

# Data Processing System Console Handbook

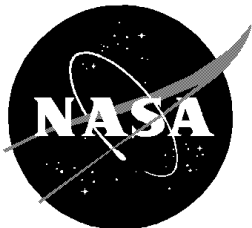
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Systems Division  
Data Systems Branch

Basic, Rev F  
April 22, 2005

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National Aeronautics and  
Space Administration

**Lyndon B. Johnson Space Center**  
Houston, Texas

DATA PROCESSING SYSTEMS CONSOLE HANDBOOK

BASIC, REV F

April 22, 2005

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SECTION 1  
PREMISSION OFFICE ACTIVITIES

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## **TITLE**

DATAPACK PROCESS

## **PURPOSE**

This procedure defines the process for building and verifying the DPS Datapack. The procedure is applicable to both the datapack builder and the verifier.

## **BACKGROUND**

The DPS Datapack is a compilation of flight-specific data used on-console during flights and integrated simulations. Like many other DPS tasks, the process of building and verifying a DPS Datapack has evolved over the years. Currently, the DPS Group Lead assigns both datapack builder and verifier, posting assignments on the flight manning list. In addition, the Group Lead can assign the datapack development tasks to anyone in the group and is not limited to personnel scheduled to support that particular mission.

Assigned personnel are notified of their datapack development responsibilities in ample time to meet the initial datapack due-date. To separate the DPS Datapack due-date from the ILC and first flight-specific integrated simulation, the due-date is based on a Mass Memory Release Schedule.

A new version of the orbiter flight software is released every mission, with one or more flight software drops occurring during each flight cycle. The first version drop is called the BASE release (BA); the second version is referred to as the BASE 2 release (B2); the third drop, the BASE 3 release (B3); and so on.

The PASS and BFS flight software developers (United Space Alliance) are required to deliver FSW products for each flight software release. These FSW products are currently delivered in a CD ROM format. A DPS Datapack is to be built for each flight release. The datapack builder and verifier will develop all datapacks that are required for their assigned flight.

The actual datapack build process utilizes a flight-specific CD ROM product, a network share drive PC-resident executable, and a network share drive PC word macro. In order to build a datapack utilizing the word macro, the datapack developer must input certain flight-specific software 'version data'. A Mass Memory Release Schedule, as illustrated in Figure 1.0-1, serves as the source for such user information, as well as, providing an estimate as to when to expect a CD ROM delivery.

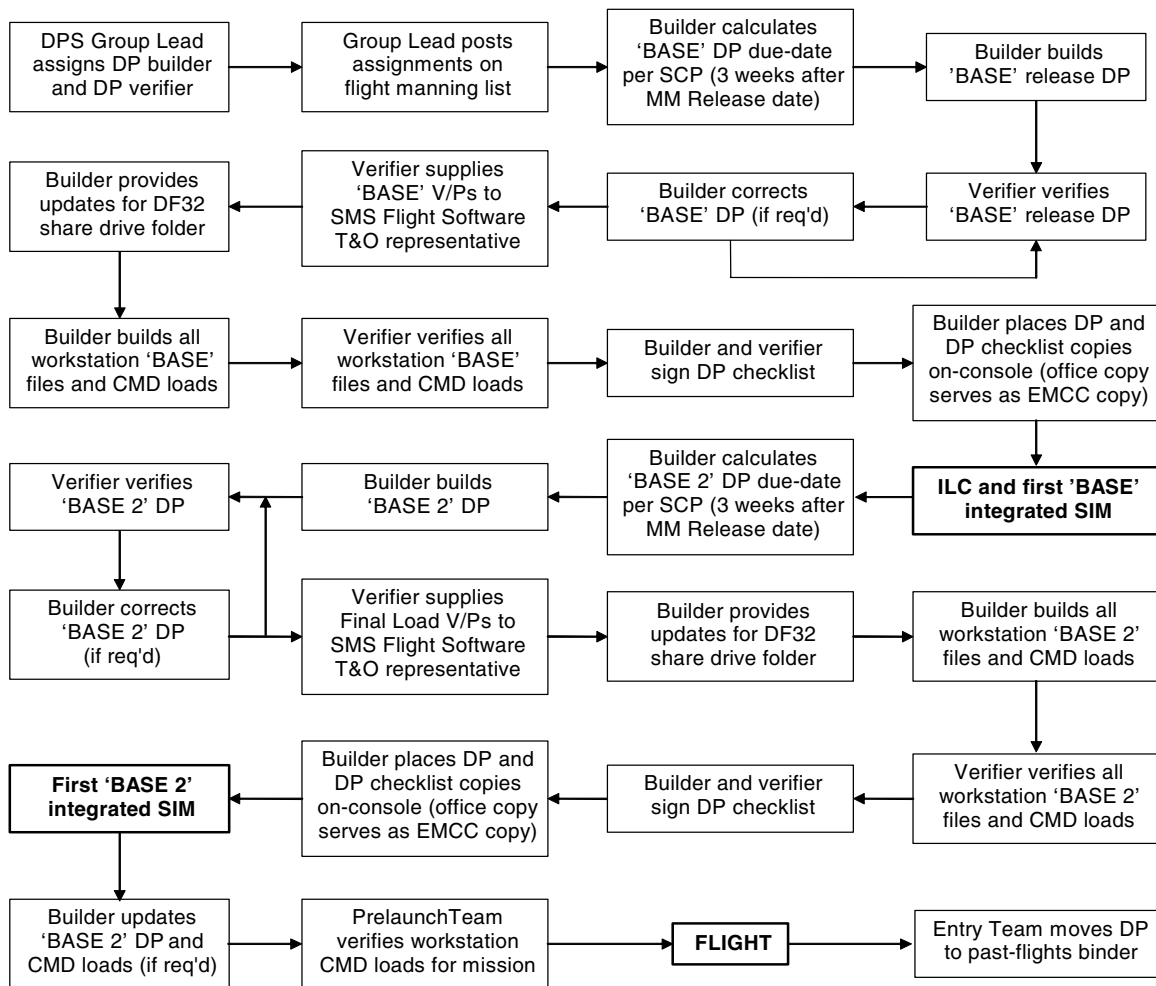
Figure 1.0-2 provides a high-level overview of the datapack (DP) development process, from DP assignments to landing. For illustrative purposes, the overview assumes two flight software drops, a 'BASE' release, and a 'BASE 2' release. If additional flight software drops should occur, the datapack build and verify processes identified for the 'BASE 2' activities would be repeated for the 'BASE 3' release, etc.

MASS MEMORY RELEASE SCHEDULE  
LAST UPDATED: 03/16/2005

C H G	MISSION INFORMATION	MMU BUILD	MM AVAILABLE DATE	PROPOSED DATES	S/W ELEMENT VERSIONS AS RELEASED							
					PASS	I-LOAD	BFS	GPC-IPL	TCS	TFL	DFL	FPL
	STS-114 - (OI30) OV104 PYLD: ISS (LF-1), MPLM 2, (P)-03 1 STRING GPS	BASE 2 COMP LD LAUNCH	(A)03/29/04 N/R N/R	N/R	03.01	03.1.0	03.45.B.10	09.05	28.02	114F0100	114F0100	114F0100
	STS-114 - (OI30) OV103 PYLD: ISS (LF-1), MPLM 2, (P)-03 1 STRING GPS	BASE 3 COMP LD LAUNCH	(A)04/26/04 N/R N/R	N/R	03.02	03.2.0	03.35.B.10	09.05	28.02	114F0200	114F0200	114F0200
*	STS-114 - (OI30) OV103 PYLD: ISS (LF-1), MPLM 2, (P)-03 1 STRING GPS	BASE 4 COMP LD LAUNCH	(A)10/20/04 05/05/05 05/15/05	N/R	03.03	03.2.0	03.35.D.10	09.05	28.02	114F0200	114F0200	114F0200
	STS-300 - (OI30) OV104 PYLD: RESCUE FLIGHT FOR STS-114 1 STRING GPS	BASE COMP LD LAUNCH	(A)11/04/04 06/03/05 06/14/05	STS-121 LGN	04.01	04.1.0	04.45.B.10	09.05	28.02	121F0000	121F0000	121F0000
	STS-121 - (OI30) OV104 PYLD: ISS (ULF-1.1), MPLM 1(P) ICC 1 STRING GPS	BASE COMP LD LAUNCH	(A)11/04/04 06/30/05 07/12/05	N/R NET	04.01	04.1.0	04.45.B.10	09.05	28.02	121F0000	121F0000	121F0000
	STS-301 - (OI30) OV103 PYLD: RESCUE FLIGHT FOR STS-121 1 STRING GPS	BASE COMP LD LAUNCH	(A)10/20/04 08/26/05 09/06/05	STS-114 LGN	03.03	03.2.0	TBD	09.05	28.02	114F0200	114F0200	114F0200

Figure 1.0-1. Typical Mass Memory Release Schedule

1.0-2  
Verify that this is the correct version before use



**Figure 1.0-2. DPS Datapack development overview (multi-BASE release)**

**PROCEDURE**

The datapack document build-procedure is identical, whether it is for the initial BASE release or for a subsequent BASE 2 (BASE 3, etc.) release. For the first flight of a new OI drop, there is an additional verification step in the overall datapack development process. However, this additional step does not actually impact the generation of the DPS Datapack document or any associated MCC command loads.

- A. Builder: Obtain a copy of the 'DPS Datapack Checklist' via the datapack template found on the DPS website or in the DF32 DATAPACK folder on the network share drive, and use it to check off milestones throughout the datapack development process. Use the version found on the DPS web-link (or network share drive). The DPS Datapack Checklist illustrated in Figure 1.0-3 may not be the latest version.

