



COM DEV

DOCUMENT REQUEST FORM

8/12/97

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Document #

1CD/MOP/113364/400

Quantity

1

Paper Req'd

8 1/2 x 11

✓

8 1/2 x 11 (3 hole)

8 1/2 x 14

A4 (Metric)

A4 (Metric 4 hole)

8 1/2 x 11 (Colored)

Finished Product

Single Sided ✓

Double Sided _____

3 Hole Binder _____

Spiral Bound _____

Tape Binding _____

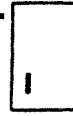
Single Staple _____



Double Staple _____



Side Staple _____



OTHER INSTRUCTIONS



COM DEV

SPACE GROUP 155 Sheldon Drive, Cambridge, Ontario Canada N1R 7H6

MOPITT

PROJECT NO.

5127

SOFTWARE SPECIFICATION
INTERFACE CONTROL DOCUMENT
ICD/MOP/113364/400

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Table of Contents

1. INTRODUCTION	10
1.1 Identification of Document.....	10
1.2 Scope of Document.....	10
1.3 Purpose and Objectives of Document	10
1.4 Document Status and Schedule	10
1.5 Organization of the Document.....	10
 2. RELATED DOCUMENTS	 12
2.1 Parent Documents	12
2.2 Applicable Documents.....	12
2.3 Informational Documents	12
 3. INTERFACE REQUIREMENTS DESCRIPTION.....	 14
3.1 Numbering Conventions.....	14
3.2 Overview of the Interfaces.....	14
 4. MOPITT INSTRUMENT COMMANDS.....	 15
4.1 Command Requirements.....	15
4.2 MIL-STD-1553B Commands and Modes.....	16
4.2.1 INHIBIT_TFB - Inhibit Terminal Flag Bit.....	16
4.2.2 INIT_SELF_TEST - Initiate Remote Terminal Controller BIT Routine.....	17
4.2.3 OVERRIDE_TRANS - Override Transmitter Shutdown.....	17
4.2.4 RESET_RT - Reset Remote Terminal	18
4.2.5 SYNC_WITHOUT_DATA - Synchronize Without Data Word	18
4.2.6 SYNC_WITH_DATA - Synchronize with Data Word	19
4.2.7 TRANS_BIT - Transmit BIT Word.....	19
4.2.8 TRANS_LAST - Transmit Last Command.....	20
4.2.9 TRANS_SHUTDOWN - Transmitter Shutdown.....	21
4.2.10 TRANS_STATUS - Transmit Status Word.....	21
4.2.11 TRANS_VECTOR - Transmit Vector Word.....	22
4.3 Spacecraft Commands.....	22
4.3.1 Instrument Commands (sub-address 1).....	23
4.3.2 LOAD_DATA - Memory Load Data.....	24
4.3.3 DUMP_DATA - Memory Dump Data.....	24
4.3.4 ANCILLARY_DATA - Ancillary Data	25

Table of Contents (cont'd)

4.3.5	IMOK - SCC "I'm OK" Indication.....	26
4.3.6	TIME_CODE - Time Code Data	26
4.3.7	SET_SAFE_MODE - Spacecraft Safe Mode Command	27
4.3.8	LOOP_BACK - MIL-STD-1553B Loop Back	27
4.3.9	HOUSE_TELEM - Housekeeping Telemetry.....	28
4.3.10	CRITICAL_TELEM - Critical Health and Safety Telemetry Transfer.....	29
4.3.11	SCIENCE_DATA - MOPITT Science Data Telemetry	29
4.4	MOPITT Instrument Commands - Operational	30
4.4.1	CLOSE_COVER_1 - Close the Earth View Port Cover.....	32
4.4.2	CLOSE_COVER_2 - Close the Space View Port Cover.....	32
4.4.3	CLOSE_LATCH_1 - Close the Earth View Port Latch.....	33
4.4.4	CLOSE_LATCH_2 - Close the Space View Port Latch	33
4.4.5	DISABLE_COVERS - Reset the Port Covers	34
4.4.6	ENABLE_COVERS - Enable the Port Covers for Operation	34
4.4.7	MOVE_MIRROR WITH mirror_number, position - Move a Scan Mirror to an Absolute Position.....	35
4.4.8	OPEN_COVER_1 - Open the Earth View Port Cover	36
4.4.9	OPEN_COVER_2 - Open the Space View Port Cover.....	36
4.4.10	OPEN_LATCH_1 - Unlatch the Earth View Port Cover.....	37
4.4.11	OPEN_LATCH_2 - Unlatch the Space View Port Cover.....	37
4.4.12	PERFORM_DEV_INIT WITH deviceNum - Initialize a Device.....	38
4.4.13	PERFORM_NOP - No Operation.....	38
4.4.14	RESET_DEVICE - Reset MOPITT Device.....	39
4.4.15	SELECT_LAUNCH - Enter Launch Mode.....	40
4.4.16	SELECT_SAFE - Enter Safe Mode	40
4.4.17	SELECT_SCIENCE - Enter Science Mode.....	41
4.4.18	SELECT_STANDBY - Enter Standby Mode	42
4.4.19	SELECT_SURVIVAL - Enter Survival Mode	42
4.4.20	SET_COOLER_TEMP - Set Stirling Cycle Cooler Temperature	43
4.4.21	SET_COOLER_DIODE - Set Stirling Cycle Cooler Diode.....	43
4.4.22	SET_DEVICE WITH device_no, state - Set a Device State	44
4.4.23	SET_HEATER WITH device_number, value - Set Heater Setting.....	45
4.4.24	TURN_OFF_DEVICE - Turn Off MOPITT Device.....	46
4.4.25	TURN_ON_BURST WITH channel, pixel, duration - Start Burst Data Collection.....	46
4.4.26	TURN_ON_DEVICE - Turn On MOPITT Device.....	47

Table of Contents (cont'd)

4.5 Instrument Commands - Maintenance.....	48
4.5.1 DISABLE_DETECTOR WITH detectorNumber - Disable SPM Detector Power.....	48
4.5.2 DISABLE_EE_BURN - Disable EEPROM Program Commands.....	48
4.5.3 DISABLE_FDIR - Disable Instrument FDIR.....	49
4.5.4 DISABLE_MAINCMDS - Disable Operation of Maintenance Commands.....	50
4.5.5 DISABLE_FUSE - Disable MOPITT Device Fuse.....	50
4.5.6 DISABLE_SAFE - Disable Safe Mode Timeout.....	51
4.5.7 DUMP_INITIATE WITH type, table, segment, offset, countHigh, countLow - Memory Dump Initiate.....	51
4.5.8 ENABLE_DETECTOR WITH detectorNumber - Enable SPM Detector Power.....	53
4.5.9 ENABLE_EE_BURN - Enable EEPROM Program Commands.....	53
4.5.10 ENABLE_FDIR - Enable Instrument FDIR.....	54
4.5.11 ENABLE_FUSE - Enable MOPITT Device Fuse.....	54
4.5.12 ENABLE_MAINCMDS - Enable Operation of Maintenance Commands.....	55
4.5.13 ENABLE_SAFE - Enable Safe Mode Timeout.....	55
4.5.14 GET_DATA WITH type, address, segment - Return a Word from ICM Memory or I/O.....	56
4.5.15 MLOAD_INITIATE WITH type, table, segment, offset, countHi, countLo, crc - Memory Load Initiate.....	57
4.5.16 PASS_COMMAND WITH deviceNumber, command - Send Command to a Device.....	58
4.5.17 PASS_DATA WITH type, address, segment, data - Send a Word of Data to ICM Memory or I/O.....	59
4.5.18 PASS_MSL WITH mslCmd1, ..., mslCmd31 - Execute MOPITT Scan Language Command.....	59
4.5.19 PERFORM_COOL_STR WITH number - Send a cooler command string.....	60
4.5.20 PERFORM_PMC_CAL WITH parameters.....	61
4.5.21 RESET_DUMP - Abort Memory Dump Operation.....	63
4.5.22 RESET_LOAD - Abort Memory Load Operation.....	63
4.5.23 RESET_LRS - Reset LRS bus.....	64
4.5.24 SELECT_COOL_CMD WITH number - Select and send a cooler command string.....	64
4.5.25 SELECT_TABLE WITH tableType, primeAlt - Select a Table for Current Usage.....	65
4.5.26 SET_FREQ TO bus - Set Active Time Mark and Frequency Bus.....	65
4.5.27 SET_TELEM WITH block, word, mask, value - Set a housekeeping telemetry point.....	66
4.5.28 TURN_OFF_EE_BURN - Abort EEPROM Program Procedure.....	67
4.5.29 TURN_OFF_SCI_DAT WITH value - Turn Off LRS Bus Data Category.....	68
4.5.30 TURN_ON_EE_BURN WITH srcSeg, srcOff, destSeg, destOff, nwords, options - Start EEPROM Program Procedure.....	69

Table of Contents (cont'd)

4.5.31	TURN_ON_SCI_DAT WITH value - Turn On LRS Bus Data Category	70
4.5.32	PERFORM_RESET WITH segment, offset - Perform software reset on ICM.....	71
4.6	MOPITT BDU Commands.....	72
4.6.1	TURN_ON_SIDE_A	72
4.6.2	TURN_OFF_SIDE_A	72
4.6.3	TURN_ON_SIDE_B	73
4.6.4	TURN_OFF_SIDE_B	73
4.6.5	TURN_ON_MPSU_A	74
4.6.6	TURN_OFF_MPSU_A	74
4.6.7	TURN_ON_MPSU_B	75
4.6.8	TURN_OFF_MPSU_B	75
4.6.9	TURN_ON_SPSU_A	76
4.6.10	TURN_OFF_SPSU_A	76
4.6.11	TURN_ON_SPSU_B	77
4.6.12	TURN_OFF_SPSU_B	77
4.6.13	ENABLE_LAUNCH_A	78
4.6.14	ENABLE_LAUNCH_B	78
4.6.15	RESET_COMPUTER.....	79
4.6.16	SELECT_PROM_A	79
4.6.17	SELECT_PROM_B	80
4.6.18	SET_RD_SPARE1.....	80
4.6.19	SET_RD_SPARE2.....	81
4.6.20	SET_RD_SPARE3.....	81
4.7	Stored Commands	82
4.8	Telemetry Monitor	82
5.	MOPITT INSTRUMENT TELEMETRY.....	83
5.1	Instrument Telemetry Requirements.....	83
5.2	Critical Health and Safety Telemetry Format	83
5.3	Housekeeping Telemetry Format	83
5.4	LRS Bus CCSDS Format	83
5.5	Science Data Format	85
5.6	Science Data Formatting.....	85
5.6.1	Data Collection Timing	85
5.6.2	Signal Processing Data Stream.....	86
5.6.3	Instrument Data Stream	86

Table of Contents (cont'd)

5.7 Engineering Data Format	87
5.8 LRS Bus Test Packet	87
5.9 LRS Bus Burst Packet	87
5.10 LRS Bus Table Packet	87
5.11 Telemetry Sampling Rates	88
5.12 MIL-STD-1553B Telemetry Bus Schedule	89
5.13 Telemetry Names	89
5.14 Byte Orientation	89
 6. TABLES	 90
6.1 MOPITT Tables	90
6.1.1 TN_NULL - Null Table	91
6.1.2 TN_INDEX - Index Table	91
6.1.3 TN_ACTIVE - Active Table	91
6.1.4 TN_STATUS - ICM Status Table	92
6.1.5 TN_STATISTICS - Statistics Table	93
6.1.6 TN_LOADDUMP - Memory Load/Dump Table	95
6.1.7 TN_DEVICE - Device Pointer Table	95
6.1.8 TN_RAM_MASK_A, TN_RAM_MASK_B - Bad Block Table	96
6.1.9 TN_CONFIG_A, TN_CONFIG_B - ICM Configuration Table	96
6.1.10 TN_ENG_TELEM_A, TN_ENG_TELEM_B - Engineering Data to H/K Telemetry Copy Table	97
6.1.11 TN_SCHED_A, TN_SCHED_B - C&T Bus Telemetry Schedule Table	98
6.1.12 TN_LIMITS_A, TN_LIMITS_B - Limits Table	98
6.1.13 TN_SCAN_A, TN_SCAN_B - Scan Table	101
6.1.14 TN_COOLER_A, TN_COOLER_B - Cooler Initialization Table	101
6.1.15 TN_TCU_A, TN_TCU_B - TCU Initialization Table	110
6.1.16 TN_SPM1_A, TN_SPM1_B, TN_SPM2_A, TN_SPM2_B - SPM Initialization Table	111
6.1.17 TN_HEATER_A, TN_HEATER_B - Heater Set Point Table	112
6.1.18 TN_COOLER_REPORT - Cooler Report Table	113
6.1.19 TN_COOLER_SHOW - Cooler Show Table	113
6.1.20 TN_COOLER_ATEM - Cooler Atem Table	114
6.1.21 TN_COOLER_CAMP - Cooler Camp Table	114

Table of Contents (cont'd)

7. DEVICE COMMAND AND TELEMETRY	115
7.1 Device Numbers	115
7.2 Device States	116
7.3 Device Status	117
7.4 Device Port Addresses	118
7.5 Device Interfaces	124
7.6 PLDM Command and Telemetry (PMC/LMC)	124
7.6.1 Command Word:	124
7.6.2 Status/Telemetry Words:	126
7.6.3 PLDM Operation	128
7.7 SCDM Command and Telemetry (Scan Mirror and Chopper)	129
7.7.1 Command Word:	129
7.7.2 Status/Telemetry Words:	130
7.7.3 SCDM Operation	132
7.8 PCDM Command and Telemetry (Port Covers and Heaters)	134
7.8.1 Command Word:	134
7.8.2 Status/Telemetry Words:	136
7.8.3 PCDM Operation	138
7.9 SPM Command and Telemetry (Signal Processing Module 1 & 2)	139
7.9.1 Command Word:	140
7.9.2 Status/Telemetry Words:	143
7.9.3 SPM Data Return Interface	145
7.9.4 SPM Operation	145
7.10 TCMM Command and Telemetry (Thermal Control and Monitoring Module)	148
7.10.1 Command Word:	148
7.10.2 Status/Telemetry Words:	159
7.10.3 TCMM Operation	160
7.11 Cooler Command and Telemetry	163
7.11.1 Cooler Operation	163
7.12 Serial Diagnostic Interface Telemetry	169
 8. TRACEABILITY TO PARENT'S DESIGN	 170

