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SPACE SHUTTLE PROGRAMS

OI20

PASS USER'S GUIDE

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PASS USER'S GUIDE

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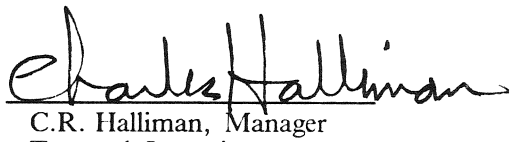

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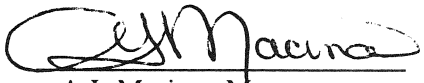

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PREFACE

This release of the PASS User's Guide has been prepared to assist users of the Primary Avionics Software System (PASS).

The organization and inclusion of material in this guide was arrived at by drawing upon experiences and technical expertise of the IBM personnel in the Avionics Software Engineering, Development, and Verification Departments and the Test & Operations personnel in the SAIL, SMS, and at KSC. Thus, it is an attempt to produce a handbook which is constrained in volume, yet provides easy reference to a desired subject.

The preparers of this document solicit your comments and critiques. Please forward any suggestions, etc., to the PASS User's Guide Coordinator, Carla J. Yager, IBM Test and Operations, MC 6206A, 3700 Bay Area Blvd., Houston, Texas 77058-1199.

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CONTENTS

1. INTRODUCTION 1.1-1
1.1 PURPOSE 1.1-1
1.2 SCOPE 1.2-1
1.3 APPLICABLE DOCUMENTS 1.3-1
1.4 FSW DELIVERABLES 1.4-1

2. SYSTEM 2.1-1
2.1 OVERVIEW 2.1-1
2.2 MASS MEMORY 2.2-1
2.2.1 GPC Memory Configuration 2.2-1
2.2.2 Mass Memory Allocation 2.2-1
2.3 SYSTEM INITIALIZATION 2.3-1
2.3.1 Initial Program Load (IPL) Sequence 2.3-2
2.3.1.1 IPL Sequence Failures 2.3-2
2.3.1.2 No Display 2.3-5
2.3.1.3 CAM Light 2.3-5
2.3.2 DEU Load 2.3-5
2.4 OPERATIONAL SEQUENCES 2.4-1
2.4.1 OPS 0 . . . . . 2.4-4
2.4.1.1 Displays Available 2.4-4
2.4.1.2 Basic Functions Available 2.4-4
2.4.2 OPS GNC9 . . . . . 2.4-5
2.4.2.1 Displays Available 2.4-5
2.4.2.2 Basic Functions Available 2.4-6
2.4.3 OPS PL9 . . . . . 2.4-7
2.4.3.1 Displays Available 2.4-7
2.4.3.2 Basic Functions Available 2.4-7
2.4.4 OPS GNC1 . . . . . 2.4-8
2.4.4.1 Displays Available 2.4-9
2.4.4.2 Basic Functions Available 2.4-10
2.4.5 OPS GNC 2 . . . . . 2.4-10
2.4.5.1 Displays Available 2.4-11
2.4.5.2 Basic Functions Available 2.4-12
2.4.6 OPS GNC3 . . . . . 2.4-12
2.4.6.1 Displays Available 2.4-13
2.4.6.2 Basic Functions Available 2.4-13
2.4.7 OPS GNC6 . . . . . 2.4-14
2.4.7.1 Displays Available 2.4-15
2.4.7.2 Basic Functions Available 2.4-15
2.4.8 OPS GNC8 . . . . . 2.4-15
2.4.8.1 Displays Available 2.4-15
2.4.8.2 Basic Functions Available 2.4-16
2.4.9 OPS SM2/4 . . . . . 2.4-16
2.4.9.1 Displays Available 2.4-17
2.4.9.2 Basic Functions Available 2.4-18
2.5 ACTUATOR/HYDRAULIC ACTIVATION RESTRICTIONS 2.5-1

3. CRT DISPLAYS 3.1-1
3.1 MCDS/GPC ASSIGNMENT HIERARCHY 3.1-2
3.2 STANDARD CRT DISPLAY PAGE 3.2-1
3.3 OPS, SPEC, DISP PAGE HIERARCHY 3.3-1
3.4 USER'S GUIDE DISPLAY FORMAT 3.4-1
3.4.1 DISPLAY: XXXXIPL MENU 3.4-3
3.4.2 DISPLAY: DEU STAND-ALONE SELF-TEST (DEU SAST) 3.4-9

3.4.2.1 NORMAL OPERATION 3.4-10
3.5 DISPLAYS 3.5-1
3.5.000 DISPLAY: GPC MEMORY 3.5.000-1
3.5.001 DISPLAY: DPS UTILITY 3.5.001-1
3.5.002 DISPLAY: TIME 3.5.002-1
3.5.006 DISPLAY: GPC/BUS STATUS 3.5.006-1
3.5.018 DISPLAY: GNC SYS SUMM 1 . . . . . 3.5.018-1
3.5.019 DISPLAY: GNC SYS SUMM 2 . . . . . 3.5.019-1
3.5.020 DISPLAY: DAP CONFIG 3.5.020-1
3.5.021 DISPLAY: IMU ALIGN 3.5.021-1
3.5.022 DISPLAY: S TRK/COAS CNTL 3.5.022-1
3.5.023 DISPLAY: RCS 3.5.023-1
3.5.025 DISPLAY: RM ORBIT 3.5.025-1
3.5.033 DISPLAY: REL NAV 3.5.033-1
3.5.034 DISPLAY: ORBIT TGT 3.5.034-1
3.5.040 DISPLAY: SENSOR TEST 3.5.040-1
3.5.041 DISPLAY: RGA/ADTA/RCS 3.5.041-1
3.5.042 DISPLAY: SWITCH/SURF 3.5.042-1
3.5.043 DISPLAY: CONTROLLERS 3.5.043-1
3.5.044 DISPLAY: SWITCHES 3.5.044-1
3.5.045 DISPLAY: NWS CHECK 3.5.045-1
3.5.050 DISPLAY: HORIZ SIT 3.5.050-1
3.5.051 DISPLAY: OVERRIDE 3.5.051-1
3.5.053 DISPLAY: CONTROLS 3.5.053-1
3.5.060 DISPLAY: SM TABLE MAINT 3.5.060-1
3.5.062 DISPLAY: PCMMU/PL COMM 3.5.062-1
3.5.064 DISPLAY: SM GROUND CHECKOUT 3.5.064-1
3.5.066 DISPLAY: ENVIRONMENT 3.5.066-1
3.5.067 DISPLAY: ELECTRIC 3.5.067-1
3.5.068 DISPLAY: CRYO SYSTEM 3.5.068-1
3.5.069 DISPLAY: FUEL CELLS 3.5.069-1
3.5.076 DISPLAY: COMM/RCDR 3.5.076-1
3.5.077 DISPLAY: EVA-MMU/FSS 3.5.077-1
3.5.078 DISPLAY: SM SYS SUMM 1 . . . . . 3.5.078-1
3.5.079 DISPLAY: SM SYS SUMM 2 . . . . . 3.5.079-1
3.5.085 DISPLAY: MASS MEMORY R/W 3.5.085-1
3.5.086 DISPLAY: APU/HYD 3.5.086-1
3.5.087 DISPLAY: HYD THERMAL 3.5.087-1
3.5.088 DISPLAY: APU/ENVIRON THERM 3.5.088-1
3.5.089 DISPLAY: PRPLT THERMAL 3.5.089-1
3.5.090 DISPLAY: PCS CONTROL 3.5.090-1
3.5.094 DISPLAY: PDRS CONTROL 3.5.094-1
3.5.095 DISPLAY: PDRS OVERRIDE 3.5.095-1
3.5.096 DISPLAY: PDRS STATUS 3.5.096-1
3.5.097 DISPLAY: PL RETENTION 3.5.097-1
3.5.099 DISPLAY: FAULT 3.5.099-1
3.5.100 DISPLAY: GTS DISPLAY 3.5.100-1
3.5.101 DISPLAY: SENSOR SELF-TEST 3.5.101-1
3.5.102 DISPLAY: RCS/RGA/ADTA TEST 3.5.102-1
3.5.104 DISPLAY: GND IMU CNTL/MON 3.5.104-1
3.5.105 DISPLAY: TCS CONTROL 3.5.105-1
3.5.106 DISPLAY: MANUAL CONTROLS 3.5.106-1
3.5.110 DISPLAY: BUS/BTU STATUS 3.5.110-1
3.5.111 DISPLAY: SL MEMORY DUMP 3.5.111-1
3.5.112 DISPLAY: GPC/BTU I/F 3.5.112-1
3.5.113 DISPLAY: ACTUATOR CONTROL 3.5.113-1
3.5.1011 DISPLAY: XXXXXX TRAJ 1
3.5.1021 DISPLAY: XXXXXX TRAJ 1
3.5.1031 DISPLAY: XXXXXX TRAJ 1

3.5.1041 DISPLAY: XXXXX MANEUVER YYYYY . . . 1
3.5.1051 DISPLAY: XXXXX MANEUVER YYYYY . . . 1
3.5.1061 DISPLAY: XXXXX MANEUVER YYYYY . . . 1
3.5.2011(G) DISPLAY: UNIV PTG . . . 1
3.5.2011(S) DISPLAY: ANTENNA . . . 1
3.5.2021(G) DISPLAY: XXXXX MANEUVER YYYYY . . . 1
3.5.2021(S) DISPLAY: PL BAY DOORS . . . 1
3.5.3011 DISPLAY: XXXXX MANEUVER YYYYY . . . 1
3.5.3021 DISPLAY: XXXXX MANEUVER YYYYY . . . 1
3.5.3031 DISPLAY: XXXXX MANEUVER YYYYY . . . 1
3.5.3041 DISPLAY: ENTRY TRAJ 1 . . . 1
3.5.3042 DISPLAY: ENTRY TRAJ 2 . . . 1
3.5.3043 DISPLAY: ENTRY TRAJ 3 . . . 1
3.5.3044 DISPLAY: ENTRY TRAJ 4 . . . 1
3.5.3045 DISPLAY: ENTRY TRAJ 5 . . . 1
3.5.3051 DISPLAY: VERT SIT 1 . . . 1
3.5.3052 DISPLAY: VERT SIT 2 . . . 1
3.5.4011(S) DISPLAY: ANTENNA . . . 1
3.5.4021(S) DISPLAY: PL BAY DOORS . . . 1
3.5.6011 DISPLAY: XXXXXX TRAJ . . . 1
3.5.6021 DISPLAY: VERT SIT 1 . . . 1
3.5.6031 DISPLAY: VERT SIT 2 . . . 1
3.5.8011 DISPLAY: FCS/DED DIS C/O . . . 1
3.5.9011(G) DISPLAY: GPC MEMORY . . . 1
3.5.9011(P) DISPLAY: MASS MEMORY R/W . . . 1

4. DEDICATED DISPLAYS . . . 4.1-1
4.1 DATA PROCESSING SYSTEM (DPS) TALKBACKS . . . 4.1-1
4.2 COMPUTER ANNUNCIATION MATRIX . . . 4.2-1
4.3 CAUTION AND WARNING LIGHTS . . . 4.3-1
4.4 MASTER ALARM . . . 4.4-1
4.5 SM ALERT LIGHT . . . 4.5-1
4.6 REMOTE MANUPULATOR SYSTEM (RMS) INDICATORS . . . 4.6-1
4.6.1 RMS Master Alarm (Panel A8A1) . . . 4.6-1
4.6.2 RMS Mode Lights (Panel A8A1) . . . 4.6-1
4.6.3 RMS Auto SEQ Lights (Panel A8A1) . . . 4.6-1
4.6.4 RMS Caution Lights (Panel A8A1) . . . 4.6-1
4.6.5 RMS Brakes Indicator (Panel A8A1) . . . 4.6-1
4.6.6 RMS Safing Barber-Pole Indicator (Panel A8A1) . . . 4.6-1
4.6.7 RMS Software Stop Barber-Pole Indicator (Panel A8A1) . . . 4.6-1
4.6.8 Rate MIN Indicator (Panel A8A1) . . . 4.6-2
4.6.9 Rate Hold Indicator (Panel A8A1) . . . 4.6-2
4.6.10 Rate Scale Indicator (Panel A8A1) . . . 4.6-2
4.6.11 EE Rigid Barber-Pole Indicator (Panel A8A1) . . . 4.6-2
4.6.12 EE Derigid Barber-Pole Indicator (Panel A8A1) . . . 4.6-2
4.6.13 EE Close Barber-Pole Indicator (Panel A8A1) . . . 4.6-2
4.6.14 EE Open Barber-Pole Indicator (Panel A8A1) . . . 4.6-2
4.6.15 EE Capture Barber-Pole Indicator (Panel A8A1) . . . 4.6-2
4.6.16 EE Extend Barber-Pole Indicator (Panel A8A1) . . . 4.6-2
4.6.17 Shoulder Brace Release Barber-Pole Indicator (Panel A8A1) . . . 4.6-2
4.6.18 STBD RMS STO/LAT Indicators (Panel A8A2) . . . 4.6-3
4.6.19 STBD RMS Ready-For-Latch AFT/MID/FWD Barber-Pole Indicators (Panel A8A2) 4.6-3
4.6.20 PORT RMS STO/LAT Indicators (Panel A8A2) . . . 4.6-3
4.6.21 PORT RMS Ready-For-Latch AFT/MID/FWD Barber-Pole Indicators (Panel A8A2) 4.6-3
4.6.22 RMS Digital Display . . . 4.6-3
4.6.23 RMS Actual And Commanded Rates Indicator . . . 4.6-3
4.7 GNC DEDICATED DISPLAYS . . . 4.7-1
4.7.1 ATTITUDE DIRECTION INDICATOR (ADI) . . . 4.7-2
4.7.2 HORIZONTAL SITUATION INDICATOR (HSI) . . . 4.7-7

4.7.3 ALPHA MACH INDICATOR (AMI) 4.7-12
4.7.4 ALTITUDE/VERTICAL VELOCITY INDICATOR (AVVI) 4.7-16
4.7.5 SURFACE POSITION INDICATOR (SPI) 4.7-20
4.7.6 FLIGHT CONTROL SYSTEM (FCS) MODE STATUS LIGHTS 4.7-22
4.7.7 REACTION CONTROL SYSTEM (RCS) ACTIVITY LIGHTS 4.7-25
4.8 HEAD-UP DISPLAY (HUD) 4.8-1

5. SWITCHES 5.1-1
5.1 TABLE FORMAT 5.1-1
5.2 DEU KEYBOARD 5.2-1

6. FAULT ANNUNCIATION AND MESSAGES 6.1-1
6.1 ANNUNCIATION 6.1-1
6.2 MESSAGES 6.2-1

7. GROUND/GPC INTERFACES 7.1-1
7.1 LAUNCH DATA BUS 7.1-1
7.1.1 LDB Protocol/Polling 7.1-1
7.1.2 LDB Polling Controls 7.1-1
7.1.3 LDB Mass Memory Operations 7.1-2
7.1.4 LDB SSME Load Operations 7.1-2
7.1.5 LDB Test Control Supervisor Operations 7.1-2
7.1.6 Explicitly Coded Programs (ECP) 7.1-5
7.1.6.1 Actuator Initialization (AI) 7.1-5
7.1.6.1.1 Control Interfaces 7.1-5
7.1.6.1.2 Limits 7.1-6
7.1.6.1.3 Error Processing 7.1-14
7.1.6.1.4 Constraints/Assumptions 7.1-14
7.1.6.2 Ramp Function Generator (RFG) 7.1-14
7.1.6.2.1 Control Interfaces 7.1-14
7.1.6.2.2 Limits 7.1-17
7.1.6.2.3 Error Processing 7.1-17
7.1.6.2.4 Constraints/Assumptions 7.1-17
7.1.6.3 Frequency Response Test (FRT) 7.1-19
7.1.6.3.1 Control Interfaces 7.1-19
7.1.6.3.2 Limits 7.1-21
7.1.6.3.3 Error Processing 7.1-21
7.1.6.3.4 Constraints/Assumptions 7.1-22
7.1.6.4 Dedicated Display Checkout (DDCO) 7.1-22
7.1.6.4.1 Control Interfaces 7.1-22
7.1.6.4.2 Limits 7.1-22
7.1.6.4.3 Error Processing 7.1-22
7.1.6.4.4 Constraints/Assumptions 7.1-22
7.1.6.5 Multiple Actuator Test (MAT) 7.1-27
7.1.6.5.1 Control Interfaces 7.1-27
7.1.6.5.2 Limits 7.1-28
7.1.6.5.3 Error Processing 7.1-29
7.1.6.5.4 Constraints/Assumptions 7.1-29
7.1.6.6 Body Flap Drive (BFD) 7.1-29
7.1.6.6.1 Control Interfaces 7.1-29
7.1.6.6.2 Limits 7.1-30
7.1.6.6.3 Error Processing 7.1-30
7.1.6.6.4 Constraints/Assumptions 7.1-31
7.1.6.7 Body Flap Monitor (BFM) 7.1-31
7.1.6.7.1 Control Interfaces 7.1-31
7.1.6.7.2 Limits 7.1-31
7.1.6.7.3 Error Processing 7.1-32
7.1.6.7.4 Constraints/Assumptions 7.1-32
7.1.7 Launch Sequence Commands 7.1-32

7.1.8 DEU Read Capability 7.1-32
7.2 UPLINK 7.2-1
7.2.1 Control Interfaces 7.2-1
7.2.2 Software Interfaces 7.2-1
7.2.2.1 NSP Data 7.2-1
7.2.2.2 Validity Checking 7.2-1
7.2.3 Uplink Commands 7.2-3
7.2.3.1 Single-Stage Commands 7.2-3
7.2.3.1.1 MDM Command 7.2-5
7.2.3.1.2 Word-By-Word Correction 7.2-6
7.2.3.1.3 Buffer Execute (Two-Stage) 7.2-6
7.2.3.1.4 Buffer Clear (Two-stage or SPC) 7.2-6
7.2.3.1.5 Uplink Activity Indicator 7.2-7
7.2.3.2 Two-Stage Commands 7.2-7
7.2.3.3 Time Executed Commands 7.2-7
7.2.3.4 Payload Throughput 7.2-7
7.2.4 Uplink Restrictions/Notes 7.2-13
7.3 DOWNLIST 7.3-1
7.3.1 FORMATS AND FORMATTER PROGRAMS 7.3-3
7.3.2 FAULT SUMMARY PAGE 7.3-7
7.3.3 DEU MESSAGES AND KEYBOARD LAYOUT 7.3-10

8. DATA ANALYSIS 8.1-1
8.1 GPC ERRORS 8.1-1
8.1.1 GPC FAIL-TO-SYNCS 8.1-1
8.1.2 GPC ERROR LOG (CZ2V_GPC_ERR_LOG) 8.1-1
8.2 INPUT/OUTPUT (I/O) ERRORS 8.2-1
8.2.1 I/O Related User Notes 8.2-17
8.2.2 I/O Error Log (CZ2V_IO_ERR_LOG) 8.2-17
8.3 DUMP ANALYSIS 8.3-1
8.3.1 SYNC TRACE LOG 8.3-1
8.3.2 WAIT STATE 8.3-2
8.4 PASS MICROFICHE 8.4-1
8.4.1 MASS MEMORY BUILD (MMBXXXX) 8.4-1
8.4.2 MASS MEMORY PATCH 8.4-1
8.4.3 MASS MEMORY DUMP (MMB) 8.4-2
8.4.4 ILOAD REPORT (ILDMAP) 8.4-2
8.4.5 PASS SYSTEM SOFTWARE 8.4-2
8.4.6 APPLICATIONS SOFTWARE 8.4-3
8.4.7 HALSTAT 8.4-3
8.4.8 DISASSEMBLY (DASS) 8.4-3
8.4.9 AUTODOC (AUTOMATIC DOCUMENTATION) 8.4-3
8.4.10 INCLUDE LIBRARY (INCL80) 8.4-4
8.5 MASS MEMORY DIRECTORY 8.5-1
8.6 DEU IPL LOG TABLE (CZ2V_DEU_IPL_LOGTB) 8.6-1

Appendix A. SUBJECT CROSS-REFERENCE A-1

Appendix B. USER NOTES CROSS-REFERENCE B-1

Appendix C. USER NOTES C-1

Appendix D. COMPILER ERRORS D-1

Appendix E. GPC ERROR MESSAGES E-1

Appendix F. I/O ERROR MESSAGES F-1

Appendix G. FAULT SUMMARY PAGE MESSAGES G-1

Appendix H. DISTRIBUTION LIST H-1

FIGURES

3-1. Standard Display Page 3.2-2
3-2. IPL (1) 3.4-3
3-3. IPL (2) 3.4-4
3. IPL (2) 3.4-9
3.000 . . . . . 3.5.000-1
3.001 . . . . . 3.5.001-1
3.002 . . . . . 3.5.002-1
3.006 . . . . . 3.5.005-1
3.018 . . . . . 3.5.018-1
3.019 . . . . . 3.5.019-1
3.020 . . . . . 3.5.020-1
3.021 . . . . . 3.5.021-1
3.022 . . . . . 3.5.022-1
3.023 . . . . . 3.5.023-1
3.025 . . . . . 3.5.025-1
3.033 . . . . . 3.5.033-1
3.034 . . . . . 3.5.034-1
3.040 . . . . . 3.5.040-1
3.041 . . . . . 3.5.041-1
3.042 . . . . . 3.5.042-1
3.043 . . . . . 3.5.043-1
3.044 . . . . . 3.5.044-1
3.045 . . . . . 3.5.045-1
3.050 . . . . . 3.5.050-1
3.051 . . . . . 3.5.051-1
3.053 . . . . . 3.5.053-1
3.060 . . . . . 3.5.060-1
3.062 . . . . . 3.5.062-1
3.064 . . . . . 3.5.064-1
3.090 . . . . . 3.5.090-1
3.094 . . . . . 3.5.094-1
3.095 . . . . . 3.5.095-1
3.099 . . . . . 3.5.099-1
3.100 . . . . . 3.5.100-1
3.101 . . . . . 3.5.101-1
3.102 . . . . . 3.5.102-1
3.104 . . . . . 3.5.104-1
3.105 . . . . . 3.5.105-1
3.106 . . . . . 3.5.106-1
3.106 . . . . . 3.5.106-1
3.110 . . . . . 3.5.110-1
3.111 . . . . . 3.5.111-1
3.112 . . . . . 3.5.112-1
3.113 . . . . . 3.5.113-1
3.1011 . . . . . 3.5.1011-1
3.1041 . . . . . 3.5.1041-2
3.2011(G) . . . . . 3.5.2011(G)-1
3.2011(S) . . . . . 3.5.2011(S)-1
3.2021(S) . . . . . 3.5.2021(S)-1
3.3041 . . . . . 3.5.3041-2
3.3042 . . . . . 3.5.3042-1
3.3043 . . . . . 3.5.3043-1
3.3044 . . . . . 3.5.3044-1
3.3045 . . . . . 3.5.3045-1

3.3051 . . . . . 3.5.3051-1
3.3052 . . . . . 3.5.3052-1
3.8011 . . . . . 3.5.8011-1
3.9011(P) . . . . . 3.5.9011(P)-1
4-1. Computer Annunication Matrix (XAM) 4.2-1
4-2. RMS Rate Meter 4.6-4
4-3. ADI Unit 4.7-3
4-4. HSI Display 4.7-8
4-5. AMI Unit 4.7-13
4-6. AVVI Unit 4.7-17
4-7. Surface Position Indicator (SPI) 4.7-20
6-1. Fault Message Format 6.1-2
7.3-1 FSP Message Definition 7.3-7
7.3-2 DEU Message Format 7.3-10
7.3-3 MDCS Keyboard Layout 7.3-12
8.1-1 GPC Error Word 5 . . . . . 8.1-2
8.2-1 I/O Errors Which May be Handled by Application Processes 8.2-2
8.2-2 I/O Errors Handled By FCOS 8.2-3
8.2-3 Example of Status Slot Layout 8.2-4
8.2-4 Format of the Transaction Status Word 8.2-5
8.2-5 Bypass/Commfault Words Description 8.2-6
8.3-1 . . . . . 8.3-1
8.5-1 MASS Memory Directory Format 8.5-2
8.6-1 DEU IPL LOG ENTRY 8.6-1

TABLES

2-1. MASS MEMORY PHASE/MEMORY CONFIGURATION 2.2-2
2-2. GPC IPL SEQUENCE 2.3-3
2-3. EXECUTION MATRIX 2.4-1
2-4. NBAT TERMINOLOGY 2.4-2
2-5. LEGAL OPS TRANSITIONS 2.4-3
2-7. NBAT FOR P9 . . . . . 2.4-8
2-8. NBAT FOR G1 . . . . . 2.4-10
2-9. NBAT FOR G2 . . . . . 2.4-12
2-10. NBAT FOR G3 . . . . . 2.4-14
2-11. NBAT FOR G8 . . . . . 2.4-16
2-12. NBAT FOR S2/S4 . . . . . 2.4-18
2-13. PASS ACTUATOR INITIALIZATION (AEROSURFACES) 2.5-2
2-14. PASS ACTUATOR INITIALIZATION (SSMEs) 2.5-4
2-15. PASS ACTUATOR INITIALIZATION (OMS) 2.5-6
2-16. PASS ACTUATOR INITIALIZATION (SRBS) 2.5-9
3-1. CRITICAL FORMATS 3.4-2
3.IPL-1 DISPLAY FUNCTIONS 3.4-5
3.IPL-2 DISPLAY ITEMS 3.4-8
3-2. CRT DISPLAYS 3.5-1
3.000-1 DISPLAY FUNCTIONS 3.5.000-2
3.000-2 DISPLAY ITEMS 3.5.000-8
3.001-1 DISPLAY FUNCTIONS 3.5.001-2
3.001-2 DISPLAY ITEMS 3.5.001-8
3.002-1 DISPLAY FUNCTIONS 3.5.002-2
3.002-2 DISPLAY ITEMS 3.5.002-8
3.006-1 DISPLAY FUNCTIONS 3.5.006-2
3.018-1 DISPLAY FUNCTIONS 3.5.018-2
3.019-1 DISPLAY FUNCTIONS 3.5.019-2
3.020-1 DISPLAY FUNCTIONS 3.5.020-2
3.020-2 DISPLAY ITEMS 3.5.020-5
3.021-1 DISPLAY FUNCTIONS 3.5.021-2
3.021-2 DISPLAY ITEMS 3.5.021-6
3.022-1 DISPLAY FUNCTIONS 3.5.022-2
3.022-2 DISPLAY ITEMS 3.5.022-6
3.023-1 DISPLAY FUNCTIONS 3.5.023-2
3.023-2 DISPLAY ITEMS 3.5.023-6
3.025-1 DISPLAY FUNCTIONS 3.5.025-2
3.025-2 DISPLAY ITEMS 3.5.025-5
3.033-1 DISPLAY FUNCTIONS 3.5.033-2
3.033-2 DISPLAY ITEMS 3.5.033-8
3.034-1 DISPLAY FUNCTIONS 3.5.034-2
3.034-2 DISPLAY ITEMS 3.5.034-5
3.040-1 DISPLAY FUNCTIONS 3.5.040-2
3.040-2 DISPLAY ITEMS 3.5.040-3
3.040-3 SENSOR SELF-TEST LIMITS 3.5.040-4
3.041-1 DISPLAY FUNCTIONS 3.5.041-2
3.041-2 DISPLAY ITEMS 3.5.041-4
3.041-3 RGA LIMIT VALUES 3.5.041-5
3.041-4 ADTA LIMIT VALUES 3.5.041-5
3.042-1 DISPLAY FUNCTIONS 3.5.042-2
3.042-2 DISPLAY ITEMS 3.5.042-3
3.043-1 DISPLAY FUNCTIONS 3.5.043-2
3.043-2 DISPLAY ITEMS 3.5.043-4
3.044-1 DISPLAY FUNCTIONS 3.5.044-2

3.044-2 DISPLAY ITEMS 3.5.044-3
3.045-1 DISPLAY FUNCTIONS 3.5.045-2
3.045-2 DISPLAY ITEMS 3.5.045-3
3.050-1 DISPLAY FUNCTIONS 3.5.050-2
3.050-2 DISPLAY ITEMS 3.5.050-5
3.051-1 DISPLAY FUNCTIONS 3.5.051-2
3.051-2 DISPLAY ITEMS 3.5.051-7
3.053-1 DISPLAY FUNCTIONS 3.5.053-2
3.053-2 DISPLAY ITEMS 3.5.053-4
3.060-1 DISPLAY FUNCTIONS 3.5.060-2
3.060-2 DISPLAY ITEMS 3.5.060-5
3.062-1 DISPLAY FUNCTIONS 3.5.062-2
3.062-2 DISPLAY ITEMS 3.5.062-5
3.064-1 DISPLAY FUNCTIONS 3.5.064-2
3.064-2 DISPLAY ITEMS 3.5.064-5
3.090-1 DISPLAY FUNCTIONS 3.5.090-2
3.090-2 DISPLAY ITEMS 3.5.090-4
3.094-1 DISPLAY FUNCTIONS 3.5.094-2
3.094-2 DISPLAY ITEMS 3.5.094-5
3.095-1 DISPLAY FUNCTIONS 3.5.095-2
3.095-2 DISPLAY ITEMS 3.5.095-5
3.099-1 DISPLAY FUNCTIONS 3.5.099-2
3.100-1 DISPLAY FUNCTIONS 3.5.100-2
3.100-2 DISPLAY ITEMS 3.5.100-6
3.101-1 DISPLAY FUNCTIONS 3.5.101-2
3.101-2 DISPLAY ITEMS 3.5.101-3
3.101-3 SENSOR SELF-TEST LIMITS 3.5.101-4
3.102-1 DISPLAY FUNCTIONS 3.5.102-2
3.102-2 DISPLAY ITEMS 3.5.102-4
3.102-3 RGA LIMIT VALUES 3.5.102-5
3.102-4 ADTA LIMIT VALUES 3.5.102-5
3.104-1 DISPLAY FUNCTIONS 3.5.104-2
3.104-2 DISPLAY ITEMS 3.5.104-8
3.105-1 DISPLAY FUNCTIONS 3.5.105-2
3.105-2 DISPLAY ITEMS 3.5.105-3
3.105-3 TCS ERROR CODES 3.5.105-5
3.106-1 DISPLAY FUNCTIONS 3.5.106-2
3.110-1 DISPLAY FUNCTIONS 3.5.110-2
3.110-2 DISPLAY ITEMS 3.5.110-3
3.111-1 DISPLAY FUNCTIONS 3.5.111-2
3.111-2 DISPLAY ITEMS 3.5.111-4
3.112-1 DISPLAY FUNCTIONS 3.5.112-2
3.112-2 DISPLAY ITEMS 3.5.112-4
3.113-1 DISPLAY FUNCTIONS 3.5.113-2
3.113-2 DISPLAY ITEMS 3.5.113-8
3.1011-1 DISPLAY FUNCTIONS 3.5.1011-2
3.1041-1 DISPLAY FUNCTIONS 3.5.1041-3
3.1041-2 DISPLAY ITEMS 3.5.1041-7
3.2011(G)-1 DISPLAY FUNCTIONS . . . . . 3.5.2011(G)-2
3.2011(G)-2 DISPLAY ITEMS . . . . . 3.5.2011(G)-7
3.2011(G)-3 BODY VECTOR IC'S . . . . . 3.5.2011(G)-8
3.2011(S)-1 DISPLAY FUNCTIONS . . . . . 3.5.2011(S)-2
3.2011(S)-2 DISPLAY ITEMS . . . . . 3.5.2011(S)-6
3.2021(S)-1 DISPLAY FUNCTIONS . . . . . 3.5.2021(S)-2
3.2021(S)-2 DISPLAY ITEMS . . . . . 3.5.2021(S)-5
3.3041-1 DISPLAY FUNCTIONS 3.5.3041-3
3.3041-2 DISPLAY ITEMS 3.5.3041-4
3.3051-1 DISPLAY FUNCTIONS 3.5.3051-2
3.8011-1 DISPLAY FUNCTIONS 3.5.8011-2

3.8011-2 DISPLAY ITEMS 3.5.8011-5
3.9011(P)-1 DISPLAY FUNCTIONS . . . . . 3.5.9011(P)-2
3.9011(P)-2 DISPLAY ITEMS . . . . . 3.5.9011(P)-7
3.9011(P)-3 MMU REGISTER A & B CONTENTS . . . . . 3.5.9011(P)-9
4.6-1 DEDICATED DISPLAY DATA 4.6-5
4.7-1 DEDICATED DISPLAY AVAILABILITY MATRIX 4.7-1
4.7.1-1 ADI DISPLAY DATA 4.7-4
4.7.1-2 DEDICATED DISPLAY SWITCH CONTROLS 4.7-5
4.7.1-3 DEDICATED DISPLAY DATA 4.7-6
4.7.2-1 DEDICATED DISPLAY SWITCH CONTROLS 4.7-9
4.7.2-2 DEDICATED DISPLAY DATA 4.7-10
4.7.3-1 DEDICATED DISPLAY SWITCH CONTROLS 4.7-14
4.7.3-2 DEDICATED DISPLAY DATA 4.7-15
4.7.4-1 DEDICATED DISPLAY SWITCH CONTROLS 4.7-18
4.7.4-2 DEDICATED DISPLAY DATA 4.7-19
4.7.5-1 DEDICATED DISPLAY DATA 4.7-21
4.7.6-1 DEDICATED DISPLAY DATA 4.7-24
5-1. SWITCHES 5.1-2
7.1-1 TCS OPERATOR CODE/MODE MATRIX 7.1-4
7.1-2 AI MODE 0 (INITIAL) 7.1-7
7.1-3 AI MODE 1 (PRECONDITIONING) 7.1-8
7.1-4 AI MODE 2 (FERRY) 7.1-9
7.1-5 AI MODE 3 (RAIN) 7.1-10
7.1-6 AI MODE 4 (GRAVITY) 7.1-11
7.1-7 AI MODE 5 (NULL) 7.1-12
7.1-8 AI MODE 6 (TURNAROUND) 7.1-13
7.1-9 ACTUATORS/DEVICE AVAILABLE FOR TEST AND INITIALIZATION 7.1-15
7.1-10 POSITION AND RATE DRIVE COMMAND UNITS 7.1-18
7.1-11 DEDICATED DISPLAY CHECKOUT CALL OPERATOR FORMAT 7.1-23
7.2-1 UPLINK COMMAND HEADER BITS 7.2-4
7.2-2 UPLINK OF CODES/MEMORY CONFIGURATION 7.2-8
7.3-2 TOGGLE BUFFERS VS MEMORY CONFIGURATION 7.3-4
7.3-3 DOWNLINK/DOWNLIST FORMATS AND TOGGLE BUFFERS 7.3-5
7.3-4 DOWNLIST FORMATS IN DOWNLINK 7.3-6
7.3-5 MAJOR FIELDS OF MESSAGES 7.3-8
7.3-6 MAJOR FIELDS OF MESSAGES 7.3-9
7.3-7 DEU KEYSTROKES 7.3-11
8.1-1 GPC ERROR GROUP/CODE 8.1-3
8.2-1 BUS NUMBERS 8.2-19
8.2-2 BCE (1 THRU 24) STATUS WORD CONTENTS 8.2-19
8.2-3 BCE (27) STATUS WORD CONTENTS 8.2-22
8.2-4 BCE (28) STATUS WORD CONTENTS 8.2-23
8.2-5 BCE (29) STATUS WORD CONTENTS 8.2-24
8.2-6 BCE (30) STATUS WORD CONTENTS 8.2-25
8.2-7 PASS FCOS I/O DEVICE IDs 8.2-26
8.2-8 BCE ELEMENT NUMBER TABLE 8.2-30

1. INTRODUCTION

1.1 PURPOSE

This User's Guide will provide the information necessary to operate and control the Primary Avionics Software System (PASS) indicated on the Change Control Page. This information is in accordance with, and fulfillment of, IRD 2a9. In addition, it will contain selected information to assist in resolution of questions pertaining to flight software performance.

-1 As such, this User's Guide has been written:

A. from a 'man-in-the-loop' viewpoint

B. so that it is easy to find specific information

C. to assist IBM T&O personnel (and any other interested parties) in providing timely answers to FSW questions.

1.2 SCOPE

This User's Guide describes how the flight software is used; including how it is loaded, external interfaces to and from the man-in-the-loop, messages, and other pertinent information. A certain level of knowledge about PASS on the part of the user has been assumed. Information about interfaces with other software such as Back-up Flight Control, SIM FLIGHT, etc. is included only as it applies to PASS related topics. User's desiring additional information about specific topics should contact the T&O personnel or IBM-Houston personnel.

1.3 APPLICABLE DOCUMENTS

The following documents form the basis from which information for the User's Guide was extracted.

Originator	Title
IBM	Software Design Specification
IBM	PASS Program Release Notice
NASA/JSC	OFT Computer Program Design Specification
NASA/JSC	Program Notes
NASA/JSC	MMU Program Release Notice
ROK	Functional subsystem Software Requirements

1.4 FSW DELIVERABLES

The User's Guide will be released as a base document for each PASS OI release. Revisions will be made as required to reflect the current PASS being used.

2. SYSTEM

2.1 OVERVIEW

This section of the User's Guide provides general information about the PASS System. Subsections and their intent are as follows:

−1 Mass Memory - a brief description of the contents of the Mass Memory Unit(s) and the format of the data.

−2 System Initialization - specifications of how to bring up each PASS System being supported; includes IPL, DEU LOAD, and any special limitations or instructions.

−3 Operational Sequences - a description of the Operational Sequences (OPS) and the legal transitions between them.

2.2 MASS MEMORY

The Mass Memory Unit (MMU) is a device used to store all PASS software plus other programs which can be loaded via a GPC into a GPC or other orbiter hardware components. Information is stored in the MMU on magnetic tape. Each MMU is subdivided into three logical areas. Each area may contain a copy of the various pieces of orbiter software programs. Thus, each MMU contains three copies of PASS, referred to as "PASS, area 1", PASS, area 2", etc. The desired area to be loaded in the GPC is selectable via an IPL MENU display (see Section 3.4.1).

2.2.1 GPC Memory Configuration

A GPC memory configuration may be loaded from a MMU via an IPL sequence (Section 2.3) or an OPS transition request (Section 2.4). (33749)

2.2.2 Mass Memory Allocation

For a detailed MAP of mass memory allocation for various pieces of software, the user should refer to the Mass Memory Build listing for the appropriate release. This listing is part of the deliverable set for all releases except paper-patch releases (paper patches do not change the MAP). A table of mass memory phase versus memory configuration is provided in Table 2-1.

TABLE 2-1. MASS MEMORY PHASE/MEMORY CONFIGURATION

PHASE NO.	MEMORY CONFIGURATION	DESCRIPTION
1*	N/A	GPC Bootstrap Loader and Mini-Directory
2	ALL	Resident System Software
3	1,2,3,8,9	GNC Major Function Base (GNC-FB)
4	1	Ascent and Abort OPS (GNC 1/6-A)
5	2	On-Orbit OPS (GNC 2-A)
6	3	Entry OPS (GNC 3-A)
7	8	VU On-Orbit OPS (GNC 8)
8	9	VU Pre-Count OPS (GNC 9)
9	6	VU Checkout Function Base (VCO-FB)
10	1	Ascent and Abort OPS (GNC 1/6-B)
11	3	Entry OPS (GNC 3-B)
12	6	VU Mass Memory OPS (PL9)
13	2	On-Orbit OPS (GNC 2-B)
14	4,5	SM Function Base (SM-FB)
15	4	Orbit-Doors OPS (SM2)
16	5	Spacelab Support OPS (SM4); Reserved
17,18	N/A	Reserved for Growth
19	N/A	Payload Control Supervisor Sequences (PCS)
20	N/A	P/L Checkpoint; Reserved
21	N/A	SM Data Checkpoint
22	N/A	IMU Calibration Checkpoint
23	N/A	PDI Decom Format Load (DFL)
24	N/A	IDI Fetch Pointer Memory Load (FPL)
25	N/A	Telemetry Format Load (TFL)
26	N/A	GPC-STP/SW Loaders (GPC-STP, SSL, LOAD TBL)
27-34	N/A	Subsystem Configuration Management (SCM)
35-60	N/A	Roll-In-Displays

* Not currently in the PASS Phase Table.

MEMORY CONFIGURATION TO PHASE CROSS REFERENCE

MEMORY CONFIGURATION	PHASE NOS.
1	2, 3, 4, 10
2	2, 3, 5, 13
3	2, 3, 6, 11
4	2, 14, 15
5	2, 14, 16
6	2, 9, 12
8	2, 3, 7
9	2, 3, 8

2.3 SYSTEM INITIALIZATION

The software supports GPC initialization with two basic options. These basic options are defined as: (1) the software support of the hardware/firmware IPL and (2) software support of non-IPL initialization.

-1 Hardware/Firmware IPL supporting software consists of a Bootstrap Loader (FCMBOOT), GPCIPL (which includes the Self Test Program (STP)), and the Systems Software Loader (FCMINSSL). FCMBOOT is loaded (from the MMU) by the IOP microcode upon IPL initiation. Upon moding the GPC from HALT to STBY, the Bootstrap Loader fetches GPCIPL and FCMINSSL from the MMU. If the fetch is successful, control of the CPU is passed to GPCIPL. GPCIPL passes control to the STP for a one cycle test. Upon completion of the STP without errors, GPCIPL gives control to the SSL. The SSL initiates loading of the selected PASS software system from the MMU.

-1.1 Non-IPL initialization is supported totally by the systems software.

-2 User Interface Software, utilizing FCOS facilities, provides for basic moding of the GPC and FCOS initialization after IPL. The definitions given below are broken into GPC moding and IPL categories, with GPC moding revolving around processing in response to the GPC MODE switch (HALT/STBY/RUN).

-3 The GPC MODE (HALT,STBY,RUN) and IPL switches are used to place the GPC into various on-line and off-line states and to control the IPL sequence. The "HALT" mode and IPL discrete are hardware functions.

-3.1 HALT mode - When in this mode, the GPC is in a hardware RESET controlled state. No software can be executed. Before execution of any software, the GPC must be powered on while in HALT.

-3.1.1 SLEEP mode - An AP-101S GPC will enter the SLEEP mode to conserve power if the following switch configuration exists for a period of 4.5 minutes:

Power Switch - ON
Mode Switch - HALT
IPL SEL SW - OFF

***** WARNING *****
A GPC in SLEEP mode will not IPL. If an MMU is selected on the IPL SEL SW and the IPL push button is depressed, the GPC will not respond.

The GPC can be removed from SLEEP mode by moving the mode switch from HALT to STBY or by toggling the GPC power switch from ON to OFF to ON.

-3.2 STBY mode - When entered from HALT, this mode causes the hardware to be released from the RESET state giving control to the software. If IPL occurred, control will be given to the Bootstrap Loader program. For non-IPL mode switch transitions from HALT to STBY, control is passed to a HISAM dump function if DI13* and DI15* are TRUE. If HISAM is not requested, resident PASS software will perform preliminary initialization functions and loop in the cyclic switch monitor until moded to RUN. It should be noted that the power up of a GPC (previously loaded with PASS) must be accomplished in the HALT mode, or the PASS will immediately place the GPC into the WAIT state.

---

* DI13 is driven true to the GPC if the GPC (1-5) Output Switch is in the TERM position.

* DI15 is driven true to the selected GPC when the "GPC Memory DUMP" panel switch is placed in a GPC position (1, 2, 3, 4, 5).

To temporarily remove a GPC from the common set (CS) or redundant set (RS) or in preparation for freeze dry sleep mode, the GPC should be moded from RUN to STBY, allowing a "MINIMUM" of three seconds for software recognition of the switch change and software cleanup. The GPC may then be moded back to RUN to rejoin the CS or moded to HALT for subsequent use. Unless adequate time is allowed for this process, the PASS cannot ensure a proper software initialization upon moding from HALT to STBY to RUN.

***** WARNING *****
If more than one GPC is moded from RUN to STBY within a one second span, the GPCs moded to STBY can issue Fail Votes against GPCs remaining in the CS or RS. Therefore, when more than one GPC is being down moded from RUN to STBY, the user should delay approximately five seconds between successive actions.

Note: If a failure occurs during software execution in STBY or RUN, the GPC should be powered off in the failed mode (i.e., STBY or RUN). This allows the CPU microcode to perform put-a-way of CPU control data and registers which may be required to isolate the cause of the failure. The GPC should be dumped via the HISAM function before re-IPL or re-use.

–3.3 RUN mode - In this mode the GPC supports normal OPS-assigned vehicle operations. On transition from STBY to RUN, the PASS system services begin cyclic execution and the "OPS 0" CRT display (if CRTs are on) will be GPC Memory.

–3.4 IPL - The IOP hardware initiates the hardware IPL sequence when this discrete input is detected while the GPC is in the HALT mode. The hardware sequence resets the IOP, stores a fixed pattern of "C9FB" in memory locations 0-1FFFF and "C6C6" in the remainder of the memory from locations 20000-7FFFF, and initiates a Mass Memory read of the bootstrap loader. Following the IPL, the CPU is left in the RESET state as described for the HALT mode.

–3.5 Due to potential ICC conflicts which could lead to CS/RS Fail-To-Syncs or other undesirable events, certain operations should be avoided when moding a GPC from STBY to RUN and during the 10 second wait after moding to RUN. (42433/46617)

2.3.1 Initial Program Load (IPL) Sequence

The following steps define a standard procedure which may be used to IPL a GPC (See Table 2-2). The steps assume no equipment (MMU, CRT, GPC, etc.) is powered on.

–1 If a "default" IPL is desired (that is, PASS, area 1 from the selected MMU is to be loaded), steps 6, 7, 9, 12 should be omitted. If any other copy of PASS or any BFS is to be loaded, steps 6, 7, 9, 12 must be included.

2.3.1.1 IPL Sequence Failures

–1 Initial IPL - After the initial IPL (Ref. Step 10) and the MODE TB does not go B/P, one of two conditions exists:

(a) Hardware/Firmware problem: If system had IPLed prior, indications are a hardware problem. GPC should be dumped before proceeding.

(b) System has not IPLed (First attempt on new system): Problem could be (a) above or checksum bad. After trying different GPC, different MM, reloading MM, IPL prior system - if hardware/firmware good, the problem is software and T&O support should be used to determine problem and corrective action.

(c) Operational notes: If IPL sequence fails at this point (Step 10) GPC must be powered off, then on, for re-try. IBM engineer should be notified before re-try is attempted.

TABLE 2-2. GPC IPL SEQUENCE

#	USER ACTION	PANEL	GPC HARDWARE	GPC SOFTWARE
1	Mass Memory Power on - MMU1 MMU2	O14 O15	No Response	No Response
2	DEU(s) Power - STANDBY	C2A2	No Response	No Response
3	Mass Memory IPL Source Select to desired MMU	O6	No Response	No Response
4	GPC to HALT mode	O6	No Response	No Response
5	GPC Power - ON	O6	No Response	No Response
6	BFC CRT display switch to ON (Menu IPL only)	C3A1	No Response	No Response
7	BFC CRT SELECT switch to 1+2, 2+3, or 3+1 (Menu IPL only)	C3A1	No Response	No Response
8	DEU(s) Power - ON (at least 30 seconds after step 2)	C2A2	No Response	No Response
9	DEU LOAD - Push, then release (P/R) (Menu IPL only)	O6	No Response	No Response
10	GPC IPL - P/R (at least 2 minutes after step 1)	O6	Drives mode TB-IPL; Fixed pattern stored in memory (C9FB from 0-1FFFF, C6C6 from 20000 - 7FFFF); Bootstrap loader read in from MMU; Mode TB reset to Barberpole **Note:** No response if GPC in SLEEP mode	No Response
11	GPC to STBY mode	O6	STBY discrete (DI01)-ON	Bootstrap fetches GPCIPL and SSL from MMU and passes CPU control to GPCIPL.

TABLE 2-2. GPC IPL SEQUENCE (Continued)

#	USER ACTION	PANEL	GPC HARDWARE	GPC SOFTWARE
11	(Continued)			STP executes one cycle; if successful, GPCIPL gives control to SSL. If step 6 is done, GPCIPL loads DEU, selected in step 7, from MMU; IPL menu presented. (Go to step 12.) If step 6 is not done, SSL loads PASS area 1 phase 2 into memory, sets mode TB-RUN. (Go to step 13.) Default load for an AP-101S GPC takes approximately 1 minute and 25 seconds from STBY to RUN talkback.
12	Select system to be loaded (Menu IPL only) 1 PASS Area 1 3 PASS Area 2 5 PASS Area 3 2 BFS Area 1 4 BFS Area 2 6 BFS Area 3	KYBD	No Response	If PASS selected, system phase 2 loaded, Mode TB-RUN. If BFS selected, the BSL2IPL menu will be presented. (Go to 14.)
13	GPC mode - RUN	O6	RUN discrete (DI02)-ON	Enters OPS 0, presents GPC Memory display. (37517) Note: To prevent ICC conflicts, wait 10 seconds after moding to RUN before doing any operations listed under the GPC mode discussion in Section 2.3-3.
14	Mass Memory - IPL Source Select OFF	O6	No Response	Removes mask to allow access of MMU. For BFS, present GPC Memory on CRT.

-2 IPL Failure on Mode Switch - If the GPC mode switch is moved to STBY (Ref. Step 13) and Talkback (TB) hangs in Barberpole on a Default IPL or no IPL Menu is displayed, the GPC may be in the WAIT state (can be verified in a Lab). Causes for IPL hang in WAIT state are:

(a) Bootstrap Loader goes to WAIT if MM Source Select SW is off. (See Par. 2.3.1.3)

(b) Bootstrap Loader checksum failures (3 tries) could be caused by MM bus errors. (See Par. 2.3.1.3)

(c) STP Failure. Some STP failures do not cause a hard WAIT state, and GPC IPL will display the STP error message if the IPL is a menu IPL.

(d) SSL goes to WAIT if MM Source Select SW is off.

(e) SSL determines checksum error. Could be caused by MM bus errors, but unlikely since IOP Microcode and Bootstrap Loader were both successful on the same bus.

(f) Operational Notes:

-1 If IPL sequence fails with Mode TB BP, the GPC should be powered off before the Mode SW is moved back to HALT. This causes a microcode put-away of the current PSW and CPU reg contents if the memory PSA is unprotected at the time of the failure.

-2 A HISAM dump may or may not succeed dependent upon whether the failure occurred before the HISAM dump code in GPC IPL was loaded from MM. Do NOT re-IPL this GPC until the GPC is dumped unless its use is absolutely mandatory.

2.3.1.2 No Display

If GPC mode switch is placed to RUN after MODE TB RUN and OPS 0 display (GPC Memory) is not presented, the DEUs may require loading. Proceed to Section 2.3.2.

2.3.1.3 CAM Light

The Bootstrap Loader activates the IOP Watchdog (W/D) Timer to provide the user an indicator in case of Bootstrap fail. The maximum count of the IOP W/D timer is 3.14+ seconds; however, the MMU position to read GPCIPL/SSL takes approximately 6 seconds, so the timer expires during the CPU loop waiting for the MM Ready discrete. (54012) The W/D Timer is reset and the CAM light extinguished at the successful conclusion of the Bootstrap Loader.

2.3.2 DEU Load

To load the Display Control Program (DCP) and Critical Format data into the DEU, place the DEU load switch (Panel O6) to LOAD and then OFF. This action causes FCOS to get the current DCP and Critical Format data off MM and place into the DEU. This action is restricted to initial OPS 0 (after IPL) or memory configuration 6 (OPS PL 9).

-1 When action is taken, the words DEU LOAD should be displayed in the lower left corner of the CRT being loaded. When load is complete, in the middle of the screen IPL COMPLETE will be flashed prior to GPC Memory (OPS 0) or MMU Read/Write (PL 9) being displayed. (37706)

-2 An entry is placed in the DEU IPL Log Table (see section 8.6) after each DEU load attempt to indicate the failure/success of the load.

2.4 OPERATIONAL SEQUENCES

The FSW is divided into major segments called OPERATIONAL SEQUENCES (OPS). An operational sequence is defined to be that software required to support a pre-defined phase of a mission. Each operational sequence is a separate memory configuration (except OPS G6 which is in the same memory configuration as OPS G1).

–1 An OPS may be subdivided into Major Modes. The modes are subdivisions of the overall OPS - all software for each mode is resident in the memory configuration of the OPS. The PASS is composed of nine OPS which are shown in the following Execution Matrix (Table 2-3). These OPS are contained in eight memory configurations; i.e., there are eight possible GPC memory loads from MM. (GNC OPS1 and OPS6 are in the same memory configuration.)

TABLE 2-3. EXECUTION MATRIX

	G1	G2	G3	G6	G8	G9	S2	S4	PL 9	OPS 0
OPS GNC 1	R								C	C
OPS GNC 2		R					C	C	C	C
OPS GNC 3			R				C	C	C	C
OPS GNC 6				R					C	C
OPS GNC 8					R		C	C	C	C
OPS GNC 9						R	C	C	C	C
OPS SM 2		C	C		C	C			C	C
OPS SM 4		C	C		C	C			C	C
OPS PL 9	C	C	C	C	C	C	C	C		C
OPS 0	C	C	C	C	C	C	C	C	C	C

R - REDUNDANT SET OPERATION ALLOWED IN TWO OR MORE GPCs.

C - COMMON SET OPERATION OF THESE MEMORY CONFIGURATIONS IS ALLOWED.

BLANK - COMMON SET OPERATION IS NOT OKAY FOR THESE TWO MEMORY CONFIGURATIONS.

–2 Each Memory Configuration (MC) is composed of three or more Phases from the MMU. A request to initiate an OPS in a GPC (or set of GPCs) will result in the requested memory configuration being loaded into the GPC(s) either directly from the appropriate MMU or from another GPC which already contains the desired memory configuration (default). (15620/28353/36094/36549/37657/37660/39021/40622/51349/51373) (33268) (33299) (52779)

–3 For each OPS/memory configuration, the user must specify which GPC(s) is to participate and which data buses are to be commanded by which GPC in the MC. A default set of assignments has been defined for each MC and is commonly referred to as a Nominal Bus Assignment Table (NBAT). This Table is actually two tables: a GPC Reconfiguration Table (GRT), and a Bus Assignment Table (BAT). See Table 2-4 for a description of the NBAT terminology.

TABLE 2-4. NBAT TERMINOLOGY

CONFIG	-	Memory Configuration/OPS
GPC	-	ID(s) of GPC(s) in target set (GRT)
STRING	-	Identifies a pair of Flight Critical BUSes, including all LRUs attached to them. Pairs are FFn-FAn, where n can be 1-4.
PL 1/2	-	Payload buses (note that the same GPC will command both).
CRT	-	MCDS bus/GPC assignment. See Section 3.1 for a description of DEU assigment based on Major Function, OPS, etc.
LAUNCH	-	Assignment of the GSE polling buses (Launch Data Bus) to a GPC (does not initiate polling).
MMU	-	Assignment of MMU buses to GPC. Affects use of MMU for non-OPS transitions only.

−4 The NBAT for a specific MC may be changed via the GPC Memory display (refer to Section 3.5.000 for a detailed write-up on the display and its use). The default assignments are specified in the following paragraphs describing each OPS.

−5 When viewing GPC Memory display, the NBAT will indicate current desired assignments for the specified memory configuration. The actual bus assignments will match those specified by the NBAT only if an OPS Transition (or Mode Recall) has been requested for that memory configuration after the NBAT has been updated. The right most number will be the ID of the GPC assigned to command the entry. (25372) (28364) (36416) (37546) (55313)

−6 Due to Direct Memory Access (DMA) interference between the IOP and CPU, a FC string imbalance may cause synchronization problems. (52100)

−7 Transitions between OPS must generally be from the first or last mode of an OPS to the first mode of the next OPS. Table 2-5 defines the legal transitions between OPS which may be made in the PASS system. (28343/30780/36183/37501)

TABLE 2-5. LEGAL OPS TRANSITIONS

TRANSITIONS	TO	GPC OR MF	FROM: 0 / 0* / 0	1 1 1 1 1 1 / 0 0 0 0 0 0 / 1 2 3 4 5 6	2 2 / 0 0 / 1 2	3 3 3 3 3 / 0 0 0 0 0 / 1 2 3 4 5	6 6 6 / 0 0 0 / 1 2 3	8 / 0 / 1	9 / 0 / 1	SM 2 2 4 4 / 0 0 0 0 / 1 2 1 2	* * / * *	PL 9 / 0 / 1
GPC OR MF	000	M			M	M			M	M M M M		M
	*	M										
	101			A					M			
	102				A			C				
	103					E		C				
	104					M	M		C			
	105						M	M				
	106						M	M				
G	201	M					R M	M		M		
N	202						M					
C												
	301						M	R E			S S S S	
	302							M E				
	303							M E				
*	304							E				
	305								M			
	601								E			
*	602								E***			
	603								M			
	801						M	M	R			
	901	M M							R			S
S	201	M					S			M M M		S
M	202	M					S			M M M		S
**	401	M					S			M M M		S
**	402	M					S			M M M		S
PL	901	M							S	S S S S		

A = AUTO TRANSITION
M = MANUAL
E = EITHER AUTO OR MANUAL
C = COMBINED AUTO AND MANUAL
R = OPS/MODE RECALL SUPPORT
S = SPECIAL, THRU OPS 0 ONLY

* GPC OPS 0 CAN BE FORCED FROM ANY OPS BY MOVING GPC MODE SW FROM RUN TO STBY THEN TO RUN; FROM MM 304 OR MM 602, TRANSITION TO OPS 0 PRIOR TO REACHING PRESCRIBED VELOCITY LIMITS WILL INHIBIT TRANSITIONS BACK TO A GNC OPS.

** THE LEGALITY OF THE SM4 OPS IS RECONFIGURABLE, THEREFORE THE TRANSITIONS TO AND FROM SM401 AND SM402 ARE LEGAL ONLY WHEN SM4 IS A VALID MEMORY CONFIGURATION.

*** THE AUTOMATIC TRANSITION MAY BE INHIBITED DURING CERTAIN CONTINGENCY ABORT SITUATIONS.

2.4.1 OPS 0

OPS 0 is active when no application functions are active. System level functions only are cyclically executing. The OPS is entered by keyboard request 'OPS 000 PRO' from OPS G201 or G901 or by moding the GPC from STANDBY to RUN (assuming power was applied in HALT). (39027)

–1 The memory configuration of OPS 0 is dependent upon how OPS 0 is entered. For entry from an IPL, only phase 2 (see Table 2-1) is present. In this configuration, the DEU load function may be utilized. Once the GPC has been transitioned to any OPS the DEU load function is not available in a subsequent OPS 0. If entry to OPS 0 is via the keyboard from another OPS, the memory configuration of the previous OPS will be maintained; however, no functions of that OPS will be active.

–2 If a GPC is IPLed and moded to RUN and is the only GPC in run (determined by checking the sync discretes of the other four GPCs) it will assume command of all buses including DEUs 1-3. If the GPC is a secondary one upon entry to OPS 0 from IPL, that is, another GPC is already in RUN, it will command no buses. DEUs will be commanded by the secondary GPC only if no DEU is commanded by any GPC already in the common set. (30138)

2.4.1.1 Displays Available

–1 SPEC 000 (GPC Memory) (OPS 0 Mode Display) - Provides GPC Reconfiguration Table (GRT), Bus Assignment Table (BAT) controls, GPC memory read/write capability, GPC memory dump capability, GPC freeze-dry load, downlist GPC selection, SYNC Trace/CAM reset, and I/O ERROR log clear.

–2 SPEC 001 (DPS Utility) - Provides MMU/Major Function selection, bus port assignments, uplink control, OPS transition overlay source selection, variable downlist parameter selection, SM checkpoint retrieval enable, and realtime command issuance. This SPEC is not available if GPC has memory configurations 1 or 3 resident.

–3 SPEC 002 (TIME) - Provides selection of GMT or MET, timer and/or tone controls, MTU update capability (both GMT and MET), MET reset, MTU accumulator/GPC sync, and time source selection. This SPEC is not available if GPC has memory configurations 1 or 3 resident.

–4 SPEC 006 (GPC/Bus Status) - Monitors GPC mode, bus assignments and status. No item entries.

–5 SPEC 099/Fault Summ Key (Fault) - Provides a historical summation of the most recent CLASS 2 and 3 CRT messages. The most recent message appears at the Top. The display supports the last 15 messages generated, the oldest of the messages disappears as newer messages are generated. The display may be called by the Fault Summ key or by SPEC 99 PRO. SPEC 99 PRO reinitializes the page and blanks all messages.

2.4.1.2 Basic Functions Available

–1 Fault Summary Page - Displays the last 15 CLASS 2 and 3 error messages. No item entries. (Available in all OPS).

–2 DEU Load - Available only in initial OPS 0 memory configuration. (33643)

–3 LDB Polling - Polling will be maintained in OPS 0 if it was active in a previous OPS, subject to constraints specified in section 7.1.

–4 Downlist - The OPS 0 downlist format is 20.

–5 GRT and BAT (NBAT) - OPS 0 does not have an NBAT. GPCs brought to OPS 0 by moding to RUN will assume control of buses as stated earlier. GPCs transitioned to OPS 0 from another OPS will simply retain any buses commanded in the previous OPS. The exception to this is the transition of a redundant set OPS G9 to OPS 0. In this case, the Flight Critical buses (strings 1-4)

will collapse to the lowest ID GPC going to OPS 0. Note that this applies only to strings 1-4. Other string/bus assignments will be preserved into OPS 0.

2.4.2 OPS GNC9

OPS G9 provides software support for vehicle checkout and pre-launch countdown. It is initiated by entering 'OPS 901 PRO' on an MCDS keyboard whose major function is GNC. The OPS may be entered from OPS 0 or from OPS G101 (if prior to SRB ignition). The OPS may be exited to OPS G101 or OPS 0.

-1 Upon initiation, the application software attempts a BITE TEST 4 read (read of discretes) of each MDM in order to initialize output buffers to the current state of the MDMs. (44724)

-2 OPS G9 may be active in a single GPC (Simplex) or multiple GPCs (Redundant). Some of the functions available in G9 are limited to operation in a simplex mode only. (34665) (47311) (52102) (37551) (41533) (25197) (100702)

2.4.2.1 Displays Available

-1 SPEC 000 (GPC Memory) (OPS G9 mode display) - See 2.4.1.1-1

-2 SPEC 001 (DPS Utility) - See 2.4.1.1-2

-3 SPEC 002 (TIME) - See 2.4.1.1-3

-4 SPEC 006 (GPC/Bus Status) - See 2.4.1.1-4

-5 SPEC 099/Fault Summ Key (Fault) - See 2.4.1.1-5

-6 SPEC 062 (PCMMU/PL COMM) - Provides Telemetry Format Loads (TFL) for PCMMU, control of PCMMU fixed or programmable format, and I/O reset of PCMMU (valid only in OPS SM2). Also provides controls for the Payload Data Interleaver (PDI) DECOM loads, DECOM FDA (valid only in OPS SM2). Finally, provides for I/O Reset of the Payload Signal Processor (PSP).

-7 SPEC 100 (GTS Display) - Provides controls for Housekeeping Data Acquisition (HDA), MEC critical commands, LDB polling. Also provides test support for: the Computer Annunciation Matrix (CAM), Dedicated Display checkout, RJD toggle tests. (51250). This SPEC provides selection of downlist formats and elevon limits. Finally, the one-time transfer of data from PASS to BFS is initiated through this SPEC.

-8 SPEC 101 (Sensor Self-Test) - Provides the capability to test the Microwave Scan Beam Landing System (MLS), TACAN, Radar Altimeter (RA), and Accelerometer Assembly (AA).

-9 SPEC 102 (RCS/RGA/ADTA Test) - Provides the capability to test the Reaction Control System (RCS), Rate Gyro Assembly (RGA), and Air Data Transducer Assembly (ADTA).

-10 SPEC 104 (GND IMU CNTL/MON) - Provides the controls to activate, calibrate, and align the Inertial Measurement Units (IMUs). Also provides the capability to preserve the results of a calibration on Mass Memory.

-11 SPEC 105 (TCS Control) - Provides the capability to call Test Control Supervisor (TCS) Sequences from Mass Memory, execute them and monitor the text outputs.

-12 SPEC 106 (Manual Controls) - Provides display of Flight Control controllers (RHC, THC, trim switches, etc.) outputs.

-13 SPEC 110 (Bus/BTU Status) - Provides status of Buses and Bus Terminal Units (BTUs).

−14 SPEC 112 (GPC/BTU I/F) - Provides testing of MDMs and other DPS hardware units. Level 1 and Level 2 tests may be done on either port (of multi-port devices). (30072) (41008) (41533)

−15 SPEC 113 (Actuator Control) - Provides control and monitoring of the position of aerosurfaces, SSME, OMS, and Body Flap actuators by utilizing the capabilities of the Ramp Function Generator (RFG) and Body Flap Drive (BFD) functions. It also supports initiation of all Actuator Initialization (AI) modes and the Body Flap Monitor (BFM) avoidance and interference checks. The SPEC allows inhibiting of OMS power discrete parameter output; the selective replacement of position limit values for SRB, Elevon, and Speedbrake actuators; the limiting of the Multiple Actuator Test (MAT) plateau segment duration and modification of the RFG rate limit.

2.4.2.2 Basic Functions Available

−1 LDB Polling - Polling is initially off upon entry to OPS G9 if it has not been turned on elsewhere. The status will be maintained during the OPS and across OPS transitions. (25187) (47292) (48500)

−2 Downlist - The default downlist format is 44. Also available via SPEC 100 are formats 42, 46, 53, 60, 97, and 99. Once selected, a format remains until a subsequent selection of another format or an OPS transition is made. An OPS Mode Recall will reselect format 44. (25197)

−3 Housekeeping Data Acquisition - HDA is automatically enabled upon transition to G9.

−4 GRT and BAT (NBAT) - The default assignments for G9 are:

TABLE 2-6. NBAT FOR G9

MEM/BUS CONFIG
1 CONFIG 9(G9)
2 GPC 1 2 3 4 0

STRING	1	7 1
	2	8 2
	3	9 3
	4	10 4
PL	1/2	11 1
CRT	1	12 1
	2	13 2
	3	14 3
	4	15 0
LAUNCH	1	16 1
	2	17 2
MM	1	18 1
	2	19 2

2.4.3 OPS PL9

OPS P9 provides the capability to load and/or modify the Mass Memory Unit(s). It also provides the avenue for loading SSME controllers from Mass Memory via LDB commands. The OPS is initiated by entering 'OPS 901 PRO' on an MCDS keyboard whose major function is PL. The OPS may be entered only from OPS 0 and must be exited to OPS 0. (47853)

−1 OPS P9 must be run in a single GPC. It may be the only GPC active or may be in Common Set with other active GPCs in major function(s) other than PL.

2.4.3.1 Displays Available

−1 OPS P9 mode display (MMU Read/Write) - Provides capability to read and/or write MMU data. (15651) It also provides the capability to dump MMU data via Downlist and to compare MMU data between the two MMU's.

−2 SPEC 000 (GPC Memory) - See 2.4.1.1-1

−3 SPEC 001 (DPS Utility) - See 2.4.1.1-2

−4 SPEC 002 (TIME) - See 2.4.1.1-3

−5 SPEC 006 (GPC/Bus Status) - See 2.4.1.1-4

−6 SPEC 099/Fault Summ Key (Fault) - See 2.4.1.1-5

−7 SPEC 100 (GTS Display) - See 2.4.2.1-7 - Only HDA and LDB control options valid.

−8 SPEC 110 (Bus/BTU Status) - See 2.4.2.1-13

−9 SPEC 111 (SL Memory Dump) - Provide control and monitor function for SL computer memory dumps.

2.4.3.2 Basic Functions Available

−1 DEU Load - Load display control program (DCP) into DEU. (33643) (36728)

−2 LDB Polling - Polling status will be maintained upon entry to PL9. Status may be changed via SPEC 100 in PL9.

−3 Downlist - If the PL9 GPC is the active downlister at OPS initialization, the downlist format will be 52. If the PL9 GPC is not the active downlister at OPS initialization, the downlist format will be 48.

−4 SSME Load - Available through LDB command to load SSME controllers. Note that the default NBAT below is not compatible with this function. The PL9 GPC must control strings 1-3 in order to load SSMEs.

−5 Capability 1 (MMU LOAD and DUMP) and Capability 2 (UPF Patch) MMU Functions.

–6 GRT and BAT (NBAT) - The default assignments for P9 are:

TABLE 2-7. NBAT FOR P9

```
MEM/BUS CONFIG
1 CONFIG 6(P9)
2 GPC 0 2 0 0 0

 STRING 1 |  7 0
        2 |  8 0
        3 |  9 0
        4 | 10 0
   PL 1/2 | 11 0

    CRT 1 | 12 2
        2 | 13 2
        3 | 14 0
        4 | 15 2

 LAUNCH 1 | 16 0
        2 | 17 0
     MM 1 | 18 2
        2 | 19 2
```

2.4.4 OPS GNC1

OPS G1 provides software support for launch countdown and ascent to orbital conditions. The memory configuration also includes all software required to support a Return-to-Launch-Site (RTLS) abort, although such an abort is controlled by another OPS. OPS G1 is initiated by entering 'OPS 101 PRO' on an MCDS keyboard whose major function is GNC. The OPS may only be entered from OPS G9. It may be exited back to G9 (if transition is done before SRB ignition), to OPS 0, G2, G3, G601, or G602. Exit points and options are dependent upon the major mode currently active. (37514) (45748)

–1 Upon initiation, the application software attempts a BITE TEST 4 read of each MDM in order to insure output buffers match the MDMs. In the event of a failure of the read (two consecutive I/O errors), the set/reset discrete pairs are all set to zero to prevent change in the MDM(s) failing the read.

–2 Between the start of OPS G1 and APU start (HPU start for SRBs), the ascent DAP cyclically commands the SRB, SSME, and aerosurface actuators to the prelaunch positions shown in the first IN column for OPS 101 in Tables 2-13, 2-14, and 2-16. (37551)

–3 OPS G1 is composed of six major modes: (36015)

–3.1 101 - Active from entry into OPS until either SRB ignition, or a return to OPS G9 is initiated (prior to SRB ignition). (37551) This mode controls the final countdown, utilizing an automated sequence from –28 seconds to SRB ignition. It will be automatically exited to mode 102 when SRB ignition is commanded.

–3.2 102 - Active from SRB ignition until SRB separation. This mode controls STS flight through tower clear through pitch over, etc. It may be exited by an automatic advance to mode 103 due to SRB SEP commanded, or manually to OPS G601 (RTLS abort). Transition to G601 will not occur until SRB separation is complete.

-3.3 103 - Active from commanded SRB separation until manual selection of mode 104, manual selection OPS G601, or completion of ET separation maneuver which causes automatic moding to mode 104. (46511)

-3.4 104 - Active from selection until manual selection of OPS G602 or mode 105 or OPS G301. This mode provides controls for the first OMS maneuver. (50776) (25108)

-3.5 105 - Active from selection until manual selection of mode 106 or OPS G301 (entry). This mode provides controls for the second OMS maneuver. (45739) (45751) (53428)

-3.6 106 - Active from selection until manual selection of OPS G201 (orbit) or G301.

2.4.4.1 Displays Available

-1 Mode displays:

-1.1 Ascent Trajectory is a monitor only display for modes 101-103.

-1.2 Maneuver is a control display for modes 104-106. It provides the capability to plan and execute maneuvers with either OMS or RCS. It also allows selection of AOA or ATO aborts.

-2 SPEC 000 (GPC Memory) - See 2.4.1.1-1

-3 SPEC 001 (DPS Utility) - See 2.4.1.1-2

-4 SPEC 006 (GPC/Bus Status) - See 2.4.1.1-4

-5 SPEC 018 (GNC SYS SUMM 1) - Provides monitor of selected GNC data: RCS, Aerosurface, Controllers, DPS, and NAVAIDs. Display function only - may be brought up by SYS SUMM key.

-6 SPEC 023 (RCS) - This display provides controls for the RCS and OMS system.

-7 SPEC 050 (HORIZ SIT) - Provides graphic representation of orbiter position and heading. Provides controls for Programmed Test Inputs (PTI), runway selection, wind profile selection, navigation state vector controls, and NAVAIDs. (42650)

-8 SPEC 051 (Override) - Provides software overrides for flight critical switches: Abort mode selection, ET separation, ET umbilical door closing, vent door controls, entry roll mode selection, RCS manifold valve. Provides the capability to reselect/deselect IMUs, ADTAs, and automatic hydraulic system management; the capability to select entry FCS elevon schedule, body bending filters, and one of three atmosphere models; and the capability to inhibit and/or enable ascent abort dumps, the orbiter propellant dump, the Major Mode 304 OMS dump, the OMS/RCS interconnect function, the AFT RCS dump, and the FWD RCS dump. Also provides the capability to change the maximum SSME throttle level, the AFT RCS dump duration, and the FWD RCS dump duration.

-9 SPEC 053 (Controls) - This display provides the capability to perform the aerosurface secondary actuator check in OPS G3. It provides the ability to control AA, RGA, and surface feedback RM. It also provides status indicators for the aerosurface and SSME actuator secondary ports in OPS G1, G3, and G6.

-10 SPEC 099/Fault Summ Key (Fault) - See 2.4.1.1-5

2.4.4.2 Basic Functions Available

–1 LDB Polling - Polling state will be maintained across G9 to G1 transition. In G1 only SACS commands are valid. Additionally, if SRB I/O was not started in G9, it will be initiated on LDB1. If SRB I/O was active, it will be maintained in G101-102. LDB polling will be terminated at SRB ignition; SRB I/O will be terminated at SRB separation. (29949)

–2 Downlist - OPS G1 downlist is format 21.

–3 Guidance - Guidance algorithms provide commands from SRB ignition through the entire OPS to achieve the nominal orbital conditions or selected abort conditions.

–4 Navigation - Navigation provides a vehicle state vector based on IMU data. (52101)

–5 Flight Control - The flight control system converts guidance commands into hardware commands based on available engines, etc. (37545) (37569) (37570) (44248)

–6 Redundant Set Launch Sequencer (RSLS) - RSLS maintains status of launch countdown by monitoring a predefined set of parameters for failure and subsequent declaration of a count hold. The RSLS also accepts commands from the ground Launch Processing System (LPS) to control the count. (25074/25184) (37537) (38765/39740)

–7 GRT and BAT (NBAT) - The default assignments for G1 are:

TABLE 2-8. NBAT FOR G1

MEM/BUS CONFIG
1 CONFIG 1(G1)
2 GPC 1 2 3 4 0

STRING	1	7 1
	2	8 2
	3	9 3
	4	10 4
PL	1/2	11 1
CRT	1	12 1
	2	13 2
	3	14 3
	4	15 0
LAUNCH	1	16 1
	2	17 2
MM	1	18 1
	2	19 2

2.4.5 OPS GNC 2

OPS G2 provides on-orbit vehicle control and maneuver capability. It is initiated by entering 'OPS 201 PRO' on an MCDS keyboard whose major function is GNC. The OPS may be entered from OPS G106 (nominally), OPS 0, OPS G801, or OPS G301. It may be exited to OPS G801, OPS G301, or OPS 0. Entry and exit is always to/from major mode 201. (37551) (37569) (42640) (48777) (52111)

-1 OPS G2 is composed of two major modes:

-1.1 201 - Active from manual entry into OPS until manual exit to either mode 202 or another OPS. This mode supports on-orbit COAST operations. (37551) (52101)

-1.2 202 - Active from manual entry from mode 201 until manual exit back to mode 201. Provides MANEUVER execution capability. (55307)

-2 In Major Mode 201, the OEX Advanced Autopilot experiment (AAPS) may be activated thru the AAPS SETUP display SPEC 32 via an item entry. When AAPS is active, the two BF AUTO/MAN lamps on the eyebrow panels will be illuminated. The AAPS is deactivated thru SPEC 32 via Item Entry, by depression of either BF AUTO/MAN PBI, automatically upon an IMU failure, or upon exiting MM201.

2.4.5.1 Displays Available

-1 Mode displays:

-1.1 Universal Pointing in mode 201 provides controls for vehicle attitude control with respect to the ADI inertial reference frame.

-1.2 Orbit Maneuver in mode 202 provides controls for doing OMS maneuvers in orbit.

-2 SPEC 000 (GPC Memory) - See 2.4.1.1-1

-3 SPEC 001 (DPS Utility) - See 2.4.1.1-2

-4 SPEC 002 (TIME) - See 2.4.1.1-3

-5 SPEC 006 (GPC/Bus Status) - See 2.4.1.1-4

-6 SPEC 018 (GNC SYS SUMM 1) - See 2.4.4.1-5

-7 SPEC 019 (GNC SYS SUMM 2) - Similar to SPEC 018. Provides monitor of RCS and OMS fuel and jets.

-8 SPEC 020 (DAP CONFIG) - This display provides selection of Digital Auto Pilot (DAP) parameters.

-9 SPEC 021 (IMU Align) - This display provides control of IMUs for selection, alignment, etc. (37549/44246)

-10 SPEC 022 (S TRK/COAS CNTL) - This display provides controls for star tracker moding, operation and IMU alignment data.

-11 SPEC 023 (RCS) - See 2.4.4.1-6

-12 SPEC 025 (RM Orbit) - This display provides data from hand controllers and the capability to select/deselect individual contacts.

-13 SPEC 033 (REL NAV) - This display provides monitoring of rendezvous parameters and controls for rendezvous navigation.

-14 SPEC 034 (Orbit TGT) - This display provides the capability to set up maneuvers for rendezvous.

-15 SPEC 099/Fault Summ Key (Fault) - See 2.4.1.1-5

2.4.5.2 Basic Functions Available

−1 LDB Polling - Although in flight no LDB polling is available, the polling state will be maintained upon entry to OPS G2.

−2 Downlist - OPS G2 downlist format is 22.

−3 GRT and BAT (NBAT) - The default assignments for G2 are:

TABLE 2-9. NBAT FOR G2

```
MEM/BUS CONFIG
1 CONFIG 2(G2)
2 GPC 1 2 0 0 0

 STRING 1 |  7 1
        2 |  8 2
        3 |  9 1
        4 | 10 2
  PL 1/2  | 11 0

    CRT 1 | 12 1
        2 | 13 2
        3 | 14 0
        4 | 15 2

 LAUNCH 1 | 16 0
        2 | 17 0
     MM 1 | 18 1
        2 | 19 2
```

2.4.6 OPS GNC3

OPS G3 provides vehicle control from pre-deorbit burn through landing and roll-out. It is initiated by entering 'OPS 301 PRO' on an MCDS keyboard whose major function is GNC. The OPS may be entered from OPS G104, G105, G106, G201, G801, or OPS 0. It may be exited to OPS 0, or to G9 from major mode 305 or to G201 from major mode 301. (37062) (37545) (37569) (41184) (41238/43357) (55328)

−1 OPS G3 performs discrete initialization as described for G9 (see section 2.4.2) and G1 (see section 2.4.4).

−2 OPS G3 is composed of five major modes: (36015)

−2.1 MM 301 - Pre-Deorbit Coast: Active from manual entry into OPS G3 until manual exit to MM 302 or to MM201. This mode monitors and controls the vehicle during coasting flight prior to initiation of the Deorbit Maneuver OMS burn. (46510) (52101)

−2.2 MM 302 - Active from manual entry from MM 301 until manual exit to MM 303 or 301 (at least some specified length of time before deorbit maneuver OMS ignition). This mode configures the vehicle for entry and provides control for the deorbit maneuver preparation and execution. (50776)

–2.3 MM 303 - Pre-Entry Monitor: Active from manual entry until manual exit to MM 304 or back to MM 301. Provides vehicle control from the end of the deorbit maneuver until an entry interface is reached. (36479)

–2.4 MM 304 - Entry: Active from manual entry until Terminal Area Energy Management (TAEM) interface conditions are met, upon which an auto-advance to MM 305 occurs. A manual advance to MM 305 may also be done if the Earth Relative Velocity is less than or equal to a specified value. This mode is designed to fly the vehicle in the required flight profile from entry interface to TAEM interface. (37551) On entry to MM 304, the FSW ramps the speedbrake from 10 degrees to 0 degrees without regard to feedbacks. (35047) (37551)

–2.5 MM 305 - TAEM/LANDING: Active from entry until manual selection of OPS G9. This mode positions the vehicle for the approach to the runway and dissipates any excess energy which may accumulate during the descent from orbit. (39417) (44248)

2.4.6.1 Displays Available

–1 Mode displays:

–1.1 301-303 - XXXXX Maneuver YYYYY display. See 2.4.4.1-1.2 (45603/45604)

–1.2 304 - Entry Trajectory is a five-page display. Each page provides navigational and guidance information for a predefined portion of the entry trajectory allowing for a comparison of the vehicle's progression to planned entry profiles and to the guidance trajectory. (37551)

–1.3 305 - Vertical Situation is a two-page display providing vehicle longitudinal information including altitude, altitude dissipation rate, and energy state during TAEM.

–2 SPEC 000 (GPC Memory) - See 2.4.1.1-1

–3 SPEC 001 (DPS Utility) - See 2.4.1.1-2

–4 SPEC 006 (GPC/Bus Status) - See 2.4.1.1-4

–5 SPEC 018 (GNC SYS SUMM 1) - See 2.4.4.1-5

–6 SPEC 021 (IMU Align) - See 2.4.5.1-9 (37549/44246)

–7 SPEC 022 (S TRK/COAS CNTL) - Major Mode 301 only. See 2.4.5.1-10

–8 SPEC 023 (RCS) - See 2.4.4.1-6

–9 SPEC 050 (HORIZ SIT) - See 2.4.4.1-7

–10 SPEC 051 (Override) - See 2.4.4.1-8

–11 SPEC 053 (Controls) - See 2.4.4.1-9

–12 SPEC 099/Fault Summ Key (Fault) - See 2.4.1.1-5

2.4.6.2 Basic Functions Available

–1 LDB Polling - Although in flight no LDB polling is available, the polling state will be maintained upon entry to G3.

–2 Downlist - OPS G3 downlist format is 23.

–3 GRT and BAT (NBAT) - The default assignments for G3 are:

TABLE 2-10. NBAT FOR G3

```
MEM/BUS CONFIG
1 CONFIG 3(G3)
2 GPC 1 2 3 4 0

 STRING 1 |  7 1
        2 |  8 2
        3 |  9 3
        4 | 10 4
   PL 1/2 | 11 1

    CRT 1 | 12 1
        2 | 13 2
        3 | 14 3
        4 | 15 0

 LAUNCH 1 | 16 1
        2 | 17 2
     MM 1 | 18 1
        2 | 19 2
```

2.4.7 OPS GNC6

OPS G6 provides a Return-to-Launch-Site (RTLS) abort capability. It is initiated either by selection via cockpit switch or by entering 'OPS 601 PRO' or 'OPS 602 PRO' on an MCDS keyboard whose major function is GNC. The OPS may be entered from OPS G103 or G104 (or G102 once SRB SEP occurs). It may be exited to OPS 0, or to OPS G901 from major mode 603. (25108) (37545)

–1 OPS G6 is composed of three major modes:

–1.1 601 - Entered as a result of a keyboard entry or switch selection during OPS G102 or G103. Performs vehicle control during the powered stages of an RTLS. Exited to mode 602 by either keyboard input or automatically at completion of ET separation. (46520)

–1.2 602 - Entered as a result of keyboard request from mode 601 or OPS G104 or automatically from mode 601. Performs vehicle control during the initial glide portion of the return (similar to OPS G304). Exited to mode 603 automatically when velocity is less than a prescribed limit or when mode 603 manually requested via keyboard and velocity is less than a prescribed limit. (46515) The automatic transition may be inhibited during certain contingency abort situations.

–1.3 603 - The final phase of RTLS controls the vehicle through touchdown and rollout. Entered from mode 602; exited only to OPS G901.

2.4.7.1 Displays Available

−1 Mode displays

601 - same as G1011
602 - same as G3051
603 - same as G3052

−2 SPEC 000 (GPC Memory) - See 2.4.1.1-1

−3 SPEC 001 (DPS Utility) - See 2.4.1.1-2

−4 SPEC 006 (GPC/Bus Status) - See 2.4.1.1-4

−5 SPEC 018 (GNC SYS SUMM 1) - See 2.4.4.1-5

−6 SPEC 050 (HORIZ SIT) - See 2.4.4.1-7

−7 SPEC 051 (Override) - See 2.4.4.1-8

−8 SPEC 053 (Controls) - See 2.4.4.1-9

−9 SPEC 099/Fault Summ Key (Fault) - See 2.4.1.1-5

2.4.7.2 Basic Functions Available

−1 LDB Polling - The polling state upon entry to RTLS (OFF in flight) will be maintained.

−2 Downlist - OPS G6 downlist format is 21. Note that this is no change from OPS G1.

−3 GRT and BAT (NBAT) - The RTLS OPS uses the G1 NBAT (See Table 2-8 in section 2.4.4.2-7).

2.4.8 OPS GNC8

OPS G8 provides the capability to check out NAVAID and Flight Control sensors while in orbit. The OPS may be entered from G201 only and is initiated by 'OPS 801 PRO' on an MCDS keyboard whose major function is GNC. The OPS may be exited to OPS 0 or to G201 or to G301. It may be executed in a single GPC or in a Redundant Set. (37551) (37569) (42640) (48777) (52111)

2.4.8.1 Displays Available

−1 Mode display (8011) - FCS/Dedicated Display Checkout. Provides the capability to test dedicated displays, mode/sequencing lights, and control the aerosurface actuator test.

−2 SPEC 000 (GPC Memory) - See 2.4.1.1-1

−3 SPEC 001 (DPS Utility) - See 2.4.1.1-2

−4 SPEC 002 (TIME) - See 2.4.1.1-3

−5 SPEC 006 (GPC/Bus Status) - See 2.4.1.1-4

−6 SPEC 018 (GNC SYS SUMM 1) - See 2.4.4.1-5

−7 SPEC 019 (GNC SYS SUMM 2) - See 2.4.5.1-7

−8 SPEC 023 (RCS) - See 2.4.4.1-6

−9 SPEC 040 (Sensor Test) - This display achieves the same function as SPEC 101 on the ground (see 2.4.2.1-7), and adds selection filter/redundancy management manipulation capability.

–10 SPEC 041 (RGA/ADTA/RCS) - This display achieves the same function as SPEC 102 on the ground (see 2.4.2.1-8), and adds selection filter/redundancy management manipulation capability.

–11 SPEC 042 (Switch/Surf) - This display provides visual indication of FCS switch contacts and allows selection filter input manipulations. (30526)

–12 SPEC 043 (Controllers) - This display provides visual indication of FCS controller and panel trim switches and body flap slew switch contacts.

–13 SPEC 044 (Switches) - This display provides visual indication of FCS push-button indicator contacts.

2.4.8.2 Basic Functions Available

–1 LDB Polling - Polling state will be maintained upon entry to OPS G8.

–2 Downlist - OPS G8 downlist format is 32.

–3 GRT and BAT (NBAT) - The default assignments for G8 are:

TABLE 2-11. NBAT FOR G8

MEM/BUS CONFIG
1 CONFIG 8(G8)
2 GPC 1 2 0 0 0

STRING 1	7	1
2	8	2
3	9	1
4	10	2
PL 1/2	11	0
CRT 1	12	1
2	13	2
3	14	0
4	15	2
LAUNCH 1	16	0
2	17	0
MM 1	18	1
2	19	2

2.4.9 OPS SM2/4

OPS SM2/4 provides the capability to monitor orbiter systems on orbit and provide annunciation of detected failures. The OPS also provides the capability to open and close the Payload Bay Doors and to modify the Mass Memory Units. (35743)

–1 The OPS consists of two major modes: S201/S401 is the basic mode entered upon selection of the OPS and provides automatic or manual S-Band and Ku-Band antenna system controls. The OPS is initiated by entering 'OPS 201 PRO'/'OPS 401 PRO' on an MCDS keyboard whose major function is SM. The OPS may be exited to OPS 0 or any of the SM major modes (e.g., 202/402). Major mode 202/402 provides controls for automatic or manual manipulation of the payload bay

doors. The major mode is entered by keyboard input of 'OPS 202 PRO'/'OPS 402 PRO' on an MCDS keyboard whose major function is SM. It may be exited to OPS 0 or any of the SM major modes (e.g., 201/401) and only if the Payload Bay Door operation is in STOP mode.

−2 The SM2/SM4 may be executed only in a single GPC. It may be run concurrently with GPCs in GNC OPS.

2.4.9.1 Displays Available

−1 Mode displays

−1.1 S201/S401: Antenna Management provides controls for the S-Band and Ku-Band antenna systems; it also provides pertinent data on antenna performance.

−1.2 S202/S402: Payload Bay Doors provides controls to open and close the Payload Bay Doors; it also provides latch status.

−2 SPEC 000 (GPC Memory) - See 2.4.1.1-1

−3 SPEC 001 (DPS Utility) - See 2.4.1.1-2

−4 SPEC 002 (TIME) - See 2.4.1.1-3

−5 SPEC 006 (GPC/Bus Status) - See 2.4.1.1-4

−6 SPEC 060 (SM Table Maint) - Provides capability to: Change parameter values, FDA limit values; enable/inhibit FDA either totally or by specific parameter; initiate an SM checkpoint write to Mass Memory.

−7 SPEC 062 (PCMMU/PL COMM) - See 2.4.2.1-6

−8 SPEC 064 (SM Ground Checkout) - Provides capability to modify certain SM processes to enhance vehicle turnaround and test processing.

−9 SPEC 066 (Environment) - Display function only of cabin environment parameters.

−10 SPEC 067 (Electric) - Display function only of the status of electrical power and distribution system.

−11 SPEC 068 (Cryo/Fuel Cells) - Display function only of fuel cells and cryogenic system status.

−12 SPEC 076 (COMM/RCDR) - Display function only of the communication system and flight recorder status.

−13 SPEC 078 (SM SYS SUMM 1) - Display function only of selected SM parameters which summarize systems monitored by SM.

−14 SPEC 079 (SM SYS SUMM 2) - Display function of more selected SM parameters.

−15 SPEC 085 (Mass Memory R/W) - See 2.4.3.1-1. Limited to Phase/Load Blocks less than 2048 halfwords in length.

−16 SPEC 086 (APU/HYD) - Display function only of APU system parameters.

−17 SPEC 087 (HYD Thermal) - Display function only of hydraulic thermal conditions.

−18 SPEC 088 (APU/ENVIRON THERM) - Display function only of thermal conditions of the APUs and flash evaporator systems.

−19 SPEC 089 (PRPLT THERMAL) - Display function only of thermal conditions of the OMS and RCS propellant systems.

−20 Payload Displays - TBD.

–21 SPEC 099/Fault Summ Key (Fault) - See 2.4.1.1-5

2.4.9.2 Basic Functions Available

–1 LDB Polling - Polling state will be maintained upon entry to OPS S2/4.

–2 Downlist - OPS S2 downlist format is 24 and S4 downlist format is 25.

–3 GRT and BAT (NBAT) - The default assignments for S2/4 are:

TABLE 2-12. NBAT FOR S2/S4

MEM/BUS CONFIG 1 CONFIG 4(S2) 2 GPC 0 0 0 4 0		
STRING	1	7 0
	2	8 0
	3	9 0
	4	10 0
PL	1/2	11 4
CRT	1	12 4
	2	13 4
	3	14 0
	4	15 4
LAUNCH	1	16 4
	2	17 0
MM	1	18 4
	2	19 4

MEM/BUS CONFIG 1 CONFIG 5(S4) 2 GPC 0 0 0 4 0		
STRING	1	7 0
	2	8 0
	3	9 0
	4	10 0
PL	1/2	11 4
CRT	1	12 4
	2	13 4
	3	14 4
	4	15 0
LAUNCH	1	16 0
	2	17 0
MM	1	18 4
	2	19 4

2.5 ACTUATOR/HYDRAULIC ACTIVATION RESTRICTIONS

In either a test or flight environment, the difference between the actual position of the actuators when they are powered up, relative to the command position being issued to them by the FSW, can result in a hazardous vehicle situation. (37551)

−1 The initial position is set by the FSW to an expected value for each major mode transition and at specific flight events. Should the sequence of events in either ground operations or flight be different than that used to initialize the actuators, vehicle damage could be encountered. To preclude damage to the vehicle, the following tables define the initialization for all actuators at events and major mode changes.

−2 The tables present the actuator commands that are generated by the FSW for aerosurfaces, SSMEs, OMS, and SRBs on entry to major modes or at events that result in a change to the commands. Some of the changes are a function of processing requests by crew inputs. The footnotes to the tables explain the conditions causing the changes.

−3 The tables show the command values issued on entry to the event or major mode and the command values present after the event occurs or major mode initialization. The command values shown are placed in the GNC cyclic output buffers and are continuously issued to the actuators until the major mode is changed, an event occurs, or a DAP starts outputting flight control commands. The command values shown are in engineering units.

TABLE 2-13. PASS ACTUATOR INITIALIZATION (AEROSURFACES)

TRANSITION/ EVENT	OPS G9(1)		OPS G101(2,5)		OPS G102-G106(3)		OPS G2(4)		OPS G8(6)	
ACTUATOR	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
LIB	AI	AI	0.0	0.0	0.0	0.0	MFB	MFB	FDBK	0.0
LOB	AI	AI	0.0	0.0	0.0	0.0	MFB	MFB	FDBK	0.0
RIB	AI	AI	0.0	0.0	0.0	0.0	MFB	MFB	FDBK	0.0
ROB	AI	AI	0.0	0.0	0.0	0.0	MFB	MFB	FDBK	0.0
RUD	AI	AI	0.0	0.0	0.0	0.0	MFB	MFB	FDBK	+ 5.0
SB	AI	AI	+ 5.0	−9.9	−9.9	−9.9	MFB	MFB	FDBK	+10.0
BF	AI	AI	0	0	0	0	MFB	MFB	FDBK	0

TABLE 2-13. PASS ACTUATOR INITIALIZATION (AEROSURFACES) (Continued)

TRANSITION/ EVENT	OPS G301-G303		OPS G304-G305		OPS G601-G603	
ACTUATOR	IN	OUT	IN	OUT	IN	OUT
LIB	MFB	THERM	FDBK	AEROJET DAP CMD VALUES	0.0	GRTLS DAP CMD VALUES
LOB	MFB	THERM	FDBK	AEROJET DAP CMD VALUES	0.0	GRTLS DAP CMD VALUES
RIB	MFB	THERM	FDBK	AEROJET DAP CMD VALUES	0.0	GRTLS DAP CMD VALUES
ROB	MFB	THERM	FDBK	AEROJET DAP CMD VALUES	0.0	GRTLS DAP CMD VALUES
RUD	FDBK	THERM	FDBK	AEROJET DAP CMD VALUES	0.0	GRTLS DAP CMD VALUES
SB	FDBK	THERM	FDBK	AEROJET DAP CMD VALUES	−9.9	GRTLS DAP CMD VALUES
BF	FDBK	THERM	FDBK	AEROJET DAP CMD VALUES	0	GRTLS DAP CMD VALUES

Notes:

1. AI Mode 1 must be executed before other actuator command functions are legal (no cyclic outputs to actuators in G9, PL9, and OPS 0).
2. Major Mode 101 cyclic output buffers initialized to IN values shown during OPS INIT. Speedbrake faded to closed position (−9.9 deg) on reaching Event 6 (GO FOR AUTO SEQUENCE START).
3. Elevons used for load relief during first stage and returned to zero after first stage.
4. MFB values same as previous OPS. If MFB obtained from MMU, the following values apply:

Elevons	0.0
Rudder	0.0
Speedbrake	5.0
TVC (SSME, OMS)	STOW

5. If Event 6 is reached (see note 2) and a recycle is requested, the Speedbrake is moved to +5.0 from wherever it is.
6. The Rudder and Speedbrake will be commanded to +5 and +10 degrees, respectively, only if the aerosurface drive test has been executed. Otherwise, they will both be zero.

TABLE 2-14. PASS ACTUATOR INITIALIZATION (SSMEs)

TRANSITION/ EVENT	OPS G9		OPS G101(1,7)		OPS G101(2,7)		OPS G102		OPS G103(3)		OPS G104(4)	
ACTUATOR	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
P1	AI	LAST COMMAND VALUES	LAST OPS 9 CMD VALUES	0.0	0.0	0.0	0.0	ASC DAP CMD VALUES	ASC DAP CMD VALUES	0.0	0.0	0.0
P2	AI	LAST COMMAND VALUES	LAST OPS 9 CMD VALUES	0.0	0.0	0.0	0.0	ASC DAP CMD VALUES	ASC DAP CMD VALUES	−10.0	−10.0	−10.0
P3	AI	LAST COMMAND VALUES	LAST OPS 9 CMD VALUES	0.0	0.0	0.0	0.0	ASC DAP CMD VALUES	ASC DAP CMD VALUES	−10.0	−10.0	−10.0
Y1	AI	LAST COMMAND VALUES	LAST OPS 9 CMD VALUES	0.0	0.0	0.0	0.0	ASC DAP CMD VALUES	ASC DAP CMD VALUES	0.0	0.0	0.0
Y2	AI	LAST COMMAND VALUES	LAST OPS 9 CMD VALUES	0.0	0.0	−3.5	−3.5	ASC DAP CMD VALUES	ASC DAP CMD VALUES	−3.5	−3.5	−3.5
Y3	AI	LAST COMMAND VALUES	LAST OPS 9 CMD VALUES	0.0	0.0	+3.5	+3.5	ASC DAP CMD VALUES	ASC DAP CMD VALUES	+3.5	+3.5	+3.5

TABLE 2-14. PASS ACTUATOR INITIALIZATION (SSMEs) (Continued)

TRANSITION/ EVENT	OPS G105-G305		OPS G601-G602		OPS G602(5)		OPS G601(6)	
ACTUATOR	IN	OUT	IN	OUT	IN	OUT	IN	OUT
P1	0.0	0.0	ASC DAP CMD VALUES	0.0	0.0	0.0	ASC DAP CMD VALUES	0.0
P2	−10.0	−10.0	ASC DAP CMD VALUES	−10.0	−10.0	−10.0	ASC DAP CMD VALUES	−10.0
P3	−10.0	−10.0	ASC DAP CMD VALUES	−10.0	−10.0	−10.0	ASC DAP CMD VALUES	−10.0
Y1	0.0	0.0	ASC DAP CMD VALUES	0.0	0.0	0.0	ASC DAP CMD VALUES	0.0
Y2	−3.5	−3.5	ASC DAP CMD VALUES	−3.5	−3.5	−3.5	ASC DAP CMD VALUES	−3.5
Y3	+3.5	+3.5	ASC DAP CMD VALUES	+3.5	+3.5	+3.5	ASC DAP CMD VALUES	+3.5

Notes:

1. MPS SLEW check, which is initiated via ground inputs, commands SSMEs to start position on completion of SLEW test. If SLEW check not performed, SSMEs are commanded to start position on Event 6 (GO FOR AUTO SEQUENCE START).
2. SSMEs are commanded to launch position at event 18A (MPS thrust >90%) if no changes to HYD-FAILS have occurred.
3. Note the dump position is equivalent to the STOW position.
4. At termination of LH2 dump (EVENT 43A), the SSMEs are commanded to the STOW position. Note the dump position is equivalent to the STOW position.
5. For contingency abort (OPS 104 to OPS 602 transition), MM initialization commands SSMEs to STOW on entry to 602.
6. For fast SEP in OPS 102, ET SEP sequencer sets SSME STOW flag and SSMEs are STOWed in OPS 601 on reaching zero thrust.
7. When a recycle count is requested, the SSMEs are moved from wherever they are (i.e., either the launch or start positions) to the gravity positions. Note gravity position is null.

TABLE 2-15. PASS ACTUATOR INITIALIZATION (OMS)

TRANSITION/ EVENT	OPS G9		OPS G101-G104(1)		START 1ST OMS BURN EVENT 37		1ST OMS BURN EVENT 42		TRIM FOR 2ND OMS BURN 44A (2)	
ACTUATOR	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
LP	AI	+5.91	+5.89	+0.4	+0.4	TRANS DAP CMD VALUES	TRANS DAP CMD VALUES	LAST OMS 1 BURN TRANS DAP CMD VALUES	LAST OMS BURN TRANS DAP CMD VALUES	SECOND OMS BURN TRIM CMDS
LY	AI	+7.29	+6.44	−5.75	−5.75	TRANS DAP CMD VALUES	TRANS DAP CMD VALUES	LAST OMS 1 BURN TRANS DAP CMD VALUES	LAST OMS BURN TRANS DAP CMD VALUES	SECOND OMS BURN TRIM CMDS
RP	AI	+5.91	+5.89	+0.4	+0.4	TRANS DAP CMD VALUES	TRANS DAP CMD VALUES	LAST OMS 1 BURN TRANS DAP CMD VALUES	LAST OMS BURN TRANS DAP CMD VALUES	SECOND OMS BURN TRIM CMDS
RY	AI	−7.29	−6.44	+5.75	+5.75	TRANS DAP CMD VALUES	TRANS DAP CMD VALUES	LAST OMS 1 BURN TRANS DAP CMD VALUES	LAST OMS BURN TRANS DAP CMD VALUES	SECOND OMS BURN TRIM CMDS

TABLE 2-15. PASS ACTUATOR INITIALIZATION (OMS) (Continued)

TRANSITION/ EVENT	START 2ND OMS BURN EVENT 46		2ND OMS BURN EVENT 48		TRIM FOR DEORBIT EVENT E10(2)		START DEORBIT EVENT E12	
ACTUATOR	IN	OUT	IN	OUT	IN	OUT	IN	OUT
LP	SECOND OMS BURN TRIM CMDS	TRANS DAP CMD VALUES	TRANS DAP CMD VALUES	LAST OMS BURN TRANS DAP CMD VALUES	LAST OMS BURN TRANS DAP CMD VALUES	TRANS DAP DEORBIT TRIM CMDS	TRANS DAP DEORBIT TRIM CMDS	TRANS DAP CMD VALUES
LY	SECOND OMS BURN TRIM CMDS	TRANS DAP CMD VALUES	TRANS DAP CMD VALUES	LAST OMS BURN TRANS DAP CMD VALUES	LAST OMS BURN TRANS DAP CMD VALUES	TRANS DAP DEORBIT TRIM CMDS	TRANS DAP DEORBIT TRIM CMDS	TRANS DAP CMD VALUES
RP	SECOND OMS BURN TRIM CMDS	TRANS DAP CMD VALUES	TRANS DAP CMD VALUES	LAST OMS BURN TRANS DAP CMD VALUES	LAST OMS BURN TRANS DAP CMD VALUES	TRANS DAP DEORBIT TRIM CMDS	TRANS DAP DEORBIT TRIM CMDS	TRANS DAP CMD VALUES
RY	SECOND OMS BURN TRIM CMDS	TRANS DAP CMD VALUES	TRANS DAP CMD VALUES	LAST OMS BURN TRANS DAP CMD VALUES	LAST OMS BURN TRANS DAP CMD VALUES	TRANS DAP DEORBIT TRIM CMDS	TRANS DAP DEORBIT TRIM CMDS	TRANS DAP CMD VALUES

TABLE 2-15. PASS ACTUATOR INITIALIZATION (OMS) (Continued)

TRANSITION/ EVENT	DEORBIT BURN EVENT E14		OPS G303		OPS G601-G603(3)		OPS G602-G603(4)	
ACTUATOR	IN	OUT	IN	OUT	IN	OUT	IN	OUT
LP	TRANS DAP CMD VALUES	LAST DEORBIT BURN TRANS DAP CMD VALUES	LAST DEORBIT BURN TRANS DAP CMD VALUES	+ 5.89	+ 5.89	+ 5.89	+ 5.89	−0.86
LY	TRANS DAP CMD VALUES	LAST DEORBIT BURN TRANS DAP CMD VALUES	LAST DEORBIT BURN TRANS DAP CMD VALUES	+ 6.44	+ 6.44	+ 6.44	+ 6.44	+ 6.44
RP	TRANS DAP CMD VALUES	LAST DEORBIT BURN TRANS DAP CMD VALUES	LAST DEORBIT BURN TRANS DAP CMD VALUES	+ 5.89	+ 5.89	+ 5.89	+ 5.89	−0.86
RY	TRANS DAP CMD VALUES	LAST DEORBIT BURN TRANS DAP CMD VALUES	LAST DEORBIT BURN TRANS DAP CMD VALUES	−6.44	−6.44	−6.44	−6.44	−6.44

Notes:

1. OMS trim for first OMS burn is accomplished in OPS 104 prior to Event 36A. The trim values shown correspond to I-LOADed values and are commanded by the TVC Command SOP. The trim values may be changed via crew inputs.
2. OMS trim values can be changed by the crew or uplink prior to each OMS burn.
3. STOW values shown for OPS 6 are valid for all transitions from OPS 1 prior to MM 104 (102 → 601 contingency and intact, and 103 → 601 intact).
4. Values shown for OPS 6 valid if the abort is selected post MECO and contingency dump selected by crew. Otherwise, the OMS engines are left in STOW positions as shown for inputs.

TABLE 2-16. PASS ACTUATOR INITIALIZATION (SRBs)

TRANSITION/ EVENT	OPS G9		OPS G101		OPS G102	
ACTUATOR	IN	OUT	IN	OUT	IN	OUT
R1	AI	0	0	0	0	0
R2	AI	0	0	0	0	0
T1	AI	0	0	0	0	0
T2	AI	0	0	0	0	0

3. CRT DISPLAYS

The Space Shuttle orbiter is equipped with four Multi-Function Cathode-Ray Tube Display Systems (MCDS) - three are in the forward part of the cockpit and one is in the aft mission specialist station. The CRT immediately in front of the commander (left side) is referred to as CRT 1 or Left CRT. The CRT immediately in front of the pilot (right side) is referred to as CRT 2 or Right CRT. The remaining forward CRT is between the commander and pilot and is referred to as CRT 3 or Center CRT. The aft CRT is referred to as CRT 4 or Aft CRT.

−1 Each MCDS is controlled by a power switch, a "Major Function" switch, two BFS switches and a keyboard.

−1.1 The power switch is a three position switch:

OFF - No power is available to MCDS.

STBY - Power is applied to internal MCDS circuits. At least 30 seconds of STBY for warm-up should be allowed before proceeding.

ON - Power is applied to CRT and video is established.

−1.2 The Major Function switch is also a three position switch:

GNC - The MCDS will be controlled by a GPC in which Guidance, Navigation, and Flight Control or Vehicle Utility Prelaunch functions are being executed.

SM - The MCDS will be controlled by a GPC in which Systems Management functions are active.

PL - The MCDS will be controlled by a GPC in which Vehicle Utility functions for Mass Memory Unit operations are active.

−1.3 The BFC CRT Display switch is an On/Off switch. If On, PASS will not command the MCDS.

−1.4 The BFC CRT Select switch is a 3 position switch used in conjunction with the On state of the BFC CRT Display switch (if that switch is Off the BFC CRT Select switch is ignored by PASS). The three positions are:

1 + 2 - BFS Commands MCDS 1 (PASS relinquishes control of MCDS 1)

2 + 3 - BFS Commands MCDS 2

3 + 1 - BFS Commands MCDS 3

(If BFS is engaged it assumes command of the second number MCDS; e.g., 1 + 2, BFS would command MCDS 1 and 2 if engaged.)

−1.5 There are two keyboards forward which support the forward three CRTs, and an aft keyboard for the aft CRT. In the case of the forward keyboards, selection of keyboard/CRT combination is made via two switches. The commander's keyboard select switch controls the left keyboard and allows selection of the left or center CRT. The pilot's keyboard select switch controls the right keyboard and allows selection of the right or center CRT. Care should be taken to avoid having both switches selected to the center CRT. The keyboard keys are defined in section 5.

–2 Messages may be sent via the Launch Data Bus (LDB) or uplink to the GPC(s), the equivalent of an MCDS message (hence, referred to as DEU-Equivalents). Any such message sent to a particular GPC from a specified DEU must have the same major function specified as the actual DEU. For DEU-Equivalent messages, the syntax is the responsibility of the issuer. (55006) Such messages can be sent to a GPC even if the specified DEU is powered off. (27521) (36329/37637) Care should be taken to insure the GPC specified in the message is in command of the DEU specified. If a RESUME message is sent to a GPC for a DEU commanded by some other CS GPC or which has been isolated, an ILLEGAL ENTRY message will appear (52780).

–3 An MCDS may be IPL'ed or loaded by a GPC in initial OPS 0 (See section 2.3.1) or OPS P901. The DEU IPL is done via a toggle switch on panel 06 which is taken to LOAD then released. At this point the CRT is blanked, followed by DEU LOAD in the lower left corner, followed by IPL COMPLETE in the center. This will flash, then a big X will appear and then the appropriate display (GPC Memory in OPS 0, Mass Memory Read/Write in PL9) will replace the big X. (37542)

3.1 MCDS/GPC ASSIGNMENT HIERARCHY

For all buses except the MCDS buses, GPC/Bus combinations are fixed at entry into an OPS and are based on the Bus Assignment Table. The MCDS buses are assigned to GPCs according to a predetermined hierarchy. The assignment is determined at any OPS transition, Major Function switch change, GPC/CRT keyboard entry, or BFC CRT Select switch manipulation.

–1 The MCDS assignment is done in 3 steps:

–1.1 The MCDS will be assigned to the GPC specified in the Bus Assignment Table (or GPC/CRT entry) if the Major Function switch is GNC and the GPC is in the redundant set. If the specified GPC is not in a redundant set, the MCDS will be assigned to the lowest ID GPC in the redundant set.

–1.2 The MCDS will be assigned to a simplex GPC with the major function active that matches the Major Function switch.

–1.3 If neither (1) or (2) are satisfied, the current GPC controlling the MCDS will be retained.

–2 The MCDS assignments may be shifted between GPCs by the use of "GPC/CRT XY EXEC" input on a keyboard where X is the GPC ID and Y is the MCDS number. If X = 0 is specified, the MCDS will be isolated; that is, no GPC will command it and a big "X" will appear on the CRT. (37512)

–3 If the DEU to be distributed is currently controlled by the BFS no transmitter change will be invoked until the control of the DEU is returned to the PASS. At that time the DEU will be distributed according to the above hierarchy.

–4 A GPC/CRT assignment may appear to fail if the request is to move the MCDS from an active software function/major function match to a mis-match. For example, if a GPC is active in GNC and controlling an MCDS whose Major Function switch is GNC and an attempt is made to give the MCDS to a GPC with SM active, the MCDS will be given to the requested GPC for one cycle only then will return to the GNC GPC due to the major function considerations. This most frequently occurs at addition of a GPC to the common set when it is desired to assign an MCDS to the OPS 0 GPC. Before a GPC/CRT may be entered, the Major Function switch must be placed to a non-active Major Function. For example, if two GPCs are in common set and active in GNC and SM and a third GPC is added to the common set (OPS 0), the MCDS Major Function switch must be placed to PL before it can be assigned to the OPS 0 GPC. (37511)

–5 Reassignment of an MCDS should be done only when it is not being used for keyboard inputs.

3.2 STANDARD CRT DISPLAY PAGE

A standard CRT page format depicts generic fields to be displayed on each display page called up by an operator. These fields and their functions are described as follows (see Figure 3-1):

A. Four-digit field used to designate the major OPS.

B. Three-digit field designating the specialist function which overlays the OPS.

C. Three-digit field identifying the display page which overlays OPS or SPEC.

D. Eighteen-character alphanumeric field reserved for the title of the page being displayed. Depending upon the OPS, portions of the title may be dynamic.

E. A two-character field for displaying uplink activities (invoked by the GPC uplink switch). The characters UL are displayed flashing.

F. One-character field which identifies the GPC that is driving the display page.

G. Twelve-character alphanumeric field which displays mission time (MT), either mission elapsed time (MET) or GMT as specified on the TIME display, in days (3 digits)/hours (2 digits): minutes (2 digits): seconds (2 digits).

H. Twelve-character alphanumeric field used to display CRT time (CRT Timer). This field is driven by the source corresponding to the Major Function select switch, is shown only when a timer is activated via the TIME display, and is the same format as G. (45609/47317)

I. Three-character alphanumeric field used to display BFS when the BFS is the source of the display. A stippled (dotted) background is used on the display format to highlight background nomenclature and/or foreground data fields that are supported and driven only by BFS.

J. Line 25 is reserved for outputting CRT messages.

K. Two-character numeric field reserved for displaying the total number of messages in the queue waiting to be processed.

L. Line 26 is reserved for the scratch pad line which is used to echo the keyboard entries made by the crew and for display of DEU detected error messages.

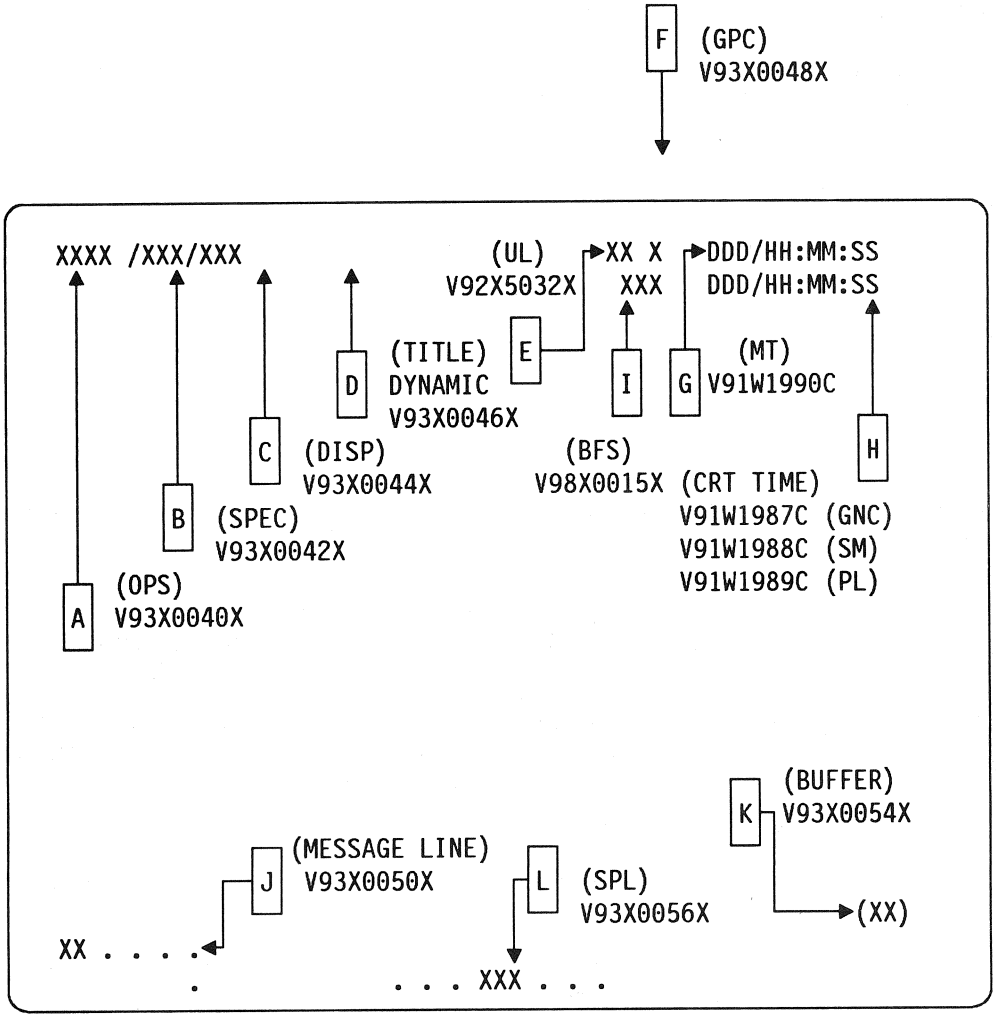


Figure 3-1. Standard Display Page

3.3 OPS, SPEC, DISP PAGE HIERARCHY

As indicated in sections 3.2 A, B, and C above, the basic ordering of "layers" of CRT images is OPS, SPEC, DISPLAY. At transition into an OPS, all CRTs with Major Function of the OPS will display the OPS/Mode display. Requesting a SPEC overlays the OPS display with the desired SPEC. Requesting a display only function (DISP) overlays the SPEC display with the desired DISPLAY. A subsequent RESUME will return the underlying SPEC display and another RESUME will return the underlying OPS display. Two SPEC functions are allowed to be active per Major Function.

–1 Requests on the same level are not stacked. That is, a SPEC request followed by a second SPEC request results in termination of the first SPEC before the second SPEC is initiated. A subsequent RESUME will return to the OPS display, not the first SPEC. (25396) (33754) (37503)

–2 A failed SPEC may be RESUMEd by one of two methods: an OPS transition may be requested (which will automatically cancel it); or a DEU-Equivalent RESUME message may be sent to the GPC controlling the failed DEU.

3.4 USER'S GUIDE DISPLAY FORMAT

The PASS contains over 70 CRT and 100 TEXT and GRAPHICS displays for presentation via keyboard request. Each display will be presented with the following information:

A. Display name.

B. Availability, which OPS.

C. Purpose of the display in a short description.

D. Picture of the CRT image.

E. Display Functions table which describes functional capability of display.

F. Display Items table which lists ITEMs versus functional capability.

−1 Since the available CRT displays change from mission to mission and since each display is an entity unto itself, presentation of the material in this section will be as follows:

A. Section, Figure, or Table number will be specified by the display number.

B. Each display will be paginated by 3.5.+ Display number + page (for example, GPC Memory will be 3.5.000-1, 3.5.000-2, etc.).

−2 Table 3-2 lists the CRT displays available in PASS.

−3 Notes concerning displays will usually appear at the place most applicable in the Display Purpose, Display Function/Item tables. However, notes of a broad nature concerning displays will be found here.

−3.1 Several of the display logouts were made assuming numerical values would be positive only. No room for a sign (+ or −) was allowed. (45822)

−3.2 There is a known 1.2 micro-second window during which the DEU is susceptible to invalid keycodes input from the keyboard adapter unit.

−4 In order to save GPC memory space, several display formats are offloaded to the Display Electronics Unit's (DEU's). These display formats are called Critical Formats and are listed in Table 3-1.

TABLE 3-1. CRITICAL FORMATS

DISPLAY #	DISPLAY TITLE	MEMORY CONFIGURATION
000	GPC MEMORY	ALL
018	GNC SYS SUMM 1	1, 2, 3, 8
021	IMU ALIGN	2, 3
022	S TRK/COAS CNTL	2, 3
023	RCS	2, 3, 8
050	HORIZ SIT	1, 3
051	OVERRIDE	1, 3
099	FAULT	ALL
1011	XXXXXX TRAJ	1
3011	XXXXX MNVR YYYYY	1, 2, 3
3041	ENTRY TRAJ 1	3
3051	VERT SIT 1(2)	1, 3

3.4.1 DISPLAY: XXXXIPL MENU

–1 AVAILABILITY: Only during GPC IPL, see Section 2.3, System Initialization.

–2 PURPOSE: The IPL Menu display provides the user with the capability to select different GPC software loads and provides access to the GPC Self-Test Program (STP) and the Real Time Processor (RTP) functions of the GPCIPL program during self-test operation. With this display, the user has the capability to run STP or RTP and has the means to control and monitor memory purge operations for the DEU, MMU, and/or GPC. The display consists of 2 pages.

```
                XXXXIPL MENU (1)XX X DDD/HH:MM:SS
PASS1   1X   PASS5   9X                DDD/HH:MM:SS
BFS1    2X   BFS5   10X  STP/PURGE CYC CNT  XXXXX
PASS2   3X   PASS6   11X  ERROR/MSG CODE       XXX
BFS2    4X   BFS6   12X  ERROR/MSG CODE CNT  XXXX
PASS3   5X   PASS7   13X  TOTAL ERR/MSG CNT   XXXX
BFS3    6X   BFS7   14X  MSGS STILL IN LIST   XXX
PASS4   7X   PASS8   15X
BFS4    8X   BFS8   16X        MCDS BITE
                                 MODE   XXXX
17 DEU FORMAT LOAD X             BSR1   XXXX
                                 BSR2   XXXX
START GPC SELF TEST 18X          SWSW   XXXX
STOP  GPC SELF TEST 19X
START DEU SELF TEST 20X

                                 XXXXXXXXXXXXX

                                 27 OPTION    X

STOP STP ON ERROR          24X
CONTINUE STP ON ERROR      25X   START       28X
INHIBIT CKPT LOAD          26X   STOP        29X

                                                (XX)
```

Figure 3. IPL (1)

```
                    GPCIPL MENU (2)XX X DDD/HH:MM:SS
                                       DDD/HH:MM:SS
17 DEU FORMAT LOAD X       STP/PURGE CYC CNT XXXXX
                           ERROR/MSG CODE      XXX
START GPC SELF TEST 18X    ERROR/MSG CODE CNT XXXX
STOP  GPC SELF TEST 19X    TOTAL ERR/MSG CNT  XXXX
START DEU SELF TEST 20X    MSGS STILL IN LIST  XXX

                                       MCDS BITE
                                            MODE XXXX
                                            BSR1 XXXX
STOP STP ON ERROR                 24X       BSR2 XXXX
CONTINUE STP ON ERROR             25X       SWSW XXXX
INHIBIT CKPT LOAD                 26X
OLD PSW  XXXX XXXX XXXX XXXX
REGISTER 0-3  XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
 SET 0   4-7  XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX

REGISTER 0-3  XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
 SET 1   4-7  XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX

FLOATING 0-3  XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
 PT REGS 4-7  XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
MAJ=XXXXX  MIN=XX SCHEDWRD=XXXXXXXX  CLOCK1=XXXXX
                                                 (XX)
```

Figure 3. IPL (2)

TABLE 3. IPL-1 DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up		
	Initial Page 1	None	The initial IPL MENU page is presented on a CRT during IPL of a GPC following procedures in Section 2.3. Basic requirements are: 1 – BFC CRT Switch ON. 2 – BFC CRT Select Switch in proper position for desired CRT. 3 – GPC IPL'ed and taken to STANDBY with DEU LOAD outstanding. At display call-up, the title will be "GPC IPL MENU (1)." Also at display call-up, a flashing message will be on the message line and MSGS STILL IN LIST will be 2 for nominal case. A MSG RESET key entry twice will remove the two nominal messages (GPCIPL AA.BB.CC.DD.EE LOADED, DCP AA.BB.CC.DD.EE LOADED).
	Page 2 and Subsequent Page 1's	SYS SUMM	The page 2 title is "GPCIPL MENU (2)." Repeated input of SYS SUMM key will toggle between page 1 and page 2.
2	GPC Software Load Selection	ITEM N EXEC	Causes software loader (SSL or BSL) to fetch requested software from selected MMU for GPC load. For PASS, N = 1, 3, or 5 for MMU area 1, 2 or 3 respectively. Upon entry, an * will be driven by the selected ITEM (For BFS, N = 2, 4 or 6 for MMU area 1, 2, or 3 respectively).
3	GPC Self-Test		One cycle of the GPC self-test program is automatically done when the GPC is moded to STANDBY. The upper right corner of the display provides self-test information: STP/PURGE CYCLE COUNT Number of times GPC self-test/purge program has executed. ERROR/MSG CODE Hex code for error message currently on message line. ERROR/MSG CODE COUNT Number of errors of the type shown by ERROR/MSG CODE which have been generated.

TABLE 3. IPL-1 DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
	GPC Self-Test (Cont'd)		TOTAL ERR/MSG COUNT Total number of errors sensed. MSGS STILL IN LIST Number of messages remaining in list to be viewed. On page 2 of IPL MENU, detailed data taken at the time of the current error is shown. This data includes the old PSW, general and floating point registers, and major/minor cycle information.
		ITEM 24 EXEC	Stop self-test execution on error. (lab use only)
		ITEM 25 EXEC	Let self-test execution continue on error (mutually exclusive with ITEM 24). (lab use only)
		ITEM 18 EXEC	Start cyclic self-test of GPC. Will continue to run (assuming no errors) until terminated.
		ITEM 19 EXEC	Stop cyclic self-test of GPC.
4	DEU Format Load	ITEM 17 EXEC	Load the DEU with a selected format load which consists of static background Format Control Words (FCWs) to be used at a later time.
5	DEU Self-Test Control	ITEM 20 EXEC	Start Stand-Alone Self-Test Program (SASTP) of DEU (refer to section 3.4.2 for a detailed write-up). NOTE: Execution of the DEU self-test is terminated by the RESUME key or the DEU LOAD switch on panel O6.

TABLE 3. IPL-1 DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
6	Memory Purge Control	ITEM 27+X EXEC	The default title is MEMORY PURGE, but will be changed as follows: Option (X) — Title 1 — DEU ERASE *** 2 — MMU1 OVERWRITE ** 3* — MMU1 ERASE *** 4 — MMU1 CHECKSUM 5 — MMU2 OVERWRITE ** 6* — MMU2 ERASE *** 7 — MMU2 CHECKSUM 8 — GPC ERASE *** NOTES: * Use option 3 or 6 to purge MMU prior to removing from a red environment. ** 1 pass only. *** GPC - 100 passes. DEU - 8 passes. MMU - 3 passes.
		ITEM 28 EXEC	Start function selected by ITEM 27.
		ITEM 29 EXEC	Stop function selected by ITEM 27.

TABLE 3. IPL-2 DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Load PASS, Area 1 into GPC				2	
2	Load BFS, Area 1 into GPC				2	
3	Load PASS, Area 2 into GPC				2	
4	Load BFS, Area 2 into GPC				2	
5	Load PASS, Area 3 into GPC				2	
6	Load BFS, Area 3 into GPC				2	
7-16	Not Currently Supported					
17	Load DEU Format				4	
18	Start Cyclic GPC Self-Test				3	
19	Stop Cyclic GPC Self-Test				3	
20	Start DEU SASTP				5	
21-23	Not supported, do not use.					
24	Stop Cyclic GPC Self-Test on Error. Lab use only.				3	
25	Continue Cyclic GPC Self-Test on Error. Lab use only.				3	
26	IMU Checkpoint Data Load					Allows the user to inhibit loading of IMU checkpoint data from MMU into the BFS GPC.
27	Select Purge Option				6	
28	Start Purge Option				6	
29	Stop Purge Option				6	

3.4.2 DISPLAY: DEU STAND-ALONE SELF-TEST (DEU SAST)

–1 AVAILABILITY: During Non-Default IPL Only

–2 PURPOSE: The DEU Stand-Alone Self-Test Display is used to check out the basic functions of the MCDS. The display for the DEU stand-alone self-test is nonstandard. This test is run independently of other functions. The only contact with the GPC is polling, so that the test may be terminated. The display does not include OPS, SPEC, or DISP page numbers. It does not include the standard title line, the GPC indicator, the mission elapsed time, the event timer, the tutorial line, the fault line, or the scratch-pad line. It cannot be overlain. This display is invoked via the IPL MENU.

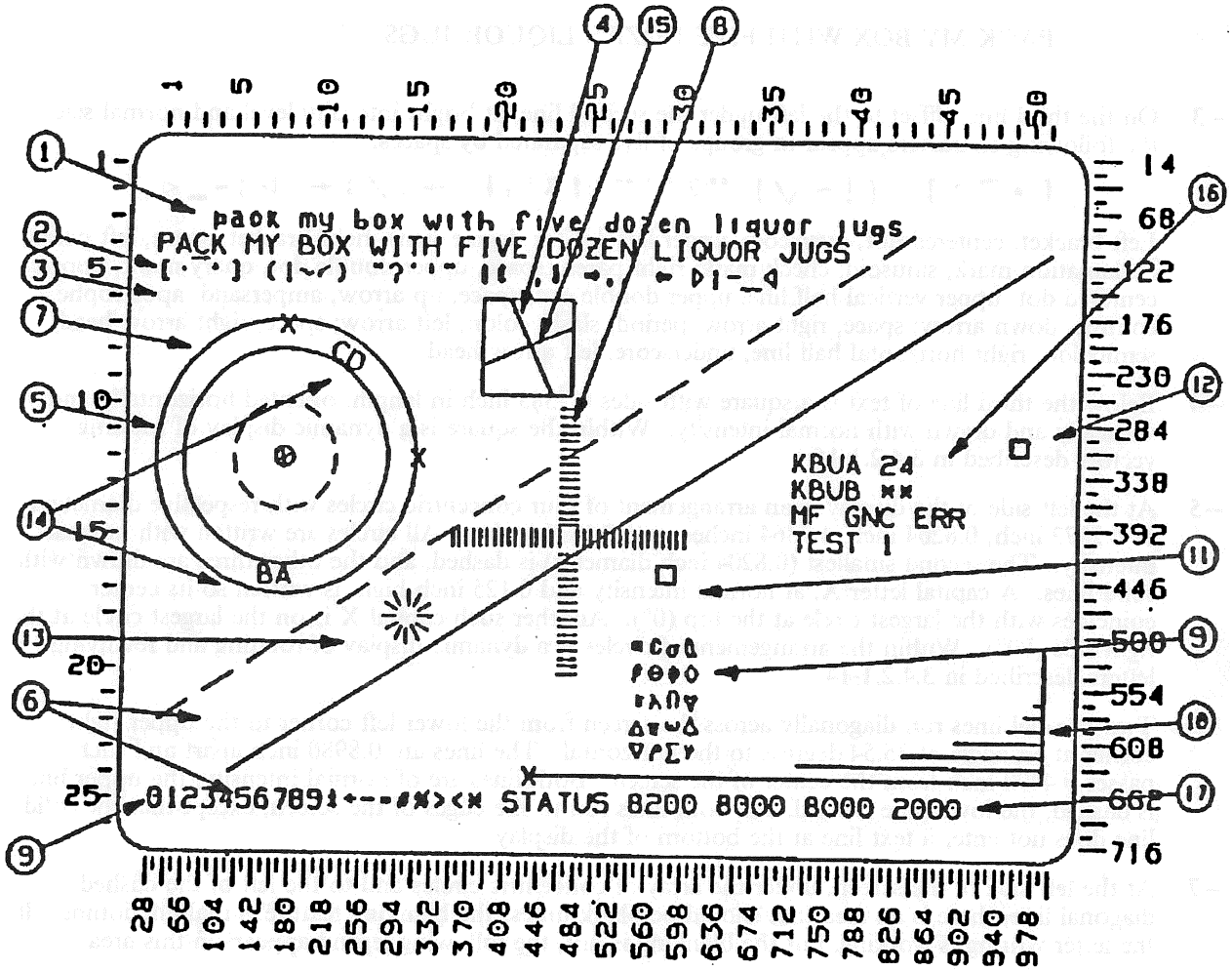


Figure 3.DEU

3.4.2.1 NORMAL OPERATION

The following descriptions pertain mainly to normal operation of the test and describe the patterns to be observed when nothing is malfunctioning. Static elements of the display are described 3.4.2.1-1 through 3.4.2.1-9. Dynamic elements are described in 3.4.2.1-10 through 3.4.2.1-15. Interactive control features of the display are described in 3.4.2.1-16 through 3.4.2.1-18.

–1 At the top of the display, the lower-case Roman letters, of normal size and at bright intensity level, appear in the sentence:

pack my box with five dozen liquor jugs

–2 On the second line, offset 3 spaces to the left under the first line, the upper-case Roman letters, of normal size and at normal intensity level, appear in the sentence:

PACK MY BOX WITH FIVE DOZEN LIQUOR JUGS

–3 On the third line, offset to the left under the second line, at bright intensity level and normal size, the following characters appear in groups of five separated by spaces:

[• ‾ •] (! ~ √) ¨ ? ° ' ¨ ↑ & ' , ↓ → . / : ← ▷ ; - _ ◁

Left bracket, centered dot, overscore, upper left dot (or degree sign), right bracket; space, left paren, exclamation mark, sinusoid, check mark, right paren; space, upper double dot, query mark, upper centered dot, upper vertical half line, upper double dot; space, up arrow, ampersand, apostrophe, comma, down arrow; space, right arrow, period, slash, colon, left arrow; space, right arrow head, semicolon, right horizontal half line, underscore, left arrow head.

–4 Below the third line of text is a square with sides 0.7383 inch in length, oriented horizontally and vertically and drawn with normal intensity. Within the square is a dynamic display of rotating vectors described in 3.4.2.1-15.

–5 At the left side of the display is an arrangement of four concentric circles with respective diameters of 0.2872 inch, 0.8204 inch, 1.7364 inches, and 2.1876 inches. All circles are written with normal intensity. The second smallest (0.8204 inch diameter) is dashed, and the other three are drawn with solid lines. A capital letter X, at normal intensity and 0.125 inch high, is written so its center coincides with the largest circle at the top (0°). Another such capital X is on the largest circle at the right side (90°). Within the arrangement of circles is a dynamic display of rotating and revolving letters described in 3.4.2.1-14.

–6 Two parallel lines run diagonally across the screen from the lower left corner to the upper right corner at an angle of 35.54 degrees to the horizontal. The lines are 0.8980 inch apart and each passes 0.4490 inch from the center of the screen. Both lines are of normal intensity, the upper line is dashed, the lower line is solid, and both lines run to the edges of the screen, except that the solid line does not enter a text line at the bottom of the display.

–7 At the left side of the screen, under the array of concentric circles and to the left of the dashed diagonal line, there is an area that should be blank unless the blanking feature is malfunctioning. If the letter writing is working, but the blanking is not, the following legend appears in this area:

BLK
(FAIL)

–8 About the center of the screen is an array of tick marks for checking focus and resolution. The tick marks are short, straight line segments from the symbol generator character matrix. To the left of screen center are 33 vertical tick marks 0.0273 inch apart in a horizontal array. To the right of screen center are 34 marks in such an array. Above the center of the screen are 33 horizontal tick

marks 0.0273 inch apart in a vertical array. Below screen center are 34 marks in such a vertical array.

−9 All 128 defined symbol elements of the DEU are displayed. In addition to upper- and lower-case letters in the top two lines and the symbols in the third line, the numerals and other symbols are displayed in the left part of the bottom (scratch-pad) line, as follows:

0 1 2 3 4 5 6 7 8 9 ± : − = # % > < *

These characters are written at normal size. The numerals are displayed at normal intensity. The mathematical symbols in the bottom line are displayed at bright intensity. The 20 remaining characters are written in an array five characters high and four characters wide below and to the right of the array of resolution marks. These 20 characters are various lower and upper case Greek letters, del (upside-down capital delta), TACAN symbol (an outline Y with all three arms of equal length and angle), diamond, and plan and elevation outlines of the Space Shuttle.

−10 Below and to the right of the four-by-five array of Greek and special characters is an array of horizontal lines of varying brightness. There are ten horizontal lines, the shortest being 0.0068 inch long and the longest being 3.5000 inches long. Successive lines double in length (0.0068, 0.0137, 0.0273, 0.0547, 0.1094, 0.2188, 0.4375, 0.8750, 1.7500, 3.5000). All ten lines are spaced vertically equidistant, and right ends are vertically aligned and connected with a vertical line. The five shortest of these ten lines are displayed at normal intensity and flashing. The five longest of these ten lines are displayed with continuously varying intensity from zero to maximum and continusously varying back to zero. This intensity variation occurs with a period of approximately 2.33 seconds.

−11 Above the array of Greek letters and special symbols and the array of flashing and variable-intensity lines there is a small square (from the symbol generator character matrix) which travels continuously back and forth in a horizontal line (between the center and the right edge of the screen). The center-to-center distance of the extreme positions of this square is 3.3975 inches. This square is displayed at normal intensity and travels back and forth at a rate of 0.374 inch per second. A complete cycle requires approximately 18.62 seconds.

−12 From the rightmost position of the horizontally moving square, there is a similar vertically moving square. The extreme positions of the vertically moving square are (1) the rightmost position of the horizontally moving square and (2) a position 0.8613 inch directly above the first position. This square is displayed at normal intensity and travels up and down at a rate of 0.374 inch per second. A complete cycle requires approximately 4.63 seconds. Every fourth cycle, this square coincides at the bottom of its travel with the horizontally moving square at its right most position.

−13 Between the diagonal lines drawn across the screen from lower left to upper right, there is a spinning "bug" consisting of 16 lines in a sunburst array, rotating about a center which moves up and to the right. The lines begin 0.2051 inch from the center of rotation and extend another 0.2051 inch outward. The array of lines rotates at 53.17 degrees per second, while the center moves up and to the right (along an incline of 35.54 degrees to the horizontal) at a rate of 1.536 inches per second. The pattern does not appear to be a rolling wheel, but rather an emblem at the center of a rolling wheel with about four times the diameter. Immediately following the upward transit, the bug reverses direction and appears to roll and slide down the hill at the same rate it moved up. Then it starts up again. The complete cycle takes approximately 26.48 seconds.

−14 In the array of circles at the left of the screen are two patterns revolving about the center within the annulus defined by the two large circles. The first patterns consists of the capital letters AB, with the A having a height of 0.150 inch and the B having a height of 0.125 inch. The A and B each remain upright, while they revolve around their common center at the same rate the pattern revolves about the center of the circles. Thus the B leads the A around the circle in a clockwise direction. The second patterns consists of the capital letters CD, with the C having a height of 0.150 inch and the D having a height of 0.125 inch. The entire pattern rotates at the same rate, it revolves (clockwise), so that the bottom of the letters is toward the center of the circles and they are read in the order CD when viewed from the center of the circles. There is also a 0.125-inch capital X at the common center of these circles, which rotates about its own center at the same rate the AB and CD

patterns revolve. The common rate of revolution and rotation of the AB, CD, and X patterns is approximately 33.84 degrees per second. The rotation cycle takes about 10.64 seconds to complete.

−15 Within the square box described in 3.4.2.1-4 is a rotating array of lines (boxed windmill). Two lines intersect at right angles in the center of square. When they are in the horizontal and vertical positions, they bisect the sides of the square. In the 45-degree position, they form the diagonals of the square. At all times, these rotating lines extend to the sides of the square, but not beyond. The array rotates counter clockwise at a variable rate. Near the position as diagonals, the rotation rate is approximately 3.15 degrees per second. Near the position perpendicular to the sides of the square, the rotation rate is approximately 6.30 degrees per second. Every 90 degrees of rotation the pattern repeats. This 90-degree rotation takes approximately 18.2 seconds.

−16 Within the angle defined by the two small squares moving, respectively, left and right, up and down, there is a small block of significant text. The top line of this text block contains the legend KBUA followed initially by two asterisks(*s). The second line contains the legend KBUB followed initially by two asterisks(*s). These lines are for checking operation of the keyboard associated with the display. If the display is on the center CRT, one line is used for each of the two keyboards that may be connected to the CRT. The keys are coded from 00 through 31, from left to right and top to bottom. As any key is depressed, its number appears on the display and remains until another key is depressed. This display of key codes goes on right along with key sequences that activate the status test. On the next line an encoding of the position of the Major Function switch is shown to the right of the letters MF as GNC, SM, or PL. The position of the Major Function switch may be changed for testing purposes. On the next line is a reminder for activation of the BITE test and indication of when it is in progress.

−17 On the right portion of the bottom line of the display, the word STATUS appears, followed by a pattern of four groups of four hexadecimal digits indicating the status of the BITE register. The digits are initially blank while the condition of the DEU is being assessed by the program. The status is then displayed. The normal display is:

```
8200 8000 8000 0000
```

If the DEU has just been reloaded, for such reason as initial startup or a power transient, the last group of four digits, instead of being 0000, will be 2000. The BITE test can be activated by entering ITEM 1 EXEC. While the test is in progress, an asterisk (*) appears to the right of TEST 1. When the test is completed, the asterisk (*) is removed and the new condition of the BITE registers is shown following the word STATUS in the bottom line of the display. Following Test 1, the STATUS display should be:

```
8276 8080 A000 0000
```

The dynamic portions of the display continue uninterrupted while this testing is in progress.

−18 To terminate the DEU stand-alone self-test display, the Major Function switch must be in the same position it was in when the self-test was initiated while the RESUME key is entered. If the Major Function switch is not set properly, the word ERR appears beside the Major Function indicator on the display and flashes. ERR remains flashing, until a key is depressed on the keyboard or until the position of the Major Function switch is changed; then the error message disappears.

3.5 DISPLAYS

Table 3-2 is a listing of the CRT displays in this section.