**DPS DATAPACK CHECKLIST**

Flight: STS-\_\_\_\_  
Rev: \_\_\_\_\_

**A. DATAPACK**

- 1. Datapack and workstation load completion are due 3-weeks after CD ROM release  
Due-date (MM/dd/yyyy): \_\_\_\_\_
- 2. Coordinate datapack build/verification schedule with verifier
- 3. Variable Parameters: ❶
  - GNC Ascent - 23001
  - GNC Orbit - 23002
  - SM Orbit - 23003
  - GNC Entry - 23004
  - GNC RNDZ - 23005 (if required)
  - GNC Docked - 23006 (if required)
  - BFS -19901 (if required)
  - Flight-specific loads: \_\_\_\_\_
- 4. DOLILU Address ❶
- 5. Roll-in Displays ❶
- 6. Sync Fail Pointers ❶
- 7. PDE's ❶
- 8. TMBU Parameters (ISS Assembly/Logistical flights only):
  - ISS C&W INHIBIT -12399
  - Verify TMBU parameters listing
- 9. SM/G9 Mission-Dependent I/O Profile (refer to SCP 1.6 for details)
- 10. Mission Summary (check with DPS Flight Lead for details)
- 11. Compare BFS Message ID/Text to OFS Recon Product (initial OI BASE drop only) ❷
- 12. Provide Datapack verifier with all hardcopies
- 13. DPS Datapack verification complete
- 14. Email electronic copies of PASS and BFS V/Ps (or entire datapack, if desired) to the SMS Flight Software T&O representative
- 15. Update DF32 share drive DATAPACK folder with completed datapack file; also, email a copy of the datapack to the DF32 Website Administrator
- 16. Paper copies of Datapack distributed (WFCR, WMPSR, and Office)
- 17. Place verification hardcopies in back of the Office Copy of datapack

❶ These products normally generated using the DPS Datapack Build PC macro  
❷ Once per OI baseline for first mission using that BFS OI drop (refer to SCP 1.7 for details)

**Figure 1.0-3. DPS datapack checklist (front page)**

**DPS DATAPACK CHECKLIST** (continued)

**B. WORKSTATION LOADS** (FCR or MPSR)

- 1. Add to flight list:
  - LOAD MANAGER
  - TMBU
- 2. Variable Parameters:
  - GNC Ascent - 23001
  - GNC Orbit - 23002
  - SM Orbit - 23003
  - GNC Entry - 23004
  - GNC RNDZ - 23005 (if required)
  - GNC Docked - 23006 (if required)
  - BFS -19901 (if required)
  - Flight-specific loads: \_\_\_\_\_
- 3. Build variable parameters scaling files
- 4. Build DEU Equivalent load(s):
  - GNC 'OPS 901 PRO' load - 20101
  - Flight-specific loads: \_\_\_\_\_
- 5. Build Station TMBU load (if ISS Assembly/Logistical mission):  
ODIN/ADCO C&W load: DSM 12399
- 6. Build pre-flight approved, time-critical implementation GMEM(s):  
Flight-specific loads: \_\_\_\_\_
- 7. Copy/build LOAD MANAGER 'pre-built loads listing' file (refer to SCP 1.10 for details)
- 8. Build Flex MDM file if applicable
- 9. Verify that PASS and BFS TMBU Data and EU (engineering units) files have been loaded into the workstation (transferred from CDE lab via "DPS File Administrator")
- 10. Workstation command loads and files verified

**C. SIGNOFF**

- 1. Builder has completed the Datapack build process (A and B above):  
\_\_\_\_\_ DATE: \_\_\_\_\_
- 2. Verifier has approved the complete datapack and workstation loads:  
\_\_\_\_\_ DATE: \_\_\_\_\_
- 3. Place copies of this checklist as last page in each datapack (original in office copy)
- 4. Post-verification Datapack updates:
 

INITIALS	DATE (MM/dd/yyyy)	DESCRIPTION OF CHANGE
<input type="checkbox"/>	_____	_____
<input type="checkbox"/>	_____	_____
<input type="checkbox"/>	_____	_____
<input type="checkbox"/>	_____	_____

**Figure 1.0-3. DPS datapack checklist (back page)**

- B. Builder: Calculate the required DPS Datapack completion due-date.
1. Locate the Mass Memory Release Schedule posted on the DF32 bulletin board. This schedule, which is updated every week by the Test and Operations (T&O) Board as an FSW product-delivery status sheet, is illustrated via Figure 1.0-1.
  2. Observe the BASE release date that corresponds to the specific flight. Add three weeks to this date to calculate when the 'BASE' release datapack should be built, verified, and distributed on the DPS WFCR and WMPSR consoles.
- C. Builder and Verifier: Coordinate the datapack build and verification schedule. An agreement should be established when the builder is to provide the datapack and all required paperwork to the verifier and when the verifier will return the datapack to the builder. Keep in mind that the DP team should allow time to build workstation command loads and associated application files (for example, VP Scaling), and for any potential datapack rework and re-verification of any redlines.
- D. Builder: Three files ('DP.EXE' and two very similar 'dpkmacro' files) located on the share drive in the DF32 "DATAPACK | DPS-PGM" folder will be utilized to generate the required datapack development products. To ensure the latest datapack formats, utilize the word macros to generate the baseline datapack document. If the CD ROM required to build the datapack is not available, contact the DPS CD ROM manager.

The procedure, "ELECTRONIC DATAPACK GENERATION", presented later in this SCP, provides a checklist-type summary required to generate an electronic datapack utilizing current datapack PC programs, input data files, and word macro templates. The datapack builder is encouraged to utilize those procedures and identified PC files to generate the datapack word files.

For the benefit of the first-time datapack builder, the SCP includes two procedures, "USING THE DP PROGRAM" and "USING THE WORD MACRO". Each provides detailed instructions on certain aspects associated with the generation of the required electronic datapack products. The SCP also includes a high-level description of current datapack PC tools, their limitations, and rationale behind the electronic file generation procedures.

- E. Builder: Provide the verifier with a completely built datapack and all the paperwork that the verifier needs to verify the datapack product:
1. Include any hard copies of the flight software listing that were utilized to build the datapack (not just deltas to the BASE datapack), the C&D Annex pages, and any additional required paperwork or forms.
  2. For the first flight utilizing a new OI release, provide the verifier with a printout of the Shuttle Software Reconfiguration product in order to verify the BFS fault messages driving the MCC OFS application (see SCP 1.7 for additional details).



- F. Verifier: Verify the datapack product by comparing the datapack pages with respect to the hard copies provided by the DP builder. The verifier has the responsibility to ensure that everything in the datapack package is correct.
- G. Builder: If applicable, implement any corrections/changes noted by the Verifier. Where practical, provide the verifier with the original redlines, as well as, the corrected copy for comparison verification.
- H. Builder and Verifier: Using an iterative approach, repeat steps F and G as necessary until an acceptable datapack product has been completed.
- I. Verifier: Email the SMS Flight Software T&O representative an electronic copy of all V/Ps. The entire DPS Datapack or a sub-set including only the PASS and BFS variable parameters may be sent to the SMS FSW T&O representative.

BASE release V/Ps are required at least one week prior to the ILC, or one week prior to any other datapack due-date. If there were no changes from previous V/P loads, send an email to inform the T&O representative that there were no changes.

- J. Builder: Transfer an electronic copy of the completed DPS Datapack to the DF32 DATAPACK folder located on the network share drive. Email an electronic copy of the verified datapack to the DF32 Website Administrator.
- K. Builder: Build all BASE release datapack MCC command loads and associated files (such as, VP Scaling files) on an MCC workstation (does not have to be a DPS workstation). Even though DPS personnel supporting integrated simulations may build flight-specific command loads, it is the ultimate responsibility of the datapack builder to ensure that workstation command loads match the official paperwork.
- L. Verifier: Verify all MCC workstation DPS command loads and associated files.
- M. Builder and Verifier: Sign the BASE release datapack checklist when complete with all items, and (builder) place a copy in transparent sleeves behind the datapack contents in each datapack binder. Keep the original checklist in the office binder.
- N. Builder: Verify that the order of contents in each datapack binder is as follows: datapack pages, official request forms for flight-specific loads, and the datapack checklist. All of these pages should be placed inside transparent sleeves.

For the initial BASE release datapack, include flight software listing hard copies, C&D Annex pages, and any verification paperwork in the office copy datapack binder. Place all such paperwork at the back of the binder. Transparent sleeves are not required for these items.

- O. Builder: Place one datapack binder at each DPS and DPS SPT console and one binder in the office library. The office copy shall also serve as the EMCC copy. These datapack binders should be placed on console prior to the deadline date calculated in step B of this procedure.

- P. Builder: Periodically tag up with the DPS Flight Lead to ensure the DPS Datapack contents are current. If required, update the datapack and workstation loads and get the verifier to check the updates prior to the next affected integrated sim. If it is impossible to meet this schedule, inform the flight lead of the issue being worked.

After the updates have been completed, place an electronic copy in the previously mentioned DF32 folder on the share drive. In addition, email a copy to the updated datapack to the DF32 Website Administrator. These changes should be noted in the datapack checklist and initialed by both datapack builder and verifier.

## **ELECTRONIC DATAPACK GENERATION**

This section of the SCP outlines a process to generate an electronic datapack word document utilizing PC-resident programs, input data files, and word macro templates. These PC tools and recommended procedure will yield two similar electronic files, which are subsequently merged into a single electronic datapack word file. The document merge action is accomplished using the Microsoft toolbar "Tools" pulldown "Compare and Merge Documents" feature.

It is recommended that the first-time datapack builder take time to read through two procedures, "USING THE DP PROGRAM" and "USING THE WORD MACRO", which provide expanded details relative to generating the required datapack development products. The following procedure assumes the datapack builder is familiar with the information provided by these two procedures.

While not mandatory, it is suggested the first-time datapack builder also take time to read through "DATAPACK PC TOOL ISSUES" at the end of the SCP. The topic provides a discussion of the datapack PC tools, their limitations, and procedural workarounds that have been implemented in the following procedure.

- A. Prior to the actual electronic datapack generation, the datapack builder needs to have acquired certain FSW-build specific information:
- Flight Number (STS mission ID)
  - BASE Release Number
  - PASS FSW Version
  - BFS FSW Version
  - PASS/BFS OI Version
  - MEDS IDP Version
  - MEDS MDUF Version

The first two data items are utilized by both the DP.EXE executable program and the word macro. If either parameter value does not match information embedded in the CD ROM, the DP.EXE program will abterm. Likewise, the word macro will abterm if those two word macro inputs do not match the file names generated by the DP.EXE program. The datapack builder can confirm the value of those two parameters by noting "VOLUME ID:" information stamped on the CD ROM label.

The remaining five parameters (three FSW-build and two MEDS parameters), while important, could be entered incorrectly, and yet, the word macro will still run to completion. However, the resulting on-console documentation would be in error.

- B. Locate a blank, formatted floppy diskette and the appropriate mission-specific CD ROM when ready to initiate the electronic datapack build process. If the desired CD ROM cannot be located, contact the DF32 CD ROM manager.

When ready to begin the actual electronic datapack generation, insert the floppy diskette in an office PC floppy drive. Then, load the CD ROM disk drive and select A-drive on the resulting pop-up window (load/access files in subsequent steps).

- C. Using the 'Windows Explorer' feature, locate the DF32 | DATAPACK | DPS-PGM folder on the network share drive. Open the 'Basic Macro' sub-folder and copy the 'VPLIST.DAT' and 'PDELIST.DAT' files from the S-drive to the A-drive. Then, minimize the window (maximized later to open the 'dpkmacro basic.dot' macro).

- D. Open a "Command Prompt" window; then enter DOS commands at the prompt (>):

1. Start | Programs | Accessories | Command Prompt
2. N:\>s:
3. s:\>cd divisions\df\private\df32\datapack\dps-pgm
4. s:\>DP XXX YY E:\stsXXXYY A:\

Where: XXX = 3-digit 'Flight No.' (e.g., 114 for STS-114)  
YY = flight software release version for this particular datapack  
( 'BA' for BASE release, 'B2' for BASE 2 release, etc.)  
stsXXXYY = XXX and YY fields as defined above

As a reminder, the datapack builder should have previously confirmed the value of 'XXX' and 'YY' by noting the "VOLUME ID:" data on the CD ROM label.