Table of Contents (cont'd)

9. ABBREVIATIONS AND ACRONYMS	174
10. GLOSSARY	176
11. NOTES	178
11.1 Scan Procedure	178

List of Appendices

APPENDIX A MOPITT INSTRUMENT DATA FORMATS	179
APPENDIX B LRS BUS SCIENCE CCSDS PACKETS	180
APPENDIX C TELEM.DAT - TELEMETRY LISTING	181
APPENDIX D TELEMETRY INTERFACE DESIGN FOR THE COOLER DRIVE ELECTRONICS	182
APPENDIX E TEST PACKET CONTENTS	183

List of Tables

Table 4.3-1 Sub-address Assignment	23
Table 4.4-1 Command Groups	30
Table 4.4-2 Command Error Codes	31
Table 5.4-1 LRS Bus CCSDS Format	84
Table 5.6-1 Science Data Compression	86
Table 5.10-1 Telemetry Sampling Rates	88
Table 5.11-1 Telemetry Bus Schedule	89
Table 6.1-1 MOPITT Tables	90
Table 7.1-1 Device Numbers	115
Table 7.2-1 Device States	116
Table 7.3-1 Device Status	117
Table 7.4-1 Peripheral Chip Select Addresses	118
Table 7.4-2 Miscellaneous and Timing Control Ports	118
Table 7.4-3 ICM Transmitter/Receiver Buffer Full Flag Status Port	121
Table 7.4-4 ICM Miscellaneous Status Register	122
Table 7.4-5 ICM Control Port	122
Table 8-1 Traceability Matrix	170

1. INTRODUCTION

1.1 Identification of Document

This is the software Interface Control Document (ICD) for the MOPITT Instrument Software System.

1.2 Scope of Document

This document specifies the software interfaces for the MOPITT Instrument.

The term "software" as used in this document relates to the instrument flight firmware installed in or uploaded into memory on the MOPITT Instrument. This document does not cover the MOPITT ground software or any software used to test or validate the MOPITT Instrument.

1.3 Purpose and Objectives of Document

This document provides a description of the software interface for the MOPITT Instrument software, including commands, telemetry and communication protocols.

1.4 Document Status and Schedule

This version of the document is being released at the start of integration of MOPITT onto the EOS-AM1 spacecraft. Subsequent versions of this document will be produced as required throughout the life of the MOPITT Instrument Project. The MOPITT Instruments Project Software Manager is responsible for maintaining this document.

1.5 Organization of the Document

Section 1, "Introduction", includes scope, objectives, purpose, and terminology.

Section 2, "Related Documents", provides a list of documents that are applicable to this document and documents which may be helpful in interpreting and implementing the MOPITT Instrument commands.

Section 3, "Interface Requirements Description", describes the data and timing requirements of the interfaces.

Section 4, "MOPITT Instrument Commands", defines the MOPITT Instrument commands and presents a discussion of their actions.

Section 5, "MOPITT Instrument Telemetry", defines the formats for the Instrument Critical Health and Safety, Housekeeping, Science and Engineering Telemetry.

Section 6, "Tables", describes the tables used in the MOPITT Instrument and the formats of these tables.

Section 7, "Device Command and Telemetry", describes the commands and telemetry used between the ICM and the devices in the Instrument.

Section 8, "Traceability to Parent's Design", provides a traceability cross-reference table.

Section 9, "Abbreviations and Acronyms", provides an alphabetized list of definitions of the abbreviations and acronyms used in this document.

Section 10, "Glossary", contains an alphabetized list of definitions for special terms used in the document.

Section 11, "Notes", contains any notes which help explain sections in this document.

Section 12, "Appendices", contains any applicable appendices.

2. RELATED DOCUMENTS

In this document references to other documents are tagged with the format "[Ref. DOC Section_list]". The "DOC" part is an identifier used to reference one of the documents listed below. The "section_list" is a list of applicable sections in the referenced document. The references to documents are used for traceability and do not impose additional requirements, unless stated otherwise.

In the event of conflict between the documents referenced herein and the contents of this specification, the guidance of the contracting officer shall be obtained.

2.1 Parent Documents

This document is part of the "MOPITT INSTRUMENT SOFTWARE SPECIFICATIONS" document set.

2.2 Applicable Documents

The following documents apply directly to this document:

- [MILSTD] "MIL-STD-1553B, Digital Time Division, Command/Response Multiplex Data Bus", 8 September 1986, Department of Defense, United States of America.
- [ICS] "MOPITT Software Specification, Instrument Controller Module", EQS/MOP/113364/402, Rev. P2, Project No. 5093.
- [COOL] "Telemetry Interface Design for the Cooler Drive Electronics", Refer to Appendix D.

2.3 Informational Documents

The following documents are informational, only:

"An Instrument Implementation Concept for the EOS-AM1 Command and Telemetry Bus", 9/22/92, Debbie Ramey, MDSSC/CSC.

[GIIS] "Earth Observing System, General Instrument Interface Specifications for the EOS Observatory", GSFC 420-03-02.

"Earth Observing System (EOS) Instrument Project Software Management Plan", GSFC 422-10-06.

"IEEE Standard Glossary of Software Engineering Terminology", ANSI/IEEE Standard 729-1983, New York: Institute of Electrical and Electronic Engineers, Inc.

- [MIS] "MOPITT Instrument Specification", EQS/MOP/113360/001, Project No. 5093.
- "MIL-STD-1553, Designer's Guide", DDC, ILC Data Device Corporation.
- "NASA Software Documentation Standard, Software Engineering Program", (Ref. NASA-STD-2100-91)
- "(Preliminary) General Instrument Interface Handbook, UID-101", Martin Marietta Corp. Astro Space, 20008502, 30 August 1993.
- "UT1553B BCRTM, Preliminary Data Sheet", United Technologies Microelectronics Center, August 1989.

3. INTERFACE REQUIREMENTS DESCRIPTION

The following subsections describe the general requirements of the MOPITT Instrument interfaces.

3.1 Numbering Conventions

Whenever commands refer to bits in this document, the following convention is used:

- highest bit number indicates the most significant bit (e.g., bit 15 = MSB of a word)
- lowest bit number indicates the least significant bit (e.g., bit 0 = LSB of a byte/word/double word)
- bits number references are from left to right, with the most significant bit at the far left (e.g., bits 15-0)

The numbering convention for words in this document is as follows:

- word 0 is always the first word
- byte 0 in a word (2 bytes) is the most significant byte (i.e., "big endian")
- words references are from top to bottom, with the first word at the top (e.g., word 0 - 31)

3.2 Overview of the Interfaces

The MOPITT Instrument consists of the Instrument Controller Module (ICM) and devices. The ICM communicates with the EOS-AM Spacecraft via the following interfaces:

- MIL-STD-1553B Command and Telemetry (C&T) bus
- MIL-STD-1553B Low Rate Science Data (LRS) bus
- Time Mark and Frequency (TMF) bus
- BDU interface (Safe and Survival Mode indicators and boot EEPROM select)

The ICM receives ground and Spacecraft commands on the C&T bus. The TMF bus provides the ICM with a periodic signal in which to synchronize timing information. The ICM sends out telemetry on the C&T bus and science information on the LRS bus. The BDU interface allows the ICM to send status information to the ground via BDU telemetry and also for the ground to control which boot EEPROM the ICM uses on reset.

The ICM also communicates with the instrument devices (e.g., port covers, scan mirrors, detectors, etc.) via serial interfaces to the following device interface modules:

- PMC and LMC Driver Module (PLDM)
- Scan Mirror and Chopper Driver Module (SCDM)
- Port Cover Driver Module (PCDM)
- Signal Processing Modules 1 and 2 (SPM1 and SPM2)
- Cooler Drive Electronics (CDE)

4. MOPITT INSTRUMENT COMMANDS

The MOPITT Instrument receives ground and Spacecraft commands on the MIL-STD-1553B C&T and Low Rate Science busses. The commands received by the MOPITT Instrument on the MIL-STD-1553B busses can be divided into the following categories [Ref. ICS 4.1.15.1]:

- MIL-STD-1553B commands and modes
- Spacecraft Commands
- MOPITT Instrument Commands

The MIL-STD-1553B Remote Terminal (RT) processes most of the mode code commands automatically without ICM intervention when the RT is properly set up. All other command types require ICM processing.

4.1 Command Requirements

This section lists the applicable command requirements from the GIIS.

1. Each command shall be unique and have the same effect in all instrument modes for which the command is applicable [Ref. GIIS 7.2.4.1]. For example, the command to go to Safe Mode should be unique and cause the ICM to go to Safe Mode when in Boot, Standby, or Science Modes.
2. The Instrument software shall not have toggle commands (i.e., single commands that toggle the instrument state between two or more states) [Ref. GIIS 7.2.5, 7.2.5.1].
3. For any command, the command format shall be identical for every mission phase and every instrument mode for which the command is applicable [Ref. GIIS 7.2.5, 7.2.5.2].
4. All instrument real-time commands shall be limited to one MIL-STD-1553B message in length [Ref. GIIS 6.1.3.1.1]. Real time commands are those that are issued from the ground to the MOPITT Instrument for immediate execution. Examples of real time commands include all Operational and Maintenance commands.
5. All instrument commands stored and distributed by the Spacecraft Control Computer (SCC) shall be limited to two 16-bit data words in length [Ref. GIIS 6.1.3.1.2]. Stored commands are MOPITT Instrument commands which are issued automatically by the SCC when a specified time is reached or when certain Housekeeping Telemetry parameters are out of bounds. Note that the ICM does not contain any "stored commands".
6. A normal mode change (i.e., Safe, Survival, Launch, Standby, or Science) shall be made by using a single command [Ref. GIIS 7.5.1.2]. For example, to go from Standby Mode to Science Mode, the `SELECT_SCIENCE` command should make the Instrument perform all necessary internal state changes to go to Science Mode.
 - a) Multifunction commands are defined as those commands which always change the state of more than one discrete condition at the same time. For example, a command which sets the enabling state of four devices each time the command is issued is a multifunction command.

- b) Commands that control a number of discrete conditions shall have individual enabling capability for each controlled function (i.e., in the form of an enabling bit) which shall be able to be changed individually or in any combination [Ref. GHS 7.2.5, 7.2.5.3]. What this means is that for the previous example, the command which sets the enabling state of four devices must have individual enabling bits associated with each device. This would make it possible to change only one device state at a time, or any combination of device states.
- c) The ICM software shall not use multifunction commands which change the state of more than one discrete condition at the same time without enabling lists.

4.2 MIL-STD-1553B Commands and Modes

MIL-STD-1553B specifies a number of Mode Code commands. The following is a list of the Mode Codes used by the C&T and Low Rate Science Data buses. The sub-address/mode indicator of either "00000" or "11111" binary is used to denote a mode command.

In most cases the Remote Terminal Controller will process the mode code commands automatically. The status word is transmitted by the Remote Terminal Controller in the cases where the command is handled automatically.

Note that mode code commands are not reflected in the MOPITT telemetry stream; i.e., the mode codes are "transparent" to the MOPITT instrument.

4.2.1 *INHIBIT_TFB - Inhibit Terminal Flag Bit*

Purpose: Inhibit the Terminal Flag from being set in the Status Word.

Format: Mode Code: "00110"
 Direction: Transmit
 Data Words: None.

Description: This command inhibits the Terminal Flag from being set in the Status Word. Note that the Terminal Flag bit is not used by the MOPITT Instrument and should never be set. This command is automatically processed by the Remote Terminal Controller.

This command is used on both the C&T and LRS busses.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.15.2.2]

See Also: OVER_INHIBIT_TFB

4.2.2 *INIT_SELF_TEST - Initiate Remote Terminal Controller BIT Routine*

Purpose: Used to test the functionality of the Remote Terminal Controller.

Format: Mode Code: "00011"
Direction: Transmit
Data Words: None.

Description: This command causes the Remote Terminal Controller to execute the (Built-In-Test) BIT routine. The results of the test are available 100 us after starting. This command is handled automatically by the Remote Terminal Controller.

This command is used on both the C&T and LRS busses.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.15.2.2]

See Also: NONE

4.2.3 *OVERRIDE_TRANS - Override Transmitter Shutdown*

Purpose: This command enables the alternate bus transmitter.

Format: Mode Code: "00101"
Direction: Transmit
Data Words: None.

Description: This command enables the alternate bus transmitter. This command is automatically processed by the Remote Terminal Controller.

This command is used on the C&T bus only.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.15.2.2]

See Also: TRANS_SHUTDOWN

4.2.4 *RESET_RT - Reset Remote Terminal*

Purpose: Reset the RT interface.

Format: Mode Code: "01000"
 Direction: Transmit
 Data Words: None.

Description: This command causes the Remote Terminal Controller to reset the encoder, decoder, and protocol logic. This command is automatically processed by the Remote Terminal Controller.

This command is used on both the C&T and LRS busses.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.15.2.2]

See Also: NONE

4.2.5 *SYNC_WITHOUT_DATA - Synchronize Without Data Word*

Purpose: This command is used by the Spacecraft to indicate the end of transfer of a CCSDS packet on the Low Rate Science Data bus.