TABLE 3-2. CRT DISPLAYS

CRT	MF	TITLE	CRT	MF	TITLE
000	ALL	GPC MEMORY (Also G9011)	097	S	PL RETENTION
001	ALL	DPS UTILITY	099	ALL	FAULT
002	ALL*	TIME	100	G,P	GTS DISPLAY
006	ALL	GPC/BUS STATUS	101	G	SENSOR SELF TEST (pre-flight)
018	G	GNC SYS SUMM 1			
019	G	GNC SYS SUMM 2	102	G	RCS/RGA/ADTA TEST
020	G	DAP CONFIG	104	G	GND IMU CNTL/MON (pre-flight)
021	G	IMU ALIGN			
022	G	S TRK/COAS CNTL	105	G	TCS CONTROL
023	G	RCS	106	G	MANUAL CONTROLS
025	G	RM ORBIT	110	G,P	BUS/BTU STATUS
033	G	REL NAV	111	P	SL MEMORY DUMP
034	G	ORBIT TGT	112	G	GPC/BTU I/F
040	G	SENSOR TEST	113	G	ACTUATOR CONTROL
041	G	RGA/ADTA/RCS	1011	G	XXXXXX TRAJ
042	G	SWITCH/SURF	1021	G	XXXXXX TRAJ
043	G	CONTROLLERS	1031	G	XXXXXX TRAJ
044	G	SWITCHES	1041	G	XXXXX MNVR YYYYY
045	G	NWS CHECK	1051	G	XXXXX MNVR YYYYY
050	G	HORIZ SIT	1061	G	XXXXX MNVR YYYYY
051	G	OVERRIDE	2011	G	UNIV PTG
053	G	CONTROLS	2021	G	ORBIT MNVR EXEC
060	S	SM TABLE MAINT	2011	S	ANTENNA
062	G,S	PCMMU/PL COMM	2021	S	PL BAY DOORS
064	S	SM GROUND CHECKOUT	3011	G	DEORB MNVR COAST
066	S	ENVIRONMENT	3021	G	DEORB MNVR EXEC
067	S	ELECTRIC	3031	G	DEORB MNVR COAST
068	S	CRYO SYSTEM	3041	G	ENTRY TRAJ 1
069	S	FUEL CELLS	3042	G	ENTRY TRAJ 2
076	S	COMM/RCDR	3043	G	ENTRY TRAJ 3
077	S	EVA-MMU/FSS	3044	G	ENTRY TRAJ 4
078	S	SM SYS SUMM 1	3045	G	ENTRY TRAJ 5
079	S	SM SYS SUMM 2	3051	G	VERT SIT 1
085	S	MASS MEMORY R/W	3052	G	VERT SIT 2
086	S	APU/HYD	4011	S	ANTENNA
087	S	HYD THERMAL	6011	G	XXXXXX TRAJ
088	S	APU/ENVIRON THERM	6021	G	VERT SIT 1
089	S	PRPLT THERMAL	6031	G	VERT SIT 2
090	S	PCS CONTROL	8011	G	FCS/DED DIS C/O
094	S	PDRS CONTROL	9011	G	GPC MEMORY
095	S	PDRS OVERRIDE	9011	P	MASS MEMORY R/W
096	S	PDRS STATUS			

* Valid in all MC except G1 and G3.

3.5.000 DISPLAY: GPC MEMORY

−1 AVAILABILITY: OPS Display - OPS 0 and G9; SPEC 000 in all OPS.

−2 PURPOSE: The GPC Memory display provides general system level controls. These are: updating the GRT (GPC reconfiguration table); updating the BAT (Bus Assignment Table); modification/display of GPC memory; dump (via downlist -FMT 90) of GPC memory; selection of GPC to be Downlisted; loading of a GPC with a given memory configuration without execution (freeze-dry); resetting of I/O error log, CAM status, and SYNC TRACE log; ENABLE/DISABLE of the downlist of a non-prime OPS O GPC; ENABLE/DISABLE OPS 3 UPLINK; and Mass Memory area selection by major function. (37536)

```
0001/   /        GPC MEMORY        XX X DDD/HH:MM:SS
                                          DDD/HH:MM:SS
MEM/BUS CONFIG  | READ/WRITE  XXX
1 CONFIG XX(XX) |  DATA 20X  BIT SET 22X  SEQ ID 24
2 GPC X X X X X |  CODE 21X  BIT RST 23X  WRITE  25
                |  26 ENG UNITS XXX     HEX 27X
 STRING 1  7 X  |  ADD ID   DESIRED   ACTUAL
        2  8 X  | 28 XXXXX  29 XXXX   ±XXXXXXXXXX
        3  9 X  | 30 XXXXX  31 XXXX   ±XXXXXXXXXX
        4 10 X  | 32 XXXXX  33 XXXX   ±XXXXXXXXXX
   PL 1/2 11 X  | 34 XXXXX  35 XXXX   ±XXXXXXXXXX
                | 36 XXXXX  37 XXXX   ±XXXXXXXXXX
      CRT 1 12 X| 38 XXXXX  39 XXXX   ±XXXXXXXXXX
        2 13 X  |-------------------------------------
        3 14 X  | MEMORY DUMP           | STORE   MC=XX
        4 15 X  |  40 START ID  XXXXX   |  45 CONFIG XX
                |  41 NO WORDS  XXXXXX  |  46 GPC X
 LAUNCH 1 16 X  |  42 WDS/FRAME XXX     |  STORE 47
        2 17 X  |  DUMP 43              |
     MM 1 18 X  |-----------------------|-----------
        2 19 X  |  44 DOWNLIST GPC X    | MM AREA
----------------|    OPS 0 ENA 49  X    |  PL  52 X
OPS 3 UPLK 50X  |                       |  GNC 53 X
OPS 3 INIT 51   | ERR LOG RESET 48      |  SM  54 X
                                                (XX)
```

Figure 3.000

TABLE 3.000-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	OPS 000 PRO	OPS 0 is also forced by GPC Mode Switch action (RUN-HALT/STANDBY-RUN). (35513) (37427)
		OPS 901 PRO	With MCDS Major Function = GNC causes transition to GNC 901.
		SPEC 000 PRO	Upon display initialization the major function active in the GPC controlling the MCDS will be shown at the right of READ/WRITE. Valid indications are GNC, SM, and PL. (37516)
2	GPC Reconfiguration Table (GRT) Update	ITEM 1+X EXEC	X is desired memory configuration number (must be input before items 2-19): (37427) X = 1 - G1 4 - SM2 7 - NA 2 - G2 5 - SM4 8 - G8 3 - G3 6 - PL9 9 - G9 Upon entry of ITEM 1, GRT & BAT reflect current values for the selected MC. (37506/104403)
		ITEM N+M EXEC	N is item number 2-6. M must be corresponding GPC number (use in MC target set) or 0 (do not use GPC in MC): ITEM GPC ITEM GPC 2 - 1 5 - 4 3 - 2 6 - 5 4 - 3 Note: Normally, GPC reconfiguration and bus assignment occur on OPS Transitions (or OPS Mode Recall) based on Items 2-19. On an OPS Transition from G1 to G3, the active G1 DPS configuration shall be used to determine the G3 DPS configuration, but only if the G3 GRT/NBAT (Items 2-19) have not been changed during G1.
3	Bus Assignment Table Update	ITEM 1+X EXEC	See entry for GRT update (function 2).

TABLE 3.000-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM N+M EXEC	N is item number for selected string/bus (7-19); M is GPC which will command bus (string) in selected MC (0 will leave bus with no commander). NOTE: Normally, GPC reconfiguration and bus assignment occur on OPS Transitions (or OPS Mode Recall) based on Items 2-19. On an OPS Transition from G1 to G3, the active G1 DPS configuration shall be used to determine the G3 DPS configuration, but only if the G3 GRT/NBAT (Items 2-19) have not been changed during G1.
4	GPC Memory Display/Modification	ITEM 20 EXEC	Selects unprotected memory for display/writing to (default value). (37547)
		ITEM 21 EXEC	Selects protected memory for display/writing to. Selection causes CODE to flash. ITEMs 20 and 21 are mutually exclusive. Selection of either will cause the display to be reinitialized.
		ITEM 26+ABB EXEC	Select desired engineering units for display of data (31987) (default is HEX): A = 1 - 16 bit/fixed 2 - 32 bit float. B = 00 - No conversion (display units in memory, not HEX) 01 - NM from ft 02 - NM from Kft 03 - ft from NM 04 - Kft from NM 05 - ft/sec^2 from G's 06 - deg/sec from Mrad/sec 07 - deg from Arc-sec 08 - ft/sec^2 from Micro-G 09 - deg from rad 10 - Kft from ft
		ITEM 27 EXEC	Select HEX for display (default) - Mutually exclusive with ITEM 26.

TABLE 3.000-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 28+XXXXX EXEC	HEX address of memory to display (0-3FFFF) (software constraint). Entry causes cyclic updating of current value in ACTUAL column. If ITEM 26 entered and A = 2, address must be even. ITEMS 30, 32, 34, 36, and 38 may also be used to enter addresses.
		ITEM 24 EXEC	Optional; Causes the next 5 addresses after the address specified via ITEM 28 to be displayed. At least one address must have been entered previously.
		ITEM 29+XXXX EXEC	HEX value to be entered in memory address specified by ITEM 28. ITEMs 31, 33, 35, 37, and 39 correspond to ITEMs 30, 32, 34, 36, and 38.
		ITEM 25 EXEC	Modifies memory by placing desired value into specified address. (55501) ACTUAL will equal desired unless the address is updated again by other software computations. If ITEM 20 selected, address(es) must already be unprotected. Address/Data must be entered as pairs prior to write.
5	Bit Set/Reset	ITEM 22 EXEC	Select bit set function.
		ITEM 23 EXEC	Select bit reset function (Mutually exclusive with ITEM 22). One to six half-words may be modified at any one time by specifying appropriate addresses.
		ITEM 28+XXXXX EXEC	Specify address of word where bit resides (Optional ITEM 24 may be used to specify 5 additional consecutive addresses).
		ITEM 29+XXXXX EXEC	The 4-HEX digit value is a mask for bit(s) to be set or reset. A '1' in the mask bit will cause the corresponding bit in the specified word to be set or reset.
		ITEM 25 EXEC	Set or Reset bits.

TABLE 3.000-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
6	GPC Memory Dump via downlist	ITEM 40+XXXXX EXEC	Start address of memory dump in HEX (0 - 3FFFF Note: Software constraint).
		ITEM 41+ XXXXXX EXEC	Number of words (decimal) of memory to be dumped (1 - 262,144 Note: Software constraint).
		ITEM 42+XXX EXEC	Number of words (decimal) per frame to be used for the dump (including header words and checksum). The maximum value is dependent upon the current downlist frame width. The following table specifies the available formats and the maximum words per format (depending on KBPS role).
			Format / HDR Words / LDR Words 20 / 32 / 16 21 / 128 / 64 22 / 112 / 56 23 / 128 / 64 24 / (1) / (1) 25 / (1) / (1) 26 / 48 / 48 32 / 112 / 56 42 / 128 / N/A (2) 44 / 128 / N/A (2) 46 / 128 / N/A (2) 48 / 32 / 16 52 / 128 / N/A (2) 53 / 128 / N/A (2) 60 / 128 / N/A (2)
			(1) SM OPS 2/4 downlist size is reconfigurable.
			(2) No low data rate (LDR) capability is supported for these formats.
		ITEM 43 EXEC	Initiate dump (data displayed for ITEMs 40 - 42 will be blanked when dump has completed).
7	Selection of GPC as Prime Downlister	ITEM 44+X EXEC	X = Number of GPC selected to become downlisting GPC (1 - 5). Selected GPC must be in common set.

TABLE 3.000-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
8	Freeze Dry GPC		Freeze Dry: Load a GPC memory with a selected Memory Configuration but do not begin execution of it.
		ITEM 45+XX EXEC	XX = desired MC (1-9, except 7).
		ITEM 46+X EXEC	X = GPC number to be loaded (1 - 5). GPC selected must be in common set (NOT redundant set). Selected GPC must be in OPS 0. MCDS used to make entries must be commanded by selected GPC.
		ITEM 47 EXEC	Causes MC to be loaded. Current MC in GPC is displayed in STORE MC = XX on display. When XX = selected MC, load is complete.
9	Error Logs/SYNC Trace Reset	ITEM 48 EXEC	Causes: SYNC Trace Log to be restarted. All U-FAIL votes of GPC to be reset. I/O Error Log to be cleared. All GPC(s) in a redundant set receiving the ITEM will take the specified actions. In common set, each GPC must have ITEM 48 EXEC entered on an MCDS keyboard being commanded by that GPC in order to clear the logs, etc.
10	OPS 0 D/L ENA/DIS (Non-Prime GPC)	ITEM 49 EXEC	OPS 0 is initialized with the D/L disabled. Execution of ITEM 49 enables the D/L and causes an asterisk to be displayed next to the 49. Subsequent executions of ITEM 49 will alternately DISABLE/ENABLE the downlist.
11	OPS 3 UPLINK	ITEM 50 EXEC	ENABLE/DISABLE OPS 3 UPLINK (toggle item). When ENABLED, this item allows OPS 3 Entry Memory Uplink to occur. It is initialized DISABLED and is valid only after overlay failure.
		ITEM 51 EXEC	Initializes the resident MC and phase to reflect MC 3. Valid only when Item 50 is ENABLED.
12	Mass Memory Area Selection	ITEM 52+X EXEC	X = Mass Memory Area (1-3) from which subsequent PL memory overlays are obtained.

TABLE 3.000-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 53+X EXEC	X = Mass Memory Area (1-3) from which subsequent GNC memory overlays are obtained.
		ITEM 54+X EXEC	X = Mass Memory Area (1-3) from which subsequent SM memory overlays are obtained.
			Notes on items 52-54: 1. It is possible to load an OPS from a different area on mass memory by using these items. It may be appropriate to select MMU/MMU as the source of the overlay (Item 10 on the DPS Utility SPEC 001) to force mass memory access. In this case, both major function base and program overlay may be obtained from the specified mass memory area. 2. Item 53 must be consistent in all participating GNC GPCs when performing a GNC OPS transition. If this is not the case, and MMU/GPC errors are present during the OPS transition, it is possible to obtain a "mixed" overlay (i.e., MFB from a different MM area than the program overlay).

TABLE 3.000-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Memory Configuration Number	1	9		2,3	CZ2V_OPS_MC 5,7 not valid
2	GPC 1 Selection	0	1		2	CZ2V_GPC_NO Only 0,1 valid
3	GPC 2 Selection	0	2		2	Only 0,2 valid
4	GPC 3 Selection	0	3		2	Only 0,3 valid
5	GPC 4 Selection	0	4		2	Only 0,4 valid
6	GPC 5 Selection	0	5		2	Only 0,5 valid
7-19	String/GPC Assignment	0	5		3	CZ2B_STRING_MC
20	Select DATA Mode				4	CDJB_ITEM_INPUT(1) Items 20 & 21
21	Select CODE Mode				4	CDJB_ITEM_INPUT(2) Exclusive
22	Set Bit				5	CDJB_ITEM_INPUT(3)
23	Reset Bit				5	CDJB_ITEM_INPUT(4)
24	Sequential Addresses				4,5	
25	Write to GPC Memory				4,5	
26	Select Engineering Units	100	210		4	CDJV_SCALE See function 4 for valid values
27	Select HEX display				4,5	CDJB_ITEM_INPUT(8)
28-38	GPC Memory Address to Display (28, 30, 32, 34, 36, 38)	00000	3FFFF	HEX	4,5	CDJ_ADD_ID(1 thru 6)
29-39	Desired value/mask (29, 31, 33, 35, 37, 39)	0000	FFFF	HEX	4,5	CDJ_DESIRED (1 thru 6)
40	GPC Memory Dump Start Address	00000	3FFFF	HEX	6	CDWV_MAIN_MEM_DMP_PRT
41	Number or words of GPC to dump	1	262144	DEC	6	CDWV_MAIN_MEM_DMP_LEN

TABLE 3.000-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
42	Number of words/downlist frame	16	128	DEC	6	CDWV_MAIN_MEM_CM_WRDS_FRM See Function 6 for valid values.
43	Initiate Downlist Dump				6	
44	Downlisting GPC Selection	1	5		7	CZ2V_GPC_P
45	Select freeze-dry MC for GPC	1	9		8	Except 5,7
46	Select GPC for freeze-dry	1	5		8	CDJV_FD_MC
47	Initiate freeze-dry load				8	CDJV_FD_MC
48	Error Log Reset				9	
49	OPS 0 Enable				10	
50	OPS 3 UPLINK				11	CZ2B_ENA_BOOTSTRAP Bit 16
51	OPS 3 INITIALIZATION				11	
52	PL MM AREA	1	3		12	CDJV_MM_AREA$(1)
53	GNC MM AREA	1	3		12	CDJV_MM_AREA$(2)
54	SM MM AREA	1	3		12	CDJV_MM_AREA$(3)

3.5.001 DISPLAY: DPS UTILITY

–1 AVAILABILITY: SPEC 001 in all OPS.

–2 PURPOSE: The DPS Utility SPEC function provides system level controls: MMU/major function assignments; MDM/string port selection; uplink controls; memory configuration overlay source/bus selection; variable downlist parameter selection; SM checkpoint retrieval control; direct command output to MDMs; G3 Archive; LDB Enable/Disable capability; and maintenance ground checkout options. (37536)

```
XXXX/001/        DPS UTILITY      XX X DDD/HH:MM:SS
                                        DDD/HH:MM:SS
 MMU ASSIGN        PORT ASSIGN
      1  2                    PRI  SEC  UL CNTL
   GNC 1X 2X     STRING 1     15X  16X   AUTO 35X
    SM 3X 4X            2     17X  18X    ENA 36X
    PL 5X 6X            3     19X  20X    INH 37X
OPS 0 7X 8X             4     21X  22X
                     PL 1/2   23X  24X  IPL SOURCE SW
MMU STATUS                             MASK 38X
  1 XXX
  2 XXX          VAR PARAM ID LIST
                      25 XXXX
MMU SOURCE/BUS        26 XXXX      G3 ARCHIVE
 GPC/MMU    9X        27 XXXX        LOAD     48X
 MMU/MMU   10X        28 XXXX        RETRIEVE 49X
 GPC/LDB   11X        29 XXXX
                      30 XXXX      GROUND OPS
CKPT RETRV            31 XXXX    GSE POLL ENA 50X
      ENA 12X         32 XXXX      SM GSE INH 51X
                      33 XXXX      SM C/O ENA 52X
RTC                   34 XXXX     GNC C/O ENA 53X
 13 XXXX XXXX                     BFC C/O ENA 54X
 CMD 14                            ALT PL9 TB 55X
                                             (XX)
```

Figure 3.001

TABLE 3.001-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-up	SPEC 001 PRO	SPEC call-up is legal in all OPS. (37427)
2	MMU/Major Function Assignment	ITEM N EXEC	Each major function may be assigned a MMU to be used for memory configuration overlays and other MMU accesses (TFL loads, checkpoints, etc.). The following matrix shows N for major function versus MMU: MMU 1 MMU 2 GNC 1 2 SM 3 4 PL 5 6 OPS 0 7 8 Selections are mutually exclusive; e.g., selection of MMU 2 for GNC (N = 2) removes selection of MMU 1 (N = 1). The default selection is MMU 1 for all major functions. Selection(s) are maintained across OPS transitions (for nominal cases). The status of each MMU is indicated by RDY (ready for access) or BSY (Off, just powered on less than 34 sec. ago; In use; or Busy, cannot accept a new access request) immediately below the MMU assignment matrix. (37420)
3	MDM/String Port Assignment	ITEM M EXEC	Flight critical string MDMs are dual port devices and the two ports are selectable on a string by string basis. The following matrix shows M for string versus port (a string is a pair of one forward and one aft MDM): String Primary Port Secondary Port 1 15 16 2 17 18 3 19 20 4 21 22 Payload buses are similarly selected. Primary selection is M = 23, secondary is M = 24. All port selections are maintained across OPS transitions.

TABLE 3.001-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
4	Memory Configuration Overlay Source/ Bus Selection		The source for a memory configuration (MC) may be selected as well as the bus over which the required overlay(s) will be transmitted. (28304)
	GPC/MMU	ITEM 9 EXEC	The MC source for the next OPS transition will be a GPC if any GPC in the target set contains the requested MC. If no GPC contains the requested MC, the MMU assigned to the major function requested (see function 2) will be used (or attempted) for the MC overlay(s). (If not successful, the MMU selection in function 2 will be automatically switched to the other MMU.) The bus used for transmitting the requested MC to GPC(s) will be the MMU bus for the selected MMU (even if a GPC has the requested MC, it will be transmitted to GPC(s) via the MMU bus). This is the default option. (28304)
	MMU/MMU	ITEM 10 EXEC	The major function base and OPS overlay for the next OPS transition will be loaded from the MMU selected (in function 2) via the MMU bus. Again, if a failure occurs, the MMU selection will be automatically switched to the other MMU and the transition will be attempted again. Upon completion of the transition, selection will revert to ITEM 9. **Note:** Care should be exercised with this option - a CLEAN copy of the Major Function Base will be fetched from MMU thus destroying memory of past events.
	GPC/LDB	ITEM 11 EXEC	The requested MC overlay(s) will be taken from a GPC in the target set and transmitted via the LDB bus corresponding to the MMU selected for the desired major function; e.g., if MMU 2 is selected, LDB 2 will be used. Again, if a failure occurs, the bus selection will be switched to the other LDB and the request retried. **WARNINGS**: 1) All other traffic on the LDB must be halted during the transition (to prevent clobbering of the MC being transmitted from the host GPC to other GPC(s)). 2) Selection will not revert back to ITEM 9 at completion of the transition (the assumption is made that this option was selected because the MMU bus was broken).

TABLE 3.001-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			WARNINGS: (Cont'd) 3) If no GPC in the target set has the requested MC, the OPS transition will fail; i.e., no attempt to get the MC from MMU(s) will be made. **Note:** Item 11 is mutually exclusive with Item 48 (G3 Load). Execution of Item 11 when Item 48 is already enabled shall result in rejection of the input, and the output of a Class 5 ILLEGAL ENTRY message.
5	Variable Downlist Selection	ITEM N + M EXEC	Up to ten GPC memory addresses in the range 0-FFFF (HEX) may be selected to be downlisted at 1 sample per second. ITEM numbers are 25-34 (N). The default address for all ten slots is 34D0. Selection of addresses is maintained across OPS transitions. Selection of addresses is not common set wide; i.e., selection is not ICCed. The user should insure that all target GPCs for redundant set formation have the same addresses for variable downlist. **Note:** Because of the location of downlist frames, if the user wants to downlist full words he must use the combinations 25-32, 26-31, 27-30 or 28-29. 33 and 34 are half word only.
6	Checkpoint Retrieval Enable	ITEM 12 EXEC	Enable the retrieval of SM checkpoint data when transitioning to SM. Initially OFF, and reverts back to OFF after a single use.
7	Realtime Commands		Allows commands to be sent to MDMs as if they were uplinked. It is a user responsibility to insure the data bus to be used is commanded by the GPC(s) in the Major Function of the DEU being used to enter the data.
		ITEM 13 + XXXXXXXX EXEC	Item 13 data is entered as HEX data defined by the following binary format: MMMMCCCCCIIIIIIIDDDDDDDDDDDDDDDD Where: MMMM Module (or card) address in the MDM. CCCCC Channel number on the card referenced. IIIIIII Index which selects the FCOS I/O Device ID and the MDM MIA Address (valid range is 1 to 17).

TABLE 3.001-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			INDEX FCOS Device Selected MIA Address 1 TCS FF1 ID 27 10 2 TCS FF2 ID 28 10 3 TCS FF3 ID 29 10 4 TCS FF4 ID 30 10 5 TCS FA1 ID 31 12 6 TCS FA2 ID 32 12 7 TCS FA3 ID 33 12 8 TCS FA4 ID 34 12 9 TCS PF1 ID 49 10 10 TCS PF2 ID 50 12 11 TCS LB ID 62 10 12 TCS LB ID 62 12 13-14 SINGLE FLEX 1/2 ID 56 * 15-16 SINGLE FLEX 3/4 ID 57 * 17 SINGLE FLEX 5 ID 58 * * Mission Dependent DD...DD Data word to be output to the MDM. Real time commands use MDM mode code '01000' (MDM Receive) only.
		ITEM 14 EXEC	Send the command set up by ITEM 13. Command will be blanked on CRT.
8	Uplink Control	ITEM 35 EXEC	Uplink enabled/inhibited based upon a "site-in-view" flag from the SM GPC.
		ITEM 36 EXEC	Uplink always enabled (default).
		ITEM 37 EXEC	Uplink always inhibited.
9	IPL SOURCE SWITCH MASK	ITEM 38 EXEC	ENABLE/DISABLE IPL SOURCE SWITCH MASK (toggle item). When ENABLED, the MMU IPL SELECT DISCRETES shall be ignored when determining the availability of MMUs to support a request for MMU I/O other than IPL. The initial state is DISABLED, but will be ENABLED upon transition to memory configuration G1.
10	G3 ARCHIVE	ITEM 48 EXEC	Enables/Disables G3 Archive Load. This item permits the user to load a copy of the G3 program overlay into upper memory during a subsequent G9 to G1 OPS transition.

TABLE 3.001-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 49 EXEC	Enables/Disables G3 Archive Retrieve. This item permits the user to retrieve the G3 program overlay from upper GPC memory on a subsequent G3 OPS Transition. **Notes:** 1. The source of the G3 program overlay shall always be the mass memory area indicated by the GNC MM AREA (Item 53 on GPC/Memory Display). 2. Items 48 and 49 are mutually exclusive. Whenever the user attempts to select either item while the other is already enabled, the other item will revert to the disabled state. 3. Upon successful completion of the G3 Archive Load, Item 48 shall be disabled, and Item 49 shall be enabled. If the G3 Archive Load was unsuccessful, Item 48 shall remain enabled and Item 49 shall remain disabled. 4. Item 48 is mutually exclusive with Item 11 on the DPS Utility Spec. An ILLEGAL ENTRY message shall be annunciated whenever the user attempts to enable either item when the other is already enabled. 5. Item 48 is valid in G9 only, and Item 49 is valid in G1, G2, G8, and OPS 0. Execution of any of these items in any OPS except as specified shall result in rejection of the input, and the output of a Class 5 ILLEGAL ENTRY message.
11	LDB ENA/DIS	ITEM 50 EXEC	Provide the capability of Enabling/Disabling LDB. Successive executions of Item 50 will alternately Enable/Disable LDB Polling. **Note:** Item 50 is valid only in OPS G9, P9, and Post IPL OPS 0. Execution of this item in any OPS except as specified shall result in rejection of the input, and the output of a Class 5 ILLEGAL ENTRY message.
12	Ground Checkout	ITEM 51 EXEC	Inhibits/Enables LDB Polling in the SM Major Function only. Initial state is enable, and item toggles.
		ITEM 52 EXEC	Enables/Inhibits SM Ground Checkout OPS. Initial state is inhibit (toggle item).

TABLE 3.001-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 53 EXEC	Enables/Inhibits GNC Ground Checkout OPS. Initial state is inhibit (toggle item). **Note:** Items 51, 52 and 53 are valid only in G9 and OPS 0. Execution of any of these items in any OPS except as specified shall result in rejection of the input, and the output of a Class 5 ILLEGAL ENTRY message.
		ITEM 54 EXEC	Enables/Inhibits the GPC commanding the DEU to output the BFS RUN discrete Initial state of this toggle item is inhibit. An asterisk is driven next to the item when the BFS RUN discrete is enabled.
		ITEM 55 EXEC	This toggle item allows selection of toggle buffer 4 or 5 for PL OPS 9 downlist. An asterisk is driven next to the item when alternate toggle buffer 5 is selected for PL9 downlist. Initial state has toggle buffer 4 selected.

TABLE 3.001-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Assign MMU1 to GNC				2	CZ2B_MM_MF Default
2	Assign MMU2 to GNC				2	
3	Assign MMU1 to SM				2	Default
4	Assign MMU2 to SM				2	
5	Assign MMU1 to PL				2	Default
6	Assign MMU2 to PL				2	
7	Assign MMU1 to OPS 0				2	Default
8	Assign MMU2 to OPS 0				2	
9	Select GPC as source, MMU bus for MC				4	CZ2B_DPS_STATUS Default
10	Select MMU as source, MMU bus for MC				4	CZ2B_DPS_STATUS
11	Select GPC as source, LDB bus for MC				4	CZ2B_DPS_STATUS
12	Enable SM Checkpoint Retrieval				6	CZ1B_CKPT_RETRV_ENA
13	Define Realtime Command				7	CDJB_RTC_IPT See function 7 definition
14	Send Realtime Command				7	
15	Select Primary Port, String 1				3	CZ2B_MODE Default
16	Select Secondary Port, String 1				3	CZ2B_MODE
17	Select Primary Port, String 2				3	CZ2B_MODE Default
18	Select Secondary Port, String 2				3	CZ2B_MODE
19	Select Primary Port, String 3				3	CZ2B_MODE Default

TABLE 3.001-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
20	Select Secondary Port, String 3				3	CZ2B_MODE
21	Select Primary Port, String 4				3	CZ2B_MODE Default
22	Select Secondary Port, String 4				3	CZ2B_MODE
23	Select Primary Port, PL 1/2				3	CZ2B_MODE Default
24	Select Secondary Port, PL 1/2				3	CZ2B_MODE
25-34	Variable Downlist Parameter	0000	FFFF	HEX	5	CDJV_WORD_AREA 9EE4 Default
35	Uplink Control-Auto				8	CZ1B_D_UL_CNTL
36	Uplink Enabled				8	CZ1B_D_UL_CNTL Default
37	Uplink Inhibited				8	CZ1B_D_UL_CNTL
38	IPL SOURCE SWITCH MASK				9	CZ2B_MMU_IPL_SW_MASK Bit 16
39-47	Null Items (Not Used)					
48	G3 ARCHIVE LOAD				10	CZ2B_G3ARCH_STAT Bit 15
49	G3 ARCHIVE RETRIEVE				10	CZ2B_G3ARCH_STAT Bit 16
50	LDB Enable/Disable				11	
51	SM GSE Inhibit				12	
52	SM Ground Checkout ENA				12	
53	GNC Ground Checkout ENA				12	
54	BFC RUN Discrete Enable				12	CZ2B_DPS_ITEMS Bit 8
55	ALT PL9 Toggle Buffer				12	CZ2B_DPS_ITEMS Bit 9

3.5.002 DISPLAY: TIME

–1 AVAILABILITY: SPEC 002 in G9, PL9, SM2/4, G2, and G8.

–2 PURPOSE: The TIME SPEC function provides selection of displayed time (GMT or MET), control of CRT timers, updating of the MTU, and selection of the time source used by the GPC(s). (37536) (45609/47317)

```
XXXX/002/            TIME          XX X DDD/HH:MM:SS
                                         DDD/HH:MM:SS
MISSION TIME                     TONE
  GMT 1X                           3  XX:XX:XX MSN T
  MET 2X                           6  XX:XX:XX
CRT TIMER
  9 SET [±]XX:XX:XX               20 [±]XX:XX:XX CRT T
  START  12  STOP 13
  14 START AT XX:XX:XX MSN T   23 DURATION  XX
  17 COUNT TO XX:XX:XX MSN T
-------------------------------------------------------
MTU
  24 GMT Δ [±]XXX/XX:XX:XX.XXX
  28 MET Δ [±]XXX/XX:XX:XX.XXX
     UPDATE 32                      MET RESET 33
-------------------------------------------------------
GPC TIME                                          GPC
                        GMT          |TRY|    1 XX
  MTU ACCUM 1 |XXX/XX:XX:XX.XXXS     |34 |    2 XX
            2 |XXX/XX:XX:XX.XXXS     |35 |    3 XX
            3 |XXX/XX:XX:XX.XXXS     |36 |    4 XX
          GPC |XXX/XX:XX:XX.XXXS     |37 |    5 XX

  TIME SYNC 38

                                                (XX)
```

Figure 3.002

TABLE 3.002-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-up	SPEC 002 PRO	SPEC Call-up is valid except in OPS G1/6 & G3. (37427)
2	Select Type of Time for CRT	ITEM 1 EXEC	Selects Greenwich Mean Time (GMT) for display as time in the upper right corner of all displays. Format is DDD/HH:MM:SS. Default selection upon PASS initialization.
		ITEM 2 EXEC	Selects Mission Elapsed Time (MET) for display as time (same format as GMT). MET will automatically be reset to OOO/OO:OO:OO at SRB ignition.
3	CRT Timer Controls		The capability exists to display a time counter immediately below the time displayed in function 2. A single timer/major function is available. Three types of counts are available: manual, start-at (wait until some mission time to start), and count-to (start now and count to specified mission time). (37504)
	Manual Timer	ITEM 9±HH±MM ±SS EXEC	The values specified are hours, minutes, seconds desired in the timer. The sign of the lowest non-zero item (ITEM 9 = hours, ITEM 10 = minutes, ITEM 11 = seconds) is taken as the entire sign; thus -01+10+00 is -1 hr. 10 min. or -70 min. Default value is 00:00:00.
		ITEM 12 EXEC	Start the timer. If the time entered is negative, the timer will count down to zero, then start counting up. If the timer entered is positive, the timer will start counting up.
	Start-At	ITEM 14+HH+MM +SS EXEC	The mission time (ignoring days) entered by ITEMs 14-16 is compared to the current mission time. When the specified mission time is reached, the CRT timer will start counting at the value specified via ITEMs 9-11, and ITEMs 9-11, 14-16 will be blanked. NOTE: If an OPS transition is made to an OPS where TIME is not a valid SPEC before the specified mission time is reached, the time will be nullified, i.e., the request will be cancelled.

TABLE 3.002-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
	Count-to	ITEM 17+HH+MM +SS EXEC	Upon receipt of the keyboard message, the input mission time is subtracted from the current mission time and the delta is displayed. The timer will then count down to zero, at which point ITEMs 17-19 will be blanked, and the timer will begin to count up.
	Timer stop	ITEM 13 EXEC	In all three cases, the timer may be stopped by entering ITEM 13.
4	Alert Tone(s) Control		Two mission times may be specified at which to sound an alert tone.
		ITEM 3+HH+MM +SS EXEC	At the specified mission time, an alert tone will be sounded and ITEMs 3-5 will be blanked.
		ITEM 6+HH+MM +SS EXEC	Identical to first entry (ITEMs 3-5).
		ITEM 20±HH±MM ±SS EXEC	Specifies the value of the CRT timer (see function 3) at which an alert tone is to be sounded. The sign of the first non-zero field entered determines the sign of the value. A value in the past relative to the CRT timer value will cause an immediate alert.
		ITEM 23+SS EXEC	Specifies the duration (in seconds) of the alert tone. The default is 1.
			Transition to an OPS where TIME is not a valid SPEC will nullify all alert tone inputs.
5	Master Timing Unit (MTU) Update		
	GMT Update	ITEM 24±DDD ±HH±MM±SS.SSS EXEC	ITEMS 24-27 are used to enter a delta to be applied to the current MTU GMT value. The entire delta will take the sign of the lowest ITEM number which is non-zero.
		ITEM 32 EXEC	This causes the GMT to be updated by the specified delta. (29284/40620)
	MET Update	ITEM 28±DDD ±HH±MM+SS.SSS EXEC	ITEMs 28-31 are used to enter a delta to be applied to the current MTU MET value. The entire delta will take the sign of the lowest ITEM number which is non-zero.

TABLE 3.002-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 32 EXEC	This causes the MET to be updated by the specified delta. The actual update may take up to two minutes to occur. A second MET update should not be attempted until the first actually occurs. NOTE: ITEMs 24-27 and 28-31 are mutually exclusive sets.
	MET Reset	ITEM 33 EXEC	The MTUs MET and all common set GPCs MET will be reset to 000/00:00:00.000 immediately.
6	GPC Time Source Selection		The values of each MTU accumulator and the internal GPC time are displayed in DDD/HH:MM:SS.SSS. Also, the time source for each GPC in the common set is shown at the far lower right of the CRT. Codes are A1-A3 for the MTU accumulators and 1-5 for GPCs 1-5. (36544) (37517)
		ITEM 34 EXEC	All GPCs in common set will attempt to use MTU accumulator 1.
		ITEM 35 EXEC	Try MTU accumulator 2.
		ITEM 36 EXEC	Try MTU accumulator 3.
		ITEM 37 EXEC	Try the internal GPC timer of the lowest ID GPC in the common set.
7	Time Source Synchronization	ITEM 38 EXEC	The MTU GMT is reset, all GPCs in common set are forced to the time in the lowest ID GPC, the MTU GMT is updated to the time in the lowest ID GPC, and finally, the GPC selects MTU accumulator 1 as the time source. The actual time synch may take up to two minutes to occur. Other activities should be suspended until it occurs.

TABLE 3.002-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select GMT for Mission Time				2	
2	Select MET for Mission Time				2	
3	Alert 1 Hours	00	23	HR	4	CAAV_TM_ITEM_I(3)
4	Alert 1 Minutes	00	59	MIN	4	CAAV_TM_ITEM_I(4)
5	Alert 1 Seconds	00	59	SEC	4	CAAV_TM_ITEM_I(5)
6	Alert 2 Hours	00	23	HR	4	CAAV_TM_ITEM_I(6)
7	Alert 2 Minutes	00	59	MIN	4	CAAV_TM_ITEM_I(7)
8	Alert 2 Seconds	00	59	SEC	4	CAAV_TM_ITEM_I(8)
9	Timer Hours	-23	+ 23	HRS	3	CAAV_TM_ITEM_I(9)
10	Timer Minutes	-59	+ 59	MIN	3	CAAV_TM_ITEM_I(10)
11	Timer Seconds	-59	+ 59	SEC	3	CAAV_TM_ITEM_I(11)
12	Start Manual Timer				3	
13	Stop Any Type Timer				3	
14	Timer - Mission Time Hrs	00	23	HR	3	CAAV_TM_ITEM_I(14)
15	Timer - Mission Time Min	00	59	MIN	3	CAAV_TM_ITEM_I(15)
16	Timer - Mission Time Sec	00	59	SEC	3	CAAV_TM_ITEM_I(16)
17	Timer - Mission Time Hrs	00	23	HR	3	CAAV_TM_ITEM_I(17)
18	Timer - Mission Time Min	00	59	MIN	3	CAAV_TM_ITEM_I(18)
19	Timer - Mission Time Sec	00	59	SEC	3	CAAV_TM_ITEM_I(19)
20	Alert Mission Time - Hrs	00	23	HR	4	CAAV_TM_ITEM_I(20)

TABLE 3.002-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
21	Alert Mission Time - Min	00	59	MIN	4	CAAV_TM_ITEM_I(21)
22	Alert Mission Time - Sec	00	59	SEC	4	CAAV_TM_ITEM_I(22)
23	Set Duration of Alert Tone	00	99	SEC	4	CAAV_TM_ITEM_I(23) Default is 1
24	GMT Delta Days	-399	+ 399	DAYS	5	CAAV_TM_GMT_DELT(I)
25	GMT Delta Hours	-23	+ 23	HRS	5	CAAV_TM_GMT_DELT(I)
26	GMT Delta Minutes	-59	+ 59	MIN	5	CAAV_TM_GMT_DELT(I)
27	GMT Delta Seconds	-59.999	+59.999	SEC	5	CAAV_TM_GMT_SEC
28	MET Delta Days	-399	+ 399	DAYS	5	CAAV_TM_MET_DELT(J)
29	MET Delta Hours	-23	+ 23	HRS	5	CAAV_TM_MET_DELT(J)
30	MET Delta Minutes	-59	+ 59	MIN	5	CAAV_TM_MET_DELT(J)
31	MET Delta Seconds	-59.999	+59.999	SEC	5	CAAV_TM_MET_SEC
32	DO GMT/MET Update				5	May take up to two minutes
33	Reset MET				5	
34	MTU Accumulator 1 Try				6	
35	MTU Accumulator 2 Try				6	
36	MTU Accumulator 3 Try				6	
37	GPC Time Try				6	
38	Time Source Synchronization				7	May take up to two minutes

3.5.006 DISPLAY: GPC/BUS STATUS

–1 AVAILABILITY: SPEC 006 in all OPS.

–2 PURPOSE: The GPC/BUS STATUS display is a display function only; i.e., no keyboard entries are defined. It provides status information on GPC and data bus health plus current commander information.

XXXX/XXX/006 GPC/BUS STATUS XX X DDD/HH:MM:SS
DDD/HH:MM:SS

GPC	1S	2S	3S	4S	5S
MODE	XXXX	XXXX	XXXX	XXXX	XXXX
OPS	XX	XX	XX	XX	XX
STRING 1 FF	XS	XS	XS	XS	XS
FA	XS	XS	XS	XS	XS
2 FF	XS	XS	XS	XS	XS
FA	XS	XS	XS	XS	XS
3 FF	XS	XS	XS	XS	XS
FA	XS	XS	XS	XS	XS
4 FF	XS	XS	XS	XS	XS
FA	XS	XS	XS	XS	XS
PL 1	XS	XS	XS	XS	XS
2	XS	XS	XS	XS	XS
LAUNCH 1	XS	XS	XS	XS	XS
2	XS	XS	XS	XS	XS
CRT 1	XS	XS	XS	XS	XS
2	XS	XS	XS	XS	XS
3	XS	XS	XS	XS	XS
4	XS	XS	XS	XS	XS

(XX)

Figure 3.006

TABLE 3.006-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	SPEC 006 PRO	Available in all OPS. This is a display function only.
2	GPC Status		The GPC health is indicated by either blank (good) or a down arrow (failed) for each GPC. The GPC Mode Switch is shown for each GPC. If the majority of the GPCs in the SPEC 006 DEU commander's common set see zero sync discretes from a GPC, then HALT is displayed for that GPC; otherwise, RUN is displayed. The current OPS of each GPC in common set with SPEC 006 DEU commander is shown. The first character denotes the major function active (G, S, P); the second character is the OPS number. For GPC(s) in HALT/STBY, the last non-zero OPS active is shown.
3	Bus Status		An * is placed in the appropriate GPC column for each bus on the display to denote the commander of the bus. A status indicator of good (blank) or bypassed/failed (down arrow) is shown.

3.5.018 DISPLAY: GNC SYS SUMM 1

–1 AVAILABILITY: SPEC 018 in G1, G2, G3, G6, G8, or SYS SUMM Key.

–2 PURPOSE: This display is one of two pages for overall monitoring of the Orbiter GNC systems configuration and operational status. The second page is applicable during the orbit phase. The status information presented allows sufficient detail for a crew member to determine the required response to a GNC caution and warning alarm. The display presents a summary of Aerosurface Status, RCS Manifold Jet Status, RCS manifold isolation valve position and status Flight Control Channel Status, GPC and Flight Critical MDM Status, and Navigation Sensor Status.

```
XXXX/XXX/018   GNC SYS SUMM 1   XX X DDD/HH:MM:SS
                                    DDD/HH:MM:SS

RCS | JET|ISOL
MANF|FAIL|VLV   SURF     POS    MOM  DPS    1 2 3 4 5
  F1|XXX | XXS  L OB     XXX.XS XXS     GPC S S S S S
   2|XXX | XXS    IB     XXX.XS XXS  MDM FF S S S S
   3|XXX | XXS  R IB     XXX.XS XXS      FA S S S S
   4|XXX | XXS    OB     XXX.XS XXS
   5|XXX | XXS  AIL      XXX.X
  L1|XXX | XXS  RUD      XXX.X        FCS CH 1 2 3 4
   2|XXX | XXS  SPD BRK  XXX.X              S S S S
   3|XXX | XXS  BDY FLP  XXX.X
   4|XXX | XXS           XXXXXX
   5|XXX | XXS                       NAV    1 2 3 4
  R1|XXX | XXS                         IMU  S S S
   2|XXX | XXS  CNTLR  1 2 3          ACC  S S S S
   3|XXX | XXS  RHC  L S S S          RGA  S S S S
   4|XXX | XXS       R S S S          TAC  S S S
   5|XXX | XXS       A S S S          MLS  S S S
                THC  L S S S          ADTA S S S S
                     A S S S
                SBTC L S S S
                     R S S S

                                                (XX)
```

Figure 3.018

TABLE 3.018-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	RCS Jet Condition		BLANK - No failures ON - Set failed on OFF - Failure to fire LK - Detected leak NOTE: The status of the number 5 Jet on each POD is displayed only in OPS2 and OPS8.
2	Isolation Valve Position		OP = open, CL = closed as determined by software. Status: Blank - no errors ? - dilemma encountered by software M - I/O error or missing data NOTE: Last position (OP or CL) remains on display.
3	Computed Aero Surface Position and Loading Status		Displayed in OPS3 & OPS6 for the elevons, aileron and rudder. The surface positions are displayed in degrees. A direction indicator is also displayed as follows: Elevons - U for up D for down Aileron - R for right (right elevons up, left elevons down) L for left (right elevons down, left elevons up) Rudder - R right rudder pedal pressure L left rudder pedal pressure Position status is displayed for elevons only: Up arrow for position saturation above upper limit. Down arrow for position saturation below down limit.

TABLE 3.018-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			The current hinge moment on the elevons is displayed as percent of maximum allowed. When the hinge moment exceeds maximum, an up arrow status indicator is displayed. For the body flap and speedbrake, positions are displayed as percent: Speedbrake - 100% is full deflection. Body flap - 0% equals -11.71 degrees and 100% equals +22.55 degrees. The body flap pilot valve status is displayed as follows: Blank - Normal operation Hold 2 - No body flap command is present but a body flap position change is detected by software. (Hold 2 reflects that Channel 2 is commanded in the opposite direction of the failure.) Hold 1 - The Hold 2 action did not correct problem (Channel 2 commands are removed and Channel 1 is commanded in the opposite direction of the failure.) Cycle - Neither Hold 1 or Hold 2 corrected problem. Fail - This is displayed when the flight control commanded direction is not followed or if a hold commanded direction is not followed (body flap moves in opposite direction).
4	Hand Controller Status		OPS1: None OPS2: RHC Left Right Aft THC Left Aft OPS3: RHC Left Aft THC Left SBTC Left Right OPS6: RHC Left Right THC Left SBTC Left Right OPS8: RHC Left Right Aft THC Left Aft

TABLE 3.018-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			Status indicators: Blank - Normal operation Down Arrow - Manual deselection or failure detected by RM ? - Dilemma encountered M - I/O missing
5	GPC Fail Status		Presented when: a. Two members of a common set cast fail votes against another GPC. b. A GPC has a fail indicator against itself. - When a set of two GPCs SYNC fail with each other, no down arrows are presented. - Fail status indicator reset occurs when the CAM output discretes are reset.
6	MDM Fail Status		An MDM failure is manifest by either all of the elements referencing that MDM being bypassed or a hard error occurring on the MDM return word I/O request. Bus masks are set against I/O strings commanded by a failed GPC after SYNC fail has occurred. Note that the opinion of the remaining members of the set and the failed GPC will be different, each will mask the other's buses. In the case of a two GPC set which has failed, each will mask and present down arrows against the data buses commanded by the other.
7	Flight Control Channels		Status indicators are driven as follows: (37567) Blank - No failures Down Arrow - Failure (Port bypass) M - I/O error, data missing For the following OPS, these components are included in the status report: OPS1 - SRB (tilt and rock) MPS (pitch and yaw) AERO (elevons, speedbrake, rudder) OPS3 - AERO OPS6 - AERO

TABLE 3.018-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
8	NAV Sensors		Status display is provided during these OPS for the listed sensors: OPS1 - IMU 1, 2, 3 ACC 1, 2, 3, 4 RGA 1, 2, 3, 4 OPS2 - IMU 1, 2, 3 OPS3 - IMU 1, 2, 3 ACC 1, 2, 3, 4 RGA 1, 2, 3, 4 TAC 1, 2, 3 MLS 1, 2, 3, 4 ADTA 1, 2, 3, 4 OPS6 - IMU 1, 2, 3 ACC 1, 2, 3, 4 RGA 1, 2, 3, 4 TAC 1, 2, 3* MLS 1, 2, 3* ADTA 1, 2, 3, 4* OPS8 - IMU 1, 2, 3 *(MM602 and 603 only). Status indicators are driven as follows: Blank - Normal status or sensor not supported in this OPS Down Arrow - Failure detected or manual deselect ? - Dilemma declared (disagree or fault detect) M - Missing data because of an I/O error or loss of lock.

3.5.019 DISPLAY: GNC SYS SUMM 2

–1 AVAILABILITY: SPEC 019 in G2, G8, or SYS SUMM Key Twice.

–2 PURPOSE: This display is the primary format for monitoring Orbit GNC systems operational status during the orbit phase. The data and status information presented provides sufficient detail for a crew member to respond to GNC caution and warning alarms. The display presents RCS consumables data and its status and the manifold jet status; and the OMS consumables data and its status.

```
 XXXX/XXX/019   GNC SYS SUMM 2   XX X DDD/HH:MM:SS
                                      DDD/HH:MM:SS
OMS AFT QTY    L     R        OMS          L     R
        OXID XX.XS XX.XS         TK P   HE XXXXS XXXXS
          FU XX.XS XX.XS              OXID  XXXS  XXXS
                                        FU  XXXS  XXXS
                          JET ISOL   N2 TK   P XXXXS XXXXS
RCS          OXID   FU  FAIL VLV       REG  P  XXXS  XXXS
FWD  HE P XXXXS XXXXS                   P VLV   XXS   XXS
     TK P  XXXS  XXXS                ENG IN   P
     QTY   XXXS  XXXS                     OXID  XXXS  XXXS
MANF  1 P  XXXS  XXXS XXX   XXS            FU  XXXS  XXXS
      2 P  XXXS  XXXS XXX   XXS          VLV 1  XXXS  XXXS
      3 P  XXXS  XXXS XXX   XXS              2  XXXS  XXXS
      4 P  XXXS  XXXS XXX   XXS                        JET ISOL
      5                XXX   XXS                OXID  FU FAIL VLV
AFT  HE P XXXXS XXXXS                   HE P XXXXS XXXXS
L    TK P  XXXS  XXXS                 R TK P  XXXS  XXXS
     QTY   XXXS  XXXS                   QTY  XXXS  XXXS
MANF  1 P  XXXS  XXXS XXX   XXS          1 P  XXXS  XXXS XXX  XXS
      2 P  XXXS  XXXS XXX   XXS          2 P  XXXS  XXXS XXX  XXS
      3 P  XXXS  XXXS XXX   XXS          3 P  XXXS  XXXS XXX  XXS
      4 P  XXXS  XXXS XXX   XXS          4 P  XXXS  XXXS XXX  XXS
      5                XXX   XXS          5                XXX  XXS
                                                            (XX)
```

Figure 3.019

TABLE 3.019-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	RCS Propulsion System		The following parameters are displayed for both oxidizer and fuel in each of the forward (F), left (L), and right (R) RCS pods: a. Pressures in PSIA 1) Helium pressure 2) Tank pressure 3) Manifold pressure b. Propellant quantities in percent. Status indicators will be output as follows: a. Helium pressure 1) Down arrow - pressure below lower limit 2) M - missing data 3) Blank - normal operation b. Tank pressure 1) Down arrow - pressure below lower limit 2) Up arrow - pressure above the upper limit 3) Blank - normal operation c. Manifold pressure 1) M - missing data 2) Blank - normal operation d. Propellant quantity 1) Down arrow - leak flag or quantity alert 2) Blank - normal operation
2	RCS Jet Manifold Status		Status indicators are presented for manifolds 1 through 5. Manifolds are listed by two-character identifiers. The first digit identifies the RCS pod F, L, and R and the second digit the manifold number 1 through 5. Fail Status: ON - failed on LK - detected leak OFF - failure to fire Blank - no failures The fail status is the logical OR of the state of all jets on a manifold.

TABLE 3.019-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			ISOL VLV position: OP - open CL - closed I/O status of valves: M - MDM or BCE commfault ? - dilemma detected by software Blank - normal operation NOTE: When an M is displayed the current valve status (OP or CL) will continue to be displayed.
3	OMS Propulsion System		The following parameters will be displayed in PSIA for the left and right pods: a. Helium b. Oxidizer c. Fuel tank pressures d. Nitrogen regulator e. Nitrogen tank pressures f. Engine oxidizer g. Fuel inlet pressures Position of left and right engine nitrogen pressure valves: OP - open CL - closed Left and right one and two engine bipropellant valve positions are displayed in percent open. Left and right oxidizer and fuel quantities are displayed in percent. Status indicators: a. Helium tank pressure and fuel tank pressure: 1. Down arrow - pressure below the lower limit 2. M - missing data 3. Blank - normal operation

TABLE 3.019-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			b. Oxidizer tank pressure, fuel tank pressure, and nitrogen regulator: 1. Down arrow - pressure below the lower limit 2. Up arrow - pressure above the upper limit 3. M - missing data 4. Blank - normal operation c. Engine oxidizer inlet pressure, fuel inlet pressure, nitrogen pressure valve position, bipropellant valve positions 1 and 2: 1. M - missing data 2. Blank - normal operation d. Oxidizer and fuel quantity: 1. Down arrow - quantity below lower limit 2. M - missing quantity data 3. Blank - normal operation

3.5.020 DISPLAY: DAP CONFIG

–1 AVAILABILITY: SPEC 020 in OPS G2.

–2 PURPOSE: The On-Orbit DAP Configuration display provides the crew with the capability to review and change the selected DAP parameters listed below:

DAP load A and B
Translation pulse size
Rotation discrete rate
Pulse size
Compensations
Attitude and rate deadbands
Jet option and control acceleration
Principal axis inertias
Alternate Jet Mode Parameters

```
XXXX/020/          DAP  CONFIG      XX X DDD/HH:MM:SS
                                         DDD/HH:MM:SS
TRANSLATION              A              B
 PULSE              1   X.XX   15      X.XX

ROTATION
 DISC RATE  NORM   2   X.XXX  16     X.XXX
            VERN   3   X.XXX  17     X.XXX
 PULSE      NORM   4    X.XX  18      X.XX    INERTIAS
            VERN   5   X.XXX  19     X.XXX   29 IX X.XXX
 COMP       NORM   6     .XX  20       .XX   30 IY X.XXX
            VERN   7    .XXX  21      .XXX   31 IZ X.XXX

                                              ALT
 ATT        NORM   8   XX.XX  22     XX.XX   RATE DB
            VERN   9  XX.XXX  23    XX.XXX    32  X.XXX
                                              JET OPT
 RATE       NORM  10    X.XX  24      X.XX    33      X
            VERN  11    .XXX  25      .XXX    # JETS
                                               34      X
JET OPT       P  12       X   26        X    ON TIME
              Y  13       X   27        X     35   X.XX
                                              DELAY
CNTL ACCEL       14       X   28        X     36  XX.XX
                                                   (XX)
```

Figure 3.020

TABLE 3.020-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 020 PRO	Orbit DAP configuration, SPEC is available in G2.
2	Translation pulse size	ITEM 1 + X.XX EXEC ITEM 15 + X.XX EXEC	Specifies the desired velocity delta resulting from a single manual translation pulse command for DAP load A (Item 1) and DAP load B (Item 15). NOTE: The pulse size is specified in feet per second.
3	Rotation discrete rate	ITEM 2 + X.XXX EXEC ITEM 3 + X.XXX EXEC	Normal and Vernier Jets; specifies the desired rotational rate to be achieved for a discrete rate manual command or an AUTO maneuver for DAP load A.
		ITEM 16 + X.XXX EXEC ITEM 17 + X.XXX EXEC	Normal and Vernier Jets; specifies the desired rotational rate to be achieved for a discrete rate manual command or an AUTO maneuver for DAP load B.
4	Pulse Size	ITEM 4 + X.XX EXEC ITEM 5 + X.XXX EXEC	Normal and Vernier Jets; specifies the rotational rate resulting from a single manual rotational pulse command for DAP load A.
		ITEM 18 + X.XX EXEC ITEM 19 + X.XXX EXEC	Normal and Vernier Jets; specifies the rotational rate resulting from a single manual rotational pulse command for DAP load B.
5	Compensations	ITEM 6 + .XX EXEC ITEM 7 + .XXX EXEC	Normal and Vernier Jets; specifies the allowable rotation rate for a given axis resulting from a rate command about another axis for DAP load A.
		ITEM 20 + .XX EXEC ITEM 21 + .XXX EXEC	Normal and Vernier Jets; specifies the allowable rotation rate for a given axis resulting from a rate command about another axis for DAP load B. NOTE: Rotation parameters are specified in degrees per second.
6	Attitude Deadbands	ITEM 8 + XX.XX EXEC ITEM 9 + XX.XXX EXEC	Normal and Vernier Jets; specifies the attitude deadbands used in the phase plane for DAP load A.

TABLE 3.020-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 22 + XX.XX EXEC ITEM 23 + XX.XXX EXEC	Normal and Vernier Jets; specifies the attitude deadbands used in the phase plane for DAP load B. NOTE: The attitude deadbands are specified in degrees.
7	Rate Deadbands	ITEM 10 + X.XX EXEC ITEM 11 + .XXX EXEC	Normal and Vernier Jets; specifies the rate deadbands used in the phase plane for DAP load A.
		ITEM 24 + X.XX EXEC ITEM 25 + .XXX EXEC	Normal and Vernier Jets; specifies the rate deadbands used in the phase plane for DAP load B. NOTE: The rate deadbands are specified in degrees per second.
8	Jet Option	ITEM 12 + X EXEC	Pitch attitude control for DAP load A.
		ITEM 26 + X EXEC	Pitch attitude control for DAP load B.
		ITEM 13 + X EXEC	Yaw attitude control for DAP load A.
		ITEM 27 + X EXEC	Yaw attitude control for DAP load B.
			The jet option is specified as a coded integer: 1 - Selects the normal jet option 2 - Selects the nose only jet 3 - Selects the tail only jet
9	Control Acceleration	ITEM 14 + X EXEC	Selects the control acceleration for DAP load A.
		ITEM 28 + X EXEC	Selects the control acceleration for DAP load B. The control acceleration selection is specified as a coded integer to select either nominal (normal/Alt/vernier) or alternate (vernier or Alt) acceleration values: 0 - Selects the nominal control 1 - Alternate 1 (vernier/Alt jets) 2 - Alternate 2 (vernier/Alt jets) 3 - Alternate 3 (vernier/Alt jets) 4 - Alternate 4 (vernier/Alt jets) 5 - Alternate 5 (vernier/Alt jets)

TABLE 3.020-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
10	Principle Axis Inertias	ITEM 29 + X.XXX EXEC ITEM 30 + X.XXX EXEC ITEM 31 + X.XXX EXEC	Specifies the thruster rotational accelerations about the principle axis (X, Y, Z). NOTE: The inertia values are specified in MEGA-Slugs/Ft^2.
11	Alternate Jet Mode	ITEM 32 + X.XXX EXEC	Alternate Jets; specifies the rate limit in deg/sec used in the phase planes.
		ITEM 33 + X EXEC	Allows for the selection of one of two control modes with Alt jets selected: 1: Nose and tail jets 3: Tail only jets NOTE: Selection of "2" shall result in an ILLEGAL ENTRY message and rejection of the entry.
		ITEM 34 + X EXEC	Selection of the maximum number of primary jets allowed to be fired simultaneously while in Alternate Primary Mode.
		ITEM 35 + X.XX EXEC	Selection of the maximum duration of each jet firing in seconds while in the Alternate Primary Mode.
		ITEM 36 + XX.XX EXEC	Selection of the minimum time delay in seconds between jet firings while in the Alternate Primary Mode. NOTE: Caution should be exercised when using Items 34 to 36. Incorrect combinations could result in excessive RMS loadings.

TABLE 3.020-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Translation Pulse Size	0.010	5.000	FT/ SEC	2	CGCV_ARY_TRANS_PULSE$1
2	Rotation Discrete Rate for Primary Jets	0.050	2.000	DEG/ SEC	3	CGCV_ARY_MNVR_RATE$(1,1)
3	Rotation Discrete Rate for Vernier Jets	0.002	1.000	DEG/ SEC	3	CGCV_ARY_MNVR_RATE$(1,2)
4	Pulse Size for Primary Jets	0.040	1.000	DEG/ SEC	4	CGCV_ARY_ROT_PULSE$(1,1)
5	Pulse Size for Vernier Jets	0.001	0.500	DEG/ SEC	4	CGCV_ARY_PULSE$(1,2)
6	Rotation Compensation for Primary Jets	0.000	0.990	DEG/ SEC	5	CGCV_ARY_COMP_THRESHOLD$(1,1)
7	Rotation Compensation for Vernier Jets	0.000	0.999	DEG/ SEC	5	CGCV_ARY_COMP_THRESHOLD$(1,2)
8	Attitude Deadbands used in the phase plane for DAP load	0.100	40.00	DEG	6	CGCV_ARRAY_DB$(1,1)
9	Attitude Deadbands used in the phase plane for DAP load	0.010	40.00	DEG/ SEC	6	CGCV_ARRAY_DB$(1,2)
10	Rate Deadbands used in the phase plane for DAP load	0.100	5.000	DEG/ SEC	7	CGCV_ARRAY_RATE_LIMIT$(1,1)
11	Rate Deadbands used in the phase plane for DAP load	0.010	0.500	DEG/ SEC	7	CGCV_ARRAY_RATE_LIMIT$(1,2)

TABLE 3.020-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
12	Jet Selection for Pitch Attitude Control	1	3		8	CGCV_A_NOM_NOSE_TAIL_PITCH$1
13	Jet Selection for Yaw Attitude Control	1	3		8	CGCV_A_NOM_NOSE_TAIL_YAW$1
14	Control Acceleration Alternate (Vernier or Alt Jets)	0	5		9	CGCV_ARY_PAYLOAD_EXTENDED$1
15	Same as 1					CGCV_ARY_TRANS_PULSE$2
16	Same as 2					CGCV_ARY_MNVR_RATE$(2,1)
17	Same as 3					CGCV_ARY_MNVR_RATE$(2,2)
18	Same as 4					CGCV_ARY_ROT_PULSE$(2,1)
19	Same as 5					CGCV_ARY_ROT_PULSE$(2,2)
20	Same as 6					CGCV_ARY_COMP_THRESHOLD$(2,1)
21	Same as 7					CGCV_ARY_COMP_THRESHOLD$(2,2)
22	Same as 8					CGCV_ARRAY_DB$(2,1)
23	Same as 9					CGCV_ARRAY_DB$(2,2)
24	Same as 10					CGCV_ARRAY_RATE_LIMIT$(2,1)
25	Same as 11					CGCV_ARRAY_RATE_LIMIT$(2,2)
26	Same as 12					CGCV_A_NOM_NOSE_TAIL_PITCH$2
27	Same as 13					CGCV_A_NOM_NOSE_TAIL_YAW$2
28	Same as 14					CGCV_ARY_PAYLOAD_EXTENDED$2
29	Principal X axis Moments of Inertia	0.750	1.000	MEGA-SLG/FT^2	10	CGCV_PRINCIPAL_INERTIA$1

TABLE 3.020-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
30	Principal Y axis Moments of Inertia	6.000	8.000	MEGA-SLG/FT^2	10	CGCV_PRINCIPAL_INERTIA$2
31	Principal Z axis Moments of Inertia	6.000	8.000	MEGA-SLG/FT^2	10	CGCV_PRINCIPAL_INERTIA$3
32	Specifies the rate limit used in the phase plane with Alt Jets selected	0.050	5.000	DEG/SEC	11	CGCV_ALT_PRIMARY_RATE_LIMIT
33	Alternate Primary Jet Option with Alt Jets selected	1	3		11	CGCV_ALT_PRIMARY_JET_OPTION
34	Maximum Number of Primary Jets During Alternate Primary Mode	1	3		11	CGCV_ALT_PRIMARY_MAX_JETS
35	Maximum Jet on Time During Alternate Primary Mode	0.08	9.99	SEC	11	CGCV_ALT_PRIMARY_ON_TIME
36	Minimum Delay Time Between Jet Firings for Alternate Primary Mode	0.00	99.99	SEC	11	CGCV_ALT_PRIMARY_DELAY_TIME

3.5.021 DISPLAY: IMU ALIGN

–1 AVAILABILITY: SPEC 021 in OPS G2 and G3.

–2 PURPOSE: This display provides the capability to monitor and control the IMU hardware and software mode of operation during the Orbit, Deorbit, and Entry phases of flight. The capability to control and monitor the alignment of the IMU's while on-orbit or prior to the deorbit maneuver is also provided.

```
XXXX/021/          IMU ALIGN        XX X DDD/HH:MM:SS
IMU                                      DDD/HH:MM:SS
      1S    2S    3S
STAT XXXX  XXXX  XXXX              ALIGN XXX
TEMP   XX    XX    XX    IMU  1 10X  STAR ALIGN 13X
STBY  21X   22X   23X         2 11X  14 IMU/IMU   X
OPER   4X    5X    6X         3 12X  MATRIX     15X
DES    7X    8X    9X
                                            EXEC 16X
                                            TERM 17
ACC
    1      2      3                  IMU BITE MASK
X ±X.XX  ±X.XX  ±X.XX                 1  XXXX  24X
Y ±X.XX  ±X.XX  ±X.XX                 2  XXXX  25X
Z ±X.XX  ±X.XX  ±X.XX                 3  XXXX  26X

ANG
     1        2        3
X  XXX.XX   XXX.XX   XXX.XX
Y  XXX.XX   XXX.XX   XXX.XX          NAV ΔV THRESH
Z  XXX.XX   XXX.XX   XXX.XX            18 XXXXXX
ΔX ±XXX.XX ±XXX.XX ±XXX.XX
ΔY ±XXX.XX ±XXX.XX ±XXX.XX           MM READ 19X
ΔZ ±XXX.XX ±XXX.XX ±XXX.XX
                                                (XX)
```

Figure 3.021

TABLE 3.021-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 021 PRO	Valid only in OPS G2 (MM201) and G3 (MM301, MM302, MM303, MM304). (45166) (47741/47752)
2	IMU Mode Control	ITEM N EXEC	N = 21, 22, or 23: Causes the respective IMU to be commanded to the STANDBY mode of operation. An asterisk will be displayed next to the Item to indicate that the IMU is in this mode of operation. The asterisk will be blanked if the IMU is commanded to the OPERATE mode (Items 4, 5, 6). Only the IMU heater circuits remain powered ON in this mode. This is the default mode of operation when the system is initialized prior to launch. (37522)
		ITEM N EXEC	N = 4, 5, or 6: Causes IMU 1, 2, 3 respectively to be commanded to the OPERATE mode of operation. An asterisk will be displayed next to the Item to indicate that the IMU is in this mode of operation. The asterisk will be blanked if the IMU is commanded to the STANDBY mode (Items 1, 2, 3). All IMU circuits are powered ON in this mode of operation. This is the normal mode of operation in OPS2 and OPS3.
3	IMU RM Selection Filter Control	ITEM N EXEC	N = 7, 8, or 9: Causes IMU 1, 2, 3 respectively to be deselected from IMU RM selection filter processing. An asterisk will be displayed next to the Item and a down arrow displayed next to the IMU number to indicate that the IMU has been deselected. Re-execution of the Item will cause the IMU to be selected for IMU RM processing and the asterisk and arrow to be blanked. Automatic selection filter changes by IMU RM will also be displayed.
4	IMU Selection For Alignment	ITEM N EXEC	N = 10, 11, or 12: Causes IMU 1, 2, 3 respectively to be selected for alignment. An asterisk will be displayed next to the Item to indicate that the IMU has been selected. Re-execution of an Item will cause the IMU to be deselected from alignment and the asterisk to be blanked. Execution of an Item during an alignment will result in an ILLEGAL ENTRY message. Initial state will be no IMU selected.

TABLE 3.021-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
5	IMU Alignment Option Selection	ITEM 13 EXEC	Selects the STAR to IMU alignment option. An asterisk will be displayed next to Item 13 to indicate that this option is selected. This option utilizes data obtained from the Star Trackers or COAS to compute the inertial reference for the alignment. ENA will be displayed next to ALIGN on the display when the Star Tracker SOP determines proper data are available for alignment. The display will be initialized with this option selected. This option will be automatically selected after all alignments complete.
		ITEM 14 + N EXEC	N = 1, 2, or 3: Selects the IMU to IMU alignment option and specifies the IMU (N = 1, 2, 3) to be used as the reference for the alignment. This option utilizes data from the specified IMU (N) to compute the inertial reference for alignment. An ILLEGAL ENTRY message will be displayed if the specified reference IMU (N) is not in the operate mode.
		ITEM 15 EXEC	Selects the Matrix to IMU alignment option. An asterisk will be displayed next to Item 15 to indicate that this option is selected. This option utilizes data obtained from the Star Trackers or COAS to update the flight software referenced IMU cluster position data. ENA will be displayed next to ALIGN on the display when the Star Tracker SOP determines proper star data are available. (37522)
6	IMU Alignment Execution	ITEM 16 EXEC	Executes the IMU alignment option specified by Items 13, 14, 15. An asterisk will be displayed next to Item 16 while the IMU alignment option is executing. When the alignment completes or is terminated the asterisk is blanked. An ILLEGAL ENTRY message will be displayed if: - A STAR or Matrix alignment is executed without proper star data; ENA not displayed next to ALIGN on the display. - A STAR or Matrix alignment is executed in MM 302, 303, 304, 305. Execution of any alignment causes the Star Trackers to be moded to TERM/IDLE. The IMU ALIGN display can be overlaid without effecting an alignment that is in progress.

TABLE 3.021-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
7	IMU Alignment Terminate	ITEM 17 EXEC	Terminates an IMU alignment that is in progress.
8	Navigation Delta Velocity Threshold Input	ITEM 18 + NNNNNNN EXEC	Inputs the delta velocity threshold, in micro-Gs, above which On-Orbit Navigation (OPS2 only) incorporates IMU sensed velocity changes into state vector propagation. An ILLEGAL ENTRY message will be displayed and input value rejected if this Item is executed in OPS3. The current displayed value will be maintained across all OPS transitions.
9	Mass Memory Read of IMU Calibration Data	ITEM 19 EXEC	Will execute a read of IMU calibration data from the mass memory unit. An asterisk will be displayed next to Item 19 to indicate that the read is in progress. An ILLEGAL ENTRY message will be displayed if any other Item entry is made while the read is in progress.
10	IMU Masking	ITEM N EXEC	Execution of Item N = 24, 25, or 26 will cause the IMU SOP to compute a mask for all bites present on IMUs 1, 2, or 3, respectively, at the time of item entry. Re-execution of the same item terminates bite masking. If a new bite is experienced while masking is in effect, it is not automatically masked; it can be masked by terminating and then reactivating masking. Execution of the mask item will have no effect when masking is not active and there are no bites on the IMU. An asterisk displayed next to the item number indicates that masking is in effect.
11	Display of IMU Sensed Accelerations		The data displayed under ACC indicates the IMU sensed accelerations in feet per second squared in the inertial coordinate frame of reference.
12	Display of IMU Angles		The data displayed under ANG and next to X, Y, Z indicates the current Body-to-Inertial Euler angles in degrees as computed for each IMU. The data displayed under ANG and next to delta-X, delta-Y, delta-Z indicates the current IMU misalignment in degrees as computed for each IMU. This data is computed on a cyclic basis from the time that an IMU alignment option is selected until the alignment completes or is terminated, at which time the angles are zeroed.

TABLE 3.021-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
13	Display of IMU Bite Masks		A bite summary word is displayed to the left of the mask item number for each IMU. It is displayed as a four character hexadecimal number, with "0000" and "FFFC" indicating the "No Bite" and "All Bites On" conditions, respectively. The bite summary word is not affected by execution of the mask item entry.

TABLE 3.021-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	NULL					
2	NULL					
3	NULL					
4	IMU 1 in OPERATE				2	CGBB_MFF_SEG2_DSCRT12$(1;1)
5	IMU 2 in OPERATE				2	CGBB_MFF_SEG2_DSCRT12$(2;1)
6	IMU 3 in OPERATE				2	CGBB_MFF_SEG2_DSCRT12$(3;1)
7	SELECT/DESELECT IMU 1 for RM				3	CGAV_IMU_FAIL$(14)
8	SELECT/DESELECT IMU 2 for RM				3	CGAV_IMU_FAIL$(15)
9	SELECT/DESELECT IMU 3 for RM				3	CGAV_IMU_FAIL$(16)
10	SELECT IMU 1 for ALIGNMENT				4	CGZB_ALIGN_IMU_WD$(2)
11	SELECT IMU 2 for ALIGNMENT				4	CGZB_ALIGN_IMU_WD$(3)
12	SELECT IMU 3 for ALIGNMENT				4	CGZB_ALIGN_IMU_WD$(4)
13	SELECT STAR ALIGNMENT METHOD				5	CGZB_ALIGN_OPT$(1)
14	SELECT IMU/IMU ALIGNMENT OPTION	1	3	None	5	CGZV_IMU_IMU_REF_NUM
15	SELECT MATRIX ALIGNMENT OPTION				5	CGZB_ALIGN_OPT$(3)
16	EXECUTE IMU ALIGNMENT				6	CGZB_IN_ALIGN$(1)
17	TERMINATE IMU ALIGNMENT				7	CGZB_IMU_TERM_FLG$(1)
18	UPDATE NAV DELTA VELOCITY THRESHOLD	0	99999999	Micro Gs	8	CGZV_IMU_NAV_ACC_THRESH

TABLE 3.021-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
19	EXECUTE MASS MEMORY READ OF IMU DATA				9	CGZB_IMU_FLG_WD$(1)
20	NULL					
21	IMU 1 in STANDBY				2	CGBB_MFF_SEG2_DSCRT12$(1;1)
22	IMU 2 in STANDBY				2	CGBB_MFF_SEG2_DSCRT12$(2;1)
23	IMU 3 in STANDBY				2	CGBB_MFF_SEG2_DSCRT12$(3;1)
24	EXECUTE IMU 1 BITE MASK/UNMASK				10	CGZB_I_MASK_CMD$(1)
25	EXECUTE IMU 2 BITE MASK/UNMASK				10	CGZB_I_MASK_CMD$(2)
26	EXECUTE IMU 3 BITE MASK/UNMASK				10	CGZB_I_MASK_CMD$(3)

3.5.022 DISPLAY: S TRK/COAS CNTL

–1 AVAILABILITY: SPEC 022 in OPS G2 and G3(MM301).

–2 PURPOSE: SPEC 022 provides for STAR TRACKER moding and control, and data and controls for COAS (Crew-Optical Alignment System) sightings and calibrations. The SPEC is valid in OPS 2 and MM 301 only of OPS 3. (30767) (35151)

```
 XXXX/022/      S TRK/COAS CNTL  XX X DDD/HH:MM:SS
                                    DDD/HH:MM:SS
 S TRK CNTL -Y  -Z       S TABLE    1     2     3
SELF-TEST   1X  2X       TRK ID     XXX   XXX   XXX
STAR TRK    3X  4X       Δ MIN      XXX   XXX   XXX
TGT TRK     5X  6X       ANG DIF  XXX.X XXX.X XXX.X
BREAK TRK   7   8            ERR  XX.XX XX.XX XX.XX
TERM/IDLE   9X 10X       SEL        17X   18X   19X
                         S TABLE CLR 20

 S TRK      -Y        -Z        COAS
REQD ID   11 XXX    12 XXX     REQD ID      21  XXX
TRK ID      XXX       XXX      ΔDEG X           ±X.X
S PRES        X         X           Y          ±X.X
ΔANG       ±X.XX     ±X.XX     SIGHT MODE   22X
THOLD     13   X    14   X     ACCEPT       23
SHUTTER      XX        XX      CAL MODE     24X
  MAN OP 15X        16x        DES          25X
STATUS    XXXXXXXXX XXXXXXXXX  POS   +X 26X  -Z 27X
          XXXX      XXXX       ΔBIAS   X.XX    X.XX
                               UPDATE   28      29


                                                (XX)
```

Figure 3.022

TABLE 3.022-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 022 PRO	Entered on an MCDS keyboard whose major function is GNC, valid in OPS 2 or OPS 3. NOTE: First item number is for −Y Star Tracker and second item number (in parenthesis) is for −Z Star Tracker.
2	Star-Tracker Mode Control		CAUTION: If an IMU alignment (SPEC 21) is initiated, Star Tracker will be placed in TERM/IDLE.
		ITEM 1 (2) EXEC	Select self-test. An * will be displayed only while self-test is active (up to approximately 7 seconds). Result(s) of self-test is shown at lower left of CRT in STATUS field as ST FAIL or ST PASS.
		ITEM 3 (4) EXEC	Select Star-Track mode. (62180) NOTE: 1. Vehicle attitude should be known within 0.5 degrees. 2. Both STs may be tracking simultaneously.
		ITEM 5 (6) EXEC	Select Target Track mode. Star Tracker tracks the current Rendezvous target. NOTE: 1. Target acquisition is signalled by a star present indication (an * next to S PRES). 2. Items 5 and 6 are mutually exclusive.
		ITEM 7 (8) EXEC	Force ST to break track in current mode. Breaking track will cause ST to break track with current star or target and start tracking the next object encountered in search pattern.
		ITEM 9 (10) EXEC	Select TERM/IDLE mode. This causes termination of all ST processing except BITE statusing.

TABLE 3.022-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
3	Star Tracker Functional Control	ITEM 11 (12) + XXX EXEC	Identification of the star to be tracked in Star Track mode above (ITEM 3/4, see Function #2). ID is zeroed, once processing on star is completed. Valid range is 10-110. In OPS3, star IDs > 60 are illegal. Data: TRK ID - ID of star being currently tracked. Zero indicates no star is locked onto. S PRES - An * denotes star is present and being tracked. Δ ANG - Angle between expected and measured line-of-sight.
		ITEM 13 (14) + X EXEC	Specify magnitude threshold for star tracking. Valid range is 0-3. Data: SHUTTER - Position of shutter on ST (OP - open; CL - closed).
		ITEM 15 (16) EXEC	Flip/flop ITEM entry to override/reset automatic ST shutter position. First entry will force ST shutter OPEN and an * will be displayed. Second entry removes * and allows automatic shutter control to resume.
4	Star Tracker Status		Data displayed to indicate status of ST: ST FAIL - ST failed self-test ST PASS - ST passed self-test FALSE TRK - Object fails position or rate reasonableness test OUT FOV - Object is not in view HI RATE - IMU-derived body rate exceeds .2 deg/sec NO TARGET - Object is in FOV but not acquired BITE - (2nd Line) indicates built-in test equipment has detected a failure. A Blanked status means everything is normal.

TABLE 3.022-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
5	Star Table Update		Displays data for 3 stars: 1. Current or most recent data 2. Next most recent data 3. Next most recent data; (i.e., 2 and 3 are progressively older data). TRK ID - ID of star in table. Δ MIN - How old each entry is (in minutes). ANG DIF - Measured separation angle between the two stars (this is a wrap around: 1-2, 2-3, 3-1). ERR - The delta between the measured separation angle and the computed star table separation angle.
		ITEM N EXEC	N = 17-19: Selects pairs of stars to be selected for alignment data. In auto mode software selects two stars and displays * beside the respective item number. May be overridden by ITEM input. The items act as a flip/flop (entry reverses current state). Selection remains in effect until new star is tracked at which time auto selection is selected. (54950)
		ITEM 20 EXEC	Clears both Star Table and COAS table.
6	Crew-Optical-Alignment-System (COAS)	ITEM 21 + XXX EXEC	Select star ID (see Function 3) Δ DEG X/Y: Displays (in degrees) the equivalent −Z COAS offsets of star/target being tracked by −Z ST.
		ITEM 22 EXEC	Select COAS sight mode. When selected, ADI Attitude Reference PB (see Section 5, ATT REF entry) is used to perform COAS mark function.
		ITEM 23 EXEC	Accepts the last COAS mark taken in sight mode (star and target track modes) and allows processing of mark data. Until entry of ITEM 23, subsequent marks will override previous marks. (35151)
		ITEM 24 EXEC	Select COAS calibration mode. Again, ADI ATT REF PB performs mark function to collect data. Collected data used to update COAS line-of-sight in NAV base coordinates.

TABLE 3.022-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 25 EXEC	Deselect the COAS. NOTE: ITEMs 22, 24, and 25 are mutually exclusive. Any star tracker mode is mutually exclusive with any COAS mode.
		ITEM 26 EXEC	Select COAS + X position.
		ITEM 27 EXEC	Select COAS −Z position.
		ITEM 28 EXEC	Update + X COAS Δ BIAS. The Δ BIAS is the angular difference (in degrees) between loaded COAS line-of-sight and measured calibration line-of-sight.
		ITEM 29 EXEC	Update −Z COAS Δ BIAS. NOTE: UPON updating, Δ BIAS is zeroed.

TABLE 3.022-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select −Y Self Test				2	CGZV_KYBD_CMD$(2)
2	Select −Z Self Test				2	CGZV_KYBD_CMD$(1)
3	Select −Y Star Track				2	CGZV_KYBD_CMD$(2)
4	Select −Z Star Track				2	CGZV_KYBD_CMD$(1)
5	Select −Y Target Track				2	CGZV_KYBD_CMD$(2)
6	Select −Z Target Track				2	CGZV_KYBD_CMD$(1)
7	Break −Y Tracking				2	CGYB_BRK_TRK$(2;)
8	Break −Z Tracking				2	CGYB_BRK_TRK$(1;)
9	Put −Y in Term/Idle				2	CGZV_KYBD_CMD$(2)
10	Put −Z in Term/Idle				2	CGZV_KYBD_CMD$(1)
11	Select −Y Star ID	0	110		3	CGZV_ID_ARR$(2)
12	Select −Z Star ID	0	110		3	CGZV_ID_ARR$(1)
13	Select −Y Threshold	0	3		3	CGZV_ID_ARR$(5)
14	Select −Z Threshold	0	3		3	CGZV_ID_ARR$(4)
15	Force −Y Shutter Open				3	CGZB_SHUTTER$(2)
16	Force −Z Shutter Open				3	CGZB_SHUTTER$(1)
17	Select Current Star Data for Alignment Data				5	CGZB_SELECT$(1)
18	Select Previous Star Data				5	CGZB_SELECT$(2)
19	Select Previous Star Data				5	CGZB_SELECT$(3)
20	Clear Star Data				5	CGZB_ID_FLAG$(9)
21	Select Star ID for COAS	1	110		6	CGZB_ID_ARR$(3)
22	Select COAS Sight Mode				6	CGZV_COAS_MODE_MFE
23	Accept Last Mark Data				6	CGZV_ID_FLAG$(10)

TABLE 3.022-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
24	Select COAS Calibration Mode				6	CGZV_COAS_MODE_MFE
25	Deselect COAS				6	CGZV_COAS_MODE_MFE
26	Select +X Position for COAS				6	CGZB_ID_FLAG$(8)
27	Select −Z Position for COAS				6	CGZB_ID_FLAG$(8)
28	Update TX Δ BIAS				6	CGZB_ID_FLAG$(12)
29	Update −Z Δ BIAS				6	CGZB_ID_FLAG$(11)

3.5.023 DISPLAY: RCS

–1 AVAILABILITY: SPEC 023 in OPS G1/6, G2, G3, and G8.

–2 PURPOSE: The RCS display provides the crew with the capability of selecting a desired RCS pod for display. The display allows for monitoring and controlling jet RM, monitoring RCS system data, OMS XFEED (Interconnect) line pressures and manifold valve status and override, and controlling OMS/RCS interconnect. It also allows the crew to select/deselect jets for use by the DAP.

XXXX/023/ RCS XX X DDD/HH:MM:SS
DDD/HH:MM:SS

RCS FWD 1X PRI JET OMS PRESS ENA
L 2X 4 FAIL LIM X L OMS 5X OMS→RCS QTY
R 3X R OMS 6X L XX.XXS
OFF 7X R XX.XXS

JET	FAIL	DES INH	JET DES	PTY
XXX	XXX	8X	9X	X
XX	XXX	10X	11X	X
Y XX	XXX	12X	13X	X
XX	XXX	14X	15X	X
XXU	XXX	16X	17X	X
XU	XXX	18X	19X	X
Z XU	XXX	20X	21X	X
XXX	XXX	22X	23X	X
XD	XXX	24X	25X	X
2D	XXX	26X	27X	X
XD	XXX	28X	29X	X
XXX	XXX	30X	31X	X
X XX	XXX	32X	33X	X
XX	XXX	34X	35X	X
X5X	XXX	36X	37X	X
V 5X	XXX	38X	39X	X

	OXID	FU
HE P	XXXXS	XXXXS
PRPLT TK P	XXXS	XXXS
T	XXXS	XXXS
QTY	XXXS	XXXS
MANF P 1	XXXS	XXXS
2	XXXS	XXXS
3	XXXS	XXXS
4	XXXS	XXXS

MANF VLVS	STAT	OVRD
1	XXS	40
2	XXS	41
3	XXS	42
4	XXS	43
5	XXS	44

XFEED P XXXS XXXS

JET RESET 45

(XX)

Figure 3.023

TABLE 3.023-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 023 PRO	The RCS Display is available in OPS G1/6, G2, G3, and G8.
2	RCS pod data display	ITEM X EXEC	X = 1, 2, or 3. Display RM-associated data in Matrix for the RCS pod. (FWD, Left or Right) indicated by asterisk.
3	RCS RM and jet matrix		JET Column: First character is dynamic, indicating module selected. Second character is dynamic indicating manifold. Third character shows direction of jet thrust (Up, Down, Left, Right, Forward, or Rearward). Jets are displayed in group order. The following table indicates which jets correspond to items 8 through 39 for each RCS pod. RCS POD ITEM 1(FWD) 2(LEFT) 3(RIGHT) 8/9 F1L L4L R4R 10/11 F3L L2L R2R 12/13 F2R L3L R3R 14/15 F4R L1L R1R 16/17 F1U L4U R4U 18/19 F3U L2U R2U 20/21 F2U L1U R1U 22/23 F1D N/A N/A 24/25 F3D L4D R4D 26/27 F2D L2D R2D 28/29 F4D L3D R3D 30/31 F1F L3A R1A 32/33 F3F L1A R3A 34/35 F2F N/A N/A 36/37 F5L L5L R5R 38/39 F5R L5D R5D FAIL Column: Displays RM status for each jet listed - ON, OFF, or LK (leaking). Jets Failed OFF or LK will be deselected as long as the Jet FAIL LIMIT (ITEM 4) has not been exceeded.

TABLE 3.023-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM XX EXEC	XX = Odd numbers, 9 to 39 under JET DES column. A jet may be deselected automatically by RM, or manually, by executing the item number associated with that jet. An asterisk (*) is displayed next to the item number of any jet deselected. Entering an item with an asterisk next to it will clear the asterisk and select the jet. Entering an item with no asterisk will drive an asterisk and deselect that jet.
		ITEM YY EXEC	YY = Even numbers, 8 to 38 under DES INH column. Resets the failed jet. If the item has an asterisk, clears the asterisk and enables RM. If the item has no asterisk, drives an asterisk, inhibits RM and reorders the PTY column. NOTE: Items 22, 23, 34 and 35 are not valid when left or right RCS data is displayed. PTY Column: Displays priority of the primary jets on the selected pod. A jet's priority may be changed by executing a deselect inhibit item (8-38) even). The deselect inhibited jet will have last priority within its group. Jets having a lower priority than the DES INH jet will now be bumped up to the next highest priority. Deselect inhibiting a jet already having last priority or a vernier jet has no effect on priority values.
4	JET FAIL LIMIT	ITEM 4+X EXEC	Change the limit on the maximum number of jets which RM may automatically deselect from the availability table for the pod displayed.
5	OMS/RCS Interconnect		OMS PRESS ENA: Provides for gauging of OMS propellant used by RCS and for auto OMS ullage pressure maintenance. (46526) Not available in OPS G1/6 or G3.
		ITEM 5 EXEC	Initiate Left OMS to RCS interconnect.
		ITEM 6 EXEC	Initiate Right OMS to RCS interconnect.
		ITEM 7 EXEC	Terminate interconnect. (39591)

TABLE 3.023-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			These 3 items are mutually exclusive such that only the last one executed will have an asterisk next to it. Initially, this display will have "OFF" selected; subsequent display calls have the last state selected.
6	OMS PRPLT used by RCS		OMS→RCS QTY: This display shows the L and R OMS propellant remaining as a percent of initial OMS propellant. (46500)
7	Oxidizer (OXID) and Fuel (FU) System Matrix		In the leftmost column are names of parameters displayed. In the center and right columns are the values of these parameters, for the OXID, and FU, respectively. Status: Blank - for good data (displayed for all parameter). M - for commfault (not displayed for propellant quantity). ↑ - out of limits high. ↓ - out of limits low. ? - Dilemma. HE P: Helium tank pressure (psia); Status characters - Blank, M, ↓. PRPLT TK: P - Propellant tank (TK) pressure (psia). T - Temperature (degrees). Status characters - Blank, M, ↑, ↓. QTY - Propellant quantities are remainder in percent of initial amounts. Status characters - Blank, ↓. MANF P: Manifold (1-4) pressures in psia. Status characters - Blank, M. MANF VLVS: Center and right columns are headed STAT for status, and OVRD for overrides. Values are displayed for each of 5 valves. STAT Column: Shows isolation valve positions. XX may be OP (Open) or CL (Closed). Status characters - Blank, M, ?. Status determined by RM.

TABLE 3.023-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM XX EXEC	XX = 40 to 44, OVRD Column: Execution of these items allows the user to override the valve position determined by RM and displayed in the STAT Column. XFEED P: Crossfeed pressure (PSIA) for the left and right RCS Systems. Status characters - Blank, M.
8	JET RESET	ITEM 45 EXEC	Execution of this item allows manual resetting of failed jets, not deselected providing the isolation valve is off.

TABLE 3.023-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	RCS Forward				2	CGZB_RCS_SELECT$1
2	RCS Left				2	CGZB_RCS_SELECT$2
3	RCS Right				2	CGZB_RCS_SELECT$3
4	Jet Fail Limit	0	9		4	CGZV_JET_FAIL_LIM Initially I-Loaded
5	Left OMS Interconnect				5	CGZB_OMS_PRESS_ENA$1
6	Right OMS Interconnect				5	CGZB_OMS_PRESS_ENA$2
7	OMS Interconnect terminate				5	CGZB_OMS_PRESS_ENA$3
8	Jet 1 RM AUTO/INH				3	CGZB_RM_INH$1
9	Jet 1 RM SEL/DES				3	CGZB_JET_DES$1
10	Jet 2 RM AUTO/INH				3	CGZB_RM_INH$2
11	Jet 2 RM SEL/DES				3	CGZB_JET DES$2
12	Jet 3 RM AUTO/INH				3	CGZB_RM_INH$3
13	Jet 3 RM SEL/DES				3	CGZB_JET_DES$3
14	Jet 4 RM AUTO/INH				3	CGZB_RM_INH$4
15	Jet 4 RM SEL/DES				3	CGZB_JET_DES$4
16	Jet 5 RM AUTO/INH				3	CGZB_RM_INH$5
17	Jet 5 RM SEL/DES				3	CGZB_JET_DES$5
18	Jet 6 RM AUTO/INH				3	CGZB_RM_INH$6
19	Jet 6 RM SEL/DES				3	CGZB_JET_DES$6
20	Jet 7 RM AUTO/INH				3	CGZB_RM_INH$7
21	Jet 7 RM SEL/DES				3	CGZB_JET_DES$7
22	Jet 8 RM AUTO/INH				3	CGZB_RM_INH$8
23	Jet 8 RM SEL/DES				3	CGZB_JET_DES$8
24	Jet 9 RM AUTO/INH				3	CGZB_RM_INH$9

TABLE 3.023-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
25	Jet 9 RM SEL/DES				3	CGZB_JET_DES$9
26	Jet 10 RM AUTO/INH				3	CGZB_RM_INH$10
27	Jet 10 RM SEL/DES				3	CGZB_JET_DES$10
28	Jet 11 RM AUTO/INH				3	CGZB_RM_INH$11
29	Jet 11 RM SEL/DES				3	CGZB_JET_DES$11
30	Jet 12 RM AUTO/INH				3	CGZB_RM_INH$12
31	Jet 12 RM SEL/DES				3	CGZB_JET_DES$12
32	Jet 12 RM AUTO/INH				3	CGZB_RM_INH$13
33	Jet 13 RM SEL/DES				3	CGZB_JET_DES$13
34	Jet 14 RM AUTO/INH				3	CGZB_RM_INH$14
35	Jet 14 RM SEL/DES				3	CGZB_JET_DES$14
36	Jet 15 RM AUTO/INH				3	CGZB_RM_INH$15
37	Jet 15 RM SEL/DES				3	CGZB_JET_DES$15
38	Jet 16 RM AUTO/INH				3	CGZB_RM_INH$16
39	Jet 16 RM SEL/DES				3	CGZB_JET_DES$16
40	Valve 1 override				7	CGRB_MANF_OPEN$(1,6,11)
41	Valve 2 override				7	CGRB_MANF_OPEN$(2,7,12)
42	Valve 3 override				7	CGRB_MANF_OPEN$(3,8,13)
43	Valve 4 override				7	CGRB_MANF_OPEN$(4,9,14)
44	Valve 5 override				7	CGRB_MANF_OPEN$(5,10,15)
45	RCS jet reset				8	

3.5.025 DISPLAY: RM ORBIT

–1 AVAILABILITY: SPEC 025 in OPS G2.

–2 PURPOSE: This Specialist Function provides the crew with a means to monitor and control the selection filters for the Translation and Rotation Hand Controllers (THC and RHC) and to inhibit/enable Switch Redundancy Management (SW RM) processing.

```
XXXX/025/          RM ORBIT          XX X DDD/HH:MM:SS
                                           DDD/HH:MM:SS


 THC TX TY TZ DES     RHC  R    P    Y    DES

 L 1 XS XS XS  1X     L 1 XXXS XXXS XXXS  7X
   2 XS XS XS  2X       2 XXXS XXXS XXXS  8X
   3 XS XS XS  3X       3 XXXS XXXS XXXS  9X

 A 1 XS XS XS  4X     R 1 XXXS XXXS XXXS 10X
   2 XS XS XS  5X       2 XXXS XXXS XXXS 11X
   3 XS XS XS  6X       3 XXXS XXXS XXXS 12X

                      A 1 XXXS XXXS XXXS 13X
                        2 XXXS XXXS XXXS 14X
                        3 XXXS XXXS XXXS 15X



                      SW RM INH 16X
                                              (XX)
```

Figure 3.025

TABLE 3.025-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 025 PRO	The RM ORBIT SPEC is available in OPS G2.
2	Forward THC TX data for LRUs 1, 2 and 3		Provides the crew with data to monitor the forward THC positive and negative X output.
3	Forward THC TY data for LRUs 1, 2 and 3		Provides the crew with data to monitor the forward THC positive and negative Y output.
4	Forward THC TZ data for LRUs 1, 2 and 3		Provides the crew with data to monitor the forward THC positive and negative Z output.
5	Forward THC TX channel status for LRUs 1, 2 and 3		Provides the crew with a status indication for the X channel.
6	Forward THC TY channel status for LRUs 1, 2 and 3		Provides the crew with a status indication for the Y channel.
7	Forward THC TZ channel status for LRUs 1, 2 and 3		Provides the crew with a status indication for the Z channel.
8	Forward THC deselect/select for LRUs 1, 2 and 3	ITEM 1 EXEC ITEM 2 EXEC ITEM 3 EXEC	Specific item numbers in the DES column provide the crew with manual control of the RM selection filters.
9	AFT THC TX data for LRUs 1, 2 and 3		Provides the crew with data to monitor the AFT THC positive and negative X output.
10	AFT THC TY data for LRUs 1, 2 and 3		Provides the crew with data to monitor the AFT THC positive and negative Y output.
11	AFT THC TZ data for LRUs 1, 2 and 3		Provides the crew with data to monitor the AFT THC positive and negative Z output.
12	AFT THC TX channel status for LRUs 1, 2 and 3		Provides the crew with a status indication for the X channel.
13	AFT THC TY channel status for LRUs 1, 2 and 3		Provides the crew with a status indication for the Y channel.
14	AFT THC TZ channel status for LRUs 1, 2 and 3		Provides the crew with a status indication for the Z channel.

TABLE 3.025-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
15	AFT THC deselect/select for LRUs 1, 2 and 3	ITEM 4 EXEC ITEM 5 EXEC ITEM 6 EXEC	Specific item numbers in the DES column provide the crew with manual control of the RM selection filters. NOTE: For the THC the status indicator displays an M to indicate missing data and a down arrow (↓) for a failed component.
16	Left RHC 1, 2 and 3 roll commands		Provides the crew with transducer data corresponding to the Roll rotational commands.
17	Left RHC 1, 2 and 3 Pitch commands		Provides the crew with transducer data corresponding to the Pitch rotational commands.
18	Left RHC 1, 2 and 3 Yaw commands		Provides the crew with transducer data corresponding to the Yaw rotational commands.
19	Right RHC 1, 2 and 3 Roll commands		Provides the crew with transducer data corresponding to the Roll rotational commands.
20	Right RHC 1, 2 and 3 Pitch commands		Provides the crew with tranducer data corresponding to the Pitch rotational commands.
21	Right RHC 1, 2 and 3 Yaw commands		Provides the crew with tranducer data corresponding to the Yaw rotational commands.
22	AFT RHC 1, 2 and 3 Roll commands		Provides the crew with transducer data corresponding to the Roll rotational commands.
23	AFT RHC 1, 2 and 3 Pitch commands		Provides the crew with transducer data corresponding to the Pitch rotational commands.
24	AFT RHC 1, 2 and 3 Yaw commands		Provides the crew with transducer data corresponding to the Yaw rotational commands. NOTE: The displayed data represents the sensed controller commands, scaled in precent of full deflection (0 to 99).
25	Left, Right and AFT 1, 2 and 3 Roll, Pitch and Yaw Status		Provides the crew with a status indication for Roll, Pitch and Yaw.

TABLE 3.025-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			NOTE: For the RHC the status indicator displays an M to indicate missing data and a down arrow (↓) for a failed component.
26	Left RHC 1, 2 and 3 deselect/select	ITEM 7 EXEC ITEM 8 EXEC ITEM 9 EXEC	Provides the crew with manual control of the RM selection filters through deselection/selection of item numbers.
27	Right RHC 1, 2 and 3 deselect/select	ITEM 10 EXEC ITEM 11 EXEC ITEM 12 EXEC	An asterisk (*) next to the item number signifies deselection.
28	AFT RHC 1, 2 and 3 deselect/select	ITEM 13 EXEC ITEM 14 EXEC ITEM 15 EXEC	An asterisk (*) next to the item number signifies deselection.
29	Switch RM Inhibit	ITEM 16 EXEC	Provides the crew with the capability to manually inhibit or enable GNC switch Redundancy Management.

TABLE 3.025-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	THC L1 deselect				8	CGZB_THC_ASTER$1
2	THC L2 deselect				8	CGZB_THC_ASTER$2
3	THC L3 deselect				8	CGZB_THC_ASTER$3
4	THC A1 deselect				15	CGZB_THC_ASTER$4
5	THC A2 deselect				15	CGZB_THC_ASTER$5
6	THC A3 deselect				15	CGZB_THC_ASTER$6
7	RHC L1 deselect				26	CGRV_RM_DATA_BASE. CGRB_STATUS_$2(15;13)
8	RHC L2 deselect				26	CGRV_RM_DATA_BASE. CGRB_STATUS_$2(15;14)
9	RHC L3 deselect				26	CGRV_RM_DATA_BASE. CGRB_STATUS_$2(15;15)
10	RHC R1 deselect				27	CGRV_RM_DATA_BASE. CGRB_STATUS_$2(12;13)
11	RHC R2 deselect				27	CGRV_RM_DATA_BASE. CGRB_STATUS_$2(12;14)
12	RHC R3 deselect				27	CGRV_RM_DATA_BASE. CGRB_STATUS_$2(12;15)
13	RHC A1 deselect				28	CGRV_RM_DATA_BASE. CGRB_STATUS_$2(18;13)
14	RHC A2 deselect				28	CGRV_RM_DATA_BASE. CGRB_STATUS_$2(18;14)
15	RHC A3 deselect				28	CGRV_RM_DATA_BASE. CGRB_STATUS_$2(18;15)
16	Switch RM Inhibit				29	CGZB_28FLAG_WD1$2 For Items 7 thru 15 data may change by Keyboard input or software processing.

3.5.033 DISPLAY: REL NAV

–1 AVAILABILITY: SPEC 033 in OPS G2.

–2 PURPOSE: The Relative Navigation Specialist function provides the crew with data and control for onorbit Navigation (NAV), particularly for Rendezvous, Station-Keeping and Payload handling. This is provided by data on the state vectors, manual control of the NAV filter, and by the capability to select the Navigation sensor from Star Tracker, Rendezvous Radar, or Crew Optical Alignment Sight (COAS). Data is also provided on translational thrust.

```
XXXX/033/          REL NAV        XX X DDD/HH:MM:SS
                                        DDD/HH:MM:SS
 RNDZ NAV ENA 1X  SV UPDATE
 KU ANT   ENA 2X   POS XX.XX       AVG G ON    5X
 MEAS     ENA 3X   VEL XX.XX      ΔVX      ±XX.XX
       NAV                       ΔVY      ±XX.XX
 SV SEL 4 XXXX      RR XXXX       ΔVZ      ±XX.XX
 RNG  XXXX.XXX  RNG  XXXX.XXXS   ΔVTOT    XXX.XX
 Ṙ    ±XXXX.XX  Ṙ    ±XXXX.XXS    RESET COMPNT 6
 θ      XXX.XX  EL     ±XXX.XS            TOT 7
 Y      ±XX.XX  AZ     ±XXX.XS     SV TRANSFER
 Ẏ      ±XXX.X  ωP      ±XX.XS   FLTR MINUS PROP
 NODE XX:XX:XX  ωR      ±XX.XS    POS       XX.XX
           FILTER                 VEL       XX.XX
 S TRK 12X   RR 13X   COAS 14X   FLTR TO PROP  8X
 STAT XXXXXXXXX  OFFSET X ±X.X   PROP TO FLTR  9X
      XXXX               Y ±X.X  ORB  TO TGT  10X
 SLOW RATE    15X                TGT  TO ORB  11X
 COVAR REINIT 16X     MARK HIST     EDIT OVRD
         RESID  RATIO ACPT  REJ    AUT  INH  FOR
 RNG    ±XX.XX   X.X  XXX   XXS    17X  18X  19X
 Ṙ      ±XX.XX   X.X  XXX   XXS    20X  21X  22X
 V/EL/Y  ±X.XX   X.X  XXX   XXS    23X  24X  25X
 H/AZ/X  ±X.XX   X.X  XXX   XXS
                                              (XX)
```

Figure 3.033

TABLE 3.033-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 033 PRO	The REL NAV SPEC is available only in OPS G2. Items 4 and 13 are valid only if Rendezvous Navigation (RNDZ NAV) has been enabled by executing Item 1.
2	Relative Motion Data		This quadrant of the display (upper left) provides state data from 2 sources: navigation (NAV) and rendezvous radar (RR).
		ITEM 4 EXEC	SV SEL: This item selects PROP or FLTR as the source of navigated relative state data. NAV Column: The left column (under Item 4) displays 6 current navigated state parameters, when RNDZ NAV is enabled. The 6 parameters are: RNG: This display shows the line-of-sight (LOS) range, in thousands of feet (K ft), between the Orbiter and the target vehicle. $\dot{R}$: This shows range rate (closing rate) between the 2 vehicles, in feet per second (fps). A negative sign indicates a closing rate, and positive an opening rate. θ: This shows the angle between the local horizontal plane and the projection of the Orbiter tracking body vector (selected on UNIV PTG DISPLAY, 2011) on the orbital plane. Y: Out-of-plane position is the perpendicular distance between the Orbiter and the target, in thousands of feet. Positive is along the negative angular momentum vector of the target. Ydot: Out-of-plane velocity is the rate at which the Orbiter is moving relative to the orbital plane of the target (in fps), positive along the negative angular momentum vector. NODE: Time of next nodal crossing, in MET - hr:min:sec.

TABLE 3.033-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			RR XXXX: The right column displays 6 radar parameters. Next to the value of each radar parameter is its status; (↓) - loss of good data; (M) - commfault or the radar is in COMM (communication) MODE; (Blank) - for data good. The 6 parameters are: RNG: LOS range (K ft) between vehicles. $\dot{R}$: Range rate - plus for opening, minus for closing. EL: Elevation of the radar antenna gimbal; positive towards +X Orbiter axis (Pitch). AZ: Azimuth (Roll) of the radar antenna gimbal; positive towards −Y Orbiter axis. ωP: Inertial pitch angle rate in milliradians/sec. positive towards +X Orbiter axis. ωR: Roll inertial angle rate in milliradians per second; positive toward the −Y Orbiter axis. XXXX (in heading of right column): This indicates the status of the Radar System. Status acronyms available are: STST: Self test in progress. Self test overrides any of the following status indicators. COMM: KU-Band antenna is in the communication (two-way signaling) MODE. GPC: The antenna pointing and search are under control of the GPC. Manual slew is inhibited. GDSG: GPC designate position, for antenna steering switch, puts antenna pointing and inertial stabilization under GPC control. ATRK: Indicates AUTO on antenna steering switch. Antenna pointing done by manual slew switches. MSLW: MAN SLEW (manual slew) position antenna pointing switch. Manual slew will do antenna pointing.

TABLE 3.033-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
3	Rendezvous Navigation Sensor Selector and Navigation		FILTER: Provides the controls necessary to select the rendezvous navigation angle sensor. Also, provides data, status and control for onorbit RNDZ NAV. The angle data is only for the NAV sensor selector. The sensors available are mutually exclusive. The item selected will be indicated by an asterisk, and are:
		ITEM 12 EXEC	S TRK: Star Tracker will be selected the first time this display is called.
		ITEM 13 EXEC	RR: Rendezvous Radar is selected.
		ITEM 14 EXEC	COAS: Crew Optical Alignment Sight is selected. STAT XXXXXXXXX: Indicates the status of the currently selected STRK - blank, ST FAIL, ST PASS, TRK, NO TARGET, HI RATE, Out of Field of View (OUT FOV). XXXX: Provides a BITE indication when appropriate. OFFSET: Two offset angles, X and Y played when −Z STR TRK is selected for star track, or target track mode.
		ITEM 15 EXEC	Slow Rate: Execution Rate for RNDZ NAV. This a flip-flop switch which controls the rate at which rendezvous navigation processes data. Execution of this item changes the rate from whatever it was to the other rate. An asterisk is displayed next to the item number whenever the slow rate is chosen.
		ITEM 16 EXEC	COVAR REINIT: Covariance matrix reinitialization. An asterisk will be driven next to this item number while the covariance matrix is being reinitialized. The appearance or removal of this asterisk will have a time delay depending on the NAV processing rate. The asterisk will be displayed for one NAV cycle. If rendezvous navigation is not enabled, execution of this item will be illegal. The navigation filter data are:

TABLE 3.033-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			RESID: The residuals are formed by subtracting the navigation-estimated value of the parameter from the sensor-observed value of the measurement. The parameter residuals displayed are for range (RNG) range rate (R); plus 2 other parameters, which differ from sensor to sensor. RATIO: The residual ratio displayed is computed by RNDZ NAV, and used for editing bad data. MARK HIST: The number of NAV marks both accepted (ACPT) and (REJ) rejected by the navigation filter. These counters are zeroed when: a. a state vector is changed. b. a state vector transfer is performed. c. RNDZ NAV is first enabled. d. the covariance matrix is reinitialized. e. after a delta velocity burn. f. the input data sensor is changed. A down arrow (↓) is driven next to the REJ data when the number of marks rejected is greater than the I-loaded value. EDIT OVRD: Provides capability to control the way the NAV filter handles data. These 3 controls - auto (AUT), inhibit (INH), and force (FOR), are mutually exclusive.
		ITEM XX EXEC	XX = 17 to 25. An asterisk is driven under the appropriate column next to the parameter number. An asterisk will be driven after a time delay which depends on the navigation processing rate. INH: The inhibit numbers will be automatically selected when this display is first called. The INH function allows residual and ratio calculations, but inhibits updating of state and MARK Rejection Counter parameters. AUT: Allows automatic processing of data in NAV filter.

TABLE 3.033-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			FOR: Lasts for only one data cycle, relaxes the edit test criterion for data entering the NAV filter.
4	Rendezvous Navigation Enabling	ITEM 1 EXEC	An asterisk is driven next to this item number when RNDZ NAV is enabled. This item is initialized disabled (no asterisk).
5	Enable KU-Band Antenna Management	ITEM 2 EXEC	Causes activation of the KU-Band antenna software.
6	Measurement Incorporation in NAV	ITEM 3 EXEC	Provides the capability to enable or inhibit the incorporation of measurements into the NAV filter.
7	State Vector Update Data		SV UPDATE: Shows the magnitude of the change to the filtered state vectors made by the RNDZ NAV in the last computation cycle. POS XX.XX: Magnitude of change to the filtered state vector position. VEL XX.XX: Magnitude of change to the filtered state vector velocity.
8	On-orbit Powered Flight Navigation	ITEM 5 EXEC	AVG G ON: This toggle switch provides the capability to control powered flight (AVG G) in MM201, for thrust monitoring.
9	Monitor Translational Thrust		ΔVX, ΔVY, ΔVZ, ΔVTOT: These are the components of translational thrust.
		ITEM 6 EXEC	RESET COMPNT: This resets all component ΔV registers to zero.
		ITEM 7 EXEC	TOT: This zeroes only the total velocity registers.
10	State Vector Transfer		SV TRANSFER: Provides information about state vector transfers, and shows the difference between the filtered and propagated state vectors. FLTR MINUS PROP: Filtered state less the propagated state. POS XX.XX: Difference between the filtered state vector position and the propagated state vector position.

TABLE 3.033-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			VEL XX.XX: Difference between the filtered state vector velocity and the propagated state vector velocity.
		ITEM 8 EXEC	FLTR TO PROP: Replace propagated state vector with filtered state vector.
		ITEM 9 EXEC	PROP TO FLTR: Replace filtered state vector with propagated state vector.
		ITEM 10 EXEC	ORB TO TGT: Replace target state vector with orbiter state vector.
		ITEM 11 EXEC	TGT TO ORB: Replace orbiter state vector with target state vector.

TABLE 3.033-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Enable and Disable RNDZ NAV				4	CGZB_REL_NAV_FLG_WD1_LFE$6 Appearance and disappearance of the asterisk has a time delay which is dependent on the NAV sequence processing rate.
2	KU-Band Antenna Enable				5	CGZB_KU_ANT_CMD RNDZ NAV must be enabled.
3	Enable/Inhibit the incorporation of measurements into the NAV filter				6	CGZB_REL_NAV_FLG_WD1_LFE$7 RNDZ NAV must be enabled and must be MM202.
4	State Vector Select				2	
5	Powered Flight Navigation On-Orbit (AVG G) on/Off				8	CGZB_REL_NAV_FLG_WD1_LFE$1 Legal only in MM201.
6	ΔV Components Reset				9	CGZV_DVXYZ
7	ΔV Magnitude Reset				10	CGZV_DVTOT
8	SV Transfer from Filtered State to Propagated State				10	RNDZ NAV must be enabled. Mutually exclusive with items 9, 10, 11 and 16.
9	SV Transfer from Propagated State to Filtered State				10	RNDZ NAV must be enabled. Mutually exclusive with items 8, 10, 11 and 16.
10	State Vector (SV) Transfer from Orbiter to Target				10	CGZB_REL_NAV_FLG_WD1_LFE$3 RNDZ NAV must be enabled. Mutually exclusive with items 8, 9, 11 and 16.
11	SV Transfer from Target to Orbiter				10	CGZB_REL_NAV_FLG_WD1_LFE$4 RNDZ NAV must be enabled. Mutually exclusive with items 8, 9, 10 and 16.
12	Select Star Tracker as RNDZ Angle Sensor				3	CGZV_ST_RR_COAS Items 12, 13, 14 are mutually exclusive.
13	Select Rendezvous Radar as RNDZ Angle Sensor				3	CGZV_ST_RR_COAS

TABLE 3.033-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
14	Select COAS as RNDZ Angle Sensor				3	CGZV_ST_RR_COAS
15	RNDZ NAV Execution Rate Selector				3	CGZB_REL_NAV_FLG_WD1_LFE$2 The appearance/disappearance of the asterisk has a time delay which is dependent on the processing rate of the Navigation sequencer (NAV SEQ). RNDZ NAV must be enabled.
16	Reinitialize the Navigation Covariance Matrix				3	CGZB_REL_NAV_FLG_WD1_LFE$5 RNDZ NAV must be enabled. Mutually exclusive with items 8, 9, 10 and 11.
17-25	NAV Filter Edit Control				3	AUT, INH, FOR capabilities are mutually exclusive; i.e., only 1 at a time will have an asterisk for parameter.
	17-19; Range edit override					CGZV_RANGE_AIF
	20-22; Range rate edit override					CGZV_RDOT_AIF
	23-25; Rendezvous angle sensor data edit override					CGZV_ANGLES_AIF
						Note: The asterisk stays in FOR column only 1 data cycle.

3.5.034 DISPLAY: ORBIT TGT

−1 AVAILABILITY: SPEC 034 in OPS G2.

−2 PURPOSE: The Orbit Targeting Specialist Function provides the crew with data for and control of successive maneuvers in a rendezvous sequence. These are provided through display of maneuver data and the capability to initialize and control maneuvers. Additionally, a time homogeneous orbiter state vector is displayed and updated every two seconds for use by the crew. (60511)

```
XXXX/034/          ORBIT TGT        XX X DDD/HH:MM:SS
                                          DDD/HH:MM:SS
MNVR    TIG          ΔVX     ΔVY     ΔVZ     ΔVT
XX X X/XX:XX:XX   ±XXX.X   ±XX.X   ±XX.X   ±XXX.X
                            PRED MATCH = XXXXXXX

INPUTS                                  CONTROLS
1 TGT NO              XX                T2 TO T1   25
2 T1 TIG   X/XX:XX:XX                   XXXX       26
6   EL          XXX.XX                  COMPUTE T1 28X
7   ΔX/DNRNG  ±XXX.XX                   COMPUTE T2 29X
8   ΔY        ±XXX.XX
9   ΔZ/ H     ±XXX.XX
10  Δẋ        ±XXX.XX
11  Δẏ        ±XXX.XX
12  Δż        ±XXX.XX
13 T2 TIG  X/XX:XX:XX                   ORBITER  STATE
17  ΔT        ±XXXX.X                  XXX/XX:XX:XX.XXX
18  ΔX        ±XXX.XX                    X ±XXXXX.XXX
19  ΔY        ±XXX.XX                    Y ±XXXXX.XXX
20  ΔZ        ±XXX.XX                    Z ±XXXXX.XXX
21 BASE TIME X/XX:XX:XX                  VX ±XX.XXXXXX
                                         VY ±XX.XXXXXX
                                         VZ ±XX.XXXXXX
                                                  (XX)
```

Figure 3.034

TABLE 3.034-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 034 PRO	Item entries on this SPEC are legal only when supported by Rendezvous Navigation (SPEC 033).
2	Maneuver Target Data Display		MNVR: The data displayed across the top are the target solution parameters on which a maneuver is based. The parameters are Target ID number. Impulsive Ignition Time (TIG) in the past is indicated by an asterisk (*). TIG: Maneuver ignition time in MET, shown as days/hours:minutes:seconds. ΔVX, ΔVY, ΔVZ: LVLH external Delta-V maneuver components (FPS). (50887) ΔVT: Total velocity change (ΔV) required in FPS. (50887) PRED MATCH: Distance to which the on-orbit predictor was matched in the targeting in feet.
3	Maneuver Initialization Data INPUTS		Zeroes are initially displayed for items 1 to 20. Thereafter, the crew may input data to these items to set up a two-impulse maneuver. Several target sets are I-LOADed. Any of these may be displayed for use or modification by first inputting the appropriate target number.
4	Target Number	ITEM 1+XX EXEC	The ID number for a pre-stored target set.
5	T1 TIG	ITEM X+YY EXEC	X = 2-5; YY = days/hours:minutes:seconds - This is the impulsive ignititon time of the first of 2 maneuvers, input in MET. TIG in the past will compute T1 TIG as current time plus a delta.
6	Elevation (EL) angle to the target	ITEM 6+ XXX.XX EXEC	Elevation angle from the Orbiter to the target, positive up. If EL = 0, TIG input is used. Otherwise, an angle search is performed about EL input and the TIG will be calculated.
7	Orbiter Relative State Vector at T1 TIG		Orbiter relative position (Kft) and velocity at T1 TIG, used in targeting computations. If all these are zero, or T1 is past, the values of these parameters are computed from navigation data and displayed along with the target solution.

TABLE 3.034-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM X± YYY.YY EXEC	X = 7 (ΔX/DNRNG) X = 8 (ΔY) Y = T1 Inputs X = 9 (ΔZ/ΔH)
		ITEM M± NNN.NN EXEC	M = 10 (ΔX) M = 11 (ΔY) N = T1 Inputs M = 12 (ΔZ)
8	T2 TIG	ITEM XX+YY EXEC	XX = 13–16; YY = days/hours:minutes:seconds - Impulsive TIG in MET in the second maneuver. Computed T2 TIG will be displayed here when the target solution is presented.
9	ΔT	ITEM 17± XXX.X EXEC	Transfer time between T1 TIG and T2 TIG. For ΔT input of zero, ΔT computed will be displayed here.
10	Orbiter SV at T2 TIG		Desired Orbiter relative position at T2 TIG (Kft).
		ITEM X± YYY.YY EXEC	X = 18 (ΔX) X = 19 (ΔY) Y = T2 Inputs X = 20 (ΔZ)
11	Base Time	ITEM XX+YY EXEC	XX = 21–24; YY = days/hours:minutes:seconds - MET time from which subsequent maneuvers are calculated. LAMBERT targeting calculations using the elevation angle option will automatically define BASE TIME as the computed MNVR TIG time.
12	Maneuver CONTROLS		Control of the maneuvers is handled by these executable items. Entry of any item while T1 or T2 computations are in progress is an ILLEGAL ENTRY and results in this message being displayed.
13	Maneuver Data Transfer	ITEM 25 EXEC	T2 to T1: Execution of this item causes the T2 TIG to transfer to the T1 TIG slot of the current maneuver sequence. This allows a three-impulse maneuver sequence.
14	LOAD Data Sets	ITEM 26 EXEC	XXXX: If any item entry is made, except TGT No., to INPUTS section, LOAD will flash until the item is executed. Execution of this item loads the entire data set under INPUTS.

TABLE 3.034-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
15	Calculate the first maneuver solution	ITEM 28 EXEC	COMPUTE T1: Execution of this item calculation of the first maneuver (T1) of a 2 maneuver sequence, and display of the results in the MNVR section at the head of this display. An asterisk will be driven by this time until computations complete. Parameters used here are specified under the INPUTS section. INPUTS not specified will be computed and displayed. The CRT clock will automatically start countdown to the next TIG when the solution is found for COMPUTE T1, or COMPUTE T2. (52763)
16	Calculate the second Maneuver solution	ITEM 29 EXEC	COMPUTE T2: Execution of this item initiates calculation of the second of maneuvers. (See #15 above)
17	Current Orbiter State Vector data display		The ORBITER STATE is the current time homogeneous M50 Orbiter State Vector and time tag. The parameters are: 1. The time tag of the orbiter state vector in GMT shown as: days/hours:minutes:seconds. 2. The orbiter M50 position components X, Y, and Z (Kft). 3. The orbiter M50 velocity components VX, VY, and VZ (Kft/Sec). Although the Orbiter State Vector is refreshed every 2 seconds, it is only recomputed every 4 seconds.

TABLE 3.034-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Target ID number	1	40		4	CGZV_PROX_TGT_SET_NO
	TIG time of the first 2 maneuvers:					
2	days	0	9	days	5	CGZV_ORB_TGT_TIME.D_H_M_S$(1;1)
3	hours	0	23	hours	5	CGZV_ORB_TGT_TIME.D_H_M_S$(1;2)
4	minutes	0	59	min	5	CGZV_ORB_TGT_TIME.D_H_M_S$(1;3)
5	seconds	0	59	sec	5	CGZV_ORB_TGT_TIME.D_H_M_S$(1;4)
6	Elevation angle to Target	0	359.99	deg	6	CGZV_ORB_TGT_DISP_EL_ANG
	Orbiter relative position:	−999.99	+999.99	Kft	7	
7	X Component					CGZV_DISP_T1_X$1
8	Y Component					CGZV_DISP_T1_X$2
9	Z Component					CGZV_DISP_T1_X$3
	Orbiter relative velocity:	−999.99	+999.99	fps	7	
10	X Component					CGZV_DISP_T1_XD$1
11	Y Component					CGZV_DISP_T1_XD$2
12	Z Component					CGZV_DISP_T1_XD$3
	TIG time of the second 2 impulse maneuvers:					
13	days	00	9	days	8	CGZV_ORB_TGT_TIME.D_H_M_S$(2;1)
14	hours	00	23	hours	8	CGZV_ORB_TGT_TIME.D_H_M_S$(2;2)
15	minutes	00	59	min	8	CGZV_ORB_TGT_TIME.D_H_M_S$(2;3)
16	seconds	00	59	sec	8	CGZV_ORB_TGT_TIME.D_H_M_S$(2;4)
17	Transfer time	−300	+300	min	9	CGZV_ORB_TGT_DISP_DT
	Desired orbiter relative position at T2 TIG:	−999.99	+999.99	Kft	10	
18	X Component					CGZV_ORB_TGT_DISP_T2$1
19	Y Component					CGZV_ORB_TGT_DISP_T2$2
20	Z Component					CGZV_ORB_TGT_DISP_T2$3
	BASE TIME:					
21	days	0	9	day	11	CGZV_ORB_TGT_TIME.D_H_M_S$(3;1)
22	hours	0	23	hours	11	CGZV_ORB_TGT_TIME.D_H_M_S$(3;2)
23	minutes	0	59	min	11	CGZV_ORB_TGT_TIME.D_H_M_S$(3;3)
24	seconds	0	59	sec	11	CGZV_ORB_TGT_TIME.D_H_M_S$(3;4)

TABLE 3.034-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
25	Maneuver data transfer				13	
26	LOAD data				14	
28	COMPUTE T1				15	CGZB_COMP_QUEUED_ACTIVE$15
29	COMPUTE T2				16	CGZB_COMP_QUEUED_ACTIVE$16

3.5.040 DISPLAY: SENSOR TEST

−1 AVAILABILITY: SPEC 040 in OPS G8.

−2 PURPOSE: The On-Orbit Sensor Self-Test display provides the capability to initiate sensor self test of Microwave Scan Beam Landing System (MLS), TACAN, Radar Altimeter, and Accelerometer Assembly (AA) and review the results. It also provides the capability to select/deselect LRU(s) for selection filter/RM processing.

```
XXXX/040/          SENSOR TEST    XX X DDD/HH:MM:SS
                                        DDD/HH:MM:SS
        DES STAT  RNG     AZ     EL
MLS 1    1X XXXX XX.XS  ±X.XXS X.XXS
    2    2X XXXX XX.XS  ±X.XXS X.XXS
    3    3X XXXX XX.XS  ±X.XXS X.XXS

        DES STAT  RNG    AZ
TAC 1    4X XXXX  X.XS XXX.XXS
    2    5X XXXX  X.XS XXX.XXS
    3    6X XXXX  X.XS XXX.XXS

        DES STAT  ALT
 RA 1    7X XXXX XXXXS
    2    8X XXXX XXXXS

        DES        Y        Z
 AA 1    9X     ±XX.XS   ±XX.XS
    2   10X     ±XX.XS   ±XX.XS
    3   11X     ±XX.XS   ±XX.XS
    4   12X     ±XX.XS   ±XX.XS

              START 13X  STOP 14X

                                                (XX)
```

Figure 3.040

TABLE 3.040-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 040 PRO	Sensor Self-Test is available only in OPS G8. Data is cyclically updated unless in testing. (see function 3.)
2	Sensor Selection/ Deselection for Selection Filter/RM	ITEM N EXEC	Enables/Disables selected sensor for selection filter/RM. N = 1-12 as follows: (Operates as a flip/flop.) 1. MLS 1 7. Radar Alt 1 2. MLS 2 8. Radar Alt 2 3. MLS 3 9. Accel. Assm. 1 4. TACAN 1 10. Accel. Assm. 2 5. TACAN 2 11. Accel. Assm. 3 6. TACAN 3 12. Accel. Assm. 4 An * present represents DISABLED. For N = 1-3, an * present may also represent failure.
3	Test Controls: Start	ITEM 13 EXEC	Start self-test of all LRUs. NOTE: 1. Data is frozen on display at completion of test until test is terminated via ITEM 14. 2. Test status is shown at completion of test as blank if good, or ↓ if failed low, or ↑ if failed high. STAT columns (except AAs) show blank (good), OFF (LRU has no power), or BITE (hardware failure). 3. Table 3.040-3 defines test values for LRUs.
	Disable	ITEM 14 EXEC	Terminate self-test. Restarts cyclic updating of LRU data and clears status indications. Must be entered after any test started before another test may be attempted.

TABLE 3.040-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	MLS 1 SELECT				2	MFE_CGRB_STATUS_2$(2;13)
2	MLS 2 SELECT				2	MFE-_CGRB_STATUS_2$(2;14)
3	MLS 3 SELECT				2	MFE_CGRB_STATUS_2$(2;15)
4	TACAN 1 SELECT				2	CGRB_TAC_FAIL$(1;5)
5	TACAN 2 SELECT				2	CGRB_TAC_FAIL$(1;6)
6	TACAN 3 SELECT				2	CGRB_TAC_FAIL$(1;7)
7	RA 1 SELECT				2	CGRB_STATUS_2$(1;13)
8	RA 2 SELECT				2	CGRB_STATUS_2$(1;14)
9	AA 1 SELECT				2	CGRB_STATUS_2$(24;13)
10	AA 2 SELECT				2	CGRB_STATUS_2$(24;14)
11	AA 3 SELECT				2	CGRB_STATUS_2$(24;15)
12	AA 4 SELECT				2	CGRB_STATUS_2$(24;16)
13	START SELF TEST				3	CNS_SPEC_040_SF(13) CGEB_VN9_ACTIVATE CNS_MLS_CYCLIC
14	TERMINATES SELF TEST				3	CNS_SPEC_040_SF(14) CNS_MLS_CYCLIC CNS_SPEC_040_CYCLIC

TABLE 3.040-3. SENSOR SELF-TEST LIMITS

DESCRIPTION	LOW	HIGH	UNITS
MLS Range	15.0	15.4	NM
MLS Elevation	5.9	6.1	DEG
MLS Azimuth - High Mode	2.9	3.1	DEG
MLS Azimuth - Low Mode	−3.1	−2.9	DEG
TACAN Range	0.0	0.5	NM
TACAN Azimuth	177.5	182.5	DEG
Radar Altimeter	900	1100	FT
Accel. Assembly -Y	14.4	17.8	FT/SEC^2
Accel. Assembly -Z	57.7	71.1	FT/SEC^2

3.5.041 DISPLAY: RGA/ADTA/RCS

−1 AVAILABILITY: SPEC 041 in OPS G8.

−2 PURPOSE: The On-Orbit RGA/ADTA/RCS Test display is used to activate and control the execution of sensor self tests of the Rate Gyro Assemblies (RGA), the Air Data Transducer Assembly (ADTA), and the Reaction Control System (RCS). It allows the users to select and deselect two test modes on each LRU: High, or Low.

```
 XXXX/041/      RGA/ADTA/RCS      XX X DDD/HH:MM:SS
                                  DDD/HH:MM:SS

    DES STAT     R        P        Y
 R1  1X XXXX  ±XX.XS   ±XX.XS   ±XX.XS
 G2  2X XXXX  ±XX.XS   ±XX.XS   ±XX.XS
 A3  3X XXXX  ±XX.XS   ±XX.XS   ±XX.XS
  4  4X XXXX  ±XX.XS   ±XX.XS   ±XX.XS

    DES STAT    PS      PαC      PαU      PαL       T
 A1  5X XXXX XX.XXXS XX.XXXS XX.XXXS XX.XXXS XXX.XXS
 D3  6X XXXX XX.XXXS XX.XXXS XX.XXXS XX.XXXS XXX.XXS
 T2  7X XXXX XX.XXXS XX.XXXS XX.XXXS XX.XXXS XXX.XXS
 A4  8X XXXX XX.XXXS XX.XXXS XX.XXXS XX.XXXS XXX.XXS

TEST   HI 9X   LOW 10X   STOP 11X

                  RCS DRIVERS

    RJDF   12X     TEST EXEC 15X     TEST XXXX
    RJDA-A 13X     CONTINUE  16X     JET   XXX
        -B 14X     STOP      17

                                                (XX)
```

Figure 3.041

TABLE 3.041-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 041 PRO	The RGA/ADTA/RCS test is available only in OPS G8.
2	RCS Selection for Testing	ITEM N EXEC	Enables selected RCS for testing. N=: 12. RJDF 13. RJDA-A 14. RJDA-B
3	RCS Test Controls: Start	ITEM 15 EXEC	Start test of selected LRUs
	Continue	ITEM 16 EXEC	Continue the RCS test that has been suspended. Illegal entry unless an RCS test is suspended. If the last thruster in a set fails (RJDF-F5R, RJDA-A-L5L, RJDA-B-L4D), select ITEM 17.
	Terminate	ITEM 17 EXEC	Terminate an RCS test that has been suspended or completed. NOTE: 1. ITEMs 12-14 are illegal while the test is executing. 2. STAT goes RUN when start test is executed, FAIL if a jet fails and the jet which failed is displayed after JET. 3. When either ITEM 16 or 17 is entered STAT and JET are blanked.
4	Sensor Selection for Selection Filter/RM	ITEM N EXEC	Enables selected sensor for a testing. N=: 1. RGA 1 5. ADTA 1 2. RGA 2 6. ADTA 2 3. RGA 3 7. ADTA 3 4. RGA 4 8. ADTA 4
5	Sensor Test Controls: Start High	ITEM 9 EXEC	Start the self test for the HIGH TEST MODE on the selected sensors.
	Start Low	ITEM 10 EXEC	Start the self test for the LOW TEST MODE on the selected sensors.

TABLE 3.041-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			NOTE: 1. Only one test (HIGH or LOW) may be selected at one time. 2. Data is frozen on display at completion of test until test is terminated. 3. Test status is shown at completion of test as blank if good or ↓ if failed low; or ↑ if failed high. STAT columns show blank (good) or SMRD (RGA) or BITE (ADTA) for hardware failure. 4. Table 3.041-3 defines test values for sensors.
	Terminate	ITEM 11 EXEC	Terminate self test, restarts cyclic updating of sensor LRU data and clears status indicators. Must be entered after test started before any other sensor entries accepted.

TABLE 3.041-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select RGA 1				4	CGRB_STATUS_2$(21;13)
2	Select RGA 2				4	CGRB_STATUS_2$(21;14)
3	Select RGA 3				4	CGRB_STATUS_2$(21;15)
4	Select RGA 4				4	CGRB_STATUS_2$(21;16)
5	Select ADTA 1				4	CGRB_ADTA_SEL$(1:1)
6	Select ADTA 2				4	CGRB_ADTA_SEL$(2:1)
7	Select ADTA 3				4	CGRB_ADTA_SEL$(3:1)
8	Select ADTA 4				4	CGRB_ADTA_SEL$(4:1)
9	Select High Test Mode				5	CNS_TEST_SELECT CNS_SPEC_041_SF(9) CGEB_VN8_ACTIVATE
10	Select Low Test Mode				5	CNS_TEST_SELECT CNS_SPEC_041_SF(10) CGEB_VN8_ACTIVATE
11	Terminate HIGH or LOW Test				5	CNS_TEST_SELECT CNS_SPEC_041_SF(11) CGEB_VN8_ACTIVATE
12	Select RCS RJDF				2	CNS_SPEC_041_SF(12)
13	Select RCS RJDA-A				2	CNS_SPEC_041_SF(13)
14	Select RCS RJDA-B				2	CNS_SPEC_041_SF(14)
15	Initiate RCS Test				3	CGEB_RCS_ACTIVATE CNS_RCS_IN_PROCESS
16	Continue RCS Test				3	CNS_SPEC_041_SF(16)
17	Terminate RCS Test				3	CNS_RCS_SUSPEND

TABLE 3.041-3. RGA LIMIT VALUES

DESCRIPTION	LOW	HIGH	UNITS
ROLL RATE			
HIGH	18.88	21.12	DEG/SEC
LOW	−21.12	−18.88	DEG/SEC
PITCH RATE			
HIGH	9.44	10.56	DEG/SEC
LOW	−10.56	−9.44	DEG/SEC
YAW RATE			
HIGH	9.44	10.56	DEG/SEC
LOW	−10.56	−9.44	DEG/SEC

TABLE 3.041-4. ADTA LIMIT VALUES

DESCRIPTION	LOW	HIGH	UNITS
STATIC PRESS			
HI ALT	0.023	0.815	IN HG
LO ALT	24.887	24.889	IN HG
CTR ALPHA PRESS (PAC)			
HI ALT	5.473	5.477	IN HG
LO ALT	29.531	29.531	IN HG
LWR ALPHA PRESS (PAL)			
HI ALT	1.708	1.712	IN HG
LO ALT	14.713	14.717	IN HG
UPR ALPHA PRESS (PAU)			
HI ALT	2.740	2.744	IN HG
LO ALT	21.708	21.712	IN HG
TOTAL TEMP			
HI ALT	173.56	173.60	DEG C
LO ALT	18.50	18.54	DEG C

3.5.042 DISPLAY: SWITCH/SURF

−1 AVAILABILITY: SPEC 042 in OPS G8.

−2 PURPOSE: The RM SWITCHES/SURFACES Feedback display provides the crew with indications of the closed contacts sensed in the FCS channel and mode switches and displays the sensed outputs of the feedback transducers for the aerosurfaces. The display provides controls for deselection and selection of sets of switch contacts or switch strings as candidates for the selection filter. (30526)

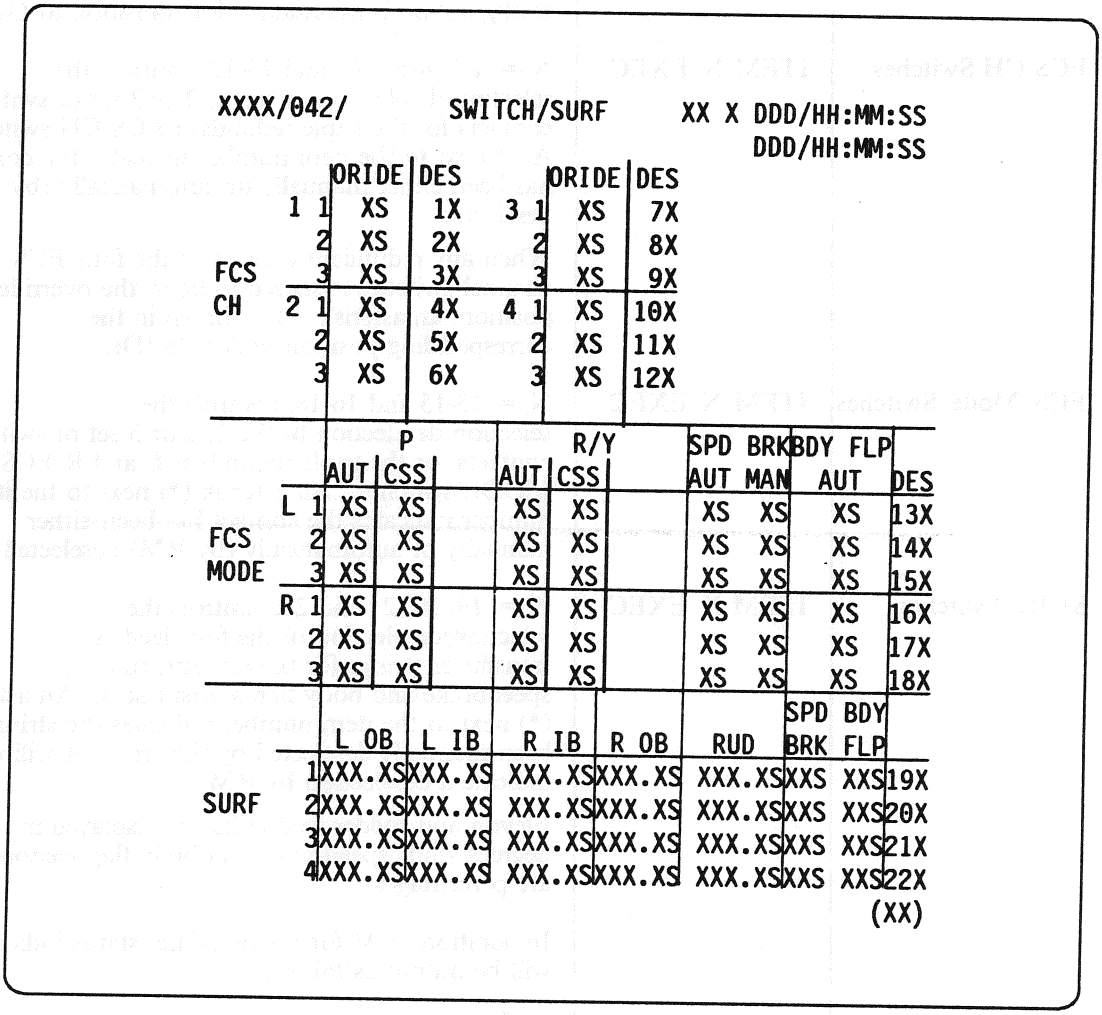


Figure 3.042

TABLE 3.042-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 042 PRO	The SWITCH/SURF display is available only in OPS G8. For all outputs an M is displayed if the signal is missing. Items 1 through 22 reverse the selection state of the associated contact or string. An asterisk (*) beside the item number indicates that the associated contact sets or switch string is deselected. The selection filters are not active during OPS 8, but the selected candidate configuration is maintained for transition to OPS 3.
2	FCS CH Switches	ITEM N EXEC	N = 1-3, 4-6, 7-9, and 10-12; controls the selection/deselection of the 1, 2 or 3 set of switch contacts for the triple redundant FCS CH switches. An * next to the item number indicates the contact has been either manually or automatically (by RM) deselected. When any redundant contact of the four FCS channel switches is sensed to be in the override position, an asterisk (*) is shown in the corresponding position under ORIDE.
3	FCS Mode Switches	ITEM N EXEC	N = 13-15 and 16-18; controls the selection/deselection of the 1, 2 or 3 set of switch contacts for the triple redundant L and R FCS MODE switches. An asterisk (*) next to the item number indicates the contact has been either manually or automatically (by RM) deselected.
4	SURF Switches	ITEM N EXEC	N = 19, 20, 21 and 22; controls the selection/deselection of the four feedback transducer strings for the elevons, rudder, speedbrake and body flap aerosurfaces. An asterisk (*) next to the item number indicates the string has been manually deselected by the crew. It will not indicate a deselection by RM. Elevon and rudder feedbacks are displayed in degrees while speedbrake and body flap feedbacks are percentages. In addition to M for missing data, status indicators will be output as follows: a. Elevons 1) U - trailing edge of the elevon is up. 2) D - trailing edge of the elevon is down. b. Rudder 1) R - trailing edge of the rudder is to the right. 2) L - trailing edge of the rudder is to the left.

TABLE 3.042-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select/deselect Contact Set 1 for FCS CH1 Switch				2	CGRB_ORB_TRIPLE_SF_STAT$(4:13)
2	Select/deselect Contact Set 2 for FCS CH1 Switch				2	CGRB_ORB_TRIPLE_SF_STAT$(5:13)
3	Select/deselect Contact Set 3 for FCS CH1 Switch				2	CGRB_ORB_TRIPLE_SF_STAT$(6:13)
4	Select/deselect Contact Set 1 for FCS CH2 Switch				2	CGRB_ORB_TRIPLE_SF_STAT$(4:14)
5	Select/deselect Contact Set 2 for FCS CH2 Switch				2	CGRB_ORB_TRIPLE_SF_STAT$(5:14)
6	Select/deselect Contact Set 3 for FCS CH2 Switch				2	CGRB_ORB_TRIPLE_SF_STAT$(6:14)
7	Select/deselect Contact Set 1 for FCS CH3 Switch				2	CGRB_ORB_TRIPLE_SF_STAT$(4:15)
8	Select/deselect Contact Set 2 for FCS CH3 Switch				2	CGRB_ORB_TRIPLE_SF_STAT$(5:15)
9	Select/deselect Contact Set 3 for FCS CH3 Switch				2	CGRB_ORB_TRIPLE_SF_STAT$(6:15)
10	Select/deselect Contact Set 1 for FCS CH4 Switch				2	CGRB_ORB_TRIPLE_SF_STAT$(4:16)
11	Select/deselect Contact Set 2 for FCS CH4 Switch				2	CGRB_ORB_TRIPLE_SF_STAT$(5:16)
12	Select/deselect Contact Set 3 for FCS CH4 Switch				2	CGRB_ORB_TRIPLE_SF_STAT$(6:16)

TABLE 3.042-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
13	Select/deselect Contact Set 1 for FCS MODE L Switch				3	CGRB_RM_SW_DISPLAYS$(1)
14	Select/deselect Contact Set 2 for FCS MODE L Switch				3	CGRB_RM_SW_DISPLAYS$(2)
15	Select/deselect Contact Set 3 for FCS MODE L Switch				3	CGRB_RM_SW_DISPLAYS$(3)
16	Select/deselect Contact Set 1 for FCS MODE R Switch				3	CGRB_RM_SW_DISPLAYS$(4)
17	Select/deselect Contact Set 2 for FCS MODE R Switch				3	CGRB_RM_SW_DISPLAYS$(5)
18	Select/deselect Contact Set 3 for FCS MODE R Switch				3	CGRB_RM_SW_DISPLAYS$(6)
19	Select/deselect Feedback Transducer String 1 for SURF Switch				4	CGRB_RM_SW_DISPLAYS$(7)
20	Select/deselect Feedback Transducer String 2 for SURF Switch				4	CGRB_RM_SW_DISPLAYS$(8)
21	Select/deselect Feedback Transducer String 3 for SURF Switch				4	CGRB_RM_SW_DISPLAYS$(9)
22	Select/deselect Feedback Transducer String 4 for SURF Switch				4	CGRB_RM_SW_DISPLAYS$(10)

3.5.043 DISPLAY: CONTROLLERS

–1 AVAILABILITY: SPEC 043 in OPS G8.