- E. The 'DP.EXE' program will begin to execute and retrieve appropriate data from the flight software CD ROM. If no problems were encountered, the entire process will take about half a minute, followed by a text message to the DOS window.
  1. If no errors were encountered, ignore the DOS message. If errors are indicated, the most probable cause is that one or both of the input data files (VPLIST.DAT and/or PDELIST.DAT) were not copied to the A-drive.
  2. Open the text file (XXXYYERR.TXT) located on the A-drive. If "Decompress" errors are indicated, they are indicative of problems finding one or more of the variable parameter addresses. Then, close the text file (no longer required).
  3. If errors were detected in either case, the problem will need to be corrected and the procedure repeated. If no problems were noted, minimize the "Command Prompt" window.

- F. Maximize the window previously minimized in Step C ('Basic Macro' sub-folder). Select the 'dpkmacro basic.dot' file. After enabling macros per the window prompt, the document opens and a series of word macro window prompts will be observed.
1. Enter the requested 'FSW-build' data inputs. Update the 'default' values with the correct data as necessary, clicking on the 'OK' button following each data entry.
- Do not use the KYBD 'Enter' key when changing default data. Do not click on the 'Cancel' button. Such actions will cause the word macro to abterm or result in corrupted data parameters in the generated datapack file.
2. Following all requested data inputs, the word macro will generate a word file, labeled "STS-XXX-YY BASIC.doc" (where XXX and YY as previously defined). Unless the datapack builder deliberately elects to modify the document-store directory path, the resultant document will automatically be stored on the network share drive in a DF32 "aWORK" folder designed to accommodate the two intermediate datapack products. The datapack builder may peruse the document, if desired, or elect to immediately close the file and window.
- G. Next, navigate back to the DF32 share drive DATAPACK | DPS-PGM folder and open the 'Delta Macro' sub-folder. Then copy the 'VPLIST.DAT' file to the A-drive (replacing the existing data file). This is a very important step as these two data files represent a different set of variable parameters. The DP.EXE program will abterm unless that precise file name (VPLIST.DAT) is utilized.
- H. Maximize the DOS "Command Prompt" window previously minimized in Step E. Then, press the KYBD 'up arrow' (↑) once, observing that the previously executed DOS command line, 's:\>DP XXX YY E:\stsXXXYY A:\', is echoed. Press the KYBD 'Enter' key to re-initiate the DOS command execution.
- I. The 'DP.EXE' program will again execute and retrieve appropriate data from the flight software CD ROM. The executable will overwrite the previous 'XXXYY' files as new files are generated. If no problems were encountered, the entire process takes about half a minute, followed by a text message to the DOS window.
1. If no errors were encountered, ignore the DOS message. Open the text file (XXXYYERR.TXT) on the A-drive confirm no errors were detected; and then close the text file (no longer required). If any error was indicated, the problem will need to be corrected and the procedure repeated.
  2. Assuming success, the DOS "Command Prompt" window and CD ROM are no longer required. The window may now be closed and the CD ROM removed.
- J. Open the word macro (dpkmacro delta.dot) located in the 'Delta Macro' folder and repeat the actions in Step F. The only difference is that the resulting word file will be stored in the 'aWORK' directory as an 'STS-XXX-YY DELTA.doc' file rather than as a 'BASIC' file. Once both electronic datapacks have been generated, the floppy disk is no longer required, and it may be removed, if desired.

- K. At this point, both of the intermediate datapack files, "STS-XXX-YY BASIC.doc" and "STS-XXX-YY DELTA.doc" should be located in the 'aWORK' folder on the DF32 share drive (or the folder specified by the datapack builder). For simplicity, the procedure assumes the word files are, in fact, stored in the default 'aWORK' folder.
- L. Merging the Datapack Files -- Using the two datapack files as inputs, a Microsoft Word 'Compare and Merge Documents' feature will be utilized to generate a new datapack word file. Once complete, this document will serve as the 'final electronic datapack' product:
1. Open one of the two newly generated datapack files located in the 'aWORK' folder. Next, on toolbars, click on 'Tools', then click on the 'Compare and Merge Documents' pull-down menu.
  2. On the resulting 'Compare and Merge Documents' window, navigate to the network share drive DF32 'aWORK' folder and click on the other file.
  3. Then, in the lower right-hand corner, click on the 'Merge' pull-down button and select 'Merge into current document'. The merge feature displays the current document with the merged results of the two intermediate datapack files.
  4. Save ('save as' feature) the merged file as a new document "STS-XXX-YY.doc" in the 'aWORK' folder, where 'XXX' and 'YY' correspond to previously defined FSW-build parameters (simply erase the 'BASIC' or 'DELTA' in the file name).
  5. Next, on toolbars, select the icon corresponding to 'Accept Change' and click on 'Accept All Changes in Document' pull-down menu. Finally, save the resultant document. This file represents the "generated electronic datapack".

## **USING THE DP PROGRAM**

The intent of this section of the SCP is to provide more detailed information relative to interfacing with the DP.EXE program than was presented in the electronic datapack generation procedure. It is recommended reading for the first-time datapack builder.

Overview -- In order to build the datapack file, it is first necessary to run a PC-resident, executable program located on the network share drive. This program, written in 'C' code, utilizes DOS (Disk Operating System) prompts to read a flight software CD ROM and generate data files on a floppy disk. Later, a word macro will utilize those same generated data files to construct an actual datapack word file.

The DP.EXE program utilizes two data input files, VPLIST.DAT and PDELIST.DAT, in its processing. If either file is not stored on the A-drive, the executable program will abort. The DP.EXE executable first uses the VPLIST.DAT data file to determine what set of variable parameter addresses are to be found, and then the data file is utilized to format each data entry using the VPLIST.DAT inputs. While DP.EXE does not require the PDELIST.DAT data file to locate the PDE addresses, the program does access the data file in order to complete the formatting of the datapack PDE addresses table.

In addition, the VPLIST.DAT data file is also utilized by a word macro to partition the variable parameter file into the desired DSM loads for the electronic datapack word file.

The PDELIST.DAT and VPLIST.DAT data files and the DP.EXE program-generated output data files are, in fact, pure text files even though they are not labeled as such. That is, there are no ‘hidden’ control characters embedded in any of the data files. However, the two input text files must be labeled as “dot DAT” files since the DP.EXE executable program is hard-coded to look for those precise file names (PDELIST.DAT and VPLIST.DAT). Otherwise, the executable will not be able to complete processing without errors.

If the datapack builder follows the recommended procedure, an ‘intermediate’ datapack word file will be generated utilizing the two data files as inputs to the DP.EXE program and a word macro-driven datapack template. A second VPLIST.DAT data file will be subsequently utilized to generate a second ‘intermediate’ datapack, using the DP.EXE executable and word macro. The datapack builder will then utilize a toolbar feature to merge the two intermediate word files into a single electronic datapack word file.

- A. The datapack builder will need to acquire the values for two FSW-build delivery parameters prior to utilizing the DP program. These data parameters, ‘Flight No.’ and ‘BASE Release’, are referred to in subsequent steps as the ‘XXX’ and ‘YY’ fields, respectively. These data parameters may be confirmed by noting the “VOLUME ID:” information on the CD ROM label. Indeed, if either parameter value does not match embedded information on the CD ROM, the ‘DP.EXE’ executable program is guaranteed to abterm. The two parameters are summarized below:

VARIABLE	FORMAT	EXAMPLE	FORMAT COMMENTS
‘Flight No.’	XXX	114	three-digit Shuttle mission identifier
BASE Release No.	YY	BA or B2	for BASE Release, ‘YY’ is always ‘BA’; for subsequent BASE releases, ‘YY’ is ‘B2’, ‘B3’, etc. (ranging from ‘B2’ to ‘B9’)

- B. Load the CD ROM and floppy diskette. Next, locate the required data files resident on the network share drive; then copy the required files to the A-drive. Initially, two data files (VPLIST.DAT and PDELIST.DAT) will be copied to the A-drive from a DF32 ‘Basic Macro’ sub-folder. Later, a second VPLIST.DAT data file will be copied to the A-drive, this time from a ‘Delta Macro’ sub-folder. The DF32 drive directory path for each of the sub-folders is DATAPACK | DPS-PGM.

Each set of data files will be used as inputs to the DP.EXE program to generate output data files ultimately utilized by a word macro to create an electronic datapack word file. By utilizing different VPLIST.DAT data files, the resulting datapacks will reflect different variable parameter loads. However, the resulting datapack word files will be identical, other than the difference in variable parameter content.

- C. A DOS command window must now be opened. Then, a series of DOS commands will be entered at the appropriate Command prompt (>). Each prompt requires specific KYBD entries, followed by pressing the 'Enter' key.

While the DOS command capability of a PC is somewhat similar to a workstation's 'X-term' command window, flight controllers rarely utilize DOS features nowadays, and such PC skills may be diminished. Therefore, the following DOS prompts are stated explicitly, much in a "cookbook" fashion.

Note that the required keystrokes are shown "boxed" for easier identification. Incidentally, either 'upper case' or 'lower case' inputs are OK, as the DOS commands are not case-sensitive.

1. To open a DOS command window, click on the following PC menu path:

Start | Programs | Accessories | Command Prompt

2. A 'Command Prompt' window will open with a DOS "N:\>" prompt. Enter the following keystrokes at the DOS prompt (>) to point to the share drive:

`s:`

3. Observe that a DOS prompt "s:\>" will appear.
4. The next set of keyboard inputs corresponds to a 'change directory' command, which serves as a pointer identifying the share drive path required to access the datapack executable, 'DP.EXE', located in the DF32 'DATAPACK | DPS-PGM' directory. (Incidentally, 'cd', followed by a space, refers to the DOS command "change directory".) Enter the following keystrokes at the DOS prompt (>):

`cd divisions\df\private\df32\datapack\dps-pgm`

5. An echo prompt will then occur:

`"s:\Divisions\DF\Private\DF32\DATAPACK\DPS-PGM>"`

6. Next, enter the following character string at the DOS prompt (>). 'DP.EXE' will utilize the input to create the datapack files and store the data on the floppy disk:

`DP XXX YY E:\stsXXXYY A:\`

Where: DP = the name of the datapack executable program (DP.EXE)  
XXX = the 3-digit flight ID (e.g., 114 for STS-114)  
YY = the flight software release version for this particular datapack ('BA' for the BASE release, 'B2' for the BASE 2 release, etc.)  
E:\ = the network drive name and path for the CD ROM containing the FSW data (for most office PCs, this will be E: drive)  
stsXXXYY = XXX and YY fields as defined above  
A:\ = floppy disk drive where DP.EXE-generated files are to be stored

Note that the “XXX YY” item entries are utilized to create labels for files generated on the A-drive. The “stsXXXYY” item entry must match labels on the CD ROM.

