A F3	LLM1A N1D45 1	8	F S
E-0578	Worst Case LLM RTI Utilization 3		L1A F4	LLM1A N1D45 2	8	F S
E-0579	Worst Case LLM RTI Utilization 4		L1A F5	LLM1A N1D56 1	8	F S
E-0580	Worst Case LLM RTI Utilization 5		L1A F6	LLM1A N1D56 2	8	F S
E-0581	Worst Case LLM RTI Utilization 6		L1A F7	LLM1A N1D83 1	8	F S
E-0582	Worst Case LLM RTI Utilization 7		L1A F8	LLM1A N1D83 2	8	F S
E-0583	Worst Case LLM RTI Utilization 8		L1A F9	LLM1A N1D84 2	8	F S
E-0584	Worst Case LLM RTI Utilization 9		L1A FA	LLM1A N1D85 1	8	F S
E-0590	HLM1B Last BC Rim Count		H1B 00	HLM1B N1F00 1	24	F S
E-0591	HLM1B Last BC Mod91		H1B 00	HLM1B N1F00 4	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0592	HLM1B BC Buffer Entry 1A		H1B 00	HLM1B N1F01 1	32	F S
E-0593	HLM1B BC Buffer Entry 2A		H1B 00	HLM1B N1F02 1	32	F S
E-0594	HLM1B BC Buffer Entry 3A		H1B 00	HLM1B N1F03 1	32	F S
E-0595	HLM1B BC Buffer Entry 4A		H1B 00	HLM1B N1F04 1	32	F S
E-0596	HLM1B BC Buffer Entry 5A		H1B 00	HLM1B N1F05 1	32	F S
E-0597	HLM1B BC Buffer Entry 6A		H1B 00	HLM1B N1F06 1	32	F S
E-0598	HLM1B BC Buffer Entry 7A		H1B 00	HLM1B N1F07 1	32	F S
E-0599	HLM1B BC Buffer Entry 8A		H1B 00	HLM1B N1F08 1	32	F S
E-0600	HLM1B BC Buffer Entry 9A		H1B 00	HLM1B N1F09 1	32	F S
E-0601	HLM1B BC Buffer Entry 10A		H1B 00	HLM1B N1F10 1	32	F S
E-0602	HLM1B BC Buffer Entry 11A		H1B 00	HLM1B N1F11 1	32	F S
E-0603	HLM1B BC Buffer Entry 12A		H1B 00	HLM1B N1F12 1	32	F S
E-0604	HLM1B BC Buffer Entry 13A		H1B 00	HLM1B N1F13 1	32	F S
E-0605	HLM1B BC Buffer Entry 14A		H1B 00	HLM1B N1F14 1	32	F S
E-0606	HLM1B BC Buffer Entry 15A		H1B 00	HLM1B N1F15 1	32	F S
E-0607	HLM1B BC Buffer Entry 16A		H1B 00	HLM1B N1F16 1	32	F S
E-0608	HLM1B Non-Buffered BC Counter		H1B 00	HLM1B N1F17 1	16	F S
E-0609	HLM1B Last Uplink Message		H1B 00	HLM1B N1F17 3	16	F S
E-0610	HLM1B S/S FC Counter		H1B 00	HLM1B N1F18 1	16	F S
E-0611	HLM1B S/S BC Counter		H1B 00	HLM1B N1F18 3	16	F S
E-0612	HLM1B F/P FC Counter		H1B 00	HLM1B N1F19 1	16	F S
E-0613	HLM1B F/P BC Counter		H1B 00	HLM1B N1F19 3	16	F S
E-0614	HLM1B LLM Bus Transactions Received		H1B 00	HLM1B N1F22 1	8	F S
E-0615	HLM1B DAC Error Counter		H1B 00	HLM1B N1F22 2	8	F S
E-0616	HLM1B MEM Copy/Tweak Error Counter		H1B 00	HLM1B N1F22 3	8	F S
E-0617	HLM1B BUM Error Limiter		H1B 00	HLM1B N1F22 4	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0618	HLM1B To LLMS Priviledged FC Counter		H1B 00	HLM1B N1F23 1	8	F S
E-0619	HLM1B To LLMS Total FC Counter		H1B 00	HLM1B N1F23 2	8	F S
E-0620	HLM1B Non-Priv CC/DC/Power Code Counter		H1B 00	HLM1B N1F23 3	8	F S
E-0621	HLM1B Priv CC/DC/Power Code Counter		H1B 00	HLM1B N1F23 4	8	F S
E-0622	HLM1B RS Commanding Enable		H1B 00	HLM1B N1F24 1	8	F S
E-0623	HLM1B PRF Command Message Counter		H1B 00	HLM1B N1F24 2	8	F S
E-0624	HLM1B RG Message Counter		H1B 00	HLM1B N1F24 3	8	F S
E-0625	HLM1B HB First Entry		H1B 00	HLM1B N1F24 4	8	F S
E-0626	HLM1B HB Entry Time		H1B 00	HLM1B N1F25 1	32	F S
E-0627	HLM1B FP Flags (S-X Band RF, TWTA RF/TWTA Thermal, Safing)		H1B 00	HLM1B N1F26 1	24	F S
E-0628	HLM1B GPV-39 (Spare)		H1B 00	HLM1B N1F26 4	8	F S
E-0629	HLM1B CRC Bank A Registers 0-3		H1B 00	HLM1B N1F27 1	32	F S
E-0630	HLM1B CRC Bank A Registers 4-6		H1B 00	HLM1B N1F28 1	24	F S
E-0631	HLM1B GPV-47 (Spare)		H1B 00	HLM1B N1F28 4	8	F S
E-0632	HLM1B CRC Bank B Registers 0-3		H1B 00	HLM1B N1F29 1	32	F S
E-0633	HLM1B CRC Bank B Registers 4-7		H1B 00	HLM1B N1F30 1	32	F S
E-0634	HLM1B HCD Command Summary Word		H1B 00	HLM1B N1F31 1	8	F S
E-0635	HLM1B Messages Received and Accepted Counter		H1B 00	HLM1B N1F31 2	8	F S
E-0636	HLM1B Messages Received and Rejected Counter		H1B 00	HLM1B N1F31 3	8	F S
E-0637	HLM1B Command Frame Errors Detected Counter		H1B 00	HLM1B N1F31 4	8	F S
E-0638	HLM1B Data Frame Errors Corrected Counter		H1B 00	HLM1B N1F32 1	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0639	HLM1B Data Frame Errors Uncorrectable Counter		H1B 00	HLM1B N1F32 2	8	F S
E-0640	HLM1B Lock Changes Counter		H1B 00	HLM1B N1F32 3	8	F S
E-0641	HLM1B CRC Status Word		H1B 00	HLM1B N1F32 4	8	F S
E-0642	HLM1B Error Words IOSL 0-1-2		H1B 00	HLM1B N1F33 1	24	F S
E-0643	HLM1B Cmd Loss Response Counter		H1B 00	HLM1B N1F33 4	8	F S
E-0644	HLM1B BUM Error Words		H1B 00	HLM1B N1F34 1	32	F S
E-0645	HLM1B DBUM Error Words		H1B 00	HLM1B N1F35 1	16	F S
E-0646	HLM1B Flag Status		H1B 00	HLM1B N1F35 3	8	F S
E-0647	HLM1B Extended Background Processing Counter		H1B 00	HLM1B N1F35 4	8	F S
E-0648	HLM1B This CDS Op Mode		H1B 00	HLM1B N1F36 1	8	F S
E-0649	HLM1B This Safe Request Flag		H1B 00	HLM1B N1F36 2	8	F S
E-0650	HLM1B This Safe Enable		H1B 00	HLM1B N1F36 3	8	F S
E-0651	HLM1B This Effectual Down Flag		H1B 00	HLM1B N1F36 4	8	F S
E-0652	HLM1B This Clock Sync Error Count		H1B 00	HLM1B N1F37 1	8	F S
E-0653	HLM1B GPV-132 (Spare to Other HLM)		H1B 00	HLM1B N1F37 2	8	F S
E-0654	HLM1B GPV-133 (Spare to Other HLM)		H1B 00	HLM1B N1F37 3	8	F S
E-0655	HLM1B This Side Launch Mode Ready		H1B 00	HLM1B N1F37 4	8	F S
E-0656	HLM1B Out-of-Range AACS Alert Code Counter		H1B 00	HLM1B N1F38 1	8	F S
E-0657	HLM1B Erroneous Alert Code Error Counter		H1B 00	HLM1B N1F38 2	8	F S
E-0658	HLM1B AACS Alert Code Received Counter		H1B 00	HLM1B N1F38 3	16	F S
E-0659	HLM1B Heartbeat Entry Counter		H1B 00	HLM1B N1F39 1	8	F S
E-0660	HLM1B Heartbeat Error Counter Accumulated		H1B 00	HLM1B N1F39 2	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0661	HLM1B Last AACS Alert Code		H1B 00	HLM1B N1F39 3	8	F S
E-0662	HLM1B AACS Alert Code Response Counter		H1B 00	HLM1B N1F39 4	8	F S
E-0663	HLM1B Command Loss Response Start Time		H1B 00	HLM1B N1F40 1	24	F S
E-0664	HLM1B AACS Heartbeat Code		H1B 00	HLM1B N1F40 4	8	F S
E-0665	HLM1B Last PRF Time		H1B 00	HLM1B N1F41 1	24	F S
E-0666	HLM1B NOT ASSIGNED					
E-0667	HLM1B NOT ASSIGNED					
E-0668	HLM1B U/V Response Counter		H1B 00	HLM1B N1F41 4	8	F S
E-0669	HLM1B S/C F/P Monitor Enable (Priv)		H1B 00	HLM1B N1F42 1	8	F S
E-0670	HLM1B S/C F/P Monitor Emergency O/T Enables		H1B 00	HLM1B N1F42 2	8	F S
E-0671	HLM1B Spare		H1B 00	HLM1B N1F42 3	8	F S
E-0672	HLM1B Spare		H1B 00	HLM1B N1F42 4	8	F S
E-0673	HLM1B S/C F/P Response Enables (Priv)		H1B 00	HLM1B N1F43 1	24	F S
E-0674	HLM1B CDS POR Response Counter		H1B 00	HLM1B N1F43 4	8	F S
E-0675	HLM1B F/P Condition (Requests) Enables		H1B 00	HLM1B N1F44 1	24	F S
E-0676	HLM1B RF Loss Response Counter		H1B 00	HLM1B N1F44 4	8	F S
E-0677	HLM1B F/P Response Inactive Enables		H1B 00	HLM1B N1F45 1	24	F S
E-0678	HLM1B Prime/Backup Status		H1B 00	HLM1B N1F45 4	8	F S
E-0679	HLM1B MOS F/P Response Enables (Non-Privileged)		H1B 00	HLM1B N1F46 1	24	F S
E-0680	HLM1B AACS Status		H1B 00	HLM1B N1F46 4	8	F S
E-0681	HLM1B MOS F/P Monitor Enable (Non-Privileged)		H1B 00	HLM1B N1F47 1	8	F S
E-0682	HLM1B MOS F/P Monitor Emergency O/T Enables		H1B 00	HLM1B N1F47 2	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0683	HLM1B Cmd Loss Reset Delta RIMS		H1B 00	HLM1B N1F47 3	16	F S
E-0684	HLM1B System Fault Status		H1B 00	HLM1B N1F48 1	24	F S
E-0685	HLM1B DED Collection Enable		H1B 00	HLM1B N1F48 4	8	F S
E-0686	HLM1B GV-117 (Spare to Other HLM)		H1B 00	HLM1B N1F20 1	8	F S
E-0687	HLM1B GV-118 (Spare to Other HLM)		H1B 00	HLM1B N1F20 2	8	F S
E-0688	HLM1B GV-119 (Spare to Other HLM)		H1B 00	HLM1B N1F20 3	8	F S
E-0689	HLM1B GV-120 (Spare to Other HLM)		H1B 00	HLM1B N1F20 4	8	F S
E-0690	HLM1B GV-121 (Spare to Other HLM)		H1B 00	HLM1B N1F21 1	8	F S
E-0691	HLM1B GV-122 (Spare to Other HLM)		H1B 00	HLM1B N1F21 2	8	F S
E-0692	HLM1B GV-123 (Spare to Other HLM)		H1B 00	HLM1B N1F21 3	8	F S
E-0693	HLM1B GV-124 (Spare to Other HLM)		H1B 00	HLM1B N1F21 4	8	F S
E-0694	HLM1B Sys Diagnostic Msg Queue Entry 1		H1B 00	HLM1B N1F49 1	16	F S
E-0695	HLM1B Sys Diagnostic Msg Queue Entry 2		H1B 00	HLM1B N1F49 3	16	F S
E-0696	HLM1B Sys Diagnostic Msg Queue Entry 3		H1B 00	HLM1B N1F50 1	16	F S
E-0697	HLM1B Sys Diagnostic Msg Queue Entry 4		H1B 00	HLM1B N1F50 3	16	F S
E-0698	HLM1B Sys Diagnostic Msg Queue Entry 5		H1B 00	HLM1B N1F51 1	16	F S
E-0699	HLM1B Sys Diagnostic Msg Queue Entry 6		H1B 00	HLM1B N1F51 3	16	F S
E-0700	HLM1B Sys Diagnostic Msg Queue Entry 7		H1B 00	HLM1B N1F52 1	16	F S
E-0701	HLM1B Sys Diagnostic Msg Queue Entry 8		H1B 00	HLM1B N1F52 3	16	F S
E-0702	HLM1B CDS Diagnostic Msg Queue Entry 1		H1B 00	HLM1B N1F53 1	16	F S
E-0703	HLM1B CDS Diagnostic Msg Queue Entry 2		H1B 00	HLM1B N1F53 3	16	F S
E-0704	HLM1B CDS Diagnostic Msg Queue Entry 3		H1B 00	HLM1B N1F54 1	16	F S
E-0705	HLM1B CDS Diagnostic Msg Queue Entry 4		H1B 00	HLM1B N1F54 3	16	F S
E-0706	HLM1B CDS Diagnostic Msg Queue Entry 5		H1B 00	HLM1B N1F55 1	16	F S
E-0707	HLM1B CDS Diagnostic Msg Queue Entry 6		H1B 00	HLM1B N1F55 3	16	F S
E-0708	HLM1B CDS Diagnostic Msg Queue Entry 7		H1B 00	HLM1B N1F56 1	16	F S
E-0709	HLM1B CDS Diagnostic Msg Queue Entry 8		H1B 00	HLM1B N1F56 3	16	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0710	HLM1B CAP/IAP Program State File		H1B 00	HLM1B N1F57 1	32	F S
E-0711	HLM1B F/P Program State File Entry 1		H1B 00	HLM1B N1F58 1	32	F S
E-0712	HLM1B F/P Program State File Entry 2		H1B 00	HLM1B N1F59 1	32	F S
E-0713	HLM1B F/P Program State File Entry 3		H1B 00	HLM1B N1F60 1	32	F S
E-0714	HLM1B F/P Program State File Entry 4		H1B 00	HLM1B N1F61 1	32	F S
E-0715	HLM1B F/P Program State File Entry 5		H1B 00	HLM1B N1F62 1	32	F S
E-0716	HLM1B F/P Program State File Entry 6		H1B 00	HLM1B N1F63 1	32	F S
E-0717	HLM1B F/P Program State File Entry 7		H1B 00	HLM1B N1F64 1	32	F S
E-0718	HLM1B F/P Program State File Entry 8		H1B 00	HLM1B N1F65 1	32	F S
E-0719	HLM1B Spare		H1B 00	HLM1B N1F81 1	32	F S
E-0720	HLM1B Spare		H1B 00	HLM1B N1F82 1	32	F S
E-0721	HLM1B S/S Program State File Entry 1		H1B 00	HLM1B N1F66 1	32	F S
E-0722	HLM1B S/S Program State File Entry 2		H1B 00	HLM1B N1F67 1	32	F S
E-0723	HLM1B S/S Program State File Entry 3		H1B 00	HLM1B N1F68 1	32	F S
E-0724	HLM1B S/S Program State File Entry 4		H1B 00	HLM1B N1F69 1	32	F S
E-0725	HLM1B S/S Program State File Entry 5		H1B 00	HLM1B N1F70 1	32	F S
E-0726	HLM1B S/S Program State File Entry 6		H1B 00	HLM1B N1F71 1	32	F S
E-0727	HLM1B S/S Program State File Entry 7		H1B 00	HLM1B N1F72 1	32	F S
E-0728	HLM1B S/S Program State File Entry 8		H1B 00	HLM1B N1F73 1	32	F S
E-0729	HLM1B S/S Program State File Entry 9		H1B 00	HLM1B N1F74 1	32	F S
E-0730	HLM1B S/S Program State File Entry 10		H1B 00	HLM1B N1F75 1	32	F S
E-0731	HLM1B S/S Program State File Entry 11		H1B 00	HLM1B N1F76 1	32	F S
E-0732	HLM1B S/S Program State File Entry 12		H1B 00	HLM1B N1F77 1	32	F S
E-0733	HLM1B S/S Program State File Entry 13		H1B 00	HLM1B N1F78 1	32	F S
E-0734	HLM1B S/S Program State File Entry 14		H1B 00	HLM1B N1F79 1	32	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0735	HLM1B S/S Program State File Entry 15		H1B 00	HLM1B N1F80 1	32	F S
E-0736	HLM1B SPARE		H1B 00	HLM1B N1F83 1	32	F S
E-0737	HLM1B SPARE		H1B 00	HLM1B N1F84 1	32	F S
E-0738	HLM1B SPARE		H1B 00	HLM1B N1F85 1	32	F S
E-0739	HLM1B SPARE		H1B 00	HLM1B N1F86 1	32	F S
E-0740	HLM1B SPARE		H1B 00	HLM1B N1F87 1	32	F S
E-0741	HLM1B SPARE		H1B 00	HLM1B N1F88 1	32	F S
E-0742	HLM1B SPARE		H1B 00	HLM1B N1F89 1	32	F S
E-0743	HLM1B SPARE		H1B 00	HLM1B N1F90 1	32	F S
E-0744	HLM1B Buffered BC Counter		H1B 00	HLM1B N1S00 1	8	F S
E-0745	HLM1B BC Buffer Entry 1B		H1B 00	HLM1B N1S01 1	8	F S
E-0746	HLM1B BC Buffer Entry 2B		H1B 00	HLM1B N1S02 1	8	F S
E-0747	HLM1B BC Buffer Entry 3B		H1B 00	HLM1B N1S03 1	8	F S
E-0748	HLM1B BC Buffer Entry 4B		H1B 00	HLM1B N1S04 1	8	F S
E-0749	HLM1B BC Buffer Entry 5B		H1B 00	HLM1B N1S05 1	8	F S
E-0750	HLM1B BC Buffer Entry 6B		H1B 00	HLM1B N1S06 1	8	F S
E-0751	HLM1B BC Buffer Entry 7B		H1B 00	HLM1B N1S07 1	8	F S
E-0752	HLM1B BC Buffer Entry 8B		H1B 00	HLM1B N1S08 1	8	F S
E-0753	HLM1B BC Buffer Entry 9B		H1B 00	HLM1B N1S09 1	8	F S
E-0754	HLM1B BC Buffer Entry 10B		H1B 00	HLM1B N1S10 1	8	F S
E-0755	HLM1B BC Buffer Entry 11B		H1B 00	HLM1B N1S11 1	8	F S
E-0756	HLM1B BC Buffer Entry 12B		H1B 00	HLM1B N1S12 1	8	F S
E-0757	HLM1B BC Buffer Entry 13B		H1B 00	HLM1B N1S13 1	8	F S
E-0758	HLM1B BC Buffer Entry 14B		H1B 00	HLM1B N1S14 1	8	F S
E-0759	HLM1B BC Buffer Entry 15B		H1B 00	HLM1B N1S15 1	8	F S
E-0760	HLM1B BC Buffer Entry 16B		H1B 00	HLM1B N1S16 1	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	BITS	NO. OF FLAGS
E-0761	HLM1B CAP FC Counter		H1B 00	HLM1B N1S17 1	8	F S
E-0762	HLM1B CAP BC Counter		H1B 00	HLM1B N1S18 1	8	F S
E-0763	HLM1B IAP FC Counter		H1B 00	HLM1B N1S19 1	8	F S
E-0764	HLM1B IAP BC Counter		H1B 00	HLM1B N1S20 1	8	F S
E-0765	HLM1B Spare		H1B 00	HLM1B N1S21 1	8	F S
E-0766	HLM1B Spare		H1B 00	HLM1B N1S22 1	8	F S
E-0767	HLM1B Spare		H1B 00	HLM1B N1S23 1	8	F S
E-0768	HLM1B Spare		H1B 00	HLM1B N1S24 1	8	F S
E-0769	HLM1B Uplink IAP Counter		H1B 00	HLM1B N1S25 1	8	F S
E-0770	HLM1B Uplink DAC Counter		H1B 00	HLM1B N1S26 1	8	F S
E-0771	HLM1B Uplink NML Counter		H1B 00	HLM1B N1S27 1	8	F S
E-0772	HLM1B Uplink IEX Counter		H1B 00	HLM1B N1S28 1	8	F S
E-0773	HLM1B Uplink MSD(P) Counter		H1B 00	HLM1B N1S29 1	8	F S
E-0774	HLM1B Uplink MSD(T) Counter		H1B 00	HLM1B N1S30 1	8	F S
E-0775	HLM1B Uplink NMSL Counter		H1B 00	HLM1B N1S31 1	8	F S
E-0776	HLM1B Uplink PMSL Counter		H1B 00	HLM1B N1S32 1	8	F S
E-0777	HLM1B Uplink CAP Counter		H1B 00	HLM1B N1S33 1	8	F S
E-0778	HLM1B Uplink NML/NMSL Error Counter		H1B 00	HLM1B N1S34 1	8	F S
E-0779	HLM1B Uplink MSL Error Counter		H1B 00	HLM1B N1S35 1	8	F S
E-0780	HLM1B Spare		H1B 00	HLM1B N1S36 1	8	F S
E-0781	HLM1B Spare		H1B 00	HLM1B N1S37 1	8	F S
E-0782	HLM1B Spare		H1B 00	HLM1B N1S38 1	8	F S
E-0783	HLM1B Spare		H1B 00	HLM1B N1S39 1	8	F S
E-0784	HLM1B Spare		H1B 00	HLM1B N1S40 1	8	F S
E-0785	HLM1B Spare		H1B 00	HLM1B N1S41 1	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	BITS	NO. OF FLAGS
E-0786	HLM1B Spare		H1B 00	HLM1B N1S42 1	8	F S
E-0787	HLM1B Spare		H1B 00	HLM1B N1S43 1	8	F S
E-0788	HLM1B Spare		H1B 00	HLM1B N1S44 1	8	F S
E-0789	HLM1B Spare		H1B 00	HLM1B N1S45 1	8	F S
E-0790	HLM1B Spare		H1B 00	HLM1B N1S46 1	8	F S
E-0791	HLM1B Spare		H1B 00	HLM1B N1S47 1	8	F S
E-0792	HLM1B Spare		H1B 00	HLM1B N1S48 1	8	F S
E-0793	HLM1B System Diagnostic Message Counter		H1B 00	HLM1B N1S49 1	8	F S
E-0794	HLM1B CDS Diagnostic Message Counter		H1B 00	HLM1B N1S50 1	8	F S
E-0795	HLM1B Mark FC Counter		H1B 00	HLM1B N1S51 1	8	F S
E-0796	HLM1B Spare		H1B 00	HLM1B N1S52 1	8	F S
E-0797	HLM1B Cap Start Link		H1B 00	HLM1B N1S53 1	8	F S
E-0798	HLM1B F/P Start Link		H1B 00	HLM1B N1S54 1	8	F S
E-0799	HLM1B IAP Start Link		H1B 00	HLM1B N1S55 1	8	F S
E-0800	HLM1B S/S Start Link		H1B 00	HLM1B N1S56 1	8	F S
E-0801	HLM1B Uplink NMSL/PMSL Sequence Number		H1B 00	HLM1B N1S57 1	8	F S
E-0802	HLM1B Uplink Checkstate		H1B 00	HLM1B N1S58 1	8	F S
E-0803	HLM1B Missing Message List 1		H1B 00	HLM1B N1S59 1	8	F S
E-0804	HLM1B Missing Message List 2		H1B 00	HLM1B N1S60 1	8	F S
E-0805	HLM1B Missing Message List 3		H1B 00	HLM1B N1S61 1	8	F S
E-0806	HLM1B Missing Message List 4		H1B 00	HLM1B N1S62 1	8	F S
E-0807	HLM1B Missing Message List 5		H1B 00	HLM1B N1S63 1	8	F S
E-0808	HLM1B Missing Message List 6		H1B 00	HLM1B N1S64 1	8	F S
E-0809	HLM1B Missing Message List 7		H1B 00	HLM1B N1S65 1	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0810	HLM1B Missing Message List 8		H1B 00	HLM1B N1S66 1	8	F S
E-0811	HLM1B Missing Message List 9		H1B 00	HLM1B N1S67 1	8	F S
E-0812	HLM1B Missing Message List 10		H1B 00	HLM1B N1S68 1	8	F S
E-0813	HLM1B Missing Message List 11		H1B 00	HLM1B N1S69 1	8	F S
E-0814	HLM1B Missing Message List 12		H1B 00	HLM1B N1S70 1	8	F S
E-0815	HLM1B Missing Message List 13		H1B 00	HLM1B N1S71 1	8	F S
E-0816	HLM1B Missing Message List 14		H1B 00	HLM1B N1S72 1	8	F S
E-0817	HLM1B Missing Message List 15		H1B 00	HLM1B N1S73 1	8	F S
E-0818	HLM1B Missing Message List 16		H1B 00	HLM1B N1S74 1	8	F S
E-0819	HLM1B Missing Message List 17		H1B 00	HLM1B N1S75 1	8	F S
E-0820	HLM1B Missing Message List 18		H1B 00	HLM1B N1S76 1	8	F S
E-0821	HLM1B Missing Message List 19		H1B 00	HLM1B N1S77 1	8	F S
E-0822	HLM1B Missing Message List 20		H1B 00	HLM1B N1S78 1	8	F S
E-0823	HLM1B Missing Message List 21		H1B 00	HLM1B N1S79 1	8	F S
E-0824	HLM1B Missing Message List 22		H1B 00	HLM1B N1S80 1	8	F S
E-0825	HLM1B Missing Message List 23		H1B 00	HLM1B N1S81 1	8	F S
E-0826	HLM1B Missing Message List 24		H1B 00	HLM1B N1S82 1	8	F S
E-0827	HLM1B Missing Message List 25		H1B 00	HLM1B N1S83 1	8	F S
E-0828	HLM1B Missing Message List 26		H1B 00	HLM1B N1S84 1	8	F S
E-0829	HLM1B Missing Message List 27		H1B 00	HLM1B N1S85 1	8	F S
E-0830	HLM1B Missing Message List 28		H1B 00	HLM1B N1S86 1	8	F S
E-0831	HLM1B Missing Message List 29		H1B 00	HLM1B N1S87 1	8	F S
E-0832	HLM1B Missing Message List 30		H1B 00	HLM1B N1S88 1	8	F S
E-0833	HLM1B Missing Message List 31		H1B 00	HLM1B N1S89 1	8	F S
E-0834	HLM1B Missing Message List 32		H1B 00	HLM1B N1S90 1	8	F S
E-0835	LLM1B Last CC/DC RIM Count MSB/ISB		L1B 80	LLM1B N1D08 1	16	F S
E-0835			L1B 81			

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0836	LLM1B Last CC/DC RIM Count LSB		L1B 82	LLM1B N1D09 1	8	F S
E-0837	LLM1B Last CC/DC MOD91		L1B 83	LLM1B N1D09 2	8	F S
E-0838	LLM1B Last CC/DC MOD10		L1B 84	LLM1B N1D10 1	8	F S
E-0839	LLM1B Last CC/DC Pointer		L1B 85	LLM1B N1D10 2	8	F S
E-0840	LLM1B CC/DC Queue Entry 1		L1B 86	LLM1B N1D11 1	16	F S
E-0840			L1B 87			
E-0841	LLM1B CC/DC Queue Entry 2		L1B 88	LLM1B N1D16 1	16	F S
E-0841			L1B 89			
E-0842	LLM1B CC/DC Queue Entry 3		L1B 8A	LLM1B N1D21 1	16	F S
E-0842			L1B 8B			
E-0843	LLM1B CC/DC Queue Entry 4		L1B 8C	LLM1B N1D22 1	16	F S
E-0843			L1B 8D			
E-0844	LLM1B CC/DC Queue Entry 5		L1B 8E	LLM1B N1D23 1	16	F S
E-0844			L1B 8F			
E-0845	LLM1B CC/DC Queue Entry 6		L1B 90	LLM1B N1D24 1	16	F S
E-0845			L1B 91			
E-0846	LLM1B CC/DC Queue Entry 7		L1B 92	LLM1B N1D25 1	16	F S
E-0846			L1B 93			
E-0847	LLM1B Priv CC/DC Executed Counter		L1B 94	LLM1B N1D34 1	8	F S
E-0848	LLM1B Non-Priv CC/DC Executed Counter		L1B 95	LLM1B N1D34 2	8	F S
E-0849	LLM1B Priv CC/DC Queued Counter		L1B 96	LLM1B N1D35 1	8	F S
E-0850	LLM1B Non-Priv CC/DC Queued Counter		L1B 97	LLM1B N1D35 2	8	F S
E-0851	LLM1B Temperature CC/DC Queued Counter		L1B 98	LLM1B N1D36 1	8	F S
E-0852	LLM1B AACS Power Codes Queued Counter		L1B A4	LLM1B N1D37 1	8	F S
E-0853	LLM1B AACS Power Codes Rejected Counter		L1B A5	LLM1B N1D37 2	8	F S
E-0854	LLM1B Pyro Event Counter		L1B FF	LLM1B N1D38 1	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0855	LLM1B Last Power Code Executed		L1B A6	LLM1B N1D38 2	8	F S
E-0856	LLM1B FCs Received Counter		L1B A9	LLM1B N1D46 1	8	F S
E-0857	LLM1B FCs Executed Counter		L1B AA	LLM1B N1D46 2	8	F S
E-0858	LLM1B Last Valid FC ID		L1B AB	LLM1B N1D48 1	8	F S
E-0859	LLM1B FCs Rejected Counter		L1B AC	LLM1B N1D48 2	8	F S
E-0860	LLM1B CVPS FC Counter		L1B AD	LLM1B N1D49 1	8	F S
E-0861	LLM1B Bus Transactions Sent Counter		L1B AE	LLM1B N1D49 2	8	F S
E-0862	LLM1B Change Packet Timing Counter		L1B AF	LLM1B N1D50 1	8	F S
E-0863	LLM1B TLM Menu Change Counter		L1B B0	LLM1B N1D50 2	8	F S
E-0864	LLM1B AACS Power Code Received Counter		L1B A2	LLM1B N1D51 1	16	F S
E-0864			L1B A3			
E-0865	LLM1B DAC CC/DC Queued Counter		L1B 99	LLM1B N1D36 2	8	F S
E-0866	LLM1B Flag Status		L1B B4	LLM1B N1D60 1	8	F S
E-0867	LLM1B CDS Diagnostic Message Counter		L1B B7	LLM1B N1D60 2	8	F S
E-0868	LLM1B CDS Diagnostic Msg Queue Entry 1		L1B B8	LLM1B N1D61 1	16	F S
E-0868			L1B B9			
E-0869	LLM1B CDS Diagnostic Msg Queue Entry 2		L1B BA	LLM1B N1D62 1	16	F S
E-0869			L1B BB			
E-0870	LLM1B CDS Diagnostic Msg Queue Entry 3		L1B BC	LLM1B N1D63 1	16	F S
E-0870			L1B BD			
E-0871	LLM1B CDS Diagnostic Msg Queue Entry 4		L1B BE	LLM1B N1D64 1	16	F S
E-0871			L1B BF			
E-0872	Not Assigned					
E-0873	LLM1B System Diagnostic Message Counter		L1B C0	LLM1B N1D73 2	8	F S

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0874	LLM1B SYS Diagnostic Msg Queue Entry 1		L1B C1	LLM1B N1D74 1	16	F S
E-0874			L1B C2			
E-0875	LLM1B SYS Diagnostic Msg Queue Entry 2		L1B C3	LLM1B N1D75 1	16	F S
E-0875			L1B C4			
E-0876	LLM1B SYS Diagnostic Msg Queue Entry 3		L1B C5	LLM1B N1D76 1	16	F S
E-0876			L1B C6			
E-0877	LLM1B SYS Diagnostic Msg Queue Entry 4		L1B C7	LLM1B N1D77 1	16	F S
E-0877			L1B C8			
E-0878	LLM1B Error Word-1 IOSL-0		L1B B5	LLM1B N1D86 1	8	F S
E-0879	LLM1B Error Word-2 IOSL-1		L1B B6	LLM1B N1D86 2	8	F S
E-0880	LLM1B DAC Map Part-1		L1B C9	LLM1B N1D87 1	16	F S
E-0880			L1B CA			
E-0881	LLM1B S/C Temperature Enable Status (Privileged)		L1B B2	LLM1B N1D55 1	8	F S
E-0882	LLM1B DAC Map Part-2		L1B CB	LLM1B N1D88 1	16	F S
E-0882			L1B CC			
E-0883	LLM1B MOS Temperature Enable Status (Non-Privileged)		L1B B3	LLM1B N1D55 2	8	F S
E-0884	LLM1B DACs Received Counter		L1B CD	LLM1B N1D89 1	8	F S
E-0885	LLM1B DACs Rejected Counter		L1B CE	LLM1B N1D89 2	8	F S
E-0886	LLM1B DAC BC Counter		L1B CF	LLM1B N1D90 1	8	F S
E-0887	LLM1B DAC Checksum Reject Counter		L1B D0	LLM1B N1D90 2	8	F S
E-0888	LLM1B DMS TIC Count Input A		L1B FB	LLM1B N1D27 1	16	F S
E-0888			L1B FC			
E-0889	LLM1B DMS TIC Count Input B		L1B FD	LLM1B N1D45 1	16	F S
E-0889			L1B FE			

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0890	LLM1B DMS FCs Executed A Counter		L1B 9A	LLM1B N1D28 1	8	F S
E-0891	LLM1B DMS FCs Executed B Counter		L1B 9B	LLM1B N1D28 2	8	F S
E-0892	LLM1B DMS FCs Rejected Counter		L1B 9C	LLM1B N1D15 1	8	F S
E-0893	LLM1B SPARE		L1B 9D	LLM1B N1D59 1	8	F S
E-0894	LLM1B Last DMS Command A Sent		L1B 9E	LLM1B N1D29 1	8	F S
E-0895	LLM1B Last DMS Command B Sent		L1B 9F	LLM1B N1D29 2	8	F S
E-0896	LLM1B Memory Copy FC Counter		L1B A7	LLM1B N1D30 2	8	F S
E-0897	LLM1B Tweak FC Counter		L1B A8	LLM1B N1D31 2	8	F S
E-0898	LLM1B Checksum Result		L1B A0	LLM1B N1D32 1	8	F S
E-0899	LLM1B Checksum Counter		L1B A1	LLM1B N1D32 2	8	F S
E-0900	DAC Time Reject Counter		L1B D1	LLM1B N1D56 1	8	F S
E-0901	DAC Slot Reject Counter		L1B D2	LLM1B N1D56 2	8	F S
E-0902	DAC ID Reject Counter		L1B D3	LLM1B N1D57 1	8	F S
E-0903	Worst Case LLM RTI Utilization 0		L1B F1	LLM1B N1D71 1	8	F S
E-0904	Worst Case LLM RTI Utilization 1		L1B F2	LLM1B N1D72 1	8	F S
E-0905	Worst Case LLM RTI Utilization 2		L1B F3	LLM1B N1D78 2	8	F S
E-0906	Worst Case LLM RTI Utilization 3		L1B F4	LLM1B N1D80 2	8	F S
E-0907	Worst Case LLM RTI Utilization 4		L1B F5	LLM1B N1D81 1	8	F S
E-0908	Worst Case LLM RTI Utilization 5		L1B F6	LLM1B N1D82 1	8	F S
E-0909	Worst Case LLM RTI Utilization 6		L1B F7	LLM1B N1D83 1	8	F S
E-0910	Worst Case LLM RTI Utilization 7		L1B F8	LLM1B N1D83 2	8	F S
E-0911	Worst Case LLM RTI Utilization 8		L1B F9	LLM1B N1D84 2	8	F S
E-0912	Worst Case LLM RTI Utilization 9		L1B FA	LLM1B N1D85 1	8	F S
E-0913	CDS +5 VDC P/C A Status	0/9 VDC	T1A 10	LLM1A N1D04 1	8	F A
E-0914	CDS +10 VDC P/C A Status	0/17.6 VDC	T1A 11	LLM1A N1D04 2	8	F A
E-0915	CDS +12 VDC P/C A Status	0/19.08 VDC	T1A 12	LLM1A N1D05 1	8	F A
E-0916	CDS -12 VDC P/C A Status	-43/3 VDC	T1A 13	LLM1A N1D05 2	8	F A

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0917	CDS Relay Voltage P/C A Status	0/20.7 VDC	T1A 14	LLM1A N1D06 1	8	F A
E-0918	CDS Memory Keep-Alive EPS-A Status	0/13.71 VDC	T1A 15	LLM1A N1D06 2	8	F A
E-0919	CDS + 10 Volt Current P/C A Status	0/4 Amps	T1A 16	LLM1A N1D39 1	8	F A
E-0920	CDS + 3 Volt ADC-B Status	0/6 VDC	T1A 28	LLM1A N1D40 1	8	F A
E-0921	CDS +5 VDC P/C B Status	0/9 VDC	T1B 10	LLM1B N1D04 1	8	F A
E-0922	CDS +10 VDC P/C B Status	0/17.6 VDC	T1B 11	LLM1B N1D04 2	8	F A
E-0923	CDS +12 VDC P/C B Status	0/19.08 VDC	T1B 12	LLM1B N1D07 1	8	F A
E-0924	CDS -12 VDC P/C B Status	-43/3 VDC	T1B 13	LLM1B N1D05 2	8	F A
E-0925	CDS Relay Voltage P/C B Status	0/20.7 VDC	T1B 14	LLM1B N1D06 1	8	F A
E-0926	CDS Memory Keep-Alive EPS-B Status	0/13.71 VDC	T1B 15	LLM1B N1D06 2	8	F A
E-0927	CDS + 10 Volt Current P/C B Status	0/4 Amps	T1B 16	LLM1B N1D39 1	8	F A
E-0928	CDS + 3 Volt ADC-A Status	0/6 VDC	T1B 28	LLM1B N1D40 1	8	F A
E-0929	COM-1A Tree-1 Zero Ref		T1A 1F		8	V A
E-0930	COM-1A Tree-2 Zero Ref		T1A 2F		8	V A
E-0931	COM-1A Tree-3 Zero Ref		T1A 3F		8	V A
E-0932	COM-1A Tree-4 Zero Ref		T1A 4F		8	V A
E-0933	COM-1A Tree-5 Zero Ref		T1A 5F		8	V A
E-0934	COM-1A Tree-6 Zero Ref		T1A 6F		8	V A
E-0935	COM-1A Tree-7 Zero Ref		T1A 7F		8	V A
E-0936	COM-1B Tree-1 Zero Ref		T1B 1F		8	V A
E-0937	COM-1B Tree-2 Zero Ref		T1B 2F		8	V A
E-0938	COM-1B Tree-3 Zero Ref		T1B 3F		8	V A
E-0939	COM-1B Tree-4 Zero Ref		T1B 4F		8	V A
E-0940	COM-1B Tree-5 Zero Ref		T1B 5F		8	V A
E-0941	COM-1B Tree-6 Zero Ref		T1B 6F		8	V A
E-0942	COM-1B Tree-7 Zero Ref		T1B 7F		8	V A

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: COMMAND, DATA, AND DATA STORAGE (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0943	DMS A Pressure	0-30 psia	T1A 45	LLM1A N1D27 1	8	FA
E-0944	DMS B Pressure	0-30 psia	T1B 45	LLM1B N1D26 1	8	FA
E-0945	DMS A Head Temp	-78/100 Deg C	T1A 63	LLM1A N1D01 2	8	FT
E-0946	DMS B Head Temp	-78/100 Deg C	T1B 63	LLM1B N1D79 1	8	FT

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: PROPULSION AND PYRO

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0153/5	Latch Valve 1 Position*				1	BD
E-0154/5	Latch Valve 2 Position**				1	BD
E-0153/3	SRM Safe/Arm 1 Safe Ind*				1	BD
E-0154/3	SRM Safe/Arm 2 Safe Ind.**				1	BD
E-0153/7	SRM Safe/Arm 1 Arm Ind.*				1	BD
E-0154/7	SRM Safe/Arm 2 Arm Ind.**				1	BD
E-0951	Pressurant Tank Pressure A (PT 1)	0/4000 PSIA	T1A 20	LLM1A T1S12 1	8	FA
E-0952	Pressurant Tank Pressure B (PT 2)	0/4000 PSIA	T1B 39	LLM1B T1S12 1	8	BA
E-0953	Propellant Tank Pressure (PT 3)	0/500 PSIA	T1A 44	LLM1A N1D57 1	8	BA
E-0954	Propellant Tank Pressure (PT 3)	0/500 PSIA	T1B 20	LLM1B N1D67 1	8	FA
E-0955	Propellant Line Pressure (PT 4)	0/500 PSIA	T1B 2C	LLM1B N1D67 2	8	FA
E-0956	Propellant Line Pressure (PT 4)	0/500 PSIA	T1A 39	LLM1A N1D44 1	8	BA

* Bi-Level, A side. See Table A2.2.9, Bi-Level Word 1, for word content.
** Bi-Level, B side. See Table A2.2.9, Bi-Level Word 2, for word content.