–2 PURPOSE: The RM CONTROLLERS specialist function provides the means to monitor data and control the selection filters for Rotation and Translation Hand Controllers (RHC and THC), Speed Brake (SPD BRK) and Rudder Pedal (RUD PED) controller, RHC and Panel (PNL) trim switches, and Body Flap (BDY FLP) slew switches. In the Deselect (DES) columns, specific item numbers allow manual selection or deselection of the associated sensor. An asterisk (*) indicates deselection, a blank, selection. The items operate like a flip flop (select or deselect). (37692)

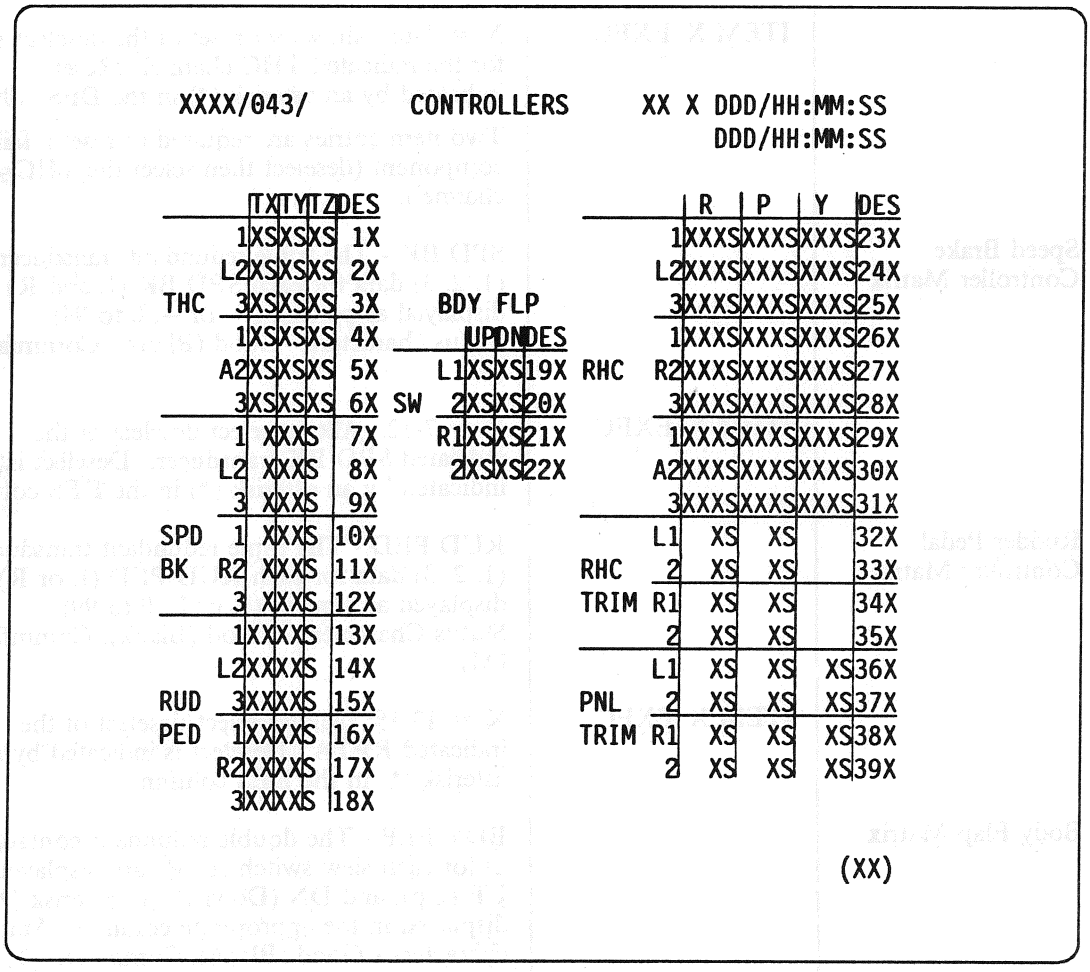


Figure 3.043

TABLE 3.043-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call Up	SPEC 043 PRO	This display is only available in OPS G8.
2	Translation Hand Controller Matrix		THC - The triple redundant transducer (1, 2, 3) data for each THC (L and A) are displayed for TX (X-axis), TY (Y-axis), and TZ (Z-axis). A (+) or (−) character indicates the sensed THC command, and a Blank indicates no sensed command. Status characters - Good (Blank), Commfault (M), Dilemma (?), Failed (↓).
		ITEM X EXEC	X = 1-6: Allows set/reset of the deselect signal for the indicated THC channel. Reset is indicated by an asterisk (*) in the DES column. Two item entries are required to reset a failed component (deselect then select the THC channel).
3	Speed Brake Controller Matrix		SPD BK - The triple redundant transducer (1, 2, 3) data for each SPD BK (L and R) are displayed as percent (+ or −, 0 to 99). Status characters - Good (Blank), Commfault (M).
		ITEM X EXEC	X = 7-12: Allows select/deselect of the indicated SPD BK transducer. Deselect is indicated by an asterisk (*) in the DES column.
4	Rudder Pedal Controller Matrix		RUD PED - The triple redundant transducer (1, 2, 3) data for each RUD PED (L or R) are displayed as percent (R or L, 0 to 99). Status Characters - Good (Blank), Commfault (M).
		ITEM X EXEC	X = 13-18: Allows select/deselect of the indicated RPTA. Deselect is indicated by an asterisk (*) in the DES column.
5	Body Flap Matrix		BDY FLP - The double redundant contacts (1, 2) for each slew switch (L, R) are displayed for UP (Up), and DN (Down). An asterisk (*) is displayed in the appropriate columns. Status characters - Good (Blank), Commfault (M).
		ITEM X EXEC	X = 19-22: Allows select/deselect of the indicated Body Flap slew switch. Deselect is indicated by an asterisk (*) in the DES column.

TABLE 3.043-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
6	Rotational Hand Controller Matrix		RHC - The triple redundant transducer (1, 2, 3) data for each RHC (L, R, A) are displayed for R (Roll), P (Pitch), Y (Yaw) as percent (0 to 99) of the direction (U, D, L, or R). Status characters - Good (Blank), Commfault (M), Dilemma (?), Failed (↓).
		ITEM X EXEC	X = 23-31: Allows set/reset of the deselect signal for the indicated RHC channel. Reset is indicated by an asterisk (*) in the DES column, can also occur when RHC FDIR declares a failed unit. To reset a deselection, execute the appropriate Deselect item number.
7	Trim Switch Matrix		RHC TRIM - The double redundant contacts (1, 2) for each trim switch (L, R) are displayed for R (Roll), and P (Pitch). An L (Left) or R (Right) will be displayed for Roll, an U (Up) or D (Down) will be displayed for Pitch, and a Blank indicates no sensed command. Status Characters - Good (Blank), Commfault (M).
		ITEM X EXEC	X = 32-35: Allows select/deselect of the indicated RHC trim switch. Deselect is indicated by an asterisk (*) in the DES column.
			PNL TRIM - The double redundant contacts (1, 2) for each trim switch (L, R) are displayed for R (Roll), P (Pitch), and Y (YAW). An L (Left) or R (Right) will be displayed for Roll or Yaw, an U (Up) or D (Down) will be displayed for Pitch, and a Blank indicates no sensed command. Status characters - Good (Blank), Commfault (M).
		ITEM X EXEC	X = 36-39: Allows select/deselect of the indicated PNL trim switch. Deselect is indicated by an asterisk (*) in the DES column.

TABLE 3.043-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select/Deselect forward THC1 from Select Filter				2	CGZB_THC_ASTER$(1)
2	Select/Deselect forward THC2 from Select Filter				2	CGZB_THC_ASTER$(2)
3	Select/Deselect forward THC3 from Select Filter				2	CGZB_THC_ASTER$(3)
4	Select/Deselect aft THC1 from Select Filter				2	CGZB_THC_ASTER$(4)
5	Select/Deselect aft THC2 from Select Filter				2	CGZB_THC_ASTER$(5)
6	Select/Deselect aft THC3 from Select Filter				2	CGZB_THC_ASTER$(6)
7	Select/Deselect left SPDBK1 from Select Filter				3	CGRV_RM_DATA_BASE. CGRB_STATUS_2$(9;13)
8	Select/Deselect left SPDBK2 from Select Filter				3	CGRV_RM_DATA_BASE. CGRB_STATUS_2$(9;14)
9	Select/Deselect left SPDBK3 from Select Filter				3	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(9;15)
10	Select/Deselect right SPDBK1 from Select Filter				3	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(11;13)
11	Select/Deselect right SPDBK2 from Select Filter				3	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(11;14)
12	Select/Deselect right SPDBK3 from Select Filter				3	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(11;15)
13	Select/Deselect left RPTA1 from Select Filter				3	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(8;13)
14	Select/Deselect left RPTA2 from Select Filter				3	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(8;14)

TABLE 3.043-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
15	Select/Deselect left RPTA3 from Select Filter				3	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(8;15)
16	Select/Deselect right RPTA1 from Select Filter				3	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(10;13)
17	Select/Deselect right RPTA2 from Select Filter				3	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(10;14)
18	Select/Deselect right RPTA3 from Select Filter				3	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(10;15)
19	Select/Deselect left Body Flap 1 from Select Filter				4	CGRB_SW_SF$(7:5)
20	Select/Deselect left Body Flap 2 from Select Filter				4	CGRB_SW_SF$(8:5)
21	Select/Deselect right Body Flap 1 from Select Filter				4	CGRB_SW_SF$(7:7)
22	Select/Deselect right Body Flap 2 from Select Filter				4	CGRB_SW_SF$(8:7)
23	Select/Deselect left RHC1 from Select Filter				5	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(15;13)
24	Select/Deselect left RHC2 from Select Filter				5	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(15;14)
25	Select/Deselect left RHC3 from Select Filter				5	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(15;15)
26	Select/Deselect right RHC1 from Select Filter				5	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(12;13)
27	Select/Deselect right RHC2 from Select Filter				5	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(12;14)

TABLE 3.043-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
28	Select/Deselect right RHC3 from Select Filter				5	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(12;15)
29	Select/Deselect aft RHC1 from Select Filter				5	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(18;13)
30	Select/Deselect aft RHC2 from Select Filter				5	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(18;14)
31	Select/Deselect aft RHC3 from Select Filter				5	CGRB_RM_DATA_BASE. CGRB_STATUS_2$(18;15)
32	Select/Deselect left RHC TRIM1 from Selection Filter				6	CGRB_SW_SF$(7:1)
33	Select/Deselect right RHC TRIM2 from Selection Filter				6	CGRB_SW_SF$(8:1)
34	Select/Deselect right THC TRIM1 from Selection Filter				6	CGRB_SW_SF$(7:11)
35	Select/Deselect right THC TRIM1				6	CGRB_SW_SF$(8:11)
36	Select/Deselect left PNL TRIM1 from Selection Filter				6	CGRB_SW_SF$(7:15)
37	Select/Deselect left PNL TRIM2 from Selection Filter				6	CGRB_SW_SF$(8:15)
38	Select/Deselect right PNL TRIM1 from Selection Filter				6	CGRB_SW_SF$(7:21)
39	Select/Deselect right PNL TRIM2 from Selection Filter				6	CGRB_SW_SF$(8:21)

3.5.044 DISPLAY: SWITCHES

−1 AVAILABILITY: SPEC 044 in OPS G8.

−2 PURPOSE: The Switches display provides a means for the crew to monitor the status of the switch contacts of the Entry Roll Mode switch. It also provides for crew selection of switch contacts to be used as candidates in the Switch RM Selection Filter. (37692)

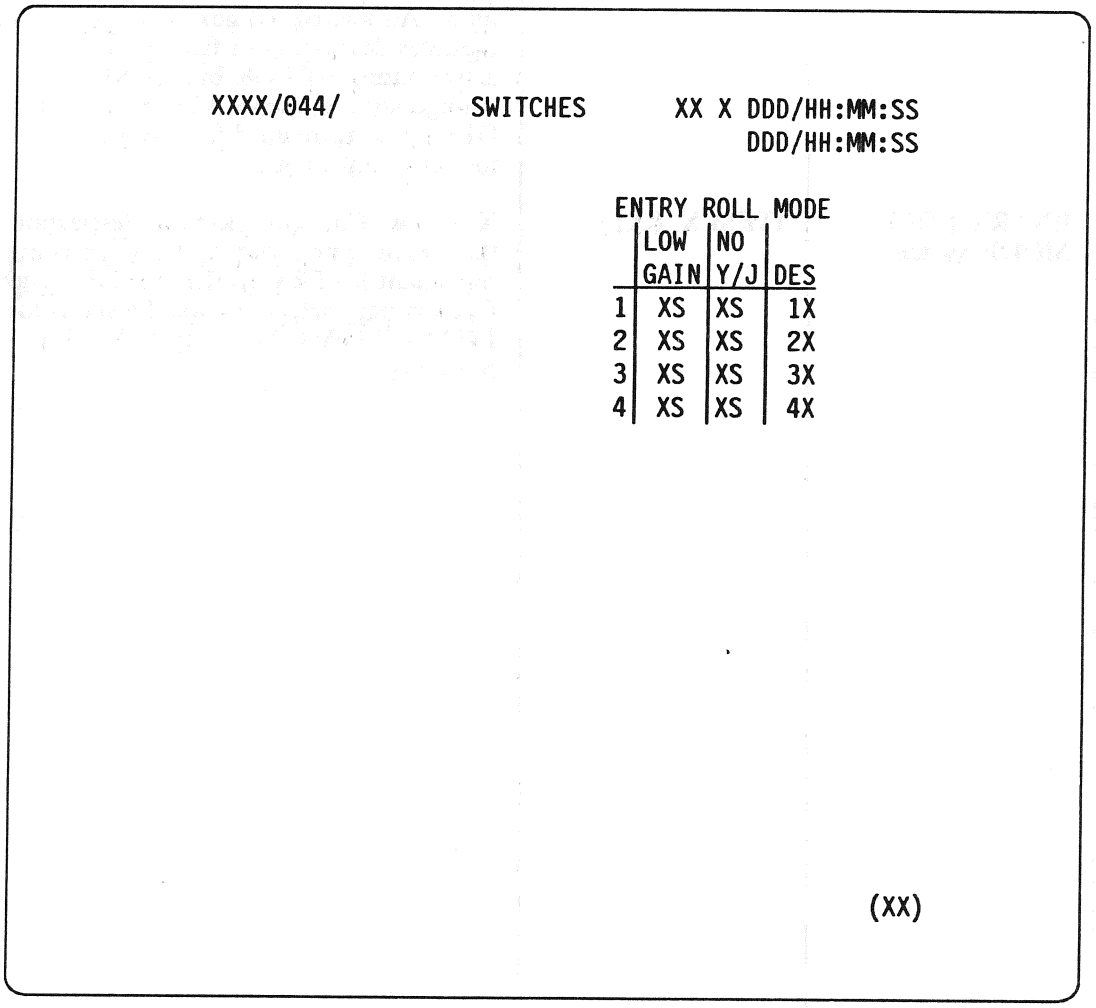


Figure 3.044

TABLE 3.044-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 044 PRO	The Switches display is available only in OPS G8. An asterisk (*) will be displayed to indicate that the contact closed position has been sensed. An M will be displayed if the signal data is missing. Items 1 through 4 are used to select/deselect sets of switch contacts to be used as candidates by the RM selection filter. An asterisk (*) next to the item number indicates deselection or failure. SF is not active during OPS G8, but the SF configuration established by the crew during OPS G8 is maintained for transitions to other memory configurations.
2	ENTRY ROLL MODE Switch	ITEM X EXEC	X = 1-4: Controls selection/ deselection of the sets of switch contacts for the quadruply redundant ENTRY ROLL MODE switch. Contact parameters provide the status for the LGAIN (LOW GAIN) and NO YJET positions.

TABLE 3.044-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select Contact Set 1 for ENTRY ROLL MODE Switch				4	CGRB_ERM_SF$(1:13)
2	Select Contact Set 2 for ENTRY ROLL MODE Switch				4	CGRB_ERM_SF$(1:14)
3	Select Contact Set 3 for ENTRY ROLL MODE Switch				4	CGRB_ERM_SF$(1:15)
4	Select Contact Set 4 for ENTRY ROLL MODE Switch				4	CGRB_ERM_SF$(1:16)

3.5.045 DISPLAY: NWS CHECK

−1 AVAILABILITY: SPEC 045 in OPS G8.

−2 PURPOSE: The On-Orbit Nose Wheel Steering Check Display provides the capability to control the enable and position commands to the nosewheel steering system. It also allows for the monitoring of the nosewheel steering enable discretes, servo currents, nosewheel strut position data, NWS-activated discretes and the NWS mode switch discretes.

This display allows the user to detect NWS faults during on orbit checkout to ensure the selection of a good nosewheel channel.

```
XXXX/045/          NWS CHECK      XX X DDD/HH:MM:SS
                                         DDD/HH:MM:SS
          HYD
     SYS  PRESS
     SEL  HIGH    ENABLE  CURRENT     POSITION

NWS1 XS    XS      A XS   XX.XXS      A  XX.XXS
                   B XS               B  XX.XXS
                                      C  XX.XXS
NWS2 XS    XS      A XS   XX.XXS
                   B XS

STIMULI
ENABLE          1X
RIGHT TURN (+)  2X
LEFT TURN  (-)  3X
STOP            4X


                                                (XX)
```

Figure 3.045

TABLE 3.045-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 045 PRO	The NWS Check Display is available in OPS G8 only.
2	ENABLE	ITEM 1 EXEC	Test response of Enable Valve Driver. Selection of this item causes the NWS Enable Commands to be set to TRUE and the NWS Position Commands to be set to zero.
3	RIGHT TURN	ITEM 2 EXEC	Test response of Nosewheel Steering System to a positive position command (right turn). Selection of this item causes the NWS Enable Commands to be set to FALSE and the NWS Position Commands to be set to a predefined positive value.
4	LEFT TURN	ITEM 3 EXEC	Test response of Nosewheel Steering System to a negative position command (left turn). Selection of this item causes the NWS ENABLE Commands to be set to FALSE and the NWS Position Commands to be set to a predefined negative value.
5	STOP	ITEM 4 EXEC	Terminates any previously selected NWS check function. Selection of this item causes the NWS Enable Commands to be set to False and the NWS Position Commands to be set to zero volts.

TABLE 3.045-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select Enable				2	CVNB_ITEM_SELECT$(1) MSID = V99X4122X
2	Select Right Turn				3	CVNB_ITEM_SELECT$(2) MSID = V99X4123X
3	Select Left Turn				4	CVNB_ITEM_SELECT$(3) MSID = V99X4124X
4	Select Stop				5	CVNB_ITEM_SELECT$(4) MSID = V99X4125X

3.5.050 DISPLAY: HORIZ SIT

−1 AVAILABILITY: SPEC 050 IN OPS G1/6 and G3.

−2 PURPOSE: The Horizontal Situation Spec provides a graphic display of orbiter position and heading relative to the Heading Alignment Cone, altimeter setting control, TAL/Landing site runway and TACAN station designation control, glideslope ground intercept redesignation control, entry point indicator and control, HAC designation and control, Nav filter update displays and controls, ADTA to G&C control, TACAN data status and mode selection, PTI status and control, HUD format selection, speedbrake mode selection, and normal acceleration data. (50085)

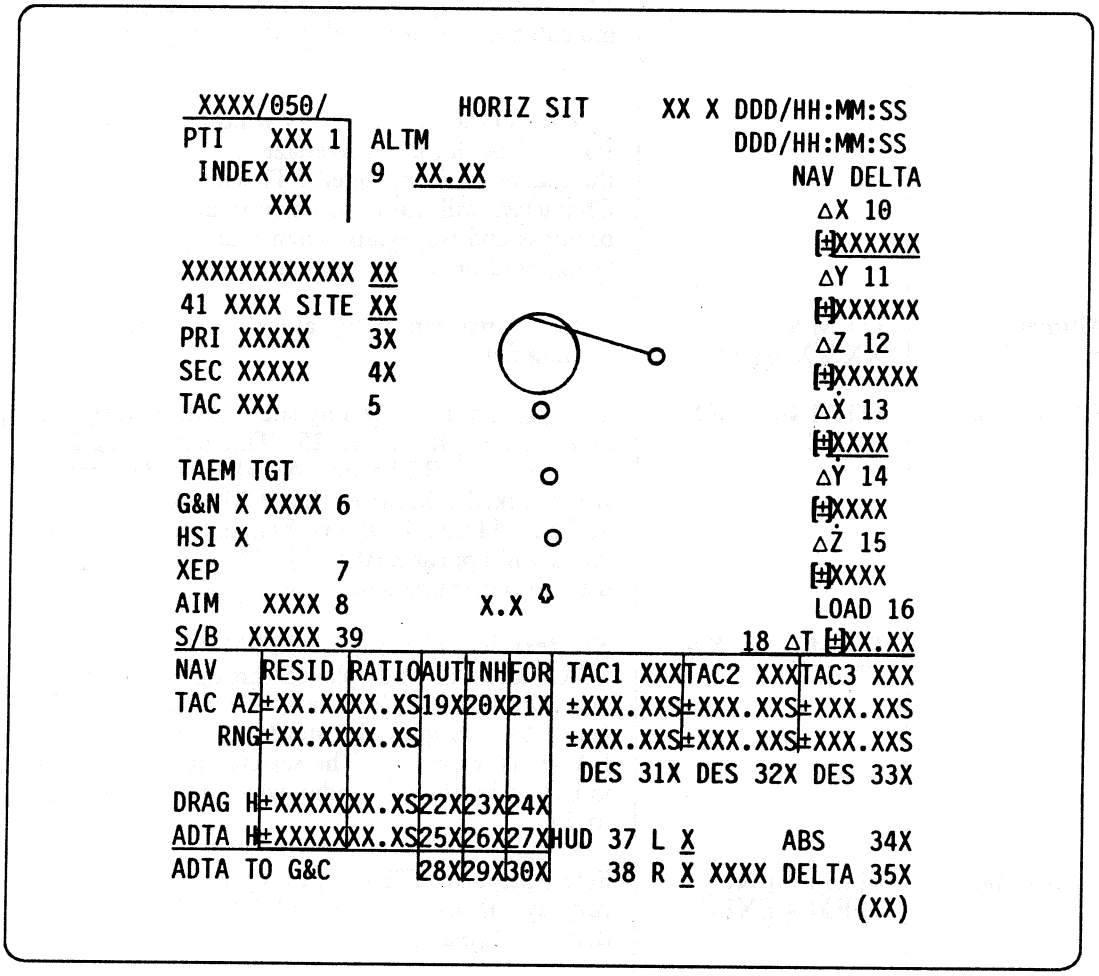


Figure 3.050

TABLE 3.050-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 050 PRO	Available in OPS G1/6 and G3.
2	Programmed Test Input	ITEM 1 EXEC	Acts as a flip-flop alternately enabling or inhibiting PTIs. ENA and INH will be displayed to indicate test status. Valid in MM 101, 102, 304, 305. The particular PTI maneuver to be performed is indicated by the PTI index which ranges from 0 to 25. In OPS G3 whenever a PTI window is entered PTI will be displayed oversize and overbright. If the maneuver is inhibited PTI will flash. Characters will not flash when maneuver is in progress and will blank when maneuver is terminated or window exited. (48415)
3	Baro Altimeter Setting	ITEM 9 + XX.XX EXEC	Enter desired barometric altimeter correction for landing field.
4	TAL Site Selection	ITEM 40 + XX EXEC	The selected TAL landing site is indicated by an index ranging from 1 to 25. This item is legal in OPS G1 until RTLS or TAL abort is declared. It is blanked otherwise. If a TAL abort is declared, ITEM 40 will be blanked and the TAL index will appear next to ITEM 41 and will be used to determine landing site data.
5	Area Selection	ITEM 41 + XX EXEC	The text displayed next to ITEM 41 will be RTLS and will be displayed throughout OPS G1 and OPS G6. If a TAL abort is declared in OPS G1, TAL is displayed instead. In OPS G3, LAND is displayed. The selected landing area is indicated by the area index which ranges from 1 to 25.
6	Runway Selection	ITEM 3 EXEC ITEM 4 EXEC	Select primary (ITEM 3) or secondary (ITEM 4) runway. Runway name and TACAN channel data are displayed.
7	TACAN Station Selection	ITEM 5 EXEC	Toggles primary or secondary TACAN station

TABLE 3.050-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
8	TAEM Targeting Control	ITEM 6 EXEC	Enables the runway approach to be toggled from an overhead approach to a straight-in approach in case of high winds or low energy. (42650) Valid in MM 101, 304, 305, 602,603. Indicators are provided for GNC and the left HSI to identify whether left or right HAC is the target point.
		ITEM 7 EXEC	Caused TAEM guidance to switch between nominal (NEP) and minimum (MEP) entry points.
		ITEM 8 EXEC	Selects the nominal (low winds) or closer to runway (high winds) glide slope ground intercept point. Switching must be done before TAL/AL interface.
9	NAV DELTA State Update	ITEM N ± XXXXXX EXEC	N = 10, 11, 12. Enter desired delta position components in runway coordinates.
		ITEM M ± XXXX EXEC	M = 13, 14, 15. Enter desired delta velocity components in runway coordinates. (37981)
		ITEM 16 EXEC	Causes the execution of the delta NAV updates using the values entered in ITEMs 10 - 15 or state update via ITEM 18.
		ITEM 18 ± XXXX EXEC	Enter desired time delta to update state vector. Legal in OPS G3 only.
10	NAV Sensor Data Control	ITEM N EXEC	N = 19 – 27. ITEMs 19, 22 and 25 enable automatic use of TACAN, DRAG, and ADTA data, respectively. ITEMs 20, 23 and 26 inhibit the use of data by NAV. (37577) ITEMs 21, 24 and 27 force use of data. An indication of how well the NAV estimate and sensor agree is given by the residuals, which represent their difference. The ratio and its status tell whether a data type is being incorporated into the state vector.
11	ADTA Control to Guidance and Flight Control	ITEM 28 EXEC	ITEM 28 provides auto transition from NAV derived to ADTA data.
		ITEM 29 EXEC	Inhibits use of ADTA data.
		ITEM 30 EXEC	Forces use of ADTA data.

TABLE 3.050-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
12	TACAN Data and Control	ITEM XX EXEC	XX = 31, 32 or 33: Toggle select/deselect status of TACANS 1, 2 and 3, respectively. (39372) (45703) (37693) XX = 34 or 35: Cause TACAN data to be displayed in absolute or delta values. Range, azimuth, station ID and status information are supplied for each TACAN.
13	Head Up Display Format Selection	ITEM 37 + X EXEC ITEM 38 + X EXEC	ITEMs are used to enter the format number for display on the left and right HUDs. Valid in MM 304, 305, 602, 603. NOTE: Selection of Format 2 will result in ILLEGAL ENTRY message and rejection of the input.
14	Normal Acceleration Data		Data is displayed in G's adjacent to shuttle symbol. Represents either total load factor (MM 304) or NZ (MM 305, 602, 603). Symbol will flash when acceleration exceeds ILOADed limit.
15	Display Graphics		The graphics portion of the display consists of a fixed orbiter symbol, three dynamic position predictor circles (20, 40, 60 seconds in the future), tic marks representing TAEM spiral at 80°, 270°, and 360° of travel, heading alignment cone (HAC), a runway touchdown point circle, and a linear extension from the touchdown point to the HAC intersection point. The HAC and runway symbols move relative to the fixed orbiter symbol. (50085)
16	Speedbrake Mode Selection	ITEM 39 EXEC	Toggles SHORT and NOM speedbrake control logic modes. Valid in OPS G3 and in OPS G6 down to the transition to Approach and Landing Guidance phase.

TABLE 3.050-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Inhibit/Enable PTI				2	CGCB_PTI_EXEC
3	Select Primary Runway				6	CGNB_PRI_SEL
4	Select Secondary Runway				6	CGNB_SEC_SEL
5	Select TACAN Station				7	CGNB_TPC_CHANGE
6	Switch from an Overhead to a Straight-In Approach				8	CGZB_HS_MF_FLAGWD
7	Switch from Nominal (NEP) Entry Point to Minumum Entry Point (MEP)				8	CGZB_ENTRY_POINT_SWITCH
8	Select Intercept Point Closer to Runway Nominal				8	CGZB_GNC_INTERCEPT_CMD
9	Input BARO Altimeter Setting Corrected to Mean Sea Level	27.00	35.00	In Hg	3	CGZV_BARO
10	X	−999999	+ 999999	FT	9	CGNV_DR_RW$1
11	Y	−999999	+ 999999	FT	9	CGNV_DR_RW$2
12	Z	−999999	+ 999999	FT	9	CGNV_DR_RW$3
13	X	−9999	+ 9999	FT/ SEC	9	CGNV_DV_RW$1
14	Y	−9999	+ 9999	FT/ SEC	9	CGNV_DV_RW$2
15	Z	−9999	+ 9999	FT/ SEC	9	CGNV_DV_RW$3

TABLE 3.050-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
16	Execute the Delta NAV Update Entered in ITEMs 10–15 or Execute the NAV State State Vector Update Entered in Item 18				9	CGZB_DO_DELTA_T_UPDATE
17	Null Entry					
18	Enter Delta Time Update for NAV State Vector Update	−99.99	+99.99	SECS	9	CGNV_DELTA_T
19	Enable Auto Use of TACAN Data to NAV				10	CGNV_TACAN_AIF
20	Inhibit Use of TACAN Data by NAV				10	CGNV_TACAN_AIF
21	Force Use of TACAN Data by NAV				10	CGNV_TACAN_AIF
22	Enable Auto Use of DRAG Data by NAV				10	CGNV_DRAG_AIF
23	Inhibit Use of DRAG Data by NAV				10	CGNV_DRAG_AIF
24	Force Use of DRAG Data by NAV				10	CGNV_DRAG_AIF
25	Enable Auto Use of ADTA Data by NAV				10	
26	Inhibit Use of ADTA Data by NAV				10	CGNV_BARO_AIF
27	Force Use of ADTA Data by NAV				10	CGNV_BARO_AIF

TABLE 3.050-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
28	Enable Auto Use of ADTA Data Instead of NAV Derived Data to Guidance and Flight Control				11	CGZV_AIR_DATA_AIF
29	Inhibit Use of ADTA Data to G&C				11	CGZV_AIR_DATA_AIF
30	Force Use of ADTA Data to G&C				11	CGZV_AIR_DATA_AIF
31	Deselect/Select TACAN 1				12	
32	Deselect/Select TACAN 2				12	
33	Deselect/Select TACAN 3				12	
34	Display Absolute TACAN Data				12	CGZB_TAC_MODE
35	Display Delta TACAN Data				12	CGZB_TAC_MODE
36	Null Entry					
37	Input Left HUD Format	0	7		13	CGZV_HUD_L_FORMAT
38	Input Right HUD Format	0	7		13	CGZV_HUD_R_FORMAT
39	Select Speedbrake Control Logic Mode				16	CGGB_I_SHORT_RW
40	Select TAL Site	1	25		4	GFK_TAL_AREA_INDEX
41	Select Landing Site	1	25		5	CGNB_NEW_AREA

3.5.051 DISPLAY: OVERRIDE

−1 AVAILABILITY: SPEC 051 IN OPS G1/6 AND G3.

−2 PURPOSE: This SPEC gives the crew the capability to deselect or reselect an ADTA, or IMU LRU or Hydraulic System to solve an RM dilemma or to force RM to consider a previously deselected LRU. It provides the crew the capability to open or close the vent doors during OPS 3 and 6. It also provides the crew the capability to select the desired SW mode for the following dedicated switch failures: ABORT SW, ET SEP SW, ET UMB DR SW, and ENTRY ROLL MODE SW. It also provides the crew capability to override any RCS MANF VLV MICRO SW dilemma which causes RM to set the MANF VLV STATUS to CLOSED. In addition, it allows the crew the capability to inhibit the ascent abort dumps during OPS 1/6; inhibit or enable the orbiter propellant dump during OPS 1/6; to inhibit or enable the MM304 OMS dump; and to inhibit or enable the OMS/RCS Interconnect Function during OPS 1/6 and OPS 3. In OPS 3, the Override Display also allows the crew to select the entry FCS elevon schedule, the body bending filters, and one of three atmosphere models. During OPS 1/6 and OPS 3, the display monitors the OMS time to go, the AFT dump time and the FWD RCS dump. The crew may also input a different AFT RCS dump duration or FWD RCS dump duration. The SPEC also allows the crew to change the maximum SSME throttle level. (37570)

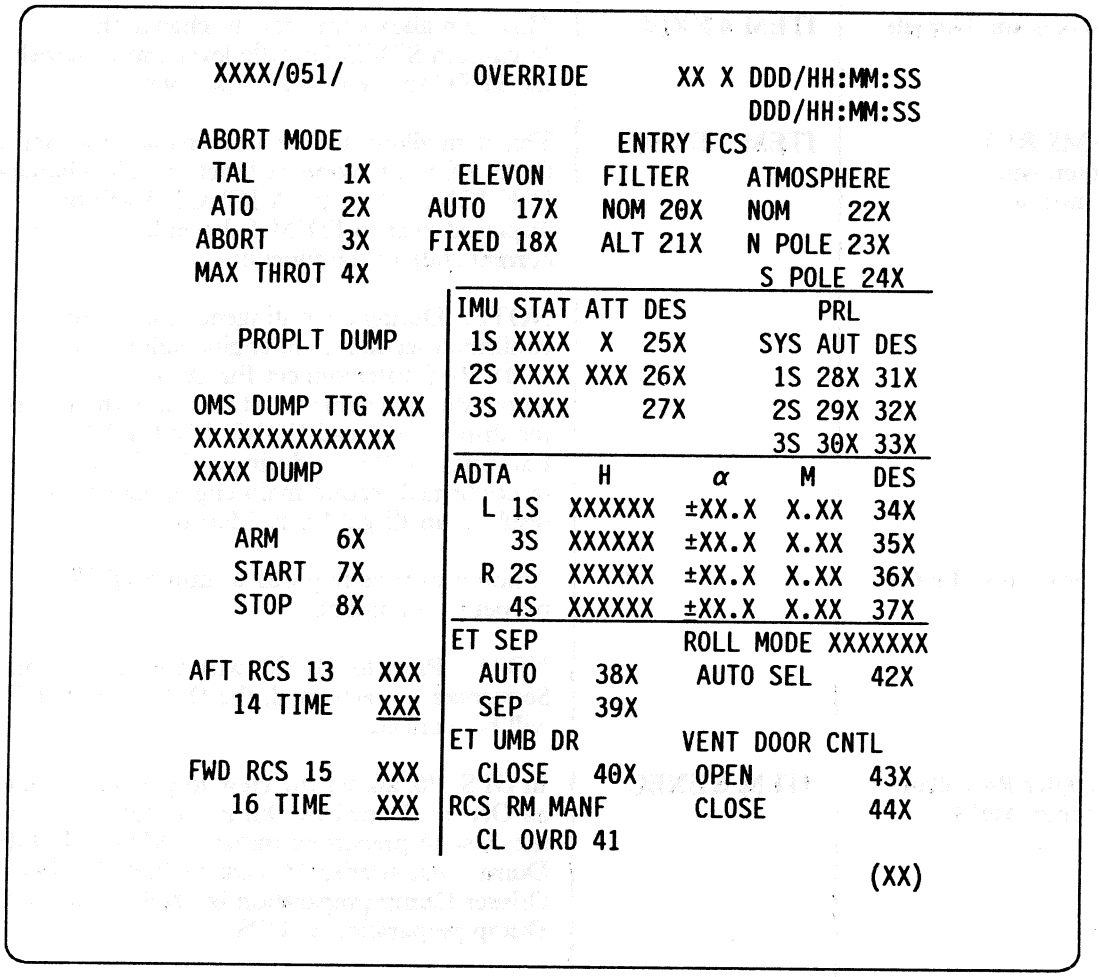


Figure 3.051

TABLE 3.051-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 051 PRO	The Override SPEC is available in GNC OPS 1/6 and 3 only.
2	Backup Abort Mode for TAL and ATO	ITEM 1 EXEC	Allows the crew to select a TAL abort. This item is allowed only in MM 103 and MM 104. (41168)
		ITEM 2 EXEC	Allows the crew to select an ATO abort. This item is allowed only in MM's 102-104.
		ITEM 3 EXEC	Allows the crew to initiate the abort selected. NOTE: Item 3 is not valid unless Item 1 or 2 has been entered.
3	Maximum Throttle	ITEM 4 EXEC	This item allows the crew to change the Maximum SSME Throttle level and to rescale the SBTC to the new throttle level.
4	OMS/RCS Interconnect Function	ITEM 5 EXEC	This item allows the crew to enable or inhibit the OMS/RCS Interconnect function. The characters INH ICNCT 5 or ENA ICNCT 5 will be displayed next to ITEM 5 dependent on the current state of the function. NOTE: During a Contingency Dump or confirmed second main engine failure, the OMS/RCS Interconnect Function is automatically enabled. At this time the text on the display will read CONT ICNCT ENA. Execution of Item 5 during a Contingency Dump or confirmed second main engine failure, will result in an Illegal Entry Message.
5	OMS Time To Go		Amount of time required to dump OMS propellant in seconds. NOTE: Prior to MECO with the Abort Control Sequencer not activated, the OMS Dump TTG will be blanked.
6	Orbiter Propellant Dump ARM	ITEM 6 EXEC	In OPS 1/6, allows the crew to prepare to initiate an Orbiter Propellant Dump. In OPS 3, allows the crew to prepare to initiate a MM 304 OMS Dump. An asterisk (*) next to Item 6 indicates Orbiter Dump preparation in OPS 1/6 or OMS Dump preparation in OPS 3.

TABLE 3.051-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
7	Orbiter Propellant Dump START	ITEM 7 EXEC	In OPS 1/6, this item allows the crew to initiate an Orbiter Propellant Dump. In OPS 3, allows the crew to initiate an OMS Dump. Asterisks by both Item 6 and 7 indicate the Orbiter Dump is in progress.
8	Orbiter Propellant Dump STOP	ITEM 8 EXEC	Allows the crew to stop an Orbiter Propellant Dump in OPS 1/6; to inhibit ascent abort dumps in OPS 1/6; to stop the MM 304 OMS Dump in OPS 3. An asterisk (*) next to Item 8 indicates the Orbiter Dump is not in progress in OPS 1/6; the ascent abort dumps are not in progress in OPS 1/6; and the MM 304 OMS Dump is not in progress in OPS 3. NOTE: No asterisk (*) next to Items 6, 7, 8 indicates that an ascent abort OMS Dump is in progress.
9	Orbiter Propellant Dump Control Characters		CONT DUMP will be displayed during OPS 1/6. OMS DUMP will be displayed during OPS 3.
10	AFT RCS DUMP FUNCTION	ITEM 13 EXEC	Allows the crew to enable or inhibit the AFT RCS Dump. The characters ENA or INH will be displayed next to ITEM 13 dependent on the current state of the function. NOTE: Once the AFT and FORWARD RCS dump counters have begun incrementing, the counters are not reset under any circumstances (even if the crew inputs a new dump duration).
11	AFT RCS DUMP TIME	ITEM 14 + XXX EXEC	Allows the crew to change the AFT RCS Dump Time. NOTE: An AFT RCS Dump may be initiated in MM 304 by inputting a non-zero dump duration via Item 14 and enabling the dump via Item 13.
12	FWD RCS DUMP FUNCTION	ITEM 15 EXEC	Allows the crew to enable or inhibit the FWD RCS Dump. The characters ENA or INH will be displayed next to Item 15 dependent on the current state of the function. NOTE: Once the AFT and FORWARD RCS dump counters have begun incrementing, the counters are not reset under any circumstances (even if the crew inputs a new dump duration).

TABLE 3.051-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
13	FWD RCS DUMP TIME	ITEM 16 + XXX EXEC	Allows the crew to change the FWD RCS Dump Time. NOTE: A FWD RCS Dump may be initiated in MM 304 by inputting a non-zero dump duration via Item 16 and enabling the dump via Item 15.
14	Select Auto Elevon Schedule	ITEM 17 EXEC	Allows crew to command the aerojet DAP to use an auto elevon schedule.
15	Select Fixed Elevon Schedule	ITEM 18 EXEC	Allows crew to command the aerojet DAP to use a fixed elevon schedule.
16	Select Nominal Body Bending Filters	ITEM 20 EXEC	Allows crew to command the aerojet DAP to use nominal body bending filters.
17	Select Alternate Body Bending Filters	ITEM 21 EXEC	Allows crew to command the aerojet DAP to use alternate body bending filters. NOTE: Items 17, 18, 20, and 21 are valid in OPS 3 only.
18	Nominal Atmospheric Model Select Command	ITEM 22 EXEC	Allows the crew to select the nominal atmospheric model. An asterisk (*) indicates nominal selection.
19	Cold Polar Atmospheric Model Select Command	ITEM 23 EXEC	Allows the crew to select the cold polar atmospheric model. An asterisk (*) indicates cold polar selection.
20	Hot Polar Atmospheric Model Select Command	ITEM 24 EXEC	Allows the crew to select the hot polar atmospheric model. An asterisk (*) indicates hot polar selection. NOTE: Items 22, 23 and 24 are valid in OPS 3 only.
21	I/O Fail Status for IMU's 1, 2 and 3		A parameter status column is provided after each LRU ID number that shall be blank for normal operation, display a down arrow (↓) for an RM declared failure or crew deselection, display a question mark (?) for an RM dilemma or an M for missing data.
22	Failure Indicator (BITE) for IMU's 1, 2 and 3		The STAT column allows display of the output of Built-in-Test Equipment (BITE) status (hardware and software). Blank for normal operation or BITE for a problem.

TABLE 3.051-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
23	Attitude Data		The ATT column has two parameters displayed, which IMU is selected for use and whether the IMU data is good or not.
24	Deselect/Reselect an LRU	ITEM XX EXEC	XX = 25-27: Allows the crew to reselect an IMU that has been declared failed by RM or to deselect an IMU for use by the IMU selection filter. (37570) NOTE: When an IMU has been declared failed by RM a down arrow (↓) will be displayed in the status column and an asterisk (*) will be driven after the deselect/select item number indicating the IMU is deselected.
25	Hydraulic System Status		A status column is provided for each Hydraulic System to display a blank for normal operation or upmoded manual system operation, a question mark (?) for an RM dilemma and a down arrow (↓) for a failure or downmoded system.
26	Automatic Hydraulic System Management	ITEM XX EXEC	XX = 28-30: Allows the crew to reselect the Automatic System Management after selecting the manual mode of operation.
27	Hydraulic System Manual Override	ITEM XX EXEC	XX = 31-33: Allows the crew to manually override the Automatic System Management. NOTE: These items are initialized in the Auto Mode.
28	Altitude Indications (H) for ADTAs 1, 2, 3 and 4		ADTA derived altitude in feet.
29	ALPHA Indications for ADTAs 1, 2, 3 and 4		ADTA derived angle of attack in degrees.
30	Mach Indications (M) for ADTAs 1, 2, 3 and 4		ADTA derived Mach number.
31	I/O Fail Status for ADTAs 1, 2, 3 and 4		A parameter status column after the ADTA ID number shall be blank for normal operation, display a down arrow (↓) for an RM declared failure or crew deselection, display a question mark (?) for an RM dilemma, or an (M) for missing data.

TABLE 3.051-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
32	Select/Deselect ADTA LRUs	ITEM XX EXEC	XX = 34-37: Allows the crew to select/deselect an ADTA for use by the ADTA selection filter. An asterisk (*) indicates the ADTA is deselected. NOTE: Items 34-37 are only valid during MM 304, 305, 602 and 603.
33	Backup ET SEP for Auto and Manual Command	ITEM 38 EXEC	Allows the crew to select the ET SEP AUTO mode.
		ITEM 39 EXEC	Allows the crew to initiate ET Separation. NOTE: These items are valid only in MM's 102, 103, 104, 105, 106, and 601.
34	ET UMB Doors Close Command	ITEM 40 EXEC	Allows the crew to backup the dedicated switch for closing the ET Umbilical Door. NOTE: This item is valid only in MM's 104, 105 and 106.
35	RCS RM Manifold Valve Override	ITEM 41 EXEC	Allows the crew to override an RCS Manifold Valve Micro switch dilemma which has forced the RCS RM to set the valve status to closed.
36	Entry Roll Mode Status		The status of the Entry Roll Mode switch
		ITEM 42 EXEC	Allows the crew to select the AUTO position in case this switch fails. NOTE: Item 42 is only valid during MM 304, 305, 602 and 603.
37	Command All Vent Doors Open	ITEM 43 EXEC	Allows the crew to issue commands to open all the vent doors. Item 43 is legal in OPS 3 and MM 602 and 603.
38	Command All Vent Doors Closed	ITEM 44 EXEC	Allows the crew to issue commands to close all the vent doors. (14442) (40375) Item 44 is legal in MM 301-304, 602, and in MM 305 & 603 only after rollout.

TABLE 3.051-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Backup TAL Abort Selected				2	
2	Backup ATO Abort Selected				2	
3	Backup Initiate Abort Command				2	
4	Maximum Throttling Command				3	
5	OMS/RCS Interconnect Function				4	
6	Orbiter Propellant Dump Arm Command				6	
7	Orbiter Propellant Dump Start Command				7	
8	Orbiter Propellant Dump Stop Command				8	
13	AFT RCS Dump Function				10	
14	AFT RCS Dump Time			SEC	11	
15	FWD RCS Dump Function				12	
16	FWD RCS Dump Time			SEC	13	
17	Auto Elevon Schedule Selected				14	
18	Fixed Elevon Schedule Selected				15	
20	Nominal Body Bending Filters Selected				16	
21	Alternate Body Bending Filters Selected				17	
22	Nominal Atmospheric Model Select Command				18	

TABLE 3.051-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
23	North Polar Atmospheric Model Select Command				19	
24	South Polar Atmospheric Model Select Command				20	
25	IMU 1 Select/Deselect Command				24	
26	IMU 2 Select/Deselect Command				24	
27	IMU 3 Select/Deselect Command				24	
28	PRL System 1 AUT/MAN Select				26	
29	PRL System 2 AUT/MAN Select				26	
30	PRL System 3 AUT/MAN Select				26	
31	PRL System 1 Select/Deselect Command				27	
32	PRL System 2 Select/Deselect Command				27	
33	PRL System 3 Select/Deselect Command			SEC	27	
34	ADTA 1 Select/ Deselect Command				32	
35	ADTA 3 Select/Deselect Command				32	
36	ADTA 2 Select/Deselect Command				32	
37	ADTA 4 Select/Deselect Command				32	

TABLE 3.051-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
38	Backup ET SEP Auto Command				33	
39	Backup ET SEP Manual Command				33	
40	Backup ET Umbilical Doors Close Command				34	
41	RCS Manifold Status Override				35	
42	Entry Switch Override				36	
43	All Vent Doors Open Command				37	
44	All Vent Doors Close Command				38	

3.5.053 DISPLAY: CONTROLS

–1 AVAILABILITY: SPEC 053 IN OPS G1/6 and G3.

–2 PURPOSE: The Controls display allows the crew to perform the aerosurface secondary actuator check in OPS G3. It provides the ability to control AA, RGA, and surface feedback RM and allows the crew to monitor the status of aerosurface and SSME actuator secondary ports.

```
 XXXX/053/          CONTROLS        XX X DDD/HH:MM:SS
                                         DDD/HH:MM:SS

SEC ACT CK     AERO PORT STAT        SSME PORT STAT
                        1 2 3 4           1 2 3 4
  CH1 1X       L OB 1 S S S S      L P S S S S
    2 2X         IB 2 S S S S        Y S S S S
    3 3X       R IB 3 S S S S      C P S S S S
    4 4X         OB 4 S S S S        Y S S S S
START 5X        RUD 5 S S S S      R P S S S S
 STOP 6X    SPD BRK 6 S S S S        Y S S S S

 NEG STIM              ACT/CH
  ENA 7X       8 BYPASS   XX
               9  RESET   XX

 LRU   AA        RGA    SURF FDBK
       DES       DES      DES
  1   10X S     14X S    18X S
  2   11X S     15X S    19X S
  3   12X S     16X S    20X S
  4   13X S     17X S    21X S


                                                (XX)
```

Figure 3.053

TABLE 3.053-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 053 PRO	The Controls SPEC is available in OPS G1/6 and G3.
2	Select Channel 1	ITEM 1 EXEC	Select Channel 1 for SEC ACT CK. Legal in MM301 - MM303 only.
3	Select Channel 2	ITEM 2 EXEC	Select Channel 2 for SEC ACT CK. Legal in MM301 - MM303 only.
4	Select Channel 3	ITEM 3 EXEC	Select Channel 3 for SEC ACT CK. Legal in MM301 - MM303 only.
5	Select Channel 4	ITEM 4 EXEC	Select Channel 4 for SEC ACT CK. Legal in MM301 - MM303 only.
6	Start Secondary Actuator Check	ITEM 5 EXEC	Issues hardover command to aerosurfaces on selected actuator channel. Illegal entry if no channel has been selected or if not in MM301 - MM304.
7	Terminate Secondary Actuator Check	ITEM 6 EXEC	Will terminate the secondary actuator check in progress. Also, a check on a channel can be terminated by selecting another channel using Item 1, 2, 3, or 4. Item 6 is legal in MM301 - MM303 only.
8	Change Polarity of Secondary Actuator Check	ITEM 7 EXEC	Alternately defines whether a positive or negative secondary actuator check is performed. Legal in MM301 - MM303 only.
9	Issue Port Bypass Command	ITEM 8 + XY EXEC	Issues port bypass command on port XY where X = 1 - 6 (Aerosurface) and Y = 1 - 4 (Port).
10	Issue Port Reset Command	ITEM 9 + XY EXEC	Issues port reset command on port XY where X = 1 - 6 (Aerosurface) and Y = 1 - 4 (Port).
11	Deselect/Reselect AA on LRU 1	ITEM 10 EXEC	Deselect/Reselect AA on LRU 1 as selection filter candidate.
12	Deselect/Reselect AA on LRU 2	ITEM 11 EXEC	Deselect/Reselect AA on LRU 2 as selection filter candidate.
13	Deselect/Reselect AA on LRU 3	ITEM 12 EXEC	Deselect/Reselect AA on LRU 3 as selection filter candidate.
14	Deselect/Reselect AA on LRU 4	ITEM 13 EXEC	Deselect/Reselect AA on LRU 4 as selection filter candidate.
15	Deselect/Reselect RGA on LRU 1	ITEM 14 EXEC	Deselect/Reselect RGA on LRU 1 as selection filter candidate.

TABLE 3.053-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
16	Deselect/Reselect RGA on LRU 2	ITEM 15 EXEC	Deselect/Reselect RGA on LRU 2 as selection filter candidate.
17	Deselect/Reselect RGA on LRU 3	ITEM 16 EXEC	Deselect/Reselect RGA on LRU 3 as selection filter candidate.
18	Deselect/Reselect RGA on LRU 4	ITEM 17 EXEC	Deselect/Reselect RGA on LRU 4 as selection filter candidate.
19	Deselect/Reselect SURF FDBK on LRU 1	ITEM 18 EXEC	Deselect/Reselect SURF FDBK on LRU 1 as selection filter candidate.
20	Deselect/Reselect SURF FDBK on LRU 2	ITEM 19 EXEC	Deselect/Reselect SURF FDBK on LRU 2 as selection filter candidate.
21	Deselect/Reselect SURF FDBK on LRU 3	ITEM 20 EXEC	Deselect/Reselect SURF FDBK on LRU 3 as selection filter candidate.
22	Deselect/Reselect SURF FDBK on LRU 4	ITEM 21 EXEC	Deselect/Reselect SURF FDBK on LRU 4 as selection filter candidate.
23	Aerosurface Port Status		A STAT field is provided for each aerosurface secondary actuator channel. A blank indicates normal operation, a down arrow indicates a failure or bypass and an 'M' indicates missing data.
24	SSME Port Status		A STAT field is provided for each SSME actuator port. A blank indicates normal operation, a down arrow indicates a failure, and an 'M' indicates missing data.

TABLE 3.053-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select Channel 1				2	
2	Select Channel 2				3	
3	Select Channel 3				4	
4	Select Channel 4				5	
5	Start Secondary Actuator Check				6	
6	Terminate Secondary Actuator Check				7	
7	Change Polarity of SEC ACT CK				8	
8	Issue Port Bypass Command	11	64		9	
9	Issue Port Reset Command	11	64		10	
10	Deselect/Reselect AA on LRU 1				11	
11	Deselect/Reselect AA on LRU 2				12	
12	Deselect/Reselect AA on LRU 3				13	
13	Deselect/Reselect AA on LRU 4				14	
14	Deselect/Reselect RGA on LRU 1				15	
15	Deselect/Reselect RGA on LRU 2				16	
16	Deselect/Reselect RGA on LRU 3				17	
17	Deselect/Reselect RGA on LRU 4				18	
18	Deselect/Reselect SURF FDBK on LRU 1				19	

TABLE 3.053-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
19	Deselect/Reselect SURF FDBK on LRU 2				20	
20	Deselect/Reselect SURF FDBK on LRU 3				21	
21	Deselect/Reselect SURF FDBK on LRU 4				22	

3.5.060 DISPLAY: SM TABLE MAINT

−1 AVAILABILITY: SPEC 060 in OPS SM2/4.

−2 PURPOSE: The SM Table Maintenance SPEC provides the user an interface to display and/or update SM Table Maintenance values; change SM special processing constants; initiate checkpoint of changed values; and inhibit/enable the SM fault detection and annunciation function.

```
XXXX/060/       SM TABLE MAINT  XX X DDD/HH:MM:SS
SM COM BUFF XXX                     DDD/HH:MM:SS
PARAM                 XXXXXX
  1 ID XXXXXXX
    VALUE= ±XXXXXXXXS
                      LIMITS
          ALERT                 BACKUP C&W
     LOW          HI         LOW          HI
2X±XXXXXXXX  3 ±XXXXX.XX11X±XXXXXXXX  12 ±XXXXX.XX
4X±XXXXXXXX  5 ±XXXXX.XX
6X±XXXXXXXX  7 ±XXXXX.XX
        8 FILTER XX             13 FILTER XX
        ENA  9X                 ENA 14X
        INH 10X                 INH 15X

CONSTANT
  16 ID XXXXXXX
  17 VALUE= ±XXXXXXXXXXXXX

CHECKPT  XXX/XX:XX:XX    FDA
  INITIATE 18             ENA 19X
  STATUS XXXX XXXX        INH 20X


                                                (XX)
```

Figure 3.060

TABLE 3.060-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-up	SPEC 060 PRO	The SM Table Maintenance display is available in OPS SM2/4. Provides a user interface with the on-orbit Systems Management (SM) software. (37572)(55343)
2	Display FDA Parameter ID and Associated Data	ITEM 1+XXXXXXX EXEC	Enable display of an SM parameter contained in the SM fault detection and annunciation (FDA) tables via a seven-digit ID code. Will display current value and status of parameter in the value field. Use following table to convert function MSID to parameter ID, e.g., PO3K1027 = 6031027. 1st Char. of MSID / Numeric (1st character of MSID must be converted to numeric character. 4th character of MSID is dropped) V 0 A 1 B 2 E 3 F 4 G 5 P 6 T 7 U 8 L 9
3	Display/Change Current Values of FDA Alert Limits	ITEM N±XX.X EXEC	N = 2, 4, or 6: Entry of 2, 4, or 6 and a new decimal value will change the LOW LIMIT ALERT value for the limit set entered. Limit values are entered as decimal quantities. An asterisk (*) is displayed next to ITEM 2, 4, or 6 depending on which limit set is being used for that parameter.
		ITEM N±XX.X EXEC	N = 3, 5, or 7: Changes high limit alert value for the limit set entered. (Entry values are as above.)
4	Out-of-Limits Annunciation Enable/Inhibit	ITEM 8+N EXEC	Entry of ITEM 8+N (N=1–15) allows change in number of consecutive samples the specified parameter must be out-of-limits before fault annunciation will take place.
		ITEM 9 EXEC	Enables annunciation of an out-of-limit condition for specified parameter.

TABLE 3.060-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 10 EXEC	Inhibits annunciation of an out-of-limit condition for specified parameter.
5	Display/Change Current Values of Backup C&W Limits	ITEM 11±XX.X EXEC	Changes low limits for backup C&W. (See function 3 for inputs)
		ITEM 12±XX.X EXEC	Changes high limits for backup C&W. (See function 3 for inputs)
6	Out-of-Limits Annunciation Enable/Inhibit (Backup C&W)	ITEM 13+N EXEC	N = 1 – 15 (see function 4).
		ITEM 14 EXEC	Enables backup C&W annunciation for specified parameter.
		ITEM 15 EXEC	Inhibits backup C&W annunciation for specified parameter.
7	SM Special Processes Constants Change	ITEM 16+ XXXXXXX EXEC	Enable display of a specified SM special process constant. - Current value of specified parameter is displayed adjacent to ITEM 17. - Seven digit parameter ID is entered according to table listed under function 2. - Refer to SM Level C FSR JSC 19590 tables for current list of valid SM constants.
		ITEM 17±XX.X EXEC	Entry allows a change of constant value to be used for specified parameter.
8	SM Checkpoint Initiation and Status	ITEM 18 EXEC	Item entry will initiate a checkpoint write of the current GPC table maintenance values to the MMU assigned to SM. Successful transfer of TM values will be indicated by a status of GOOD. In addition, the GMT indicated next to checkpoint as DDD/HH:MM:SS will show time of latest successful update. If transfer is unsuccessful, status will indicate FAIL.

TABLE 3.060-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
9	Fault Detection Annunciation Operation	ITEM 19 EXEC	Enables fault detection annunciation of SM parameters currently enabled.
		ITEM 20 EXEC	Inhibits fault detection annunciation of SM parameters currently enabled. Upon SM initialization, FDA will be enabled.
10	SM Common Buffer Status		RDY or BSY will indicate status of SM common buffer (used by checkpoint and uplink operations).
11	Uplink Indicator		Indicator will flash UPLINK to indicate active uplink processing. NOTE: All keyboard entries are prohibited while uplink is active.

TABLE 3.060-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Selects Parameter ID to be Displayed	0000000	9999999	Dec	2	CSTV_ITEM_I Refer to conversion table in function 2 for converting MSID numbers to parameter ID.
2	FDA Set 1 Low Limit			*	3	CSTV_ITEM_S *All limit values are input as decimal quantities, and analog and digital parameter limits are entered in the units defined for that parameter.
3	FDA Set 1 Hi Limit			*	3	CSTV_ITEM_S
4	FDA Set 2 Low Limit			*	3	CSTV_ITEM_S
5	FDA Set 2 Hi Limit			*	3	CSTV_ITEM_S
6	FDA Set 3 Low Limit			*	3	CSTV_ITEM_S
7	FDA Set 3 Hi Limit			*	3	CSTV_ITEM_S
8	Alert Noise Filter Value	1	15	Dec	4	CSTV_ITEM_S
9	Enable FDA				4	STS_ITEM_NO
10	Inhibit FDA				4	STS_ITEM_NO
11	Backup C&W Low Limit			*	5	CSTV_ITEM_S
12	Backup C&W Hi Limit			*	5	CSTV_ITEM_S
13	Backup C&W Noise Filter Value	1	15	Dec	6	CSTV_ITEM_I
14	Enable FDA				6	STS_ITEM_NO
15	Inhibit FDA				6	STS_ITEM_NO
16	SM Constant ID			*	7	CSTV_ITEM_I
17	SM Constant Value Scalar Discrete Integer Double Scalar	 0 -32768	 1 32767	*	7	CSTV_ITEM_S

TABLE 3.060-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
18	Checkpoint Initiate				8	STS_ITEM_NO
19	FDA Enable				9	STS_ITEM_NO
20	FDA Inhibit				9	STS_ITEM_NO

3.5.062 DISPLAY: PCMMU/PL COMM

–1 AVAILABILITY: SPEC 062 in OPS SM2/4 and OPS G9.

–2 PURPOSE: The PCMMU/Payload Communication display provides controls for the Pulse-Code Modulation Master Unit (PCMMU), Payload Signal Processor (PSP), and Payload Data Interrogator (PDI).

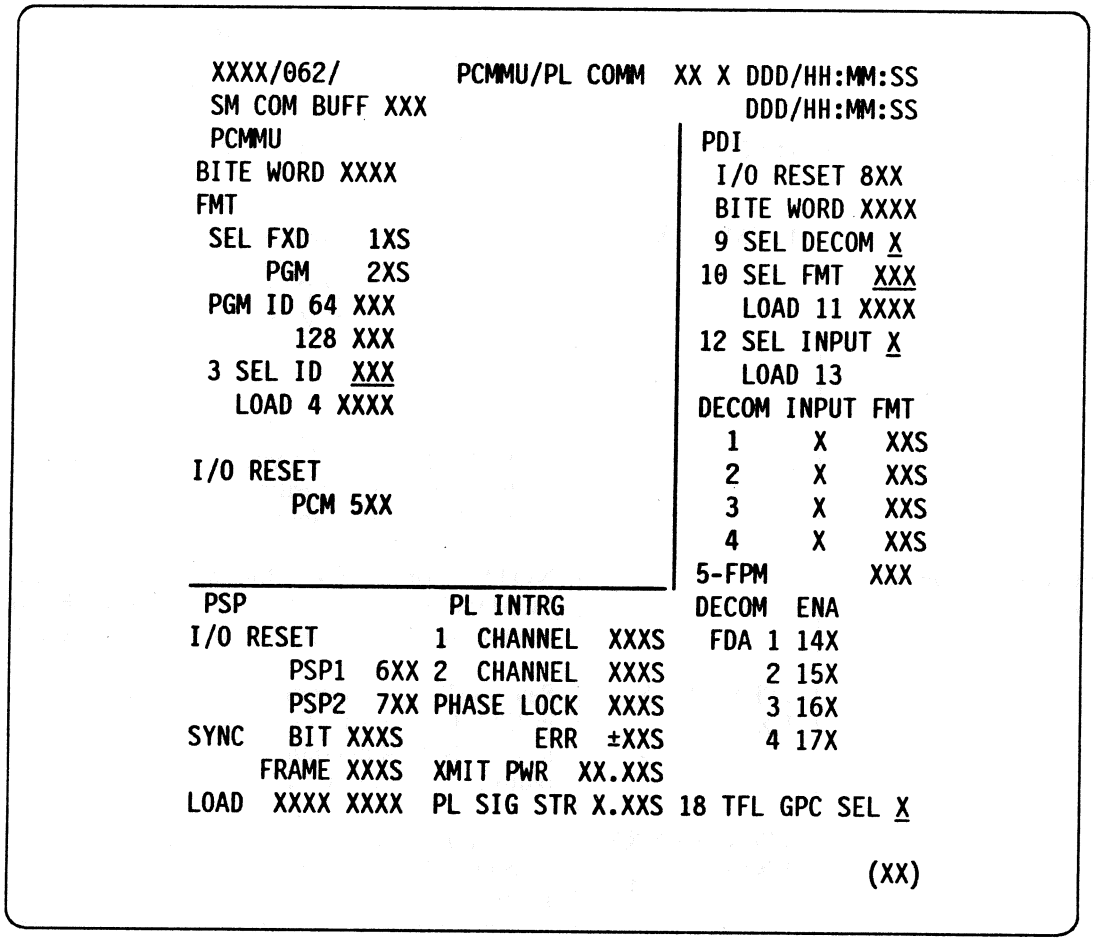


Figure 3.062

TABLE 3.062-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 062 PRO	The PCMMU/PL COMM SPEC is available only in OPS SM2/4 and OPS G9. In OPS G9 ITEMs 5, 8, 14-17 are invalid. In OPS S2/4 ITEM 18 is invalid. Before any load functions may be done, the SM Common Buffer status (shown in upper left corner of CRT) must be RDY. If BSY, loads will be rejected. (37584)
2	PCMMU Format Selection	ITEM 1 EXEC	Select FIXED downlink format (129).
		ITEM 2 EXEC	Select SOFT (programmable) downlink format (format ID will be the last 64 and 128 KB format loaded in the PCMMU (function 3) since power-up of the PCMMU). NOTE: a. For either ITEM to be effective, the PCMMU control switch on panel C3 must be in the GPC position. b. ITEMs 1 and 2 are mutually exclusive.
3	PCMMU Format Load		NOTE: For a 128 KB format (ID > 127), the PCMMU must be in FIXED format (either by switch on panel C3 or ITEM 1 in Function 2).
		ITEM 18+X EXEC	Select GPC ID to perform TFL. Must be input in OPS G9 prior to ITEM 4. (56296) Not valid in OPS SM2/4 and entire entry on CRT is blanked. The valid GPC IDs are 1 through 5.
		ITEM 3+XXX EXEC	Select format to be loaded. An ID from 1 through 127 is a small (64 KB) format; and an ID from 128 through 254 is a large (128 KB) format. Valid formats are reconfigurable from flight to flight.

TABLE 3.062-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 4 EXEC	Load selected format. NOTE: a. Display will show status of load - RUN while load is in progress; FAIL or CPLT when it is completed. b. If an OPS transition is initiated during the load, the load will be terminated and the status will be FAIL. c. If a RESUME is requested during the load (or another SPEC is requested) the load process will continue to completion and the appropriate status will be shown. d. The status is maintained for display when the SPEC is recalled. e. Load attempt will be rejected with ILLEGAL ENTRY if SM common buffer indicates BSY on CRT.
4	PCMMU I/O Reset	ITEM 5 EXEC	Attempt to restore communication with the PCMMU. This function is not valid in OPS G9.
5	Payload Signal Processor (PSP) I/O Reset	ITEM 6 EXEC	Attempt to restore communication between PSP1 and payload.
		ITEM 7 EXEC	Attempt to restore communication between PSP2 and payload. NOTE: a. ITEMs 6 and 7 are mutually exclusive. b. Data fields on display are driven with valid data only in OPS SM2/4. c. This is not a standard I/O Reset; the Bypass Indicator is reset, but the transaction counter is not reset. If the PSP was previously bypassed and an I/O error is encountered on the first attempted read, the PSP will be bypassed again.
6	Payload Data Interrogator (PDI) Controls	ITEM 8 EXEC	Attempt to restore communication with PDI Switch Matrix (illegal in OPS G9). (55302)
		ITEM 9+X EXEC	Select DECOM to be loaded (X = 1-4 for DECOMs, X = 5 selects Fetch Pointer Memory - FPM).

TABLE 3.062-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 10+XXX EXEC	Select format to load in selected DECOM (or FPM). Formats are reconfigurable. ITEM 9 is required prior to input of ITEM 10.
		ITEM 11 EXEC	Load selected format. Status is shown as in function 3.
		ITEM 12+X EXEC	Select input source for PDI. X = 1-5 for respective attached payloads. X = 6 for the operative PSP (see function 5). ITEM 9 required prior to input of ITEM 12.
		ITEM 13 EXEC	Start data flow between selected Payload and PDI. ITEM 12 required prior to ITEM 13.
		ITEM N EXEC	Enable/Inhibit fault detection & annunciation for the selected source/PDI. (Not valid in OPS G9.) N = 14-DECOM 1 N = 15-DECOM 2 N = 16-DECOM 3 N = 17-DECOM 4 These are flip/flop entries; first entry enables, second entry inhibits, etc.

TABLE 3.062-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select FIXED Format (129) - PCMMU				2	Switch on panel C3 must be in GPC position.
2	Select Soft Format-PCMMU				2	Switch on panel C3 must be in GPC position.
3	Select Format ID to Load in PCMMU	1	254		3	
4	Load Selected Format in PCMMU				3	ITEMs 3 & 18 required prior to ITEM 4.
5	I/O Reset of PCMMU				4	Not valid in OPS G9.
6	I/O Reset of PSP 1				5	
7	I/O Reset of PSP 2				5	
8	I/O Reset of PDI				6	Not valid in OPS G9.
9	Select PDI DECOM to Load	1	5		6	
10	Select Format to Load in Selected DECOM	0 1	31 999		6	Valid range for DFL. Valid range for FPM.
11	Load Selected Format in DECOM				6	
12	Select Payload as Input Source	0	6		6	
13	Start Interface Between Selected Payload and DECOM				6	
14	Enable FDA for DECOM 1				6	Not valid in OPS G9.
15	Enable FDA for DECOM 2				6	Not valid in OPS G9.
16	Enable FDA for DECOM 3				6	Not valid in OPS G9.
17	Enable FDA for DECOM 4				6	Not valid in OPS G9.
18	Select GPC to do TFL	1	5		3	Not valid in OPS SM2/4.

3.5.064 DISPLAY: SM GROUND CHECKOUT

–1 AVAILABILITY: SPEC 064 in OPS SM2/4.

–2 PURPOSE: The SM Ground Checkout SPEC provides the ability to modify certain SM processes to enhance vehicle turnaround and test processing. Item entries are provided to: enable/inhibit FDA processing; enable/inhibit FDA annunciation; select and load downlist formats; enable/inhibit special process outputs; resume processing of the SM OPS; and perform RMS functions that (1) select/deselect constants for turnaround, reinstall, singularity, and joint rate limit processes, (2) select joints and attenuation limits, and (3) select an arm ID with predetermined joint biases.

```
XXXX/064/    SM GROUND CHECKOUT XX X DDD/HH:MM:SS
                                     DDD/HH:MM:SS
XXXXXXXXXXXXXXX
            ENA INH    PROCESS INH/ENA
FDA          2X  3X                INH
PL ANNUN     4X   X    S P O/P  15 X
SM ANNUN     5X   X

    DOWNLIST
6 SEL FMT    XX
LOAD         7X

    RMS TOOLS
SOFT STOP/REACH
 TURNAROUND  8X
 REINSTALL   9X
SINGULARITY 10X
JOINT
 RATE LIMIT 11X
 12 JOINT SEL X
 13 ATTEN LIM XX
14 ARM SELECT XXX
                  OPS ACTIVATE 1X

                                          (XX)
```

Figure 3.064

TABLE 3.064-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	SPEC 064 PRO	Provides for selection of SM Ground Checkout options. When the ground checkout discrete is OFF (see DPS utility SPEC), all item entries in the SM Ground Checkout SPEC will be rejected with a class 5 error message.
2	FDA Options		
	FDA	ITEM 2 EXEC	This item enables FDA processing. An asterisk (*) is displayed in the ENA column when FDA processing is enabled.
		ITEM 3 EXEC	This item inhibits FDA processing. An asterisk (*) is displayed in the INH column when FDA processing is inhibited.
	PL ANNUN	ITEM 4 EXEC	This item enables/inhibits the FDA annunciation of PL messages. This is a toggle item. An asterisk (*) in the appropriate column (ENA or INH) displays the current status of this item.
	SM ANNUN	ITEM 5 EXEC	This item enables/inhibits the FDA annunciation of SM messages. This is a toggle item. An asterisk (*) in the appropriate column (ENA or INH) displays the current status of this item.
3	Downlist Format		A downlist format may be selected and loaded. These items are allowable only in OPS SM2.
	SEL FMT	ITEM 6+XX EXEC	This item is used to select a valid downlist format ID. This item will be rejected with a Class 5 error message if the format ID is invalid or if the item is entered in OPS SM4. When the format ID is valid, it shall be displayed. If an invalid format ID is entered, the last successfully loaded format ID (see Item 7) remains active.
	LOAD	ITEM 7 EXEC	This item causes the downlist format selected by Item 6 to be used by the downlist code. After successful execution of Item 7, an asterisk will be displayed next to Item 7.
4	RMS Tools		Predefined RMS table values may be selected for vehicle turnaround or arm reinstallation.

TABLE 3.064-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
	SOFT STOP/REACH TURNAROUND	ITEM 8 EXEC	This item selects/deselects turnaround values for the software stops and reach limits of the RMS arm. This is a toggle item. An asterisk will be displayed next to this item when the turnaround values are selected. A blank will be displayed if the original values are selected. Item 8 and Item 9 are mutually exclusive. A request to select one of these items while the other item is already selected will be rejected with a Class 5 error message.
	REINSTALL	ITEM 9 EXEC	This item selects/deselects reinstallation values for the software stops and reach limits of the RMS arm. This is a toggle item. An indicator next to this item displays the current status of this item (* = reinstallation values, blank = original values). Item 8 and Item 9 are mutually exclusive (see item 8).
	SINGULARITY	ITEM 10 EXEC	This item is used to select/deselect the Elbow Pitch singularity joint bias value for the RMS arm. It sets the Elbow Joint bias value to preclude annunciation conditions. This is a toggle item. When selected, an asterisk (*) is displayed adjacent to the item number. Reentry of item 10 blanks the status indicator (*) and restores the singularity joint bias value to a nominal predefined flight support value. Note: Item 14 selection overrides the item 10 function and blanks the item 10 status indicator (*) if item 10 is selected prior to item 14.
	RATE LIMIT	ITEM 11 EXEC	This item selects/deselects checkout coarse joint rate limits for the unloaded RMS arm for all six joints. This is a toggle item. An indicator next to this item displays the current status of this item (* = predefined values, blank = original values).
	JOINT SEL	ITEM 12+X EXEC	This item is used to select a joint of the RMS arm. This item will be rejected with a Class 5 error message if the input value is not valid. (Valid input range is 1 through 6.) When the input value is valid, the selected joint and its current attenuation value shall be displayed next to Item 13. If the SM GROUND CHECKOUT ENABLE discrete is enabled, the item value will default to 1 upon OPS initialization.

TABLE 3.064-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
	ATTEN LIM	ITEM 13+XX EXEC	This item is used to change the attenuation limit of the selected RMS joint. This item will be rejected with a Class 5 error message if the input value is not valid. (Valid input range is 0 through 15.) When the input value is valid, the new attenuation value shall be displayed.
	ARM SELECT	ITEM 14+XXX EXEC	This item is used to load the joint biases associated with an RMS arm ID. This item will be rejected with a Class 5 error message if the arm ID is invalid or if the RMS software is executing. Valid arm ID selections are 201, 301, and 303. When the arm ID is valid, the arm ID is displayed, the singularity item is overridden, and the joint biases associated with the arm ID are loaded for use by the RMS software. If the SM GROUND CHECKOUT ENABLE discrete is enabled, the ARM SEL data field will be blanked at OPS transition.
5	Process INH/ENA		Execution of special process outputs may be controlled.
	S P O/P	ITEM 15 EXEC	This item is used to enable/disable the cyclic output of the following functions: 1. Antenna Management 2. Fuel Cell Purge 3. Hydraulic Fluid Temp. Control 4. Standby H_2O Coolant Loop Control This is a toggle item. An asterisk (*) is displayed next to this item when execution of special process outputs is inhibited.
6	OPS Activate	ITEM 1 EXEC	This item is used to complete scheduling of SM processes for the SM OPS. Executing this item will complete activation of the SM OPS.

TABLE 3.064-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Activate SM OPS				6	
2	Enable FDA				2	
3	Inhibit FDA				2	
4	Enable/Inhibit Payload Annunciation				2	
5	Enable/Inhibit Systems Management Annunciation				2	
6	Select Downlist Format ID	24	26		3	
7	Load Selected Downlist Format (Item 6)				3	
8	Select/Deselect Turnaround Software Stop & Reach Limit Values for RMS Arm				4	Mutually Exclusive with Item 9
9	Select/Deselect Reinstallation Software Stop & Reach Limit Values for RMS Arm				4	Mutually Exclusive with Item 8
10	Select/Deselect the Singularity Joint Bias Value for the RMS Arm				4	
11	Select/Deselect Checkout coarse rate limits for all six joints of the unloaded RMS arm.				4	
12	Select a joint of the RMS arm.	1	6		4	
13	Select the attenuation limit of a selected RMS joint. (Item 12.)	0	15		4	
14	Select an RMS arm ID with predetermined joint biases.				4	Valid arm ID selections are 201, 301, and 303.

TABLE 3.064-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
15	Enable/Disable the Cyclic Output of Special Process Functions				5	

3.5.066 DISPLAY: ENVIRONMENT

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.067 DISPLAY: ELECTRIC

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.068 DISPLAY: CRYO SYSTEM

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.069 DISPLAY: FUEL CELLS

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.076 DISPLAY: COMM/RCDR

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.077 DISPLAY: EVA-MMU/FSS

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.078 DISPLAY: SM SYS SUMM 1

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.079 DISPLAY: SM SYS SUMM 2

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.085 DISPLAY: MASS MEMORY R/W

–1 AVAILABILITY: SPEC 085 in OPS SM2/4.

–2 PURPOSE: See page 3.9011(P)-1 for a description of the Mass Memory Read/Write Display.

3.5.086 DISPLAY: APU/HYD

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.087 DISPLAY: HYD THERMAL

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.088 DISPLAY: APU/ENVIRON THERM

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.089 DISPLAY: PRPLT THERMAL

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.090 DISPLAY: PCS CONTROL

–1 AVAILABILITY: SPEC 090 in OPS SM2/4.

–2 PURPOSE: The PCS CONTROL display is a specialist function display that is available in OPS SM2 and SM4. This display provides the crew the capability to call, schedule, execute, and interactively control the execution of payload control sets and sequences that are mass memory resident. In addition this function provides the capability to display text messages and status of the sequences currently scheduled.

```
XXXX/090/        PCS CONTROL      XX X DDD/HH:MM:SS
                                       DDD/HH:MM:SS
1 SET XX XXXXXX     | SEQ  STAT  NAME      GMT
                    | XXXX XXXX XXXXXX XXX/XX:XX:XX
2 SEQ XXXX XXXXXX   | XXXX XXXX XXXXXX XXX/XX:XX:XX
3 GMT XXX/XX:XX:XX  | XXXX XXXX XXXXXX XXX/XX:XX:XX
7 HOLD STEP    XXX  | XXXX XXXX XXXXXX XXX/XX:XX:XX
                    | XXXX XXXX XXXXXX XXX/XX:XX:XX
                    | XXXX XXXX XXXXXX XXX/XX:XX:XX
ENA   8 HOLD    9X  | XXXX XXXX XXXXXX XXX/XX:XX:XX
TERM 10 RESUME 11   | XXXX XXXX XXXXXX XXX/XX:XX:XX
TERM ALL   12       | XXXX XXXX XXXXXX XXX/XX:XX:XX
CLEAR TEXT 13       | XXXX XXXX XXXXXX XXX/XX:XX:XX
                    | SEQ  STEP       TEXT
                    | XXXX  XXX XXXXXXXXXXXXXXX
SEQ UPDATE          | XXXX  XXX XXXXXXXXXXXXXXX
14 STEP  XXX        | XXXX  XXX XXXXXXXXXXXXXXX
15 DELAY XX:XX      | XXXX  XXX XXXXXXXXXXXXXXX
                    | XXXX  XXX XXXXXXXXXXXXXXX
CURRENT XXX         | XXXX  XXX XXXXXXXXXXXXXXX
ERROR   XXX/X       | XXXX  XXX XXXXXXXXXXXXXXX
                    | XXXX  XXX XXXXXXXXXXXXXXX
                    | XXXX  XXX XXXXXXXXXXXXXXX
                    | XXXX  XXX XXXXXXXXXXXXXXX
                                              (XX)
```

Figure 3.090

TABLE 3.090-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 090 PRO	The PCS CONTROL SPEC is available in OPS SM2 and SM4.
2	SET ID	ITEM 1+NN EXEC	Provides the crew with the ability to recall SET NN into the memory, if the set is not in memory. The set number NN is flight and function dependent. (Note: 2)
3	SEQ ID	ITEM 2+NN EXEC	Provides the crew with the ability to call SEQ NN in the SET shown. (Notes: 3, 4, 5)
4	START GMT	ITEM 3+DDD+HH+MM+SS EXEC	Provides the crew with the ability to update sequence start time. (Notes: 3, 6, 7)
5	HOLD STEP	ITEM 7+NNN EXEC	Provides the crew with the ability to update the hold step. The sequence will hold its execution at the specified hold step number. (Notes: 3, 6, 8)
6	ENABLE	ITEM 8 EXEC	Provides the crew with the ability to: a) Enable execution of the sequence at a pre-set start time (if GMT in item 3 is in the future), or b) Execute the sequence immediately if the GMT is present or past. (Notes: 3, 6, 7, 10, 11)
7	HOLD	ITEM 9 EXEC	Provides the crew with the ability to hold the sequence at the next valid hold step. (Notes: 3, 6, 13)
8	TERMINATE	ITEM 10 EXEC	Provides the crew with the ability to: a) If running, sequence will go to safing step and continue to last step if safing step was defined, or b) Cancels immediately. (Notes: 3, 6)
9	RESUME	ITEM 11 EXEC	Provides the crew with the ability to resume the sequence after a hold. (Notes: 3, 6, 14)
10	STEP	ITEM 14+NNN EXEC	Provides the crew with the ability to call up a specific step in the sequence selected to modify the delay time per items 15 and 16. (Notes: 1, 3, 6)
11	DELAY	ITEM 15+MM+SS EXEC	Provides the crew with the ability to update the delay time by entering the delay time as minutes and seconds. (Notes: 1, 3, 6, 9)

TABLE 3.090-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
12	TERM ALL	ITEM 12 EXEC	Provides the crew with the ability to terminate all selected sequences.
13	CLEAR TEXT	ITEM 13 EXEC	Provides the crew with the ability to clear the text message area.
14	SET NAME		Displays the name of the currently selected set.
15	SEQUENCE NAME		Displays the name of the currently selected sequence.
16	SEQUENCE NUMBER		Displays sequence ID and call number (i.e., IDNN) of a currently selected sequence.
17	SEQUENCE STATUS INDICATION		Displays sequence status of the form XXXX. (Note: 15)
18	SEQUENCE NAME		Displays sequence name.
19	GMT		Displays the start GMT of the selected sequence.
20	SEQUENCE NUMBER		Displays sequence ID and call number as function 16 of the sequence writing the text message.
21	STEP NUMBER		Displays the step number in the sequence writing the text message.
22	TEXT		Displays the text message from the sequence.
23	CURRENT ERROR STOP		Displays the step number the error was on.
24	CURRENT ERROR CODE		Displays the current error code in the range 0 - 6. (Note: 16)

TABLE 3.090-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	SET ID NUMBER	01	99		2	
2	SEQUENCE ID NUMBER	1	9999		3	
3	START GMT DAYS	0	400		4	
4	START GMT HOURS	0	24		4	
5	START GMT MINUTES	0	60		4	
6	START GMT SECONDS	0	60		4	
7	HOLD STEP NUMBER	0	999		5	
8	ENABLE				6	
9	HOLD				7	
10	TERMINATE				8	
11	RESUME				9	
12	TERMINATE ALL SEQ				12	
13	CLEAR TEXT AREA				13	
14	STEP NUMBER	1	999		10	
15	DELAY TIME MINUTES	0	59		11	
16	DELAY TIME SECONDS	0	59		11	

NOTES:

1 Functions 10 - 11 (ITEMs 14 - 16) must be entered prior to ITEM 8 EXEC (Enable).

2 Set must be resident in mass memory or a class 5 error will be generated.

3 Set must be selected (ITEM 1) prior to this entry.

4 Sequence must be valid for this set or a class 5 error will be generated.

5 Use NNXX form where NN is sequence number and XX is the incremental number of times the sequence was called in the range 01 - 99 (if more that 99 times will wrap to 01) when recalling a previously selected sequence.

6 Sequence must be selected (ITEM 2) prior to this entry.

7 If start time (ITEM 4) has passed, the sequence will begin execution when enabled (ITEM 8).

8 Step must have been predefined as a valid (hold) step or a class 5 error will be generated.

9 Step number (ITEM 14) must be entered prior to this entry.

10 A maximum of 10 sequences may be selected at one time provided they are all in the selected set.

11 Sequence must be unenabled to be enabled or a class 5 error will be generated.

12 Sequence cannot be cancelled from terminate or error state or a class 5 error will be generated.

13 Sequence cannot be held except from the active, exception, or inactive states or a class 5 error will be generated.

14 Sequence cannot be resumed from any state except hold or a class 5 error will be generated.

15 Valid status codes are as follows:

Blank	unenabled or not executing after cancel
ACT	executing normally or after a hold was resumed
ERR	executing after an error
TERM	terminating
EXCP	executing after an exception
ENA	not executing after a resume or not executing
HOLD	not executing after a hold
SSPD	not executing after an error

16 Error codes are as follows:

0	No error
1	I/O error
2	Sequence active at start time
3	Illegal arithmetic operation was attempted
4	Unused
5	Payload communication software was not enabled
6	Payload communication software transmission error

3.5.094 DISPLAY: PDRS CONTROL

–1 AVAILABILITY: SPEC 094 in OPS SM2.

–2 PURPOSE: This specialist function provides crew control over RMS software functions. It also provides the capability to monitor the RMS retention latches to verify that the manipulator is in a stowed or deployed position.

```
 XXXX/094/          PDRS CONTROL    XX X DDD/HH:MM:SS
                                          DDD/HH:MM:SS
RMS SEL: XXXX   RMS PWR XXX                  ENA INH
     PORT  1X                      SOFT STOP   7X  8X
     STBD  2X     I/O ON 5X        AUTO BRAKE  9X 10X
  3 PL ID  XX        OFF 6X        POS ENC CK 11X 12X
  4 END EFF X

                   AUTO MODES
    1       2       3       4      17 START PT XXX
   13 XX   14 XX   15 XX   16 XX        LAST  PT XXX

               OPR CMD MODES
  END POS       END ATT      24 PL INIT ID  XX
18 X ±XXXX    21 P ±XXX
19 Y ±XXXX    22 Y ±XXX     CMD CK 25 XXXX
20 Z ±XXXX    23 R ±XXX

RMS   STO/DPLY              26 WR RANGE X
 SHLD X X X X
                            AUTO BRAKE CK 27X
RMS   LAT/REL/RDY
 AFT  X X X X X X
 MID  X X X X X X
 FWD  X X X X X X
                                              (XX)
```

Figure 3.094

TABLE 3.094-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 094 PRO	PDRS CONTROL is available in either OPS SM2 or SM4. (25384) (44990)
2	Arm Selection RMS SEL		Display text for the position of the arm select switch on the D and C panel. Displays OFF, PORT, or STBD.
	RMS PWR		Display text for the status of the RMS Power Switch. Displays OFF, PRI, or B/U.
		ITEM X EXEC	X = 1 or 2: Selection of either arm as available for initialization. Items 1 and 2 are mutually exclusive with 1 being the default selection when the SPEC is first brought up.
3	Payload ID Selection	ITEM 3+XX EXEC	Used for selection of the ID of the Payload to be handled by RMS. Initially zero.
4	END Effector ID Selection	ITEM 4+X EXEC	Provides selection capability for the ID of the END effector to be used by the arm selected. Initially 1.
5	MCIU I/O Selection	ITEM X EXEC	X = 5 or 6: Provides the capability to initiate or terminate I/O communication with the MCIU. Items 5 and 6 are mutually exclusive with 6 being the default when the SPEC is first brought up.
6	Soft Stop Limits	ITEM X EXEC	X = 7 or 8: Provides the capability to enable or inhibit the software stop limits. Initially enabled; if INHIBIT is selected the soft stop limits will be automatically enabled at mode change (except in single mode when the RMS is in software stop condition).
7	Auto Braking	ITEM X EXEC	X = 9 or 10: Provides the capability to enable or inhibit the auto brake function of the consistency check. Initially the auto brake is enabled.
8	Position Encoder Check	ITEM X EXEC	X = 11 or 12: Provides the capability to enable or inhibit the position encoder check function. Initially the position encoder is enabled.

TABLE 3.094-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
9	Auto Sequence Selection	ITEM NN+XX EXEC	Provides the capability to select 4 of up to 20 auto sequences stored in main memory for execution. The execution of any of the entered auto sequences is determined by the setting of the mode switch on the D and C panel. ITEM entry mode switch position corresponds as follows: NN Mode switch setting 13 Auto Mode 1 14 Auto Mode 2 15 Auto Mode 3 16 Auto Mode 4 Initially values are 1, 2, 3, and 4 for items 13, 14, 15, and 16 respectively.
10	Start Point Selection	ITEM 17+XXX EXEC	Provides the capability to start an auto sequence at any of its prestored points. Initially blanked.
11	END Effector Position	ITEM NN+XXXX EXEC	NN = 18, 19, or 20: Used to describe the X, Y, Z coordinates of the point of resolution for an operator commanded auto sequence in the ORBITER Body Axis Reference frame. (42318)
12	END Effector Attitude	ITEM NN+XXX EXEC	NN = 21, 22, or 23: Used to describe the pitch, yaw, and roll coordinates of the point of resolution for an operator commanded auto sequence. (42318) An item 22 (Yaw) value GT 90 degrees and LT 270 degrees is rejected and an "ILLEGAL ENTRY" message is displayed. Item 22 values LT 0 or GT 360 are also rejected.
13	Payload Initiation Identification	ITEM 24+XX EXEC	Provides the capability to change the Payload ID which the software will assume is attached to the RMS when validating the desired point of resolution (entered via items 18-23).
14	Command Check	ITEM 25 EXEC	Used to verify that the point described in items 18-23 is within the reach limits of the arm selected. Does not verify that the path that the arm must travel to arrive at the point is either safe or desirable.

TABLE 3.094-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
15	Wrist Roll Range	ITEM 26+X EXEC	Provides the capability to correct the wrist roll range value in the event I/O is lost and the wrist roll is moved. Values with these corresponding ranges are as follows: WR Range ID — Actual Range 1 — -450 to -360 2 — -360 to -180 3 — -180 to 0 4 — 0 to 180 5 — 180 to 360 6 — 360 to 450
16	Auto Brake Check	ITEM 27 EXEC	Used to verify that the auto brake circuitry will apply the brake. After execution, the brake indicator on panel A8A1 should be on and an asterisk should be displayed next to item 27. NOTE: The brake switch should be off while performing this check. Otherwise, the results are inconclusive.

TABLE 3.094-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Port Arm Selected				2	CRGV_ARM_INIT_DISP
2	STBD Arm Selected				2	CRGV_ARM_INIT_DISP
3	PL ID Selection	0	5		3	CRGV_DISP_PYLD_ID CRGV_RMS_PL_ID$1 CRGV_RMS_PL_ID$2
4	Select End Effector	1	2		4	CRGV_DISP_EE_ID CRGV_RMS_EE_ID$1 CRGV_RMS_EE_ID$2
5	Initiate MCIU I/O				5	CRAB_MCIU_IO
6	Terminate MICU Communication				5	CRAB_MCIU_IO
7	Enable Soft Stops				6	CRAB_SOFT_STOP_ENABLE
8	Inhibit Soft Stops				6	CRAB_SOFT_STOP_ENABLE
9	Enable Auto Brakes				7	CRAB_CONSIS_FLAG
10	Inhibit Auto Brakes				7	CRAB_CONSIS_FLAG
11	Enable Position Encoder Checks				8	CRAB_ENCOD_ENA_INH_FLAG
12	Inhibit Position Encoder Checks				8	CRAB_ENCOD_ENA_INH_FLAG
13	Select Sequence for Auto Mode 1	1	20		9	CRGV_AUTO_SEQ_ID$1 Maximum value determined by the number of sequences in memory.
14	Select Sequence for Auto Mode 2	1	20		9	CRGV_AUTO_SEQ_ID$2
15	Select Sequence for Auto Mode 3	1	20		9	CRGV_AUTO_SEQ_ID$3
16	Select Sequence for Auto Mode 4	1	20		9	CRGV_AUTO_SEQ_ID$4
17	Select Start Point	1	199		10	CRGV_AUTO_SEQ_STR_PT
18	Select POR X Coord.			inch	11	CRAV_POR_COR_DESIRED$1 (Note: 1)
19	Select POR Y Coord.			inch	11	CRAV_POR_COR_DESIRED$2 (Note: 1)

TABLE 3.094-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
20	Select POR Z Coord.			inch	11	CRAV_POR_COR_DESIRED$3 (Note: 1)
21	Select POR Pitch Coord.	0	+359	Deg	12	CRAV_POR_COR_DESIRED$4 (Note: 1)
22	Select POR Yaw Coord.	0 +270	+90 +359	Deg	12	CRAV_POR_COR_DESIRED$5 (Note: 1)
23	Select POR Roll Coord.	0	+359	Deg	12	CRAV_POR_COR_DESIRED$6 (Note: 1)
24	Select PL Init ID	0	5		13	CRAV_DISP_PL_INIT CRAV_PL_INIT
25	Check Validity of Selected POR				14	CRAV_OPR_CMD_CK_INDEX Display Text to indicate validity of POR selected. Displays either 'GOOD' or 'FAIL'.
26	Select WR Range	1	6		15	CRAV_WRR_RANGE$1 CRAV_WRR_RANGE$2
27	Auto Brake Command				16	CRAB_ALL_BRAKES_REQ_LP

NOTE:

1 See entry in display function table for input limit checks.

3.5.095 DISPLAY: PDRS OVERRIDE

–1 AVAILABILITY: SPEC 095 in OPS SM2 and SM4.

–2 PURPOSE: This specialist function provides the crew with the ability to override the RMS Mode Select Switch, the RMS Joint Select Switch, the Rate Selection Switch, and the Auto Sequence Proceed/Stop Switch, to reassign the Single/Direct Drive Switch, to toggle the Loaded Rate Limit Flag, to allow operation of the RMS in the MPM stowed position, and to change the sense of the translational or rotational hand controllers (THC, RHC).

```
 XXXX/095/XXX   PDRS OVERRIDE    XX X DDD/HH:MM:SS
                                     DDD/HH:MM:SS
MODE OVERRIDE  1X   JOINT    SEL
                    OVERRIDE 17X  RATE OVERRIDE 26X
   MODE    SEL IND
  ORB UNL  2X   X     SHY    18X    VERNIER     27X
  SINGLE   3X   X     SHP    19X    COARSE      28X
  END EFF  4X   X     ELP    20X
  ORB LD   5X   X     WRP    21X  AUTO OVERRIDE 29X
  PL       6X   X     WRY    22X
  OPR CMD  7X   X     WRR    23X    PROCEED     30
  AUTO 1   8X   X     EE T   24X    STOP        31
  AUTO 2   9X   X     CRIT T 25X
  AUTO 3  10X   X                  AXIS CHANGE  32X
  AUTO 4  11X   X
  TEST    12X   X                    THC        33X
                                     RHC        34X
  ENTER   13

LOADED RATES  14X

STOWED OPS    15X

SINGLE/DIRECT DR REASSIGN 16X
                                                (XX)
```

Figure 3.095

TABLE 3.095-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-up	SPEC 095 PRO	PDRS Override is available in either OPS SM2 or SM4. RMS software must be active for complete override processing.
2	Mode Override	ITEM 1 EXEC	Toggle the capability to override the RMS Mode Select switch and the Mode Enter push button.
		ITEM X EXEC	Override the RMS Mode Select Switch with the X mode requested if Item 1 is selected. X items are mutually exclusive and range from 2 -12 as follows: X MODE — X MODE 2 Orbiter Unloaded — 8 Auto 1 3 Single — 9 Auto 2 4 End Effecter — 10 Auto 3 5 Orbiter Loaded — 11 Auto 4 6 Payload — 12 Test 7 Operator Commanded While Item 1 is deselected, Items 2 -12 are inhibited and will reflect the actual position of the RMS Mode Select Switch as sensed by the FSW. Data in the IND column shall reflect the mode selected indicator lights on the RMS Displays and Controls panel.
		ITEM 13 EXEC	Mimic the Mode Enter push button. While Item 1 is deselected or if mode select Items 2 -12 are all deselected, Item 13 is inhibited.
3	Loaded Rates Toggle	ITEM 14 EXEC	Toggle the current state of the loaded rate limit flag.
4	Stowed OPS Toggle	ITEM 15 EXEC	Toggle the capability to enable or disable RMS Stowed operations.
5	Single/Direct Drive Reassign Toggle	ITEM 16 EXEC	Toggle the capability to reassign the Single/Direct Drive Switch to the Auto Sequence Stop/Proceed Switch. Inhibited if Item 29 has been selected.
6	Joint Override	ITEM 17 EXEC	Toggle the capability to override the RMS Joint Select Switch.

TABLE 3.095-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM X EXEC	Override the RMS Joint Select Switch with the X joint requested if Item 17 is selected. X items are mutually exclusive and range from 18 - 25 as follows: X JOINT 18 Shoulder Yaw 19 Shoulder Pitch 20 Elbow Pitch 21 Wrist Pitch 22 Wrist Yaw 23 Wrist Roll 24 End Effector Temp 25 Critical Temp While Item 17 is deselected, Items 18 - 25 are inhibited and will reflect the actual position of the RMS Joint Select Switch as sensed by the FSW.
7	Rate Override	ITEM 26 EXEC	Toggle the capability to override the RMS Rate Select Switch.
		ITEM X EXEC	Override the RMS Rate Select Switch with the X rate requested if Item 26 is selected. X items are mutually exclusive and range from 27 - 28 as follows: X RATE 27 Vernier 28 Coarse Upon selection of Item 26, Item 27 shall be automatically selected and Item 28 shall be automatically deselected. While Item 26 is deselected, Items 27-28 are inhibited and will reflect the actual position of the RMS Rate Select Switch as sensed by the FSW.
8	Auto Override	ITEM 29 EXEC	Toggle the capability to override the RMS Auto Sequence Stop/Proceed Switch. Inhibited if Item 16 has been selected.

TABLE 3.095-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM X EXEC	Override the RMS Auto Sequence Stop/Proceed Switch with the X Item requested if Item 29 is selected. X ITEM 30 Proceed 31 Stop While Item 29 is deselected, Items 30-31 are inhibited.
9	Axis Change Toggle	ITEM 32 EXEC	Toggle the capability to change the sense of the translational or rotational hand controllers.
	THC Change	ITEM 33 EXEC	Toggle the capability to change or restore the original sense of the translational hand controller if Item 32 is selected. Inhibited if Item 32 is deselected. Upon selection or deselection of Item 32, Item 33 shall be automatically deselected.
	RHC Change	ITEM 34 EXEC	Toggle the capability to change or restore the original sense of the rotational hand controller if Item 32 is selected. Inhibited if Item 32 is deselected. Upon selection or deselection of Item 32, Item 34 shall be automatically deselected.

TABLE 3.095-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Override Mode				2	CRGB_CVRD_MODE_SWITCH
2	Reflect FSW Sensed Mode Select Switch				2	CRBB_MAN_ORB_UNL_REQ CRBB_SINGL_JNT_REQ CRBB_MAN_EE_REQ CRBB_MAN_ORB_LOD_REQ CRBB_MAN_PYLD_REQ CRBB_OPR_CMD_REQ CRBB_AUTO_1_REQ CRBB_AUTO_2_REQ CRBB_AUTO_3_REQ CRBB_AUTO_4_REQ CRBB_TEST_REQ
3	Override Mode Select				2	CRGB_OVRD_ORB_UNL_MODE CRGB_OVRD_SINGL_MODE CRGB_OVRD_EE_MODE CRGB_OVRD_ORB_LOD_MODE CRGB_OVRD_PL_MODE CRGB_OVRD_OPR_CMD_MODE CRGB_OVRD_AUTO_1_MODE CRGB_OVRD_AUTO_2_MODE CRGB_OVRD_AUTO_3_MODE CRGB_OVRD_AUTO_4_MODE CRGB_OVRD_TEST_MODE
4	Mimic Mode Enter Push Button				2	CRGB_OVRD_MODE_ENTER
5	Toggle Loaded Rates (1 cycle)				3	CRAB_LOADED_RATE_LIM_FLAG
6	Disable Stowed OPS				4	CRGB_STOWED_OPS_REQ
7	Enable Stowed OPS				4	CRGB_STOWED_OPS_REQ
8	Reassign Single/Direct Drive Switch				5	CRGB_SINGL_DRIVE_REASSIGN
9	Override Joint				6	CRGB_OVRD_JNT_SWITCH
10	Reflect FSW Sensed Joint Select Switch				6	CRBB_JNT_REQ_SHY CRBB_JNT_REQ_SHP CRBB_JNT_REQ_ELP CRBB_JNT_REQ_WRP CRBB_JNT_REQ_WRY CRBB_JNT_REQ_WRR CRBB_EE_TEMP_REQ CRBB_CRIT_TEMP_REQ

TABLE 3.095-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
11	Override Joint Select Switch				6	CRGB_OVRD_JNT_SHY CRGB_OVRD_JNT_SHP CRGB_OVRD_JNT_ELP CRGB_OVRD_JNT_WRP CRGB_OVRD_JNT_WRY CRGB_OVRD_JNT_WRR CRGB_OVRD_EE_TEMP CRGB_OVRD_CRIT_TEMP
12	Override Rate				7	CRGB_OVRD_RATE_SWITCH
13	Reflect FSW Sensed Rate Select Switch				7	CRBB_VERNIER_RATE_REQ
14	Override Rate Select Switch				7	CRGB_OVRD_VERNIER_RATE CRGB_OVRD_COARSE_RATE
15	Override Auto Sequence Stop/Proceed Switch				8	CRGB_OVRD_AUTO_SWITCH
16	Override Auto Select Items				8	CRGB_OVRD_AUTO_PROCEED CRGB_OVRD_AUTO_STOP
17	Toggle Axis Change				9	CRGB_HC_AXIS_CHANGE_REQ
18	Change THC Sense				9	CRGB_THC_AXIS_CHANGE
19	Change RHC Sense				9	CRGB_RHC_AXIS_CHANGE

3.5.096 DISPLAY: PDRS STATUS

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.097 DISPLAY: PL RETENTION

Reference SM FSSR JSC-19590-XXX(XXX = Flight Number), Section 6.

3.5.099 DISPLAY: FAULT

–1 AVAILABILITY: SPEC 099 (or FAULT SUMM KEY) in all OPS.

–2 PURPOSE: The Fault Summary Page (FSP) presents the last 15 Caution & Warning messages output by PASS to the DEU message line.

```
XXXX/XXX/099        FAULT          XX X DDD/HH:MM:SS
                                          DDD/HH:MM:SS

   CRT       FAULT       C/W   GPC       TIME
   ID

   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX
   XXX XXXXXXXXXX XXXX   X    XXXXX XXX/XX:XX:XX

                                                (XX)
```

Figure 3.099

TABLE 3.099-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	FAULT SUMM	The FSP is always available. Entry of the FAULT SUMM key presents the display of the latest 15 C and W messages.
2	Display Data		CRT ID: A 3 character ID of a SPEC function where detailed data related to the message may be found. FAULT: The major/minor text of the message (See Section 6 for a list of PASS messages). C/W: An * indicates the message is a class 2 error (See Section 6). GPC: Indicates which GPC(s) logged the message. The GPC ID of each GPC generating the message is shown. TIME: The MET when the message was generated.
3	FSP Clear	SPEC 099 PRO	The FSP is cleared of all messages. The display page is still on the CRT. The user will notice a blink of the messages as they are cleared.

3.5.100 DISPLAY: GTS DISPLAY

−1 AVAILABILITY: SPEC 100 in OPS G9 and P9.

−2 PURPOSE: The General Test Support (GTS) display provides the following vehicle checkout functions:

Housekeeping data acquisition (HDA) control
CAM testing
Downlist format selection
LDB polling control
PASS/BFS data transfer
RJD toggle testing
Dedicated display unit testing
MEC critical command control
Elevon limit selection
Space Lab Communications

```
XXXX/100/        GTS DISPLAY    XX X DDD/HH:MM:SS
                                     DDD/HH:MM:SS
HDA CONTROL          DED DISP
  ENA 1X  INH 2X       FWD  18X  AFT 19X  DRIVE 24X
                       HIGH 20X  LOW 21X
CSL/RML  TEST          FLAG 22X  OFF 23X
 UF1 3X UF4 6X
 UF2 4X UF5 7X       CRIT MEC CMDS   ELEV LMT SEL
 UF3 5X IFA 8X         ENA  25X            HORZ  27X
 9 FAIL GPC SEL X      INH  26X            VERT  28X
 TEST EXEC 10X                             OWPS  29X
 RESET     11X
                     SL COMM      SSC      EXC
DL FORMAT              CH A ENA  30X      35X
    12 SEL  XX            B ENA  31X      36X
      LOAD 13X             DSBL  32X      37X
                        MDM TESTS
GSE POLL ENA  14X       RTRN CHW 33 XXXX 38 XXXX
                        RTRN MSG 34 XXXX 39 XXXX
PASS/BFS XFER 15        COUPLER
                        STATE     XXXX     XXXX
RJD TOGGLER             ERR CD      XX       XX
  ON 16X  OFF 17X

                                                (XX)
```

Figure 3.100

TABLE 3.100-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 100 PRO	General Test Support SPEC is available only in G9, PL9. In PL9, only functions 2 and 5 are valid.
2	Housekeeping Data Acquisition (HDA)	ITEM 1 EXEC	Enable HDA reads (Automatically turned on upon entry to G9).
		ITEM 2 EXEC	Inhibit HDA reads (Initial condition after IPL). NOTE: State (Enable/Inhibit) maintained across OPS transitions (except 0 to G9).
3	Computer Annunciation Matrix (CAM) Status Light and GPC Redundancy Logic Test	ITEM N EXEC	N = 3 - 7: U-FAIL Test: Select GPC(s) which will participate in test by issuing U-FAIL vote against test fail GPC (selected by item 9). Selected GPC(s) must be in Redundant Set. Item versus GPC: 3 - GPC1; 4 - GPC2; 5 - GPC3; 6 - GPC4; 7 - GPC5. Individual I-FAIL Test: The diagonal I-FAIL lights can be individually turned on by selecting a voting GPC (item 3-7) to vote against itself (item 9).
		ITEM 9+X EXEC	Select GPC for test fail (X = 1-5).
		ITEM 10 EXEC	Executes U-FAIL test or Individual I-FAIL test as set up by items 3-7 and item 9, or executes I-FAIL ALL (IFA) test as set up by item 8. For the U-FAIL test, if two or more voting GPCs are selected, the test fail GPC will turn on its own I-FAIL light via RM hardware logic.
		ITEM 11 EXEC	Turn off CAM lights. A second item execute is required to turn off I-FAIL lights that were turned on via RM hardware logic.
		ITEM 8 EXEC	Selects the I-FAIL light for each GPC in the Redundant Set to be turned on when test is executed. Item 8 is mutually exclusive of items 3-7 and item 9.
4	Downlist Format Selection	ITEM 12+XX EXEC	XX is desired format ID. In G9, valid formats are: 42, 44, 46, 53, 60, 97, 98, 99.
		ITEM 13 EXEC	Start downlist of selected format. Remains in effect until OPS transition or a new ITEM 12 and 13 input.

TABLE 3.100-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
5	Launch Data Bus Control (GSE Poll)	ITEM 14 EXEC	This is a flip-flop item; first entry turns on polling, second entry turns off polling, etc. (an asterisk, *, present signals polling is on). a. Polling status maintained across OPS transition. b. Polling initiation is always attempted on LDB1.
6	PASS One Time Transfer of Data to BFS	ITEM 15 EXEC	Causes a predefined set of data to be transferred from the PASS GPC(s) to the BFS GPC. Entries on BFS displays are required in conjunction with this item to accomplish the transfer. (38748) The one-shot transfer of IMU calibration data from the PASS to the BFS in OPS G9 is not interprocess protected. If IMU SOP calibration procedure or a MM read is in the process of updating the calibration data, then a set of non-homogeneous data could be sent to the BFS. Preflight Cal A (the last IMU SOP procedure to change the calibration data sent to the BFS) or a MM read of IMU calibration data must be completed before the one-shot is initiated. The correct procedure for the day of flight is: a. Perform MM read of IMU checkpoint data. b. Perform attitude determination. c. Wait for TERM/IDLE. d. Perform Preflight Cal A. e. Wait for TERM/IDLE. f. Perform Gyrocompass Alignment. g. Initiate one-shot. h. Wait for gyrocompass CPLT to appear on GND IMU CNTL/MON display (the asterisk will still be beside GYROCOMP). i. PRO into OPS G1.
7	Reaction Jet Driver (RJD) Toggle Test	ITEM 16 EXEC	Initiate simultaneous commands to 44 RCS jets for toggle test. (48423)
		ITEM 17 EXEC	Stop toggle test.
8	Dedicated Display Checkout	ITEM 18 EXEC	Select forward displays for test (default). (51250)
		ITEM 19 EXEC	Select aft displays for test. (ITEMs 18 and 19 are mutually exclusive.)

TABLE 3.100-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 20 EXEC	Select HIGH test: Drive all units to a pre-defined set of high values.
		ITEM 21 EXEC	Select LOW test: Drive all units to a pre-defined set of low values.
		ITEM 22 EXEC	Select FLAG test: All units will remain at current reading with mechanical flags (where applicable) extended.
		ITEM 24 EXEC	Select DRIVE test: All units are driven at nominal flight rates through entire range in continuous drive. NOTE: ITEMs 20, 21, 22, and 24 are mutually exclusive. A selected test must be stopped (ITEM 23) before another test may be selected.
		ITEM 23 EXEC	Terminate selected test.
9	Master Events Controller (MEC) Critical Command Control	ITEM 25 EXEC	Enable issuance of critical commands to MEC.
		ITEM 26 EXEC	Inhibit issuance of critical commands to MEC (default).
10	Elevon Limit Selection	ITEM 27 EXEC	Select horizontal limits for elevons and set drive rate beyond soft-stop to ¼ PCM for all actuators.
		ITEM 28 EXEC	Select vertical limits for elevons and set drive rate beyond soft-stop to 0 PCM for all actuators.
		ITEM 29 EXEC	Select I-Loaded OWPS limits for elevons and set drive rate beyond soft stop to I-Loaded value (default).
11	Spacelab Computer	ITEM 30 EXEC	Enable polling on Channel A of the SSC SL computer.
		ITEM 31 EXEC	Enable polling on Channel B of the SSC SL computer.
		ITEM 32 EXEC	Disable polling for SSC SL computer.
		ITEM 33 EXEC	Enable an MDM return command header test on the SSC. The result of the test is displayed as FAIL or Blank for good.

TABLE 3.100-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 34 EXEC	Enable an MDM return message test to be performed on the SSC. The result of the test is displayed as FAIL or Blank for good.
		ITEM 35 EXEC	Enable polling on Channel A of the EXC SL computer.
		ITEM 36 EXEC	Enable polling on Channel B of the EXC SL computer.
		ITEM 37 EXEC	Disable polling for EXC SL computer.
		ITEM 38 EXEC	Enable an MDM return command header test on the EXC. The result of the test is displayed as FAIL or Blank for good.
		ITEM 39 EXEC	Enable an MDM return message test to be performed on the EXC. The result of the test is displayed as FAIL or Blank for good.
			NOTE: For items 30-32 and 35-37 an (*) indicator will be displayed after the number of the selected item controls. Items 30, 31 and 32 are mutually exclusive for the SSC. Items 35, 36 and 37 are mutually exclusive for the EXC. Items 30-39 are valid only in G9.

TABLE 3.100-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	HDA Enable				2	CZIV_D_ITEM_NO
2	HDA Inhibit				2	CZIV_D_ITEM_NO
3	Select GPC1 as Voter in CSL Test				3	CZIV_D_ITEM_NO
4	Select GPC2 as Voter in CSL Test				3	CZIV_D_ITEM_NO
5	Select GPC3 as Voter in CSL Test				3	CZIV_D_ITEM_NO
6	Select GPC4 as Voter in CSL Test				3	CZIV_D_ITEM_NO
7	Select GPC5 as Voter in CSL Test				3	CZIV_D_ITEM_NO
8	Select I-FAIL of Test GPC				3	CZIV_D_ITEM_NO
9	Select Test GPC for CSL Test	1	5		3	CZIV_D_ITEM_I
10	Start CSL/RML Test				3	CZIV_D_ITEM_NO
11	Stop CSL/RML Test				3	CZIV_D_ITEM_NO
12	Select Downlist Format	42	99		4	CVAV_GTS_DL_FMTID
13	Load Selected Downlist Format				4	CZIV_D_ITEM_NO
14	LDB Polling Control				5	VGT_GSE_POLLS(2)
15	PASS/BFS Data				6	See function 6 for restrictions.
16	Start RJD Test				7	
17	Stop RJD Test				7	
18	Select Forward DDUs				8	CVAV_FWD_AFT
19	Select Aft DDUs				8	CVAV_FWD_AFT
20	Select HIGH Test				8	CVDV_DDCO_INDEX
21	Select LOW Test				8	CVDV_DDCO_INDEX

TABLE 3.100-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
22	Select FLAG Test				8	CVDV_DDCO_INDEX
23	Terminate DDU Test				8	CZIV_D_ITEM_NO
24	Select DRIVE Test				8	CVDV_DDCO_INDEX
25	Enable MEC Critical Commands				9	CZ1B_D_MEC_CMD(1)
26	Inhibit MEC Critical Commands				9	CZ1B_D_MED_CMD(1)
27	Select Horizontal Elevon Limits				10	
28	Select Vertical Elevon Limits				10	
29	Select OWPS Elevon Limits				10	
30	SSC Channel A Enable				11	
31	SSC Channel B Enable				11	
32	SSC Inhibit Polling				11	
33	SSC Return CHW				11	
34	SSC Return MDM MSG				11	
35	EXC Channel A Enable				11	
36	EXC Channel B Enable				11	
37	EXC Inhibit Polling				11	
38	EXC Return CHW				11	
39	EXC Return MDM				11	

3.5.101 DISPLAY: SENSOR SELF-TEST

–1 AVAILABILITY: SPEC 101 in OPS G9.

–2 PURPOSE: The Preflight Sensor Self-Test (SST) display provides the capability to initiate sensor self-test of microwave scan beam landing system (MLS), TACAN, radar altimeter, and accelerometer assembly (AA) and review the results.

```
XXXX/101/     SENSOR SELF-TEST  XX X DDD/HH:MM:SS
                                     DDD/HH:MM:SS

   ENA STAT  RNG    AZ     EL
M1  1X XXXX XX.XS  ±X.XXS X.XXS
L2  2X XXXX XX.XS  ±X.XXS X.XXS
S3  3X XXXX XX.XS  ±X.XXS X.XXS

   ENA STAT  RNG    AZ
T1  4X XXXX  X.XS XXX.XXS
A2  5X XXXX  X.XS XXX.XXS        TEST CONTROL:
C3  6X XXXX  X.XS XXX.XXS         START      13X
                                  AUTO SEQ   14X
   ENA STAT  ALT                  TERM       15X
R1  7X XXXX XXXXS
A2  8X XXXX XXXXS                    INH ALL 16X

   ENA        Y       Z
A1  9X     ±XX.XS  ±XX.XS
A2 10X     ±XX.XS  ±XX.XS
 3 11X     ±XX.XS  ±XX.XS
 4 12X     ±XX.XS  ±XX.XS


                                                (XX)
```

Figure 3.101

TABLE 3.101-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 101 PRO	Sensor Self-Test is available only in G9. HDA must be active before initiating tests. Data is cyclically updated unless in testing (see function 3).
2	Sensor Selection for Testing	ITEM N EXEC	Enables selected sensor for testing. N = 1-12 as follows: 1. MLS 1 7. Radar Alt 1 2. MLS 2 8. Radar Alt 2 3. MLS 3 9. Accel. Assm. 1 4. TACAN 1 10. Accel. Assm. 2 5. TACAN 2 11. Accel. Assm. 3 6. TACAN 3 12. Accel. Assm. 4
3	Test Controls	ITEM 13 EXEC	Start test of selected LRUs.
		ITEM 14 EXEC	Start test of all LRUs in automatic sequence. Once a test is started, all ITEM entries are illegal until it is completed. Data is frozen on display at completion of test until test is terminated via ITEM 15. Test status is shown at completion of test as Blank if good, or ↓ if failed low, or ↑ if failed high. STAT columns (except AAs) show Blank (good), OFF (LRU has no power), or BITE (hardware failure). Table 3.101-3 defines test values for LRUs.
		ITEM 15 EXEC	Terminate self-test. Restarts cyclic updating of LRU data and clears status indications. Must be entered after any test started before any other entries accepted. Entry will be rejected if test is still in progress.
4	Sensor Deselection	ITEM 16 EXEC	Deselects all LRUs on page. Entry will be rejected if a test has been started (ITEMs 13, 14) and has not been terminated (ITEM 15).

TABLE 3.101-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	MLS 1 SELECT				2	CVS_TEST_TABLE CVS_TEST_ENA(1) ITEMS 1 through 12 are mutually exclusive with ITEM 14.
2	MLS 2 SELECT				2	CVS_TEST_ENA(2)
3	MLS 3 SELECT				2	CVS_TEST_ENA(3)
4	TACAN 1 SELECT				2	CVS_TEST_ENA(4)
5	TACAN 2 SELECT				2	CVS_TEST_ENA(5)
6	TACAN 3 SELECT				2	CVS_TEST_ENA(6)
7	RA 1 SELECT				2	CVS_TEST_ENA(7)
8	RA 2 SELECT				2	CVS_TEST_ENA(8)
9	AA1 SELECT				2	CVS_TEST_ENA(9)
10	AA2 SELECT				2	CVS_TEST_ENA(10)
11	AA3 SELECT				2	CVS_TEST_ENA(11)
12	AA4 SELECT				2	CVS_TEST_ENA(12)
13	START MANUAL TEST				3	CVS_ITEM_NO_A
14	START AUTO TEST SEQ				3	CVS_ITEM_NO_A
15	TERMINATES SELF TEST				3	CVS_STIMULI_TYPE_IND
16	INHIBIT ALL				4	CVS_DEVICE_TABLE CVS_DEV_ENA(1 to 4)

TABLE 3.101-3. SENSOR SELF-TEST LIMITS			
DESCRIPTION	LOW	HIGH	UNITS
MLS Range	15.0	15.4	NM
MLS Elevation	5.9	6.1	DEG
MLS Azimuth - High Mode	2.9	3.1	DEG
MLS Azimuth - Low Mode	−3.1	−2.9	DEG
TACAN Range	0.0	0.5	NM
TACAN Azimuth	177.5	182.5	DEG
Radar Altimeter	900	1100	FT
Accel. Assembly −Y	14.4	17.8	FT/SEC^2
Accel. Assembly −Z	57.7	71.1	FT/SEC^2

3.5.102 DISPLAY: RCS/RGA/ADTA TEST

–1 AVAILABILITY: SPEC 102 in OPS G9.

–2 PURPOSE: The Preflight RCS/RGA/ADTA Test display is used to activate and control the execution of sensor self tests of the Reaction Control System (RCS), Rate Gyro Assemblies (RGA), and the Air Data Transducer Assemblies (ADTA). It allows the users to select and deselect three test modes on each LRU: High, Low, and High/Low modes.

```
XXXX/102/     RCS/RGA/ADTA TEST XX X DDD/HH:MM:SS
                                     DDD/HH:MM:SS
RCS DRIVERS

  RJDF   1X    START TEST 4X  STAT XXXX
  RJDA-A 2X    CONT       5X  JET   XXX
      -B 3X    TERM       6   STEP    X



SENSORS                                TEST CONTROL:
                                        HIGH START 15X
   ENA STAT     R       P       Y      LOW START  16X
R1  7X XXXX  ±XX.XS  ±XX.XS  ±XX.XS AUTO SEQ   17X
G2  8X XXXX  ±XX.XS  ±XX.XS  ±XX.XS TERM       18X
A3  9X XXXX  ±XX.XS  ±XX.XS  ±XX.XS
 4 10X XXXX  ±XX.XS  ±XX.XS  ±XX.XS INH ALL    19X

   ENA STAT   PαC      PS       PαU      PαL      TT
A1 11X XXXX XX.XXXS XX.XXXS XX.XXXS XX.XXXS XXX.XXS
D3 12X XXXX XX.XXXS XX.XXXS XX.XXXS XX.XXXS XXX.XXS
T2 13X XXXX XX.XXXS XX.XXXS XX.XXXS XX.XXXS XXX.XXS
A4 14X XXXX XX.XXXS XX.XXXS XX.XXXS XX.XXXS XXX.XXS

                                                (XX)
```

Figure 3.102

TABLE 3.102-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 102 PRO	RCS/RGA/ADTA test is available only in GNC9. HDA must be active before initiating tests.
2	RCS Selection for Testing	ITEM N EXEC	Enables selected RCS for testing. N = 1-3 as follows: 1. RJDF 2. RJDA-A 3. RJDA-B
3	RCS Test Controls	ITEM 4 EXEC	Start test of selected LRUs. (48423)
		ITEM 5 EXEC	Continue the RCS test that has been suspended. Illegal entry unless an RCS test is suspended. If the last thruster in a set fails (RJDF-F5R, RJDA-A-L5L, RJDA-B-L4D), select ITEM 6.
		ITEM 6 EXEC	Terminate an RCS test that has suspended. Legal only if an RCS test is suspended or complete. NOTE: 1. ITEMs 1-6 are illegal while the test is executing. 2. STAT goes RUN when start test is executed, FAIL if a jet fails and the jet which failed is displayed after JET. 3. When either ITEM 5 or 6 is entered STAT and JET are blanked.
4	Sensor Selection for Testing	ITEM N EXEC	Enables selected sensor for a testing. N = 7-14 as follows: 7. RGA 1 11. ADTA 1 8. RGA 2 12. ADTA 2 9. RGA 3 13. ADTA 3 10. RGA 4 14. ADTA 4
5	Sensor Test Controls	ITEM 15 EXEC	Start the self test for the HIGH TEST MODE on the selected sensors.
		ITEM 16 EXEC	Start the self-test for the LOW TEST MODE on the selected sensors.
		ITEM 17 EXEC	Start the self-test for both the HIGH TEST MODE and LOW TEST MODE on all sensors, in automatic sequence.

TABLE 3.102-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			NOTE: 1. Once a test is started Item entries 7-19 are illegal until it has completed. 2. Data is frozen on display at completion of test until test is terminated. 3. Test status is shown at completion of test as Blank if good or ↓ if failed low; or ↑ if failed high. STAT columns show Blank (good) or SMRD (RGA) or BITE (ADTA) for hardware failure. 4. Table 3.102-3 defines test values for sensors.
		ITEM 18 EXEC	Terminate self-test, restarts cyclic updating of sensor LRU data and clears status indicators. Must be entered after test started before any other sensor entries accepted. Will be rejected if test is still in progress.
6	Sensor Deselection	ITEM 19 EXEC	Deselects all sensor LRUs on page. Entry will be rejected if a test has been started (ITEM 15, 16, 17) and has not been terminated (ITEM 18).

TABLE 3.102-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select RCS RJDF				2	CVS_ITEM_STATUS_2(1)
2	Select RCS RJDA-A				2	CVS_ITEM_STATUS_2(2)
3	Select RCS RJDA-B				2	CVS_ITEM_STATUS_2(3)
4	Initiate RCS Test				3	CVS_ITEM_NO_B
5	Continue RSC Test				3	CVS_ITEM_NO_B
6	Terminate RCS Test				3	CVS_ITEM_NO_B
7	Select RGA 1 For Test				4	CVS_TEST_TABLE CVS_TEST_ENA_1(1)
8	Select RGA 2 For Test				4	CVS_TEST_ENA_1(2)
9	Select RGA 3 For Test				4	CVS_TEST_ENA_1(3)
10	Select RGA 4 For Test				4	CVS_TEST_ENA_1(4)
11	Select ADTA 1 For Test				4	CVS_TEST_ENA_1(5)
12	Select ADTA 2 For Test				4	CVS_TEST_ENA_1(6)
13	Select ADTA 3 For Test				4	CVS_TEST_ENA_1(7)
14	Select ADTA 4 For Test				4	CVS_TEST_ENA_1(8)
15	Select High Test Mode				5	CVS_HI_LO_AUTO
16	Select Low Test Mode				5	CVS_HI_LO_AUTO
17	Select Auto Test Mode				5	CVS_SEQ_AUTO_IND
18	Disable The Sensor Self-Test				5	CVS_STIMULI_TYPE_IND_2
19	Deselected The Sensors That Were Selected For Test				6	CVS_DEVICE_TABLE CVS_TEST_ENA_1(1 to 2)

TABLE 3.102-3. RGA LIMIT VALUES

DESCRIPTION	LOW	HIGH	UNITS
ROLL RATE			
HIGH	18.88	21.12	DEG/SEC
LOW	−21.12	−18.88	DEG/SEC
PITCH RATE			
HIGH	9.44	10.56	DEG/SEC
LOW	−10.56	−9.44	DEG/SEC
YAW RATE			
HIGH	9.44	10.56	DEG/SEC
LOW	−10.56	−9.44	DEG/SEC

TABLE 3.102-4. ADTA LIMIT VALUES

DESCRIPTION	LOW	HIGH	UNITS
STATIC PRESS			
HI ALT	0.023	0.815	IN HG
LO ALT	24.887	24.889	IN HG
CTR ALPHA PRESS (PAC)			
HI ALT	5.473	5.477	IN HG
LO ALT	29.527	29.531	IN HG
LWR ALPHA PRESS (PAL)			
HI ALT	1.708	1.712	IN HG
LO ALT	14.713	14.717	IN HG
UPR ALPHA PRESS (PAU)			
HI ALT	2.740	2.744	IN HG
LO ALT	21.708	21.712	IN HG
TOTAL TEMP			
HI TEMP	173.56	173.60	DEG C
LO TEMP	18.50	18.54	DEG C

3.5.104 DISPLAY: GND IMU CNTL/MON

–1 AVAILABILITY: SPEC 104 in OPS G9.

–2 PURPOSE: The Ground IMU Control/Monitor display supports ground IMU operations including calibrations, alignments, MMU Reads/Writes of IMU data, and inertial and TERM/IDLE processing. (17176/25221)

```
XXXX/104/      GND IMU CNTL/MON  XX X DDD/HH:MM:SS
                                      DDD/HH:MM:SS

IMU        1          2          3
X     1 XXX.XX   4 XXX.XX   7 XXX.XX    SEL IMU 1 16X
Y     2 XXX.XX   5 XXX.XX   8 XXX.XX            2 17X
Z     3 XXX.XX   6 XXX.XX   9 XXX.XX            3 18X

     O  XXX.XX     XXX.XX     XXX.XX   ATT DET    19X
     M  XXX.XX     XXX.XX     XXX.XX   HNGR CAL A 20X
     I  XXX.XX     XXX.XX     XXX.XX            B 21X
    IR  XXX.XX     XXX.XX     XXX.XX            C 22X
 V  X  ±XX.XX     ±XX.XX     ±XX.XX   PREFLT CAL 23X
    Y  ±XX.XX     ±XX.XX     ±XX.XX   GYROCOMP   24X
    Z  ±XX.XX     ±XX.XX     ±XX.XX    XXXX  XXXX
 VRSS   XX.XX      XX.XX      XX.XX   INERTIAL   25X
                                      PLAT POS   26X
B HDW    XXXX       XXXX       XXXX   TERM/IDLE  27X
I S/W    XX         XX         XX
TSTAT    XX         XX         XX     28 MM WRITE  X
                                           READ 29X
PWR ON    X          X          X     MM STATUS XXXX
I/O       S          S          S
STBY    10X        11X        12X     30 SITE SEL  X
OPER    13X        14X        15X     ACTUAL      XXX
                                                  (XX)
```

Figure 3.104

TABLE 3.104-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 104 PRO	The Ground IMU Control/Monitor SPEC is available in OPS G9 only. (45166) (47741/47752) (48995)
2	Euler Angles Definition	ITEM N+XXX.XX EXEC	Manual selection of Euler angles defining the NAV-Base-To-Desired-Cluster transformation for each IMU, to support the Platform Positioning function (function 6, ITEM 26). XXX.XX = desired angle in degrees (0 to 360). N = 1-9 in sets of 3 (1-3, 4-6, 7-9) for angle selection as follows: IMU1 IMU2 IMU3 Roll 1 4 7 Pitch 2 5 8 Azimuth 3 6 9
3	Command IMUs to Standby	ITEM N EXEC	Request for IMU hardware to go to STANDBY mode; discrete IMU data sent to GPC input buffer (but not serial data). N = 10-12 for IMUs 1-3 respectively. (37522)
4	Command IMUs to Operate	ITEM N EXEC	Request for IMU hardware to go to Operate mode (takes 38 to 53 seconds); discrete and serial IMU data sent to GPC input buffer. N = 13-15 for IMUs 1-3 respectively. (37522) NOTE: 1) Operate mode is required for any IMU to support submode processing (e.g., calibrations, alignments, inertial). 2) An IMU-internal delay timer prevents IMUs from going immediately from Operate to Standby, and back to Operate (takes 2.5 to 3.75 minutes); likewise, this same timer delays the Operate mode, for about 3 minutes, after power is applied to an IMU which is receiving an Operate command. 3) If an IMU is commanded to Operate while powered off, the FSW sets the In-Operate status on after 300 seconds.
5	Select IMUs for Submode Processing	ITEM N EXEC	Selection of IMU(s) (N = 16-18 for IMUs 1-3 respectively) to be used for calibrations, alignments, and Mass Memory Read/Write of IMU checkpoint data; automatic deselection occurs at completion or manual termination of these operations.

TABLE 3.104-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
6	Initiate IMU Submode	ITEM 19 EXEC	Attitude Determination - 4 minute operation to verify validity of IMU checkpoint data; normally performed prior to IMU calibration or alignment. (35322) (37462) NOTE: GPC errors will occur if any IMU powered off, commfaulted, or not selected during Attitude Determination.
		ITEM 20 EXEC	Hangar Calibration-A - Approximate eight hour operation which torques each IMU selected to 25 cluster orientations; updates corresponding subset of IMU checkpoint data in compool; usually followed by a Mass Memory Write to IMU checkpoint area. NOTE: IMUs must be calibrated via this submode within 14 days of each flight.
		ITEM 21 EXEC	Hangar Calibration-B - Approximate 5½ hour operation which torques each IMU selected to four positions; updates corresponding subset of IMU checkpoint data in compool; not usually followed by a Mass Memory Write (just done for off-line data collection and analysis).
		ITEM 22 EXEC	Hangar Calibration-C - Approximate six minute operation; not run at KSC.
		ITEM 23 EXEC	Preflight Calibration-A - Approximate 2½ hour operation which torques each IMU selected to 13 cluster positions (subset of Hangar Calibration-A); updates corresponding subset of IMU checkpoint data in compool; usually followed by a Mass Memory Write to IMU checkpoint area. NOTE: IMUs must be calibrated via this submode within 15 hours of each flight.
		ITEM 24 EXEC	Gyrocompass Alignment - Approximate 48 minute, two part operation which establishes each IMU's alignment relative to the M50 (Inertial) reference frame; upon successful completion of the first (cluster align) part (approx. 38 minutes) the software automatically advances to the second part (Velocity/Tilt) which, after 10 minutes, displays CPLT or FAIL beneath ITEM 24; if the cluster align part fails, FAIL is displayed beneath GYROCOMP, before starting the Velocity/Tilt part.

TABLE 3.104-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 25 EXEC	Inertial Processing - Holds the inertial alignment, after CPLT displayed beneath ITEM 24 (true inertial is attained at the Platform Release event at T-12 seconds in the launch countdown sequence). NOTE: 1) Inertial processing may also be initiated via OPS 1 PRO from OPS G9; likewise for transitions from OPS G9 to OPS G2 or G3 (via OPS 0). 2) Inertial processing may be terminated via T/I request (ITEM 27), IMU Power-Off, or Standby request (ITEM 10-12).
		ITEM 26 EXEC	Platform Positioning - Provides capability to maneuver the platform to manually selected positions (function 2); order rotations is roll, pitch, azimuth (X,Y,Z).
		ITEM 27 EXEC	Terminate/Idle - Represents the default or quiescent, state of IMU SOP processing entered when any other submode is terminated; IMU torque and slew commands are zeroed. NOTE: At least one IMU must be in Operate in order to make a legal T/I request. General Submode Notes: 1) Calibrations and Att. Det. automatically return to T/I, upon completion. 2) Submode operations may be terminated at any time, via ITEM 27 EXEC (return to T/I). 3) Submode requests are valid only under the following conditions: a) All selected IMUs are in T/I mode (except when requesting T/I or Inertial mode); b) At least one IMU is Selected and in Operate (at least two for HC-B and HC-C). c) A Mass Memory Operation (with IMU checkpoint data) cannot be in progress.

TABLE 3.104-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
7	Mass Memory Operations	ITEM 28+X EXEC	Mass Memory Write - Transfers IMU checkpoint data from compool to the MMU checkpoint area designated (X = 1, 2 or 3), for the IMUs selected (See function 5). The MMU written to will be the one selected for the GNC major function on DPS Utility (SPEC 1). (45345)
		ITEM 29 EXEC	Mass Memory Read - Transfers IMU checkpoint data from the same Mass Memory area that the corresponding GPC IPL was made from, to the COMPOOL locations representing the selected IMUs. (45345)
			General Mass Memory Notes: 1. Mass Memory Reads are two-step operations involving a 512 half-word buffer. During Mass Memory Reads the entire Mass Memory checkpoint area overlays the buffer, the COMPOOLS are updated only for selected IMUs. 2. Mass Memory Operations can be performed only if at least one IMU is selected and in Operate; if an IMU is commanded to operate while off, allow at least five minutes before requesting Mass Memory Reads or Writes (function 4). 3. The following criteria must also be satisfied before initiating Mass Memory operations: a. IPL source switch off; b. Correct MM/GNC assignment (SPEC 1, ITEM 1/2); c. Correct MM bus assignments on G9 NBAT (SPEC 0, ITEM 18/19). 4. Mass Memory Writes are a three-step operation if one or two IMUs are selected. First, the current contents of the designated MMU checkpoint area is read into the buffer. Second, only the data for the selected IMUs are moved from the COMPOOL locations into the buffer. Finally, the entire buffer overlays the designated Mass Memory checkpoint area. With all three IMUs selected, only Steps 2 and 3 are done.

TABLE 3.104-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			5. The MM STATUS shows: a. IP when the Mass Memory Read or Write is in progress; b. CMPT when the operation sucessfully completes (usually MMU read or write 15-20 seconds); c. FAIL when any operation is not successful.
8	Site Selection	ITEM 30 + X EXEC	Makes available to the IMU SOP the values of I-LOADed site dependent parameters representing the site selected - Normally: Pad 39A (X = 1), Vehicle Assembly Building (X = 2), Orbiter Processing Facility (X = 3), Shuttle Avionics Laboratory (X = 4), Palmdale (X = 5), Flight Systems Laboratory (X = 6), PAD 39B (X = 7), PAD LC6 (X = 8), Orbiter Maintenance Complex (X = 9), the actual site indication will be '39A', 'VAS', 'OPF', 'JSC', 'PMD', or 'DNY', '39B', 'LC6', or 'OMC'. NOTE: Default site is X = 1.
9	IMU Monitoring Function		Outer, Middle, Inner, and Inner Roll compensated resolver angles for each IMU's gimbals. • ΔV (Acceleration) terms for X,Y,Z axis of each IMU's accelerometers (ft/sec/sec) platform coordinates. • ΔV Root Sum of Squares for each IMU. (When the vehicle is at rest on the ground this value is the same as gravitiational acceleration, i.e., 32.17 ft/sec/sec) - platform coordinates. • BITE Words 1) Hardware - indicates health of the IMU hardware and its ability to transmit valid data. (Nominal Value: '8000' - i.e., high order bit is IMU data good flag; other bits being on indicate nature of problem when data good bit is off - see IMU SOP FSSR (STS-83-0013) for further details).

TABLE 3.104-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			2) Software - reflects IMU SOP BITE data processing to detect accelerometer/gyro out-of-limits conditions. (Nominal Value: '00' - i.e., no failures detected - see IMU SOP FSSR for further details.) NOTE: High-order bit is never On. 3) Composite Status - reflects temperature and pressure conditions of each IMU, as well as In-Operate status. (Nominal Value: '3F' - i.e., temperatures and pressure readings satisfactory, and IMU In-Operate; '2F' - temperature, pressure okay, but IMU in Standby.) NOTE: Two high-order bits are never On. • Power On Indication - displays '*' when power is applied to each IMU; displays blanks when power is off. • I/O Commfault Indication - displays 'M' for missing I/O data; displays Blanks when normal I/O data present, or when IMU is off. (43940/50235/56091)

TABLE 3.104-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Desired Cluster-To-NB Roll Angle (IMU1)	000.00	360.00	Deg	2	CGUV_DC_NB_ANG$(1,1)
2	Desired Cluster-To-NB Pitch Angle (IMU1)	000.00	360.00	Deg	2	CGUV_DC_NB_ANG$(2,1)
3	Desired Cluster-To-NB Azimuth Angle (IMU1)	000.00	360.00	Deg	2	CGUV_DC_NB_ANG$(3,1)
4	Desired Cluster-To-NB Roll Angle (IMU2)	000.00	360.00	Deg	2	CGUV_DC_NB_ANG$(1,2)
5	Desired Cluster-To-NB Pitch Angle (IMU2)	000.00	360.00	Deg	2	CGUV_DC_NB_ANG$(2,2)
6	Desired Cluster-To-NB Azimuth Angle (IMU2)	000.00	360.00	Deg	2	CGUV_DC_NB_ANG$(3,2)
7	Desired Cluster-To-NB Roll Angle (IMU3)	000.00	360.00	Deg	2	CGUV_DC_NB_ANG$(1,3)
8	Desired Cluster-To-NB Pitch Angle (IMU3)	000.00	360.00	Deg	2	CGUV_DC_NB_ANG$(2,3)
9	Desired Cluster-To-NB Azimuth Angle (IMU3)	000.00	360.00	Deg	2	CGUV_DC_NB_ANG$(3,3)
10	Command IMU 1 to Standby				3	CGBB_OUT12_HFF_SEG3_ DSCRT4$(1;10)
11	Command IMU 2 to Standby				3	CGBB_OUT12_HFF_SEG3_ DSCRT4$(2;10)
12	Command IMU 3 to Standby				3	CGBB_OUT12_HFF_SEG3_ DSCRT4$(3;10)
13	Command IMU 1 to Operate				4	CGBB_OUT12_HFF_SEG3_ DSCRT4$(1;10)
14	Command IMU 2 to Operate				4	CGBB_OUT12_HFF_SEG3_ DSCRT4$(2;10)
15	Command IMU 3 to Operate				4	CGBB_OUT12_HFF_SEG3_ DSCRT4$(3;10)
16	Select IMU 1 for SOP Processing				5	CGMB_IMU_SEL_DFG$1
17	Select IMU 2 for SOP Processing				5	CGMB_IMU_SEL_DFG$2

TABLE 3.104-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
18	Select IMU 3 for SOP Processing				5	CGMB_IMU_SEL_DFG$3
19	Request Attitude Determination				6	CGMB_IMU_FLAG_WD2$1
20	Request Hangar Cal-A				6	CGMB_IMU_FLAG_WD2$2
21	Request Hangar Cal-B				6	CGMB_IMU_FLAG_WD2$3
22	Request Hangar Cal-C				6	CGMB_IMU_FLAG_WD2$4
23	Request Preflight Cal-A				6	CGMB_IMU_FLAG_WD2$5
24	Request Gyrocompass Alignment				6	CGMB_IMU_FLAG_WD2$6
25	Request Inertial Processing				6	CGMB_IMU_FLAG_WD2$9
26	Request Platform Processing				6	CGMB_IMU_FLAG_WD2$10
27	Request Term/Idle Processing				6	CGMB_TERM_IDLE_DFG$16
28	Mass Memory Write	1	3	Dec	7	CGUV_MM_WRITE_AREA
29	Mass Memory Read				7	CGUB_MM_R
30	Site Selection	1	9	Dec	8	CGUV_SITE_SEL

3.5.105 DISPLAY: TCS CONTROL

–1 AVAILABILITY: SPEC 105 in OPS G9.

–2 PURPOSE: The TCS CONTROL display is a specialist function that is available in OPS G9. This display provides the capability to call, execute, and interactively control the execution of Test Sequences that are Mass Memory resident. In addition, this function provides the capability to display text messages from Mass Memory resident or ground originating sequences and to monitor Test Sequence progress.

```
XXXX/105/        TCS CONTROL    XX X DDD/HH:MM:SS
                                     DDD/HH:MM:SS
1 SELECT ID XX    NAME XXXXXXXX    ECP  ERROR XXX
MM READ 2 XXXX    STATUS   XXXX    ERROR CODE XXX
  STEP   XXXXX    TIME XX:XX:XX    BITE      XXXX
  STOP   3      4 STOP AT XXXXX    CANCEL     5
  RESUME 6      7 RSM AT  XXXXX    CLEAR MSGS 8

   TIME              TEXT
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 XX:XX:XX     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                                              (XX)
```

Figure 3.105

TABLE 3.105-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 105 PRO	The TCS control display is available only in OPS G9.
2	TCS Sequence Selection and Load	ITEM 1+XX EXEC	Selects sequence XX for execution. 1 - VFBB4 BF POSTLAND SUPPORT 2 - VFB84 RAIN DRAIN 3 - VFB89 VENTS PURGE 4 - VFB85 SSME FERRY 5 - VFB88 AEROSURF FERRY 6 - VFM01 VENTS FERRY 7 - VFB79 MDM BSR 8 - VFBF3 POSTLAND-SSME NULLING 9 - VFD08 POSTLAND-OMS GN2 VENTING 10 - VFE03 POSTLAND-MPS CONFIGURE
		ITEM 2 EXEC	Reads sequence from MM and loads it into the sequence buffer and initiates execution. If successful status = CPLT. OPS transitions are inhibited while sequence is being loaded.
3	Stop and Cancel Sequence	ITEM 3 EXEC	Causes sequence to stop after completing the current step. Status = SPND.
		ITEM 4+XXXX EXEC	Causes sequence to stop when the specified step (XXXXX) is reached, main sequence only. Step XXXXX displayed.
		ITEM 5 EXEC	Causes the main sequence to be cancelled.
4	Resume Sequence	ITEM 6 EXEC	Causes initiation of the sequence at the next step. Status = RUN.
		ITEM 7+XXXXX EXEC	Causes a stopped or suspended sequence to resume at the step number specified. Step = XXXXX.
5	Clear MSGS	ITEM 8 EXEC	Causes the text messages and associated times that are currently being displayed to be blanked.