Once the DOS inputs are entered, the ‘DP.EXE’ program will execute and retrieve the appropriate data from the flight software CD ROM. Assuming that no problems were encountered, the entire process takes only about half a minute to complete. If no errors were detected, the program will output text to the DOS window similar to the format illustrated in Figure 1.0-4. If errors were detected, the advisory at the bottom of the text message will identify the number of error conditions encountered.

```
*****  
CREATING THE 114 (B4) DATAPACK, STANDBY...  
Generating SYNC FAIL INDICATORS...  
      start time  -- 12:30:33  
      end time    -- 12:30:36  
Generating ROLLINS..  
      start time  -- 12:30:36  
      end time    -- 12:30:47  
Generating PDEs..  
      start time  -- 12:30:47  
      end time    -- 12:30:48  
Generating VPs..  
      start time  -- 12:30:48  
      end time    -- 12:31:06  
  
No errors occurred during datapack creation.  
The files containing the datapack pages are  
located in A:\  
*****
```

**Figure 1.0-4. Typical screen output of DP.EXE program**

The DOS output text ‘start time’ and ‘end time’ values, which correspond to the local times the files were generated, have no significance and may be ignored. At this point, temporarily minimize (but don’t close) the DOS ‘Command Prompt’ window.

- D. If the DOS message window does indicate that one or more errors were detected, the most likely cause is that one or both of the input data files (VPLIST.DAT and/or PDELIST.DAT) were not copied to the A-drive. Also, if the ‘DP.EXE’ program is unable to locate a desired variable parameter address, the executable will abterm.
- E. Barring errors, the ‘DP.EXE’ program will generate a series of five output files, all stored on the A-drive, each utilizing the ‘XXXYY’ labels in their file names. As previously noted, ‘XXX’ corresponds to the flight ID and ‘YY’ identifies the flight software BASE release (‘BA’, ‘B2’, etc.) for which the datapack is being generated.
  - 1. Four files (XXXYY.SPF, XXXYY.ROL, XXXYY.PDE, and XXXYY.VP) will serve as inputs to a word macro utilized to build and format the electronic datapack document. These files contain detailed data required to generate the datapack Sync Fail Pointers (XXXYY.SPF), Roll-In SPECs (XXXYY.ROL), PDE address listing (XXXYY.PDE), and up to four variable parameter tables (XXXYY.VP).



2. The remaining file (XXXYYERR.TXT) contains a 'health status' message relative to the preceding file generation process. The text file is not utilized in the actual datapack development. The file will contain error messages, if any, for errors detected by the executable program 'DP.EXE'.

For example, error messages will be generated if the specified CD ROM inputs cannot be found, if output files cannot be written, or if decompress errors are detected upon reading the CD ROM. 'Decompress' type errors are generally indicative of problems associated with variable parameters data acquisition.

- F. The datapack builder should confirm that no errors were detected during the preceding DP.EXE program execution. Utilize the "Windows Explorer" application to open the just-generated 'XXXYYERR.TXT' file stored on the A-drive. If no errors were detected, the text message, as illustrated in Figure 1.0-5, will be observed:

```
SYNC FAIL INDICATOR errors  
ROLLIN errors  
PDEs errors  
VP errors  
No errors found
```

**Figure 1.0-5. 'Text Message' output of DP.EXE program**

If an error message in either the XXXYYERR.TXT file or in the Command Prompt window should indicate that a problem was, in fact, detected, then the error condition should be corrected and the entire process repeated.

For additional information on these five files and various known problems with the 'DP.EXE' program, refer to the "DPS Datapack & DPK Macro Certification Folder".

- G. At this point, assuming that no errors had occurred during the preceding steps, the datapack builder is ready to utilize a word macro to generate an electronic datapack document using the files stored on the A-drive. Details for using this PC-resident program are provided in the following section. Following the generation of the datapack file, 'DP.EXE' will again be utilized to generate a second datapack file.

## USING THE WORD MACRO

The intent of this section of the SCP is to provide more detailed information relative to interfacing with the word macro than was presented in the previous electronic datapack generation procedure. It is recommended reading for the first-time datapack builder.

- A. Before performing the datapack build process, it will have been necessary to gather certain FSW-build information from various sources. In addition, to the two data parameters required as inputs to both the word macro and the 'DP.EXE' executable program (i.e., the 'Flight No.' and 'BASE Release'), three additional FSW-build specific parameters and two MEDS software-version parameters are required as data inputs to the word macro. These five parameters are summarized below:

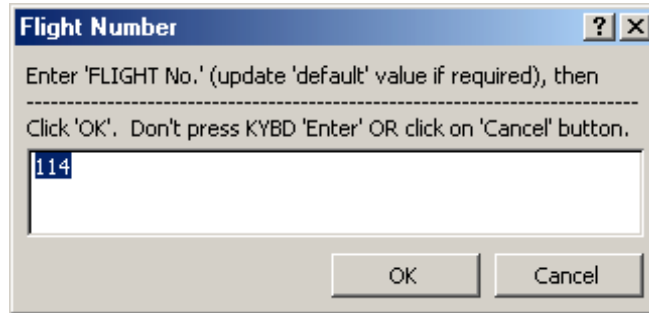
VARIABLE	FORMAT	EXAMPLE	FORMAT COMMENTS
PASS FSW Version	xx.yy	04.01	'xx' and 'yy' are numeric characters (0-9)
BFS FSW Version	ww.xx.y.zz	04.45.B.10	'y' is an alpha character (A-Z), and 'ww', 'xx', and 'zz' are numeric characters (0-9)
PASS/BFS OI Version	xx	30	'xx' are numeric characters (0-9)
MEDS IDP Version	xx.yy	04.01	'xx' and 'yy' are numeric characters (0-9)
MEDS MDUF Version	xx.yy	05.00	

The FSW-build parameters may be found on the Mass Memory Release Schedule, normally posted on the DF32 bulletin board outside the Group Lead office. The MEDS software version data may be found on the Boeing website, "Documents: MEDS White Papers & Misc" (reference the 'FSW Compatibility Matrix').

- B. Overview - A network-resident word macro, 'dpkmacro.dot', will be utilized to take the output files on the A-drive, which were generated by the 'DP.EXE' program, and construct a datapack file. If the word template is opened as a "new document", the macro feature should start-up automatically. Then, simply follow the text box prompts that the macro provides you in order to complete the semi-automated portions of the electronic datapack build process.
- C. On a network PC, select the 'dpkmacro.dot' word file located in the share drive DF32 "DATAPACK | DPS-PGM" folder. Either of two approaches, as presented below, will correctly open up the word macro template as a "new document".
  1. Open a "Windows Explorer" window, then navigate to the network share drive DF32 "DATAPACK | DPS-PGM" folder. Select the appropriate 'Basic Macro' or 'Delta Macro' sub-folder and open the 'dpkmacro.dot' template.
  2. The word macro may be also opened via initially selecting the 'My Computer' icon, then selecting the network share drive path. From this point, navigate to the DF32 "DATAPACK | DPS-PGM" folder. Then, open the appropriate 'Basic Macro' or 'Delta Macro' sub-folder and its corresponding 'dpkmacro.dot' file.
  3. Avoid opening the 'dpkmacro' word file via Microsoft Word icon or via the path: 'Start | Programs | Microsoft Word', etc. Either directory path will open the actual word macro document for direct editing, rather than creating a "new document" version of the template. Normally, this is not the desired approach if one is simply interested in building a DPS Datapack document.

If you accidentally do this, the cue is that the macro text box prompts will not be present to direct the user to enter the data inputs required to build the datapack electronic files. Simply close the file and utilize one of the recommended approaches to open the word macro template as a "new document". Also, the file name (Document1.doc) for a new document will be displayed at the top left-hand corner of the Microsoft Word window.

- D. When the word macro is opened, a series of input data box prompts will be presented, requesting flight specific data inputs. A typical data box prompt is illustrated in Figure 1.0-6.



**Figure 1.0-6. Typical word macro Data Box Prompt**

For each input box, modify the 'default' value as necessary, clicking on the 'OK' button after the input has been entered. Be careful to observe the following constraints, or the macro will abterm.

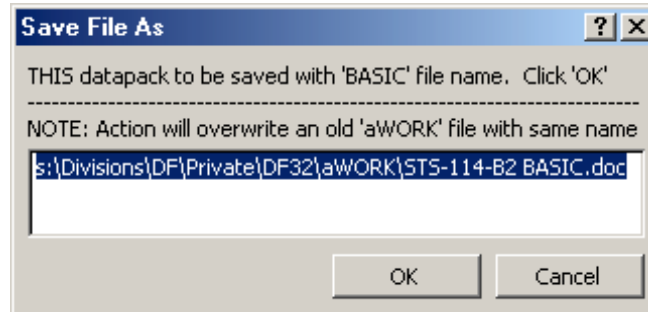
Do not use the KYBD 'Enter' key when changing default data. Do not click on the 'Cancel' button. Such actions will cause the word macro to 'abterm' or result in corrupted data parameters in the generated datapack file.

Prompts will occur for each of the following seven data parameters (five FSW-build parameters and two MEDS software version parameters). Input the correct value for the data, updating the input data 'default' value as required:

INPUT BOX PARAMETER	'DEFAULT' VALUE
Flight Number (STS mission ID)	114
BASE Release Number	BA
PASS FSW Version	04.01
BFS FSW Version	04.45.B.10
PASS/BFS OI Version	30
MEDS IDP Version	04.01
MEDS MDUF Version	05.00

- E. Following the seven data input window prompts, a window prompt will display the desired directory path where the generated datapack file is to be saved. The default location for storing the datapack file is a folder, labeled "aWORK", that is located on the network share drive in our standard DF32 directory. The 'File Save' window prompt is illustrated in Figure 1.0-7.

Unlike the source for data files for the DP.EXE executable program, the datapack builder may elect to enter a different directory path the one specified in the data window prompt. However, the default input defines the recommended document store path. If the default is modified, follow the 'data entry' caution in Step D above.



**Figure 1.0-7. 'File Save' word macro Data Box Prompt**

It should be noted that the word macro does not check the document store directory path for validity. The specified path is assumed to be valid once the 'OK' button is selected. The word macro will then generate the datapack word file irrespective as to whether or not the document-store directory path is valid.

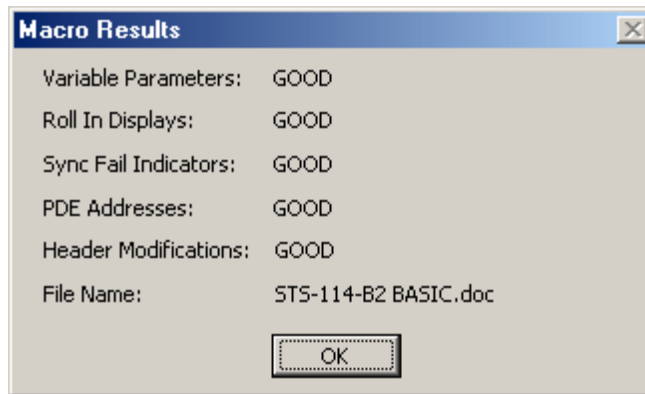
If the datapack builder has elected to change the generated datapack file store location, it is the responsibility of the user to specify a valid directory path. If an invalid path is specified, the subsequent file store will fail and an advisory window will be displayed. When the advisory message is acknowledged, the word macro will 'abterm' and the word macro template will need to be reopened and a new datapack file created. However, the DP.EXE-generated files stored on the A-drive are OK, so the entire procedure does not need to be repeated.