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ATTITUDE AND ARTICULATION CONTROL

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-1001	Reaction Wheel 1 Temp	-78/100°C	T1A 56	LLM1A N1D39 2	8	FT
E-1002	Reaction Wheel 2 Temp	-78/100°C	T1B 56	LLM1B N1D39 2	8	FT
E-1003	Reaction Wheel 3 Temp	-78/100°C	T1A 77	LLM1A N1D27 2	8	FT
E-1004	Sun Sensor A Temp	-102/74°C	T1A 7C	LLM1A N1D70 2	8	FT
E-1005	Sun Sensor B Temp	-102/74°C	T1B 7C	LLM1B N1D43 1	8	FT
E-1006	ARU A-Gyro 1 Current	0/378 mA	T1B 29	LLM1B N1D19 2	8	BA
E-1007	ARU A-Gyro 2 Current	0/378 mA	T1A 48	LLM1A N1D26 1	8	BA
E-1008	ARU B-Gyro 1 Current	0/378 mA	T1B 43	LLM1B N1D19 1	8	BA
E-1009	ARU B-Gyro 2 Current	0/378 mA	T1A 32	LLM1A N1D15 1	8	BA
E-1010	Star Scanner Temp A	-78/100°C	T1B 79	LLM1B N1D12 1	8	FT
E-1011	Star Scanner Temp B	-78/100°C	T1A 79	LLM1A N1D15 2	8	FT
E-1012	IODA A Temp	-78/100°C	T1A 72	LLM1A N1D80 2	8	FT
E-1013	IODA B Temp	-78/100°C	T1B 72	LLM1B N1D15 2	8	FT
E-1014	OBC A Temp	-78/100°C	T1A 71	LLM1A N1D13 2	8	FT
E-1015	OBC B Temp	-78/100°C	T1B 5C	LLM1B N1D80 1	8	FT
E-1016	Reaction Wheel 1 Motor Current	0/5 Amp	T1A 42	LLM1A N1D14 1	8	FA
E-1017	Reaction Wheel 2 Motor Current	0/5 Amp	T1B 4D	LLM1B N1D18 1	8	FA
E-1018	Reaction Wheel 3 Motor Current	0/5 Amp	T1A 43	LLM1A N1D18 1	8	FA
E-1019	Commanded Solar Panel Position 1			AACS T1D00	16*	FS
E-1020	Commanded Solar Panel Position 2			AACS T2D00	16*	FS
E-1021	AACS S/W Mode**			AACS T3D00	16	FS
E-1022	Current Attitude Quaternion 1			AACS T1D01	16*	BS
E-1023	Current Attitude Quaternion 2			AACS T2D01	16*	BS
E-1024	Current Attitude Quaternion 3			AACS T3D01	16*	BS

* Scaled from 32 bits
**See Table A2.2.9 for measurement breakdown.

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ATTITUDE AND ARTICULATION CONTROL (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-1025	Desired Reference Quaternion 1			AACS N2D26	16*	FS
E-1026	Desired Reference Quaternion 2			AACS N2D27	16*	FS
E-1027	Desired Reference Quaternion 3			AACS N2D28	16*	FS
E-1028	Attitude Error Vector (X)			AACS Z1D00	16*	FS
E-1029	Attitude Error Vector (Y)			AACS Z2D00	16*	FS
E-1030	Attitude Error Vector (Z)			VP 15	16*	VS
E-1031	Average Body Rate Vector (X)			AACS T1D02	16*	BS
E-1032	Average Body Rate Vector (Y)			AACS T2D02	16*	BS
E-1033	Average Body Rate Vector (Z)			AACS T3D02	16*	BS
E-1034	Rate Error Vector (X)			AACS T1D03	16*	FS
E-1035	Rate Error Vector (Y)			AACS T2D03	16*	FS
E-1036	Rate Error Vector (Z)			AACS T3D03	16*	FS
E-1037	Reaction Wheel 1 Command			VP11	16	VS
E-1038	Reaction Wheel 2 Command			VP11	16	VS
E-1039	Reaction Wheel 3 Command			VP12	16	VS
E-1040	Reaction Wheel 1 Tach Speed			AACS T1D07	16	BS
E-1041	Reaction Wheel 2 Tach Speed			AACS T2D07	16	BS
E-1042	Reaction Wheel 3 Tach Speed			AACS T3D07	16	BS
E-1043	Sun Sensor Unit 1 A Reticle Data			AACS T1D08	16	FS
E-1044	Sun Sensor Unit 2 A Reticle Data			AACS T2D08	16	FS
E-1045	SADM 1 Potentiometer			AACS T3D08	16	FS
E-1046	Sun Sensor Unit 1 B Reticle Data			AACS T1D09	16	FS
E-1047	Sun Sensor Unit 2 B Reticle Data			AACS T2D09	16	FS
E-1048	SADM 2 Potentiometer			AACS T3D09	16	FS

* Scaled from 32 bits

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ATTITUDE AND ARTICULATION CONTROL (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-1049	AACS Status Wd 1 (Packed Word 2)*			AACS T2D11	16	FS
E-1050	H/W Configuration Status Wd 1**			AACS T1D10	16	FS
E-1051	Reaction Wheel Direction***			AACS T3D06	16	FS
E-1052	H/W Configuration Status Wd 2**			AACS T2D10	16	FS
E-1053	H/W Configuration Status Wd 3**			AACS T3D10	16	FS
E-1054	H/W Configuration Status Wd 4**			AACS T1D11	16	FS
E-1055	Trickle ID			AACS N1D00	16	FS
E-1056	Spare					
E-1057	ARU Net Counts Word 1 (A1X)			AACS T1D06	16	BS
E-1058	ARU Net Counts Word 2 (A1Y)			AACS T1D04	16	BS
E-1059	ARU Net Counts Word 3 (A2X)			AACS T1D05	16	BS
E-1060	ARU Net Counts Word 4 (A2Y)			AACS T2D04	16	BS
E-1061	ARU Net Counts word 5 (B1X)			AACS T2D06	16	BS
E-1062	ARU Net Counts Word 6 (B1Y)			AACS T2D05	16	BS
E-1063	ARU Net Counts Word 7 (B2X)			AACS T3D04	16	BS
E-1064	ARU Net Counts Word 8 (B2Y)			AACS T3D05	16	BS
E-1065	Gyro Channel Select Counter			AACS N2D45	16	FS
E-1066	Sun Source****			AACS N2D01	16	FS
E-1067	Parameter Set Pointer			AACS N2D02	16	FS
E-1068	Online Command Reject Counter			AACS N2D03	16	FS
E-1069	Offline Command Reject Counter			AACS N2D25	16	FS

* See Table A2.2.7.a
** See Table A2.2.7.b
*** See Table A2.2.9 for Word Content
****See Table A2.2.9 for measurement breakdown

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ATTITUDE AND ARTICULATION CONTROL (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-1070	Fault Action Count			AACS N2D43	16	FS
E-1071	Fault Source Count			AACS N2D08	16	FS
E-1072	Fault Protection State Change Count			AACS N2D00	16	FS
E-1073	SPARE			AACS N2D47	16	FS
E-1074	SPARE			AACS N2D48	16	FS
E-1075	Power Code Count			AACS N2D49	16	FS
E-1076	Alert Code Count			AACS N2D50	16	FS
E-1077	Online AACS DMA Msg Parity Error Count			AACS N2D39	16	FS
E-1078	Online CDS/DMA Bus Parity Error Count			AACS N2D40	16	FS
E-1079	Offline AACS DMA Msg Parity Error Count			AACS N2D41	16	FS
E-1080	Offline CDS/DMA Bus Parity Error Count			AACS N2D42	16	FS
E-1081	Invalid Configuration Request Count			AACS N2D46	16	FS
E-1082	Command Counter			AACS N2D52	16	FS
E-1083	Low End Calibration Voltage			AACS N2D82	16	FS
E-1084	High End Calibration Voltage			AACS N2D83	16	FS
E-1085	STU A Detection Threshold			AACS N2D80	16	FS
E-1086	STU B Detection Threshold			AACS N2D81	16	FS
E-1087	ARU A-Gyro 1 Temp			AACS N1D08	16	FS
E-1088	ARU A-Gyro 2 Temp			AACS N2D04	16	FS
E-1089	ARU B-Gyro 1 Temp			AACS N2D05	16	FS
E-1090	ARU B-Gyro 2 Temp			AACS N2D06	16	FS

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ATTITUDE AND ARTICULATION CONTROL (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-1091	Thruster Control Command Word*			AACS N2D29	16	FS
E-1092	Engine Control Command Word*			AACS N2D30	16	FS
E-1093	Pulse Duration*			AACS N2D31	16	FS
E-1094	Thruster On-Time Miscompare (X)			AACS N2D32	16	FS
E-1095	Thruster On-Time Miscompare (Y)			AACS N2D33	16	FS
E-1096	Thruster On-Time Miscompare (Z)			AACS N2D34	16	FS
E-1097	REA Accumulator 1			AACS N2D13	16	FS
E-1098	REA Accumulator 2			AACS N2D14	16	FS
E-1099	REA Accumulator 3			AACS N2D15	16	FS
E-1100	REA Accumulator 4			AACS N2D16	16	FS
E-1101	REA Accumulator 5			AACS N2D17	16	FS
E-1102	REA Accumulator 6			AACS N2D18	16	FS
E-1103	REA Accumulator 7			AACS N2D19	16	FS
E-1104	REA Accumulator 8			AACS N2D20	16	FS
E-1105	REA Accumulator 9			AACS N2D21	16	FS
E-1106	REA Accumulator 10			AACS N2D22	16	FS
E-1107	REA Accumulator 11			AACS N2D23	16	FS
E-1108	REA Accumulator 12			AACS N2D24	16	FS
E-1109	REA Accumulator 13			AACS N2D09	16	FS
E-1109	REA Accumulator 13			AACS N2D35	16	FS
E-1109	REA Accumulator 13			AACS N2D61	16	FS
E-1110	REA Accumulator 14			AACS N2D10	16	FS
E-1110	REA Accumulator 14			AACS N2D36	16	FS
E-1110	REA Accumulator 14			AACS N2D62	16	FS

* See Table A2.2.9 for Word Content

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ATTITUDE AND ARTICULATION CONTROL (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-1111	REA Accumulator 15			AACS N2D11	16	FS
E-1111	REA Accumulator 15			AACS N2D37	16	FS
E-1111	REA Accumulator 15			AACS N2D63	16	FS
E-1112	REA Accumulator 16			AACS N2D12	16	FS
E-1112	REA Accumulator 16			AACS N2D38	16	FS
E-1112	REA Accumulator 16			AACS N2D64	16	FS
E-1113	REA Accumulator 17			AACS T1D12	16	FS
E-1114	REA Accumulator 18			AACS T3D11	16	FS
E-1115	REA Accumulator 19			AACS T2D12	16	FS
E-1116	REA Accumulator 20			AACS N1D11	16	FS
E-1116	REA Accumulator 20			AACS N1D24	16	FS
E-1116	REA Accumulator 20			AACS N1D37	16	FS
E-1116	REA Accumulator 20			AACS N1D50	16	FS
E-1116	REA Accumulator 20			AACS N1D63	16	FS
E-1116	REA Accumulator 20			AACS N1D76	16	FS
E-1116	REA Accumulator 20			AACS N1D89	16	FS
E-1117	REA Accumulator 21			AACS T3D12	16	FS
E-1118	REA Accumulator 22			AACS N1D10	16	FS
E-1118	REA Accumulator 22			AACS N1D23	16	FS
E-1118	REA Accumulator 22			AACS N1D36	16	FS
E-1118	REA Accumulator 22			AACS N1D49	16	FS
E-1118	REA Accumulator 22			AACS N1D62	16	FS
E-1118	REA Accumulator 22			AACS N1D75	16	FS
E-1118	REA Accumulator 22			AACS N1D88	16	FS

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ATTITUDE AND ARTICULATION CONTROL (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-1119	REA Accumulator 23			AACS N1D12	16	FS
E-1119	REA Accumulator 23			AACS N1D25	16	FS
E-1119	REA Accumulator 23			AACS N1D38	16	FS
E-1119	REA Accumulator 23			AACS N1D51	16	FS
E-1119	REA Accumulator 23			AACS N1D64	16	FS
E-1119	REA Accumulator 23			AACS N1D77	16	FS
E-1119	REA Accumulator 23			AACS N1D90	16	FS
E-1120	REA Accumulator 24			AACS N1D09	16	FS
E-1120	REA Accumulator 24			AACS N1D22	16	FS
E-1120	REA Accumulator 24			AACS N1D35	16	FS
E-1120	REA Accumulator 24			AACS N1D48	16	FS
E-1120	REA Accumulator 24			AACS N1D61	16	FS
E-1120	REA Accumulator 24			AACS N1D74	16	FS
E-1120	REA Accumulator 24			AACS N1D87	16	FS
E-1121	SADM Drive Command Word			AACS N2D54	16	FS
E-1122	NOT ASSIGNED					
E-1123	SSU A VATA A			AACS N2D76	16	FS
E-1124	SSU B VATA A			AACS N2D77	16	FS
E-1125	SSU A VATA B			AACS N2D78	16	FS
E-1126	SSU B VATA B			AACS N2D79	16	FS
E-1127	STU A +15V PS			AACS N2D55	16	FS
E-1128	STU A -12V PS			AACS N2D56	16	FS
E-1129	STU A +5V PS			AACS N2D57	16	FS
E-1130	STU B +15V PS			AACS N2D58	16	FS

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ATTITUDE AND ARTICULATION CONTROL (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-1131	STU B -12V PS			AACS N2D59	16	FS
E-1132	STU B +5V PS			AACS N2D60	16	FS
E-1133	RW 1 +5V PS			AACS N2D65	16	FS
E-1134	RW 2 +5V PS			AACS N2D66	16	FS
E-1135	RW 3 +5V PS			AACS N2D67	16	FS
E-1136	SSU A +10V PS			AACS N2D68	16	FS
E-1137	SSU B +10V PS			AACS N2D69	16	FS
E-1138	IODA +15V PS			AACS N2D70	16	FS
E-1139	IODA -15V PS			AACS N2D71	16	FS
E-1140	IODA +12V PS			AACS N2D72	16	FS
E-1141	IODA -12V PS			AACS N2D73	16	FS
E-1142	IODA +11V PS			AACS N2D74	16	FS
E-1143	IODA +5V PS			AACS N2D75	16	FS
E-1144	AACS Status Word 2 (Packed Word 3)*			AACS N2D07	16	FS
E-1145	Gyro Status Word***			AACS N2D44	16	FS
E-1146	Fault Prot/Det. Status (Packed Word 1)*			VP15	16	VS
E-1147	Trickle Contents**			AACS Z3D00	16	FS
E-1148	Online RAM Checksum			AACS N1D01	16	FS
E-1149	Offline RAM Checksum			AACS N1D02	16	FS
E-1150	Checksum Start Address Segment 1			AACS N1D03	16	FS
E-1151	Checksum End Address Segment 1			AACS N1D04	16	FS

* See Table A2.2.7.a
** See Table A2.2.7.c
*** See Table A2.2.9 for Word Content

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ATTITUDE AND ARTICULATION CONTROL (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-1152	Online DMA Hi Add Limit Violation Cnt			AACS N1D05	16	FS
E-1153	Online DMA Low Add Limit Violation Cnt			AACS N1D06	16	FS
E-1154	Offline DMA Hi Add Limit Violation Cnt			AACS N1D07	16	FS
E-1155	Offline DMA Low Add Limit Violation Cnt			AACS N1D13	16	FS
E-1156	Online Memory Pseudoacknowledge Cnt			AACS N1D14	16	FS
E-1157	Offline Memory Pseudoacknowledge Cnt			AACS N1D15	16	FS
E-1158	Online CPU Hi Add Limit Violation Cnt			AACS N1D16	16	FS
E-1159	Online CPU Low Add Limit Violation Cnt			AACS N1D17	16	FS
E-1160	Offline CPU Hi Add Limit Violation Cnt			AACS N1D18	16	FS
E-1161	Offline CPU Low Add Limit Violation Cnt			AACS N1D19	16	FS
E-1162	CPU Online W/P Limit			AACS N1D20	16	FS
E-1163	CPU Offline W/P Limit			AACS N1D21	16	FS
E-1164	DMA Online W/P Limit			AACS N1D26	16	FS
E-1165	DMA Offline W/P Limit			AACS N1D27	16	FS
E-1166	Star Pair Number			AACS N1D28	16	FS
E-1167	7COMM Change ID			AACS N1D29	16	FS
E-1168	7DBSE Change ID			AACS N1D30	16	FS
E-1169	7PAR Change ID			AACS N1D31	16	FS
E-1170	7PACK Change ID			AACS N1D32	16	FS
E-1171	7SCAL Change ID			AACS N1D33	16	FS
E-1172	Fault Protection Status Word 1*			AACS N1D41	16	FS
E-1173	Fault Protection Status Word 2*			AACS N1D42	16	FS
E-1174	Fault Protection Status Word 3*			AACS N1D43	16	FS
E-1175	Checksum Start Address Segment 2			AACS N1D39	16	FS
E-1176	Checksum End Address Segment 2			AACS N1D40	16	FS

* Ref Table A2.2.9 for Word Content

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ATTITUDE AND ARTICULATION CONTROL (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-1177	Middle Select Counter 1			AACS N1D65	16	FS
E-1178	Middle Select Counter 2			AACS N1D66	16	FS
E-1179	Middle Select Counter 3			AACS N1D67	16	FS
E-1180	Middle Select Counter 4			AACS N1D68	16	FS
E-1181	Middle Select Counter 5			AACS N1D69	16	FS
E-1182	Middle Select Counter 6			AACS N1D70	16	FS
E-1183	Middle Select Counter 7			AACS N1D71	16	FS
E-1184	Middle Select Counter 8			AACS N1D72	16	FS
E-1185	Desired Maneuver*			AACS N1D78	16	FS
E-1186	Retrace Indicator			AACS N1D79	16	FS
E-1187	Operational Gain and Phase Plane Index*			AACS N1D80	16	FS
E-1188	Operational Thruster Select Table*			AACS N1D81	16	FS
E-1189	Star Data Indicator			AACS N1D82	16	FS
E-1190	STU Desired Channel*			AACS N1D83	16	FS
E-1191	YZ Sun Angle SSU 1			AACS N1D84	16	FS
E-1192	YZ Sun Angle SSU 2			AACS N2D84	16	FS
E-1193	Mission Phase*			AACS N2D87	16	FS
E-1194	Control Attitude Number*			AACS N2D88	16	FS
E-1195	Swath Number*			AACS N2D89	16	FS
E-1196	Swap IODA Delay			AACS N1D53	16	FS
E-1197	Open Primary ILV Delay			AACS N1D54	16	FS
E-1198	Swap ILV Delay			AACS N1D55	16	FS
E-1199	Fire Final Pyro Delay			AACS N1D56	16	FS

* See Table A2.2.9 for measurement breakdown

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: ATTITUDE AND ARTICULATION CONTROL (cont)

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-1200	Power Engine String OFF Delay			AACS N1D57	16	FS
E-1201	Switch Gyro Channel Delay			AACS N1D58	16	FS
E-1202	Swap Engine String Delay			AACS N1D59	16	FS
E-1203	Go To ACT Control Delay			AACS N1D60	16	FS
E-1204	Command Buffer Pointer			AACS N1D34	16	FS
E-1205	Current Attitude Quaternion 4(MSB)			VP15	8	VS
E-1206	RAM Safing Time			VP14	32	VS

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: IUS

NUMBER	MEASUREMENT TITLE	ENGINEERING RANGE	TREE POS.	COMM POS.	NO. OF BITS	FLAGS
E-0152/8	IUS-Shuttle Orbiter Separation Indicator**				1	BD
E-0153/8	SFS-IUS Separation Indicator A*				1	BD
E-0154/8	SFS-IUS Separation Indicator B**				1	BD
E-1300	IUS Status Word 1*		T1A 02		8	VD
E-1301	IUS Status Word 2**		T1B 02		8	VD
	Start Sequence 1 (bit pattern 1 $\overline{2}$ 3 $\overline{4}$ 5 $\overline{6}$ 7 $\overline{8}$)					
	Start Sequence 2 (bit pattern $\overline{1}$ 2 $\overline{3}$ 4 $\overline{5}$ 6 $\overline{7}$ 8)					
	Start Sequence 3 (bit pattern $\overline{1}$ $\overline{2}$ 3 4 $\overline{5}$ $\overline{6}$ 7 8)					
	Start Sequence 4 (bit pattern 1 2 $\overline{3}$ 4 5 6 $\overline{7}$ 8)					
	Start Sequence 5 (bit pattern 1 2 $\overline{3}$ $\overline{4}$ 5 6 $\overline{7}$ $\overline{8}$)					
	Start Sequence 6 (bit pattern $\overline{1}$ 2 3 $\overline{4}$ $\overline{5}$ 6 7 $\overline{8}$)					
	Start Sequence 7 (bit pattern 1 $\overline{2}$ $\overline{3}$ 4 5 $\overline{6}$ $\overline{7}$ 8)					
	Start Sequence 8 (bit pattern $\overline{1}$ $\overline{2}$ 3 $\overline{4}$ $\overline{5}$ $\overline{6}$ 7 $\overline{8}$)					

* Bi-Level, A side. See Table A2.2.9 for word content.
** Bi-Level, B side. See Table A2.2.9 for word content.

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: RADAR SYSTEM

NUMBER	HAC MEAS. ID	ENGINEERING MEASUREMENT TITLE	ENGINEERING RANGE	COMM POS. (FRAME #, WORD #)	NO. OF BITS	FLAGS
		T&C Unit Measurments				
R-0150	V1	Voltage (+5V), Active T&C	0/9.96V	(7,15), (18,14)	8	F A
R-1150	V22	Voltage (+5V), Inactive T&C	0/9.96V	(12,7), (18,15)	8	F A
R-0160	I1	Prereg Current, Active T&C	0/0.96A	(2,2), (3,2), (8,2), (9,2), (14,2), (15,2), (20,2), (21,2)	8	F A
R-1160	I34	Prereg Current, Inactive T&C	0/0.96A	(4,8), (5,8), (12,8), (13,8), (16,8), (17,8), (22,8) (23,8)	8	F A
R-0170	T1	Temperature, Active T&C	-74.3/+113°C	(8,15), (19,14),	8	F A
R-1170	T30	Temperature, Inactive T&C	-74.3/+113°C	(13,7), (19,15)	8	F A
R-2101	B1	STALO B (On/Off)	N/A	(0,2), (6,2), (12,2), (18,2)	1	F D
R-2102	B2	STALO A	N/A	(0,2), (6,2), (12,2), (18,2)	1	F D
R-2103	B3	BPU B	N/A	(0,2), (6,2), (12,2), (18,2)	1	F D
R-2104	B4	BPU A	N/A	(0,2), (6,2), (12,2), (18,2)	1	F D
R-2105	B5	RX B	N/A	(0,2), (6,2), (12,2), (18,2)	1	F D
R-2106	B6	RX A	N/A	(0,2), (6,2), (12,2), (18,2)	1	F D
R-2107	B7	ONU B	N/A	(0,2), (6,2), (12,2), (18,2)	1	F D
R-2108	B8	ONU A	N/A	(0,2), (6,2), (12,2), (18,2)	1	F D
R-2109	B9	XMTR B	N/A	(0,3), (6,3), (12,3), (18,3)	1	F D
R-2110	B10	XMTR A	N/A	(0,3), (6,3), (12,3), (18,3)	1	F D
R-2111	B11	RDU B	N/A	(0,3), (6,3), (12,3), (18,3)	1	F D
R-2112	B12	RDU A	N/A	(0,3), (6,3), (12,3), (18,3)	1	F D
R-2113	B13	PRF/TU B	N/A	(0,3), (6,3), (12,3), (18,3)	1	F D
R-2114	B14	PRF/TU A	N/A	(0,3), (6,3), (12,3), (18,3)	1	F D
R-2115	B15	DFU B	N/A	(0,3), (6,3), (12,3), (18,3)	1	F D
R-2116	B16	DFU A	N/A	(0,3), (6,3), (12,3), (18,3)	1	F D
R-2117	B17	RF XFER SW	N/A	(0,4), (6,4), (12,4), (18,4)	1	F D

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: RADAR SYSTEM (cont)

NUMBER	HAC MEAS. ID	ENGINEERING MEASUREMENT TITLE	ENGINEERING RANGE	COMM POS. (FRAME #, WORD #)	NO. OF BITS	FLAGS
		T&C Unit Measurments (concl)				
R-2118	B18	DC RESTORE A	N/A	(0,4), (6,4), (12,4), (18,4)	1	F D
R-2119	B19	DC RESTORE B	N/A	(0,4), (6,4), (12,4), (18,4)	1	F D
R-2120	B20	OUTPUT INHIBIT A	N/A	(0,4), (6,4), (12,4), (18,4)	1	F D
R-2121	B21	OUTPUT INHIBIT B	N/A	(0,4), (6,4), (12,4), (18,4)	1	F D
R-2122	B22	EMERGENCY OFF	N/A	(0,4), (6,4), (12,4), (18,4)	1	F D
R-2123	B23	SAR REDUNDANCY SWITCH	N/A	(0,4), (6,4), (12,4), (18,4)	1	F D
R-2124	B24	ALT REDUNDANCY SWITCH	N/A	(0,4), (6,4), (12,4), (18,4)	1	F D
	B25, B26	LEVEL CMD SPARE 1 & 2	N/A	(0,5), (6,5), (12,5), (18,5)	2	F D
	B27-B32	UNUSABLE		(0,5), (6,5), (12,5), (18,5)	6	
	B33-B40	UNUSABLE		(0,6), (6,6), (12,6), (18,6)	8	
		PRF/Timing Unit Meas.				
R-0251	V2	STALO Voltage (+15V) A	0/29.88V	(1,12), (5,12), (9,12), (13,12), (17,12), (21,12)	8	F A
R-1251	V3	STALO Voltage (+15V) B	0/29.88V	(2,13), (6,13), (10,13), (14,13), (18,13), (22,13)	8	F A
R-0250	V4	Voltage (+5V) A	0/9.96V	(2,10)	8	F A
R-1250	V5	Voltage (+5V) B	0/9.96V	(3,10)	8	F A
R-0260	I4	Prereg Current A	0/2.09A	(2,4), (8,4), (14,4), (20,4)	8	F A
R-1260	I5	Prereg Current B	0/2.09A	(3,4), (9,4), (15,4) (21,4)	8	F A
R-0270	T2	STALO Temperature A	-74.3/+113°C	(0,9), (12,9), (20,14)	8	F A
R-1270	T3	STALO Temperature B	-74.3/+113°C	(1,9), (13,9), (20,15)	8	F A
R-0261	I2	STALO Current A	0/149.414 mA	(2,3,) (8,3,) (14,3) (20,3)	8	F A
R-1261	I3	STALO Current B	0/149.414 mA	(3,3), (9,3), (15,3), (21,3)	8	F A
R-0230	B41-B45	Echo Sample Gate Pos A	0/219.61 microsec	(1,2) (7,2), (13,2), (19,2)	5	F D
R-1230	B46-B50	Echo Sample Gate Pos B	0/219.61 microsec	(1,3) (7,3), (13,3), (19,3)	5	F D

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: RADAR SYSTEM (cont)

NUMBER	HAC MEAS. ID	ENGINEERING MEASUREMENT TITLE	ENGINEERING RANGE	COMM POS. (FRAME #, WORD #)	NO. OF BITS	FLAGS
		RDU Measurements				
R-0350	V6	Voltage (+5V) A	0/9.96V	(6,10), (21,14)	8	F A
R-1350	V7	Voltage (+5V) B	0/9.96V	(7,10), (21,15)	8	F A
R-0360	I6	Prereg Current A	0/0.797A	(2,5), (8,5), (14,5) (20,5)	8	F A
R-1360	I7	Prereg Current B	0/0.797A	(3,5), (9,5), (15,5) (21,5)	8	F A
R-0370	T4	Temperature A	-74.3/+113°C	(4,9)	8	F A
R-1370	T5	Temperature B	-74.3/+113°C	(5,9)	8	F A
R-0380	P1	RF Power A	11.405/29.911 dBm	(4,3), (10,3), (16,3), (22,3)	8	F A
R-1380	P2	RF Power B	11.405/29.911 dBm	(5,3), (11,3), (17,3), (23,3)	8	F A
R-0381	P3	LO Power A	-18.63/+5.394 dBm	(4,4), (10,4), (16,4), (22,4)	8	F A
R-1381	P4	LO Power B	-18.63/+5.394 dBm	(5,4), (11,4), (17,4), (23,4)	8	F A
		Transmitter Measurements				
R-0450	V8	Voltage (+32V) A	0/63.75V	(10,10), (22,14)	8	F A
R-1450	V9	Voltage (+32V) B	0/63.75V	(11,10), (22,15)	8	F A
R-0451	V10	Voltage (+28V) A	0/55.78V	(14,10), (23,14)	8	F A
R-1451	V11	Voltage (+28V) B	0/55.78V	(15,10), (23,15)	8	F A
R-0460	I8	Prereg Current A	0/18A	(4,2), (10,2), (16,2) (22,2)	8	F A
R-1460	I9	Prereg Current B	0/18A	(5,2), (11,2), (17,2) (23,2)	8	F A
R-0461	I10	Current Driver 1 A	0/100 mA	(0,14)	8	F A
R-1461	I18	Current Driver 1 B	0/100 mA	(8,14)	8	F A
R-0462	I11	Current Driver 2 A	0/226.67 mA	(1,14)	8	F A
R-1462	I19	Current Driver 2 B	0/226.67 mA	(9,14)	8	F A
R-0463	I12	Current Driver 3 A	0/657 mA	(2,14)	8	F A
R-1463	I20	Current Driver 3 B	0/657 mA	(10,14)	8	F A

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: RADAR SYSTEM (cont)

NUMBER	HAC MEAS. ID	ENGINEERING MEASUREMENT TITLE	ENGINEERING RANGE	COMM POS. (FRAME #, WORD #)	NO. OF BITS	FLAGS
		Transmitter Measurements (cont)				
R-0464	I13	Current Driver 4 A	0/1.37 A	(3,14)	8	F A
R-1464	I21	Current Driver 4 B	0/1.37 A	(11,14)	8	F A
R-0465	I14	Current Driver 5 A	0/4.23 A	(4,14)	8	F A
R-1465	I22	Current Driver 5 B	0/4.23 A	(12,14)	8	F A
R-0466	I17	Current Output Driver A	0/8.37 A	(7,14)	8	F A
R-1466	I25	Current Output Driver B	0/8.37 A	(15,14)	8	F A
R-0467	I15	Current Output Bank 1 A	0/17.18 A	(5,14)	8	F A
R-1467	I23	Current Output Bank 1 B	0/17.18 A	(13,14)	8	F A
R-0468	I16	Current Output Bank 2 A	0/17.93 A	(6,14)	8	F A
R-1468	I24	Current Output Bank 2 B	0/17.93 A	(14,14)	8	F A
R-0472	T8	Temperature Driver 1 A	-79.4/+101.3°C	(2,15)	8	F A
R-1472	T15	Temperature Driver 1 B	-79.4/+101.3°C	(11,15)	8	F A
R-0473	T9	Temperature Driver 2 A	-111.0/+78.9°C	(3,15)	8	F A
R-1473	T16	Temperature Driver 2 B	-111.0/+78.9°C	(12,15)	8	F A
R-0474	T12	Temperature Output Driver 1 A	-96.0/+84.4°C	(6,15)	8	F A
R-1474	T19	Temperature Output Driver 1 B	-96.0/+84.4°C	(15,15)	8	F A
R-0475	T10	Temperature Output Bank 1 A	-90.4/+85.0°C	(4,15)	8	F A
R-1475	T17	Temperature Output Bank 1 B	-90.4/+85.0°C	(13,15)	8	F A
R-0476	T11	Temperature Output Bank 2 A	-79.24/+98.5°C	(5,15)	8	F A
R-1476	T18	Temperature Output Bank 2 B	-79.24/+98.5°C	(14,15)	8	F A
R-0470	T6	Temperature Prereg A	-74.3/+113°C	(0,15)	8	F A
R-1470	T13	Temperature Prereg B	-74.3/+113°C	(9,15)	8	F A
R-0471	T7	Temperature Postreg A	-74.3/+113°C	(1,15)	8	F A
R-1471	T14	Temperature Postreg B	-74.3/+113°C	(10,15)	8	F A

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: RADAR SYSTEM (cont)