TABLE 3.105-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Selects a Sequence for Execution	1	84	DEC	2	
2	Reads and Executes the Sequence Identified in ITEM 1				2	
3	Causes Execution to Stop at the end of the Current Step				3	
4	Causes Execution to Stop When the Specified Step is Reached, Main Sequence Only	0	32763	DEC	3	
5	Terminates the Sequence and Clears it from the Display and Buffer				3	A remote text indicator of END is driven to display.
6	Resumes a Suspended Sequence at the Next Step				4	A remote text indicator of RUN is driven to display.
7	Resumes a Suspended Sequence at the Specified Step	0	16383	DEC	4	
8	Clears Out All the Messages on the Display Together with Their Associated Time Tags				5	

−3 The following additional notes are provided to further define status fields, etc., on SPEC 105.

−3.1 Display parameter definition - The following parameters are driven to the display as a result of sequence execution. The parameters are driven to the display for sequences called from the TCS CONTROL SPEC.

−3.1.A Step XXXXX - The decimal equivalent of the current operator step number. If the sequence is suspended by a stop (or stop-at) or TCS error (refer to CPDS SS-P-0002-150, OFT LDB Software Interface Requirements), the next step number is displayed.

−3.1.B Status XXXX - A remote text indicator with the following characteristics is driven:

RUN - A RUN indicator is displayed when the sequence is in memory, resolved, and is in nonsuspended execution.

SPND - A suspend indication is displayed any time the sequence is suspended by a TCS error or stopped by a TCS operator.

END - An END indicator is displayed when the end operator is processed (either by normal or TCS cancel termination).

−3.1.C Error code XXX - The decimal equivalent of the error code is displayed when an error is encountered by TCS. Error codes, conditions and sequence execution shall be the same as specified in CPDS SS-P-0002-150 (OFT LDB Software Interface Requirements). The error code field is blanked upon a RESUME or CANCEL item entry. See Table 3.105-3 for error codes.

−3.1.D BITE XXXX - The hexadecimal equivalent of the TCS/call program error response RW 8 is displayed upon TCS processing of an error. The BITE field is blanked upon a RESUME or CANCEL item entry.

−3.1.E Time XX:XX:XX - The Greenwich Mean Time (GMT) time of day (HR:MIN:SEC) of the error is displayed upon TCS processing an error. The time field is blanked upon a RESUME or CANCEL item entry.

−3.1.F Time XX:XX:XX/text - The text entry data from the text operators and text operator execution time is displayed from the latest 15 text operators in a pushdown fashion. The 16th oldest text entry is discarded sequentially. All text operators (with onboard destinations) are displayed on this display, regardless of whether they result from execution of sequences under the control of the LDB or the TCS CONTROL display function. (14474)

−3.1.G ECP error XXX - The decimal equivalent of the Explicitly-Coded Program (ECP) error code is displayed when a CALL program error is encountered. The error codes and conditions are the same as specified in Section 7.1.6. The ECP error code field is blanked upon the start of a new ECP.

−3.2 TCS Control Display Function Description

−3.2.A Initialization - When the SPEC is called, the display is initialized blank except for the text messages and for the conditions described in item B below. When the display is initialized, the latest text messages (up to 15) are displayed. That is, the text message entries are constructed independently of whether or not the TCS CONTROL display function is active, so that any time the display is called, the text entries reflect the results of all (LDB and SPEC) TCS text operators (with onboard destinations) that have been executed since initialization of TCS or since the clear message (Item 8) has been entered.

TABLE 3.105-3. TCS ERROR CODES

DECIMAL NO.	MESSAGE
0	Spare.
1	A worker task is not available or the sequence specified is not active.
2	Too many sequences requested.
3	Illegal OP code 7 request (GPC select).
4	User attempted to resume a sequence that was not stopped.
5	TCS MEC command interlock violation attempted.
6	Nonzero BITE.
7	Illegal arithmetic operation attempted.
8	Unable to honor OP Code 6 request or OP Code 5.
9	Spare.
10	Nonexistent step number specified.
11	Sequence is not on mass memory.
12	Nonexistent sequence specified.
13	GPC port/BTU is invalid.
14	Format or information for operator code is incomplete or illegal.
15	Invalid operator code.
16	Explicitly-coded program busy or not found or buffer is not available.
17	I/O error encountered.
18	Mass memory sequence request/retrieval/miscompare.
19	Payload communications software not enabled.
20	Payload communications software transmission error.

–3.2.B Cleanup - When the TCS CONTROL SPEC is deselected, the cleanup results in a TCS CANCEL to the sequence, if the sequence was called via the TCS CONTROL SPEC. In the event TCS sequence processing is suspended awaiting for the sequence response buffer to be transmitted to the ground, the cancellation of the sequence can be delayed until sequence processing starts up again. If the TCS CONTROL SPEC is re-entered before the sequence has cancelled, the display will reflect the status of the sequence prior to SPEC transition. Also, Items 1-7 will be rejected as ILLEGAL ENTRY until the sequence has cancelled. When the END operator is processed by the sequence (or upon CANCEL Item entry), the display function blanks all parameter fields, with the exception that the STATUS remote text that is driven to END.

–3.2.C Sequence operation - Only one main sequence at a time can be run from the TCS CONTROL SPEC. Subsequences can be referenced by the main sequence, but the display interaction with the user is with the main sequence only. Once a sequence is called (ITEM 2 EXEC), the sequence must run to completion (processing of the main sequence END operator) or a TCS CANCEL (Item 5) must be entered before another sequence ID can be entered.

–3.3 Error processing - Error processing shall make use of the standard TCS error codes for user errors and errors associated with TCS execution. An appropriate TCS error code shall be driven for the following:

–3.2.A Input of sequence ID for which the corresponding MTSD entry has binary zeros for the name.

–3.2.B Attempting to call a sequence from MM if sufficient buffers are not available.

–3.2.C Entry of resume (or resume-at) if the sequence is not suspended.

–3.2.D Any other errors fielded by TCS as defined in CPDS SS-P-0002-150, OFT LDB Software Interface Requirements.

–3.4 The TCS Control SPEC will generate an ILLEGAL ENTRY message for the message line (class 5) if the user attempts the following:

–3.2.A An item entry of 1 through 7 while a previous item entry (1 through 7) process is in progress.

–3.2.B An item entry of 1 through 7 during TCS processing of the priority change operator (operator code 24).

–3.2.C Input of sequence ID greater than 64 or equal to zero.

3.5.106 DISPLAY: MANUAL CONTROLS

−1 AVAILABILITY: SPEC 106 in OPS G9.

−2 PURPOSE: The MANUAL CONTROLS display is available in OPS G9 only. The display function provides the capability to test the GPC interface with switch contacts and transducers associated with the trim switches, body-flap switches, rotational and translational hand controllers, Speed Brake Thrust Controllers (SBTC), and Rudder Pedal Transducer Assemblies (RPTA). When SPEC 106 is active, all outputs from the controllers to the data buses are inhibited; i.e., movement of a controller or switch will result only in display of the data.

```
XXXX/XXX/106   MANUAL CONTROLS  XX X DDD/HH:MM:SS
                                     DDD/HH:MM:SS

 RHC     R    P    Y
  L  1 ±XXX ±XXX ±XXX                    L 1  ±XX
     2 ±XXX ±XXX ±XXX                 S   2  ±XX
     3 ±XXX ±XXX ±XXX                 B   3  ±XX
  R  1 ±XXX ±XXX ±XXX                 T  R 1  ±XX
     2 ±XXX ±XXX ±XXX                 C   2  ±XX
     3 ±XXX ±XXX ±XXX                     3  ±XX
  A  1 ±XXX ±XXX ±XXX                    L 1 ±XXX
     2 ±XXX ±XXX ±XXX                 R   2 ±XXX
     3 ±XXX ±XXX ±XXX                 P   3 ±XXX
                                      T  R 1 ±XXX
 TRIM SW   R P Y      BDY FLP         A   2 ±XXX
  PNL L  1 X X X       L   1X             3 ±XXX
         2 X X X           2X
      R  1 X X X       R   1X   THC   TX TY TZ
         2 X X X           2X    L  1  X  X  X
 RHC L  1 X X                       2  X  X  X
         2 X X                      3  X  X  X
      R  1 X X                   A  1  X  X  X
         2 X X                      2  X  X  X
                                    3  X  X  X

                                              (XX)
```

Figure 3.106

TABLE 3.106-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 106 PRO	The manual controls display is available only in OPS G9. HDA must be active to collect dynamic data for processing and display.
2	Switch and Transducer Data		Rotational Hand Controllers (RHC): Data is displayed as percent of deflection (0-99%). Left - L Three channels each of Right - R roll (R), pitch (P), and Aft - A yaw (Y) displayed. Speed Brake Thrust Controller (SBTC) and Rudder Pedal Transducers Assemblies (RPTA): Three channels each for left and right hand stations. Data is displayed as percent of deflection (0-99%). Trim Switches - Roll, pitch and yaw axes. Two channels each for left-hand and right-hand panel switches and for left-hand and right-hand RHC switches (no RHC yaw trim switches). Data is displayed as + or −. Body Flap Switches - Two channels each for left and right stations. Displayed data is U (up) or D (down). Translation Hand Controllers - X, Y, and Z axes. Three channels each for forward and aft stations. Data is displayed as + or −.

3.5.110 DISPLAY: BUS/BTU STATUS

−1 AVAILABILITY: SPEC 110 is available in OPS G9 and OPS P9 only.

−2 PURPOSE: The BUS/BTU status display provides information about the health of LRUs. It may only be requested when only one GPC is in RUN. All other GPCs must be in HALT.

```
XXXX/110/      BUS/BTU STATUS    XX X DDD/HH:MM:SS
                B T O P          B T O P  DDD/HH:MM:SS
          FF1P  X X X X LF1P     X X X X          B T O P
MODE X     1S   X X X X   1S     X X X X PMU      X X X X
MC   X     2P   X X X X LA1P     X X X X EIU1A    X X X X
MF  XX     2S   X X X X   1S     X X X X    1B    X X X X
    XX     3P   X X X X PM1P     X X X X    1C    X X X X
CPU XX     3S   X X X X   1S     X X X X    1D    X X X X
           4P   X X X X LL1P     X X X X    2A    X X X X
          FF4S  X X X X   1S     X X X X    2B    X X X X
PRI/SEC   FA1P  X X X X   2P     X X X X    2C    X X X X
 PORTS     1S   X X X X   2S     X X X X    2D    X X X X
           2P   X X X X LR1P     X X X X    3A    X X X X
PRI 1X     2S   X X X X   1S     X X X X    3B    X X X X
SEC 2X     3P   X X X X   2P     X X X X    3C    X X X X
           3S   X X X X   2S     X X X X EIU3D    X X X X
           4P   X X X X MCIU     X X X X MEC1A    X X X X
          FA4S  X X X X                    1B    X X X X
          MMU1  X X X X LDIUP    X X X X    1C    X X X X
             2  X X X X     S    X X X X    1D    X X X X
          DEU1  X X X X PF1P     X X X X    2A    X X X X
             2  X X X X   1S     X X X X    2B    X X X X
             3  X X X X   2S     X X X X    2C    X X X X
             4  X X X X   2P     X X X X MEC2D    X X X X
                                                   (XX)
```

Figure 3.110

TABLE 3.110-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	SPEC 110 PRO	The BUS/BTU status display is available in OPS G9 and OPS P9 only.
2	Port Selection	ITEM 1 EXEC	Select primary port status for display (default).
		ITEM 2 EXEC	Select secondary port status for display.
3	GPC Status		MODE - Always R for RUN MC - Memory Configuration in GPC (9-G9 or 6-P9) MF - Major Function currently active (GN or PL) - NOTE, 2nd field is always blank CPU - Duty cycle of CPU in percent
4	Bus Status		For each bus shown, a count of four types of sensed errors is shown. The count ranges 0-9, rolls over, and is active only when the display is active, and is initialized to 0 for each call-up. Type of errors are: B: Count of Digital Data Bus errors: Time out (other than 1st word), parity, MIA mismatch, SYNC, SEV, block timeout. T: Count of initial time out (1st word errors). O: Count of output errors: transmitter disabled, gap. P: Count of program errors: self-test illegal OP code, boundary alignment, MSC time out, DMA instruction-read parity, DNA data-read parity.

TABLE 3.110-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select Primary Port				2	
2	Select Secondary Port				2	

3.5.111 DISPLAY: SL MEMORY DUMP

–1 AVAILABILITY: SPEC 111 in OPS P9.

–2 PURPOSE: The Spacelab Computer Memory Dump Display is a specialist function that is available in OPS P9. This display provides control and monitoring functions for the dumping of data from the spacelab computers.

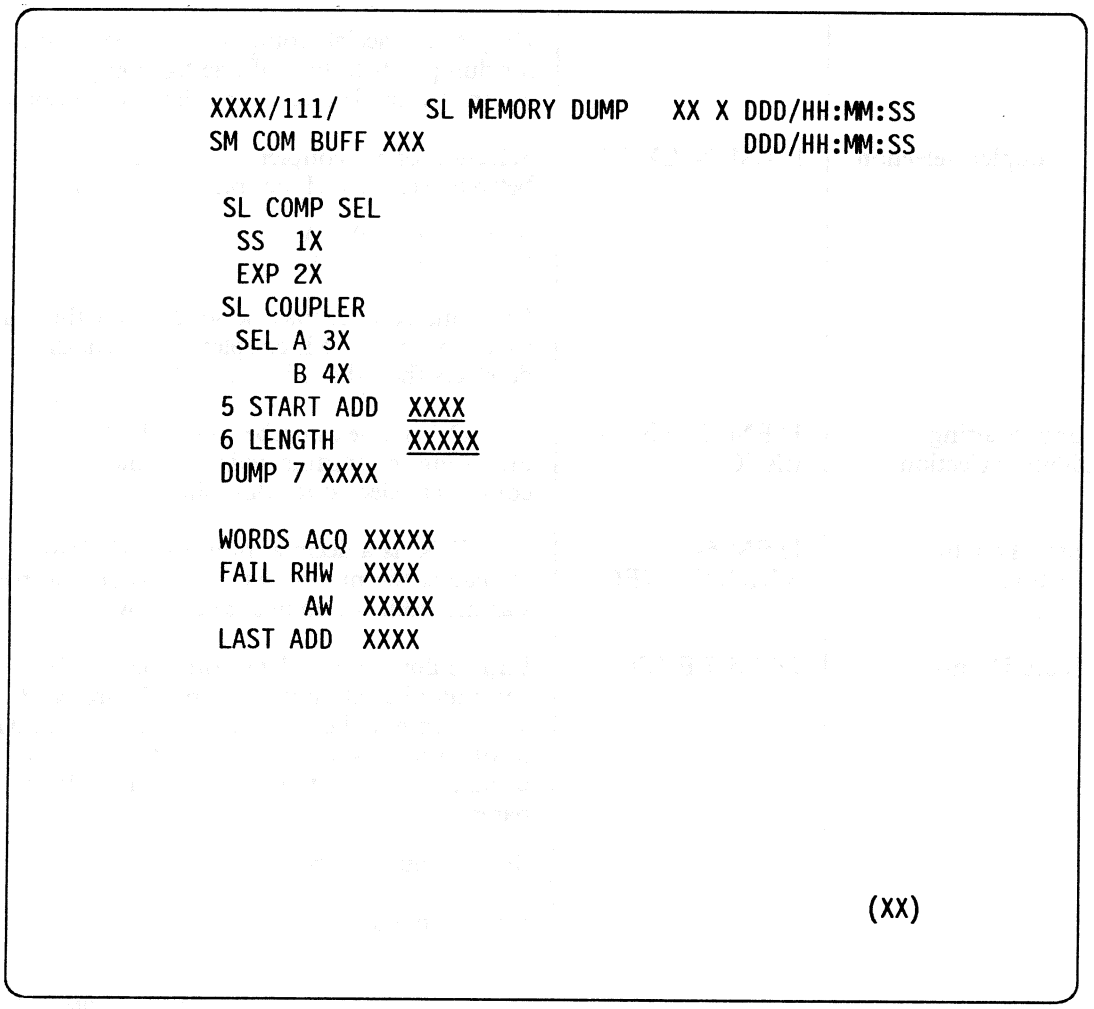


Figure 3.111

TABLE 3.111-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 111 PRO	The Spacelab Computer Memory Dump SPEC is available in OPS P9 only.
2	SL Computer Selection	ITEM N EXEC	Selection of Spacelab computer for dumping: N = 1: Subsystem computer (SSC) N = 2: Experiment computer (EXC) Only one spacelab computer may be selected for dump. (Selection of one SL computer automatically deselects the other SL computer.)
3	SL Coupler Selection	ITEM N EXEC	Selection of SL coupler for data transfer between selected SL coupler and the GPC. N = 3: Coupler A N = 4: Coupler B Only one coupler may be selected for the dump (selection of one SL coupler automatically deselects the other SL coupler).
4	Dump Starting Address Selection	ITEM 5+XXXX EXEC	'XXXX' is a hex number (0000-FFFF) indicating the starting address of the SL computer selected for dumping.
5	Dump Length Selection	ITEM 6+ XXXXX EXEC	'XXXXX' is a decimal number (1-16384) indicating the number of words to be dumped, starting from the address selected with ITEM 5.
6	Initiate Dump	ITEM 7 EXEC	Initiate dumping of data from selected SL computer based on item entries 1 through 6. This item may be entered prior to any ITEM 1 through 6 entries, and will result in a dump using the initialization (default) values for all parameters: SL Computer = SSC Coupler = A Start Address = 0 Length = 1 This item entry will be rejected as illegal if the (start address + length > 65536) or the SM common buffer is busy. NOTE: <u>All</u> item entries will be rejected as illegal whenever a status of 'LOAD' or 'DUMP' appears next to ITEM 7.

TABLE 3.111-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
7	Dump Status		Reflects current status of the dump in progress (after ITEM 7 EXEC): 'XXXX' = Blank - no dump since OPS transition. LOAD - data transfer from SL to GPC. DUMP - downlist processing. CPLT - successful - all data requested has been tranferred to the ground. FAIL - I/O error prevented transfer of all data requested, partial dump data may have been transferred.
8	Status at Dump Completion		WORDS ACQ XXXXX FAIL RHW XXXX AW XXXXX LAST ADD XXXX In case of failure, gives ground an indication of how much data was collected before the dump terminated (WORDS ACQ in decimal, LAST ADD in Hex) and displays in hex the Address Word (AW) and Response Header Word (RHW) of the failed I/O transaction.
9	SM Common Buffer Availability		SM COM BUFF: XXX = BSY or RDY based on the present status of the common buffer. ITEM 7 entry is illegal when the buffer is busy.

TABLE 3.111-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	SSC Computer Select				2	
2	EXC Computer Select				2	
3	Coupler A Select				3	
4	Coupler B Select				3	
5	Start Address	0000	FFFF	Hex	4	
6	Length	1	16384	Dec	5	
7	Dump Initiation				6	

3.5.112 DISPLAY: GPC/BTU I/F

–1 AVAILABILITY: SPEC 112 in OPS G9.

–2 PURPOSE: The GPC/BTU Interface display provides the capability to test the interfaces between a GPC and the Bus Terminal Units (BTUs) connected to it. Two levels of testing are available: Level 1 provides a basic wrap test between the GPC and selected BTUs; Level 2 provides a high resolution test of the selected BTUs as well as the wrap test.

```
XXXX/112/        GPC/BTU I/F      XX X DDD/HH:MM:SS
                                        DDD/HH:MM:SS
  BTU SELECTION     TEST STATUS
FF1 1X  PCMMU 12X          XXXX  MDM OUTPUT TEST
  2 2X  MMU1  13X  BTU ITEM XX       MODULE XX
  3 3X     2  14X  STEP XXXXXX
  4 4X  MEC1  15X  RDW     XXXX  ANALOG OUTPUTS
FA1 5X     2  16X  BCE STAT RG    0 ±X.XX  1 ±X.XX
  2 6X  EIU1  17X     XXXXXXXX    2 ±X.XX  3 ±X.XX
  3 7X     2  18X                 4 ±X.XX  5 ±X.XX
  4 8X     3  19X PORT SEL 1 31X  6 ±X.XX  7 ±X.XX
PF1 9X  DDU   20X           2 32X 8 ±X.XX  9 ±X.XX
  2 10X MCIU  21X                10 ±X.XX 11 ±X.XX
        CMD   22X                12 ±X.XX 13 ±X.XX
        SRB   23X                14 ±X.XX 15 ±X.XX
ALL      DES
MDMS 11X  ALL   24X              DISCRETE OUTPUTS
                                 CHANNEL 0  XXXXXX
        LEVEL 1    25X           CHANNEL 1  XXXXXX
TEST    LEVEL 2    26X           CHANNEL 2  XXXXXX
        MDM OUTPUT 27X
CONTROL TERMINATE  28
        CONTINUE   29          BTU CYCLIC BITE 30X

                                                (XX)
```

Figure 3.112

TABLE 3.112-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 112 PRO	The GPC/BTU I/F display is available in redundant set in OPS G9 with the exception of the PCMMU test which is executed with GPC in SIMPLEX.
2	Bus Terminal Unit Selection	ITEM N EXEC	Select BTUs to be tested (N = 1-10, 12-23). (41008)(41533)
		ITEM 11 EXEC	Select all MDMs.
		ITEM 24 EXEC	Deselect all BTUs. NOTE: a. No non-MDM BTU may be selected if any MDM is selected. b. Only one non-MDM BTU may be selected at a time. c. ITEM 11, when input, will deselect any non-MDM selected. d. No change may be made when a test is in progress or suspended.
3	Port Selection	ITEM 31 EXEC	Select port 1 of BTU(s) being tested.
		ITEM 32 EXEC	Select port 2 of BTU(s) being tested (mutually exclusive ITEMs).
4	Test Controls	ITEM 25 EXEC	Initiate level 1 test.
		ITEM 26 EXEC	Initiate level 2 test.
		ITEM 27 EXEC	Initiate MDM output test. (30072) NOTE: When test is initiated, TEST STATUS on display is driven to ACT. If an error causes the test to be suspended the STEP, RDW, and (possibly) BCE STAT REG are displayed. Normal completion sets TEST STATUS = CPLT.
		ITEM 29 EXEC	Optional - required only if test is suspended. Resume test which was suspended (illegal otherwise). Upon entry, STEP, RDW and BCE STAT REG are blanked.

TABLE 3.112-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 28 EXEC	Optional - Terminate test which is in progress or suspended (illegal otherwise). TEST STATUS = CPLT; other data blanked. NOTE: The user should refer to requirements document SS-P-0002-550, Section 4.2 for detailed data which may be displayed for various LRUs/steps, etc.
5	BTU Cyclic BITE Read	ITEM 30 EXEC	This is a flip/flop switch. Upon first entry, a cyclic read at a 1.92 sec rate of all MDM BITEs is initiated. Data is downlisted at 1 HZ rate. Reads continue until terminated by ITEM 30 again, or an OPS transition is initiated.

TABLE 3.112-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select FF1 MDM				2	Selection of any MDM for Level 2 test with any IMU in other than STANDBY will result in an ILLEGAL ENTRY message.
2	Select FF2 MDM				2	
3	Select FF3 MDM				2	
4	Select FF4 MDM				2	
5	Select FA1 MDM				2	
6	Select FA2 MDM				2	
7	Select FA3 MDM				2	
8	Select FA4 MDM				2	
9	Select PF1 MDM				2	
10	Select PF2 MDM				2	
11	Select all MDMs				2	
12	Select PCMMU				2	Selection of PCMMU for test will result in an ILLEGAL ENTRY message if GPCs are other than SIMPLEX.
13	Select MMU1				2	
14	Select MMU2				2	
15	Select MEC1				2	
16	Select MEC2				2	
17	Select EIU 1				2	
18	Select EIU 2				2	
19	Select EIU 3				2	
20	Select DDU				2	
21	Select MCIU				2	
22	Select CMD				2	
23	Select SRB				2	
24	Deselect all BTUs				2	
25	Initiate Level 1 Test				4	
26	Initiate Level 2 Test				4	

TABLE 3.112-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
27	Initiate MDM Output Test				4	
28	Terminate Test				4	Valid only if test is suspended.
29	Continue Test				4	Valid only if test is suspended.
30	Initiate BTU Cyclic BITE				5	
31	Select Port 1 of BTUs				3	
32	Select Port 2 of BTUs				3	

3.5.113 DISPLAY: ACTUATOR CONTROL

–1 AVAILABILITY: SPEC 113 in OPS G9.

–2 PURPOSE: The Actuator Control display provides control and monitoring of the positioning of an aerosurface, SSME, OMS, and body flap actuators by utilizing the capabilities of the ramp function generator (RFG) and body flap drive (BFD) functions. It also supports initiation and termination of all actuator initialization (AI) modes and the body flap monitor (BFM) avoidance and interference checks; the inhibiting of OMS power discrete parameter output; the selective replacement of position limit values for SRB, elevon, and speedbrake actuators; the selective inhibiting of RFG and FRT collision avoidance and interference checks; the limiting of the multiple actuator test (MAT) plateau segment duration and modification of the RFG rate limit.

```
 XXXX/113/     ACTUATOR CONTROL  XX X DDD/HH:MM:SS
   MONITOR            FAIL           DDD/HH:MM:SS
  CMD     POS  ACT     A B C D  ACTUATOR GIMBALING
±XX.XX ±XX.XX  SB  1X S S S S RATE 29 XX.XX DEG/SEC
±XX.XX ±XX.XX RUD  2X S S S S FIN POS 30 ±XX.XX DEG
±XX.XX ±XX.XX LIE  3X S S S S START 31XXX  STOP 32X
±XX.XX ±XX.XX RIE  4X S S S S           STATUS XXXX
±XX.XX ±XX.XX LOE  5X S S S S  HYD PR  ECP ERR XXX
±XX.XX ±XX.XX ROE  6X S S S S   1 XXXX   BF MON 33X
±XX.XX ±XX.XX  1P  7X S S S S   2 XXXX
±XX.XX ±XX.XX  1Y  8X S S S S   3 XXXX
±XX.XX ±XX.XX  2P  9X S S S S         AI SRB/NW 34X
±XX.XX ±XX.XX  2Y 10X S S S S ME ISO V
±XX.XX ±XX.XX  3P 11X S S S S 1X 2X 3X  FC LIM CHNG
±XX.XX ±XX.XX  3Y 12X S S S S           R/SB MAT 35X
±XX.XX ±XX.XX RPA 13X                R/SB RFG/FRT 36X
±XX.XX ±XX.XX RPS 14X  AI MODES        MAT P 40MS 37X
±XX.XX ±XX.XX RYA 15X 0 SAFE 22 X      NOP CA RFG 38X
±XX.XX ±XX.XX RYS 16X 1 MDM  23 X      NOP CA FRT 39X
±XX.XX ±XX.XX LPA 17X 2 FERY 24 X         NOP OMS 40X
±XX.XX ±XX.XX LPS 18X 3 RAIN 25 X     SRB S/S LIM 41X
±XX.XX ±XX.XX LYA 19X 4 GRAV 26 X      EL POS LIM 42X
±XX.XX ±XX.XX LYS 20X 5 NULL 27 X     S/B POS LIM 43X
 XX    ±XX.XX  BF 21X 6 TURN 28 X R RATE .5 PCM 44X
                                              (XX)
```

Figure 3.113

TABLE 3.113-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	SPEC Call-Up	SPEC 113 PRO	Display of command position data will be blanked if AI mode has not previously executed in OPS G9.
2	Actuator Select	ITEM N EXEC	Select actuator (N = 1 through 21) for positioning and enable item status. Actuator selection will cause rate, final position and actuator direction of movement display fields to be blanked and will deselect any previously selected actuator or AI mode. Attempting to select an actuator while actuator positioning is in progress or AI is executing will result in an ILLEGAL ENTRY message. Displayed data: The commanded and actual (feedback) positions for each actuator are displayed in degrees to the left of actuator item select. Status of feedback I/O channels for aerosurface and SSME actuators is displayed to the right of the actuator item select. I/O channel status: 1. Blank for good Feedback data. 2. Down arrow for hardware channel failure. 3. Character M for commfault (missing data). The last valid position will be displayed for an actuator if no valid feedbacks are available. The CMD position for Body Flap indicates the commanded deflection: UP, DN, or Blank (no drive).
3	Select AI mode	ITEM N EXEC	Select actuator initialization (AI) mode (N = 22 through 28), start the AI function and enable item status. N = 22: Select AI Mode 0, initial position for all applicable actuators. N = 23: Select AI Mode 1, MDM preconditioning option for all applicable actuators. N = 24: Select AI Mode 2, ferry position for all applicable actuators. N = 25: Select AI Mode 3, rain position for all applicable actuators.

TABLE 3.113-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			N = 26: Select AI Mode 4, gravity position for all applicable actuators. N = 27: Select AI Mode 5, null position for all applicable actuators. N = 28: Select AI Mode 6, turn around position for all applicable actuators. ECP ERR will be blank when an AI mode is initially selected. All item entries except ITEM 33 will result in an ILLEGAL ENTRY message when SPEC initiated AI is executing. AI Mode selection will blank actuator direction of movement display and deselect any previously selected actuator or AI mode. NOTE: Items 1 through 28 are mutually exclusive.
4	Actuator Rate Select	ITEM 29 + XX.XX EXEC	Rate in deg/sec of actuator movement for the selected actuator. Entry is ignored when either OMS or Body Flap actuators are selected for positioning. Entry without an actuator selected for positioning results in an ILLEGAL ENTRY message. Input data range is + 00.00 to + 99.99.
5	Actuator Final Position Select	ITEM 30 ± XX.XX EXEC	Final position in degrees for the selected actuator. Entry of data which would cause overflow of the Ramp Function Generator (RFG) ECP call operator final value field will result in this call operator field set to its maximum positive/negative value. Input data range is −99.99 to + 99.99. Entry without an actuator selected for positioning will result in an ILLEGAL ENTRY message.

TABLE 3.113-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
6	Start Actuator Positioning	ITEM 31 EXEC	Entry will initiate positioning of the selected actuator, blank the ECP ERROR display and enable item status. Entry of ITEM 31 with ITEM 32 (STOP) active, without an actuator selected, without final position entered or without rate (except OMS or Body Flap actuators) will result in an ILLEGAL ENTRY message. All item entries except ITEM's 32 and 33 will result in an ILLEGAL ENTRY when SPEC initiated actuator positioning is in progress. Displayed Data: Arrow(s) indicating aerosurface/engine direction of movement viewing the orbiter from the rear are displayed to the right of ITEM 31 status. Both left and right arrows (← →) indicate opening speedbrake; right and left arrows (→ ←) indicate closing speedbrake. The arrows are displayed after selection of a final position and prior to selection of ITEM 31. There is no direction of movement displayed during AI execution. The STATUS display indicates the state of the last request for actuator positioning or AI execution. 1. RUN is displayed when actuator positioning is in progress or AI is executing. 2. CPLT is displayed when actuator positioning or AI terminates normally. 3. STOP is displayed when actuator positioning or AI terminates abnormally. 4. BUSY is displayed when a request for actuator positioning or AI occurs while a non SPEC initiated mutually exclusive ECP is active. The SPEC request for actuator positioning or AI is ignored. Any ECP error code encountered during actuator positioning, AI execution or body flap monitor (SPEC and non SPEC initiated) is displayed in the ECP ERROR field.

TABLE 3.113-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
7	Stop Actuator Positioning	ITEM 32 EXEC	The first entry of ITEM 32 will cause movement of the selected actuator or AI mode to stop, enable status indicating stop active, and remove the ITEM 31 status. It will also inhibit entry of ITEMs 22-28 and 31 until a second entry of ITEM 32 is made. The second entry of ITEM 32 will enable ITEM 22-28 and 31 entries, blank the rate and final position fields, deselect the last actuator or AI mode and remove the ITEM 22-28 and 32 statuses. Entry of ITEM 32 without an active SPEC initiated actuator positioning process will result in an ILLEGAL ENTRY message.
8	Body Flap Monitor Select/Deselect	ITEM 33 EXEC	Entry will activate/deactivate execution of body flap monitor (BFM) function depending on the last state (active/inactive) of the BFM process. The item status is displayed when BFM is active.
9	SRB and Nosewheel Actuator Select/Deselect	ITEM 34 EXEC	The first entry of ITEM 34 causes SRB and nosewheel actuator MDMs to be commanded in AI modes 0 and 1 and enables item status. A second entry of ITEM 34 causes these actuator MDMs to be excluded from AI commanding and removes the item status.
10	Rudder/Speedbrake MAT Interference Bypass	ITEM 35 EXEC	The first entry of ITEM 35 causes rudder/speedbrake interference check to be bypassed in the MAT function and enables item status. A second entry of ITEM 35 enables the interference check and removes item status.
11	Rudder/Speedbrake RFG and FRT Interference Bypass	ITEM 36 EXEC	The first entry of ITEM 36 causes rudder/speedbrake interference check to be bypassed in the RFG and FRT functions and enables item status. A second entry of ITEM 36 enables the interference checks and removes item status.
12	40 msec MAT Plateau Select	ITEM 37 EXEC	The first entry of ITEM 37 causes MAT plateau duration to be set at 40 msec and enables item status. A second entry of ITEM 37 returns the plateau duration to its original value and removes item status.

TABLE 3.113-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
13	RFG Collision Avoidance Bypass	ITEM 38 EXEC	The first entry of ITEM 38 causes collision avoidance and SSME1/OMS pods clearance checks to be bypassed in the RFG functions and enable item status. A second entry of ITEM 38 enables these checks and removes the item status.
14	FRT Collision Avoidance Bypass	ITEM 39 EXEC	The first entry of ITEM 39 causes collision avoidance in the FRT function to be bypassed and enables item status. A second entry of ITEM 39 enables FRT collision avoidance checks and removes item status.
15	OMS Power Discretes Bypass	ITEM 40 EXEC	ITEM 40 inhibits output of the OMS power discretes by the actuator ECP functions and inhibits the resultant out of tolerance error codes from the AI function for OMS actuators. This item is initialized to the inhibit state during the OPS G9 initialization process and item status is enabled (*). An entry of ITEM 40 enables the output of OMS discretes, re-enables the AI function error processing and removes the item status.
16	SRB Software Stop Limits Select	ITEM 41 EXEC	The first entry of ITEM 41 causes the SRB software stop limits to replace the high and low position limits for SRB actuators and enables the item status. A second entry of ITEM 41 returns SRB limits to original values and removes item status.
17	Elevon High Position Limit Select	ITEM 42 EXEC	The first entry of ITEM 42 causes the elevon high position limits to be replaced and enables item status. A second entry of ITEM 42 returns these limits to their original values and removes the item status.
18	Speedbrake Low Position Limit Select	ITEM 43 EXEC	The first entry of ITEM 43 causes the speedbrake low position limit to be replaced and enables the item status. A second entry of ITEM 43 returns this limit to its original value and removes the item status.
19	0.5 PCM Counts RFG Rate Limit Select	ITEM 44 EXEC	The first entry of ITEM 44 causes the RFG function rate limit to be set at 0.5 PCM counts and enables the item status. A second entry of ITEM 44 returns RFG rate limit to its original value and removes the item status.

TABLE 3.113-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			Displayed data: The pressure in psia for hydraulic systems 1, 2, and 3 is displayed to the left of ITEM 33, body flap monitor select/deselect. The open/close position of the main engine (ME) isolation valves is displayed to the left of ITEM 34, SRB and nosewheel actuator select/deselect. A 'C' will be displayed after the number 1, 2 or 3 for each of the isolation valves that are in the closed position. A Blank is displayed after the number if the valve is in the open position. NOTE: Values displayed for CMD, POS, FAIL, ABCD, HYD PR 1 2 3, and ME ISO V 1 2 3 are updated cyclically at 2 Hz.

TABLE 3.113-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select Speedbrake Actuator				2	
2	Select Rudder Actuator				2	
3	Select LIE Actuator				2	
4	Select RIE Actuator				2	
5	Select LOE Actuator				2	
6	Select ROE Actuator				2	
7	Select SSME 1P Actuator				2	
8	Select SSME 1Y Actuator				2	
9	Select SSME 2P Actuator				2	
10	Select SSME 2Y Actuator				2	
11	Select SSME 3P Actuator				2	
12	Select SSME 3Y Actuator				2	
13	Select OMS RPA Actuator				2	
14	Select OMS RPS Actuator				2	
15	Select OMS RYA Actuator				2	
16	Select OMS RYS Actuator				2	
17	Select OMS LPA Actuator				2	
18	Select OMS LPS Actuator				2	
19	Select OMS LYA Actuator				2	

TABLE 3.113-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
20	Select OMS LYS Actuator				2	
21	Select Body Flap Actuator				2	All 3 Body Flap actuators selected.
22	Select and Start AI Mode 0				3	
23	Select and Start AI Mode 1				3	
24	Select and Start AI Mode 2				3	
25	Select and Start AI Mode 3				3	
26	Select and Start AI Mode 4				3	
27	Select and Start AI Mode 5				3	
28	Select and Start AI Mode 6				3	ITEMS 1 through 28 are mutually exclusive.
29	Actuator Rate Select	0.0	+99.99	deg/ sec	4	
30	Actuator Final Position Select	−99.99	+99.99	deg	5	
31	Start Actuator Positioning				6	
32	Stop Actuator/AI Positioning				7	
33	Body Flap Monitor Select/Deselect				8	
34	SRB and Nosewheel MDMs Select/Deselect				9	
35	Rudder/Speedbrake MAT Interference Bypass				10	

TABLE 3.113-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
36	Rudder/Speedbrake RFG and FRT Interference Bypass				11	
37	40 msec MAT Plateau Select				12	
38	RFG Collision Avoidance Bypass				13	
39	FRT Collision Avoidance Bypass				14	
40	OMS Power Discretes Bypass				15	
41	SRB Software Stop Limits Select				16	
	Active	−512	511	PCM		
	Inactive	−460	460	PCM		
42	Elevon High Position Limit Select				17	
	Active		511	PCM		
	Inactive		480	PCM		
43	Speedbrake Low Position Limit Select				18	
	Active	−512		PCM		
	Inactive	−344		PCM		
44	0.5 PCM Counts RFG Limit Select				19	

-3 NOTES:

-3.1 Termination of the SPEC function causes the following actions:

a. Uncompleted positioning of an individually selected actuator will be terminated. SPEC initiated BFD and RFG processes are cancelled.
b. The BFM and AI processes are unaffected by SPEC termination.

-3.2 The following display fields are blanked by SPEC termination:

a. ITEM status for items 1 through 21.
b. ITEM status for items 31 and 32
c. RATE
d. FINAL POSITION
e. Direction of Movement

-3.3 The following display fields are unaffected by SPEC initialization:

a. ITEM status for items 22 through 28
b. ITEM status for items 33 through 44
c. ECP ERROR
d. STATUS
e. CMD values
f. POSN values
g. FAIL status columns
h. HYD PR values
i. ME ISO V.

-3.4 If an actuator rate of 0.0 deg/sec is entered, the RFG will execute until cancelled by entry of ITEM 32, Test Control Supervisor (TCS) cancel operator, SPEC termination, or OPS transition.

-3.5 Items 35-44 inhibit normal FC limits and collision avoidance checks. Use of these items should be limited to those unique situations where inhibiting these built in limits and checks poses no danger of damage to the orbiter.

3.5.1011 DISPLAY: XXXXXX TRAJ

–1 AVAILABILITY: OPS G1 DISPLAY (MM101, 102, 103) and OPS G6 DISPLAY (MM601).

–2 PURPOSE: The XXXXXX TRAJ display provides the crew with trajectory and guidance information during ascent and manual aborts. The central plot displays range vs. altitude rate. At abort initiations, the mode selected (AOA, ATO, RTLS, TAL) is indicated as part of the title as follows:

XXXXXX Title	Major Mode
LAUNCH	MM101
AOA or ASCENT	MM102
ATO, TAL, or ASCENT	MM103
RTLS	MM601

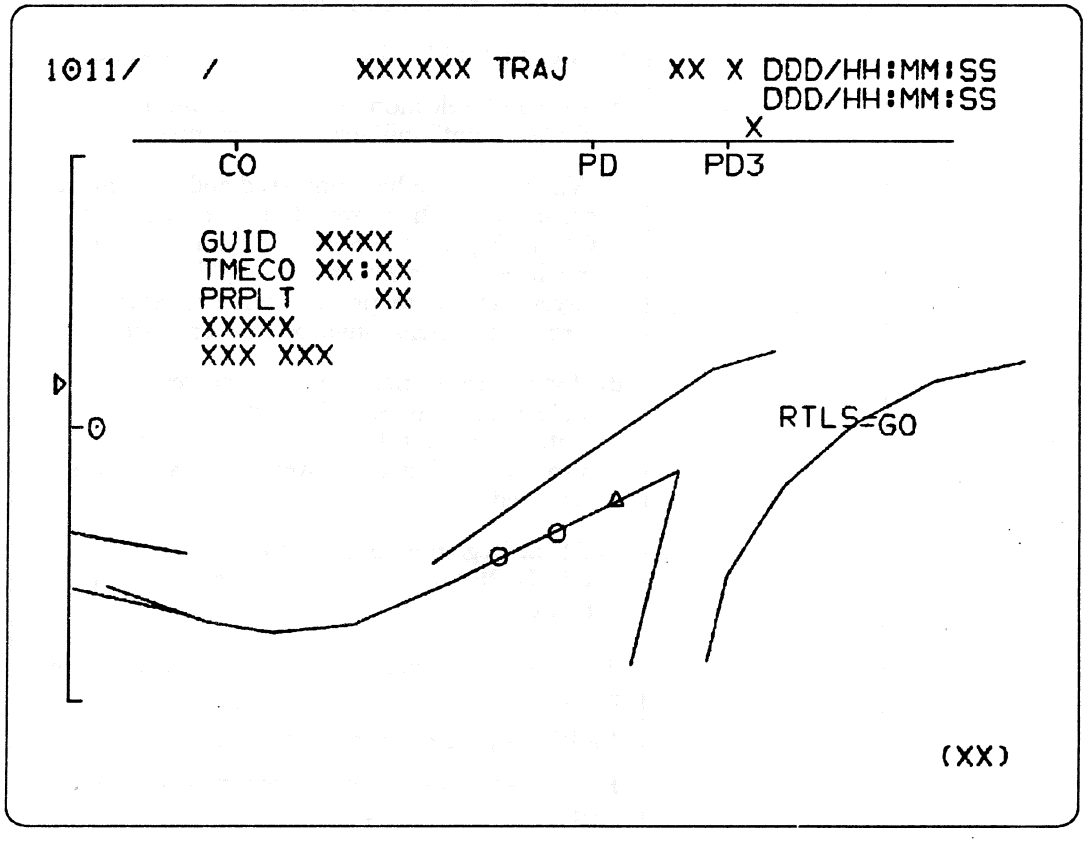


Figure 3.1011

TABLE 3.1011-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	OPS 101 PRO	This entry activates the LAUNCH TRAJ display. Thereafter, automatic mode transitions bring up Displays 1021, 1031, 6011. (37551) Display 6011 can also be brought up manually.
2	Display Data		In the upper left corner of the plot space are these entries: GUID - the value of the guidance status parameter (GUID) appears at RTLS selection (MM601). GUID provides an indication of the status of the guidance solution prior to powered pitcharound. The value of GUID is blank, a mnemonic or a 3 digit integer. a) Prior to RTLS selection the field is blanked. b) At RTLS selection GUID INIT will be displayed until initialization is complete. c) When guidance has converged and the vehicle progresses to the powered pitcharound point, GUID displays the percent deviation of the predicted final mass from the RTLS mass target. This numeric value will decrement to zero as the pitcharound point is approached. d) If guidance is unconverged or powered pitcharound has been delayed due to an attitude violation GUID INHB will be displayed to indicate powered pitcharound is inhibited. e) At the beginning of powered pitcharound GUID PPA will be displayed and the field will be frozen. TMECO - predicted time of Main Engine Cutoff, in MET. PRPLT - propellant left in ET, in percent. PC < 50 - flashes double overbright when SRB chamber pressure is less than 50 psi. SEP INH - flashes double overbright a) in MM102, when SRB Auto SEP is inhibited; this occurs when RGA rates, or dynamic pressure ($\bar{q}$) exceed limits.

TABLE 3.1011-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			b) in MM103, when ET AUTO SEP is inhibited; this occurs if either the angle of attack (α) the side-slip angle (β), or RGA rotation rates exceed limits. In the upper right corner (X = 38,Y = 3) a double overbright flashing alpha "F" will be displayed when guidance enters the fine countdown mode during RTLS.
3	Axes of Graph		Horizontal axis - the scale across the top is Glide Range Potential (ΔR); this is the horizontal component of relative velocity, indicated by "∇." On this axis are vertical bars (tick marks), indicating where certain events are expected to occur: PD tickmark - nominal 2 engine RTLS powered pitchdown. PD 3 tickmark - pitchdown for a 3 engine RTLS. Vertical axis - the scale on the left side is the DELTA HDOT scale. This is the HDOT from navigation minus a reference HDOT, which yields a change in vertical velocity.
4	Plots		The central plot (curved line) is the RTLS abort trajectory (altitude (H) vs. the horizontal component of relative velocity). ATO and RTLS indicate abort regions. The following symbols indicate vehicles states: Δ - A moving, overbright triangle shows current vehicle state from navigation. 0 - 2 moving, overbright circles show the predicted vehicle states, 10 and 20 seconds in the future. 2 lines - 1 above and 1 below the central plot, are $\bar{q}$ constraints. Below the lower line, $\bar{q} > 10$ psf. Above the upper line, $\bar{q} < 2$ psf. These are ET separation constraints and are not mission dependent. ▶ - a moving overbright right pointing triangle, to the left of the DELTA HDOT scale represents current DELTA HDOT. This flashes if the value is off-scale. The right most curve is the nominal ascent profile.

TABLE 3.1011-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			The line to the left of the nominal ascent line is for the engine out at liftoff case.

3.5.1021 DISPLAY: XXXXXX TRAJ

–1 AVAILABILITY: OPS G1 DISPLAY for MM102.

–2 PURPOSE: This display is identical to that described for MM101, refer to section 3.5.1011-1. (45176)

3.5.1031 DISPLAY: XXXXXX TRAJ

–1 AVAILABILITY: OPS G1 DISPLAY for MM103. (40556)

–2 PURPOSE: This display is identical to that described for MM101, refer to page 3.5.1011-1. (45176)

3.5.1041 DISPLAY: XXXXX MANEUVER YYYYY

-1 AVAILABILITY: DISPLAY for GNC MM104, 105, 106, 202, 301, 302 and 303.

-2 PURPOSE: This display provides a means of entering maneuvers utilizing the OMS and RCS propulsion, evaluating their effects on the trajectory, and adjusting parameters, as necessary. It also assists the crew in maneuver setup, maneuver monitoring, and is used for trimming burn residuals when required. Selection of the active gimbal drive system and initiation of the automatic check of the active gimbal drive systems is also provided. Actual engine gimbal angle readouts are provided to monitor TVC operation and status.

-2.1 In Major Modes 104 and 105, the display provides the crew with the capability to declare an AOA or ATO abort as well as an override of the automatic target selection. The capability to change the type of abort desired is also provided. In MM105, the display provides the crew with an indication that the targeting for the AOA OMS 2 burn is complete by flashing 'OPS 301 PRO' in the body of the display. In OPS 3 only, it provides the crew the additional capability to execute and terminate: 1) a burnoff of forward RCS propellant for center-of-gravity control, and 2) the simultaneous motion of all aerosurfaces for hydraulic fluid thermal conditioning. In OPS 1 and 3, when guidance mode is PEG 4, or in OPS 2 when guidance mode is LAMBERT, the values of VGO_LVLH components are displayed for items 19-21.

-3 TITLE: The title of this display is partially dynamic due to the number of maneuvers it must support. For Major Mode 104, the following titles will be driven on the display:

OMS 1 MNVR EXEC
ATO 1 MNVR EXEC
AOA 1 MNVR EXEC

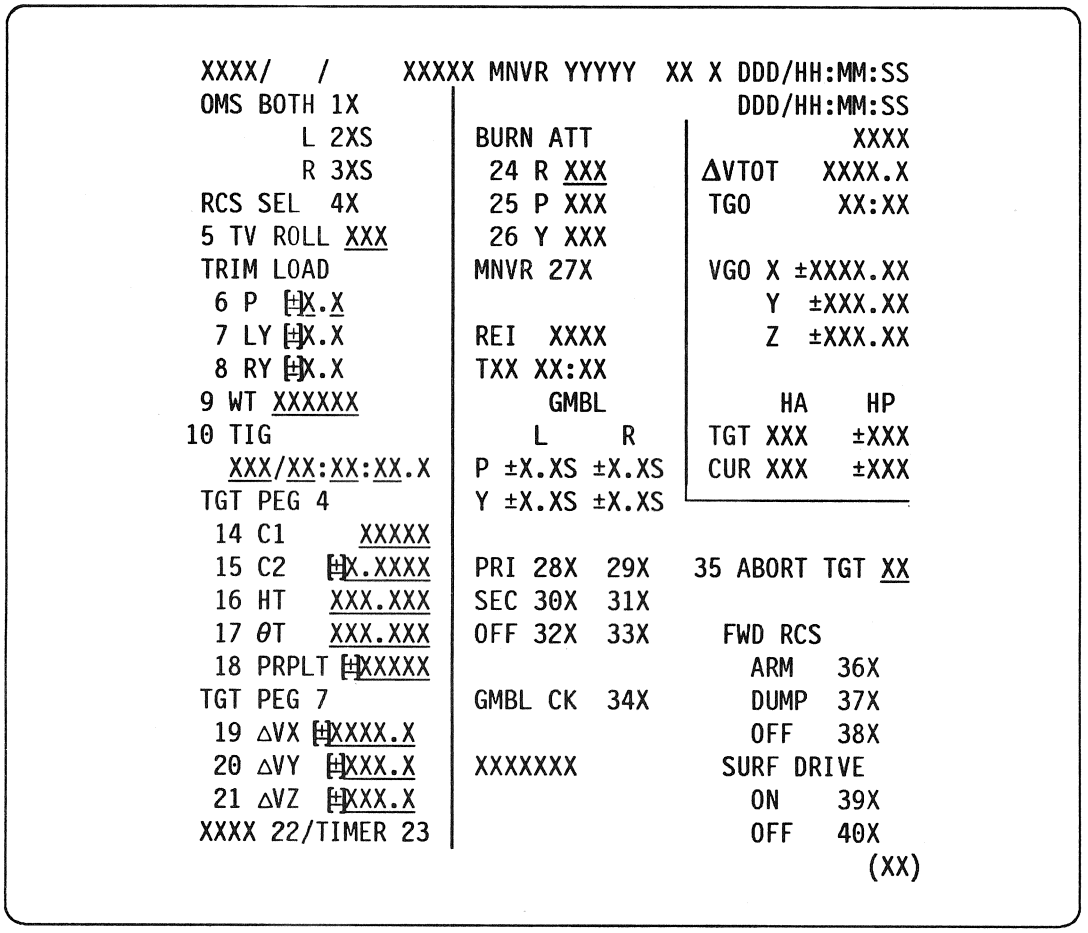


Figure 3.1041

TABLE 3.1041-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	OPS 104 PRO	Good only in MM103. (44206)
		OPS 105 PRO	Good only in MM104.
		OPS 106 PRO	Good only in MM105. (55121)
		OPS 202 PRO	Good only in MM201. (44206)
		OPS 301 PRO	Good only in OPS 0, MM104,105,106, 201,301,302,303,801. (44206)
		OPS 302 PRO	Good only in MM301.
		OPS 303 PRO	Good only in MM302.
2	Select Engines for Burn		A down arrow is displayed in the parameter status column when threshold for chamber pressure ΔV are exceeded. (37564)
		ITEM 1 EXEC	Selects both OMS. (55314)
		ITEM 2 EXEC	Selects left OMS.
		ITEM 3 EXEC	Selects right OMS.
		ITEM 4 EXEC	Selects RCS.
3	Desired TV Roll Angle	ITEM 5+XXX EXEC	The desired Local Roll Angle at Ignition (0=Heads Up).
4	Desired OMS Engine Trim Attitudes	ITEM 6±X.X EXEC	OMS Gimbal Pitch. (39371) (37564)
		ITEM 7±X.X EXEC	OMS Gimbal Left Yaw.
		ITEM 8±X.X EXEC	OMS Gimbal Right Yaw.
5	Orbiter Weight	ITEM 9+XXXXXX EXEC	Orbiter WT in lbs. (37593)(44892)
6	PEG4 Maneuver Targeting Information	ITEM 10+XXX EXEC	TIG days in MET. (37564) (37585) (41148)
		ITEM 11+XX EXEC	TIG hours in MET.
		ITEM 12+XX EXEC	TIG minutes in MET.

TABLE 3.1041-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 13+XX.X EXEC	TIG seconds in MET.
		ITEM 14+XXXXX EXEC	Desired intercept of target line.
		ITEM 15±X.XXXX EXEC	Desired slope of target line.
		ITEM 16+XXX.XXX EXEC	Desired target altitude.
		ITEM 17+XXX.XXX EXEC	Desired target angle.
7	Propellant to be Wasted and Direction	ITEM 18±XXXXX EXEC	Defines the total propellant to be used by deorbit maneuver. (45749)
8	PEG 7 Maneuver Targeting Information		In OPS 1 and 3, when guidance mode is PEG 4, or in OPS 2 when guidance mode is LAMBERT, the values of VGO_LVLH components are displayed for items 19-21.
		ITEM 19±XXXX.X EXEC	External target delta velocity in the X direction (local vertical). Initiates a guidance switch to PEG 7. (37564) (37585) (41148)
		ITEM 20±XXX.X EXEC	External target delta velocity in Y direction.
		ITEM 21±XXX.X EXEC	External target delta velocity in Z direction.
9	LOAD Maneuver Information, Premaneuver Targeting	ITEM 22 EXEC	Transfers engine selection trim data, vehicle weight and target data to guidance, performed automatically in MM104. (36176)(41148)
10	Start CRT Timer	ITEM 23 EXEC	Initiates CRT event timer for countdown to the loaded TIG in guidance. (37591)
11	Desired Roll, Pitch, and Yaw ADI Attitude	ITEM 24+XXX EXEC ITEM 25+XXX EXEC ITEM 26+XXX EXEC	The burn roll, pitch and yaw attitude computed by guidance is displayed cyclically upon execution of LOAD. A desired attitude may be entered prior to the execution of LOAD, or override the guidance computed burn attitude after execution of LOAD.

TABLE 3.1041-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
12	Initiate Automatic Maneuver to Desired Burn Attitude	ITEM 27 EXEC	An asterisk will appear during the maneuver. (55325)
13	OMS Gimbals Selection Controls	ITEM 28 EXEC	Select primary active gimbal drive system on left side.
		ITEM 29 EXEC	Select primary active gimbal drive system on right side.
		ITEM 30 EXEC	Select secondary active gimbal drive system on left side.
		ITEM 31 EXEC	Select secondary active gimbal drive system on right side.
		ITEM 32 EXEC	Remove power from the left OMS gimbal drive system.
		ITEM 33 EXEC	Remove power from the right OMS gimbal drive system. (14444) NOTES: a) PRI, SEC, and OFF are mutually exclusive; b) A down arrow will be driven next to pitch and yaw displays for an FDI gimbal actuator failure. A commfault will invoke a M which has priority over a down arrow.
14	Perform OMS Gimbal System Check	ITEM 34 EXEC	Initiates an automatic TVC check of the active gimbal drive systems in all major modes where display is available. (37561)
15	Select AOA or ATO Abort	ITEM 35 EXEC	NOTES: Illegal entry if: 1) Execution of Abort TGT Item except in MM104, MM105; 2) Entry of Abort TGT ID $\neq$ 1 or 3-5 in MM104; 3) Entry of Abort TGT ID $\neq$ 1-12 in MM105; 4) Entry of Abort TGT ID while OMS burn is enabled or in progress.
16	FRCS Fuel Dump Controls	ITEM 36 EXEC ITEM 37 EXEC ITEM 38 EXEC	Provides capability to arm, dump and turn off forward RCS propellant burnoff in OPS 3 only. NOTE: OFF is mutually exclusive with ARM and DUMP

TABLE 3.1041-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
17	Surf Drive Controls	ITEM 39 EXEC ITEM 40 EXEC	Provides simultaneous motion of all aerosurfaces in OPS 3 only. NOTE: Automatically turned off at MM304 transition.
18	Enable the OMS Burn	EXEC	A dynamic character field EXEC flashes at TIG −Z seconds. (46526)
19	Burn Data Information		ΔVTOT: Total delta velocity in feet per sec predicted for burn of target maneuver as displayed. TGO: Time to go is predicted burn time in (min:sec). VGO: Velocity to be gained by the maneuver in vehicle body axis components (fps). (14460) HA,HP: Apogee and perigee in nautical miles above spherical earth. TGT,CUR: Predicted post burn values of apogee and perigee. Current orbit apogee and perigee values.
20	Mission Milestones		REI: Orbiter range from 400K feet to target landing site in nautical miles. TXX where XX = TA,TP,TC,FF: OPS 1 and OPS 2 - time to next apsis in minutes (TTA - Time to Apogee; TTP = Time to Perigee; TTC = circular orbit and time value is blank). OPS 3 - TFF (Time of Free Fall) time to 400k feet (entry interface).

TABLE 3.1041-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select Both OMS				1	CGZB_MNVR_DISP_FLAGWD2$2 CGRB_INIT_OMS_ENGINE_FDI CGZV_PROP_SYS_IND_FLAG (OPS 3 only) (37564) (45749)
2	Select Left OMS				1	CGZB_MNVR_DISP_FLAGWD2$3 CGZV_PROP_SYS_IND_FLAG (OPS 3 only) (37564) (45749)
3	Select Right OMS				1	CGZB_MNVR_DISP_FLAGWD2$4 CGZV_PROP_SYS_IND_FLAG (OPS 3 only) (37564) (45749)
4	Select RCS				1	CGZB_MNVR_DISP_FLAGWD2$5 CGZV_PROP_SYS_IND_FLAG (OPS 3 only) (37564) (45749)
5	Enter TV Roll Angle	0	359	Deg	3	OPS 2 only
6	Enter OMS Pitch Trim	−9.9	+9.9	Deg	4	CGCV_OMS_PITCH_TRIM_HFE CGCV_OMS_PITCH_TRIM_MFE (37564) (45749)
7	Enter OMS Left Yaw Trim	−9.9	+9.9	Deg	4	CGCV_OMS_YAW_TRIM_HFE$1 CGCV_OMS_YAW_TRIM_MFE$1 (37564) (45749)
8	Enter OMS Right Yaw Trim	−9.9	+9.9	Deg	4	CGCV_OMS_YAW_TRIM_HFE$2 CGCV_OMS_YAW_TRIM_MFE$2 (37564) (45749)
9	Enter Orbiter Weight	100000	999999	LBS	5	CGZV_WEIGHT_DISP (45749)
10	Enter TIG Days	0	365	Days	6	CGZV_TIG_DAY_DISP (37564) (45749)
11	Enter TIG Hours	0	23	Hours	6	CGZV_TIG_HRS_DISP (37564) (45749)
12	Enter TIG Minutes	0	59	Min	6	CGZV_TIG_MIN_DISP (37564) (45749)
13	Enter TIG Seconds	0	59.9	Sec	6	CGZV_TIG_SEC_DISP (37564) (45749) (46526)
14	Enter Intercept of Target Line (C1)	0	99999	FPS	6	CGZV_TIG_INTERCEPT_DISP (45749)

TABLE 3.1041-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
15	Enter Slope of Target Line (C2)	−9.9999	+9.9999		6	CGZV_TGT_SLOPE_DISP (45749)
16	Enter Target Altitude	000.000	999.999	NM		CGZV_TGT_ATTITUDE_DISP (45749)
17	Enter Target Angle	0	359.9	Deg	6	CGZV_TGT_THETA_DISP (45749)
18	Enter PRPLT to be burned and Fuel Wasting Direction	−99999	+99999	LBS	7	CGZV_WEIGHT_OM2_TOBE_BURNED CGZV_FUEL_WASTING_DIRECTION CGZV_TGT_PRDLT_WT (45749)
19	Enter TGT External Delta Velocity in X Direction	−9999.9	+9999.9	FPS	8	CGZV_EXTERN_DELTA_V_DISP$1 (37564) (45749)
20	Enter TGT External Delta Velocity in Y Direction	−9999.9	+9999.9	FPS	8	CGZV_EXTERN_DELTA_V_DISP$2 (37564) (45749)
21	Enter TGT External Delta Velocity in Z Direction	−9999.9	+9999.9	FPS	8	CGZV_EXTERN_DELTA_V_DISP$3 (37564) (45749)
22	Perform Targeting for a Burn				9	CGZV_TIG_MFE CGZB_LOADFLASH CGGV_MASS_MFE (45749)
23	Start CRT Event Timer Countdown to TIG				10	CZ1_EVT_CONTROL$(2;16) ICC_CZ1V_EVT_ZERO_GMT2 CZ1V_EVT_ZERO_GMT$2 (45749) Automatic in MM104 (37591)
24	Enter Desired ADI Roll Attitude Angle	0	359	Deg	11	CGZV_VEH_ROLL OPS 301, 302, 303 (45749)

TABLE 3.1041-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
25	Enter Desired ADI Pitch Attitude Angle	0	359	Deg	11	CGZV_VEH_PITCH OPS 301, 302, 303 (45749)
26	Enter Desired ADI Pitch Attitude Angle	0	359	Deg	11	CGZV_VEH_YAW OPS 301, 302, 303 (45749)
27	Initiate Automatic Maneuver to Desired Attitude				12	(55325)
28	Select Primary Left OMS Gimbal Drive System				13	CGKV_L_OMS_CHAN CGZB_MNVR_DISP_FLAG2$9 CGRB_OMS_FDI_FLAGS_HFE$1 CGRB_OMS_FDI_FLAGS_HFE$2
29	Select Primary Right OMS Gimbal Drive System				13	CGKV_R_OMS_CHAN CGZB_MNVR_DISP_FLAG2$12 CGRB_OMS_FDI_FLAGS_HFE$3 CGRB_OMS_FDI_FLAGS_HFE$4
30	Select Secondary Left OMS Gimbal Drive System				13	CGKV_L_OMS_CHAN CGZB_MNVR_DISP_FLAG2$10 CGRB_OMS_FDI_FLAGS_HFE$1 CGRB_OMS_FDI_FLAGS_HFE$2
31	Select Secondary Right OMS Gimbal Drive System				13	CGKV_R_OMS_CHAN CGZB_MNVR_DISP_FLAG2$13 CGRB_OMS_FDI_FLAGS_HFE$3 CGRB_OMS_FDI_FLAGS_HFE$4
32	Power Down Left OMS Gimbal Drive System				14	CGKV_L_OMS_CHAN CGZB_MNVR_DISP_FLAG2$11
33	Power Down Right OMS Gimbal Drive System				14	CGKV_R_OMS_CHAN CGZB_MNVR_DISP_FLAG2$14

TABLE 3.1041-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
34	Perform TVC Check of Active Gimbal Drive Systems				14	CGKB_OMSDRIVE CGCB_MC16238_FLAG_1$8
35	Select AOA or ATO Abort				15	(45749)
36	Arm Forward RCS Propellant Burnoff				16	CGZB_RCS_ARM CGZB_RCS_OFF (45749)
37	Initiate Forward RCS Propellant				16	CGZB_RCS_DUMP CGCB_NOSE_DUMP (45749)
38	Terminate Forward RCS Propellant				16	CGZB_RCS_OFF CGZB_RCS_ARM CGZB_RCS_DUMP CGZB_NOSE_DUMP (45749)
39	Initiate Surface Drive Function				17	CGZB_SURF_DRIVE
40	Terminate Surface Drive Function				17	CGZB_SURF_DRIVE CGRB_RM_FLAG1$1 CGRB_RM_FLAG1$2 CGRB_RM_FLAG1$3 CGCV_BF_DEF_CMD CGEB_HFE_DTU_FLAG_HFE

–4 SUBNOTES:

–1 Maneuver display responses to target loads. (37573)
–2 OMS TVC feedback reinitialized on OPS transition. (37123)
–3 Uplinked bad engine IDs are not ignored on CRT. (38163)
–4 Weight initialization required for in-flight IPL. (41148)
–5 Some values of TIG seconds displayed as "60.0". (52759)
–6 Illegal entry on transition to MM104. (40556)
–7 Orbit OPS transition or mode recall during attitude maneuver. (57385)

3.5.1051 DISPLAY: XXXXX MANEUVER YYYYY

-1 This display is defined in section 3.5.1041 (53428)

-2 For Major Mode 105, the following titles will be driven on the display:

OMS 2 MNVR EXEC
ATO 2 MNVR EXEC
AOA MNVR TRANS

3.5.1061 DISPLAY: XXXXX MANEUVER YYYYY

-1 This display is defined in section 3.5.1041.

-2 For Major Mode 106, the following titles will be driven on the display:

OMS 2 MNVR COAST
ATO 2 MNVR COAST

3.5.2011(G) DISPLAY: UNIV PTG

–1 AVAILABILITY: OPS Mode Display in OPS G2, MM 201.

–2 PURPOSE: The Universal Pointing display provides the crew with the capability to monitor orbit and vehicle attitude data, to command automatic attitude control through four different options. The four control options are: Maneuver, Track, Rotate, and Cancel.

```
2011/   /          UNIV PTG       XX X DDD/HH:MM:SS
  CUR MNVR COMPL XX:XX:XX                DDD/HH:MM:SS
 1 START TIME XXX/XX:XX:XX
                                  CUR FUT
MNVR OPTION     START MNVR 18 X   X
 5 R XXX.XX           TRK  19 X   X
 6 P XXX.XX           ROT  20 X   X
 7 Y XXX.XX          CNCL  21

TRK/ROT OPTIONS     ATT MON
 8 TGT ID XXX        22 MON AXIS X XX
                     ERR TOT 23X
 9  RA   XXX.XXX     ERR DAP 24X
 10 DEC  ±XX.XXX
 11 LAT  ±XX.XXX           ROLL    PITCH     YAW
 12 LON ±XXX.XXX     CUR   XXX.XX  XXX.XX  XXX.XX
 13 ALT ±XXXXX.X     REQD  XXX.XX  XXX.XX  XXX.XX
                     ERR  ±XXX.XX ±XXX.XX ±XXX.XX
 14 BODY VECT X      RATE ±XX.XXX ±XX.XXX ±XX.XXX

 15 P  XXX.XX
 16 Y  XXX.XX
 17 OM XXX.XX

                                                (XX)
```

Figure 3.2011(G)

TABLE 3.2011(G)-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	OPS 201 PRO	Entered on KYBD, this command causes transition to OPS G2, MM 201, if the major function switch is in the GNC position.
2	Estimated time of Completion of Current Maneuver		CUR MNVR COMPL: This data shows in hours, minutes, and seconds of MET the estimated time of completion of the current maneuver, track, or rotation option. The time displayed will be frozen whenever the attitude comes within 1.1 times the DAP attitude deadband about the desired attitude, or DAP LVLH mode is selected while a maneuver is in progress. If no maneuver is in progress at the time of CNCL or DAP MAN or LVLH selection, MNVR COMPL time reflects the completion time of the last selected option. If a maneuver is in progress at the time of CNCL selection, MNVR CMPL time will be zeroed.
3	Start-Up Time	ITEM X+NNN EXEC	X = 1-4, NNN = the starting time in MET, for days:hours:minutes:seconds, respectively. The selected attitude control option will start at the time displayed, if the on-orbit DAP is in the automatic mode. If displayed time is in the past, an option will start as soon as it is selected.
4	Option Selection		The four attitude control options are mutually exclusive. The first 3 move the vehicle according to data input by the crew through this display; the 4th (CNCL) is an attitude hold.
		ITEM 18 EXEC	START MNVR: Allows the crew to maneuver the vehicle to the inertial attitude specified by items 5 thru 7.
		ITEM 19 EXEC	TRK: Allows the crew to point the Orbiter body vector specified by items 14 thru 17 to the target specified by Item 8.
		ITEM 20 EXEC	ROT: Allows rotation of the Orbiter about the body vector specified by items 14 thru 16 at the DAP rate specified by Spec 20.

TABLE 3.2011(G)-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 21 EXEC	CNCL: Causes deselection of any other option, and attitude hold about the attitude existing at the time this item was selected. Choice of this option also deselects any future option. The first time this display comes up, Item 21 will be selected automatically. The MNVR, ROT or TRK option will be initiated only if the DAP is in AUTO mode, and the START TIME (Item 1) keyed in for the maneuver has been achieved. If the start time is current or in the past, the option will be initiated and an asterisk (*) will appear next to that option's Item number under the current (CUR) column. If the option start time is in the future, an asterisk will appear next to the option's Item number under the Future (FUT) column, and the option will be initialized when the start time specified is attained. At that time, the asterisk under FUT will disappear, and another will appear under CUR, for that option. When an option start time is within 30 seconds of current time, and orbit DAP AUTO is not selected, a class 3 alert, and SEL AUTO CRT message will be generated. When one option is under way, data for a future option may also be entered. When time for the future option is then attained, the current option will be deselected. When data for future option is changed after that option has been selected, the option will be deselected. To execute this future option, it must then be reselected.
5	Desired Attitude for Maneuver	ITEM Y+XXX.XX EXEC	Y = 5, 6, or 7: Selects the roll (R), pitch (P), yaw (Y), respectively, of the desired final inertial attitude of the vehicle in degrees (deg). These items are initialized to zero.

TABLE 3.2011(G)-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
6	Tracking & Rotation Option Data		TRK/ROT OPTIONS: Data is input to support the various TRK and ROT options.
7	Target ID	ITEM 8+XXX EXEC	Select the TGT ID for a tracking option. This item is initialized to 2 (Center of the Earth). (53101) ID=1 - Orbiting Vehicle. LOS to another orbiting vehicle is determined from state vectors of the 2 vehicles; used for TRK. ID=2 - Center of the Earth. LOS is defined by the Orbiter state vector in Earth-centered coordinates for local attitude holds. ID=3 - Earth Relative. Target LOS is determined from latitude (LAT), longitude (LON), and altitude (ALT) from Fisher Ellipsoid. ID=4 - Center of Sun LOS is defined by a polar ephemeris maintained by NAV. ID=5 - Celestial Target. LOS is determined from right ascension (RA) and declination (DEC), for attitude holds. ID=6 to 10 - Unassigned. ID=11 to 110 - Navigation. Star LOS is obtained from the navigation star table for any of 100 stars therein.
8	Angles to a Celestial Target	ITEM 9+ XXX.XXX EXEC ITEM 10 ± XX.XXX EXEC	RA, right ascension and, DEC, declination are defined in degrees in mean-of-50, to the target. RA and DEC are displayed for NAV stars as well as celestial targets. RA and DEC for IDs 11-110 will come from the NAV star tables, and attempting to write in for these TGTs will result in an ILLEGAL ENTRY message. When TGT ID of 5 is entered, RA and DEC will flash until the data is entered, a control option selection is made or until the TGT ID is changed.

TABLE 3.2011(G)-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
9	Coordinates of an Earth-relative Target	ITEM 11± XX.XXX EXEC ITEM 12± XXX.XXX EXEC ITEM 13± XXXXX.X EXEC	LAT (latitude), LON (longitude), and ALT (altitude), measured with respect to the Fisher ellipsoid, are the input parameters which locate an Earth-relative target (TGT ID = 3). When this ID is input, these 3 parameters flash until the data is loaded, a control option selection is made or the TGT ID is changed. These data are initialized to zeroes.
10	Body Vector for Vehicle Pointing	ITEM 14 + X EXEC	Select a pointing vector for TRK, or an axis of rotation for ROT. The BODY VECT IDs are listed in Table 3.2011-3. Is initialized to 1 (+X axis).
11	Selectable Body Pointing Vector Components	ITEM 15+ XXX.XX EXEC ITEM 16+ XXX.XX EXEC	P (pitch), and Y (yaw), in degrees, are the components of the selectable BODY VECTOR (ID = 5) for ITEM 14. Entering ITEM 14 + 5 causes P and Y to flash until the data is entered, the BODY VECT ID is changed, or a new control option is entered. These data are initialized to zeroes.
12	Orbiter Orientation about the Pointing Vector	ITEM 17+ XXX.XX EXEC	OM (omicron) is the angle for 3 axis tracking (TRK). Omicron is the angle between two planes. These planes are formed by the negative angular momentum vector and the Orbiter to target vector, and that formed by the +Y axis and body pointing vector. OM flashes if 3-axis tracking is selected and a BODY VECT ID is entered, until the data is entered or the control option selection is made. OM is initialized to zero.
13	Attitude Monitor Control		Controls the kind of attitude data presented in the attitude data matrix.
		ITEM 22+X EXEC	Select the attitude axis for which data will be displayed. Choices are: 1 - Present data relative to the standard Orbiter body axis. Display +X next to the 1 input. 2 - Present data relative to an axis rotated 180° about the Z Orbiter body axis (i.e., about −X). Display −X right of the input. Initialized with 1 +X as the data displayed.
		ITEM 23 EXEC	ERR TOT, total attitude error.

TABLE 3.2011(G)-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
14	Displayed Attitude Parameters Matrix	ITEM 24 EXEC	ERR DAP, digital auto pilot attitude error. These selections are mutually exclusive. The choice selected is indicated by an '&'. The selected error drives the ADI. Total attitude errors are obtained by differencing the current and required attitudes, with respect to the eigen axis. The DAP attitude error is obtained by differencing the DAP desired and the DAP estimated current attitudes. (15194) Four functions of ROLL, PITCH, and YAW (the column headings) are displayed. (58926) The Current (CUR) and required (REQD) attitudes are displayed. ADI inertial Euler angles Attitude Errors (ERR) are described in the previous function number. Attitude rates (RATE) are obtained from the DAP state estimator.

TABLE 3.2011(G)-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
	MNVR OPTION START TIME:			3		
1	days	0	365			CGZV_UP_START_TIME.D_H_M_S$1
2	hours	0	23			CGZV_UP_START_TIME.D_H_M_S$2
3	minutes	0	59			CGZV_UP_START_TIME.D_H_M_S$3
4	seconds	0	59			CGZV_UP_START_TIME.D_H_M_S$4
5	MNVR Roll Angle	0	359.99	deg	5	CGZV_AUTO_ATT_ANGLES$1
6	MNVR Pitch Angle	0	359.99	deg	5	CGZV_AUTO_ATT_ANGLES$2
7	MNVR Yaw Angle	0	90.00	deg	5	CGZV_AUTO_ATT_ANGLES$3
8	TGT ID	1	110		7	CGZV_TGT_ID ID's 6-10 are unassigned.
9	Right Ascension	0	359.999	deg	8	CGZV_RA_DEC$1
10	Declination	−90	+90	deg	8	CGZV_RA_DEC$2
11	Latitude	−90	+90	deg	9	CGZV_LAT_LON_ALT$1
12	Longitude	−180	+180	deg	9	CGZV_LAT_LON_ALT$2
13	Altitude	−3444	20000	nm	9	CGZV_LAT_LON_ALT$3 Measured from the Fisher ellipsoid rather than the actual Earth's surface, the altitude may be minus.
14	Body Vector	1	5		10	CGZV_BV_ID
15	Body Pitch	0	359.99	deg	11	CGZV_AUTO_ATT_ANGLES$4
16	Body Yaw	0, 270	90, 359.99	deg	11	CGZV_AUTO_ATT_ANGLES$5
17	Omicron	0	359.99	deg	12	CGZV_AUTO_ATT_ANGLES$6
18	MNVR				4	CGZV_FUT_OPT_Y
19	TRK				4	CGZV_FUT_OPT_Y
20	ROT				4	CGZV_FUT_OPT_Y
21	CNCL				4	CGZV_CUR_OPT_Y
22	Axis Monitor Indicator	1	2		13	CGZV_MON_AXIS
23	Total Attitude Error				13	CGZV_28_FLAG_WD1$1
24	DAP Attitude Error				13	CGZV_28_FLAG_WD1$1

TABLE 3.2011(G)-3. BODY VECTOR ID'S

Body Vector ID's	Axis
1	+X
2	−X
3	−Z
4	Passive Thermal Control.
5	Selectable, in ITEMs 15, 16, (and possibly 17).

3.5.2011(S) DISPLAY: ANTENNA

–1 AVAILABILITY: OPS Mode Display in OPS SM2/4, MM201/401.

–2 PURPOSE: The Antenna Management display provides control of the GPC automatic antennna management sequence for the S-Band and KU-Band antenna systems. It also provides a means of monitoring the antenna systems and their associated electronics.

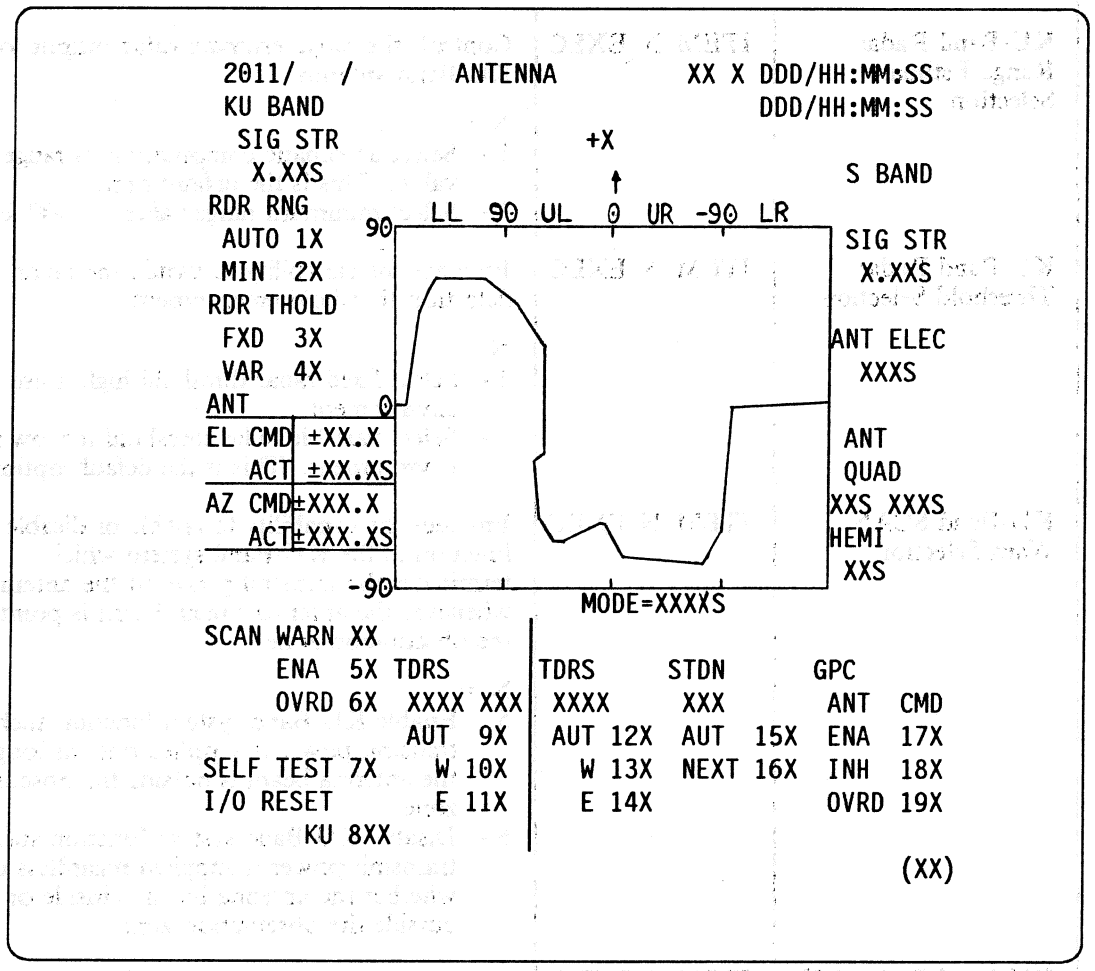


Figure 3.2011(S)

TABLE 3.2011(S)-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	OPS 201 PRO OPS 401 PRO	Entered on an MCDS with major function in SM. (55343)
2	KU-Band Radar Range Estimate Selection	ITEM N EXEC	Controls the range estimate value output to the KU-Band antenna. N = 1 - Select automatic computation of range value. This is the default option. 2 - Select minimum range value of 2400 feet.
3	KU-Band Radar Threshold Selection	ITEM N EXEC	Provides the capability to switch the radar detection threshold environment. N = 3 - Select fixed radar threshold high noise environment. 4 - Select variable radar threshold for low noise environment. This is the default option.
4	KU-Band SCAN Warn Selection	ITEM N EXEC	Provides the capability to enable or disable a function in the KU-Band system which terminates the transmit power to the antenna whenever the antenna's main beam is pointed at the obscuration zone. N = 5 - Enable KU-Band system function such that transmit power is supplied only as long as the antenna beam is outside the obscuration zone. 6 - Disable KU-Band system function such that tramsmit power is supplied regardless of whether the antenna beam is inside or outside the obscuration zone.
5	KU-Band Radar Self Test	ITEM 7 EXEC	Provides the capability to initiate or terminate the radar self test function.
6	I/O Reset KU	ITEM 8 EXEC	Provide the capability to initiate communication between the GPC and the KU-Band system.

TABLE 3.2011(S)-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
7	KU-Band TDRS Selection	ITEM N EXEC	Select TDRS for use with KU-Band: N = 9 - Use AM (Automatic Antenna Management) to select the proper TDRS for antenna pointing and acquisition. TDRS West will be tried first, and if in view, will be selected until not in view. This is the default option. When TDRS West is not in view TDRS East will be selected. 10 - Force West TDRS selection. 11 - Force East TDRS selection.
8	KU-Band Data		The following data is displayed providing information about the KU-Band system: SIG STR - Uplink received signal strength of the KU-Band antenna. EL CMD - Pitch angle (in degrees) being supplied by the AM sequence to the KU-Band antenna for the currently selected TDRS. AZ CMD - Roll angle (in degrees) being supplied by the AM sequence to the KU-Band antenna for the currently selected TDRS. EL ACT - Actual pitch angle (in degrees) of KU-Band antenna. AZ ACT - Actual roll angle (in degrees) of KU-Band antenna.
9	S-Band TDRS Selection	ITEM N EXEC	Select TDRS for use with S-Band: N = 12 - Use AM (Automatic Antenna Management) to select the proper antenna pointing. TDRS West will be tried first, and if in line-of-sight, will be used until loss of line-of-sight. If not in line-of-sight, TDRS East will be selected. This is the default option. 13 - Force West TDRS selection. 14 - Force East TDRS selection.

TABLE 3.2011(S)-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
10	S-Band STDN Selection	ITEM N EXEC	Select ground station (STDN - Spaceflight Tracking and Data Network; SGLS - Space Ground Link Station). Selected station ID is displayed above ITEMs. N = 15 - Use AM to select site from table (search for first in-view site starts with first enabled site in table, continues through table until site is encountered which is in-view). This is the default option. 16 - Select the next enabled site that is in-view from the table after the current site. Note: Entry of this ITEM results in re-selection of AUTO once the next site is found.
11	S-Band Antenna Selection Control	ITEM N EXEC	Enables or inhibits GPC controlled selection of S-Band antenna to use. N = 17 - Enable GPC to automatically select S-Band antenna to use (default). 18 - Inhibit GPC from selecting S-Band antenna to use. Antenna selection will be via RF Uplink, or crew switch.
12	S-Band Antenna TDRS Mode Override	ITEM 19 EXEC	Provides the capability to initiate or inhibit a software forced override of the S-Band Antenna to the TDRS mode.
13	S-Band Data		Provides information about the S-Band system. SIG STR - Uplink received signal strength (Volts) of the active antenna. ANT ELEC - Denotes which antenna switch assembly has power applied. Fields are: 1 - Switch Assembly 1 2 - Switch Assembly 2. OFF - Neither Assembly. Blank - Both Assemblies. ANT QUAD - Selected Quad S-Band Antenna: UR - Upper Right UL - Upper Left LR - Lower Right LL - Lower Left FWD - Forward AFT - Aft

TABLE 3.2011(S)-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
14	Antenna Management Plot		ANT HEMI - Selected Hemi-Antenna: UP - Upper LO - Lower MODE - Current mode of S-Bank system: TDRS S-HI (STDN - high) S-LO (STDN - low) SGLS (DOD Space Ground Link System) The Antenna Management Plot provides the crew with the actual target look angle information on the S-Band PM QUAD and KU-Band high-gain antennas relative to Orbiter coordinates. The Orbiter −Z axis is located at 0,0 and the +X axis is located at 90,0 on the plot. The relative look angle to a given target is represented by a (W) for the West TDRS, (E) for the East TDRS, and (S) for an STDN site. The scaling of the plot is −90 to +90 degrees elevation, and −180 to +180 degrees azimuth. θ, ϕ coordinates for the S-Band antennas correspond directly to pitch and roll of the KU-Band antennas. Background lines provide for vehicle blockage information for the KU-Band system. No background data are needed for line-of-sight blockage of the S-Band system.

TABLE 3.2011(S)-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	KU-Band Radar Range Estimate - AUTO				2	CSMB_RADAR_RANGE_EST$1
2	KU-Band Radar Range Estimate - MINIMUM				2	CSMB_RADAR_RANGE_EST$2
3	KU-Band Radar Threshold - FIXED				3	CSMB_RADAR_THRESHOLD
4	KU-Band Radar Threshold - VARIABLE				3	CSMB_RADAR_THRESHOLD
5	KU-Band SCAN WARN - ENABLE				4	CSMB_KUBAND_SCAN_WARN
6	KU-Band SCAN WARN - OVERRIDE				4	CSMB_KUBAND_SCAN_WARN
7	KU-Band Radar Self Test INITIATE/ TERMINATE				5	CSMB_RADAR_SELF_TEST_INIT
8	I/O Reset KU				6	CPCB_PCI_DATA$(4:9)
9	KU-Band TDRS Selection - AUTO				7	CSMB_KUBAND_TDRS_SEL$1
10	KU-Band TDRS Selection - West				7	CSMB_KUBAND_TDRS_SEL$2
11	KU-Band TDRS Selection - East				7	CSMB_KUBAND_TDRS_SEL$3
12	S-Band TDRS Selection - AUTO				9	CSMB_SBAND_TDRS_SEL$1

TABLE 3.2011(S)-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
13	S-Band TDRS Selection - West				9	CSMB_SBAND_TDRS_SEL$2
14	S-Band TDRS Selection - East				9	CSMB_SBAND_TDRS_SEL$3
15	Ground Station Selection - AUTO				10	CSMB_SBAND_SITE_SEL$1
16	Ground Station Selection - NEXT				10	CSMB_SBAND_SITE_SEL$2 Selection used, then reverts to AUTO
17	GPC S-Band Antenna Select ENABLE				11	CSMB_SBAND_AUTO_SEL$1
18	GPC S-Band Antenna Select INHIBIT				11	CSMB_SBAND_AUTO_SEL$2
19	GPC S-Band Antenna TDRS Mode Override				12	CSMB_SBAND_TDRS_OVERRIDE

3.5.2021(G) DISPLAY: XXXXX MANEUVER YYYYY

–1 This display is defined in section 3.5.1041.

–2 For Major Mode 202, the following title will be driven on the display:

ORBIT MNVR EXEC

3.5.2021(S) DISPLAY: PL BAY DOORS

–1 AVAILABILITY: OPS Mode Display in OPS SM2, MM 202.

–2 PURPOSE: The Payload Bay Doors display is presented upon moding into SM 202 and provides control for opening and closing the Orbiter payload bay doors.

```
2021/   /        PL BAY DOORS     XX X DDD/HH:MM:SS
                                          DDD/HH:MM:SS
 AC POWER   ON  1X
            OFF 2X  PBD SW-XXXXS
 AUTO MODE SEL  3X                 |MICRO-SW STAT
                                    LATS  DOORS
                |MAN|OP/CL|AUTO|   CCOO  CRRRO
CENTER LATCHES  |SEL|     |SEQ|   ABAB   ABC
          5- 8  | 4X| XXS |  X|   XXXX
          9-12  | 5X| XXS |  X|   XXXX
          1- 4  | 6X| XXS |  X|   XXXX
         13-16  | 7X| XXS |  X|   XXXX
STBD
   FWD LATCHES  | 8X| XXS |  X|   XXXX  XXXXX
   AFT LATCHES  | 9X| XXS |  X|   XXXX  XXXXX
   DOOR         |10X|XXXS |  X|
PORT
   FWD LATCHES |11X| XXXS |  X|   XXXX  XXXXX
   AFT LATCHES |12X| XXXS |  X|   XXXX  XXXXX
   DOOR        |13X| XXXS |  X|

                      OPEN 15X
 PBD SW BYPASS 14X    STOP 16X
                     CLOSE 17X
                                              (XX)
```

Figure 3.2021(S)

TABLE 3.2021(S)-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	OPS 202 PRO	Entered on MCDS keyboard with major function of SM.
2	Electrical Power Controls	ITEM 2 EXEC	Removes AC power from ALL PBD latch and motor actuator motor control assemblies.
		ITEM 1 EXEC	Applies AC power to ALL PBD latch and motor actuator motor control assemblies. NOTE: 1. Default selection upon entry to mode 202 is OFF. 2. Any Out-of-Sequence failure in AUTO mode will result in OFF being selected. 3. Termination of major mode 202 will turn off AC power.
3	Automatic PBD Open/Close		Door manipulation is accomplished by a combination of MCDS keyboard entry(ies) and the PBD Control Switch on panel R13.
		ITEM 3 EXEC	Select Auto mode for door operations. PBD switch must be in STOP, or Over-ride STOP must be selected. PBD SWITCH: Status is displayed for switch position. For mission data, status is M; for failed switch, status is FAIL. Additionally, an AUTO-SEQ column provides an indication (↓) of a failure of door/latch to open or close within a specified time. OPEN: PBD in a predefined sequence automatically. Status is OP. CLOSE: Close PBD in a predefined sequence automatically. Status is CL. STOP: Suspend current PBD operations. Status is STOP.
		ITEM 14 EXEC	Software override of PBD switch position. This may be entered at any time, regardless of PBD switch position. Upon entry, STOP mode is selected. The following 3 entries are mutually exclusive and are valid only if ITEM 14 has been executed.

TABLE 3.2021(S)-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 15 EXEC	Open PBD in a predefined sequence automatically.
		ITEM 16 EXEC	Stop PBD operations currently in work.
		ITEM 17 EXEC	Close PBD in a predefined sequence automatically.
			NOTE: In either case (PBD switch or keyboard entry), suspension of a sequence by STOP may be resumed from stopping point by reselection of OPEN or CLOSE. When the entire selected sequence is complete, auto mode is deselected.
4	Manual PBD Open/Close		Door manipulation is accomplished by a combination of MCDS keyboard entries and the PBD switch. Before any of the manual select items may be entered the PBD switch/override must be in STOP. Once a manual latch group has been selected, additional groups may be selected regardless of PBD switch/override position. Groups may be deselected only when PBD switch/override position is STOP. For each latch/door group, status is displayed as follows (in addition to for failure): OP - open CL - closed ? - off nominal micro-switch configuration but does not necessarily prevent completion of sequence. M - missing data Blank - latch/door in transient between open and close.

TABLE 3.2021(S)-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM N EXEC	Select latch/door to be opened manually where N = 4 - center latches 5-8 5 - center latches 9-12 6 - center latches 1-4 7 - center latches 13-16 8 - Starboard (right) forward latches 9 - Starboard aft latches 10 - Starboard doors 11 - Port (left) forward latches 12 - Port aft latches 13 - Port doors
5	Micro-Switch Status		The status of the micro-switch is displayed as 0 for open and 1 for close. In the latch group, contacts A & B status given for close (C) and Open (O). For the doors, five switch statuses are shown: C - close; RA, RB, RC-ready to latch; O - open.

TABLE 3.2021(S)-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Apply AC Power				2	CSBB_POWER_ON_OFF_SELECT_ITEM$(1)
2	Remove AC Power				2	CSBB_POWER_ON_OFF_SELECT_ITEM$(2)
3	Auto Mode				3	CSBB_AUTO_MODE_SELECT_ITEM$(1)
4	Manual, C5-8				4	CSBB_MANUAL_MODE_SELECT_ITEM$(2)
5	Manual, C9-12				4	CSBB_MANUAL_MODE_SELECT_ITEM$(3)
6	Manual, C1-4				4	CSBB_MANUAL_MODE_SELECT_ITEM$(4)
7	Manual, C13-16				4	CSBB_MANUAL_MODE_SELECT_ITEM$(5)
8	Manual, Right Fwd. Latches				4	CSBB_MANUAL_MODE_SELECT_ITEM$(6)
9	Manual, Right Aft. Latches				4	CSBB_MANUAL_MODE_SELECT_ITEM$(7)
10	Manual, Right Doors				4	CSBB_MANUAL_MODE_SELECT_ITEM$(8)
11	Manual, Left Fwd. Latches				4	CSBB_MANUAL_MODE_SELECT_ITEM$(9)
12	Manual, Left Aft. Latches				4	CSBB_MANUAL_MODE_SELECT_ITEM$(10)
13	Manual, Left Doors				4	CSBB_MANUAL_MODE_SELECT_ITEM$(11)
14	Override PBD Switch				3	CSBB_SWITCH_BYPASS_ITEM
15	Open PBD				3	CSBB_PBD_OPEN_ITEM
16	Stop PBD				3	CSBB_PBD_STOP_ITEM
17	Close PBD				3	CSBB_PBD_CLOSE_ITEM

3.5.3011 DISPLAY: XXXXX MANEUVER YYYYY

−1 This display is defined in section 3.5.1041.

−2 For Major Mode 301, the following title will be driven on the display:

DEORB MNVR COAST

3.5.3021 DISPLAY: XXXXX MANEUVER YYYYY

−1 This display is defined in section 3.5.1041.

−2 For Major Mode 302, the following title will be driven on the display:

DEORB MNVR EXEC

3.5.3031 DISPLAY: XXXXX MANEUVER YYYYY

−1 This display is defined in section 3.5.1041.

−2 For Major Mode 303, the following title will be driven on the display:

DEORB MNVR COAST

3.5.3041 DISPLAY: ENTRY TRAJ 1

−1 AVAILABILITY: OPS Mode Display in OPS G3, MM 304.

−2 PURPOSE: The ENTRY TRAJECTORY displays constitute the mode displays for major mode 304, presenting navigational and guidance information to the crew from entry interface to TAEM interface. The fixed background is mission-dependent and designed to allow the crew to monitor the vehicle's progression compared to planned entry profiles and the guidance trajectory.

−3 ENTRY TRAJ 1 is automatically driven at the start of Major Mode 304. As relative velocity decreases ENTRY TRAJ 1 is replaced by ENTRY TRAJ 2, then by ENTRY TRAJ 3, and then by ENTRY TRAJ 4. When the energy over weight ratio reaches a predetermined mission-dependent value, ENTRY TRAJ 4 is replaced by ENTRY TRAJ 5. The display background consists of two fixed vertical tape scales and a mission-dependent central plot containing various lines and numbers. The alpha (angle of attack) vertical tape scale and the drag vertical tape scale are on the left of the display. The central plot lines are of two types: (1) nominal guidelines (solid lines) and (2) constant nominal drag acceleration lines (dashed lines). These lines are plotted as a function of range and relative velocity. The constant nominal drag acceleration lines are labeled with the drag value the line represents. The guidelines are not labeled. The central plot also contains nominal altitude rate values that correspond to the altitude rates required to guide the shuttle trajectory parallel to the guidelines when the actual drag acceleration is matched to the nominal value. A shuttle profile symbol is dynamically displayed to represent the current range and relative velocity. A square box is dynamically displayed to represent the guidance range and relative velocity. Each of these dynamic symbols has a maximum of six trailer symbols representing previous positions. A shuttle trailer (triangle symbol pointed left) is placed at the shuttle's current position every 28.8 seconds (15 entry guidance cycles). While entry guidance is active a guidance trailer (dot) is placed at guidance's current position the same time a shuttle trailer is placed on the display. There are two dynamic symbols driven on the vertical drag tape scale: (1) reference drag (arrow pointed left), and (2) actual drag (triangle pointed left). There are two dynamic symbols driven on the alpha vertical tape scale: (1) actual angle of attack (triangle pointed right) and commanded angle of attack (arrow pointed right). The dynamic symbols on the alpha and drag vertical tape scales will flash according to the following: when a symbol reaches an off-scale position, the symbol will flash and will remain in the off-scale position; when the commanded angle of attach symbol and the actual angle of attack differ by more than two degrees, the actual angle of attack symbol will flash. Also, items are displayed: (1) the shuttle character and the phugoid bank scale will flash when the heading error exceeds the maximum and the heading error and the bank angle are in the same direction (15177), (2) dynamic pressure ($\bar{q}$), (3) altitude rate correction term (H BIAS), (4) reference altitude rate (H REF), (5) aileron or rudder trim, (6) reference roll angle (ROLL REF), (7) commanded roll angle (CMD), (8) lateral accel trim, and (9) selected AA lateral trim.

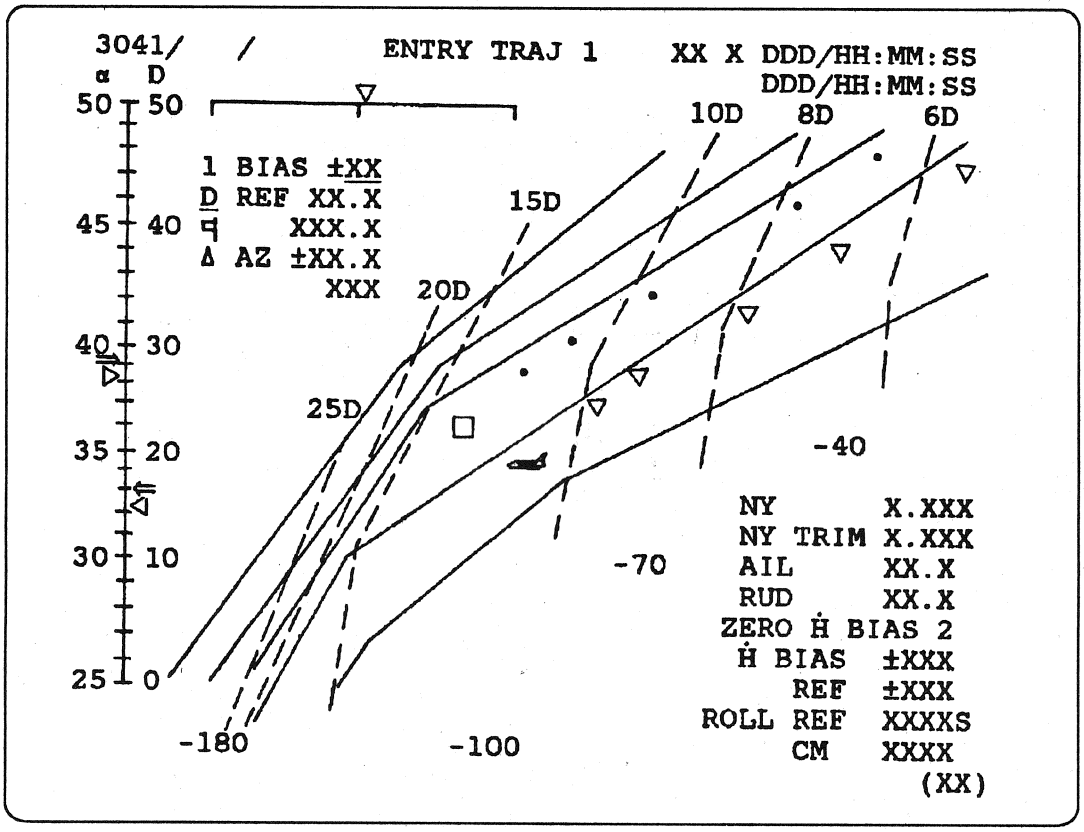


Figure 3.3041

TABLE 3.3041-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	OPS 304 PRO	Keyboard entry automatically activates ENTRY TRAJ 1 display.
2	Bias Drag Acceleration	ITEM 1 ±XX EXEC	Allows the crew to bias the entry DIP reference drag.
3	Zero H-Dot Bias	Item 2 EXEC	Resets the guidance computed altitude correction term to zero.

TABLE 3.3041-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Set Bias Drag Acceleration	−10	+ 10		2	Initialized to zero on entry to MM 304.
2	Reset H-Dot Bias				3	H-Dot Bias is zeroed upon each execution of Item 2.

3.5.3042 DISPLAY: ENTRY TRAJ 2

–1 AVAILABILITY: OPS Mode Display in OPS G3, MM 304.

–2 PURPOSE: This display automatically replaces the ENTRY TRAJ 1 display when relative velocity decreases below a predetermined, mission-dependent value and remains until automatically replaced by ENTRY TRAJ 3. Otherwise this display is identical to ENTRY TRAJ 1 (section 3.5.3041).

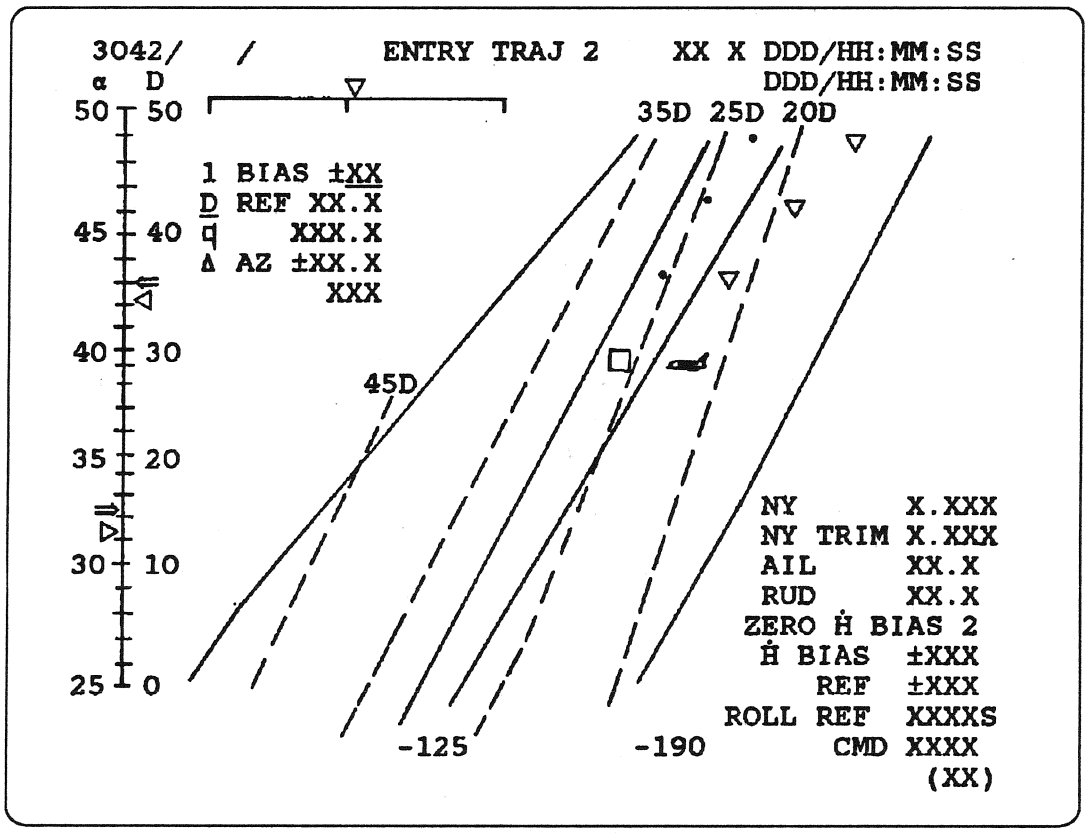


Figure 3.3042

3.5.3043 DISPLAY: ENTRY TRAJ 3

−1 AVAILABILITY: OPS Mode Display in OPS G3, MM 304.

−2 PURPOSE: This display automatically replaces the ENTRY TRAJ 2 display when relative velocity decreases below a predetermined, mission-dependent value and remains until automatically replaced by ENTRY TRAJ 4. The shuttle and guidance trailer symbols are placed on the display every 15.36 (8 entry guidance cycles) instead of every 28.8 seconds. Otherwise this display is identical to ENTRY TRAJ 1 (section 3.5.3042).

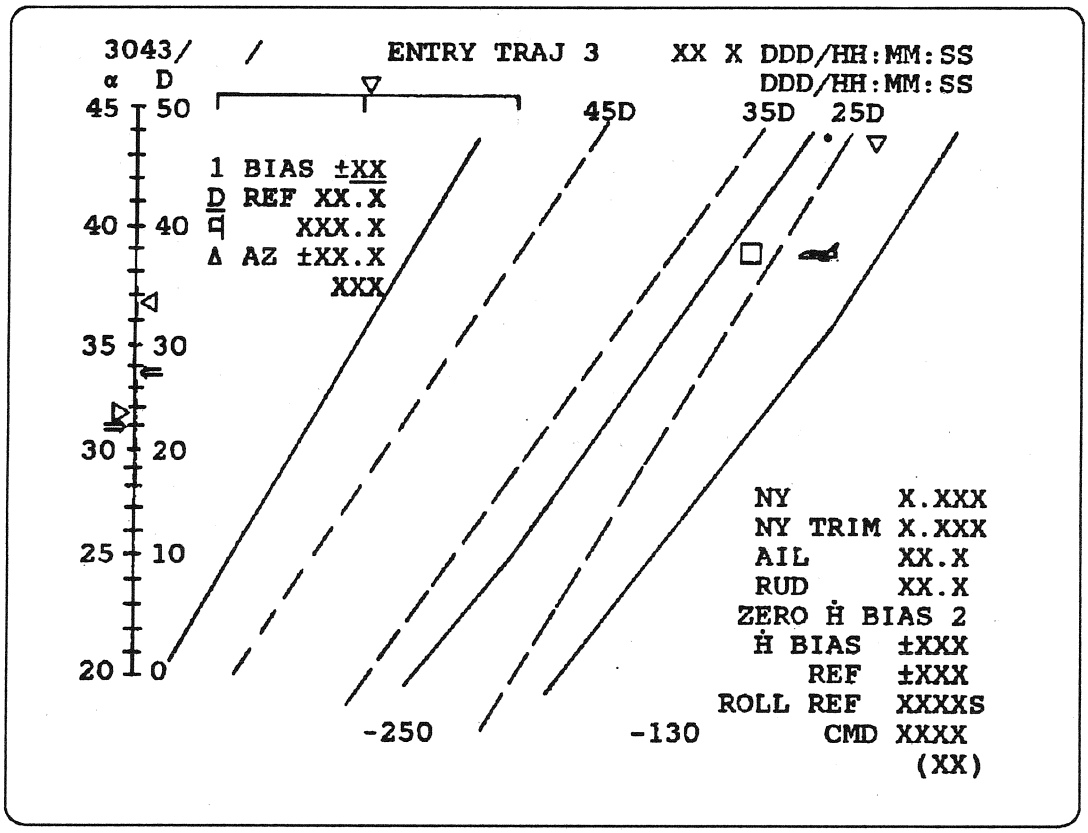


Figure 3.3043

3.5.3044 DISPLAY: ENTRY TRAJ 4

−1 AVAILABILITY: OPS Mode Display in OPS G3, MM 304.

−2 PURPOSE: This display automatically replaces the ENTRY TRAJ 3 display when relative velocity decreases below a predetermined, mission-dependent value and remains until automatically replaced by ENTRY TRAJ 5. The mission-dependent central plot of lines and numbers are plotted as a function of range and energy over weight. The shuttle symbol, six shuttle trailer symbols, guidance symbol, and six guidance trailer symbols are plotted as a function of range and energy over weight. Otherwise this display is identical to ENTRY TRAJ 3 (section 3.5.3043).

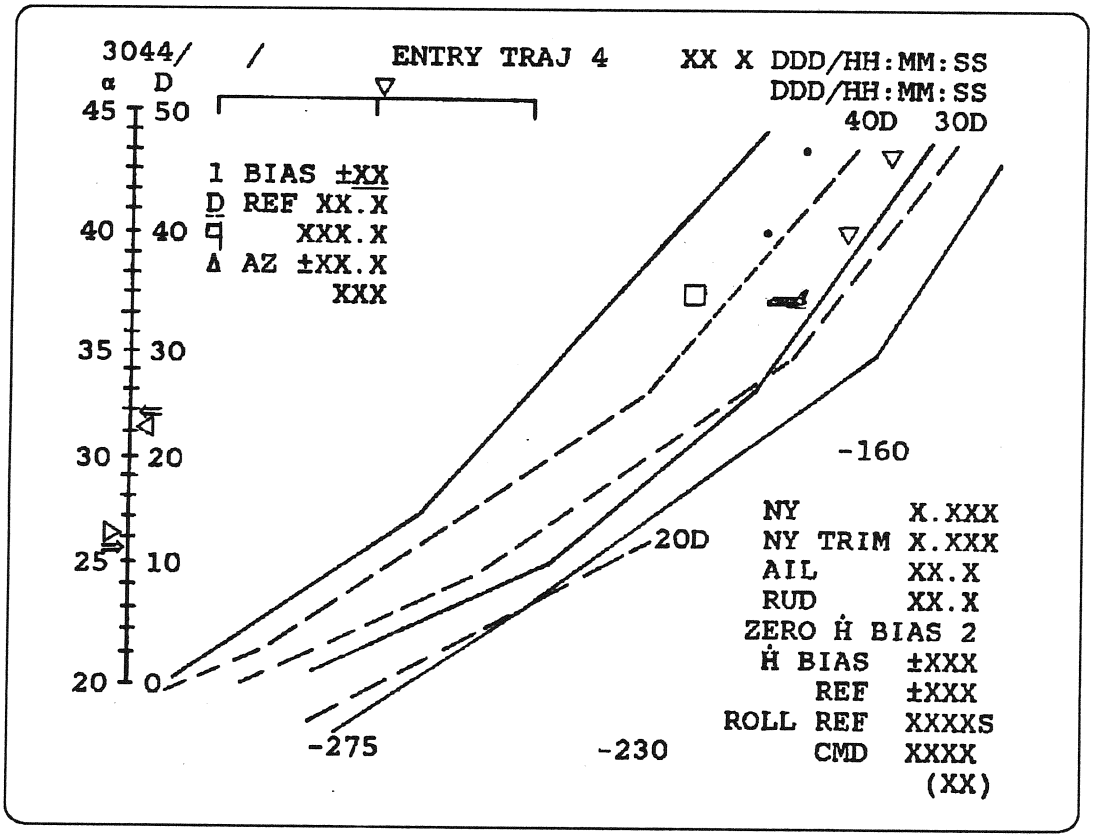


Figure 3.3044

3.5.3045 DISPLAY: ENTRY TRAJ 5

−1 AVAILABILITY: OPS Mode Display in OPS G3, MM 304.

−2 PURPOSE: This display automatically replaces the ENTRY TRAJ 4 display when energy over weight reaches a predetermined, mission-dependent value. The shuttle profile symbol remains fixed once TAEM interface conditions are reached. Otherwise this display is identical to ENTRY TRAJ 4 (section 3.5.3044).

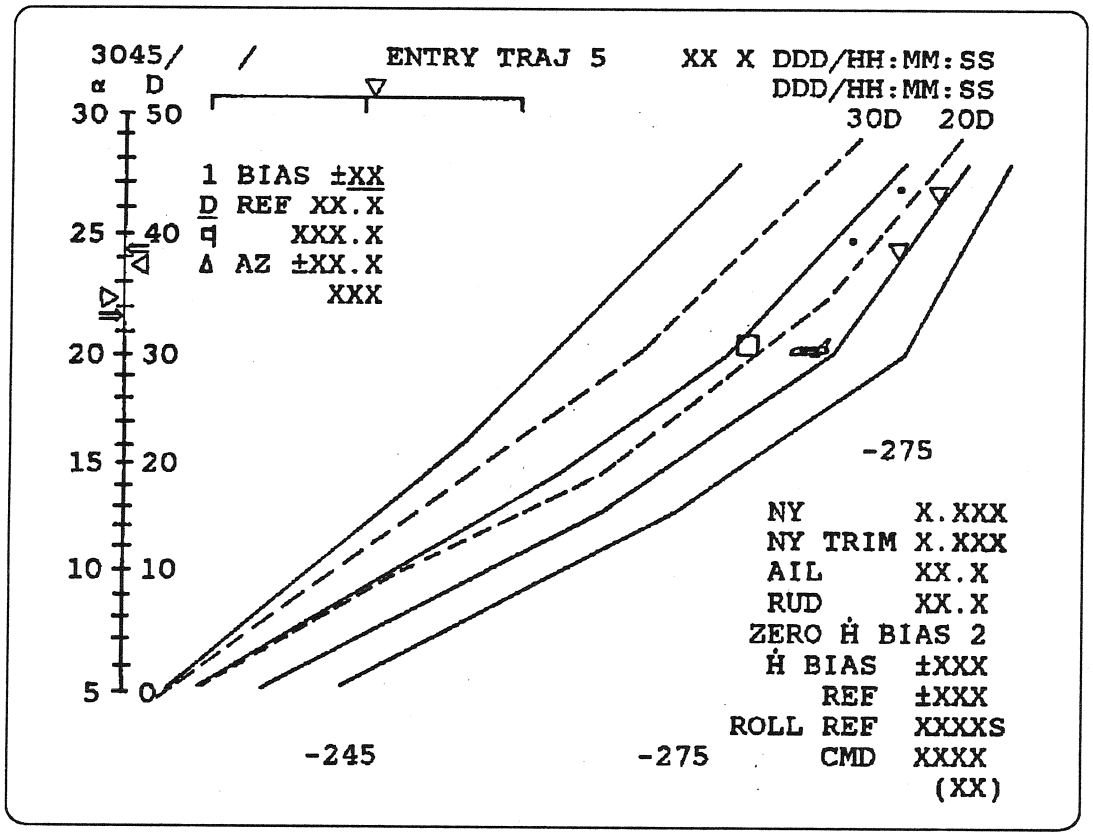


Figure 3.3045

3.5.3051 DISPLAY: VERT SIT 1

−1 AVAILABILITY: OPS Mode Display in OPS G3 and G6, MM 305, 602, and 603.

−2 PURPOSE: The Vertical Situation Displays, VERT SIT 1 and VERT SIT 2, are the OPS displays for major modes 305, 602 and 603. The shuttle symbol is displayed on an Alpha-mach profile during MM 602 and within a set of mission dependent flight and TAEM guidance profiles during MM 603 and MM 305. VERT SIT 1 is automatically driven at the start of major modes 305 and 602. As the vehicle altitude drops below approximately 30,000 feet, VERT SIT 1 is replaced by VERT SIT 2. A shuttle profile symbol is displayed to represent vehicle longitudinal information. The altitude dissipation rate is indicated by rotating the shuttle profile character. On the right side of the display are vertical scales for energy over weight and pitch attitude. A triangle pointer represents the current vehicle energy state. Tick marks are used to represent nominal energy state and the guidance energy limits. The triangular pointer will flash during S-turns or when TAEM guidance is being redesignated to MEP. The OTT downmode energy state is displayed with a left pointing arrow. When the range to the runway is less than I-loaded limit, the display of the OTT Downmode energy symbol will be blanked. A triangle is also used to represent the current vehicle pitch attitude. The pitch attitude is scaled as a function of the pitch profiles for flight at a dynamic pressure of 300 psf and for flight at maximum lift over drag. The actual and commanded speedbrake position are displayed in percent just to the left of the pitch scale. Also, displayed are the selected AA lateral acceleration in g's the lateral acceleration trim in g's, the aileron trim in degrees, the rudder trim in degrees, and the pullout normal acceleration in G's. At the top left of the display is the Bailout Mode status. BAILOUT is flashed when the Bailout Mode is armed, but not engaged. When the Bailout Mode is engaged, BAILOUT is displayed, but not flashed. BAILOUT is blanked at all other times.

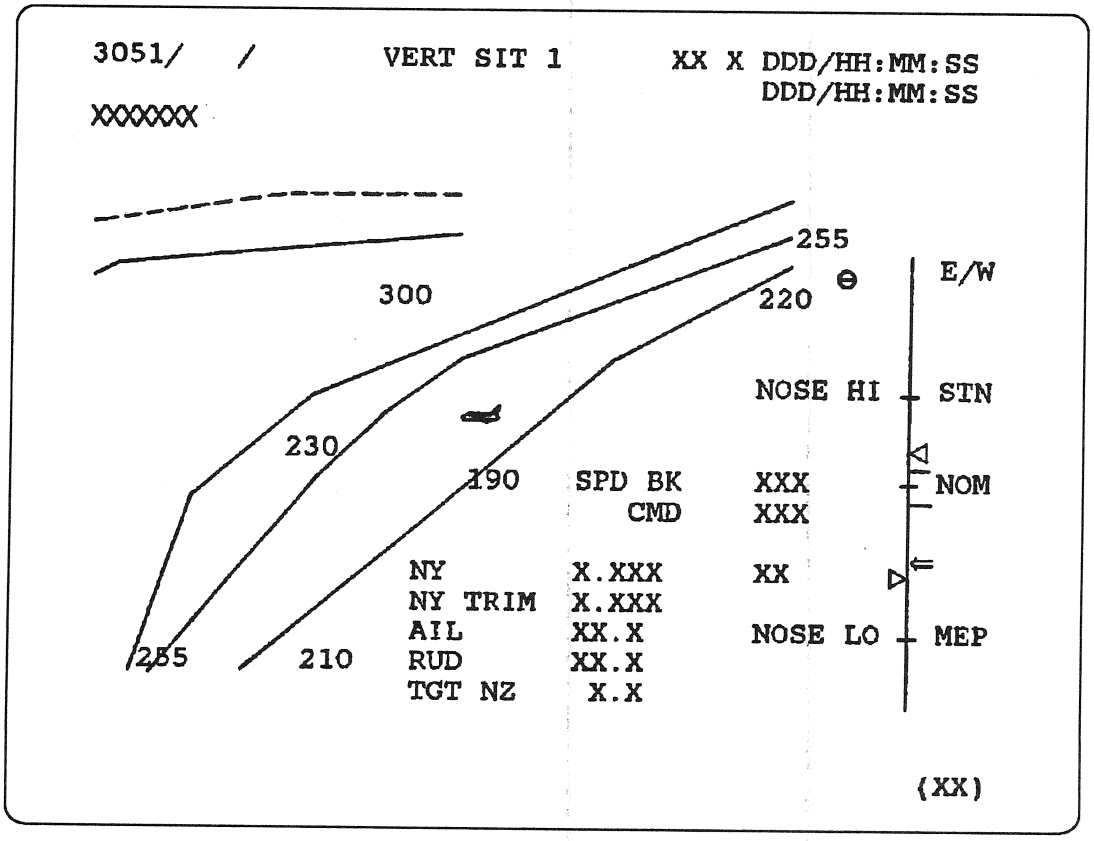


Figure 3.3051

TABLE 3.3051-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	OPS 305 PRO OPS 602 PRO OPS 603 PRO	Keyboard entry automatically activates the Vertical Situation display. This display is a monitor function only.

3.5.3052 DISPLAY: VERT SIT 2

−1 AVAILABILITY: OPS Mode Display in OPS G3 and G6, MM 305 and 603.

−2 PURPOSE: This display automatically replaces VERT SIT 1 as the orbiter passes through 30,000 feet in altitude and remains until major mode 305 (or 603) is exited. A/L will be displayed and flashing when TAEM terminate and auto-land begins. Otherwise this display is identical to VERT SIT 1 (section 3.5.3051). (60313)

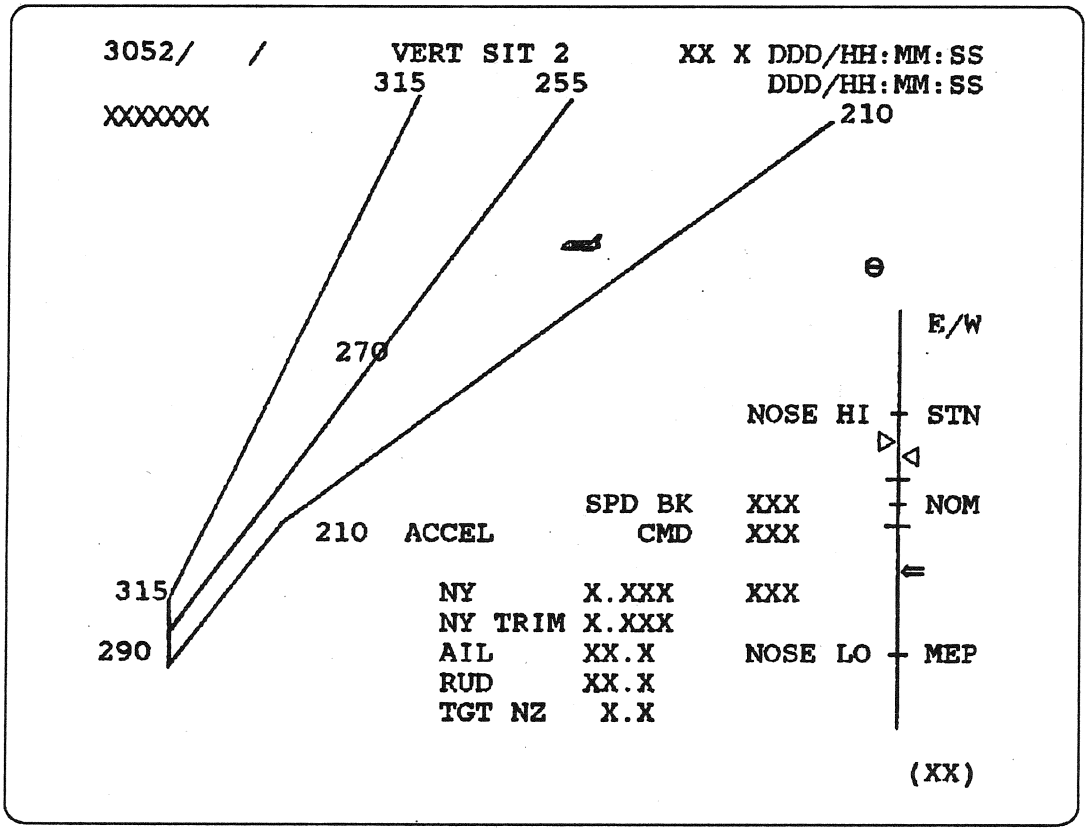


Figure 3.3052

3.5.4011(S) DISPLAY: ANTENNA

−1 AVAILABILITY: OPS Mode Display in OPS SM4, MM 401.

−2 PURPOSE: This display is identical to that defined for Antenna Management in SM2 in section 3.5.2011(S).

3.5.4021(S) DISPLAY: PL BAY DOORS

-1 AVAILABILITY: OPS Mode Display in OPS SM4, MM 402.

-2 PURPOSE: This display is identical to that defined for Payload Bay Doors in SM2 in section 3.5.2021(S).

3.5.6011 DISPLAY: XXXXXX TRAJ

-1 AVAILABILITY: OPS Mode Display in OPS G6, MM 601.

-2 PURPOSE: This display is identical to that described for MM 101, refer to section 3.5.1011.

3.5.6021 DISPLAY: VERT SIT 1

-1 AVAILABILITY: OPS Mode Display in OPS G6, MM 602.

-2 PURPOSE: The VERT SIT 1 display for RTLS is identical to that defined for OPS G3, MM 305, in section 3.5.3051.

3.5.6031 DISPLAY: VERT SIT 2

–1 AVAILABILITY: OPS Mode Display in OPS G6, MM 603.

–2 PURPOSE: The VERT SIT 2 display for RTLS is identical to that defined for OPS G3, MM 305, in section 3.5.3052.

3.5.8011 DISPLAY: FCS/DED DIS C/O

–1 AVAILABILITY: OPS Mode Display in OPS G8, MM 801.

–2 PURPOSE: The FCS/Dedicated Display Checkout display provides control for testing of the aerosurfaces while in orbit, preparatory to entry. It also provides controls for testing of the dedicated displays.

```
8011/   /      FCS/DED DIS C/O  XX X DDD/HH:MM:SS
                                   DDD/HH:MM:SS

 DED DIS            MODE LT        AVG G  ON  9X
FWD 1X  HIGH 3X     ON   7X
AFT 2X  LOW  4X     OFF  8X
        FLAG 5X
        OFF  6X
                   SURF DR  START 10X  STOP 11X
 BODY FLP DES
VLV 1 XXX 12X
    2 XXX 13X    SURF       CMD    POS   1 2 3 4
    3 XXX 14X   ELEV L OB  XXX.X  XXX.XS S S S S
                     IB    XXX.X  XXX.XS S S S S
 SEC ACT CK        R IB    XXX.X  XXX.XS S S S S
CH 1  15X            OB    XXX.X  XXX.XS S S S S
CH 2  16X       RUD        XXX.X  XXX.XS S S S S
CH 3  17X       SPD BRK    XXX.X  XXX.XS S S S S
CH 4  18X       BDY FLP      XX   XXX.X
STOP  19X
POS STIM                              SEC ACT
  ENA 20X                           21 BYPASS  XX
                                    22 RESET   XX

                                              (XX)
```

Figure 3.8011

TABLE 3.8011-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	OPS 801 PRO	Must be entered on MCDS keyboard with GNC major function. At initiation of the OPS, forward DDU is selected (see function 2, ITEM 1), and a positive polarity for secondary actuator check is selected (See function 7, ITEM 20). NOTE: If a test is in progress and a SPEC is requested, the test will continue to execute to its completion. If another OPS (G2) is requested any test active will be terminated.
2	Dedicated Display Checkout	ITEM 1 EXEC	Select forward displays for test (default).
		ITEM 2 EXEC	Select aft displays for test. (ITEMs 1 and 2 are mutually exclusive.)
		ITEM 3 EXEC	Select HIGH test: Drive all units to a pre-defined set of high values.
		ITEM 4 EXEC	Select LOW test: Drive all units to a pre-defined set of low values.
		ITEM 5 EXEC	Select FLAG test: All units will remain at current reading with mechanical flags (except HSI power) extended. NOTE: ITEMS 3-5 are mutually exclusive.
		ITEM 6 EXEC	Terminate selected test.
3	FCS Mode Light Checkout	ITEM 7 EXEC	Causes both right and left FCS mode lights to be illuminated. Lights are AUTO and CSS lamps for pitch and roll/yaw control axes, and AUTO/MAN lamps for speedbrake and bodyflap.
		ITEM 8 EXEC	Extinguish all lamps.
4	Powered-Flight NAV Control	ITEM 9 EXEC	This is a flip/flop item which initiates or terminates the average G navigation algorithm for powered flight on-orbit.
5	Bodyflap Pilot Valve Control	ITEM N EXEC	N = 12-14 for bodyflap valves 1-3 respectively. All 3 are initially enabled. Item is a flip/flop; an * present denotes valve is deselected (or inhibited). Status is denoted ENA or INH.

TABLE 3.8011-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
6	Aerosurface Drive Test (ADT)	ITEM 10 EXEC	Causes output of cyclic commands to left inboard and outboard elevons, right inboard and outboard elevons, rudder, speedbrake, and bodyflap. Commands are triangular waveform. Continues until crew input (ITEM 11) stops the test.
		ITEM 11 EXEC	Terminates the alternating drive test (if active) and positions aerosurfaces for entry. NOTE: ITEM 10 is NOT required before ITEM 11. Displayed Data: The commanded and actual position (selected feedback) along with status is shown for each aerosurface. The elevons and rudder are in degrees, the speedbrake in percent of full deflection. For the bodyflap, command is UP or DN, position is percent of full deflection. The sign of deflection on the elevons is displayed as U or D; the rudder is L or R. For positive polarity (see function 7), a positive command will result in a negative deflection and thus a D and L; a negative command will result in a positive deflection and thus a U and R. For negative polarity the results are reversed; positive command will yield U and R, negative command will yield D and L. The status is driven during the drive test (ITEM 10) by computing the delta between command and position. If the tolerance (2 degrees) is exceeded, a down arrow is displayed. A bypass status to each channel of each surface is also displayed (blank is good, down arrow is bypassed).
7	Secondary Actuator Check	ITEM 20 EXEC	Optional Item: Selects positive or negative polarity for test. Initial condition is positive. (35572/44250/46503)
		ITEM N EXEC	N = 15-18 for channels 1-4 respectively. Selection of item will cause hardover command to all aerosurfaces on selected channel, secondary port. Command will remain until crew removes it with selection of another channel or a STOP (ITEM 19). Upon selection, all statuses in selected channel column (right side of CRT) should show ↓.

TABLE 3.8011-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
		ITEM 19 EXEC	Terminate secondary actuator check(s).
8	Secondary Actuator Bypass/Reset	ITEM 21+XY EXEC	Set the Bypass indicator on for the secondary actuator selected by XY, where Y is desired channel (1-4) and X is desired actuator: 1 - LOB 4 - RIB 2 - LIB 5 - RUD 3 - ROB 6 - SPD BRK Upon selection the appropriate actuator/channel will be bypassed and a ↓ displayed in status.
		ITEM 22+XY EXEC	Reset the Bypass indicator for the selected secondary actuator/channel. XY is defined as above.

TABLE 3.8011-2. DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1	Select Forward DDUs				2	CGZB_ACT_IT_ASTERISK$(1)
2	Select AFT DDU (ADI)				2	CGZB_ACT_IT_ASTERISK$(2)
3	Select HIGH Test Mode				2	CGZB_ACT_IT_ASTERISK$(3)
4	Select LOW Test Mode				2	CGZB_ACT_IT_ASTERISK$(4)
5	Select FLAG Test Mode				2	CGZB_ACT_IT_ASTERISK$(5)
6	Stop Test				2	CGZB_ACT_IT_ASTERISK$(6)
7	Start FCS Mode Lamp Test				3	CGZB_ACT_IT_ASTERISK$(7)
8	Stop FCS Mode Lamp Test				3	CGZB_ACT_IT_ASTERISK$(8)
9	Average G NAV Control				4	
10	Start ADT				6	CVYB_DISP_ITEM_ASTERISK$(1)
11	Stop ADT				6	CVYB_DISP_ITEM_ASTERISK$(2)
12	Bodyflap Valve 1 Control				5	CVYB_DISP_ITEM_ASTERISK$(5)
13	Bodyflap Valve 2 Control				5	CVYB_DISP_ITEM_ASTERISK$(6)
14	Bodyflap Valve 3 Control				5	CVYB_DISP_ITEM_ASTERISK$(7)
15	Secondary Actuator Channel 1 Check				7	CVYB_DISP_ITEM_ASTERISK$(8)

TABLE 3.8011-2. DISPLAY ITEMS (Continued)

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
16	Secondary Actuator Channel 3 Check				7	CVYB_DISP_ITEM_ASTERISK$(9)
17	Secondary Actuator Channel 3 Check				7	CVYB_DISP_ITEM_ASTERISK$(10)
18	Secondary Actuator Channel 4 Check				7	CVYB_DISP_ITEM_ASTERISK$(11)
19	Stop Secondary Actuator Check				7	CVYB_DISP_ITEM_ASTERISK$(12)
20	Select Polarity for Actuator Check				7	
21	Set Secondary Actuator Bypass	11	64		8	
22	Reset Secondary Actuator Bypass	11	64		8	

3.5.9011(G) DISPLAY: GPC MEMORY

–1 AVAILABILITY: OPS Mode Display for OPS G9.

–2 PURPOSE: See section 3.5.000 for description.

3.5.9011(P) DISPLAY: MASS MEMORY R/W

−1 AVAILABILITY: OPS Mode Display for OPS P9 or SPEC 85 in OPS SM2 or SM4.

−2 PURPOSE: The Mass Memory Read/Write display provides the capability to read, modify, and dump (via downlist) the MMUs on-board. It also provides the capability to compare data from both MMUs.

−3 WARNING: No MMU write (ITEM 50 EXEC) shall be done without proper authorization within the procedures of the sites where MMUs reside.

```
9011/   /     MASS MEMORY R/W   XX X DDD/HH:MM:SS
SM COM BUFF XXX                      DDD/HH:MM:SS
DESIRED ACTUAL  DESIRED ACTUAL
 1 XXXX  XXXX   21 XXXX  XXXX        SELECT
 2 XXXX  XXXX   22 XXXX  XXXX  MMU 1          40X
 3 XXXX  XXXX   23 XXXX  XXXX  MMU 2          41X
 4 XXXX  XXXX   24 XXXX  XXXX  42 S/W SYSTEM   X
 5 XXXX  XXXX   25 XXXX  XXXX  43 PHASE      XXX
 6 XXXX  XXXX   26 XXXX  XXXX  44 LOAD BLK   XXX
 7 XXXX  XXXX   27 XXXX  XXXX  45 OFFSET   XXXXX
 8 XXXX  XXXX   28 XXXX  XXXX  46 NUMBER      XX
 9 XXXX  XXXX   29 XXXX  XXXX  47 PATCH ID  XXXX
10 XXXX  XXXX   30 XXXX  XXXX     VIOLATE    XXX
11 XXXX  XXXX   31 XXXX  XXXX  READ LOAD BLK  48X
12 XXXX  XXXX   32 XXXX  XXXX  MERGE          49X
13 XXXX  XXXX   33 XXXX  XXXX  WRITE LOAD BLK 50X
14 XXXX  XXXX   34 XXXX  XXXX  COMPARE        51X
15 XXXX  XXXX   35 XXXX  XXXX  STATUS       XXXX
16 XXXX  XXXX   36 XXXX  XXXX     ERROR CODE   X
17 XXXX  XXXX   37 XXXX  XXXX  REGISTER A   XXXX
18 XXXX  XXXX   38 XXXX  XXXX           B   XXXX
19 XXXX  XXXX   39 XXXX  XXXX  MM VERSION  XX.XX
20 XXXX  XXXX   CHECKSUM XXXX  DUMP VIA DL   52X

                                          (XX)
```

Figure 3.9011(P)

TABLE 3.9011(P)-1. DISPLAY FUNCTIONS

#	FUNCTION	KYBD ENTRY(S)	NOTES
1	Display Call-Up	OPS 901 PRO	Entered on a Keyboard/DEU with major function in PL, causes transition to OPS P9, MM 901.
		SPEC 85 PRO	Entered on a Keyboard/DEU with major function in SM and assigned to a GPC in OPS S2/4. The CRT will be driven with data based on requested operations, whether from the ground via LDB (capability 2 only) or on-board via keyboard. Information supplied below will contain some LDB references in addition to CRT data. NOTE: Before any MMU operations may be initiated, the SM common buffer must be available. This is indicated by RDY in the upper left corner of the CRT (SM COM BUFF). A status of BSY will cause all ITEM entries to be rejected. Once a MMU sequence has been started (read of loadblock), the buffer will remain BSY until: 1. Entire sequence is complete (write to both MMUs). 2. Completion of an RPL only read (phase = 0, loadblock = 1). 3. Completion of a MMU to MMU compare. Also, DEU loads in PL-9 should not be done when MMU has the buffer BSY (DEU load program does not check buffer status). Finally, simultaneous ground and on-board MMU operations must be avoided to prevent inadvertent contamination of MMU contents.
2	MMU Selection	ITEM N EXEC	N = 40 for MMU1, 41 for MMU2 (default is neither selected). Upon selection the selected MMU's status registers are displayed in HEX in lower right corner of CRT as REGISTER A & B (see Table 3.9011(P)-3 for a detailed description of the contents). Selection is mutually exclusive. Either MMU may be selected, regardless of which one the GPC was IPL'ed from. (37420) (55345)

TABLE 3.9011(P)-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
3	Software System Selection	ITEM 42+X EXEC	Provides ID of software element desired from MMU. ID's are: 1 - PASS Area 1 2 - PASS Area 2 3 - PASS Area 3 4 - BFS 5 - DEU 6 - SSME 7 - TCS Sequences 0 - Test & Graphics NOTE: For ID's 4-7 & 0, MMU area selection is done by phase number (ITEM 43).
4	Select Loadblock	ITEM 43+XXX EXEC	Specify phase to be operated on. Refer to a MMU directory for valid phases. (37529)
		ITEM 44+XXX EXEC	Specify loadblock to be operated on. Refer to a MMU directory for valid loadblocks. WARNING: If in S2/4 (SPEC 85), the specified loadblock cannot be more than 2048 halfwords in length. NOTE: Input of ITEM 43 or 44 causes data fields for ITEMs 1-39, 45-47 to be blanked. Selection of phase 0, loadblock 1 selects the Revision Patch Log (RPL). Upon doing a read of the RPL, the MM version will be displayed in the lower right corner of the CRT.
5	Loadblock Operations		Modification of a MMU requires a sequence of read, merge, write.
		ITEM 48 EXEC	Begins read of selected phase/loadblock from selected MMU into the buffer. At entry of request, STATUS on CRT will indicate progress as follows: IP - Read is in progress. CPLT - Access complete without error. ERR - An error occurred during operation. (14474)

TABLE 3.9011(P)-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			At completion (assuming no error), the loadblock checksum will be displayed at the bottom of the second column. If an error occurs, the ERROR CODE will identify type (also LDB code): 1 - MMU I/O error. 2 - Unresolved phase/loadblock (not found). 3 - Configuration control information incorrect. 4 - Word-by-Word compare error. 5 - Checksum failure on read. 6 - Deleted. 7 - Loadblock length violation. 8 - MMU version violation. To re-try the read, simply reenter ITEM 48 EXEC. Also, SM COMM BUFF indicates BSY and will stay on as noted earlier.
		ITEMS 45+ DDDDD EXEC	Specify offset (decimal) into loadblock of first contiguous word to be changed. Entry causes data fields for ITEMs 1-39 and 46 to be blanked.
		ITEM 46+WW EXEC	Specify the number (decimal) of contiguous words to be changed (1-39). Upon entering of this data, the CRT will be updated to show the current value of the location(s) to be patched.
		ITEM 47+PPPP EXEC	Specify the patch ID (HEX) to be placed in the RPL when the write to MMU is done. This must be entered before a MERGE request (ITEM 49). Also, use of a patch ID more than once is not recommended. Use of a patch ID of 0000 with a write request will cause the VIOLATE status on the CRT to read YES.
		ITEM N+XXXX EXEC	Specify data to be placed on mass memory, N = 1-39, XXXX is HEX data to be placed on MMU. Desired data will be displayed on CRT next to N.
		ITEM 49 EXEC	Cause patch data to be merged into loadblock in GPC buffer (the number of patch data's entered must be the same as specified by ITEM 46 for the MERGE to be successful). STATUS on CRT will be driven as specified earlier for ITEM 49 EXEC (IP, then CPLT or ERR). If successful, the checksum is updated to the new value.

TABLE 3.9011(P)-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
			NOTE: At this point, multiple updates at varying offsets in the loadblock may be done by repeating ITEMs 45, 46, N's + XXXX, and 49; that is by specifying a new offset, number of contiguous words, and patch data. Two restrictions are imposed: (1) the patch must be in the same loadblock, and (2) the same patch ID must be † used.
		ITEM 50 EXEC	Causes updated loadblock to be written from the buffer to the MMU. Again, as in the read, the STATUS is driven to monitor the write. The write is actually a write followed by a read back and comparison against the buffer. During the write itself, STATUS = IP and VIOLATE = NO. During the read back and compare, STATUS stays IP and VIOLATE changes to YES. At the completion of the compare, if everything compares, STATUS = CPLT, VIOLATE = NO. If VIOLATE remains YES, it is an indication that either a patch ID = O was specified or that an unsuccessful write was pending when an OPS transition or SPEC resume was requested. If an error occurs, the write may be re-tried by entering ITEM 50 EXEC again.
			NOTE: The patch may be applied to the other MMU by selecting it (ITEM 40 or 41) supplying a patch ID (ITEM 47) and doing ITEM 50 EXEC again.
6	MMU Compare	ITEM M EXEC	Select MMU as comparator (see function 2).
		ITEM 42 + X EXEC	Selected software system ID (0-7) (see function 3).
		ITEM 43 + PPP EXEC	Select phase of software system to compare.
		ITEM 44 + LLL EXEC	Select loadblock in phase to compare.
		ITEM 51 EXEC	STATUS will be driven as before (IP, CPLT or ERR). The loadblock is compared on a word-by-word basis. Other status parameters are as defined earlier. (25242)

TABLE 3.9011(P)-1. DISPLAY FUNCTIONS (Continued)

#	FUNCTION	KYBD ENTRY(S)	NOTES
7	MMU Dump via Downlist	ITEM M EXEC	Select MMU to read and dump (see function 2).
		ITEM 42+X EXEC	Select software system ID (0-7) (see function 3).
		ITEM 43+PPP EXEC	Select phase to dump.
		ITEM 52 EXEC	This will cause the selected phase/loadblock to be read into the buffer then dumped via downlist.
			WARNING: This will cause the downlist format ID to change from 52 (or 48) to 91.
8	MMU To MMU Copy	ITEM M EXEC	Select MMU to read from.
		ITEM 42+X EXEC	Select software system ID (0-7) (see function 3).
		ITEM 43+PPP EXEC	Select phase to copy.
		ITEM 44+LLL EXEC	Select loadblock to copy.
		ITEM 48 EXEC	Read selected loadblock.
		ITEM M EXEC	Select the other MMU to write to; i.e., if first M=40, second would be 41 and vice versa.
		ITEM 47+PPPP EXEC	For Configuration Control.
		ITEM 50 EXEC	Write loadblock to MMU. Status indicators done as before. (15651)

TABLE 3.9011(P)-2 DISPLAY ITEMS

#	DEFINITION	MIN	MAX	UNIT	FN	HAL NAME/NOTES
1-39	Desired Data for MMU Patch	0000	FFFF	HEX	5	
40	Select MMU1				2, 6-8	
41	Select MMU2				2, 6-8	
42	Select Software System ID	0	7		3, 6-8	
43	Phase	0	999	DEC	4, 6-8	
44	Loadblock	0	999	DEC	4, 6-8	
45	Offset into Loadblock	0	16384	DEC	5	In S2/4 MAX is 2048.
46	Number of Words to Patch	0	39	DEC	5	Sum of offset and number of words cannot exceed 16384. (2048 in S2/4)
47	Patch ID	0001	FFFF	HEX	5	
48	Read Loadblock				5-8	Must have valid ITEM 40-44.
49	Merge Desired Data				5	
50	Write Loadblock				5,8	
51	MMU Compare				6	
52	Dump MMU				7	

TABLE 3.9011(P)-3. MMU REGISTER A & B CONTENTS

BIT	REGISTER A	REGISTER B
0	Power Transient	Data Count Word Low
1	File Address Not Equal	Read Tape Data Dropout
2	Command error	Read Check Assurance Lost
3	Write Protect Violation	Read Tape Parity Error
4	Invalid Op Code	MIA Invalid Manchester Code
5		Command Received When Not Ready
6		EOF Block Count Zero
7		EOF No Search Address Compare
8		Malfunction
9		BOT Sensed
10		EOF Sensed
11		Power Supply Out of Tolerance
12		Bit Count Error
13		Parity Error
14		Invalid 101 Check
15		MIA Data/Address Error

4. DEDICATED DISPLAYS

In the User's Guide the definition of dedicated display encompasses lights, meters, and other indicators (such as talkbacks, etc.) which provide the user with visual data or notification other than that provided via the MCDS system as defined in Section 3.