One additional point should be noted. When the word macro is executed, it will overwrite any file with the same name if the newly generated datapack is stored in the folder. To avoid this problem when using the recommended procedure, two different word macros are utilized to generate the 'intermediate' datapack word files. However, these two word macros are identical in every respect except that they are designed to store their resulting datapack word file with a different file name (one is labeled "BASIC" and the other file is labeled "DELTA").

- F. Once the datapack builder clicks on the 'OK' button for the "Save File As" window prompt, the word macro will begin to execute. The process should take less than ten seconds to complete, unless problems are encountered. If problems are, in fact, detected, then the word macro will abort. If so, correct the problem and repeat the procedure. Depending upon the problem, this could be no more involved than repeating the word macro. However, if one or more of the 'XXXYY' data files stored on the A-drive are invalid, the entire datapack generation procedure might need to be repeated (i.e., re-running the DP.EXE executable program).

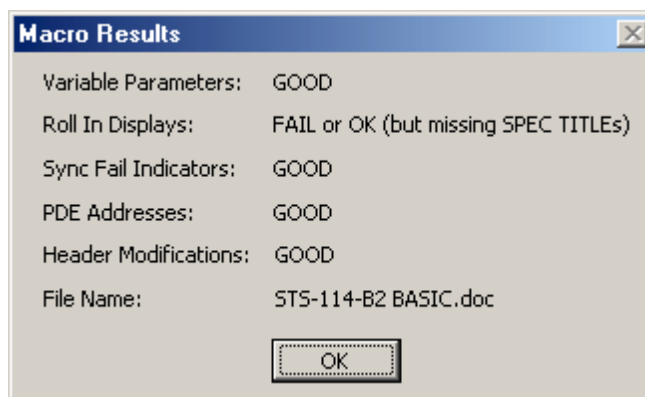
One of the more common procedural errors is to inadvertently accept the 'default' value for one or both of the first two data inputs (Flight Number or BASE Release Number). If the data input (in this case, the 'default' value) does not precisely match the 'XXXY' value for the data files stored on the A-drive, the word macro is guaranteed to abterm. Simply restart the word macro, and enter the correct inputs.

- G. If the word macro runs to completion as expected, then a dialog window will provide feedback on most macro processing, including file errors or other detected problems. The macro tracks the success of each operation, typically reporting the results of the execution as 'GOOD' or 'FAIL' after the macro completes processing. A status of all 'GOOD' results does not necessarily guarantee the contents of the resultant word file to be technically correct. However, it does indicate that no overt problems were detected by the word macro. Figure 1.0-8 illustrates the expected status window display.



**Figure 1.0-8. All 'GOOD' word macro status box**

If errors occur a 'FAIL' status indicates a detected problem. One exception is in the area of Roll-In Displays. A newly defined Roll-In SPEC (greater than '178') will display a "NOTFOUND" title. The word macro will recognize this and flag the feedback status accordingly. Figure 1.0-9 illustrates the resulting status window display.



**Figure 1.0-9. 'FAIL' word macro status box**

- H. This essentially completes the generation of the “BASIC” version of the electronic datapack word file. Next, a “DELTA” version of the electronic datapack word file will be generated utilizing these same procedures. Finally, the datapack builder will use a toolbar feature to merge the two intermediate datapack word files. The resulting merged document represents the electronic datapack document.

Because the DP.EXE executable program and dpkmacro are both certified console development products, any electronic datapack file generated using these PC tools and these SCP procedures do NOT require further detailed verification of each data parameter entry. However, the datapack builder will visually inspect the product to ensure no unexplained file dropouts had occurred,

- I. At this point the datapack is complete, except for some of the flight-specific data. The BFS VPs, if any, and any flight-specific PASS VPs need to be obtained from the DPS VP Coordinator. The BFS VP addresses may then be located, following the procedure outlined in the last part of Section 1.8.

If these changes are to be permanent changes to all future datapack documents, the DPS datapack manager should be advised so that the appropriate data files (typically, one or both of the VPLIST.DAT data files) or word macro can be updated and recertified for those changes,

Most of the first page Mission Summary information for the datapack, including flight crew assignments, may be obtained from the NASA/JSC Human Spaceflight website, Shuttle ‘Future Missions’ link. Additional information, including specific mission specialist crew assignments, may also be determined using the FDF “Flight Plan” timeline and/or the “Flight Plan Notes” section at the back of the Flight Plan.

Flight Director information may be obtained from the Flight Director Office website, ‘FD Mission Assignments’ link. However, not all flight director assignments may be identified by the time the first datapack product is required to support an ILC. DPS Console Manning information is provided by the DPS Group Lead.

## **DATAPACK PC TOOL ISSUES**

This section of the SCP is intended to serve two functions: (1) capture current corporate knowledge relative to the electronic datapack generation process; and (2) provide the first-time datapack builder with an overview of the current datapack development tools and their limitations. Presented with such information, the datapack builder is in an informed position to recognize when the datapack PC tools require future modifications.

- A. Background –In addition to the four standard Ascent, Orbit (GNC and SM), and Entry V/P loads, datapack documentation has seen the addition of specific variable parameter loads to accommodate rendezvous and Station-docked mission phases.

From an electronic datapack generation perspective, it is desirable to include these now standard V/P loads in the electronic datapack template. Unfortunately, this is

not as straight-forward as it might first seem. To better understand the issues, an overview of the electronic datapack product is desirable. There are six essential components that comprise the electronic datapack generation process:

1. CD ROM –a USA deliverable, flight-spec ific FSW-listing product. The CD ROM is accessed to acquire FSW data required for the electronic datapack product.
2. Floppy diskette –an input/output m edium to support a DOS executable. The executable program is hard-coded to access certain input data files located on the A-drive; as well as, write generated output data files out to the A-drive.
3. DP.EXE –an executable pr ogram written in ‘C’. This program is hard-coded to access the A-drive to identify both requested FSW data parameters and obtain specific formatting data. The DP.EXE program will then access the CD ROM to acquire specific FSW data, format the parametric data into structured data files, and then write the files out to the A-drive. DP.EXE is permanently resident on the network shared drive in a DF32 directory. More details of this PC tool will be discussed in subsequent paragraphs.
4. PDELIST.DAT –a data file accessed by the DP.EXE program in order to format and build a data file utilized to generate the datapack PDE addresses table. PDELIST.DAT is permanently resident on the network shared drive in a DF32 sub-directory. However, the file must be copied to the A-drive on the PC prior to initiating the electronic datapack generation process.
5. VPLIST.DAT –a data file accessed by the DP.EXE program in order to format and build a data file utilized in the generation of variable parameters datapack data. In addition, a word macro accesses both the VPLIST.DAT file and the DP.EXE-generated variable parameters data file on the A-drive to format and generate the various V/P tables in the electronic datapack.

In order to accommodate ISS Assembly/Logistical missions, there are two identically labeled versions of the VPLIST.DAT data file. However, the content of each file is unique, defining a different set of variable parameter loads.

Each data file will serve as an input for generating an electronic datapack. Note, however, that the desired file must be copied to the A-drive on the PC prior to initiating the specific electronic datapack process. Furthermore, the DP.EXE program will fail execution unless the file name is precisely ‘VPLIST.DAT’.

In order to simplify the electronic datapack generation process and avoid the necessity of manually modifying a file name, the two data files were given identical names and stored on separate DF32 sub-directories on the network share drive.

6. Word macro (dpkmacro.dot) –a Micr osoft word macro designed to generate a ‘doc’ type word file, which forms the basis for the electronic datapack. The word

macro is, in turn, composed of two elements: (1) a macro program written in WordBasic; and (2) a skeleton document template. Each word macro element is discussed below.

The macro program is designed to utilize user-defined inputs, plus input data files stored on the A-drive (the VPLIST.DAT file and the various data files generated by the DP.EXE program) to format and generate major flight-specific data portions of the electronic datapack. To more efficiently accommodate ISS Assembly/Logistical missions, the generic macro code has been modified slightly in order to allow each of the two macros to generate a uniquely named electronic datapack file. Otherwise, the macros are identical in every respect.

The skeleton word document template controls the basic “look and feel” of the actual datapack product. It can be modified independently of the macro code. Two word macros are utilized to support the electronic datapack generation process. These are ‘dpkmacro basic.dot’ and ‘dpkmacro delta.dot’, each permanently resident word files located on the network shared drive in one of two DF32 sub-directories. The actual word template is identical for each of the word macros.

In fact, the only difference between these two macros is a deliberate macro code modification to allow the macros to store their resultant word document with separate file names. This allows the electronic datapack process to utilize two distinct VPLIST.DAT files to generate datapacks with different variable parameters tables. The two uniquely named datapacks are designed to be procedurally merged into one final electronic datapack file. The advantage of this feature will become evident.

- B. The previously identified executable program (DP.EXE) is one of the more critical components of the electronic datapack generation process. The program is utilized to capture required flight software parametric data from a CD ROM containing flight specific PASS and BFS FSW listing files. It is designed to access two data files (VPLIST.DAT and PDELIST.DAT) located on the A-drive. The external file inputs serve to support target data identification, processing, and formatting of variable parameter files and PDE address files. The executable also acquires and formats roll-in SPEC and sync fail pointer information based upon hard-coded instructions. In addition, as data files are generated, hard-coded instructions direct the DP.EXE program to write these files to the A-drive.

The current DP.EXE program, which was adapted to a PC-resident format back in the mid-1990’s, has several hard-coded features that now limit its ability to generate a ‘finished product’ electronic datapack. Among these limitations are a maximum of four PASS V/P loads per electronic datapack build; an incomplete list of roll-in SPEC titles; and fixed column-width field limitations for the PDE address data files.

Under normal circumstances, the deficiencies could be corrected by updating the DP.EXE executable code. However, the ‘C’ source code listing for the program is



no longer available (lost). Thus, the only viable options are (1) to live with the current limitations and procedurally workaround the known problems; or (2) to develop, debug, and certify an entirely new version of the executable program.

In a perfect world, a new 'C' program would be developed and certified, allowing the electronic datapack to be a one-step process. However, the process is not totally broken, and a straightforward procedural workaround does exist. Consequently, a decision was made to live with the current version of the DP.EXE executable program, utilize procedural workarounds to the degree practical, and manually correct any datapack deficiencies not resolved by procedural workarounds.

C. Various issues that result from hard-coded constraints in the DP.EXE program:

1. The PDE fixed column-width field limitations are very minor and the resulting datapack PDE address table is more than adequate.
2. The DP.EXE program is designed to decode FSW data in module '#PCDR15D' and generate a list of all valid roll-in SPEC numbers. Thus, the SPEC numbers listed in the ROLL-IN DISPLAYS table in the electronic datapack should always be correct. The only deficiencies are associated with the SPEC display titles. An array of roll-in SPEC display titles was hard-coded in the executable. The highest numbered valid SPEC at that time was SPEC 168. Thus, any roll-in above SPEC 168 will be labeled as "NOTFOUND" by DP.EXE (roll-in SPEC number will be correct). However, the word macro code has been modified to correctly label all defined roll-in SPECS up through, and including SPEC 178.