Format: Mode Code: "00001"
 Direction: Transmit
 Data Words: None.

Description: This mode command is used to signal the end of a CCSDS data packet transmission. This command is handled automatically by the Remote Terminal Controller.

This command is used on the LRS bus only.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.15.2.2]

See Also: NONE

4.2.6 SYNC_WITH_DATA - Synchronize with Data Word

Purpose: This command is used to synchronize the ICM with the spacecraft major/minor cycle count on the Command and Telemetry bus.

Format: Mode Code: "10001"
Direction: Receive
Data Words:

<u>Word</u>	<u>Bit</u>	<u>Value</u>	<u>Description</u>
0	15-14	--	Reserved
0	13-8	0-63	Major Cycle count
0	7	--	Reserved
0	6-0	0-127	Minor Cycle count

Description: This command is used only on the C&T bus.

This command is issued once ever 256 milliseconds (32 minor cycles) by the CTIU. This command is issued within 200 microseconds of a minor cycle and can be used to synchronize ICM MIL-STD-1553B bus activities with command processing.

The ICM will maintain a local major/minor cycle count which will be reset if it differs from the one contained in the data word.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.15.2.2, GLIS 6.1.2.4.1, 6.1.2.4.1.1, 6.1.2.4.1.2, 6.1.2.4.1.3, 6.1.2.4.1.4]

See Also: NONE

4.2.7 TRANS_BIT - Transmit BIT Word

Purpose: Send the BIT (Built In Test) status word.

Format: Mode Code: "10011"
Direction: Transmit
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15	0-1	Bus B failure (1 = failure)
0	14	0-1	Bus A failure (1 = failure)
0	13-0	0	Reserved

Description: The Remote Terminal Controller transmits the BIT information from the BIT Register. The BIT information indicates the status of the RT self test and does not indicate the status of the ICM. This command is processed automatically by the Remote Terminal Controller.

This command is used on the C&T bus only.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.15.2.2]

See Also: NONE

4.2.8 *TRANS_LAST - Transmit Last Command*

Purpose: Transmit the last command executed.

Format: Mode Code: "10010"

Direction: Transmit

Data Words:

<u>Word</u>	<u>Bits</u>	<u>Description</u>
0	15-0	Previous command executed by RT

Description: The Remote Terminal Controller transmits the previous command executed. This command is processed automatically by the Remote Terminal Controller.

This command is used both on the C&T and LRS busses.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.15.2.2]

See Also: NONE

4.2.9 *TRANS_SHUTDOWN - Transmitter Shutdown*

Purpose: This command disables the alternate bus transmitter.

Format: Mode Code: "00100"
 Direction: Transmit
 Data Words: None.

Description: This command disables the alternate bus transmitter. This command is automatically processed by the Remote Terminal Controller.

This command is used on the C&T bus only.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.15.2.2]

See Also: OVERRIDE_TRANS

4.2.10 *TRANS_STATUS - Transmit Status Word*

Purpose: This command is used to make the RT send the status word associated with the previous valid command.

Format: Mode Code: "00010"
 Direction: Transmit
 Data Words: None.

Description: This command causes the RT to transmit the status word associated with the previous valid command word. This command is handled automatically by the Remote Terminal Controller.

This command is used both on the C&T and LRS busses.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.15.2.2]

See Also: NONE

4.2.11 *TRANS_VECTOR - Transmit Vector Word*

Purpose: Determine the size of a Low Rate Science Data Bus packet.

Format: Mode Code: "10000"
Direction: Transmit
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Description</u>
0	15-0	Number of octets (bytes) to be transferred.

Description: This command is used only on the Low Rate Science Data bus and causes a data word to be transmitted from the RT. This command is automatically processed by the Remote Terminal Controller.

The Spacecraft will poll the ICM with the TRANS_VECTOR command periodically. The ICM is required to indicate that a packet is ready by setting the service request bit in the status word and indicate the number of octets (bytes) to be transferred in the MIL-STD-1553B data word associated with this command.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.7.3, 4.1.15.2.2, GLIS 6.3.5.4]

See Also: NONE

4.3 **Spacecraft Commands**

Spacecraft commands are sent via RT sub-addresses and are used for communicating commands and data between the Spacecraft and the Instrument. Table 4.3-1 shows the commands and sub-addresses for both the C&T and the Low Rate Science Data buses [Ref. ICS 4.1.18.1, 4.1.18.2, 4.1.18.3].

Table 4.3-1: Sub-address Assignment

Sub-address	Bus	Data Direction from RT	Command
1	C&T	Receive	Instrument Commands, see Operational and Maintenance Commands sections, below.
2	C&T	Receive	LOAD_DATA
2	C&T	Transmit	DUMP_DATA
4	C&T	Receive	ANCILLARY_DATA
5	C&T	Receive	IMOK
6	C&T	Receive	TIME_CODE
7	C&T	Receive	SET_SAFE_MODE
9	Both	Transmit/Receive	LOOP_BACK
17	C&T	Transmit	HOUSE_TELEM
18	C&T	Transmit	CRITICAL_TELEM
10-25	Science	Transmit	Used for the 16 Low Rate Science Data Output Buffers
0, 31	Both	Transmit/Receive	Used for Spacecraft Commands with Mode Codes (see Spacecraft Commands with Mode Codes section, above)
other	Both	--	All remaining subaddress numbers are reserved

4.3.1 Instrument Commands (sub-address 1)

Purpose: C&T bus sub-address is used to send MOPITT Instrument commands (i.e., Operational and Maintenance) to the ICM computer.

Format: Sub-address: 1
Direction: Transmit/Receive
Data Words:

Word	Bits	Description
0	15-8	Command Groups
0	7-0	Command Sub-identifier
1-31	15-0	Command specific data

Description: This command is used to send MOPITT Instrument commands to the ICM computer. See the Operational and Maintenance Commands sections for more details, below.

Error Codes: See Operational and Maintenance Commands.

Traceability: [Ref. ICS 4.1.18.1]

See Also: Operational and Maintenance Commands, below.

4.3.2 *LOAD_DATA - Memory Load Data*

Purpose: Load a maximum of 32 word of data into memory.

Format: Sub-address: 2

Direction: Receive

Data Words:

<u>Word</u>	<u>Bits</u>	<u>Description</u>
0-31	15-0	Words of load data.

Description: This command is used to transfer memory load data to the ICM. The memory load data sequence is initiated with a MLOAD_INITIATE command followed by one or more LOAD_DATA commands. A maximum of 32 words can be loaded with each LOAD_DATA command. After the last LOAD_DATA message, the ICM indicates the result of the 16 bit CRC value calculated for the loaded data compared with the expected result via the telemetry field BS_ICM_MLOAD_OK.

One C&T bus major cycle (about 1.024 seconds) is required for the ICM to prepare to accept LOAD_DATA commands after the reception of the MLOAD_INITIATE command.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.18.1, 4.1.19.2, GHS 6.1.3.3]

See Also: MLOAD_INITIATE, RESET_LOAD

4.3.3 *DUMP_DATA - Memory Dump Data*

Purpose: Dump a maximum of 32 words of data from memory.

Format: Sub-address: 2

Direction: Transmit

Data Words:

<u>Word</u>	<u>Bits</u>	<u>Description</u>
0-31	15-0	Words of dump data.

Description: This command is used to transfer memory dump data from the ICM. The memory dump data sequence is initiated with a DUMP_INITIATE command followed by one or more DUMP_DATA commands. A maximum of 32 words can be transferred with each DUMP_DATA command. A C&T bus major cycle (about 1.024 seconds) is required for the ICM to prepare for the DUMP_DATA command after the reception of the DUMP_INITIATE command.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.18.1, 4.1.19.2, GLIS 6.1.3.4]

See Also: DUMP_INITIATE, RESET_DUMP

4.3.4 *ANCILLARY_DATA - Ancillary Data*

Purpose: Receive Spacecraft ancillary data.

Format: Sub-address: 4
Direction: Receive
Data Words: 32 words formatted as per GLIS Table 6-2 and Table 6-3.

Description: This command is used by the Spacecraft to transmit to the MOPITT Instrument Spacecraft Ancillary Data.

The ICM will receive the Ancillary Data once per major cycle from the Spacecraft. The ICM will attach headers to the Ancillary Data and send it down in the Engineering Data packet on the Low Rate Science Data bus once every 8 major cycles.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.18.1, GLIS 6.1.2.4.6.1, 6.1.3.5.1, 6.1.3.5.2]

See Also: NONE

4.3.5 IMOK - SCC "I'm OK" Indication

Purpose: This is the SCC "I'm OK" message. The absence of this message means that communications on the C&T bus with the SCC has been lost.

Format: Sub-address: 5
Direction: Receive
Data Words: "600D" hexadecimal

Description: The IMOK message is sent to the instrument once per major cycle from the SCC. The ICM will respond with a non-error status word.

If this message is not received within 5 major cycles (5.12 seconds) of the last IMOK, the instrument will execute the SELECT_SAFE_MODE Command if automatic Safe Mode entry is enabled. The default instrument configuration is to have automatic Safe Mode entry enabled.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.18.1, GISS 6.1.2.4.6.1, 6.1.3.1.4]

See Also: ENABLE_SAFE, DISABLE_SAFE, SET_SAFE_MODE

4.3.6 TIME_CODE - Time Code Data

Purpose: Time code data information.

Format: Sub-address: 6
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Description</u>
0	15-0	Days since 1958 January 1
1	15-0	Milliseconds of Day (MSW)
2	15-0	Milliseconds of Day (LSW)
3	15-0	Microsecond of Millisecond

Description: This command is used by the Spacecraft to send the Spacecraft Time Code to the MOPITT Instrument once every major cycle. The Time Code Data is used to synchronize the internal MOPITT Instrument time with the Spacecraft time.

The time indicated by the time code is valid at exactly the Time Mark Instant indicated on the Time Mark and Frequency bus. The time code is sent to the instrument 100 to 900 milliseconds before the associated time mark instant on the Time Mark and Frequency Bus. Time Marks occur every major cycle (1.024 seconds). The Time Mark instant is the beginning of a major cycle.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.18.1, GLIS 6.1.2.4.6.1, 6.1.3.6.1, 6.1.3.6.2, 6.1.3.6.3, 6.2.1, 6.2.2]

See Also: NONE

4.3.7 *SET_SAFE_MODE - Spacecraft Safe Mode Command*

Purpose: Spacecraft generated command to put the MOPITT Instrument into Spacecraft Safe Mode.

Format: Sub-address: 7
 Direction: Receive
 Data Words: "D734" hexadecimal

Description: The Spacecraft issues SAFE_MODE command when the Spacecraft has lost lock on the Earth and will be transitioning to Sun pointing orientation.

This command is the same as the SELECT_SAFE command.

Error Codes: NONE

Telemetry: SS_INST_MODE, BR_BDU_SAFE_MODE

Traceability: [Ref. ICS 4.1.18.1, GLIS 6.1.2.4.6.1, 6.1.3.1.3, 7.5.2.3]

See Also:

4.3.8 *LOOP_BACK - MIL-STD-1553B Loop Back*

Purpose: Data loop back on the MIL-STD-1553B bus.

Format: Sub-address: 9
 Direction: Transmit/Receive
 Data Words:

Word	Bits	Description
0-31	15-0	Any value

Description: The command is used by the BC on the C&T bus and LRS bus for diagnostic purposes. The BC can write a value to this sub-address and then read it back. The Remote Terminal (RT) controller is set up to handle this command automatically by the ICM. No top-level processing is required from the ICM.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.18.1]

See Also: NONE

4.3.9 HOUSE_TELEM - Housekeeping Telemetry

Purpose: Transmit the Housekeeping Telemetry (C&T bus, only).

Format: Sub-address: 17 (C&T bus, only)
Direction: Transmit
Data Words: 32 words of Housekeeping Telemetry (see Housekeeping Telemetry Format)

Description: This command requests the Housekeeping Telemetry data be sent by the MOPITT Instrument.

The Spacecraft will collect the Housekeeping Telemetry from the instrument once per major cycle on a scheduled basis. The Housekeeping Telemetry from the MOPITT instrument is sub-commutated and consists of 8 blocks. Each telemetry block contains the major cycle count the telemetry was collected by the Spacecraft and the telemetry block number.

The minor cycle in which telemetry is gathered is indicated by the Telemetry Schedule tables (i.e., table numbers TN_SCHED_A and TN_SCHED_B). By uploading a new table and making the new table the active table (via the SELECT_TABLE command), the telemetry schedule may be changed. The schedule change will take about 8 major cycles (about 8 seconds) to complete.

Note that the Telemetry Schedule must be set so that there is enough time to collect the telemetry and process it before the Spacecraft collects it. At a minimum, one major cycle should separate the end of the telemetry collection and when the Spacecraft is scheduled to collect it. Also, the telemetry must remain undisturbed for one major cycle after the Spacecraft is scheduled to collect it.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.18.1]

See Also: CRITICAL_TELEM

4.3.10 *CRITICAL_TELEM - Critical Health and Safety Telemetry Transfer*

Purpose: Transmit the Critical Health and Safety Telemetry data (C&T bus, only).

Format: Sub-address: 18 (C&T bus, only)
 Direction: Transmit
 Data Words: 32 bits (2 words) of Critical Health and Safety Telemetry (see
 Critical Health and Safety Telemetry Format)

Description: This command will cause the instrument to transmits 32 bits of Critical Health and
 Safety Telemetry data. This is done as a single MIL-STD-1553B message. During
 contingencies, this may be the only data transmitted by the instrument.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.18.1]

See Also: HOUSE_TELEM

4.3.11 *SCIENCE_DATA - MOPITT Science Data Telemetry*

Purpose: Transmit MOPITT Instrument Science Data.