NUMBER	HAC MEAS. ID	ENGINEERING MEASUREMENT TITLE	ENGINEERING RANGE	COMM POS. (FRAME #, WORD #)	NO. OF BITS	FLAGS
		Transmitter Measurements (concl)				
R-0480	P5	SAR Output Power A	0/548.1 W	(4,5), (10,5), (16,5), (22,5)	8	F A
R-1480	P6	SAR Output Power B	0/548.1 W	(5,5), (11,5), (17,5), (23,5)	8	F A
R-0481	P7	ALT Output Power A	0/471.9 W	(4,6), (10,6), (16,6), (22,6)	8	F A
R-1481	P8	ALT Output Power B	0/471.9 W	(5,6), (11,6), (17,6), (23,6)	8	F A
R-0482	P9	Driver Element Power A	0/68.64 W	(4,7), (10,7), (16,7), (22,7)	8	F A
R-1482	P10	Driver Element Power B	0/68.64 W	(5,7), (11,7), (17,7), (23,7)	8	F A
		ONU Measurements				
R-0560	I26	Prereg Current A	0/0.39844A	(2,6), (8,6), (14,6), (20,6)	8	F A
R-1560	I27	Prereg Current B	0/0.39844A	(3,6), (9,6), (15,6), (21,6)	8	F A
R-0570	T20	Temp SAR Power Monitor A	-74.3/+113°C	(6,9)	8	F A
R-1570	T21	Temp SAR Power Monitor B	-74.3/+113°C	(7,9)	8	F A
R-0571	T22	Temp ALT Power Monitor A	-74.3/+113°C	(10,9)	8	F A
R-1571	T23	Temp ALT Power Monitor B	-74.3/+113°C	(11,9)	8	F A
R-0580	P11	Power Forward SAR A	0/938.6 W	(0,11), (2,11), (4,11), (6,11), (8,11), (10,11), (12,11) (14,11) (16,11), (18,11), (20,11), (22,11)	8	F A
R-1580	P12	Power Forward SAR B	0/938.6 W	(1,11), (3,11), (5,11), (7,11), (9,11), (11,11), (13,11) (15,11) (17,11), (19,11), (21,11), (23,11)	8	F A
R-0581	P13	Power Reverse SAR A	0/28.82 W	(0,13), (6,7), (8,13), (10,8), (16,13), (19,7)	8	F A
R-1581	P14	Power Reverse SAR B	0/28.82 W	(4,13), (6,8), (11,8), (12,13) (19,8), (20,13)	8	F A

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: RADAR SYSTEM (cont)

NUMBER	HAC MEAS. ID	ENGINEERING MEASUREMENT TITLE	ENGINEERING RANGE	COMM POS. (FRAME #, WORD #)	NO. OF BITS	FLAGS
		ONU Measurements (concl)				
R-0582	P15	Power Forward ALT A	0/885 W	(0,12), (1,8), (4,12), (7,8), (8,12), (12,12), (16,12), (20,12)	8	F A
R-1582	P16	Power Forward ALT B	0/885 W	(0,8), (2,12), (6,12), (10,12), (14,12), (18,12), (22,12)	8	F A
R-0583	P17	Power Reverse ALT A	0/36 W	(0,7), (1,13), (7,7), (9,13), (17,13), (18,8)	8	F A
R-1583	P18	Power Reverse ALT B	0/36 W	(1,7), (5,13), (13,13), (18,7), (21,13)	8	F A
R-0540	B51	SAR Redundancy Switch Bar A	N/A	(1,4), (7,4), (13,4), (19,4)	1	F D
R-1540	B52	SAR Redundancy Switch Bar B	N/A	(1,4), (7,4), (13,4), (19,4)	1	F D
R-0541	B53	ALT Redundancy Switch Bar A	N/A	(1,4), (7,4), (13,4), (19,4)	1	F D
R-1541	B54	ALT Redundancy Switch Bar B	N/A	(1,4), (7,4), (13,4), (19,4)	1	F D
R-0542	B55	RCVR Sel Switch Bar A	N/A	(1,4), (7,4), (13,4), (19,4)	1	F D
R-1542	B56	RCVR Sel Switch Bar B	N/A	(1,4), (7,4), (13,4), (19,4)	1	F D
		RXU Measurements				
R-0660	I28	Prereg Current A	0/0.89648 A	(2,7), (8,7), (14,7), (20,7)	8	F A
R-1660	I29	Prereg Current B	0/0.89648 A	(3,7), (9,7), (15,7), (21,7)	8	F A
R-0670	T24	Temp, Preamp A	-107.7/+94.5°C	(16,9)	8	F A
R-1670	T25	Temp, Preamp B	-107.7/+94.5°C	(17,9)	8	F A
R-0680	P19	Echo Sample Gate Power A	-110.2/-56.6 dBm	(1,5), (7,5), 13,5), (19,5)	8	F A
R-1680	P20	Echo Sample Gate Power B	-110.2/-56.6 dBm	(1,6), (7,6), 13,6), (19,6)	8	F A

TABLE A2.2.7 ENGINEERING MEASUREMENTS (cont)

SUBSYSTEM: RADAR SYSTEM (concl)

NUMBER	HAC MEAS. ID	ENGINEERING MEASUREMENT TITLE	ENGINEERING RANGE	COMM POS. (FRAME #, WORD #)	NO. OF BITS	FLAGS
		BPU Measurements				
R-0750	V12	Voltage (+5V) A	0/9.96 V	(16,14), (18,10)	8	F A
R-1750	V13	Voltage (+5V) B	0/9.96 V	(16,15), (19,10)	8	F A
R-0751	V14	DC Restore (1) A	-250/+250 mV	(3,12), (11,12), (19,12)	8	F A
R-1751	V16	DC Restore (1) B	-250/+250 mV	(7,12), (15,12), (23,12)	8	F A
R-0752	V15	DC Restore (2) A	-250/+250 mV	(3,13), (11,13), (19,13)	8	F A
R-1752	V17	DC Restore (2) B	-250/+250 mV	(7,13), (15,13), (23,13)	8	F A
R-0760	I30	Prereg Current A	0/1.9922 A	(2,8), (8,8), (14,8), (20,8)	8	F A
R-1760	I31	Prereg Current B	0/1.9922 A	(3,8), (9,8), (15,8), (21,8)	8	F A
R-0770	T26	Temperature A	-74.3/+113 °C	(18,9)	8	F A
R-1770	T27	Temperature B	-74.3/+113 °C	(19,9)	8	F A
		DFU Measurements				
R-0850	V18	Voltage (+5V) A	0/9.96 V	(17,14), (22,10)	8	F A
R-1850	V19	Voltage (+5V) B	0/9.96 V	(17,15), (23,10)	8	F A
R-0860	I32	Prereg Current A	0/2.9682 A	(2,9), (8,9), (14,9), (20,9)	8	F A
R-1860	I33	Prereg Current B	0/2.9682 A	(3,9), (9,9), (15,9), (21,9)	8	F A
R-0870	T28	Temperature A	-74.3/+113 °C	(22,9)	8	F A
R-1870	T29	Temperature B	-74.3/+113 °C	(23,9)	8	F A
		PDU Measurements				
R-0950	V20	S/C Bus Voltage Bus A	0/55.78 V	(0,10), (4,10), (8,10), (12,10) (16,10), (20,10)	8	F A
R-1950	V21	S/C Bus Voltage Bus B	0/55.78 V	(1,10), (5,10), (9,10), (13,10) (17,10), (21,10)	8	F A

Table A2.2.7.a AACS PACKED WORDS

BIT NO.*	PACKED WORD 1 FAULT PROT/DETECT STATUS E-1146	PACKED WORD 2 FD STATUS/AACS STATUS WORD 1 E-1049	PACKED WORD 3 AACS STATUS WORD 2 E-1144
0	ATT ERROR FLAG	MEM/DMA TIMEOUT DETECT	ATT PROPAGATION ENABLE
1	ATT RATE FLAG	DISCRIMINATED SUN PRES 1	DELTA V COMPLETE FLAG
2	AVG. BODY RATE FAULT FLAG	DISCRIMINATED SUN PRES 2	OFFLINE POWER INDICATOR
3	SSU REF LOSS FLAG	VALID RAM IND	ATTITUDE CONTROL FAULT INDICATOR
4	SSU MISCOMPARE FAULT OCCURRENCE	OFFLINE RAM IND	IGNORE SEQUENCE INDICATOR
5	SADM CONT LOSS FLAG	GYRO LOW RATE TRANS ENABLE	ATTITUDE CONTROL FAULT RECOVERY INDICATOR
6	SADM MISCOMPARE FAULT OCCURRENCE	REACTION WHEEL CTRL ENABLE	TABLE TRANSITION ENABLE
7	CDS INTER LOSS FAULT OCCURRENCE	MASS EXPULSION CTRL ENABLE	SPARE
8	STAR SCAN FAILURE FAULT OCCURRENCE	SADM POWERED HOLD ENABLE	SPARE

(Continued)

Table A2.2.7.a AACS PACKED WORDS (Continued)

BIT NO.*	PACKED WORD 1 FAULT PROT/DETECT STATUS E-1146	PACKED WORD 2 FD STATUS/AACS STATUS WORD 1 E-1049	PACKED WORD 3 AACS STATUS WORD 2 E-1144
9	GYRO CHANNEL VARIANCE FLAG	MIDDLE SELECT ENABLE	SPARE
10	GYRO MISCOMPARE FLAG	ALBEDO DETECT ENABLE	SPARE
11	GYRO CHANNEL STATIC READOUT FLAG	COMMANDED DESATURATION INDICATOR	SPARE
12	THRUSTER ONTIME MISCOMPARE FLAG	SPARE	SPARE
13	SUN LOSS FAULT OCCURRENCE	SPARE	SPARE
14	ARU RATE/RANGE FLAG	DESATURATION DETECT	SPARE
15	IODA DATA BUS FAULT FLAG	IODA TIMEOUT DETECT	SPARE

* BIT 0 = LSB
BIT 15 = MSB

Table A2.2.7.b AACS HARDWARE CONFIGURATION STATUS WORDS

BIT NO.*	WORD 1 E-1050	WORD 2 E-1052	WORD 3 E-1053	WORD 4 E-1054
0	ARU B RATE**	IODA/SADM ECU B OFF/ON	R/W 3 OFF	STU B OFF
1	ARU A RATE**	IODA/SADM ECU A OFF/ON	R/W 3 ON	STU B ON
2	GYRO B2 OFF	ILV COIL DE-ENERGIZED	R/W 2 OFF	STU A OFF
3	GYRO B2 ON	ILV COIL ENGERGIZED	R/W 2 ON	STU A ON
4	GYRO B1 OFF	ILV 2 CLOSED	R/W 1 OFF	STU B SELF TEST NOT INITIATED
5	GYRO B1 ON	ILV 2 OPEN	R/W 1 ON	STU B SELF TEST INITIATED
6	ARU B OFF	ILV 1 CLOSED	REA 14, 15, 18, 20, 22, 24, POWER OFF	STU A SELF TEST NOT INITIATED
7	ARU B ON	ILV 1 OPEN	REA 14, 15, 18, 20, 22, 24, POWER ON	STU A SELF TEST INITIATED
8	GYRO A2 OFF	ILV 2 POWER OFF	REA 13, 16, 17, 19, 21, 23, POWER OFF	STU B SELF TEST NOT EVALUATED
9	GYRO A2 ON	ILV 2 POWER ON	REA 13, 16, 17, 19, 21, 23, POWER ON	STU B SELF TEST EVALUATED
10	GYRO A1 OFF	ILV 1 POWER OFF	UNUSED	STU A SELF TEST NOT EVALUATED
11	GYRO A1 ON	ILV 1 POWER ON	UNUSED	STU A SELF TEST EVALUATED
12	ARU A OFF	LATCH VALVE 1 ENABLE	UNUSED	STU B NOT VALID
13	ARU A ON	LATCH VALVE 1 DISABLE	UNUSED	STU B VALID
14	ARU +SSU ELEC B OFF/ON	LATCH VALVE 2 ENABLE	UNUSED	STU A NOT VALID
15	ARU +SSU ELEC A OFF/ON	LATCH VALVE 2 DISABLE	UNUSED	STU A VALID

* BIT 0 = LSB
BIT 15 = MSB
** 0 = LOW RATE
1 = HIGH RATE

TABLE A2.2.7.c AACS TRICKLE CONTENTS

NOTE: All measurements are 2's complement integers.

	MEASUREMENT	BYTES
T-0001	CMD History Buffer Wd 1	2
T-0002	CMD History Buffer Wd 2	2
T-0003	CMD History Buffer Wd 3	2
T-0004	CMD History Buffer Wd 4	2
T-0005	CMD History Buffer Wd 5	2
T-0006	CMD History Buffer Wd 6	2
T-0007	CMD History Buffer Wd 7	2
T-0008	CMD History Buffer Wd 8	2
T-0009	CMD History Buffer Wd 9	2
T-0010	CMD History Buffer Wd 10	2
T-0011	CMD History Buffer Wd 11	2
T-0012	CMD History Buffer Wd 12	2
T-0013	CMD History Buffer Wd 13	2
T-0014	CMD History Buffer Wd 14	2
T-0015	CMD History Buffer Wd 15	2
T-0016	CMD History Buffer Wd 16	2
T-0017	CMD History Buffer Wd 17	2
T-0018	CMD History Buffer Wd 18	2
T-0019	CMD History Buffer Wd 19	2
T-0020	CMD History Buffer Wd 20	2
T-0021	CMD History Buffer Wd 21	2
T-0022	CMD History Buffer Wd 22	2
T-0023	CMD History Buffer Wd 23	2
T-0024	CMD History Buffer Wd 24	2
T-0025	CMD History Buffer Wd 25	2
T-0026	CMD History Buffer Wd 26	2
T-0027	CMD History Buffer Wd 27	2
T-0028	CMD History Buffer Wd 28	2
T-0029	CMD History Buffer Wd 29	2
T-0030	CMD History Buffer Wd 30	2
T-0031	CMD History Buffer Wd 31	2
T-0032	CMD History Buffer Wd 32	2
T-0033	History Buffer Wd 1	2
T-0034	History Buffer Wd 2	2
T-0035	History Buffer Wd 3	2
T-0036	History Buffer Wd 4	2
T-0037	History Buffer Wd 5	2
T-0038	History Buffer Wd 6	2
T-0039	History Buffer Wd 7	2
T-0040	History Buffer Wd 8	2
T-0041	History Buffer Wd 9	2

TABLE A2.2.7.c AACS TRICKLE CONTENTS (cont)

	MEASUREMENT	BYTES
T-0042	History Buffer Wd 10	2
T-0043	History Buffer Wd 11	2
T-0044	History Buffer Wd 12	2
T-0045	History Buffer Wd 13	2
T-0046	History Buffer Wd 14	2
T-0047	History Buffer Wd 15	2
T-0048	History Buffer Wd 16	2
T-0049	History Buffer Wd 17	2
T-0050	History Buffer Wd 18	2
T-0051	History Buffer Wd 19	2
T-0052	History Buffer Wd 20	2
T-0053	History Buffer Wd 21	2
T-0054	History Buffer Wd 22	2
T-0055	History Buffer Wd 23	2
T-0056	History Buffer Wd 24	2
T-0057	History Buffer Wd 25	2
T-0058	History Buffer Wd 26	2
T-0059	History Buffer Wd 27	2
T-0060	History Buffer Wd 28	2
T-0061	History Buffer Wd 29	2
T-0062	History Buffer Wd 30	2
T-0063	History Buffer Wd 31	2
T-0064	History Buffer Wd 32	2
T-0065	History Buffer Wd 33	2
T-0066	History Buffer Wd 34	2
T-0067	History Buffer Wd 35	2
T-0068	History Buffer Wd 36	2
T-0069	History Buffer Wd 37	2
T-0070	History Buffer Wd 38	2
T-0071	History Buffer Wd 39	2
T-0072	History Buffer Wd 40	2
T-0073	History Buffer Wd 41	2
T-0074	History Buffer Wd 42	2
T-0075	History Buffer Wd 43	2
T-0076	History Buffer Wd 44	2
T-0077	History Buffer Wd 45	2
T-0078	History Buffer Wd 46	2
T-0079	History Buffer Wd 47	2
T-0080	History Buffer Wd 48	2
T-0081	History Buffer Wd 49	2
T-0082	History Buffer Wd 50	2
T-0083	History Buffer Wd 51	2
T-0084	History Buffer Wd 52	2

TABLE A2.2.7.c AACS TRICKLE CONTENTS (cont)

	MEASUREMENT	BYTES
T-0085	History Buffer Wd 53	2
T-0086	History Buffer Wd 54	2
T-0087	History Buffer Wd 55	2
T-0088	History Buffer Wd 56	2
T-0089	History Buffer Wd 57	2
T-0090	History Buffer Wd 58	2
T-0091	History Buffer Wd 59	2
T-0092	History Buffer Wd 60	2
T-0093	History Buffer Wd 61	2
T-0094	History Buffer Wd 62	2
T-0095	History Buffer Wd 63	2
T-0096	History Buffer Wd 64	2
T-0097	History Buffer Wd 65	2
T-0098	History Buffer Wd 66	2
T-0099	History Buffer Wd 67	2
T-0100	History Buffer Wd 68	2
T-0101	History Buffer Wd 69	2
T-0102	History Buffer Wd 70	2
T-0103	History Buffer Wd 71	2
T-0104	History Buffer Wd 72	2
T-0105	History Buffer Wd 73	2
T-0106	History Buffer Wd 74	2
T-0107	History Buffer Wd 75	2
T-0108	History Buffer Wd 76	2
T-0109	History Buffer Wd 77	2
T-0110	History Buffer Wd 78	2
T-0111	History Buffer Wd 79	2
T-0112	History Buffer Wd 80	2
T-0113	History Buffer Wd 81	2
T-0114	History Buffer Wd 82	2
T-0115	History Buffer Wd 83	2
T-0116	History Buffer Wd 84	2
T-0117	History Buffer Wd 85	2
T-0118	History Buffer Wd 86	2
T-0119	History Buffer Wd 87	2
T-0120	History Buffer Wd 88	2
T-0121	History Buffer Wd 89	2
T-0122	History Buffer Wd 90	2
T-0123	History Buffer Wd 91	2
T-0124	History Buffer Wd 92	2
T-0125	History Buffer Wd 93	2
T-0126	History Buffer Wd 94	2
T-0127	History Buffer Wd 95	2

TABLE A2.2.7.c AACS TRICKLE CONTENTS (cont)

	MEASUREMENT	BYTES
T-0128	History Buffer Wd 96	2
T-0129	Cumulative Thruster On-Time Error Counter (X)	2
T-0130	Cumulative Thruster On-Time Error Counter (Y)	2
T-0131	Cumulative Thruster On-Time Error Counter (Z)	2
T-0132	Cumulative Gyro Channel A1X Static Readout Counter	2
T-0133	Cumulative Gyro Channel A1Y Static Readout Counter	2
T-0134	Cumulative Gyro Channel A2X Static Readout Counter	2
T-0135	Cumulative Gyro Channel A2Y Static Readout Counter	2
T-0136	Cumulative Gyro Channel B1X Static Readout Counter	2
T-0137	Cumulative Gyro Channel B1Y Static Readout Counter	2
T-0138	Cumulative Gyro Channel B2X Static Readout Counter	2
T-0139	Cumulative Gyro Channel B2Y Static Readout Counter	2
T-0140	Cumulative Gyro Channel A1X Variance Error Counter	2
T-0141	Cumulative Gyro Channel A1Y Variance Error Counter	2
T-0142	Cumulative Gyro Channel A2X Variance Error Counter	2
T-0143	Cumulative Gyro Channel A2Y Variance Error Counter	2
T-0144	Cumulative Gyro Channel B1X Variance Error Counter	2
T-0145	Cumulative Gyro Channel B1Y Variance Error Counter	2
T-0146	Cumulative Gyro Channel B2X Variance Error Counter	2
T-0147	Cumulative Gyro Channel B2Y Variance Error Counter	2
T-0148	Cumulative A1Y A2Y B2X Miscompare Counter	2
T-0149	Cumulative A2X B1Y B2Y Miscompare Counter	2
T-0150	Cumulative A1Y A2Y Miscompare Counter	2
T-0151	Cumulative A1Y B2X Miscompare Counter	2
T-0152	Cumulative A2Y B2X Miscompare Counter	2
T-0153	Cumulative A2X B1Y Miscompare Counter	2
T-0154	Cumulative A2X B2Y Miscompare Counter	2
T-0155	Cumulative B1Y B2Y Miscompare Counter	2
T-0156	Cumulative A1X B1X Miscompare Counter	2
T-0157	Cumulative IODA Timeout Counter	2
T-0158	Cumulative Star Data Invalid Error Counter	2
T-0159	Cumulative Pot Wiper Miscompare Counter	2
T-0160	Cumulative SSU Miscompare Counter	2
T-0161	Cumulative SADM 1 Control Loss Error	2
T-0162	Cumulative SADM 2 Control Loss Error	2
T-0163	Cumulative SSU 1 Reference Loss Counter	2
T-0164	Cumulative SSU 2 Reference Loss Counter	2
T-0165	Cumulative Gyro Attitude Rate Error Counter (X)	2
T-0166	Cumulative Gyro Attitude Rate Error Counter (Y)	2
T-0167	Cumulative Gyro Attitude Rate Error Counter (Z)	2
T-0168	Cumulative Attitude Rate Error Counter (X)	2
T-0169	Cumulative Attitude Rate Error Counter (Y)	2
T-0170	Cumulative Attitude Rate Error Counter (Z)	2
T-0171	Cumulative Attitude Error Counter (X)	2

TABLE A2.2.7.c AACS TRICKLE CONTENTS (concl)

	MEASUREMENT	BYTES
T-0172	Cumulative Attitude Error Counter (Y)	2
T-0173	Cumulative Attitude Error Counter (Z)	2
T-0174	Cumulative CDS Interface Loss Counter	2
T-0175	Cumulative MEM/DMA Timeout Counter	2
T-0176	Cumulative Sun Loss Error Counter	2
T-0177	Cumulative Desaturation Fault Error Counter	2
T-0178	Cumulative Data Bus Fault Error Counter A	2
T-0179	Cumulative Data Bus Fault Error Counter B	2
T-0180	Cumulative Rate/Range Fault Error Counter	2
T-0181	Cumulative Phase Plane Transition Fault Error Counter	2
	Total Bytes	362

TABLE A2.2.7.d AACS STAR CALIBRATION TELEMETRY

NOTE: All 2-byte measurements are 2's complement integers; all 4-byte measurements are floating point.

	MEASUREMENT	BYTES
E-3000	Crossing Star Magnitude, 1	2
E-3001	Crossing Star Magnitude, 2	2
E-3002	Crossing Star Magnitude, 3	2
E-3003	Crossing Star Magnitude, 4	2
E-3004	Crossing Star Magnitude, 5	2
E-3005	Crossing Star Magnitude, 6	2
E-3006	Crossing Star Magnitude, 7	2
E-3007	Crossing Star Magnitude, 8	2
E-3008	Quaternion 1, Crossing 1	4
E-3009	Quaternion 2, Crossing 1	4
E-3010	Quaternion 3, Crossing 1	4
E-3011	Quaternion 4, Crossing 1	4
E-3012	Quaternion 1, Crossing 2	4
E-3013	Quaternion 2, Crossing 2	4
E-3014	Quaternion 3, Crossing 2	4
E-3015	Quaternion 4, Crossing 2	4
E-3016	Quaternion 1, Crossing 3	4
E-3017	Quaternion 2, Crossing 3	4
E-3018	Quaternion 3, Crossing 3	4
E-3019	Quaternion 4, Crossing 3	4
E-3020	Quaternion 1, Crossing 4	4
E-3021	Quaternion 2, Crossing 4	4
E-3022	Quaternion 3, Crossing 4	4
E-3023	Quaternion 4, Crossing 4	4
E-3024	Quaternion 1, Crossing 5	4
E-3025	Quaternion 2, Crossing 5	4
E-3026	Quaternion 3, Crossing 5	4
E-3027	Quaternion 4, Crossing 5	4
E-3028	Quaternion 1, Crossing 6	4
E-3029	Quaternion 2, Crossing 6	4
E-3030	Quaternion 3, Crossing 6	4
E-3031	Quaternion 4, Crossing 6	4
E-3032	Quaternion 1, Crossing 7	4
E-3033	Quaternion 2, Crossing 7	4
E-3034	Quaternion 3, Crossing 7	4
E-3035	Quaternion 4, Crossing 7	4
E-3036	Quaternion 1, Crossing 8	4
E-3037	Quaternion 2, Crossing 8	4
E-3038	Quaternion 3, Crossing 8	4
E-3039	Quaternion 4, Crossing 8	4

TABLE A2.2.7.d AACS STAR CALIBRATION TELEMETRY (cont)

	MEASUREMENT	BYTES
E-3040	Average X Body Rate, Crossing 1	4
E-3041	Average Y Body Rate, Crossing 1	4
E-3042	Average Z Body Rate, Crossing 1	4
E-3043	Average X Body Rate, Crossing 2	4
E-3044	Average Y Body Rate, Crossing 2	4
E-3045	Average Z Body Rate, Crossing 2	4
E-3046	Average X Body Rate, Crossing 3	4
E-3047	Average Y Body Rate, Crossing 3	4
E-3048	Average Z Body Rate, Crossing 3	4
E-3049	Average X Body Rate, Crossing 4	4
E-3050	Average Y Body Rate, Crossing 4	4
E-3051	Average Z Body Rate, Crossing 4	4
E-3052	Average X Body Rate, Crossing 5	4
E-3053	Average Y Body Rate, Crossing 5	4
E-3054	Average Z Body Rate, Crossing 5	4
E-3055	Average X Body Rate, Crossing 6	4
E-3056	Average Y Body Rate, Crossing 6	4
E-3057	Average Z Body Rate, Crossing 6	4
E-3058	Average X Body Rate, Crossing 7	4
E-3059	Average Y Body Rate, Crossing 7	4
E-3060	Average Z Body Rate, Crossing 7	4
E-3061	Average X Body Rate, Crossing 8	4
E-3062	Average Y Body Rate, Crossing 8	4
E-3063	Average Z Body Rate, Crossing 8	4
E-3064	Gyro Delta Time, Crossing 1	2
E-3065	Gyro Delta Time, Crossing 2	2
E-3066	Gyro Delta Time, Crossing 3	2
E-3067	Gyro Delta Time, Crossing 4	2
E-3068	Gyro Delta Time, Crossing 5	2
E-3069	Gyro Delta Time, Crossing 6	2
E-3070	Gyro Delta Time, Crossing 7	2
E-3071	Gyro Delta Time, Crossing 8	2
E-3072	S/C Time at Crossing 1 (16 LSB)	2
E-3073	S/C Time at Crossing 2 (16 LSB)	2
E-3074	S/C Time at Crossing 3 (16 LSB)	2
E-3075	S/C Time at Crossing 4 (16 LSB)	2
E-3076	S/C Time at Crossing 5 (16 LSB)	2
E-3077	S/C Time at Crossing 6 (16 LSB)	2
E-3078	S/C Time at Crossing 7 (16 LSB)	2
E-3079	S/C Time at Crossing 8 (16 LSB)	2
E-3080	Inertial Attitude Error Angle X	4
E-3081	Inertial Attitude Error Angle Y	4
E-3082	Inertial Attitude Error Angle Z	4

TABLE A2.2.7.d AACS STAR CALIBRATION TELEMETRY (concl)

	MEASUREMENT	BYTES
E-3083	Measurement Sensitivity Matrix 1	4
E-3084	Measurement Sensitivity Matrix 2	4
E-3085	Measurement Sensitivity Matrix 3	4
E-3086	Measurement Sensitivity Matrix 4	4
E-3087	Measurement Sensitivity Matrix 5	4
E-3088	Measurement Sensitivity Matrix 6	4
E-3089	Measurement Sensitivity Matrix 7	4
E-3090	Measurement Sensitivity Matrix 8	4
E-3091	Measurement Sensitivity Matrix 9	4
E-3092	Measurement Sensitivity Matrix 10	4
E-3093	Measurement Sensitivity Matrix 11	4
E-3094	Measurement Sensitivity Matrix 12	4
E-3095	ARU Bias 1	4
E-3096	ARU Bias 2	4
E-3097	ARU Bias 3	4
E-3098	ARU Bias 4	4
E-3099	ARU Bias 5	4
E-3100	ARU Bias 6	4
E-3101	ARU Bias 7	4
E-3102	ARU Bias 8	4
E-3103	ARU Bias 9	4
E-3104	ARU Bias 10	4
E-3105	ARU Bias 11	4
E-3106	ARU Bias 12	4
E-3107	ARU Bias 13	4
E-3108	ARU Bias 14	4
E-3109	ARU Bias 15	4
E-3110	ARU Bias 16	4
E-3111	ARU Bias 17	4
E-3112	ARU Bias 18	4
E-3113	ARU Bias 19	4
E-3114	ARU Bias 20	4
E-3115	ARU Bias 21	4
E-3116	ARU Bias 22	4
E-3117	ARU Bias 23	4
E-3118	ARU Bias 24	4
E-3119	ARU Bias 25	4
E-3120	ARU Bias 26	4
E-3121	ARU Bias 27	4
E-3122	ARU Bias 28	4
E-3123	ARU Bias 29	4
E-3124	ARU Bias 30	4
E-3125	ARU Bias 31	4
E-3126	ARU Bias 32	4
	Total Bytes	460

TABLE A2.2.7.e AACS MEMORY COMPARE TELEMETRY

	MEASUREMENT	BYTES
	NOTE: All measurements are Floating Point.	
1	ARU Misalignment Set 1, Item 1	4
2	ARU Misalignment Set 1, Item 2	4
3	ARU Misalignment Set 1, Item 3	4
4	ARU Misalignment Set 1, Item 4	4
5	ARU Misalignment Set 1, Item 5	4
6	ARU Misalignment Set 1, Item 6	4
7	ARU Misalignment Set 1, Item 7	4
8	ARU Misalignment Set 1, Item 8	4
9	ARU Misalignment Set 1, Item 9	4
10	ARU Misalignment Set 1, Item 10	4
11	ARU Misalignment Set 1, Item 11	4
12	ARU Misalignment Set 1, Item 12	4
13	ARU Misalignment Set 1, Item 13	4
14	ARU Misalignment Set 1, Item 14	4
15	ARU Misalignment Set 1, Item 15	4
16	ARU Misalignment Set 1, Item 16	4
17	ARU Misalignment Set 2, Item 1	4
18	ARU Misalignment Set 2, Item 2	4
19	ARU Misalignment Set 2, Item 3	4
20	ARU Misalignment Set 2, Item 4	4
21	ARU Misalignment Set 2, Item 5	4
22	ARU Misalignment Set 2, Item 6	4
23	ARU Misalignment Set 2, Item 7	4
24	ARU Misalignment Set 2, Item 8	4
25	ARU Misalignment Set 2, Item 9	4
26	ARU Misalignment Set 2, Item 10	4
27	ARU Misalignment Set 2, Item 11	4
28	ARU Misalignment Set 2, Item 12	4
29	ARU Misalignment Set 2, Item 13	4
30	ARU Misalignment Set 2, Item 14	4
31	ARU Misalignment Set 2, Item 15	4
32	ARU Misalignment Set 2, Item 16	4
33	ARU Negative Count Scale Factor 1	4
34	ARU Negative Count Scale Factor 2	4
35	ARU Negative Count Scale Factor 3	4
36	ARU Negative Count Scale Factor 4	4
37	ARU Negative Count Scale Factor 5	4
38	ARU Negative Count Scale Factor 6	4
39	ARU Negative Count Scale Factor 7	4
40	ARU Negative Count Scale Factor 8	4
41	ARU Negative Count Scale Factor 9	4
42	ARU Negative Count Scale Factor 10	4
43	ARU Negative Count Scale Factor 11	4

TABLE A2.2.7.e AACS MEMORY COMPARE TELEMETRY (cont)

	MEASUREMENT	BYTES
44	ARU Negative Count Scale Factor 12	4
45	ARU Negative Count Scale Factor 13	4
46	ARU Negative Count Scale Factor 14	4
47	ARU Negative Count Scale Factor 15	4
48	ARU Negative Count Scale Factor 16	4
49	ARU Positive Count Scale Factor 1	4
50	ARU Positive Count Scale Factor 2	4
51	ARU Positive Count Scale Factor 3	4
52	ARU Positive Count Scale Factor 4	4
53	ARU Positive Count Scale Factor 5	4
54	ARU Positive Count Scale Factor 6	4
55	ARU Positive Count Scale Factor 7	4
56	ARU Positive Count Scale Factor 8	4
57	ARU Positive Count Scale Factor 9	4
58	ARU Positive Count Scale Factor 10	4
59	ARU Positive Count Scale Factor 11	4
60	ARU Positive Count Scale Factor 12	4
61	ARU Positive Count Scale Factor 13	4
62	ARU Positive Count Scale Factor 14	4
63	ARU Positive Count Scale Factor 15	4
64	ARU Positive Count Scale Factor 16	4
65	Attitude Update Fixed Filter Gain 1	4
66	Attitude Update Fixed Filter Gain 2	4
67	Attitude Update Fixed Filter Gain 3	4
68	Attitude Update Fixed Filter Gain 4	4
69	Attitude Update Fixed Filter Gain 5	4
70	Attitude Update Fixed Filter Gain 6	4
71	Attitude Update Fixed Filter Gain 7	4
72	Attitude Update Fixed Filter Gain 8	4
73	Attitude Update Fixed Filter Gain 9	4
74	Attitude Update Fixed Filter Gain 10	4
75	Attitude Update Fixed Filter Gain 11	4
76	Attitude Update Fixed Filter Gain 12	4
77	Attitude Update Fixed Filter Gain 13	4
78	Attitude Update Fixed Filter Gain 14	4
79	Attitude Update Fixed Filter Gain 15	4
80	Attitude Update Fixed Filter Gain 16	4
81	Attitude Update Fixed Filter Gain 17	4
82	Attitude Update Fixed Filter Gain 18	4
83	Attitude Update Fixed Filter Gain 19	4
84	Attitude Update Fixed Filter Gain 20	4
85	Attitude Update Fixed Filter Gain 21	4
86	Attitude Update Fixed Filter Gain 22	4
87	Attitude Update Fixed Filter Gain 23	4

TABLE A2.2.7.e AACS MEMORY COMPARE TELEMETRY (cont)

	MEASUREMENT	BYTES
88	Attitude Update Fixed Filter Gain 24	4
89	Attitude Update Fixed Filter Gain 25	4
90	Attitude Update Fixed Filter Gain 26	4
91	Attitude Update Fixed Filter Gain 27	4
92	Attitude Update Fixed Filter Gain 28	4
93	Attitude Update Fixed Filter Gain 29	4
94	Attitude Update Fixed Filter Gain 30	4
95	Attitude Update Fixed Filter Gain 31	4
96	Attitude Update Fixed Filter Gain 32	4
97	Attitude Update Fixed Filter Gain 33	4
98	Attitude Update Fixed Filter Gain 34	4
99	Attitude Update Fixed Filter Gain 35	4
100	Attitude Update Fixed Filter Gain 36	4
101	Attitude Update Fixed Filter Gain 37	4
102	Attitude Update Fixed Filter Gain 38	4
103	Attitude Update Fixed Filter Gain 39	4
104	Attitude Update Fixed Filter Gain 40	4
105	Attitude Update Fixed Filter Gain 41	4
106	Attitude Update Fixed Filter Gain 42	4
107	Attitude Update Fixed Filter Gain 43	4
108	Attitude Update Fixed Filter Gain 44	4
109	Attitude Update Fixed Filter Gain 45	4
110	Attitude Update Fixed Filter Gain 46	4
111	Attitude Update Fixed Filter Gain 47	4
112	Attitude Update Fixed Filter Gain 48	4
113	Attitude Update Fixed Filter Gain 49	4
114	Attitude Update Fixed Filter Gain 50	4
115	Attitude Update Fixed Filter Gain 51	4
116	Attitude Update Fixed Filter Gain 52	4
117	Attitude Update Fixed Filter Gain 53	4
118	Attitude Update Fixed Filter Gain 54	4
119	Attitude Update Fixed Filter Gain 55	4
120	Attitude Update Fixed Filter Gain 56	4
121	Attitude Update Fixed Filter Gain 57	4
122	Attitude Update Fixed Filter Gain 58	4
123	Attitude Update Fixed Filter Gain 59	4
124	Attitude Update Fixed Filter Gain 60	4
125	Attitude Update Fixed Filter Gain 61	4
126	Attitude Update Fixed Filter Gain 62	4
127	Attitude Update Fixed Filter Gain 63	4
128	Attitude Update Fixed Filter Gain 64	4
129	Attitude Update Fixed Filter Gain 65	4
130	Attitude Update Fixed Filter Gain 66	4

TABLE A2.2.7.e AACS MEMORY COMPARE TELEMETRY (cont)

	MEASUREMENT	BYTES
131	Attitude Update Fixed Filter Gain 67	4
132	Attitude Update Fixed Filter Gain 68	4
133	Attitude Update Fixed Filter Gain 69	4
134	Attitude Update Fixed Filter Gain 70	4
135	Attitude Update Fixed Filter Gain 71	4
136	Attitude Update Fixed Filter Gain 72	4
137	Attitude Update Fixed Filter Gain 73	4
138	Attitude Update Fixed Filter Gain 74	4
139	Attitude Update Fixed Filter Gain 75	4
140	Attitude Update Fixed Filter Gain 76	4
141	Attitude Update Fixed Filter Gain 77	4
142	Attitude Update Fixed Filter Gain 78	4
143	Attitude Update Fixed Filter Gain 79	4
144	Attitude Update Fixed Filter Gain 80	4
145	Attitude Update Fixed Filter Gain 81	4
146	Attitude Update Fixed Filter Gain 82	4
147	Attitude Update Fixed Filter Gain 83	4
148	Attitude Update Fixed Filter Gain 84	4
149	Attitude Update Fixed Filter Gain 85	4
150	Attitude Update Fixed Filter Gain 86	4
151	Attitude Update Fixed Filter Gain 87	4
152	Attitude Update Fixed Filter Gain 88	4
153	Attitude Update Fixed Filter Gain 89	4
154	Attitude Update Fixed Filter Gain 90	4
155	Attitude Update Fixed Filter Gain 91	4
156	Attitude Update Fixed Filter Gain 92	4
157	Attitude Update Fixed Filter Gain 93	4
158	Attitude Update Fixed Filter Gain 94	4
159	Attitude Update Fixed Filter Gain 95	4
160	Attitude Update Fixed Filter Gain 96	4
161	Attitude Update Fixed Filter Gain 97	4
162	Attitude Update Fixed Filter Gain 98	4
163	Attitude Update Fixed Filter Gain 99	4
164	Attitude Update Fixed Filter Gain 100	4
165	Attitude Update Fixed Filter Gain 101	4
166	Attitude Update Fixed Filter Gain 102	4
167	Attitude Update Fixed Filter Gain 103	4
168	Attitude Update Fixed Filter Gain 104	4
169	Attitude Update Fixed Filter Gain 105	4
170	Attitude Update Fixed Filter Gain 106	4
171	Attitude Update Fixed Filter Gain 107	4
172	Attitude Update Fixed Filter Gain 108	4
173	Attitude Update Fixed Filter Gain 109	4
174	Attitude Update Fixed Filter Gain 110	4

TABLE A2.2.7.e AACS MEMORY COMPARE TELEMETRY (concl)

	MEASUREMENT	BYTES
175	Attitude Update Fixed Filter Gain 111	4
176	Attitude Update Fixed Filter Gain 112	4
177	Attitude Update Fixed Filter Gain 113	4
178	Attitude Update Fixed Filter Gain 114	4
179	Attitude Update Fixed Filter Gain 115	4
180	Attitude Update Fixed Filter Gain 116	4
181	Attitude Update Fixed Filter Gain 117	4
182	Attitude Update Fixed Filter Gain 118	4
183	Attitude Update Fixed Filter Gain 119	4
184	Attitude Update Fixed Filter Gain 120	4
185	Attitude Update Fixed Filter Gain 121	4
186	Attitude Update Fixed Filter Gain 122	4
187	Attitude Update Fixed Filter Gain 123	4
188	Attitude Update Fixed Filter Gain 124	4
189	Attitude Update Fixed Filter Gain 125	4
190	Attitude Update Fixed Filter Gain 126	4
191	Attitude Update Fixed Filter Gain 127	4
192	Attitude Update Fixed Filter Gain 128	4
193	Attitude Update Fixed Filter Gain 129	4
194	Attitude Update Fixed Filter Gain 130	4
195	Attitude Update Fixed Filter Gain 131	4
196	Attitude Update Fixed Filter Gain 132	4
197	Attitude Update Fixed Filter Gain 133	4
198	Attitude Update Fixed Filter Gain 134	4
199	Attitude Update Fixed Filter Gain 135	4
200	Attitude Update Fixed Filter Gain 136	4
201	Attitude Update Fixed Filter Gain 137	4
202	Attitude Update Fixed Filter Gain 138	4
203	Attitude Update Fixed Filter Gain 139	4
204	Attitude Update Fixed Filter Gain 140	4
205	Attitude Update Fixed Filter Gain 141	4
206	Attitude Update Fixed Filter Gain 142	4
207	Attitude Update Fixed Filter Gain 143	4
208	Attitude Update Fixed Filter Gain 144	4
	Total Bytes	832

TABLE A2.2.7.f AACS INTERMEDIATE BUFFER CONTENTS

Integer Data:

	MEASUREMENT NO.	TITLE
1	E-1040	RW 1 Tach Spd
2	E-1041	RW 2 Tach Spd
3	E-1042	RW 3 Tach Spd
4	E-1051	RW Direction
5	E-1043	SSU 1A Reticle Data
6	E-1046	SSU 1B Reticle Data
7	E-1044	SSU 2A Reticle Data
8	E-1047	SSU 2A Reticle Data
9	E-1045	SADM 1 Pot.
10	E-1048	SADM 2 Pot.