The incomplete list of roll-in SPEC titles was resolved by utilizing the word macro to replace any identified erroneous/missing display titles. However, the macro 'replace' code is not a universal, automatically adapting feature. As new roll-in SPECS are defined, the word macro code would need to be updated to accommodate the new roll-in display title [a DPS datapack manager function].

3. Due to DP.EXE hard-coding constraints, a maximum of four PASS V/P loads can be generated when an electronic datapack is generated. However, the specific content of each variable parameter load is not hard-coded, but rather, is controlled by the content of the VPLIST.DAT located on the A-drive. While less than perfect, this allows the datapack builder to take advantage of this important feature. That is, if the content of VPLIST.DAT is modified, the DP.EXE program will generate a corresponding different data field for the electronic datapack.

This allows the option to generate different datapack word files based upon different versions of VPLIST.DAT data files. The resulting word files can later be merged into a single datapack word file. This approach is utilized to generate the electronic datapack document.

**TITLE**

**PREMISSION CHECKLIST –D PS PRELAUNCH CHECKLIST**

CREW AND WEATHER BRIEFING (ascent team - L - 1 day)

- \_\_\_ 1. Log on to workstation
- \_\_\_ 2. Initialize console log
- \_\_\_ 3. Discuss open waivers/problems with FLT and KSC
- \_\_\_ 4. Incorporate flight-specific OMI updates
- \_\_\_ 5. Verify FDF errata package is available
- \_\_\_ 6. Verify GMEM/RASS in DPS datapack
  - \_\_\_ Alternate I-loads RASS
  - \_\_\_ Preapproved GMEMs
- \_\_\_ 7. Log off workstation

Completed by \_\_\_\_\_ Date \_\_\_\_\_

ITEMS TO BE TAKEN TO CONSOLE (prelaunch team - completed by prelaunch)

- \_\_\_ 1. Check if CD ROM disks (PASS and BFS) are on console
  - \_\_\_ Recon 1 and final
  - \_\_\_ OI baseline S/W (PASS and BFS)
- \_\_\_ 2. BFS documents (lead FCRs preference)
- \_\_\_ 3. Supplies
  - \_\_\_ Office supplies
  - \_\_\_ DPS forms (check with forms manager)
- \_\_\_ 4. Cargo systems manual (lead FCRs preference)

Completed by \_\_\_\_\_ Date \_\_\_\_\_

PRELAUNCH TEAM CHECKLIST (L - 13 hours)

- \_\_\_ 1. Console
  - \_\_\_ Log on to workstation
  - \_\_\_ Start OFS, SPECS, DPS Overview, MIAMI, DTEX, DPS C&W, DPS ASC/ENT, and IMG0 (FCR only for IMG0)
  - \_\_\_ Clear OFS
  - \_\_\_ Clear SPECS
  - \_\_\_ Delete preexisting files by DPS DNAV II Tools I Reset Log Areas (both FCR and MPSR)
  - \_\_\_ Delete unnecessary loads on workstation
  - \_\_\_ Clear console PC flight note directories (work and in-box) on U:drive
  - \_\_\_ Start ELOG (both FCR and MPSR)
- \_\_\_ 2. Verify workstation loads against datapack
  - \_\_\_ Variable parameters
    - \_\_\_ Ascent - DSM 23001      \_\_\_ Entry - DSM 23004      \_\_\_ VP Scaling
    - \_\_\_ GNC orbit - DSM 23002      \_\_\_ BFS - DSM 199xx
    - \_\_\_ SM2 orbit - DSM 23003      \_\_\_ Flight specific - If required
- \_\_\_ 3. Send loads and verify
  - \_\_\_ Variable parameters
    - \_\_\_ Ascent - DSM 23001      \_\_\_ Entry - DSM 23004
    - \_\_\_ GNC orbit - DSM 23002      \_\_\_ BFS - DSM 199xx
    - \_\_\_ SM2 orbit - DSM 23003      \_\_\_ Flight specific - If required

- \_\_\_ 4. Safe loads
  - \_\_\_ Variable parameters
    - \_\_\_ Ascent - DSM 23001
    - \_\_\_ GNC orbit - DSM 23002
    - \_\_\_ SM2 orbit - DSM 23003
    - \_\_\_ Entry - DSM 23004
    - \_\_\_ BFS - DSM 199xx
    - \_\_\_ Flight specific - If required
  
- \_\_\_ 5. TMBUs
  - \_\_\_ Clear TMBU program uplink log
  - \_\_\_ Verify MECO + 5 and prelaunch BFS TMBUs in MOC
  - \_\_\_ Fax prelaunch TMBUs to KSC (if not previously done)
  
- \_\_\_ 6. Verify addresses for day-of-launch I-loads (DOLILUs) against the CD ROM and RASS
- \_\_\_ 7. Coordinate BFS prelaunch TMBUs with KSC per OMI
- \_\_\_ 8. Incorporate FDF errata package (if needed) and record the affected books below. Do not dispose of the removed pages. Place them in inner-leaf pocket of affected book.
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
  - c. \_\_\_\_\_
  - d. \_\_\_\_\_
  - e. \_\_\_\_\_
  - f. \_\_\_\_\_
  - g. \_\_\_\_\_
  - h. \_\_\_\_\_
  - \_\_\_ Verify correct FDF document versions on console.
  - \_\_\_ Verify access to EDP
  
- \_\_\_ 9. Uplink PASS VPs, and input ascent VP Scaling if countdown reaches that OMI step within this shift

Completed by \_\_\_\_\_ Date \_\_\_\_\_

**ASCENT TEAM CHECKLIST (L - 5 hours)**

- \_\_\_ 1. Reverify BFS TMBUs and chain when all loads in MOC
- \_\_\_ 2. Reverify PASS and BFS VPs and scaling parameters
- \_\_\_ 3. Uplink PASS VPs (if not previously done)
  - \_\_\_ Input ascent VP scaling
- \_\_\_ 4. Zero out the MTU1 and 2  $\Delta$ Ts (after final GMT alignment)
- \_\_\_ 5. Unsafe BFS VP - DSM 199xx (T - 20-min. hold)
- \_\_\_ 6. Hard copy PASS and BFS fault messages and SPECS log (T - 20-min hold)
- \_\_\_ 7. Clear PASS and BFS fault messages and SPECS log, after announcement on the flight loop (T - 20-min hold)
- \_\_\_ 8. Zero out the BFS and GNC  $\Delta$ Ts (after the OPS 9 to 1 transition)
- \_\_\_ 9. Uplink BFS VPs and prelaunch TMBUs

Completed by \_\_\_\_\_ Date \_\_\_\_\_

**ASCENT TEAM SCRUB/ABORT CHECKLIST**

- \_\_\_ 1. Obtain OPS transition times
- \_\_\_ 2. Unchain any chained command loads (i.e., BFS TMBUs)

Completed by \_\_\_\_\_ Date \_\_\_\_\_

## TITLE

IDENTIFICATION OF ROLL-IN DISPLAYS

## PURPOSE

This procedure explains how to determine which displays are roll-in displays for a particular flight software load. The primary procedure for extracting this data to build the DPS datapack is documented in SCP 1.0, Datapack Process.

## BACKGROUND

The addresses for the SM roll-in displays are stored in the sixth display format buffer (DFB). This is a CSECT called #PCDR15D for SM 2 and PCDR16D for SM 4. The table containing this data has four halfwords of overhead and then three halfwords of data for each roll-in display. Words 1 and 4 contain the number of roll-in displays defined for that phase. Words 2 and 3 contain the major function (MF) identification (ID) that roll-ins are valid for (only SM). Word 5 starts the data entries for the individual displays. The first word of each group of three is the display number multiplied by 10 and stored in hex format. The second word is the packed four-digit MMU address of the display in the hex format. These four digits contain the MMU file, track, subfile, and block information. The third word is the number of halfwords (storage) in hex that the display takes up on the MMU. The DFB that contains the roll-in addresses is accessed through pointers set up from addresses contained in the applications moding table (AMT) loaded at the time that a new ops is initialized in GPC memory.

## PROCEDURE

- A. Access the flight-specific DASS-SM2 file (and/or the DASS-SM4 file, if applicable for a particular flight).
- B. Select the Global option (F7 key) under the Search Menu. Use CSECT name #PCDR15D (or #PCDR16D for SM4) as the search query. Use the Next option (F6 key) under the Search Menu to find the desired occurrences in the Memory Map section (refer to Figure 1.2-1). Use the F8 key to make a frame hard copy for documentation purposes.

Global searches start at the frame currently being accessed. Use the First Page option under the Page Menu to guarantee that the search starts at the beginning of the file.

- C. Select the Module \_AP101\_Addr index under the Search Menu (F4 key) to find the address located in step B. When searching for addresses, define only the last five characters. Select the second entry in the list of search results, and press Go to Page (refer to Figure 1.2-2). Use the F8 key to make a frame hard copy for documentation purposes.

- D. The fourth halfword in the CSECT defines the number (in hex) of roll-in displays. In the example, 000E hex equals 14 in decimal, which defines the total number of roll-in displays.
- E. Each subsequent group of three halfwords defines each roll-in. Locate the first word of each group of three. Convert this word from hex to decimal and divide by 10. This process provides the display number. For example, 0294 in hex equals 660 in decimal, divided by 10 equals display number 66.
- F. After the entries for the assigned displays, the table is filled with data entries of 0000, 2420, 007A. This pattern indicates the end of the roll-in display definitions.
- G. Select the Existing Reports option under the File Menu to reestablish the Select Report screen.