Format: Sub-address: 10-25 (Low Rate Science Data bus, only)
 Direction: Transmit
 Data Words: 1 - 32 words of MOPITT science data (see Low Rate Science Data
 Bus Packet Format)

Description: This command (to any one of 16 sub-addresses) is used to cycle through 16 buffers
 of science data (1 to 32 words each) as required to transmit MOPITT science data
 on the LRS bus, only.

 The protocol used on the LRS bus is descibed in the GIIS.

Error Codes: NONE

Traceability: [Ref. ICS 4.1.18.1]

See Also: NONE

4.4 MOPITT Instrument Commands - Operational

The following subsections list the Operational MOPITT Instrument Commands. The Operational Commands are received on the C&T bus, sub-address 1, and are used in normal instrument operation.

Operational Commands use the first data word (word 0) to identify the command group (MSB) and sub-identifier (LSB) and there may be one or more data words associated with a command.

Command groups are shown in Table 4.4-1. Within each command group are one or more commands. These commands are identified by the command sub-identifier. The commands and sub-identifiers are described later in this section.

Table 4.4-1: Command Groups

Command Group	Value (Hex)	Description
CG_INVALID	0	Command Group 0 is invalid
CG_ICM	10	Miscellaneous ICM commands
CG_COVER	20	Port Cover commands
CG_DEVICE	30	Device specific commands
CG_MODE	40	Instrument mode commands
CG_LRS	50	LRS MIL-STD-1553B bus commands
CG_CALIBRATE	60	Long Calibration procedure commands
CG_HOUSEKEEPING	70	ICM housekeeping commands
CG_MEMORY	80	Memory Load/Dump commands
CG_EEPROM	90	EEPROM programming commands

All Operational Commands return an error code upon completion of the command. The assigned error codes are shown in Table 4.4-2.

Table 4.4-2: Command Error Codes

Error Code	Value (Hex)	Meaning
ERR_OK	0 (00)	Command performed successfully.
ERR_BAD	-1 (FF)	Bad command. This error code is returned when no matching command group or sub-identifier is found for the command.
ERR_BUSY	-2 (FE)	Command not performed, device is busy.
ERR_DISABLED	-3 (FD)	Command not performed, device is disabled or failed.
ERR_MODE	-4 (FC)	Command not performed, command not allowed in this instrument mode.
ERR_PARAMETER	-5 (FB)	Command not performed, parameter data within the command is bad.
ERR_IN_PROGRESS	-6 (FA)	Command not performed, already in progress.
ERR_NO_MEMORY	-7 (F9)	Command not performed, no memory available.
ERR_TIMEOUT	-8 (F8)	Error, timed out waiting for data from device.
ERR_NONE	-9 (F7)	Error, no status/telemetry available.
ERR_BAD_DATA	-10 (F6)	Error, bad return data.
ERR_STATE	-11 (F5)	Error, device state transition not allowed
ERR_NOT_ALLOWED	-12 (F4)	Error, operation not allowed
ERR_SERIAL	-13 (F3)	Error, serial interface

For all Operational and Maintenance commands, the following apply:

- The telemetry point SS_CMD_ERROR returns the error code, as shown in Table 4.4-2, for the command.
- The telemetry point SS_CMD_TOGGLE is a 4 bit counter which increments for each new command received. The counter counts from 0 to 15 and rolls over at 15.
- The telemetry point BS_CMD_STATUS indicates when the ICM is busy processing a command. The point is set to one when the ICM is processing a command and reset to zero when the ICM is finished.

4.4.1 CLOSE_COVER_1 - Close the Earth View Port Cover

Purpose: This command causes the earth view port cover to be closed.

Format: Sub-address: 1
Direction: Receive
Data Words:

Word	Bits	Value	Description
0	15 - 0	0x2011	Command

Description: This command is used to close the earth view port cover. The port cover must have been previously enabled by the ENABLE_COVERS command before being closed. This command will cause the motor to drive the clutch if the port cover is already closed against the hard stop.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_DISABLED

Telemetry: SS_DEV_COVER1

Traceability: [Ref. ICS 4.4.9.2]

See Also: ENABLE_COVERS, OPEN_LATCH_1, OPEN_COVER_1, DISABLE_COVERS

4.4.2 CLOSE_COVER_2 - Close the Space View Port Cover

Purpose: This command causes the space view port cover to be closed.

Format: Sub-address: 1
Direction: Receive
Data Words:

Word	Bits	Value	Description
0	15 - 0	0x2021	Command

Description: This command is used to close the space view port cover. The port cover must have been previously enabled by the ENABLE_COVERS command before being closed. This command will cause the motor to drive the clutch if the cover is already closed against the hard stop.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_DISABLED

Telemetry: SS_DEV_COVER2

Traceability: [Ref. ICS 4.4.9.3]

See Also: ENABLE_COVERS, OPEN_LATCH_2, OPEN_COVER_2, DISABLE_COVERS

4.4.3 *CLOSE_LATCH_1 - Close the Earth View Port Latch*

Purpose: This command causes the earth view port latch to be closed.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x2013	Command

Description: This command is used to close (de-energize) the earth view port latch. The port cover must have been previously enabled by the ENABLE_COVERS command before issuing this command.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_DISABLED

Telemetry: SS_DEV_COVER1

Traceability: [Ref. ICS 4.4.9.2]

See Also: ENABLE_COVERS, OPEN_LATCH_1, OPEN_COVER_1, DISABLE_COVERS

4.4.4 *CLOSE_LATCH_2 - Close the Space View Port Latch*

Purpose: This command causes the space view port latch to be closed.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x2023	Command

Description: This command is used to close (de-energize) the space view port latch. The port cover must have been previously enabled by the ENABLE_COVERS command before using this command.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_DISABLED

Telemetry: SS_DEV_COVER2

Traceability: [Ref. ICS 4.4.9.3]

See Also: ENABLE_COVERS, OPEN_LATCH_2, OPEN_COVER_2, DISABLE_COVERS

4.4.5 *DISABLE_COVERS - Reset the Port Covers*

Purpose: This command causes the port covers to be disabled (via a reset).

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 8	0x2030	Command

Description: This command is used to reset the port covers.

Error Codes: ERR_OK, ERR_DISABLED

Telemetry: BS_DEV_COVERS

Traceability: [Ref. ICS 5.3.1]

See Also: OPEN_LATCH_1, OPEN_COVER_1, CLOSE_COVER_1, ENABLE_COVERS

4.4.6 *ENABLE_COVERS - Enable the Port Covers for Operation*

Purpose: This command causes the port covers to be enabled (i.e., armed) for operation.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x2031	Command

Description: This command is used to enable both the earth view and space view port covers for operation. The default power up state for the cover is disabled.

Once enabled, the covers will remain enabled until either explicitly disabled by the DISABLE_COVERS command or until about 10-15 minutes have elapsed, whichever occurs first.

Error Codes: ERR_OK, ERR_DISABLED

Telemetry: BS_DEV_COVERS

Traceability: [Ref. ICS 5.3.1]

See Also: OPEN_LATCH_1, OPEN_COVER_1, CLOSE_COVER_1, DISABLE_COVERS

4.4.7 MOVE_MIRROR WITH mirror_number, position - Move a Scan Mirror to an Absolute Position

Purpose: This command moves a Scan Mirror to an absolute position.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x3012	Command
1	15 - 0	1..4	Scan Mirror Number
2	15 - 0	--	Absolute position (0=nadir, 150=space view, 100=calib. source)

Description: This command moves a Scan Mirror to an absolute position. The scan mirror positions are referenced from Nadir or Earth view, which is position zero. A positive position value implies the number of steps in the clockwise direction while a negative position implies the number of steps in the counter-clockwise direction.

The direction in which the mirror is moved is the shortest distance from the current position to the commanded position.

Scan Mirror rotation reference is based on viewing the MOPITT Instrument from the Scan Mirror end along the positive X axis (i.e., looking at the base of the scan motor and back of the mirror). Counter-clockwise rotation of 90 degrees (i.e., position 150) will place the mirror in the space view. The calibration source is located at 180 degrees from Nadir (i.e., position 100).

Position values in the range ± 200 are accepted. Negative positions are equivalent (0 - nadir, -50 = space view, -100 = calib. source)

Earth view for a standard 29 step stare is in the range of positions ± 14 , inclusive.

The Scan Mirror must be placed in device Maintenance State before this command can take effect. The scan mirror position is returned in the Housekeeping Telemetry.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_DISABLED, ERR_PARAMETER, ERR_MODE

Telemetry: SR_POS_MIRROR1,
 SR_POS_MIRROR2,
 SR_POS_MIRROR3,
 SR_POS_MIRROR4

Traceability: [Ref. ICS 4.4.8.3]

See Also: SET_DEVICE

4.4.8 *OPEN_COVER_1 - Open the Earth View Port Cover*

Purpose: This command causes the earth view port cover to be opened.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x2010	Command

Description: This command is used to open the earth view port cover. The cover must be previously enabled and unlatched before being opened. This command will cause the motor to drive the clutch if the cover is already open against the hard stop.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_DISABLED

Telemetry: SS_DEV_COVER1

Traceability: [Ref. ICS 4.4.9.3]

See Also: ENABLE_COVERS, OPEN_LATCH_1, CLOSE_COVER_1, DISABLE_COVERS

4.4.9 *OPEN_COVER_2 - Open the Space View Port Cover*

Purpose: This command causes the space view port cover to be opened.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x2020	Command

Description: This command is used to open the space view port cover. The cover must be previously enabled and unlatched before being opened. This command will cause the motor to drive the clutch if the cover is already open against the hard stop.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_DISABLED

Telemetry: SS_DEV_COVER2

Traceability: [Ref. ICS 4.4.9.3]

See Also: ENABLE_COVERS, OPEN_LATCH_2, CLOSE_COVER_2, DISABLE_COVERS

4.4.10 *OPEN_LATCH_1 - Unlatch the Earth View Port Cover*

Purpose: This command causes the earth view port cover to be unlatched.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x2012	Command

Description: This command is used to unlatch the earth view port cover. The cover is latched shut during launch and needs to be unlatched before it can be opened. The cover must be previously enabled by the ENABLE_COVERS command before this command can take effect.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_DISABLED

Telemetry: SS_DEV_LATCH1

Traceability: [Ref. ICS 4.4.9.2]

See Also: ENABLE_COVERS, OPEN_LATCH_1, OPEN_COVER_1, DISABLE_COVERS

4.4.11 *OPEN_LATCH_2 - Unlatch the Space View Port Cover*

Purpose: This command causes the space view port cover to be unlatched.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x2022	Command

Description: This command is used to unlatch the space view port cover. The cover is latched shut during launch and needs to be unlatched before it can be opened. The cover must be previously enabled by the ENABLE_COVERS command before this command can take effect.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_DISABLED

Telemetry: SS_DEV_LATCH2

Traceability: [Ref. ICS 4.4.9.2]

See Also: ENABLE_COVERS, OPEN_LATCH_2, OPEN_COVER_2, DISABLE_COVERS

4.4.12 *PERFORM_DEV_INIT WITH deviceNum - Initialize a Device*

Purpose: This command is used to initialize a device with the initialization parameters from the active initialization table.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x3010	Command
1	15 - 0	--	Device Number

Description: This command causes a device to be initialized with the parameters from the active device parameter table, if applicable. The device number must be valid, otherwise the command is ignored and an error code of ERR_PARAMETER is returned. The device must be placed in device Maintenance State via the SET_DEVICE command before this command can take effect.

This command calls the startup() software function for the specified device. Note that each device has a unique startup() function to perform device dependent start up actions.

Error Codes: ERR_OK, ERR_BUSY, ERR_TIMEOUT, ERR_DISABLED, ERR_PARAMETER

Telemetry: SS_DEV_INIT is set to the device number upon successful initialization, -1 otherwise.

Traceability: [Ref. ICS 4.4.2.3, 4.4.4.3, 4.4.5.4, 5.1.13.2]

See Also: SET_DEVICE

4.4.13 *PERFORM_NOP - No Operation*

Purpose: The NOP command is used to verify that the command interface to the ICM is functional. This is a do nothing command that is useful for synchronization.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x1010	Command

Description: This command does nothing. The ICM will respond with the ERR_OK status in the SS_CMD_ERROR telemetry.

Error Codes: ERR_OK

Telemetry: SS_CMD_ERROR, BS_CMD_STATUS, SS_CMD_TOGGLE

Traceability: NONE

See Also: NONE

4.4.14 RESET_DEVICE - Reset MOPITT Device

The RESET_DEVICE command does a device initialization and performs a hardware reset for the choppers, LMC, PMC and SPM devices (CHOPPER_RESET, LMC_RESET, PMC_RESET, SPM_RESET). The command also selects the appropriate side for the SPM, either side A or B (SPM_SIDEA OR SPM_SIDEB).

Purpose: This command is used to manually reset a MOPITT device.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x3019	Command
1	15 - 0	--	Device Number

Description: This command is used to manually reset a device. The device must be placed in device Maintenance State first before this command can take effect.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_DISABLED, ERR_PARAMETER, ERR_MODE

Telemetry: SS_RESET_DEVICE is set to the device number upon successful completion of the command, -1 otherwise.

Traceability: NONE

See Also: TURN_ON_DEVICE, TURN_OFF_DEVICE, PERFORM_DEV_INIT

4.4.15 *SELECT_LAUNCH - Enter Launch Mode*

Purpose: This command is used to make the Instrument enter the Launch Mode.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x4010	Command

Description: This command causes the ICM computer to prepare for entry into the Launch Mode. The Launch Mode is entered from Safe Mode only. The ICM will prepare for Launch Mode by configuring the LMCs and Choppers. The ICM will also set the BDU Survival Mode indicator after completing the Launch Mode activities.