Floating Point Data:

	MEASUREMENT NO.	TITLE
1	E-1022	Current Attitude Quaternion 1
2	E-1023	Current Attitude Quaternion 2
3	E-1024	Current Attitude Quaternion 3
4	E-1031	Average Body Rate X
5	E-1032	Average Body Rate Y
6	E-1033	Average Body Rate Z
7	E-1034	Rate Error X
8	E-1035	Rate Error Y
9	E-1036	Rate Error Z
10	E-1025	Desired Reference Quaternion 1
11	E-1026	Desired Reference Quaternion 2
12	E-1027	Desired Reference Quaternion 3
13	E-1191	YZ Sun Angle SSU 1
14	E-1192	YZ Sun Angle SSU 2

A2.2.11.2 Engineering Formats

There are 4 VRM engineering formats. These formats are: anomaly, launch phase, maneuver (used during interplanetary cruise and mapping phase), and Delta-V. Each of these formats consists of a fixed area containing measurements common to all formats, and a variable area, containing packets of measurements unique to the specific format. Figure A2.2.10 is an overview of the engineering commutator structure, showing the fixed and variable areas.

A2.2.11.2.1 Fixed Area Measurement Assignments

Figures A2.2.11 through A2.2.15 indicate the commutator position assigned to measurements in the fixed area.

A2.2.11.2.2 Variable Area Measurement Assignments

The variable area measurements are grouped into packets, any of which may be placed into one or more engineering formats. The packets are listed in Table A2.2.8, along with their associated measurements. The actual formats are shown in Figure A2.2.16, and described below.

a. Anomaly Format. The anomaly format shall provide telemetry for enhanced visibility into the spacecraft system for troubleshooting anomalies. This format shall be selectable either by ground command or by an onboard fault detection and correction routine. The format shall be permanently assigned to commutation map identifier 0.

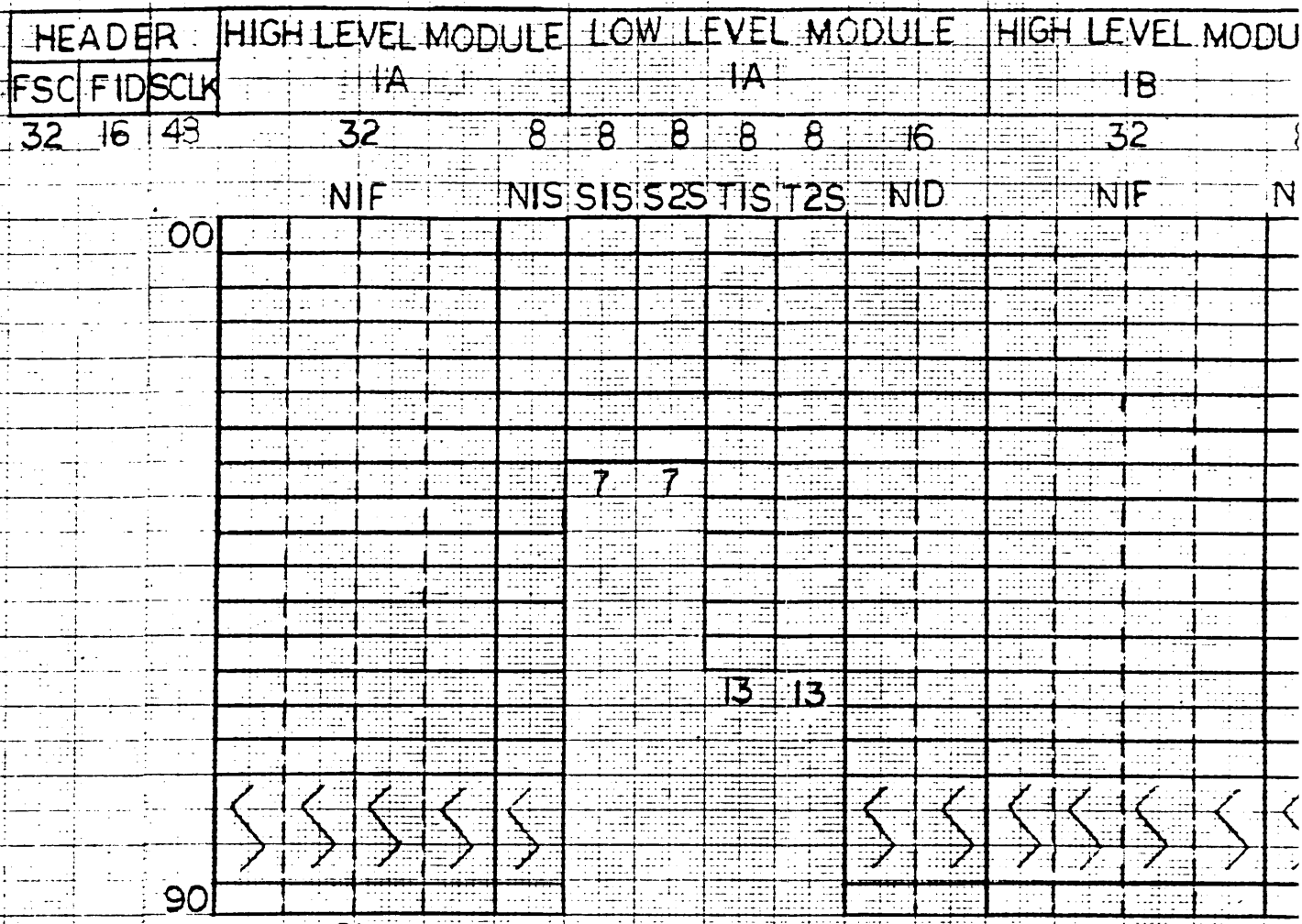
b. Launch Phase Format. The launch phase format shall provide telemetry from launch through the completion of the launch phase. The format shall be assigned to commutation map identifier 1.

c. Delta-V Format. The delta-V format shall provide telemetry during all delta-V maneuvers, including TCMs, OTMS, and VOI. The format shall be assigned to commutation map identifier 2.

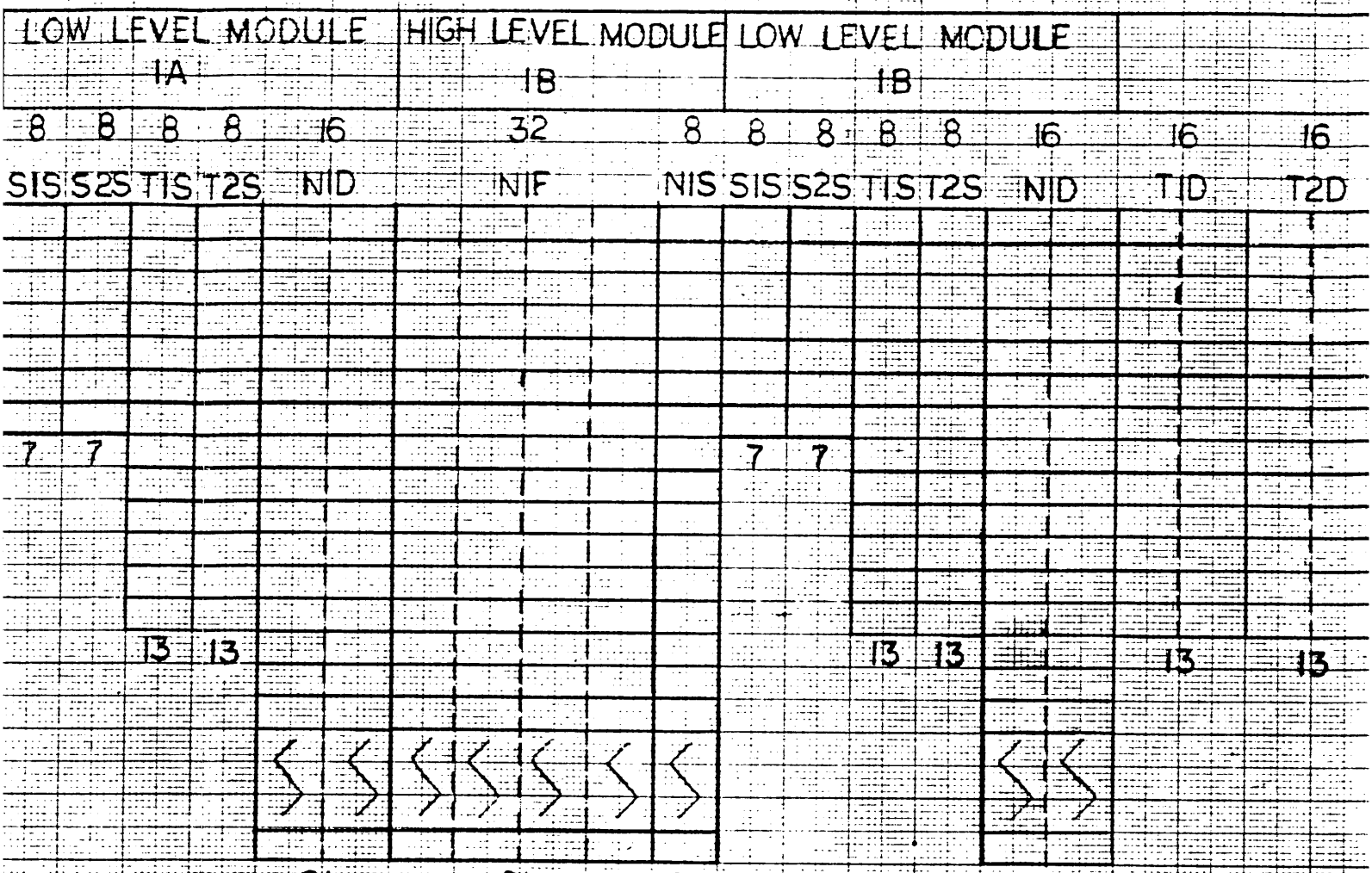
d. Maneuver Format. The maneuver format shall provide telemetry during all attitude maneuvers. The format shall be used during interplanetary cruise and mapping phase (including orbital playback), and shall be assigned to commutation map identifier 3.

A2.2.11.2.2.1 Memory Readout (MRO)

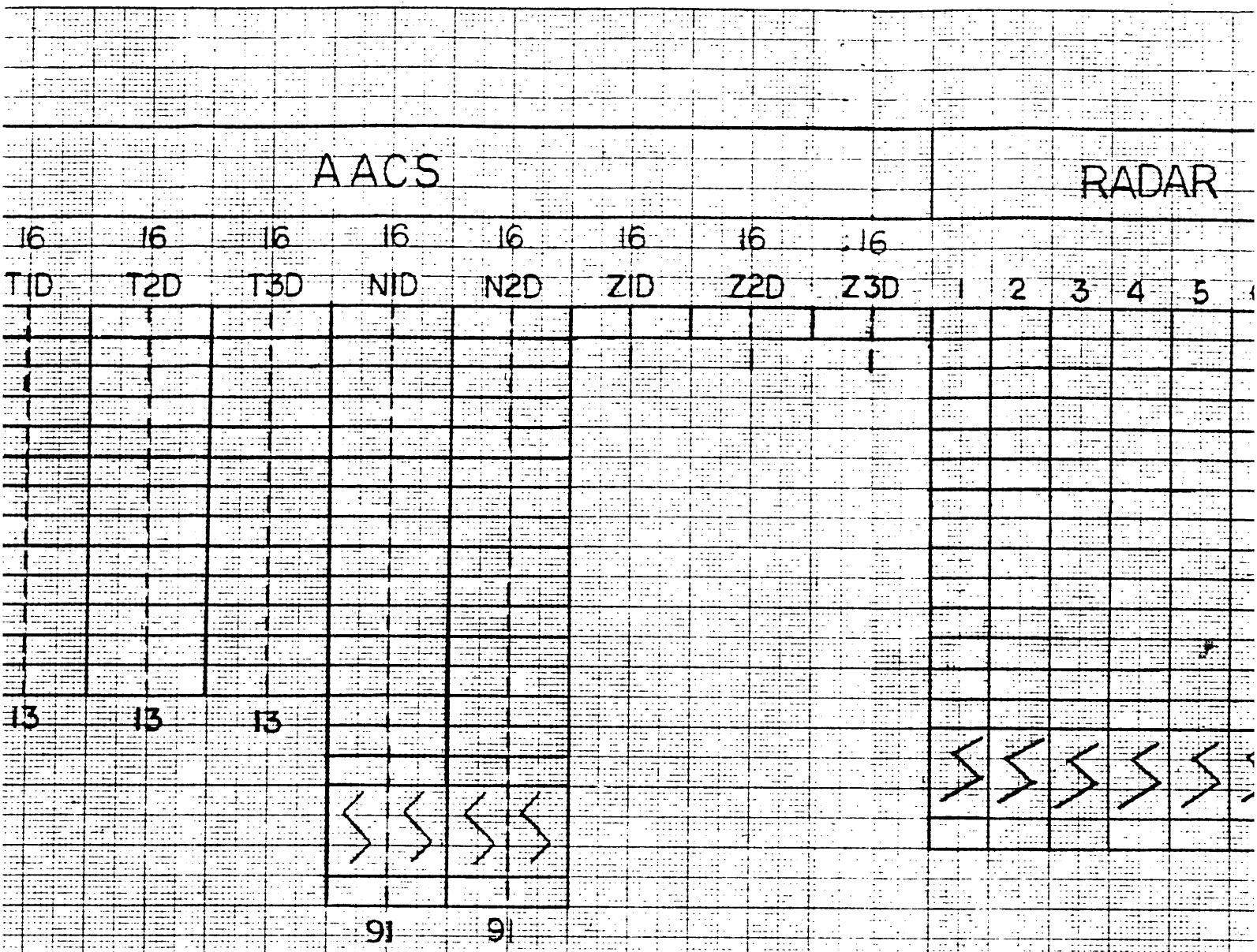
When Memory readout is selected, a readout of any selected spacecraft memory shall pre-empt the first five variable packets and supersede the selected formats in these packets. The measurements in packets 6 and 7 shall be those of the format previously selected. The MRO shall stop when the preselected memory is completely downlinked.



ENGR RATE B/S \ SAMPLING PERIOD	1	7	13	91
40	20 SEC.	140 SEC.	260 SEC.	1820 SEC.
1200	2/3 SEC.	4-2/3 SEC	8-2/3 SEC.	60-2/3 SEC.



7	13	91
0	260 SEC.	1820 SEC.
/3	8-2/3 SEC.	60-2/3 SEC.


AACS
RADAR
16
T1D
16
T2D
16
T3D
16
N1D
16
N2D
16
Z1D
16
Z2D
16
Z3D
1
2
3
4
5
13
13
13
91
91

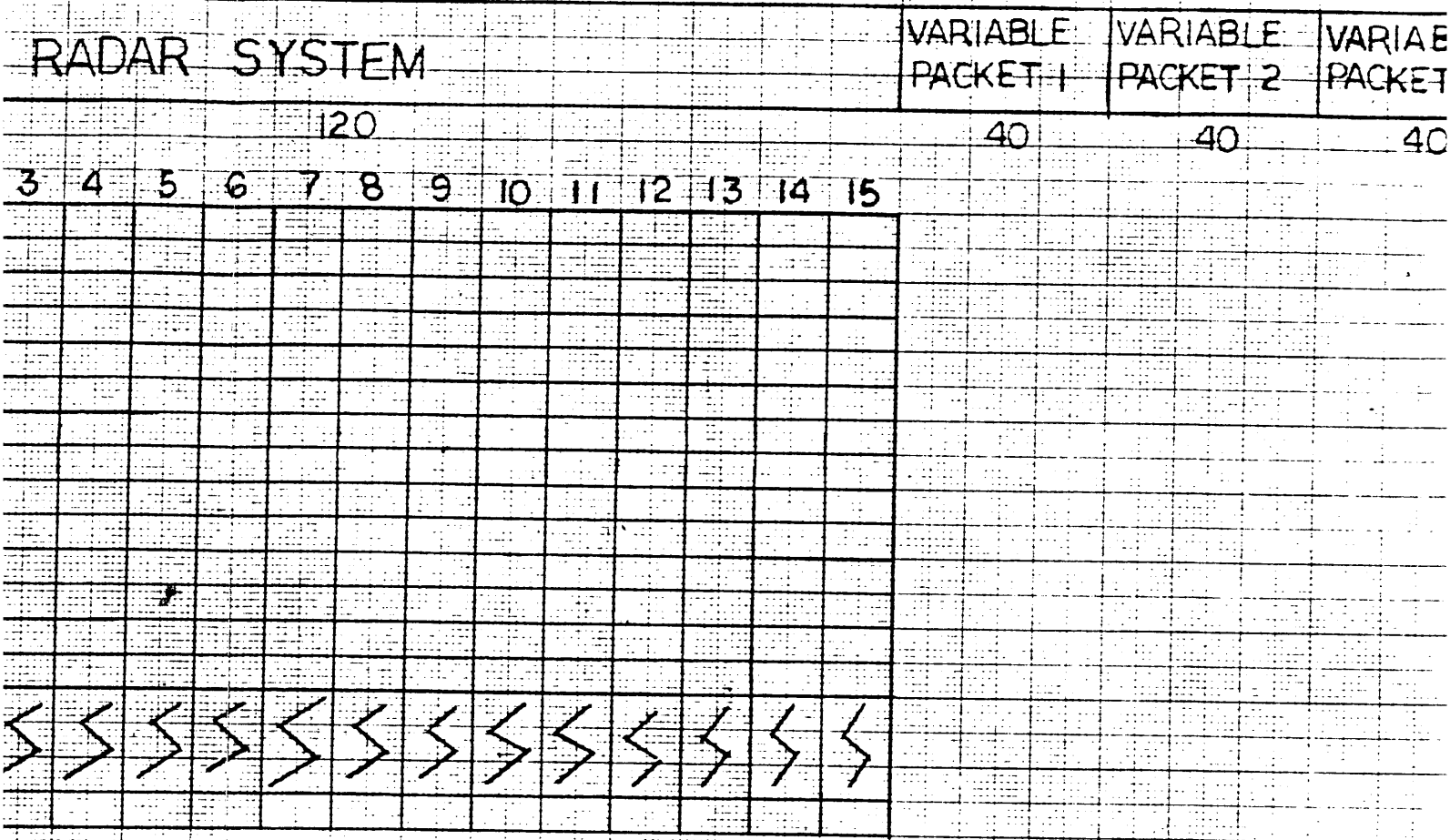


FIGURE A22.10: ENGINEEI

LE 1	VARIABLE PACKET 2	VARIABLE PACKET 3	VARIABLE PACKET 4	VARIABLE PACKET 5	VARIABLE PACKET 6	VARIABLE PACKET 7
	40	40	40	40	40	40

A22.10: ENGINEERING TELEMETRY COMMUTATOR STRUCTURE

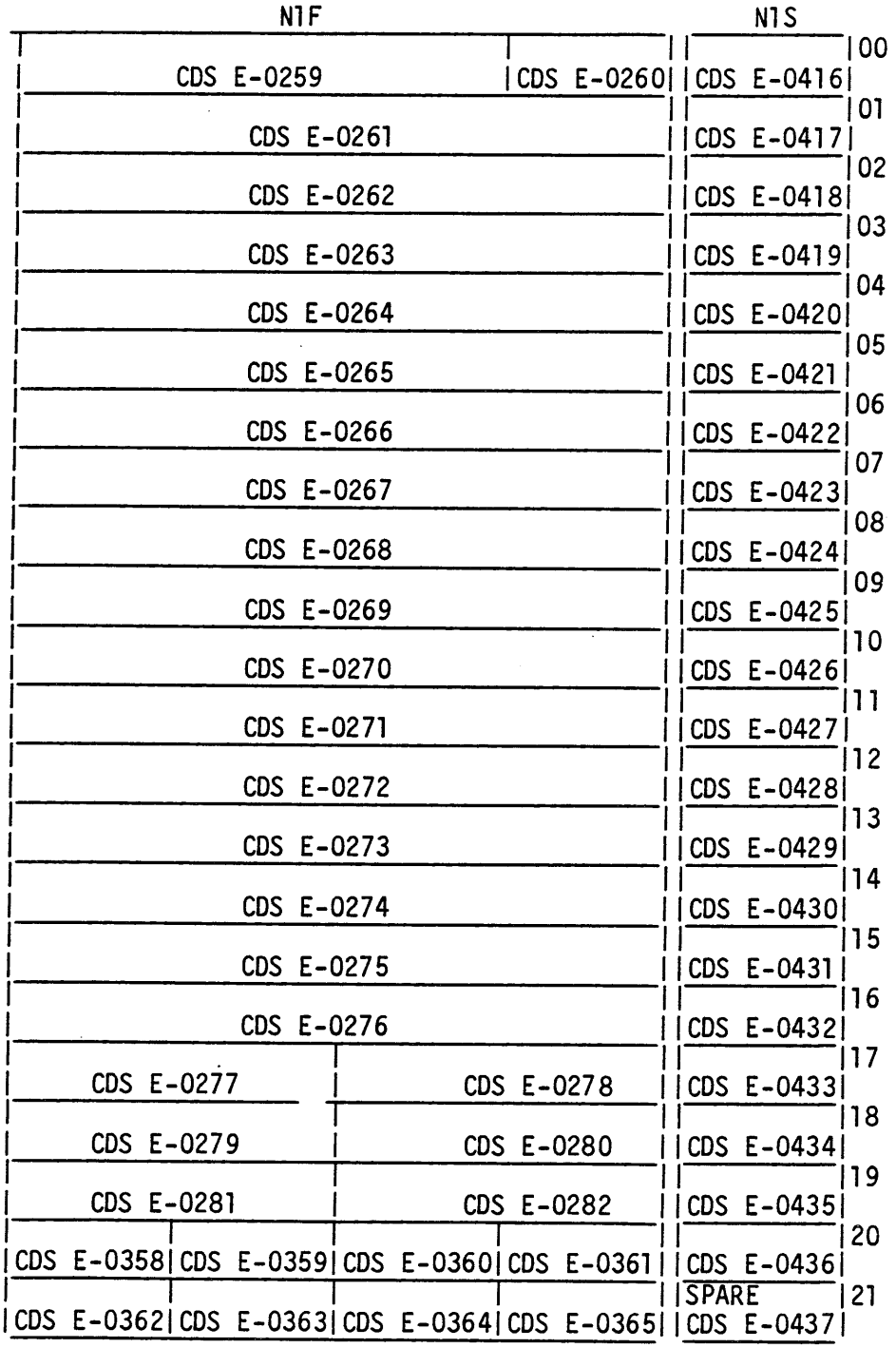


Figure A2.2.11 Fixed Area Measurement Assignment - HLM 1A

N1F (cont)				N1S (cont)	
CDS E-0285	CDS E-0286	CDS E-0287	CDS E-0288	SPARE CDS E-0438	22
CDS E-0289	CDS E-0290	CDS E-0291	CDS E-0292	SPARE CDS E-0439	23
SPARE CDS E-0293	SPARE CDS E-0294	SPARE CDS E-0295	CDS E-0296	SPARE CDS E-0440	24
CDS E-0297				CDS E-0441	25
CDS E-0298			SPARE CDS -0299	CDS E-0442	26
CDS E-0300				CDS E-0443	27
CDS E-0301			SPARE CDS E-0302	CDS E-0444	28
CDS E-0303				CDS E-0445	29
CDS E-0304				CDS E-0446	30
CDS E-0305	CDS E-0306	CDS E-0307	CDS E-0308	CDS E-0447	31
CDS E-0309	CDS E-0310	CDS E-0311	CDS E-0312	CDS E-0448	32
CDS E-0313			CDS E-0314	CDS E-0449	33
CDS E-0315				CDS E-0450	34
CDS E-316		CDS E-0317	CDS E-0318	CDS E-0451	35
CDS E-0319	CDS E-0320	CDS E-0321	CDS E-0322	SPARE CDS E-0452	36
SPARE CDS E-0323	SPARE CDS E-0324	SPARE CDS E-0325	CDS E-0326	SPARE CDS E-0453	37
CDS E-0327	CDS E-0328	CDS E-0329		SPARE CDS E-0454	38
CDS E-0330	CDS E-0331	CDS E-0332	CDS E-0333	SPARE CDS E-0455	39
CDS E-0334			CDS E-0336	SPARE CDS E-0456	40
CDS E-0337			CDS E-0340	SPARE CDS E-0457	41
SPARE CDS E-0341	SPARE CDS E-0342	SPARE CDS E-0343	SPARE CDS E-0344	SPARE CDS E-0458	42
CDS E-0345*			CDS E-0346	SPARE CDS E-0459	43
CDS E-0347			CDS E-0348	SPARE CDS E-0460	44

*DED Group 2

Figure A2.2.11 Fixed Area Measurement Assignment - HLM 1A (cont)

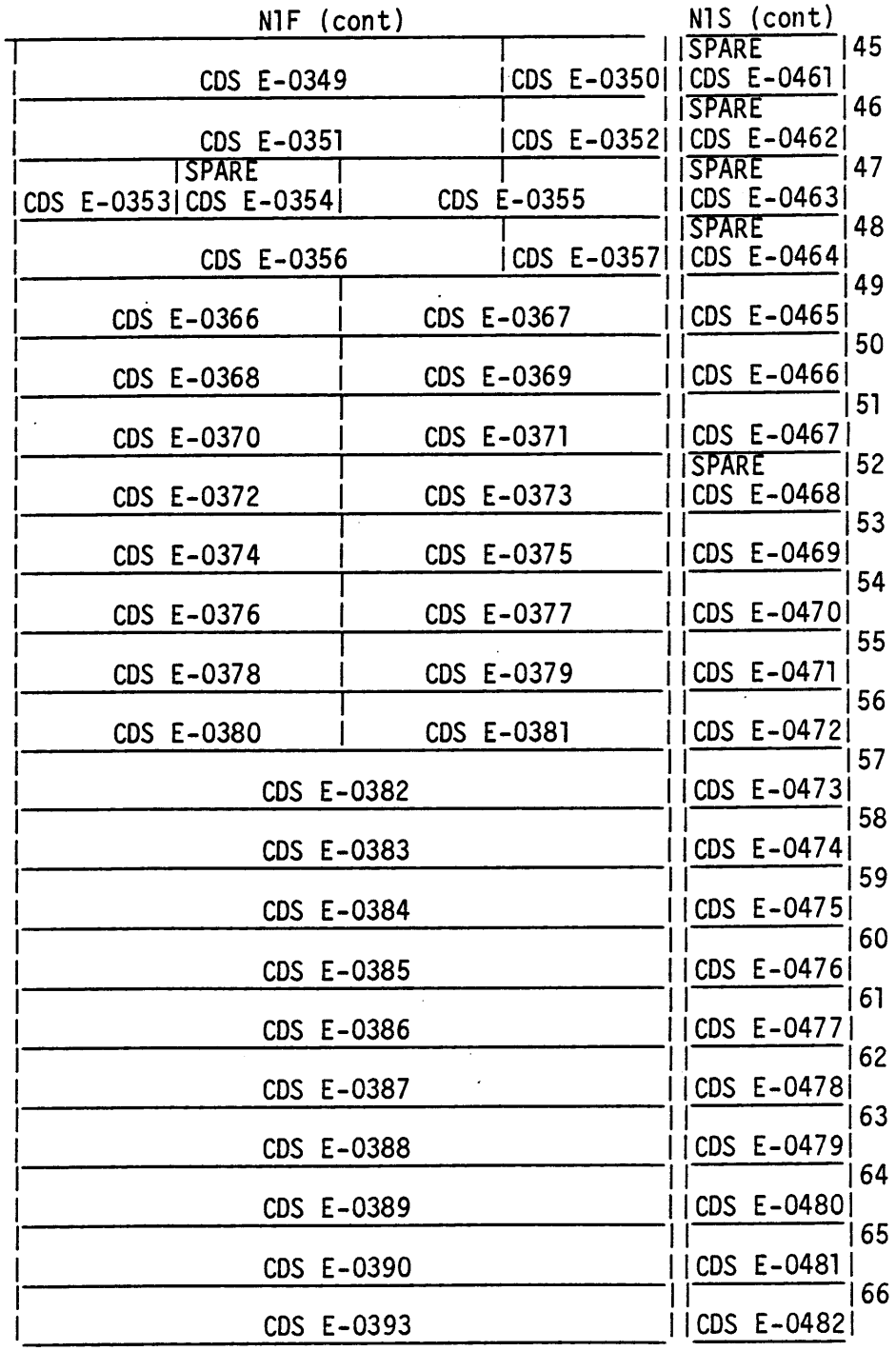


Figure A2.2.11 Fixed Area Measurement Assignment - HLM 1A (cont)

N1F (cont)	N1S (cont)	
		67
CDS E-0394	CDS E-0483	
		68
CDS E-0395	CDS E-0484	
		69
CDS E-0396	CDS E-0485	
		70
CDS E-0397	CDS E-0486	
		71
CDS E-0398	CDS E-0487	
		72
CDS E-0399	CDS E-0488	
		73
CDS E-0400	CDS E-0489	
		74
CDS E-0401	CDS E-0490	
		75
CDS E-0402	CDS E-0491	
		76
CDS E-0403	CDS E-0492	
		77
CDS E-0404	CDS E-0493	
		78
CDS E-0405	CDS E-0494	
		79
CDS E-0406	CDS E-0495	
		80
CDS E-0407	CDS E-0496	
SPARE		81
CDS E-0391	CDS E-0497	
SPARE		82
CDS E-0392	CDS E-0498	
SPARE		83
CDS E-0408	CDS E-0499	
SPARE		84
CDS E-0409	CDS E-0500	
SPARE		85
CDS E-0410	CDS E-0501	
SPARE		86
CDS E-0411	CDS E-0502	
SPARE		87
CDS E-0412	CDS E-0503	
SPARE		88
CDS E-0413	CDS E-0504	
SPARE		89
CDS E-0414	CDS E-0505	
SPARE		90
CDS E-0415	CDS E-0506	

Figure A2.2.11 Fixed Area Measurement Assignment - HLM 1A (concl)

N1F				N1S	
CDS E-0590		CDS E-0591		CDS E-0744	00
CDS E-0592				CDS E-0745	01
CDS E-0593				CDS E-0746	02
CDS E-0594				CDS E-0747	03
CDS E-0595				CDS E-0748	04
CDS E-0596				CDS E-0749	05
CDS E-0597				CDS E-0750	06
CDS E-0598				CDS E-0751	07
CDS E-0599				CDS E-0752	08
CDS E-0600				CDS E-0753	09
CDS E-0601				CDS E-0754	10
CDS E-0602				CDS E-0755	11
CDS E-0603				CDS E-0756	12
CDS E-0604				CDS E-0757	13
CDS E-0605				CDS E-0758	14
CDS E-0606				CDS E-0759	15
CDS E-0607				CDS E-0760	16
CDS E-0608		CDS E-0609		CDS E-0761	17
CDS E-0610		CDS E-0611		CDS E-0762	18
CDS E-0612		CDS E-0613		CDS E-0763	19
SPARE CDS E-0686	SPARE CDS E-0687	SPARE CDS E-0688	SPARE CDS E-0689	CDS E-0764	20
SPARE CDS E-0690	SPARE CDS E-0691	SPARE CDS E-0692	SPARE CDS E-0693	SPARE CDS E-0765	21
CDS E-0614	CDS E-0615	CDS E-0616	SPARE CDS E-0617	SPARE CDS E-0766	22
CDS E-0618	CDS E-0619	CDS E-0620	CDS E-0621	SPARE CDS E-0767	23
SPARE CDS E-0622	SPARE CDS E-0623	SPARE CDS E-0624	CDS E-0625	SPARE CDS E-0768	24