4.1 DATA PROCESSING SYSTEM (DPS) TALKBACKS

GPCs and MCDSs have mechanical indicators (talkbacks) to provide a visual notification of status. For GPCs, the talkbacks are located on panel 06; for MCDSs, the talkbacks are located on the CRT enclosure plate immediately below the screen.

−1 For GPCs, each talkback is a mechanical plate driven to various states behind a viewing lens. Talkbacks and positions are as follows:

MODE:	IPL	-	The IPL pushbutton has been pressed and the micro-code is loading the Bootstrap Loader (FCM BOOT) from MMU. (If present for more than 15 seconds, indicates an IPL Hang condition.)
	Barberpole	-	(Gray/Black striped) - The GPC is idle due to mode switch position (in STBY for PASS, or HALT for PASS or BFS), IPLing, or failure.
	RUN	-	The GPC is actively processing in PASS or BFS.
OUTPUT:	Barberpole	-	The IOP transmitters are not enabled. For PASS, this may occur as a result of a fail-to-sync, BFS engaged, or output switch being in other than NORMAL (BFS or TERMINATE). For BFS, the talkback is barberpole unless BFS is engaged.
	Grey	-	The IOP transmitters are enabled and the software is performing outputs to flight critical buses.

−2 MCDS talkbacks are CORN-FLOWERS - a round disk of 3 white and 3 black wedges has a second round disk over it with 3 wedges removed. In the non-error state, the cover disk hides the white wedges of the first disk so that the indicator is all black. When tripped, the cover disk rotates clockwise to reveal the white wedges. It is reset (assuming the cause for tripping has been corrected) by rotating the cover counter-clockwise. Each MCDS has a display-unit (DU) talkback and a display electronics unit (DEU) talkback.

4.2 COMPUTER ANNUNCIATION MATRIX

The Computer Annunciation Matrix is a 5X5 set of lights located on panel O1. Figure 4-1 illustrates the matrix.

-1 The rows represent the voting GPCs, the columns represent failed GPCs. Each PASS GPC votes on itself and the other GPCs containing PASS and operating in either a Common or Redundant Set. If an off-diagonal light is illuminated, it means the voting computer for that row has issued a fail vote against the computer corresponding to the GPC column. Any diagonal light means that the computer has issued a fail vote against itself or two or more GPC's have issued failed votes against the computer. (55300)

	FAILED GPC						
VOTING GPC			1	2	3	4	5
	1						
	2						
	3						
	4						
	5						

Figure 4-1. Computer Annunciation Matrix (CAM)

4.3 CAUTION AND WARNING LIGHTS

The C&W lights are an 8X5 matrix (multicolored) located on panel F7. These lamps are illuminated when a failure of a specific nature is detected. Failures are annunciated when either a predetermined (hardware) limit has been exceeded or FSW detects a failure.

–1 Failures annunciated by FSW are:

BKUP C/W	When software has detected a class 2 fault in the C&W.
GPC	When a GPC has set its I-FAIL.
FCS SATURATION	When position of elevon exceeds limit or hinge moment greater than maximum.
IMU	When IMU redundancy management detects an IMU dilemma.
RGA/ACCEL	When AA or RGA FDIR encounters a dilemma condition.
LEFT RHC	When RHC FDIR encounters a left RHC dilemma condition.
RIGHT/AFT RHC	When RHC FDIR encounters an AFT or Right RHC dilemma condition.
FCS CHANNEL	When a failure has been detected in one of the four FCS channels.
AIR DATA	When ADTA RM encounters a dilemma condition.
RCS JET	When RCS RM detects failure in the forward, left, or right RCS jets.
FWD RCS	When a high/low tank pressure or leak condition is detected in the FWD RCS FU/OX tanks.
LEFT RCS	Same as for FWD RCS.
RIGHT RCS	Same as for FWD RCS.
OMS TVC	When OMS RM detects a left or right OMS gimbal failure.
LEFT OMS	When a left OMS high/low OX/FU tank pressure is detected or Chamber Pressure Fail indication occurs.
RIGHT OMS	Same as for left ones.

4.4 MASTER ALARM

The master alarm lamps are located on panels F2 and F4 and are illuminated and the C&W tone annunciated for predefined conditions. When software detects a fault in the Caution and Warning category, the signals are sent to the CW electronics unit to light the Master Alarm lights and turn on the C&W tone. The tone and Master Alarm lights are extinguished by depressing the Master Alarm PBI (with no software interface).

4.5 SM ALERT LIGHT

The SM Alert light is located on panel F7 and is illuminated when the FSW detects a fault in the Alert category. It is turned off by depressing the ACK or MSG RESET key on the keyboard.

4.6 REMOTE MANUPULATOR SYSTEM (RMS) INDICATORS

The RMS has several dedicated indicators to show the health of the ARM and status of its components. The presence of the RMS is mission dependent; thus, for some flights the indicators will not be available.

4.6.1 RMS Master Alarm (Panel A8A1)

The light illuminates and a caution and warning tone is annunciated for predefined conditions. The tone and light remain on until the Master Alarm button is depressed. (41533)

4.6.2 RMS Mode Lights (Panel A8A1)

These 12 lights are used to indicate which mode the RMS system is in (TEST, OPR CMD, AUTO 1, AUTO 2, AUTO 3, AUTO 4, ORB ONL, ORB LD, END EF, PAYLOAD, SINGLE, or DIRECT).

4.6.3 RMS Auto SEQ Lights (Panel A8A1)

Two lights are available for auto sequence execution (READY, IN PROG). The Ready Light indicates that the GPC is ready to execute the auto sequence. The In Progress light indicates that the GPC is executing the auto sequence. (42263)

4.6.4 RMS Caution Lights (Panel A8A1)

These lights indicate that a problem has occurred. The MCIU light indicates that a failure has occurred in the MCIU. The DERIGIDIZE light indicates that the end effector has derigidized without being commanded to do so (called an uncommanded derigidigation). The ABE light indicates that a failure has occurred in the arm based electronics. The RELEASE light indicates that the end effector has released the grapple fixture without being commanded to do so (called an uncommanded release). The GPC DATA light indicates that invalid data was transmitted by the orbiter GPC to the MCIU and the RMS Safing routine has begun executing. The SINGULAR light indicates that the configuration of the arm is approaching an arm singularity condition. The CHECK CRT light indicates that a failure message is on the orbiter CRT. The CONTR ERR light indicates joint abnormal conditions that may not be detected by BITE. The REACH LIM light indicates that one of the joints is close to its reach limit. The STBD TEMP light indicates that the temperature of a unit within the starboard arm is outside its safe operating range. The PORT TEMP light indicates that the temperature of a unit within the port arm is outside its safe operating range.

4.6.5 RMS Brakes Indicator (Panel A8A1)

ON indicates that all brakes are on. OFF indicates that all brakes are off.

4.6.6 RMS Safing Barber-Pole Indicator (Panel A8A1)

The gray indicates that safing is not in progress. The barber pole indicates that safing is in progress.

4.6.7 RMS Software Stop Barber-Pole Indicator (Panel A8A1)

The gray indicates that a stop has not been commanded by the GPC. The barber pole indicates that a software stop has occurred.

4.6.8 Rate MIN Indicator (Panel A8A1)

ON indicates that the vernier speed has been selected. OFF indicates that the coarse speed has been selected.

4.6.9 Rate Hold Indicator (Panel A8A1)

ON indicates that rate hold was commanded and has been implemented by the GPC. OFF indicates that the rate hold function is not in effect.

4.6.10 Rate Scale Indicator (Panel A8A1)

The gray indicates that the effective scales are as shown on the translational rate meter. X1O indicates that all readings should be multiplied by 10 for an actual reading.

4.6.11 EE Rigid Barber-Pole Indicator (Panel A8A1)

The gray indicates the end effector is rigidized. The barber pole indicates the end effector is not rigidized.

4.6.12 EE Derigid Barber-Pole Indicator (Panel A8A1)

The gray indicates the end effector is between the zero tension point and the fully extended position (i.e., the EE is derigidized). The barber pole indicates the end effector is between the zero tension point and the fully rigidization position (i.e., the EE is not derigidized).

4.6.13 EE Close Barber-Pole Indicator (Panel A8A1)

The gray indicates that the capture mechanism is closed. The barber pole indicates that the capture mechanism is open or between the two states.

4.6.14 EE Open Barber-Pole Indicator (Panel A8A1)

The gray indicates that the capture mechanism is in the fully open position. The barber pole indicates that the capture mechanism is closed or between the two states.

4.6.15 EE Capture Barber-Pole Indicator (Panel A8A1)

The gray indicates that the snares of the end effector have been driven against the grapple fixture and have come to rest. The barber pole indicates that the end effector has not captured a payload grapple pin.

4.6.16 EE Extend Barber-Pole Indicator (Panel A8A1)

The gray indicates the end effector is fully extended. The barber pole indicates the end effector is somewhere between the rigidized and the extended positions.

4.6.17 Shoulder Brace Release Barber-Pole Indicator (Panel A8A1)

The gray indicates that the shoulder brace has been unlatched. The barber pole indicates that the shoulder brace is still latched.

4.6.18 STBD RMS STO/LAT Indicators (Panel A8A2)

These flags indicate the stow/deploy status of the arm and the status of the RMS retention latches. STO, indicates that the arm is in a stowed position. DEP, indicates that the arm is in a deployed position. LAT, indicates that the three RMS retention latches are latched. REL, indicates that the three RMS retention latches are released.

4.6.19 STBD RMS Ready-For-Latch AFT/MID/FWD Barber-Pole Indicators (Panel A8A2)

The gray indicates that the particular retention fitting is in position for latching. The barber pole indicates that the particular retention fitting is not in position for latching.

4.6.20 PORT RMS STO/LAT Indicators (Panel A8A2)

These flags indicate the stow/deploy status of the arm and the status of the RMS Retention latches. STO, indicates that the arm is in a stowed position. DEP, indicates that the arm is in a deployed position. LAT, indicates that the three RMS Retention latches are latched. REL, indicates that the three RMS Retention latches are released.

4.6.21 PORT RMS Ready-For-Latch AFT/MID/FWD Barber-Pole Indicators (Panel A8A2)

The gray flag indicates that the particular retention fitting is in position for latching. The barber pole indicates that the particular retention fitting is not in position for latching.

4.6.22 RMS Digital Display

These three readouts display RMS status information based on the position of the parameter select rotary switch. The readouts have four digits and a sign. The parameters available for display are: TEST, POSITION X/Y/Z, ATTITUDE P/Y/R, JOINT ANGLE, VEL X/Y/Z, RATE P/Y/R, TEMP LED/ABE/ID PORT, and STBD.

4.6.23 RMS Actual And Commanded Rates Indicator

The rate indicator on panel A8A1 displays actual and commanded rates. The indicator is shown in Figure 4-2. On the left of the scale, the ACT indicates the actual speed of the end effector along the resultant vector of the coordinate system in effect. The right side of the meter, labeled CMD, indicates the commanded speed of the end effector along the resultant vector of the coordinate system in effect. These values represent feet per second. The tape behind the pointers is fixed and the pointers in the meter will move up and down for the correct meter reading. To find out whether or not the values shown need to be multiplied by ten, the SCALE indicator (discussed in Section 4.6.10) must be considered. If the scale indicator is gray, the pointer values are correct. If the scale indicator shows a X1O, then the readings should be multiplied by ten.

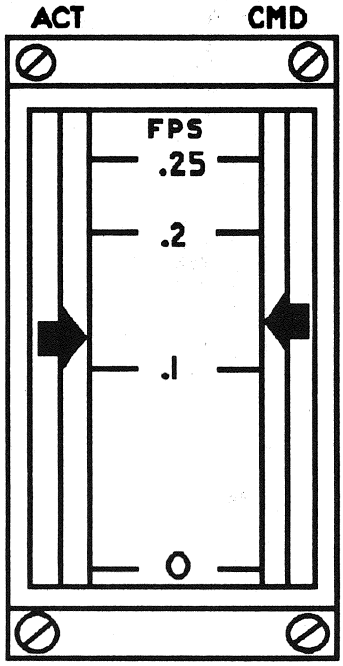


Figure 4-2. RMS Rate Meter

TABLE 4.6-1. DEDICATED DISPLAY DATA

METER: RMS Rate Indicator		VALID OPS/MODES: 201, 202, 401, 402		
INDICATOR	SWITCH POSITION	DESCRIPTION	UNITS	LIMITS
ACTUAL		Actual Rate of RMS	FPS	0, 0.25* 0, 2.5
COMMAND		Command rate of RMS	FPS	0, 0.25* 0, 2.5

*Selection of limits based on scale indicator (4.6.10).

4.7 GNC DEDICATED DISPLAYS

Allows the crew to monitor continuous presentations of time critical flight parameters, an independent means of monitoring automatic flight control performance, and the flight data necessary for manual override of vehicle control. Additionally, the Dedicated Display lamps permit the crew to status the flight control mode, entry/landing events, and reaction control system activity.

–1 The Dedicated Displays consist of the following meters and lights:

- Attitude Director Indicator (ADI)
- Horizontal Situation Indicator (HSI)
- Alpha/Mach Indicator (AMI)
- Altitude/Vertical Velocity Indicator (AVVI)
- Surface Position Indicator (SPI)
- Flight Control System Mode Status Lights
- Reaction Control System Activity Lights
- Head-Up Display (HUD)

–2 The ADI, HSI, AMI, and AVVI are driven by a Display Driver Unit (DDU); the HUD by a Head-Up Display Electronics unit (HUDE), and the SPI and lights by the Multiplexer/Demultiplexer (MDM). However, the DDU, HUDE and MDM all receive their data from the flight software. Availability of the various meters and lights throughout the major modes are shown in Table 4.7-1.

TABLE 4.7-1. DEDICATED DISPLAYS AVAILABILITY MATRIX

METERS/LIGHTS DESCRIPTIONS	MAJOR MODES																
	101	102	103	104	105	106	201	202	301	302	303	304	305	601	602	603	801
AMI		X	X									X	X	X	X	X	
AVVI		X	X									X	X	X	X	X	
ADI (FWD)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
ADI (AFT)							X	X									X
HSI	X	X	X									X	X	X	X	X	
SPI									X	X	X	X	X		X	X	
RCS ACTIVITY LAMPS									X	X	X	X	X		X	X	
HUD												X	X		X	X	
FCS STATUS LAMPS												X	X	X	X	X	

4.7.1 ATTITUDE DIRECTION INDICATOR (ADI)

The ADI displays:

- Orbiter roll, pitch, yaw attitude via gimballed ball
- Attitude errors via three meter-position needles
- Attitude rates via three meter-position pointers
- Condition of indicators

−1 All ADI displays are FLY-TO indications (i.e., directions in which the crew should maneuver the vehicle). For condition of the indicators, an OFF flag signifies when one or more of the attitude ball positioning signals is invalid. For the attitude error and rate indicators, the needle or pointer is stowed (out-of-view) upon occurrence of an invalid signal.

−2 Three ADIs are installed in the Shuttle vehicle; one each in the commander, pilot, and aft stations. Additionally the aft station includes a sense switch for more control of the aft ADI display. The two forward ADIs are supported throughout the entire mission, while the aft ADI is active only during on-orbit operations. Additionally, the three ADIs may be tested during on-orbit checkout via the FCS/Dedicated Display Checkout Spec Function.

−3 The ADI quantities displayed are updated at different rates, depending on the parameter and operational mode.

−4 The ADI indicators are shown in Figure 4-3.

−5 Roll attitude is displayed as clockwise/counterclockwise movement of the gimballed ball with the angle indicated on the circular scale enclosing the ball. Pitch attitude is displayed as up/down movement, with the angle read as a horizontal scale of the ball. Yaw attitude is displayed as sidewise movement, with the angle read as a vertical scale of the ball. A more positive angle on an axis will drive the attitude ball in the following manner: roll, counterclockwise; pitch, downward; and yaw, left. Attitude information is derived with respect to a reference frame, which is predefined during entry/landing. During ascent and on-orbit operations, reference frame selection is provided by the ADI ATTITUDE switch. In conjunction with the attitude switch REF position an attitude reference switch further defines reference frame selection. The reference frame in effect for an operational mode is shown in Table 4.7.1-1.

−6 The roll attitude error is indicated by a needle which moves along the top of the gimballed ball about an outer scale on the plate enclosing the ball. The pitch attitude error is indicated by a needle which moves up and down the right side of the ball about an outer scale on the plate; and the yaw error needle moves across the bottom of the ball.

−7 A positive polarity signal will drive its associated needle in the following direction: roll error, left; pitch error, down; yaw error, left. The error data displayed is dependent upon the operational mode, as shown in Table 4.7.1-1. Further, the magnitude of the displayed data is controlled by the error scale selection switch.

−8 The roll attitude rate is displayed by a pointer and scale above the gimballed ball. The pointer moves left/right. The pitch attitude rate is displayed by a pointer and scale located to the right of the ball. This pointer moves up/down. The yaw attitude rate pointer and scale are below the attitude ball, with the pointer moving left/right. A positive polarity signal will drive its associated pointer in the following direction: roll rate, right; pitch rate, up;yaw rate, right. The rate data displayed is dependent upon the operational mode, as specified in Table 4-1. Similarly for the error data, the magnitude of the displayed data is controlled by the rate scale selection switch. (37538)

−9 The following notes document various mannerisms exhibited by the various needles and flags of the ADI:

−9.1 The ADI rotation rates may be much higher than the actual body rates whenever the yaw angle approaches 90 degrees. (39408)

−9.2 The ADI pitch error needle becomes very sensitive as time-to-go (tgo) becomes small during +4x RCS maneuvers. (37562)

−9.3 The ADI yaw error needle is sensitive during fuel wasting maneuvers (OPS 3). This sensitivity is usually most noticeable near cutoff shortly before the PEG thrust pointing commands are frozen (tgo = 6 seconds). Typically the yaw needle will diverge suddenly or appear to jump near a tgo of 6 seconds. (37559)

−9.4 The ADI error needles will not automatically use the OPS 202 PEG guidance solution as their attitude reference. (46512)

−9.5 When both OMS engines are shut off prematurely via ARM/PRESS switch and guidance is not yet converged to RCS solution, commanded body attitude task uses last OMS thrust direction value and I-loaded RCS trim value. (46505)

−9.6 Current GNC PASS software does not withdraw the RCS jets associated with a powered-off Reaction Jet Driver Assembly (RJDA) from the Flight Control usage availability; consequently, those jets may be commanded to fire by the on-orbit DAP. In that event, the on-orbit DAP will compute an expected attitude rate in its state estimator logic and will pass that value to the ADI for display. (42085)

−9.7 The ADI needles will be stowed if guidance remains uncoverged for 5 cycles (approximately 10 seconds). (51805/51807)

−9.8 Pre-launch ADI reference (37528) (37538)

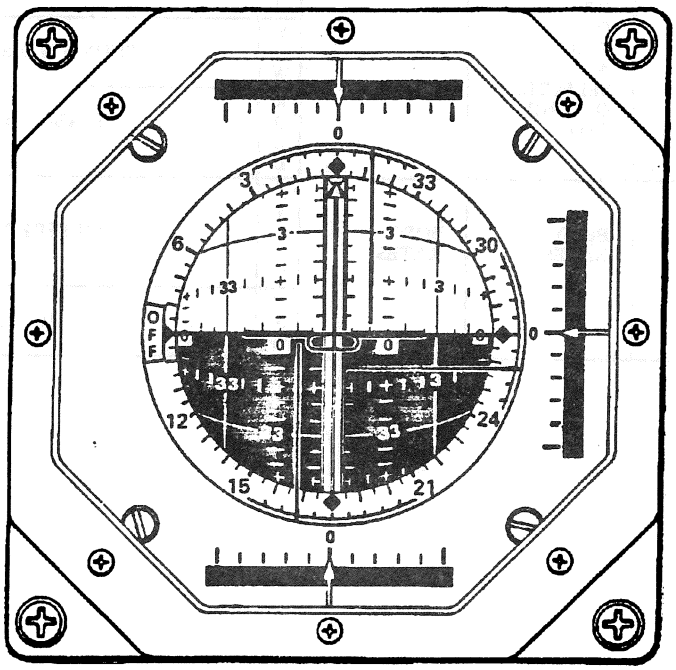


Figure 4-3. ADI Unit

TABLE 4.7.1-1. ADI DISPLAY DATA

DISPLAY	OPS 1 ASCENT	OPS 2 ON-ORBIT	OPS 3/OPS 6 PRE ENTRY	ENTRY	TAEM	TOUCHDOWN
			301,302,303	304	305	305
			< X SEC AFTER 602	X SEC AFTER 602	603	

ATTITUDE	INRTL	INERTIAL REFERENCE FRAME	ROLL	LOCAL HORIZONTAL		
	REF	STORED REFERENCE FRAME	PITCH	LOCAL VERTICAL, TOPODETIC		
	LVLH	LOCAL VERTICAL, LOCAL HORIZONTAL FRAME	YAW	FIXED AT ZERO		
ERRORS	LAUNCH GUIDANCE COMMAND ERRORS	ON-ORBIT GUIDANCE COMMAND ERRORS TOTAL OR DAP ERROR AS SELECTED ON UNIV PTG	DIGITAL AUTOPILOT COMMAND ERRORS	ROLL	BANK GUIDANCE	ROLL ATTITUDE ERROR	ROLL ATTITUDE ERROR
				PITCH	602 ALPHA	602 NZ HLD	SLAPDOWN PITCH RATE ERROR
					AOA GUIDANCE ERROR	NORMAL ACCELERATION ERROR	
				YAW	ESTIMATED SIDESLIP ERROR		
				ROLL	STABILITY ROLL RATE		
RATES	BODY RATES	BODY RATES	BODY RATES	PITCH	FILTERED PITCH RATE		
				YAW	STABILITY YAW RATE		

TABLE 4.7.1-2. DEDICATED DISPLAY SWITCH CONTROLS

METER: ADI	VALID OPS/MODES: All GNC Flight OPS/Modes
SWITCH POSITION	DEFINITION
Commander ADI Attitude	Switch is forced to LVLH in major modes 304, 305, 602, and 603 by PASS.
INRTL	Display roll, pitch, and yaw with respect to the inertial reference frame.
LVLH	Display roll, pitch, and yaw with respect to the local vertical, local horizontal reference system.
REF	Display roll, pitch, and yaw with respect to a pre-defined reference frame: body frame if Attitude Reference PBI is on; or stored ADI reference if it is not.
Commander Attitude Reference Select	Push-button which selects either the stored reference frame or body frame as the reference system for ADI data when ADI Attitude switch is in REF. Flip/flop to choose between the two.
Commander ADI Error	Displays roll, pitch, and yaw errors.
HIGH	Full scale deflection = 10 degrees, except pitch in MM 305 = 1.25g (normal acceleration).
MED	Full scale deflection = 5 degrees, except pitch in MM 305 = 1.25g.
LOW	Full scale deflection = 1 degree, except pitch in MM 305 = .5g.
Commander ADI Rate	Displays roll, pitch, and yaw rates.
HIGH	Full scale deflection = 10 degrees.
MED	Full scale deflection = 5 degrees.
LOW	Full scale deflection = 1 degree.
Pilot	All pilot switches are identical to the commander's.
AFT	All AFT switches are identical to the commander's.

TABLE 4.7.1-3. DEDICATED DISPLAY DATA

METER: ADI		VALID OPS/MODES: All GNC Flight OPS/Modes		
INDICATOR	SWITCH POSITION	DESCRIPTION	UNITS	LIMITS
Roll	All	Roll angle with respect to selected reference frame.	Deg	0,360
Pitch	All	Pitch angle with respect to selected reference frame.	Deg	0,360
Yaw	All	Yaw angle with respect to selected reference frame. NOTE: In MM 304-305 and MM 602-603, the selected reference frame is forced to LVLH and Yaw = 0.	Deg	0,360
Roll Error	HIGH	Delta in roll between actual and commanded (see Table 4.7.1-1).	Deg	−10, + 10
	MED	Same.	Deg	−5, + 5
	LOW	Same.	Deg	−1, + 1
Pitch Error	HIGH	Delta in pitch between actual and commanded (see Table 4.7.1-1), except in MM 305 (TAEM).	Deg g's	−10, + 10 −1.25, + 1.25
	MED	Same.	Deg g's	−5, + 5 −1.25, + 1.25
	LOW	Same.	Deg g's	−1, + 1 −.5,+.5
Yaw Error	HIGH	Delta in yaw between actual and commanded (see Table 4.7.1-1), except in MM 304-305 and MM 602-603, fixed zero.	Deg	−10, + 10
	MED	Same.	Deg	−5, + 5
	LOW	Same.	Deg	−1, + 1
Roll Rate	HIGH	Rate at which vehicle is rotating about the roll axis.	Deg/Sec	−10, + 10
	MED	Same.	Deg/Sec	−5, + 5
	LOW	Same.	Deg/Sec	−1, + 1
Pitch Rate	HIGH	Rate at which vehicle is rotating about the pitch axis.	Deg/Sec	−10, + 10
	MED	Same.	Deg/Sec	−5, + 5
	LOW	Same.	Deg/Sec	−1, + 1

4.7.2 HORIZONTAL SITUATION INDICATOR (HSI)

The HSI provides the crew with a pictorial view of the vehicle position with respect to various navigation points, and a visual perspective of GNC parameters including directions, distances, and course/glidepath deviations. The information presented constitutes the minimum necessary for manual vehicle control. The data sources and computational software associated with manual control enable the crew to independently monitor and assess the GNC automatic mode. Finally, the HSI provides real-time diagnosis and correction of problems through status flags, which permit the crew to select good input sources and inhibit bad sources from the automatic mode.

Two HSIs and their associated switches are installed in the cockpit; one each in the commander and pilot stations. The HSIs are supported during entry/landing and during powered flight in ascent/RTLS. They may be tested during on-orbit checkout by the Dedicated Display Checkout program when activated by the FCS/DED DISP C/O display.

The two HSIs are supported independently by the HSI 3.125 Hz Processing program. During ground checkout, the two HSIs may be tested by the Dedicated Display Checkout Cyclic I/O Processor of the Vehicle Utility Software.

The HSI displays the following information:

- magnetic heading
- selected course
- course deviation
- glide slope deviation
- primary and secondary bearing
- primary and secondary distance
- validity flags

The nomenclature for the HSI is shown in Figure 4-4.

−1,2 The compass card displays the magnetic heading, which is read as the value on the card under the fixed lubber line. For a zero heading, the compass card is positioned at 0 degrees (N). The compass card rotates counterclockwise as the heading increases.

−3 The course pointer, which rotates along the inside edge of the compass card, displays the selected course. The selected course is read as the value on the compass card at the tip of the course pointer. For a zero course input, the pointer is positioned at the lubber line regardless of the compass card position, since the pointer is driven relative to the HSI case. The course pointer rotates clockwise as the course input increases.

−4 Course deviation is reflected in movement of the course deviation bar located between the course pointer and the reciprocal course pointer. If the deviation input to the meter is zero, the bar will be aligned with the pointers. As the vehicle deviates left of the selected course, the deviation bar will deflect right of the course pointer to direct a command to fly right. A vehicle deviation right of course will cause a left displacement of the bar. The deviation angle is defined by the position of the bar relative to the dots of the scale.

−5 Glide slope deviation is exhibited by the position of the glide slope deviation pointer on the right side of the HSI. Displacement of the vehicle above the glide slope causes the pointer to deflect downward, corresponding to a command to fly down. Similarly, displacement below the glide slope causes an upward deflection of the pointer. The distance above or below the glide slope is determined by the position of the pointer with respect to the dots of the scale.

−6 The primary (P) and secondary (S) bearing pointers rotate along the outside edge of the compass card and present bearing information relative to the compass card when the card is positioned by heading data. When the bearing input is zero, the pointer will be positioned at the lubber line, regardless of the card position. An increase in bearing causes the pointer to rotate clockwise. The bearing angle is read as the value on the compass card coincident with the pointer.

–7 The primary and secondary distance wheel indicators (PRI MILES/SEC MILES) in the upper corners of the HSI provide a measurement of the distance between the vehicle and various navigation points. The display range of these indicators is 0000 to 3999 miles. (30139)

–8,9,10 To signify validity of the instrument and indicators, the following flags are provided on the HSI:

- OFF, power off or low power (less than 20 watts)
- BRG, heading and primary/secondary bearing may be invalid
- GS, glide slope deviation display invalid
- Barberpole, PRI/SEC MILES invalid

For the parameters described above, in major modes 304, 305, 602 and 603, two other entities affect both their meanings and values: the software, and the data source used for the computation of the parameters. Software selection is controlled by the HSI Select Mode switch, major mode, and altitude above the runway; data source selection is controlled by the HSI Select Source switches and the associated TACAN or MLS controls. The HSI switch controls are defined in Table 4.7.2-1 and the meaning of the parameters with respect to the Mode Switch Setting is defined in Table 4.7.2-2.

During major modes 101-103 and 601, the HSI is used to provide the crew with lateral directional data.

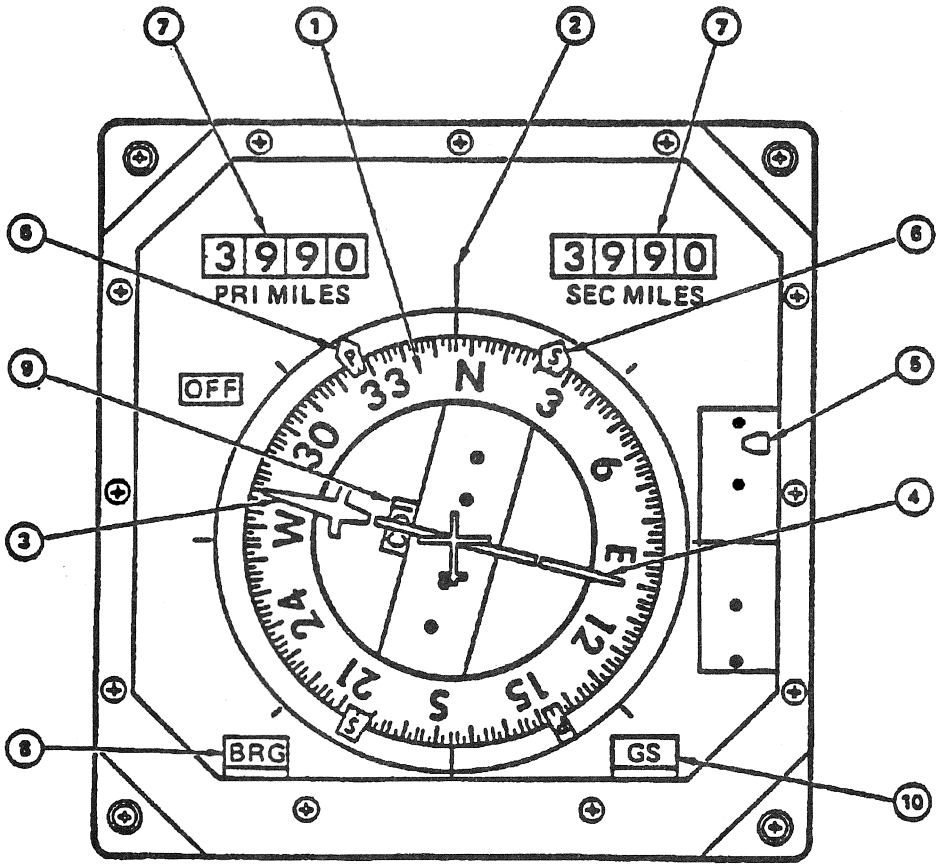


Figure 4-4. HSI Display

TABLE 4.7.2-1. DEDICATED DISPLAY SWITCH CONTROLS	
METER: HSI	VALID OPS/MODES: 101-103, 601-603, 304, 305
SWITCH POSITION	DEFINITION
Commander HSI Select Mode	Not sensed in MM 101-103 and 601. Refer to Data Table for a detailed definition.
ENTRY	Selects the computation of parameters based on initial entry equations.
TAEM	Selects the computation of parameters based on TAEM equations.
A/L	Selects the computation of parameters based on A/L equations.
Commander HSI Select Source	Not used in MM 101-103 and 601. NAV position is assumed.
TACAN	Use TACAN data as source for computations.
NAV	Use navigationally derived data as source for computations.
MSBLS	Use MSBLS data as source for computations.
Commander HSI Select Source	Not used in MM 101-103 and 601. In 602, 603, 304, and 305 if the HSI select source switch above is in the NAV position, this switch is not used in processing.
1	Use data from TACAN 1 or MSBLS 1 as selected above.
2	Use data from TACAN 2 or MSBLS 2 as selected above.
3	Use data from TACAN 3 or MSBLS 3 as selected above.
Pilot	Pilot's switches are identical to the commander's.

TABLE 4.7.2-2. DEDICATED DISPLAY DATA

METER: HSI		VALID OPS/MODES: 101-103, 601-603, 304, 305		
INDICATOR	SWITCH POSITION	DESCRIPTION	UNITS	LIMITS
Primary Miles	ASCENT	Not computed.		0,0
	ENTRY	Spherical surface range to WP-2 on primary runway via WP-1 for NEP (LSB = 1 NM).	NM	0,3999*
	TAEM	Horizontal distance to WP-2 on primary runway via WP-1 for selected EP (LSB = .1 NM).	NM	0,3999*
	A/L	Horizontal distance to WP-2 on primary runway (LSB = .1 NM).	NM	0,3999*
Secondary Miles	ASCENT	Not computed.		0,0
	ENTRY	Spherical surface range to WP-2 on secondary runway via WP-1 for NEP (LSB = 1 NM).	NM	0,3999*
	TAEM	Horizontal distance to center of selected HAC for primary runway (LSB = .1 NM).	NM	0,3999*
	A/L	Horizontal distance to WP-2 on primary runway (LSB = .1 NM).	NM	0,3999*
		*NOTE: For both primary and secondary distance > 999 NM, or in MM 304 or MM 602, or velocity > 6000 FPS, the units wheel will be zero.		
Primary Bearing	ASCENT	Bearing to primary runway.	Deg	0,360
	ENTRY	Spherical bearing to WP-1 for selected HAC at primary runway.	Deg	0,360
	TAEM	Bearing to WP-1 on selected HAC as viewed from shuttle.	Deg	0,360
	A/L	Bearing to WP-2 at primary runway as viewed from shuttle.	Deg	0,360
Secondary Bearing	ASCENT	Inertial velocity direction.	Deg	0,360
	ENTRY	Spherical bearing to WP-1 for selected HAC at secondary runway.	Deg	0,360
	TAEM	Bearing to center of selected HAC for primary runway.	Deg	0,360

TABLE 4.7.2-2. DEDICATED DISPLAY DATA (Continued)

METER: HSI		VALID OPS/MODES: 101-103, 601-603, 304, 305		
INDICATOR	SWITCH POSITION	DESCRIPTION	UNITS	LIMITS
	A/L	Same as primary bearing.	Deg	0,360
Course Deviation	ASCENT	Inertial sideslip angle using inertial velocity WRT the air mass.	Deg	0,360
	ENTRY	Not computed (= 0).		0,0
	TAEM	Deviation from extended runway centerline.	Deg	−10, + 10
	A/L	Deviation from extended runway centerline.	Deg	−2.5, + 2.5
Glide Slope Deviation	ASCENT	Not computed.		0,0
	ENTRY	Not computed. Flag for GSI set invalid.		
	TAEM	Vertical deviation from TAEM guidance reference altitude.	FT	−5000, + 5000
	A/L	Vertical deviation from linear segment reference altitude. Not computed after final flare.	FT	−1000, + 1000
Compass Card	ASCENT	Yaw attitude WRT the orbital insertion plane.	Deg	0,360
	ENTRY	Magnetic heading of vehicle earth relative velocity vector.	Deg	0,360
	TAEM	Magnetic heading of body X-axis.	Deg	0,360
	A/L	Magnetic heading of body X-axis.	Deg	0,360
Selected Course	ASCENT	Heading of vehicle relative to runway.	Deg	0,360
	ENTRY	Same as compass card.	Deg	0,360
	TAEM	Same as compass card.	Deg	0,360
	A/L	Same as compass card.	Deg	0,360

4.7.3 ALPHA MACH INDICATOR (AMI)

The AMI displays the following flight parameters to the crew:

- angle of attack
- vehicle acceleration
- vehicle mach/velocity
- equivalent airspeed
- condition of indicators

–1 The AMI is shown in Figure 4-5.

–2 On the AMI, the left-most scale, ALPHA, indicates the angle of attack in degrees. The angle is read as the value on the scale opposite a movable pointer. Left of center, the scale, ACCEL, indicates the vehicle acceleration in feet per second square or G's; right of center, M/VEL indicates Mach number or velocity in M or feet per second; and right-most, EAS indicates equivalent air speed in knots. The ACCEL, M/VEL, and EAS scales consist of moving tapes behind fixed lubber lines. The vehicle acceleration, mach number or velocity, and equivalent air speed are read as the value on the associated scale at the lubber line.

–3 In Entry, the AMI data are affected by the source of information. For input to the AMI, the AIR DATA switch selects left or right air data probe, or navigation derived data as the source. For air data probe selection to be meaningful, the appropriate air data probe deployment switch must be engaged. In Ascent, the AMI data source is Guidance and the air data probe deployment switch has no effect on the AMI.

–4 Each of the four AMI scales includes a mechanically spring loaded flag which indicates its condition. A flag will appear when there is a malfunction in the indicator or invalid data is received. If all four flags are displayed, a power failure condition exists.

–5 One AMI and its associated AIR DATA switch are located in the commander station of the Shuttle; another AMI and switch in the pilot station. The AIR DATA PROBE deployment switches are located on panel C3 of the forward lower center station. The AMIs are active during ascent and entry/landing and may be tested during on-orbit checkout via the FCS/Dedicated Display Checkout SPEC. The AMI parameters are updated at the following rates:

Control word	1.04 Hz
Angle of attack	6.25 Hz
Vehicle acceleration	6.25 Hz
Mach number/velocity	6.25 Hz
Equivalent air speed	1.04 Hz

–6 The two AMIs are driven independently during Entry by the AMI/AVVI Processor and are individually tested during ground checkout by the Dedicated Display Checkout Cyclic I/O Processor of the Vehicle Utility software. In Ascent, the two AMIs are driven from the same data.

–7 The AMI switch controls and display data are defined in Tables 4.7.3-1 and 4.7.3-2, respectively.

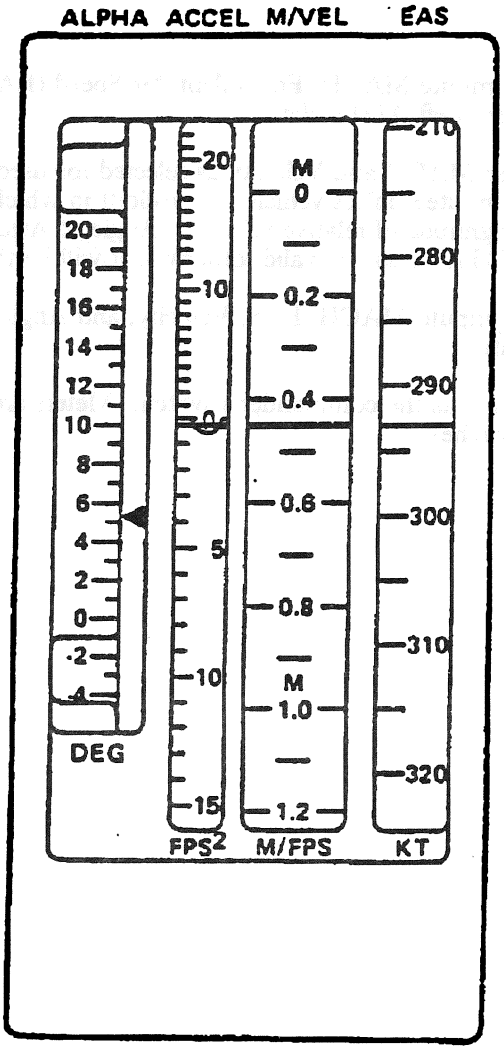


Figure 4-5. AMI Unit

TABLE 4.7.3-1. DEDICATED DISPLAY SWITCH CONTROLS

METER: AMI	VALID OPS/MODES: 304, 305, 602, 603
SWITCH POSITION	DEFINITION
Commander Air Data Source Select	
LEFT	Compute MACH, Equivalent Air Speed (EAS), Velocity, and Angle of Attack from Left ADTA data.
NAV	Use MACH and Velocity as selected for used by NAV. EAS will be computed unless vehicle is in rollout in which case EAS is replaced by the magnitude of relative velocity. Angle of Attack will be computed from ADTAs if data is valid, otherwise it will be the NAV derived value.
RIGHT	Compute MACH, EAS, Velocity, and Angle of Attack from Right ADTA data.
Pilot Air Data Source Select	Same as the commander's switch. Meters are driven based on the independent switches.

TABLE 4.7.3-2. DEDICATED DISPLAY DATA

METER: AMI		VALID OPS/MODES: 102, 103, 304, 305, 601-603		
INDICATOR	SWITCH POSITION	DESCRIPTION	UNITS	LIMITS
ALPHA	LEFT	Angle of Attack from left ADTA.	DEG	−18, + 60
	NAV	Computed Angle of Attack from selected ADTA data if valid, otherwise, NAV data.	DEG	−18, + 60
	RIGHT	Angle of Attack from right ADTA.	DEG	−18, + 60
		Guidance derived Angle of Attack in MM 102 and 103.	DEG	−18, + 60
ACCEL		Guidance derived vehicle acceleration in MM 304, after WOW in MM 305 and 603.	ft/sec^2	−50, + 100
		Normal Accel. from AA in MM 602, prior to WOW in MM 305 and 603.	ft/sec^2	−50, + 100
		Total load (in g's) in MM 102, 103, and 601.	ft/sec^2	−50, + 100
MACH/VEL	LEFT	MACH or velocity from left ADTA data in MM 304, 305, 602, and 603.	MACH Kft/sec	0,4 4,27
	NAV	MACH or velocity from selected ADTA in MM 304, 305, 602, and 603.	MACH Kft/sec	0,4 4,27
	RIGHT	MACH or velocity from right ADTA data in MM 304, 305, 602, and 603.	MACH Kft/sec	0,4 4,27
		Guidance derived MACH in MM 102, 103, and 601.	MACH Kft/sec	0,4 4,27
EAS	LEFT	Equivalent Air Speed from left ADTA.	Knots	0,500
	NAV	EAS from selected ADTA or if in rollout use relative velocity.	Knots	0,500
	RIGHT	EAS from right ADTA.	Knots	0,500
		Guidance derived EAS in MM 102, 103, and 601.	Knots	0,500

4.7.4 ALTITUDE/VERTICAL VELOCITY INDICATOR (AVVI)

The AVVI displays the following flight parameters to the crew:

- vertical acceleration
- vertical velocity
- barometric altitude
- radar altitude
- condition of indicators

–1 The AVVI is shown in Figure 4-6.

–2 On the AVVI, the left-most scale, ALT ACCEL, indicates the vertical acceleration in feet per second square. The acceleration is read as the value on the scale opposite a movable pointer. Left of center, the scale, ALT RATE, indicates vertical velocity in feet per second; right of center, ALT indicates barometric altitude in feet and right-most, RDR ALT indicates radar altitude in feet. The ALT RATE, ALT, and RDR ALT scales consist of moving tapes behind fixed lubber lines. The vertical velocity, barometric altitude, and radar altitude is read as the value on the associated scale at the lubber line. The barometric altitude is commonly referred to as the indicated altitude. In Ascent, only the ALT and ALT Rate Scales are used; in Entry all scales are used.

–3 In Entry, the AVVI data are affected by the sources of information. For input to the AVVI, the AIR DATA switch selects left or right air data probe, or navigation derived data as one source of information; and the RADAR ALTM switch selects radar altimeter 1 or 2 as the other source of information. For the radar altimeter selection to be meaningful, the radar altimeter power switches must be engaged; for air data source selection, the appropriate air data probe deployment switch must be enabled. It should be noted that radar altimeter controls affect only the radar altitude indication. In Ascent, the data is not affected by these switches.

–4 To indicate its condition, each indicator of the AVVI includes a mechanically spring loaded flag. The flag will appear when a malfunction in the indicator or invalid data is received. If all four flags are displayed, a power failure condition exists.

–5 One AVVI and its associated air data source and radar altimeter selection switches are located in the commander station of the Shuttle; another AVVI and its control switches in the pilot station. The AIR DATA PROBE deployment switches are located on panel C3 of the forward lower center station and the RADAR ALTIMETER power switches, on panel 08 of the forward right overhead station. The AVVIs are active during ascent and entry/landing and may be tested during on-orbit checkout via the FCS/Dedicated Dispaly Checkout SPEC. The AVVI parameters are updated at the following rates:

Control word	1.04 Hz
Vertical acceleration	6.25 Hz
Vertical velocity	6.25 Hz
Indicated (barometric) altitude	6.25 Hz

–6 The two AVVIs are driven independently during Entry by the AMI/AVVI Processor and are individually tested during ground checkout by the Dedicated Display Checkout Cyclic I/O Processor of the Vehicle Utility software. In Ascent, the two instruments are set the same.

–7 The AVVI switch controls and display data are defined in Tables 4.7.4-1 and 4.7.4-2, respectively.

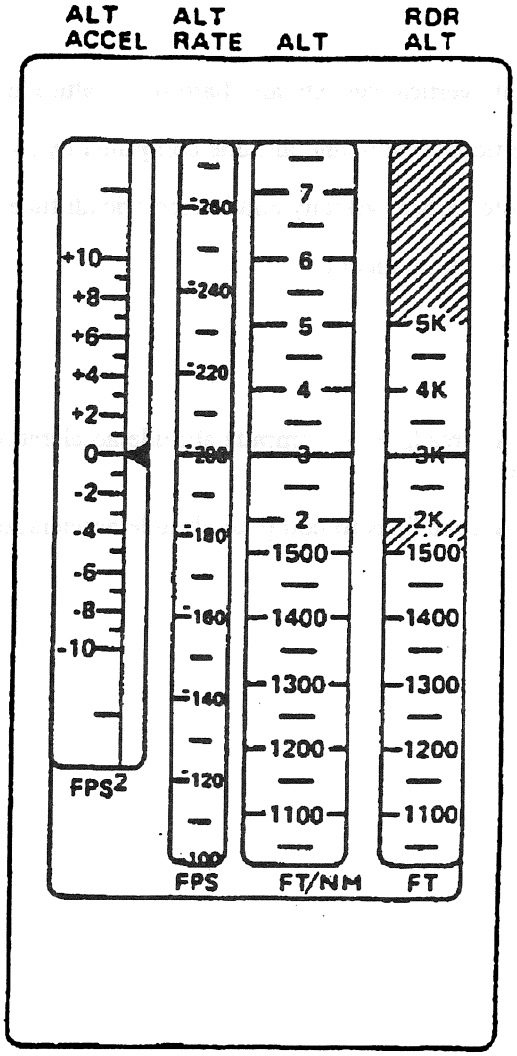


Figure 4-6. AVVI Unit

TABLE 4.7.4-1. DEDICATED DISPLAY SWITCH CONTROLS	
METER: AVVI	VALID OPS/MODES: 101-103, 602, 603, 304, 305
SWITCH POSITION	DEFINITION
Commander Air Data Source Select	
LEFT	Compute vertical velocity and barometric altitude using left ADTA data.
NAV	Use vertical velocity and altitude computed by navigation.
RIGHT	Compute vertical velocity and barometric altitude using right ADTA data.
Pilot Air Data Source Select	Same as Commander's.
Commander Radar Altimeter	
1	Use RA 1 readings to compute altitude acceleration (vertical) and radar altitude.
2	Use RA 2 readings to compute altitude acceleration (vertical) and radar altitude.

TABLE 4.7.4-2. DEDICATED DISPLAY DATA

METER: AVVI		VALID OPS/MODES: 101-103, 602, 603, 304, 305		
INDICATOR	SWITCH POSITION	DESCRIPTION	UNITS	LIMITS
Altitude Acceleration		Ascent: Not computed.		0,0
		Vertical vehicle acceleration computed by User Parameters.	FPSS	−12.75, +12.75
Radar Altitude		Ascent: Not computed.		0,0
	RA-1	Radar altitude based on data from radar altimeter 1.	FT	0,500 500,9000
	RA-2	Same as RA-1 except radar altimeter 2 is used.	FT	0,500 500,9000
Altitude		Ascent: Vehicle altitude computed by User Parameters.	FT	−1100, 100K
	LEFT	Vehicle altitude based on left ADTA data (WRT mean sea level).	FT	−1100, 100K
	NAV	Vehicle altitude based on NAV derived parameters (WRT ellipsoid).	FT	−1100, 100K
	RIGHT	Vehicle altitude based on right ADTA data (WRT mean sea level)	FT	−1100, 100K
Altitude Rate		Rate computed by User Parameters, based on major mode.	FPS	−2940, +2940

4.7.5 SURFACE POSITION INDICATOR (SPI)

The SPI displays the position of the vehicle control surfaces and the GNC speedbrake command which include:

- position of the elevons
- position of the body flap
- position of the rudder
- position of the aileron
- speedbrake position and command
- condition of the indicators

–1 The SPI is shown in Figure 4-7.

–2 Only one SPI is installed on a vehicle, and is located in the center of Panel F7 of the forward crew station. The SPI may be tested during ground checkout via Spec 100.

–3 The position of the elevons is indicated by the leftmost four scales labeled ELEVONS-DEG. The left outboard and inboard positions are depicted by the two scales adjacent to the letter L and the right inboard and outboard positions, by the two scales adjacent to the letter R. Elevon position is measured as an angle up or down from a level position, with positive polarity in the downward direction. Thus, maximum negative elevon indication corresponds to the full up position; maximum positive, to the full down position.

–4 BODY FLAP % indicates body flap position as a percentage of the full amount that the body flap can extend from the vehicle body. RUDDER DEG is the angular position of the rudder, left or right, of a center position. AILERON_DEG is the angular position of the aileron, left or right, of a center position. The aileron position is calculated as the difference between the average left and right elevon positions. SPEEDBRAKE % indicates the degree the speedbrake is deployed and is measured as a percentage of full deployment. COMMAND indicates the deployment, as a percentage of maximum capability, as requested by the crew. Each indicator on the SPI consists of a fixed scale and a movable pointer.

–5 To indicate the condition of the SPI, a single validity flag is provided. An OFF flag will be displayed upon loss of power, failure of a channel, or error in a signal.

–6 No controls are provided which directly affect the display. The SPI display data is defined in Table 4.7.5-1.

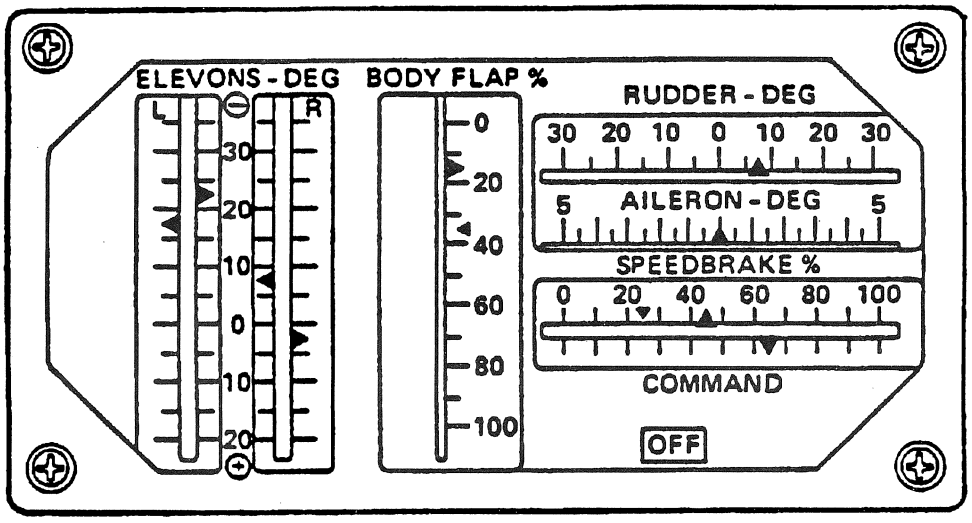


Figure 4-7. Surface Position Indicator (SPI)

TABLE 4.7.5-1. DEDICATED DISPLAY DATA

METER: SPI		VALID OPS/MODES: 301-305, 602, 603		
INDICATOR	SWITCH POSITION	DESCRIPTION	UNITS	LIMITS
Elevons		Selected elevon position feedback.	Deg	−36.5, +21.5
LOB		Left outboard elevon		
LIB		Left inboard elevon		
RIB		Right inboard elevon		
ROB		Right outboard elevon		
Rudder		Selected rudder position feedback.	Deg	−27.1, +27.1
Body Flap		Body flap position (−15.825 deg to +26.675 deg).	%	0,100
Speedbrake		Selected speedbrake position (0 to 98.6 degrees).	%	0,100
Speedbrake		Computed speedbrake command from guidance or flight control.	%	0,100
Aileron		Aileron position (delta between elevons).	Deg	−5, +5

4.7.6 FLIGHT CONTROL SYSTEM (FCS) MODE STATUS LIGHTS

The FCS mode status lights indicate the control mode in which the FCS is currently operating. The FCS lights display the manner in which controls are developed for the following type of commands:

- pitch
- roll/yaw
- speedbrake
- body flap

−1 Two sets of FCS status lights are installed on a Shuttle vehicle on the cockpit glare shield; one on Panel F2 at the commander station, the other on Panel F4 at the pilot station. Switches which control the lights are located in the following areas: on the glare shield, integrated with the lights as push-button indicators; commander body flap switch on forward panel L2; pilot body flap switch on forward center panel C3; commander/pilot RHC's; and commander/pilot SBTC's.

−2 The FCS mode status lights are normally driven by the Aerojet or GRTLS DAP Recon during entry/landing, by the Mode/Sequence Lights Test during on-orbit check, and by Ascent Recon during ascent.

−3 For pitch and roll/yaw, each has associated with it two lights: AUTO and Control Stick Steering (CSS). AUTO denotes automatic mode of operation, in which the RCS jets are fired and/or aeroforce effectors are deflected or thrust vector controls actuators are deflected in response to G&N inputs and feedback signals from vehicle motion sensors. Manual commands are inhibited; but manual surface trim is allowed. The CSS light indicates an augmented command mode of operation, in which the RCS jets are fired and/or aeroforce effectors are deflected or thrust vector control actuators are deflected in response to crew manual inputs, and the response is augmented by feedback signals from vehicle motion sensors to enhance control response and/or stability. Automatic G&N commands are inhibited during CSS.

−4 The AUTO light is illuminated at both stations, and mode engaged, by depression of either of two switches, which is integrated with its light as a pushbutton indicator (PBI). The CSS lights are illuminated by depression of either of their associated PBIs, or upon takeover by either rotational hand controller. Selection of one mode will cause the lights of the other mode to be extinguished, and the other mode to be deselected. If AUTO and CSS modes are simultaneously requested, CSS will take precedence. The FCS is initialized in the CSS mode.

−5 The following interpretations apply for the specific selection:

PITCH

AUTO - control to alpha command from Entry Guidance, and to normal acceleration command from TAEM and AL Guidance; control of pitch rate during slapdown static load relief; ascent control to body axis attitude rate and error commands from Guidance/Control Steering Interface (GC_STEER).

CCS - augmented control to RHC pitch rate command.

ROLL/YAW

AUTO - control to roll angle command from guidance during Entry, TAEM, and AL; control to wings level command during flatturn and subsequent landing; for nosewheel steering control to yaw rate command from AL guidance during rollout and velocity less than 155 kt; ascent control to body axis attitude rate and error commands from GC_STEER.

CCS - augmented control to RHC roll rate command; for nosewheel steering, direct control from RPTA commands during rollout and non-zero velocity less than the limit.

-6 For speedbrake and body flap, each has an associated AUTO/MAN light. AUTO signifies that these effectors are deflected in response to G&N inputs; MAN, the effectors are deflected directly in response to manual inputs. In AUTO mode, manual commands are inhibited, just as automatic G&N commands are inhibited in MAN mode.

-7 The AUTO portions of the SPD BK/THROT lights at both crew stations are illuminated when the speedbrake automatic mode is selected as a result of depressing the switch feature of a speedbrake PBI. The MAN portion of a speedbrake light is illuminated by depressing the takeover switch of a speedbrake/thrust controller (SBTC). A MAN light will only illuminate at the station selecting the mode, while the entire annunciator light at the other station is extinguished. At system initialization, the commander MAN lamp will be lit to indicate commander control of the speedbrake.

-8 The AUTO portion of the BODY FLAP lights at both crew stations illuminate when the automatic mode has been selected by depressing the switch of a bodyflap PIB on the glareshield when both BODYFLAP switches (on panels 12 and C3) are in the AUTO/OFF position.

-9 The MAN lights will illuminate when the manual mode has been selected by positioning any BODY FLAP switch off the center (AUTO/OFF) position. Such action will also cause the AUTO lights to extinguish. The MAN body flap PBIs will be lit at system initialization.

-10 The operations in effect during a mode are summarized below for the speedbrake and bodyflap PBIs:

SPD BK/THROT

AUTO - control to deflection command from guidance during TAEM and AL; and from Fc during Entry.

MAN - control to deflection command from SBTC.

BODY FLAP

AUTO - control to null elevator trim command; at auto-flare, retract upon guidance command, subject to proper speedbrake condition.

MAN - control to discrete rate command from crew.

-11 Aerosurface (Elevons, Rudder, Speedbrake, Body Flap) controls are either automatic (for load relief) or locked (for minimum drag) during Ascent.

TABLE 4.7.6-1. DEDICATED DISPLAY DATA

METER: FCS Mode Lamps		VALID OPS/MODES: 304, 305, 601-603		
INDICATOR	SWITCH POSITION	DESCRIPTION	UNITS	LIMITS
Left Auto Pitch Right Auto Pitch Left Auto ROLL/YAW Right Auto ROLL/YAW Left CSS Pitch Right CSS Pitch Left CSS ROLL/YAW Right CSS ROLL/YAW Left Body Flap Manual Right Body Flap Manual Left Body Flap Auto Right Body Flap Auto Left Speedbrake Auto Right Speedbrake Auto		Shows status of FCS modes. Lamp ON = selected, OFF = deselected.		

4.7.7 REACTION CONTROL SYSTEM (RCS) ACTIVITY LIGHTS

The RCS activity lights indicate the presence of RCS commands. However, under certain conditions, aileron or elevator rate saturation is displayed. Only one set of lights is on a Shuttle vehicle. The set is located on the commander panel F6.

−1 The RCS activity lights are supported by the Reaction Control System Activity Lights Processor during entry/landing.

−2 The RCS activity lights are identified by the label RCS COMMAND, and are comprised of the ROLL L/R, YAW L/R, and PITCH U/D lamps. The yaw indicator lights are active as long as termination of yaw jets is not signalled. Illumination of the yaw left lamp indicates a yaw jet command in the negative sense; and of the yaw right lamp, in the positive sense. Darkness of both yaw lamps indicates the absence of a yaw jet command.

−3 The roll indicator lights assume different meanings, as determined by the magnitude of the GN&C dynamic pressure. When the pressure is below that at which roll jet deactivation occurs, illumination of the roll left lamp indicates a roll jet command in the negative sense and illumination of the roll right lamp indicates a command in the positive sense. When the dynamic pressure exceeds a specified value, illumination of both roll jet lamps indicates three or more yaw jets have been commanded.

−4 The pitch indicator lights assume different meanings as determined by the magnitude of the GN&C dynamic pressure. When the pressure is below that at which pitch jet deactivation occurs, illumination of the pitch down lamp indicates a pitch jet command in the negative sense and illumination of the pitch up lamp indicates a pitch jet command in the positive sense. When the dynamic pressure exceeds a specified value, illumination of both pitch jet lamps indicates an aileron or elevator rate saturation condition has occurred.

−5 On orbit, in OPS2 and OPS8, the RCS activity lights always indicate jet firing status. During normal operations, lamps are lit as jets are commanded; and processing is performed by the orbit digital autopilot (GFF). During OEX Advanced Autopilot operations, all six lights are illuminated whenever a jet is fired; and processing is performed by the OEX DAP.

−6 No controls are provided for directly modifying the operation of the RCS activity lights.

4.8 HEAD-UP DISPLAY (HUD)

The HUD is designed to provide the crew with information required to accomplish precise and repeatable manual approaches and landings. There are two HUD units in the cockpit and each is operated independently of the other. The information provided by the HUD is superimposed on the out-the-window view. This is accomplished by projecting data on transparent screens located in front of the commander and pilot stations.

−1 The HUD is primarily used in MM305 and 603, with some information available in MM304 and 602. OPS 8 and 9 both provide checkout capability.

−2 Several different display formats are available on each HUD. The format to be displayed is selected using the Horizontal Situation Display, item 37 for the commander and item 38 for the pilot. Each HUD unit also has a declutter switch which is generally used to reduce the amount of data displayed on a given format. However, after the lowest level of declutter is reached, the next operation of the declutter switch reintroduces the existing format in its entirety.

−3 The possible HUD formats are as follows:

−3.1 Format 0. This format blanks the display when selected.

−3.2 Format 1. This is the Approach and Landing format. It provides situation data including current altitude, airspeed, pitch and roll angle, normal acceleration, speedbrake position, a graphic display of the run-way, steep and shallow aimpoints, and a velocity vector symbol which indicates the direction the vehicle is moving. Post weight-on-wheels (WOW) the data includes the brake deceleration, ground speed and aileron load balancing. Also displayed are guidance references for altitude, flare, and speedbrake position along with a guidance symbol which depicts the direction to which the orbiter must be flown to satisfy the GPC derived guidance solution. Also available post WOW are guidance references for brake deceleration and aileron load balancing. Messages for landing gear, guidance phase, MLS, body flap, and CCS are displayed as they occur.

−3.3 Format 2. (DELETED)

−3.4 Format 3. (TBD)

−3.5 Format 4. (TBD)

−3.6 Format 5. (TBD)

−3.7 Format 6. This is the Test Format and is used to provide a check of the HUD system integrity by exercising the display symbology.

5. SWITCHES

This section lists all cockpit switches which are utilized by PASS. The switches are listed alphabetically by the nomenclature used in the orbiter cockpit. (37692)

5.1 TABLE FORMAT

The table format is defined as follows:

SWITCH — Name of switch.

TYP — The type of switch (may be used in combinations).

- K - Knob
- L - Latched
- M - Momentary
- R - Rotary
- PBI - Push button indicator (back-lighted)
- PB - Push button
- T - Toggle
- Th - Thumbwheel

PNL — Orbiter cockpit panel where switch is located.

OPS — The valid OPS/major modes where switch is used.

FREQ — Frequency of switch read.

MSID — The MSIDs assigned to the switch contact(s) as read by PASS.

STATE — The position(s) the switch may be placed in.

DEFINITION — Use of the switch/state in PASS.

–1 There is a class of multiposition cockpit switches which is used to control spacecraft hardware via either the GPC/MDM path or an independent (external to the GPC/MDM's) direct hard-wire path. (46513)

TABLE 5-1. SWITCHES

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
ABORT	PBI	F6	102-105, 305, 603			PRESS	Causes RTLS, TAL, AOA, or ATO discretes to be sent from the Abort Mode switch to the GPC.
ABORT MODE	R	F6	102-105, 305, 603	6.25		OFF	Disables all Abort PBI initiated Abort modes. OPS 601 PRO is still valid.
					V72K6085X V72K6086X V72K6087X	RTLS	Allows the Abort PBI to initiate an RTLS Abort.
					V72K6080X V72K6081X V72K6082X	TAL/ AOA-S	Allows the Abort PBI to initiate an AOA or TAL Abort.
					V72K6075X V72K6076X V72K6077X	ATO	Allows the Abort PBI to initiate an ATO Abort and enables Bailout Abort in 305 and 603.
ADI ATTITUDE	T	F6 F8 A6	101-106, 601, 301-303, 201, 202, 801	1.04	V72K2015X V72K2065X V72K2101X	INRTL	Selects inertial attitude data for ADI on same panel. (F6-CDR, F8-PLT, A6-AFT.)
					V72K2016X V72K2066X V72K2102X	LVLH	Selects local vertical/local horizontal attitude data for ADI.
					V72K2017X V72K2067X V72K2103X	REF	Selects reference attitude for ADI.
ADI ERROR	T	F6 F8 A6	101-106, 601-603, 301-305, 201, 202, 801	1.04	V72K8504X V72K8604X V72K2097X	HIGH	Selects high mode for full-scale deflection of ADI error needles.
					V72K8505X V72K8605X V72K2098X	MED	Selects medium mode for full-scale deflection of ADI error needles.
					V72K8506X V72K8606X V72K2099X	LOW	Selects low mode for full-scale deflection of ADI error needles.

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
ADI RATE	T	F6 F8 A6	101-106, 601-603, 301-305, 201, 202, 801	1.04	V72K2008X V72K2060X V72K2093X	HIGH	Selects high mode for full-scale deflection of ADI rate pointers.
					V72K2009X V72K2061X V72K2094X	MED	Selects medium mode for full-scale deflection of ADI rate pointers.
					V72K2011X V72K2062X V72K2095X	LOW	Selects low mode for full-scale deflection of ADI rate pointers.
AIR DATA	T	F6 F8	304, 305, 602, 603	1.04	V72K6381X V72K6391X	LEFT	Selects left air data probe as source of data for AMI and AVVI.
					V72K6382X V72K6392X	NAV	Selects navigation-derived data as source of data for AMI and AVVI.
					V72K6383X V72K6393X	RIGHT	Selects right air data probe as source of data for AMI and AVVI.
AIR DATA PROBE - L	LT	C3				DPLY/ HEAT	
						DPLY	
						STOW	
AIR DATA PROBE - R	LT	C3				DPLY/ HEAT	
						DPLY	
						STOW	
AIR DATA PROBE STOW - L	T	C3				ENABLE	
						INHIBIT	
AIR DATA PROBE STOW - R	T	C3				ENABLE	
						INHIBIT	

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
ATT REF	PB	F6	101-106, 601,	6.25	V72K2051X V72K2052X	PRESS	Resets attitude reference frame to current orbiter body axes. (37519)
		F8	201, 202, 801		V72K2001X V72K2002X		
		A6U			V72K2091X V72K2092X		
BFC CRT DISPLAY	LT	C3	ALL	1.04		ON	Relinquish control of MCDS specified for BFS
						OFF	Ignore BFC CRT select switch
BFC CRT SELECT	R	C3	ALL	1.04		1+2	Give up control of MCDS 1
						2+3	Give up control of MCDS 2
						3+1	Give up control of MCDS 3 (Only applicable if BFC CRT DISPLAY switch is on)
					V92X7384X V92X7385X V92X7444X V92X7445X V92X7504X V92X7505X V92X7564X V92X7565X V92X7624X V92X7625X		GPC 1 BFS CRT Select A (DI38) BFS CRT Select B (DI39) GPC 2 GPC 3 GPC 4 GPC 5
BFS ENGAGE	PB	RHC	ALL	1.04		PRESS	
BODY FLAP AUTO/ MAN	PBI	F4	201 304, 305, 602,	6.25	V72K4893X V72K4894X V72K4895X	AUTO/ MAN	In OPS 3 and 6, changes Body Flap control from manual to automatic when Body Flap Switch in Auto/Off position. (44254)
		F2	603		V72K4993X V72K4994X V72K4995X		

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
BODY FLAP	M,T		304, 305, 601-603	6.25		AUTO/ OFF	Enables S/W control of Body Flap (manual mode inputs are OFF). Body Flap PBI must be depressed to effect AUTO mode. (44254)
		L2			V72K2077X V72K2078X	UP	Body Flap is placed/ remains in manual mode and is rotated up while switch is momentarily held in this position.
		C3			V72K2087X V72K2088X		
		L2			V72K2079X V72K2080X	DOWN	Body Flap is placed/ remains in manual mode and is rotated down while switch is momentarily held in this position.
		C3			V72K2089X V72K2090X		
CRT MAJOR FUNCTION			ALL	2.08		GNC	Selects GNC major function to drive CRT data and process keystrokes. Bits 8-9 : 01.
CRT1		C2			V92U6717C		
CRT2		C2			V92U6776C		
CRT3		C2			V92U6840C	SM	Selects SM major function to drive CRT data and process keystrokes. Bits 8-9 : 10.
CRT4		R12			V92U6900C		
						PL	Selects PL major function to drive CRT data and process keystrokes. Bits 8-9 : 00.
DEU 1-4 LOAD	MT	06	000, P9	2.08		OFF	Normal DEU operation.
DEU1					V92U6723X	LOAD	Forces DEU IPL from MM (CRT must be assigned to a GPC in P9, initial OPS 0, or running GPC IPL). This discrete is in the first word of the DEU poll. The ON state may not be seen in D/L since it is downlisted at 1 Hz but is polled by the GPC at 2.08 Hz.
DEU2					V92U6782X		
DEU3					V92U6846X		
DEU4					V92U6906X		

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
DISPLAY ELEC-TRONICS UNIT 1	MT	06				LOAD	
DISPLAY ELEC-TRONICS UNIT 2	MT	06				LOAD	
DISPLAY ELEC-TRONICS UNIT 3	MT	06				LOAD	
DISPLAY ELEC-TRONICS UNIT 4	MT	06				LOAD	
ENTRY ROLL MODE	T	L2	304 305, 602, 603	6.25	V72K6314X V72K6315X V72K6316X V62K6317X	LO GAIN	Causes use of early entry roll control gains.
					V72K6320X V72K6321X V72K6322X V72K6323X	NO Y JET	Causes use of late entry roll control gains.
						AUTO	Causes use of blended early/late control gains.
ET SEPARA-TION	T	C3	102, 103, 305, 601-603	6.25	V72K6201X V72K6202X V72K6203X	MAN	Enables use of ET Separation PB to manually separate the SRBs. If PB is not depressed, separation will not occur. Also enables use of SEP PB to set the WOW and WONG discretes in 305 and 603.
						AUTO	
ET SEPARA-TION	PB	C3	102, 103, 601-603, 305	6.25	V72K6205X V72K6206X V72K6207X	PRESS	When ET Separation Switch is in MAN, this PB will initiate manual separation (fast separation can be initiated in 102 and 601). In 305 and 603 it causes the WOW and WONG discretes to be set.

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
ET UMBILICAL DOOR MODE	LT	R2				GPC GPC/ MAN	
FCS CHANNEL 1 SWITCH	MT	C3	101-104, 301-305, 601-603, 201, 202, 801	6.25	V72K3170X V72K3171X V72K3172X	OVER-RIDE AUTO OFF	Enables Channel 1 actuator operation to continue even after a failure is detected. (37567) Allows a channel bypass to occur when a failure is detected. Allows channel bypass, but override capability is lost.
FCS CHANNEL 2 SWITCH	MT	C3	101-104, 301-305, 601-603, 201, 202, 801	6.25	V72K3179X V72K3176X V72K3178X	OVER-RIDE AUTO OFF	Enables Channel 2 actuator operation to continue even after a failure is detected. (37567) Allows a channel bypass to occur when a failure is detected. Allows channel bypass, but override capability is lost.
FCS CHANNEL 3 SWITCH	MT	C3	101-104, 301-305, 601-603, 201, 202, 801	6.25	V72K3183X V72K3180X V72K3182X	OVER-RIDE AUTO OFF	Enables Channel 3 actuator operation to continue even after a failure is detected. (37567) Allows a channel bypass to occur when a failure is detected. Allows channel bypass, but override capability is lost.

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
FCS CHANNEL 4 SWITCH	MT	C3	101-104, 301-305, 601-603, 201, 202, 801	6.25	V72K3189X V72K3186X V72K3188X	OVER-RIDE	Enables Channel 4 actuator operation to continue even after a failure is detected. (37567)
						AUTO	Allows a channel bypass to occur when a failure is detected.
						OFF	Allows channel bypass, but override capability is lost.
GPC MEMORY DUMP	ROT	MO 42F				OFF	Sends the Dump CMD discrete (DI15) to the selected GPC. GPC HISAM dump is software initiated when DI15, DI13, (I/O TERM B), and DI01 (STBY) discretes are all true for the selected GPC upon moding from HALT to STBY. Dump will be in Toggle Buffer 5, Format 93.
GPC1					V92X7377X	1	
GPC2					V92X7437X	2	
GPC3					V92X7497X	3	
GPC4					V92X7557X	4	
GPC5					V92X7617X	5	
GPC 1-5 IPL	MPB	06				PRESS	Depression of PB initiates the GPC IPL sequence. GPC must be in HALT, with power ON, MMU selected and ready.
GPC 1-5 MODE	LT	06					
GPC 1				1.04	V92X7362X	HALT	Inhibits software execution (DI00). Resets hardware logic discrete outputs. Permits IPL to occur. GPC may be in SLEEP mode, see Section 2.3-3.1.1.
GPC 2					V92X7423X		
GPC 3					V92X7483X		
GPC 4					V92X7542X		
GPC 5					V92X7602X		
				1.04			
					V92X7363X	STBY	Allows software execution (DI01). From HALT to STBY initiates system initialization. From RUN to STBY cancels all application software execution.
					V92X7423X		
					V92X7483X		
					V92X7543X		
					V92X7603X		
					V92X7364X	RUN	Allows nominal GPC FSW execution (DI02).
					V92X7424X		
					V92X7484X		
					V92X7544X		
					V92X7604X		

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
GPC 1-5 OUTPUT	LT	06		1.04		TERM	Terminates transmitters for buses FC1-8 (Discrete ON) (DI13).
GPC1					V92X7375X		
GPC2					V92X7435X		
GPC3					V92X7495X	NORM	Transmitters for buses FC1-8 are enabled. (Discrete OFF) (DI13).
GPC4					V92X7555X		
GPC5					V92X7615X		
						BKUP	Identifies GPC is loaded with BFS. (Discrete ON) (DI13).
GPC 1-5 POWER	LT	06				OFF	GPC has no power.
GPC1					V72S7160E	ON	GPC is powered up.
GPC2					V72S7166E		
GPC3					V72S7172E		
GPC4					V72S7175E		
GPC5					V72S7181E		
HSI SELECT MODE	T	F6 F8	304, 305, 602, 603	1.04	V72K8580X V72K8680X	ENTRY	Selects Entry phase data for display on HSI.
					V72K8581X V72K8681X	TAEM	Selects TAEM phase data for display on HSI.
					V72K8582X V72K8682X	AP-PROACH	Selects Approach phase data for display on HSI.
HSI SELECT SOURCE	T	F6 F8	304, 305, 602, 603	1.04	V72K8587X V72K8687X	TACAN	Selects TACAN as source of data for HSI.
					V72K8588X V72K8688X	NAV	Selects navigation-derived data as source for HSI.
					V72K8589X V72K8689X	MLS	Selects MSBLS as source of data for HSI.
HSI SELECT SOURCE	T	F6 F8	304, 305, 602, 603	1.04	V72K8501X V72K8601X	1	Selects TACAN 1 or MLS 1. (Switch is not functional when NAV is source.)
					V72K8502X V72K8602X	2	Selects TACAN 2 or MLS 2.
					V72K8503X V72K8603X	3	Selects TACAN 3 or MLS 3.

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
IPL SOURCE GPC1 GPC2 GPC3 GPC4 GPC5	LT	06			V92X7366X V92X7426X V92X7486X V92X7546X V92X7606X	MM1	MM1 selected for IPL (DI04). The state of the discrete can be seen in any downlisting GPC.
					V92X7367X V92X7427X V92X7487X V92X7547X V92X7607X	MM2	MM2 selected for IPL (DI05).
						OFF	MMUs available for other functions (i.e., OPS transitions, DEU loads, TFLs, etc.).
LEFT CRT SEL	LT	C2	ALL	3		1	Left keyboard assigned to DEU1.
						3	Left keyboard assigned to DEU3.
MAIN ENGINE LIMIT SHUTDN	T	C3	102, 103, 601	6.25	V72K0051X V72K0052X V72K0053X	ENABLE	Allows any main engine to be shut down automatically.
					V72K0071X V72K0072X V72K0073X	AUTO	Allows one engine to be shut down automatically, and inhibits shut down of the remaining two.
					V72K0061X V72K0062X V72K0063X	INHIBIT	Allows no engine to be shut down automatically.
MAIN ENGINE SHUTDN-CTR	PB	C3	102, 103, 601	6.25	V72K0091X V72K0092X	PRESS	Causes shutdown enable and shutdown commands to be issued to SSME-1.
MAIN ENGINE SHUTDN-LEFT	PB	C3	102, 103, 601	6.25	V72K0093X V72K0094X	PRESS	Causes shutdown enable and shutdown commands to be issued to SSME-2.

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
MAIN ENGINE SHUTDN-RIGHT	PB	C3	102, 103, 601	6.25	V72K0095X V72K0096X	PRESS	Causes shutdown enable and shutdown commands to be issued to SSME-3.
MANUAL MODE ROTATION PITCH ACCEL	PBI	C3	201, 202, 801	6.25	V72K2824X V72K2825X	PRESS	Same as ROLL ACCEL (substituting pitch axis for roll axis).
		A6			V72K6464X V72K6465X		
MANUAL MODE ROTATION PITCH DISC RATE	PBI	C3	103-106 301-303,	6.25	V72K2822X V72K2823X	PRESS	Same as ROLL DISC RATE (substituting pitch axis for roll axis).
		A6	201, 202, 801		V72K6460X V72K6461X		
MANUAL MODE ROTATION PITCH PULSE	PBI	C3	103-106, 301-303,	6.25	V72K2826X V72K2827X	PRESS	Same as ROLL PULSE (substituting pitch axis for roll axis).
		A6	201, 202, 801		V72K6468X V72K6469X		
MANUAL MODE ROTATION ROLL ACCEL	PBI	C3	201, 202, 801	6.25	V72K2814X V72K2815X	PRESS	Directs the Orbital DAP to enter ACCEL mode in the roll axis. Primary thrusters fire while the RHC is out of detent and stop firing only when the RHC is returned to detent, allowing attitude to drift freely.
		A6			V72K6444X V72K6445X		
MDM-FLT CRIT							
AFT FA1	T	06				ON	
						OFF	
FA2	T	06				ON	
						OFF	
FA3	T	06				ON	
						OFF	

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
FA4	T	06				ON	
						OFF	
MDM-FLT CRIT FWD							
FF1	T	06				ON	
						OFF	
FF2	T	06				ON	
						OFF	
FF3	T	06				ON	
						OFF	
FF4	T	06				ON	
						OFF	
MDM-PL 1	T	06				ON	
						OFF	
2	T	06				ON	
						OFF	
3	T	06				ON	
						OFF	
MODE ROTATION ROLL DISC RATE	PBI	C3 A6	103-106, 301-303, 201, 202, 801	6.25	V72K2812X V72K2813X V72K6440X V72K6441X	PRESS	Directs the Transition and Orbital DAPs to enter DISCRETE RATE mode in the roll axis. Primary thrusters fire to attain a predetermined rotational rate as long as the RHC is held out of detent. Rate is nulled when RHC returned to detent.

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
MANUAL MODE ROTATION ROLL PULSE	PBI	C3 A6	103-106, 301-303, 201, 202, 801	6.25	V72K2816X V72K2817X V72K6448X V72K6449X	PRESS	Directs the Transition and Orbital DAPs to enter PULSE mode in the roll axis. Primary thrusters fire to generate a predetermined body rate increment response to each deflection of the RHC. No further firing occurs until the RHC is returned to detent and deflected again.
MANUAL MODE ROTATION YAW ACCEL	PBI	C3 A6	201, 202, 801	6.25	V72K2834X V72K2835X V72K6484X V72K6485X	PRESS	Same as ROLL ACCEL above (substituting yaw axis for roll axis).
MANUAL MODE ROTATION YAW DISC RATE	PBI	C3 A6	103-106, 301-303, 201-202, 801	6.25	V72K2832X V72K2833X V72K6480X V72K6481X	PRESS	Same as ROLL DISC RATE above (substituting yaw axis for roll axis).
MANUAL MODE ROTATION YAW PULSE	PBI	C3 A6	103-106, 301-303, 201, 202 801	6.25	V72K2836X V72K2837X V72K6488X V72K6489X	PRESS	Same as ROLL PULSE above (substituting yaw axis for roll axis).
MANUAL MODE TRANSLATION X HIGH	PBI	C3 A6	201, 202, 801	6.25		PRESS	This mode is not currently being used. When used, this mode will require both primary and backup thrusters in the X-axis to fire as long as the THC is held out of detent.
MANUAL MODE TRANSLATION X NORM	PBI	C3 A6	201, 202, 801	6.25	V72K2860X V72K2861X V72K6510X V72K6511X	PRESS	Directs the Orbital DAP to enter NORMAL ACCEL mode, in which the primary jets in the X-axis are fired as long as the THC is held out of detent (no backup thruster firings normally).

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
MANUAL MODE TRANSLATION X PULSE	PBI	C3 A6	201, 202, 801	6.25	V72K2862X V72K2863X V72K6513X V72K6514X	PRESS	Directs the Orbital DAP to enter PULSE mode, in which the primary thrusters in the X-axis are fired for a preset increment in response to each THC deflection. No further firing occurs until the THC is returned to detent and deflected again.
MANUAL MODE TRANSLATION Y LOW Z	PBI	C3 A6	201, 202, 801	6.25		PRESS	This mode is not currently being used. See HIGH mode definition above (substitute Y axis for X axis).
MANUAL MODE TRANSLATION Y NORM	PBI	C3 A6	201, 202, 801	6.25	V72K2870X V72K2871X V72K6520X V72K6521X	PRESS	See NORM mode definition above (substitute Y axis for X axis).
MANUAL MODE TRANSLATION Y PULSE	PBI	C3 A6	201, 202, 801	6.25	V72K2872X V72K2873X V72K6523X V72K6524X	PRESS	See PULSE mode definition above (substitute Y axis for X axis).
MANUAL MODE TRANSLATION Z HIGH	PBI	C3 A6	201, 202, 801	6.25	V72K2884X V72K2885X V72K6537X V72K6538X	PRESS	Directs the Orbital DAP to enter HIGH ACCEL mode, in which the primary and backup jets in the Z axis are fired as long as the THC is held out of detent.
MANUAL MODE TRANSLATION Z NORM	PBI	C3 A6	201, 202, 801	6.25	V72K2880X V72K2881X V72K6530X V72K6531X	PRESS	See NORM mode definition (substitute Z axis for X axis).

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
MASTER RCS CROSS-FEED	T	07	101-106, 301-305	1.04	V72K4510X V72K4511X V72K4512X	FEED FROM LEFT	Configures valves to feed right RCS engines from left oxidizer and fuel tanks.
					V72K4515X V72K4516X V72K4517X	FEED FROM RIGHT	Configures valves to feed left RCS engines from right oxidizer and fuel tanks.
						OFF	Reconfigures valves to normal.
MPS PRPLT DUMP SEQUENCE	T	R2	103, 104, 602	1.04	V72K0085X V72K0086X	START	Manually initiates LH_2 dump sequence.
					V72K0087X V72K0088X	STOP	Manually terminates LH_2 dump sequence.
						GPC	Enables automatic initiation and termination of LH_2 dump sequence. This is normal position.
MPS PRPLT DUMP BACKUP LH_2 VALVE	T	R2	103, 104, 602	1.04	V72K0081X V72K0082X	OPEN	
					V72K0083X V72K0084X	GPC	
						CLOSE	
NOSE WHEEL STEERING	T	L2	301-303, 201, 202, 801	1.04	V72K1715X	GPC	Enables GPC control of nose wheel steering (either AUTO or CSS).
					V17K1710X	DIRECT	Enables direct control (from RPTA to steering control box).
						OFF	Removes power from the nose wheel control package, disabling nose wheel steering.
OI PCMMU FORMAT	T	C3				GPC	
						FIXED	
						PRO-GRAM	

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
OI PCMMU PWR	T	C3				1	
						2	
						OFF	
OMS ENG LEFT	T	C3	104, 105, 202, 302	1.04	V43S4572X V43S4573X	ARM	Enables S/W control of engine control valves. (37555)
					V43S4570X V43S4571X	ARM/ PRESS	Enables GN2 purge of engine following OMS cutoff.
						OFF	Disables engine valve control, thus disabling the engine. (55306) (57330)
OMS ENG RIGHT	T	C3	104, 105, 202, 302	1.04	V43S5572X V43S5573X	ARM	Enables S/W control of engine control valves. (37555)
					V43S5570X V43S5571X	ARM/ PRESS	Enables GN2 purge of engine following OMS cutoff. (See left engine.)
						OFF	Disables engine valve control, thus disabling the engine. (55306) (57330)
ORBITAL DAP CONTROL AUTO	PBI	C3	103-106, 301-303,	6.25	V72K2840X V72K2841X V72K2842X	PRESS	Directs the Transition DAP in OPS 1 and 3 and the Orbit DAP in OPS 2 to assume automatic.
		A6	201, 202, 801		V72K6490X V72K6491X V72K6492X		(Panel A6 inputs used in OPS 2 only.)
ORBITAL DAP CONTROL MAN	PBI	C3	103-106	6.25	V72K2845X V72K2846X	PRESS	Directs the Transition DAP in OPS 1 and 3 and the Orbit.
ORBITAL DAP RCS JETS NORM	PBI	C3	201, 202, 801	6.25	V72K2851X V72K2852X V72K2857X	PRESS	Directs the Orbital DAP to use the 38 normal (870 lb) jets for rotational and translational control.
		A6			V72K6505X V72K6506X V72K6500X		

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
ORBITAL DAP RCS JETS VERN	PBI	C3	201, 202, 801	6.25	V72K2853X V72K2854X V72K2858X	PRESS	Directs the Orbital DAP to use the 6 vernier (25-lb.) jets for rotational and translational control.
		A6			V72K6507X V72K6508X V72K6501X		
ORBITAL DAP SELECT A	PBI	C3	201, 202, 801	6.25	V72K2801X V72K2802X V72K2805X	PRESS	Directs the Orbital DAP to use set A (coarse) flight control parameters (gains, deadbands, etc.).
		A6			V72K6430X V72K6431X V72K6419X		(Panel A6 inputs used in OPS 2 only.)
ORBITAL DAP SELECT B	PBI	C3	201, 202, 801	6.25	V72K2803X V72K2804X V72K2806X	PRESS	Directs the Orbital DAP to use set B (fine) flight control parameters (gains, deadbands, etc.).
		A6			V72K6432X V72K6433X V72K6420X		
PITCH AUTO	PBI	F2	101-103, 601-603,	6.25	V72K5251X V72K5252X V72K5253X	PRESS	During ascent modes all axes to Auto. During entry modes only roll/yaw axes to Auto.
		F4	305		V72K5151X V72K5152X V72K5153X		
PITCH CSS	PBI	F2	101-103, 601-603,	6.25	V72K5256X V72K5257X V72K5258X	PRESS	During ascent modes all axes to Manual. During entry modes only pitch axis to manual.
		F4	304, 305		V72K5156X V72K5157X V72K5158X		
PITCH TRIM	MT	C3	101-106, 601-603,	6.25	V72K1503X V72K1504X V72K1515X V72K1516X	DOWN	Rotates elevons down. Establishes new trim surface position for elevons.
		L2	301-305		V72K1500X V72K1501X V72K1512X	CNTR	Leaves elevons in last trim configuration.
					V72K1513X	UP	Rotates elevons up. Establishes new trim surface position for elevons.

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
RADAR ALTM	T	F6 F8	304, 305, 602, 603	1.04	V72K8585X V72K8685X	1	Selects RA 1 as source of data for AVVI.
					V72K8586X V72K8686X	2	Selects RA 2 as source of data for AVVI.
RHC TRIM	PB	LRHC	101-106, 601-603, 301-305	6.25	V72K1151X V72K1166X V72K1150X V72K1165X V72K1153X V72K1168X V72K1152X V72K1167X	PRESS	Establishes a pitch and/or roll rate as a function of the duration the pushbutton is depressed. Rate is maintained when pushbutton is released.
		RRHC			V72K1196X V72K1216X V72K1195X V72K1215X V72K1198X V72K1218X V72K1197X V72K1217X		
RIGHT CRT SEL	LT	C2	ALL	2.03		2	Right keyboard assigned to DEU 2.
						3	Right keyboard assigned to DEU 3.
ROLL TRIM	MT	C3, L2	101-106, 601-603, 301, 305	6.25	V72K1509X V72K1510X V72K1521X V72K1522X	L	Rotates elevons for left roll. Establishes new trim surface position for elevons (S/W performs redundancy mgmt and downlist only.).
						CNTR	Leaves elevons in last trim configuration.
					V72K1506X V72K1507X V72K1518X V72K1519X	R	Rotates elevons for right roll. Establishes new trim surface position for elevons.
ROLL/YAW AUTO	PBI	F2	101-103, 601-603,	6.25	V72K5265X V72K5266X V72K5267X	PRESS	During ascent modes all axes to Auto. During entry modes only roll/yaw axes to Auto.
		F4	304, 305		V72K5165X V72K5166X V72K5167X		

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
ROLL/YAW CSS	PBI	F2	101-103, 601-603,	6.25	V72K5270X V72K5271X V72K5272X	PRESS	During ascent modes all axes to Auto. During entry modes only roll/yaw axes to Auto.
		F4	304, 305		V72K5170X V72K5171X V72K5172X		
S-BAND PM ANTENNA	R	C3				LRAFT LRFWD URAFT URFWD ULAFT ULFWD LLAFT LLFWD GPC	
S-BAND PM ANTENNA CONTROL	T	C3				CMD PANEL	
SBTC TAKOVER	PB	L2	102, 103, 601-603,	6.25	V72K1577X V72K1580X V72K1583X	PRESS	Causes manual takeover of the SBTC function. Manual control of the speedbrake can be established from either the L2 (PLT) or C3 (CDR) panel. Thrust control is possible only from the L2 (PLT) panel.
		C3	304, 305		V72K1587X V72K1590X V72K1593X		
SPD BK/ THROT AUTO/ MAN	PBI	F2	102, 103, 601-603	6.25	V72K1570X V72K1571X V72K1572X	PRESS	Changes SBTC mode from manual to automatic, disabling the active SBTC. Manual control is reestablished via SBTC takeover pushbutton.
		F4			V72K1600X V72K1601X V72K1602X		

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
SRB SEPARA-TION	T	C3	102, 305, 603	6.25	V72K4613X V72K4614X V72K4619X	MAN/ AUTO	Enables use of SRB separation SEP PBI to manually separate the SRBs. If PBI is not depressed, separation will still occur automatically. Also enables use of SEP PBI to set the WOW and WONG discretes in 305 and 603.
					V72K4611X V72K4612X V82L4719X	AUTO	Enables only auto separation.
SRB SEPARA-TION	PBI	C3				PRESS	
TACAN 1 ANT SEL	T	07	304, 305, 602, 603	1.04		UPPER	Selects upper antenna for Tacan.
						LOWER	Selects lower antenna for Tacan.
						AUTO	Allows GPC to select upper and lower antenna GPC is always sending out selection commands, but they are inhibited when switch is in UPPER or LOWER position.
TACAN 2 ANT SEL	T	07	304, 305, 602, 603	1.04		UPPER LOWER AUTO	(Same as TACAN 1.)
TACAN 3 ANT SEL	T	07	304, 305, 602 603	1.04		UPPER LOWER AUTO	(Same as TACAN 1.)
TACAN 1 CHANNEL	TH	07	304, 305, 602, 603	1.04	V72M6598P		Defines TACAN 1 Channel when in T/R Mode.
TACAN 2 CHANNEL	TH	07	304, 305, 602, 603	1.04	V72M6648P		Defines TACAN 2 Channel when in T/R Mode.

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
TACAN 3 CHANNEL	TH	07	304, 305, 602, 603	1.04	V72M6698P		Defines TACAN 3 Channel when in T/R Mode.
TACAN 1 MODE	R	07	304, 305, 602, 603	1.04	V72K8410X	GPC	Channel selection controlled by GPC (otherwise channel selection controlled by thumbwheels).
						T/R	Tacan in Transmit/Receive mode set in thumbwheels.
						RCV	Tacan in receive only mode (on channel set in thumbwheels).
						OFF	Tacan not powered up.
TACAN 2 MODE	R	07	304, 305, 602, 603	1.04	V72X8430X	GPC T/R RCV OFF	(Same as TACAN 1.)
TACAN 3 MODE	R	07	304, 305, 602, 603	1.04	V72K8450X	GPC T/R RCV OFF	(Same as TACAN 1.)
THC		F5					
TRTM RHC/PNL - LH	T	F6	101-106, 601-603, 301-305, 201, 202, 801	6.25	V72K1160X	ENABLE	Enables commander's RHC Trim inputs.
					V72K1161X	INHIBIT	Allows no RHC Trim inputs from LH RHC.
TRTM RHC/PNL - RH	T	F8	101-106, 601-603, 301-305, 201, 202, 801	6.25	V72K1210X	ENABLE	Enables pilot's RHC Trim inputs.
					V62K1211X	INHIBIT	Allows no RHC Trim inputs from RH RHC.

TABLE 5-1. SWITCHES (Continued)

SWITCH	TYP	PNL	OPS	FRQ	MSID	STATE	DEFINITION
UPLINK	LT	C3				NSP BLOCK	
						GPC BLOCK	
						ENABLE	
YAW TRIM	MT	C3, L2	101, 106, 601-603, 301-305	6.25	V72K1149X V72K1164X V72K1194X	L	Rotates rudder for left yaw. Establishes new trim surface position for rudder.
					V72K1214X	CNTR	Leaves rudder in last trim configuration.
					V72K1148X V72K1163X V72K1193X	R	Rotates rudder for right yaw. Establishes new trim surface position for rudder.

5.2 DEU KEYBOARD

The Keyboard on panel C2 is a matrix of thirty-two keys which are used to provide manual inputs to the FSW system. The keys and the resulting actions of each are defined as follows (list is by rows):

FAULT SUMM	A single-key entry which presents the Fault Summary Page (FSP) display (099) to the CRT.
SYS SUMM	This single-key entry results in a System Summary Page being requested as a DISPLAY supported function. Display page number is determined by Major Function switch position and a table in FSW. If a two-page System Summary is defined for the current OPS, successive depressions of this key will cause the two pages to be requested in rotating fashion.
MSG RESET	This single-key entry results in the removal of the current message from the bottom message line of the display, blanking the entire line. See Section 6 for other actions associated with this key.
ACK	This single-key entry results in changing the message being displayed on the bottom message line to a static message if flashing. If the current message is a fault or GPC error message, the keyed entry is made available to Lights and Alarm Processing so that the appropriate Caution and Warning subsystem lights and tones are turned off.
GPC/CRT	This keyed entry results in one of the DEUs (1, 2, 3, or 4) being assigned to one of the GPCs (1, 2, 3, 4, or 5) or, in the case of '0' for the GPC number of isolating the specified DEU by terminating polling by all GPCs. Entered as GPC/CRT/NM EXEC, where N is GPC number, M is DEU number.
A	Enters a Hex A.
B	Enters a Hex B.
C	Enters a Hex C.
I/O RESET	Depression of this key followed by EXEC causes BCE elements to be restored and data path masks to be cleared for each string/bus assigned to the GPC set listening to the DEU from which the request was made.
D	Enters a Hex D.
E	Enters a Hex E.
F	Enters a Hex F.
ITEM	This key is used to initiate a message to select an item on the CRT being viewed. Data may or may not follow item number(s).
1	Enters a numeric 1.
2	Enters a numeric 2.
3	Enters a numeric 3.
EXEC	A terminator key used to end ITEM, GPC/CRT, and I/O RESET messages. It may be defined additionally as a special single-key, no-number item for a display, allowing crew to enter the specific item by pushing 'EXEC'.
4	Enters a numeric 4.
5	Enters a numeric 5.
6	Enters a numeric 6.

OPS	This key is a function initiation key which brings a message of OPS XXX PRO to cause an OPS Transition or Mode Recall.
7	Enters a numeric 7.
8	Enters a numeric 8.
9	Enters a numeric 9.
SPEC	This key is a function initiation key which begins a message of SPEC XXX PRO to initiate a Specialist Function or a DISPLAY. It also freezes the CRT display until the next keystroke is entered.
–	Key used for negative sign with data. It also is a delimeter between data entries.
0	Enters a numeric 0.
+	Key used for positive sign with data. It also is a delimeter between data entries.
RESUME	This single-key entry terminates SPEC functions, FSP, SYS SUM to present the previous display.
CLEAR	Removes the last keystroke from the scratch pad line: if last key was terminator key, clears entire scratch pad line.
.	Decimal point used for entering data.
PRO	A terminator key used as the completion keystroke for calling OPS and SPEC's.

6. FAULT ANNUNCIATION AND MESSAGES

6.1 ANNUNCIATION

Faults are detected by the operating system, GN&C, VU, PL and SM software. They result from hardware failures, or warning of failures, operator errors, and software or data problems. Faults are classified as Caution and Warning (class 2), Alert (class 3), GPC detected (class 4), and Operator error (class 5). They are identified by the indications summarized below:

−1 Class 2 - Caution Warning

−1.1 Flashing fault message appears on Fault message line of all CRT displays. If a message is already there, the number at the right of the message line is incremented.

−1.2 GNC, SM and Payload indicator alarms are outputs.

−2 Class 3 - Alert

−2.1 Flashing fault message appears on fault message line of all CRT displays. If a message is already there, the number at the right of the message line is incremented.

−2.2 SM Alert Light is lit.

−2.3 SM Alert Tone is sounded.

−3 Class 4 - GPC detected error

−3.1 Flashing fault message appears on fault message line of all CRT displays. If a message is already there, the number at the right of the message line is incremented.

−4 Class 5 - Operator Error

−4.1 Flashing fault message appears on fault message line of CRT attached to offending keyboard. Any message currently displayed on that CRT is saved and will reappear on the message line if a message reset is entered on the CRT displaying the operator error message. (33619)

−5 Following a class 2, 3 or 4 message, the keyboard ACK key stops the message from flashing, issues an alert light off command, and resets any associated tone. Thus, the message itself is still displayed and the specific error lamps associated with the error (if any) remain illuminated.

−6 The MSG RESET key will delete the current message from all CRTs displaying that message, and reset the tone and all indicators lamps remaining illuminated as a result of that message.

−7 Faults are stored chronologically on the Fault Summary Page which may contain up to 15 messages. (55324)

−8 Fault Summary Page Interlock Function - When multiple failures occur that result in the same (identical text) class 2, 3 or 4 fault message from the same source GPC(s), the FSW filters all but the first message within a fixed interlock period of 4.8 seconds. This is done to avoid excessive repeated annunciation of identical fault messages. Internal indicators are reset every 4.8 seconds to allow re-annunciation to the message line and the Fault Summary Page.

−9 The standard Fault Message line format is shown in Figure 6-1.

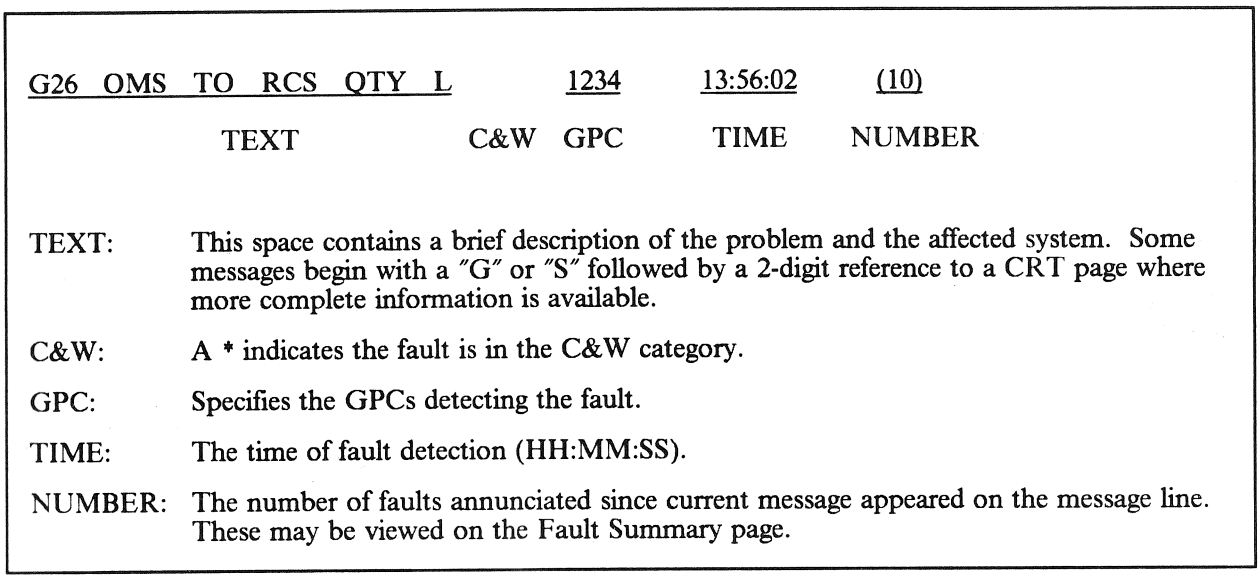


Figure 6-1. Fault Message Format

6.2 MESSAGES

See Appendix G for fault messages.

7. GROUND/GPC INTERFACES

The Ground Interfaces with the on-board computers through two major capabilities; a Launch Data Bus (LDB) system, and a radio frequency Network Signal Processor (NSP) Uplink. Section 7.1 describes the LDB system, including the Test Control Supervisor (TCS), and Section 7.2 addresses Uplink processing.

7.1 LAUNCH DATA BUS

The LDB is a dual bus system providing an interface between external users and the orbiter. Communications may be established in a Direct I/O mode or a GPC mode. In the Direct Mode, commands are sent from the ground to the Command Decoders (2) which direct the commands to the requested unit. In the GPC mode, commands are sent to the on-board computer (GPC). It is this capability that will be addressed in this document.

7.1.1 LDB Protocol/Polling

The basic polling rate between the GPC and the ground is 25 Hz, or one poll each 40 ms. The established protocol results in a total communication cycle each 120 ms.

−1 Protocol consists of INTERROGATION, RESPONSE to INTERROGATION, GO-AHEADS to data requests, DATA TRANSMISSION, and STATUS indications. In case both the GPC and the ground wish to transfer data, the ground transmission will take place first.

7.1.2 LDB Polling Controls

LDB polling may be started and stopped via SPEC 100, Item 14 and SPEC 001, Item 50. Polling will always attempt to start on LDB1. If the GPC is unable to establish valid protocol on LDB1, it will (unless prevented by a ground command), attempt to establish polling on LDB2. If that is unsuccessful, it will Toggle back to LDB1. This process continues indefinitely until either valid polling is established or it is stopped via another Item Entry. (28350)

−1 LDB polling may be requested by any GPC. However, LDB polling will be activated in the GPC assigned to command LDB1. If the commander of LDB1 is a member of a RS, all of those RS members will participate in LDB polling. The * on SPEC 100 (Item 14), or SPEC 001 (Item 50) merely indicates that LDB polling has been requested, not that the GPC displaying the * is participating in the polling.

−2 The ground, through TCS operator code 7 (see Section 7.1.5), has several possible LDB polling controls. These, with known restrictions, etc. are:

−2.1 Turn off polling - all GPCs in Common Set terminate polling.

−2.2 Assign current polling bus to another GPC.

−2.2.1 Specified GPC must be member of CS or an error code of 3 is returned.

−2.2.2 All GPCs (other than the specified GPC) not in RS with specified GPC terminate polling.

−2.3 Assign polling to a specified bus (assume the current non-polling bus specified) - Specified bus must be commanded by GPC currently polling or by a GPC in RS with current polling GPC. If not, and AUTO-Switchover is enabled, 3 pseudo time-outs will be logged and polling will be re-established on the original bus.

−2.4 LDB Auto-Switch enable/disable. (46506)

−3 In general, no LDB control operators should be issued during an OPS transition since they can cause CS Fail-to-Sync in certain timing situations.

−4 If the LDB buses ever get used for a GPC-to-GPC memory overlay, then all subsequent Initial Timeout I/O errors will be logged as MSC Timeouts (for GSE, SRB, MCIU). (47243)

−5 DGI cycle overrun can occur when the flight software system is executing at a high processing I/O level. (46507)

7.1.3 LDB Mass Memory Operations

The Ground/GPC interface provides the capability to perform read and/or write operations to the MMUs. The operations may be performed in one of two modes; capability 1 - MMU hardware addressing by using absolute addresses (File, Track, Subfile, Block); or capability 2 by using Phase/Load Block addressing. In either case, it is a user responsibility to avoid attempting simultaneous updates to the MMU from on-board and the ground. Such an attempt would compromise the acceptability of the software on the MMU.

−1 The following guidelines for capability 1 apply:

−1.1 The smallest write is 1 Block.

−1.2 Full block(s) shall be written (512 words). (47853)

−1.3 The largest write or read is 128 Blocks.

−2 Capability 2 provides patching capability whereby specific locations within a software Load Block may be modified. The following guidelines for capability 2 apply:

−2.1 The sequence of operations is read, merge, write.

−2.2 Universal Patch Format (UPF) shall be adhered to.

7.1.4 LDB SSME Load Operations

The ground initiates loading of the SSME controllers via LDB command to the SSME Load Program. Controller programs reside on MMUs on-board; however, commands to transfer the program from the MMU through the GPC/Engine Interface Unit to the controller are sent from the ground. (48500)

7.1.5 LDB Test Control Supervisor Operations

A set of ground commands exist to provide the capability to checkout the Shuttle system for launch. These commands are sent via the LDB to the GPC(s) controlling LDB polling for execution. Commands may be sent individually (in which case they are referred to as TCS-1 or SACS) or in groups to be executed together (called a sequence). TCS sequences may also be stored on a MMU and brought into the GPC and executed via ground command or the TCS Control SPEC (SPEC 105).

−1 Commands may be defined in three categories:

−1.1 Software Avionics Command Support (SACS) - subset of TCS 1-for-1 commands which may be issued in any OPS except G8. (55017)

−1.2 TCS 1-for-1 - individual commands which are sent and generate a response back to the ground. Three of these are especially for controlling a TCS sequence and are referred to as Interactive.

−1.3 TCS Sequence - a logical collection of operators grouped together into a package which is sent from the ground (or fetched from a MMU) to the GPC for execution. (37530)

–2 Table 7.1-1 provides a list of TCS operator codes and availability of each in the three categories. Detailed information about each operator may be found in the OFT Launch Data Bus Software Interface Requirements (SS-P-0002-150). The following restrictions apply to TCS usage:

–2.1 TCS Sequence Buffers - There are three TCS sequence buffers (1024 words each). A TCS sequence may require one, two, or all three of the TCS buffers. The user must set the End-of-buffer Indicator in the last operator of every buffer except the last buffer for a sequence (it is not necessary to set the End-of-buffer Indicator in the END operator but it will not cause a problem if it is set).

–2.2 Only one multi-buffer sequence may be loaded at any one time. (Currently the number of sequence buffers restricts the number of multi-buffer sequences to one. If the number of sequence buffers is increased the user must assure that only one multi-buffer sequence is loaded at one time.)

–2.3 All TCS sequences loaded in the GPC at a given time should have unique names. If the user attempts to load a sequence with the same name as a sequence that is already loaded, TCS will terminate the request and transmit an error response to the ground.

–2.4 The STOP AT step number is updated when a STOP AT item is entered. It is zeroed when any STOP AT step is reached. Thus, multiple STOP ATs in one sequence at one time are not indicated on the display. Also, the STOP AT step number field could be zero on the display when a STOP AT step still exists in the sequence.

–2.5 TCS Operator Responses - The TCS Operator Responses have been standardized in OFT. Response words one through five are the same for each operator. Any response words unique to an operator are in response words 6-N. Responses to TCS Interactive Operators are placed into the sequence response buffer as well as being transmitted immediately as a result of the execution of any single command operator.

–2.6 There are three independent capabilities that enable the user to input an equivalent DEU message into the GPC: TCS, SACS & Uplink. The user should assure that no two equivalent DEU capabilities are utilized during the same MCDS processing cycle (1 second).

–2.7 TCS Priority Processing - While TCS is executing a set of TCS operators in a priority series, no other TCS operators will be processed. The use of the TCS Priority Change operator causes the defined operations to be executed at a higher priority level. (47292)

–2.7.1 Single Commands: The first single command received during this time will be held and executed after the priority series is completed (or an error is encountered in the series). Other single commands will be rejected and Functional Destination Cannot Accept Data error status is returned. This includes both Interactive and 1-for-1 commands.

–2.7.2 Sequence Blocks: Same as single commands.

–2.8 TCS-1/TCS-S INTERACTION - The TCS sequencer processes TCS operators originating from SPEC 105, TCS-1 operators via the LDB, and TCS-S operators loaded via the LDB or MMU. The TCS sequencer interleaves the processing of these operators with the following priority: 1) SPEC 105 operator, 2) TCS-1 operator, and 3) TCS-S operator. If more than one test sequence is loaded (up to three possible) and executing concurrently, the processing of the steps of test sequences will be interleaved.

TABLE 7.1-1. TCS OPERATOR CODE/MODE MATRIX

OPERATOR CODES	FUNCTIONAL DESTINATION (GND-TO-GPC)				RESPONSE (GPC-TO-GND)			
		TCS-1		TCS-S		TCS-1		TCS-S
	SACS	1-FOR-1	INTER-ACTIVE	SEQUENCE	SACS	1-FOR-1	INTER-ACTIVE	SEQUENCE
1-BEGIN				X				
2-END				X				X
3-ISSUE	X	X		X	X	X		X
4-G-MEM WRITE	X	X		X	X	X		X
5-G-MEM READ	X	X		X	X	X		X
6-EQ DEU	X	X		X	X	X		X
7-LDB CTL	X	X			X	X		
8-READ	X	X		X	X	X		X
9-DELAY				X				
10-BRANCH				X				
11-TEST				X				X
12-CALL		X		X		X		X
13-TEXT		X		X		X		X
14-STOP			X	X			X	X
15-RESUME			X				X	
16-CANCEL		X	X	X		X	X	X
17-EIU CMD	X	X		X	X	X		X
18-EIU CMD	X	X		X	X	X		X
19-MEC CMD		X		X		X		X
20-MEC RD	X	X		X	X	X		X
21-LOAD REG		X		X		X		X
22-TEST REG				X				X
23-ARITHMETIC		X		X		X		X
24-PRIO CHG				X				X
25-SACS EP	X				X			
26-PL DATA		X		X		X		X

The following demonstrates the priority and order of operator execution assuming three test sequences active and control SPEC and TCS-1 operators always present:

- Control SPEC operator
- TCS-1 operator
- Test Sequence "A" operator
- Control SPEC operator
- TCS-1 operator
- Test Sequence "B" operator
- Control SPEC operator
- TCS-1 operator
- Test Sequence "C" operator

If only one sequence is loaded or active, the operators from that sequence only are interleaved with control SPEC and TCS-1 operators (if present). Nominally several TCS-S operators are executed sequentially since control SPEC operators are dependent on display processing rates and TCS-1 operators are dependent on LDB protocol rates. Interactive commands (from the control SPEC or TCS-1) to control a test sequence are not executed until the current operator of that test sequence is complete.

Note: A TCS-1 interactive command (e.g., STOP) to a test sequence performing a DELAY operator will be held and executed after the TCS-S DELAY operator is complete. This can cause the TCS-1 Functional Destination to remain busy for the length of time in the DELAY operator plus the time required to process the TCS-1 STOP operator.

7.1.6 Explicitly Coded Programs (ECP)

Several Vehicle Utility Checkout functions are not possible using the stand-alone TCS operators described in section 7.1.5. The functions are provided by on-board software programs which are coded to do an explicit job and only that job. These programs are initiated via the TCS CALL operator (see Table 7.1-1, OP CODE 12). A description of each program is provided. The description includes function, control interfaces, error processing, and any constraints and assumptions.

7.1.6.1 Actuator Initialization (AI)

The AI process performs the following functions: 1) Drives each actuator to a specified initial position, mode 0; 2) preconditions the Actuator MDMs with position feedback Values, mode 1; 3) Drives OMS, SSME, Body Flap and Speedbrake/Rudder to a FERRY position, mode 2; RAIN position, mode 3; GRAVITY position, mode 4; NULL position, mode 5; and TURNAROUND position, mode 6. Each task can be selected via the TCS Call operator. (25187)

7.1.6.1.1 Control Interfaces

The test is called via the TCS CALL operator using the AI CALL function and is available only in OPS G9.

−1 Upon initialization, the AI function is required to run in mode 1 prior to the running of mode 0 and it is required to run successfully in mode 0 prior to running any of the other modes (2,3,4,5,6).

-2 The CALL is formatted as follows:

BITS	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DW4	ACTUATOR INITIALIZATION PROGRAM ID (1)															
DW5	B	SPARES												MODE ID		

DW	BITS	DESCRIPTION
4	9 - 24	Actuator Initialization Program - Decimal 1; LSB is BIT 24.
5	9	SRB and Nosewheel Actuator MDMs Bypassed When Set To Zero.
5	10 - 21	SPARES - Set To Zero
5	22 - 24	MODE ID

000 = Initial Positioning Mode
001 = MDM Preconditioning Mode
010 = Ferry Positioning Mode
011 = Rain Positioning Mode
100 = Gravity Positioning Mode
101 = Null Positioning Mode
110 = Turnaround Positioning Mode

-3 Initial Positioning - Mode 0

The AI function will perform the initialization task by issuing commands to drive the SSME and OMS engines pitch and yaw Actuators, Aerosurface Actuators, SRB actuators, Nosewheel and Body Flap actuators to predefined positions in a predefined order as shown in Table 7.1-2. If specified in the Call operator, the SRB and Nosewheel Actuator MDMs can be bypassed.

-4 MDM Preconditioning - Mode 1

For each aerosurface, the commanded position is the result of a Middle-Value Selection performed on the four actuator feedbacks. For each OMS engine the Active Actuator position command corresponds to the Active Actuator position feedback, and the Standby command to the Standby feedback. The Body Flap is sent an Inhibit command. For the SSME, OMS, SRB, and ELVN Actuators, the position feedbacks are limit checked against the maximum initialization values listed in Table 7.1-2. If the position feedback value or the middle value for any of these actuators is outside the limits, the position command issued is equal to the maximum initialization value. The Nosewheel is commanded to the initial position referenced in Table 7.1-3 without any reference to its present position. If specified in the Call operator, the SRB and Nosewheel Actuators will be bypassed.

-5 Ferry/Rain/Gravity/Null/Turnaround Position - Modes 2, 3, 4, 5, 6

The AI function will perform the positioning of the SSME and OMS engines pitch and yaw actuators and the Body Flap actuator, the Speedbrake actuator and the Rudder actuator to a Ferry (mode 2), Rain (mode 3), Gravity (mode 4), Null (mode 5), or Turnaround (mode 6) position as shown in Tables 7.1-4, 5, 6, 7 and 8.

7.1.6.1.2 Limits

None

TABLE 7.1-2. AI MODE 0 (INITIAL)

ACTUATOR DEVICES AND SEQUENCES	COMMAND POSITION		LOW VALUE		HIGH VALUE	
	PCM	DEG	PCM	DEG	PCM	DEG
BODY FLAP	−66	+2.5	−123	0.0	−9	+5.0
L OMS YAW (ACT&STBY)	+420	+6.9	−50	−0.8	+492	+8.1
L OMS PITCH (ACT&STBY)	+356	+5.8	−443	−7.3	+443	+7.3
R OMS YAW (ACT&STBY)	+420	−6.9	−50	+0.8	+492	−8.1
R OMS PITCH (ACT&STBY)	+356	+5.8	−443	−7.3	+443	+7.3
SSME 1 PITCH	+144	−3.3	+63	−1.5	+224	−5.2
SSME 1 YAW	+10	+0.2	−62	−1.2	+82	+1.5
SSME 2 PITCH	+36	+0.8	−35	−0.8	+108	+2.5
SSME 2 YAW	+274	+5.1	+190	+3.6	+475	+8.9
SSME 3 PITCH	−7	+0.2	−79	+1.8	+64	−1.5
SSME 3 YAW	−261	−4.9	−475	−8.9	−178	−3.3
SPEEDBRAKE	−215	+21.0	−226	+19.8	−158	+27.2
RUDDER	0	0.0	−42	−2.3	+42	+2.3
LEFT INBOARD ELVN	+136	+0.4	+104	−1.5	+167	+2.2
RIGHT INBOARD ELVN	+136	+0.4	+104	−1.5	+167	+2.2
LEFT OUTBOARD ELVN	+138	+0.5	+104	−1.5	+169	+2.3
RIGHT OUTBOARD ELVN	+138	+0.5	+104	−1.5	+169	+2.3
SRB L ROCK *	0		−73	−1.0	+73	+1.0
SRB L TILT *	0		−73	−1.0	+73	+1.0
SRB R ROCK *	0		−73	−1.0	+73	+1.0
SRB R TILT *	0		−73	−1.0	+73	+1.0
NOSEWHEEL	0		NA		NA	

Note: * Engineering Unit is Inches, not Degrees

TABLE 7.1-3. AI MODE 1 (PRECONDITIONING)

ACTUATOR DEVICES AND SEQUENCES	COMMAND POSITION		LOW VALUE		HIGH VALUE	
	PCM	DEG	PCM	DEG	PCM	DEG
BODY FLAP			NA		NA	
L OMS YAW (ACT&STBY)			−512	−8.4	+511	+8.4
L OMS PITCH (ACT&STBY)			−512	−8.4	+511	+8.4
R OMS YAW (ACT&STBY)			−512	−8.4	+511	+8.4
R OMS PITCH (ACT&STBY)			−512	+8.4	+511	−8.4
SSME 1 PITCH			−433	+10.0	+433	−10.0
SSME 1 YAW			−433	−8.1	+433	+8.1
SSME 2 PITCH			−433	−10.0	+433	+10.0
SSME 2 YAW			−433	−8.1	+433	+8.1
SSME 3 PITCH			−433	+10.0	+433	−10.0
SSME 3 YAW			−433	−8.1	+433	+8.1
SPEEDBRAKE			−394	+1.6	+500	+98.6
RUDDER			−490	−27.1	+490	+27.1
LEFT INBOARD ELVN			−476	−35.1	+476	+20.1
RIGHT INBOARD ELVN			−476	−35.1	+476	+20.1
LEFT OUTBOARD ELVN			−477	−35.1	+477	+20.1
RIGHT OUTBOARD ELVN			−477	−35.1	+477	+20.1
SRB L ROCK *			−433	−6.1	+433	+6.1
SRB L TILT *			−433	−6.1	+433	+6.1
SRB R ROCK *			−433	−6.1	+433	+6.1
SRB R TILT *			−433	−6.1	+433	+6.1
NOSEWHEEL			NA		NA	

Note: * Engineering Unit is Inches, not Degrees

TABLE 7.1-4. AI MODE 2 (FERRY)

ACTUATOR DEVICES AND SEQUENCES	COMMAND POSITION		LOW VALUE		HIGH VALUE	
	PCM	DEG	PCM	DEG	PCM	DEG
BODY FLAP	+346	+20.7	+289	+18.2	+403	+23.2
L OMS YAW (ACT&STBY)	−384	−6.3	−434	−7.1	−334	−5.5
L OMS PITCH (ACT&STBY)	+373	+6.1	+323	+5.3	+423	+6.9
R OMS YAW (ACT&STBY)	−384	+6.3	−434	+7.1	−334	+5.5
R OMS PITCH (ACT&STBY)	+373	+6.1	+323	+5.3	+423	+6.9
SSME 1 PITCH	−432	+10.0	−475	+11.0	−336	+7.8
SSME 1 YAW	+10	+0.2	−62	−1.2	+82	+1.5
SSME 2 PITCH	−148	−3.4	−229	−5.3	−67	−1.5
SSME 2 YAW	−32	−0.6	−104	−1.9	+40	+0.8
SSME 3 PITCH	+173	−4.0	+91	−2.1	+255	−5.9
SSME 3 YAW	+48	+0.9	−24	−0.5	+120	+2.2
SPEEDBRAKE	−317	+10.0	−374	+3.8	−260	+16.2
RUDDER	0		−42	−2.3	+42	+2.3

TABLE 7.1-5. AI MODE 3 (RAIN)

ACTUATOR DEVICES AND SEQUENCES	COMMAND POSITION		LOW VALUE		HIGH VALUE	
	PCM	DEG	PCM	DEG	PCM	DEG
BODY FLAP	+346	+20.7	+289	+18.2	+403	+23.2
L OMS YAW (ACT&STBY)	+420	+6.9	+370	+6.1	+438	+7.2
L OMS PITCH (ACT&STBY)	+356	+5.8	+306	+5.0	+376	+6.2
R OMS YAW (ACT&STBY)	+420	−6.9	+370	−6.1	+438	−7.2
R OMS PITCH (ACT&STBY)	+356	+5.8	+306	+5.0	+376	+6.2
SSME 1 PITCH	−432	+10.0	−475	+11.0	−336	+7.8
SSME 1 YAW	+10	+0.2	−62	−1.2	+82	+1.5
SSME 2 PITCH	+434	+10.0	+338	+7.8	+511	+11.8
SSME 2 YAW	+10	+0.2	−62	−1.2	+82	+1.5
SSME 3 PITCH	−432	+10.0	−475	+11.0	−336	+7.8
SSME 3 YAW	+10	+0.2	−62	−1.2	+82	+1.5
SPEEDBRAKE	−215	+21.0	−226	+19.8	−158	+27.2
RUDDER	0		−42	−2.3	+42	+2.3

TABLE 7.1-6. AI MODE 4 (GRAVITY)

ACTUATOR DEVICES AND SEQUENCES	COMMAND POSITION		LOW VALUE		HIGH VALUE	
	PCM	DEG	PCM	DEG	PCM	DEG
BODY FLAP	−123	0.0	−180	−2.5	−66	+2.5
L OMS YAW (ACT&STBY)	+367	+6.0	+372	+6.7	+407	+7.2
L OMS PITCH (ACT&STBY)	+354	+5.8	+314	+5.1	+376	+6.2
R OMS YAW (ACT&STBY)	+367	−6.4	+327	−6.7	+407	−7.2
R OMS PITCH (ACT&STBY)	+354	+5.8	+314	+5.1	+376	+6.2
SSME 1 PITCH	−397	+9.2	−477	+11.0	−301	+6.9
SSME 1 YAW	+10	+0.2	−62	−1.2	+82	+1.5
SSME 2 PITCH	+281	+6.5	+196	+4.5	+366	+8.5
SSME 2 YAW	−106	−2.0	−184	−3.4	−27	−0.5
SSME 3 PITCH	−252	+5.8	−335	+7.7	−169	+3.9
SSME 3 YAW	+124	+2.3	+45	+0.8	+204	+3.8
SPEEDBRAKE	−362	+5.1	−421	−1.3	−301	+11.7
RUDDER	0		−42	−2.3	+42	+2.3

TABLE 7.1-7. AI MODE 5 (NULL)

ACTUATOR DEVICES AND SEQUENCES	COMMAND POSITION		LOW VALUE		HIGH VALUE	
	PCM	DEG	PCM	DEG	PCM	DEG
BODY FLAP	−123	0.0	−157	−1.5	−89	+1.5
L OMS YAW (ACT&STBY)	+367	+6.0	+327	+5.4	+407	+6.7
L OMS PITCH (ACT&STBY)	+354	+5.8	+314	+5.1	+376	+6.2
R OMS YAW (ACT&STBY)	+367	−6.0	+327	−5.4	+407	−6.7
R OMS PITCH (ACT&STBY)	+354	+5.8	+314	+5.1	+376	+6.2
SSME 1 PITCH	+14	−0.3	−29	−0.7	+58	−1.3
SSME 1 YAW	+10	+0.2	−44	−0.8	+63	+1.2
SSME 2 PITCH	+14	+0.3	−29	−0.7	+58	+1.3
SSME 2 YAW	+10	+0.2	−44	−0.8	+63	+1.2
SSME 3 PITCH	+14	−0.3	−29	+0.7	+58	−1.3
SSME 3 YAW	+10	+0.2	−44	−0.8	+63	+1.2
SPEEDBRAKE	−362	+5.1	−421	+1.3	−301	+16.7
RUDDER	0		−42	−2.3	+42	+2.3

TABLE 7.1-8. AI MODE 6 (TURNAROUND)

ACTUATOR DEVICES AND SEQUENCES	COMMAND POSITION		LOW VALUE		HIGH VALUE	
	PCM	DEG	PCM	DEG	PCM	DEG
BODY FLAP	+346	+20.7	+289	+18.2	+403	+23.2
L OMS YAW (ACT&STBY)	−367	+6.0	+327	+5.4	+407	+6.7
L OMS PITCH (ACT&STBY)	+354	+5.8	+314	+5.1	+376	+6.2
R OMS YAW (ACT&STBY)	+367	−6.0	+327	−5.4	+407	−6.7
R OMS PITCH (ACT&STBY)	+354	+5.8	+314	+5.1	+376	+6.2
SSME 1 PITCH	+101	−2.3	+58	−1.3	+143	−3.3
SSME 1 YAW	+10	+0.2	−44	−0.8	+63	+1.2
SSME 2 PITCH	−73	−1.7	−117	−2.7	−29	−0.7
SSME 2 YAW	+10	+0.2	−44	−0.8	+63	+1.2
SSME 3 PITCH	+101	−2.3	+58	−1.3	+143	−3.3
SSME 3 YAW	+10	+0.2	−44	−0.8	+63	+1.2
SPEEDBRAKE	−362	+5.1	−421	−1.3	−301	+11.7
RUDDER	0		−42	−2.3	+42	+2.3

Note: The command position values are listed in PCM counts.

SSMEs/SRBs (POSITION F.B. IN PCM COUNTS - A_0) (A_1) = CMD VALUE
A_0 = COMPENSATION BIAS = 250 PCM COUNTS (I-LOADABLE)
A_1 = MULTIPLICATION FACTOR = 1.818 (I-LOADABLE)

7.1.6.1.3 Error Processing

An appropriate CALL program error response code may be generated relative to the conditions defined below. For all such error conditions, the GPC shall reject the call operator and inhibit the test. The error code shall be made available for the TCS CALL program error response and to the TCS control display.

CONDITIONS	ERROR CODE
HDA function not active for reading position feedback	102
Actuator position not within tolerance	103
A CALL operator which requests either AI Mode 0, Mode 2, Mode 3 or Mode 4 to run after OPS 9 initialization and prior to running AI Mode 1	102
Actuator position feedback values invalid due to I/O errors	104
A CALL operator which requests either Mode 2, 3 or 4 prior to AI Mode 0	102

7.1.6.1.4 Constraints/Assumptions

−1 AI cannot run concurrently with FRT, MAT, RAMP, or BFD. The AI mode 0 process will complete processing all actuators even though a positioning error (error code = 103) might occur. Once all the actuators have been driven the error response is transmitted to the ground or SPEC 105 display, if necessary. The HDA processor must be active.

−2 If AI is executed while an IMU submode is active, there is a small probability that the IMU jitter requirement may be violated for one cycle. Such an occurrence will be transparent to the user as well as to the results of the submode.

7.1.6.2 Ramp Function Generator (RFG)

The RFG outputs a ramp function stimulus to specified aerosurface actuators, SSME/SRB Thrust Vector Control (TVC) actuators, Orbital Maneuvering System (OMS) actuators, nosewheel actuator and RGA devices as defined in Table 7.1-9. Only one actuator/device can be selected per test via the ramp function call operator (see call format). The capability also exists to output a stimulus to a single channel of a four-channel actuator.

7.1.6.2.1 Control Interfaces

The test is called via the TCS call operator using the RFG call function and is available only in OPS G9. Upon initialization the AI function is required to run in Mode 1 prior to the running of the RFG function the first time.

−1 The RFG function is deactivated by TCS cancel, OPS transition, or the selected surface reaching its final value.

Table 7.1-9. ACTUATORS/DEVICE AVAILABLE FOR TEST AND INITIALIZATION

DEVICE ID	BINARY	ACTUATOR/DEVICE
0	000000	NOSEWHEEL ACTUATOR
1	000001	SPEEDBRAKE (SB) ACTUATOR
2	000010	RUDDER (RUD) ACTUATOR
3	000011	LEFT INBOARD ELEVON (LIE) ACTUATOR
4	000100	RIGHT INBOARD ELEVON (RIE) ACTUATOR
5	000101	LEFT OUTBOARD ELEVON (LOE) ACTUATOR
6	000110	RIGHT OUTBOARD ELEVON (ROE) ACTUATOR
7	000111	SSME 1 PITCH ACTUATOR
8	001000	SSME 1 YAW ACTUATOR
9	001001	SSME 2 PITCH ACTUATOR
10	001010	SSME 2 YAW ACTUATOR
11	001011	SSME 3 PITCH ACTUATOR
12	001100	SSME 3 YAW ACTUATOR
13	001101	SRB LEFT ROCK ACTUATOR
14	001110	SRB LEFT TILT ACTUATOR
15	001111	SRB RIGHT ROCK ACTUATOR
16	010000	SRB RIGHT TILT ACTUATOR
17	010001	RIGHT OMS PITCH-ACTIVE ACTUATOR
18	010010	RIGHT OMS PITCH-STANDBY ACTUATOR
19	010011	RIGHT OMS YAW-ACTIVE ACTUATOR
20	010100	RIGHT OMS YAW-STANDBY ACTUATOR
21	010101	LEFT OMS PITCH-ACTIVE ACTUATOR
22	010110	LEFT OMS PITCH-STANDBY ACTUATOR
23	010111	LEFT OMS YAW-ACTIVE ACTUATOR
24	011000	LEFT OMS YAW-STANDBY ACTUATOR
25	011001	RGA 1 ROLL GYRO
26	011010	RGA 1 PITCH GYRO
27	011011	RGA 1 YAW GYRO
28	011100	RGA 2 ROLL GYRO
29	011101	RGA 2 PITCH GYRO
30	011110	RGA 2 YAW GYRO
31	011111	RGA 3 ROLL GYRO
32	100000	RGA 3 PITCH GYRO
33	100001	RGA 3 YAW GYRO
34	100010	RGA 4 ROLL GYRO
35	100011	RGA 4 PITCH GYRO
36	100100	RGA 4 YAW GYRO

–2 The RFG call is formatted as follows:

BITS	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DW 4	RAMP PROGRAM ID (2)															
DW 5	OMS	SPARES						CH NO		I/O	ACTUATOR/RGA SELECT					
DW 6	SLOPE															
DW 7	FINAL VALUE										SPARES					

DW	BITS	DESCRIPTION
4	9 - 24	Ramp program ID - Decimal 2 (LSB is bit 24)
5	9 - 10	OMS SELECT ACTIVE/STBY-1/2 discretes control. Determines the logic state of the ACTIVE/STBY-1/2 discretes to be output by the GPC for the selected OMS actuator device. 1 = GPC outputs logic one 0 = GPC outputs logic zero
5	11 - 15	Spares - Set to zero
5	16 - 17	Channel number to drive with ramp function stimulus for single-channel I/O mode select (refer to DW 5, bit 18) for device ID selects of 1 through 16 (QUAD-CHANNEL DEVICE): 00 = Channel A 01 = Channel B 10 = Channel C 11 = Channel D For device ID select of 0 (Nosewheel): 00 = Channel B (FF02) 01 = Channel C (FF03) Channel selects of '10' or '11' are invalid for device ID of 0. DW 5, bits 16-17 not applicable for device IDs other than 0-16.
5	18	I/O mode select for ID selects of 1 through 16: 0 = Quad channel I/O 1 = Single channel I/O I/O mode select for ID select = 0 (Nosewheel): 0 = Dual-channel I/O 1 = Single-channel I/O DW 5, bit 18 not applicable for device IDs other than 0-16.
5	19 - 24	Actuator or RGA selected for stimulus input - Decimal 0 to 36 (refer to Table 7.1-9 for designated actuator or RGA IDs.) (LSB is bit 24)
6	9 - 24	Slope value - LSB equal 1/32 PCM count (unsigned).
7	9 - 18	Final value in hardware units - Plus 511 to –512 PCM counts representing an analog stimulus value (negative values in 2s complement form)

7.1.6.2.2 Limits

The following limits are checked prior to or during the RFG execution:

−1 Position Limit Checks (Table 7.1-10).

−2 Rate Limit if the position limit is exceeded.

−3 Collision avoidance on the collision potential actuators (SSME's, OMS, and Body Flap)

−4 SSME-1 clearance with the OMS pods

−5 Rudder/Speedbrake

7.1.6.2.3 Error Processing

An appropriate CALL program error response code may be generated relative to the error conditions defined below. For all such error conditions, the GPC shall inhibit the test. The error code shall be made available for the TCS call program error response and to the TCS control display.

CONDITIONS	ERROR CODE
HDA function not active for reading position feedback	202
The call generates an out-of-limits position or rate	200
A test which invokes a collision potential situation	206
Call to RAMP the first time prior to running AI Mode 1	202
Actuator position feedback values invalid due to I/O errors	204
Speedbrake/rudder travel range is not within limits	205
A call operator with an invalid actuator/RGA ID	200
SSME1/OMS pod clearance not within limits	206
Invalid nosewheel channel selected	200

7.1.6.2.4 Constraints/Assumptions

−1 The HDA processor must be active.

−2 The RFG, FRT, MAT, AI, and BFD functions are all mutually exclusive; i.e., only one may be active at any one time. (37708)

TABLE 7.1-10. POSITION AND RATE DRIVE COMMAND UNITS

ACTUATOR/DEVICES	POSITION LIMITS			
	LOW		HIGH	
	PCM	DEG	PCM	DEG
SPEEDBRAKE	−344	+ 7.0	+ 504	+ 99.0
RUDDER	−504	−27.9	+ 504	+ 27.9
LEFT INBOARD ELEVON (VERTICAL)*	−220	−20.3	+ 480	+ 20.3
LEFT INBOARD ELEVON (HORIZONTAL)*	−480	−35.3	+ 480	+ 20.3
RIGHT INBOARD ELEVON (VERTICAL)*	−220	−20.3	+ 480	+ 20.3
RIGHT INBOARD ELEVON (HORIZONTAL)*	−480	−35.3	+ 480	+ 20.3
LEFT OUTBOARD ELEVON (VERTICAL)*	−220	−20.3	+ 480	+ 20.3
LEFT OUTBOARD ELEVON (HORIZONTAL)*	−480	−35.3	+ 480	+ 20.3
RIGHT OUTBOARD ELEVON (VERTICAL)*	−220	−20.3	+ 480	+ 20.3
RIGHT OUTBOARD ELEVON (HORIZONTAL)*	−480	−35.3	+ 480	+ 20.3
SSME 1 PITCH	−440	+ 10.2	+ 440	−10.2
SSME 1 YAW	−440	−8.2	+ 440	+ 8.2
SSME 2 PITCH	−440	−10.2	+ 440	+ 10.2
SSME 2 YAW	−440	−8.2	+ 440	+ 8.2
SSME 3 PITCH	−440	+ 10.2	+ 440	−10.2
SSME 3 YAW	−440	−8.2	+ 440	+ 8.2
SRB L ROCK **	−460	−6.4	+ 460	+ 6.4
SRB L TILT **	−460	−6.4	+ 460	+ 6.4
SRB R ROCK **	−460	−6.4	+ 460	+ 6.4
SRB R TILT **	−460	−6.4	+ 460	+ 6.4
RIGHT OMS ENG PITCH ACTUATOR/ACTIVE	−364	−6.0	+ 358	+ 5.9
RIGHT OMS ENG PITCH ACTUATOR/STANDBY	−364	−6.0	+ 358	+ 5.9
RIGHT OMS ENG YAW ACTUATOR/ACTIVE	−420	+ 6.9	+ 420	−6.9
RIGHT OMS ENG YAW ACTUATOR/STANDBY	−420	−6.9	+ 420	−6.9
LEFT OMS ENG PITCH ACTUATOR/ACTIVE	−364	−6.0	+ 358	+ 5.9
LEFT OMS ENG PITCH ACTUATOR/STANDBY	−364	−6.0	+ 358	+ 5.9
LEFT OMS ENG YAW ACTUATOR/ACTIVE	−420	−6.9	+ 420	+ 6.9
LEFT OMS ENG YAW ACTUATOR/STANDBY	−420	−6.9	+ 420	+ 6.9
NOSEWHEEL STEERING ACTUATOR	−500	−10.0	+ 500	+ 10.0

Note: A single rate limit equal to a 1/4 PCM count (scaled per DW6) shall be applicable for all devices except the SRBs (which have no rate limit requirements) when the horizontal elevon low limits are selected via the GTS display. A single rate limit equal to a zero PCM count shall be applicable when the vertical elevon low limits are selected via the GTS display (default).

* The elevon position low limits are selectable via the GTS display. The default values are the vertical low limits.

** For SRB actuators, the value is in inches, not degrees.

7.1.6.3 Frequency Response Test (FRT)

The FRT provides the capability to output a sine wave or step function stimulus to either an aerosurface actuator, an SSME actuator, an SRB actuator, an OMS actuator, the nosewheel actuator or an RGA. Only one actuator or RGA can be selected per test. The actuators and RGAs available to receive the FRT stimulus and their selection ID are defined in Table 7.1-9. The nosewheel actuator (device select = 0) shall be handled as a dual-channel device, i.e., the stimulus will be output on both channels. Additionally, the capability shall exist to output the stimulus on either one of these two channels. The capability shall exist to output a stimulus to a single channel of a Quad-channel device (ref. Table 4.7-1, Device ID selects 1-16). The FRT stimulus is output at a 100 samples-per-second rate for the selected actuator and a 25 samples-per-second rate for the selected RGA.

7.1.6.3.1 Control Interfaces

The test is called via the TCS call operator using the FRT call function and is available only in OPS G9 simplex GPC configuration. Upon initialization, the AI function is required to run in Mode 1 prior to the running of the FRT function the first time.

–1 The FRT function is deactivated by TCS CANCEL, OPS transition or successful completion of the test.

–2 The FRT CALL is formatted as follows:

BITS	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DW 4	FRT PROGRAM ID (3)															
DW 5	OMS	SPARES					CH NO		I/O	SID	ACTUATOR/RGA SELECT					
DW 6	FUNCTION MAXIMUM VALUE										SPARES					
DW 7	FUNCTION MINIMUM VALUE										SPARES					
DW 8	TEST PERIOD															
DW 9	SINE SIGNAL FREQUENCY															
DW 10	STEP INITIAL LEVEL DURATION															
DW 11	STEP HIGH/LOW LEVEL DURATION															

DW	BITS	DESCRIPTION
4	9 - 24	FRT program ID - Decimal 3 (LSB, Bit 24)
5	9 - 10	OMS SELECT ACTIVE/STBY-1/2 discretes control. Determines the logic state of the ACTIVE/STBY-1/2 discretes to be output by the GPC for the selected OMS actuator device. 1 = GPC outputs logic one 0 = GPC outputs logic zero
5	11 - 14	Spares - Set to zero

DW	BITS	DESCRIPTION
5	15 - 16	Channel number that will be driven with the FRT Function when single channel I/O (Ref. DW5, Bit 17) is requested for device ID selects 1 through 16: 00 = Channel A 01 = Channel B 10 = Channel C 11 = Channel D For device ID select of 0 (Nosewheel): 00 = Channel B (FF02) 01 = Channel C (FF03) Channel selects of '10' or '11' are invalid for device ID 0. DW5, bits 15-16 not applicable for device IDs other than 0-16.
5	17	I/O mode select for ID selects of 1 through 16: 0 = Quad-Channel I/O 1 = Single-Channel I/O I/O mode select for ID select of 0 (Nosewheel): 0 = Dual-Channel I/O 1 = Single-Channel I/O DW 5, bit 17 not applicable for device IDs other than 0-16.
5	18	Stimulus ID (SID) 1 = Sine stimulus 0 = Step stimulus
5	19 - 24	Actuator or RGA selected for stimulus input - Decimal 0 to 36 (refer to Table 7.1-9 for designated actuator or RGA IDs) (LSB is bit 24).
6	9 - 18	Function maximum value in hardware units - Plus 511 to 512 PCM counts representing an analog value (negative values in 2s complement); LSB is bit 18.
6	19 - 24	Spares - Set to zero
7	9 - 18	Function minimum value in hardware units - Plus 511 to 512 PCM counts representing an analog value (negative values in 2s complement); LSB is bit 18.
7	19 - 24	Spares - Set to zero
8	9 - 24	Test period in cycles; LSB is bit 24 and equals 1.0 cycle.
9	9 - 24	Sine signal frequency in Hz; LSB is bit 24 and equals 0.1 Hz.
10	9 - 24	Step function initial level duration; LSB is bit 24 and equals 10 msec for the 100 Hz rate and 40 msec for the 25 Hz rate.
11	9 - 24	Step function high/low level duration; LSB is bit 24 and equals 10 msec for the 100 Hz rate and equals 40 msec for the 25 Hz rate.