Error Codes: ERR_OK, ERR_MODE

Telemetry: SS_INST_MODE, BR_BDU_SURV_MODE

Traceability: [Ref. ICS 4.4.6.4, 4.4.7.4, 5.1.11.5.2.2]

See Also: SELECT_SAFE

4.4.16 *SELECT_SAFE - Enter Safe Mode*

Purpose: Ground command to put the MOPITT Instrument into Safe Mode.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x4011	Command

Description: This ground command (real time/stored) makes the MOPITT Instrument enter Safe Mode. The ICM will configure itself into the Safe Mode within 30 seconds of receiving this command. The ICM will remain in Safe Mode until changed by external intervention.

The ICM will do the following upon receipt of this command if the current mode is Standby or Science:

- Stop all non-essential instrument operations (e.g., collecting Science Data, etc.)
- Point all scan mirrors to a "safe" position (i.e., a position that eliminates the possibility of reflecting sunlight into the instrument optics in any orientation of the Spacecraft).
- Set the Safe Mode Indicator to the BDU

If entering Safe Mode from Boot Mode, upon receipt of this command the ICM will perform the following:

- Configure memory by allocating the required buffers for LRS bus and devices.

This command should not be confused with the SET_SAFE_MODE command, which the Spacecraft issues when the Spacecraft is not pointing at Earth. The SET_SAFE_MODE will also set the ICM into Safe Mode as described above, except for Boot Mode where the ICM will ignore the SET_SAFE_MODE command (since Boot Mode is a sub-mode of Safe Mode).

Error Codes: ERR_OK, ERR_MODE

Telemetry: SS_INST_MODE, BR_BDU_SAFE_MODE

Traceability: [Ref. GLIS 7.5.2.3]

See Also: IM_OK, ENABLE_SAFE, DISABLE_SAFE, SELECT_SURVIVAL, SELECT_LAUNCH, SELECT_STANDBY, SET_SAFE_MODE

4.4.17 *SELECT_SCIENCE - Enter Science Mode*

Purpose: This command is used to make the Instrument enter the Science Mode.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

Word	Bits	Value	Description
0	15 - 0	0x4012	Command

Description: This command causes the ICM to enter the Science Mode. The Science Mode is entered from Standby Mode only. In Science Mode, the ICM collects Science Data and Engineering Data and sends these on the LRS bus. The mirrors are scanned by the ICM in this mode.

Error Codes: ERR_OK, ERR_MODE

Telemetry: SS_INST_MODE

Traceability: [Ref. ICS 5.1.11.10.3.2]

See Also: SELECT_SAFE, SELECT_STANDBY, SELECT_SURVIVAL

4.4.18 *SELECT_STANDBY - Enter Standby Mode*

Purpose: This command is used to make the Instrument enter the Standby Mode.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

Word	Bits	Value	Description
0	15 - 0	0x4013	Command

Description: This command causes the ICM to enter the Standby Mode. The Standby Mode is entered from Safe Mode or Science Mode. If entering from Safe Mode, the ICM will start up all devices not in the FAILED or MAINTENANCE device states. If entering from Science Mode, the scan procedure is terminated.

Error Codes: ERR_OK, ERR_MODE

Telemetry: SS_INST_MODE

Traceability: [Ref. ICS 5.1.11.9.3.2]

See Also: SELECT_SAFE, SELECT_SCIENCE, SELECT_SURVIVAL, SET_DEVICE

4.4.19 *SELECT_SURVIVAL - Enter Survival Mode*

Purpose: This command is used to make the MOPITT Instrument to go to Survival Mode.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

Word	Bits	Value	Description
0	15 - 0	0x4014	Command

Description: This command is used to make the ICM prepare for entry into Survival Mode. As part of the Survival Mode preparations, the ICM do the following:

- Point the scan mirrors to a safe view
- Disable of all devices under ICM control.
- Set the BDU Survival Mode indicator
- Wait for the power to be removed (via BDU commands stored in Spacecraft).

The Instrument will complete all Survival Mode preparation activities within 30 seconds of receiving this command.

This command is not accepted in Boot mode or Launch mode.

Error Codes: ERR_OK, ERR_MODE

Telemetry: SS_INST_MODE, BR_BDU_SURV_MODE

Traceability: [Ref. GHS 7.2.2.3.4, 7.5.2.3, ICS 5.1.11.6.3.3]

See Also: SELECT_SURVIVAL, SELECT_SAFE, SELECT_STANDBY, SELECT_SCIENCE

4.4.20 *SET_COOLER_TEMP - Set Stirling Cycle Cooler Temperature*

Purpose: This command is used to set the MOPITT cooler temperature.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x301a	Command
1	15 - 0	--	Setting

Description: This command is used to manually set the cooler temperature.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_MODE, ERR_DISABLED

Telemetry: NONE

Traceability: NONE

See Also: SET_DEVICE

4.4.21 *SET_COOLER_DIODE - Set Stirling Cycle Cooler Diode*

Purpose: This command is used to select the MOPITT cooler diode used for temperature monitoring.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x301b	Command
1	15 - 0	0/2	Diode 0 or 2

Description: This command is used to manually set the cooler temperature control source.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_MODE, ERR_DISABLED

Telemetry: NONE

Traceability: NONE

See Also: SET_DEVICE

4.4.22 SET_DEVICE WITH device_no, state - Set a Device State

Purpose: This command is used to enable an Instrument device for a type of operation (i.e., set a Device State).

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x3011	Command
1	15 - 0	--	Device number
2	15 - 0	0 - 3	Device State

Description: This command is used to enable a device for a specific type of operation. The default power up state for all devices is Disabled. This command may be issued at any time, except in Boot Mode.

This command is not valid for the Earth and Space port devices.

Device Numbers and Device States are defined in the "Device Command and Telemetry" section of this document, below.

Error Codes: ERR_OK, ERR_BUSY, ERR_TIMEOUT, ERR_MODE

Telemetry: SS_SET_DEVICE is set to the device number upon successful completion of the command, -1 otherwise.

also:

SS_DEV_CHOP1, SS_DEV_CHOP2, SS_DEV_CHOP3, SS_DEV_CHOP4,
 SS_DEV_COOLER,
 SS_DEV_LMC1, SS_DEV_LMC2, SS_DEV_LMC3, SS_DEV_LMC4,
 SS_DEV_MIRROR1, SS_DEV_MIRROR2,

SS_DEV_MIRROR3, SS_DEV_MIRROR4,
 SS_DEV_PMC1, SS_DEV_PMC2,
 SS_DEV_TCMM,
 SS_DEV_SPM1, SS_DEV_SPM2,
 SS_HTR_CAL1, SS_HTR_CAL2, SS_HTR_CAL3, SS_HTR_CAL4,
 SS_HTR_SIEVE1, SS_HTR_SIEVE2, SS_HTR_SIEVE3, SS_HTR_SIEVE4,
 SS_HTR_NEST1, SS_HTR_NEST2,
 SS_HTR_PCA_EA, SS_HTR_PCA_SP,
 SS_HTR_LATCH_EA, SS_HTR_LATCH_SP

Traceability: [Ref. ICS 4.4.2.2, 4.4.3.2, 4.4.4.4, 4.4.5.3, 4.4.6.3, 4.4.7.3, 4.4.8.4, 5.1.14.2.6]

See Also: NONE

4.4.23 *SET_HEATER WITH device_number, value - Set Heater Setting*

Purpose: This command sets a heater setting to a value.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x3013	Command
1	15 - 0	--	Device Number
2	15 - 0	0...255	Heater Setting (Coarse/normal)
3	15 - 0	0...255	Heater Setting (Fine)]

Description: This command sets the designated heater to the desired setting. For all heaters, the coarse setting is used. For sieve heaters, only, the fine setting is used as well. The fine setting should be set to zero if it is not used.

This command updates the corresponding heater entry in the active heater initialization table, TN_HEATER_x.

The heater must be placed in the device Maintenance State before this command can take effect.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_DISABLED

Telemetry: SS_SET_HEATER is set to the device number upon successful completion of the command, -1 otherwise. Also dump active TN_HEATER_x table for the latest settings.

Traceability: [Ref. ICS 4.4.3.3, 4.4.10.2]

See Also: SET_DEVICE

4.4.24 *TURN_OFF_DEVICE - Turn Off MOPITT Device*

Purpose: This command is used to manually turn off a MOPITT device.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x3018	Command
1	15 - 0	--	Device Number

Description: This command is used to manually turn off a device. The device must be placed in the Device Maintenance State before this command can take effect.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_MODE, ERR_PARAMETER, ERR_DISABLED

Telemetry: SS_OFF_DEVICE is set to the device number upon successful completion of the command, -1 otherwise.

Traceability: NONE

See Also: RESET_DEVICE, TURN_ON_DEVICE, PERFORM_DEV_INIT

4.4.25 *TURN_ON_BURST WITH channel, pixel, duration - Start Burst Data Collection*

Purpose: This command is used to start the burst data collection procedure.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x5010	Command
1	15 - 9	0	Reserved
1	8 - 6	0 - 7	Channel
1	5 - 4	0 - 3	Pixel
1	3 - 0	1 - 11	Duration

Description: This command causes the Instrument to begin the burst data collection on the specified pixel and channel. The burst data collection can be a maximum of approximately 0.28 seconds and terminates automatically.

This command should be invoked in Standby Mode. A maximum of 46 KB of A/D readings are collected by this procedure, this is limited internally by a LRS buffer size. The data is sent as Science Data on the LRS bus. A maximum of 20 seconds is required to send all the collected burst data from the ICM. Attempting to TURN_ON_BURST while burst is in progress will return an ERR_IN_PROGRESS error code.

The burst data collection uses the LRS bus science buffers. If these buffers are full of science data when TURN_ON_BURST is first initiated, the existing science data will be discarded.

Note: Burst cannot be turned on when test packets are being generated. Turn off test packets first before starting burst.

Error Codes: ERR_OK, ERR_IN_PROGRESS, ERR_NOT_ALLOWED, ERR_MODE

Telemetry: BS_BURST_ON, BS_BURST, SS_BURST_MODE

Traceability: [Ref. ICS 5.1.17.1]

See Also: NONE

4.4.26 *TURN_ON_DEVICE - Turn On MOPITT Device*

Purpose: This command is used to manually turn on a MOPITT device.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x3017	Command
1	15 - 0	--	Device Number

Description: This command is used to manually turn on a device. The device must be placed in the Device Maintenance State before this command can take effect.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_MODE, ERR_PARAMETER, ERR_DISABLED

Telemetry: SS_ON_DEVICE is set to the device number upon successful completion of the command, -1 otherwise.

Traceability: NONE

See Also: RESET_DEVICE, TURN_OFF_DEVICE, PERFORM_DEV_INIT

4.5 Instrument Commands - Maintenance

The Maintenance commands are used for MOPITT Instrument maintenance and in contingency situations. The command groups and return error codes are as shown in "Operational Commands - Operational", above in previous section.

4.5.1 *DISABLE_DETECTOR WITH detectorNumber - Disable SPM Detector Power*

Purpose: Disable a SPM detector power.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x3015	Command
1	15 - 0	1 - 8	Detector Number

Description: This command disables the power to the specified detector. Detector numbers 1 to 4 are controlled by SPM1 and detector numbers 5 to 8 are controlled by SPM2. On power up or reset, the detector power is disabled.

Error Codes: ERR_OK

Telemetry: SS_DIS_DETECTOR is set to the detector number upon successful completion of the command, -1 otherwise. Also SR_DEV_SPM1, SR_DEV_SPM2

Traceability: [Ref. ICS 4.4.4.4]

See Also: ENABLE_DETECTOR

4.5.2 *DISABLE_EE_BURN - Disable EEPROM Program Commands*

Purpose: Disable the operation of EEPROM Program commands.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x9010	Command

Description: This command disables the operation of these commands: TURN_ON_EE_BURN, TURN_OFF_EE_BURN. EEPROM programming can be potentially disruptive; thus, this command is used to disable the programming commands. Programming commands are disabled by default.

Error Codes: ERR_OK

Telemetry: BS_EEBURN

Traceability: [Ref. ICS 5.3.5]

See Also: ENABLE_EE_BURN, TURN_ON_EE_BURN, TURN_OFF_EE_BURN

4.5.3 *DISABLE_FDIR - Disable Instrument FDIR*

Purpose: Disable instrument failure detection, isolation and recovery.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x7010	Command

Description: This command disables autonomous activities associated with ICM failure detection functions. This command is useful during integration and test as well as on-orbit contingency situations. The actions performed by this command include the following:

- Disable background RAM test.

FDIR is disabled by default.

Error Codes: ERR_OK

Telemetry: BS_FDIR_ON

Traceability: [Ref. ICS 5.5.14.4.3]

See Also: ENABLE_FDIR.

4.5.4 *DISABLE_MAINCMDS - Disable Operation of Maintenance Commands*

Purpose: Disable the operation of the following maintenance commands: PASS_DATA, PASS_COMMAND, SET_TELEM.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x7011	Command

Description: This command disables the operation of maintenance commands which could be potentially disruptive to normal autonomous instrument operation. The following commands will be disabled by this command:

PASS_DATA

PASS_COMMAND

SET_TELEM

Error Codes: ERR_OK

Telemetry: BS_MAINTENANCE

Traceability: [Ref. ICS 5.3.5]

See Also: ENABLE_MAINCMDS

4.5.5 *DISABLE_FUSE - Disable MOPITT Device Fuse*

Purpose: Disable device fuse.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x301d	Command
1	15 - 0	--	Device number
2	15 - 0	0-3	Detector number

Description: This command disables the device fuse. Only sieve heaters, detector nest heaters, and the SPMs have fuses which can be disabled. The device must be set in device Maintenance State first before this command can take effect.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_DISABLED, ERR_PARAMETER

Telemetry: SS_DISABLE_FUSE is set to the detector number upon successful completion of the command, -1 otherwise. Also SR_DEV_SPM1, SR_DEV_SPM2, SR_DEV_TCMM

Traceability: NONE

See Also: ENABLE_FUSE

4.5.6 *DISABLE_SAFE - Disable Safe Mode Timeout*

Purpose: Disable entry into Spacecraft Safe Mode by IMOK timeout.