MEMORY MAP --- SM2

#LROUND	009D1A	#LSNCS	007FDC	#LSQRT	009D7A	#LTAN	007FD8	#LVV10D3	009D88	#LVV10S3	009D8A	#LVV5D3	007FFA
#LVV5S3	007FF8	#PCAASCC	0043BE	#PCANNC0	030120	#PCDAP15	004168	#PCDB021	0286A6	#PCDCPHA	0300E4	#PCDCSPC	003D44
#PCDD142	029656	#PCDF153	02A234	#PCDG154	02E18C	#PCDHMMU	005254	#PCDH155	02E792	#PCDIMMU	02473E	#PCDJRWD	003218
#PCDKANN	030FD4	#PCDLANN	001D9C	#PCDMUIC	001F04	#PCDND14	02A140	#PCDND15	02E0D4	#PCDN102	029616	#PCDQANN	030328
#PCDR15D	02ED98	#PCDSANN	031326	#PCDTANN	030D3E	#PCDULNK	00328C	#PCDVS9C	00334A	#PCDWDOW	003368	#PCDZANN	030F90
#PCD0001	0286FA	#PCD0002	0286A8	#PCD0003	0286D8	#PCD0010	02893A	#PCD0020	029658	#PCD0060	028C70	#PCD0990	0295C6
#PCGBIM3	003508	#PCGEDIS	00789E	#PCGEGNC	002A4E	#PCPADGT	004F0C	#PCPADOW	004D38	#PCPAMSP	007FA8	#PCPASCA	007A74
#PCPASSI	0078A8	#PCPCANI	00CB6A	#PCPCCCS	00D108	#PCPCCLT	004B12	#PCPCCST	00D512	#PCPCDIT	004F64	#PCPCPCI	00CAF8
#PCPCTCI	00CB08	#PCPCVID	004A3A	#PCPGGNC	004DF2	#PCPKCOT	00CB36	#PCPPCOT	00CB64	#PCPPMMD	00D038	#PCPPPCS	00CC42
#PCPPPSB	02534C	#PCPPPIB	00CC2C	#PCPSSLD	00D534	#PCPSSLT	00BF34	#PCPSSLX	00D6A0	#PCPSSSC	00CB20	#PCPSSSU	005012
#PCPUSLS	00CB94	#PCP2GXT	025552	#PCRATE	00D146	#PCRBMI	00E25C	#PCRCOT	0051C8	#PCRDICL	00E28E	#PCREMCO	00E3D6
#PCRFA5C	03236C	#PCRGOPT	00556C	#PCRILVC	00C416	#PCRJMDT	032866	#PCRTDIS	00E404	#PCSABCT	0048E8	#PCSAERT	00497A
#PCSAFCT	00BF36	#PCSAPDT	00A37E	#PCSAFFT	0049CA	#PCSAFST	031B3C	#PCSASAT	00BB44	#PCSASMC	004EDC	#PCSBPBT	0055E6
#PCSPCCM	00D054	#PCSDHYB	0049D6	#PCSDMDT	00C9FC	#PCSDMD1	00C93A	#PCSDMD2	005610	#PCSDRTC	00C89A	#PCSDRT1	00C9EA
#PCSDRT2	0056FC	#PCSLFOR	0055A8	#PCSMAMC	004F2C	#PCSPCLB	00CA70	#PCSPCON	004F12	#PCSPRTB	03155A	#PCSPTEC	00D0CE
#PCSSCOT	005018	#PCSSDDT	00BD96	#PCSSSPA	00778E	#PCSSSPC	004EF8	#PCSSSPO	00BE40	#PCSTCAT	033C8C	#PCSTTMC	004E7A
#PCSZICC	00BEA4	#PCS0600	02A236	#PCS0620	02A4D6	#PCS0640	02A97A	#PCS0780	02B680	#PCS0790	02BAD0	#PCS0940	02AAF4
#PCS0950	029DCA	#PCS2DAR	007D2C	#PCS21FT	007A2A	#PCS21NB	0078FA	#PCS21NI	00787C	#PCS21PT	003E66	#PCS21XP	005748
#PCS21X2	005808	#PCS21X3	0058C8	#PCS21X4	005988	#PCS21X5	005A48	#PCS21X6	005B08	#PCS21X7	005BC8	#PCS21MPT	00DF80
#PCS2PAR	00E6A2	#PCS2PAT	0078A0	#PCS2PCT	007ADC	#PCS2PDT	00D6E6	#PCS2PXT	032E40	#PCS2PX2	033322	#PCS2PX3	033802
#PCS2011	02AED6	#PCS2021	02B2C2	#PCS2080	02BE7E	#PCS2100	02C1BA	#PCS2110	02C650	#PCS2120	02CA6A	#PCS2130	02CD50
#PCS2140	02CEF4	#PCS2200	02D386	#PCS2220	02D8A6	#PCS2230	02DBDA	#PCS2240	02DF78	#PCVAMMD	007F1A	#PCVECOM	005566
#PCVJFDE	003568	#PCVKASC	003598	#PCVNMU	022534	#PCVUSRB	0036DC	#PCVVLDB	00376E	#PCV2L1N	003778	#PCV3GME	003B92
#PCV3LOT	003986	#PCV8011	0298FA	#PCZ1COM	002118	#PCZ2COM	002452	#PCZ3COM	002A1A	#PCZMCOM	009BA6	#PCZMPT	01CB32
#PFIOTR	009CF8	#QACOS	0002AC	#QASIN	0002AE	#QATAN	0002B0	#QCAS	0001EA	#QCASPV	0001C2	#QCASR	0002B2
#QCA1V	0002B4	#QCPAS	0001C4	#QCPASP	0001EC	#QCPTR	0002B6	#QDEXP	0001AC	#QDLOG	0001AE	#QDMOD	0001D0
#QDSORT	0001B0	#QEATAN2	0002D4	#QEMAX	0002B8	#QEMIN	0002FA	#QEMOD	0002EE	#QEPWRE	0002DC	#QEPWRH	000228
#QEXP	0001B2	#QGTBYTE	0001BA	#QHMAX	0002F0	#QHMOD	0001EE	#QHREM	0001C8	#QHTOC	0001F0	#QIMOD	00022E
#QIREM	00020A	#QLQG	0001B4	#QMM11S3	0002F2	#QMM6S3	0002DE	#QMSTR	000204	#QMV6S3	0002C0	#QSNIN	0002BA
#QSNCS	0002BC	#QSQRT	0001B6	#QSTBYTE	0001BC	#QTM	0002BE	#QVM6S3	0002F4	#QVVDN	0001CA	#QVV0SN	0001CC
#QVV1S3	0002F6	#QVV1T3	0002D6	#QVV1W3	0002C2	#QVV10D3	0002D8	#QVV10S3	0002DA	#QVV2S3	0002F8	#QVV3D3	0002CA
#QVV3S3	0002E0	#QVV4D3	0002C6	#QVV4S3	0002E2	#QVV5D3	0002C8	#QVV5S3	0002CA	#QVV6S3	0002CC	#QVV7S3	0002CE
#QVV9D3	0002D0	#QVV9S3	0002D2	#QVX6S3	0002E4	#XAI DDEU	000756	#XARFDP3	0030D6	#XASISPE	00076E	#XASITMC	0043BC
#XDGGSE	003214	#XDNXBMS	000754	#XDPSPC	003D42	#XDSPP3C	003D06	#XPC1N1T	00415A	#XPC1TE	004158	#XPPFCNT	004162
#Y021001	008030	#Y023001	01D2BA	#Y025001	029618	#Y140001	003C72	#Y143001	01E2B2	#Y145001	02A142	#Y151001	00FF9A
#Y153001	01D85A	#Y155001	02E0D6	#ZAI DDEU	0001B8	#ZARDCSB	0001FA	#ZARFDP3	0001E8	#ZARGREC	000208	#ZARXRSB	000206
#ZARYMPB	0001E4	#ZAS1SPE	0001BE	#ZASLTMC	0001FC	#ZDCDDG31	0001D2	#ZDCDDG2	0001D4	#ZDCDDG3	0001D6	#ZDCDIX8	0001D8
#ZDCDDG9	0001DA	#ZDCDDOW	0001CE	#ZCDDSS2	0001DC	#ZCDDSS4	0001DE	#ZCDDSS8	0001E0	#ZDDLVAR	000230	#ZDGESE	00022A
#ZDGNLIG	0001F4	#ZDGGGSE	0001E2	#ZDG9LIG	0001F6	#ZDIMTCC	0001E6	#ZDISPLA	0001C6	#ZDLALIG	0001F2	#ZDMAMAC	0001C0
#ZDMMNCD	00020C	#ZDMNNEW	000220	#ZDMRRES	000212	#ZDMZLOG	000214	#ZDM1KEY	00021E	#ZDM2APP	000232	#ZDM3D1S	000216
#ZDM4DEU	00020E	#ZDM5NWE	000218	#ZDM6OPS	000222	#ZDM7REQ	000224	#ZDMBSPE	000210	#ZDM9ITE	000226	#ZDNXBMS	0001FE
#ZDPSPC	000200	#ZDPL1IG	0001F8	#ZDPSPC	000202	#ZDXCCCS	00021A	#ZDXRDMM	00022C	#ZDXXCSE	00021C	#ZFIOCCR	0001A8
#ZPC1N1T	000244	#ZPC1TE	000242	#ZPMCCYC	00025C	#ZPMOSTA	000248	#ZPMPSLP	000284	#ZPMQTEC	00025E	#ZPMRSLR	000270
#ZPMTSLG	000260	#ZPMWELW	000262	#ZPPFCNT	000264	#ZPUSLS	000272	#ZPU3MUP	000274	#ZPMQTEC	00025E	#ZPU4MUP	000276
#ZPUSMUP	000278	#ZPU6MUP	00027A	#ZPU7MUP	000288	#ZPUBMUP	00027C	#ZPUSMUP	000274	#ZPUSMUP	000274	#ZRBMHWD	0002E6
#ZRD0DD1	00028C	#ZRFPIOS	00029E	#ZRHMLLT	00028E	#ZRTOCGR	0001AA	#ZRTITTEM	0002A0	#ZRSJSHN	0002A2	#ZRKGIN	0002A4
#ZRNCCNC	000290	#ZROVKYB	000292	#ZROCTPC	000294	#ZRRPRRA	000296	#ZRSCGIN	0002A6	#ZRTVPT	000298	#ZRUDKYB	00029A
#ZRVCOM	0002EA	#ZRWPPHC	00029C	#ZRXYCIN	0002A8	#ZRYECNV	0002EC	#ZSACPMU	00023C	#ZSAMITE	0002FC	#ZSBCSM	000306
#ZSBNDITE	0002FE	#ZSBISM	000308	#ZSBSBAC	00024A	#ZSDTSM	000246	#ZSGCKIP	000300	#ZSMNCLN	00027E	#ZSO2CON	000280
#ZSPCPCP	000266	#ZSPEPSP	0002AA	#ZSPPPRE	00023E	#ZSPRPRB	00024C	#ZSRESTO	000238	#ZSSAAPU	00024E	#ZSSBPLB	000268
#ZSSCFUE	000250	#ZSSEBQC	00026A	#ZSSFFUE	000252	#ZSSHHYD	000254	#ZSSMANT	00026C	#ZSSNO2N	000282	#ZSSOSPD	000256
#ZSSRREC	00026E	#ZSSSTBY	000240	#ZSSSSTA	000258	#ZSSTHYD	00025A	#ZSSTTAB	00023A	#ZS2ICLN	000302	#ZVMP1TE	000304
#OETHO	0004B8	#OITOD	00051C	#OITOE	000516	#OROUND	00046C	@OATBPGC	00148A	@OAIES1P	0014E6	@OATGDEU	0048B6
@OARAGPC	001582	@OARBLDL	0015FE	@OARCGPC	0016D4	@OARKDOW	001738	@OASC7IM	004536	@OASGCYC	0045B6	@OASGWE	00174C
@OASMAUX	001760	@OASNGME	001798	@ODGILDB	001972	@ODGMWRT	0005AC	@ODGRGSE	00199A	@ODIRTOR	0017C8	@ODMCSUP	0017DC

Verify that this is the correct version before use  
1.2-3

Figure 1.2-1. Sample memory map index

M E M O R Y M A P --- SM2

```
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111' BTN'1111111111111111'
```

Hex number of roll-in displays.