−3 Sine stimulus; The sine stimulus transmitted to the selected actuator or RGA and has the following characteristics:

−3.1 Stimulus characteristics; The stimulus begins at the initial value, continues in a positive direction toward the maximum amplitude value, then continues until completion of the full number of cycles specified. The type of stimulus is a symmetrical and cyclic waveshape representing a sine wave.

−3.2 Number-of-cycles range; 1.0 to 100 cycles

−3.3 Frequency range; 0.1 to 25 Hz

−4 Step stimulus; The step stimulus transmitted to the selected actuator or RGA is an analog signal with the following characteristics:

−4.1 Stimulus characteristics; The stimulus begins on the initial level and sends the operator-defined levels for the operator-defined test period until the number of full cycles specified are completed. The stimulus value ends on the last initial level of the specified stimulus for a complete test run. The stimulus type is operator-defined and cyclic.

−4.2 Number-of-cycles range; 1.0 to 100 cycles

−4.3 Initial level duration range; 0 to 60,000 msec.

−4.4 High and low level duration range; 10 to 60,000 msec for the 100 Hz rate and 40 to 60,000 msec for the 25 Hz rate.

−4.5 If the initial level duration equals zero, the transition from high level value to low level value, or vice-versa, shall be instantaneous (i.e., no output at the initial value).

−4.6 If the high/low level duration equals zero, there shall be no output and an error condition is generated.

7.1.6.3.2 Limits

The following limits are checked prior to or during the FRT execution:

−1 Position Limit Checks (Table 7.1-10) except RGAs

−2 SSME1 and OMS Pod

−3 Collision avoidance on the collision potential actuators (SSME's, OMS, and Body Flap).

−4 Rudder/Speedbrake

All limit checks listed above shall be bypassed when single-channel I/O is requested of a quad device (Speedbrake, Rudder, Elevon, SSME, and SRB Actuators).

7.1.6.3.3 Error Processing

An appropriate CALL program error response code may be generated relative to the error conditions defined below. For all such error conditions, the GPC shall inhibit the test. The error code shall be made available for the TCS call program error response and to the TCS control display.

CONDITIONS	ERROR CODE
A CALL to FRT with other GPCs in the RUN mode	302
HDA function not active for reading position feedback	302
A CALL operator with a high/low-level duration equal to zero	300
A CALL operator which generates an out-of-limits position or rate	300
A test which invokes a collision-potential situation	306
An initial value which is not within the Call-operator-specified maximum and minimum values	300
Call to FRT the first time prior to running AI Mode 1	302
Actuator position feedback values invalid due to I/O errors	304
Speedbrake/rudder travel range is not within limits	305
A CALL operator with an invalid actuator/RGA ID	300
SSME1/OMS pod clearance not within limits	306
Invalid nosewheel channel selected	300

7.1.6.3.4 Constraints/Assumptions

–1 The initial value for all RGA processing is zero.

–2 The HDA function is required to be active.

–3 At the completion of the test period, the function continues to output a stimulus (start values) for two seconds and then close. (37531)

7.1.6.4 Dedicated Display Checkout (DDCO)

DDCO provides the capability of loading the low-value test data for each DDU-drive indicator and the HUD unique data, according to the instructions and data received through the TCS CALL operator.

7.1.6.4.1 Control Interfaces

The Test is called via the TCS CALL Operator using the DDCO CALL function and is available only in OPS G9. The CALL Operator is predefined, with a fixed length format. The Software will overlay the dedicated display low test values and the HUD unique data with the CALL Operator data. The DDCO CALL Operation Format is shown in Table 7.1-11.

7.1.6.4.2 Limits

None

7.1.6.4.3 Error Processing

None

7.1.6.4.4 Constraints/Assumptions

DDCO can be run concurrently with AI, RFG, FRT, MAT, BFD, and BFM.

TABLE 7.1-11. DEDICATED DISPLAY CHECKOUT CALL OPERATOR FORMAT

BITS	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DW 4	DEDICATED DISPLAY CHECKOUT PROGRAM ID (4)															
DW 5	ADI CONTROL WORD													SPARES		
DW 6	ADI TEST WORD															
DW 7	ROLL SINE													SPARES		
DW 8	ROLL COSINE													SPARES		
DW 9	PITCH SINE													SPARES		
DW 10	PITCH COSINE													SPARES		
DW 11	YAW SINE													SPARES		
DW 12	YAW COSINE													SPARES		
DW 13	ROLL RATE													SPARES		
DW 14	PITCH RATE													SPARES		
DW 15	YAW RATE													SPARES		
DW 16	ROLL ERROR													SPARES		
DW 17	PITCH ERROR													SPARES		
DW 18	YAW ERROR													SPARES		
DW 19	HSI CONTROL WORD										SPARES					
DW 20	HSI TEST WORD															
DW 21	SELECTED COURSE												SPARES			
DW 22	HEADING												SPARES			

TABLE 7.1-11. DEDICATED DISPLAY CHECKOUT CALL OPERATOR FORMAT (CONTINUED)

	BITS 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
DW 23	PRIMARY BEARING | SPARES
DW 24	SECONDARY BEARING | SPARES
DW 25	PRIMARY DISTANCE
DW 26	SECONDARY DISTANCE
DW 27	COURSE DEVIATION CMD | SPARES
DW 28	GLIDESLOPE DEVIATION | SPARES
DW 29	AAVI CONTROL WORD | SPARES
DW 30	AVVI TEST WORD
DW 31	INDICATED ALTITUDE | SPARES
DW 32	VERTICAL VELOCITY | SPARES
DW 33	RADAR ALTITUDE | SPARES
DW 34	VERTICAL ACCELERATION | SPARES
DW 35	AMI CONTROL WORD | SPARES
DW 36	AMI TEST WORD
DW 37	MACH/VELOCITY | SPARES
DW 38	ALPHA | SPARES
DW 39	EQUIVALENT AIR SPEED | SPARES
DW 40	VEHICLE ACCELERATION | SPARES
DW 41	HUD DATA SCALING CONTROL WORD

TABLE 7.1-11. DEDICATED DISPLAY CHECKOUT CALL OPERATOR FORMAT (CONTINUED)

BITS	9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
DW 42	HUD TEST WORD
DW 43	GPC TO HUD FLAGS WORD 1
DW 44	GPC TO HUD FLAGS WORD 2
DW 45	SPEEDBRAKE POSITION
DW 46	SPEEDBRAKE COMMAND
DW 47	X POSITION WRT RUNWAY
DW 48	Y POSITION WRT RUNWAY
DW 49	Z POSITION WRT RUNWAY
DW 50	X VELOCITY WRT RUNWAY
DW 51	Y VELOCITY WRT RUNWAY
DW 52	Z VELOCITY WRT RUNWAY
DW 53	HEADING
DW 54	ACC_DRAG
DW 55	H_DOT_ELLIPSOID
DW 56	FLIGHT PATH REFERENCE 2
DW 57	ROLL ERROR
DW 58	PITCH ERROR
DW 59	RUNWAY HEADING
DW 60	AIRSPEED REFERENCE

TABLE 7.1-11. DEDICATED DISPLAY CHECKOUT CALL OPERATOR FORMAT (CONTINUED)

BITS	9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
DW 61	FLIGHT PATH REFERENCE 1
DW 62	X_ZERO
DW 63	HERROR/H_ERROR
DW 64	ENERGY_UPPER_LIMIT
DW 65	ENERGY_SHUTTLE
DW 66	ENERGY_LOWER_LIMIT
DW 67	ENERGY_NOMINAL
DW 68	AILERON POSITION
DW 69	AILERON LOAD BALANCE INCREMENT
DW 70	PITCH ADJUSTMENT
DW 71	VV FILTER FREQUENCY
DW 72	HUD MESSAGE 2 CONTROL WORD
DW 73	RUNWAY REMAINING TO STOP
DW 74	RUNWAY TO GO MINIMUM
DW 75	MAX DECELERATION CMD
DW 76	RUNWAY LENGTH
DW 77	SPARE (RESERVED FOR AUTOLAND MON)
DW 78	SPARE (RESERVED FOR AUTOLAND MON)

TABLE 7.1-11. DEDICATED DISPLAY CHECKOUT CALL OPERATOR FORMAT (CONTINUED)

BITS	9 – 24
DW 79	SPARE (RESERVED FOR AUTOLAND MON)
DW 80	SPARE (RESERVED FOR AUTOLAND MON)
DW 81	SPARE
DW 82	SPARE
DW 83	SPARE

Note: For a complete description of each data word, see SS-P-002-550 Table 4.13-7).

7.1.6.5 Multiple Actuator Test (MAT)

MAT simultaneously outputs a trapezoidal waveform stimulus to specified groups of aerosurface actuators or SSME and SRB thrust vector control actuators. Only one group can be selected per test. The actuators available in each group to receive the stimulus and the group selection ID are defined in the CALL Operator format description. The capability also exists to output the trapezoidal stimulus on a single channel for the selected actuator group.

7.1.6.5.1 Control Interfaces

The test is called via the TCS CALL Operator using the MAT CALL function and is available only in OPS G9. The group of actuators to be tested and the trapezoidal characteristics are selected by user inputs made available via the MAT Call Operator.

–1 Upon initialization, the AI function is required to run in Mode 1 prior to the running of the MAT function the first time.

–2 The MAT function is inhibited when the specified number of trapezoidal transitions are complete, when the TCS Sequencer that called the function is cancelled, by a TCS CANCEL Operator to MAT, or by an OPS transition. If the function is to be inhibited prior to completion, it will cease after the output of the current computed stimulus value.

–3 The Multiple Actuator Test Call Operator Format is as follows:

BITS	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DW 4	MAT PROGRAM ID (5)															
DW 5	P	SLOPE VALUE											LED	SPARE		
DW 6	DEFLECTION										SPARE		TRANSITIONS			
DW 7	AGS			I/O	CH NO		SPARE									

DW	BITS	DESCRIPTION
4	9 - 24	MAT PROGRAM ID - DECIMAL 5 (LSB, BIT 24)
5	9	SLOPE POLARITY (P) 0 = POSITIVE SLOPE 1 = NEGATIVE SLOPE
5	10-20	SLOPE VALUE - LSB EQUALS 1/32 PCM COUNT
5	21	LEFT ELVN DEFLECTION (LED) (VALID WITH ACTUATOR GROUP 001 ONLY) 0 = SAME POLARITY AS RIGHT ELVN 1 = OPPOSITE POLARITY AS RIGHT ELVN
5	22-24	SPARE
6	9-18	DEFLECTION VALUE IN HARDWARE UNITS - PLUS 1 TO 1023 PCM COUNTS REPRESENTING AN ANALOG STIMULUS VALUE
6	19-20	SPARE - SET TO ZERO
6	21-24	TRANSITIONS - LSB IS BIT 24 AND EQUALS ONE TRANSITION OF THE TRAPEZOIDAL WAVE STIMULUS. RANGE IS 1 TO 15 (DECIMAL).
7	9-12	ACTUATOR GROUP SELECT (AGS) 0000 = LIE, RIE, LOE, ROE AND RUDDER ACTUATORS 0001 = LIE, RIE, LOE AND ROE ACTUATORS 0010 = LIE AND LOE ACTUATORS 0011 = RIE AND ROE ACTUATORS 0100 = SSME 1, 2, AND 3 PITCH AND YAW ACTUATORS 0101 = SSME 1, 2, AND 3 PITCH ACTUATORS 0110 = SSME 1, 2, AND 3 YAW ACTUATORS 0111 = SRB RIGHT ROCK AND TILT ACTUATORS 1000 = SRB LEFT ROCK AND TILT ACTUATORS 1001 = SRB LEFT ROCK, LEFT TILT, RIGHT ROCK, AND RIGHT TILT ACTUATORS
7	13	I/O MODE SELECT 0 = QUAD-CHANNEL 1 = SINGLE CHANNEL I/O
7	14-15	CHANNEL NUMBER TO DRIVE WITH MAT FUNCTION STIMULUS FOR SINGLE CHANNEL I/O MODE SELECT (ref. DW7, BIT 13) 00 = CHANNEL A 01 = CHANNEL B 10 = CHANNEL C 11 = CHANNEL D
7	16-24	SPARE

7.1.6.5.2 Limits

The limits are checked prior to or during MAT EXECUTION:

−1 OMS clearance

−2 Body Flap clearance

−3 Rudder/Speedbrake

−4 The following Algorithm is used to insure the MAX DEFLECTION does not exceed the values shown in 7.1.6.5-3:

(Last CMD Val) + (Slope)(INTEGER (DEFLECTING/SLOPE))

7.1.6.5.3 Error Processing

An appropriate CALL program error response code may be generated relative to the error conditions defined below. For all such error conditions, the GPC shall reject the Call operator and/or inhibit the test. The error code is made available for the TCS CALL program error response and to the TCS control display.

CONDITIONS	ERROR CODE
A call operator with the slope value deflection value, or transition value equal to zero	500
A call operator with a deflection value greater than the MAT deflection limit	500
A call operator with an undefined actuator group selection	500
Call to MAT prior to the execution of AI call operator ID= 1 since OPS initialization	502
HDA function not active for reading position feedbacks	502
OMS and body flap feedback values invalid due to two consecutive input errors	504
Speedbrake/rudder travel range is not within limits	505
OMS, body flap, or OMS pod/SSME1 not within clearance limits	506

7.1.6.5.4 Constraints/Assumptions

−1 The Multiple Actuator Test (MAT), Actuator Initialization (AI), RAMP Function Generator (RAMP), Frequency Response Test (FRT), and Body Flap Drive (BFD) are mutually exclusive.

−2 The HDA function is required to be active.

7.1.6.6 Body Flap Drive (BFD)

BFD provides the capability to position the body flap to a desired position. The capability also exists to output a stimulus to a single channel. (25187)

7.1.6.6.1 Control Interfaces

The test is called via the TCS Call Operator using the BFD Call Function and is available only in OPS G9. The BF desired position and Channel Selection are specified by the User via BFD function Call Operator.

−1 The BFD function is deactivated when the desired position is reached, a TCS cancel, the Sequencer that called the BFD is cancelled via a TCS CANCEL Operator, or by an OPS transition.

−2 The BFD CALL is formatted as follows:

BITS	9 10 11 12 13 14 15 16 17 18 19 20 21 22	23 24
DW 4	BF DRIVE PROGRAM ID (6)	
DW 5	SPARE	CS
DW 6	POSITION VALUE	SPARE

DW	BITS	DESCRIPTION
4	9 - 24	BFD Program ID - Decimal 6 (LSB, Bit 24)
5	9-22	Spare - Set to Zero
5	23-24	Channel Select (CS) 00 = Channel 1, 2 and 3 01 = Channel 1 10 = Channel 2 11 = Channel 3
6	9-18	Function position value in hardware units - + 511 to −512 PCM counts representing an analog value (negative values in 2's complement); LSB is bit 18. NOTE: the valid range for the position value is limited to ± 400 PCM counts.
6	19-24	Spare - Set to zero

7.1.6.6.2 Limits

The following limits are checked prior to or during the BFD execution:

−1 Position limit checks are +400 PCM counts (23.1°) and −400 PCM counts (−12.2°).

−2 Collision avoidance with SSME 2 and 3 pitch.

SSME 2 < 198 (2.18°)

SSME 3 > 286 (1.51°)

7.1.6.6.3 Error Processing

An appropriate CALL program error response code may be generated relative to the conditions defined below. For all such error conditions, the GPC shall reject the CALL Operator and/or inhibit the test. The error code shall be made available for the TCS CALL program error response and to the TCS control display.

CONDITIONS	ERROR CODE
A CALL operator with a position value that exceeds the BF position limit.	600
HDA not active for reading position feedbacks.	602
No valid BF or SSME 2 pitch or SSME 3 pitch position data available.	604
A potential collision situation.	606
No BF movement response.	607

7.1.6.6.4 Constraints/Assumptions

−1 The HDA function is required to be active.

−2 The BFD, RFG, FRT, MAT, and AI are all mutually exclusive.

7.1.6.7 Body Flap Monitor (BFM)

The BFM provides the capability to cyclically check the actual position of the BF and prevent it from exceeding predefined position limits using BF inhibit commands.

7.1.6.7.1 Control Interfaces

The monitor is called via the TCS Call Operator using the BFM Call function and is available only in OPS G9. The BFM function is initiated by user inputs made available via the BFM Call Operator.

−1 The BFM function can only be terminated by a TCS CANCEL Operator, when the sequence that called the BFM is cancelled via a TCS CANCEL Operator, or by an OPS transition.

−2 The BFM Call is formatted as follows:

BITS	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DW 4	BF MONITOR PROGRAM ID (7)															
DW 5	SPARE															E

DW	BITS	DESCRIPTION
4	9-24	BF monitor program ID decimal 7 (LSB, bit 24)
5	9-23	Spare - set to zero
5	24	BFM Enable (E) 0 = Not assigned, format error response 1 = Enable of BFM

7.1.6.7.2 Limits

The BFM function shall cyclically check the actual position of the BF and determine if the BF is within proper limits for the set commands. If the BF position is greater than +433 PCM counts (24.5°) or less than −433 PCM counts (−13.7°), the BF enable commands and the UP/DN commands shall be reset. If the BF position is within the enable limits, the BF position shall then be checked against the UP limit and the DN limit. If the BF position is less than −411 PCM counts (−12.5°), the UP command shall be reset. Also, if the BF position is greater than +411 PCM counts (23.6°), the DN command shall be

reset. An out of limit condition shall generate a CALL program error response, but the BFM function shall remain active. The BF set commands shall not be altered by the BFM function for BF positions within the above range limits.

7.1.6.7.3 Error Processing

An appropriate call program error response code may be generated relative to the conditions defined below. For error code 700, the GPC shall reject the CALL operator and not initiate the test. For the other error codes, the GPC shall generate the error response only once for the same condition. The error code shall be made available for the TCS CALL program error response and to the TCS control display. (50953)

CONDITIONS	ERROR CODE
BFM CALL format error	700
HDA not active for reading position feedbacks	702
No valid BF position feedback data to the BFM function	704
BF position outside of limits.	705

7.1.6.7.4 Constraints/Assumptions

−1 The HDA function is required to be active.

−2 The BFM can be run concurrently with AI, RFG, FRT, MAT, and BFD.

7.1.7 Launch Sequence Commands

The ground, via the LDB, may send commands to the on-board RSLS to control the countdown for launch. Several commands such as RESUME COUNT, GO-FOR-AUTO-SEQUENCE, GO-FOR-SSME-START, etc., are required inputs in OPS G1. Some commands, such as SRB calibration update, are unique to OPS G9.

−1 In case of a count recycle, some indicator/commands are reset during RSLS resetting and must be entered again. The responsibility for all such actions lies with the user. (37537) (38765/39740) (50278)

7.1.8 DEU Read Capability

The ground/GPC interface provides the capability to perform the reading of up to 128 words of DEU memory. The operation can be performed in OPS G9 through a TCS operator. It is performed in OPS P9 via the MM utility process. In either case, the user supplies the DEU number, the DEU starting address, and the length of continuous data to be dumped.

−1 The data read is sent to the ground via the LDB.

7.2 UPLINK

The uplink system provides the capability to transmit data from the ground via RF signals to the Orbiter. Communication is via two Network Signal Processors (NSPs) connected to flight critical MDMs and thus to the GPC.

7.2.1 Control Interfaces

The uplink system is configured through a combination of cockpit switches and MCDS entries. Power may be applied to only one NSP at a time and is controlled by either ground command or a switch on panel A1L. Selection of the control method is via the S-Band PM Control switch on panel C3. This switch may be in the CMD position (nominal) which enables the NSPs for ground control of power or it may be in the PANEL position which limits control of NSP power to the switch on panel A1L. The A1L switch may be in NSP1, OFF, or NSP2 position. Command acceptance/processing is controlled via a switch on panel C3A5 which may take positions: NSP-B - block all commands (data inhibit); GPC-B - acceptance/rejection is under control of the GPC (see next paragraph); ENA - all commands will be accepted by the NSP (assuming they are valid). (37528/56516/56677)

−1 The DPS Utility SPEC function (see Section 3.5.001) allows control of NSP processing via ITEM entries:

35 (AUTO) - Uplink is enabled or inhibited based on the Site-In-View flag from the SM2 GPC.
36 (ENA) - Uplink is always enabled (default)
37 (INH) - Uplink is always inhibited

7.2.2 Software Interfaces

At PASS initialization, the GPC controlling FF1 (and thus, NSP1) will attempt to read data from NSP1. If valid data is received, it will be processed. If NSP1 is not powered on, and/or two I/O Errors occur, the attempted read will be bypassed; i.e., the GPC will quit attempting to communicate with NSP1. If NSP2 is powered on, the GPC controlling it (via FF3) will attempt to read it. If two I/O errors occur it also will be bypassed. An I/O RESET must be performed to attempt to establish communication again with the NSPs (NSP1 first, then NSP2).

−1 A GPC in Operational Sequence SM2 will compute a Site-In-View flag which may be used to accept or reject commands. The NSP (if valid) will be read regardless of the state of the flag; however, if ITEM 35 of the DPS Utility (SPEC) has been selected, the data will be processed only if the flag is set.

7.2.2.1 NSP Data

The PASS attempts to read 30 words of data and 2 discrete words every 160 ms, or at a 6.25 Hz rate from the current NSP. The data is formatted:

Word 1	NSP Status Word (See 7.2.2.2)
Word 2-31	NSP Data: Up to 10 Command Words of 48 bits each. Fill data (Idle Pattern) of O's is stored by NSP in non-command words.
Word 32	NSP Validity Word (See 7.2.2.2)

7.2.2.2 Validity Checking

The PASS, upon a successful (no I/O Errors) read of NSP data, does validity checking on both hardware (NSP supplied) validity, and command validity. The results of the checking are downlisted in two 16-bit words; GPC-VAL provides the status of the software checking while NSP-VAL provides the status of the hardware (NSP) checking. (25300)

−1 Bits in GPC-VAL are defined as follows:

0	0	Command 1 in buffer is valid.
	1	Command 1 in buffer is not valid. Reason for error can be improper: Vehicle Code GPC/Major Function ID OP Code versus Memory Configuration First Word/Last word specification
1 - 9		Same as bit 0 for commands 2-10.
10	0	GPC/MF valid for all commands.
	1	GPC/MF specified for at least one command was invalid.
11	0	PASS processing of uplink load is complete.
	1	PASS processing of uplink load is still active. Note that this is effectively a Cycle Wrap indication. Bit is set at start of processing, reset upon completion.
12	0	Orbiter Stored Program Command (SPC) buffer available.
	1	Orbiter SPC buffer is full - cannot accept SPC.
13	0	OP Code versus Memory Configuration valid for all commands.
	1	Invalid OP Code/MC for at least one command.
14	0	Two-Stage (see 7.2.3.2) commands accepted.
	1	Two different Two-Stage commands interspersed or an attempt was made to load more than 67 words (16 bits).
15	0	Payload Stored Program Command (SPC) buffer available.
	1	Payload SPC buffer is full - cannot accept SPC.

−2 Bits in NSP-VAL are defined as follows:

0-9		Hardware defined - not referenced by PASS.
10	0	First and Last Word (FW/LW) of command(s) accepted.
	1	Error in First or Last Word of command(s): a. FW/LW indicator set in improper sequence. b. FW sent to a complete Two-Stage load with same OP Code as commands in buffer. c. FW is in error (i.e., not properly formatted).
11	0	Single-Stage MDM discrete output command accepted.
	1	MDM address specified in single-stage MDM discrete output command is invalid (undefined).
12	0	Two-Stage buffer execute accepted.
	1	Two-Stage buffer execute rejected due to no LW in buffer.
13	0	Always zero. Not set.
14	0	Valid vehicle ID.
	1	Invalid vehicle ID specified.
15	0	PASS processing enabled by switch on panel C3 (See 7.2.1).
	1	Switch is in GPC Block position; i.e., processing of commands is inhibited.

7.2.3 Uplink Commands

Valid commands via uplink fall into four categories:

−1 Single Stage - Command contains destination information and does not require preview. It is processed upon receipt.

−2 Two-Stage - Command(s) require an execute command to cause processing to occur. The first word of a Two-Stage buffer must be a 48 bit command word consisting of 16 bits of header information and 32 bits of command data. Up to 32 additional 48 bit words may be included; however, the first 16 bits of each word must be identical. The buffer is downlisted to allow inspection before attempted execution. (37534)

−3 Stored-Program Command (SPC) - A special case of a Two-Stage command which has an execute time associated with it. There are two types of SPC commands: Orbiter SPC commands and Payload SPC commands. Up to 10 Orbiter SPC commands can be queued at one time. The Payload SPC buffer will accommodate up to 25 SPC requests although only ten may be uplinked at a time. The buffer-execute command causes the SPC(s) to be Armed to be executed within ±2 seconds of the specified execution time. If the specified time is in the past, the SPC will be executed immediately.

−4 Payload Throughput Command (TPC). The Two-Stage buffer is used to buffer a TPC until the TPC is complete (Last Command Word received). At that point it is immediately sent to the appropriate application for processing. If the requested payload link is busy, the command will not be buffered.

7.2.3.1 Single-Stage Commands

Execution of Single-Stage command(s) occurs upon receipt from the NSP (up to 10 per NSP read). Single-Stage commands may be interleaved with Two-Stage commands. The header information (first 16 bits of each 48 bit command word) must conform to the definition in Table 7.2-1.

−1 All Single-Stage commands are valid in all memory configurations except SPC Buffer clear (7.2.3.1.4) which is valid only in OPS SM2/4.

TABLE 7.2-1. UPLINK COMMAND HEADER BITS

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
VEH ADD			MAJOR FCN/GPC				OP CODE							F	L

BITS	DESCRIPTION
1 - 3	Vehicle address - Three-bit code that identifies the vehicle that shall respond to a given CW. 000 - Illegal 010 - Vehicle 102 011 - Vehicle 103 100 - Vehicle 104 101 - Vehicle 105 110 - Vehicle 106 111 - Vehicle 107
4 - 7	Major FNC/GPC - Identifies the GPC or MF to which the command is addressed. (43987) The codes are defined as follows: 0000 - Illegal 0001 - GPC 1 0010 - GPC 2 0011 - GPC 3 0100 - GPC 4 0101 - GPC 5 0110 - All active GPCs 0111 - GN&C 1000 - SM 1001 - PL - Payloads 1010 - BFCS - used by the Backup Flight Control System 1011 - Illegal codes thru 1111 - Codes 0001 through 0101 are illegal if GPC is a member of a Redundant Set (RS). Uplink software shall test GPC number codes versus RS status. Codes 0001 through 0110 are illegal for Two-Stage OP codes greater than 5.
8 - 14	OP Code - This seven-bit field shall contain the OP code listed in Table 7.2-2. (45215) The first bit of the OP code is one for all single-stage or interactive commands and zero for all two-stage commands.
15 - 16	
1 0	First CW in the load.
0 1	Last CW in the load.
1 1	Single CW loads.
0 0	Intermediate CWs in loads greater than two command words.

7.2.3.1.1 MDM Command

The format for the single-stage MDM command is as follows:

BITS	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	MOD ADD				CH ADD					MDM NO.						

BITS	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
	ANALOG/DISCRETE MASK															

BITS	DESCRIPTION
1 - 16	Refer to Table 7.2-1 for data field definition. OP Code: 1000101
17 - 20	Module address - Four-bit binary code (LSB, bit 20) which identifies the I/O module where the selected channels are located.
21 - 25	Channel address - Five-bit binary code (LSB, bit 25) that identifies the channel number: bit 21 is the set/reset bit, bits 22 and 23 are spares which are set to zero, and bits 24 and 25 are the channel select bits. Bit 21: 1 = Set channel discrete(s) 0 = Reset channel discrete(s)
26 - 32	MDM number - Seven-bit binary code (LSB, bit 32) designating the MDM to be addressed:

MDM Number	MDM
0000001	FF1
0000010	FF2
0000011	FF3
0000100	FF4
0000101	FA1
0000110	FA2
0000111	FA3
0001000	FA4
0001001	PF1
0001010	PF2
0001011	LF1
0001100	LA1
0001101*	FLX1
0001110*	FLX2
0001111*	FLX3
0010000*	FLX4
0010001*	FLX5

33 - 48	Analog/Discrete mask - For Discretes, identifies discretes that are reset or set as indicated by Bit 21. For Analogs, identifies the left justified 10-Bit signed Two's complement PCM value.

*Indicates mission dependent payload flex MDM (or equivalent BTU.)

7.2.3.1.2 Word-By-Word Correction

This Single-Stage command allows correction of the Two-Stage buffer on a word-by-word basis:

BITS	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	SPARE									BUFFER WORD NUMBER						

BITS	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
	DATA															

BITS	DESCRIPTION
1 - 16	Refer to Table 7.2-1 for data field definition. OP Code: 1000100
17 - 25	Spares - Set to all zeros.
26 - 32	Word number - Seven-bit code (LSB, bit 32) indicating the 16-bit word in the Two-Stage buffer to be updated. 0000000 First word (0) 1000010 Last word (66)
33 - 48	Data

7.2.3.1.3 Buffer Execute (Two-Stage)

This command is a single 48 bit command word which is used to execute the contents of the Two-Stage buffer (is not part of buffer). Uplink software does not process the Two-Stage buffer upon receipt of the buffer-execute command unless the last command word indicator has been received for the load residing in the Two-Stage buffer. An attempt to execute the Two-Stage buffer without the last command word indicator shall be rejected and an error indicator shall be set.

BITS	DESCRIPTION
1 - 16	Refer to Table 7.2-1 for data field definitions. OP Code: 100001111
17 - 32	Set pattern: 1111111011110000
33 - 48	All zeros

7.2.3.1.4 Buffer Clear (Two-stage or SPC)

This command is a single 48 bit command word which is used to clear either the Two-Stage or the Stored Program buffers (The buffers will be set to all zeros.):

BITS	DESCRIPTION
1 - 16	Refer to Table 7.2-1 for data field definitions. 2-stage OP Code: 1000001 Orbiter SPC OP Code: 1000010 Payload SPC OP Code: 1001001
17 - 48	All zeros

7.2.3.1.5 Uplink Activity Indicator

This single 48 bit command may be used to override the PASS control of the Uplink activity indicator on the CRT.

BITS	DESCRIPTION
1 - 16	Refer to Table 7.2-1 for data field definitions. On OP Code: 1000111 OFF OP Code: 1000110
17 - 48	All zeros.

7.2.3.2 Two-Stage Commands

Two-stage commands are uplinked to the two-stage buffer and, once in the buffer, are downlisted to allow inspection by the ground for correctness before execution. The first command word of the buffer must have '10' as bits 15-16, and the last command word must have '01' as bits 15-16 (a single command word load must have '11' as bits 15-16). Intermediate command words must have bits 15-16 set to '00'.

—1 Data formats for specific Two-Stage commands are defined in the requirements document SS-P-0002-140 (Downlist/Uplink Requirements). Commands/OP codes available are given in Table 7.2-2.

7.2.3.3 Time Executed Commands

The Time Executed Serial I/O command (OP Code 0101110) is valid only in OPS SM2/4. A 32 bit (fixed point) GMT time of execution is specified. Refer to paragraph 6.3.32 in SS-P-0002-140 for detailed definition of words/bits.

7.2.3.4 Payload Throughput

The payload throughput command (OP code 0111101) is valid only in OPS SM2/4. It should not be confused with the Payload Data Load command (OP Code 0011010). Refer to paragraph 6.3.40 of SS-P-0002-140 for a detailed description of Payload Throughput.

TABLE 7.2-2. UPLINK OP CODES/MEMORY CONFIGURATION

COMMANDS	OPS* CODES	MEMORY CONFIGURATIONS								
		0 OPS0	1 G1/6	2 G2	3 G3	4 S2	5 S4	6 P9	8 P8	9 G9
G-MEM Contiguous	0000001 (3)	X		X		X	X	X	X	X
G-MEM Scatter	0000010 (3.1)	X		X		X	X	X	X	X
MDM Multiple Command	0000011 (1.1)	X	X	X	X	X	X	X	X	X
Orbiter MDM Multiple SPC Commands	0000100 (1.2)					X	X			
Equivalent DEU	0000101 (5)	X	X	X	X	X	X	X	X	X
Mass Memory Unit Patch	0000110 (4)					X	X	X		
KU-Band/S Band Antenna Control Uplink Load	0000111 (9)					X	X			
IMU REFSMMAT Load	0001000 (10)			X	MM 301 Only					
Orbiter State Vector Load	0001001 (11)		X	X	X				X	
Rendezvous Vehicle State Vector Load	0001010 (12)			X						
Guidance Polynomial Load-PPOLY	0001011 (13)									X
Guidance Polynomial Load-PSI	0001100 (13)									X
Guidance Polynomial Load-THET 1,I	0001101 (13)									X
Guidance Polynomial Load-THETA Bias	0001110 (13)									X
Launch Targeting Load	0001111 (14)		X							X
On-Orbit Guidance Target PEG 7 Load	0010000 (15)			X						

TABLE 7.2-2. UPLINK OP CODES/MEMORY CONFIGURATION (Continued)

COMMANDS	OPS* CODES	MEMORY CONFIGURATIONS								
		0 OPS0	1 G1/6	2 G2	3 G3	4 S2	5 S4	6 P9	8 P8	9 G9
Deorbit Guidance Target PEG 7 Load	0010001 (16)			X	X					
IMU Gyro Bias Load	0010010 (17)		MM 101 Only	X	MM 301 Only					
IMU Accelerometer Bias	0010011 (18)			X	MM 301 Only					
Deorbit Guidance PEG 4 Load	0010100 (22)			X	X					
Deorbit Landing Site Parameters Load	0010101 (23)				X					
TDRS State Vector Load	0010110 (19)					X	X			
KU-Band Antenna Bias Matrix Load	0010111 (20)					X	X			
ADI Inertial Quaternion Load	0011000 (21)			X	X					
OMS Targeting Load	0011001 (30)		X							X
Payload Data Load	0011010 (25)					X	X			
PSP Configuration Message Load	0011011 (26)					X	X			
Vehicle Inertia Matrix	0011100 (27)		X							
ADI Reference Quaternion Load	0011101 (21)			X	X					X
ADI Bias LVLH Quaternion Load	0011110 (21)			X	X					X
Deorbit TACAN Parameters	0011111 (28)				X					
Delta NAV Command	0100000 (29)		X		X					

TABLE 7.2-2. UPLINK OP CODES/MEMORY CONFIGURATION (Continued)

COMMANDS	OPS* CODES	MEMORY CONFIGURATIONS								
		0 OPS0	1 G1/6	2 G2	3 G3	4 S2	5 S4	6 P9	8 P8	9 G9
Table Maintenance Block Update	0100001 (34)					X	X			
Global Table Update	0100010 (44)			X						
Command Channel Update	0100011 (45)			X						
Command Antenna Update	0100100 (46)			X						
Guidance Polynomial Load-THET 2,I	0100101 (13)									X
IMU Accelerometer Scale Factor	0100110 (48)			X	MM 301 Only					
Guidance Polynomial Load-THET 3,I	0100111 (13)									X
Guidance Polynomial Load-PHI I	0101000 (13)									X
VENT/RCS Body Force Vector Load	0101001 (24)			X					X	
Drag Model Parameter Load	0101010 (36)			X					X	
Covariance Matrix Parameters Load	0101011 (38)			X						
MDM BITE Data Read	0101100 (35)	X		X		X	X		X	
Insertion Guidance Target-PEG 4 Command Load	0101101 (31)		X							
Time Executed Command (TEC) Load	0101110 (32)					X	X			
Orbiter Rate Gyro Bias Update	0110000 (49)				MM 301 Only					

TABLE 7.2-2. UPLINK OP CODES/MEMORY CONFIGURATION (Continued)

COMMANDS	OPS* CODES	MEMORY CONFIGURATIONS								
		0 OPS0	1 G1/6	2 G2	3 G3	4 S2	5 S4	6 P9	8 P8	9 G9
Accelerometer Assembly Bias Update	0110001 (50)				MM 301 Only					
RCS Quantity Monitoring	0110010 (37)			X						X
PCMMU Telemetry and PDI Decom Format Load	0110110 (43)			X						
Variable D/L Select	0110111 (42)	X	X	X	X	X	X	X	X	X
Time Execute Command Clear	0111000 (39)					X	X			
Payload Scaling Coefficient Set Update	0111100 (51)					X	X			
Payload Throughput	0111101 (40)					X	X			
Payload MDM Multiple SPC Commands	0111110 (1.3)					X	X			
Two-Stage Buffer Clear Command	1000001 (7)	X	X	X	X	X	X	X	X	X
Stored Program Buffer Clear (Orbiter)	1000010 (7)					X	X			
Two-Stage Buffer Execute Command	1000011 (6)	X	X	X	X	X	X	X	X	X
Word-by-Word Correction	1000100 (2)	X	X	X	X	X	X	X	X	X
MDM Command (Single-Stage)	1000101 (1)	X	X	X	X	X	X	X	X	X
Uplink Activity Indicator OFF Command	1000110 (8.2)	X	X	X	X	X	X	X	X	X
Uplink Activity Indicator ON Command	1000111 (8.1)	X	X	X	X	X	X	X	X	X

TABLE 7.2-2. UPLINK OP CODES/MEMORY CONFIGURATION (Continued)

COMMANDS	OPS* CODES	MEMORY CONFIGURATIONS								
		0 OPS0	1 G1/6	2 G2	3 G3	4 S2	5 S4	6 P9	8 P8	9 G9
Memory Overlay Uplink**	1001000 (4)	X	X	X	X	X	X	X	X	X
Stored Program Buffer Clear (Payload)	1001001 (7)					X	X			

* The number in parenthesis refers to paragraph 6.3.XX in SS-P-0002-140 Requirements Document.
** This OP code is valid only when the recipient GPC is in OPS 00 and enabled via G-MEM procedure (refer to paragraph 4.6.6.3.2 of CPDS SS-P-0002-170).

Note: Because of software design considerations, any future single-stage OP code commands should be assigned sequentially, beginning with OP code $4A_{16}$ (1001010).

7.2.4 Uplink Restrictions/Notes

−1 Certain restrictions exist for several of the GNC uplink loads. (37528/56516/56677)

−2 An invalid engine ID uplinked in PEG 4 or PEG 7 target set will not be rejected. (38163)

−3 The uplink software detects certain error conditions which results in no indication to the ground that an error occurred or that the command did not execute. (37553)

−4 If an uplink to the PSP is defective such that when the PSP receives the command it requests a retransmission, the GPC will resend the same command again. (55330)

−5 Whenever multiple RTCIO requests for the flight critical buses are made in a flight OPS, the possibility exists of jittering the start of HFE I/O. (56157)

−6 The uplink of a target state vector that defines an orbit with a semi-major axis that is greater than 1X108 feet will yield erroneous results when the state vector is predicted to current time. (57282)

7.3 DOWNLIST

The downlist capability provides selected data from the on-board GPC memory to the ground via the telemetry link. Parameters are sampled at various rates; placed in fifty downlist frames of up to 128 words each. Each frame is transmitted at a .5 Hz rate.

−1 The contents of each downlist frame are defined in computerized loading reports. Three different reports are generated to facilitate location of parameters: a frame and word listing, a Master Measurement List (MML), and a HAL name listing.

−2 Each of the three reports described above have the same format of data for each entry (the only difference being the order of the entries). Column headings and their definitions are as follows.

−2.1 Measurement Number. The MML number associated with the parameter. Format of the number is AXXA′XXXXA″, where A, A′, and A″ are alphabetic, X′s are digits.

NOTE:

For the MML sort A′, A″ are ignored; that is, the sort is done by the first character (A), and the six digit number of XX()XXXX.

−2.2 Measurement Name. The nomenclature of the parameter.

−2.3 KBS IND. Kilobits Indicator: 0 = 128 KBS only. 1 = 64 and 128 KBS.

−2.4 OUT RATE. The output rate in samples per second (100, 25, 12.5, 5 or 1).

−2.5 DL FMT ID. The Downlist Format ID.

−2.6 HOMO SET NO. The Time Homogenous Set Number. 0 - Not part of a homogenous set. Non-0 - The homogenous set number.

–2.7 PARM TYP. The parameter type as described below.

Type	Meaning	Length (Bits)
01	Floating Point - Single Precision	32
02	Floating Point - Double Precision	64
03	Parent Discrete Word	16
04	Fixed Point - Signed	16, 32 or 48
05	Fixed Point - Signed	32
06	Discrete	1
07	Packed Bit String - Signed***	2 to 32
08	Packed Bit String - Unsigned***	2 to 32
09	Raw BTU Data*	n
10	Variable Parameter **	2 to 16

* Type 9 Supercedes all other parameter types and is used whenever applicable.

** Type 10 parameters are those whose format/interpretation is indeterminate at loading time (eg., Uplink 2 Stage Buffer).

*** Type 7 and/or 8 is used to define all parameters that are bit strings but require less than 16 bits for data representation (i.e., command words output as 16 bits but only ten bits are data).

–2.8 PARM LEN. Length of the parameter in bits where applicable.

–2.9 START BIT. The starting bit position of the parameter where applicable. A Start Bit of 1 in the Flight Software corresponds to bit 0 in the Downlist Loading.

–2.10 START FRAME. The Downlist Frame number.

–2.11 START WORD. The word number in the Downlist Frame.

–2.12 COMPOOL NAME. The name of the COMPOOL from which the parameter is extracted.

–2.13 ENTRY NAME. The HAL name by which the parameter is referenced.

7.3.1 FORMATS AND FORMATTER PROGRAMS

The collections of data output into the downlist stream are organized into groups called formats, each with its own ID. Table 7.3-1 contains a matrix of format IDs and the memory configuration in which each is valid.

TABLE 7.3-1. DOWNLIST FORMAT ID VS. MEMORY CONFIGURATION

FMT ID	OPS 0	MC1 G1	MC2 G2	MC3 G3	MC4 SM2	MC5 SM4	MC6 PL9	MC8 G8	MC9 G9	Name
20(A)	X									OPS 0
21(B)		X								GNC Ascent/Abort
22(B,H)			X							GNC On-Orbit
23(B)				X						GNC Entry
24(B,H)					X					SM/RMS/PL
25(B,H)						X				SM/RMS/PL
26(G)					X					SM Ground Checkout
32(B,H)								X		On-Orbit Checkout
42(C)									X	Init and Checkout - GNC 9
44(B)									X	Precount - GNC 9
46(C)									X	FRT Checkout
48(J)							X			PL9 - MM Utility
52(I)							X			PL9 - MM Utility
53(C)									X	FCS Checkout
60(C)									X	Payload Checkout
91(E)					X	X	X			Mass Memory Dump
92(F)							X			Spacelab M/M Dump Through GPC in PL9 (SPEC 111)
93(D)	X	X	X	X	X	X	X	X	X	Main Memory HISAM Dump
97(C)									X	PCMMUCheckout - Address
98(C)									X	PCMMUCheckout - 052525 Octal
99(C)									X	PCMMUCheckout - 125252 Octal

NOTES:

A. Format 20 also output during OPS transitions. All format 20 content is output when another format has at least one format 20 requirement.
B. Format automatically selected by software.
C. Format user selectable. See Table 3.100-1, function 4.
D. Format automatically selected by software during main memory dump. See Table 3.000-1, function 6, or during HISAM dump.
E. Format automatically selected by software during mass memory dump. See Table 3.9011(P)-1, function 7.
F. Format 92 momentarily available only during period of actual dump.
G. Format user selectable. See Table 3.064-1, function 3.
H. When transmitting Low Data Rate, these format numbers are incremented by 40 (e.g., 62, 64, 65).
I. Format automatically selected if PL9 GPC is the active downlist GPC at OPS initialization.
J. Format automatically selected if PL9 GPC is NOT the active downlist GPC at OPS initialization.

–1 Flight Software Downlist Output is written to the PCM Master Unit device, addressed to one of the five Computer Data RAMS (known as Toggle Buffers). PCMMU software, called formatter programs, retrieve Toggle Buffer data (downlist) and Orbiter Instrumentation (downlink) and ship both to the ground by the telemetry link.

–2 Table 7.3-2 lists toggle buffer assignments by Memory Configuration. Non-prime members of a redundant set or non-prime members of an OPS-O common set downlist to an invalid PCMMU MIA address to prevent toggle buffer assignment conflict.

TABLE 7.3-2. TOGGLE BUFFERS VS MEMORY CONFIGURATION

Memory Config	0[A]	1	2	3	4	5	6	8	9
Toggle Buffer	4[B]	1	1	1	2	2	4[B]	1	1

NOTES:

A. A non-prime OPS 0 GPC can be forced to downlist into toggle buffer 4 by entry of Item 49 on the GPC MEMORY SPEC.

B. Toggle buffer conflicts with two machines downlisting to one toggle buffer will result if:

1. A non-prime OPS 0 GPC is directed to toggle buffer 4 when a non-prime PL9 MC is operating in the Common Set; or

2. A PASS HISAM dump is executed in one GPC with another GPC downlisting to toggle buffer 1. Must terminate prime GPC downlist to toggle buffer 1 before starting a HISAM dump.

–3 The Formatter Programs are available for low data rate (64 KBPS) and high data rate (128 KBPS) telemetry. There is one 'Hard' (always available) formatter for high data rate; all others are 'Soft' or programmable formatters. The Soft formatter programs are resident on Mass Memory and are loadable under software control. See Sections 3.5.100 and 3.5.062.

–4 Table 7.3-3 identifies the formatter programs available, the Toggle buffers they access, and the number of telemetry words for downlink and downlist.

–5 Table 7.3-4 defines which downlist formats are valid in downlink formats available (see Table 3.062-1, function 3).

TABLE 7.3-3. DOWNLINK/DOWNLIST FORMATS AND TOGGLE BUFFERS

	Downlink/PDI Decom					Downlist			
64 KBPS Formatter Programmable	Downlink No. of Words	PDI Decom 1 No. of Words	PDI Decom 2 No. of Words	PDI Decom 3 No. of Words	PDI Decom 4 No. of Words	Toggle Buffer No. of Words	Toggle Buffer No. of Words	Toggle Buffer No. of Words	
102 Ascent	80					1-64	5-16		
103 Orbit	80					1-56	2-24		
104 Orbit	80					1-56	2-24		
105 Entry	80					1-64	5-16		
106 Orbit	64					1-56	2-24	4-16	
107 Orbit	68	4	4	4	–	1-56	2-24		
108 Orbit	68	4	4	–	4	1-56	2-24		
109 Orbit	68	4	–	4	4	1-56	2-24		
110 Orbit	68	–	4	4	4	1-56	2-24		
128 KBPS Formatter									
HARD 129 Ascent/ Checkout	160					1-128	5-32		
SOFT									
160 Prelaunch	160					1-128	4-32		
161 Orbit	160					1-112	2-48		
162 Orbit	160					1-112	2-48		
163 Orbit	128					1-112	2-48	4-32	
164 Entry	160					1-128	5-32		
165 Orbit	144	4	4	4	4	1-112	2-48		
168 Orbit	144	4	4	4	4	1-112	2-48		
171 Prelaunch	160					1-128	5-32		
172 Prelaunch	144					1-128	2-48		

TABLE 7.3-4. DOWNLIST FORMATS IN DOWNLINK

DOWNLINK–PHASE	DOWNLIST FORMAT ID'S																			* 12	* 13
	20	21	22	23	24	32	42	44	46	48	52	53	60	90	91	93	97	98	99		
102–A	X	X	X	X		X	X	X	X	X	X	X	X	X	X					X	X
103–O	X		X		X	X				X				X	X						
104–O	X		X		X	X				X				X	X						
105–E	X	X	X	X		X	X	X	X	X	X	X	X	X	X					X	X
106–O	X		X		X	X				X				X	X						
107–O	X		X		X	X				X				X	X						
108–O	X		X		X	X				X				X	X						
109–O	X		X		X	X				X				X	X						
110–O	X		X		X	X				X				X	X						
111–O	X		X		X	X				X				X	X						
160–V	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		
161–O	X		X		X	X				X				X	X	X					
162–O	X		X		X	X				X				X	X	X					
163–O	X		X		X	X				X				X	X	X					
164–E	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
165–O	X		X		X	X				X				X	X	X					
168–O	X		X		X	X				X				X	X	X					
169–A	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
171–V	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
172–V	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
173–A	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
174–O	X		X		X	X			X	X				X	X	X					
175–O	X		X		X	X			X	X				X	X	X					
176–V	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
177–V	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
252–P	X				X									X							

* BFS Formats - Not Selectable in PASS

PHASE -

A - Ascent
O - Orbit
E - Entry
P - Payload Checkout
V - Vehicle Checkout

7.3.2 FAULT SUMMARY PAGE

The downlist data includes the last five entries in the fault summary page. Each entry is composed of four 16 bit words. The first two words define the message (see Figure 7.3-1), and the second two words contain the time of the message.

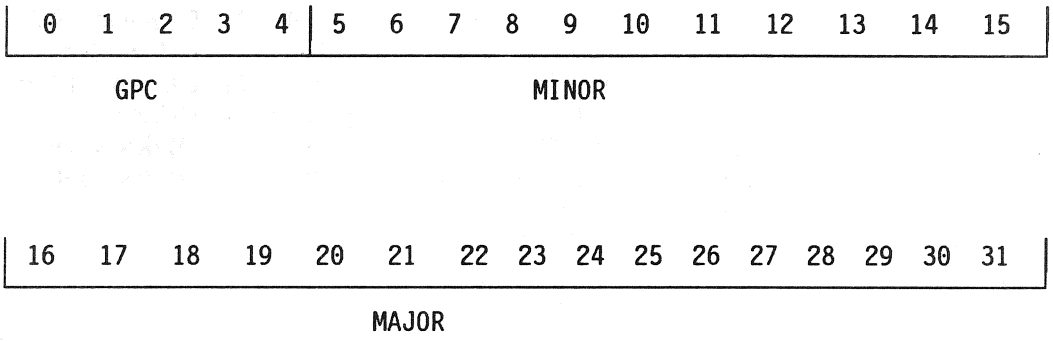


Figure 7.3-1. FSP Message Definition

–1 The individual bits 0-4 specify which GPC(s) detected the error. The major field is a numeric value (IDs in decimal) representing the major text of the message (Table 7.3-5). The MINOR field is a numeric value representing the minor text of the message (Table 7.3-6). Major and minor ID's for SM and PM can be found in the corresponding flight FSR. Reference Section 6 for a detailed description of Fault Annunciation and Messages.

TABLE 7.3-5. MAJOR FIELDS OF MESSAGES

ID	FIELD	ID	FIELD	ID	FIELD
100	ILLEGAL ENTRY	160	MPS HYD	355	S94 PDRS WR R
101	OFF/BUSY	161	SSME FAIL	358	212 SL LINK
102	GPC	162	HIGH G	359	SM GRDCK
103	I/O ERROR	163	GNC GRD CK	360	211 SS RAU ERR
104	> 3 DEU	164	TARGET ERR	361	211 INVAL RAU
105		165	F RCS	362	213 EX RAU ERR
106	BCE STRG 1	166	L RCS	363	213 INVAL RAU
107	BCE STRG 2	167	R RCS	364	PDRS SLIP
108	BCE STRG 3	168	G23 RCS SYSTEM	365	PDRS TEST
109	BCE STRG 4	169	DAP RECONF		
110	SUMWORD	170	SPD BRK		
111	CRT BITE	171	SEL AUTO		
112	MDM OUTPUT	173	ET SEP-INH		
113	TIME	174	NAV EDIT		
114	BCE BYP	175	SW TO MEP		
115	S62 BCE BYP	176	SSME REPRO		
131	FCS CH	177	AERO DRIVE		
132	SBTC/THC	178			
133	RHC	182	OTT ST IN		
134	FCS SAT	186	DISPLAY SW		
135	BODY FLAP	187	PROBES		
136	RM FAIL	189	ROLL REF		
137	G33 RNDZ RADAR	190	RCS XFEED		
138	RM DLMA	307	S60 CHECKPT		
139	IMU BITE/T	309	TFL LOAD		
140	TGT T	310	ITEM RJCT		
141	ET SEP-MAN	314	S69 FC END HTR		
142	BDY FLP SW	329	FC PURGE		
143	PNL TRIM	333	PBD CONF		
147	RCS PWR	336	PBD SEQ		
148	SENSE SW	340	CIRC PUMP		
149	ME SHDN SW	341	PDRS DERIG		
150	MPS CMD	342	PDRS REL		
151	ET SEP-AUT	343	S96 PDRS ABE		
152	G51 RL MODE SW	344	PDRS SING		
153	TGT EL ANG	345	S96 PDRS CNTL		
154	TGT ITER	346	S96 PDRS RCH		
155	MPS DATA	347	PDRS TEMP		
156	L OMS	348	S96 PDRS CKCRT		
157	R OMS	349	S94 PDRS GPC		
158	G23 OMS/RCS	350	S96 PDRS MCIU		
159	MPS ELEC	354	S90 PCS ERROR		

TABLE 7.3-6. MINOR FIELDS OF MESSAGES

ID		FIELD	ID		FIELD	ID		FIELD
HEX	DEC		HEX	DEC		HEX	DEC	
0	0		2E	47	ICC5	5F	95	RTLS
1	1	1	30	48	L	60	96	GMBL
2	2	2	31	49	R	61	97	QTY
3	3	3	32	50	MANF	62	98	VLV
4	4	4	33	51	IMU	63	99	PC
5	5	5	34	52	MLS	64	100	HE P
6	6	A	35	53	PRL	65	101	TK P
7	7	B	36	54	TAC	66	102	LEAK
8	8	C	37	55	HOLD	67	103	DJET
9	9	TEMP	38	56	CYCL	68	104	FJET
A	10	COMM	3A	58	SY	69	105	LJET
B	11	JPC1	3B	59	SP	70	112	RJET
C	12	JPC2	3C	60	EP	71	113	UJET
D	13	OF A	3D	61	WP	72	114	AJET
E	14	OF B	3E	62	WY	73	115	PVT
F	15	OA	3F	63	WR	86	134	FAIL
10	16	CONF	40	64	MCIU	88	136	R/Y
12	18	FF1	41	65	F	89	137	6
13	19	FF2	42	66	POS	90	144	EE
14	20	FF3	43	67	MOM	91	145	T CK
15	21	FF4	44	68	ADTA	95	149	ALT
16	22	FA1	45	69	CRT2	96	150	KU
17	23	FA2	46	70	CRT3	97	151	D/L
18	24	FA3	47	71	CRT4	98	152	PSP1
19	25	FA4	48	72	BITE	99	153	PSP2
1A	26	PL	49	73	NSP	9A	154	PSP
1B	27	FLEX	4A	74	MADC	9B	155	BRK
1C	28	SCA	4B	75	MCPC	9C	156	C/W
1D	29	PORT	4C	76	ICF	9D	157	NMI
1E	30	STBD	4D	77	HC	9E	158	FS
1F	31	PDI	4E	78	ALL	9F	159	LOSS
20	32	PL1	4F	79	ENA			
21	33	PL2	50	80	TONE			
22	34	LF1	51	81	MTU			
23	35	LA1	52	82	SEQ			
24	36	CRT1	53	83	STKR			
25	37	PCM	54	84	RGA			
28	40	D	55	85	ACC			
29	41	WOW	5A	90	MMU1			
2B	43	ICC1	5B	91	MMU2			
2C	44	ICC2	5C	92	ERR			
2D	45	ICC3	5D	93	TERM			
2E	46	ICC4	5E	94	TAL			

7.3.3 DEU MESSAGES AND KEYBOARD LAYOUT

Keyboard entries are placed in the downlist buffers at a 1 Hz rate. Each message has 10 HWs of keystroke data with three keystrokes per half-word as shown in Figure 7.3-2; bit 15 is set to zero.

–1 Each value may be converted to a keystroke from Table 7.3-7 to construct the message received by the GPC(s).

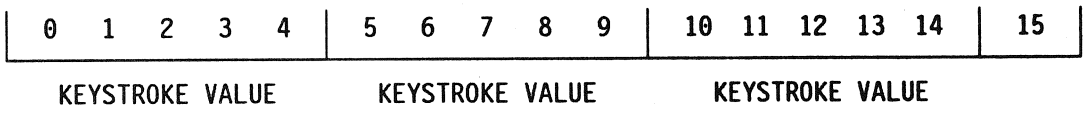


Figure 7.3-2. DEU Message Format

TABLE 7.3-7. DEU KEYSTROKES

VALUE		KEYSTROKE
DEC	HEX	
00	0	0
01	1	1
02	2	2
03	3	3
04	4	4
05	5	5
06	6	6
07	7	7
08	8	8
09	9	9
10	A	A
11	B	B
12	C	C
13	D	D
14	E	E
15	F	F
16	10	SYS SUMM
17	11	OPS
18	12	SPEC
19	13	FAULT SUMM
20	14	ITEM
21	15	–
22	16	+
23	17	.
24	18	I/O RESET
25	19	GPC/CRT
26	1A	CLEAR
27	1B	RESUME
28	1C	ACK
29	1D	MSG RESET
30	1E	EXEC
31	1F	PRO

–2 The lower number shown in each key location indicates the keystroke code (in hexadecimal) sent to the GPC when the message is transmitted. The number is a 5-bit code.

FAULT SUMM 13	SYS SUMM 10	MSG RESET 1D	ACK 1C
GPC/ CRT 19	A 0A	B 0B	C 0C
I/O RESET 18	D 0D	E 0E	F 0F
ITEM 14	1 01	2 02	3 03
EXEC 1E	4 04	5 05	6 06
OPS 11	7 07	8 08	9 09
SPEC 12	– 15	0 00	+ 16
RESUME 1B	CLEAR 1A	• 17	PRO 1F

Figure 7.3-3. MCDS Keyboard Layout

8. DATA ANALYSIS

This section of the User's Guide is basically a T&O support section. Several topics are addressed to provide information necessary to analyze data which may be available for troubleshooting in an expedited fashion. Topics addressed include GPC errors, I/O errors, GPC dump analysis, Microfiche available, and MMU directory.

8.1 GPC ERRORS

This section will address software induced GPC errors, and software indications of any GPC hardware problems.

8.1.1 GPC FAIL-TO-SYNCS

Multiple computers with PASS loaded and in RUN will be in at least Common Set (unless a previous error has occurred). Multiple computers in common set with the same major function active are said to be in Redundant Set.

−1 When GPCs in Common Set (CS) and/or Redundant Set (RS) fail to arrive at a synch point together (within some tolerance) a Fail-To-Synch (FTS) is declared. The GPC(s) voting against a GPC light their respective U-FAIL light on the CAM (see section 4.2). If a GPC receives two or more U-FAIL votes, it will declare itself failed, light its I-FAIL on the CAM, and freeze its SYNC trace table (as will other GPCs in the CS/RS).

−2 The following items are peculiarities the user should be aware of when a FTS occurs:

−2.1 A dual commander situation can be encountered at the completion of an unsuccessful OPS Transition/OPS Mode Recall attempting to expand the current R/S. (38458)

−2.2 GPC Failed Out of Common Set/Redundant Set (37543)

−2.3 Multiple Commanders of a DEU Can Result in an F-T-S (37590)

−2.4 Output Switch in TERMINATE at RS Formation (32119)

−2.5 Overlay Failure Following F-T-S During Overlay (25159)

−2.6 Possible common set F.T.S. due to I/O completion (55318)

8.1.2 GPC ERROR LOG (CZ2V_GPC_ERR_LOG)

The GPC Error Log is available for downlist in all D/L formats and consists of:

- Last 5 GPC errors
- Last error in each GPC
- Cumulative error count for each GPC
- GPC error log index to next available log entry. (0, 6, 12,. . .)

−1 Each error is defined in six 16 bit words in downlist. The first word is a 16 bit PDE address. (25119) The next 3 words (words 2, 3 and 4) contain time of error (run time). Word two is 16 bit half hour count (LSB = 30 min.). Word three and four are 32 bit microseconds counter (LSB = 1 microsec). Word five contains a 4 bit BSR of the block in error, a 6 bit error code, and a 6 bit error group (see Figure 8.1-1). The error groups and codes are given in Table 8.1-1.

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

Figure 8.1-1. GPC ERROR WORD 5

−2 The sixth word contains the 16 bit address at the time of error. If the first bit of this address is not zero (first hex digit > 7), then extended addressing is required. In this case the first digit of word six is replaced with two digits as determined by the first digit (BSR) of word 5. Table 8.1-2 defines the replacement digits as a function of the values of word 6, digit 1 and word 5 digit 1. (25137)

−3 Additional information for each of the last five GPC errors is logged in an auxiliary GPC error Log. This information is NOT downlisted. However, it is available in GPC dumps and is very useful in resolving compiler defined errors. The auxiliary error data is found in compool FCMCOM, structure TFCMAUXL. TFCMAUXL is indexed in the same manner as the GPC error log (i.e., the first entry in the auxiliary error log corresponds to the first entry in the GPC error log, the second to the second, etc.). Each entry in the auxiliary error log is 4 halfwords long and is formatted as follows:

HW 0, 1 - First word of PSW from the stack
HW 2, 3 - The contents of the HAL Linkage Register

TABLE 8.1-1. GPC ERROR GROUP/CODE

GROUP	CODE	WORD 5 HEX *	APPEN-DIX**	ERROR CONDITION**
02	13	X342	E	CYCLIC OVERRUN.
03	00	X003	E	ILLEGAL OPERATION CODE.
03	01	X043	E	PRIVILEGED INSTRUCTION.
03	04	X103	E	FIXED POINT OVERFLOW.
03	05	X143	E	SIGNIFICANCE.
03	07	X1C3	E	CPU PROTECTION VIOLATION.
03	09	X243	E	EXPONENT UNDERFLOW (FLOATING POINT).
03	10	X283	E	OVERFLOW CONVERT.
03	11	X2C3	E	EXPONENT OVERFLOW.
03	12	X303	E	DIVIDE (FLOATING POINT).
03	20	X503	E	INSTRUCTION MONITOR.
04	04	X104	D	EXPONENTIATION OF 0 TO POWER < = 0.
04	05	X144	D	SQUARE ROOT ARG < 0.
04	06	X184	D	EXP FUNCTION ARG > 174.673.
04	07	X1C4	D	LOG FUNCTION ARG < = 0.
04	08	X204	D	SIN OR COS FUNCTION |ARG| > (2.621 E5)PI (1.126 E15)PI.
04	09	X244	D	SINH OR COSH FUNCTION ARG > 175,366.
04	10	X284	D	ARCSIN OR ARCCOS FUNCTION |ARG| > 1.
04	11	X2C4	D	TAN FUNCTION |ARG| > 2.621 E5 1.126 E15.
04	12	X304	D	TAN FUNCTION ARG TOO CLOSE TO (2N+1)PI / 2.
04	14	X384	D	CLOSE REACHED ON FUNCTION.
04	15	X3C4	D	SCALAR TOO LARGE OR TOO SMALL FOR INTEGER CONVERSION.

TABLE 8.1-1. GPC ERROR GROUP/CODE (Continued)

GROUP	CODE	WORD 5 HEX *	APPEN-DIX**	ERROR CONDITION**
04	16	X404	D	IN REMAINDER (A,B) B = 0.
04	17	X444	D	ILLEGAL CHARACTER SUBSCRIPT.
04	18	X484	D	LENGTH IN LJUST OR RJUST FUNCTION IS > STRING LENGTH OR IS < 0.
04	19	X4C4	D	IN A MOD B, B = 0, A < 0.
04	20	X504	D	STRING NOT IN STANDARD FORMAT FOR CHARACTER TO SCALAR CONVERSION.
04	22	X584	D	STRING NOT IN STANDARD FORMAT FOR CHARACTER TO INTEGER CONVERSION.
04	24	X604	D	A**B WITH A < = 0 AND B < = 0.
04	25	X644	D	VECTOR OR MATRIX DIVISION BY ZERO.
04	27	X6C4	D	ARG OF INVERSE IS SINGULAR.
04	28	X704	D	ARG OF UNIT VECTOR IS NULL VECTOR.
04	29	X744	D	ILLEGAL BIT STRING.
04	30	X784	D	SUBBIT SUBSCRIPT EXCEEDED BIT LENGTH.
04	31	X7C4	D	BIT @ OCT INVALID CHARACTER.
04	32	X804	D	BIT @ HEX INVALID CHARACTER.
04	59	XEC4	D	ARCCOSH ARG < 1.
04	60	XF04	D	ARCTANH |ARG| > = 1.
04	62	XF84	D	ARCTAN2 FUNCTION ERROR ARG1 = ARG2 = 0.
05	00	X005	E	I/O ERROR ON ICC RETRY.
05	01	X045	E	DISAGREE ON TRANSMITTER STATUS.
05	04	X105	E	I/O ERROR STORE PROTECT VIOLATION.

TABLE 8.1-1. GPC ERROR GROUP/CODE (Continued)

GROUP	CODE	WORD 5 HEX *	APPEN-DIX**	ERROR CONDITION**
05	05	X145	E	ILLEGAL DEVICE ID.
05	06	X185	E	INVALID EVENT ADDRESS SPECIFIED.
05	07	X1C5	E	CHECKSUM ERROR ON ICC RETRY.
06	01	X046	E	ZERO MESSAGE LENGTH IN DEU RESPONSE BUFFER.
06	02	X086	E	INVALID ICC HEADER.
06	03	X0C6	E	INVALID ICC DATA CONTROL.
06	05	X146	E	INVALID SVC PARAMETER LIST FOR MTU UPDATE.
06	06	X186	E	PMU TIME INVALID.
06	07	X187	E	DO CASE OUT OF RANGE.
07	01	X047	E	PRE-INITIALIZED IOQE BUSY FOR HFE INPUT.
07	02	X087	E	PRE-INITIALIZED IOQE BUSY FOR HFE OUTPUT.
07	03	X0C7	E	PRE-INITIALIZED IOQE BUSY FOR MFE INPUT.
07	04	X107	E	PRE-INITIALIZED IOQE BUSY FOR NSP (UPLINK) INPUT.
07	05	X147	E	PRE-INITIALIZED IOQE BUSY FOR DOWNLIST.
07	06	X187	E	PRE-INITIALIZED IOQE BUSY FOR SRB INPUT.
07	07	X1C7	E	PRE-INITIALIZED IOQE BUSY FOR ICC.
07	08	X207	E	PRE-INITIALIZED IOQE BUSY FOR LDB.
07	09	X247	E	PRE-INITIALIZED IOQE BUSY FOR MCIU INPUT.
07	10	X287	E	PRE-INITIALIZED IOQE BUSY FOR MCIU OUTPUT.
07	11	X2C7	E	PRE-INITIALIZED IOQE BUSY FOR HDA INPUT.

TABLE 8.1-1. GPC ERROR GROUP/CODE (Continued)

GROUP	CODE	WORD 5 HEX *	APPEN-DIX**	ERROR CONDITION**
07	12	X307	E	PRE-INITIALIZED IOQE BUSY FOR PL HIGH RATE.
07	13	X347	E	PRE-INITIALIZED IOQE BUSY FOR PMU OI/PL RAM.

* Value of X denotes sector (0-6).

** Error Conditions are listed in the indicated Appendix in alphabetical order.

TABLE 8.1-2. EXTENDED ADDRESSING

If the first digit of Word 6 is greater than 7, then replace that digit with the two digits, as determined by the value of Word 5, digit 1, given in the following table to derive the extended address.

1st digit (Word 6)	1st digit Word 5 (BSR)				
	2	3	4	5	6
8	10	18	20	28	30
9	11	19	21	29	31
A	12	1A	22	2A	32
B	13	1B	23	2B	33
C	14	1C	24	2C	
D	15	1D	25	2D	
E	16	1E	26	2E	
F	17	1F	27	2F	

8.2 INPUT/OUTPUT (I/O) ERRORS

The GPC, through a data bus network, sends data to Line Replaceable Units (LRUs) (Output) and via commands to LRUs receives data back (Input). Limited error checking (transmitter disabled MIA busy) is done on the transmission of data. The input is error checked, and if an error occurs, appropriate storing of information and annunciation (if any) is done.

−1 I/O Error Management is divided into two distinct types of processing, 1) errors that can be associated with the input/output of data, and 2) errors detected by CPU/IOP hardware which must be handled by FCOS because the error is severe and processing may be halted. Figure 8.2-1 contains a list of those errors for which an applications process can be notified. These errors really are of three types: BCE NO/GO, MSC Timeout, and Pseudo Timeout. The first thirteen errors listed are BCE NO/GOs. Figure 8.2-2 contains a list of CPU/IOP hardware detected errors which are handled by FCOS. These errors are detected via Level A and B hardware interrupts.

−2 Application processes may request status explicitly via the I/O macros or implicitly, as certain macros have the status request built-in as a part of the specification which generates the I/O SVC parameter list. Two types of status request are allowed; one method, called regular status, is accomplished by FCOS storing certain information in slots prior to the application buffer. A fullword (32 bits) of status, called the transaction status word, is stored at LOC minus four half-words. If a BCE NO/GO occurs, FCOS stores the residual word count at buffer minus two halfwords. If a MSC timeout occurs, FCOS stores zero at buffer minus two halfwords. The last 16 bits of the absolute buffer address are stored at buffer minus one halfword (the absolute buffer address is retrieved from the BCE Local Store). The residual word count is also obtained from BCE local store and represents the data words remaining to be received or transmitted. If a MSC Timeout or PSEUDO Timeout occurs, FCOS stores zero at buffer minus two halfwords and minus one at buffer minus one halfword. See Figure 8.2-3 for a visual layout of the status slots and Figure 8.2-4 for a definition of the transaction status word. FCOS does not clear or maintain the status words for this type of request. (14403/55237) (25062/25140)

−3 A second type of status is known as COMMFAULT. COMMFAULT is implemented to allow application processes to determine the validity of data on an LRU basis. FCOS maintains an array which contains one bit for each LRU to be COMFAULTed. This array is called the status indicator and is located in CZ1_COMMON (CZEB_COMM_FAULT) with an external equate for the symbol, FIOBCES1. FCOS also maintains another array which has the same format as the status indicator and this word is called the bypass indicator. Each bit set to one in the bypass indicator means that LRU has been bypassed in the BCE chain of which it is a member. The bypass indicator is named FIOBCEB1 and is located in the FCOS COMPOOL, FCMCOM. COMFAULTing occurs in the following manner. FCOS clears the status indicator word of faulted bits for a given request prior to initiating I/O for that transaction. The bypass indicators are then ORed into this. If an error(s) occurs on a given BCE in a transaction, every element on that transaction's chain (BCE) is marked as having bad data forming a composite mask representing all LRUs with bad data for this I/O transaction. If the same error occurs on consecutive I/O cycles, only the erring BCE element will be COMFAULTed and the rest of the COMMFAULTs for the non-erring elements on that BCE chain will be cleared. Figure 8.2-5 shows a layout of the bypass words. Note that when a bus is deselected, all the bypass indicators for that bus get set, including those for transactions not in the current OPS. The bypass indicators are OR'ed into commfault indicators which then also have bits set for transactions not in the current OPS. (25074/25184) (31435) (33304) (33698) (34656) (35211) (37507) (37509) (37533) (37706) (39054) (39359)

−4 An '*' as an element number in Figure 8.2-5 represents those elements which may be included for any particular mission. The numbering of these elements begins with 105 and continues sequential to a maximum of 252. These element numbers are unique within a set of mission dependent I/O programs (S2, S4, VU) rather than being unique for the flight as are the elements with listed numbers.

Initial Timeout - an RDS, RDL, or MIN instruction timed out while waiting for the first input word to arrive.	
Timeout - an RDS, RDL, or MIN instruction timed out while waiting for a data word, other than the first, to arrive.	
Transmitter Disabled - at some point in the execution of a TDS, TDL, MOUT, or MIN instruction the MIA associated with the BCE had its transmitter disabled. This error may also indicate a MIA found busy when it was time to initiate transmission of a new data word or the MIN command word.	
Parity - while executing an RDS, RDL, or MIN instruction, an input word with bad parity was detected.	
MIA Mismatch - while executing an RDS, RDL, or MIN instruction, a mismatch between the input IUA and BCE's IUAR occurred.	
Self Test Error - a BCE self test instruction has detected a fault in a BCE.	
GAP - a gap greater than 20 microseconds occurred during execution of a TDL or TDS instruction, or a 5 microsecond gap on an MOUT.	
SYNC Error - while executing an RDS, RDL, or MIN instruction, an input word with command sync was received.	
S	Power transient has caused normalization of the IU registers.
E	Subsystem serial channel error.
V	Validity of data is suspect.
Illegal OP Code - a given BCE has encountered an illegal instruction in the execution of a program.	
Boundary Alignment - a given BCE encountered a long format instruction on an odd halfword boundary.	
MSC Timeout - hung or looping BCE.	

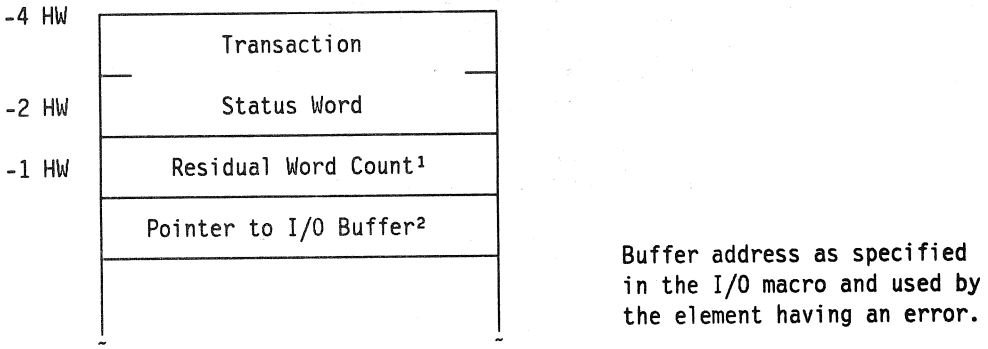
Figure 8.2-1. I/O Errors Which May be Handled by Application Processes

Error Description	FCOS Response
GO/NO GO Timer Expiration	Not used by PASS (except in Bootstrap Loader). Should never occur in normal PASS execution.
IOP Fail Latch	Set as a result of receiving two or more U-FAIL Votes (FTS). Log I/O Error and continue.
C/M Idle	Ignore. This is not an error and occurs during System Initialization and whenever the IOP is reset.
ROS Parity	Reset IOP, turn on I-FAIL light, enter WAIT state with interrupts disabled.
IOP Fault	Reset IOP, turn on I-FAIL light, enter WAIT state with interrupts disabled.
Spares	Log error, ignore and continue.
DMA Q Overflow	Reset IOP, turn on I-FAIL light, enter WAIT state with interrupts disabled.
DMA Timeout	Reset IOP, turn on I-FAIL light, enter WAIT state with interrupts disabled.
I/O Address Specification	Force Close Current Process, Log GPC error, start highest priority ready to execute process.
I/O Store Protect	Force Close Current Process, Log GPC error, start highest priority ready to execute process.
AGE Interrupt	Reset IOP, turn on I-FAIL light, enter WAIT state with interrupts disabled.

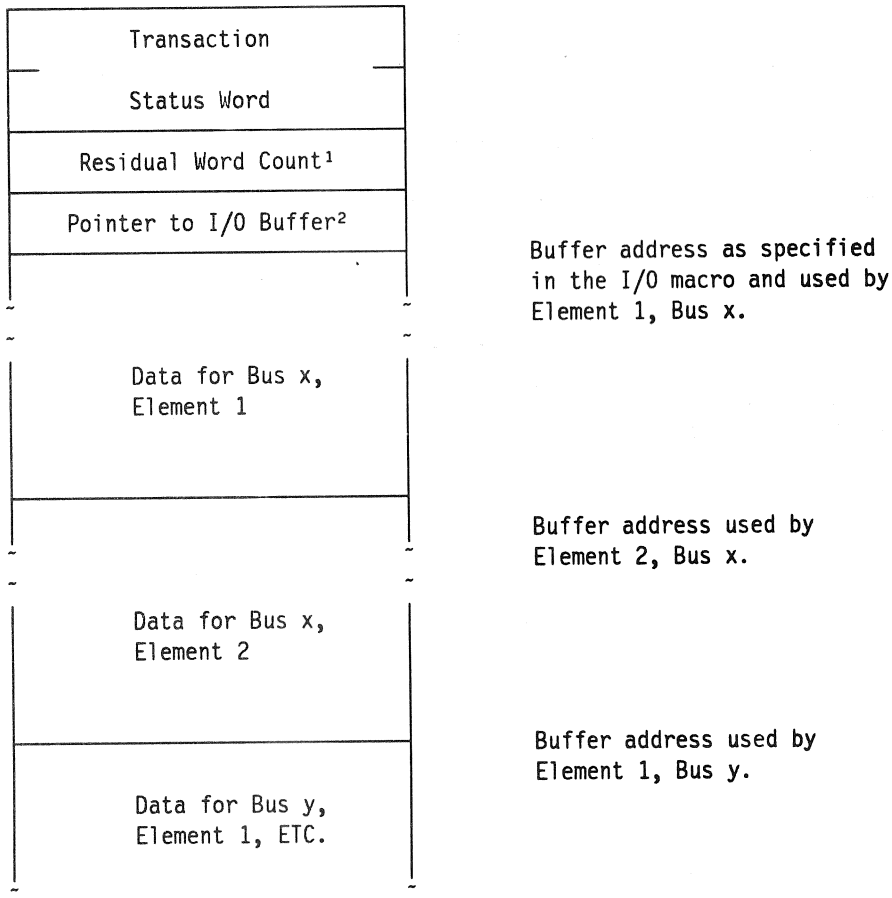
Note: All errors are logged as I/O errors, except erroneous setting of spare bits.

Figure 8.2-2. I/O Errors Handled By FCOS

Single Bus and No BCE Chaining



Multi-bus and/or BCE Chaining



Notes: 1. This count will be zero if a PSEUDO or MSC TIMEOUT.

2. This pointer will be set to HEX'FFFF' for a PSEUDO TIMEOUT and to the last 16 bits of the absolute buffer address of the last error for other errors.

Figure 8.2-3. Example of Status Slot Layout

BIT POSITION	SET TO '1' FOR THE FOLLOWING REASON
0	ENTIRE TRANSACTION FAILED. NO GOOD DATA EXISTS. SET IN ALL GPCS PARTICIPATING IN THE TRANSACTION.
1	FAILURE SOMEWHERE IN THE TRANSACTION. SET ONLY IN THE GPC'S EXPERIENCING THE ERROR.
2	SELF HAD ERROR.
3	MSC TIMEOUT HAS OCCURRED. SET ONLY IN THE GPC EXPERIENCING THE ERROR.
4	PSEUDO TIMEOUT HAS OCCURRED. SET ONLY IN THE GPC EXPERIENCING THE ERROR.
5	INITIAL TIMEOUT HAS OCCURRED. SET ONLY IN THE GPC EXPERIENCING THE ERROR.
6	FAILED OR POWERED DOWN MM. MM OR GPC-TO-GPC AS APPLICABLE. SET ONLY IN THE GPC EXPERIENCING THE ERROR.
7	MM SELECTED FOR IPL
8	CHECKSUM ERROR
9	BUS BUSY OR CHECKSUM BUFFER RESERVED
10-23	MASK OF BUSES, 10-23 ONLY, WITH MSC TIMEOUT OR PSEUDO TIMEOUT
24-26	NOT USED
27-31	MASK OF GPC'S WHICH FAILED OVERLAY (MM/GPC-TO-GPC ONLY - SET IN ALL GPCS PARTICIPATING IN OVERLAY) BIT 27 - GPC1 BIT 28 - GPC2 BIT 29 - GPC3 BIT 30 - GPC4 BIT 31 - GPC5

Figure 8.2-4. Format of the Transaction Status Word

WORD	BIT	BTU	ELE#	ELEMENT	TRANSACTION
0	0	FF1	31	FF Input Prom Seq 1,2	MFE
	1	FF2	36	FF Input Prom Seq 1,2	MFE
	2	FF3	40	FF Input Prom Seq 1,2	MFE
	3	FF4	46	FF Input Prom Seq 1,2	MFE
	4	FF1	33	TACAN/RA	MFE
	5	FF2	38	TACAN/RA	MFE
	6	FF3	42	TACAN/RA	MFE
	7	Null		Null	Null
	8	FF1	34	MSBLS	MFE
	9	FF2	39	MSBLS	MFE
	10	FF3	43	MSBLS	MFE
	11	Null		Null	Null
	12	FF1	32	IMU	MFE
	13	FF2	37	IMU	MFE
	14	FF3	41	IMU	MFE
	15	Null		Null	Null
	16	Null		Null	Null
	17	Null		Null	Null
	18	FF1	35	STU	MFE
	19	FF3	44	STU	MFE
	20	FF3	45	Rendezvous Radar	MFE
	21	Null		Null	Null
	22	Null		Null	Null
	23	Null		Null	Null
	24	EIU1	51	EIU1/P1	MFE
	25	EIU2	52	EIU2/P1	MFE
	26	EIU3	53	EIU3/P1	MFE
	27	Null		Null	Null
	28	FA1	47	FA Input Prom Seq 1,2	MFE
	29	FA2	48	FA Input Prom Seq 1,2	MFE
	30	FA3	49	FA Input Prom Seq 1,2	MFE
	31	FA4	50	FA Input Prom Seq 1,2	MFE

Figure 8.2-5. Bypass/Commfault Words Description

WORD	BIT	BTU	ELE#	ELEMENT	TRANSACTION
1	0	FF1	7	MDM Return Word	HFE/HDA
	1	FF2	11	MDM Return Word	HFE/HDA
	2	FF3	14	MDM Return Word	HFE/HDA
	3	FF4	17	MDM Return Word	HFE/HDA
	4	FF1	10	FF Input Prom Seq 2,6	HFE/HDA
	5	FF2	13	FF Input Prom Seq 2,6	HFE/HDA
	6	FF3	16	FF Input Prom Seq 2,6	HFE/HDA
	7	FF4	19	FF Input Prom Seq 2,6	HFE/HDA
	8	FF1	9	ADTA	HFE/HDA
	9	FF2	12	ADTA	HFE/HDA
	10	FF3	15	ADTA	HFE/HDA
	11	FF4	18	ADTA	HFE/HDA
	12	FA1	20	MDM Return Word	HFE/HDA
	13	FA2	22	MDM Return Word	HFE/HDA
	14	FA3	25	MDM Return Word	HFE/HDA
	15	FA4	28	MDM Return Word	HFE/HDA
	16	FA1	21	FA Input Prom Seq 3,10	HFE/HDA
	17	FA2	24	FA Input Prom Seq 3,10	HFE/HDA
	18	FA3	27	FA Input Prom Seq 3,10	HFE/HDA
	19	FA4	30	FA Input Prom Seq 3,10	HFE/HDA
	20	EIU1	1	EIU1/P1	HFE
	21	EIU1	4	EIU1/P4	HFE
	22	EIU2	2	EIU2/P1	HFE
	23	EIU2	5	EIU2/P4	HFE
	24	EIU3	3	EIU3/P1	HFE
	25	EIU3	6	EIU3/P4	HFE
	26	Null		Null	Null
	27	Null		Null	Null
	28	Null		Null	Null
	29	FA2	23	Hyd. Sys 3 Press. C	HFE/HDA
	30	FA3	26	OMS Lt. Eng. Press.	HFE/HDA
	31	FA4	29	OMS Rt. Eng. Press.	HFE/HDA

Figure 8.2-5. Bypass/Commfault Words Description (Continued)

WORD	BIT	BTU	ELE#	ELEMENT	TRANSACTION
2	0	FF1	54	MTU1	MTU
	1	FF2	55	MTU2	MTU
	2	FF3	56	MTU3	MTU
	3	Null		Null	Null
	4	FF1	66	NSP1 Discretes	NSP
	5	FF3	68	NSP2 Discretes	NSP
	6	FF1	67	NSP1 Data	NSP
	7	FF3	69	NSP2 Data	NSP
	8	FA1	78	FA1 MDM	GNC OPS INIT
	9	FA2	79	FA2 MDM	GNC OPS INIT
	10	FA3	80	FA3 MDM	GNC OPS INIT
	11	FA4	81	FA4 MDM	GNC OPS INIT
	12	FF1	74	FF1 MDM	GNC OPS INIT
	13	FF2	75	FF2 MDM	GNC OPS INIT
	14	FF3	76	FF3 MDM	GNC OPS INIT
	15	FF4	77	FF4 MDM	GNC OPS INIT
	16	LL1	70	SRB Prom	SRB
	17	LL2	71	SRB Prom	SRB
	18	LR1	72	SRB Prom	SRB
	19	LR2	73	SRB Prom	SRB
	20	FF1	57	MDM Return Word	IMU
	21	FF2	60	MDM Return Word	IMU
	22	FF3	63	MDM Return Word	IMU
	23	Null		Null	Null
	24	FF1	59	IMU Discretes	IMU
	25	FF2	62	IMU Discretes	IMU
	26	FF3	65	IMU Discretes	IMU
	27	Null		Null	Null
	28	FF1	58	IMU Data	IMU
	29	FF2	61	IMU Data	IMU
	30	FF3	64	IMU Data	IMU
	31	Null		Null	Null

Figure 8.2-5. Bypass/Commfault Words Description (Continued)

WORD	BIT	BTU	ELE#	ELEMENT	TRANSACTION
3	0	Null		Null	Null
	1	Null		Null	Null
	2	Null		Null	Null
	3	Null		Null	Null
	4	Null		Null	Null
	5	Null		Null	Null
	6	Null		Null	Null
	7	Null		Null	Null
	8	Null		Null	Null
	9	Null		Null	Null
	10	Null		Null	Null
	11	Null		Null	Null
	12	Null		Null	Null
	13	Null		Null	Null
	14	Null		Null	Null
	15	Null		Null	Null
	16	Null		Null	Null
	17	Null		Null	Null
	18	Null		Null	Null
	19	Null		Null	Null
	20	Null		Null	Null
	21	Null		Null	Null
	22	Null		Null	Null
	23	Null		Null	Null
	24	Null		Null	Null
	25	Null		Null	Null
	26	Null		Null	Null
	27	Null		Null	Null
	28	PFI	95	PDI	PDI PF1
	29	MCIU	82	MCIU	MCIU
	30	PF1	83	PSP1	PSP PF1
	31	PF2	84	PSP2	PSP PF2

Figure 8.2-5. Bypass/Commfault Words Description (Continued)

WORD	BIT	BTU	ELE#	ELEMENT	TRANSACTION
4	0	PF1	91	MDM Return Word	PF Low Rate
	1	PF1	92	KU-Band Radar	PF Low Rate
	2	PF1	*	Element 2	PF Low Rate
	3	PF1		Element 3	PF Low Rate
	4	PF1		Element 4	PF Low Rate
	5	PF1		Element 5	PF Low Rate
	6	PF1		Element 6	PF Low Rate
	7	PF1		Element 7	PF Low Rate
	8	PF1		Element 8	PF Low Rate
	9	PF1		Element 9	PF Low Rate
	10	PF1		Element 10	PF Low Rate
	11	PF1		Element 11	PF Low Rate
	12	PF1		Element 12	PF Low Rate
	13	PF1		Element 13	PF Low Rate
	14	PF1		Element 14	PF Low Rate
	15	Null		Null	Null
	16	PF2	93	MDM Return Word	PF Low Rate
	17	PF2	94	Fuel Cell Purge	PF Low Rate
	18	PF2	*	Element 2	PF Low Rate
	19	PF2	*	Element 3	PF Low Rate
	20	PF2		Element 4	PF Low Rate
	21	PF2		Element 5	PF Low Rate
	22	PF2		Element 6	PF Low Rate
	23	PF2		Element 7	PF Low Rate
	24	PF2		Element 8	PF Low Rate
	25	PF2		Element 9	PF Low Rate
	26	PF2		Element 10	PF Low Rate
	27	PF2		Element 11	PF Low Rate
	28	PF2		Element 12	PF Low Rate
	29	PF2		Element 13	PF Low Rate
	30	PF2		Element 14	PF Low Rate
	31	Null		Null	Null

Figure 8.2-5. Bypass/Commfault Words Description (Continued)

WORD	BIT	BTU	ELE#	ELEMENT	TRANSACTION
5	0	FLX 1	*	MDM Return Word	Single FLX 1/2
	1	FLX 1		Element 1	Single FLX 1/2
	2	FLX 1		Element 2	Single FLX 1/2
	3	FLX 1		Element 3	Single FLX 1/2
	4	FLX 1		Element 4	Single FLX 1/2
	5	FLX 1		Element 5	Single FLX 1/2
	6	FLX 1		Element 6	Single FLX 1/2
	7	FLX 1		Element 7	Single FLX 1/2
	8	FLX 1		Element 8	Single FLX 1/2
	9	FLX 1		Element 9	Single FLX 1/2
	10	FLX 1		Element 10	Single FLX 1/2
	11	FLX 1		Element 11	Single FLX 1/2
	12	FLX 1		Element 12	Single FLX 1/2
	13	FLX 1		Element 13	Single FLX 1/2
	14	FLX 1		Element 14	Single FLX 1/2
	15	Null		Null	Null
	16	FLX 2	*	MDM Return Word	Single FLX 1/2
	17	FLX 2		Element 1	Single FLX 1/2
	18	FLX 2		Element 2	Single FLX 1/2
	19	FLX 2		Element 3	Single FLX 1/2
	20	FLX 2		Element 4	Single FLX 1/2
	21	FLX 2		Element 5	Single FLX 1/2
	22	FLX 2		Element 6	Single FLX 1/2
	23	FLX 2		Element 7	Single FLX 1/2
	24	FLX 2		Element 8	Single FLX 1/2
	25	FLX 2		Element 9	Single FLX 1/2
	26	FLX 2		Element 10	Single FLX 1/2
	27	FLX 2		Element 11	Single FLX 1/2
	28	FLX 2		Element 12	Single FLX 1/2
	29	FLX 2		Element 13	Single FLX 1/2
	30	FLX 2		Element 14	Single FLX 1/2
	31	Null		Null	Null

Figure 8.2-5. Bypass/Commfault Words Description (Continued)

WORD	BIT	BTU	ELE#	ELEMENT	TRANSACTION
6	0	FLX 3	*	MDM Return Word	Single FLX 3/4
	1	FLX 3		Element 1	Single FLX 3/4
	2	FLX 3		Element 2	Single FLX 3/4
	3	FLX 3		Element 3	Single FLX 3/4
	4	FLX 3		Element 4	Single FLX 3/4
	5	FLX 3		Element 5	Single FLX 3/4
	6	FLX 3		Element 6	Single FLX 3/4
	7	FLX 3		Element 7	Single FLX 3/4
	8	FLX 3		Element 8	Single FLX 3/4
	9	FLX 3		Element 9	Single FLX 3/4
	10	FLX 3		Element 10	Single FLX 3/4
	11	FLX 3		Element 11	Single FLX 3/4
	12	FLX 3		Element 12	Single FLX 3/4
	13	FLX 3		Element 13	Single FLX 3/4
	14	FLX 3		Element 14	Single FLX 3/4
	15	Null		Null	Null
	16	FLX 4	*	MDM Return Word	Single FLX 3/4
	17	FLX 4		Element 1	Single FLX 3/4
	18	FLX 4		Element 2	Single FLX 3/4
	19	FLX 4		Element 3	Single FLX 3/4
	20	FLX 4		Element 4	Single FLX 3/4
	21	FLX 4		Element 5	Single FLX 3/4
	22	FLX 4		Element 6	Single FLX 3/4
	23	FLX 4		Element 7	Single FLX 3/4
	24	FLX 4		Element 8	Single FLX 3/4
	25	FLX 4		Element 9	Single FLX 3/4
	26	FLX 4		Element 10	Single FLX 3/4
	27	FLX 4		Element 11	Single FLX 3/4
	28	FLX 4		Element 12	Single FLX 3/4
	29	FLX 4		Element 13	Single FLX 3/4
	30	FLX 4		Element 14	Single FLX 3/4
	31	Null		Null	Null

Figure 8.2-5. Bypass/Commfault Words Description (Continued)

WORD	BIT	BTU	ELE#	ELEMENT	TRANSACTION
7	0	FLX 5	*	MDM Return Word	Single FLX 5
	1	FLX 5		Element 1	Single FLX 5
	2	FLX 5		Element 2	Single FLX 5
	3	FLX 5		Element 3	Single FLX 5
	4	FLX 5		Element 4	Single FLX 5
	5	FLX 5		Element 5	Single FLX 5
	6	FLX 5		Element 6	Single FLX 5
	7	FLX 5		Element 7	Single FLX 5
	8	FLX 5		Element 8	Single FLX 5
	9	FLX 5		Element 9	Single FLX 5
	10	FLX 5		Element 10	Single FLX 5
	11	FLX 5		Element 11	Single FLX 5
	12	FLX 5		Element 12	Single FLX 5
	13	FLX 5		Element 13	Single FLX 5
	14	FLX 5		Element 14	Single FLX 5
	15	Null		Null	Null
	16	FLX	*	MDM Return Word	Dual Port 3
	17	FLX/SCA		Element 1	Dual Port 3
	18	FLX/SCA		Element 2	Dual Port 3
	19	FLX		Element 3	Dual Port 3
	20	FLX		Element 4	Dual Port 3
	21	FLX		Element 5	Dual Port 3
	22	FLX		Element 6	Dual Port 3
	23	FLX		Element 7	Dual Port 3
	24	FLX		Element 8	Dual Port 3
	25	FLX		Element 9	Dual Port 3
	26	FLX		Element 10	Dual Port 3
	27	FLX		Element 11	Dual Port 3
	28	FLX		Element 12	Dual Port 3
	29	FLX		Element 13	Dual Port 3
	30	FLX		Element 14	Dual Port 3
	31	Null		Null	Null

Figure 8.2-5. Bypass/Commfault Words Description (Continued)

WORD	BIT	BTU	ELE#	ELEMENT	TRANSACTION
8	0	FLS	*	MDM Return Word	Dual Port 1
	1	FLX/SCA		Element 1	Dual Port 1
	2	FLX/SCA		Element 2	Dual Port 1
	3	FLX		Element 3	Dual Port 1
	4	FLX		Element 4	Dual Port 1
	5	FLX		Element 5	Dual Port 1
	6	FLX		Element 6	Dual Port 1
	7	FLX		Element 7	Dual Port 1
	8	FLX		Element 8	Dual Port 1
	9	FLX		Element 9	Dual Port 1
	10	FLX		Element 10	Dual Port 1
	11	FLX		Element 11	Dual Port 1
	12	FLX		Element 12	Dual Port 1
	13	FLX		Element 13	Dual Port 1
	14	FLX		Element 14	Dual Port 1
	15	Null		Null	Null
	16	FLX	*	MDM Return Word	Dual Port 1
	17	FLX/SCA		Element 1	Dual Port 1
	18	FLX/SCA		Element 2	Dual Port 1
	19	FLX		Element 3	Dual Port 1
	20	FLX		Element 4	Dual Port 1
	21	FLX		Element 5	Dual Port 1
	22	FLX		Element 6	Dual Port 1
	23	FLX		Element 7	Dual Port 1
	24	FLX		Element 8	Dual Port 1
	25	FLX		Element 9	Dual Port 1
	26	FLX		Element 10	Dual Port 1
	27	FLX		Element 11	Dual Port 1
	28	FLX		Element 12	Dual Port 1
	29	FLX		Element 13	Dual Port 1
	30	FLX		Element 14	Dual Port 1
	31	Null		Null	Null

Figure 8.2-5. Bypass/Commfault Words Description (Continued)

WORD	BIT	BTU	ELE#	ELEMENT	TRANSACTION
9	0	FLX	*	MDM Return Word	Dual Port 2
	1	FLX/SCA		Element 1	Dual Port 2
	2	FLX/SCA		Element 2	Dual Port 2
	3	FLX		Element 3	Dual Port 2
	4	FLX		Element 4	Dual Port 2
	5	FLX		Element 5	Dual Port 2
	6	FLX		Element 6	Dual Port 2
	7	FLX		Element 7	Dual Port 2
	8	FLX		Element 8	Dual Port 2
	9	FLX		Element 9	Dual Port 2
	10	FLX		Element 10	Dual Port 2
	11	FLX		Element 11	Dual Port 2
	12	FLX		Element 12	Dual Port 2
	13	FLX		Element 13	Dual Port 2
	14	FLX		Element 14	Dual Port 2
	15	Null		Null	Null
	16	FLX	*	MDM Return Word	Dual Port 2
	17	FLX/SCA		Element 1	Dual Port 2
	18	FLX/SCA		Element 2	Dual Port 2
	19	FLX		Element 3	Dual Port 2
	20	FLX		Element 4	Dual Port 2
	21	FLX		Element 5	Dual Port 2
	22	FLX		Element 6	Dual Port 2
	23	FLX		Element 7	Dual Port 2
	24	FLX		Element 8	Dual Port 2
	25	FLX		Element 9	Dual Port 2
	26	FLX		Element 10	Dual Port 2
	27	FLX		Element 11	Dual Port 2
	28	FLX		Element 12	Dual Port 2
	29	FLX		Element 13	Dual Port 2
	30	FLX		Element 14	Dual Port 2
	31	Null		Null	Null

Figure 8.2-5. Bypass/Commfault Words Description (Continued)

WORD	BIT	BTU	ELE#	ELEMENT	TRANSACTION
10	0	PF1	85	PBD	PL High Rate
	1	PF1	86	PBD	PL High Rate
	2	PF1	87	PBD	PL High Rate
	3	PL1	*	Element 4	PL High Rate
	4	PL1		Element 5	PL High Rate
	5	PL1		Element 6	PL High Rate
	6	PL1		Element 7	PL High Rate
	7	PL1		Element 8	PL High Rate
	8	PL1		Element 9	PL High Rate
	9	PL1		Element 10	PL High Rate
	10	PL1		Element 11	PL High Rate
	11	PL1		Element 12	PL High Rate
	12	PL1		Element 13	PL High Rate
	13	PL1		Element 14	PL High Rate
	14	PL1		Element 15	PL High Rate
	15	PL1		Element 16	PL High Rate
	16	PF2	88	PBD	PL High Rate
	17	PF2	89	PBD	PL High Rate
	18	PF2	90	PBD	PL High Rate
	19	PL2	*	Element 4	PL High Rate
	20	PL2		Element 5	PL High Rate
	21	PL2		Element 6	PL High Rate
	22	PL2		Element 7	PL High Rate
	23	PL2		Element 8	PL High Rate
	24	PL2		Element 9	PL High Rate
	25	PL2		Element 10	PL High Rate
	26	PL2		Element 11	PL High Rate
	27	PL2		Element 12	PL High Rate
	28	PL2		Element 13	PL High Rate
	29	PL2		Element 14	PL High Rate
	30	PL2		Element 15	PL High Rate
	31	PL2		Element 16	PL High Rate

Figure 8.2-5. Bypass/Commfault Words Description (Continued)

8.2.1 I/O Related User Notes

Because of the complex nature of the PASS I/O technique, several items are not self-evident to the user. These are included here to prevent misapplication of the software and to provide a quick-look reference for unexpected occurrences.

−1 Consecutive I/O Resets (31435)

−2 I/O Reset With Failed MTU Causes BFS to Downmode a String (35211)

−3 Downlist I/O Error Log Overrun Conditions (37509)

−4 Restore NSP Element (34656)

−5 DEU IPL - "I/O ERROR CRT" (37706)

−6 No Re-Enable of DEU I/O Error Annunciation For Hard DEU I/O Failures (37507)

−7 Unannunciated BCE Bypasses (14403/55237)

−8 Transient I/O Errors When Downmoding a RS to OPS 0 (34665)

−9 Resetting BTU Port Failure Indicators (33304)

−10 BFS - PASS I/O Windows Missed (39359)

−11 Setting of NSP and MTU Commfaults After an FF MDM Bypass (37533)

−12 BCE Element Bypass on Power Transient Detection (39054)

8.2.2 I/O Error Log (CZ2V_IO_ERR_LOG)

−1 The I/O Error Log includes the following:

- First five I/O errors since IPL or since the previous ERR LOG RESET on GPC Memory.
- Last five I/O errors (Downlisted).
- Index to the last entry made in the error log.
- Last I/O error from each GPC including the cumulative count in each GPC (Downlisted).

−2 Each error is defined in eight 16 bit words.

−3 Words 1 & 2

3.1 Bits 0-4 contain the BUS number on which the error occurred (Table 8.2-1).

3.2 Bits 5-9 UNUSED.

3.3 Bits 10-16 contain the device ID (Table 8.2-7).

3.4 Bits 17-20 contain the operation code (Table 8.2-7). (30107)

3.5 Bits 21-31 contain the residual word count. (25062/25140)

–4 Word 3: Bits 0-7 BUS control element number

COMFAULTABLE

FD - No Bus Management Table entry found

FE - Overlay in progress, unable to search Bus Management Table

XX - Valid Element Number, Bus Management Table entry found (see Table 8.2-8).

NON-COMFAULTABLE

OO - Not protected, not TCS Quad FA, nor TCS Quad FF, nor TCS MSEC/EIU

FF - Protected, TCS Quad FA, TCS Quad FF, or TCS MSEC/EIU

–5 Words 4 & 5: IOP status register (Tables 8.2-2 through 8.2-6).

–6 Words 6, 7, & 8: Time of the error - RUNTIME (Word 6: Time of the error (LSB of 30 Min); Word 7 & 8: Time of the error (LSB = 1 microsecond).

–7 Word 9: Cumulative count of Errors.

TABLE 8.2-1. BUS NUMBERS

Bus	Unit
1	ICC1
2	ICC2
3	ICC3
4	ICC4
5	ICC5
6	DK1
7	DK2
8	DK3
9	DK4
10	PF1, 2 Mission Dependent (Flex MDMs/SCAs)
11	PF1-2(B)
12	MCIU, LF1, LA1, LL1-2, LR1-2, PM03, LB1
13	LF1(B), LA1(B), LL1-2(B), LR1-2(B), PM03(B), LB2
14	FA1, FF1(B), MEC1-2, EIU1-3
15	FA2, FF2(B), MEC1-2, EIU1-3
16	FA3, FF3(B), MEC1-2, EIU1-3
17	FA4, FF4(B), MEC1-2, EIU1-3
18	MM1
19	MM2
20	FF1, FA1(B), DDU1-3
21	FF2, FA2(B), DDU1-3
22	FF3, FA3(B), DDU1-3
23	FF4, FA4(B), DDU1-3
24	PCM1, 2
25	
26	
27	MM Error (Table 8.2-3)
28	MSC Time Out (Table 8.2-4)
29	Level B Hardware Interrupt (Table 8.2-5)
30	Level A Hardware Interrupt (Table 8.2-6)

TABLE 8.2-2. BCE (1 THRU 24) STATUS WORD CONTENTS

	WORD 1																						WORD 2												
BIT POSITION	0										1										2										3				
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1			
ERROR DESCRIPTION	0	0	0	SIG MIS	PARITY	S	E	V	B	I	T	I	U	A	0	0	SYNC	0	0	0	0	0	GAP	SELF TEST	XMIT DIS	0	INIT T/O	T/O	BLOCK T/O	BOUNDARY	OP CODE	0	0			

WD1	WD2	BIT #	ERROR	DESCRIPTION
1000	0000	3	SIG MIS	Signature Mismatch detected by MC/Hardware(I). While executing an RDS, RDL, or MIN instruction, microcode detected a mismatch between the input IUA and the BCE's IUAR (BCE Local Store (LS) REG C5). Wait State, Data not stored.
0800	0000	4	PARITY	Parity detected by the MIA(I). While executing a Receive Data Instruction, an input word with bad parity was detected. Wait State, Data not stored in MIA buffer.
0X00	0000	5-7	SEV BIT	SEV Bits detected by MC/Hardware(I). This field is the logical OR of the SEV bits of all input words that were detected to have errors during execution of previous Receive Data Instruction. The S and V bits were inverted before the OR, thus any pattern other than 101 will be recorded in these bits. Wait State, Data not stored in MIA buffer.
00X8	0000	8-12	IUA	Subsystem Address field is the logical OR of the received subsystem address of the input word that was detected to have an error during execution of previous Receive Data Instruction.
0001	0000	15	SYNC	Sync Error detected by the MC(I,O). While executing a Receive Data Instruction, an input word with command sync was received. Wait State, Data not stored in MIA buffer.

TABLE 8.2-2. BCE (1 THRU 24) STATUS WORD CONTENTS (Continued)

WD1	WD2	BIT #	ERROR	DESCRIPTION
0000	0400	21	GAP	GAP detected by MC Time Out (O). A gap of greater than 20 micro seconds occurred during execution of a Transmit Data Instruction or 5 micro seconds during a MOUT. Wait State.
0000	0200	22	SELF TEST	Self Test Error detected by BCE Self Test. A BCE Self Test Instruction has detected a fault in the BCE. Valid during self test only, will not be seen in flight.
0000	0100	23	XMIT DIS	Transmitter Disabled, detected by MC Test (I/O). At the point of execution of a TDS, TDL, MOUT, or MIN Instruction, the MIA associated with this BCE had its transmitter disabled. This bit is also set if the MIA was found busy when it was time to initiate transmission of a new data word or the MIN command word. Wait State.
0000	0040	25	INIT T/O	Initial Time Out detected by MC Time Out (I). A Receive Data Instruction timed out while waiting for the first input word to arrive. Wait State.
0000	0020	26	T/O	Time Out detected by MC Time Out (I). A Receive Data Instruction timed out while waiting for a data word to arrive. This time out occurred on data inputs other than the first word.
0000	0010	27	BLOCK T/O	Block Time Out detected by MC Time Out (I). A Receive Data Instruction timed out while waiting for an interblock gap to end. Only valid when getting data from Mass Memory.
0000	0008	28	BOUNDARY	Boundary Alignment Error detected by MC (I). This BCE encounters a long format instruction on an odd halfword boundary. Wait State.
0000	0004	29	OP CODE	Illegal Op Code detected by MC (I,O). This BCE encountered an illegal instruction in the execution of a program. Wait State.

MC = Microcode; (I) = Input Operation; (O) = Output Operation;
WAIT STATE = BCE Program goes to WAIT STATE.

NOTE: A BCE of 1-5 with an IOP Status Register of zero indicates an ICC message buffer checksum miscompare for the given BCE/GPC.

TABLE 8.2-3. BCE (27) STATUS WORD CONTENTS

	WORD 1																				WORD 2												
BIT POSITION	0										1										2										3		
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	
ERROR DESCRIPTION	0	0	0	0	0	0	FAILED MM	SEL FOR IPL	CHECKSUM	BUSY	0	0	LDB 1 BUS	LDB 2 BUS	0	0	0	0	MM1 BUS	MM2 BUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WD1	WD2	BIT #	ERROR	DESCRIPTION
0200	0000	6	FAILED MM	Failed of Powered down MM.
0100	0000	7	SEL FOR IPL	MM selected for IPL.
0080	0000	8	CHECKSUM	Checksum Error.
0040	0000	9	BUSY	Bus Busy or Checksum Buff Reserved.
0008	0000	12	LDB 1 BUS	Error on LB1 Bus 12.
0004	0000	13	LDB 2 BUS	Error on LB2 Bus 13.
0000	2000	18	MM1 BUS	Error on MM1 Bus 18.
0000	1000	19	MM2 BUS	Error on MM2 Bus 19.

TABLE 8.2-4. BCE (28) STATUS WORD CONTENTS

	WORD 1																				WORD 2												
BIT POSITION	0										1										2										3	
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
ERROR DESCRIPTION	0	BUS 1	BUS 2	BUS 3	BUS 4	BUS 5	BUS 6	BUS 7	BUS 8	BUS 9	BUS 10	BUS 11	BUS 12	BUS 13	BUS 14	BUS 15	BUS 16	BUS 17	BUS 18	BUS 19	BUS 20	BUS 21	BUS 22	BUS 23	BUS 24	0	0	0	0	0	0	0

WD1	WD2	BIT #	ERROR	DESCRIPTION
4000	0000	1	BUS 1	Bus 1 on which MSC Timeout occurred.
2000	0000	2	BUS 2	Bus 2 on which MSC Timeout occurred.
1000	0000	3	BUS 3	Bus 3 on which MSC Timeout occurred.
0800	0000	4	BUS 4	Bus 4 on which MSC Timeout occurred.
0400	0000	5	BUS 5	Bus 5 on which MSC Timeout occurred.
0200	0000	6	BUS 6	Bus 6 on which MSC Timeout occurred.
0100	0000	7	BUS 7	Bus 7 on which MSC Timeout occurred.
0080	0000	8	BUS 8	Bus 8 on which MSC Timeout occurred.
0040	0000	9	BUS 9	Bus 9 on which MSC Timeout occurred.
0020	0000	10	BUS 10	Bus 10 on which MSC Timeout occurred.
0010	0000	11	BUS 11	Bus 11 on which MSC Timeout occurred.
0008	0000	12	BUS 12	Bus 12 on which MSC Timeout occurred.
0004	0000	13	BUS 13	Bus 13 on which MSC Timeout occurred.
0002	0000	14	BUS 14	Bus 14 on which MSC Timeout occurred.
0001	0000	15	BUS 15	Bus 15 on which MSC Timeout occurred.
0000	8000	16	BUS 16	Bus 16 on which MSC Timeout occurred.
0000	4000	17	BUS 17	Bus 17 on which MSC Timeout occurred.
0000	2000	18	BUS 18	Bus 18 on which MSC Timeout occurred.
0000	1000	19	BUS 19	Bus 19 on which MSC Timeout occurred.
0000	0800	20	BUS 20	Bus 20 on which MSC Timeout occurred.
0000	0400	21	BUS 21	Bus 21 on which MSC Timeout occurred.
0000	0200	22	BUS 22	Bus 22 on which MSC Timeout occurred.
0000	0100	23	BUS 23	Bus 23 on which MSC Timeout occurred.
0000	0080	24	BUS 24	Bus 24 on which MSC Timeout occurred.

TABLE 8.2-5. BCE (29) STATUS WORD CONTENTS

	WORD 1																				WORD 2																			
BIT POSITION	0										1										2										3									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1								
ERROR DESCRIPTION	0	0	0	0	OVERFLOW	TIMEOUT	0	0	0	0	0	0	0	INTERRUPT	LEVEL B	CODE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								

WD1	WD2	BIT #	ERROR	DESCRIPTION
8000	0000	0	NONE	Not defined for AP-101S.
4000	0000	1	NONE	Not defined for AP-101S.
2000	0000	2	NONE	Not defined for AP-101S.
0800	0000	4	OVERFLOW	DMA Q Overflow.
0400	0000	5	TIMEOUT	DMA Timeout.
000X	0000	13-15	INTERRUPT LEVEL B CODE	Level B Interrupt Code. 1 (100) I/O Store Protect Violation. 2 (110) AGE Interrupt. All other codes undefined for AP-101S.

TABLE 8.2-6. BCE (30) STATUS WORD CONTENTS

| | WORD 1 | | |

TABLE 8.2-7. PASS FCOS I/O DEVICE IDs

DEVICE	ID	OPERATION CODE **								
		1	2	3	4	5	6	7	8	9
IPR Via ICC (RS)	1									
GPC to GPC	2	WRT	RDS	No-op						
*SSIP ICC	3									
SSUS Output	4	WRT								
DEU #1	5	Fill	Poll	IPL Fill	Dump	Request BITE Status	Reset Scratch Pad Li.	Crit. Format Fill	Remote Fill	Remote Dump
DEU #2	6	Fill	Poll	IPL Fill	Dump	Request BITE Status	Reset Scratch Pad Li.	Crit. Format Fill	Remote Fill	Remote Dump
DEU #3	7	Fill	Poll	IPL Fill	Dump	Request BITE Status	Reset Scratch Pad Li.	Crit. Format Fill	Remote Fill	Remote Dump
DEU #4	8	Fill	Poll	IPL Fill	Dump	Request BITE Status	Reset Scratch Pad Li.	Crit. Format Fill	Remote Fill	Remote Dump
DDU	9	WRT ALL DDU	WRT ADI							
PMU's[1]	10	WRT GPC Data RAM	WRT 128 KBPS Program	WRT 64 KBPS Program	RDS 128 KBPS Program	RDS 64 KBPS Program	RDS BITE	Hard FMT Select	Program FMT Select	SM RDS OI/PL RAM
MMU[2]	11	WRT With Chksum	WRT Without Chksum	RDS With Chksum	RDS Without Chksum	MM Utility WRT	Read Stat Reg.	Overlay Read	Position Tape	MM Utility Read
FC Bite Acquisi.	12		RDS							
*HFE Input	13		RDS							
*HFE Output	14	WRT								
*MFE Input	15		RDS							
GNC OPS Initial Input (BITE Test 4)	16		RDS							
IMU Input	17		RDS							
IMU Output	18	WRT								

TABLE 8.2-7. PASS FCOS I/O DEVICE IDs (Continued)

DEVICE	ID	OPERATION CODE **								
		1	2	3	4	5	6	7	8	9
MTU 1 RS	19	WRT	MET RESET							
MTU 2 RS	20	WRT	MET RESET							
MTU 3 RS	21	WRT	MET RESET							
MTU ALL	22		RDS							
FC C & W WRT	23	WRT								
*NSP Cyclic Input	24		RDS							
FAOUT	25	WRT								
*HDA Input 1	26		RDS							
TCS FF1	27	WRT	RDS							
TCS FF2	28	WRT	RDS							
TCS FF3	29	WRT	RDS							
TCS FF4	30	WRT	RDS							
TCS FA1	31	WRT	RDS							
TCS FA2	32	WRT	RDS							
TCS FA3	33	WRT	RDS							
TCS FA4	34	WRT	RDS							
TCS QUAD FA	35	WRT	RDS							
TCS QUAD FF	36	WRT	RDS							
RJD CMD A TOGGLER	37	WRT								
NSW STEERING	38		RDS							
MECFIRE 2 FIRE 3	39	WRT	RDS							

TABLE 8.2-7. PASS FCOS I/O DEVICE IDs (Continued)

DEVICE	ID	OPERATION CODE **								
		1	2	3	4	5	6	7	8	9
G9 ONE SHOT	40	WRT								
TCS MODEABLE	41	WRT	RDS							
TCS MULTI-BUS	42	WRT	RDS							
PF BITE ACQUI.	43		RDS							
PF 1 DISC	44	WRT								
PF 2 DISC	45	WRT								
TCS PF1	46	WRT	RDS							
TCS PF2	47	WRT	RDS							
SM PF FIXED OUTPUTS	48	Cyclic Output	Payload Bay Drs							
PSP PF1	49	WRT	STATUS							
PSP PF2	50	WRT	STATUS							
PL HIGH RATE*	51		RDS							
PF LOW RATE	52		RDS							
DUAL Port 1	53		RDS							
DUAL Port 2	54		RDS							
DUAL Port 3	55		RDS							
Single Flex ½	56		RDS							
Single Flex ¾	57									
Single Flex 5	58		RDS							
SM Table Driven	59		RDS							
PDI	60	WRT	RDS							
LDB*	61	INT. W/O DATA	INT. WITH DATA	GO AHEAD	TRANS ENABLE	STATUS REQUEST	STATUS	WAVE OFF		

TABLE 8.2-7. PASS FCOS I/O DEVICE IDs (Continued)

DEVICE	ID	OPERATION CODE **								
		1	2	3	4	5	6	7	8	9
TCS LB MDMs	62	WRT	RDS							
SRB*	63		RDS							
TCS SRB	64	WRT	RDS							
MCIU IN	65		RDS							
MCIU OUT	66	WRT								
TCS MCIU	67	WRT	RDS							
TCS BUS 10	68	WRT	RDS							
TCS BUS 11	69	WRT	RDS							
TCS BUS 14	70	WRT	RDS							
TCS Bus 15	71	WRT	RDS							
TCS Bus 16	72	WRT	RDS							
TCS Bus 17	73	WRT	RDS							
TCS Bus 20	74	WRT	RDS							
TCS Bus 21	75	WRT	RDS							
TCS Bus 22	76	WRT	RDS							
TCS Bus 23	77	WRT	RDS							
TCS MSEC /EIU	80	WRT								

[1]OP Code 10: TCS RDS OI/PL RAM. OP Code 11: WRT 64 KBPS one Word. OP Code 12: TCS RDS 64/128 KBPS Program.

[2]OP Code 10: TCS MM BITE Status.

*Pre-Initialized IOQUE

**For Single OP Code Device ID's, an OP Code of zero may be indicated in the I/O Error Log.

TABLE 8.2-8. BCE ELEMENT NUMBER TABLE

ELEM	BUS	BTU	DESCRIPTION
1	14	EIU1	Port 1 (HFE)
2	15	EIU2	Port 1 (HFE)
3	16	EIU3	Port 1 (HFE)
4	17	EIU1	Port 4 (HFE)
5	17	EIU2	Port 4 (HFE)
6	17	EIU3	Port 4 (HFE)
7	20/14	FF1	MDM Return Word
8	20/14	FF1	Payload Sensor
9	20/14	FF1	ADTA
10	20/14	FF1	Input Prom Seq 2,6
11	21/15	FF2	MDM Return Word
12	21/15	FF2	ADTA
13	21/15	FF2	Input Prom Seq 2,6
14	22/16	FF3	MDM Return Word
15	22/16	FF3	ADTA
16	22/16	FF3	Input Prom Seq 2,6
17	23/17	FF4	MDM Return Word
18	23/17	FF4	ADTA
19	23/17	FF4	Input Prom Seq 2,6
20	14/20	FA1	MDM Return Word
21	14/20	FA1	Input Prom Seq 3,10
22	15/21	FA2	MDM Return Word
23	15/21	FA2	Hyd. Sys 3 Press. C.
24	15/21	FA2	Input Prom Seq 3,10
25	16/22	FA3	MDM Return Word
26	16/22	FA3	OMS Left Eng. Press.
27	16/22	FA3	Input Prom Seq 3,10
28	17/23	FA4	MDM Return Word
29	17/23	FA4	OMS Rt. Eng. Press.
30	17/23	FA4	Input Prom Seq 3,10
31	20/14	FF1	Input Prom Seq 1,2
32	20/14	FF1	IMU (MFE)
33	20/14	FF1	TACAN/RA
34	20/14	FF1	MSBLS
35	20/14	FF1	STU
36	21/15	FF2	Input Prom Seq 1,2
37	21/15	FF2	IMU (MFE)
38	21/15	FF2	TACAN/RA
39	21/15	FF2	MSBLS

TABLE 8.2-8. BCE ELEMENT NUMBER TABLE (Continued)

ELEM	BUS	BTU	DESCRIPTION
40	22/16	FF3	Input Prom Seq 1,2
41	22/16	FF3	IMU (MFE)
42	22/16	FF3	TACAN/RA
43	22/16	FF3	MSBLS
44	22/16	FF3	STU
45	22/16	FF3	Rend. Radar
46	23/17	FF4	Input Prom Seq 1,2
47	14/20	FA1	Input Prom Seq 1,2
48	15/21	FA2	Input Prom Seq 1,2
49	16/22	FA3	Input Prom Seq 1,2
50	17/23	FA4	Input Prom Seq 1,2
51	14	EIU1	Port 1 (MFE)
52	15	EIU2	Port 1 (MFE)
53	16	EIU3	Port 1 (MFE)
54	20/14	FF1	MTU 1
55	21/15	FF2	MTU 2
56	22/16	FF3	MTU 3
57	20/14	FF1	MDM Return Wd (IMU)
58	20/14	FF1	IMU Data (IMU)
59	20/14	FF1	IMU Discretes
60	21/15	FF2	MDM Returned (IMU)
61	21/15	FF2	IMU Data (IMU)
62	21/15	FF2	IMU Discretes
63	22/16	FF3	MDM Return Wd (IMU)
64	22/16	FF3	IMU Data (IMU)
65	22/16	FF3	IMU Discretes
66	20/14	FF1	NSP1 Discretes
67	20/14	FF1	NSP1 Data
68	22/16	FF3	NSP2 Discretes
69	22/16	FF3	NSP2 Data
70	12/13	LL1	SRB Prom
71	12/13	LL2	SRB Prom
72	12/13	LR1	SRB Prom
73	12/13	LR2	SRB Prom
74	20/14	FF1	MDM Discretes (OPS Init)
75	21/15	FF2	MDM Discretes (OPS Init)
76	22/16	FF3	MDM Discretes (OPS Init)
77	23/17	FF4	MDM Discretes (OPS Init)
78	14/20	FA1	MDM Discretes (OPS Init)

TABLE 8.2-8. BCE ELEMENT NUMBER TABLE (Continued)

ELEM	BUS	BTU	DESCRIPTION
79	15/21	FA2	MDM Discretes (OPS Init)
80	16/22	FA3	MDM Discretes (OPS Init)
81	17/23	FA4	MDM Discretes (OPS Init)
82	12	MCIU	MCIU Data
83	10/11	PF1	PSP1
84	10/11	PF2	PSP2
85	10/11	PF1	PL Bay Doors
86	10/11	PF1	PL Bay Doors
87	10/11	PF1	PL Bay Doors
88	10/11	PF2	PL Bay Doors
89	10/11	PF2	PL Bay Doors
90	10/11	PF2	PL Bay Doors
91	10/11	PF1	MDM Return Wd
92	10/11	PF1	KU-Band Radar
93	10/11	PF2	MDM Return Wd
94	10/11	PF2	Fuel Cell Purge
95			
96			
97			
98			
99			
100			
101			
102			
103			
104			
105	10	SCA1	SCA Cd0Ch0(G9)
106	10	SCA1	SCA Cd1Ch0(G9)
107	11	SCA2	SCA Cd0Ch0(G9)
108	11	SCA2	SCA Cd1Ch0(G9)
109	10	SCA1	SCA Cd0Ch0(S2)
110	10	SCA1	SCA Cd1Ch0(S2)
111	11	SCA2	SCA Cd0Ch0(S2)
112	11	SCA2	SCA Cd1Ch0(S2)

8.3 DUMP ANALYSIS

This section of the User's Guide will address various topics relating to information which may be gleaned from a GPC dump.

8.3.1 SYNC TRACE LOG

The Sync trace function within the STS PASS software records PC2 timer interrupts, sync SVC's, and I/O interrupts. The SYNC trace function logs all system interrupts that require CS (Common Set) or RS (Redundant Set) sync in a core resident trace table (FCMTRCLG). The trace log is a circular wrap table (i.e., when the table fills up the oldest entry is overlayed) of fifty (50) entries. The trace function is activated on system initialization. On sync failure, the trace function is deactivated by setting the index to the next entry (TPSATAMW) equal to zero. This effectively causes all future sync trace entries to overlay the entry following the last good trace entry. (25048/33907) The sync trace function is not deactivated if the failing GPC exhibits zero sync discretes.

–1 The following parameters provide data relative to the trace log:

NAME	LOC	CONTENT		DESCRIPTION
TPSATENT	0008	XXXX	XXXX –	Pointer to next trace entry, i.e., effective address of 1 XXXX
TPSATAMW	0009	0008/0000	0008 – 0000 –	Index to the next trace entry Indicates the trace is deactivated
TPSATBGN	000A	8XXX	8XXX –	Starting location of the trace log, i.e., effective address of 18XXX
TPSATEND	000B	8XXX	8XXX –	End of trace log, i.e., Loc. 18XXX

–2 Following a RS or CS sync failure, the failed GPC and at least one of the other GPCs in the RS or CS should be dumped so the sync trace entries and other pertinent data can be analyzed. After the computer dumps have been performed, the sync trace function should be restarted. The entry of ITEM 48 EXEC on the GPC Memory display restarts the sync trace logging, clears the first five/last five entries of the I/O error log, and resets the U-Fail votes. This entry is effective only in the GPC commanding the CRT and those GPCs listening on that bus, i.e., RS members. Thus for CS only members this entry must be performed on a CRT commanded by each GPC in the CS.

–3 Each sync trace entry is eight (8) halfwords long. Figure 8.3-1 presents the word layout of a trace entry.

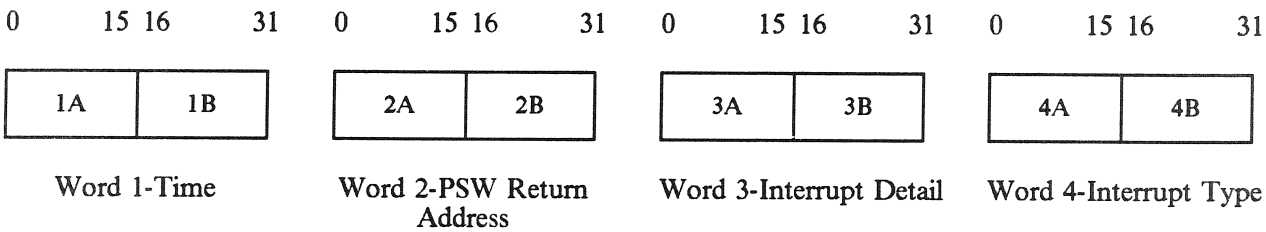


Figure 8.3-1

–3.1 Word 1-TIME (1A & 1B): A fullword containing the time (GMT) of the entry. This word is a 30 minute counter in microseconds. For SVC and I/O entries, it is the time of a successful sync or when a sync timeout is detected. For Timer entries, it is the time that the interrupt occurred.

–3.2 Word 2-Return Address (2A & 2B): A fullword containing the first fullword of the appropriate old PSW which gives the return address. Indicates what program and location was executing when the interrupt occurred.

–3.3 Word 3-Interrupt Detail

If Type	= SVC	3A:	Bits 0-15 contain the address of the SVC parameter list.
		3B:	Bits 16-31 contain the SVC number
	= I/O	3A:	Bits 0-15 contain the device ID (Ref. Table 8.2-7)
		3B:	Bits 16-31 contain the Op Code (Ref. Table 8.2-7)
	= TIMER	3A:	Bits 0-15 contain the halfhour count field from the TQE
		3B:	Bits 16-31 contain the TQE flags field 0001 = SIP TIMER 0008 = HFE/DGI/HDA

–3.4 Word 4-Trace Type

4A:	A halfword containing the trace entry 1 = SVC entry 2 = I/O entry 3 = TIMER entry
4B:	Reserved (should contain 0)

8.3.2 WAIT STATE

If a GPC is in the wait state and is powered off prior to moding to HALT, the put-a-way PSW at location 10-13 will contain the current PSW at the time the GPC entered the wait state.

8.4 PASS MICROFICHE

The flight software documentation medium is microfiche. A brief description of the documentation deliverables and their possible usage follows.

8.4.1 MASS MEMORY BUILD (MMBXXXX)

This is the map of the base software release. In other words, one build map for each major release. The information tables are arranged in mass memory phase/load block order.

−1 The following data is included:

Phase.

Load block.

Protect/unprotect status of the load block.

MMU address of load block (file, track, subfile, block).

Load block checksum (address (FTSBB), offset in block, value).

CSECT information (name, GPC address, length).

CSECT location on MMU (FTSBB and offset) NOTE: FTSBB is physical MMU block CSECT begins in; offset is from beginning of load block).

8.4.2 MASS MEMORY PATCH

For each MMU update by patch, two types of listings are delivered by microfiche. The first is a list of the input patch files and the second is a list of the patches in Universal Patch Format.

−1 For the patch files, information specified is:

LOC	- Name of the location to be patched
DATAX	- New contents of location
BLOCK	- MMU address (FTSBB)
LOC	- Offset in MMU block
OLD DATA	- Contents of location before patch
NEW DATA	- Contents of location after patch

−2 The UPF is a standardized format of card images (A-E). These cards are defined as follows:

A. BEGIN PATCH card which signals start of a new patch with optional comments.

B. Specifies the Patch ID to be inserted in the Revision Patch Log (RPL) for the patch with optional comments.

C. System identifiers: Software Element ID (1-7) as defined in Section 8.5; MMU version, and phase/load block of the specified system the patch is to be applied to.

D. Location identifiers: Offset (decimal) in load block, number (decimal) of consecutive words to be patched, GPC memory address of first word, and protect status of location(s).

E. Provides desired contents of locations to be patched (maximum of five per card).

−3 Each patch must begin with an A, B, and C card (only one of each). Multiple pairs of D/E cards may be in the patch as long as the locations are in the phase/load block specified on the C card. Multiple E cards may be used with a D card if needed to provide the specified number of consecutive patch contents.

8.4.3 MASS MEMORY DUMP (MMB)

This is the hexadecimal dump of the entire mass memory tape. The data is in file, track, subfile, block (FTSBB) order and each block is labeled.

−1 This mass memory documentation is typically used to resolve miscompares when doing a mass memory dump and compare. The dump/compare data is listed by F/T/S/BB and may be correlated to phase/load block/offset by use of mass memory build, mass memory patch, and mass memory dump reports.

8.4.4 ILOAD REPORT (ILDMAP)

An ILOAD report is generated for each update of the PASS ILOAD parameters. Within the microfiche report are three sorts of the parameters: by MSID, HAL name, and FSSR name. Information provided on the first three rows defines the ILOAD parameter itself:

Row 1 -

MSID: V97U0717C
FSSR NAME: GELERROR(1) (Requirements document name)
PF: G4.227 > G4.36 (Principle function number in FSSR)
MC: 00 (Memory configuration - not specified)
VALUE: + 1.409836E + 00
RI UNITS: ND (Units in FSSR)

Row 2 -

HAL NAME: CGCS_GELERROR1
UOC: GCA_AERO_PITCH_25H (Unit of Compilation)
BLOCK: Left blank
IBM UNITS: ND (Units in code)

Row 3 -

PH: 6 (Phase)
LB: 6 (Load block)
OFFSE: 952 (Offset in load block in decimal)
FTSBB: 56028 (MMU block address)
O-S: 440 (Offset in MMU block in decimal)
GPCAD: 0AA42 (Address of parameter in GPC memory)
MM VAL: 1.4098358E + 00 (Value on MMU)
MMVAL-HEX: 41168EB0 (Value on MMU in HEX)
CVAL: 1.4098358E + 00 (Value in COMPOOL)
CVAL-HEX: 41168EB0 (Value in COMPOOL in HEX)

−1 Additional data defines derived parameters. Rows 2 and 3 are provided for the derived parameter. If it is not of the same value, the equation used to derive the value is specified in terms of MSIDs.

8.4.5 PASS SYSTEM SOFTWARE

System Software modules are of two types: HAL coded and AP-101 Assembler Language coded (FCOS). For the HAL modules, the HAL source code and relatively addressed object code is listed. Additionally, a symbol cross reference, compool references, data structures and local data are shown. For Assembler Language modules, the assembled program and its external references are listed.

8.4.6 APPLICATIONS SOFTWARE

All applications modules are coded in HAL. Again the source code, unresolved object code, external references, and symbol cross references are listed.

8.4.7 HALSTAT

This is the universal reference for all HAL modules and symbols. The first section gives the statistics for each compilable unit (module). The second section provides information about data structure templates. Information given is:

Size of structure in both HEX and decimal

References to the structure (parameters in it) by HAL modules/statement numbers in it

Layout of the structure definition statement

Memory allocation (relative to start of structure) of parameters in structure.

The third section, and the one most commonly used, is the Global Symbol Dictionary. This is the symbolic cross reference for all HAL names. Relative address and size is specified, followed by the absolute address for all memory configurations. A list of the HAL modules that reference the name is given along with the source statement number at which it is referenced. The type of reference is also given using the following code:

0 = Definition
1 = Subscript
2 = Reference (i.e., to right of = sign)
4 = Assignment (i.e., to left of = sign)
6 = Reference and Assignment (ex: x = x + 1)

Data type and word length information is also included in this section.

8.4.8 DISASSEMBLY (DASS)

DASS is a set of microfiche which provides, for each memory configuration, an Assembly Language listing of the entire GPC memory. This is produced by Dis-Assembling the link-edited memory configuration; thus, all relative addressings have been resolved, etc. Assembler-type comments are provided within limitations of space.

8.4.9 AUTODOC (AUTOMATIC DOCUMENTATION)

The AUTODOC microfiche provides a module/parameter cross reference for all HAL modules. Information contained in the report for each parameter includes:

HAL name of parameter

What the parameter is (ITEM column which is mostly left blank)

Modules which reference the parameter

Types of reference by the module

D - Declaration
A - Assignment
R - Reference
S - Subscript

MSID of parameter

Description - which includes type, attributes assigned by compiler and any additional commentary on the parameter.

−1 AUTODOC is provided by software development area (SSW, GNC, SM, etc.). Each area may have from one to three sets of AUTODOC. These multiple sets are not duplicates - each set contains different modules from the specified development area. Within a set, the modules are in alphabetical order but are not necessarily contiguous. For example, in GNC, set 1 contains, among others, modules GCA-GC9. Set 2 contains, among others, GAA-GAI, then skips to GEH, does not contain GEI, does have GEJ, does not have GEK, etc. Set 3 does have GEI and GEK. Thus, one must search diligently on occasion to find a particular module.

8.4.10 INCLUDE LIBRARY (INCL80)

This set of microfiche is a listing of members composed of HAL source level statements which are not compilable units. By compiler directive, a member is merged (included) into the HAL source statements of the unit being processed before it is compiled. The include directives are usually done with a No List option to inhibit printing of the included statements. This presents problems in code inspections, thus a copy of the source member library is vital to each site. A large part of the include library is the input source for the off-line Display Format Generator which produces the GPC code required to drive the on-board CRT displays.

8.5 MASS MEMORY DIRECTORY

The mass memory directory is constructed to allow UPF access to all elements on the mass memory tape. This directory is arranged on the M/M tape in System ID order. Entries in the directory allow accessing of either a patch directory (for those elements which possess a patch directory) or the appropriate phase and load block (for those elements which do not possess a patch directory). Due to LDB limitations, there exists a maximum of 8 System IDs.

−1 There exists only one M/M directory to reference all the elements contained on the mass memory. This allows PL9/SM2, regardless of the FSW system in which it is contained, to reference any element on the tape.

−2 Format of the directory is per Figure 8.5-1, each entry is 16-bit halfwords.

−3 Length of 1st section driven by # System IDs which is fixed at 8, thus length of 1st section = 41 halfwords

−4 Length of 2nd and 3rd sections are data related.

−5 For those elements which possess patch directories - the ↑ and # Sys n Patch Directory fields will be non-zero and allow UPF software direct access to the patch directory MMU address. ↑ points directly to load block/MM address section of table.

−6 For those elements which contain patchable items not contained in a patch directory, the and # Sys n non-Patch Directory fields will be non-zero and will refer UPF software to the phase section of the directory which will give the load block information for the applicable phase. Once the load block information is determined, UPF software will then reference the load block section to determine MMU address for the requested patchable item.

−7 Detailed information for the elements containing patch directories.

System IDs 1, 2, 3 will contain a value of 1 in the # Sys n Patch Directory Entries field since there is a patch directory for each version of the FSW.

System ID 4 will contain a value of 1 in the # Sys n Patch Directory Entries field since there is a single BFS patch directory with up to 3 phases in the patch directory representing the different versions of the BFS software.

System ID 6 will contain a value of 3 in the # Sys n Patch Directory Entries field since there is a different SSME patch directory for each version of SSME software.

−8 Use of this directory means that when patches to a M/M element which has a patch directory (such as a phase table) are desired, 4 M/M operations are required 1) read M/M Directory to locate address of elements patch directory, 2) read that element patch directory, 3) read the appropriate phase/load block, 4) read the RPL for that element. However for those elements which do not possess a patch directory, only 3 MM operations are required - 1) read M/M Directory to locate element, 2) read the appropriate phase/load block for that element, 3) read the RPL for that element.

−9 These M/M operations will be transparent to the user. He merely enters his System ID, phase, and load block and software does the rest.

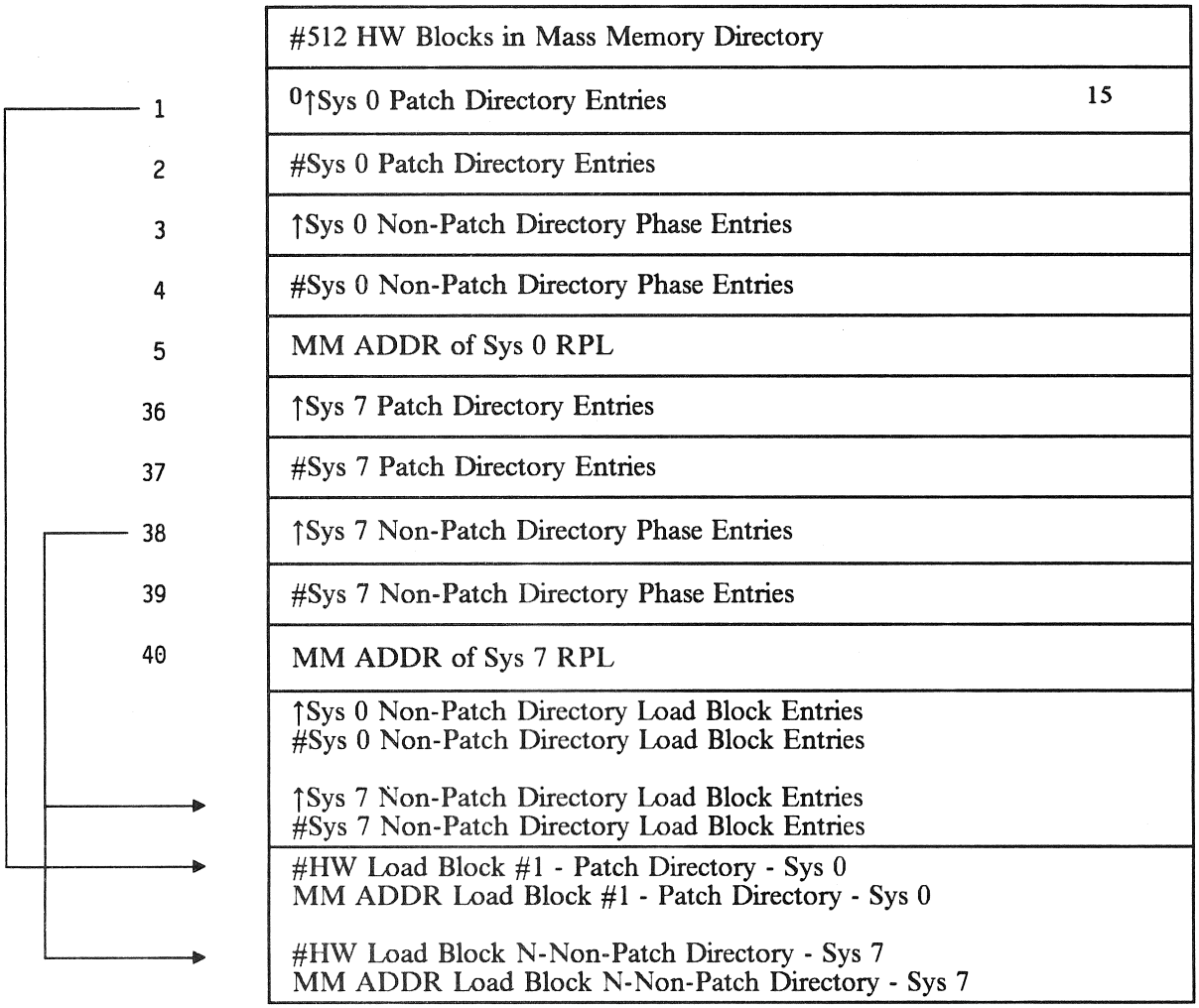


Figure 8.5-1. MASS Memory Directory Format

8.6 DEU IPL LOG TABLE (CZ2V_DEU_IPL_LOGTB)

The DEU IPL Log provides a history of DEU IPL attempts. It is able to store 10 entries, and is divided into two parts. The first half of the table stores the first 5 DEU IPL attempt entries, and then becomes static. The second half of the table is wrap-around and stores the last 5 DEU IPL attempt entries (i.e., when the second half fills up, the oldest entry is overlaid).

–1 Each entry in the log identifies the time of a DEU IPL request, the DEU id, and a completion code to indicate the failure/success of the DEU IPL (see Figure 8.6-1). The valid DEU IPL completion codes are:

0 - No error, IPL Attempt Successful
1 - DEU I/O Error On BITE Status Response
2 - Invalid DEU BITE Status Response
3 - DEU I/O Error On DCP Fill
4 - DEU I/O Error On DCP Time Fill
5 - DEU I/O Error On DCP Poll
6 - DEU Invalid DCP Poll Response
7 - DEU I/O Error On Critical Format Fill
8 - DEU Critical Format Checksum Error
9 - MMU1 I/O Error On DCP Read
10 - MMU1 I/O Error On Critical Format Read
11 - MMU2 I/O Error On DCP Read
12 - MMU2 I/O Error On Critical Format Read
13 - DEU IPL Attempt Invalid - Improper Memory Configuration
14 - DEU IPL Attempt Invalid - IPL in Progress On Another DEU

–2 The DEU IPL Log Table can be cleared by executing Item 48 on Spec 000.