Figure A2.2.12 Fixed Area Measurement Assignment - HLM 1B

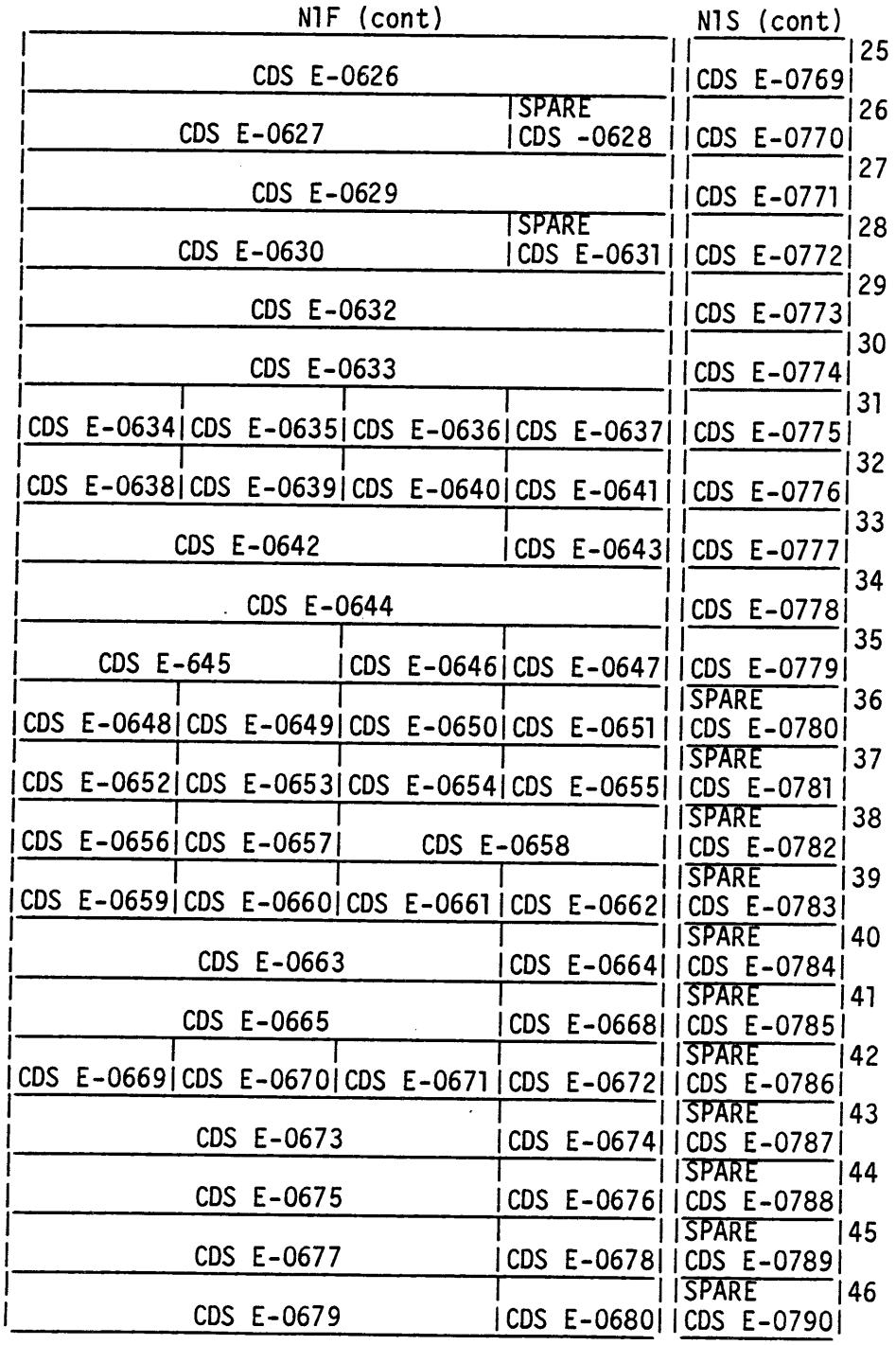


Figure A2.2.12 Fixed Area Measurement Assignment - HLM 1B (cont)

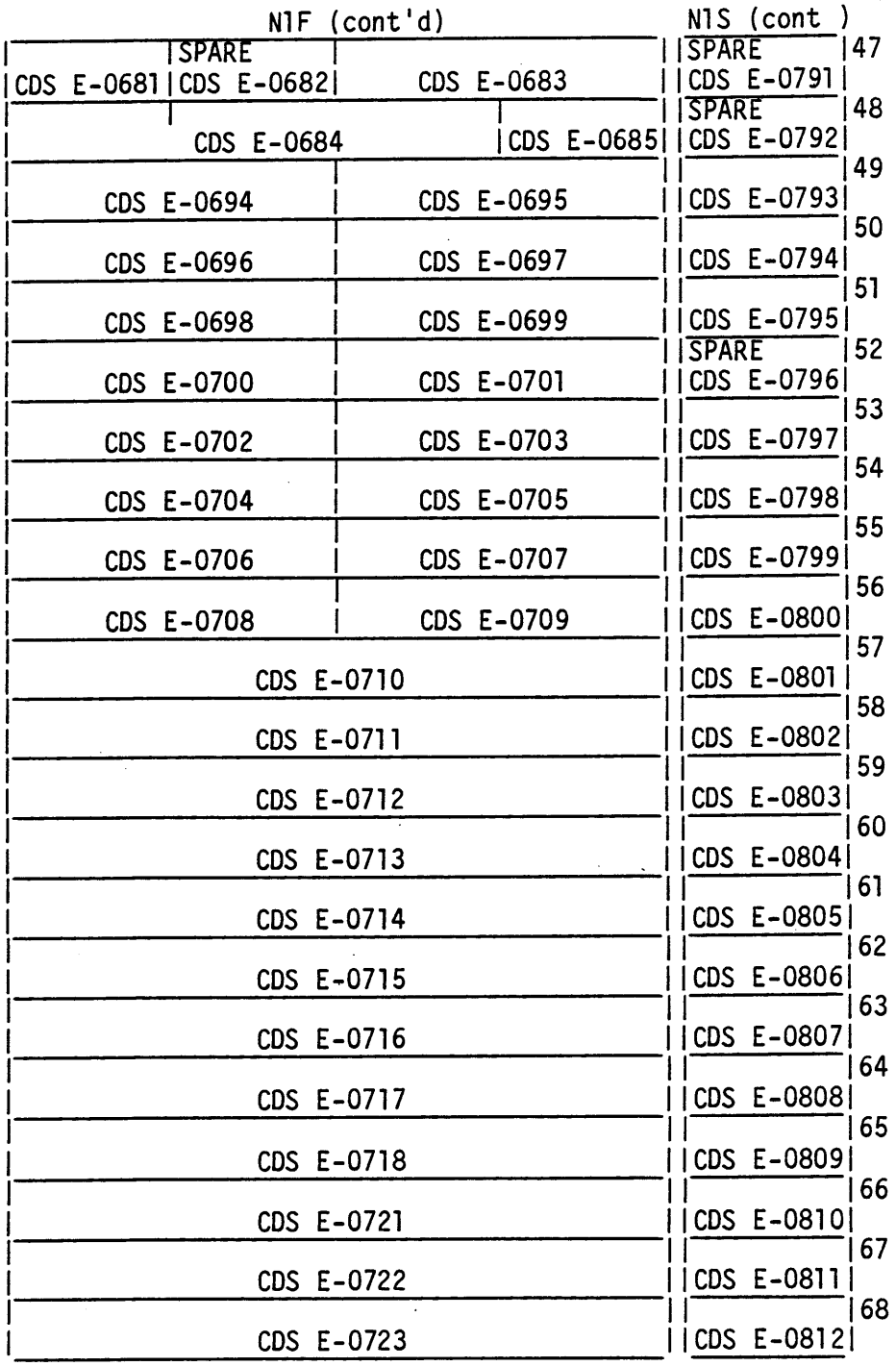
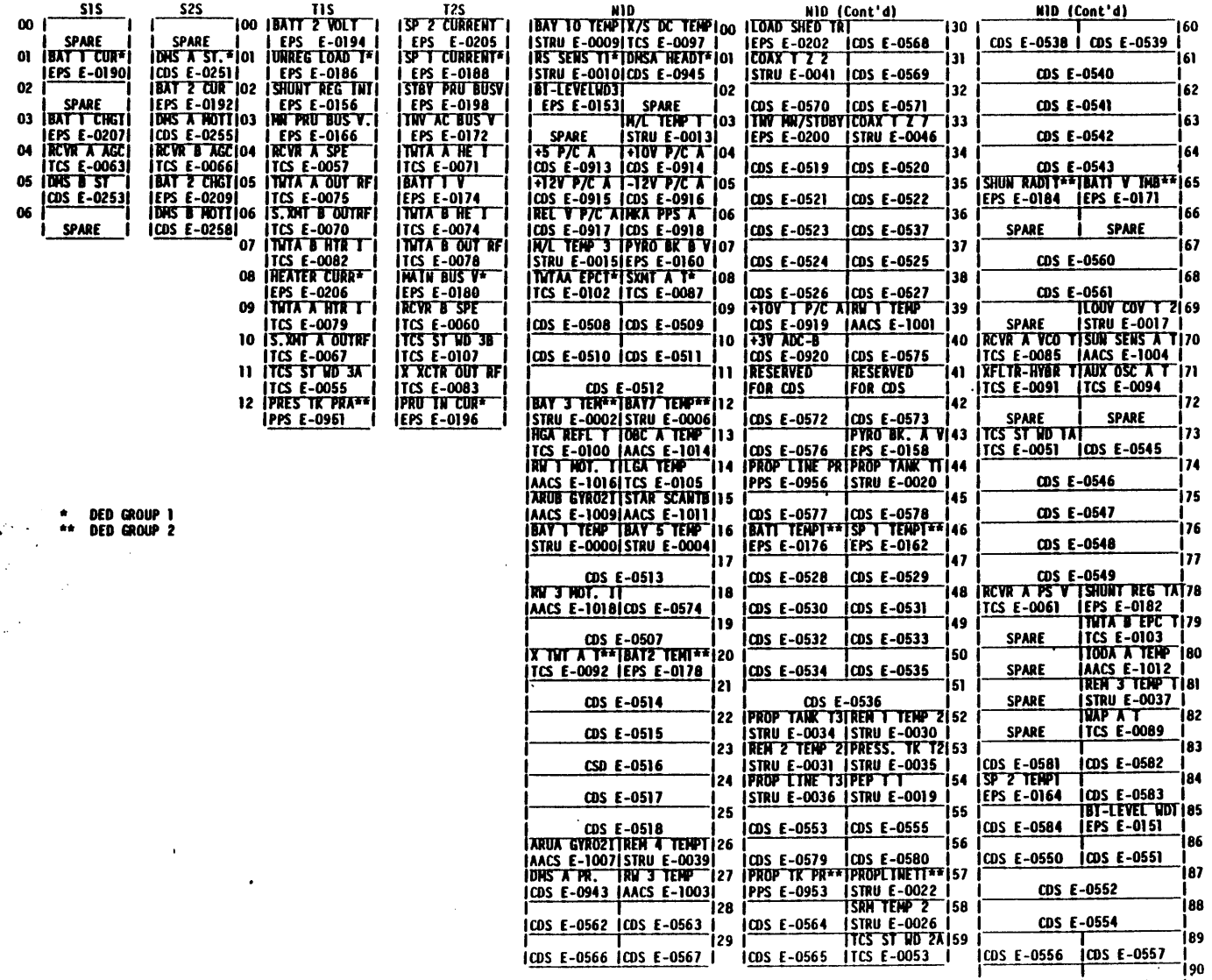


Figure A2.2.12 Fixed Area Measurement Assignment - HLM 1B (cont)

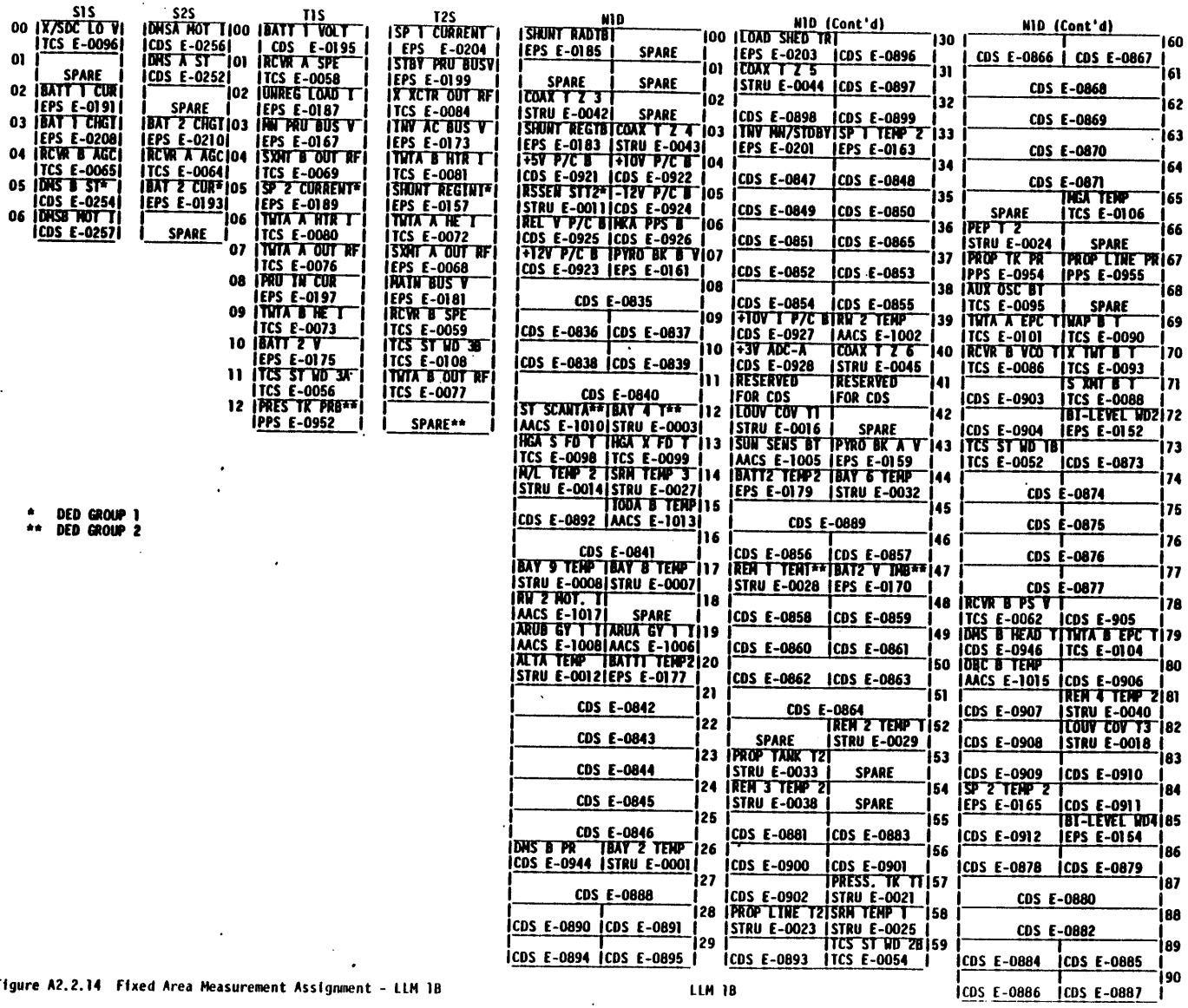
N1F (cont)	N1S (cont)	
		69
CDS E-0724	CDS E-0813	
		70
CDS E-0725	CDS E-0814	
		71
CDS E-0726	CDS E-0815	
		72
CDS E-0727	CDS E-0816	
		73
CDS E-0728	CDS E-0817	
		74
CDS E-0729	CDS E-0818	
		75
CDS E-0730	CDS E-0819	
		76
CDS E-0731	CDS E-0820	
		77
CDS E-0732	CDS E-0821	
		78
CDS E-0733	CDS E-0822	
		79
CDS E-0734	CDS E-0823	
		80
CDS E-0735	CDS E-0824	
SPARE		81
CDS E-0719	CDS E-0825	
SPARE		82
CDS E-0720	CDS E-0826	
SPARE		83
CDS E-0736	CDS E-0827	
SPARE		84
CDS E-0737	CDS E-0828	
SPARE		85
CDS E-0738	CDS E-0829	
SPARE		86
CDS E-0739	CDS E-0830	
SPARE		87
CDS E-0740	CDS E-0831	
SPARE		88
CDS E-0741	CDS E-0832	
SPARE		89
CDS E-0742	CDS E-0833	
SPARE		90
CDS E-0743	CDS E-0834	

Figure A2.2.12 Fixed Area Measurement Assignment - HLM 1B (concl)



* DED GROUP 1
** DED GROUP 2

Figure A2.2.13 Fixed Area Measurement Assignment - IIM 1A



* DED GROUP 1
** DED GROUP 2

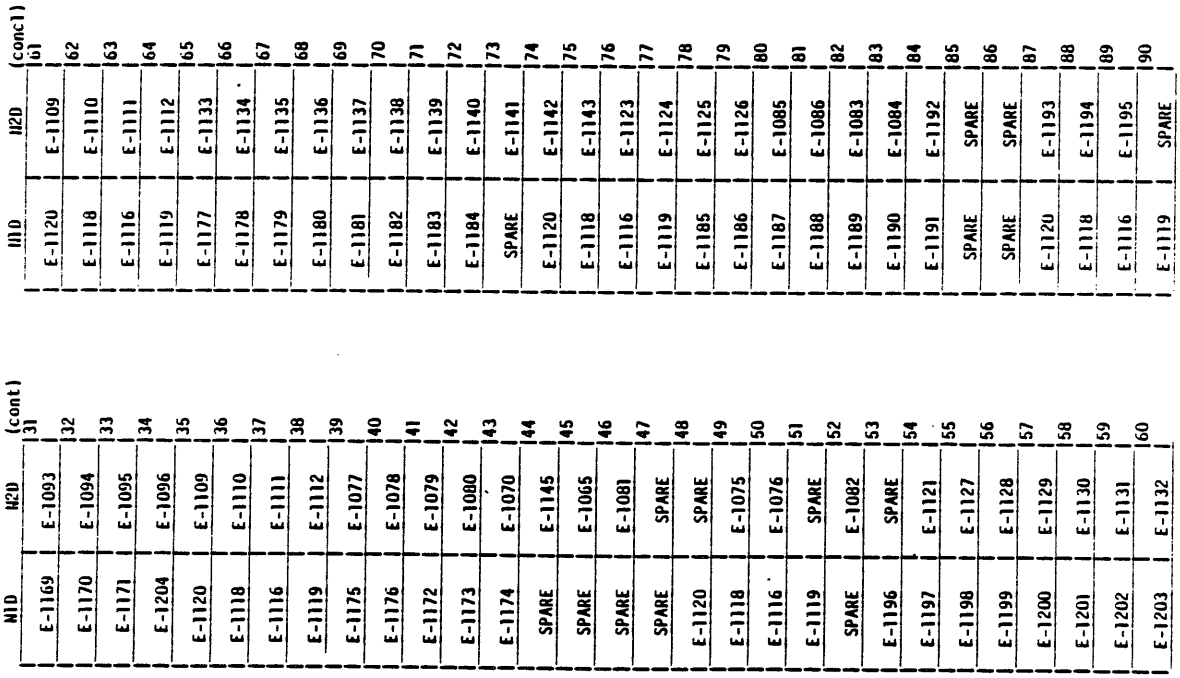
Figure A2.2.14 Fixed Area Measurement Assignment - LLM 1B

LLM 1B

T1D	T2D	T3D
E-1019	E-1020	E-1021
E-1022	E-1023	E-1024
E-1031	E-1032	E-1033
E-1034	E-1035	E-1036
E-1058	E-1060	E-1063
E-1059	E-1062	E-1064
E-1057	E-1061	E-1051
E-1040	E-1041	E-1042
E-1043	E-1044	E-1045
E-1046	E-1047	E-1048
E-1050	E-1052	E-1053
E-1054	E-1049	E-1114
E-1113	E-1115	E-1117

N1D	N2D
E-1055	E-1072
E-1148	E-1066
E-1149	E-1067
E-1150	E-1068
E-1151	E-1088
E-1152	E-1089
E-1153	E-1090
E-1154	E-1144
E-1087	E-1071
E-1120	E-1109
E-1118	E-1110
E-1116	E-1111
E-1119	E-1112
E-1155	E-1097
E-1156	E-1098
E-1157	E-1099
E-1158	E-1100
E-1159	E-1101
E-1160	E-1102
E-1161	E-1103
E-1162	E-1104
E-1163	E-1105
E-1120	E-1106
E-1118	E-1107
E-1116	E-1108
E-1119	E-1069
E-1164	E-1025
E-1165	E-1026
E-1166	E-1027
E-1167	E-1091
E-1168	E-1092

N1U	N2U	N3U
E-1028	E-1029	E-1147



N1D	N2D (cont)	
E-1169	E-1093	31
E-1170	E-1094	32
E-1171	E-1095	33
E-1204	E-1096	34
E-1120	E-1109	35
E-1118	E-1110	36
E-1116	E-1111	37
E-1119	E-1112	38
E-1175	E-1077	39
E-1176	E-1078	40
E-1172	E-1079	41
E-1173	E-1080	42
E-1174	E-1070	43
SPARE	E-1145	44
SPARE	E-1065	45
SPARE	E-1081	46
SPARE	SPARE	47
E-1120	SPARE	48
E-1118	E-1075	49
E-1116	E-1076	50
E-1119	SPARE	51
SPARE	E-1082	52
E-1196	SPARE	53
E-1197	E-1121	54
E-1198	E-1127	55
E-1199	E-1128	56
E-1200	E-1129	57
E-1201	E-1130	58
E-1202	E-1131	59
E-1203	E-1132	60

N1D	N2D (concl)	
E-1120	E-1109	61
E-1118	E-1110	62
E-1116	E-1111	63
E-1119	E-1112	64
E-1177	E-1133	65
E-1178	E-1134	66
E-1179	E-1135	67
E-1180	E-1136	68
E-1181	E-1137	69
E-1182	E-1138	70
E-1183	E-1139	71
E-1184	E-1140	72
SPARE	E-1141	73
E-1120	E-1142	74
E-1118	E-1143	75
E-1116	E-1123	76
E-1119	E-1124	77
E-1185	E-1125	78
E-1186	E-1126	79
E-1187	E-1085	80
E-1188	E-1086	81
E-1189	E-1083	82
E-1190	E-1084	83
E-1191	E-1192	84
SPARE	SPARE	85
SPARE	SPARE	86
E-1120	E-1193	87
E-1118	E-1194	88
E-1116	E-1195	89
E-1119	SPARE	90

Figure A2.2.15 Fixed Area Measurement Assignments - AACS (concl)

THIS PAGE INTENTIONALLY LEFT ALMOST BLANK.
To visualize what it would have looked like
had it been left totally blank, turn page over.

TABLE A2.2.8 VRM VARIABLE TELEMETRY PACKET LISTING

PACKET SOURCE	PACKET NAME	MEAS. 1	MEAS. 2	MEAS. 3	MEAS. 4	MEAS. 5
Low Level Module 1A	LLM 1A 01	E-0151 Bi-L Wd.1	E-0153 Bi-L Wd.3	Spare	Spare	E-1300 IUS Stat Wd. 1
	LLM 1A 02	E-1007 ARU A Gy 2 Current	E-1009 ARU B Gy 2 Current	E-0953 Prop TK. PR B	E-0956 Prop Line PR	Spare
Low Level Module 1B	LLM 1B 01	E-0152 Bi-L Wd.2	E-0154 Bi-L Wd.4	E-0952 Press. TK PR B	E-1006 ARU A Gy 1 Current	E-1008 ARU B Gy 1 Current
	LLM 1B 02	Spare	Spare	Spare	Spare	E-1301 IUS Stat Wd 2
AACS	AACS 01	E-1031 Average Body Rate Vector X				Spare
	AACS 02	E-1032 Average Body Rate Vector Y				Spare
	AACS 03	E-1033 Average Body Rate Vector Z				Spare
	AACS 04	E-1022 Current Attitude Quaternion 1				Spare
	AACS 05	E-1023 Current Attitude Quaternion 2				Spare
	AACS 06	E-1024 Current Attitude Quaternion 3				Spare
	AACS 07	E-1057 ARU Net Counts Wd 1		E-1058 ARU Net Counts Wd 2		Spare
	AACS 08	E-1059 ARU Net Counts Wd 3		E-1060 ARU Net Counts Wd 4		Spare
	AACS 09	E-1061 ARU Net Counts Wd 5		E-1062 ARU Net Counts Wd 6		Spare
	AACS 10	E-1063 ARU Net Counts Wd 7		E-1064 ARU Net Counts Wd 8		Spare
	AACS 11	E-1037 RW 1 Command		E-1038 RW 2 Command		Spare
	AACS 12	E-1039 RW 3 Command		E-1040 Tach 1 Speed		Spare
	AACS 13	E-1041 Tach 2 Speed		E-1042 Tach 3 Speed		Spare
	AACS 14	E-1206 RAM Safing Time				Spare
	AACS 15	E-1030 Att. Error Vector Z		E-1146 FP Status (Pk Wd 1)		E-1205 Current Att. Quaternion 4 (MSB)

Packet Position	1	2	3	4	5	6	7
Packet Name	LLM1A 01	LLM1B 01	LLM1B 02	AACS 14	SPARE	SPARE	AACS 15
Timing Position	A	A	B	N/A	N/A	N/A	N/A

Anomaly Format

Packet Name	LLM1A 01	LLM1B 01	LLM1B 02	AACS 01	AACS 02	AACS 03	AACS 15
Timing Position	A	A	B	N/A	N/A	N/A	N/A

Launch Phase Format

Packet Name	LLM1A 01	LLM1A 02	LLM1B 01	AACS 01	AACS 02	AACS 03	AACS 15
Timing Position	A	B	A	N/A	N/A	N/A	N/A

Delta-V Format

Packet Name	AACS 11	AACS 12	AACS 13	AACS 01	AACS 02	AACS 03	AACS 15
Timing Position	N/A	N/A	N/A	N/A	N/A	N/A	N/A

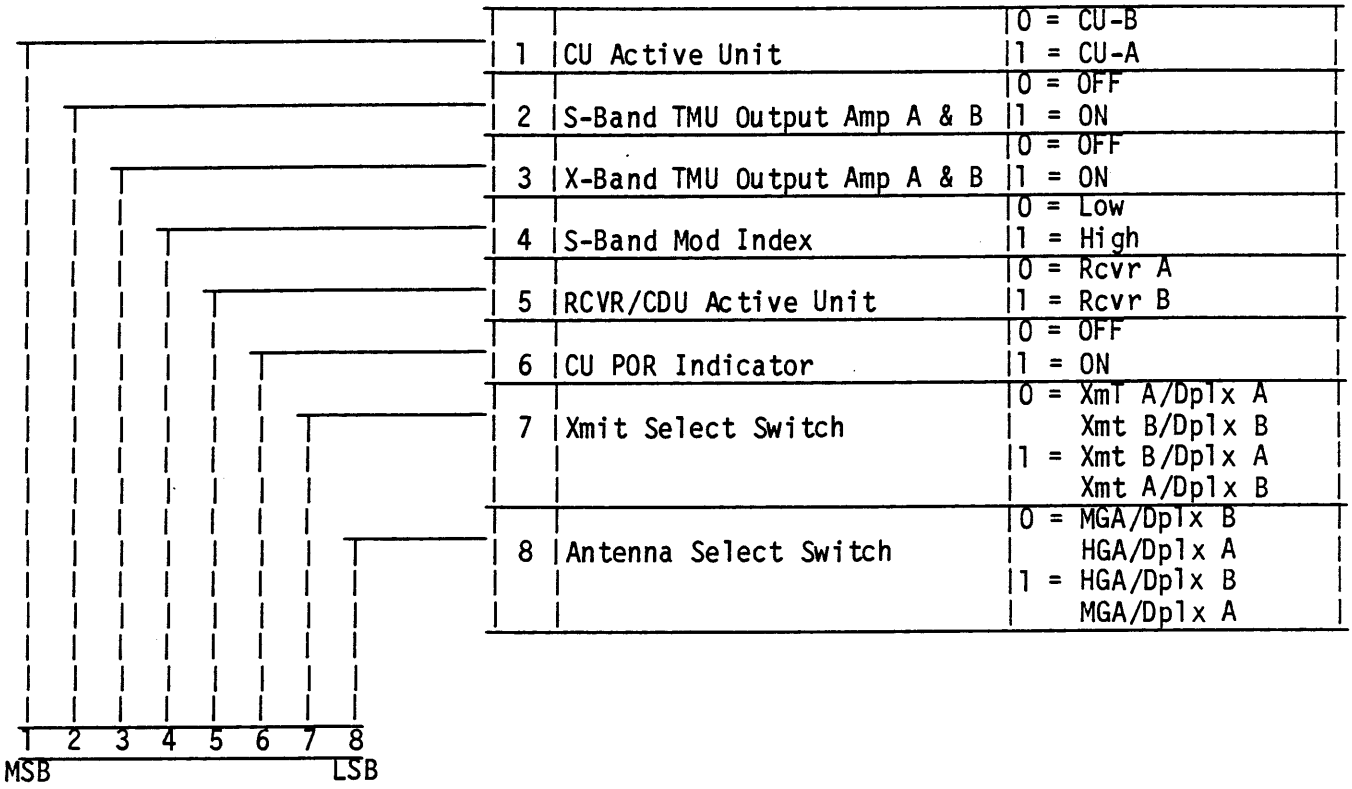
Maneuver Format

Figure A2.2.16. VRM Variable Engineering Formats

A2.2.11.3 Digital and Software Measurements

Table A2.2.9 provides detailed data for each digital software measurement. This data includes subsystem, title, measurement engineering number, type (digital/software), width in bits, and the interpretation of individual bits.

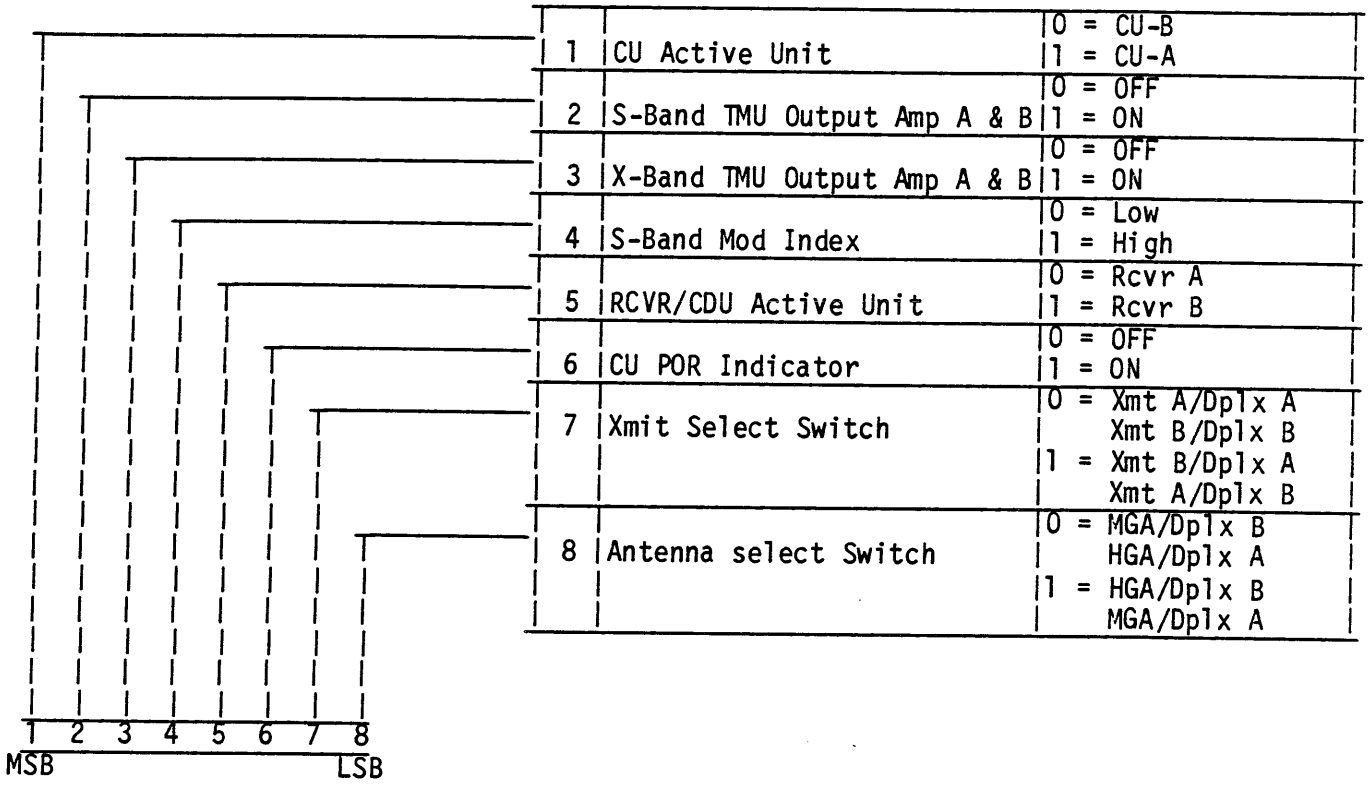
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS



1	CU Active Unit	0 = CU-B 1 = CU-A
2	S-Band TMU Output Amp A & B	0 = OFF 1 = ON
3	X-Band TMU Output Amp A & B	0 = OFF 1 = ON
4	S-Band Mod Index	0 = Low 1 = High
5	RCVR/CDU Active Unit	0 = Rcvr A 1 = Rcvr B
6	CU POR Indicator	0 = OFF 1 = ON
7	Xmit Select Switch	0 = Xmt A/Dplx A Xmt B/Dplx B 1 = Xmt B/Dplx A Xmt A/Dplx B
8	Antenna Select Switch	0 = MGA/Dplx B HGA/Dplx A 1 = HGA/Dplx B MGA/Dplx A

E-0051 TCS Status Word 1(A)

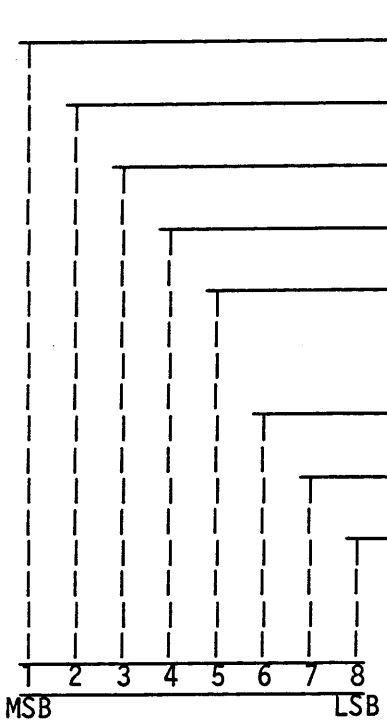
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)



1	CU Active Unit	0 = CU-B 1 = CU-A
2	S-Band TMU Output Amp A & B	0 = OFF 1 = ON
3	X-Band TMU Output Amp A & B	0 = OFF 1 = ON
4	S-Band Mod Index	0 = Low 1 = High
5	RCVR/CDU Active Unit	0 = Rcvr A 1 = Rcvr B
6	CU POR Indicator	0 = OFF 1 = ON
7	Xmit Select Switch	0 = Xmt A/Dplx A Xmt B/Dplx B 1 = Xmt B/Dplx A Xmt A/Dplx B
8	Antenna select Switch	0 = MGA/Dplx B HGA/Dplx A 1 = HGA/Dplx B MGA/Dplx A

E-0052 TCS Status Word 1(B)

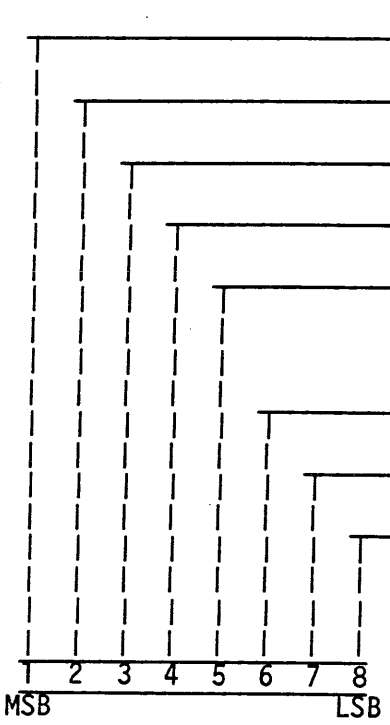
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)



1	Rcvr In Lock Indicator	0 = Out Of Lock 1 = In Lock
2	TWTA A and B	0 = OFF 1 = ON
3	X-Band Exciter	0 = OFF 1 = ON
4	X-Band Eng Subcarrier A & B	0 = OFF 1 = ON
5	Rcvr Select Switch	0 = Rcvr A/Dplx Sel Sw. Rcvr B/LGA 1 = Rcvr B/Dplx Sel Sw. Rcvr A/LGA
6	Dplxr Select Switch	0 = Rcvrs/Dplx A 1 = Rcvrs/Dplx B
7	LO Select Switch	0 = Rcvr A/XSDC 1 = Rcvr B/XSDC
8	CDU Cmd Bit Rate	0 = 62.5 1 = 7.8125

E-0053 TCS Status Word 2(A)

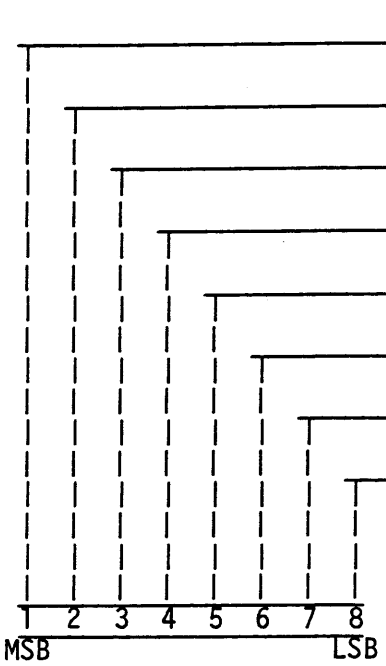
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)



1	Rcvr In Lock Indicator	0 = Out Of Lock 1 = In Lock
2	TWTA A and B	0 = OFF 1 = ON
3	X-Band Exciter	0 = OFF 1 = ON
4	X-Band Eng Subcarrier A & B	0 = OFF 1 = ON
5	Rcvr Select Switch	0 = Rcvr A/Dplx Sel Sw. Rcvr B/LGA 1 = Rcvr B/Dplx Sel Sw. Rcvr A/LGA
6	Dplxr Select Switch	0 = Rcvrs/Dplx A 1 = Rcvrs/Dplx B
7	LO Select Switch	0 = Rcvr A/XSDC 1 = Rcvr B/XSDC
8	CDU Cmd Bit Rate	0 = 62.5 1 = 7.8125

E-0054 TCS Status Word 2(B)