Format: Sub-address: 1

Direction: Receive

Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x7012	Command

Description: This command inhibits the entry of the MOPITT Instrument into Safe Mode when the IMOK message is not received for more than 5 consecutive C&T bus major cycles.

Error Codes: ERR_OK

Telemetry: BS_SAFE_ON

Traceability: [Ref. ICS 5.1.11.8.3.5]

See Also: IMOK, ENABLE_SAFE

4.5.7 *DUMP_INITIATE WITH type, table, segment, offset, countHigh, countLow - Memory Dump Initiate*

Purpose: Used to download data tables or software code.

Format: Sub-address: 1

Direction: Receive

Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x8010	Command
1	15-8	--	Dump Type (0=table, 1-memory)
1	7-0	0-255	Table Number
2	15-0	--	Start Address (Segment, bits 1-16)
3	15-0	--	Start Address (Offset, bits 15-0)
4	15-0	--	Word Count (MSW, bits 31-16)
5	15-0	--	Word Count (LSW, bits 15-0)

Description: This command initiates a memory dump sequence. One or more DUMP_DATA commands follow to dump the data. "Word Count" words of data are expected to follow in response to the subsequent DUMP_DATA commands. This data is downloaded to the spacecraft for transmission to the ground.

For table dumps, only the Table Number and word count are required. For memory dump, all fields except the Table Number are required.

The Dump Start Address is the absolute address in the ICM memory in Intel 80C186 segment-offset format.

The instrument telemetry flag BS_ICM_MDUMP is set to 1 (i.e., ON) when the dump is active and set to 0 (i.e., OFF) when the dump is finished.

The dumped data has a dump header attached to it with the following format:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 8	0/1	Dump Type (0=table, 1=memory)
0	7 - 0	--	Table Number (table dumps only)
1	15 - 8	0	Not used
1	7 - 0	--	Table Flags (table dumps only)
2	15 - 0	--	Word Count, MSW
3	15 - 0	--	Word Count, LSW

NOTE: One C&T Bus major cycle (i.e., 1.024 seconds) must separate the reception of this command and the reception of the first DUMP_DATA command.

Error Codes: ERR_OK, ERR_PARAMETER

Telemetry: BS_ICM_MDUMP

Traceability: [Ref. ICS 4.1.19.1, 4.1.19.3, 4.1.20.2]

See Also: DUMP_DATA, RESET_DUMP

4.5.8 *ENABLE_DETECTOR WITH detectorNumber - Enable SPM Detector Power*

Purpose: Enable a SPM detector power.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x3014	Command
1	15 - 0	1 - 8	Detector Number

Description: This command enables the power to the specified detector. Detector numbers 1 to 4 are controlled by SPM1 and detector numbers 5 to 8 are controlled by SPM2. On power up or reset, the detector power is disabled. Each detector must be enabled using this command before science data can be collected.

Error Codes: ERR_OK

Telemetry: SS_EN_DETECTOR is set to the detector number upon successful completion of the command, -1 otherwise. Also SR_DEV_SPM1, SR_DEV_SPM2

Traceability: [Ref. ICS 4.4.4.4]

See Also: DISABLE_DETECTOR

4.5.9 *ENABLE_EE_BURN - Enable EEPROM Program Commands*

Purpose: Enable the operation of EEPROM Program commands.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x9011	Command
1	15 - 0	-	Bank ID

Description: This command enables the operation of these commands: TURN_ON_EE_BURN, TURN_OFF_EE_BURN. EEPROM programming can be potentially disruptive; thus, this command is used to enable the programming commands.

The bank ID 0x9332 is used for addresses 0xc0000 and 0xd0000.

Error Codes: ERR_OK

Telemetry: BS_EEBURN

Traceability: [Ref. ICS 5.3.5]

See Also: DISABLE_EE_BURN, TURN_ON_EE_BURN, TURN_OFF_EE_BURN

4.5.10 *ENABLE_FDIR - Enable Instrument FDIR*

Purpose: Enable instrument failure detection, isolation and recovery.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x7020	Command

Description: This command enables autonomous activities associated with MOPITT Instrument failure detection. This command is useful during integration and test as well as on-orbit contingency situations. Upon power up, the instrument FDIR is disabled.

The actions performed by this command include the following:

- Enables background RAM test.

Error Codes: ERR_OK

Telemetry: BS_FDIR_ON

Traceability: [Ref. ICS 5.5.14.4.3]

See Also: DISABLE_FDIR

4.5.11 *ENABLE_FUSE - Enable MOPITT Device Fuse*

Purpose: Enable device fuse.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x301c	Command
1	15 - 0	--	Device number
2	15 - 0	0-3	Detector number

Description: This command enables the device fuse. Only sieve heaters, detector nest heaters, and the SPMs have fuses which can be enabled. The device must be set in device Maintenance State first before this command can take effect.

Error Codes: ERR_OK, ERR_TIMEOUT, ERR_DISABLED, ERR_PARAMETER

Telemetry: SS_ENABLE_FUSE is set to the detector number upon successful completion of the command, -1 otherwise. Also SR_DEV_SPM1, SR_DEV_SPM2, SR_DEV_TCMM

Traceability: NONE

See Also: DISABLE_FUSE

4.5.12 *ENABLE_MAINCMDS - Enable Operation of Maintenance Commands*

Purpose: Enable the operation of these maintenance commands: PASS_DATA, PASS_COMMAND, SET_TELEM.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x7021	Command

Description: This command enables the operation of these maintenance commands which could be potentially disruptive to normal autonomous instrument operation:

PASS_DATA

PASS_COMMAND

SET_TELEM

The power on default is disabled. An automatic timeout disable occurs after 900 seconds (15 min.).

Error Codes: ERR_OK

Telemetry: BS_MAINTENANCE

Traceability: [Ref. ICS 4.1.19.8, 5.3.5]

See Also: DISABLE_MAINCMDS

4.5.13 *ENABLE_SAFE - Enable Safe Mode Timeout*

Purpose: Enable entry into Spacecraft Safe Mode by IMOK timeout.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x7022	Command

Description: This command enables the IMOK timeout. When no IMOK message is received on the C&T bus for more than 5 consecutive major cycles, the ICM enters the Safe Mode.

On power up, the IMOK timer is enabled.

Error Codes: ERR_OK

Telemetry: BS_SAFE_ON

Traceability: [Ref. ICS 5.1.11.8.3.5]

See Also: DISABLE_SAFE, IMOK.

4.5.14 GET_DATA WITH type, address, segment - Return a Word from ICM Memory or I/O

Purpose: This command returns a word of data from the ICM memory or I/O.

Format: Sub-address: 1
Direction: Receive
Data Words:

Word	Bits	Value	Description
0	15 - 0	0x7030	Command
1	15 - 0	0/1	Type (0=memory, 1=I/O)
2	15 - 0	--	Address offset (port address for I/O)
3	15 - 0	--	Segment (zero for I/O)

Description: This command returns a word of data from the ICM memory or I/O. This command is intended for contingency use where it is necessary to access the ICM memory or I/O directly via ground command. The data from this command is returned in the NR_GETDATA telemetry in the H/K Telemetry. The BS_GETDATA_VALID telemetry indicates whether NR_GETDATA is valid or not.

Error Codes: ERR_OK

Telemetry: NR_GETDATA, BS_GETDATA_VALID

Traceability: [Ref. ICS 4.1.19.7]

See Also: ENABLE_MAINCMDS, DISABLE_MAINCMDS, PASS_DATA, PASS_COMMAND

4.5.15 MLOAD_INITIATE WITH type, table, segment, offset, counthi, countLo, crc - Memory Load Initiate

Purpose: Begin a table or memory upload.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

Word	Bits	Value	Description
0	15 - 0	0x8011	Command
1	15-8	--	Load Type (0=table, 1=memory)
1	7-0	--	Table Number
2	15-0	--	Start Address (Segment, bits 31-16)
3	15-0	--	Start Address (Offset, bits 15-0)
4	15-0	--	Word Count (MSW, bits 31-16)
5	15-0	--	Word Count (LSW, bits 15-0)
6	15-0	0	Verification Code (MSW, bits 31-16)
7	15-0	--	Verification Code (LSW, bits 15-0)

Description: This command initiates a memory load sequence. One or more LOAD_DATA commands follow to load data. "Word Count" words of data are expected to follow in LOAD_DATA commands.

For table loads, the Load Start Address fields are not used (i.e., set to zero).

The Load Start Address is in Intel 80C186 segment-offset format and indicates an absolute address in the ICM memory.

The verification code is a 16 bit CRC (cyclic redundancy check) code with a format that is defined in Appendix A of "MOPITT Software Specification, Instrument Controller Module".

When MLOAD_INITIATE is successfully received, the telemetry flag BS_ICM_MLOAD is set to 1 (i.e., ON) to indicate load is active. Upon successful load of table or memory, the BS_ICM_MLOAD flag is reset to zero (i.e., OFF) and the BS_ICM_MLOAD_OK flag is set to 1 (i.e., PASS).

NOTE: One C&T Bus major cycle (i.e., 1.024 seconds) must separate when this command is received and when the first LOAD_DATA command is received.

Error Codes: ERR_OK, ERR_PARAMETER

Telemetry: BS_ICM_MLOAD, BS_ICM_MLOAD_OK

Traceability: [Ref. ICS 4.1.19.1, 4.1.19.3]

See Also: LOAD_DATA, RESET_LOAD

4.5.16 *PASS_COMMAND WITH deviceNumber, command - Send Command to a Device*

Purpose: This command sends a device command to a device.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x7031	Command
1	15 - 0	--	Device Number
2	15 - 0	--	Device Command

Description: This command sends a word to an ICM port address. The command will wait for return value from the port address by checking the ICM Transmitter/Receiver Buffer Full Flag Status Port. If no value is returned from the port in about 500 us, the command will return with Error Code "ERR_TIMEOUT". If status/telemetry is available, it is placed in the H/K Telemetry NR_GETDATA.

This command is intended for use in contingency situations where it is necessary to directly command a device through the device interface.

Because this command can be potentially disruptive to the normal autonomous operation of the instrument, enabling this command is required via the command ENABLE_MAINCMDS.

Note: In instrument Boot Mode, this command cannot be used since no devices exist. Use the PASS_DATA and GET_DATA commands instead.

Error Codes: ERR_OK, ERR_DISABLED, ERR_TIMEOUT, ERR_MODE

Telemetry: NR_GETDATA

Traceability: [Ref. ICS 4.1.19.6]

See Also: ENABLE_MAINCMDS, DISABLE_MAINCMDS, PASS_DATA, GET_DATA

4.5.17 *PASS_DATA WITH type, address, segment, data - Send a Word of Data to ICM Memory or I/O*

Purpose: Sends a word to ICM memory or I/O.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x7032	Command
1	15 - 0	0/1	Type (0=memory, 1=I/O)
2	15 - 0	--	Address offset (port address for I/O)
3	15 - 0	--	Segment (zero for I/O)
4	15 - 0	--	Data word

Description: This command sends a word to ICM memory or I/O.

This command is intended for use in contingency situations where it is necessary to directly access location in ICM memory or I/O.

Because this command can be potentially disruptive to the normal autonomous operation of the instrument, enabling this command is required via the command **ENABLE_MAINCMDS**.

Error Codes: **ERR_OK, ERR_DISABLED, ERR_TIMEOUT**

Telemetry: **BS_PASS_DATA**

Traceability: [Ref. ICS 4.1.19.6]

See Also: **ENABLE_MAINCMDS, DISABLE_MAINCMDS, PASS_COMMAND, GET_DATA**

4.5.18 *PASS_MSL WITH mslCmd1, ..., mslCmd31 - Execute MOPITT Scan Language Command*

Purpose: Execute MOPITT Scan Language Command

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x7033	Command
1-31	15-0	--	MSL Commands

Description: This command is obsolete, it will return ERR_BAD if used. The following description is retained for reference only.

This command passes MOPITT Scan Language (MSL) commands to the ICM's MSL Interpreter. Words 1 to 31 of the command word must contain valid MSL commands. All MSL command should end with an MSL "return" command.

The ENABLE_MAINCMDS command must be issued first to enable the processing of MSL commands before the PASS_MSL command can be issued.

Note: This command cannot be used when in instrument Science Mode. Exit to Standby Mode to run this command.

Error Codes: ERR_OK, ERR_DISABLED, ERR_PARAMETER, ERR_MODE

Telemetry: NONE

Traceability: [Ref. ICS 5.1.16.6]

See Also: ENABLE_MAINCMDS, DISABLE_MAINCMDS

4.5.19 *PERFORM_COOL_STR WITH number - Send a cooler command string*

Purpose: Send a cooler command string.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x3021	Command
1...31	15 - 0	--	Comand string

Description: This command send an ASCII string to the cooler. Cooler command strings are 8 bit ASCII commands packed into 16 bit 1553 words with up to 31 words total used. Command strings MUST END WITH a carriage return folowed by a null character, this is "\r0". Thus, the maximum cooler command string is 60 characters plus the return plus the null character.