ENTRY TIME	DEU ID	DEU IPL COMPLETION CODE
(2 halfwords)	(1 halfword)	(1 halfword)

Figure 8.6-1. DEU IPL LOG ENTRY

APPENDIX A. SUBJECT CROSS-REFERENCE

This Appendix provides a cross-reference between Subjects (Keywords) and the User's Guide sections where they can be found.

The User's Guide Subject Cross-Reference Data Base Form shows the Keyword definitions. This form may be used to update the subject cross-reference. Completed forms should be sent to the PASS User's Guide Coordinator (see Appendix H).

The individual Keyword Reports are ordered alphabetically.

USER'S GUIDE SUBJECT CROSS-REFERENCE DATA BASE FORM
INDICATE ALL OF THE APPROPRIATE AREAS INVOLVED
(Keywords are highlighted)

ORIGINATOR: DATE:

User's Guide Section Number:

User's Guide Section Title:

Principal Functions (PF):

Ops MODES Affected: 0__ G1__ G2__ G3__ G6__ G8__ G9__ S2__ S4__ PL9__

Major Software Area: SSW( )GNC( )VU( )SM/PL( )

KEYWORDS

__ABORT - Abort(s)
__ADI - Attitude Direction Indicator
__AMI - Alpha Mach Indicator (AMI)
__ASCENT - Ascent
__BCE - Bus Control Element
__COMMFAULTS - Commfaults/Bypass
__CROSSFEED - Crossfeed(s)
__DAP - Digital Autopilot
__DED-DISP - Dedicated-Displays (DD)
__DISP - Display Function (DISP)
__DUMP - Dump Processing
__ECP - Explicitly Coded Program
__ENTRY - Entry
__FCS - Flight Control System
__FTS - Fail-To-Sync, RS/CS
__GUID - Guidance (GUID)
__HSI - Horizontal Situation Indicator
__HW - Hardware
__I/O - Input/Output Error Processing
__ILOAD - Initialization Load
__IPL - Initial Program Load
__KU-BAND - Ku-Band
__LEVEL C - Level C Data
__MDM - Multiplexer/Demultiplexer
__MISSION - Mission Dependent Processor
__MPS - Main Propulsion System
__NAVAID - Navigation Aids
__OPS - Operation Sequence
__PANEL - Panel (PNL)
__PCS - Payload Control Supervisor
__POWERED - Powered Flight (PF)
__PSP COMM - PSP Communication
__RM - Redundancy Management
__RUNWAY - Runway
__SC - System Control
__SPEC - Specialist Function
__SSME - Space Shuttle Main Engine
__STP - Self Test Program
__SWITCHES - Switch Position/Contacts
__TCS - Test Control Supervisor
__UI - User Interface

__ACTUATORS - Actuator(s) (ACT)
__AM - Antenna Management
__ANNUNCIATION - Indicators/DEU Messages
__AVVI - Altitude/Vertical Velocity Indicator
__BUS - Bus, Data or MDM
__COMPILER - Compiler
__CYCLE-WRAP - Cycle-Wrap
__DCP - DEU Control Program
__DEU - Display Electronic Unit
__DOWNLIST - Downlist (D/L)
__DYNAMICS - Flight Dynamics
__EIU - Engine Interface Unit
__FCOS - Flight Computer Operating System
__FDA - Fault Detection & Annunciation
__GPC - GPC/Error Processing
__HIP - Hardware Interface Program
__HUD - Head Up Display
__HYD - Hydraulics (HYD)
__ICC - Intercomputer Communication
__IMU - Inertial Measurement Unit
__KEYBOARD - Keyboard (KB)
__LDB - Launch Data Bus
__MCDS INTERFACE - MCDS Interface
__MECO - Main Engine Cutoff
__MMU - Mass Memory Unit
__NAV - Navigation
__OMS - Orbital Maneuvering System
__ORBIT - Orbit
__PAYLOADS - Payloads (P/L)
__PDT - Parameter Data Tape
__PRELAUNCH - Prelaunch (PL)
__RCS - Reaction Control System
__RMS - Remote Manipulator System
__SACS - Software Avionics Command Support
__SEQ - Sequencers, SM or GNC
__SPI - Surface Position Indicator
__STATUS - Display Status/Arrows/Asterisks
__SVC - Supervisor Call
__TARGET - Target(s)/Targeting
__TRANSITIONS - Transition(s)
__UPLINK - Uplink (UL)

MAJOR SOFTWARE AREA
GNC

SECTION NUMBER	SECTION TITLE
2.4	OPERATIONAL SEQUENCES
2.4.2	OPS GNC9
2.4.2.1	DISPLAYS AVAILABLE
2.4.2.2	BASIC FUNCTIONS AVAILABLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.5	OPS GNC2
2.4.5.1	DISPLAYS AVAILABLE
2.4.5.2	BASIC FUNCTIONS AVAILABLE
2.4.6	OPS GNC3
2.4.6.1	DISPLAYS AVAILABLE
2.4.6.2	BASIC FUNCTIONS AVAILABLE
2.4.7	OPS GNC6
2.4.7.1	DISPLAYS AVAILABLE
2.4.7.2	BASIC FUNCTIONS AVAILABLE
2.4.8	OPS GNC8
2.4.8.1	DISPLAYS AVAILABLE
2.4.8.2	BASIC FUNCTIONS AVAILABLE
3.5	DISPLAYS
3.5.000	GPC MEMORY
3.5.001	DPS UTILITY
3.5.002	TIME
3.5.018	GNC SYS SUMM 1
3.5.019	GNC SYS SUMM 2
3.5.020	DAP CONFIG
3.5.021	IMU ALIGN
3.5.022	S TRK/COAS CNTL
3.5.023	RCS
3.5.025	RM ORBIT
3.5.033	REL NAV
3.5.034	ORBIT TGT
3.5.040	SENSOR TEST
3.5.041	RGA/ADTA/RCS
3.5.042	SWITCH/SURF
3.5.043	CONTROLLERS
3.5.044	SWITCHES
3.5.045	NWS CHECK
3.5.050	HORIZ SIT

MAJOR SOFTWARE AREA
GNC (Continued)

SECTION NUMBER	SECTION TITLE
3.5.051	OVERRIDE
3.5.053	CONTROLS
3.5.1011	XXXXXX TRAJ
3.5.1021	XXXXXX TRAJ
3.5.1031	XXXXXX TRAJ
3.5.1041	XXXXX MNVR YYYYY
3.5.1051	XXXXX MNVR YYYYY
3.5.1061	XXXXX MNVR YYYYY
3.5.2011(G)	UNIV PTG
3.5.2021(G)	XXXXX MNVR YYYYY
3.5.3011	XXXXX MNVR YYYYY
3.5.3021	XXXXX MNVR YYYYY
3.5.3031	XXXXX MNVR YYYYY
3.5.3041	ENTRY TRAJ 1
3.5.3042	ENTRY TRAJ 2
3.5.3043	ENTRY TRAJ 3
3.5.3044	ENTRY TRAJ 4
3.5.3045	ENTRY TRAJ 5
3.5.3051	VERT SIT 1
3.5.3052	VERT SIT 2
3.5.6011	XXXXXX TRAJ
3.5.6021	VERT SIT 1
3.5.6031	VERT SIT 2
3.5.8011	FCS/DED DISP C/O
4.7.1	ATTITUDE DIRECTION INDICATOR (ADI)
4.7.2	HORIZONTAL SITUATION INDICATOR (HSI)
4.7.3	ALPHA MACH INDICATOR
4.7.4	ALTITUDE/VERTICAL VELOCITY INDICATOR
4.7.5	SURFACE POSITION INDICATOR
4.7.6	FLIGHT CONTROL SYSTEM MODE STATUS LIGHTS
4.7.7	REACTION CONTROL SYSTEM ACTIVITY LIGHTS
4.8	HEAD-UP DISPLAY
5.	TABLE 5-1. SWITCHES
5.2	DEU KEYBOARD
6.1	ANNUNCIATION
6.2	MESSAGES
7.1.7	LAUNCH SEQUENCE COMMANDS
7.3	DOWNLIST

MAJOR SOFTWARE AREA
SM/PL

SECTION NUMBER	SECTION TITLE
2.3.2	DEU LOAD
2.4	OPERATIONAL SEQUENCES
2.4.3.2	BASIC FUNCTIONS AVAILABLE
2.4.9	OPS SM2/4
2.4.9.1	DISPLAYS AVAILABLE
2.4.9.2	BASIC FUNCTIONS AVAILABLE
3.5	DISPLAYS
3.5.000	GPC MEMORY
3.5.001	DPS UTILITY
3.5.002	TIME
3.5.060	SM TABLE MAINT
3.5.062	PCMMU/PL COMM
3.5.064	SM GROUND CHECKOUT
3.5.066	ENVIRONMENT
3.5.067	ELECTRIC
3.5.068	CRYO SYSTEM
3.5.069	FUEL CELLS
3.5.076	COMM/RCDR
3.5.077	EVA-MMU/FSS
3.5.078	SM SYS SUMM 1
3.5.079	SM SYS SUMM 2
3.5.085	MASS MEMORY R/W
3.5.086	APU/HYD
3.5.087	HYD THERMAL
3.5.088	APU/ENVIRON THERM
3.5.089	PRPLT THERMAL
3.5.090	PCS CONTROL
3.5.094	PDRS CONTROL
3.5.095	PDRS OVERRIDE
3.5.096	PDRS STATUS
3.5.097	PL RETENTION
3.5.100	GTS DISPLAY
3.5.110	BUS/BTU STATUS
3.5.111	SL MEMORY DUMP
3.5.2011(S)	ANTENNA
3.5.2021(S)	PL BAY DOORS

MAJOR SOFTWARE AREA
SM/PL (Continued)

SECTION NUMBER	SECTION TITLE
3.5.4011(S)	ANTENNA
3.5.4021(S)	PL BAY DOORS
4.6	REMOTE MANIPULATOR SYSTEM (RMS) INDICATORS
5.	TABLE 5-1. SWITCHES
5.2	DEU KEYBOARD
6.1	ANNUNCIATION
6.2	MESSAGES
7.2.3.3	STORED PROGRAM COMMAND
7.2.3.4	PAYLOAD THROUGHPUT
7.3	DOWNLIST
8.5	MASS MEMORY DIRECTORY

MAJOR SOFTWARE AREA
SSW

SECTION NUMBER	SECTION TITLE
2.1	OVERVIEW
2.2	MASS MEMORY
2.3	SYSTEM INITIALIZATION
2.3.1	INITIAL PROGRAM LOAD (IPL) SEQUENCE
2.3.1.1	IPL SEQUENCE FAILURES
2.3.1.2	NO DISPLAY
2.3.2	DEU LOAD
2.4	OPERATIONAL SEQUENCES
2.4.1	OPS O
2.4.1.1	DISPLAYS AVAILABLE
2.4.1.2	BASIC FUNCTIONS AVAILABLE
2.4.2	OPS GNC9
2.4.4	OPS GNC1
2.5	ACTUATOR/HYDRAULIC ACTIVATION RESTRICTIONS
3.	CRT DISPLAYS
3.1	MCDS/GPC ASSIGNMENT HIERARCHY
3.2	STANDARD CRT DISPLAY PAGE
3.3	OPS, SPEC, DISP PAGE HIERARCHY
3.4.1	IPL MENU
3.5	DISPLAYS
3.5.000	GPC MEMORY
3.5.001	DPS UTILITY
3.5.002	TIME
3.5.006	GPC/BUS STATUS
3.5.099	FAULT
4.1	DATA PROCESSING SYSTEM (DPS) TALKBACKS
4.2	COMPUTER ANNUNCIATION MATRIX
4.3	CAUTION AND WARNING LIGHTS
4.4	MASTER ALARM
4.5	SM ALERT LIGHT
5.	TABLE 5-1. SWITCHES
5.2	DEU KEYBOARD
6.1	ANNUNCIATION
6.2	MESSAGES
7.1.6	EXPLICITLY CODED PROGRAMS (ECP)

MAJOR SOFTWARE AREA
SSW (Continued)

SECTION NUMBER	SECTION TITLE
7.3	DOWNLIST
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.1	I/O RELATED USER NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)
8.3	DUMP ANALYSIS
8.3.1	SYNC TRACE LOG
8.3.2	WAIT STATE
8.4.5	PASS SYSTEM SOFTWARE

MAJOR SOFTWARE AREA
VU

SECTION NUMBER	SECTION TITLE
2.3.2	DEU LOAD
2.4	OPERATIONAL SEQUENCES
2.4.2	OPS GNC9
2.4.2.1	DISPLAYS AVAILABLE
2.4.2.2	BASIC FUNCTIONS AVAILABLE
2.4.3	OPS PL9
2.4.3.1	DISPLAYS AVAILABLE
2.4.3.2	BASIC FUNCTIONS AVAILABLE
2.4.8	OPS GNC8
3.	CRT DISPLAYS
3.5	DISPLAYS
3.5.000	GPC MEMORY
3.5.001	DPS UTILITY
3.5.002	TIME
3.5.062	PCMMU/PL COMM
3.5.100	GTS DISPLAY
3.5.101	SENSOR SELF-TEST
3.5.102	RCS/RGA/ADTA TEST
3.5.104	GND IMU CNTL/MON
3.5.105	TCS CONTROL
3.5.106	MANUAL CONTROLS
3.5.110	BUS/BTU STATUS
3.5.111	SL MEMORY DUMP
3.5.112	GPC/BTU I/F
3.5.113	ACTUATOR CONTROL
3.5.9011(G)	GPC MEMORY
3.5.9011(P)	MASS MEMORY R/W
4.7.1	ATTITUDE DIRECTION INDICATOR (ADI)
4.7.2	HORIZONTAL SITUATION INDICATOR (HSI)
4.7.3	ALPHA MACH INDICATOR
4.7.4	ALTITUDE/VERTICAL VELOCITY INDICATOR
4.7.5	SURFACE POSITION INDICATOR
4.7.6	FLIGHT CONTROL SYSTEM MODE STATUS LIGHTS
4.7.7	REACTION CONTROL SYSTEM ACTIVITY LIGHTS
4.8	HEAD-UP DISPLAY

MAJOR SOFTWARE AREA
VU (Continued)

SECTION NUMBER	SECTION TITLE
5.	TABLE 5-1. SWITCHES
5.2	DEU KEYBOARD
6.1	ANNUNCIATION
6.2	MESSAGES
7.1.5	LDB TEST CONTROL SUPERVISOR OPERATIONS
7.1.6	EXPLICITLY CODED PROGRAMS
7.1.6.1	ACTUATOR INITIALIZATION (AI)
7.1.6.2	RAMP FUNCTION GENERATOR (RFG)
7.1.6.3	FREQUENCY RESPONSE TEST (FRT)
7.1.6.4	DEDICATED DISPLAY CHECKOUT (DDCO)
7.1.6.5	MULTIPLE ACTUATOR TEST (MAT)
7.1.6.6	BODY FLAP DRIVE (BFD)
7.1.6.7	BODY FLAP MONITOR (BFM)
7.1.8	DEU READ CAPABILITY
7.2.2.1	NSP DATA
7.2.2.2	VALIDITY CHECKING
7.3	DOWNLIST
7.3.1	FORMATS AND FORMATTER PROGRAMS
8.5	MASS MEMORY DIRECTORY

KEYWORD
ABORT

SECTION NUMBER	SECTION TITLE
3.5.1011	XXXXXX TRAJ
3.5.1031	XXXXXX TRAJ
3.5.1041	XXXXX MNVR YYYYY
3.5.1051	XXXXX MNVR YYYYY
3.5.1061	XXXXX MNVR YYYYY
3.5.3051	VERT SIT 1
3.5.3052	VERT SIT 2
5.	TABLE 5-1. SWITCHES

KEYWORD
ACTUATORS

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.8	OPS GNC8
2.4.8.1	DISPLAYS AVAILABLE
2.5	ACTUATOR/HYDRAULIC ACTIVATION RESTRICTIONS
3.5.018	GNC SYS SUMM 1
3.5.051	OVERRIDE
3.5.053	CONTROLS
3.5.113	ACTUATOR CONTROL
4.7.6	FLIGHT CONTROL SYSTEM MODE STATUS LIGHTS
5.	TABLE 5-1. SWITCHES
7.1.6.1	ACTUATOR INITIALIZATION (AI)
7.1.6.2	RAMP FUNCTION GENERATOR (RFG)
7.1.6.3	FREQUENCY RESPONSE TEST (FRT)
7.1.6.5	MULTIPLE ACTUATOR TEST (MAT)
7.1.6.6	BODY FLAP DRIVE (BFD)
7.1.6.7	BODY FLAP MONITOR (BFM)

KEYWORD
ADI

SECTION NUMBER	SECTION TITLE
4.7	GNC DEDICATED DISPLAYS
4.7.1	ATTITUDE DIRECTION INDICATOR (ADI)
5.	TABLE 5-1. SWITCHES

KEYWORD
AM

SECTION NUMBER	SECTION TITLE
3.5.2011(S)	ANTENNA
3.5.4011(S)	ANTENNA

KEYWORD
AMI

SECTION NUMBER	SECTION TITLE
4.7.3	ALPHA MACH INDICATOR

KEYWORD
ANNUNCIATION

SECTION NUMBER	SECTION TITLE
2.3.1.1	IPL SEQUENCE FAILURES
2.3.2	DEU LOAD
2.4.4	OPS GNC1
2.4.9.2	BASIC FUNCTIONS AVAILABLE
3.	CRT DISPLAYS
3.4	USER'S GUIDE DISPLAY FORMAT
3.4.1	IPL MENU
3.5	DISPLAYS
3.5.018	GNC SYS SUMM 1
3.5.019	GNC SYS SUMM 2
3.5.064	SM GROUND CHECKOUT
3.5.099	FAULT
3.5.104	GND IMU CNTL/MON
4.1	DATA PROCESSING SYSTEM (DPS) TALKBACKS
4.2	COMPUTER ANNUNCIATION MATRIX
4.3	CAUTION AND WARNING LIGHTS
4.4	MASTER ALARM
4.5	SM ALERT LIGHT
5.2	DEU KEYBOARD
6.1	ANNUNCIATION
6.2	MESSAGES
7.3	DOWNLIST
7.3.2	FAULT SUMMARY PAGE
7.3.3	DEU MESSAGES AND KEYBOARD LAYOUT
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.1	I/O RELATED USER NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)
8.3	DUMP ANALYSIS
8.3.2	WAIT STATE

KEYWORD
ASCENT

SECTION NUMBER	SECTION TITLE
3.5.1011	XXXXXX TRAJ
3.5.1021	XXXXXX TRAJ
3.5.1031	XXXXXX TRAJ

KEYWORD
AVVI

SECTION NUMBER	SECTION TITLE
4.7	GNC DEDICATED DISPLAYS
4.7.4	ALTITUDE/VERTICAL VELOCITY INDICATOR
5.	TABLE 5-1. SWITCHES

KEYWORD
BCE

SECTION NUMBER	SECTION TITLE
5.2	DEU KEYBOARD
6.2	MESSAGES

KEYWORD
BUS

SECTION NUMBER	SECTION TITLE
2.4	OPERATIONAL SEQUENCES
2.4.1	OPS O
2.4.1.1	DISPLAYS AVAILABLE
2.4.1.2	BASIC FUNCTIONS AVAILABLE
2.4.2.1	DISPLAYS AVAILABLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.7.2	BASIC FUNCTIONS AVAILABLE
3.1	MCDS/GPC ASSIGNMENT HIERARCHY
3.5.000	GPC MEMORY
3.5.001	DPS UTILITY
3.5.006	GPC/BUS STATUS
3.5.018	GNC SYS SUMM 1
3.5.053	CONTROLS
3.5.110	BUS/BTU STATUS
3.5.112	GPC/BTU I/F
3.5.9011(G)	GPC MEMORY
3.5.9011(P)	MASS MEMORY R/W
5.	TABLE 5-1. SWITCHES
5.2	DEU KEYBOARD
6.2	MESSAGES
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.1	I/O RELATED USER NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)
8.3	DUMP ANALYSIS

KEYWORD
COMMFAULTS

SECTION NUMBER	SECTION TITLE
2.4.4.1	DISPLAYS AVAILABLE
2.4.5	OPS GNC2
4.7.1	ATTITUDE DIRECTION INDICATOR (ADI)
6.1	ANNUNCIATION
6.2	MESSAGES
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)

KEYWORD
COMPILER

SECTION NUMBER	SECTION TITLE
APPENDIX D	COMPILER ERRORS

KEYWORD CROSSFEED

SECTION NUMBER	SECTION TITLE
5.	TABLE 5-1. SWITCHES

KEYWORD
CYCLE-WRAP

SECTION NUMBER	SECTION TITLE
3.5.022	S TRK/COAS CNTL
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.3	DUMP ANALYSIS

KEYWORD
DAP

SECTION NUMBER	SECTION TITLE
3.5.020	DAP CONFIG
3.5.023	RCS
6.2	MESSAGES

KEYWORD
DCP

SECTION NUMBER	SECTION TITLE

KEYWORD
DED-DISP

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.5	OPS GNC2
2.4.8	OPS GNC8
3.5.100	GTS DISPLAY
3.5.8011	FCS/DED DISP C/O
4.	DEDICATED DISPLAYS
4.1	DATA PROCESSING SYSTEM (DPS) TALKBACKS
4.2	COMPUTER ANNUNCIATION MATRIX
4.6	REMOTE MANIPULATOR SYSTEM (RMS) INDICATORS
4.6.22	RMS DIGITAL DISPLAY
4.7	GNC DEDICATED DISPLAYS
4.7.1	ATTITUDE DIRECTION INDICATOR (ADI)
4.7.2	HORIZONTAL SITUATION INDICATOR (HSI)
4.7.3	ALPHA MACH INDICATOR (AMI)
4.7.4	ALTITUDE/VERTICAL VELOCITY INDICATOR
4.7.5	SURFACE POSITION INDICATOR
4.7.6	FLIGHT CONTROL SYSTEM MODE STATUS LIGHTS
4.7.7	REACTION CONTROL SYSTEM ACTIVITY LIGHTS
4.8	HEAD-UP DISPLAY
5.	TABLE 5-1. SWITCHES
7.1.6.4	DEDICATED DISPLAY CHECKOUT (DDCO)

KEYWORD
DEU

SECTION NUMBER	SECTION TITLE
2.3.1.2	NO DISPLAY
2.3.2	DEU LOAD
3.1	MCDS/GPC ASSIGNMENT HIERARCHY
3.5.021	IMU ALIGN
3.5.104	GND IMU CNTL/MON
3.5.110	BUS/BTU STATUS
4.1	DATA PROCESSING SYSTEM (DPS) TALKBACKS
5.	TABLE 5-1. SWITCHES
5.2	DEU KEYBOARD
6.2	MESSAGES
7.1.8	DEU READ CAPABILITY
7.3	DOWNLIST
7.3.3	DEU MESSAGES AND KEYBOARD LAYOUT

KEYWORD
DISP

SECTION NUMBER	SECTION TITLE
2.3.1.2	NO DISPLAY
2.4	OPERATIONAL SEQUENCES
2.4.1	OPS O
2.4.1.1	DISPLAYS AVAILABLE
2.4.1.2	BASIC FUNCTIONS AVAILABLE
2.4.2.1	DISPLAYS AVAILABLE
2.4.2.2	BASIC FUNCTIONS AVAILABLE
2.4.3	OPS PL9
2.4.3.1	DISPLAYS AVAILABLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.5	OPS GNC2
2.4.5.1	DISPLAYS AVAILABLE
2.4.6.1	DISPLAYS AVAILABLE
2.4.7	OPS GNC6
2.4.7.1	DISPLAYS AVAILABLE
2.4.7.2	BASIC FUNCTIONS AVAILABLE
2.4.8	OPS GNC8
2.4.8.1	DISPLAYS AVAILABLE
2.4.9.1	DISPLAYS AVAILABLE
2.4.9.2	BASIC FUNCTIONS AVAILABLE
3.	CRT DISPLAYS
3.2	STANDARD CRT DISPLAY PAGE
3.3	OPS, SPEC, DISP PAGE HIERARCHY
3.4	USER'S GUIDE DISPLAY FORMAT
3.4.1	IPL MENU
3.4.2	DEU STAND-ALONE SELF-TEST (DEU SAST)
3.5	DISPLAYS
3.5.006	GPC/BUS STATUS
3.5.018	GNC SYS SUMM 1
3.5.019	GNC SYS SUMM 2
3.5.066	ENVIRONMENT
3.5.067	ELECTRIC
3.5.068	CRYO SYSTEM

KEYWORD
DISP (Continued)

SECTION NUMBER	SECTION TITLE
3.5.069	FUEL CELLS
3.5.076	COMM/RCDR
3.5.077	EVA-MMU/FSS
3.5.078	SM SYS SUMM 1
3.5.079	SM SYS SUMM 2
3.5.086	APU/HYD
3.5.087	HYD THERMAL
3.5.088	APU/ENVIRON THERM
3.5.089	PRPLT THERMAL
3.5.096	PDRS STATUS
3.5.097	PL RETENTION
3.5.099	FAULT
3.5.106	MANUAL CONTROLS
3.5.1011	XXXXXX TRAJ
3.5.1021	XXXXXX TRAJ
3.5.1031	XXXXXX TRAJ
3.5.3051	VERT SIT 1
3.5.3052	VERT SIT 2
3.5.6011	XXXXXX TRAJ
3.5.6021	VERT SIT 1
3.5.6031	VERT SIT 2
5.	TABLE 5-1. SWITCHES
5.2	DEU KEYBOARD
6.1	ANNUNCIATION
6.2	MESSAGES
7.3.2	FAULT SUMMARY PAGE
7.3.3	DEU MESSAGES AND KEYBOARD LAYOUT
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.1	I/O RELATED USER NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)

KEYWORD DOWNLIST

SECTION NUMBER	SECTION TITLE
2.4.1.2	BASIC FUNCTIONS AVAILABLE
2.4.2.2	BASIC FUNCTIONS AVAILABLE
2.4.3.1	DISPLAYS AVAILABLE
2.4.3.2	BASIC FUNCTIONS AVAILABLE
2.4.4	OPS GNC1
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.5	OPS GNC2
2.4.5.2	BASIC FUNCTIONS AVAILABLE
2.4.6.2	BASIC FUNCTIONS AVAILABLE
2.4.7.2	BASIC FUNCTIONS AVAILABLE
2.4.8.2	BASIC FUNCTIONS AVAILABLE
2.4.9.2	BASIC FUNCTIONS AVAILABLE
3.4.1	IPL MENU
3.5.000	GPC MEMORY
3.5.001	DPS UTILITY
3.5.064	SM GROUND CHECKOUT
3.5.100	GTS DISPLAY
5.	TABLE 5-1. SWITCHES
7.	GROUND/GPC INTERFACES
7.2.3.2	TWO-STAGE COMMANDS
7.3	DOWNLIST
7.3.1	FORMATS AND FORMATTER PROGRAMS
7.3.2	FAULT SUMMARY PAGE
7.3.3	DEU MESSAGES AND KEYBOARD LAYOUT
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.1	I/O RELATED USER NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)
8.3	DUMP ANALYSIS

KEYWORD
DUMP

SECTION NUMBER	SECTION TITLE
2.3.1.1	IPL SEQUENCE FAILURES
2.4.3	OPS PL9
3.5.111	SL MEMORY DUMP
7.3	DOWNLIST
8.	DATA ANALYSIS
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.3	DUMP ANALYSIS

KEYWORD DYNAMICS

SECTION NUMBER	SECTION TITLE

KEYWORD
ECP

SECTION NUMBER	SECTION TITLE
3.5.113	ACTUATOR CONTROL
7.1.6	EXPLICITLY CODED PROGRAMS (ECP)
7.1.6.1	ACTUATOR INITIALIZATION (AI)
7.1.6.2	RAMP FUNCTION GENERATOR (RFG)
7.1.6.3	FREQUENCY RESPONSE TEST (FRT)
7.1.6.5	MULTIPLE ACTUATOR TEST (MAT)
7.1.6.6	BODY FLAP DRIVE (BFD)
7.1.6.7	BODY FLAP MONITOR (BFM)

KEYWORD
EIU

SECTION NUMBER	SECTION TITLE

KEYWORD
ENTRY

SECTION NUMBER	SECTION TITLE
3.5.050	HORIZ SIT
3.5.053	CONTROLS
3.5.1041	XXXXX MNVR YYYYY
3.5.3011	XXXXX MNVR YYYYY
3.5.3041	ENTRY TRAJ 1
3.5.3042	ENTRY TRAJ 2
3.5.3043	ENTRY TRAJ 3
3.5.3044	ENTRY TRAJ 4
3.5.3045	ENTRY TRAJ 5
3.5.3051	VERT SIT 1
3.5.3052	VERT SIT 2
5.	TABLE 5-1. SWITCHES

KEYWORD
FCOS

SECTION NUMBER	SECTION TITLE
2.3	SYSTEM INITIALIZATION
2.3.1	INITIAL PROGRAM LOAD (IPL) SEQUENCE
2.3.1.1	IPL SEQUENCE FAILURES
2.4	OPERATIONAL SEQUENCES
2.4.1	OPS O
2.4.1.1	DISPLAYS AVAILABLE
2.4.1.2	BASIC FUNCTIONS AVAILABLE
2.4.2	OPS GNC9
2.4.2.1	DISPLAYS AVAILABLE
2.4.2.2	BASIC FUNCTIONS AVAILABLE
2.4.4	OPS GNC1
3.5	DISPLAYS
4.1	DATA PROCESSING SYSTEM (DPS) TALKBACKS
4.2	COMPUTER ANNUNCIATION MATRIX
7.3.1	FORMATS AND FORMATTER PROGRAMS
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.1	I/O RELATED USER NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)
8.3.1	SYNC TRACE LOG

KEYWORD
FCS

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.5	OPS GNC2
2.4.6	OPS GNC3
2.4.7	OPS GNC6
2.4.7.1	DISPLAYS AVAILABLE
2.4.8	OPS GNC8
3.5.018	GNC SYS SUMM 1
3.5.020	DAP CONFIG
4.7.1	ATTITUDE DIRECTION INDICATOR (ADI)
4.7.2	HORIZONTAL SITUATION INDICATOR (HSI)
4.7.3	ALPHA MACH INDICATOR
4.7.5	SURFACE POSITION INDICATOR
4.7.6	FLIGHT CONTROL SYSTEM MODE STATUS LIGHTS
4.7.7	REACTION CONTROL SYSTEM ACTIVITY LIGHTS
4.8	HEAD-UP DISPLAY
5.	TABLE 5-1. SWITCHES

KEYWORD
FDA

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.7.1	DISPLAYS AVAILABLE
2.4.9	OPS SM2/4
2.4.9.2	BASIC FUNCTIONS AVAILABLE
3.5	DISPLAYS
3.5.006	GPC/BUS STATUS
3.5.019	GNC SYS SUMM 2
3.5.060	SM TABLE MAINT
3.5.099	FAULT
4.1	DATA PROCESSING SYSTEM (DPS) TALKBACKS
4.2	COMPUTER ANNUNCIATION MATRIX
4.3	CAUTION AND WARNING LIGHTS
4.4	MASTER ALARM
4.5	SM ALERT LIGHT
6.1	ANNUNCIATION
6.2	MESSAGES
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.1	I/O RELATED USER NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)

KEYWORD
FTS

SECTION NUMBER	SECTION TITLE
3.5.018	GNC SYS SUMM 1
4.1	DATA PROCESSING SYSTEM (DPS) TALKBACKS
4.2	COMPUTER ANNUNCIATION MATRIX
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)

KEYWORD
GPC

SECTION NUMBER	SECTION TITLE
2.3.1.2	NO DISPLAY
2.3.1.3	CAM LIGHT
2.4	OPERATIONAL SEQUENCES
2.4.4	OPS GNC1
3.5.006	GPC/BUS STATUS
3.5.099	FAULT
5.	TABLE 5-1. SWITCHES
6.2	MESSAGES
8.	DATA ANALYSIS
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.3	DUMP ANALYSIS
8.3.2	WAIT STATE

KEYWORD
GUID

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.5	OPS GNC2
2.4.7	OPS GNC6
2.4.7.1	DISPLAYS AVAILABLE
4.7.2	HORIZONTAL SITUATION INDICATOR (HSI)
4.7.3	ALPHA MACH INDICATOR
4.8	HEAD-UP DISPLAY
5.	TABLE 5-1. SWITCHES

KEYWORD
HIP

SECTION NUMBER	SECTION TITLE

KEYWORD
HSI

SECTION NUMBER	SECTION TITLE
4.7	GNC DEDICATED DISPLAYS
4.7.2	HORIZONTAL SITUATION INDICATOR (HSI)
5.	TABLE 5-1. SWITCHES

KEYWORD
HUD

SECTION NUMBER	SECTION TITLE
4.8	HEAD-UP DISPLAY

KEYWORD
HW

SECTION NUMBER	SECTION TITLE
2.3.1.1	IPL SEQUENCE FAILURES
2.3.1.3	CAM LIGHT
2.4.8	OPS GNC8
3.4.1	IPL MENU
3.5.043	CONTROLLERS
3.5.101	SENSOR SELF-TEST
4.1	DATA PROCESSING SYSTEM (DPS) TALKBACKS
4.2	COMPUTER ANNUNCIATION MATRIX
4.3	CAUTION AND WARNING LIGHTS
4.4	MASTER ALARM
4.5	SM ALERT LIGHT
4.6.1	RMS MASTER ALARM (PANEL A8A1)
4.6.2	RMS MODE LIGHT (PANEL A8A1)
4.6.3	RMS AUTO SEQ LIGHTS (PANEL A8A1)
4.6.4	RMS CAUTION LIGHTS (PANEL A8A1)
4.6.5	RMS BRAKES INDICATOR (PANEL A8A1)
4.6.6	RMS SAFING BARBER-POLE INDICATOR (PANEL A8A1)
4.6.7	RMS SOFTWARE STOP BARBER-POLE INDICATOR (PANEL A8A1)
4.6.8	RATE MIN INDICATOR (PANEL A8A1)
4.6.9	RATE HOLD INDICATOR (PANEL A8A1)
4.6.10	RATE SCALE INDICATOR (PANEL A8A1)
4.6.11	EE RIGID BARBER-POLE INDICATOR (PANEL A8A1)
4.6.12	EE DERIGID BARBER-POLE INDICATOR (PANEL A8A1)
4.6.13	EE CLOSE BARBER-POLE INDICATOR (PANEL A8A1)
4.6.14	EE OPEN BARBER-POLE INDICATOR (PANEL A8A1)
4.6.15	EE CAPTURE BARBER-POLE INDICATOR (PANEL A8A1)
4.6.16	EE EXTEND BARBER-POLE INDICATOR (PANEL A8A1)
4.6.17	SHOULDER BRACE RELEASE BARBER-POLE INDICATOR (PANEL A8A1)
4.6.18	STBD RMS STO/LAT INDICATORS (PANEL A8A2)
4.6.19	STBD RMS READY-FOR-LATCH AFT/MID/FWD BARBER-POLE INDICATORS (PANEL A8A2)
4.6.20	PORT RMS STO/LAT INDICATORS (PANEL A8A2)
4.6.21	PORT RMS READY-FOR-LATCH AFT/MID/FWD BARBER-POLE INDICATORS (PANEL A8A2)

KEYWORD
HW (Continued)

SECTION NUMBER	SECTION TITLE
4.6.23	RMS ACTUAL AND COMMANDED RATES INDICATOR
4.7.1	ATTITUDE DIRECTION INDICATOR (ADI)
4.7.6	FLIGHT CONTROL SYSTEM MODE STATUS LIGHTS
4.7.7	REACTION CONTROL SYSTEM ACTIVITY LIGHTS
5.	TABLE 5-1. SWITCHES
6.2	MESSAGES
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)
8.3	DUMP ANALYSIS

KEYWORD
HYD

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.8	OPS GNC8
2.4.8.1	DISPLAYS AVAILABLE
2.5	ACTUATOR/HYDRAULIC ACTIVATION RESTRICTIONS
3.5.018	GNC SYS SUMM 1
3.5.051	OVERRIDE
3.5.053	CONTROLS
4.7.6	FLIGHT CONTROL SYSTEM MODE STATUS LIGHTS
5.	TABLE 5-1. SWITCHES
7.1.6.1	ACTUATOR INITIALIZATION (AI)
7.1.6.2	RAMP FUNCTION GENERATOR (RFG)
7.1.6.3	FREQUENCY RESPONSE TEST (FRT)
7.1.6.5	MULTIPLE ACTUATOR TEST (MAT)
7.1.6.6	BODY FLAP DRIVE (BFD)
7.1.6.7	BODY FLAP MONITOR (BFM)

KEYWORD
I/O

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
3.4.1	IPL MENU
3.4.2	DEU STAND-ALONE SELF-TEST (DEU SAST)
3.5.000	GPC MEMORY
3.5.006	GPC/BUS STATUS
3.5.051	OVERRIDE
3.5.099	FAULT
4.1	DATA PROCESSING SYSTEM (DPS) TALKBACKS
4.2	COMPUTER ANNUNCIATION MATRIX
5.2	DEU KEYBOARD
6.1	ANNUNCIATION
6.2	MESSAGES
7.2.2	SOFTWARE INTERFACES
7.2.2.2	VALIDITY CHECKING
8.	DATA ANALYSIS
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.1	I/O RELATED USER NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)
8.3	DUMP ANALYSIS
8.3.2	WAIT STATE

KEYWORD
ICC

SECTION NUMBER	SECTION TITLE
2.4.7.2	BASIC FUNCTIONS AVAILABLE
6.2	MESSAGES
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.1	I/O RELATED USER NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)

KEYWORD
ILOAD

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.5	OPS GNC2
3.5.104	GND IMU CNTL/MON
8.4.4	ILOAD REPORT (ILDMAP)

KEYWORD
IMU

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.5	OPS GNC2
2.4.7	OPS GNC6
2.4.7.1	DISPLAYS AVAILABLE
3.5.001	DPS UTILITY
3.5.018	GNC SYS SUMM 1
3.5.021	IMU ALIGN
3.5.022	S TRK/COAS CNTL
3.5.051	OVERRIDE
3.5.100	GTS DISPLAY
3.5.104	GND IMU CNTL/MON
5.	TABLE 5-1. SWITCHES
6.1	ANNUNCIATION
6.2	MESSAGES

KEYWORD
IPL

SECTION NUMBER	SECTION TITLE
2.1	OVERVIEW
2.2.1	GPC MEMORY CONFIGURATION
2.3	SYSTEM INITIALIZATION
2.3.1	INITIAL PROGRAM LOAD (IPL) SEQUENCE
2.3.1.1	IPL SEQUENCE FAILURES
2.3.1.2	NO DISPLAY
2.3.1.3	CAM LIGHT
2.3.2	DEU LOAD
2.4.5	OPS GNC2
3.	CRT DISPLAYS
4.1	DATA PROCESSING SYSTEM (DPS) TALKBACKS
5.	TABLE 5-1. SWITCHES

KEYWORD
KEYBOARD

SECTION NUMBER	SECTION TITLE
3.1	MCDS/GPC ASSIGNMENT HIERARCHY
3.4	USER'S GUIDE DISPLAY FORMAT
3.5.022	S TRK/COAS CNTL
3.5.104	GND IMU CNTL/MON
3.5.1041	XXXXX MNVR YYYYY
3.5.1051	XXXXX MNVR YYYYY
3.5.1061	XXXXX MNVR YYYYY
3.5.2021(G)	XXXXX MNVR YYYYY
3.5.3021	XXXXX MNVR YYYYY
3.5.3031	XXXXX MNVR YYYYY
4.1	DATA PROCESSING SYSTEM (DPS) TALKBACKS
4.2	COMPUTER ANNUNCIATION MATRIX
5.2	DEU KEYBOARD
7.3	DOWNLIST
7.3.3	DEU MESSAGES AND KEYBOARD LAYOUT
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)

KEYWORD
KU-BAND

SECTION NUMBER	SECTION TITLE
3.5.2011(S)	ANTENNA

KEYWORD
LDB

SECTION NUMBER	SECTION TITLE
2.4	OPERATIONAL SEQUENCES
2.4.1.2	BASIC FUNCTIONS AVAILABLE
2.4.2.2	BASIC FUNCTIONS AVAILABLE
2.4.3	OPS PL9
2.4.3.1	DISPLAYS AVAILABLE
2.4.3.2	BASIC FUNCTIONS AVAILABLE
2.4.4	OPS GNC1
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.5.2	BASIC FUNCTIONS AVAILABLE
2.4.6.2	BASIC FUNCTIONS AVAILABLE
2.4.7.2	BASIC FUNCTIONS AVAILABLE
2.4.8.2	BASIC FUNCTIONS AVAILABLE
2.4.9.2	BASIC FUNCTIONS AVAILABLE
3.	CRT DISPLAYS
3.5.001	DPS UTILITY
3.5.006	GPC/BUS STATUS
3.5.100	GTS DISPLAY
5.	TABLE 5-1. SWITCHES
7.	GROUND/GPC INTERFACES
7.1	LAUNCH DATA BUS
7.1.1	LDB PROTOCOL/POLLING
7.1.2	LDB POLLING CONTROLS
7.1.3	LDB MASS MEMORY OPERATIONS
7.1.4	LDB SSME LOAD OPERATIONS
7.1.5	LDB TEST CONTROL SUPERVISOR OPERATIONS
7.1.6	EXPLICITLY CODED PROGRAMS (ECP)
7.1.6.1	ACTUATOR INITIALIZATION (AI)
7.1.6.2	RAMP FUNCTION GENERATOR (RFG)
7.1.6.3	FREQUENCY RESPONSE TEST (FRT)
7.1.6.4	DEDICATED DISPLAY CHECKOUT (DDCO)
7.1.6.5	MULTIPLE ACTUATOR TEST (MAT)
7.1.6.6	BODY FLAP DRIVE (BFD)
7.1.6.7	BODY FLAP MONITOR (BFM)
7.1.7	LAUNCH SEQUENCE COMMANDS
7.1.8	DEU READ CAPABILITY
8.2.1	I/O RELATED USER NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)
8.5	MASS MEMORY DIRECTORY

KEYWORD
LEVEL C

SECTION NUMBER	SECTION TITLE

KEYWORD
MCDS INTERFACE

SECTION NUMBER	SECTION TITLE

KEYWORD
MDM

SECTION NUMBER	SECTION TITLE
3.5.001	DPS UTILITY
3.5.006	GPC/BUS STATUS
3.5.018	GNC SYS SUMM 1
3.5.053	CONTROLS
3.5.100	GTS DISPLAY
3.5.110	BUS/BTU STATUS
3.5.112	GPC/BTU I/F
3.5.9011(G)	GPC MEMORY
3.5.9011(P)	MASS MEMORY R/W
6.2	MESSAGES
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.1	I/O RELATED USER NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)
8.3	DUMP ANALYSIS

KEYWORD
MECO

SECTION NUMBER	SECTION TITLE
5.	TABLE 5-1. SWITCHES
6.2	MESSAGES

KEYWORD
MISSION

SECTION NUMBER	SECTION TITLE
2.4.9.2	BASIC FUNCTIONS AVAILABLE

KEYWORD
MMU

SECTION NUMBER	SECTION TITLE
2.1	OVERVIEW
2.2	MASS MEMORY
2.2.1	GPC MEMORY CONFIGURATION
2.2.2	MASS MEMORY ALLOCATION
2.3.1	INITIAL PROGRAM LOAD (IPL) SEQUENCE
2.3.1.1	IPL SEQUENCE FAILURES
2.3.1.3	CAM LIGHT
2.3.2	DEU LOAD
2.4	OPERATIONAL SEQUENCES
2.4.3	OPS PL9
2.4.3.1	DISPLAYS AVAILABLE
2.4.3.2	BASIC FUNCTIONS AVAILABLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.9	OPS SM2/4
2.4.9.1	DISPLAYS AVAILABLE
2.4.9.2	BASIC FUNCTIONS AVAILABLE
3.4.1	IPL MENU
3.5.001	DPS UTILITY
3.5.090	PCS CONTROL
3.5.104	GND IMU CNTL/MON
3.5.105	TCS CONTROL
3.5.110	BUS/BTU STATUS
3.5.9011(P)	MASS MEMORY R/W
5.	TABLE 5-1. SWITCHES
6.2	MESSAGES
7.1.3	LDB MASS MEMORY OPERATIONS
7.1.4	LDB SSME LOAD OPERATIONS
8.	DATA ANALYSIS
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)
8.4.1	MASS MEMORY BUILD (MMBXXXX)
8.4.2	MASS MEMORY PATCH
8.4.3	MASS MEMORY DUMP (MMB)
8.5	MASS MEMORY DIRECTORY

KEYWORD
MPS

SECTION NUMBER	SECTION TITLE
5.	TABLE 5-1. SWITCHES
6.2	MESSAGES

KEYWORD
NAV

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.5	OPS GNC2
2.4.6	OPS GNC3
2.4.7	OPS GNC6
2.4.7.1	DISPLAYS AVAILABLE
2.4.8	OPS GNC8
3.5.018	GNC SYS SUMM 1
3.5.021	IMU ALIGN
3.5.022	S TRK/COAS CNTL
3.5.033	REL NAV
3.5.3041	ENTRY TRAJ 1
3.5.3042	ENTRY TRAJ 2
3.5.3043	ENTRY TRAJ 3
3.5.3044	ENTRY TRAJ 4
3.5.3045	ENTRY TRAJ 5
4.7.2	HORIZONTAL SITUATION INDICATOR (HSI)
4.7.4	ALTITUDE/VERTICAL VELOCITY INDICATOR
5.	TABLE 5-1. SWITCHES
6.1	ANNUNCIATION
6.2	MESSAGES

KEYWORD
NAVAID

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.5	OPS GNC2
2.4.6	OPS GNC3
2.4.7	OPS GNC6
2.4.7.1	DISPLAYS AVAILABLE
2.4.8	OPS GNC8
3.5.018	GNC SYS SUMM 1
3.5.021	IMU ALIGN
3.5.022	S TRK/COAS CNTL
3.5.033	REL NAV
3.5.3041	ENTRY TRAJ 1
3.5.3042	ENTRY TRAJ 2
3.5.3043	ENTRY TRAJ 3
3.5.3044	ENTRY TRAJ 4
3.5.3045	ENTRY TRAJ 5
4.7.2	HORIZONTAL SITUATION INDICATOR (HSI)
4.7.4	ALTITUDE/VERTICAL VELOCITY INDICATOR
5.	TABLE 5-1. SWITCHES
6.1	ANNUNCIATION
6.2	MESSAGES

KEYWORD
OMS

SECTION NUMBER	SECTION TITLE
3.5.019	GNC SYS SUMM 2
3.5.023	RCS
5.	TABLE 5-1. SWITCHES
6.1	ANNUNCIATION
6.2	MESSAGES

KEYWORD
OPS

SECTION NUMBER	SECTION TITLE
2.4	OPERATIONAL SEQUENCES
2.4.1	OPS O
2.4.1.1	DISPLAYS AVAILABLE
2.4.1.2	BASIC FUNCTIONS AVAILABLE
2.4.2	OPS GNC9
2.4.2.1	DISPLAYS AVAILABLE
2.4.2.2	BASIC FUNCTIONS AVAILABLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.5	OPS GNC2
2.4.6	OPS GNC3
2.4.7	OPS GNC6
2.4.7.1	DISPLAYS AVAILABLE
2.4.8	OPS GNC8
3.1	MCDS/GPC ASSIGNMENT HIERARCHY
3.4	USER'S GUIDE DISPLAY FORMAT
5.	TABLE 5-1. SWITCHES
5.1	TABLE FORMAT
5.2	DEU KEYBOARD
6.2	MESSAGES
7.1.2	LDB POLLING CONTROLS

KEYWORD
ORBIT

SECTION NUMBER	SECTION TITLE
3.5.033	REL NAV
3.5.034	ORBIT TGT
3.5.1041	XXXXX MNVR YYYYY
3.5.2011(G)	UNIV PTG
3.5.2021(G)	XXXXX MNVR YYYYY
3.5.2021(S)	PL BAY DOORS
3.5.3021	XXXXX MNVR YYYYY
3.5.8011	FCS/DED DISP C/O
5.	TABLE 5-1. SWITCHES

KEYWORD
PANEL

SECTION NUMBER	SECTION TITLE
2.3.1.1	IPL SEQUENCE FAILURES
2.3.1.3	CAM LIGHT
2.4.8	OPS GNC8
3.4.1	IPL MENU
3.5.043	CONTROLLERS
4.1	DATA PROCESSING SYSTEM (DPS) TALKBACKS
4.2	COMPUTER ANNUNCIATION MATRIX
4.3	CAUTION AND WARNING LIGHTS
4.4	MASTER ALARM
4.5	SM ALERT LIGHT
4.6.1	RMS MASTER ALARM (PANEL A8A1)
4.6.2	RMS MODE LIGHT (PANEL A8A1)
4.6.3	RMS AUTO SEQ LIGHTS (PANEL A8A1)
4.6.4	RMS CAUTION LIGHTS (PANEL A8A1)
4.6.5	RMS BRAKES INDICATOR (PANEL A8A1)
4.6.6	RMS SAFING BARBER-POLE INDICATOR (PANEL A8A1)
4.6.7	RMS SOFTWARE STOP BARBER-POLE INDICATOR (PANEL A8A1)
4.6.8	RATE MIN INDICATOR (PANEL A8A1)
4.6.9	RATE HOLD INDICATOR (PANEL A8A1)
4.6.10	RATE SCALE INDICATOR (PANEL A8A1)
4.6.11	EE RIGID BARBER-POLE INDICATOR (PANEL A8A1)
4.6.12	EE DERIGID BARBER-POLE INDICATOR (PANEL A8A1)
4.6.13	EE CLOSE BARBER-POLE INDICATOR (PANEL A8A1)
4.6.14	EE OPEN BARBER-POLE INDICATOR (PANEL A8A1)
4.6.15	EE CAPTURE BARBER-POLE INDICATOR (PANEL A8A1)
4.6.16	EE EXTEND BARBER-POLE INDICATOR (PANEL A8A1)
4.6.17	SHOULDER BRACE RELEASE BARBER-POLE INDICATOR (PANEL A8A1)
4.6.18	STBD RMS STO/LAT INDICATORS (PANEL A8A2)
4.6.19	STBD RMS READY-FOR-LATCH AFT/MID/FWD BARBER-POLE INDICATORS (PANEL A8A2)
4.6.20	PORT RMS STO/LAT INDICATORS (PANEL A8A2)
4.6.21	PORT RMS READY-FOR-LATCH AFT/MID/FWD BARBER-POLE INDICATORS (PANEL A8A2)
4.6.23	RMS ACTUAL AND COMMANDED RATES INDICATOR

KEYWORD
PANEL (Continued)

SECTION NUMBER	SECTION TITLE
4.7.1	ATTITUDE DIRECTION INDICATOR (ADI)
4.7.6	FLIGHT CONTROL SYSTEM MODE STATUS LIGHTS
4.7.7	REACTION CONTROL SYSTEM ACTIVITY LIGHTS
5.	TABLE 5-1. SWITCHES
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.1.2	GPC ERROR LOG (CZ2V_GPC_ERR_LOG)
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)
8.3	DUMP ANALYSIS

KEYWORD
PAYLOADS

SECTION NUMBER	SECTION TITLE
2.4.9.2	BASIC FUNCTIONS AVAILABLE
3.5.006	GPC/BUS STATUS
3.5.090	PCS CONTROL
3.5.094	PDRS CONTROL
3.5.096	PDRS STATUS
3.5.097	PL RETENTION
3.5.100	GTS DISPLAY
4.6	REMOTE MANIPULATOR SYSTEM (RMS) INDICATORS
5.	TABLE 5-1. SWITCHES
7.2.3	UPLINK COMMANDS

KEYWORD
PCS

SECTION NUMBER	SECTION TITLE
6.2	MESSAGES

KEYWORD
PDT

SECTION NUMBER	SECTION TITLE

KEYWORD
POWERED

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.5	OPS GNC2
2.4.7	OPS GNC6
2.4.7.1	DISPLAYS AVAILABLE
4.7.1	ATTITUDE DIRECTION INDICATOR (ADI)
4.7.2	HORIZONTAL SITUATION INDICATOR (HSI)
4.7.3	ALPHA MACH INDICATOR
4.7.4	ALTITUDE/VERTICAL VELOCITY INDICATOR
4.7.6	FLIGHT CONTROL SYSTEM MODE STATUS LIGHTS
5.	TABLE 5-1. SWITCHES

KEYWORD
PRELAUNCH

SECTION NUMBER	SECTION TITLE
2.4.1	OPS 0
2.4.1.1	DISPLAYS AVAILABLE
2.4.1.2	BASIC FUNCTIONS AVAILABLE
2.4.2	OPS GNC9
2.4.2.1	DISPLAYS AVAILABLE
2.4.2.2	BASIC FUNCTIONS AVAILABLE
2.4.3	OPS PL9
2.4.3.1	DISPLAYS AVAILABLE
2.4.3.2	BASIC FUNCTIONS AVAILABLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.4.2	BASIC FUNCTIONS AVAILABLE
3.5.104	GND IMU CNTL/MON
5.	TABLE 5-1. SWITCHES
7.1.6.1	ACTUATOR INITIALIZATION (AI)
7.1.6.2	RAMP FUNCTION GENERATOR (RFG)
7.1.6.3	FREQUENCY RESPONSE TEST (FRT)
7.1.6.4	DEDICATED DISPLAY CHECKOUT (DDCO)
7.1.6.5	MULTIPLE ACTUATOR TEST (MAT)
7.1.6.6	BODY FLAP DRIVE (BFD)
7.1.6.7	BODY FLAP MONITOR (BFM)
7.1.7	LAUNCH SEQUENCE COMMANDS

KEYWORD
PSP COMM

SECTION NUMBER	SECTION TITLE

KEYWORD
RCS

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.5	OPS GNC2
2.4.7	OPS GNC6
2.4.8	OPS GNC8
3.5.018	GNC SYS SUMM 1
3.5.019	GNC SYS SUMM 2
3.5.020	ORBIT DAP CONFIGURATION (DAP CONFIG)
3.5.023	RCS
3.5.041	RGA/ADTA/RCS
3.5.051	OVERRIDE
3.5.100	GTS DISPLAY
3.5.102	RCS/RGA/ADTA TEST
4.7.1	ATTITUDE DIRECTION INDICATOR (ADI)
4.7.2	HORIZONTAL SITUATION INDICATOR (HSI)
4.7.3	ALPHA MACH INDICATOR
4.7.4	ALTITUDE/VERTICAL VELOCITY INDICATOR
4.7.6	FLIGHT CONTROL SYSTEM MODE STATUS LIGHTS
4.7.7	REACTION CONTROL SYSTEM ACTIVITY LIGHTS
5.	TABLE 5-1. SWITCHES
6.1	ANNUNCIATION
6.2	MESSAGES

KEYWORD
RM

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.5	OPS GNC2
3.5.023	RCS
3.5.025	RM ORBIT
3.5.040	SENSOR TEST
3.5.042	SWITCH/SURF
3.5.044	SWITCHES
3.5.051	OVERRIDE
3.5.053	CONTROLS
6.1	ANNUNCIATION
6.2	MESSAGES

KEYWORD
RMS

SECTION NUMBER	SECTION TITLE
2.4.9.2	BASIC FUNCTIONS AVAILABLE
3.5.064	SM GROUND CHECKOUT
3.5.094	PDRS CONTROL
3.5.096	PDRS STATUS
4.6	REMOTE MANIPULATOR SYSTEM (RMS) INDICATORS
4.6.1	RMS MASTER ALARM (PANEL A8A1)
4.6.2	RMS MODE LIGHT (PANEL A8A1)
4.6.3	RMS AUTO SEQ LIGHTS (PANEL A8A1)
4.6.4	RMS CAUTION LIGHTS (PANEL A8A1)
4.6.5	RMS BRAKES INDICATOR (PANEL A8A1)
4.6.6	RMS SAFING BARBER-POLE INDICATOR (PANEL A8A1)
4.6.7	RMS SOFTWARE STOP BARBER-POLE INDICATOR (PANEL A8A1)
4.6.8	RATE MIN INDICATOR (PANEL A8A1)
4.6.9	RATE HOLD INDICATOR (PANEL A8A1)
4.6.10	RATE SCALE INDICATOR (PANEL A8A1)
4.6.11	EE RIGID BARBER-POLE INDICATOR (PANEL A8A1)
4.6.12	EE DERIGID BARBER-POLE INDICATOR (PANEL A8A1)
4.6.13	EE CLOSE BARBER-POLE INDICATOR (PANEL A8A1)
4.6.14	EE OPEN BARBER-POLE INDICATOR (PANEL A8A1)
4.6.15	EE CAPTURE BARBER-POLE INDICATOR (PANEL A8A1)
4.6.16	EE EXTEND BARBER-POLE INDICATOR (PANEL A8A1)
4.6.17	SHOULDER BRACE RELEASE BARBER-POLE INDICATOR (PANEL A8A1)
4.6.18	STBD RMS STO/LAT INDICATOR (PANEL A8A2)
4.6.19	STBD RMS READY-FOR-LATCH AFT/MID/FWD BARBER-POLE INDICATORS (PANEL A8A2)
4.6.20	PORT RMS STO/LAT INDICATOR (PANEL A8A2)
4.6.21	PORT RMS READY-FOR-LATCH AFT/MID/FWD BARBER-POLE INDICATORS (PANEL A8A2)
4.6.22	RMS DIGITAL DISPLAY (PANEL A8A2)
4.6.23	RMS ACTUAL AND COMMANDED RATES INDICATOR
6.2	MESSAGES

KEYWORD
RUNWAY

SECTION NUMBER	SECTION TITLE
3.5.050	HORIZ SIT
3.5.3051	VERT SIT 1
3.5.3052	VERT SIT 2

KEYWORD
SACS

SECTION NUMBER	SECTION TITLE
4.7.1	ATTITUDE DIRECTION INDICATOR (ADI)
7.1.5	LDB TEST CONTROL SUPERVISOR OPERATIONS

KEYWORD
SC

SECTION NUMBER	SECTION TITLE
2.4	OPERATIONAL SEQUENCES
2.4.1.1	DISPLAYS AVAILABLE
3.5	DISPLAYS
3.5.000	GPC MEMORY
3.5.001	DPS UTILITY
6.2	MESSAGES

KEYWORD
SEQ

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.7	OPS GNC6
7.1.7	LAUNCH SEQUENCE COMMANDS

KEYWORD
SPEC

SECTION NUMBER	SECTION TITLE
2.3.1.2	NO DISPLAY
2.4	OPERATIONAL SEQUENCES
2.4.1	OPS O
2.4.1.1	DISPLAYS AVAILABLE
2.4.1.2	BASIC FUNCTIONS AVAILABLE
2.4.2.1	DISPLAYS AVAILABLE
2.4.2.2	BASIC FUNCTIONS AVAILABLE
2.4.3	OPS PL9
2.4.3.1	DISPLAYS AVAILABLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.4.2	BASIC FUNCTIONS AVAILABLE
2.4.5	OPS GNC2
2.4.5.1	DISPLAYS AVAILABLE
2.4.6.1	DISPLAYS AVAILABLE
2.4.7	OPS GNC6
2.4.7.1	DISPLAYS AVAILABLE
2.4.7.2	BASIC FUNCTIONS AVAILABLE
2.4.8	OPS GNC8
2.4.8.1	DISPLAYS AVAILABLE
2.4.9.1	DISPLAYS AVAILABLE
2.4.9.2	BASIC FUNCTIONS AVAILABLE
3.	CRT DISPLAYS
3.2	STANDARD CRT DISPLAY PAGE
3.3	OPS, SPEC, DISP PAGE HIERARCHY
3.4	USER'S GUIDE DISPLAY FORMAT
3.5	DISPLAYS
3.5.000	GPC MEMORY
3.5.001	DPS UTILITY
3.5.002	TIME
3.5.020	DAP CONFIG
3.5.021	IMU ALIGN
3.5.022	S TRK/COAS CNTL
3.5.023	RCS
3.5.025	RM ORBIT

KEYWORD
SPEC (Continued)

SECTION NUMBER	SECTION TITLE
3.5.033	REL NAV
3.5.034	ORBIT TGT
3.5.040	SENSOR TEST
3.5.041	RGA/ADTA/RCS
3.5.042	SWITCH/SURF
3.5.043	CONTROLLERS
3.5.044	SWITCHES
3.5.050	HORIZ SIT
3.5.051	OVERRIDE
3.5.053	CONTROLS
3.5.060	SM TABLE MAINT
3.5.062	PCMMU/PL COMM
3.5.064	SM GROUND CHECKOUT
3.5.085	MASS MEMORY R/W
3.5.090	PCS CONTROL
3.5.094	PDRS CONTROL
3.5.100	GTS DISPLAY
3.5.101	SENSOR SELF-TEST
3.5.102	RCS/RGA/ADTA TEST
3.5.104	GND IMU CNTL/MON
3.5.105	TCS CONTROL
3.5.110	BUS/BTU STATUS
3.5.111	SL MEMORY DUMP
3.5.112	GPC/BTU I/F
3.5.113	ACTUATOR CONTROL
3.5.1041	XXXXX MNVR YYYYY
3.5.1051	XXXXX MNVR YYYYY
3.5.1061	XXXXX MNVR YYYYY
3.5.2011(G)	UNIV PTG
3.5.2011(S)	ANTENNA
3.5.2021(G)	XXXXX MNVR YYYYY
3.5.2021(S)	PL BAY DOORS
3.5.3011	XXXXX MNVR YYYYY
3.5.3021	XXXXX MNVR YYYYY
3.5.3031	XXXXX MNVR YYYYY
3.5.3041	ENTRY TRAJ 1
3.5.3042	ENTRY TRAJ 2

KEYWORD
SPEC (Continued)

SECTION NUMBER	SECTION TITLE
3.5.3043	ENTRY TRAJ 3
3.5.3044	ENTRY TRAJ 4
3.5.3045	ENTRY TRAJ 5
3.5.4011(S)	ANTENNA
3.5.4021(S)	PL BAY DOORS
3.5.8011	FCS/DED DISP C/O
3.5.9011(G)	GPC MEMORY
3.5.9011(P)	MASS MEMORY R/W
4.7.1	ATTITUDE DIRECTION INDICATOR (ADI)
4.7.6	FLIGHT CONTROL SYSTEM MODE STATUS LIGHTS
5.	TABLE 5-1. SWITCHES
5.2	DEU KEYBOARD
6.1	ANNUNCIATION
6.2	MESSAGES
7.1.2	LDB POLLING CONTROLS
7.1.6.1	ACTUATOR INITIALIZATION (AI)
7.1.6.2	RAMP FUNCTION GENERATOR (RFG)
7.1.6.3	FREQUENCY RESPONSE TEST (FRT)
7.1.6.5	MULTIPLE ACTUATOR TEST (MAT)
7.2.1	CONTROL INTERFACES
7.2.2	SOFTWARE INTERFACES
7.3.3	DEU MESSAGES AND KEYBOARD LAYOUT
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.2	INPUT/OUTPUT (I/O) ERRORS
8.2.1	I/O RELATED USER NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)

KEYWORD
SPI

SECTION NUMBER	SECTION TITLE
4.7.5	SURFACE POSITION INDICATOR

KEYWORD
SSME

SECTION NUMBER	SECTION TITLE
2.4.3.1	DISPLAYS AVAILABLE
6.2	MESSAGES
7.1.4	LDB SSME LOAD OPERATIONS
8.5	MASS MEMORY DIRECTORY

KEYWORD
STATUS

SECTION NUMBER	SECTION TITLE
2.4	OPERATIONAL SEQUENCES
2.4.4	OPS GNC1
2.4.5	OPS GNC2
2.4.7	OPS GNC6
2.4.7.1	DISPLAYS AVAILABLE
3.5	DISPLAYS
3.5.000	GPC MEMORY
3.5.001	DPS UTILITY
3.5.002	TIME
3.5.006	GPC/BUS STATUS
3.5.019	GNC SYS SUMM 2
3.5.021	IMU ALIGN
3.5.023	RCS
3.5.025	RM ORBIT
3.5.033	REL NAV
3.5.041	RGA/ADTA/RCS
3.5.042	SWITCH/SURF
3.5.043	CONTROLLERS
3.5.044	SWITCHES
3.5.050	HORIZ SIT
3.5.051	OVERRIDE
3.5.053	CONTROLS
3.5.060	SM TABLE MAINT
3.5.062	PCMMU/PL COMM
3.5.064	SM GROUND CHECKOUT
3.5.066	ENVIRONMENT
3.5.067	ELECTRIC
3.5.068	CRYO SYSTEM
3.5.069	FUEL CELLS
3.5.076	COMM/RCDR
3.5.077	EVA-MMU/FSS
3.5.078	SM SYS SUMM 1
3.5.079	SM SYS SUMM 2
3.5.085	MASS MEMORY R/W
3.5.086	APU/HYD
3.5.087	HYD THERMAL
3.5.088	APU/ENVIRON THERM
3.5.089	PRPLT THERMAL

KEYWORD
STATUS (Continued)

SECTION NUMBER	SECTION TITLE
3.5.090	PCS CONTROL
3.5.094	PDRS CONTROL
3.5.096	PDRS STATUS
3.5.097	PL RETENTION
3.5.100	GTS DISPLAY
3.5.101	SENSOR SELF-TEST
3.5.102	RCS/RGA/ADTA TEST
3.5.104	GND IMU CNTL/MON
3.5.106	MANUAL CONTROLS
3.5.110	BUS/BTU STATUS
3.5.112	GPC/BTU I/F
3.5.113	ACTUATOR CONTROL
3.5.1041	XXXXX MNVR YYYYY
3.5.1051	XXXXX MNVR YYYYY
3.5.1061	XXXXX MNVR YYYYY
3.5.2011(G)	UNIV PTG
3.5.2011(S)	ANTENNA
3.5.2021(G)	XXXXX MNVR YYYYY
3.5.2021(S)	PL BAY DOORS
3.5.3021	XXXXX MNVR YYYYY
3.5.3031	XXXXX MNVR YYYYY
3.5.3041	ENTRY TRAJ 1
3.5.3042	ENTRY TRAJ 2
3.5.3043	ENTRY TRAJ 3
3.5.3044	ENTRY TRAJ 4
3.5.3045	ENTRY TRAJ 5
3.5.8011	FCS/DED DISP C/O
3.5.9011(G)	GPC MEMORY
3.5.9011(P)	MASS MEMORY R/W
4.7.1	ATTITUDE DIRECTION INDICATOR (ADI)
6.1	ANNUNCIATION
6.2	MESSAGES
7.3.3	DEU MESSAGES AND KEYBOARD LAYOUT
8.1	GPC ERRORS
8.1.1	GPC FAIL-TO-SYNCS
8.2.1	I/O RELATED USER NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)

KEYWORD
STP

SECTION NUMBER	SECTION TITLE

KEYWORD
SVC

SECTION NUMBER	SECTION TITLE

KEYWORD SWITCHES

SECTION NUMBER	SECTION TITLE
2.3	SYSTEM INITIALIZATION
2.3.1	INITIAL PROGRAM LOAD (IPL) SEQUENCE
2.3.1.1	IPL SEQUENCE FAILURES
2.3.2	DEU LOAD
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.7	OPS GNC6
2.4.8	OPS GNC8
2.4.8.1	DISPLAYS AVAILABLE
3.	CRT DISPLAYS
3.1	MCDS/GPC ASSIGNMENT HIERARCHY
3.5.000	GPC MEMORY
3.5.006	GPC/BUS STATUS
3.5.025	RM ORBIT
3.5.042	SWITCH/SURF
3.5.044	SWITCHES
3.5.051	OVERRIDE
4.1	DATA PROCESSING SYSTEM (DPS) TALKBACKS
4.2	COMPUTER ANNUNCIATION MATRIX
4.7.6	FLIGHT CONTROL SYSTEM MODE STATUS LIGHTS
5.	SWITCHES, TABLE 5-1. SWITCHES
7.2.1	CONTROL INTERFACES

KEYWORD
TARGET

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.5	OPS GNC2
2.4.7	OPS GNC6
2.4.7.1	DISPLAYS AVAILABLE
3.5.022	S TRK/COAS CNTL
5.	TABLE 5-1. SWITCHES

KEYWORD
TCS

SECTION NUMBER	SECTION TITLE
3.5.001	DPS UTILITY
3.5.105	TCS CONTROL
7.	GROUND/GPC INTERFACES
7.1.2	LDB POLLING CONTROLS
7.1.5	LDB TEST CONTROL SUPERVISOR OPERATIONS
7.1.6.1	ACTUATOR INITIALIZATION (AI)
7.1.6.2	RAMP FUNCTION GENERATOR (RFG)
7.1.6.3	FREQUENCY RESPONSE TEST (FRT)
7.1.6.4	DEDICATED DISPLAY CHECKOUT (DDCO)
7.1.6.5	MULTIPLE ACTUATOR TEST (MAT)
7.1.6.6	BODY FLAP DRIVE (BFD)
7.1.6.7	BODY FLAP MONITOR (BFM)
7.1.7	LAUNCH SEQUENCE COMMANDS
7.1.8	DEU READ CAPABILITY

KEYWORD TRANSITIONS

SECTION NUMBER	SECTION TITLE
2.1	OVERVIEW
2.2.1	GPC MEMORY CONFIGURATION
2.4	OPERATIONAL SEQUENCES
2.4.2.1	DISPLAYS AVAILABLE
2.4.2.2	BASIC FUNCTIONS AVAILABLE
2.4.4	OPS GNC1
2.4.5	OPS GNC2
6.2	MESSAGES

KEYWORD
UI

SECTION NUMBER	SECTION TITLE
2.4	OPERATIONAL SEQUENCES
2.4.1.1	DISPLAYS AVAILABLE
2.4.2.1	DISPLAYS AVAILABLE
3.4.1	IPL MENU
3.4.2	DEU STAND-ALONE SELF-TEST (DEU SAST)
3.5	DISPLAYS
6.1	ANNUNCIATION
6.2	MESSAGES

KEYWORD
UPLINK

SECTION NUMBER	SECTION TITLE
2.4.4	OPS GNC1
2.4.4.1	DISPLAYS AVAILABLE
2.4.5	OPS GNC2
2.4.7.2	BASIC FUNCTIONS AVAILABLE
3.	CRT DISPLAYS
3.5.001	DPS UTILITY
3.5.060	SM TABLE MAINT
3.5.062	PCMMU/PL COMM
7.	GROUND/GPC INTERFACES
7.2	UPLINK
7.2.1	CONTROL INTERFACES
7.2.2	SOFTWARE INTERFACES
7.2.2.1	NSP DATA
7.2.2.2	VALIDITY CHECKING
7.2.3	UPLINK COMMANDS
7.2.3.1	SINGLE STAGE COMMANDS
7.2.3.2	TWO STAGE COMMANDS
7.2.3.3	STORED PROGRAM COMMAND
7.2.3.4	PAYLOAD THROUGHPUT
7.2.4	UPLINK RESTRICTIONS/NOTES
8.2.2	I/O ERROR LOG (CZ2V_IO_ERR_LOG)

APPENDIX B. USER NOTES CROSS-REFERENCE

This Appendix provides a cross-reference between User Notes (for PASS FSW DRs) and the User's Guide paragraph(s) where the note applies. See the Flight Software Program Notes and Waivers (PNW), document number JSC-19320, for the complete User Note text.

The NASA approved User Note title is also provided.

When multiple DRs are answered by the same note, the subsequent DR references the original DR.

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
014403	8.2-2, 8.2.1-7	BCE	Unannunciated BCE Bypasses.
014442	T3.051-1#38	DISP, SEQ, SPEC	Vent Door Control Open/Closed Requests.
014444	T3.1041-1#13	FCS, OMS	OMS Engine Problems Caused by GPC or String Failures.
014460	T3.1041-1#19	DOWNLIST, TARGET	VGO-DISP Downlisted Incorrectly During Deorbit Maneuver Targeting.
014474	3.5.105-3.1.F, T3.9011(P)-1#5	DEU, SPEC	Demand Update Data Flash.
015177	3.5.3041-3	DISP, GUID	Blinking of Phugoid Symbol.
015194	T3.2011(G)-1#13	DAP, SPEC	Displayed DAP Attitude Errors Discontinuities On-Orbit.
015620	2.4-2, APP.G (I/O Error MMU X)	MMU, OPS, TRANSITIONS	MMU and Other Contentions with OPS Transition.
015651	2.4.3.1-1, T3.9011(P)-1#8	MMU, SPEC	Procedure for Reading From One MM and Writing to Another.
017176	3.5.104-2	IMU	FSW Storage of IMU Pair Data.
025048	8.3.1	GPC	Double SVC SYNC Trace Entry.
025062	8.2-2, 8.2.2-3.5	I/O, BCE	I/O Error Log Residual Word Count.
025074	2.4.4.2-6, 8.2.3, APP.G (Display SW X)	COMMFAULTS, FCOS, BCE	Effects of Commfaults.
025108	2.4.4-3.4, 2.4.7	DOWNLIST	Invalid TACAN Control Register Output.
025119	8.1.2-1	GPC, FCOS	FCOS Errors in the GPC Error Log.
025137	8.1.2-2	DOWNLIST, GPC, I/O	System Software Downlist Parameters are Not Necessarily a Homogeneous Set.
025140	8.2-2, 8.2.2-3.5	I/O, BCE	Reference DR 25062.
025159	8.1.1-2.5	FTS, OPS, TRANSITIONS, MMU	Overlay Failure Following F-T-S During Overlay.
025184	2.4.4.2-6, 8.2-3, APP.G (Display SW X)	COMMFAULTS, FCOS, BCE	Reference DR 25074.
025187	2.4.2.2-1, 7.1.6.1, 7.1.6.6, APP.G (GPC X)	ACTUATORS, ECP, SSME, OMS	F-T-S Due to PCMMU Data.
025197	2.4.2-2, 2.4.2.2-2, T8.1-1, APP.E (I/O Cycle Wrap)	DOWNLIST, CYCLE-WRAP	Possible Downlist I/O Cycle Wrap in G9.
025221	3.5.104-2	IMU	Reference DR 17176.

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE (Continued)

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
025242	T3.9011(P)-1#6	MMU, SPEC	MM Utility Dump Capability.
025300	7.2.2.2	UPLINK	Incorrect "BAD CHECKSUM" Indication, MC3 Overlay Uplink.
025372	2.4-5, APP.G (I/O Error MMU X)	MMU, SPEC, OPS, TRANSITIONS	SPEC 0 Not Presented on DEU After Mass Memory Pre-Position Failure.
025384	T3.094-1#1	RMS, SPEC	RMS Master Alarm.
025396	3.3-1	SPEC, SWITCHES	System SPEC Sensitivity to MAJ FUNC Switch Setting.
027521	3-2	SWITCHES, DEU, TCS	MAJ FUNC Switch Setting on DEU Equivalent Messages.
028304	T3.001-1#4	LDB, I/O, MMU, BUS, ANNUNCIATION	LDB GPC-to-GPC Error Message.
028343	2.4-7	SPEC, OPS, TRANSITIONS	SPEC 0-00, GPC Memory, Page Presented After Overlay Failure in All Required GPCs.
028350	7.1.2, APP.G (GPC X)	FTS, LDB ICC, I/O	Possible FAIL-to-SYNC due to LDB Errors and ICC Overload.
028353	2.4-2	MMU, OPS, TRANSITIONS	Reference DR 15620.
028364	2.4-5, APP.G (I/O Error MMU X)	MMU, I/O, ANNUNCIATION	Mass Memory Error Annunciation.
029284	T3.002-1#5	SPEC, KEYBOARD, FTS	SPEC 002, GMT Updates.
029949	2.4.4.2-1, T8.1-1	I/O	SRB Data Acquisition I/O Errors at SRB Separation.
030072	2.4.2.1-14, T3.112-1#4	I/O, SPEC	BTU Readiness Test Stops on Undefined Step.
030107	8.2.2-3.4	I/O	Invalid OP Codes in I/O Error Log.
030138	2.3-3.5, 2.4.1-2	SWITCHES, ICC, FTS	Reference DR 42433.
030139	4.7.2-10	HSI, DED-DISP	HSI Truncation of the Range Counters.
030526	2.4.8.1-11, 3.5.042-2	COMMFAULTS, FCS, SWITCHES	Commfault Status Not Checked for FCS Channel Switches.
030767	3.5.022-2	SPEC	Request for S TRK/COAS CNTL Display (SPEC 22) in MM 302-305.
030780	2.4-7	SPEC, OPS, TRANSITIONS	Reference DR 28343.
031435	8.2-3, 8.2.1-1	I/O, BCE, ANNUNCIATION	Consecutive I/O Resets.

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE (Continued)

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
.031987	T3.000-1#4	SPEC	Read/Write Function, Conversion of Large Magnitude Engineering Units (EUs) Data Values.
032119	8.1.1-2.4	SWITCHES, OPS, TRANSITIONS, FTS	Output Switch in TERMINATE at RS Formation.
033268	2.4-2, APP.G (I/O Error MMU X)	LDB, OPS, TRANSITIONS, MMU	OPS Transition Failure Manifestations.
033299	2.4-2	LDB, OPS, TRANSITIONS	LDB Bus Assignments at OPS Transition/Mode Recall.
033304	8.2-3, 8.2.1-9	BUS, DOWNLIST	Resetting BTU Port Failure Indicators.
033619	6.1-4.1, T8.1-1	ANNUNCIATION	Garbled Message on Display Message Line.
033643	2.4.1.2-2, 2.4.3.2-1	DEU, IPL	DEU Recovery Procedure Following an Invalid DEU IPL Request.
033698	8.2-3	BUS, BCE, COMMFAULTS	Bus Deselection Reflected in BCE Bypass and Commfault Indicators.
033749	2.2.1, APP.G (I/O Error MMU X)	MMU, SWITCHES, OPS, TRANSITIONS	Fail to Transition After MMU Power "OFF," then "ON."
033754	3.3-1	DISP	Automatic Resume to CRT Pages Which are Display (DISP) Only.
033907	8.3.1	GPC	Reference DR 25048.
034656	8.2-3, 8.2.1-4	ANNUNCIATION, I/O, DOWNLIST	Restore NSP Element.
034665	2.4.2-2, 8.2.1-8	I/O, BUS	Transient I/O Errors When Downmoding a RS to OPS 0.
035047	2.4.6-2.4	TRANSITIONS, DAP, FCS	Attitude Error Limitation at Transition to MM 304/FCS AUTO.
035151	3.5.022-2, T3.022-1#6	SPEC	Improper COAS Operation.
035211	8.2-3, 8.2.1-2	KEYBOARD, BUS	I/O Reset with Failed MTU Causes BFS to Downmode a String.
035322	T3.104-1#6, T8.1-1	IMU, GPC	IMU ATT DET Caused Library Routine Error.
035513	T3.000-1#1	SPEC, OPS, TRANSITIONS	SPEC 0 Initialization (GMEM Items).
035572	T3.8011-1#7	ACTUATORS, DISP	Execution of Secondary Actuator Check.

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE (Continued)

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
.035743	2.4.9	SPEC, OPS, TRANSITIONS, UI	CRT X's on SM OPS 2 Overlay.
036015	2.4.4-3, 2.4.6-2	TARGET, DISP, TRANSITIONS	MM Transitions with Targeting Active.
036094	2.4-2	MMU, OPS, TRANSITIONS	Reference DR 15620.
036176	T3.1041-1#9	SPEC, UPLINK	Targeting Time-of-Ignition (TIG) Affected by MET Update.
036183	2.4-7	SPEC, OPS, TRANSITIONS	Reference DR 28343.
036329	3-2	DEU, TCS	DEU Equivalent Commands.
036416	2.4-5	TRANSITIONS, DAP, ORBIT	State of Transition and Orbit DAPs After an OPS Mode Recall or OPS Transition.
036479	2.4.6-2.3	TRANSITIONS, ENTRY, SPEC, DISP	Transition From 303 to 301 Immediately After State Vector Update.
036544	T3.002-1#6	DISP, RM	MTU Down Arrows Not Removed on TM SPEC.
036549	2.4-2	MMU, OPS, TRANSITIONS	Reference DR 15620.
036728	2.4.3.2-1	IPL, SPEC, DEU	PL9 Mass Memory READ/DEU Loader.
037062	2.4.6, T8.1-1	TRANSITIONS, CYCLE-WRAP, ENTRY	MFE Overruns at OPS Transition From OPS 0 to OPS 3.
037123	3.5.1041-4-2	OMS, TRANSITIONS	OMS TVC Feedback Reinitialized on OPS Transition.
037420	T3.001-1#2, T3.9011(P)-1#2	MMU, SPEC, LDB, UPLINK, ICC, DEU	Failure to ICC Mass Memory Indicator.
037427	T3.000-1#1, T3.000-1#2, T3.001-1#1, T3.002-1#1	ICC, SPEC	ICC Interface of Simultaneous Inputs.
037462	T3.104-1#6	IMU, ECP	IMU Time Tag Jitter.
037501	2.4-7	SPEC, OPS, TRANSITIONS	Reference DR 28343.
037503	3.3-1	SPEC, DEU	Unable to Resume SPEC From a Failed DEU.
037504	T3.002-1#3	SPEC	TM, SPEC 002, Updating the Sign for: GMT DELTA, MET DELTA, SET, CRT.
037506	T3.000-1#2	DISP, SPEC, UI	Stale Data on GPC Memory Display (SPEC 0).

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE (Continued)

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
037507	8.2-3, 8.2.1-6	I/O, DEU, ANNUNCIATION	No Pre-Enable of DEU I/O Error Annunciation for Hard DEU I/O Failures.
037509	8.2-3, 8.2.1-3	DOWNLIST, I/O	Downlist I/O Error Log Overrun Conditions.
037511	3.1-4	DEU, SWITCHES, OPS, TRANSITIONS	DEU MAJ FUNC Switch Setting Mismatch with OPS Transition.
037512	3.1-2	DEU, SWITCHES	DEU Control Loss Associated with the BFS CRT SEL Switch.
037514	2.4.4	TRANSITIONS, IPL, ASCENT	GPC-to-GPC Overlay of MC1 Hangs System.
037516	T3.000-1#1	SPEC	GPC Memory SPEC Initialization.
037517	T2-2#13, T3.002-1#6	SPEC, DISP	Primary GPC Time Initialization.
037519	T5-1(ATT)	ADI, SWITCHES	ATT_REF Push Button Hold.
037522	T3.021-1#2 T3.021-1#5 T3.104-1#3 T3.104-1#4	IMU	Once the IMU Software In-Operate (CGMB_IMU_INOP) is Set, It Will Never be Reset.
037528	4.7.1-9.8, 7.2.1, 7.2.4-1, T8.1-1, APP.E (CPU Protection Violation, Overflow Convert)	UPLINK	GNC Uplink Load Restrictions.
037529	T3.9011(P)-1#4	MMU	MM Patch Limitations.
037530	7.1.5-1.3	TCS	TCS Priority Change Operator Environment Limitations.
037531	7.1.6.3.4-3	ECP, TCS	FRT Environment Limitations.
037533	T8.1-1, 8.2-3, 8.2.1-11	COMMFAULTS, MDM	Setting of NSP and MTU Commfaults After an FF MDM Bypass.
037534	7.2.3-2	UPLINK	Partial Uplink of Fixed Length Loads.
037536	3.5.000-2, 3.5.001-2, 3.5.002-2	SPEC, DEU, KEYBOARD	Restrictions on System Software SPEC Usage.
037537	2.4.4.2-6, 7.1.7-1	SEQ	LPS Bypass Commands Should be Re-entered on Recycle.
037538	4.7.1-8, 4.7.1-9.8	ADI	Pre-Launch ADI Reference.
037542	3-3	DEU, IPL	DEU IPL'ed by BFS Not Usable by PASS.
037543	8.1.1-2.2	FTS, IPL	GPC Failed Out of Common Set/Redundant Set.
037545	2.4.4.2-5, 2.4.6, 2.4.7	GPC	Procedures for Multiple GPC Failures in a Redundant Set (Potential Loss of Control).

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE (Continued)

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
037546	2.4-5	TRANSITIONS, OPS, BUS	No Bus or GPC Reconfiguration on OPS Mode-to-Mode.
037547	T3.000-1#4	SPEC, UPLINK, TCS, SACS	Restrictions on Use of GPC Memory Read/Write Capabilities.
037549	2.4.5.1-9, 2.4.6.1-4	IMU, IPL, ORBIT	IMU "Software" Operate Mode Initialization After an Orbit IPL.
037551	2.4.2-2, 2.4.4-2, 2.4.4-3.1, 2.4.5, 2.4.5-1.1, 2.4.6-2.4, 2.4.6.1-1.2, 2.4.8, 2.5, T3.1011-1#1	ACTUATORS, HYD, OPS, TRANSITIONS	Actuator/Hydraulic Subsystem Activation Restrictions.
037553	7.2.4-3	UPLINK	Uplink Error Processing.
037555	T5-1 (OMS)	OMS, SWITCHES	Engine Response to the Arm/Press Switch.
037559	4.7.1-9.3	ADI	ADI Yaw Error Needle Sensitivity for Fuel Wasting.
037561	T3.1041-1#14	OMS, GUID	OMS Gimbal Drive Check During OMS Maneuvers.
037562	4.7.1-9.2	RCS, ADI	Pitch Error Needle Sensitivity for RCS Maneuvers.
037564	T3.1041-1#2, T3.1041-1#4, T3.1041-1#6, T3.1041-1#8, T3.1041-2	RCS, SPEC, KEYBOARD	Keyboard Entries During an RCS Maneuver.
037567	T3.018-1#7, T5-1 (FCS)	FCS, DISP	Momentary FCS Channel Down Arrows.
037569	2.4.4.2-5, 2.4.5 2.4.6, 2.4.8	FCS, DAP	Simultaneous RHC Control in Trans DAP and Orbit DAP.
037570	2.4.4.2-5, 3.5.051-2, T3.051-1#24	IMU, SSME	Main Engine Throttling Following Intermittent 3 IMU Loss.
037572	T3.060-1#1	UPLINK, SPEC	Table Maintenance - SPEC vs Uplink Interaction.
037573	3.5.1041-4-1	TARGET, DISP	Maneuver Display Responses to Target Loads.
037577	T3.050-1#10	SPEC, DISP	Invalid TACAN Bearing Data Displayed on HSD.
037584	T3.062-1#1	SPEC	TFL Fail if SPEC 62 Dropped.
037585	T3.1041-1#6, T3.1041-1#8	GUID, DISP	Guidance-Computed Burn Attitude Not Displayed for Yaw Desired Near + or −90 Degrees.

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE (Continued)

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
037590	8.1.1-2.3	DEU, FTS	Multiple Commanders of a DEU Can Result in an F-T-S.
037591	T3.1041-1#10, T3.1041-2#23	SPEC, ENTRY, DISP	Timer Countdown Terminated Unconditionally on MM 301 INIT or MNVR Target Item Update.
037593	T3.1041-1#5	IMU, SPEC	Weight Decrements on MNVR EXEC DISP in MM 302 or 202 When No Thrust is Applied.
037594	APP.G (MPS CMD X)	SSME	Erroneous Command Path Failure Annunciation.
037637	3-2	DEU, TCS	Reference DR 36329.
037657	2.4-2	MMU, OPS, TRANSITIONS	Reference DR 15620.
037660	2.4-2	MMU, OPS, TRANSITIONS	Reference DR 15620.
037692	3.5.043-2, 3.5.044-2, 5	SWITCHES, COMMFAULTS, RM, DISP	Three Contact Switch Faulty Indications.
037693	T3.050-1#12	NAV, RM	Potential Repetitive TACAN Self-Test.
037706	2.3.2-1, 8.2-3, 8.2.1-5, APP.G (I/O Error CRT X)	DEU, IPL, ANNUNCIATION	DEU IPL - "I/O Error CRT."
037708	7.1.6.2.4-2	ECP	Method of Calculating Ramp Slope Increment.
037981	T3.050-1#9	NAV, UPLINK	State Vector Update During Entry.
038163	3.5.1041-4-3, 7.2.4-2	UPLINK, TARGET, SSME SPEC, DISP	Uplinked Bad Engine IDs are Not Ignored on CRT.
038458	8.1.1-2.1	ICC, OPS, TRANSITIONS	Dual Commanders After Loss of Reconfiguration ICC Messages.
038733	3.1-5	DEU	GPC/CRT Input Interference.
038748	T3.100-1#6	IMU	G9 One-Shot Transfer of Data From PASS to BFS.
038765	2.4.4.2-6, 7.1.7-1	SEQ, ASCENT, DAP, ACTUATORS	RS Launch Sequencer and Terminal Count Processing.
039021	2.4-2	MMU, OPS, TRANSITIONS	Reference DR 15620.
039027	2.4.1	SWITCHES, ANNUNCIATION	MTU Message at Secondary GPC Initialization.
039054	8.2-3, 8.2.1-12	BCE	BCE Element Bypass on Power Transient Detection.

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE (Continued)

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
039065	T8.1-1	GPC	Incorrect GPC Error Log Interface From TM Function.
039359	T8.1-1, 8.2-3, 8.2.1-10	OPS, BUS, I/O	BFS-PASS I/O Windows Missed.
039371	T3.1041-1#4	SPEC	Maneuver Displays Show Stale Data.
039372	T3.050-1#12	DISP	Dilemma Indicated for All (3) TACANs.
039408	4.7.1-9.1	ADI	ADI Rates When Yaw Angle Approximately Equal to 90 Degrees.
039417	2.4.6-2.5	ENTRY, GUID	HAC Roll Oscillations.
039591	T3.023-1#5	RCS	Final Input Not Processed by RCS Quantity Gauging.
039740	2.4.4.2-6, 7.1.7-1	SEQ, ASCENT, DAP, ACTUATORS	Reference DR 38765.
040375	T3.051-1#38	SEQ, SPEC	GRTLS/Entry Manual Vent Door Command Response.
040556	3.5.1031-1, 3.5.1041-4-6	ANNUNCIATION, TRANSITIONS, ASCENT	Illegal Entry on Transition to MM 104.
040620	T3.002-1#5	SPEC, KEYBOARD, FTS	Reference DR 29284.
040622	2.4-2	MMU, OPS, TRANSITIONS	Reference DR 15620.
041008	2.4.2.1-14, T3.112-1#2	ECP, SPEC	GPC/BTU Readiness Test of the MCIU.
041148	T3.1041-1#6, T3.1041-1#8, T3.1041-1#9, 3.5.1041-4-4, T8.1-1	IPL	Weight Initialization Required for In-Flight IPL.
041168	T3.051-1#2	DISP, RM, SEQ, SWITCHES	No OMS Dump Change for Abort Downmode in MM 103.
041184	2.4.6	SEQ	Orbit OMS/RCS Connect Function Not Active Across OPS Transition.
041238	2.4.6	IMU, RM, TRANSITIONS, DAP, OPS	OPS 3 Transition with Three IMUs Deselected by RM.
041533	2.4.2-2, 2.4.2.1-14, T3.112-1#2, 4.6.1	RMS, BUS, TCS, SPEC	RMS Master Alarm in OPS S9 and G9.
042085	4.7.1-9.6	ADI, RCS, FCS	Erroneous Attitude Rate Indication on ADI with RJDs Off.

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE (Continued)

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
042263	4.6.3	RMS, SWITCHES, SPEC, DISP, PAYLOADS	Select RMS Auto Mode, but No Ready Light.
042303	APP.G (Time MTU)	ANNUNCIATION	No MTU Fault Down Message Annunciation During Initialization.
042318	T3.094-1#11, T3.094-1#12	RMS	Operator Commanded Auto Sequence Caution.
042433	2.3-3.5, 2.4.1-2	FTS, ICC, SWITCHES	Potential F-T-S Due to ICC Contention at New GPC Start-up.
042574	APP.G (IMU BITE/T X)	IMU, TRANSITIONS	Potential False IMU BITE/T Message at G9 to G1 Transition.
042640	2.4.5, 2.4.8	ORBIT, DAP, IMU	Orbit DAP Configuration During and After IMU Fail or OPS Mode Recall.
042650	2.4.4.1-4, T3.050-1#8	ASCENT, SPEC, DISP	SPEC 50 (Horizontal Situation) Will Not Toggle From STRT to OVHD in OPS 1.
043357	2.4.6	TRANSITIONS, IMU, RM, DAP, OPS	Reference DR 41238.
043940	T3.104-1#9, APP.G (IMU BITE/T X)	IMU	False Redundant Gyro or Velocity Over Limit Bite Failure Annunciation.
043987	T7.2-1 Bits 4-7	UPLINK, OPS	Uplink to RS OPS-000.
044206	T3.1041-1#1	SPEC, DISP	Incorrect MNVR Display Title for 1 Second.
044246	2.4.5.1-9, 2.4.6.1-4	IMU, IPL, ORBIT	Reference DR 37549.
044248	2.4.4.2-5, 2.4.6-2.5	FCS, DAP	Flight Control QBAR Lower Limit Error During Split-Mode Rollout.
044250	T3.8011-1#7	ACTUATORS, DISP	Reference DR 35572.
044254	T5-1 (Body)	RM, SWITCHES	Body Flap Limit Cycle Filtering Not Done While BF AUTO/MAN PBI Depressed.
044391	T8.1-1, APP.E (Cyclic Overrun)	CYCLE-WRAP, DEU, DISP	Cycle Wraps in Cyclic Display Processor.
044724	2.4.2-1	IMU	IMU Downmode From Operate to Standby for Double Bite Test 4 Failure.
044892	T3.1041-1#5	ABORT	Incorrect Orbiter Mass Displayed During a TAL Abort.
044990	T3.094-1#1	RMS	RMS Shoulder Yaw Motion Near Shoulder Singularity.
045166	T3.021-1#1, T3.104-1#1	IMU	Bite Test Ignores IMU Selected After Failure.

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE (Continued)

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
045215	T7.2-1 Bits 8-14	UPLINK, LDB	G-MEM Contiguous and G-MEM Scatter Restrictions.
045335	T8.1-1, APP.E (Exponent Overflow)	IMU, GPC	Potential GPC Errors for IMU Failure.
045345	T3.104-1#7	IMU	Procedure for IMU Checkpoint Read/Write with IMUs Powered Off.
045603	2.4.6.1-1.1	IMU, TRANSITIONS, NAV	Two IMU Failures Can Cause NAV State Discontinuity at OPS Transition.
045604	2.4.6.1-1.1	IMU, NAV, TRANSITIONS	Reference DR 45603.
045609	3.2-H, 3.5.002-2	DISP	CRT Timer Decrements During Launch Holds.
045703	T3.050-1#12	DISP	TACAN Dilemma Indication.
045739	2.4.4-3.5	ABORT, OMS, TARGET, SPEC	Unsupported AOA/ATO Requests in 105 After OMS-2 Burn.
045748	2.4.4	MPS, DUMP	Interruptions to MPS Dump.
045749	T3.1041-1#7, T3.1041-2	SPEC	PRPLT Item Validity Restrictions.
045751	2.4.4-3.5	SEQ	ET Umbilical Door Closure Not Completed.
045822	3.4-3.1	DISP	Minus Signs in Incorrect Display Column.
046500	T3.023-1#6	OMS, RCS	OMS/RCS Interconnect Gauging.
046501	T8.1-1	GPC	Potential GPC Errors During Braking on Runway.
046503	T3.8011-1#7	ACTUATORS, DISP	Reference DR 35572.
046505	4.7.1-9.5	ADI	Spike in ADI Error Needle Pitch Axis.
046506	7.1.2-2.4	LDB, OPS, TRANSITIONS	Auto-Switchover and LDB Polling Interface.
046507	7.1.2-5, T8.1-1, APP.E (Cyclic Overrun)	LDB, CYCLE-WRAP	DGI Cycle Overrun.
046510	2.4.6-2.1	GUID	Target Miss Related to TIG in the Past.
046511	2.4.4-3.3	DUMP, SSME	No Automatic Pre-MECO Dumps After 2 SSME Failure Situation.
046512	4.7.1-9.4	ADI, GUID, SPEC, DAP	Auto MNVR (Item 27) Required to Reference ADI Errors to the Guidance Solution in OPS 2.
046513	5.1-1	SWITCHES, MDM, HW	Moving Switches to "GPC" Position and PASS GPC Recovery.

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE (Continued)

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
046515	2.4.7-1.2	ABORT, ADI	Alpha-Recovery/NZ-Hold Transition in OPS 6.
046520	2.4.7-1.1	ABORT, GUID	PEG Slow to Converge During Fuel Dissipation Phase of RTLS.
046526	T3.023-1#5, T3.1041-1#18, T3.1041-2#13	ORBIT, OMS, RCS	HE/VAP ISO VLV CMDS Terminated by Orbit OMS/RCS Interconnect.
046617	2.3-3.5, 2.4.1-2	FTS, ICC, SWITCHES	Reference DR 42433.
047243	7.1.2-4	LDB, BUS, I/O	MSC Timeouts in Commander of LDB.
047292	2.4.2.2-1, 7.1.5-2.7	TCS	Invalid TCS Priority Change Operators.
047311	2.4.2-2, T8.1-1, APP.E (Cyclic Overrun, I/O Cycle Wrap)	CYCLE-WRAP, DED-DISP, TCS	Cyclic I/O Cycle Wraps in G9.
047317	3.2-H, 3.5.002-2	DISP	Reference DR 45609.
047741	T3.021-1#1, T3.104-1#1	IMU	False IMU Bite Test Failures.
047752	T3.021-1#1, T3.104-1#1	IMU	Reference DR 47741.
047853	2.4.3, 7.1.3-1.2	MMU, SPEC	Ground Responsibility When Using MMU Capability 1 WRITE.
048415	T3.050-1#2	DISP, ENTRY	PTI Indications on ENTRY TRAJ and HORIZ SIT Displays.
048423	T3.100-1#7, T3.102-1#3	RCS, PRELAUNCH SPEC	Terminating SPEC 100 Does Not Terminate RJD Toggle.
048500	2.4.2.2-1, 7.1.4	SSME, LDB, TRANSITIONS, OPS	SSME Load LDB Response Lost During OPS Transition.
048777	2.4.5, 2.4.8	OPS, TRANSITIONS	Loss of Vent Data at OPS Transition.
048995	T3.104-1#1	IMU	Procedure to Increase IMU Read Rate During IMU Moding.
050085	3.5.050-2, T3.050-1#15	DISP	HAC Radius Position Uninitialized in MM 304.
050235	T3.104-1#9, APP.G (IMU BITE/T X)	IMU	Reference DR 43940.
050278	7.1.7-1, T8.1-1, APP.E (Cyclic Overrun, I/O Cycle Wrap)	LDB, CYCLE-WRAP, GPC	DGI LDB Cycle Overrun After Launch Sequence Hold.

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE (Continued)

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
050776	2.4.4-3.4, 2.4.6-2.2	DAP, RCS	Trans-DAP State After Cancelled Guided RCS Burn.
050887	T3.034-1#2	ORBIT, DISP, TARGET, SPEC	Left Truncation on Orbit Targeting Display.
051250	2.4.2.1-7, T3.100-1#8	HUD, DED-DISP	Data Items Blink on Right HUD in G9.
051349	2.4-2	MMU, OPS, TRANSITIONS	Reference DR 15620.
051373	2.4-2	MMU, OPS, TRANSITIONS	Reference DR 15620.
051805	4.7.1-9.7	ADI	ADI Needles.
051807	4.7.1-9.7	ADI	Reference DR 51805.
052100	2.4-6	BUS	Bus Distribution Restrictions.
052101	2.4.4.2-4, 2.4.5-1.1 2.4.6-2.1	TARGET, UPLINK, OPS, TRANSITIONS	Loss of Targeting and Uplink Data During OPS Transition.
052102	2.4.2-2, T8.1-1, APP.E (CPU Protection Violation), APP.G (GPC BITE X)	GPC, FCOS	Possible Program Check in OPS G9.
052111	2.4.5, 2.4.8	ORBIT, DAP, ANNUNCIATION	Orbit DAP Vernier Downmode Annunciation.
052759	3.5.1041-4-5	DISP, SPEC	Some Values of TIG Seconds Displayed as "60.0."
052763	T3.034-1#15	GUID, RCS	Compute T1 Terminates Guidance During RCS Burn.
052779	2.4-2	SPEC, OPS, TRANSITIONS, DEU	SPEC Request Concurrent with OPS Transition Request.
052780	3-2	DEU, TCS, ANNUNCIATION	Resume Request via DEU Equivalent May Cause Illegal Entry.
053101	T3.2011(G)-1#7, T8.1-1	TARGET, NAV	Target Tracking Selected Without Rendezvous Navigation.
053428	2.4.4-3.5 3.5.1051-1	UPLINK, OMS, TARGET	Uplink of OMS-2 Targets in MM 104.
054012	2.3.1.3	IPL	CAM Light On/Off During Successful IPL.
054950	T3.022-1#5	SPEC	Incorrect Star Table Displayed for Two Seconds.
055006	3-2	DEU, UPLINK, LDB, TCS	DEU-Equivalent Messages are Not SYNTAX-Checked.

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE (Continued)

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
055017	7.1.5-1.1	SACS, LDB, OPS, TRANSITIONS	Executing SACS Operator Across OPS Transition.
055053	APP.E (I/O Cycle Wrap)	DED-DISP, CYCLE-WRAP, SPEC, SPI, DOWNLIST	Downlist Cycle Wraps During DDU Tests (High, Low, Drive).
055121	T3.1041-1#1, T8.1-1	GPC, ABORT	GPC Errors if MM106 is Entered During an AOA.
055237	8.2-2, 8.2.1-7	BCE	Reference DR 14403.
055246	APP.G (SUMWORD X)	LDB, SPEC, ANNUNCIATION	GSE Polling Active with No LDBs May Cause Common Set Sumword Annunciation.
055300	4.2-1	FTS, ANNUNCIATION, OPS, TRANSITIONS	Inconsistent Annunciation of FTS During OPS Transition.
055302	T3.062-1#6	ANNUNCIATION, PAYLOADS	Non-Processing of PDI Payload Data Streams May Cause S2 Annunciations.
055306	T5-1 (OMS)	OMS, RM, DUMP	Contingency Dump Termination via Arm/Press Switches.
055307	2.4.5-1.2	FCS, IMU	IMU Data Loss During MM 202 Preburn Maneuver.
055313	2.4-5	DAP, ENTRY	Trans DAP Maneuvers After MM301 OPS Recall.
055314	T3.1041-1#2	OMS, DISP	OMS L/R Down Arrows Not Cleared After Both Item on MNVR Display.
055318	8.1.1-2.6	FTS, I/O, BUS	Possible Common Set F-T-S Due to I/O Completion.
055324	6.1-7	ANNUNCIATION, OPS, TRANSITIONS	Missing Time Tag on Error Message.
055325	T3.1041-1#12, T3.1041-2#27	RCS, SPEC, ORBIT	QBI Snapshot at End of Manual Burn.
055328	2.4.6	ABORT, OPS, TRANSITIONS	Velocity Errors Due to Delay in TAL OPS 3 Transition.
055343	T3.060-1#1, T3.2011(S)-1#1	KU-BAND, SPEC	KU-Band Variable Beta Angle Operational Range.
055345	T3.9011(P)-1#2, APP.F (MSC T/O Bus X), APP.G (I/O Error MMU X)	ANNUNCIATION, MMU, SPEC, DOWNLIST	MM Bite Status Data Following an MM MSC Time Out.
055355	T8.1-1, APP.E (I/O Cycle Wrap)	DOWNLIST, CYCLE-WRAP	Downlist I/O Cycle Wraps After MTU Updates.

PASS USER'S GUIDE USER NOTE CROSS-REFERENCE (Continued)

DR NUMBER	USER'S GUIDE REFERENCE	KEYWORDS	TITLE
055501	T3.000-1#4	SPEC	Memory Writes via GPC Memory Display May be Delayed.
056091	T3.104-1#9, APP.G (IMU BITE/T X)	IMU	Reference DR 43940.
056157	7.2.4-5	I/O	Multiple RTCIO Uplinks on FC Buses May Jitter HFE I/O.
056296	T3.062-1#3	SPEC, FCOS	G9 Redundant Set TFL Load Failures.
056516	7.2.1, 7.2.4-1	UPLINK	Reference DR 37528.
056677	7.2.1, 7.2.4-1	UPLINK	Reference DR 37528.
057282	7.2.4-6	TARGET, ORBIT, UPLINK	Incorrect Target State Vector Prediction for High Orbits.
057330	T5-1 (OMS)	OMS	Manual OMS Shutdown.
057385	3.5.1041-4-7	OPS, TRANSITIONS, RCS	Orbit OPS Transition or Mode Recall During Attitude Maneuver.
058926	T3.2011(G)-1#14	SPEC, DISP	UNIV PTG Displayed ATT Angles Incorrect at Yaw = 270.
060313	3.5.3052-2	NAV, FCS	Autoland Oscillations Due to Incorrect T_EPOCH/RNP Matrix.
100702	2.4.2-2, T8.1-1, APP.E (I/O Cycle Wrap)	I/O, CYCLE-WRAP, GPC	Possible PMU OI/PL RAM I/O Cycle Wrap in G9.
100710	T8.1-1, APP.E (PMU Time Invalid)	IPL, GPC	MTU Reset Not Performed in Primary GPC Initialization.
100897	T8.1-1, APP.E (Invalid SVC for MTU)	SPEC, GPC	GMT/MET Updates.
104403	T3.000-1#2	DISP, SPEC, UI	Reference DR 37506.

APPENDIX C. USER NOTES

This Appendix previously provided a numerically ordered listing of the PASS User Notes (PASS DR numbers), with NASA approved text, referenced in this PASS User's Guide. These notes have been deleted from this document since the Flight Software Program Notes and Waivers (PNW), document number JSC-19320, contains listings of these notes.

APPENDIX D. COMPILER ERRORS

This Appendix provides a tabled list of Compiler Errors in alphabetical order. Each error condition is shown with Manifestation, Description, and Possible Causes information.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
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GPC COMPILER ERRORS	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
A**B WITH A < 0	GPC ERROR GROUP 4 CODE 24	RESULT = |A|**B	GENERAL NOTE ON COMPILER ERRORS COMPILER ERRORS ARE REPORTED DURING SPECIAL TESTS, SUCH AS END TO END, WHERE IMU DATA IS NOT PRESENT AND DUMMY DATA IS USED IN A FLIGHT OPS. THE ERRORS ARE LOGGED AND THE PROCESS CONTINUES EXECUTION.
ARCCOSH ARG < 1	GPC ERROR GROUP 4 CODE 59	RESULT = 0	
ARCSIN OR ARCCOS |ARG| > 1	GPC ERROR GROUP 4 CODE 10	FOR ARCSIN, RESULT = SIGN(ARG) * PI/2 FOR ARCCOS, RESULT = 0 IF ARG > 1 RESULT = PI IF ARG < –1	
ARCTANH |ARG| > OR EQUAL TO 1	GPC ERROR GROUP 4 CODE 60	RESULT = 0	
ARCTAN2 FUNCTION ERROR ARG1 = ARG2 = 0	GPC ERROR GROUP 4 CODE 62	RESULT = 0	
ARG OF INVERSE IS SINGULAR	GPC ERROR GROUP 4 CODE 27	THE FUNCTION INVERSE(A) WAS CALLED WHEN A IS A SINGULAR MATRIX. RESULT = IDENTITY MATRIX	

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GPC COMPILER ERRORS	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
ARG OF UNIT IS NULL VECTOR	GPC ERROR GROUP 4 CODE 28	THE FUNCTION UNIT(A) WAS CALLED WHERE VECTOR ARGUMENT A HAS ALL ELEMENTS EQUAL TO ZERO. RESULT = INPUT MATRIX	
BIT @ HEX INVALID CHARACTER	GPC ERROR GROUP 4 CODE 32	ROUTINE IN ERROR WAS BIT @ HEX (A) - CONVERT A FROM A HEX STRING IN CHARACTER FORMAT TO A BIT FORMAT. ARGUMENT A DOES NOT REPRESENT A HEX STRING IN CHARACTER FORMAT. RESULT = ZERO	
BIT @ OCT INVALID CHARACTER	GPC ERROR GROUP 4 CODE 31	ROUTINE IN ERROR WAS BIT @ OCT (A) - CONVERT A FROM AN OCTAL IN CHARACTER FORMAT TO A BIT FORMAT. ARGUMENT A DOES NOT REPRESENT AN OCTAL IN CHARACTER FORMAT. RESULT = ZERO	
CLOSE REACHED ON FUNCTION	GPC ERROR GROUP 4 CODE 14	NO RETURN STATEMENT WAS ENCOUNTERED PRIOR TO REACHING THE CLOSE OF THE FUNCTION.	
EXP FUNCTION ARG > 174.673	GPC ERROR GROUP 4 CODE 6	RESULT = MAX POSITIVE INTEGER	
EXPONENTIA-TION OF ZERO TO POWER < = 0	GPC ERROR GROUP 4 CODE 4	RESULT = 0	

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GPC COMPILER ERRORS	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
ILLEGAL BIT STRING	GPC ERROR GROUP 4 CODE 29	ROUTINE IN ERROR WAS BIT @ BIN (A). CONVERT A FROM BINARY IN CHARACTER FORMAT TO A BIT STRING. ARGUMENT A DOES NOT CONSIST OF 1'S, 0'S OR BLANKS IN CHARACTER FORMAT. RESULT = ZERO BIT STRING	
ILLEGAL CHARACTER SUBSCRIPT	GPC ERROR GROUP 4 CODE 17	DETECTED IN CHR(A TO B), WHERE CHR IS A CHARACTER STRING. IF A < DEFINED LOWER SUBSCRIPT OF CHR THEN RESULT = FIRST CHARACTER POSITION OF CHR. IF B > DEFINED UPPER SUBSCRIPT OF CHR THEN RESULT = LAST CHARACTER POSITION OF CHR. IF B < A-1 THEN THE CHR REMAINS UNCHANGED.	
IN A MOD B, B=0 AND A<0	GPC ERROR GROUP 4 CODE 19	RESULT = A	
IN REMAINDER (A,B) B=0	GPC ERROR GROUP 4 CODE 16	RESULT = A	

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GPC COMPILER ERRORS	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
LENGTH IN LJUST OR RJUST FUNCTION IS > STRING LENGTH OR IS < 0	GPC ERROR GROUP 4 CODE 18	TRUNCATION TO THE SPECIFIED LENGTH OCCURS ON THE LEFT (RJUST) OR RIGHT (LJUST)	
LOG FUNCTION ARG < = 0	GPC ERROR GROUP 4 CODE 7	IF ARG = 0 THEN RESULT = MAX NEG INTEGER ELSE RESULT = LOG OF |ARG|	
SCALAR TOO LARGE OR TOO SMALL FOR INTEGER CONVERSION	GPC ERROR GROUP 4 CODE 15	IF ARG TOO SMALL THEN RESULT = MAXIMUM NEGATIVE INTEGER IF ARG TOO LARGE THEN RESULT = MAXIMUM POSITIVE INTEGER DETECTED IN THE FOLLOWING LIBRARY FUNCTIONS: ROUND, CEILING, FLOOR, TRUNCATE, INTEGER, SCALAR, MATRIX, VECTOR	
SIN OR COS |ARG| > (2.621 E5)PI	GPC ERROR GROUP 4 CODE 8	RESULT = $\frac{\text{SQ. ROOT OF 2}}{2}$	
SINH OR COSH ARG > 175,366	GPC ERROR GROUP 4 CODE 9	RESULT = MAX POSITIVE INTEGER	
SQUARE ROOT ARG < 0	GPC ERROR GROUP 4 CODE 5	RESULT = SQUARE ROOT OF |ARG|	

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GPC COMPILER ERRORS	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
STRING NOT IN STANDARD FORMAT FOR INTEGER CONVERSION	GPC ERROR GROUP 4 CODE 22	ROUTINE IN ERROR WAS EITHER INTEGER @ DOUBLE (A) - CONVERT A TO A DOUBLE PRECISION INTEGER OR BIT @ DEC (A) - CONVERT A INTO A BIT STRING. ARGUMENT A DOES NOT REPRESENT AN INTEGER IN CHARACTER FORMAT, RESULT = 0	
STRING NOT IN STANDARD FORMAT FOR SCALAR CONVERSION	GPC ERROR GROUP 4 CODE 20	ROUTINE IN ERROR WAS EITHER SCALAR(A) - CONVERT A INTO A SINGLE PRECISION SCALAR OR SCALAR @ DOUBLE (A) - CONVERT A INTO A DOUBLE PRECISION SCALAR. ARGUMENT A DOES NOT REPRESENT A SCALAR IN CHARACTER FORMAT, RESULT = 0	
SUBBIT SUBSCRIPT EXCEEDED BIT LENGTH	GPC ERROR GROUP 4 CODE 30	ROUTINE IN ERROR WAS BIT-STRING = SUBBIT A TO B (CHR), WHERE CHR IS A CHARACTER STRING. IF A < 1 THEN A IS SET TO 1 IF A > LENGTH OF CHR THEN A IS SET TO LENGTH OF CHR IF B > LENGTH OF CHR THEN B IS SET TO LENGTH OF CHR IF CHR IS NULL THEN RESULT = ZERO BIT STRING	
TAN FUNCTION |ARG| > 2.621 E5 (SP) OR 1.126 E15 (DP)	GPC ERROR GROUP 4 CODE 11	RESULT = 1	

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GPC COMPILER ERRORS	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
TAN ARG TOO CLOSE $\frac{(2N+1)PI}{2}$	GPC ERROR GROUP 4 CODE 12	RESULT = MAX POSITIVE INTEGER	
VECTOR OR MATRIX DIVISION BY ZERO	GPC ERROR GROUP 4 CODE 25	RESULT = ORIGINAL VECTOR/MATRIX	

APPENDIX E. GPC ERROR MESSAGES

This Appendix provides a tabled list of GPC Error Conditions in alphabetical order. Each error condition is shown with Manifestation, Description, and Possible Causes information.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS" "CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"			
GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
CHECKSUM ERROR ON ICC RETRY	ENTRY IN THE GPC ERROR LOG FOR: GROUP 5 CODE 7 A GPC 'ICC-X' FAULT SUMMARY MESSAGE WILL BE ANNUNCIATED. X = 1, 2, 3, or 4. CAM LIGHT(S) INDICATING A FAILED GPC WILL BE LIT. MASTER ALARM GPC C/W LIGHT B/U C/W LIGHT	A CHECKSUM MISCOMPARE WAS DETECTED ON THE ICC MESSAGE, AFTER THE SECOND CONSECUTIVE ERROR ON THE SAME MESSAGE. FCOS WILL DETERMINE WHICH GPC(S) CAUSED THE ERROR AND WILL FORCE THEM TO FAIL-TO-SYNC.	THIS ERROR IS PROBABLY CAUSED BY A FAILING GPC (E.G., ICC DATA BUS PROBLEM). IT COULD ALSO BE THE RESULT OF A SOFTWARE ERROR IN THE PROCESSING OF THE VARIANT DATA AMONG THE MEMBERS OF A NON-SIMPLEX SET OF GPC'S.

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GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
CPU PROTECTION VIOLATION	ENTRY IN THE GPC ERROR LOG FOR: GROUP 3 CODE 7 A PROGRAM CHECK INTERRUPT WITH AN INTERRUPT CODE OF 7 WILL BE STORED IN MEMORY LOCATIONS. 48 - 4B. FSP MESSAGE, "GPC BITE."	AN ATTEMPT WAS MADE TO STORE INTO A GPC MAIN MEMORY LOCATION THAT HAD THE STORE PROTECT BIT ON. IF THE ERROR WAS DETECTED IN FCOS, THE FCOS DISPATCHER WILL PASS CONTROL OF THE CPU TO THE HIGHEST PRIORITY APPLICATION PROCESS WHICH IS READY FOR EXECUTION (I.E., NOT WAITING FOR I/O, SOME EVENT, OR FUTURE TIME). IF THE ERROR WAS DETECTED IN AN APPLICATION PROCESS, THAT PROCESS WILL BE FORCE CLOSED (I.E., THE APPLICATION PROCESS WILL BE TERMINATED), AND THE FCOS DISPATCHER WILL PASS CONTROL OF THE CPU TO THE HIGHEST PRIORITY APPLICATION PROCESS WHICH IS READY FOR EXECUTION (I.E., NOT WAITING FOR I/O, SOME EVENT, OR FUTURE TIME).	1. SOFTWARE PROBLEM NOTE: DR 52102 EXCEEDING THE STATED LIMIT OF ACTIVE PROCESSES MAY CAUSE THIS ERROR. THIS IS CAUSED BY THE NUMBER OF REQUESTED PROCESSES EXCEEDING THE NUMBER OF DEDICATED PROCESS CONTROL TABLE ENTRIES. VERIFY GMEMS/PATCHES NOTE: DR 37528 IF GN&C PASS UNLINK LOADS HAVE BEEN PERFORMED, VERIFY THE LOAD RESTRICTIONS WERE OBSERVED. 2. THE MOST PROBABLE CAUSE FOR THIS ERROR IS THE IMPROPER SPECIFICATION OR USE OF INSTRUCTIONS OR DATA. 3. SOFTWARE INDICATION THAT QUEUE SPACE IS EXHAUSTED FOR ONE OF THE FOLLOWING: IOQEs EQEs BRQEs TQEs THIS CAN BE CAUSED BY CPU OR IOP HARDWARE PROBLEM OR BY A SOFTWARE PROBLEM. 4. HARDWARE FAILURE.

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GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
CYCLIC OVERRUN	ENTRY IN THE GPC ERROR LOG FOR: GROUP 2 CODE 13	THIS ERROR IS LOGGED WHEN AN ATTEMPT IS MADE TO START A CYCLIC PROCESS WHICH HAS NOT YET REACHED ITS CLOSE STATEMENT FROM THE PREVIOUS CYCLE. THE CLOSE STATEMENT TELLS FCOS TO REMOVE PROCESS FROM ACTIVE QUEUE. THE FIRST PROCESS WILL CONTINUE EXECUTION AND THE SECOND PROCESS WILL BE REMOVED FROM THE ACTIVE QUEUE. THE THIRD REQUEST WILL NOT RUN UNTIL THE NEXT SCHEDULED EXECUTION TIME.	THERE ARE THREE GENERAL CAUSES FOR THIS ERROR: 1) UNUSUALLY HIGH CPU ACTIVITY BY FCOS FOR ERROR PROCESSING AND HIGHER PRIORITY PROCESSES AT THE TIME OF THE OVERFLOW ERROR. 2) WAIT FOR I/O TO COMPLETE (BOTH, THAT I/O ISSUED BY THE PROCESS AS WELL AS TIMER INITIATED I/O THAT MUST COMPLETE BEFORE EXECUTION CAN BEGIN ON A GIVEN CYCLE). 3) WAIT ON EVENTS. THE PROCESS IS WAITING FOR EVENT TO OCCUR BEFORE PROCEEDING. NOTES: 44391, 46507, 47311, 50278 CYCLIC OVERRUN ERRORS MAY OCCUR DURING A LAUNCH HOLD DUE TO THE RSLS ISSUING 2 MEC MASTER RESETS FOR MEC 1 AND 2. PAST OCCURRENCE ON STS-61C.

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GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
DISAGREE ON TRANS-MITTER STATUS	ENTRY IN THE GPC ERROR LOG FOR: GROUP 5 CODE 1 A GPC 'X' FAULT SUMMARY MESSAGE WILL BE ANNUNCIATED. THE CAM DIAGONAL IS LIT FOR THE GPC WITH THE ERROR, AND THE OUTPUT TALKBACK IS SET TO BARBER-POLE. MASTER ALARM GPC C/W LIGHT B/U C/W LIGHT	FCOS DETECTED A DISAGREEMENT DURING A CHECK OF THE EXPECTED (COMMANDED) VS ACTUAL STATUS OF THE MIA TRANSMITTER. (CHECKS VALUES OF TRANSMITTER ENABLE BIT IN BCE STATUS REGISTER 3, 1 BIT FOR EACH OF 24 BCE'S.) THE GPC WILL FORCE ITSELF TO THE WAIT STATE WHICH COULD CAUSE A FAIL TO SYNC.	1. THIS PROBLEM IS INDICATIVE OF A MIA TRANSMITTER THAT HAS FAILED 'ON' IN THE IOP. 2. THERE IS A LESSER CHANCE THAT THIS ERROR COULD BE CAUSED BY A SOFTWARE PROBLEM IN FCOS.

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GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
DIVIDE FLOATING POINT	ENTRY IN THE GPC ERROR LOG FOR: GROUP 3 CODE 12 A PROGRAM CHECK INTERRUPT WITH AN INTERRUPT CODE OF 12 WILL BE STORED IN MEMORY LOCATIONS 48 - 4B.	THE DIVISOR IN A FLOATING POINT DIVIDE INSTRUCTION WAS EQUAL TO TRUE 0 (NORMALIZED). HOWEVER, IF THE DIVISOR WAS UN-NORMALIZED (THE HIGHEST ORDER PLACE OF A FRACTIONAL HEX DIGIT WAS ZERO), THE ERROR FOR UN-NORMALIZED INPUTS WOULD HAVE OCCURRED. (GROUP 3 CODE 6 ERROR TAKES PRECEDENCE.) THE ERROR IS IGNORED BY FCOS AND APPLICATION PROCESSES, AND NORMAL EXECUTION CONTINUES.	SEE OVERFLOW ERROR (GROUP 3 CODE 10).

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GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
EXPONENT OVERFLOW	ENTRY IN THE GPC ERROR LOG FOR: GROUP 3 CODE 11 A PROGRAM CHECK INTERRUPT WITH AN INTERRUPT CODE OF 11 WILL BE STORED IN MEMORY LOCATIONS 48 - 4B.	THE RESULT OF A FLOATING POINT ARITHMETIC OPERATION PRODUCED AN EXPONENT THAT EXCEEDED THE MAXIMUM LEGAL VALUE. (RANGE E-64 TO E+63) THE ERROR IS IGNORED BY FCOS AND APPLICATION PROCESSES, AND NORMAL EXECUTION CONTINUES.	SEE OVERFLOW ERROR (GROUP 3 CODE 10). NOTE: 45335 GPC EXPONENT OVERFLOW ERRORS MAY OCCUR FOLLOWING AN IMU FAILURE.
EXPONENT UNDERFLOW (FLOATING POINT)	ENTRY IN THE GPC ERROR LOG FOR: GROUP 3 CODE 9 A PROGRAM CHECK INTERRUPT WITH AN INTERRUPT CODE OF 9 WILL BE STORED IN MEMORY LOCATIONS 48 - 4B.	THE RESULT OF A FLOATING POINT ARITHMETIC OPERATION PRODUCED A NEGATIVE EXPONENT LESS THAN ZERO WITH A NON-ZERO FRACTIONAL COMPONENT. THE ERROR IS IGNORED BY FCOS AND APPLICATION PROCESSES, AND NORMAL EXECUTION CONTINUES.	FSW EXECUTES WITH THIS INTERRUPT MASKED (PSW BIT 22=0), THEREFORE THIS ERROR SHOULD NEVER OCCUR. IF PATCHES HAVE BEEN APPLIED, VERIFY THEY ARE CORRECT.

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"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
FIXED POINT OVERFLOW	ENTRY IN THE GPC ERROR LOG FOR: GROUP 3 CODE 4 A PROGRAM CHECK INTERRUPT WITH AN INTERRUPT CODE OF 4 WILL BE STORED IN MEMORY LOCATIONS 48 - 4B.	THE MAGNITUDE OF THE RESULT OF A FIXED POINT ARITHMETIC OPERATION WAS TOO LARGE TO BE REPRESENTED IN THE RESULT'S OPERAND (MEMORY LOCATION OR REGISTER). THE OPERATION IS TERMINATED WITHOUT CHANGING THE OPERANDS. THIS ERROR IS IGNORED BY FCOS AND APPLICATION PROCESSES, AND NORMAL EXECUTION CONTINUES.	FSW EXECUTES WITH THIS INTERRUPT MASKED (PSW BIT 20 = 0), THEREFORE THIS ERROR SHOULD NEVER OCCUR. IF PATCHES HAVE BEEN APPLIED, VERIFY THEY ARE CORRECT.

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GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
ILLEGAL DEVICE ID	ENTRY IN THE GPC ERROR LOG FOR: GROUP 5 CODE 5	WHILE INITIALIZING AN IOQE (I/O QUEUE ELEMENT), FCOS MODULE FIOSVC DETECTED AN INVALID DEVICE ID (DEVICE ID LESS THAN ZERO OR GREATER THAN 128). AFTER LOGGING THE ERROR, FIOSVC TERMINATES IOQE INITIALIZATION AND RETURNS CONTROL TO THE CALLING SEQUENCE. IF ONLY ONE GPC SEES ERROR, A FAIL-TO-SYNC WILL OCCUR.	THIS ERROR WOULD INDICATE A SOFTWARE PROBLEM IN THE CODE THAT STORES THE DEVICE ID PARAMETER IN THE I/O SVC PARAMETER LIST.

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GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
ILLEGAL OP CODE	ENTRY IN THE GPC ERROR LOG FOR: GROUP 3 CODE 0 A PROGRAM CHECK INTERRUPT WITH AN INTERRUPT CODE OF 0 WILL BE STORED IN MEMORY LOCATIONS 48 - 4B. CLASS 3 ERROR MESSAGE FSP MESSAGE, "GPC BITE."	THE ERROR OCCURS WHEN AN ATTEMPT IS MADE TO EXECUTE A INSTRUCTION (OP CODE), THAT IS NOT SUPPORTED BY THE GPC. IF THE ERROR IS DETECTED IN FCOS, THE FCOS DISPATCHER WILL PASS CONTROL OF THE CPU TO THE HIGHEST PRIORITY APPLICATION PROCESS WHICH IS READY FOR EXECUTION (I.E., NOT WAITING FOR I/O, SOME EVENT, OR FUTURE TIME). IF THE ERROR WAS DETECTED IN AN APPLICATION PROCESS, THAT PROCESS WILL BE FORCE CLOSED AND THE FCOS DISPATCHER WILL PASS CONTROL OF THE CPU TO THE HIGHEST PRIORITY APPLICATION PROCESS WHICH IS READY FOR EXECUTION (I.E., NOT WAITING FOR I/O, SOME EVENT, OR FUTURE TIME). MAY RESULT IN A FAIL-TO-SYNC.	1. THIS ERROR IS CAUSED BY IMPROPER SPECIFICATION OR USE OF INSTRUCTIONS OR DATA. IT IS MOST LIKELY A SOFTWARE PROBLEM. IF PATCHES HAVE BEEN APPLIED, VERIFY THEY ARE CORRECT. 2. POSSIBLE HARDWARE FAILURE.

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GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
INSTRUCTION MONITOR	ENTRY IN THE GPC ERROR LOG FOR: GROUP 3 CODE 20 AN INSTRUCTION MONITOR INTERRUPT WILL BE STORED IN MEMORY LOCATIONS 70 - 73. FSP MESSAGE, "GPC BITE."	AN ATTEMPT WAS MADE TO EXECUTE AS INSTRUCTIONS, DATA STORED IN UNPROTECTED MEMORY LOCATIONS. ALL INSTRUCTION CODES ARE STORED IN MEMORY ADDRESSES WHICH HAVE THE PROTECT BIT SET ON. MOST DATA IS STORED IN UNPROTECTED MEMORY LOCATIONS. THE FALSE INSTRUCTION WILL NOT BE EXECUTED. IF THE ERROR WAS DETECTED WHILE FCOS WAS EXECUTING, THE FCOS DISPATCHER WILL PASS CONTROL OF THE CPU TO THE HIGHEST PRIORITY APPLICATION PROCESS WHICH IS READY FOR EXECUTION (I.E., NOT WAITING FOR I/O, SOME EVENT, OR FUTURE TIME).	1. THIS ERROR IS CAUSED BY IMPROPER SPECIFICATION OR USE OF INSTRUCTIONS OR DATA. IF PATCHES HAVE BEEN APPLIED, VERIFY THEY ARE CORRECT. 2. POSSIBLE HARDWARE ADDRESSING OR MEMORY PROBLEM.

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"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
INSTRUCTION MONITOR (CONTINUED)		IF THE ERROR WAS DETECTED IN AN APPLICATION PROCESS, THAT PROCESS WILL BE FORCE CLOSED (I.E., THE APPLICATION PROCESS WILL BE TERMINATED), AND THE FCOS DISPATCHER WILL PASS CONTROL OF THE CPU TO THE HIGHEST PRIORITY APPLICATION PROCESS WHICH IS READY FOR EXECUTION (I.E., NOT WAITING FOR I/O, SOME EVENT, OR FUTURE TIME). PROBABLE FAIL-TO-SYNC.	
INVALID EVENT ADDRESS SPECIFIED	ENTRY IN THE GPC ERROR LOG FOR: GROUP 5 CODE 6	FCOS MODULE FPMEVAL DETECTED AN EVENT WHOSE ADDRESS FELL OUTSIDE THE ADDRESS LIMITS OF THE EQE (EVENT QUEUE ELEMENT) POOL. AFTER LOGGING THE ERROR, FPMEVAL TERMINATES THE EVENT EVALUATION, AND RETURNS CONTROL TO THE CALLING PROGRAM.	THIS ERROR WOULD INDICATE A SOFTWARE PROBLEM IN THE CODE THAT GENERATED THE INVALID EVENT VARIABLE ADDRESS.

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GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
INVALID ICC DATA CONTROL	ENTRY IN THE GPC ERROR LOG FOR: GROUP 6 CODE 3	THE SYSTEM INTERFACE PROCESSOR (AIESIP) DETECTED A PARAMETER IN THE VARIANT DATA PORTION OF THE ICC MESSAGE BUFFER THAT WAS INVALID. EACH ICC MESSAGE HAS A SPECIFIED SET OF PARAMETERS AND EACH OF THESE PARAMETERS HAS LIMITS. AIESIP WILL LOG THIS ERROR AND TERMINATE PROCESSING OF THE ICC MESSAGE BUFFER.	SEE 'INVALID ICC HEADER' ERROR (GROUP 6 CODE 2).

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"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
INVALID ICC HEADER	ENTRY IN THE GPC ERROR LOG FOR: GROUP 6 CODE 2	THE SYSTEM INTERFACE PROCESSOR (AIESIP) COULD NOT MATCH THE MESSAGE HEADER IN THE ICC BUFFER WITH ANY OF THE LEGAL VALUES IN THE ICC MESSAGE TABLE. AIESIP WILL LOG THIS ERROR AND TERMINATE PROCESSING OF THE ICC MESSAGE BUFFER.	THREE GENERAL TYPES OF PROBLEMS OFFER THE POTENTIAL TO INTRODUCE THIS ERROR. IN EACH CASE THE PROBLEM IS ASSUMED TO BE UNDETECTABLE BY THE GPC BITE CIRCUITRY. 1) DATA IN THE SOURCE GPC'S ICC BUFFER IS GOOD, BUT SOMEWHERE BETWEEN THERE AND STORING THE DATA INTO THE DESTINATION GPC'S ICC BUFFER, THE DATA BECOMES BAD. COMPARISON BETWEEN THE SOURCE AND DESTINATION GPC'S, WOULD SHOW DIFFERENT DATA IN THEIR RESPECTIVE BUFFERS. 2) DATA IN THE SOURCE GPC'S ICC BUFFER IS BAD. THE SOFTWARE IS PERFORMING THE CORRECT PROCESSING, BUT SOMEWHERE IN MOVING THE DATA TO THE SOURCE'S ICC BUFFER, THE DATA IS POLLUTED. COMPARISON BETWEEN THE SOURCE AND DESTINATION GPC'S WOULD SHOW THE SAME DATA IN THEIR RESPECTIVE BUFFERS. 3) DATA IN THE SOURCE GPC'S ICC BUFFER IS BAD. THE SOFTWARE IS SOMEHOW IN THE WRONG PROCESSING LOOP, STORING OTHERWISE VALID ICC MESSAGES INTO THE BUFFER, BUT THERE IS NO LEGITIMATE REASON TO DO SO. COMPARISON BETWEEN THE SOURCE AND DESTINATION GPC'S WOULD SHOW THE SAME DATA IN THEIR RESPECTIVE BUFFERS.

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GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
INVALID SVC FOR MTU	ENTRY IN THE GPC ERROR LOG FOR: GROUP 6 CODE 5	THE MTU UPDATE PROCESSOR (FPMUPMTU) RECEIVES ITS UPDATE DATA IN A PARAMETER LIST VIA A SUPERVISOR CALL (SVC). DURING VALIDATION OF THE PARAMETER LIST, INVALID OR OUT OF LIMITS DATA WAS DETECTED. VALID DATA WOULD BE TIME THAT IS ENTERED IN STANDARD FORMAT (DDD/HH/MM/SS.SSS) AND VALUES (E.G., MM BETWEEN 00 AND 59). THE PROCESSOR LOGS THE ERROR, AND TERMINATES THE MTU UPDATE.	ERROR IN UPDATE PARAMETERS ENTERED ON SPEC 2. NOTE: 100897 IN OPS 0 SIMPLEX, INDIVIDUAL ITEM ENTRIES ARE NOT CHECKED. HOWEVER, A DELTA RESULTING IN GMT GREATER THAN 399 DAYS OR MET GREATER THAN 364 DAYS WILL CAUSE THIS ERROR.

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GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
I/O CYCLE WRAP FOR:	ENTRY IN THE GPC ERROR LOG FOR: GROUP 7 CODE N NOTE: N = 1-13 SEE THE FOLLOWING IOQE'S FOR THE APPROPRIATE CODE.	I/O CYCLE WRAPS (GROUP 7 ERRORS) ARE LOGGED WHEN AN ATTEMPT IS MADE TO INITIATE CYCLIC I/O THAT USES A PRE-INITIALIZED I/O QUEUE ELEMENT (PIOQE - BUILT AT SYSTEM BUILD TIME), IF THAT I/O HAS NOT YET COMPLETED FROM THE PREVIOUS CYCLE. THIS CONDITION IS DETECTED BY THE PIOQE INDICATING IT IS IN USE (OR BUSY) AT THE TIME OF INITIATION. THE CODE 1 THRU 13 CORRESPONDS TO THE ID OF THE PIOQE PREVIOUSLY ASSIGNED TO IT. I/O INITIATED ON ONE SIP CYCLE DOES NOT COMPLETE BEFORE THE NEXT SIP TIMER. SIP TIMER INITIATES I/O EVERY 40 MSEC. THE ERROR WILL BE LOGGED, I/O CYCLE WILL BE SKIPPED, AND THEN THE COLLECTION OF DATA RESUMES NORMALLY ON THE NEXT CYCLE.	THESE ERRORS COULD BE CAUSED BY ONE OF THE FOLLOWING CONDITIONS: NOTE: 47311 UNUSUALLY HIGH I/O ACTIVITY ON THE SAME BUS(ES) AS THE TRANSACTION IN ERROR OR ON BUS(ES) FOR TRANSACTIONS WITH HIGHER PRIORITIES (E.G., DDU DYNAMIC DRIVE TEST). NOTE: 25197 ACTIONS SUCH AS AN OPS MODE RE-CALL OR AN OPS TRANSACTION WITH MULTIPLE LRU'S POWERED DOWN, RESULTING IN HIGH I/O ERROR ACTIVITY.

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"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
I/O CYCLE WRAP FOR: (CONTINUED)			
HFE INPUT	CODE = 1		
HFE OUTPUT	CODE = 2		
MFE INPUT	CODE = 3		
NSP-UPLINK INPUT	CODE = 4		
DOWNLIST	CODE = 5		NOTE: DR 25197 - OPS MODE RECALL OR AN OPS TRANSITION WITH MULTIPLE LRU'S POWERED DOWN RESULTS IN HIGH I/O ERROR ACTIVITY THAT CAN CAUSE THIS ERROR. NOTE: DR 55355 - DOWNLIST CYCLE WRAP WILL BE SEEN AT OPS TRANSITIONS IF CUMULATIVE GMT UPDATES TOTAL TO THE LIMITS (BETWEEN 19 AND 25 MS, −16 AND −21 MS, OR ANY TOTAL IN INCREMENTS OF ±40 MS). THIS WAS SEEN IN STS-31 TERMINAL COUNT AT G9 TO G1 TRANSITION. NOTE: DR 55053 - THIS ERROR MAY BE CAUSED BY THE EXECUTION OF THE DDU LOW/DRIVE TESTS. SEEN DURING STS-51L COUNTDOWN.

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"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
I/O CYCLE WRAP FOR: (CONTINUED)			
SRB INPUT	CODE = 6		NOTE: DR 50278 - DURING A LAUNCH HOLD, THIS ERROR MAY OCCUR WHEN RSLS ISSUES TWO SUCCESSIVE MEC MASTER RESETS WHICH ARE A HIGHER PRIORITY THAN SRB DATA INPUTS. THIS ERROR MAY ALSO OCCUR AT T-O (SRB IGNITION) CAUSED BY MEC RESET I/O ISSUED BY THE HFE. SEEN ON STS-51L AT T-O. THIS ERROR OCCURS AT G9 TO G1 TRANSITION DURING LAUNCH COUNTDOWN. THIS IS AN EXPECTED ERROR DUE TO THE LOW PRIORITY OF THE SRB INPUT I/O.
ICC	CODE = 7		
LDB	CODE = 8		
MCIU INPUT	CODE = 9		
MCIU OUTPUT	CODE = 10		
HDA INPUT	CODE = 11		
PL HIGH RATE	CODE = 12		
PMU OI/PL RAM	CODE = 13		NOTE: DR 100702 - OPS MODE RECALL OR OPS TRANSITION WITH MULTIPLE LRU'S POWERED DOWN MAY CAUSE THIS ERROR IN G9 WITH HDA ON.

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"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
I/O ERROR ON ICC RETRY	ENTRY IN THE GPC ERROR LOG FOR: GROUP 5 CODE 0 A GPC 'X' FAULT SUMMARY MESSAGE WILL BE ANNUNCIATED. CAM LIGHTS INDICATING A FAILED GPC WILL BE LIT.	TWO CONSECUTIVE I/O ERRORS ON THE ICC BUS WERE DETECTED ON A RETRY OF THE SAME ICC MESSAGE. FCOS WILL DETERMINE WHICH GPC(S) CAUSE THE ICC FAILURE AND WILL FORCE THE GUILTY GPC(S) TO FAIL-TO-SYNC. THIS ERROR WILL BE PRECEDED BY I/O ERRORS ON ICC BUS.	THIS FAILURE IS INDICATIVE OF A FAILED ICC BUS MIA IN THE TRANSMITTING OR RECEIVING IOP. THERE IS A LESSER CHANCE OF AN ICC DATA BUS PROBLEM.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
I/O ERROR STORE PROTECT VIOLATION	ENTRY IN THE GPC ERROR LOG FOR: GROUP 5 CODE 4 AN EXTERNAL-1 (LEVEL B) INTERRUPT WITH AN INTERRUPT CODE OF 4 WILL BE STORED IN MEMORY LOCATIONS 80 - 83. FSP MESSAGE, "GPC BITE."	WHILE THE IOP WAS PROCESSING THE DMA (DIRECT MEMORY ACCESS) QUEUE, AN ATTEMPT WAS MADE TO STORE INTO A MAIN MEMORY LOCATION THAT HAD THE STORE PROTECT BIT SET ON. IF THE ERROR WAS DETECTED WHILE FCOS WAS IN EXECUTION, THE FCOS DISPATCHER WILL PASS CONTROL OF THE CPU TO THE HIGHEST PRIORITY APPLICATION PROCESS WHICH IS READY FOR EXECUTION (I.E., NOT WAITING FOR I/O, SOME EVENT, OR FUTURE TIME). IF THE ERROR WAS DETECTED DURING THE EXECUTION OF AN APPLICATION PROCESS, THAT PROCESS WILL BE FORCE CLOSED (I.E., THE APPLICATION PROCESS WILL BE TERMINATED), AND THE FCOS DISPATCHER WILL PASS CONTROL OF THE CPU TO THE HIGHEST PRIORITY APPLICATION PROCESS WHICH IS READY FOR EXECUTION (I.E., NOT WAITING FOR I/O, SOME EVENT, OR FUTURE TIME). PROBABLE FAIL-TO-SYNC.	SEE I/O ADDRESS SPECIFICATION ERROR (GROUP 5 CODE 3).