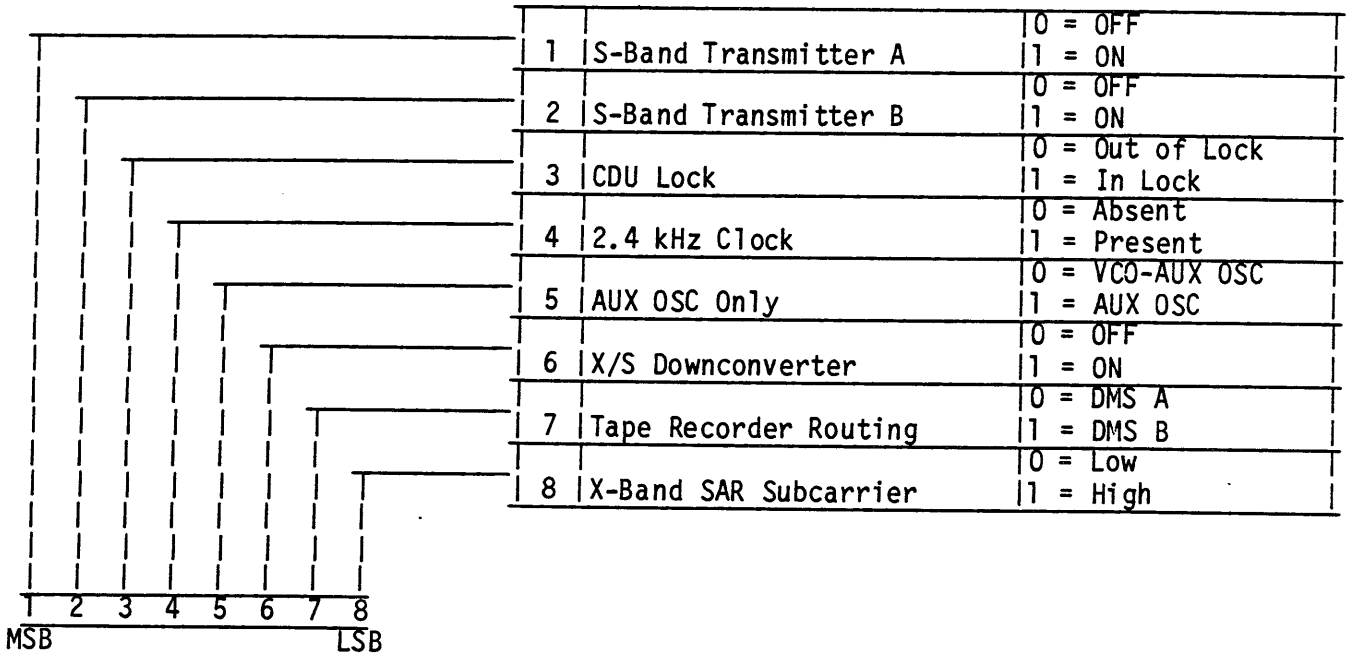
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)



1	S-Band Transmitter A	0 = OFF 1 = ON
2	S-Band Transmitter B	0 = OFF 1 = ON
3	CDU Lock	0 = Out of Lock 1 = In Lock
4	2.4 kHz Clock	0 = Absent 1 = Present
5	AUX OSC Only	0 = VCO-Aux OSC 1 = Aux OSC
6	X/S Downconverter	0 = OFF 1 = ON
7	Tape Recorder Routing	0 = DMS A 1 = DMS B
8	X-Band SAR Subcarrier	0 = Low 1 = High

E-0055, 0056 TCS Status Word 3A

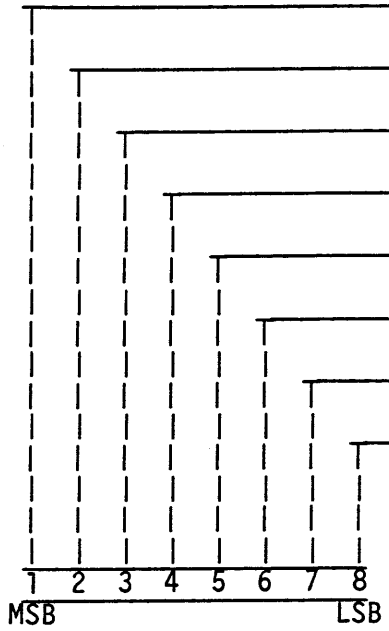
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)



1	S-Band Transmitter A	0 = OFF 1 = ON
2	S-Band Transmitter B	0 = OFF 1 = ON
3	CDU Lock	0 = Out of Lock 1 = In Lock
4	2.4 kHz Clock	0 = Absent 1 = Present
5	AUX OSC Only	0 = VCO-AUX OSC 1 = AUX OSC
6	X/S Downconverter	0 = OFF 1 = ON
7	Tape Recorder Routing	0 = DMS A 1 = DMS B
8	X-Band SAR Subcarrier	0 = Low 1 = High

E-0107, 0108 TCS Status Word 3B

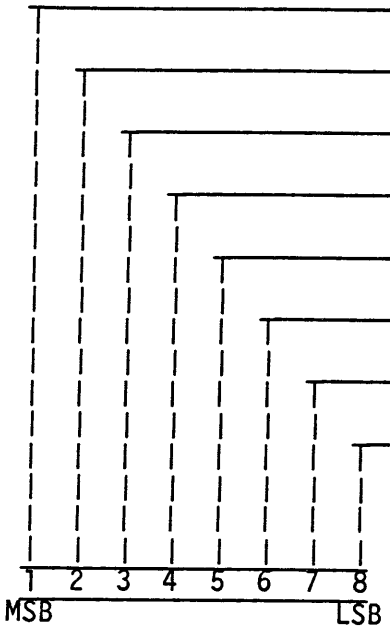
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)



Bit	Measurement	Contents
1	SPARE	
2	Batt. 1 Cell Fail Det. En	0 = Enabled 1 = Inhibited
3	Batt. 1 Float/Reconnect	0 = Reconnect 1 = Float
4	PSU Pyro Arm Ind.	0 = Armed 1 = Not Armed
5	Batt. 1 Disconnect	0 = Connected 1 = Disconnected
6	Batt. 1 Overtemp C/O Enable	0 = Enabled 1 = Inhibited
7	Batt. 1 Recond L/V Det. En.	0 = Enabled 1 = Inhibited
8	Solar Panel Deployment Lock	0 = Not Deployed 1 = Deployed

E-0151 Bi-Level Word 1

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

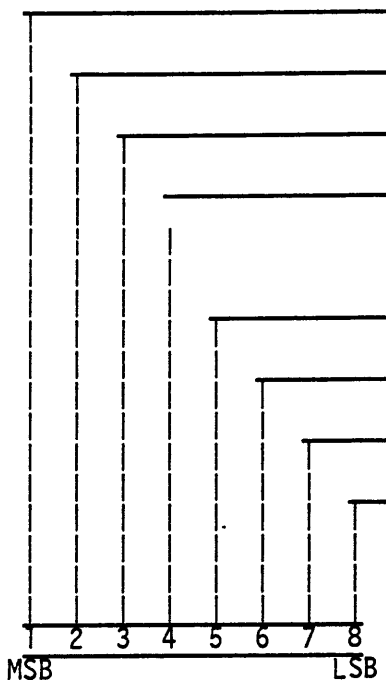


Bit	Measurement	Contents
1	PSU Pyro Unshort Ind.	0 = Unshorted 1 = Shorted
2	Batt. 2 Cell Fail Det. En.	0 = Enabled 1 = Inhibited
3	Batt. 2 Float/Reconnect	0 = Reconnect 1 = Float
4	DC Bus U/V Sensor Enable	0 = Enabled 1 = Inhibited
5	Batt. 2 Disconnect	0 = Connected 1 = Disconnected
6	Batt. 2 Overtemp C/O Enable	0 = Enabled 1 = Inhibited
7	Batt. 2 Recond L/V Det En.	0 = Enabled 1 = Inhibited
8	IUS-Shuttle Orb Sep Ind.	0 = Separation 1 = No Separation

E-0152 Bi-Level Word 2

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

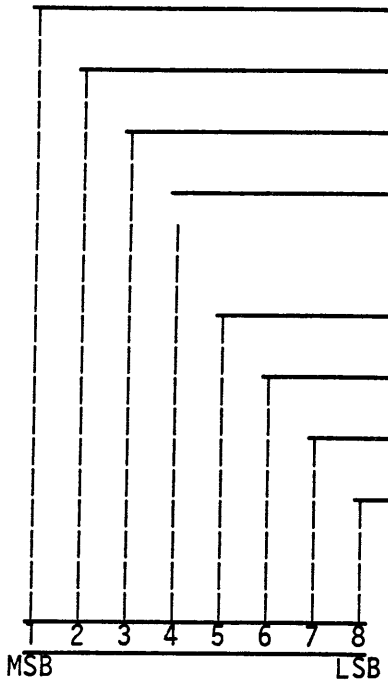
Bit	Measurement	Contents
1	CDS 4.8 kHz Test A	0 = Inhibited 1 = Enabled
2	V/T Level 7-8	0 = On Curve 7-8 1 = Not on Curve 7-8
3	SRM Safe/Arm 1 Safe Ind.	0 = Not Safe 1 = Safe
4	EPS Pyro Amps 1A Status	0 = Even # of Pyro Events since BOM/POR 1 = Odd # of Pyro Events since BOM/POR
5	Latch Valve 1 Open Position	0 = Not Open 1 = Open
6	PSU 1A Enable Relays A Stat	0 = Disabled 1 = Not Disabled
7	SRM Safe/Arm 1 Arm Ind.	0 = Not Armed 1 = Armed
8	SFS-IUS Sep Ind. 1	0 = Separation 1 = No Separation



E-0153 Bi-Level Word 3

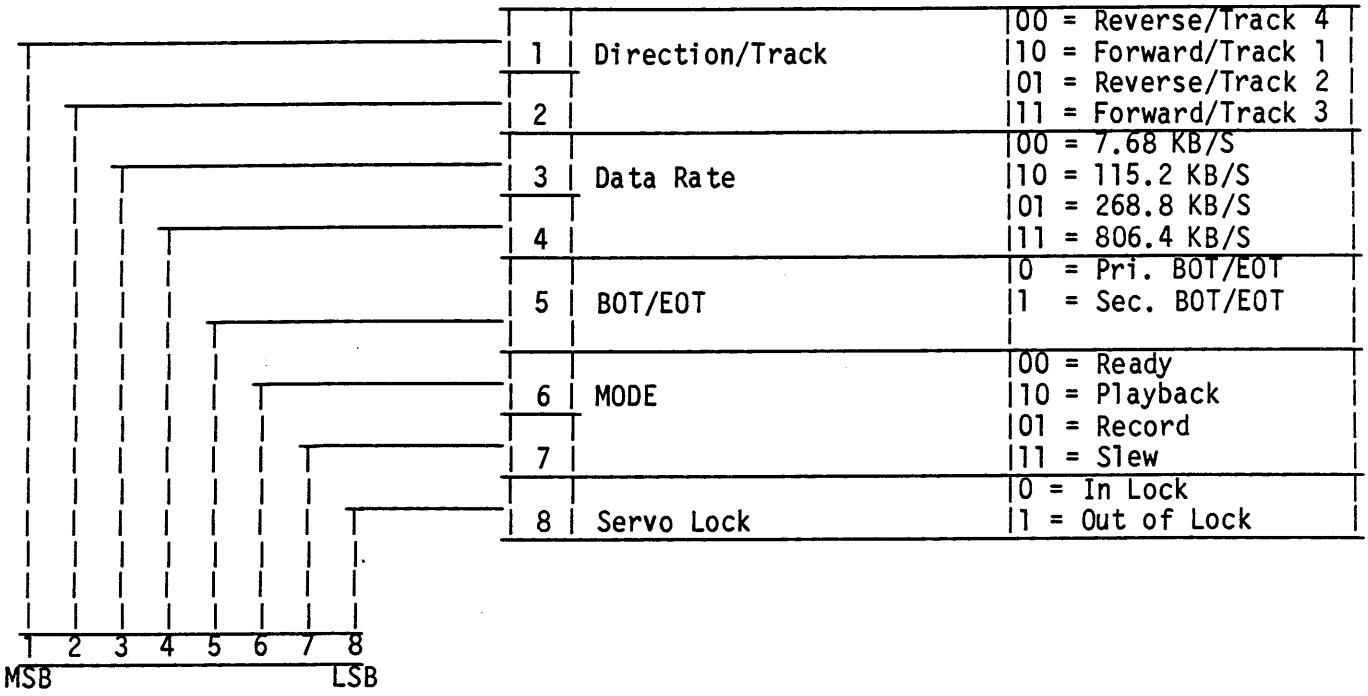
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Bit	Measurement	Contents
1	CDS 4.8 kHz Test B	0 = Inhibited 1 = Enabled
2	V/T Level 7-8	0 = On Curve 7-8 1 = Not on Curve 7-8
3	SRM Safe/Arm 2 Safe Ind.	0 = Not Safe 1 = Safe
4	EPS Pyro Amps 1B Status	0 = Even # of Pyro Events since BOM/POR 1 = Odd # of Pyro Events since BOM/POR
5	Latch Valve 2 Open Position	0 = Not Open 1 = Open
6	PSU 1B Enable Relays B Stat	0 = Disabled 1 = Not Disabled
7	SRM Safe/Arm 2 Arm Ind.	0 = Not Armed 1 = Armed
8	SFS-IUS Sep Ind. 2	0 = Separation 1 = No Separation



E-0154 Bi-Level Word 4

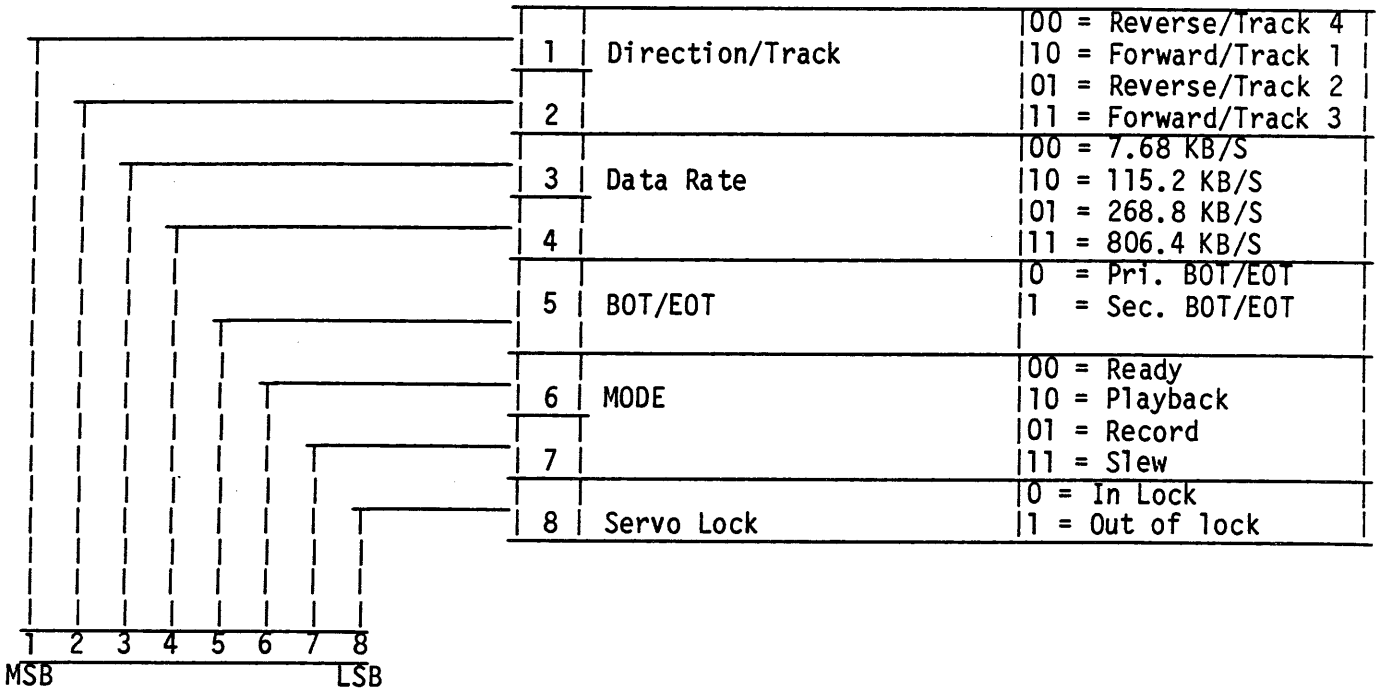
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)



1	Direction/Track	00 = Reverse/Track 4 10 = Forward/Track 1 01 = Reverse/Track 2 11 = Forward/Track 3
2		
3	Data Rate	00 = 7.68 KB/S 10 = 115.2 KB/S 01 = 268.8 KB/S 11 = 806.4 KB/S
4		
5	BOT/EOT	0 = Pri. BOT/EOT 1 = Sec. BOT/EOT
6	MODE	00 = Ready 10 = Playback 01 = Record 11 = Slew
7		
8	Servo Lock	0 = In Lock 1 = Out of Lock

E-0251, 0252: DMS A - Status Data

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)



E-0253, E-0254: DMS B - Status Data

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1	HLM-1A MPLO	0 = Off 1 = On	D
2	HLM-1A Memory Swap	0 = Low 1 = High	D
3	HLM-1A write protect 5000-5FFF; D000-DFFF	0 = Off 1 = On	D
4	HLM-1A write protect 4000-4FFF; C000-CFFF	0 = Off 1 = On	D
5	HLM-1A write protect 3000-3FFF; B000-BFFF	0 = Off 1 = On	D
6	HLM-1A write protect 2000-2FFF; A000-AFFF	0 = Off 1 = On	D
7	HLM-1A write protect 1000-1FFF; 9000-9FFF	0 = Off 1 = On	D
8	HLM-1A write protect 0000-0FFF; 8000-8FFF	0 = Off 1 = On	D

1 2 3 4 5 6 7 8

HLM1A CRC BANK A REGISTERS 0-3 (MSB) E-0300

Bit(s)	Measurement	Contents	
1	LLM-1A MPLO	0 = Off 1 = On	D
2	LLM-1A Memory Swap	0 = Low 1 = High	
3	LLM-1A CC/DC disable	0 = Off 1 = On	D
4	LLM-1A bus select	0 = BUS-1A 1 = BUS-1B	D
5	LLM-1A bus adapter write protect	0 = Off 1 = On	D
6	LLM-1A write protect 2000-2FFF; 6000-6FFF	0 = Off 1 = On	D
7	LLM-1A write protect 0000-1FFF; 4000-5FFF	0 = Off 1 = On	D
8	SPARE		

1 2 3 4 5 6 7 8

HLM1A CRC BANK A REGISTERS 0-3 (2SB) E-0300

D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1	BUM-1A BA-2B write protect 1800-1FFF; 5800-5FFF	0 = Off 1 = On	D
2	BUM-1A BA-2B write protect 1000-17FF; 5000-57FF	0 = Off 1 = On	D
3	BUM-1A BA-2B write protect 0800-0fff; 4800-4FFF	0 = Off 1 = On	D
4	BUM-1A BA-2B write protect 0000-07FF; 4000-47FF	0 = Off 1 = On	D
5	BUM-1A BA-1A write protect 1800-1FFF; 5800-5FFF	0 = Off 1 = On	D
6	BUM-1A BA-1A write protect 1000-17FF; 5000-57FF	0 = Off 1 = On	D
7	BUM-1A BA-1A write protect 0800-0FFF; 4800-4FFF	0 = Off 1 = On	D
8	BUM-1A BA-1A write protect 0000-07FF; 4000-47FF	0 = Off 1 = On	D

1 2 3 4 5 6 7 8

HLM1A CRC BANK A REGISTERS 0-3 (3SB) E-0300

1	BUM-1A I/O Select Write Control	0 = BA-1A 1 = BA-2B	D
2	SPARE		
3	BUM-1A BA-2B bus select	0 = BUS-1A 1 = BUS-1B	D
4	BUM-1A BA-1A bus select	0 = BUS-1A 1 = BUS-1B	D
5	BUM-1A Memory Swap	0 = Low 1 = High	D
6	BUM-1A write protect 3000-37FF; 7000-7FFF	0 = Off 1 = On	D
7	BUM-1A write protect 2800-2FFF; 6800-6FFF	0 = Off 1 = On	D
8	BUM-1A write protect 2000-27FF; 6000-6700	0 = Off 1 = On	D

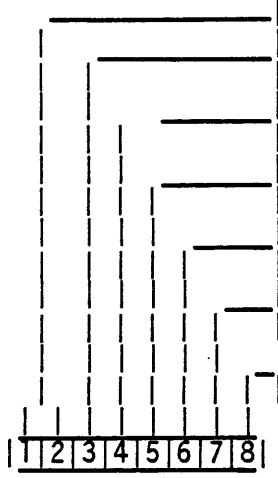
1 2 3 4 5 6 7 8

HLM1A CRC BANK A REGISTERS 0-3 (LSB) E-0300

D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1-2	Spare		
3	4.8 KHz reference select	0 = REF-1A 1 = REF-1B	D
4	DMS B Secondary BOT/EOT Select	0 = Enabled 1 = Inhibited	
5	DMS A Secondary BOT/EOT Select	0 = Enabled 1 = Inhibited	
6	Digital engineering serial-binary select	0 = LLM-1A 1 = LLM-1B	D
7	Digital engineering timing chain select	0 = TC-1A 1 = TC-1B	D
8	CRC-1A critical enable master	0 = Off 1 = On	



HLM1A CRC BANK A REGISTERS 4-6 (MSB) E-0301

1	HCD POR test control	0 = Off 1 = On	D
2-4	Spare		
5	HCD-1A override-3	0 = On 1 = Off	
6	HCD-1A override-2	0 = Off 1 = On	
7	HCD-1A override-1	0 = Off 1 = On	
8	HCD-1B disable	0 = Off 1 = On	

HLM1A CRC BANK A REGISTERS 4-6 (2SB) E-0301

D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1-2	Spare		
3	Critical enable F Batt. Disconnect Enable	0 = Inhibit 1 = Enable	
4	Critical enable E SRM Ignition Enable	0 = Inhibit 1 = Enable	
5	Critical enable D SRM Separation Enable	0 = Inhibit 1 = Enable	
6	Critical enable C (AACS memory B write protect)	0 = Reset 1 = Set	*
7	Critical enable B (AACS memory A write protect)	0 = Reset 1 = Set	*
8	Critical enable A Inverter Standby/Main	0 = Inhibit 1 = Enable	

1 2 3 4 5 6 7 8

HLM1A CRC BANK A REGISTERS 4-6 (LSB) E-0301

* Write Protect disabled when opposing string is set similarly;
Write Protect enabled when opposing string is set differently.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1	HLM-1B MPLO	0 = Off 1 = On	D
2	HLM-1B Memory Swap	0 = Low 1 = High	D
3	HLM-1B write protect 5000-5FFF; D000-DFFF	0 = Off 1 = On	D
4	HLM-1B write protect 4000-4FFF; C000-CFFF	0 = Off 1 = On	D
5	HLM-1B write protect 3000-3FFF; B000-BFFF	0 = Off 1 = On	D
6	HLM-1B write protect 2000-2FFF; A000-AFFF	0 = Off 1 = On	D
7	HLM-1B write protect 1000-1FFF; 9000-9FFF	0 = Off 1 = On	D
8	HLM-1B write protect 0000-0FFF; 8000-8FFF	0 = Off 1 = On	D

1 2 3 4 5 6 7 8

HLM1A CRC BANK B REGISTERS 0-3 (MSB) E-0303

1	LLM-1A MPLO	0 = Off 1 = On	D
2	LLM-1B Memory Swap	0 = Low 1 = High	
3	LLM-1B CC/DC disable	0 = Off 1 = On	D
4	LLM-1B bus select	0 = BUS-1A 1 = BUS-1B	D
5	LLM-1B bus adapter write protect	0 = Off 1 = On	D
6	LLM-1B write protect 2000-2FFF; 6000-6FFF	0 = Off 1 = On	D
7	LLM-1B write protect 0000-1FFF; 4000-5FFF	0 = Off 1 = On	D
8	SPARE		

1 2 3 4 5 6 7 8

HLM1A CRC BANK B REGISTERS 0-3 (2SB) E-0303

D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1	BUM-1B BA-2A write protect 1800-1FFF; 5800-5FFF	0 = Off 1 = On	D
2	BUM-1B BA-2A write protect 1000-17FF; 5000-57FF	0 = Off 1 = On	D
3	BUM-1B BA-2A write protect 0800-0FFF; 4800-4FFF	0 = Off 1 = On	D
4	BUM-1B BA-2A write protect 0000-07FF; 4000-47FF	0 = Off 1 = On	D
5	BUM-1B BA-1B write protect 1800-1FFF; 5800-5FFF	0 = Off 1 = On	D
6	BUM-1B BA-1B write protect 1000-17FF; 5000-57FF	0 = Off 1 = On	D
7	BUM-1B BA-1B write protect 0800-0FFF; 4800-4FFF	0 = Off 1 = On	D
8	BUM-1B BA-1B write protect 0000-07FF; 4000-47FF	0 = Off 1 = On	D

1 2 3 4 5 6 7 8

HLM1A CRC BANK B REGISTERS 0-3 (3SB) E-0303

1	BUM-1B I/O Select Write Control	0 = BA-1B 1 = BA-2A	D
2	SPARE		D
3	BUM-1B BA-2A bus select	0 = BUS-1A 1 = BUS-1B	D
4	BUM-1B BA-1B bus select	0 = BUS-1A 1 = BUS-1B	D
5	BUM-1B Memory Swap	0 = Low 1 = High	D
6	BUM-1B write protect 3000-3FFF; 7000-7FFF	0 = Off 1 = On	D
7	BUM-1B write protect 2800-2FFF; 6800-6FFF	0 = Off 1 = On	D
8	BUM-1B write protect 2000-27FF; 6000-67FF	0 = Off 1 = On	D

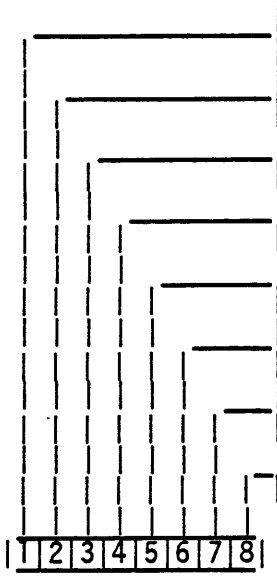
1 2 3 4 5 6 7 8

HLM1A CRC BANK B REGISTERS 0-3 (LSB) E-0303

D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

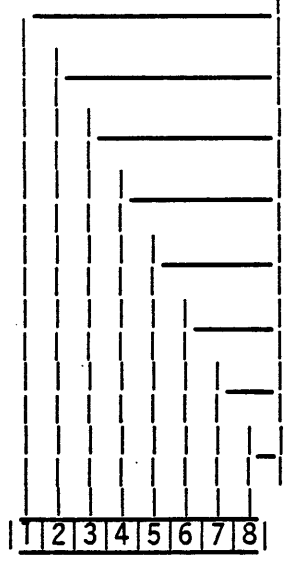
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1	Spare bus select	0 = BUS-1A 1 = BUS-1B	D
2	Spare bus select	0 = BUS-1A 1 = BUS-1B	D
3	RS-B bus select	0 = BUS-1A 1 = BUS-1B	D
4	RS-A bus select	0 = BUS-1A 1 = BUS-1B	D
5	Spare bus select	0 = BUS-1A 1 = BUS-1B	D
6	Spare bus select	0 = BUS-1A 1 = BUS-1B	D
7	AACS-B bus select	0 = BUS-1A 1 = BUS-1B	D
8	AACS-A bus select	0 = BUS-1A 1 = BUS-1B	D



HLM1A CRC BANK B REGISTERS 4-7 (MSB) E-0304

1	DBUM-1B Memory Swap	0 = Low 1 = High	D
2	DBUM-1A Memory Swap	0 = Low 1 = High	D
3	Spare		
4	HCD POR test select	0 = PC-1A 1 = PC-1B	D
5	Timing chain manual select control	0 = Off 1 - On	D
6	Timing chain manual (enable)	0 = TC-1A 1 = TC-1B	D
7	POR fault override control	0 = Off 1 = On	D
8	POR fault override select	0 = PC-B 1 = PC-A	D

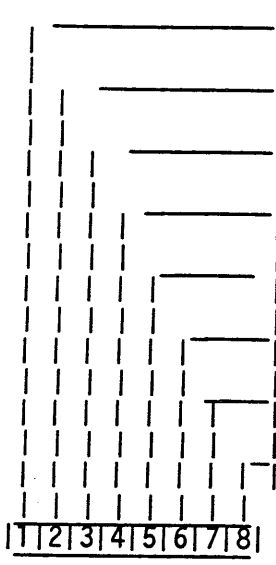


HLM1A CRC BANK B REGISTERS 4-7 (2SB) E-0304

D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

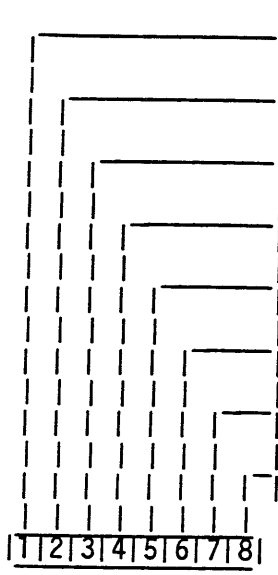
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents
1	Spare	
2	CU-B TLM Select	0 = CDS A 1 = CDS B
3	DMS B Pri EOT/BOT Sel	0 = Inhibited 1 = Enabled
4	SPARE	
5	SPARE	
6	CU-A TLM Select	0 = CDS A 1 = CDS B
7	DMS A Pri EOT/BOT Sel	0 = Inhibited 1 = Enabled
8	SPARE	



HLM1A CRC BANK B REGISTERS 4-7 (3SB) E-0304

1	DMS B DBUM select	0 = DBUM-1A 1 = DBUM-1B	D
2	DBUM-1B bus select	0 = BUS-1A 1 = BUS-1B	D
3	DMS A DBUM select	0 = DBUM-1A 1 = DBUM-1B	D
4	DBUM-1A bus select	0 = BUS-1A 1 = BUS-1B	D
5	CRC-1B bus adapter write protect	0 = Off 1 = On	D
6	CRC-1B bus select	0 = BUS-1A 1 = BUS-1B	D
7	CRC-1A bus adapter write protect	0 = Off 1 = On	D
8	CRC-1A bus select	0 = BUS-1A 1 = BUS-1B	D



HLM1A CRC BANK B REGISTERS 4-7 (LSB) E-0304

D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

Note 1 - The LLMs are the source only if both strings' CRC bit 3 are reset (logical 0).
The A string (LLM or BUM) is the source only if both strings' CRC bit 2 are reset (logical 0).

Note 2 - The LLMs are the source only if both strings' CRC bit 7 are reset (logical 0).
The B string (LLM or BUM) is the source only if both strings' CRC bit 6 are set (logical 1).

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents
1-6	HCD-1A command message number	6 LSBs of cmd message to HCD-1A
7	HCD-1A start word bit error status	0 = error-free start word 1 = error in start word
8	HCD-1A message status	0 = accepted 1 = rejected

|1|2|3|4|5|6|7|8|

HLM1A HCD COMMAND SUMMARY WORD E-0305

1-8	HCD-1A messages received and accepted counter	Increments by one for each message accepted by HCD-1A (MOD 256)

|1|2|3|4|5|6|7|8|

HLM1A MSG RCVD AND ACCEPTED COUNTER E-0306

1-8	HCD-1A messages received and rejected counter	Increments by one for each message rejected by HCD-1A (MOD 256)

|1|2|3|4|5|6|7|8|

HLM1A MSG RECEIVED AND REJECTED COUNTER E-0307

1-8	HCD-1A command frame errors detected counter	Increments by one for each command frame detected with errors by HCD-1A (MOD 256)

|1|2|3|4|5|6|7|8|

HLM1A CMD FRAME ERRORS DETECTED COUNTER E-0308

1-8	HCD-1A data frame errors corrected counter	Increments by one for each data frame corrected by HCD-1A (MOD 256)

|1|2|3|4|5|6|7|8|

HLM1A DATA FRAME ERRORS CORRECTED COUNTER E-0309

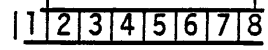
1-8	HCD-1A data frame errors uncorrectable counter	Increments by one for each erroneous data frame uncorrectable by HCD-1A (MOD 256)

|1|2|3|4|5|6|7|8|

HLM1A DATA FRAME ERRORS UNCORRECTABLE COUNTER E-0310

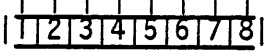
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents
1-8	HCD-1A lock changes errors detected counter	Increments by one for each lock change provided to HCD-1A (MOD 256)



HLM1A LOCK CHANGES COUNTER E-0311

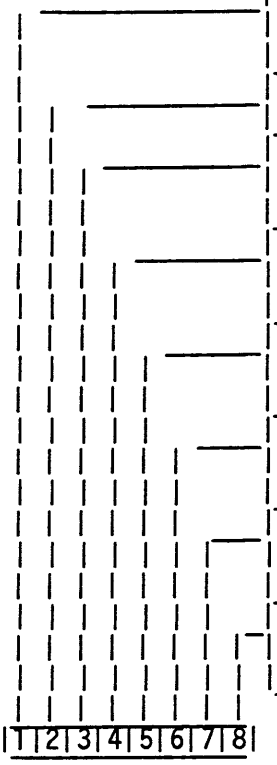
Bit(s)	Measurement	Contents
1	CRC-1A BA write busy error status	0 = no error 1 = write attempt when busy
2	CRC-1A BA write protect error status	0 = no error 1 = error
3	CRC-1A command block write attempt	0 = no attempt 1 = one or more attempts
4	CRC-1A power converter/ HCD POR status	0 = no POR 1 = one or more PORs
5	Spare	
6	Multiple frame CMD with zero data frames	0 = No error 1 = One or more errors
7	CRC-1A BA BUS parity error status	0 = No error 1 = One or more errors, any BA involved
8	CRC-1A BA transaction parity error status	0 = No error 1 = One or more errors, CRC-1A BA involved



HLM1A CRC STATUS WORD E-0312

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents
1	BUS-1A overrun status	0 = No overrun 1 = Overrun error, bus transaction in process at RTI
2	HLM-1A self-test failure status	0 = Pass 1 = Fail
3	HLM-1A keep-alive POR status	0 = No KAPOR 1 = One or more KAPORS with memory loss
4	HLM 1A POR status	0 = No POR 1 = One or more PORs, any power failure
5	HLM-1A microprocessor sync-idle status	0 = In sync 1 = Out of sync (1802 vs BIS) /idle lockup
6	SPARE	
7	HLM-1A BA bus parity error status	0 = No error 1 = One or more errors, any BA involved (BC or MUX)
8	HLM-1A BA transaction parity error status	0 = No error 1 = One or more errors, HLM-1A BA involved



HLM1A ERROR WORDS IOSL 0-1-2 (MSB) E-0313

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents
1	HCD parity error status	0 = No error 1 = One or more parity errors from HCD to HLM-1A
2	HLM-1A microprocessor memory read parity error status	0 = No error 1 = One or more parity errors when memory read by processor
3	HLM-1A BA memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA
4	HLM-1A bus controller memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BC
5	HLM-1A microprocessor lockout status	0 = No MPLO 1 = MPLO
6	HLM-1A BA write protect error status	0 = No error 1 = Write attempt by BA into protected memory
7	HLM-1A microprocessor write protect error status	0 = No error 1 = Write attempt by processor into protected memory
8	HCD write protection error status	0 = No error 1 = Write attempt by HCD into protected memory

1 2 3 4 5 6 7 8

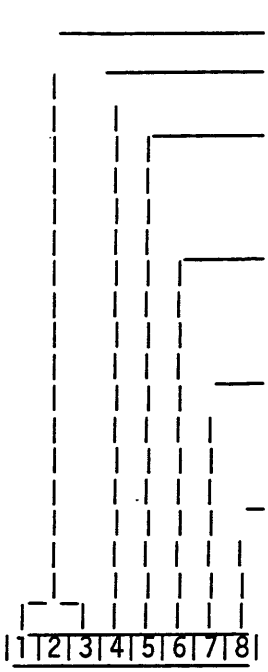
HLM1A ERROR WORDS IOSL 0-1-2 (2SB) E-0313

1-2	Grounded spare	
3	PLL-1B timing chain select status	0 = Timing chain A 1 = Timing chain B
4	PLL-1A timing chain select status	0 = Timing chain A 1 = Timing chain B
5-6	Grounded spare	
7	Phase locked loop 1B POR status	0 = No POR 1 = One or more PORs
8	Phase locked loop 1A POR status	0 = No POR 1 = One or more PORs

1 2 3 4 5 6 7 8

HLM1A ERROR WORDS IOSL 0-1-2 (LSB) E-0313

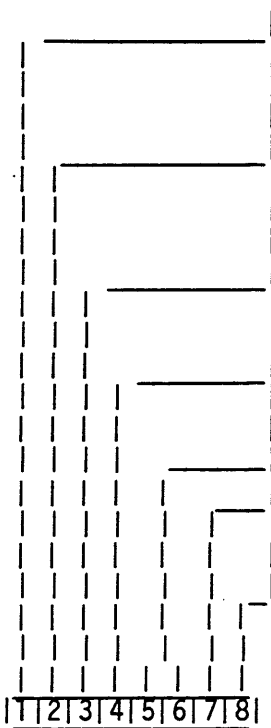
OTABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)