Error Codes: ERR_OK, ERR_BUSY

Telemetry: SS_CMD_TOGGLE

Traceability: [Ref. ICS 4.4.5.4]

See Also: NONE

4.5.20 *PERFORM_PMC_CAL WITH parameters*

Purpose: Perform the PMC calibration procedure.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x1012	Command
1	15 - 0	--	PMC number, 1 or 2
2	15 - 0	--	number of steps in the sweep [11]
3	15 - 0	--	start frequency divide value [228 ~ 43 Hz]
4	15 - 0	--	step size, counts [2 = 0.5 Hz. @ 43 Hz.]
5	15 - 0	--	low amplitude [0]
6	15 - 0	--	high amplitude [0 - 255]
7	15 - 0	--	# of 8 major cycle pauses (3 minimum)

Description: This command is used to execute a frequency sweep calibration procedure for the selected PMC.

The frequency calibration procedure follows these steps:

1. Set the amplitude to the low value
 Set the frequency to the start frequency value
 Set SS_FREQSCAN_STEP = 0
 Wait 4 telemetry cycles (32 major cycles or ~32 sec)
2. Set the amplitude to the high value
 Wait 4 telemetry cycles (32 major cycles or ~32 sec)
3. Set the frequency to:
 start frequency + step size * SS_FREQSCAN_STEP
 Increment SS_FREQSCAN_STEP by 1
 Wait 2 + (pause-3) telemetry cycles (16 major cycles or ~16 sec minimum)
4. Set SS_FREQSCAN_OK to 1
 Wait 1 telemetry cycle (8 major cycles or ~8 sec)
5. Set SS_FREQSCAN_OK to 0
 If SS_FREQSCAN_STEP < number of steps
 goto 3
6. Set the amplitude to the low value
 Wait 4 telemetry cycles (32 major cycles or ~32 sec)
7. Reset frequency to value prior to the starting the procedure
 Startup the PMC

Note: Prior to resuming science data collection, a `PERFORM_DEV_INIT` must be performed on the TCU to re-establish PMC phase alignment. There is a problem with the TCU that results in the inability to reset fully the TCU clocks, specifically PMC to chopper edge alignment. Thus after a PMC calibration the instrument will require one of the following:

- a) power on reset
- b) `RESET_COMPUTER`
- c) examine burst mode data and flip chopper and LMC command clock invert bits as required using the `PASS_DATA` command to correct alignment.

PMC frequency is determined by the 8 bit divider value loaded in the TCU. The `perform_pmc_cal` command uses the following to determine the divide value for each step:

$$\text{divide value} = \text{start value} + (\text{step size} * (\text{step \#} - 1))$$

the frequency is:

$$\text{PMC frequency} = 10.2 \text{ MHz} / (1024 * (\text{divide value} + 1))$$

Thus positive step sizes will lower the frequency for each step, while negative step sizes will increase the frequency.

The `IR_PMC#_MTR` telemetry points are an average of 8 major cycle samples.

Error Codes: `ERR_OK`, `ERR_BUSY`

Telemetry: `BS_FREQSCAN_OK` - set to 1 when step data is valid, then reset to 0

`SS_FREQSCAN_STEP` - current step # (0...n)

`SS_FREQSCAN_PMC` - selected pmc # (1, 2)

`SS_FREQSCAN_FREQ` - commanded PMC frequency (0-255)

`SS_FREQSCAN_AMP` - commanded PMC amplitude (0-255)

`IR_PMC#_MTR` - PMC motor current telemetry (8 major cycle average)

`TR_PMC#_MTR` - PMC motor temperature telemetry (raw)

Traceability: [Ref. ICS 4.4.5.4]

See Also: NONE

4.5.21 *RESET_DUMP - Abort Memory Dump Operation*

Purpose: Abort memory dump operation.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x8012	Command

Description: This command aborts a memory dump operation. DUMP_DATA commands will no longer be sent and the memory dump sequence is terminated.

Error Codes: ERR_OK

Telemetry: BS_ICM_MDUMP

Traceability: [Ref. ICS 4.1.19.4]

See Also: DUMP_INITIATE, DUMP_DATA

4.5.22 *RESET_LOAD - Abort Memory Load Operation*

Purpose: Abort memory load operation.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x8013	Command

Description: This command aborts a memory load operation. Memory Load Data commands will no longer be accepted and the memory load sequence is terminated.

Error Codes: ERR_OK

Telemetry: BS_ICM_MLOAD, BS_ICM_MLOAD_OK

Traceability: [Ref. ICS 4.1.19.4]

See Also: LOAD_INITIATE, LOAD_DATA

4.5.23 RESET_LRS - Reset LRS bus

Purpose: Reset the LRS bus via the C&T bus.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

Word	Bits	Value	Description
0	15 - 0	0x5011	Command

Description: This command aborts any current LRS bus message and resets the LRS 1553 bus.

Error Codes: ERR_OK, ERR_DISABLED

Telemetry: BS_SCIENCE_BUS

Traceability: [Ref. ICS 4.1.19.4]

See Also: LOAD_INITIATE, LOAD_DATA

4.5.24 SELECT_COOL_CMD WITH number - Select and send a cooler command string

Purpose: Select and send a built-in cooler command string.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

Word	Bits	Value	Description
0	15 - 0	0x3020	Command
1	15 - 0	0.5	string index number

Description: This command selects and send to the cooler on of 6 builtin cooler command strings.

string 0 - initialization command string

string 1 - startup command string, temp control mode

string 2 - stop command string

string 3 - startup command string, fixed stroke nominal

string 4 - startup command string, fixed stroke maximum

string 5 - spare

Error Codes: ERR_OK, ERR_BUSY

Telemetry: SS_CMD_TOGGLE

Traceability: [Ref. ICS 4.4.5.4]

See Also: NONE

4.5.25 *SELECT_TABLE WITH tableType, primeAlt - Select a Table for Current Usage*

Purpose: Select the current table to use.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x1011	Command
1	15 - 8	0-255	Table Type
1	7 - 0	0/1	Primary/Alternate table (0=primary)

Description: This command is used to select the current table. For most tables, a default table exists in EEPROM. However, an uploaded table may also be present. Upon processor reset, the default table is always used. However, if a table is uploaded, this command can be used to select the uploaded table for use.

NOTE: If a new telemetry schedule table is selected, the new schedule will not be fully implemented until after 8 major cycles have passed since the reception of the SELECT_TABLE command.

Error Codes: ERR_OK, ERR_PARAMETER, ERR_NOT_ALLOWED

Telemetry: SS_SELECT_TABLE is updated with a copy of table type and primary/alternate flag or -1 if an error occurs. Dump table TN_ACTIVE for latest settings.

Traceability: [Ref. ICS 5.1.3.2]

See Also: LOAD_INITIATE, DUMP_INITIATE

4.5.26 *SET_FREQ TO bus - Set Active Time Mark and Frequency Bus*

Purpose: Set active Time Mark and Frequency bus A or B for use.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x7034	Command
1	15 - 0	0/1	Bus to use (0 = A, 1 = B)

Description: This command is used to select the desired Time Mark and Frequency Bus for use. The command will be implemented by the ICM immediately upon reception. The current Time Mark and Frequency bus selection is indicated in the Critical Health and Safety Telemetry.

Upon power up, Time Mark and Frequency bus A is selected as a default.

Error Codes: ERR_OK

Telemetry: BS_TMF_SELECT is set to the TMF Bus number upon successful completion of the command, -1 otherwise.

Traceability: [Ref. ICS 4.2.2]

See Also: NONE

4.5.27 *SET_TELEM WITH* block, word, mask, value - Set a housekeeping telemetry point

Purpose: Set a housekeeping telemetry point to a specific value.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x7035	Command
1	15 - 8	--	Reserved
1	7 - 5	0 - 7	Housekeeping Block #
1	4 - 0	0 - 31	Word within block
2	15 - 0	--	Mask bits (anded with value)
3	15 - 0	--	Value

Description: This command is used to force telemetry points to a value for testing the C&T bus to GSE data gathering.

The telemetry field is located by specifying the block and word in the command. The field within a word (fields less than 16 bits) is specified by the mask bits. The new field value is the result of anding the mask with the value.

$$\text{new} = (\text{old} \& \sim \text{mask}) \mid (\text{value} \& \text{mask})$$

The ENABLE_MAINCMDS command must be issued first to enable this command. Instrument should be in BOOT mode to prevent mis-interpretation and update of telemetry while this command is being used.

Houskeeping block words 0, 1 and 2 contain critical and system information that should not be modified by use of this command. Block 1 word 3 should not be modified.

Error Codes: ERR_OK

Telemetry: SS_CMD_TOGGLE, BS_SET_TELEM

Traceability: NONE

See Also: NONE

4.5.28 *TURN_OFF_EE_BURN - Abort EEPROM Program Procedure*

Purpose: This command aborts the EEPROM program procedure.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x9012	Command

Description: This command aborts the EEPROM program procedure. The command has no effect if the procedure is not running. Note that aborting the EEPROM procedure may cause the EEPROM CRC value to be incorrect. The TURN_ON_EE_BURN command should be used to reprogram the CRC value.

Error Codes: ERR_OK, ERR_DISABLED

Telemetry: BS_EEBURN_STATUS, BS_EEBURN_ON

Traceability: [Ref. ICS 5.3.5]

See Also: TURN_ON_EE_BURN, ENABLE_EE_BURN, DISABLE_EE_BURN

4.5.29 *TURN_OFF_SCI_DAT WITH value - Turn Off LRS Bus Data Category*

Purpose: This command turns off the transmission of one or more categories of data on the Low Rate Science Data bus.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x7040	Command
1	15	0/1	Science CCSDS Quick Look Flag
1	14	0/1	Eng. CCSDS Quick Look Flag
1	13	0/1	Table CCSDS Quick Look Flag
1	12	0/1	Test CCSDS Quick Look Flag
1	11 - 8	0	Not used
1	7	0/1	Science CCSDS Packet
1	6	0/1	Engineering CCSDS Packet
1	5	0/1	Table CCSDS Packet
1	4	0/1	Test CCSDS Packet
1	3 - 2	0	Not used
1	1	0/1	H/K Telemetry (Eng. CCSDS packet)
1	0	0/1	Ancillary Data (Eng. CCSDS packet)

NOTE: A value of 0=ignore, 1=turn off

Description: This command is used to reset the quick look flag on LRS bus CCSDS packets and to turn off LRS bus data categories. The command has no effect if the quick look flag or data category is already off.

The power up default for the quick look flag is off for Science and Engineering CCSDS packets and on for Test CCSDS packets.

The power up default for data categories are all data categories, except Test Packet, are initially set to be transmitted.

Note: The formats of the Science and Engineering Data, Test Packet, Housekeeping Telemetry, and Ancillary Data are described in the Appendices of this document. There is no associated telemetry point to indicate the status of table packets.

Error Codes: ERR_OK

Telemetry: BS_ANCILLARY, BS_SCIENCE, BS_ENGINEERING, BS_TEST_PACKET, BS_HOUSEKEEPING, BS_TABLES

Traceability: [Ref. ICS 4.1.7.10]

See Also: TURN_ON_SCI_DAT

4.5.30 *TURN_ON_EE_BURN WITH* srcSeg, srcOff, destSeg, destOff, nwords, options - *Start EEPROM Program Procedure*

Purpose: This command start the EEPROM program procedure.

Format: Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x9013	Command
1	15 - 0	--	Source Segment (hex)
2	15 - 0	--	Source Offset (hex)
3	15 - 0	--	Destination Segment (hex)
4	15 - 0	--	Destination Offset (hex)
5	15 - 0	--	Number of Words or Table Number
6	15 - 0	--	Options Flag: 0 = Program 2 = Program CRC, only 3 = Table Program

Description: This command starts programming an EEPROM bank. The source and destination addresses are in Intel segment:offset format in hex. Up to 65535 words can be programmed at once. The source and destination should be set to zero when the Table Program option is used.

When the option flag is set to zero, the EEPROM bank is programmed and the verified on a byte by byte basis.

When the Option Flag is set to 2, the EEPROM bank CRC is calculated and written to the last word in the bank address space.

When the Option Flag is set to 3, the table corresponding to the specified table number is copied into the spare EEPROM bank. Note that the version of software currently executing and the version of software in the spare EEPROM bank **MUST** be the same!! Otherwise, the spare EEPROM bank will be corrupted. Use option 0 instead if the versions are different (user must figure out source and destination addresses). After programming a table, the command must be used again with the options flag set to 2 to calculate a new bank CRC.

The EEPROM program may take several minutes to complete, depending upon the option selected and the number of words to program.

Error Codes: ERR_OK, ERR_DISABLED

Telemetry: BS_EEBURN_STATUS, BS_EEBURN_ON

Traceability: [Ref. ICS 5.5.17.1]

See Also: TURN_OFF_EE_BURN, ENABLE_EE_BURN, DISABLE_EE_BURN

4.5.31 *TURN_ON_SCI_DAT WITH value - Turn On LRS Bus Data Category*

Purpose: This command turns on the transmission of one or more categories of data on the Low Rate Science Data bus.

Format: Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x7041	Command
1	15	0/1	Science CCSDS Quick Look Flag
1	14	0/1	Eng. CCSDS Quick Look Flag
1	13	0/1	Table CCSDS Quick Look Flag
1	12	0/1	Test CCSDS Quick Look Flag
1	11 - 8	0	Not used
1	7	0/1	Science CCSDS Packet
1	6	0/1	Engineering CCSDS Packet
1	5	0/1	Table CCSDS Packet
1	4	0/1	Test CCSDS Packet
1	3 - 2	0	Not used
1	1	0/1	H/K Telemetry (Eng. CCSDS packet)
1	0	0/1	Ancillary Data (Eng. CCSDS packet)

NOTE: A value of 0=ignore, 1=turn on

Description: This command is used to set the quick look flag on LRS bus CCSDS packets and to turn on LRS bus data categories. The command has no effect if the quick look flag or data category is already on.