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
OVERFLOW CONVERT	ENTRY IN THE GPC ERROR LOG FOR: GROUP 3 CODE 10 A PROGRAM CHECK INTERRUPT WITH AN INTERRUPT CODE OF 10 WILL BE STORED IN MEMORY LOCATIONS 48 - 4B.	AN ATTEMPT WAS MADE TO CONVERT TO FIXED POINT A FLOATING POINT VALUE THAT WAS OUT OF RANGE FOR THE INSTRUCTION (BEYOND THE CAPABILITY OF REGISTER LENGTH). THE ERROR IS IGNORED BY FCOS AND APPLICATION PROCESSES, AND NORMAL EXECUTION CONTINUES.	THE CAUSE FOR THIS ERROR IS IMPROPER SPECIFICATION OR USE OF INSTRUCTIONS OR DATA. IF PATCHES HAVE BEEN APPLIED, VERIFY THEY ARE CORRECT. NOTE: 37528 IF GN&C UPLINK LOADS HAVE BEEN PERFORMED, VERIFY THE LOAD RESTRICTIONS WERE OBSERVED.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
PMU TIME INVALID	ENTRY IN THE GPC ERROR LOG FOR: GROUP 6 CODE 6	WHEN THE FIRST GPC IS MODED TO RUN, THE SIP TIME SOURCE IS SELECTED. TO ACCOMPLISH THIS, THE MTU IS READ AND THE TIME IS SAVED IN GPC MEMORY AS RUNTIME. THEN TIME IS READ FROM THE PMU. LIMIT CHECKS ARE PERFORMED ON THE PMU TIME VALUE USING RUNTIME AS THE REFERENCE. IF THE PMU TIME IS NEITHER AHEAD OF RUNTIME, NOR MORE THAN 1.02 SECONDS BEHIND RUNTIME, PMU TIME BECOMES THE SIP TIME SOURCE. THIS IS THE DESIRED RESULT. OTHERWISE RUNTIME IS USED AS THE SIP TIME SOURCE, AND THIS ERROR IS LOGGED.	THIS ERROR WOULD INDICATE A PROBLEM EXTERNAL TO THE GPC. THE PROBLEM IS PROBABLY BETWEEN THE PMU AND MTU, OR POSSIBLY BETWEEN THE PMU AND THE GPC. NOTE: 100710 THE MOST PROBABLE CAUSE FOR THIS ERROR IS READING THE MTU PRIOR TO PERFORMING AN MTU RE-SET. THIS ERROR WILL ALSO OCCUR IF MTU IS POWERED DOWN OR DRIFTING DUE TO INADEQUATE WARMUP TIME (16 HOURS). PMU TIME AHEAD OF RUNTIME INDICATES MTU IS FAST. PMU TIME BEHIND RUNTIME INDICATES MTU IS SLOW. IF THIS ERROR OCCURS DURING COUNTDOWN WHEN FORMING G9 RS, THE GPC SHOULD BE TAKEN TO STANDBY/RUN TO FORCE PASS TO USE PMU TIME. THIS IS NECESSARY SINCE BFS USES PMU TIME AND BOTH MUST USE THE SAME SOURCE TO PREVENT TIME SKEW. (THIS ERROR SHOULD NOT OCCUR DURING COUNTDOWN RS FORMATION SINCE THE MTU WILL NORMALLY BE WARMED UP AT THIS POINT IN THE COUNT.)

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS" "CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"			
GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
PRIVILEGED INSTRUCTION	ENTRY IN THE GPC ERROR LOG FOR: GROUP 3 CODE 1 A PROGRAM CHECK INTERRUPT WITH AN INTERRUPT CODE OF 1 WILL BE STORED IN MEMORY LOCATIONS 48 - 4B. CLASS 3 ERROR MESSAGE FSP MESSAGE, "GPC BITE."	THIS ERROR OCCURS WHEN AN APPLICATION PROCESS ATTEMPTS TO EXECUTE AN INSTRUCTION THAT IS LEGAL ONLY IN THE SUPERVISOR STATE (FCOS). UPON DETECTION OF THIS ERROR THE INSTRUCTION WILL NOT BE EXECUTED AND THE APPLICATION PROCESS WILL BE FORCE CLOSED (I.E., THE APPLICATION PROCESS WILL BE TERMINATED). THE FCOS DISPATCHER WILL PASS CONTROL OF THE CPU TO THE HIGHEST PRIORITY APPLICATION PROCESS WHICH IS READY FOR EXECUTION. (I.E., NOT WAITING FOR I/O, SOME EVENT, OR FUTURE TIME).	1. SOFTWARE PROBLEM - THE ERROR IS CAUSED BY THE IMPROPER USE OF PRIVILEGED INSTRUCTIONS. IF PATCHES HAVE BEEN APPLIED, VERIFY THEY ARE CORRECT. 2. HARDWARE FAILURE.

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"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
SIGNIFI-CANCE	ENTRY IN THE GPC ERROR LOG FOR: GROUP 3 CODE 5 A PROGRAM CHECK INTERRUPT WITH AN INTERRUPT CODE OF 5 WILL BE STORED IN MEMORY LOCATIONS 48 - 4B.	A LOSS OF SIGNIFICANCE WAS DETECTED DURING THE EXECUTION OF FLOATING POINT ARITHMETIC INSTRUCTIONS. THIS ERROR INDICATES SIGNIFICANT BIT(S) REQUIRED FOR ACCURACY WERE DROPPED FROM THE FRACTION OF A NUMBER. THIS ERROR IS IGNORED BY FCOS AND APPLICATION PROCESSES, AND NORMAL EXECUTION CONTINUES.	FSW EXECUTES WITH THE INTERRUPT MASKED (PSW BIT 23 = 0), THEREFORE THIS ERROR SHOULD NEVER OCCUR. THIS ERROR IS CAUSED BY IMPROPER SPECIFICATION OR USE OF INSTRUCTIONS OR DATA. IF PATCHES HAVE BEEN APPLIED, VERIFY THEY ARE CORRECT.

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"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

GPC ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
ZERO MSG LENGTH IN DEU RESP BUFF	ENTRY IN THE GPC ERROR LOG FOR: GROUP 6 CODE 1	WHILE PROCESSING A DEU RESPONSE MESSAGE, THE MCDS INPUT PROCESSOR (DMI_MCDS_IN) FOUND THE MESSAGE READY BIT ON BUT THE NUMBER OF KEYSTROKES INDICATED WAS ZERO. THE KEYSTROKES ARE DISCARDED. THE PROCESSOR WILL LOG THE ERROR MESSAGE, AND THEN RESET (TURN OFF) THE MESSAGE READY INDICATOR.	NOTE: (SMS D019) DURING THE DEU'S PROCESSING OF THE TERMINATOR KEYS: PRO, EXEC, FAULT SUMM, SYS SUMM, RESUME; THERE IS A 45 MICRO-SECOND WINDOW THAT PERMITS ERRONEOUS TRANSFERS OF THE KEYBOARD DATA TO THE GPC. IF POLLING FROM THE GPC OCCURS DURING THE WINDOW, THIS ERROR IS A POSSIBLE RESULT. IN CASES WHERE A POLL FAIL IS INDICATED, REASSIGN THE POLL FAIL DEU BY GPC/CRT FROM ANOTHER DEU AND RE-ENTER THE MESSAGE. OTHER POSSIBLE RESULTS INCLUDE "ILLEGAL ENTRY" (PASS), "I/O ERR CRT" (BFS), OR SIMPLY NO RESPONSE FROM THE GPC. THE USER SHOULD RE-KEY THE MESSAGE.

APPENDIX F. I/O ERROR MESSAGES

This Appendix provides a tabled list of I/O Error Conditions divided into three sections: Section 1 contains DEVICE ID/OP CODE error messages listed in DEVICE ID order; Section 2 contains BCE ELEMENT error messages listed in alphabetical order; and Section 3 contains STATUS REGISTER error messages listed in alphabetical order. Each error condition is shown with Manifestation, Description, and Possible Causes information.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
IPR VIA ICC-RS	DEVICE ID = 1 OP CODE = 0	IF AN I/O ERROR OCCURS ON CERTAIN RS I/O TRANSACTIONS (E.G., HFE OR MFE), ERROR DATA ABOUT THE TRANSACTION IS EXCHANGED OVER THE ICC BUSSES. THIS IS CALLED AN IPR (I/O PROBLEM REPORT) ICC TRANSACTION.	
GPC TO GPC WRT	DEVICE ID = 2 OP CODE = 1	ERROR ON GPC-TO-GPC OPS OVERLAY WRITE OPERATION. ERROR HANDLING SAME AS MMU OVERLAY.	
GPC TO GPC RDS	DEVICE ID = 2 OP CODE = 2	ERROR ON GPC-TO-GPC OPS OVERLAY READ OPERATION. ERROR HANDLING SAME AS MMU OVERLAY.	
GPC TO GPC NO-OP	DEVICE ID = 2 OP CODE = 3	ERROR ON GPC-TO-GPC OPS NO-OP. ERROR HANDLING SAME AS MMU OVERLAY.	
SSIP ICC	DEVICE ID = 3 OP CODE = 0	ERROR ON 124 HALF-WORD COMMON SET SYNC MESSAGE - SSIP (SYSTEM SOFTWARE INTERFACE PROCESSOR).	
SSUS OUTPUT WRT	DEVICE ID = 4 OP CODE = 1		

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
DEU X FILL	DEVICE ID = * OP CODE = 1	AN ERROR WITH THIS OP CODE INDICATES A FAILURE ON A GPC DISPLAY FILL COMMAND (MESSAGE TYPE 28, SUBFIELD 3) WHICH IS USED TO LOAD DISPLAY INSTRUCTIONS INTO THE "DISPLAY BUFFER."	
DEU X POLL	DEVICE ID = * OP CODE = 2	AN ERROR WITH THIS OP CODE INDICATES A FAILURE ON GPC TIME FILL COMMAND (MESSAGE TYPE 28, SUBFIELD 0) OR ITS "CHAINED" MCDS STATUS REQUEST (MESSAGE TYPE 0, SUBFIELD 4) WHICH FOLLOWS IT.	
DEU X IPL FILL	DEVICE ID = * OP CODE = 3	AN ERROR WITH THIS OP CODE INDICATES A FAILURE ON A GPC COMMAND (MESSAGE TYPE 28, SUBFIELD 0) INTENDED FOR A DEU WITH THE IPL PROM PROGRAM RUNNING; THAT IS WITH DEU LOAD DISPLAYED ON THE CRT.	
DEU X DUMP	DEVICE ID = * OP CODE = 4	AN ERROR WITH THIS OP CODE INDICATES A FAILURE ON A GPC REQUEST (MESSAGE TYPE 29) TO DUMP UP TO 511 WORDS FROM THE DEU, STARTING AT A GIVEN DEU ADDRESS. DEU SHOULD RESPOND WITH THE REQUESTED NUMBER OF WORDS.	
X = 1,2,3,4	* = 5,6,7,8 (FOR DEU 1,2,3,4 RESPECTIVELY)		

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
DEU X REQ BITE STAT	DEVICE ID = * OP CODE = 5	AN ERROR WITH THIS OP CODE INDICATES A FAILURE ON A GPC REQUEST (MESSAGE TYPE 0, SUBFIELD 4) INTENDED FOR A DEU WITH THE IPL PROM PROGRAM RUNNING; THAT IS, WITH "DEU LOAD" DISPLAYED ON THE CRT. THIS COMMAND MUST BE RECEIVED BY THE IPL PROM BEFORE THE DEU CAN ACCEPT A LOAD (FILL COMMAND).	
DEU X RESET SCR PD LINE	DEVICE ID = * OP CODE = 6	THIS OP CODE IS THE GPC COMMAND TO THE DEU (MESSAGE TYPE 4) TO CLEAR THE CRT SCRATCH PAD LINE, ON WHICH THE DEU DISPLAYS THE CURRENT KEYBOARD MESSAGE. THE GPC CLEARS THE LINE WHEN A NEW PAGE IS DISPLAYED.	
X = 1,2,3,4	* = 5,6,7,8 (FOR DEU 1,2,3,4 RESPECTIVELY)		

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
DEU X CRIT FORMAT FILL	DEVICE ID = * OP CODE = 7	AN ERROR WITH THIS OP CODE INDICATES A FAILURE ON A GPC COMMAND (MESSAGE TYPE 28, SUBFIELD 5) WHICH IS USED TO LOAD DISPLAY INSTRUCTIONS INTO THE "CRITICAL FORMAT BUFFER."	
DEU X REMOTE FILL	DEVICE ID = * OP CODE = 8	THIS FUNCTION NOT PRESENTLY USED.	
DEU X REMOTE DUMP	DEVICE ID = * OP CODE = 9		
X = 1,2,3,4	* = 5,6,7,8 (FOR DEU 1,2,3,4 RESPECTIVELY)		

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
DDU WRT ALL DDU	DEVICE ID = 9 OP CODE = 1	ERROR ON G9/P9 WRITE TO DDU 1 (LEFT) AND 2 (RIGHT) VIA FC1-4. DDU OUTPUTS ARE ON DEMAND, VIA SPEC 100.	
DDU WRT ADI	DEVICE ID = 9 OP CODE = 2	ERROR ON G9/P9 WRITE TO DDU 3 (AFT) VIA FC1-4. DDU OUTPUTS ARE ON DEMAND VIA SPEC 100.	
PMU'S WRT GPC DATA RAM	DEVICE ID = 10 OP CODE = 1	PCMMU ERROR ON WRITING DOWNLIST TO THE TOGGLE BUFFER.	
PMU'S WRT 128 KBPS PGM	DEVICE ID = 10 OP CODE = 2	PCMMU ERROR ON WRITING TFL DATA TO THE HIGH DATA RATE FORMATTER MEMORIES.	VALID ONLY IN SM AND VU.
PMU'S WRT 64 KBPS PGM	DEVICE ID = 10 OP CODE = 3	PCMMU ERROR ON WRITING TFL DATA TO THE LOW DATA RATE FORMATTER MEMORIES.	VALID ONLY IN SM AND VU.
PMU'S RDS 128 KBPS PGM	DEVICE ID = 10 OP CODE = 4 I/O ERROR LOGGED FSP MESSAGE (I/O ERROR PCM)	PCMMU ERROR ON READING THE HIGH DATA RATE (HDR) RAM CHECKSUM VALUE.	VALID ONLY IN SM AND VU.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
PMU'S RDS 64 KBPS PGM	DEVICE ID = 10 OP CODE = 5 I/O ERROR LOGGED FSP MESSAGE (I/O ERROR PCM)	PCMMU ERROR ON READING THE LOW DATA RATE (LDR) RAM CHECKSUM VALUE.	VALID ONLY IN SM AND VU.
PMU'S RDS BITE	DEVICE ID = 10 OP CODE = 6	PCMMU ERROR DURING CYCLIC BITE STATUS REGISTER READ.	VALID ONLY IN SM AND VU.
PMU'S HARD FMT SELECT	DEVICE ID = 10 OP CODE = 7	ERROR ON A GPC ONE-WORD COMMAND TO THE PCMMU VIA THE IP BUS TO SELECT THE FIXED FORMAT (PRDM) MEMORY TO BE EXECUTED BY THE 128 KBPS FORMATTER.	VALID ONLY IN SM AND VU.
PMU'S PROG FMT SELECT	DEVICE ID = 10 OP CODE = 8	PCMMU ERROR ON ISSUING COMMAND TO SELECT PROGRAMMABLE FORMAT FOR THE 128 KB FORMAT MEMORY.	VALID ONLY IN SM AND VU.
PMU'S SM RDS OI/PL RAM	DEVICE ID = 10 OP CODE = 9	ERROR ON READING THE OI/PL RAM FROM THE PCMMU.	VALID ONLY IN SM AND VU.
PMU'S TCS RDS OI/PL PM	DEVICE ID = 10 OP CODE = 10		

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
PMU'S WRT 64 KBPS 1 WD	DEVICE ID = 10 OP CODE = 11	PCMMU ERROR DURING A ONE-TIME WRITE OF THE SYNC WORD INTO WORD 88 (THE OI SYNC WORD) OF THE 64 KBPS MEMORY.	
PMU'S TCS RDS 64/128 P	DEVICE ID = 10 OP CODE = 12		
MMU WRT W/ CKSUM	DEVICE ID = 11 OP CODE = 1 I/O ERROR LOGGED MMU BSR SET FSP MESSAGE (I/O ERROR MMU X, WHERE X=1 OR 2)	THIS TRANSACTION ERROR INDICATES A FAILURE OCCURRED DURING A GPC-TO-MMU WRITE WITH CHECKSUM OPERATION. (SEE RELATED BCE 27 STATUS REGISTER ERROR.)	1. MMU HARDWARE FAILURE. 2. MMU TAPE DAMAGE OR CONTAMINATION. 3. MMU LOAD PROBLEM. 4. GPC TRANSMITTER/RECEIVER FAILURE.
MMU WRT W/O CKSUM	DEVICE ID = 11 OP CODE = 2 I/O ERROR LOGGED FSP MESSAGE (I/O ERROR MMU X, WHERE X=1 OR 2) MMU BSR SET	THIS TRANSACTION ERROR INDICATES A FAILURE OCCURRED DURING A GPC-TO-MMU WRITE WITHOUT CHECKSUM OPERATION. (SEE RELATED BCE 27 STATUS REGISTER ERROR.)	1. MMU HARDWARE FAILURE. 2. MMU TAPE DAMAGE OR CONTAMINATION. 3. MMU LOAD PROBLEM. 4. GPC TRANSMITTER/RECEIVER FAILURE.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
MMU RDS W/ CKSUM	DEVICE ID = 11 OP CODE = 3 I/O ERROR LOGGED FSP MESSAGE (I/O ERROR MMU X, WHERE X=1 OR 2) MMU BSR SET	FAILURE DURING A GPC-TO-MMU READ WITH CHECKSUM OPERATION. (SEE RELATED BCE 27 STATUS REGISTER ERROR.)	1. MMU HARDWARE FAILURE. 2. MMU TAPE DAMAGE OR CONTAMINATION. 3. MMU LOAD PROBLEM. 4. MMU DUMP AND/OR COMPARE PROBLEM. 5. GPC TRANSMITTER/RECEIVER FAILURE. 6. FAILURE OF A TFL OR PDI LOAD.
MMU RDS W/O CKSUM	DEVICE ID = 11 OP CODE = 4 I/O ERROR LOGGED FSP MESSAGE (I/O ERROR MMU X, WHERE X=1 OR 2) MMU BSR SET	FAILURE DURING A GPC-TO-MMU READ WITHOUT CHECKSUM OPERATION. (SEE RELATED BCE 27 STATUS REGISTER ERROR.)	1. MMU HARDWARE FAILURE. 2. MMU TAPE DAMAGE OR CONTAMINATION. 3. MMU LOAD PROBLEM. 4. MMU DUMP AND/OR COMPARE PROBLEM. 5. GPC TRANSMITTER/RECEIVER FAILURE.
MMU MM UTILITY WRT	DEVICE ID = 11 OP CODE = 5 I/O ERROR LOGGED FSP MESSAGE MMU OFF/BUSY	ERROR DURING A GPC-TO-MMU UTILITY_WRITE_REQUEST. ONLY USED FOR CAPABILITY 1 TYPE WRITES (FILE, TRACK, SUBFILE, BLOCK GROUND COMMANDS VIA THE LDB).	ONLY OCCURS IN SM OR PL9 OPS.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
MMU READ STAT REG	DEVICE ID = 11 OP CODE = 6	TRANSACTION ERROR DURING A GPC-TO-MMU STATUS REQUEST COMMAND. STATUS REQUEST COMMAND IS ISSUED BEFORE AND AFTER EVERY MMU OPERATION.	
MMU OVERLAY READ	DEVICE ID = 11 OP CODE = 7	ERROR OCCURRED DURING A GPC-TO-MMU OPS OVERLAY REQUEST.	
MMU POSITION TAPE	DEVICE ID = 11 OP CODE = 8	TRANSACTION ERROR DURING A GPC-TO-MMU POSITION REQUEST COMMAND.	
MMU MMU UTILITY READ	DEVICE ID = 11 OP CODE = 9		LIMITED TO PL9 OPS ONLY.
MMU TCS MM BITE STATUS	DEVICE ID = 11 OP CODE = 10		
FC BITE ACQU RDS	DEVICE ID = 12 OP CODE = 2	ERROR IN G9 WHILE CYCLICALLY READING FF AND FA MDM'S BITE STATUS REGISTER. INITIATED BY SPEC 112 ENTRY.	

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
HFE INPUT RDS	DEVICE ID = 13 OP CODE = 2	HIGH FREQUENCY EXECUTIVE (HFE) I/O WHICH RUNS CYCLICALLY AT 25 Hz IN G1/G6, G2, G3, AND G8.	
HFE OUTPUT WRT	DEVICE ID = 14 OP CODE = 1	HIGH FREQUENCY EXECUTIVE (HFE) I/O WHICH RUNS CYCLICALLY AT 25 Hz IN G1/G6, G2, G3, AND G8.	
MFE INPUT RDS	DEVICE ID = 15 OP CODE = 2	MID FREQUENCY EXECUTIVE (MFE) I/O WHICH RUNS CYCLICALLY AT 6.25 Hz IN G1/G6, G2, G8, AND G3 AND 12.5 Hz IN G9 AND PL9.	
GNC OPS INT IN RDS	DEVICE ID = 16 OP CODE = 2	ONE SHOT READ AT G9, G1, G2 AND G3 OPS TRANSITION. BITE TEST 4 OF ALL FF AND FA MDM'S.	
IMU INPUT RDS	DEVICE ID = 17 OP CODE = 2		
IMU OUTPUT WRT	DEVICE ID = 18 OP CODE = 1		
MTUX (RS) (X=1,2,3) WRT	DEVICE ID = 19, 20, 21 OP CODE = 1		
MTUX (RSA) (X=1,2,3) MET RESET	DEVICE ID = 19, 20, 21 OP CODE = 2		

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
MTU ALL RDS	DEVICE ID = 22 OP CODE = 2		
FC C&W WRT	DEVICE ID = 23 OP CODE = 1		
NSP CYCLIC IN RDS	DEVICE ID = 24 OP CODE = 2		
FAOUT WRT	DEVICE ID = 25 OP CODE = 1		
HDA INPUT 1 RDS	DEVICE ID = 26 OP CODE = 2	HFE TYPE INPUT IN G9 OR PL9.	
TCS FFX WRT (X=1,2,3,4)	DEVICE ID = 27, 28, 29, 30 OP CODE = 1		
TCS FFX RDS (X=1,2,3,4)	DEVICE ID = 27, 28, 29, 30 OP CODE = 2		
TCS FAX WRT (X=1,2,3,4)	DEVICE ID = 31, 32, 33, 34 OP CODE = 1		
TCS FAX RDS (X=1,2,3,4)	DEVICE ID = 31, 32, 33, 34 OP CODE = 2		

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
TCS QUAD FA WRT	DEVICE ID = 35 OP CODE = 1		
TCS QUAD FA RDS	DEVICE ID = 35 OP CODE = 2		
TCS QUAD FF WRT	DEVICE ID = 36 OP CODE = 1		
TCS QUAD FF RDS	DEVICE ID = 36 OP CODE = 2		
RJD CMD A TGLR WRT	DEVICE ID = 37 OP CODE = 1		
G9 ONE SHOT WRT	DEVICE ID = 38 OP CODE = 1		
SPARE DEVICE	DEVICE ID = 39, 40, 41, 42		
PF BITE ACQU RDS	DEVICE ID = 43 OP CODE = 2		
PFX DISCRETES WRT (X = 1,2)	DEVICE ID = 44, 45 OP CODE = 1		
TCS PF1 WRT	DEVICE ID = 46 OP CODE = 1		

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
TCS PF2 WRT	DEVICE ID = 47 OP CODE = 1		
TCS PFC RDS	DEVICE ID = 47 OP CODE = 2		
SM PF FIXD OUT CYCLIC OUTPUTS	DEVICE ID = 48 OP CODE = 1		
SM PF FIXD OUT PYLD BAY DOORS	DEVICE ID = 48 OP CODE = 2		
PSP PFX WRT (X = 1,2)	DEVICE ID = 49, 50 OP CODE = 1		
PSP PFX STATUS (X = 1,2)	DEVICE ID = 49, 50 OP CODE = 2		
PL HIGH RATE RDS	DEVICE ID = 51 OP CODE = 2	ERROR DURING A HIGH-RATE (6.25 Hz) READ OF THE PL MDM.	
PF LOW RATE RDS	DEVICE ID = 52 OP CODE = 2	ERROR DURING A LOW-RATE (1.04 Hz) READ OF THE PL MDM.	
DUAL PORT X RDS (X=1,2,3)	DEVICE ID = 53, 54, 55 OP CODE = 2		

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
SINGLE FLX 1/2 RDS	DEVICE ID = 56 OP CODE = 2		
SINGLE FLX 3/4	DEVICE ID = 57		
SINGLE FLEX 5 RDS	DEVICE ID = 58 OP CODE = 2		
SM TBL DRIVEN RDS	DEVICE ID = 59 OP CODE = 2		
PDI WRT	DEVICE ID = 60 OP CODE = 1		
PDI RDS	DEVICE ID = 60 OP CODE = 2 FSP MESSAGE (S62 BCE BYP PDI)	ERROR DURING CYCLIC READS OF THE PDI INPUT SWITCH MATRIX.	
LDB INT W/O DATA	DEVICE ID = 61 OP CODE = 1		
LDB INT W/ DATA	DEVICE ID = 61 OP CODE = 2		
LDB GO-AHEAD	DEVICE ID = 61 OP CODE = 3		

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
LDB TRANS ENABLE	DEVICE ID = 61 OP CODE = 4		
LDB STATUS REQUEST	DEVICE ID = 61 OP CODE = 5		
LDB STATUS	DEVICE ID = 61 OP CODE = 6		
LDB WAVE OFF	DEVICE ID = 61 OP CODE = 7		
TCS LB MDM'S WRT	DEVICE ID = 62 OP CODE = 1		
TCS LB MDM'S RDS	DEVICE ID = 62 OP CODE = 2		
SRB RDS	DEVICE ID = 63 OP CODE = 2		
TCS SRB WRT	DEVICE ID = 64 OP CODE = 1		
TCS SRB RDS	DEVICE ID = 64 OP CODE = 2		
MCIU IN RDS	DEVICE ID = 65 OP CODE = 2		
MCIU OUT WRT	DEVICE ID = 66 OP CODE = 1		

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
TCS MCIU WRT	DEVICE ID = 67 OP CODE = 1		
TCS MCIU RDS	DEVICE ID = 67 OP CODE = 2		
TCS BUS 10 WRT	DEVICE ID = 68 OP CODE = 1		
TCS BUS 10 RDS	DEVICE ID = 68 OP CODE = 2		
TCS BUS 11 WRT	DEVICE ID = 69 OP CODE = 1		
TCS BUS 11 RDS	DEVICE ID = 69 OP CODE = 2		
TCS BUS 14 WRT	DEVICE ID = 70 OP CODE = 1		
TCS BUS 14 RDS	DEVICE ID = 70 OP CODE = 2		
TCS BUS 15 WRT	DEVICE ID = 71 OP CODE = 1		
TCS BUS 15 RDS	DEVICE ID = 71 OP CODE = 2		

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
TCS BUS 16 WRT	DEVICE ID = 72 OP CODE = 1		
TCS BUS 16 RDS	DEVICE ID = 72 OP CODE = 2		
TCS BUS 17 WRT.	DEVICE ID = 73 OP CODE = 1		
TCS BUS 17 RDS	DEVICE ID = 73 OP CODE = 2		
TCS BUS 20 WRT	DEVICE ID = 74 OP CODE = 1		
TCS BUS 20 RDS	DEVICE ID = 74 OP CODE = 2		
TCS BUS 21 WRT	DEVICE ID = 75 OP CODE = 1		
TCS BUS 21 RDS	DEVICE ID = 75 OP CODE = 2		
TCS BUS 22 WRT	DEVICE ID = 76 OP CODE = 1		
TCS BUS 22 RDS	DEVICE ID = 76 OP CODE = 2		

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 1 - DEVICE ID/OP CODE ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
TCS BUS 23 WRT	DEVICE ID = 77 OP CODE = 1		
TCS BUS 23 RDS	DEVICE ID = 77 OP CODE = 2		
TCS MMX WRT (X = 1,2)	DEVICE ID = 78, 79 OP CODE = 1		
TCS MMX RDS (X = 1,2)	DEVICE ID = 78, 79 OP CODE = 2		
TCS MEC/EIU WRT	DEVICE ID = 80 OP CODE = 1	TCS QUAD I/O COMMAND TO MEC OR EIU VIA ALL FOUR FC BUSSES.	

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 2 - BCE ELEMENT ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
EIUX/P1 (X = 1,2,3)	BCE ELEMENT = 1(EIU1) 2(EIU2) 3(EIU3) 51(EIU1) 52(EIU2) 53(EIU3)	ENGINE INTERFACE UNIT X PORT 1 BUS 14 BUS 15 BUS 16 BUS 14 BUS 15 BUS 16	BCE ELEMENTS 1, 2, and 3 VALID IN G1/G6 ONLY AND BCE ELEMENTS 51, 52, and 53 VALID IN G1/G6 AND VU ONLY. MAY BE OBSERVED AT POWER OFF OF MAIN ENGINE CONTROLLER.
EIUX/P4 (X = 1,2,3)	BCE ELEMENT = 4(EIU1) 5(EIU2) 6(EIU3)	ENGINE INTERFACE UNIT X PORT 4 BUS 17 BUS 17 BUS 17	VALID IN G1/G6 ONLY. MAY BE OBSERVED AT POWER OFF OF MAIN ENGINE CONTROLLER.
FAX IN PR SQ 3-10 (X = 1,2,3,4)	BCE ELEMENT = 21(FA1) 24(FA2) 27(FA3) 30(FA4)	FLIGHT AFT X MDM INPUT PROM SEQUENCE 3-10.	
FAX IN PR SQ 1,2 (X = 1,2,3,4)	BCE ELEMENT = 47(FA1) 48(FA2) 49(FA3) 50(FA4)	FLIGHT AFT X MDM INPUT PROM SEQUENCE 1,2.	
FAX MDM (X = 1,2,3,4)	BCE ELEMENT = 78(FA1) 79(FA2) 80(FA3) 81(FA4)	FLIGHT AFT X MDM DISCRETES	

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 2 - BCE ELEMENT ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
FAX MDM RETURN WORD (X = 1,2,3,4)	BCE ELEMENT = 20(FA1) 22(FA2) 25(FA3) 28(FA4)	MDM RETURN WORD IS FORMED BY SHIFTING THE GPC MDM COMMAND WORD LEFT BY 2 BITS (I.E., EFFECTIVELY TRUNCATING THE FIRST 2 BITS AND ADDING TWO ZEROES TO THE END). TYPICALLY SENT AT BEGINNING OF SELECTED MDM TRANSACTIONS. ERROR ON FLIGHT CRITICAL HDA CYCLIC INPUTS (G9/P9) OR HFE INPUT (G1-G8).	
FA2 HYDR SYS 3 PRESS	BCE ELEMENT = 23	FLIGHT AFT 2 MDM HYDRAULIC SYSTEM 3 PRESSURE C ERROR ON READ OF FA2 CARD 14 CHANNEL 28.	
FA3 OMS L ENG CH PRS	BCE ELEMENT = 26	FLIGHT AFT 3 MDM OMS LEFT ENGINE CHAMBER PRESSURE.	
FA4 OMS R ENG CH PRS	BCE ELEMENT = 29	FLIGHT AFT 4 MDM OMS RIGHT ENGINE CHAMBER PRESSURE.	
FFX ADTA (X = 1,2,3,4)	BCE ELEMENT = 9(FF1) 12(FF2) 15(FF3) 18(FF4)	FLIGHT FORWARD MDM X AIR DATA TRANSDUCER ASSEMBLY. SERIAL I/O DATA FROM THE ADTA.	

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 2 - BCE ELEMENT ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
FFX IMU (X = 1,2,3)	BCE ELEMENT = 32(FF1) 37(FF2) 41(FF3)	FLIGHT FORWARD X MDM INERTIAL MEASUREMENT UNIT. ERROR ON MID FREQUENCY EXECUTIVE (MFE) INPUT IMU FF PROM STRING A.	
FFX IMU DATA (X = 1,2,3)	BCE ELEMENT = 58(FF1) 61(FF2) 64(FF3)	FLIGHT FORWARD X MDM INERTIAL MEASUREMENT UNIT DATA. ERROR ON G9 CYCLIC READS OF SERIAL I/O DATA FROM IMU.	VALID IN G9 ONLY.
FFX IMU DISCRETES (X = 1,2,3)	BCE ELEMENT = 59(FF1) 62(FF2) 65(FF3)	FLIGHT FORWARD X INERTIAL MEASUREMENT UNIT DISCRETES. ERROR ON G9 CYCLIC READS, IMU OPERATE/BITE DISCRETES.	VALID IN G9 ONLY.
FFX IN PR SQ 1,2 (X = 1,2,3,4)	BCE ELEMENT = 31(FF1) 36(FF2) 40(FF3) 46(FF4)	FLIGHT FORWARD X MDM INPUT PROM SEQUENCE 1,2.	
FFX IN PR SQ 2-6 (X = 1,2,3,4)	BCE ELEMENT = 10(FF1) 13(FF2) 16(FF3) 19(FF4)	FLIGHT FORWARD X MDM INPUT PROM SEQUENCE 2-6.	

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 2 - BCE ELEMENT ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
FFX MDM (X = 1,2,3,4)	BCE ELEMENT = 74(FF1) 75(FF2) 76(FF3) 77(FF4)	FLIGHT FORWARD X MDM DISCRETES.	
FFX MDM RETURN WORD (X = 1,2,3,4)	BCE ELEMENT = 7(FF1) 11(FF2) 14(FF3) 17(FF4) 57(FF1 IMU) 60(FF2 IMU) 63(FF3 IMU)	MDM RETURN WORD IS FORMED BY SHIFTING THE GPC MDM COMMAND WORD LEFT BY 2 BITS (I.E., EFFECTIVELY TRUNCATING THE FIRST 2 BITS AND ADDING TWO ZEROES TO THE END). TYPICALLY SENT AT BEGINNING OF TRANSACTIONS. ERROR ON FLIGHT CRITICAL HDA CYCLIC INPUTS (G9/P9) OR HFE INPUT (G1-G8).	BCE ELEMENTS 57, 60, AND 63 VALID IN G9 ONLY.
FFX MSBLS (X = 1,2,3)	BCE ELEMENT = 34(FF1) 39(FF2) 43(FF3)	FLIGHT FORWARD X MDM MICROWAVE SCANNING BEAM LANDING SYSTEM. SERIAL I/O DATA FROM MSBLS.	
FFX MTU X (X = 1,2,3)	BCE ELEMENT = 54(FF1) 55(FF2) 56(FF3)	FLIGHT FORWARD X MDM MASTER TIMING UNIT X. SERIAL I/O DATA FROM MTU.	

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 2 - BCE ELEMENT ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
FFX STU (X = 1,3)	BCE ELEMENT = 35(FF1) 44(FF3)	FLIGHT FORWARD X MDM STAR TRACKER UNIT. STU1 - Z STU2 - Y	
FFX TACAN/RA (X = 1,2,3)	BCE ELEMENT = 33(FF1) 38(FF2) 42(FF3)	FLIGHT FORWARD X MDM TACTICAL AIR NAVIGATION/RADAR ALTIMETER.	
FF1 NSP1 DATA	BCE ELEMENT = 67(FF1)	FLIGHT FORWARD 1 MDM NETWORK SIGNAL PROCESSOR 1 DATA. SERIAL I/O DATA FROM NSP.	
FF1 NSP1 DISCRETES	BCE ELEMENT = 66(FF1)	FLIGHT FORWARD 1 MDM NETWORK SIGNAL PROCESSOR 1 DISCRETES. NSP POWER/BLK DISCRETES.	
FF1 PAYLOAD SENSOR	BCE ELEMENT = 8(FF1)	FLIGHT FORWARD 1 MDM PAYLOAD SENSOR.	
FF3 NSP2 DATA	BCE ELEMENT = 69(FF3)	FLIGHT FORWARD 3 MDM NETWORK SIGNAL PROCESSOR 2 DATA. SERIAL I/O DATA FROM NSP.	
FF3 NSP2 DISCRETES	BCE ELEMENT = 68(FF3)	FLIGHT FORWARD 3 MDM NETWORK SIGNAL PROCESSOR 2 DISCRETES. NSP POWER/BLK DISCRETES.	

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 2 - BCE ELEMENT ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
FF3 RENDEZVOUS RADAR	BCE ELEMENT = 45(FF3)	FLIGHT FORWARD 3 MDM RENDEZVOUS RADAR.	VALID IN VU AND G2 ONLY.
LLX SRB PROM (X = 1,2)	BCE ELEMENT = 70(LL1) 71(LL2)	SRB MDM PROM	VALID IN VU AND G1/G6 ONLY.
LRX SRB PROM (X = 1,2)	BCE ELEMENT = 72(LR1) 73(LR2)	SRB MDM PROM	VALID IN VU AND G1/G6 ONLY.
MCIU	BCE ELEMENT = 82(MCIU)	MANIPULATOR CONTROLLER INTERFACE UNIT. SERIAL I/O DATA FROM MCIU.	VALID IN SM AND VU ONLY.
MCIU SINGLE FLX2 EL4	BCE ELEMENT = 11	MANIPULATOR CONTROLLER INTERFACE UNIT SINGLE FLEX 2 MDM ELEMENT 4. (MISSION UNIQUE ELEMENT NUMBER)	VALID IN SM ONLY.
PFX MDM RETURN WORD (X = 1,2)	BCE ELEMENT = 91(PF1) 93(PF2)	PAYLOAD FORWARD X MDM RETURN WORD. (MDM RETURN WORD IS FORMED BY SHIFTING THE GPC MDM COMMAND WORD LEFT BY 2 BITS (I.E., EFFECTIVELY TRUNCATING THE FIRST 2 BITS AND ADDING TWO ZEROES TO THE END).) TYPICALLY SENT AT BEGINNING OF TRANSACTIONS.	VALID IN SM AND VU ONLY.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 2 - BCE ELEMENT ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
PFX PBD (X = 1,2)	BCE ELEMENT = 85(PF1) 86(PF1) 87(PF1) 88(PF2) 89(PF2) 90(PF2)	PAYLOAD FORWARD X MDM PAYLOAD BAY DOORS. PAYLOAD HIGH RATE READS OF THE PBD DISCRETES.	VALID IN SM AND VU ONLY.
PFX PSP X (X = 1,2)	BCE ELEMENT = 83(PF1) 84(PF2)	PAYLOAD FORWARD X MDM PAYLOAD SIGNAL PROCESSOR.	VALID IN SM ONLY.
PF1 PDI	BCE ELEMENT = 95(PF1)	PAYLOAD FORWARD 1 MDM PAYLOAD DATA INTERLEAVER.	VALID IN SM AND G9 ONLY.
PF1 KU-BAND RADAR	BCE ELEMENT = 92(PF1)	PAYLOAD FORWARD 1 MDM KU-BAND RADAR. ERROR ON PAYLOAD LOW DATA RATE READ.	VALID IN SM AND VU ONLY.
PF2 FUEL CELL PURGE	BCE ELEMENT = 94(PF2)	PAYLOAD FORWARD 2 MDM FUEL CELL PURGE. PAYLOAD LOW RATE READ OF THE FUEL CELL PURGE DISCRETES.	VALID IN SM AND VU ONLY.
SCAX CD0CH0 (X = 1,2)	BCE ELEMENT = 105,107,109,111	SEQUENCE CONTROL ASSEMBLY X (PAM) CARD 0 CHANNEL 0. (MISSION UNIQUE ELEMENT NUMBERS)	

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 2 - BCE ELEMENT ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
SCAX CD1CH0 (X = 1,2)	BCE ELEMENT = 106,108,110,112	SEQUENCE CONTROL ASSEMBLY X(PAM) CARD 1 CHANNEL 0. (MISSION UNIQUE ELEMENT NUMBERS)	
SCA2 DUL PT1 ELX (X = 1,2,3,4,5)	BCE ELEMENT = 120,121,122,123,124	SEQUENCE CONTROL ASSEMBLY 2 (PAM) DUAL PORT 1 ELEMENT X. (MISSION UNIQUE ELEMENT NUMBERS)	
SCA2 DUL PT1 R/W	BCE ELEMENT = 11	SEQUENCE CONTROL ASSEMBLY 2(PAM) DUAL PORT 1 RETURN WORD. (MISSION UNIQUE ELEMENT NUMBER)	
SCA2 DUL PT2 ELX (X = 1,2)	BCE ELEMENT = 125, 126	SEQUENCE CONTROL ASSEMBLY 2 (PAM) DUAL PORT 2 ELEMENT X. (MISSION UNIQUE ELEMENT NUMBERS)	
SCA2 SINGLE FLX2 ELX (X = 1,2,3,5)	BCE ELEMENT = 114,115,116,118	SEQUENCE CONTROL ASSEMBLY 2 (PAM) SINGLE FLEX 2 MDM ELEMENT X. (MISSION UNIQUE ELEMENT NUMBERS)	VALID IN SM ONLY.
SCA2 SINGLE FLX2 R/W	BCE ELEMENT = 11	SEQUENCE CONTROL ASSEMBLY 2 (PAM) SINGLE FLEX 2 MDM RETURN WORD. (MISSION UNIQUE ELEMENT NUMBER)	VALID IN SM ONLY.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
AGE INT	I/O ERROR LOGGED ALL I/O FROM THIS GPC STOPS. MASTER ALARM GPC C/W LIGHT B/U C/W LIGHT SIMPLEX: I-FAIL LIGHT RS/CS: FAIL TO SYNC, FSP MESSAGES, I-FAIL/U-FAIL LIGHTS	LEVEL B I/O ERROR STAT REG - BITS 13-15 (110) (STATUS WORD FOR BCE 29) AGE INTERRUPT WITH I/O QUEUE ACTIVE. GENERATES A CPU EXT. 1 INTERRUPT CPU DETECTED ERROR.	1. CPU FAILURE
BLK T/O	I/O ERROR LOGGED FSP MESSAGE (I/O ERROR MMU X, WHERE X=1 OR 2)	BCE STATUS REGISTER - BIT 27 (STATUS WORD FOR BCE 1-24) A RECEIVE DATA INSTRUCTION TIMED OUT WHILE WAITING FOR AN INTERBLOCK GAP TO END. ONLY VALID WHEN GETTING DATA FROM MASS MEMORY.	1. MMU FAILURE 2. IOP FAILURE (NON-UNIVERSAL ERROR ONLY) 3. FSW ERROR (MOST LIKELY DURING PATCHING OR FSW DEVELOPMENT).

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
BOUNDRY	I/O ERROR LOGGED	BCE STATUS REGISTER - BIT 28 (STATUS WORD FOR BCE 1-24) A GIVEN BCE ENCOUNTERED A LONG FORMAT INSTRUCTION (32 BITS) ON AN ODD HALFWORD (16 BITS) BOUNDARY.	1. IOP FAILURE (NON-UNIVERSAL ERROR ONLY) 2. FSW ERROR (MOST LIKELY DURING PATCHING OR FSW DEVELOPMENT)
BUSY/BUF	I/O ERROR LOGGED FSP MESSAGE, MMU OFF/BUSY	BCE STATUS REGISTER - BIT 9 (STATUS WORD FOR BCE 27) BCE BUSY/WAIT STATUS INDICATES BUSY, SUCH AS ANOTHER I/O TRANSACTION IN PROGRESS ON THIS BUS (AS DEFINED BY BIT 12, 13, 18, OR 19). THE CHECKSUM BUFFER IS NEEDED TO HOLD THE ORIGINAL COPY OF THE DATA TO BE WRITTEN TO MASS MEMORY, FOR LATER RE-WRITE (BY MANUAL COMMAND) IN CASE OF FAILURE OF THE ORIGINAL REQUEST. BUS EXPERIENCING THE ERROR WILL BE INDICATED IN BIT 12 (ERR LDB1), 13 (ERR LDB2), 18 (ERR MM1), OR 19 (ERR MM2).	1. PROCEDURAL ERROR (E.G., REQUESTING A DEU LOAD WHILE ONE IS IN PROGRESS). 2. REQUESTING OPS OVERLAY ON THE LDB BUSES WITHOUT TERMINATING GSE POLLING AND/OR SRB I/O. 3. A PROCEDURAL ERROR CAN CAUSE THE BUFFER TO BE UNAVAILABLE, AS BY WRITING TO BOTH MASS MEMORIES CONCURRENTLY.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
CKSUM	I/O ERROR LOGGED FSP MESSAGE, I/O ERROR MMU X, WHERE X = 1 OR 2	BCE STATUS REGISTER - BIT 8 (STATUS WORD FOR BCE 27) CHECKSUM WORD (LAST WORD IN LOADBLOCK) DOES NOT MATCH THE GPC COMPUTED CHECKSUM OF ALL OTHER WORDS IN BLOCK. BUS EXPERIENCING THE ERROR WILL BE INDICATED IN BIT 12 (ERR LB1), 13 (ERR LB2), 18 (ERR MM1), OR 19 (ERR MM2).	1. MMU LOAD PROBLEM 2. FAILURE IN IOP OR CPU

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
CM IDLE	I/O ERROR LOGGED	LEVEL A INTERRUPT REGISTER - BIT 2 (STATUS WORD FOR BCE 30 = 2000 0000) THE IOP CONTROL MONITOR (C/M) IDLE SIGNAL IS SET BY: 1. MOVING THE MODE SW FROM HALT OR STANDBY TO RUN 2. GPC POWER CYCLE OR POWER TRANSIENT TO CPU OR IOP 3. PROGRAM CONTROLLED OUTPUT (PCO) MASTER RESET COMMAND 4. IOP FAIL RESET (CAUSED BY IOP READ ONLY STORAGE (ROS) PARITY ERROR OR IOP FAULT) GENERATES A CPU EXT. 0 INTERRUPT	THIS I/O ERROR WITH ONLY THE C/M IDLE BIT SET IS NORMALLY THE FIRST I/O ERROR IN THE I/O ERROR LOG AFTER AN IPL. IT IS CAUSED BY A PCO MASTER RESET DURING FSW INITIALIZATION. THIS ERROR LOG ENTRY SHOULD BE EXPECTED ONLY AT IPL OR AFTER MODING THE GPC FROM RUN TO STANDBY OR HALT AND BACK TO RUN. THIS BIT WILL ALSO BE SET IN THE I/O ERROR LOG ENTRIES FOR IOP ROS PARITY ERROR OR IOP FAULT.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
DMA Q OVERFLOW	I/O ERROR LOGGED ALL I/O FROM THIS GPC STOPS. MASTER ALARM GPC C/W LIGHT B/U C/W LIGHT SIMPLEX: I-FAIL LIGHT RC/CS: FAIL TO SYNC, FSP MESSAGES, I-FAIL/U-FAIL LIGHTS	LEVEL B INTERRUPT REGISTER - BIT 4 (STATUS WORD FOR BCE 29 = 0800 - 0000) THE OVERFLOW CIRCUITRY HAS DETECTED AN ATTEMPT TO HOLD MORE THAN 64 DIRECT MEMORY ACCESS (DMA) REQUESTS. IOP GENERATES A CPU EXT. 1 INTERRUPT	1. IOP FAILURE 2. CPU FAILURE

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
DMA TIMEOUT	I/O ERROR LOGGED ALL I/O FROM THIS GPC STOPS. MASTER ALARM GPC C/W LIGHT B/U C/W LIGHT SIMPLEX: I-FAIL LIGHT RS/CS: FAIL TO SYNC, FSP MESSAGES, I-FAIL/U-FAIL LIGHTS	LEVEL B INTERRUPT REGISTER - BIT 5 (STATUS WORD FOR BCE 29 = 0400 0000) THE 8 MICROSECOND TIMER HAS DETECTED A DMA THAT HAS BEEN IN PROCESS FOR MORE THAN 8 MICROSECONDS. IOP GENERATES A CPU EXT. 1 INTERRUPT	1. IOP FAILURE 2. CPU FAILURE 3. ERRONEOUS PROGRAM CONTROLLED OUTPUT (PCO) COMMAND (PCO CW C100 8000) INHIBIT COMPLETION OF A DMA CYCLE - CAUSES CHANNEL TO INHIBIT COMPLETION OF DMA CHANNEL TO TEST DMA 8 MICROSECOND TIMER.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
E BIT	I/O ERROR LOGGED	BCE STATUS REGISTER - BIT 6 (STATUS WORD FOR BCE 1-24) MDM: SET ONLY ON SERIAL I/O TRANSACTIONS. INDICATES SERIAL I/O DATA NOT SUCCESSFULLY RECEIVED. NOTE: STATUS WORD WILL ALSO CONTAIN THE IUA (INTERFACE UNIT ADDRESS) OF THE RECEIVED DATA WORD. EIU COMPUTER I/F ADAPTER (CIA) DETECTED ERRORS. PMU DETECTED ERRORS. DEU DETECTED ERRORS. MMU E-BIT DISABLED - ALWAYS ZERO. EXCEPT FOR EIU, SERIAL CHANNEL TRANSMISSION ERRORS DO NOT CAUSE A BIT TO BE SET IN THE BSR.	COMMON I/O ERROR SIGNATURE RECEIVED FROM A POWERED OFF OR FAILED SERIAL LRU SUCH AS AN IMU, TACAN, OI MDM (PMU READ), ETC.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
ERR LB1	I/O ERROR LOGGED FSP MESSAGE, OFF/BSY MMU 1 OR I/O ERROR MMU 1	BCE STATUS REGISTER - BIT 12 (STATUS WORD FOR BCE 27) THIS ERROR OCCURS IF THE LDB HAS BEEN SELECTED FOR A GPC-TO-GPC OVERLAY AND BUS BUSY OR CHECKSUM BUFFER IN USE OR CHECKSUM ERROR ON OVERLAY.	1. LDB POLLING AND SRB I/O MUST BE TERMINATED BEFORE USING LDB FOR GPC-TO-GPC OVERLAYS. 2. CHECKSUM BUFFER RESERVED FOR SOME OTHER FUNCTION IN PROGRESS. 3. PATCH HAS BEEN APPLIED TO THE SOURCE GPC OPS OVERLAY WITHOUT CHANGING THE LOAD BLOCK CHECKSUM.
ERR LB2	I/O ERROR LOGGED FSP MESSAGE, OFF/BSY MMU 2 OR I/O ERROR MMU 2	BCE STATUS REGISTER - BIT 13 (STATUS WORD FOR BCE 27) SAME AS FOR ERROR ON LDB1 BUS 12 ABOVE.	SAME AS FOR ERROR ON LDB1 BUS 12 ABOVE.
ERR MM1	I/O ERROR LOGGED FSP MESSAGE, OFF/BSY MMU 1 OR I/O ERROR MMU 1	BCE STATUS REGISTER - BIT 18 (STATUS WORD FOR BCE 27)	THIS ERROR OCCURS IF MM1 HAS BEEN SELECTED FOR AN OVERLAY AND BUS IS BUSY, CHECKSUM BUFFER IS IN USE, OR A CHECKSUM ERROR OCCURS ON THE OVERLAY.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
ERR MM2	I/O ERROR LOGGED FSP MESSAGE, OFF/BSY MMU 2 OR I/O ERROR MMU 2	BCE STATUS REGISTER - BIT 19 (STATUS WORD FOR BCE 27)	THIS ERROR OCCURS IF MM2 HAS BEEN SELECTED FOR AN OVERLAY AND BUS IS BUSY, CHECKSUM BUFFER IS IN USE, OR A CHECKSUM ERROR OCCURS ON THE OVERLAY.
FL/PWR DN	I/O ERROR LOGGED FSP MESSAGE, OFF/BSY MMU X (X = 1, 2)	BCE STATUS REGISTER - BIT 6 (STATUS WORD FOR BCE 27) SELECTED MASS MEMORY UNIT NOT READY AS INDICATED BY THE MM READY DISCRETE. BUS EXPERIENCED THE ERROR WILL BE INDICATED IN BIT 18 (ERR MM1) OR 19 (ERR MM2).	1. MMU(S) POWERED OFF 2. FAILED MMU. MMU READY DISCRETE INDICATED NOT READY.
GAP	I/O ERROR LOGGED	BCE STATUS REGISTER - BIT 21 (STATUS WORD FOR BCE 1-24) A GAP GREATER THAN 20 MICROSECONDS OCCURRED DURING EXECUTION OF A TDL OR TDS INSTRUCTION, OR A 5 MICROSECOND GAP ON A MOUT INSTRUCTION. TRANSMITTER OUTPUT IS MONITORED BY WRAP BACK TO RECEIVER.	GPC FAILURE INDICATION (IOP OR CPU). TDL - TRANSMIT DATA LONG TDS - TRANSMIT DATA SHORT MOUT - MSG OUT

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
GO/NO-GO TIMER	I/O ERROR LOGGED I-FAIL LIGHT MASTER ALARM GPC C/W LIGHT B/U C/W LIGHT	LEVEL A INTERRUPT REGISTER - BIT 0 (STATUS WORD FOR BCE 30) THE IOP WATCHDOG TIMER HAS TIMED OUT AND GENERATED A CPU EXT. 0 INTERRUPT	ONLY IPL BOOTSTRAP LOADER (FCMBOOT) SETS THE WATCHDOG TIMER IN PASS FSW, THEREFORE THIS ERROR SHOULD NEVER BE SEEN BY PASS. IF IT DOES OCCUR, SUSPECT: 1. IOP FAILURE 2. CPU FAILURE (ERRONEOUS PGM CONTROLLED OUTPUT CMD TO LOAD IOP WATCHDOG TIMER)
INIT T/O	I/O ERROR LOGGED	BCE STATUS REGISTER - BIT 25 (STATUS WORD FOR BCE 1-24) AN RDS, RDL OR MIN INSTRUCTION TIMED OUT WHILE WAITING FOR THE FIRST INPUT WORD TO ARRIVE. BUS INITIAL TIMEOUT VALUES ICC - 33 MICROSECONDS DK - 5 MILLISECONDS PL - 33 MICROSECONDS LDB - 610.5 MICROSECONDS FC - 33 MICROSECONDS MM - 1.96 SECONDS (EXCEPT FOR MM STATUS READS) PMU - 49.5 MICROSECONDS (RDS = RECEIVE DATA SHORT) (RDL = RECEIVE DATA LONG) (MIN = MESSAGE IN)	1. POWERED OFF OR FAILED BTU. 2. IOP FAILURE IF ERROR WAS NON-UNIVERSAL. 3. DEU INITIAL TIMEOUT CAN OCCUR DURING DEU IPL.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
I/O STORE PROT	I/O ERROR LOGGED GPC BITE FSP MESSAGE IF ERROR IS NON-UNIVERSAL: FAIL TO SYNC, FSP MESSAGES, I-FAIL/U-FAIL LIGHTS MASTER ALARM GPC C/W LIGHT B/U C/W LIGHT	LEVEL B I/O ERROR STAT REG - BITS 13-15 (100) (STATUS WORD FOR BCE 29) A DMA INPUT FROM THE IOP ATTEMPTED TO STORE DATA IN A PROTECTED MEMORY LOCATION. CPU DETECTED ERROR. GENERATES A CPU EXT. 1 INTERRUPT	1. IOP FAILURE 2. CPU FAILURE 3. CABLE CONNECTOR PROBLEM BETWEEN CPU J2 AND IOP J1. 4. SOFTWARE ERROR (CPU/MSC/BCE). IF ERROR IS MANIFESTED BY ONLY ONE GPC IN A REDUNDANT SET, THE ERROR SHOULD BE CONSIDERED A HARDWARE FAILURE.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
IOP FAIL LATCH	I/O ERROR LOGGED I-FAIL LIGHT, FAIL TO SYNC, FSP MESSAGES MASTER ALARM GPC C/W LIGHT B/U C/W LIGHT	LEVEL A INTERRUPT REGISTER - BIT 1 (STATUS WORD FOR BCE 30) THE IOP VOTER FAIL LATCH IS SET BY THE HARDWARE RM VOTER LOGIC WHENEVER TWO OR MORE FAIL VOTE DISCRETES ARE RECEIVED. THIS LATCH CAN ALSO BE SET BY SOFTWARE BY USING THE PROGRAM CONTROLLED OUTPUT (PCO) "LOAD TEST REGISTER". THE FAIL LATCH SIGNAL GENERATES A CPU EXT. 0 INTERRUPT.	THIS I/O ERROR IS LOGGED IN A GPC WHICH HAS FAILED TO SYNC FROM A COMMON SET OR REDUNDANT SET. THE COMPUTER HAS NOT HALTED, BUT IS NO LONGER A MEMBER OF THE REDUNDANT SET.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
IOP FAULT	I/O ERROR LOGGED ALL I/O FROM THIS GPC STOPS. MASTER ALARM GPC C/W LIGHT B/U C/W LIGHT SIMPLEX: I-FAIL LIGHT RS/CS: FAIL TO SYNC, FSP MESSAGES, I-FAIL/U-FAIL LIGHTS	LEVEL A INTERRUPT REGISTER - BIT 4 (STATUS WORD FOR BCE 30) THE BIT IS SET WHEN A TIMING FAULT IS DETECTED ON THE IOP OSCILLATOR. IOP GENERATES A CPU EXT. 0 INTERRUPT THIS FAILURE ALSO SETS THE C/M IDLE SIGNAL (BIT 2).	1. IOP HARDWARE FAILURE. 2. THE IOP OSCILLATOR HAS STOPPED.
IPL	I/O ERROR LOGGED FSP MESSAGE, OFF/BSY MMU X (X = 1, 2)	BCE STATUS REGISTER - BIT 7 (STATUS WORD FOR BCE 27) CURRENT I/O OPERATION IN PROGRESS WILL BE TERMINATED BECAUSE MM SELECTED FOR IPL AS INDICATED BY THE MM IPL DISCRETE. BUS EXPERIENCING THE ERROR WILL BE INDICATED IN BIT 18 (ERR MM1) OR 19 (ERR MM2).	IPL SEL SW SELECTED FOR MMU1 OR MMU2

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
MSC T/O BUS X (X = 1-24)	I/O ERROR LOGGED	BCE NUMBER = 28 STATUS REGISTER BITS EQUATE TO BUS NUMBER BCE (BUS) IN ERROR WAS BUSY TOO LONG (MONITORED BY MSC).	1. NOISE ON BUS 2. OPEN BUS 3. INVALID TIME IN BCE LOCAL STORE REG (B3) 4. IOP OR CPU FAILURE NOTE: 55345 FOLLOWING AN MMU MSC T/O, RESIDUAL DATA COULD BE PICKED UP INSTEAD OF MMU BITE STATUS REGISTER CONTENTS DURING THE TRAILING BITE STATUS READ.
OP CODE	I/O ERROR LOGGED	BCE STATUS REGISTER - BIT 29 (STATUS WORD FOR BCE 1-24) THIS BCE ENCOUNTERED AN ILLEGAL INSTRUCTION IN THE EXECUTION OF A PROGRAM.	1. IOP FAILURE 2. FSW ERROR (MOST LIKELY DURING PATCHING OR FSW DEVELOPMENT) 3. INDICATION OF MDM A/D CONVERTER FAILURE (ERROR FORCED BY FSW).

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
PARITY	I/O ERROR LOGGED	BCE STATUS REGISTER - BIT 4 (STATUS WORD FOR BCE 1-24) WHILE EXECUTING AN RDS, RDL OR MIN INSTRUCTION, AN INPUT WORD WITH BAD PARITY, INVALID MANCHESTER, OR BIT COUNT ERROR WAS RECEIVED. (AP-101S GPC) (RDS = RECEIVE DATA SHORT) (RDL = RECEIVE DATA LONG) (MIN = MESSAGE IN)	1. IOP MIA GENERATED 2. DATA BUS PROBLEM

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
ROS PARITY ERR	I/O ERROR LOGGED ALL I/O FROM THIS GPC STOPS. MASTER ALARM GPC C/W LIGHT B/U C/W LIGHT SIMPLEX: I-FAIL LIGHT RS/CS: FAIL TO SYNC, FSP MESSAGES, I-FAIL/U-FAIL LIGHTS	LEVEL A INTERRUPT REGISTER - BIT 3 (STATUS WORD FOR BCE 30) A PARITY ERROR HAS OCCURRED DURING TRANSFER FROM IOP READ ONLY STORAGE (ROS). THIS FAILURE ALSO SETS THE C/M IDLE SIGNAL (BIT 2). IOP GENERATES A CPU EXT. 0 INTERRUPT	IOP HARDWARE FAILURE

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SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
S BIT	I/O ERROR LOGGED	BCE STATUS REGISTER - BIT 5 (STATUS WORD FOR BCE 1-24) POWER DOWN/UP SEQUENCE HAS OCCURRED SINCE THE TRANSMISSION OF THE LAST MESSAGE. NOTE: STATUS WORD WILL ALSO CONTAIN THE IUA (INTERFACE UNIT ADDRESS) OF THE RECEIVED DATA WORD.	POWER CYCLE OR POWER TRANSIENT ON A BTU (E.G., MDM). THE S-BIT SHALL BE SET TO "0" ON THE FIRST RESPONSE DATA WORD TRANSMITTED BY THE MDM FOLLOWING A POWER DOWN/POWER UP SEQUENCE.

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"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
SIG MIS	I/O ERROR LOGGED	BCE STATUS REGISTER - BIT 3 (STATUS WORD FOR BCE 1-24) WHILE EXECUTING AN RDS, RDL OR MIN INSTRUCTION, MICROCODE DETECTED A MISMATCH BETWEEN THE INPUT BTU ADDRESS AND THE BCE'S IUAR (BCE LOCAL STORE (LS) REG C5) (RDS = RECEIVE DATA SHORT) (RDL = RECEIVE DATA LONG) (MIN = MESSAGE IN)	THE BTU ADDRESS LOGGED IN BITS 8-12 OF THIS I/O ERROR ENTRY SHOULD BE COMPARED WITH THE BTU ADDRESS OF ALL BTU'S ON THIS BUS FOR A CLUE TO ISOLATE THE CAUSE OF THE ERROR. IF THE LOGGED BTU ADDRESS IS NOT VALID FOR ANY BTU ON THE BUS (E.G., ALL ONES OR ALL ZEROES), IT MAY NOT BE POSSIBLE TO ISOLATE THE CAUSE UNLESS ALL GPC'S IN A REDUNDANT SET SEE THE ERROR OR IT IS A NON-UNIVERSAL I/O ERROR. POSSIBLE CAUSES: 1. IOP FAILURE (IF NON-UNIVERSAL ERROR) 2. BTU FAILURE (MDM, EIU, ETC.) IDENTIFIED BY I/O ERROR DEVICE ID AND BCE ELEMENT (IF ERROR SEEN BY ALL GPC'S IN A REDUNDANT SET).
SLF TST	I/O ERROR LOGGED	BCE STATUS REGISTER - BIT 22 (STATUS WORD FOR BCE 1-24) A BCE SELF TEST INSTRUCTION (STP) HAS DETECTED A FAULT IN THE BCE. VALID ONLY DURING SELF TEST (IPL).	IF ANNUNCIATED DURING PASS EXECUTION, IT IS AN INDICATION OF GPC FAILURE, SINCE THE SELF TEST INSTRUCTION IS NOT USED BY PASS.

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SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
SYNC	I/O ERROR LOGGED	BCE STATUS REGISTER - BIT 15 (STATUS WORD FOR BCE 1-24) WHILE EXECUTING AN RDS, RDL OR MIN INSTRUCTION, AN INPUT WORD WITH COMMAND SYNC WAS RECEIVED.	CMD SYNC SHOULD ONLY BE GENERATED BY ANOTHER GPC. THIS ERROR SIGNATURE IS A MANIFESTATION OF DUAL COMMANDERS ON A BUS.
TIMEOUT	I/O ERROR LOGGED	BCE STATUS REGISTER - BIT 26 (STATUS WORD FOR BCE 1-24) AN RDS, RDL OR MIN INSTRUCTION TIMED OUT WHILE WAITING FOR A DATA WORD, OTHER THAN THE FIRST, TO ARRIVE. THE BCE EXPECTS A DATA WORD EVERY 33 MICROSECONDS AFTER THE FIRST WORD IS RECEIVED.	1. COMMON I/O ERROR ON CRT BUS WHEN DEU IPL REQUESTED. GPC EXPECTS 16 WORD RESPONSE FROM DEU. DEU IPL PROGRAM RESPONDS WITH ONLY 1 WORD. 2. NOISE ON DATA BUS. 3. DUAL COMMANDERS ON THE DATA BUS. 4. IOP FAILURE OR BTU FAILURE

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SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
V BIT	I/O ERROR LOGGED	BCE STATUS REGISTER - BIT 7 (STATUS WORD FOR BCE 1-24) VALIDITY OF DATA IS SUSPECT. NOTE: STATUS WORD WILL ALSO CONTAIN THE IUA (INTERFACE UNIT ADDRESS) OF THE RECEIVED DATA WORD. EIU: V-BIT IS DISABLED. MDM: V-BIT SET BY NONEXISTENT CHANNEL DETECTED, INTERNAL SCU ERROR, NO TRANSFER INDICATION FROM IDM.	ERROR INDICATION SET IN A BTU (E.G., MMU OR MDM) RESPONSE DATA WORD TO INDICATE THE BTU BITE HAS DETECTED A DATA ERROR OR INTERNAL FAILURE. ADDITIONAL ERROR DATA IS USUALLY AVAILABLE IN THE BTU BITE STATUS REGISTER (BSR).

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SECTION 3 - STATUS REGISTER ERRORS

I/O ERROR CONDITION	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
XMIT DIS	I/O ERROR LOGGED	BCE STATUS REGISTER - BIT 23 (STATUS WORD FOR BCE 1-24) AT SOME POINT IN THE EXECUTION OF A TDS, TDL OR MOUT INSTRUCTION, THE MIA ASSOCIATED WITH THE BCE HAD ITS TRANSMITTER DISABLED AS DETECTED BY BIT 23 OR THE MIA WAS BUSY WHEN IT WAS TIME TO INITIATE TRANSMISSION OF A NEW DATA WORD. (TDS = TRANSMIT DATA SHORT) (TDL = TRANSMIT DATA LONG) (MOUT = MESSAGE OUT)	POSSIBLE INDICATIONS: 1. THE GPC OUTPUT SW IS IN BACKUP OR TERM POSITION 2. DUAL COMMANDERS ON THE BUS (PROCEDURAL ERROR) 3. OPEN BUS CONDITION 4. SOME BTU ON THE BUS CONTINUOUSLY EMITTING DATA 5. IOP FAILURE

APPENDIX G. FAULT SUMMARY PAGE MESSAGES

This Appendix provides a tabled list of Fault Summary Page Messages in alphabetical order. Each error condition is shown with Manifestation, Description, and Possible Causes information.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
AERO DRIVE	A CLASS 3 FAULT MESSAGE (ALERT). THE TEXT IS PRINTED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE. A DOWN ARROW PSI IS DISPLAYED ADJACENT TO THE APPLICABLE ACTUATOR POSITION FEEDBACK PARAMETER ON THE OPS 801 MODE DISPLAY.	DURING THE AEROSURFACE DRIVE TEST IN OPS 8, AN ACTUATOR POSITION FEEDBACK WAS NOT WITHIN TOLERANCE OF ITS COMMAND STIMULUS.	IN GENERAL THIS ERROR INDICATES THE POSSIBILITY OF AN ACTUATOR CONTROL OR HARDWARE PROBLEM. WHENEVER SECONDARY ACTUATOR CHECK IS EXECUTED ON CHANNEL 1, THE FAULT MESSAGE WILL BE GENERATED BECAUSE IT CAUSES A 6 DEGREE DIFFERENCE BETWEEN THE ACTUATOR FEEDBACK POSITION AND THE ACTUATOR COMMAND.
BCE BYP MCIU	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MESSAGE TEXT IS DISPLAYED ON THE MESSAGE LINE AND THE FAULT SUMMARY PAGE. TWO I/O ERRORS ARE LOGGED.	MCIU INTERFACE TO THE SM GPC FAILED DURING THE ACQUISITION OF MCIU DATA	IN GENERAL THIS ERROR INDICATES THE POSSIBILITY OF A MCIU HARDWARE OR GPC TO MCIU COMMUNICATION LINK PROBLEMS. MSG ALSO OCCURS IF MCIU POWER IS OFF.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
BCE BYP PDI	A CLASS 3 FAULT MESSAGE (ALERT). THE MESSAGE TEXT IS DISPLAYED ON THE MESSAGE LINE AND THE FAULT SUMMARY PAGE. TWO I/O ERRORS ARE LOGGED.	TWO CONSECUTIVE I/O ERRORS OCCURRED ON THE PDI INTERFACE TO THE SM GPC. FAILURE DURING THE ACQUISITION OF PDI DATA. PDI SWITCH MATRIX WORD.	IN GENERAL THIS ERROR INDICATES THE POSSIBILITY OF A PDI HARDWARE OR GPC TO PDI COMMUNICATION LINK PROBLEM. MSG ALSO OCCURS IF PDI IS POWERED OFF.
BCE BYP X (X = PL1,PL2)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MESSAGE TEXT IS DISPLAYED ON THE MESSAGE LINE AND THE FAULT SUMMARY PAGE. TWO I/O ERRORS ARE LOGGED.	TWO CONSECUTIVE I/O ERRORS OCCURRED WHEN COMMUNICATING WITH THE PF1/PF2 MDM. BCE BYPASS OF THE PF1/PF2 MDM. NO INPUT COMMUNICATION WITH THE PF1/PF2 MDM OR ASSOCIATED SUBSYSTEM ELEMENTS WILL BE PERFORMED. NO AFFECT ON OUTPUTS TO THE MDM OR ASSOCIATED SUBSYSTEM ELEMENTS. VALID OPS 1/6, 3, 9	POSSIBLE HARDWARE PROBLEMS OVER THE PL1/PL2 BUS LINKAGE OF THE GPC TO THE PF1/PF2 MDM'S, OR HARDWARE PROBLEMS WITH THE PF1/PF2 MDM'S, OR TRANSMITTER/RECEIVER PROBLEMS WITHIN THE IOP.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
BCE STRG 1X (X = A,B,C,D)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MESSAGE TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE. TWO I/O ERRORS ARE LOGGED.	THIS ERROR INDICATES A FAILURE OCCURRED ON THE EXECUTION OF ONE OF THE INPUT PROM SEQUENCES: THE I/O ELEMENT IS BYPASSED. A = FF1 PROM SEG 1-2 B = FF1 PROM SEG 2-6 C = FA1 PROM SEG 1-2 D = FA1 PROM SEG 3-10	IN GENERAL THIS ERROR INDICATES THE POSSIBILITY OF HARDWARE PROBLEMS IN THE COMMUNICATIONS LINK BETWEEN THE GPC AND THE MDM'S AND THE LRU'S THE PROM SEQUENCES READ.
BCE STRG 1X (X = ADTA, TAC, MLS, IMU, MTU, STRK, NSP)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MESSAGE TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE. TWO I/O ERRORS ARE LOGGED.	THIS ERROR INDICATES A FAILURE OCCURRED ON THE READ OF THE SERIAL I/O DEVICE (ADTA, TAC/RA, MLS, IMU, MTU, STKR, NSP) VIA THE FF1 MDM. THIS I/O TRANSACTION VIA THE FF1 MDM TO THE INDICATED LRU IS BYPASSED.	IN GENERAL THIS ERROR INDICATES THE POSSIBILITY OF HARDWARE PROBLEMS IN THE COMMUNICATIONS LINK BETWEEN THE GPC AND THE FF1 MDM AND THE LRU. THE ERROR MAY ALSO INDICATE THE POSSIBILITY OF HARDWARE PROBLEMS WITH THE SERIAL I/O LRU OR THAT THE LRU IS POWERED OFF.
BCE STRG 2X (X = A,B,C,D)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MESSAGE TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON FAULT SUMMARY PAGE. TWO I/O ERRORS ARE LOGGED.	THIS ERROR INDICATES A FAILURE OCCURRED ON THE EXECUTION OF ONE OF THE INPUT PROM SEQUENCES: THE I/O ELEMENT IS BYPASSED. A = FF2 PROM SEG 1-2 B = FF2 PROM SEG 2-6 C = FA2 PROM SEG 1-2 D = FA2 PROM SEG 3-10	IN GENERAL THIS ERROR INDICATES THE POSSIBILITY OF HARDWARE PROBLEMS IN THE COMMUNICATIONS LINK BETWEEN THE GPC AND THE MDM'S AND THE LRU'S THE PROM SEQUENCES READ.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
BCE STRG 2X (X = ADTA, TAC, MLS, IMU, MTU)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MESSAGE TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON FAULT SUMMARY PAGE. TWO I/O ERRORS ARE LOGGED.	THIS ERROR INDICATES A FAILURE OCCURRED ON THE READ OF THE SERIAL I/O DEVICE (ADTA, TAC, MLS, IMU, MTU) VIA THE FF2 MDM. THIS I/O TRANSACTION VIA THE FF2 MDM TO THE INDICATED LRU IS BYPASSED.	IN GENERAL THIS ERROR INDICATES THE POSSIBILITY OF HARDWARE PROBLEMS IN THE COMMUNICATIONS LINK BETWEEN THE GPC AND THE FF2 MDM AND THE LRU. THE ERROR MAY ALSO INDICATE THE POSSIBILITY OF HARDWARE PROBLEMS WITH THE SERIAL I/O LRU OR THAT THE LRU IS POWERED OFF.
BCE STRG 3X (X = A,B,C,D)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MESSAGE TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE. TWO I/O ERRORS ARE LOGGED.	THIS ERROR INDICATES A FAILURE OCCURRED ON THE EXECUTION OF ONE OF THE INPUT PROM SEQUENCES: THE I/O ELEMENT IS BYPASSED. A = FF3 PROM SEG 1-2 B = FF3 PROM SEG 2-6 C = FA3 PROM SEG 1-2 D = FA3 PROM SEG 3-10	IN GENERAL THIS ERROR INDICATES THE POSSIBILITY OF HARDWARE PROBLEMS IN THE COMMUNICATIONS LINK BETWEEN THE GPC AND THE MDM'S AND THE LRU THE PROM SEQUENCES READ.
BCE STRG 3X (X = ADTA, TAC, MLS, IMU, STKR, NSP, MTU)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MESSAGE TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE. TWO I/O ERRORS ARE LOGGED.	THIS ERROR INDICATES A FAILURE OCCURRED ON THE READ OF THE DEVICE (ADTA, TAC/RA, MLS, IMU, STKR, NSP, MTU) VIA THE FF3 MDM. THIS I/O TRANSACTION VIA THE FF3 MDM TO THE INDICATED LRU IS BYPASSED.	IN GENERAL THIS ERROR INDICATES THE POSSIBILITY OF HARDWARE PROBLEMS IN THE COMMUNICATIONS LINK BETWEEN THE GPC AND THE FF3 MDM AND THE LRU. THE ERROR MAY ALSO INDICATE THE POSSIBILITY OF HARDWARE PROBLEMS WITH THE LRU OR THAT THE LRU IS POWERED OFF.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
BCE STRG 4X (X=A,B,C,D)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MSG TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE. TWO I/O ERRORS ARE LOGGED.	THIS ERROR INDICATES A FAILURE OCCURRED ON THE EXECUTION OF ONE OF THE INPUT PROM SEQUENCES: THE I/O ELEMENT IS BYPASSED. A = FF4 PROM SEG 1-2 B = FF4 PROM SEG 2-6 C = FA4 PROM SEG 1-2 D = FA4 PROM SEG 3-10	IN GENERAL THIS ERROR INDICATES THE POSSIBILITY OF HARDWARE PROBLEMS IN THE COMMUNICATIONS LINK BETWEEN THE GPC AND THE MDM'S AND THE LRU THE PROM SEQUENCES READ.
BCE STRG 4 ADTA	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MSG TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE. TWO I/O ERRORS ARE LOGGED.	THIS ERROR INDICATES A FAILURE OCCURRED ON THE READ OF THE ADTA VIA THE FF4 MDM. THIS I/O TRANSACTION VIA THE FF4 MDM TO THE ADTA IS BYPASSED.	IN GENERAL THIS ERROR INDICATES THE POSSIBILITY OF HARDWARE PROBLEMS IN THE COMMUNICATIONS LINK BETWEEN THE GPC AND THE FF4 MDM AND THE ADTA. THE ERROR MAY ALSO INDICATE THE POSSIBILITY OF HARDWARE PROBLEMS WITH THE ADTA OR THAT THE ADTA IS POWERED OFF.
BODY FLAP CYCL	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATOR ON GNC SYS SUMM 1 DISPLAY	BODY FLAP ALERT CYCLE MSG. THE BODY FLAP IS MOVING WITHOUT BEING COMMANDED BY FLIGHT CONTROL. OPS 1/6, 3	NO BODY FLAP COMMAND HAS BEEN ISSUED BY FLIGHT CONTROL BUT THE BODY FLAP IS MOVING AND RM HOLD COMMANDS HAVE NOT STOPPED THE MOVEMENT.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
BODY FLAP FAIL	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATOR ON GNC SYS SUMM 1 DISPLAY	BODY FLAP ALERT FAIL MSG. THE BODY FLAP HAS NOT MOVED AS COMMANDED BY FLIGHT CONTROL. OPS 1/6, 3	FLIGHT CONTROL HAS ISSUED A BODY FLAP COMMAND BUT THE BODY FLAP DOES NOT MOVE AND EITHER A HOLD CONDITION DOES NOT EXIST OR THE HOLD DIRECTION IS DIFFERENT FROM THE BODY FLAP MOTION.
BODY FLAP HOLD	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATOR ON GNC SYS SUMM 1 DISPLAY	BODY FLAP ALERT HOLD MESSAGE. THE BODY FLAP IS MOVING WITHOUT BEING COMMANDED BY FLIGHT CONTROL. OPS 1/6, 3, 2, 8	NO BODY FLAP COMMAND HAS BEEN ISSUED BY FLIGHT CONTROL BUT THE BODY FLAP IS MOVING AND A HOLD COMMAND HAS BEEN ISSUED BY RM TO STOP THE MOVEMENT.
BODY FLAP SW L	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	BODYFLAP DN(UP) SWITCH DISAGREEMENT ON CDR SIDE OF COCKPIT.	1. TWO SWITCH CONTACTS DO NOT AGREE FOR UP OR DOWN POSITION. 2. THE NO OUTPUT STATE OF THE CONTACT IS USED BY FSW.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
BODY FLAP SW R	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	BODYFLAP DN(UP) SWITCH DISAGREEMENT ON PLT SIDE OF COCKPIT.	1. TWO SWITCH CONTACTS DO NOT AGREE FOR THE UP OR DOWN POSITION. 2. THE NO OUTPUT STATE OF THE CONTACT IS USED BY FSW.
CRT BITE X (X=1,2,3,4)	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	THIS ERROR INDICATES A CRITICAL BITE ERROR WAS DETECTED ON THE INDICATED DEU. ONE OR MORE ERRORS WERE DETECTED. A. CPU BITE SOFTWARE FAIL B. KEYBOARD CHANNEL A FAIL C. KEYBOARD CHANNEL B FAIL D. CPU MEMORY PARITY ERROR	IN GENERAL THIS ERROR INDICATES THAT THE DEU HAS DETECTED DEU HARDWARE PROBLEMS.
DAP RECONF	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	ORBIT DOWNFIRING VERNIER JET(S) FAILED OFF/LEAK OR DESELECTED. ORBIT DAP WILL DOWNMODE TO MANUAL IF CURRENTLY IN AUTO. VALID IN OPS 2	HARDWARE MALFUNCTION; CREW OPTION
DISPLAY SW X X = A (AFT) X = R (RIGHT) X = L (LEFT)	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	NO POSITION OR MULTIPLE POSITIONS SELECTED FOR: - THESE SWITCHES IN OPS 1/6, 2, 3, AND 8: • LH/RH ADI RATE SWITCH (HIGH/MED/LOW - DEFAULT IS MED) • LH/RH ADI ERROR SWITCH (HIGH/MED/LOW - DEFAULT IS MED)	1. HARDWARE MALFUNCTION 2. SHORTED OR OPEN SWITCH CONTACT(S) 3. DR 25074: I/O RESET WITH BCE ELEMENTS POWERED DOWN WILL CAUSE COMMFAULT, AND IF DISPLAY SWITCH PROCESSOR IS RUNNING AT THE SAME TIME, THIS FSP MESSAGE WILL OCCUR.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
DISPLAY SW X X = A (AFT) X = R (RIGHT) X = L (LEFT) (CONTINUED)		• LH/RH ADI ATT SEL SWITCH (INRTL/LVLH/REF - DEFAULT IS LVLH) • LH/RH HSI MODE SWITCH (ENTRY/TAEM - DEFAULT IS ENTRY) • LH/RH HSI SOURCE SWITCH (TACAN/NAV/MLS - DEFAULT IS NAV) • LH/RH HSI TRANS SWITCH (1/2/3 - DEFAULT IS 3) - THESE ADDITIONAL SWITCHES IN OPS 2 AND 8: • AFT ADI RATE SWITCH (HIGH/MED/LOW - DEFAULT IS MED) • AFT ADI ERROR SWITCH (HIGH/MED/LOW - DEFAULT IS MED) • AFT ADI ATT SEL SWITCH (INRTL/LVLH/REF - DEFAULT IS LVLH) - THESE ADDITIONAL SWITCHES IN OPS 3 AND 6: • LH/RH AIR DATA SWITCH (LEFT/NAV/RIGHT - DEFAULT IS NAV) • LH/RH RADAR ALT SWITCH (1/2 - DEFAULT IS 1) AN INPUT PROM SEQ 1, 2 COMMFAULT ON - FF1 (LEFT) - FF2 (RIGHT) - FF3 (AFT)	

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
ET SEP-AUT	CLASS 3 MESSAGE APPEARS ON MESSAGE LINE AND FAULT SUMMARY. SM ALERT LIGHT IS LIT. SM TONE IS SOUNDED	ET SEP MODE SWITCH RM FAILURE THE SWITCH CONTACTS FOR ET SEP SWITCH INDICATE BOTH POSITIONS OR NEITHER POSITION. DEFAULT POSITION AUTO IS USED. VALID IN OPS 6 ONLY	
ET SEP-INH	CLASS 3 MESSAGE APPEARS ON MESSAGE LINE AND FAULT SUMMARY. SM ALERT LIGHT IS LIT. SM TONE IS SOUNDED.	ET SEPARATION IS INHIBITED DUE TO FAILURE TO SATISFY ONE OR MORE SEPARATION CRITERIA.	IN OPS 1 ET SEP-INH COULD BE CAUSED BY BODY RATES AND THE CONFIGURATION OF THE FEEDLINE DISCONNECT VALVES. IN OPS 6 BODY RATES, ALPHA AND BETA, AND THE CONFIGURATION OF THE FEEDLINE DISCONNECT VALVES COULD CAUSE SEP-INH.
ET SEP-MAN	CLASS 3 MESSAGE APPEARS ON MESSAGE LINE AND FAULT SUMMARY. SM ALERT LIGHT IS LIT. SM TONE IS SOUNDED.	ET SEP MODE SWITCH RM FAILURE THE SWITCH CONTACTS FOR THE ET SEP SWITCH INDICATE BOTH POSITIONS OR NEITHER POSITION. DEFAULT POSITION MANUAL IS USED. VALID IN OPS 1 ONLY	

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
FCS CH X (X = 1,2,3,4)	A CLASS 2 FAULT MESSAGE (CAUTION WARNING). FCS CHANNEL CAUTION AND WARNING LIGHT ON. CAUTION AND WARNING TONE. A DOWN ARROW WILL BE DISPLAYED ON SYSTEM SUMMARY DISPLAY.	FCS CHANNEL FAILED (EXCEEDED DELTA PRESSURE).	ANY OF THE FOLLOWING CHANNEL FAILS WILL CAUSE MESSAGE: 1. SRB ROCK OR TILT ACTUATOR CHANNEL A, (B,C,D) FAILED OR MPS ENG PITCH OR YAW ACTUATOR CHANNEL A, B, C FAILED. 2. ELEVON, RUDDER OR SPEEDBRAKE ACTUATOR CHANNEL A, B, C, OR D FAILED. 3. ELECTRONICS FAILURE IN ASA OR ATVC.
FCS SAT MOM	A CLASS 2 FAULT MESSAGE (CAUTION WARNING): • MASTER ALARM LIGHT • C&W TONE • BACKUP C/W ALARM LIGHT ON THE CAUTION AND WARNING MATRIX • FCS SATURATION LIGHT ON THE CAUTION AND WARNING MATRIX • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATOR ON GNC SYS SUMM 1 DISPLAY	FCS HINGE MOMENT (HM) EXCEED MSG. THE ELEVON PRIMARY DELTA PRESSURE HAS EXCEEDED A PREDEFINED SET OF LIMITS.	THE ELEVON PRIMARY DELTA PRESSURE WHICH IS USED BY THE GPC TO CALCULATE ELEVON HINGE MOMENT (MOM) HAS EXCEEDED A LIMIT OF 80 PERCENT (±2400 PSI). THIS PRESSURE IS THE HYDRAULIC PRESSURE WITHIN THE AEROSURFACE PRIMARY ACTUATOR.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
FCS SAT POS	A CLASS 2 FAULT MESSAGE (CAUTION WARNING): • MASTER ALARM LIGHT • C&W TONE • BACKUP C/W ALARM LIGHT ON THE CAUTION AND WARNING MATRIX • FCS SATURATION LIGHT ON THE CAUTION AND WARNING MATRIX • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATOR ON GNC SYS SUMM 1 DISPLAY	FCS POSITION SATURATION MSG. THE ELEVON POSITION FEEDBACK HAS EXCEEDED A PREDEFINED SET OF LIMITS.	THE ELEVON POSITION FEEDBACK WHICH IS USED FOR FLIGHT CONTROL PURPOSES HAS EXCEEDED THE LIMIT OF 12 DEGREES IN THE POSITIVE DIRECTION OR 15 DEGREES IN THE NEGATIVE DIRECTION.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
F RCS XJET X = F (FORWARD) X = U (UP) X = D (DOWN) X = L (LEFT) X = R (RIGHT)	CLASS 2 MESSAGE ON MESSAGE LINE AND FAULT SUMMARY PAGE. RCS JET CAUTION AND WARNING LIGHT ON. C/W TONE ON. AN "OFF", "ON", OR "LK" STATUS DISPLAYED ON THE RCS SPEC. STATUS ALSO DISPLAYED ON SYSTEM SUMMARY.	THIS ERROR DESCRIBES THE FAIL STATUS OF THE X MANIFOLD OF THE FORWARD POD. RM WILL AUTOMATICALLY DESELECT JETS FAILED OFF OR LEAKING, BUT WILL NOT AUTOMATICALLY DESELECT JETS FAILED ON. OPS 1/6, 2, 3, 8	A FORWARD POD X JET HAS EITHER FAILED OFF, FAILED ON, OR FAILED LEAK. PASS DAP USES THE FOLLOWING RM LOGIC: 1. DRIVER OUTPUT INDICATION IS ON WHILE COMMAND B IS OFF, INDICATING A JET FAILED ON. 2. PROPELLANT INJECTOR TEMPERATURE IS LOW, INDICATING A LEAKING JET. 3. CHAMBER PRESSURE INDICATION IS OFF WHILE COMMAND B IS ON, INDICATING A JET FAILED OFF.
F RCS HE P	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	ORBIT THE PRESSURE IN THE HELIUM TANK FOR THE FORWARD RCS FUEL OF OXIDIZER TANK IS BELOW LIMIT.	
F RCS LEAK	A CLASS 2 FAULT MESSAGE (CAUTION WARNING). FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, CLASS 2 ALARM, C/W LIGHT ON	ORBIT/ENTRY FORWARD RCS: DIFFERENCE BETWEEN FUEL AND OXIDIZER QUANTITIES EXCEEDS THE LEAK DETECTION LIMIT	A LEAK IN ONE PROPELLANT TANK; OX/FU DELTA QUANTITY GREATER THAN 12.6%

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
F RCS PVT	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	ORBIT/ENTRY FORWARD RCS FUEL OR OXIDIZER	QUANTITY CALCULATION SUSPENDED. THIS IS DUE TO BOTH PRIMARY AND SUBSTITUTE SOURCE OF THE MEASUREMENT NEEDED FOR RCS TANK QUANTITY ARE COMMFAULTED AND NOT AVAILABLE.
F RCS TK P	A CLASS 2 FAULT MESSAGE (CAUTION WARNING): • MASTER ALARM LIGHT • C&W TONE • BACKUP C/W ALARM LIGHT ON THE CAUTION AND WARNING MATRIX	ORBIT THE PRESSURE IN THE RCS FORWARD FUEL OR OXIDIZER TANK IS BELOW LIMIT OR EXCEEDS LIMIT	
G23 OMS/RCS QTY	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	ORBIT THE AMOUNT OF OMS PROPELLANT USED EXCEEDS THE LIMIT DURING AN OMS/RCS INTERCONNECT	LARGE AMOUNT OF MANEUVER ACTIVITY; LEAKAGE DURING A LONG PERIOD OF INTERCONNECT.
G23 RCS SYSTEM X X = L (LEFT AFT) X = R (RIGHT AFT) X = F (FWD)	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	ORBIT AT LEAST ONE OF THE FOLLOWING IS EITHER BELOW LIMIT OR EXCEEDS LIMIT: RCS-X FU TANK OUT PRESS RCS-X OX TANK OUT PRESS RCS-X FU TANK TEMP 1 RCS-X OX TANK TEMP 1	

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
G33 RNDZ RADAR	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	ORBIT RENDEZVOUS RADAR LOSES TRACK ON A TARGET WHILE IN GPC ACQUISITION MODE	TARGET MOVES OUT OF RANGE; HARDWARE MALFUNCTION
G51 RL MODE SW	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	ASCENT/ENTRY ENTRY ROLL MODE SWITCH: NUMBER OF CONTACTS SET FOR AILERON POSITION DISAGREES WITH NUMBER SET FOR YAW JET/RUDDER POSITION; DEFAULT IS POSITION WITH THE HIGHER NUMBER OF CONTACTS	HARDWARE MALFUNCTION
GPC BITE X (X = 1,2,3,4,5)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MSG TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE. A POSSIBLE GPC ERROR IS LOGGED.	WHILE PERFORMING NORMAL GPC PROCESSING, THE GPC ENCOUNTERED A PROGRAM OR SYSTEM INTERRUPT WHICH WAS GENERATED DUE TO AN IMPROPER SPECIFICATION OR USE OF INSTRUCTIONS OR DATA. ONE OF THE FOLLOWING CAUSED THIS "BITE" CONDITION: - ILLEGAL OPERATION CODE (GPC ERROR GP 3 CODE 0). - CPU ADDRESS SPECIFICATION (GPC ERROR GP 3 CODE 3). - PRIVILEGED INSTRUCTION. (GPC ERROR GP 3 CODE 1) - INSTRUCTION MONITOR (GPC ERROR GP 3 CODE 20) - I/O STORE PROTECT VIOLATION (GPC ERROR GP 5 CODE 4).	IN GENERAL THIS ERROR INDICATES THE POSSIBILITY OF A PROGRAMMING ERROR OR HARDWARE ERROR. UNDER NO CONDITIONS WOULD THIS ERROR BE EXPECTED. - USER NOTE 52102.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
GPC BITE X (X = 1,2,3,4,5) (CONTINUED)		- I/O ADDRESS SPECIFICATION (GPC ERROR GP 5 CODE 3). - CPU STORE PROTECT (GPC ERROR GP3 CODE 7) UPON RECEIVING THIS ERROR, THE GPC WILL "FORCE CLOSE" ON THE SPECIFIC APPLICATION TASK IT WAS EXECUTING AT THAT TIME AND MOVE TO THE NEXT APPLICATION HIGHEST PRIORITY TASK READY TO RUN.	
GPC CONF	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MSG TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE.	AN OPS TRANSITION WAS REQUESTED THAT SPECIFIED AN INVALID TARGET GPC.	THE OPS TRANSITION SPECIFIED A TARGET GPC THAT WAS NOT IN THE REDUNDANT OR COMMON SET OR OPS ZERO. MOST LIKELY CAUSED BY A PROCEDURAL ERROR.
GPC X (X = 1,2,3,4,5)	A CLASS 2 ANNUNCIATION MESSAGE IS ISSUED. THE MSG TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE. THE APPROPRIATE CAM LIGHT WILL ALSO BE LIT.	GPC X HAS FAILED TO SYNC WITH OTHER GPC'S. THE GPC'S WHICH HAVE FAILED TO SYNC WITH GPC X WILL BE IDENTIFIED IN THE GPC COLUMN ON THE FSP AND ALSO BY THE CAM LIGHTS.	IN GENERAL A GPC MAY BE FAILED TO SYNC BECAUSE OF SOFTWARE ERRORS, GPC/IOP HARDWARE FAILURES OR THE DETECTION OF A GPC BEING MODED TO STANDBY/HALT OR POWERED OFF. AI COLLISION AVOIDANCE CHECKS COULD CAUSE A FTS DUE TO THE USE OF POSITION FEEDBACK DATA OBTAINED FROM THE PCMMU VIA INDIVIDUAL READS BY EACH GPC. DR 25187

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
GPC X (X = 1,2,3,4,5) (CONTINUED)			IF CONTINUOUS LDB ERRORS AND THE ASSOCIATED TOGGLING IS OCCURRING AND AN OPS TRANSITION WITH SECONDARY GPC'S IS REQUESTED, A FTS MAY RESULT. DR 28350
> 3 DEU	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MSG TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE.	AN ATTEMPT WAS MADE TO ASSIGN A FOURTH DEU TO THE COMMAND SET.	THE MESSAGE IS ANNUNCIATED WHEN AN ATTEMPT IS MADE TO ASSIGN A FOURTH DEU TO A GPC IN THE COMMON SET. MOST LIKELY CAUSED BY PROCEDURAL ERROR.
HIGH G	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • HIGH G INDICATOR ON HORIZ SIT DISPLAY • HIGH G INDICATOR ON HUD	THE TOTAL LOAD IN MM 304 OR NORMAL ACCELERATION IN MM 305, 602, 603 HAS BEEN EXCEEDED.	WHEN THE APPROPRIATE G DATA IS GREATER THAN THE I-LOADED LOAD FLASH VALUE, A HIGH-G INDICATOR IS SET ON FOR THE HORIZONTAL SITUATION DISPLAY AND A HIGH-G INDICATOR IS SET ON FOR THE HUD. WHEN THE APPROPRIATE LOAD DATA IS GREATER THAN THE ILOADED LOAD LIMIT, A HIGH-G INDICATOR IS SET ON FOR GAX. BELOW THE LOAD FLASH VALUE ALL 3 HIGH-G INDICATORS ARE OFF.

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ILLEGAL ENTRY	A CLASS 5 ANNUNCIATION MESSAGE ON THE MESSAGE LINE OF THE CRT ATTACHED TO THE OFFENDING KEYBOARD.	THIS GENERIC MESSAGE IS GENERATED WHEN SOME SOFTWARE KEYBOARD INTERFACE HAS BEEN VIOLATED.	ILLEGAL KYDB ENTRY WITH RESPECT TO OPS SELECT/TRANSITION, DATA LOAD, INITIALIZATION, MEMORY RECONFIGURATION, GPC ASSIGN, KYBD SYNTAX, FREEZE DRY LOAD, ETC. THE ENTRY IS REJECTED AND THE REQUESTED ACTION(S) IS NOT TAKEN. USUALLY CAUSED BY USER INPUT ERROR.
I/O ERROR X (X = CRT1, CRT2, CRT3, CRT4)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MSG TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE. ONE OR MORE I/O ERRORS ARE LOGGED.	A SINGLE I/O ERROR HAS OCCURRED ON AN I/O TRANSACTION WITH THE INDICATED DEU.	IN GENERAL THIS ERROR IS CAUSED BY DEU HARDWARE PROBLEMS OR BY A DEU THAT HAS NO POWER, OR BY TRANSMITTER/RECEIVER PROBLEMS IN THE IOP. IF A DEU IPL SWITCH IS ENTERED JUST PRIOR TO A POLL BY THE GPC, THE DCP MAY BE BUSY EXECUTING THE IPL SOFTWARE AND UNABLE TO RESPOND TO THE POLL REQUEST. THIS MAY RESULT IN AN INITIAL TIME-OUT OR INTERWORD TIME-OUT OF THE POLL REQUEST WHICH CAUSES THE FAULT MESSAGE TO BE ANNUNCIATED. DR 37706
I/O ERROR X (X = FA1, FA2, FA3, FA4, FF1, FF2, FF3, FF4, LA1, LF1, PL1, PL2)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MSG TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE. ONE OR MORE I/O ERRORS ARE LOGGED.	THIS ERROR INDICATES A FAILURE OCCURRED ON THE MDM RETURN WORD READ. BCE BYPASS (WHOLE MDM BYPASS) DUE TO TWO CONSECUTIVE I/O ERROR MDM RETURN WORDS.	THE ERROR MAY BE THE RESULT OF DATA BUS PROBLEMS OR HARDWARE PROBLEMS AT THE MDM. A TRANSMITTER/RECEIVER PROBLEM IN THE IOP WILL ALSO GENERATE THE MESSAGE.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
I/O ERROR MMU X (X=1,2)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MSG TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE. ONE OR MORE I/O ERRORS ARE LOGGED.	THIS ERROR INDICATES A FAILURE OCCURRED ON A READ OR WRITE TRANSACTION TO THE MMU OR AN INTERNAL MMU ELECTRONICS FAILURE. THIS ERROR INDICATES THE GPC IS UNABLE TO PROPERLY COMMUNICATE WITH THE MMU DUE TO ONE OF THE FOLLOWING FAILURES: - INITIAL TIMEOUT - TIMEOUT - PARITY - BLOCK TIMEOUT ON MM DATA - ILLEGAL OPCODE - FAILED OR POWERED DOWN MM - MM SELECTED FOR IPL - CHECKSUM ERROR - BUS BUSY/CHECKSUM BUFFER RESERVED - ERROR ON MM X (BUS 18 OR 19) - MSC TIMEOUT. - I/O ADDRESS SPECIFICATION (GPC ERROR GP 5 CODE 3). THIS ERROR IS ANNUNCIATED ON THE FIRST I/O ERROR FROM THE INDICATED MMU.	THIS ERROR MAY OCCUR DURING AN OPS TRANSITION IF A MM IS DOWN, SELECTED FOR IPL, OR CONFLICTING MM OPERATIONS ARE ACTIVE (DR 33268). THIS ERROR MAY ALSO OCCUR DURING AN OPS TRANSITION IF ANY OF THE FOLLOWING MMU FUNCTIONS ARE ACTIVE (DR 15620): - DEU IPL - GPC IPL (PASS OR BFS) - FREEZE DRY - OPS TRANSITION IN ANOTHER GPC - DISPLAY FORMAT OVERLAY (SM2 ONLY) - CHECKPOINT - PCMMU FORMAT RETRIEVAL - TCS SEQ READ OR WRITES TO MMU - MM DUMPS - IMU CALIBRATION REQUESTS IF A MM PREPOSITION OPERATION FAILS DURING AN OPS TRANSITION, SPEC 000 WILL NOT COME UP (DR 25372). IF MM ERRORS OCCUR DURING AN OPS TRANSITION, THERE MAY BE MORE ERRORS LOGGED THAN THERE ARE ANNUNCIATION MESSAGES (DR 28364). THE MMU MUST BE POWERED ON AT LEAST 34 SECONDS PRIOR TO ATTEMPTING ACCESS, OTHERWISE A MMU I/O ERROR MAY OCCUR (DR 33749).

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
I/O ERROR MMU X (X = 1,2) (CONTINUED)			FOLLOWING A MM MSC T/O, RESIDUAL DATA COULD BE PICKED UP INSTEAD OF MM BSR CONTENT DURING THE TRAILING BITE STATUS READ. THIS WOULD BE VISIBLE ON THE MM R/W SPEC AND IN DOWNLIST (DR 55345). IF A SIMPLEX GPC SUSTAINS THIS ERROR, AN I/O ERROR WHICH SHOULD BE LOGGED AS AN INITIAL TIMEOUT WILL BE ERRONEOUSLY LOGGED AS AN MSC TIMEOUT.
IMU BITE/T X X = 1,2,3	A CLASS 3 FAULT MESSAGE (ALERT). FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED.	ASCENT/ORBIT/ENTRY HARDWARE OR SOFTWARE DETECTED FAULT: HARDWARE - DATA GOOD NOT SET; - COMMAND WORD TRANSMISSION FAILURE; - PLATFORM/CAPRI TEMPERATURE NOT READY/SAFE SOFTWARE - REDUNDANT AXIS RATE FAILURE; - INNER ROLL LIMIT FAILURE; - TORQUE COMMAND FAILURE; - SLEW COMMAND FAILURE; - ACCELEROMETER GAIN SETTING FAILURE; - VELOCITY LIMIT FAILURE OPS 1/6, 2, 3	1. IMU POWERED OFF 2. HARDWARE MALFUNCTION 3. INCORRECT ILOADS 4. UNACCEPTABLE TEMPERATURE CONDITION 5. DR'S 42574, 43940, 50235, AND 56091.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
L OMS GMBL	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, OMS TVC ALERT LIGHT ON, A DOWN ARROW BY THE FAILED ACTUATOR, AND SM ALERT TONE SOUNDED.	ASCENT/ORBIT/ENTRY THE DIFFERENCE BETWEEN THE POSITION COMMAND AND FEEDBACK FOR AN OMS PITCH OR YAW ACTUATOR FOR THE LEFT POD REMAINS GREATER THAN 2 DEGREES FOR AT LEAST 3.84 SECONDS. THIS IMPLIES THE ACTUATOR EITHER DOES NOT DRIVE WHEN COMMANDED OR THE DRIVE RATE IS LESS THAN 2.9 DEG/SEC.	SLOW DRIVE RATES OF OMS GIMBAL ACTUATOR, FAILURE TO DRIVE AT ALL, OR FAILURE OF THE POSITION MEASUREMENT SEEN BY THE GPC.
L OMS PC	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED. CLASS 2 ALARM	ASCENT/ORBIT/ENTRY LEFT OMS ENGINE: CHAMBER PRESSURE FALLS BELOW LIMIT AFTER AN ENGINE FAILURE	HARDWARE MALFUNCTION PC LESS THAN 80%
L OMS QTY	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED. CLASS 3 ALARM	ASCENT/ORBIT/ENTRY LEFT OMS POD: TANK LOW LEVEL CONDITION DETECTED FOR FUEL OR OXIDIZER	1. CONSUMPTION OF PROPELLANT(S) 2. LEAKAGE QUANTITY LESS THAN 5%

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"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

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L OMS VLV	LASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED. CLASS 3 ALARM	ORBIT A HELIUM AND/OR VAPOR ISOLATION VALVE REMAINS OPEN AFTER REPRESSURIZATION DURING A LEFT OMS/RCS INTERCONNECT	1. HARDWARE MALFUNCTION 2. OPEN SIGNAL ON ONE OF FOUR VALVES AFTER 1/5 SECOND DELAY.
L RCS XJET X = A (AFT) X = U (UP) X = D (DOWN) X = L (LEFT)	CLASS 2 MESSAGE ON MESSAGE LINE AND FAULT SUMMARY PAGE. RCS JET CAUTION AND WARNING LIGHT ON. C/W TONE SOUNDED. AN "OFF", "ON", OR "LK" STATUS DISPLAYED ON THE RCS SPEC. STATUS ALSO DISPLAYED ON SYSTEM SUMMARY.	THIS ERROR DESCRIBES THE FAIL STATUS OF THE X MANIFOLD OF THE LEFT POD. RM WILL AUTOMATICALLY DESELECT JETS FAILED OFF OR LEAKING, BUT WILL NOT AUTOMATICALLY DESELECT JETS FAILED ON. OPS 1/6, 2, 3, 8	A LEFT POD X JET HAS EITHER FAILED OFF, FAILED ON, OR FAILED LEAK. PASS DAP USES THE FOLLOWING RM LOGIC: 1. DRIVER OUTPUT INDICATION IS ON WHILE COMMAND B IS OFF, INDICATING A JET FAILED ON. 2. PROPELLANT INJECTOR TEMPERATURE IS LOW, INDICATING A LEAKING JET. 3. CHAMBER PRESSURE INDICATION IS OFF WHILE COMMAND B IS ON, INDICATING A JET FAILED OFF.
L RCS HE P	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	ORBIT THE PRESSURE IN THE HELIUM TANK FOR THE LEFT AFT RCS FUEL OR OXIDIZER TANK IS BELOW LIMIT.	

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L RCS LEAK	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, CLASS 2 ALARM C/W LIGHT ON	ORBIT/ENTRY LEFT AFT RCS: DIFFERENCE BETWEEN FUEL AND OXIDIZER QUANTITIES EXCEEDS THE LEAK DETECTION LIMIT	1. A LEAK IN ONE PROPELLANT TANK 2. OX/FU DELTA QUANTITY GREATER THAN 12.6%
L RCS PVT	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	ORBIT/ENTRY LEFT AFT RCS FUEL OR OXIDIZER	QUANTITY CALCULATION SUSPENDED. THIS IS DUE TO BOTH PRIMARY AND SUBSTITUTE SOURCE OF THE MEASUREMENT NEEDED FOR RCS TANK QUANTITY ARE COMMFAULTED AND NOT AVAILABLE.
L RCS TK P	A CLASS 2 FAULT MESSAGE (CAUTION WARNING): • MASTER ALARM LIGHT • C&W TONE • BACKUP C/W ALARM LIGHT ON THE CAUTION AND WARNING MATRIX	ORBIT THE PRESSURE IN THE RCS LEFT AFT FUEL OR OXIDIZER TANK IS BELOW LIMIT OR EXCEEDS LIMIT.	

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MDM OUTPUT X (X = FA1, FA2, FA3, FA4, FF1, FF2, FF3, FF4, PL1, PL2)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MSG TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE.	THE MDM RETURN WORD DID NOT COMPARE WITH THE EXPECTED PATTERN. THREE CONSECUTIVE MISCOMPARES WERE DETECTED. OPS 1/6, 2, 3	THE ERROR MAY BE THE RESULT OF DATA BUS PROBLEMS, HARDWARE PROBLEMS AT THE MDM, OR IOP FAILURE. NOTE: MDM OUTPUT PL1(2) ONLY VALID DURING ACTIVE G1 TRANSITION TO BFS TO RUN.
ME SHDN SW X (X = C,L,R)	CLASS 3 MESSAGE APPEARS ON THE MESSAGE LINE AND FAULT SUMMARY. SM ALERT LIGHT IS LIT AND SM TONE SOUNDED.	THE TWO SWITCH CONTACTS OF THE APPROPRIATE MAIN ENGINE SHUTDOWN PUSHBUTTON DISAGREE.	SWITCH FAILURE, CONTROL BUS FAILURE, OR MDM FAILURE. IF THIS OCCURS UPON PRESSING THE PUSHBUTTON TO SHUTDOWN THE RESPECTIVE SSME, THE GPC WILL NOT ISSUE THE SHUTDOWN COMMAND.
MPS CMD X (X = C,L,R)	CLASS 3 MESSAGE APPEARS ON MESSAGE LINE AND FAULT SUMMARY. SM ALERT LIGHT IS LIT AND SM TONE SOUNDED. IN MM 102-103 AND 601. THE AMBER ENGINE STATUS LIGHT COMES ON.	MAIN ENGINE COMMAND PATH FAILURE POST SRB IGNITION, THE SSME SOP WILL POST THIS FAILURE MESSAGE UNDER THE FOLLOWING CONDITIONS: 1. THE GPC SENT A COMMAND TO THE SSMEC, AND THE SSMEC REJECTED IT. 2. THE GPC SENT A COMMAND TO THE SSMEC, AND THE SSMEC DID NOT RESPOND WITHIN THREE CYCLES.	THE SSMEC WILL REJECT A COMMAND IF IT IS NOT COMPATIBLE WITH THE CURRENT PHASE/MODE. POST SRB IGNITION, THE SSMEC VOTES 2 OF 3 ON ALL COMMANDS, SO A COMBINATION OF TWO OF THE FOLLOWING FAILURES THAT CAUSE A LOSS OF TWO CHANNELS TO THE SSMEC WILL CAUSE THIS MESSAGE: 1. GPC FAILURES (E.G., MIA FAULT, HALT, ETC.) - GPC 1 OR 2 FOR SSME1 (CENTER) - GPC 2 OR 3 FOR SSME2 (LEFT) - GPC 1 OR 3 FOR SSME3 (RIGHT)

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MPS CMD X (X = C,L,R) (CONTINUED)		3. THE SSMEC INDICATES IT HAS ACCEPTED A COMMAND BUT THE GPC DID NOT ISSUE ONE.	2. FLIGHT CRITICAL BUS FAILURES - FC 5 OR 6 FOR SSME1 - FC 6 OR 7 FOR SSME2 - FC 5 OR 7 FOR SSME3 3. EIU FAILURES (E.G., MIA FAULT, CIA FAULT, P.S. FAILURE OR STATUS BUFFER FAILURE.) 4. SSMEC FAILURES, FOR EXAMPLE: - DCU HALT - VEEI COMMAND CHANNEL A, B, OR C FAILURE - POWER INPUT OR SUPPLY FAILURE - AC 1 OR 2 (SSME1) - AC 2 OR 3 (SSME2) - AC 1 OR 3 (SSME3) 5. SSMEC TO EIU DATA BUS FAILURE. SSME IS SHUTDOWN MANUALLY VIA COCKPIT SSMEC POWER SWITCHES FOR COMMAND PATH FAILURE.
MPS DATA X (X = C,L,R)	CLASS 3 MESSAGE APPEARS ON MESSAGE LINE AND FAULT SUMMARY. SM ALERT LIGHT IS LIT AND SM TONE SOUNDED. IN MM 102-103 AND 601. THE AMBER ENGINE STATUS LIGHT COMES ON.	MAIN ENGINE FLIGHT DATA PATH FAILURE THE SSME SOP WILL DECLARE THIS FAILURE AFTER THE FOLLOWING SEQUENCE OF EVENTS OCCUR: 1. BOTH THE PRIMARY AND SECONDARY DATA PATHS ARE FAILED FOR FOUR CYCLES.	A COMBINATION OF TWO OF THE FOLLOWING FAILURES THAT CAUSE A LOSS OF BOTH DATA PATHS WILL CAUSE THIS FSP MESSAGE: FAILURES THAT CAUSE PRIMARY DATA PATH FAILURES: 1. GPC FAILURES (EG. MIA FAULT, HALT, ETC.) - GPC 1 FAILURE FOR SSME 1 - GPC 2 FAILURE FOR SSME 2 - GPC 3 FAILURE FOR SSME 3

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MPS DATA X (X = C,L,R) (CONTINUED)		2. A SWITCH VDT COMMAND IS ISSUED TO THE SSMEC. 3. BOTH THE PRIMARY AND SECONDARY DATA PATHS ARE STILL FAILED FOR FOUR CYCLES. A PRIMARY OR SECONDARY DATA PATH FAILURE IS DECLARED WHEN THE SSME CONTROLLER'S TIME REFERENCE WORD IS NOT UPDATING OR ID WORDS 1 AND 2 ARE NOT 1'S COMPLEMENT OF EACH OTHER FOR TWO CONSECUTIVE CYCLES.	2. FLIGHT CRITICAL BUS 5 FAILURE FOR SSME 1 FLIGHT CRITICAL BUS 6 FAILURE FOR SSME 2 FLIGHT CRITICAL BUS 7 FAILURE FOR SSME 3 3. EIU FAILURES - MIA 1 FAULT - CIA 1 FAULT - STATUS BUFFER 1 FAULT - POWER SUPPLY CHANNEL A FAILURE 4. SSMEC FAILURES - DCU A HALT - VEEI CH A RECORDER DATA FAILURE - CH A POWER INPUT OR SUPPLY FAILURE -- SSME1/AC1, SSME2/AC2, SSME3/AC3 5. SSMEC TO EIU PRIMARY DATA BUS FAILURE. FAILURES THAT CAUSE SECONDARY DATA PATH FAILURES: 1. GPC 4 FAILURE 2. FLIGHT CRITICAL BUS 8 FAILURE 3. EIU FAILURES - MIA 2 FAULT - CIA 2 FAULT - STATUS BUFFER 2 FAULT - POWER SUPPLY CHANNEL B FAILURE 4. SSMEC FAILURES - DCU B HALT - VEEI CH B RECORDER - CH B POWER INPUT OR SUPPLY FAILURE -- SSME1/AC2, SSME2/AC3, SSME3/AC1

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"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
MPS ELEC X (X = C,L,R)	CLASS 3 MESSAGE APPEARS ON MESSAGE LINE AND FAULT SUMMARY. SM ALERT LIGHT IS LIT. SM TONE IS SOUNDED. IN MM 102-103 AND 601 WILL CAUSE AN AMBER ENGINE STATUS LIGHT.	MAIN ENGINE ELECTRONIC LOCKUP. IF BOTH CHANNELS OF THE FUEL FLOWRATE OR Pc MEASUREMENTS ARE DISQUALIFIED DURING THE START OR MAINSTAGE PHASES, THE SSME CONTROLLER MODES TO ELECTRONIC LOCKUP. IN THIS MODE THE THRUST LEVEL IS HELD AT THE LAST COMMANDED STATE. VALID IN MM101, 102, AND 103.	OPEN OR SHORT IN HARNESSES OR TRANSDUCERS. ALSO A LOSS OF ONE INPUT ELECTRONICS IN ONE CHANNEL AND THE ABOVE IN THE OTHER CHANNEL. PRE-LAUNCH: LAUNCH HOLD/ABORT AND ENGINE STATUS LIGHT. POST-LAUNCH: ENGINE STATUS LIGHT.
MPS HYD X (X = C,L,R)	CLASS 3 MESSAGE APPEARS ON MESSAGE LINE AND FAULT SUMMARY. SM ALERT LIGHT IS LIT. SM TONE IS SOUNDED. IN MM 102-103 AND 601 WILL CAUSE AN AMBER ENGINE STATUS LIGHT.	MAIN ENGINE HYDRAULIC LOCKUP IF BOTH CHANNELS OF THE SSME ACTUATORS FAIL DURING THE START AND MAINSTAGE PHASES, THE SSME CONTROLLER MODES TO HYDRAULIC LOCKUP. IN THIS MODE THE THRUST LEVEL IS HELD BY HYDRAULICALLY LOCKING THE ACTUATORS AT THE POSITION WHEN THE FAILURE OCCURRED.	PRE-LAUNCH: LAUNCH ABORT AND STATUS LIGHT. POST-LAUNCH: ENGINE STATUS LIGHT. POSSIBLE CAUSES COULD INCLUDE A COMBINATION OF THE FOLLOWING FAILURES: - HYDRAULIC SYSTEMS FAILURE IN THE MAIN ENGINE OR ORBITER - FAILURE OF THE RVDT FEEDBACKS - OUTPUT ELECTRONICS FAILURE (ON ONLY ONE CHANNEL) - OPEN OR SHORT IN THE HARNESSES BETWEEN THE SSMEC AND ACTUATORS - FAILURE OF SERVOS OR SERVO-SWITCHES ON THE ACTUATOR - VALVE SEIZURE

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS" "CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"			
ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
NAV EDIT ALT	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • EDIT HISTORY INDICATOR ON HORIZ SIT DISPLAY	DRAG OR ADTA ALTITUDE DATA IS INSUFFICIENT FOR PROCESSING BELOW MACH 2.5 AND ABOVE AN I-LOADED ALTITUDE LIMIT.	THE AIR DATA PROBES ARE NOT DEPLOYED. THE PROBE-SENSED ALTITUDE (ADTA H) IS IN THE INHIBIT MODE (INH) MODE ON THE HORIZ SIT DISPLAY. NO AIR DATA TRANSDUCER ASSEMBLIES (ADTA'S) ARE FUNCTIONAL. THREE OUT OF THE LAST FOUR ALTITUDE MEASUREMENTS FROM THE AIR DATA SENSOR OR DRAG ALTITUDE PROCESSOR HAVE FAILED THE EDIT TEST.
NAV EDIT TAC	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • EDIT HISTORY INDICATOR ON HORIZ SIT DISPLAY	TACAN SENSOR DATA IS INSUFFICIENT FOR PROCESSING ABOVE AN I-LOADED ALTITUDE LIMIT.	THREE OUT OF THE LAST FOUR RANGE/BEARING MEASUREMENTS FROM THE TACAN SENSOR HAVE FAILED THE RESIDUAL EDIT TEST.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

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OFF/BSY X (X = MMU1, MMU2)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MSG TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE. ONE OR MORE I/O ERRORS ARE LOGGED.	THE INDICATED MMU DID NOT RESPOND TO THE READ/WRITE REQUEST PROPERLY. (MM READY DISCRETE NOT PRESENT)	A MMU TRANSACTION WAS REQUESTED WHEN THE MMU WAS OFF/BUSY, FAILED OFF, OR SELECTED FOR IPL.
OTT ST IN	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	TAEM GUID DOWNMODE MSG OPTIONAL TAEM TARGETING (OTT) OPS 1/6, 3	THE INDICATED ENERGY OVER WEIGHT RATIO IS LESS THAN THE REQUIRED VALUE FOR AN OVHD APPROACH.
PNL TRIM L	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	LH PNL TRIM SW MSG TWO OF THE COMMANDER'S SWITCH CONTACTS DO NOT AGREE FOR POSITIVE OR NEGATIVE PITCH, ROLL, OR YAW TRIM. OPS 1/6, 3	1. HARDWARE FAILURE 2. SHORTED OR OPEN SWITCH CONTACT(S)

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

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PNL TRIM R	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	RH PNL TRIM SW MSG TWO OF THE PILOT'S SWITCH CONTACTS DO NOT AGREE FOR POSITIVE OR NEGATIVE PITCH, ROLL, OR YAW TRIM. OPS 1/6, 3	1. HARDWARE FAILURE 2. SHORTED OR OPEN SWITCH CONTACT(S)
PROBES	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	A FAILURE IN THE DEPLOY OF AN ADTA PROBE HAS OCCURRED.	BOTH AIR DATA TRANSDUCER ASSEMBLY (ADTA) PROBES HAVE NOT BEEN SUCCESSFULLY DEPLOYED BELOW A MACH NUMBER OF 2.5.
R OMS GMBL	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, OMS TVC ALERT LIGHT ON, A DOWN ARROW BY THE FAILED ACTUATOR, AND SM ALERT TONE SOUNDED.	ASCENT/ORBIT/ENTRY THE DIFFERENCE BETWEEN THE POSITION COMMAND AND FEEDBACK FOR AN OMS PITCH OR YAW ACTUATOR FOR THE RIGHT POD REMAINS GREATER THAN 2 DEGREES FOR AT LEAST 3.84 SECONDS. THIS IMPLIES THE ACTUATOR EITHER DOES NOT DRIVE WHEN COMMANDED OR THE DRIVE RATE IS LESS THAN 2.9 DEG/SEC.	SLOW DRIVE RATES OF OMS GIMBAL ACTUATOR, FAILURE TO DRIVE AT ALL, OR FAILURE OF THE POSITION MEASUREMENT SEEN BY THE GPC.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

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R OMS PC	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED. CLASS 2 ALARM	ASCENT/ORBIT/ENTRY RIGHT OMS ENGINE: CHAMBER PRESSURE FALLS BELOW LIMIT AFTER AN ENGINE FAILURE	1. HARDWARE MALFUNCTION 2. PC LESS THAN 80%
R OMS QTY	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED.	ASCENT/ORBIT/ENTRY RIGHT OMS POD; TANK LOW LEVEL CONDITION DETECTED FOR FUEL OR OXIDIZER	1. CONSUMPTION OF PROPELLANT(S) 2. LEAKAGE QUANTITY LESS THAN 5%
R OMS VLV	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED. CLASS 3 ALARM	ORBIT A HELIUM AND/OR VAPOR ISOLATION VALVE REMAINS OPEN AFTER REPRESSURIZATION DURING A RIGHT OMS/RCS INTERCONNECT	1. HARDWARE MALFUNCTION 2. OPEN SIGNAL ON ONE OF FOUR VALVES AFTER 1.5 SECOND DELAY

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

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R RCS XJET X = A (AFT) X = U (UP) X = D (DOWN) X = R (RIGHT)	CLASS 2 MESSAGE ON MESSAGE LINE AND FAULT SUMMARY PAGE. RCS JET CAUTION AND WARNING LIGHT ON. C/W TONE SOUNDED AN "OFF", "ON", OR "LK" STATUS DISPLAYED ON THE RCS SPEC. STATUS ALSO DISPLAYED ON SYSTEM SUMMARY	THIS ERROR DESCRIBES THE FAIL STATUS OF THE X MANIFOLD OF THE RIGHT POD. RM WILL AUTOMATICALLY DESELECT JETS FAILED OFF OR LEAKING, BUT WILL NOT AUTOMATICALLY DESELECT JETS FAILED ON. OPS 1/6, 2, 3, 8	A RIGHT POD X JET HAS EITHER FAILED OFF, FAILED ON, OR FAILED LEAK. PASS DAP USES THE FOLLOWING RM LOGIC: 1. DRIVER OUTPUT INDICATION IS ON WHILE COMMAND B IS OFF, INDICATING A JET FAILED ON. 2. PROPELLANT INJECTOR TEMPERATURE IS LOW, INDICATING A LEAKING JET. 3. CHAMBER PRESSURE INDICATION IS OFF WHILE COMMAND B IS ON, INDICATING A JET FAILED OFF.
R RCS HE P	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	ORBIT THE PRESSURE IN THE HELIUM TANK FOR THE RIGHT AFT RCS FUEL OR OXIDIZER TANK IS BELOW LIMIT.	
R RCS LEAK	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, CLASS 2 ALARM C/W LIGHT ON.	ORBIT/ENTRY RIGHT AFT RCS: DIFFERENCE BETWEEN FUEL AND OXIDIZER QUANTITIES EXCEEDS THE LEAK DETECTION LIMIT.	A LEAK IN ONE PROPELLANT TANK; OX/FU DELTA QUANTITY GREATER THAN 12.6%

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

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R RCS PVT	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	ORBIT/ENTRY RIGHT AFT RCS FUEL OR OXIDIZER	QUANTITY CALCULATION SUSPENDED. THIS IS DUE TO BOTH PRIMARY AND SUBSTITUTE SOURCE OF THE MEASUREMENT NEEDED FOR CS TANK QUANTITY ARE COMMFAULTED AND NOT AVAILABLE.
R RCS TK P	A CLASS 2 FAULT MESSAGE (CAUTION WARNING): • MASTER ALARM LIGHT • C&W TONE • BACKUP C/W ALARM LIGHT ON THE CAUTION AND WARNING MATRIX	ORBIT THE PRESSURE IN THE RCS RIGHT AFT FUEL OR OXIDIZER TANK IS BELOW LIMIT OR EXCEEDS LIMIT.	
RCS PWR FAIL	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED. CLASS 3 ALARM	ASCENT/ORBIT/ENTRY FORWARD/AFT RCS: NO OPEN/CLOSE SELECTION FOR FUEL OR OXIDIZER MANIFOLD ISOLATION VALVE. OPEN AND CLOSE INDICATIONS ALL READ ZERO.	

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

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RHC X (X = A,L,R)	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED.	ORBIT/ENTRY LEFT/RIGHT RHC: FAIL - COMMANDS ON THE LEAST TWO CHANNELS DISAGREE DILEMMA - COMMANDS FROM THE TWO AVAILABLE CHANNELS DISAGREE ORBIT AFT RHC: FAIL/DILEMMA SAME AS FOR LEFT/RIGHT RHC	HARDWARE MALFUNCTION
RM DLMA RGA/ACC	A CLASS 2 FAULT MESSAGE. MESSAGE APPEARS ON THE MESSAGE LINE AND FAULT SUMMARY. GNC INDICATOR ALARM OUTPUT C&W LIGHT ON CONSOLE.	RGA OR ACCELEROMETER ASSEMBLY (AA) DILEMMA CONDITION SUCH THAT RM CANNOT ISOLATE FAILURE. A DILEMMA CONDITION EXISTS WHEN THE YSTEM HAS BEEN REDUCED TO TWO FUNCTIONING SENSORS SUCH THAT RM CANNOT DISTINGUISH THE GOOD SENSOR FROM THE BAD SENSOR.	DISAGREEMENT IN RGA OR AA DATA. RM CANNOT DETERMINE WHICH DATA IS GOOD. SOLUTION TO DILEMMA IS TO MANUALLY DESELECT DATA CONSIDERED BAD.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS" "CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"			
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RM DLMA ADTA	A CLASS 2 FAULT MESSAGE (CAUTION WARNING): • MASTER ALARM LIGHT • C&W TONE • BACKUP C/W ALARM LIGHT ON THE CAUTION AND WARNING MATRIX • AIR DATA LIGHT ON CAUTION AND WARNING MATRIX • DILEMMA STATUS INDICATORS ON GNC SYS SUMM 1 AND OVERRIDE DISPLAYS	ADTA DLMA MSG COMMON PRESSURES BETWEEN ADTA'S HAVE MISCOMPARED BY A CERTAIN AMOUNT FOR THREE CONSECUTIVE TIMES CREATING A FAILURE AND RM CANNOT ISOLATE THE FAILURE RESULTING IN A DILEMMA. OPS 1/6, 3	THE ADTA'S ARE USABLE ON BOTH SIDES AND THE DETECTED FAILURE EXISTS BETWEEN SIDES. NO ADTA'S ARE USABLE ON ONE SIDE AND THE DETECTED FAILURE EXISTS BETWEEN ADTA'S ON THE REMAINING SIDE. NO ADTA'S ARE AVAILABLE ON EITHER SIDE.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

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RM DLMA IMU	A CLASS 2 FAULT MESSAGE (CAUTION WARNING): • MASTER ALARM LIGHT • C&W TONE • BACKUP C/W ALARM LIGHT ON THE CAUTION AND WARNING MATRIX	ASCENT/ORBIT/ENTRY • IMU REDUNDANCY MANAGEMENT/TWO IMU'S AVAILABLE: THE SQUARED ATTITUDE/VELOCITY ERROR FOR AN IMU EXCEEDS THE FAULT DETECTION THRESHOLD • DILEMMA STATUS INDICATORS ON GNC SYS SUMM 1 ASCENT/ENTRY • DILEMMA STATUS INDICATORS ON OVERRIDE DISPLAY ORBIT/ENTRY • DILEMMA STATUS INDICATORS ON IMU ALIGN DISPLAY	1. HARDWARE MALFUNCTION 2. INCORRECT ILOAD(S)
RM DLMA MANF	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED.	ASCENT/ORBIT/ENTRY FORWARD/AFT RCS: SIMULTANEOUS OPEN/CLOSE SELECTION FOR FUEL OR OXIDIZER MANIFOLD ISOLATION VALVE(S)	

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS" "CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"			
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RM DLMA MLS	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATOR ON GNC SYS SUMM 1 DISPLAY	MLS DLMA MSG A MISCOMPARE EXISTS IN THE ORBITER ELEVATION, RANGE, AND/OR AZIMUTH DETERMINATIONS AND RM CANNOT ISOLATE THE BAD DATA THUS CREATING A DILEMMA. OPS 3	
RM DLMA PRL	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	HYDRAULIC SYSTEMS DISAGREEMENT. RM IS UNABLE TO ISOLATE FAILURE. PRIORITY RATE LIMITING (PRL)	LOW HYDRAULIC PRESSURES. FOLLOW CREW POCKET CHECKLIST PROCEDURES FOR LOW PRESSURES.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

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RM DLMA TAC	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATORS ON GNC SYS SUMM 1 AND HORIZ SIT DISPLAYS	TAC DLMA MSG REDUNDANCY MANAGEMENT (RM) EVALUATES RANGE AND BEARING DATA INDEPENDENTLY AND WHEN A PARAMETER MISCOMPARES AND THE AUTOMATIC RM SELF-TEST CANNOT ISOLATE THE BAD DATA, A DILEMMA OCCURS. OPS 1/6, 3	AT THE TWO-LRU LEVEL, THE TWO TACAN SENSORS MISCOMPARE AND THE TACAN RM SELF-TEST DOES NOT ISOLATE THE BAD TACAN.
RM DLMA WOW	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S	WEIGHT ON WHEELS (WOW) DLMA MSG IF THE WEIGHT ON WHEEL (WOW) FLAG HAS NOT BEEN SET "ON" AND NO COMMFAULTS EXIST AND ALL LANDING GEAR DISCRETES INDICATE WEIGHT ON ALL GEARS, THIS MESSAGE WILL BE DISPLAYED. OPS 1/6, 3	A SIMULTANEOUS DUAL FAILURE OF THE AC2 PHASE A BUS AND THE AC3 PHASE A BUS DURING THE APPROACH/LANDING (A/L) GUIDANCE SUBPHASE.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS" "CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"			
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RM FAIL ACC	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S SYSTEM SUMMARY DOWN ARROW FOR FAILED UNIT.	ACCELEROMETER ASSEMBLY (AA) UNIT FAILURE (1/2/3/4). FAILED UNIT DATA NOT USED. FAILED SENSOR DIVERGED FROM THE SELECTED VALUE MORE THAN THE ALLOWED TOLERANCE CAUSING THE GPC TO SET THE FAIL/DESELECT DISCRETE.	1. HARDWARE FAILURE OF AA. 2. ELECTRONICS FAILURE.
RM FAIL ADTA	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • FAIL STATUS INDICATORS ON GNC SYS SUMM 1 AND OVERRIDE DISPLAYS.	ADTA 1/2/3/4 FL MSG COMMON PRESSURES BETWEEN ADTA'S HAVE MISCOMPARED BY A CERTAIN AMOUNT FOR THREE CONSECUTIVE TIMES CREATING A FAILURE AND RM CAN ISOLATE THE FAILURE. OPS 1/6, 3	THE CREW HAS DESELECTED AN ADTA. THE AIR DATA PROBE (ADP) HAS NOT DEPLOYED.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

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RM FAIL IMU	A CLASS 3 FAULT MESSAGE (ALERT). FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED.	ASCENT/ORBIT/ENTRY IMU REDUNDANCY MANAGEMENT/THREE IMU'S AVAILABLE: THE SQUARED ATTITUDE/VELOCITY ERROR FOR AN IMU EXCEEDS THE ATTITUDE/VELOCITY FAULT DETECTION THRESHOLD	1. HARDWARE MALFUNCTION 2. IMPROPER ILOAD(S)
RM FAIL MLS	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATOR ON GNC SYS SUMM 1 DISPLAY	MLS 1/2/3 FL MSG A MISCOMPARE EXISTS IN THE ORBITER ELEVATION, RANGE, AND/OR AZIMUTH DETERMINATIONS AND RM HAS ISOLATED THE BAD DATA AND DECLARED A FAILURE. OPS 3	

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

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RM FAIL RGA	A CLASS 3 FAULT MESSAGE (ALERT). • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S SYSTEM SUMMARY DOWN ARROW FOR FAILED UNIT.	RGA UNIT FAILURE (1/2/3/4). FAILED UNIT DATA NOT USED. FAILED SENSOR DIVERGED FROM THE SELECTED VALUE MORE THAN THE ALLOWED TOLERANCE CAUSING THE GPC TO SET THE FAIL/DESELECT DISCRETE.	1. HARDWARE FAILURE OF RGA 2. ELECTRONICS FAILURE
RM FAIL TAC	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATORS ON GNC SYS SUMM 1 AND HORIZ SIT DISPLAYS	TAC 1/2/3 FL MSG RM EVALUATES RANGE AND BEARING DATA INDEPENDENTLY AND WHEN A PARAMETER MISCOMPARES AND RM CAN ISOLATE THE BAD DATA, A FAILURE IS DECLARED. OPS 1/6, 3	AT THE THREE-LRU LEVEL, TACAN RM EVALUATES RANGE AND BEARING DATA INDEPENDENTLY, DECLARING A PARAMETER FAILED WHEN IT MISCOMPARES WITH THE OTHER TWO LRU'S BY MORE THAN A GIVEN THRESHOLD. AT THE TWO-LRU LEVEL, AUTOMATIC TACAN SELF-TEST CAN ISOLATE A FAILED PARAMETER IF BOTH LRU'S ARE IN THE GPC MODE.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS" "CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"			
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ROLL REF	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATOR ON ENTRY TRAJ X DISPLAYS	ROLL REF MSG THE GUIDANCE COMPUTED REFERENCE BODY ROLL ANGLE (ROLL REF) IS BELOW A CALCULATED VALUE. OPS 3	
SBTC/THC A	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATORS ON GNC SYS SUMM 1 AND RM ORBIT DISPLAYS AND CONTROLLERS DISPLAY.	A THC CH 1/2/3 FL/DLMA MSG AFT THC INITIAL COMMFAULT OR FAILURE OR DILEMMA HAS BEEN DETECTED. OPS 2/8	AFT THC TRANSIENT FAILURE. DDU POWER SUPPLY FAILURE WHICH CAUSES THE CORRESPONDING AFT THC CHANNEL TO BE LOST. AFT THC TX/TY/TZ CONTACT FAILED OR MDM PARAM LOSS. COMBINATIONS OF ABOVE PROBLEMS WILL CAUSE DISAGREEMENT BETWEEN SIGNALS FROM CONTROLLER LRU'S.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

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SBTC/THC L	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATORS ON GNC SYS SUMM 1 AND RM ORBIT DISPLAYS AND CONTROLLERS DISPLAY.	L SBTC/THC CH 1/2/3 FL/DLMA MSG LEFT SBTC/THC INITIAL COMMFAULT OR FAILURE OR DILEMMA HAS BEEN DETECTED. OPS 2/8, 3	LEFT TRANSLATIONAL HAND CONTROLLER (THC) TRANSIENT FAILURE. DISPLAY DRIVER UNIT (DDU) POWER SUPPLY FAILURE CAUSING THE CORRESPONDING LEFT SBTC OR THC CHANNEL TO BE LOST. LEFT THC TX/TY/TZ CONTACT FAILED OR MDM PARAM LOSS. LEFT SPEEDBRAKE/THRUST CONTROLLER (SBTC) COMMAND FAILURE OR DISAGREE. COMBINATIONS OF ABOVE PROBLEMS WILL CAUSE DISAGREEMENT BETWEEN SIGNALS FROM CONTROLLER LRU'S.
SBTC/THC R	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATOR ON GNC SYS SUMM 1 DISPLAY, RM ORBIT AND CONTROLLERS DISPLAYS.	R SBTC CH 1/2/3 FL/DLMA MSG RIGHT SBTC INITIAL COMMFAULT OR FAILURE OR DILEMMA HAS BEEN DETECTED. OPS 3	DDU POWER SUPPLY FAILURE WHICH CAUSES THE CORRESPONDING RIGHT SBTC CHANNEL TO BE LOST. RIGHT SBTC COMMAND FAILURE OR DISAGREE. COMBINATIONS OF ABOVE PROBLEMS WILL CAUSE DISAGREEMENT BETWEEN SIGNALS FROM CONTROLLER LRU'S.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

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SEL AUTO	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED.	ORBIT A MANEUVER/TRACK/ROTATION OPTION HAS BEEN SELECTED ON THE UNIVERSAL POINTING DISPLAY BUT THE ORBIT DAP IS NOT IN AUTO MODE, OR IT IS 5 SECONDS BEFORE A MANEUVER/TRACK/ ROTATION OPTION IS TO BECOME CURRENT BUT THE ORBIT DAP IS NOT IN AUTO MODE.	1. CREW ERROR 2. HARDWARE MALFUNCTION
SENSE SW	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED.	ORBIT NO OR SIMULTANEOUS −Z/−Y SELECTION FOR THE ADI SENSE SWITCH; DEFAULT SWITCH PROCESSING SELECTS −Z	HARDWARE MALFUNCTION
SPD BRK	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • HUD INDICATOR	THE SPEEDBRAKE HAS EXCEEDED A SPECIFIED DEVIATION FROM THE COMMANDED POSITION.	SPEED BRAKE POSITION GREATER THAN 20 PERCENT FROM AUTO SCHEDULE FOR MACH NUMBER BETWEEN 0.95 AND 10. SPEEDBRAKE POSITION IS OUTSIDE OF I-LOADED LIMITS BELOW AN I-LOADED ALTITUDE AND PRIOR TO WEIGHT ON WHEELS.

"INFORMATION ON THIS PAGE NOT TO BE USED FOR LAUNCH HOLD DECISIONS"
"CONSULT LOCAL T&O REPRESENTATIVE AS REQUIRED"

ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
SSME FAIL X (X = C,L,R)	CLASS 3 MESSAGE ON MESSAGE LINE AND FAULT SUMMARY. SM ALERT LIGHT IS LIT. SM TONE IS SOUNDED. RED ENGINE STATUS LIGHT. PASS WILL NOT ISSUE MESSAGE IN MM101. (ONLY BFS)	PREMATURE MAIN ENGINE SHUTDOWN, I.E. THE SSME IS IN SHUTDOWN OR POST SHUTDOWN PHASE PRIOR TO THE MECO COMMAND BEING SET. THIS MESSAGE IS VALID IN MM102 AND MM103.	SSMEC INITIATES SHUTDOWN FOR EXCEEDING THE LIMITS OF THE FOLLOWING PARAMETERS: 1. HPFT TURBINE DISCHARGE TEMP 2. HPOT TURBINE DISCHARGE TEMP 3. HPFT COOLANT LINER PRESSURE 4. HPOP INTERMEDIATE SEAL PURGE PRESSURE 5. HPOT SECONDARY SEAL CAVITY PRESSURE 6. P_c VS P_c REFERENCE
SUMWORD X (X = ICC1, ICC2, ICC3, ICC4, ICC5)	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MSG TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE.	SUMWORD OF SSW CRITICAL DATA ICC'ED BETWEEN GPC'S MISCOMPARED WITH THE SUMWORD OF THE INDICATED GPC. THE COMPARE IS PERFORMED ONCE EACH MAJOR CYCLE (960 MS). THREE CONSECUTIVE MISCOMPARES MUST BE DETECTED BEFORE THE MESSAGE IS ANNUNCIATED.	IN GENERAL THIS PROBLEM IS CAUSED BY GPC'S HAVING DIFFERENT CRITICAL DATA AND IS USUALLY AN INDICATION OF GPC HARDWARE OR SOFTWARE FAILURES OR THE RESULTS OF A USER ERROR. THE MESSAGE MAY BE ANNUNCIATED IF BOTH LDB'S BUSES ARE DROPPED FROM THE SET OR HARD FAILED WHILE GSE POLLING IS ACTIVE AND AUTO TOGGLING OF LDB BUSES IS ENABLED. DR 55246
SW TO MEP	A CLASS 3 FAULT MESSAGE (ALERT): • SM ALERT LIGHT • SM ALERT TONE • FLASHING FAULT MESSAGE ON ALL CRT'S • STATUS INDICATOR ON VERT SIT X DISPLAYS	MEP ALERT MSG MINIMUM ENTRY POINT (MEP) ALERT. OPS 1/6, 3	THE ENERGY OVER WEIGHT RATIO (E/W) IS TOO LOW TO MAKE IT TO THE RUNWAY AND THE CREW NEEDS TO MOVE THE HAC TO THE MEP WHICH IS CLOSER TO THE RUNWAY.

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
TARGET ERR RTLS	CLASS 3 MESSAGE ON MESSAGE LINE AND FAULT SUMMARY. SM ALERT LIGHT IS LIT AND SM TONE IS SOUNDED	INVALID RTLS SITE IS DESIGNATED.	THIS MESSAGE IS GENERATED WHEN THE RTLS SITE INDEX ENTERED VIA ITEM 41 ON SPEC 50 HAS BEEN DESIGNATED AS A TAL SITE
TARGET ERR TAL	CLASS 3 MESSAGE ON MESSAGE LINE AND FAULT SUMMARY. SM ALERT LIGHT IS LIT AND SM TONE IS SOUNDED.	INVALID TAL SITE IS DESIGNATED.	THIS MESSAGE IS GENERATED WHEN THE TAL SITE INDEX ENTERED VIA ITEM 41 ON SPEC 50 HAS BEEN DESIGNATED AS AN RTLS SITE.
TIME MTU	A CLASS 3 ANNUNCIATION MESSAGE IS ISSUED. THE MSG TEXT IS DISPLAYED ON THE MESSAGE LINE AND ON THE FAULT SUMMARY PAGE.	GPC HAS HAD AN AUTOMATIC TIME SOURCE CHANGE FROM ONE MTU ACCUMULATOR TO ANOTHER ACCUMULATOR, OR TO INTERNAL TIME. GPC WILL FAULT DOWN TO NEXT MTU ACCUMULATOR IF THE DELTA BETWEEN THE GPC'S INTERNAL CLOCK AND THE MTU ACCUMULATOR IS GREATER THAN 800 MICROSECONDS.	IN GENERAL THIS ERROR OCCURS BECAUSE THE TIME FROM THE SELECTED MTU ACCUMULATOR IS OUT OF TOLERANCE. THIS MAY BE CAUSED BY GPC TO MTU LINK PROBLEMS OR BY A HARDWARE FAILURE OF THE MTU. DR 42303
TGT DELTA T	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED.	ORBIT TARGETING OPERATIONS (SPEC 34): SINGULARITY DURING DELTA VELOCITY CALCULATIONS	1. IMPROPER TRANSFER TIME REQUESTED 2. IMPROPER ILOAD(S)

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ERROR NAME	HOW MANIFESTED TO USER	DESCRIPTION OF THE ERROR	POSSIBLE CAUSES / KNOWN SCENARIOS AND RELATED PROBLEMS (NOTE #)
TGT EL ANG	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED.	ORBIT TARGETING OPERATIONS (SPEC 34): MAXIMUM NUMBER OF ITERATIONS REACHED DURING CALCULATION OF TPI TIG FOR THE SPECIFIED ELEVATION ANGLE	1. IMPROPER TARGETS SPECIFIED 2. IMPROPER ILOAD(S)
TGT ITER	FLASHING MESSAGE ON FAULT MESSAGE LINE OF ALL CRT DISPLAYS, SM ALERT LIGHT ON, AND SM ALERT TONE SOUNDED.	ORBIT TARGETING OPERATIONS (SPEC 34): LAMBERT TGT TRANSFER ANGLE NEAR SINGULARITY POINT; COMPUTATIONS FOR A PARABOLIC TRANSFER; MAXIMUM NUMBER OF ITERATIONS REACHED DURING A COMPUTATION	1. IMPROPER TARGETS SPECIFIED 2. IMPROPER ILOAD(S)

APPENDIX H. DISTRIBUTION LIST

Following this Appendix is a listing of the PASS User's Guide Distribution List. If you wish to be included on the Distribution List and are currently not, please complete a copy of the blank Distribution List Request form included in this Appendix and send the completed form to the PASS User's Guide Coordinator:

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