Bit(s)	Measurement	Contents
1-3	Spare	
4	BUM-1A POR status	0 = No POR 1 = One or more PORs
5	BUM-1A BA 2B bus parity error status	0 = No error 1 = One or more parity errors involving any BA on its bus
6	BUM-1A BA 2B transaction parity error status	0 = No error 1 = One or more parity errors involving BUM-1A's BA-2B
7	BUM-1A BA 1A bus parity error status	0 = No error 1 = One or more parity errors involving any BA on its bus
8	BUM-1A BA 1A transaction parity error status	0 = No error 1 = one or more parity errors involving BUM-1A's BA-1A

1 2 3 4 5 6 7 8

HLM1A BUM ERROR WORDS (IOSL 0) (MSB) E-0315



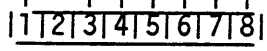
1	BUM-1A telemetry formatter memory read parity error status	0 = No error 1 = One or more parity errors when memory read by formatter
2	BUM-1A telemetry sequencer memory read parity error status	0 = No error 1 = One or more parity errors when memory read by sequencer
3	BUM-1A BA-2B memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA-2B
4	BUM-1A BA-1A memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA-1A
5-6	Grounded Spare	
7	BUM-1A BA-2B write protect error status	0 = No error 1 = Write attempt by BA-2B into protected memory
8	BUM-1A BA write protect error status	0 = No error 1 = Write attempt by BA-1A into protected memory

1 2 3 4 5 6 7 8

HLM1A BUM ERROR WORDS (IOSL 1) (2SB) E-0315

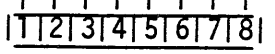
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents
1-3	Spare	
4	BUM-1B POR status	0 = No POR 1 = One or more PORs
5	BUM-1B BA-2A bus parity error status	0 = No error 1 = One or more parity errors involving any BA on its bus
6	BUM-1B BA-2A transaction parity error status	0 = No error 1 = One or more parity errors involving BUM-1B's BA 2
7	BUM-1B BA-1B bus parity error status	0 = No error 1 = One or more parity errors involving any BA on its bus
8	BUM-1A BA-1B transaction parity error status	0 = No error 1 = one or more parity errors involving BUM-1B's BA-1



HLM1A BUM ERROR WORDS (IOSL 0)(3SB) E-0315

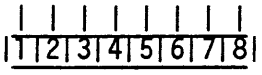
1	BUM-1B telemetry formatter memory read parity error status	0 = No error 1 = One or more parity errors when memory read by formatter
2	BUM-1B telemetry sequencer memory read parity error status	0 = No error 1 = One or more parity errors when memory read by sequencer
3	BUM-1B BA-2A memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA-2A
4	BUM-1B BA-1B memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA-1B
5-6	Grounded Spare	
7	BUM-1B BA-2A write protect error status	0 = No error 1 = Write attempt by BA-2A into protected memory
8	BUM-1B BA-1B write protect error status	0 = No error 1 = Write attempt by BA-1B into protected memory



HLM1A BUM ERROR WORDS (IOSL 1) (LSB) E-0315

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

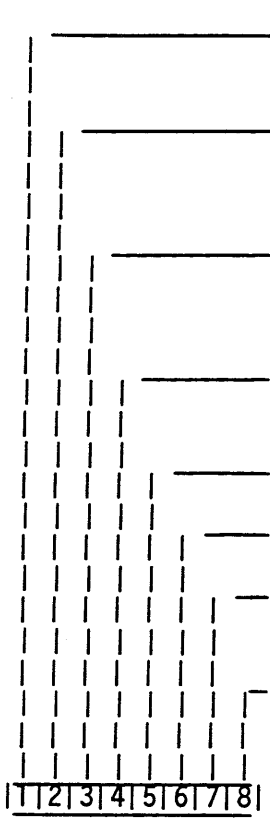
Bit(s)	Measurement	Contents
1	DMS illegal command status	0 = No illegal command 1 = Illegal cmd (not per DMS CMD dictionary)
2	DBUM-1A sequencer output memory read parity error status	0 = No error 1 = One or more parity errors when memory read by DBUM sequencer
3	DBUM-1A formatter memory read parity error status	0 = No error 1 = One or more parity errors when memory read by formatter
4	DBUM-1A bus adapter memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA
5	DMS A tape direction status	0 = Forward 1 = Reverse
6	DBUM-1A POR status	0 = No POR 1 = One or more PORs
7	DBUM-1A bus adapter bus parity error status	0 = No error 1 = one or more parity errors involving any BA
8	DBUM-1A BA transaction parity error status	0 = No error 1 = One or more parity errors involving DBUM-1A BA



HLM1A DBUM ERROR WORDS (IOSL 0) (MSB) E-0316

NOTE: This data not valid unless DBUM 1A is switched to String A.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)



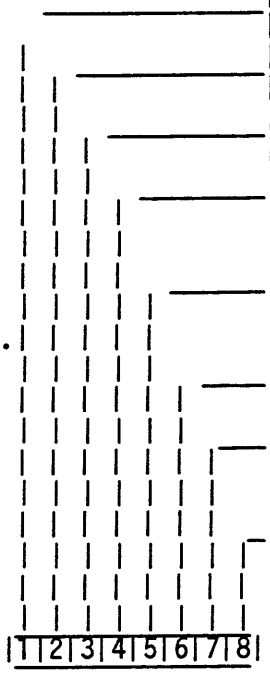
Bit(s)	Measurement	Contents
1	DMS illegal command status	0 = No illegal command 1 = Illegal cmd (not per DMS CMD dictionary)
2	DBUM-1B sequencer output memory read parity error status	0 = No error 1 = One or more parity errors when memory read by DBUM sequencer
3	DBUM-1B formatter memory read parity error status	0 = No error 1 = One or more parity errors when memory read by formatter
4	DBUM-1b bus adapter memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA
5	DMS B tape direction status	0 = Forward 1 = Reverse
6	DBUM-1B POR status	0 = No POR 1 = One or more PORs
7	DBUM-1B bus adapter bus parity error status	0 = No error 1 = one or more parity errors involving any BA
8	DBUM-1B BA transaction parity error status	0 = No error 1 = One or more parity errors involving DBUM-1B BA

HLM1A DBUM ERROR WORDS (IOSL 0) (LSB) E-0316

NOTE: This data not valid unless DBUM 1B is switched to String A.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

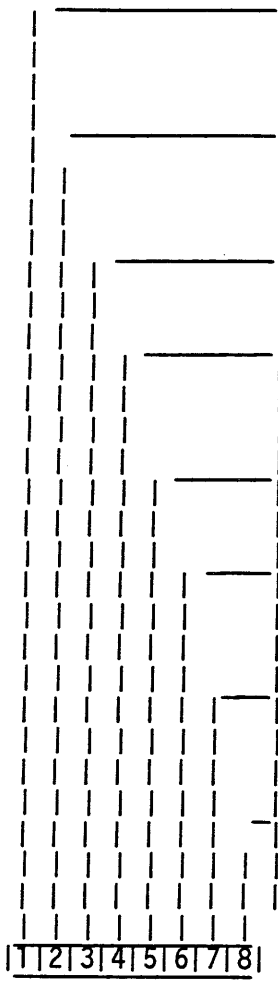
Bit(s)	Measurement	Contents
1	LLM-1A microprocessor lockout status	0 = No MPLO 1 = MPLO
2	LLM-1A self-test failure status	0 = Pass 1 = Fail
3	CC/DC in-process status	0 = No cmd beginning execute 1 = Cmd beginning execute
4	LLM-1A POR status	0 = No POR 1 = One or more PORs, any power failure
5	LLM-1A microprocessor sync-idle error status	0 = In sync 1 = Out of sync (1802 vs BIS) /idle lockup
6	CC/DC hardware buffer full status	0 = Empty 1 = Full
7	LLM-1A BA bus parity error status	0 = No error 1 = one or more errors, any BA involved
8	LLM-1A BA transaction parity error status	0 = No error 1 = One or more errors, LLM-1A BA involved



LLM1A ERROR WORD-1 IOSL-0 E-0550

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

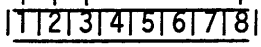
Bit(s)	Measurement	Contents
1	LLM-1A TLM port memory read parity error status	0 = No error 1 = One or more parity errors when memory read by TLM port
2	LLM-1A microprocessor memory read parity error status	0 = No error 1 = One or more parity errors when memory read by processor
3	LLM-1A BA memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA
4	Engineering control port memory read parity error status	0 = No error 1 = One or more parity errors when memory read by engr. control port
5	CC/DC error status	0 = Overwrite not attempted 1 = Attempt to load CC/DC H/W buffer when already full
6	LLM-1A BA write protect error status	0 = No error 1 = Write attempt by BA into protected memory, or I/O selects
7	LLM-1A microprocessor write protect error status	0 = No error 1 = Write attempt by processor into protected memory
8	Engineering data port write protect error status	0 = No error 1 = Write attempt by engr. data port into protected memory



LLM1A ERROR WORD-2 IOSL-1 E-0551

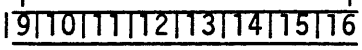
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents
1	DMS BOT/EOT status	0 = BOT 1 = EOT
2	DMS leader/tape status	0 = On tape 1 = On leader
3-8	Tic count status (6 MSB)	6 MSBs of the 14 bit tic count



LLM1A DMS TIC COUNT INPUT A, B (IOSL 7) (MSB)
E-0560, E-0561

9-16	Tic count status (8 LSB)	8 LSBs of the 14 bit tic count



LLM1A DMS TIC COUNT INPUT A, B (IOSL 8) (LSB)
E-0560, 0561

NOTE: E-0560 valid if DBUM 1A is switched to String A.

E-0561 valid if DBUM 1B is switched to String A.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1	HLM-1A MPLO	0 = Off 1 = On	D
2	HLM-1A Memory Swap	0 = Low 1 = High	D
3	HLM-1A write protect 5000-5FFF; D000-DFFF	0 = Off 1 = On	D
4	HLM-1A write protect 4000-4FFF; C000-CFFF	0 = Off 1 = On	D
5	HLM-1A write protect 3000-3FFF; B000-BFFF	0 = Off 1 = On	D
6	HLM-1A write protect 2000-2FFF; A000-AFFF	0 = Off 1 = On	D
7	HLM-1A write protect 1000-1FFF; 9000-9FFF	0 = Off 1 = On	D
8	HLM-1A write protect 0000-0FFF; 8000-8FFF	0 = Off 1 = On	D

1 2 3 4 5 6 7 8

HLM1B CRC BANK A REGISTERS 0-3 (MSB) E-0629

1	LLM-1A MPLO	0 = Off 1 = On	D
2	LLM-1A Memory Swap	0 = Low 1 = High	
3	LLM-1A CC/DC disable	0 = Off 1 = On	D
4	LLM-1A bus select	0 = BUS-1A 1 = BUS-1B	D
5	LLM-1A bus adapter write protect	0 = Off 1 = On	D
6	LLM-1A write protect 2000-2FFF; 6000-6FFF	0 = Off 1 = On	D
7	LLM-1A write protect 0000-1FFF; 4000-5FFF	0 = Off 1 = On	D
8	SPARE		

1 2 3 4 5 6 7 8

HLM1B CRC BANK A REGISTERS 0-3 (2SB) E-0629

D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1	BUM-1A BA-2B write protect 1800-1FFF; 5800-5FFF	0 = Off 1 = On	D
2	BUM-1A BA-2B write protect 1000-17FF; 5000-57FF	0 = Off 1 = On	D
3	BUM-1A BA-2B write protect 0800-0fff; 4800-4FFF	0 = Off 1 = On	D
4	BUM-1A BA-2B write protect 0000-07FF; 4000-47FF	0 = Off 1 = On	D
5	BUM-1A BA-1A write protect 1800-1FFF; 5800-5FFF	0 = Off 1 = On	D
6	BUM-1A BA-1A write protect 1000-17FF; 5000-57FF	0 = Off 1 = On	D
7	BUM-1A BA-1A write protect 0800-0FFF; 4800-4FFF	0 = Off 1 = On	D
8	BUM-1A BA-1A write protect 0000-07FF; 4000-47FF	0 = Off 1 = On	D

1 2 3 4 5 6 7 8

HLM1B CRC BANK A REGISTERS 0-3 (3SB) E-0629

1	BUM-1A I/O Select Write Control	0 = BA-1A 1 = BA-2B	D
2	SPARE		
3	BUM-1A BA-2B bus select	0 = BUS-1A 1 = BUS-1B	D
4	BUM-1A BA-1A bus select	0 = BUS-1A 1 = BUS-1B	D
5	BUM-1A Memory Swap	0 = Low 1 = High	D
6	BUM-1A write protect 3000-37FF; 7000-7FFF	0 = Off 1 = On	D
7	BUM-1A write protect 2800-2FFF; 6800-6FFF	0 = Off 1 = On	D
8	BUM-1A write protect 2000-27FF; 6000-67FF	0 = Off 1 = On	D

1 2 3 4 5 6 7 8

HLM1B CRC BANK A REGISTERS 0-3 (LSB) E-0629

D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1-2	Spare		
3	4.8 KHz reference select	0 = REF-1A 1 = REF-1B	D
4-5	Spare		
6	Digital engineering serial-binary select	0 = LLM-1A 1 = LLM-1B	D
7	Digital engineering timing chain select	0 = TC-1A 1 = TC-1B	D
8	CRC-1B critical enable master	0 = Off 1 = On	

1 2 3 4 5 6 7 8

HLM1B CRC BANK A REGISTERS 4-6 (MSB) E-0630

1	HCD POR test control	0 = Off 1 = On	D
2-4	Spare		
5	HCD-1B override-3	0 = On 1 = Off	
6	HCD-1B override-2	0 = Off 1 = On	
7	HCD-1B override-1	0 = Off 1 = On	
8	HCD-1A disable	0 = Off 1 = On	

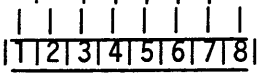
1 2 3 4 5 6 7 8

HLM1B CRC BANK A REGISTERS 4-6 (2SB) E-0630

D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1-2	Spare		
	Critical enable F	0 = Inhibit	
3	Batt. Disconnect Enable	1 = Enable	
	Critical enable E	0 = Inhibit	
4	SRM Ignition Enable	1 = Enable	
	Critical enable D	0 = Inhibit	
5	SRM Separation Enable	1 = Enable	
	Critical enable C	0 = Reset	*
6	AACS Memory B Write Prot	1 = Set	
	Critical enable B	0 = Reset	
7	AACS Memory A Write Prot	1 = Set	*
	Critical enable A	0 = Inhibit	
8	Inverter Standby/Main	1 = Enable	

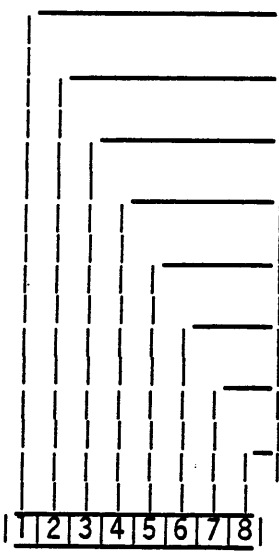


HLM1B CRC BANK A REGISTERS 4-6 (LSB) E-0630

* Write Protect disabled when opposing string is set similarly;
Write Protect enabled when opposing string is set differently.

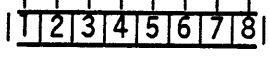
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1	HLM-1B MPLO	0 = Off 1 = On	D
2	HLM-1B Memory Swap	0 = Low 1 = High	D
3	HLM-1B Write Protect 5000-5FFF; D000-DFFF	0 = Off 1 = On	D
4	HLM-1B Write Protect 4000-4FFF; C000-CFFF	0 = Off 1 = On	D
5	HLM-1B Write Protect 3000-3FFF; B000-BFFF	0 = Off 1 = On	D
6	HLM-1B Write Protect 2000-2FFF; A000-AFFF	0 = Off 1 = On	D
7	HLM-1B Write Protect 1000-1FFF; 9000-9FFF	0 = Off 1 = On	D
8	HLM-1B Write Protect 0000-0FFF; 8000-8FFF	0 = Off 1 = On	D



HLM1B CRC BANK B REGISTERS 0-3 (MSB) E-0632

1	LLM-1A MPLO	0 = Off 1 = On	D
2	LLM-1B Memory Swap	0 = Low 1 = High	
3	LLM-1B CC/DC disable	0 = Off 1 = On	D
4	LLM-1B Bus Select	0 = BUS-1A 1 = BUS-1B	D
5	LLM-1B Bus Adapter Write Protect	0 = Off 1 = On	D
6	LLM-1B Write Protect 2000-2FFF; 6000-6FFF	0 = Off 1 = On	D
7	LLM-1B Write Protect 0000-1FFF; 4000-5FFF	0 = Off 1 = On	D
8	SPARE		



HLM1B CRC BANK B REGISTERS 0-3 (2SB) E-0632

D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1	BUM-1B BA-2A Write Protect 1800-1FFF; 5800-5FFF	0 = Off 1 = On	D
2	BUM-1B BA-2A Write Protect 1000-17FF; 5000-57FF	0 = Off 1 = On	D
3	BUM-1B BA-2A Write Protect 0800-0FFF; 4800-4FFF	0 = Off 1 = On	D
4	BUM-1B BA-2A Write Protect 0000-07FF; 4000-47FF	0 = Off 1 = On	D
5	BUM-1B BA-1B Write Protect 1800-1FFF; 5800-5FFF	0 = Off 1 = On	D
6	BUM-1B BA-1B Write Protect 1000-17FF; 5000-57FF	0 = Off 1 = On	D
7	BUM-1B BA-1B Write Protect 0800-0FFF; 4800-4FFF	0 = Off 1 = On	D
8	BUM-1B BA-1B Write Protect 0000-07FF; 4000-47FF	0 = Off 1 = On	D

1 2 3 4 5 6 7 8 HLM1B CRC BANK B REGISTERS 0-3 (3SB) E-0632

1	BUM-1B TLM control BA select	0 = BA-1B 1 = BA-2A	D
2	SPARE		D
3	BUM-1B BA-2A bus select	0 = BUS-1A 1 = BUS-1B	D
4	BUM-1B BA-1B bus select	0 = BUS-1A 1 = BUS-1B	D
5	BUM-1B Memory Swap	0 = Low 1 = High	D
6	BUM-1B Write Protect 3000-3FFF; 7000-7FFF	0 = Off 1 = On	D
7	BUM-1B Write Protect 2800-2FFF; 6800-6FFF	0 = Off 1 = On	D
8	BUM-1B Write Protect 2000-27FF; 6000-67FF	0 = Off 1 = On	D

1 2 3 4 5 6 7 8 HLM1B CRC BANK B REGISTERS 0-3 (LSB) E-0632

D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1	Spare bus select	0 = BUS-1A 1 = BUS-1B	D
2	Spare bus select	0 = BUS-1A 1 = BUS-1B	D
3	RS-B bus select	0 = BUS-1A 1 = BUS-1B	D
4	RS-A bus select	0 = BUS-1A 1 = BUS-1B	D
5	Spare bus select	0 = BUS-1A 1 = BUS-1B	D
6	Spare bus select	0 = BUS-1B 1 = BUS-1B	D
7	AACS-B bus select	0 = BUS-1A 1 = BUS-1B	D
8	AACS-A bus select	0 = BUS-1A 1 = BUS-1B	D

1 2 3 4 5 6 7 8

HLM1B CRC BANK B REGISTERS 4-7 (MSB) E-0633

1	DBUM-1B Memory Swap	0 = Low 1 = High	D
2	DBUM-1A Memory Swap	0 = Low 1 = High	D
3	Spare		
4	HCD POR test select	0 = PC-1A 1 = PC-1B	D
5	Timing chain manual select control	0 = Off 1 = On	D
6	Timing chain manual (enable)	0 = TC-1A 1 = TC-1B	D
7	POR fault override control	0 = Off 1 = On	D
8	POR fault override select	0 = PC-B 1 = PC-A	D

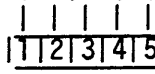
1 2 3 4 5 6 7 8

HLM1B CRC BANK B REGISTERS 4-7 (2SB) E-0633

D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

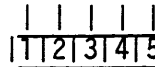
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents	
1	Spare		
2-3	Hi rate TLM Mod CU-B select	00 = LLM-1A (Note 1) 01 = BUM-1A 10 = LLM-1B 11 = BUM-1B	
4	Low rate TLM mod CU-B select	0 = LLM-1A 1 = LLM-1B	D
5	Spare		
6-7	Hi rate TLM mod CU-A select	00 = LLM-1A (Note 2) 01 = BUM-1A 10 = LLM-1B 11 = BUM -1B	
8	Low rate TLM mod CU-A select	0 = LLM-1A 1 = LLM-1B	D



HLM1B CRC BANK B REGISTERS 4-7 (3SB) E-0633

1	Spare DBUM select	0 = DBUM-1A 1 = DBUM-1B	D
2	DBUM-1B bus select	0 = BUS-1A 1 = BUS-1B	D
3	DMS DBUM select	0 = DBUM-1A 1 = DBUM-1B	D
4	DBUM-1A bus select	0 = BUS-1A 1 = BUS-1B	D
5	CRC-1B bus adapter write protect	0 = Off 1 = On	D
6	CRC-1B bus select	0 = BUS-1A 1 = BUS-1B	D
7	CRC-1A bus adapter write protect	0 = Off 1 = On	D
8	CRC-1A bus select	0 = BUS-1A 1 = BUS-1B	D



HLM1B CRC BANK B REGISTERS 4-7 (LSB) E-0633

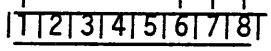
D = Dependent. This state only occurs when the opposing string's CRC bit is set similarly.

Note 1 - The LLMs are the source only if both strings' CRC bit 3 are reset (logical 0).
The A string (LLM or BUM) is the source only if both strings' CRC bit 2 are reset (logical 0).

Note 2 - The LLMs are the source only if both strings' CRC bit 7 are reset (logical 0).
The B string (LLM or BUM) is the source only if both strings' CRC bit 6 are set (logical 1).

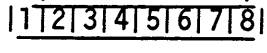
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents
1-6	HCD-1B command message number	6 LSBs of cmd message to HCD-1B
7	HCD-1B start word bit error status	0 = error-free start word 1 = error in start word
8	HCD-1B msg disposition	0 = accepted 1 = rejected



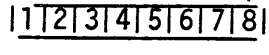
HLM1B HCD COMMAND SUMMARY WORD E-0634

1-8	HCD-1B messages received and accepted counter	Increments by one for each message accepted by HCD-1B (MOD 256)



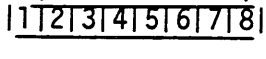
HLM1B MSG RCVD AND ACCEPTED COUNTER E-0635

1-8	HCD-1B messages received and rejected counter	Increments by one for each message rejected by HCD-1B (MOD 256)



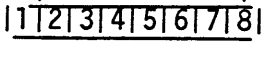
HLM1B MSG RECEIVED AND REJECTED COUNTER E-0636

1-8	HCD-1B command frame errors detected counter	Increments by one for each command frame detected with errors by HCD-1B (MOD 256)



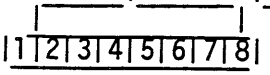
HLM1B CMD FRAME ERRORS DETECTED COUNTER E-0637

1-8	HCD-1B data frame errors corrected counter	Increments by one for each data frame corrected by HCD-1B (MOD 256)



HLM1B DATA FRAME ERRORS CORRECTED COUNTER E-0638

1-8	HCD-1B data frame errors uncorrectable counter	Increments by one for each erroneous data frame uncorrectable by HCD-1B (MOD 256)



HLM1B DATA FRAME ERRORS UNCORRECTABLE COUNTER E-0639

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents
1-8	HCD-1B lock changes errors detected counter	Increments by one for each lock change provided to HCD-1B (MOD 256)

|1|2|3|4|5|6|7|8|

HLM1B LOCK CHANGES COUNTER E-0640

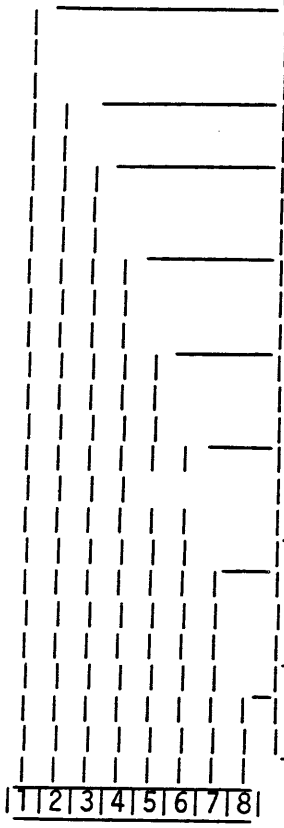
Bit(s)	Measurement	Contents
1	CRC-1B BA write busy error status	0 = no error 1 = write attempt when busy
2	CRC-1B BA write protect error status	0 = no error 1 = error
3	CRC-1B command block write attempt	0 = no attempt 1 = one or more attempts
4	CRC-1B power converter/ HCD POR status	0 = no POR 1 = one or more PORs
5	Spare	
6	Multiple frame CMD with zero data franes	0 = No error 1 = One or more errors
7	CRC-1B BA Bus parity error status	0 = No error 1 = One or more errors, any BA involved
8	CRC-1B BA transaction parity error status	0 = No error 1 = One or more errors, CRC-1A BA involved

|1|2|3|4|5|6|7|8|

HLM1B CRC STATUS WORD E-0641

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

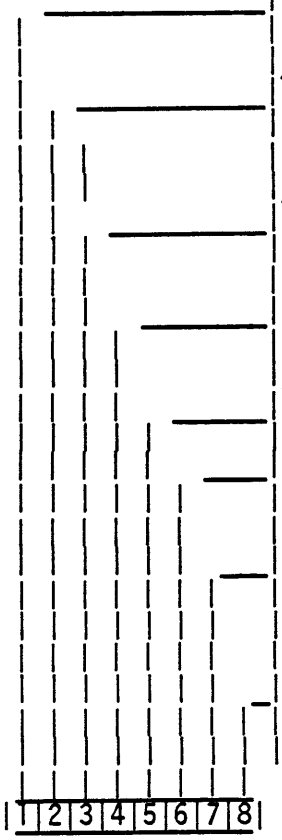
Bit(s)	Measurement	Contents
1	BUS-1B overrun status	0 = No overrun 1 = Overrun error, bus transaction in process at RTI
2	HLM-1B self-test failure status	0 = Pass 1 = Fail
3	HLM-1B keep-alive POR status	0 = No KAPOR 1 = One or more KAPORS with memory loss
4	HLM 1B POR status	0 = No POR 1 = One or more PORs, any power failure
5	HLM-1B microprocessor sync-idle error status	0 = In sync 1 = Out of sync (1802 vs BIS) /idle lockup
6	SPARE	
7	HLM-1B BA bus parity error status	0 = No error 1 = One or more errors, any BA involved (BC or MUX)
8	HLM-1B BA transaction parity error status	0 = No error 1 = One or more errors, HLM-1B BA involved



HLM1B ERROR WORDS IOSL 0-1-2 (MSB) E-0642

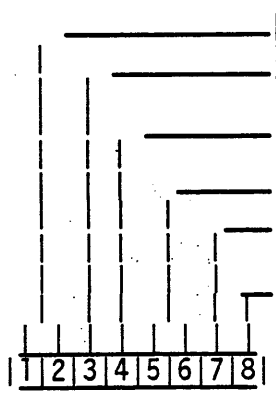
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents
1	HCD parity error status	0 = No error 1 = One or more parity errors from HCD to HLM-1B
2	HLM-1B microprocessor memory read parity error status	0 = No error 1 = One or more parity errors when memory read by processor
3	HLM-1B BA memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA
4	HLM-1B bus controller memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BC
5	HLM-1B microprocessor lockout status	0 = No MPLO 1 = MPLO
6	HLM-1B BA write protect error status	0 = No error 1 = Write attempt by BA into protected memory
7	HLM-1B microprocessor write protect error status	0 = No error 1 = Write attempt by processor into protected memory
8	HCD write protect error status	0 = No error 1 = Write attempt by HCD into protected memory



HLM1B ERROR WORDS IOSL 0-1-2 (2SB) E-0642

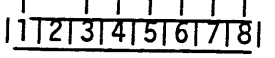
1-2	Grounded spare	
3	PLL-1B timing chain select status	0 = Timing chain A 1 = Timing chain B
4	PLL-1A timing chain select status	0 = Timing chain A 1 = Timing chain B
5-6	Grounded spare	
7	Phase locked loop 1B POR status	0 = No POR 1 = One or more PORs
8	Phase locked loop 1A POR status	0 = No POR 1 = One or more PORs



HLM1B ERROR WORDS IOSL 0-1-2 (LSB) E-0642

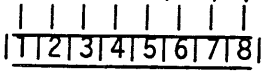
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents
1-3	Spare	
4	BUM-1A POR status	0 = No POR 1 = One or more PORs
5	BUM-1A BA-2B bus parity error status	0 = No error 1 = One or more parity errors involving any BA on its bus
6	BUM-1A BA-2B transaction parity error status	0 = No error 1 = One or more parity errors involving BUM-1A's BA-2B
7	BUM-1A BA-1A bus parity error status	0 = No error 1 = One or more parity errors involving any BA on its bus
8	BUM-1A BA-1A transaction parity error status	0 = No error 1 = one or more parity errors involving BUM-1A's BA-1A



HLM1B BUM ERROR WORDS (IOSL 0) (MSB) E-0644

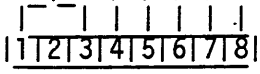
1	BUM-1A telemetry formatter memory read parity error status	0 = No error 1 = One or more parity errors when memory read by formatter
2	BUM-1A telemetry sequencer memory read parity error status	0 = No error 1 = One or more parity errors when memory read by sequencer
3	BUM-1A BA-2B memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA-2B
4	BUM-1A BA-1A memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA-1A
5-6	Grounded Spare	
7	BUM-1A BA-2B write protect error status	0 = No error 1 = Write attempt by BA-2B into protected memory
8	BUM-1A BA-1A write protect error status	0 = No error 1 = Write attempt by BA-1A into protected memory



HLM1B BUM ERROR WORDS (IOSL 1) (2SB) E-0644

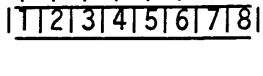
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents
1-3	Spare	
4	BUM-1B POR status	0 = No POR 1 = One or more PORs
5	BUM-1B BA-2A bus parity error status	0 = No error 1 = One or more parity errors involving any BA on its bus
6	BUM-1B BA-2A transaction parity error status	0 = No error 1 = One or more parity errors involving BUM-1B's BA-2A
7	BUM-1B BA-1B bus parity error status	0 = No error 1 = One or more parity errors involving any BA on its bus
8	BUM-1B BA-1B transaction parity error status	0 = No error 1 = one or more parity errors involving BUM-1B's BA-1A



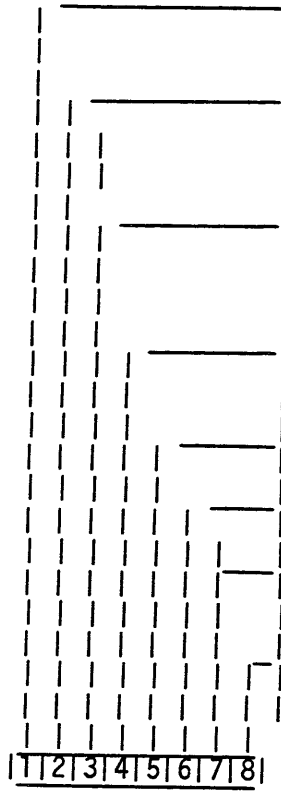
HLM1B BUM ERROR WORDS (IOSL 0) (3SB) E-0644

1	BUM-1B telemetry formatter memory read parity error status	0 = No error 1 = One or more parity errors when memory read by formatter
2	BUM-1B telemetry sequencer memory read parity error status	0 = No error 1 = One or more parity errors when memory read by sequencer
3	BUM-1B BA-2A memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA-2A
4	BUM-1B BA-1B memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA-1B
5-6	Grounded Spare	
7	BUM-1B BA-2A write protect error status	0 = No error 1 = Write attempt by BA-2A into protected memory
8	BUM-1B BA-1B write protect error status	0 = No error 1 = Write attempt by BA-1B into protected memory



HLM1B BUM ERROR WORDS (IOSL 1) (LSB) E-0644

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)



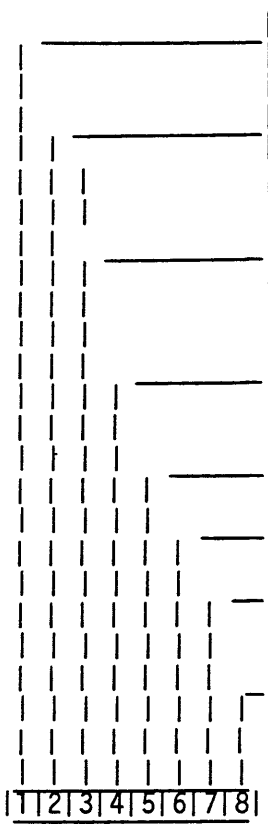
Bit(s)	Measurement	Contents
1	DMS illegal command status	0 = No illegal command 1 = Illegal cmd (not per DMS CMD dictionary)
2	DBUM-1A sequencer output memory read parity error status	0 = No error 1 = One or more parity errors when memory read by DBUM sequencer
3	DBUM-1A formatter memory read parity error status	0 = No error 1 = One or more parity errors when memory read by formatter
4	DBUM-1A bus adapter memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA
5	DMS A tape direction status	0 = Forward 1 = Reverse
6	DBUM-1A POR status	0 = No POR 1 = One or more PORs
7	DBUM-1A bus adapter bus parity error status	0 = No error 1 = one or more parity errors involving any BA
8	DBUM-1A BA transaction parity error status	0 = No error 1 = One or more parity errors involving DBUM-1A BA

1 2 3 4 5 6 7 8

HLM1B DBUM ERROR WORDS (IOSL 0) (MSB) E-0645 Note 1

Note 1 - This data not valid unless DBUM-1A switched to String B.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

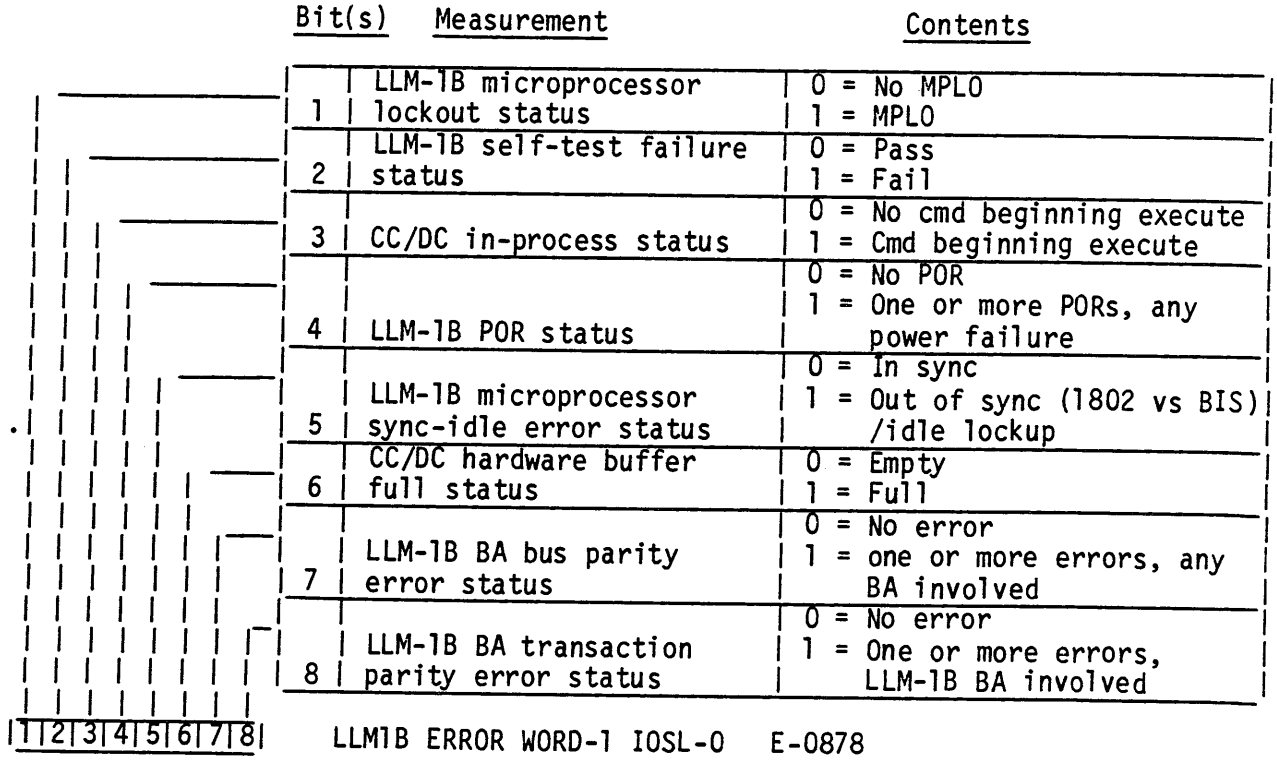


Bit(s)	Measurement	Contents
1	DMS illegal command status	0 = No illegal command 1 = Illegal cmd (not per DMS CMD dictionary)
2	DBUM-1B sequencer output memory read parity error status	0 = No error 1 = One or more parity errors when memory read by DBUM sequencer
3	DBUM-1B formatter memory read parity error status	0 = No error 1 = One or more parity errors when memory read by formatter
4	DBUM-1B bus adapter memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA
5	DMS B tape direction status	0 = Forward 1 = Reverse
6	DBUM-1B POR status	0 = No POR 1 = One or more PORs
7	DBUM-1B bus adapter bus parity error status	0 = No error 1 = one or more parity errors involving any BA
8	DBUM-1B BA transaction parity error status	0 = No error 1 = One or more parity errors involving DBUM-1B BA

1 2 3 4 5 6 7 8 HLM1B DBUM ERROR WORDS (IOSL 0) (LSB) E-0645 Note 1

Note 1 - This data not valid unless DBUM-1B switched to String B.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)



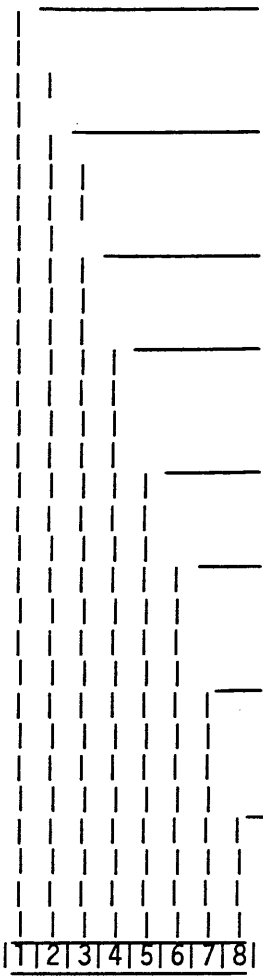
Bit(s)	Measurement	Contents
1	LLM-1B microprocessor lockout status	0 = No MPLO 1 = MPLO
2	LLM-1B self-test failure status	0 = Pass 1 = Fail
3	CC/DC in-process status	0 = No cmd beginning execute 1 = Cmd beginning execute
4	LLM-1B POR status	0 = No POR 1 = One or more PORs, any power failure
5	LLM-1B microprocessor sync-idle error status	0 = In sync 1 = Out of sync (1802 vs BIS) /idle lockup
6	CC/DC hardware buffer full status	0 = Empty 1 = Full
7	LLM-1B BA bus parity error status	0 = No error 1 = one or more errors, any BA involved
8	LLM-1B BA transaction parity error status	0 = No error 1 = One or more errors, LLM-1B BA involved

1 2 3 4 5 6 7 8

LLM1B ERROR WORD-1 IOSL-0 E-0878

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

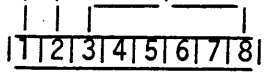
Bit(s)	Measurement	Contents
1	LLM-1B TLM port memory read parity error status	0 = No error 1 = One or more parity errors when memory read by TLM port
2	LLM-1B microprocessor memory read parity error status	0 = No error 1 = One or more parity errors when memory read by processor
3	LLM-1B BA memory read parity error status	0 = No error 1 = One or more parity errors when memory read by BA
4	Engineering control port memory read parity error status	0 = No error 1 = One or more parity errors when memory read by engr. control port
5	CC/DC error status	0 = Overwrite not attempted 1 = Attempt to load CC/DC H/W buffer when already full
6	LLM-1B BA write protect error status	0 = No error 1 = Write attempt by BA into protected memory, or I/O selects
7	LLM-1B microprocessor write protect error status	0 = No error 1 = Write attempt by processor into protected memory
8	Engineering data port write protect error status	0 = No error 1 = Write attempt by engr. data port into protected memory



LLM1B ERROR WORD-2 IOSL-1 E-0879

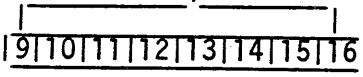
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (Bit 1 is MSB)(cont)

Bit(s)	Measurement	Contents
1	DMS BOT/EOT status	0 = BOT 1 = EOT
2	DMS leader/tape status	0 = On tape 1 = On leader
3-8	Tic count status (6 MSB)	6 MSBs of the 14 bit tic count



LLM1B DMS TIC COUNT INPUT A, B(MSB) E-0888, E-0889

1-8	Tic count status (8 LSB)	8 LSBs of the 14 bit tic count



LLM1B DMS TIC COUNT INPUT A,B (LSB) E-0888, E-0889

NOTE: E-0888 valid if DBUM 1A is switched to String B.