The power up default for the quick look flag is off for Science, Engineering, and table CCSDS packets and on for Test CCSDS packets.

The power up default for data categories are all data categories, except Test Packet, are initially set to be transmitted.

Note: The formats of the Science and Engineering Data, Test Packet, Housekeeping Telemetry, and Ancillary Data are described in the Appendices of this document.

Error Codes: ERR_OK

Telemetry: BS_ANCILLARY, BS_SCIENCE, BS_ENGINEERING, BS_TABLE, BS_TEST_PACKET

Traceability: [Ref. ICS 4.1.7.10, 4.1.22.1]

See Also: TURN_OFF_SCI_DAT

4.5.32 *PERFORM_RESET WITH segment, offset - Perform software reset on ICM*

Purpose: This command performs a software reset of the ICM for test purposes or for running the ICM code from RAM. Note: This command has not been fully implemented and is described here only for completeness.

Format: Sub-address: 1
Direction: Receive
Data Words:

Word	Bits	Value	Description
0	15 - 0	0x1090	Command
1	15 - 0	--	memory segment
2	15 - 0	--	memory offset

Description: This command is used to perform a software reset of the ICM by jumping to the given memory address. The command currently does not do any reset of the ICM hardware so its use will have unpredictable results. To implement the command properly, modifications to the boot code is necessary. The command is currently used to test portions of code or to execute ICM code from RAM. The command works in boot mode.

Error Codes: ERR_OK, ERR_PARAMETER

Telemetry: SS_INST_MODE

Traceability:

See also: 00000000000000RESET_COMPUTER

4.6 MOPITT BDU Commands

The MOPITT BDU commands are executed by the Spacecraft's BDU. These commands are used to perform relay drive commands for MOPITT Instrument power and configuration. The BDU has its own MIL STD 1553B address.

4.6.1 *TURN_ON_SIDE_A*

Purpose: Turn on primary power convertor, side A.

Format: RT Address: 24
 Sub-address: 1
 Direction: Receive
 Data Words:

Word	Bits	Value	Description
0	15 - 0	0x4007	Command

Description: This command instructs the Spacecraft's BDU to turn on MOPITT side A primary convertor.

Telemetry: BR_BDU_PWR_A

Traceability:

See Also: TURN_OFF_SIDE_A

4.6.2 *TURN_OFF_SIDE_A*

Purpose: Turn off primary power convertor, side A.

Format: RT Address: 24
 Sub-address: 1
 Direction: Receive
 Data Words:

Word	Bits	Value	Description
0	15 - 0	0x4008	Command

Description: This command instructs the Spacecraft's BDU to turn off MOPITT side A primary convertor.

Telemetry: BR_BDU_PWR_A

Traceability:

See Also: TURN_ON_SIDE_A

4.6.3 *TURN_ON_SIDE_B*

Purpose: Turn on primary power convertor, side B.

Format: RT Address: 24
Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x4047	Command

Description: This command instructs the Spacecraft's BDU to turn on MOPITT side B primary convertor.

Telemetry: BR_BDU_PWR_B

Traceability:

See Also: TURN_OFF_SIDE_B

4.6.4 *TURN_OFF_SIDE_B*

Purpose: Turn off primary power convertor, side B.

Format: RT Address: 24
Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x4048	Command

Description: This command instructs the Spacecraft's BDU to turn on MOPITT side B primary convertor.

Telemetry: BR_BDU_PWR_B

Traceability:

See Also: TURN_ON_SIDE_B

4.6.5 *TURN_ON_MPSU_A*

Purpose: Turn on secondary convertor for main power supply unit A.

Format: RT Address: 24
Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x4009	Command

Description: This command instructs the Spacecraft's BDU to turn on MOPITT main power supply unit A. This command disables the MOPITT Instrument launch side A.

Telemetry: BR_BDU_PWR_MPSUA

Traceability:

See Also: TURN_OFF_MPSU_A, ENABLE_LAUNCH_A

4.6.6 *TURN_OFF_MPSU_A*

Purpose: Turn off secondary convertor for main power supply unit A.

Format: RT Address: 24
Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x400A	Command

Description: This command instructs the Spacecraft's BDU to turn off MOPITT main power supply unit A.

Telemetry: BR_BDU_PWR_MPSUA

Traceability:

See Also: TURN_ON_MPSU_A, ENABLE_LAUNCH_A

4.6.7 *TURN_ON_MPSU_B*

Purpose: Turn on secondary convertor for main power supply unit B.

Format: RT Address: 24
 Sub-address: 1
 Direction: Receive
 Data Words:

Word	Bits	Value	Description
0	15 - 0	0x4049	Command

Description: This command instructs the Spacecraft's BDU to turn on MOPITT main power supply unit B. This command disables the MOPITT Instrument launch side B.

Telemetry: BR_BDU_PWR_MPSUB

Traceability:

See Also: TURN_OFF_MPSU_B, ENABLE_LAUNCH_B

4.6.8 *TURN_OFF_MPSU_B*

Purpose: Turn off secondary convertor for main power supply unit B.

Format: RT Address: 24
 Sub-address: 1
 Direction: Receive
 Data Words:

Word	Bits	Value	Description
0	15 - 0	0x404A	Command

Description: This command instructs the Spacecraft's BDU to turn on MOPITT main power supply unit B.

Telemetry: BR_BDU_PWR_MPSUB

Traceability:

See Also: TURN_ON_MPSU_B, ENABLE_LAUNCH_B

4.6.9 **TURN_ON_SPSU_A**

Purpose: Turn on secondary convertor for survival power supply unit A.

Format: RT Address: 24
 Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x400B	Command

Description: This command instructs the Spacecraft's BDU to turn on MOPITT survival power supply unit A.

Telemetry: BR_BDU_PWR_SPSUA

Traceability:

See Also: TURN_OFF_SPSU_A

4.6.10 **TURN_OFF_SPSU_A**

Purpose: Turn off secondary convertor for survival power supply unit A.

Format: RT Address: 24
 Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x400C	Command

Description: This command instructs the Spacecraft's BDU to turn off MOPITT survival power supply unit A.

Telemetry: BR_BDU_PWR_SPSUA

Traceability:

See Also: TURN_ON_SPSU_A

4.6.11 *TURN_ON_SPSU_B*

Purpose: Turn on secondary convertor for survival power supply unit B.

Format: RT Address: 24
Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x404B	Command

Description: This command instructs the Spacecraft's BDU to turn on MOPITT survival power supply unit B.

Telemetry: BR_BDU_PWR_SPSUB

Traceability:

See Also: TURN_OFF_SPSU_B

4.6.12 *TURN_OFF_SPSU_B*

Purpose: Turn off secondary convertor for survival power supply unit B.

Format: RT Address: 24
Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x404C	Command

Description: This command instructs the Spacecraft's BDU to turn on MOPITT survival power supply unit B.

Telemetry: BR_BDU_PWR_SPSUB

Traceability:

See Also: TURN_ON_SPSU_B

4.6.13 **ENABLE_LAUNCH_A**

Purpose: Enable launch A.

Format: RT Address: 24
 Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x400E	Command

Description: This command instructs the Spacecraft's BDU to enable the MOPITT Instrument launch side A. The MPSU side A is required to be on. MPSU power rails are turned off, except for launch rails.

Telemetry: BR_BDU_LAUNCH_A, BR_BDU_PWR_MPSUA

Traceability:

See Also: TURN_OFF_MPSU_A

4.6.14 **ENABLE_LAUNCH_B**

Purpose: Enable launch B.

Format: RT Address: 24
 Sub-address: 1
 Direction: Receive
 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x404E	Command

Description: This command instructs the Spacecraft's BDU to enable the MOPITT Instrument launch side B. The MPSU side B is required to be on. MPSU power rails are turned off, except for launch rails.

Telemetry: BR_BDU_LAUNCH_B, BR_BDU_PWR_MPSUB

Traceability:

See Also: TURN_OFF_MPSU_B

4.6.15 *RESET_COMPUTER*

Purpose: Reset the ICM computer.

Format: RT Address: 24
Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x4006	Command

Description: This command instructs the Spacecraft's BDU to reset the MOPITT Instrument ICM computer.

Telemetry: SS_INST_MODE

Traceability:

See Also: PERFORM_RESET

4.6.16 *SELECT_PROM_A*

Purpose: Select EEPROM bank A.

Format: RT Address: 24
Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x4005	Command

Description: This command instructs the Spacecraft's BDU to select the MOPITT Instrument ICM EEPROM primary bank as the boot prom.

Telemetry: BR_BDU_PROM_BANK

Traceability:

See Also: SELECT_PROM_B

4.6.17 *SELECT_PROM_B*

Purpose: Select EEPROM bank B.

Format: RT Address: 24

 Sub-address: 1

 Direction: Receive

 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x4045	Command

Description: This command instructs the Spacecraft's BDU to select the MOPITT Instrument ICM EEPROM secondary bank as the boot prom.

Telemetry: BR_BDU_PROM_BANK

Traceability:

See Also: SELECT_PROM_A

4.6.18 *SET_RD_SPARE1*

Purpose: Spare

Format: RT Address: 24

 Sub-address: 1

 Direction: Receive

 Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x400F	Command

Description: None.

Telemetry:

Traceability:

See Also:

4.6.19 SET_RD_SPARE2

Purpose: Spare

Format: RT Address: 24
Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x404D	Command

Description: None.

Telemetry:

Traceability:

See Also:

4.6.20 SET_RD_SPARE3

Purpose: Spare

Format: RT Address: 24
Sub-address: 1
Direction: Receive
Data Words:

<u>Word</u>	<u>Bits</u>	<u>Value</u>	<u>Description</u>
0	15 - 0	0x400D	Command

Description: None.

Telemetry:

Traceability:

See Also:

4.7 Stored Commands

Most MOPITT Operational Commands can be stored in the Spacecraft Control Computer (SCC) and executed at predetermined times. Such commands are known as Stored Commands. There are two types of Stored Commands [Ref. GLIS 7.2.2.2]:

- Absolute Time Command (ATC)
- Relative Time Command (RTC)

Absolute Time Commands (ATC) are issued from the SCC at a specified absolute time. An ATC is typically loaded into the SCC once per day.

Relative Time Commands (RTC) are issued at a specified period of time after the previous command. A sequence of related stored Relative Time Commands is called a Relative Time Sequence (RTS) [Ref. GLIS 7.2.2.2.2.1]. The RTS are typically static and do not need to be reloaded every day.

The RTS is sent from the SCC when triggered by an Absolute Time Command, real time command, or command from the telemetry monitor [Ref. GLIS 7.2.2.2.2.2]. Each command in an RTS will be separated by a time delay [Ref. GLIS 7.2.2.2.2.3]. The time delay will be between 128 ms and 8388 seconds [Ref. GLIS 7.2.2.2.2.4]. The time delay is specified by the Time Tag word in the RTC, with the minimum time delay being 128 ms (Time Tag of 1) and the maximum time delay being 8388 seconds (Time Tag of 65535). The number of commands in an RTS is indicated by the "Command Count" field in the RTS header.

4.8 Telemetry Monitor

The SCC provides the capability to issue a MOPITT Instrument command via the C&T bus based upon a telemetry state monitored by the on-board telemetry monitor. The Instrument shall define the telemetry monitor commands and provide the ability to execute these commands. [Ref. GLIS 7.2.2.3, 7.2.2.3.2].

1. The SCC is capable of monitoring designated telemetry from the housekeeping telemetry stream. Based on the value of a telemetry point, the SCC can either issue a Spacecraft command, activate a Relative Time Command Sequence, or take no action. The telemetry point comparison definitions are made using TMON definitions, which consist of relational operators (e.g., <, >, =, <>, etc.) and logical operators (e.g., AND, OR, NOT).
2. Appendix E lists the Telemetry Monitor Commands and the associated points to monitor in the Housekeeping Telemetry [Ref. GLIS 7.3.3.6].

5. MOPITT INSTRUMENT TELEMETRY

MOPITT Instrument Telemetry consists of Critical Health and Safety Telemetry, Housekeeping Telemetry, Science Data, and Engineering Data. The following subsections describe the MOPITT Instrument Telemetry.

5.1 Instrument Telemetry Requirements

The following section lists the applicable requirements from the GLIS.

1. All telemetry points shall be unambiguously identifiable by the major cycle count and position in the message data field [Ref. GLIS 6.1.2.4.1.6].
2. The instrument telemetry mnemonic shall be as per GLIS 7.3.4.7 [Ref. GLIS 7.3.4.7, 7.3.4.8].
3. The Housekeeping Telemetry sub-commutation schedule shall allow the Spacecraft Telemetry Monitor to sample all telemetry blocks within a master cycle at sampling rates of 1, 8, or 64 major cycles [Ref. GLIS 7.3.2.3.2].
4. The Housekeeping Telemetry sub-commutated block formats shall repeat on the same schedule [Ref. GLIS 7.3.2.3.3].

5.2 Critical Health and Safety Telemetry Format

Critical Health and Safety Telemetry is 32 bits (2 words) long and contains the critical MOPITT Instrument status information. The Critical Health and Safety Telemetry is a subset of the Housekeeping Telemetry. Appendix A of this document describes the format of the Critical Health and Safety Telemetry [Ref. ICS 5.1.1.1, 5.1.6.1, 5.1.6.3, GLIS 7.3.3.3].

5.3 Housekeeping Telemetry Format

H/K Telemetry is 512 bits (32 words) long and contains the current H&S Telemetry is included in the H/K Telemetry. Appendix of the H/K Telemetry [Ref. ICS 5.1.1.1, 5.1.2.2, 7.3.3.5].

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5.4 LRS Bus CCSDS Format

Science Data and
Low Rate Science
Data bus CCSDS

19310 = C1