E-0889 valid if DBUM 1B is switched to String B.

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

AACS S/W Mode (E-1021)

INTEGER VALUE	MODE
0	Idle
1	Attitude Reference Hold
2	Slew to Attitude
3	Delta-V
4	VOI
5	Mapping
6	RAM Safing

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Reaction Wheel Direction (E-1051)

Bit 15 is MSB
0 = Positive Rotation
1 = Negative Rotation

BITS	FUNCTION
3-15	Not Used (Zeros)
2	RW 3 Direction
1	RW 2 Direction
0	RW 1 Direction

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Sun Source (E-1066)

INTEGER VALUE	FUNCTION
0	No Command
1	Sun Sensor Data
2	Computed Sun Vector
3	Uplink Command

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Thruster Control Command (E-1091)

Bit 15 is MSB
0 = Off
1 = On

BITS	FUNCTION
12-15	Not Used (Zeros)
11	Thruster 12
10	Thruster 11
9	Thruster 10
8	Thruster 9
7	Thruster 8
6	Thruster 7
5	Thruster 6
4	Thruster 5
3	Thruster 4
2	Thruster 3
1	Thruster 2
0	Thruster 1

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Engine Control Command (E-1092)

Bit 15 is MSB
0 = Off
1 = On

BITS	FUNCTION
12-15	Not Used (Zeros)
11	Engine 24
10	Engine 23
9	Engine 22
8	Engine 21
7	Engine 20
6	Engine 19
5	Engine 18
4	Engine 17
3	Thruster 16
2	Thruster 15
1	Thruster 14
0	Thruster 13

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Pulse Duration (E-1093)

Bit 15 is MSB
LSB = 11.11 Milliseconds

BITS	FUNCTION
12-15	Not Used (Zeros)
8-11	Z - Axis Duration
4-7	Y - Axis Duration
0-3	X - Axis Duration

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Gyro Status Word (E-1145)

Bit 15 is MSB

BITS	FUNCTION	BIT VALUE	COMMENTS
15	A1Y	For Bits 8-15,	Bits 13, 14, 15 Represent
14	A2Y	0 = Not Selected	X-Axis Selected Channel
13	B2X	1 = Selected	
12	A2X		Bits 10, 11, 12 Represent
11	B1Y		Y-Axis Selected Channel
10	B2Y		
9	A1X		Bits 8, 9 Represent Z-Axis
8	B1X		Selected Channel
7	A1X	For Bits 0-7,	
6	A1Y	0 = Channel is unusable	
5	A2X	1 = Channel is usable	
4	A2Y		
3	B1X		
2	B1Y		
1	B2X		
0	B2Y		

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Fault Protection Status Word 1 (E-1172)

Bit 15 is MSB
0 = Disabled
1 = Enabled

BITS	FUNCTION
15	Attitude Error Detect
14	Attitude Rate Error Detect
13	Average Body Rate Detect
12	SSU Ref Loss Detect
11	SSU Miscompare Detect
10	SADM Miscompare Detect
9	SADM Control Loss Detect
8	CDS Interface Detect
7	Gyro Miscompare Detect
6	Gyro Static Readout Detect
5	Gyro Variance Detect
4	Star Scanner Detect
3	Thrusting Detect
2	Sun Loss Detect
1	Desat Detect
0	Power ARU Response

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Fault Protection Status Word 2 (E-1173)

Bit 15 is MSB
0 = Disabled
1 = Enabled

BITS	FUNCTION
15	Switch Gyro Ch. Response
14	Swap IODA Response
13	Swap ILV Response
12	Open Primary ILV Response
11	Swap Engine String Response
10	Fire Final Pyro Response
9	Power Secondary Engine String Response
8	Fire Initial Pyro Response
7	RAM Safing Response
6	Mark SSU Unusable Response
5	Go to ACT Control Response
4	Terminate Heartbeat Response
3	CDS Loss Alert Code Response
2	RAM Safing Enable 1
1	RAM Safing Enable 2
0	Data Bus Detect

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Fault Protection Status Word 3 (E-1174)

Bit 15 is MSB
0 = Disabled
1 = Enabled

BITS	FUNCTION
15	ARU Rate/Range Detect
14	Phase Plane Transition Detect
13	Attitude Control Fault Enable
0-12	Not Used (Zeros)

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Desired Maneuver (E-1185)

INTEGER VALUE	FUNCTION
1	Maneuver to Cruise Attitude
2	Maneuver to Delta-V Attitude
3	Maneuver to VOI Attitude
4	Maneuver to Earth Point Attitude
5	Maneuver to Alternate Earth Point Attitude
6	Maneuver to Mapping Attitude
7	Maneuver to Preloaded Attitude #1
8	Maneuver to Preloaded Attitude #2
9	Maneuver to Initial Star Scan Attitude
10	Maneuver to Final Star Scan Attitude
11	Maneuver to Relative Attitude

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Phase Plane Index (E-1187)

INTEGER VALUE	FUNCTION
1	Phase Plane A
2	Phase Plane B
3	Phase Plane C
4	Phase Plane D

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Thruster Select Table (E-1188)

INTEGER VALUE	FUNCTION
1	Thruster Select Table A
2	Thruster Select Table B
3	Thruster Select Table C

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

STU Desired Channel (E-1190)

INTEGER VALUE	FUNCTION
Not 0	STU A
0	STU B

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Mission Phase (E-1193)

INTEGER VALUE	FUNCTION
0	Launch
1	Tipoff
2	Cruise
3	VOI
4	Orbital Operations

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Control Attitude Number (E-1194)

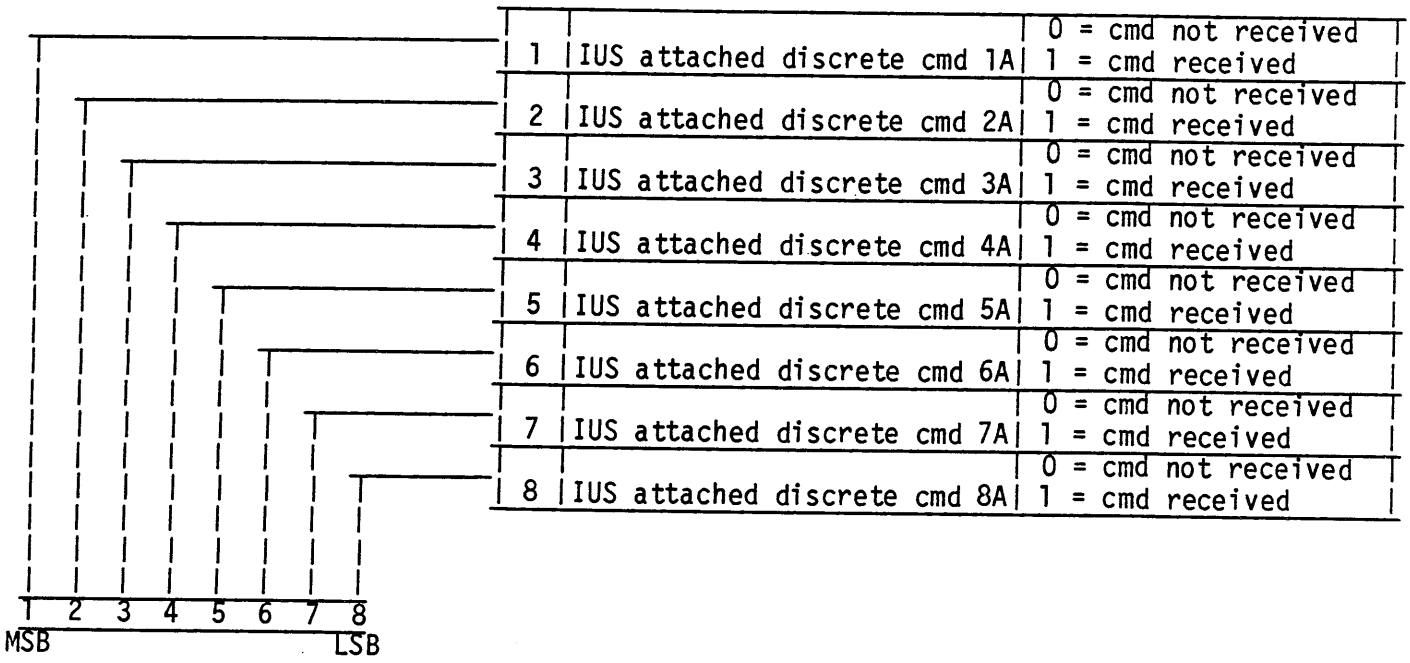
INTEGER VALUE	FUNCTION
1	Slew to Attitude
2	Mapping
3	Cruise
4	Earth Point
5	Alternate Earth Point
6	Previous Attitude Hold

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)

Swath Number (E-1195)

INTEGER VALUE	FUNCTION
1	Immediate Swath
2	Delayed Swath

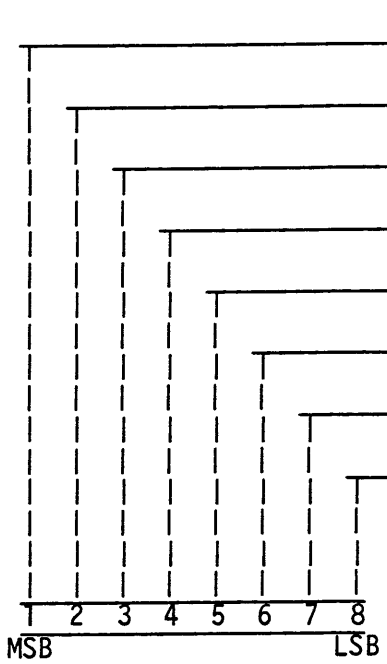
TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)



1	IUS attached discrete cmd 1A	0 = cmd not received 1 = cmd received
2	IUS attached discrete cmd 2A	0 = cmd not received 1 = cmd received
3	IUS attached discrete cmd 3A	0 = cmd not received 1 = cmd received
4	IUS attached discrete cmd 4A	0 = cmd not received 1 = cmd received
5	IUS attached discrete cmd 5A	0 = cmd not received 1 = cmd received
6	IUS attached discrete cmd 6A	0 = cmd not received 1 = cmd received
7	IUS attached discrete cmd 7A	0 = cmd not received 1 = cmd received
8	IUS attached discrete cmd 8A	0 = cmd not received 1 = cmd received

E-1300 IUS Status Word 1

TABLE A2.2.9 DIGITAL AND SOFTWARE BIT DEFINITIONS (cont)



1	IUS attached discrete cmd 1B	0 = cmd not received 1 = cmd received
2	IUS attached discrete cmd 2B	0 = cmd not received 1 = cmd received
3	IUS attached discrete cmd 3B	0 = cmd not received 1 = cmd received
4	IUS attached discrete cmd 4B	0 = cmd not received 1 = cmd received
5	IUS attached discrete cmd 5B	0 = cmd not received 1 = cmd received
6	IUS attached discrete cmd 6B	0 = cmd not received 1 = cmd received
7	IUS attached discrete cmd 7B	0 = cmd not received 1 = cmd received
8	IUS attached discrete cmd 8B	0 = cmd not received 1 = cmd received

E-1301 IUS Status Word 2

A2.2.11.4 CDS Treeswitch Assignments.

Table A2.2.10 identifies the usage of CDS treeswitch positions by reference to the engineering measurement numbers defined in Table A2.2.7.

TABLE A2.2.10 CDS Treeswitch Assignments

	Tree Position	T1A	CDS A CONN	T1B	CDS B CONN
Digital	00	E-0151		E-0152	
	01	E-0153		E-0154	
	02	E-1300		E-1301	
	03	SPARE		SPARE	
	04	SPARE		SPARE	
	05	SPARE		SPARE	
	06	N/A		N/A	
	07	N/A		N/A	
	08	E-0055		E-0056	
	09	E-0107		E-0108	
	0A	E-0051		E-0052	
	0B	E-0053		E-0054	
	0C	E-0251		E-0252	
	0D	E-0253		E-0254	
	0E	N/A		N/A	
	0F	N/A		N/A	
Analog	10	E-0913	J2-50	E-0921	J7-50
	11	E-0914	J2-47	E-0922	J7-47
	12	E-0915	J3-4	E-0923	J6-4
	13	E-0916	J3-14	E-0924	J6-14
	14	E-0917	J3-18	E-0925	J6-18
	15	E-0918	J3-34	E-0926	J6-34
	16	E-0919	J3-36	E-0927	J6-36
	17	E-0061	J3-2	E-0062	J6-2
	18	E-0156	J3-12	E-0157	J6-12
	19	E-0060	J3-35	E-0191	J6-35
	1A	E-0082	J3-3	E-0080	J6-3
	1B	E-0057	J3-11	E-0081	J6-11
	1C	SPARE	J3-46	E-0084	J6-46
	1D	E-0166	J3-48	E-0096	J6-48
	1E	E-0070	J3-19	E-0101	J6-19
	1F	E-0929	--	E-0936	--

TABLE A2.2.10 CDS Treeswitch Assignments (Cont'd)

	Tree Position	T1A	CDS A CONN	T1B	CDS B CONN
Analog	20	E-0951	J3-20	E-0954	J6-20
	21	E-0078	J3-24	E-0068	J6-24
	22	E-0074	J3-29	E-0104	J6-29
	23	E-0186	J3-50	E-0187	J6-50
	24	E-0067	J3-7	E-0073	J6-7
	25	E-0258	J4-32	E-0257	J5-32
	26	E-0102	J3-32	E-0065	J6-32
	27	E-0103	J3-33	SPARE	J6-33
	28	E-0920	--	E-0928	--
	29	SPARE	J3-10	E-1006	J6-10
	2A	E-0079	J3-30	E-0076	J6-30
	2B	E-0160	J3-28	E-0161	J6-28
	2C	E-0188	J3-47	E-0955	J6-47
	2D	E-0075	J3-39	E-0059	J6-39
	2E	N/A	J3-45	N/A	J6-45
	2F	E-0930	--	E-0937	--
Analog	30	E-0171	J3-6	E-0189	J6-6
	31	E-0196	J3-27	E-0167	J6-27
	32	E-1009	J3-42	E-0170	J6-42
	33	E-0063	J3-23	E-0181	J6-23
	34	E-0207	J3-38	E-0208	J6-38
	35	E-0255	J4-16	E-0256	J5-16
	36	E-0180	J3-26	E-0072	J6-26
	37	E-0190	J3-22	E-0193	J6-22
	38	E-0083	J2-42	SPARE	J7-42
	39	E-0956	J2-8	E-0952	J7-8
	3A	E-0192	J2-41	E-0204	J7-41
	3B	E-0205	J2-44	E-0175	J7-44
	3C	E-0206	J2-48	E-0173	J7-48
	3D	E-0172	J2-11	E-0064	J7-11
	3E	E-0174	J2-16	SPARE	J7-16
	3F	E-0931	--	E-0938	--
Analog	40	E-0158	J3-5	E-0159	J6-5
	41	E-0194	J3-8	E-0058	J6-8
	42	E-1016	J3-25	E-0195	J6-25
	43	E-1018	J3-37	E-1008	J6-37
	44	E-0953	J3-9	E-0197	J6-9
	45	E-0943	J4-15	E-0944	J5-15
	46	E-0066	J3-40	E-0069	J6-40
	47	E-0071	J3-15	E-0199	J6-15
	48	E-1007	J3-13	E-0201	J6-13
	49	E-0198	J3-17	E-0203	J6-17
	4A	E-0200	J3-41	E-0210	J6-41
	4B	N/A	J3-45	N/A	J6-45
	4C	E-0202	J3-43	E-0077	J6-43
	4D	E-0209	J3-16	E-1017	J6-16
	4E	SPARE	J3-44	SPARE	J6-44
	4F	E-0932	--	E-0939	--

TABLE A2.2.10 CDS Treeswitch Assignments (Cont'd)

	Tree Position	T1A	CDS A CONN	T1B	CDS B CONN
Temp	50	E-0176	J2-36	E-0177	J7-36
	51	E-0036	J2-39	E-0185	J7-39
	52	E-0184	J2-37	E-0106	J7-37
	53	E-0105	J2-5	E-0028	J7-5
	54	E-0015	J2-10	E-0012	J7-10
	55	E-0031	J2-43	E-0163	J7-43
	56	E-1001	J2-1	E-1002	J7-1
	57	E-0041	J2-49	E-0042	J7-49
	58	E-0013	J2-18	E-0099	J7-18
	59	E-0162	J2-7	E-0014	J7-7
	5A	E-0000	J2-2	E-0001	J7-2
	5B	E-0085	J2-34	E-0086	J7-34
	5C	E-0164	J2-46	E-1015	J7-46
	5D	E-0019	J2-6	E-0165	J7-6
	5E	E-0097	J2-38	E-0044	J7-38
	5F	E-0933	--	E-0940	--
Temp	60	E-0178	J2-12	E-0179	J7-12
	61	E-0035	J1-5	E-0033	J8-5
	62	E-0030	J1-38	E-0040	J8-38
	63	E-0945	J1-37	E-0946	J8-37
	64	E-0091	J1-46	E-0021	J8-46
	65	E-0089	J1-41	E-0090	J8-41
	66	E-0182	J1-39	E-0183	J8-39
	67	E-0046	J1-34	E-0095	J8-34
	68	E-0092	J2-14	E-0093	J7-14
	69	E-0022	J2-13	E-0023	J7-13
	6A	E-0087	J2-3	E-0088	J7-3
	6B	E-0002	J2-9	E-0007	J7-9
	6C	E-0026	J1-3	E-0024	J8-3
	6D	E-0034	J1-44	E-0025	J8-44
	6E	E-0006	J1-6	E-0032	J8-6
	6F	E-0934	--	E-0941	--
Temp	70	SPARE	J1-7	SPARE	J8-7
	71	E-1014	J1-42	E-0038	J8-42
	72	E-1012	J1-9	E-1013	J8-9
	73	E-0037	J1-47	E-0018	J8-47
	74	E-0020	J1-14	E-0027	J8-14
	75	E-0100	J1-13	E-0098	J8-13
	76	E-0094	J1-16	E-0043	J8-16
	77	E-1003	J1-50	E-0045	J8-50
	78	E-0017	J1-43	E-0029	J8-43
	79	E-1011	J1-10	E-1010	J8-10
	7A	E-0009	J1-2	E-0008	J8-2
	7B	E-0010	J1-36	E-0011	J8-36
	7C	E-1004	J1-48	E-1005	J8-48
	7D	E-0039	J1-12	E-0016	J8-12
	7E	E-0004	J1-29	E-0003	J8-29
	7F	E-0935	--	E-0942	--

A2.3 Memory Readout Data

A2.3.1 Memory Readout Structure.

The spacecraft data system shall provide a common structure for reading out CDS and AACS onboard computer memory. The structure shall support both 8 and 16 bit memory readouts.

The format of this structure is shown in Figure A2.3.1 and described in greater detail in Table A2.3.1.

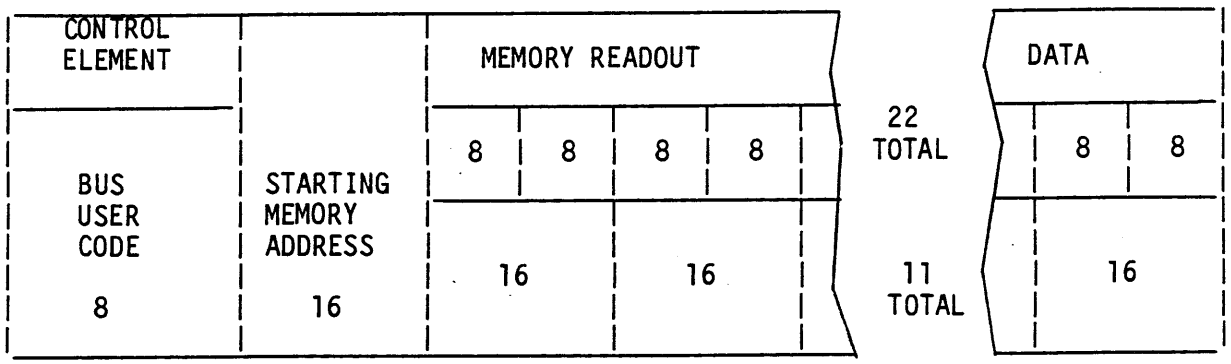


Figure A2.3.1. Memory Readout Structure

Table A2.3.1. Memory Readout Structure

Data Description	Bits/ Frame	Offset to Data Start	Paragraph
Bus User Code	8	0	A2.3.1.1
Starting Address	16	8	A2.3.1.2
Memory Readout Data	176	24	A2.3.1.3

A.2.3.1.1 Bus User Codes.

The Bus User Code area contains Bus source codes, and describes the data contained within the memory readout portion of the frame. The contents shall be interpreted in accordance with Table A2.3.2

Table A2.3.2 Bus User Codes

Subsystem/ Module	Bus User (source) code	Data Field Width (bits)	Number of Data Fields in Frame
AACS-A	87	16.	11
AACS-B	88	16	11
CDS			
HLM-1A	84	8	22
HLM-1B	85	8	22
LLM-1A	8C	8	22
LLM-1B	8D	8	22
BUM-1A-1A	90*	8	22
BUM-1A-2B	91*	8	22
BUM-1B-1B	94*	8	22
BUM-1B-2A	95*	8	22
DBUM-1A	8A	8	22
DBUM-1B	8B	8	22
CRC-1A	8E	8	22
CRC-1B	8F	8	22

*SES software shall consider 90 or 91 as BUM-1A and 94 or 95 as BUM-1B.

A2.3.1.2 Starting Address.

This field shall represent the address corresponding to the first memory readout word in the readout data.

In order to provide a consistant readout format for all spacecraft computer memories, the memory readout shall start at a specified address.

A2.3.1.3 Memory Readout Data.

The data in this portion of the frame shall contain the contents of consecutive memory locations. The first data word shall be the contents of the memory location specified by the starting address field.

A2.3.1.3.1 Subsystem Memory.

For any subsystem commanded memory readout, the number of consecutive memory locations read out per block shall be 11 or 22 corresponding to 16 or 8 bit processor word sizes respectively.

A2.3.1.3.2 Commutation Map Readout Data.

In order to facilitate ground reconstruction of on-board engineering commutation maps, the maps shall be stored in a known location. In the event that the spacecraft partitions the engineering commutation maps among various CDS and AACS memories, the various partitions shall all be stored in known locations.

A2.3.2 Variable Packet Replacement Readout.

The spacecraft data system shall have the capability to read out any on-board processor memory in the engineering data stream. The format of the variable packet replacement memory readout shall be as shown in Figure A2.3.2.

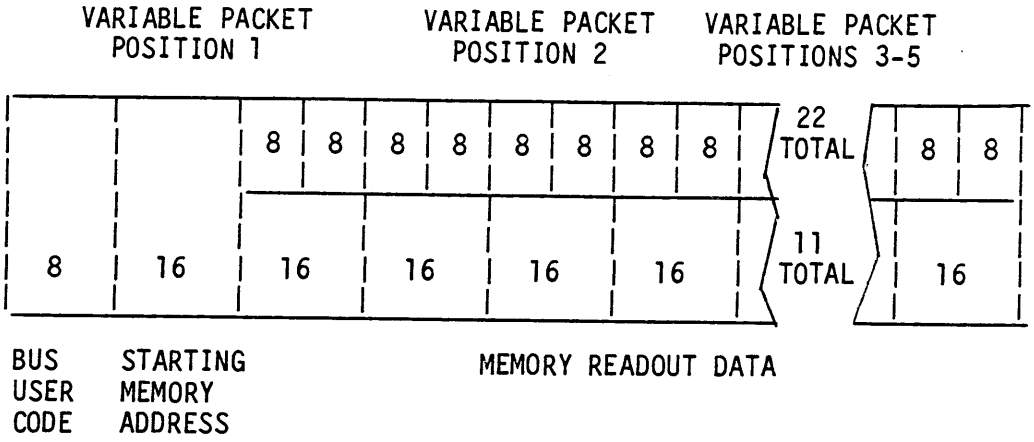


Figure A2.3.2 Variable Packet Replacement Memory Readout

A2.3.2.1 Description.

The CDS shall collect the memory readout data from the desired subsystem and create a memory readout structure identical to paragraph A2.3.1. This structure will replace the first 5 variable packets in the engineering frame.

A2.3.3 Memory Readout Data Stream.

The Sequence in which the 22-byte blocks of memory readout data appear in the engineering telemetry is dependent on both the engineering telemetry data rate and the memory readout mode selected within the CDS, as described in the following paragraphs.

A2.3.3.1 Memory Readout within 1200 b/s Engineering.

Successive frames of the high rate engineering (EHR) shall contain 22-byte blocks of memory readout data from sequential locations when the high rate memory readout mode is selected. When the low rate memory readout data is selected, each 22-byte block of memory readout data shall appear in thirty successive high rate engineering frames. The sequence of memory readout data within the 1200 b/s engineering telemetry is depicted in Figure A2.3.3 for the high and low rate memory readout modes of the CDS.

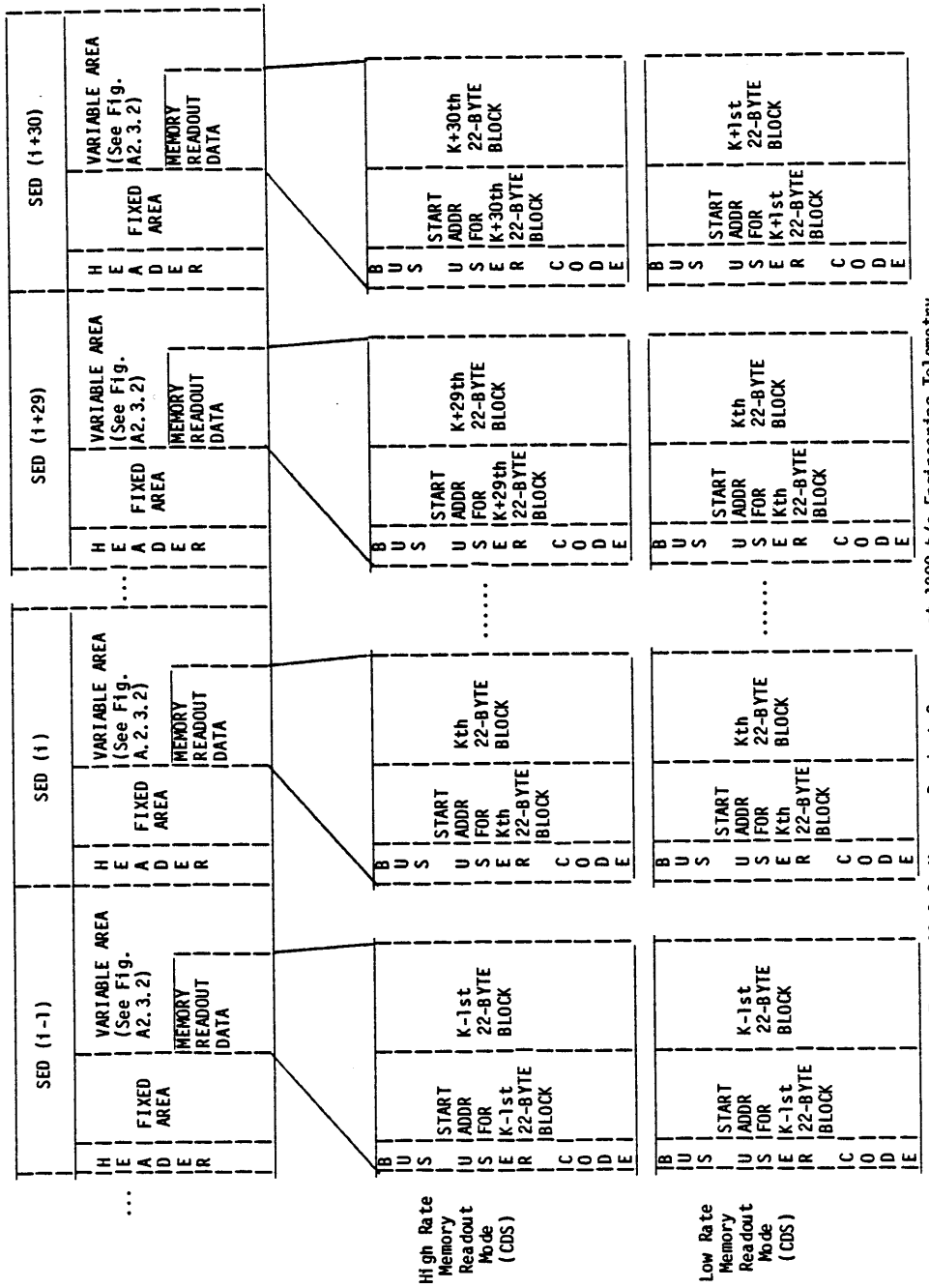


Figure A2.3.3 Memory Readout Sequence at 1200 b/s Engineering Telemetry

A2.3.3.2 Memory Readout within 40 b/s Engineering.

Successive frames of the 40 b/s snapshot engineering (ESS) shall contain 22-byte blocks of memory readout data from sequential locations when the low rate memory readout mode is selected. When the high rate memory readout mode is selected, every thirtieth 22-byte block of memory readout data shall appear in successive frames of the 40 b/s snapshot engineering. The sequence of memory readout data which shall appear within the 40 b/s (snapshot) engineering telemetry is depicted in Figure A2.3.4 for the high and low rate memory readout modes of the CDS.

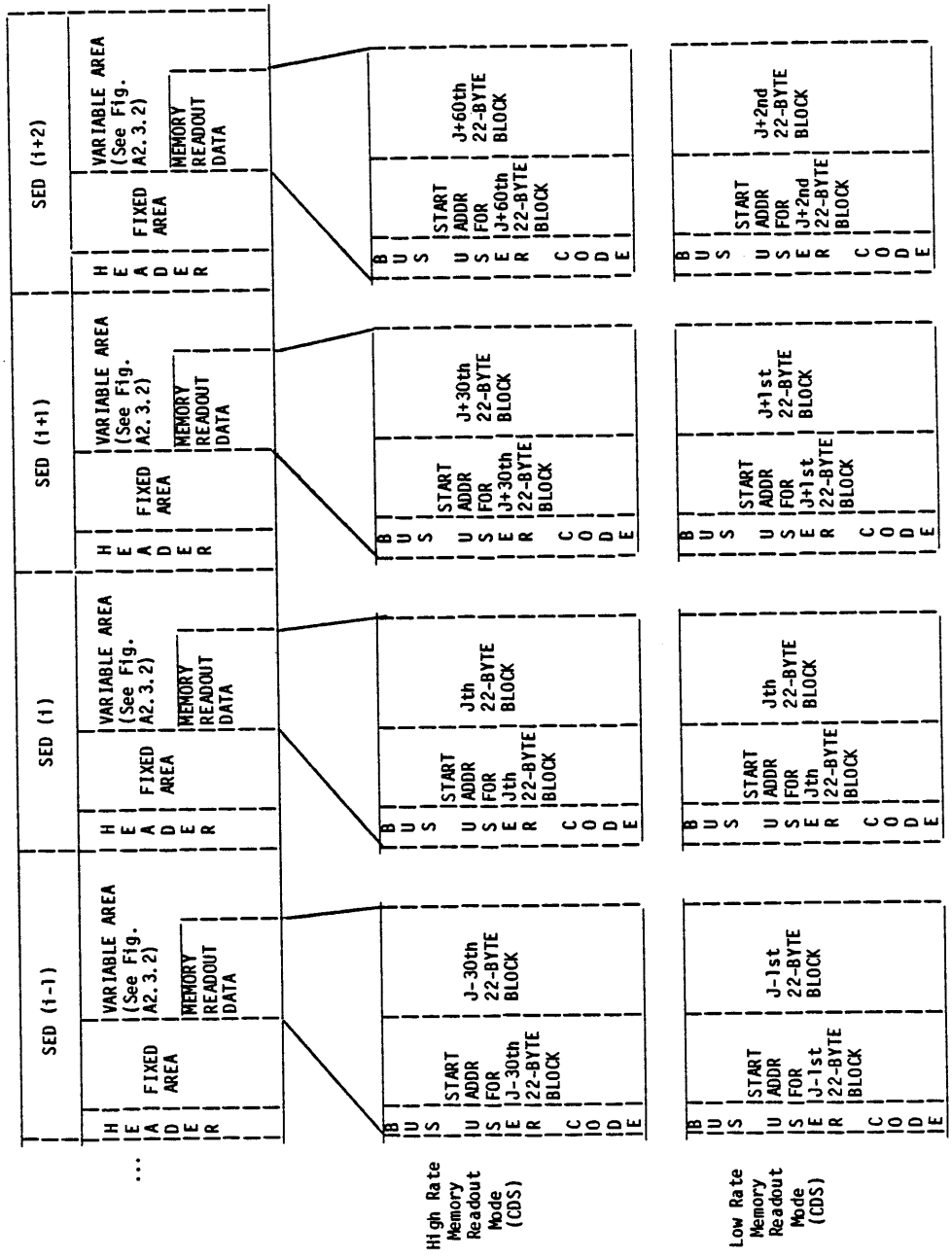


Figure A2.3.4 Memory Readout Sequence at 40 b/s Engineering Telemetry

A2.3.4 Memory Readout Sampling Time.

All memory readout data shall be sampled between 476-2/3 and 533-1/3 milliseconds after the SCLK contained in the engineering frame header containing the readout.