Display number x10 in hex.

```
02ED98-02EE10 #PCDR15D *0079( 121) DATA CSECT Word 1 I CDR15D
02ED98-02ED99 #PCDR15D+0000 CDR15D_HDR ARRAY BIT STRING VARIABLE
02ED98-02ED99 #PCDR15D+0000 000E 0003
BTN'0000000000001110' BTN'0000000000000811'
CDR15DAR ARRAY BIT STRING VARIABLE
*0003 *000E *0294 *1F00 *0600 *029E *1F03 *0600 *02A8 *1F06 *0600 *02B2 *1F09 *0600 *02F8 *1F0C
*0600 *0302 *1F0F *0600 *035C *1F12 *0600 *0366 *1F15 *0600 *0370 *1F18 *0600 *037A *1F1B *0600
*03C0 *1F1E *0600 *03CA *1F21 *0600 *0690 *1F24 *0600 *08CA *1F27 *0600 0000 *2420 *007A 0000
*2420 *007A 0000 *2420 *007A 0000 *2420 *007A 0000 *2420 *007A 0000 *2420 *007A 0000 *2420
*007A 0000 *2420 *007A 0000 *2420 *007A 0000 *2420 *007A 0000 *2420 *007A 0000 *2420 *007A
0000 *2420 *007A 0000 *2420 *007A 0000 *2420 *007A 0000 *2420 *007A 0000 *2420 *007A 0000
*2420 *007A 0000 *2420 *007A 0000 *2420 *007A 0000 *2420 *007A 0000 *2420 *007A 0000 *2420
*007A 0000 *2420 *007A 0000 *2420 *007A
```

Verify that this is the correct version before use  
1.2-4

Figure 1.2-2. Sample memory address area

## TITLE

FLEX MDM FILE

## PURPOSE

This procedure documents how to build the flex MDM file that COMMANDO uses to determine which flex MDMs are valid for a particular flight.

## BACKGROUND INFORMATION

The MDM built-in test equipment (BITE) Read command allows the DPS operator to acquire information to troubleshoot/isolate an MDM problem in flight. The flex MDM file is used by COMMANDO to determine which flex MDMs are valid for a flight. The DPS SDT representative is responsible for creating this file by executing the Shuttle Data Tape program. For flights with flex MDMs, the DPS SDT representative will provide a printout of the Flex file, if applicable, to the datapack builder. An example of this file is shown in Figure 1.3-1.

## PROCEDURE

- A. Acquire the printout from the DPS SDT representative.
- B. Log on to an MPSR workstation.
- C. Pull up a development window. Type "cd /users/dps/rw\_common/cmdo" at the command line.
- D. Create the file on the workstation by using a text editor, such as vi. The naming convention for the data file containing the flex information is xxxyflx.mdm, where xxx is the flight number and y is the version number (1 = recon version, f = final version). Include the path and filename in the first line of the file. This example is the final version for STS-61.

```
/users/dps/rw_common/cmdo/061fflx.mdm  
1  
FX1  
6  
0-AID  
1-AID  
2-AID  
3-DOH  
4-DIH  
7-DIH
```

*Figure 1.3-1. Example data file*



**TITLE**

SYNC FAIL POINTER ADDRESSES

**PURPOSE**

This procedure provides an explanation of what kind of information the Sync-Fail Pointer parameter in the variable parameters provides and explains how to find the pointer values for each software release. The primary procedure for extracting this data for the DPS datapack is documented in SCP 1.0, Datapack Process.

**BACKGROUND**

When a GPC experiences a fail to sync (FTS), FCOS branches to a routine called FCMSFAIL. This routine controls the processing that is required in support of a forced or actual GPC FTS. The return address of the routine that was executing when the FTS condition occurred is stored in GPC memory at a location called FC\$SFIL (15th H/W). This location, displayed via variable parameter, is the Sync-Fail Pointer Address and enables the console operator to determine which routine was executing prior to entrance into FCMSFAIL and, therefore, gives some insight into the cause of the FTS. The routines that may be running when an FTS occurs are as follows:

<u>CSECT name</u>	<u>Description</u>
FCMCSYNC	Common set SSIP sync point (1)
FCMISYNC	All I/O sync points - RS and CS ICC
FCMISYNC	Special branch for normal STBY-HALT (1)
FCMSSYNC	RS SVC sync point
FCMTSYNC	RS timer sync point
FIOERRLC	Branch for RS nonuniversal I/O errors (2)
FIOCMLPT	ICC failure or ICC checksum failure (3)
FPMSVC	Special branch for normal target set collapse. This is not an FTS.

- Notes: (1) A sync pattern of "000" satisfies SSIP sync. Therefore, a GPC showing this pattern (one moded to STBY) will fail at the subsequent ICC I/O sync point.
- (2) This signature will be observed only if the downlisting GPC is the one with the problem. The actual FTS is at the next sync point following the GPC self-fail.
- (3) For ICC failures, a "Group 5/Code 0" GPC error will be logged. For ICC checksum failures, a "Group 5/Code 7" GPC error will be logged.

## PROCEDURE

- A. Select the flight-specific DASS-SSW file.
- B. Use the Global option (F7 key) under the Search Menu to find the following CSECTs: FCMCSYNC, FCMISYNC, FCMSSYNC, FCMTSYNC, FIOCMPLT, FIOERRLC, and FPMSVC. The first occurrence of these modules is in the Memory Map area. Most likely, they will all appear in the same frame or in two consecutive frames (Figure 1.4-1). Use the F8 key to make frame hard copies for documentation purposes.

Global searches start at the frame currently being accessed. Use the First Page option under the Page Menu to guarantee that the search always starts at the beginning of the file.

- C. Use the Module `_AP101_Addr` index under the Search Menu (F4) to locate each CSECT in the DASS-SSW (i.e., FCMCSYNC+0000, FCMISYNC+0000, etc.). Use the addresses (last five characters) found in step B as index queries. Select an entry in the list of search results and press Go to Page to view the desired occurrence. If this is not the desired occurrence, select another by using the Search Results (F9 key) under the Search menu.
- D. For each CSECT found in step C, except for FPC SVC, use the Global option (F7) under the Search Menu to find the FCMSFAIL string accompanied by a BAL statement in the previous line. The address to be recorded is the one found in the line following the FCMSFAIL string (Figure 1.4-2). Use the F8 key to make a frame hard copy for documentation purposes.

Keep in mind that FCMISYNC contains two such statements, the first one for I/O Sync Point and the second one for normal STBY-HALT. Use the Next option (F6 key) to view the second occurrence.

- E. For the FPMSVC CSECT found in step C, the user will look for the FPMSVC1 label with a BAL statement in the previous line. In this case, the global search will be performed on string FPMSVC1. The address to be recorded is the one found in the same line where the FPMSVC1 string appears (Figure 1.4-3). Use the F8 key to make a frame hard copy for documentation purposes.
- F. The addresses found for each CSECT above are what the sync-fail pointer will indicate if that CSECT was being processed at the time of the FTS. Notice that the offset into each CSECT will not necessarily remain constant between software releases. Refer to appendix H for extended addressing calculations.
- G. Select the Existing Reports option under the File Menu to reestablish the Select Report screen.

MEMORY MAP --- SSW

018BD3-018BD4	FCMCSYNC+008F	BAF3	9CA6	009CA6	STH	R2,X'9CA6'		
018BD5	FCMCSYNC+0091				DS	0H		
018BD5	FCMCSYNC+0091	D800		018BD6	BCF	0,0	NOP	#@LB20 +1
018BD6-018BD7	FCMCSYNC+0092	9AF3	0158	000158	LH	R2,X'0158'	TCVTIFLG	
018BD8-018BD9	FCMCSYNC+0094	B3E2	0400		TRB	R2,X'0400'	1024	
018BDA-018BDB	FCMCSYNC+0096	C3F3	8C1E	018C1E	BC	3,X'8C1E'	BNZ	FCMCSLPE
018BDC-018BDD	FCMCSYNC+0098	ECF3	8410		LHI	R4,X'8410'		
018BDE-018BDF	FCMCSYNC+009A	1DF3	0180	000180	L	R5,X'0180'	TCVTSIPI	
018BE0	FCMCSYNC+009C				DDEC	R5,R4		
018BE1-018BE2	FCMCSYNC+009D	1DF3	0168	000168	L	R5,X'0168'	TCVTCSSM	
018BE3-018BE4	FCMCSYNC+009F	18F3	0178	000178	L	R0,X'0178'	TCVTSITK	
018BE5	FCMCSYNC+00A1				NR	R0,R5		
018BE6-018BE7	FCMCSYNC+00A2	25F3	0172	000172	N	R5,X'0172'	TCVTSIPM	
018BE8-018BE9	FCMCSYNC+00A4	EEF3	0818		LHI	R6,X'0818'		
018BEA	FCMCSYNC+00A6				FCMCSOUL	DS	0H	
018BEA	FCMCSYNC+00A6			77E7	XR	R7,R7		
018BEB	FCMCSYNC+00A7			D9E7	ICR	R1,R7		
018BEC-018BED	FCMCSYNC+00A8	09F3	8244	008244	S	R1,X'8244'	FCMSNTO2	
018BEE	FCMCSYNC+00AA				FCMCSMNL	DS	0H	
018BEE	FCMCSYNC+00AA	DAEE			PC	R2,R6		
018BEF	FCMCSYNC+00AB	DBE7			ICR	R3,R7		
018BF0-018BF1	FCMCSYNC+00AC	0BF3	81EA	0081EA	S	R3,X'81EA'	FCMNOISE	
018BF2	FCMCSYNC+00AE	1CE2			LR	R4,R2		
018BF3	FCMCSYNC+00AF	F410			SLL	R4,4		
018BF4	FCMCSYNC+00B0	72E4			XR	R2,R4		
018BF5	FCMCSYNC+00B1	DCE7			ICR	R4,R7		
018BF6	FCMCSYNC+00B2	0CE1			SR	R4,R1		
018BF7-018BF8	FCMCSYNC+00B3	24F3	81E8	0081E8	N	R4,X'81E8'	FCMBIT16	
018BF9	FCMCSYNC+00B5	DC20		018C02	BCF	4,8	BZ	FCMDIAR2
018BFA	FCMCSYNC+00B6	22E5			NR	R2,R5		
018BFB-018BFC	FCMCSYNC+00B7	E7F3	95D6	0195D6	BAL	R7,X'95D6'	FCMSFINT	
018BFD-018BFE	FCMCSYNC+00B9	B2E0	8000		OHI	R0,X'8000'	-32768	
018BFF-018C00	FCMCSYNC+00BB	E7F3	9400	019400	BAL	R7,X'9400'	FCMSFAIL	
018C01	FCMCSYNC+00BD	DF70		018C1E	BCF	7,X'001C'	B	FCMCSLPE
018C02	FCMCSYNC+00BE				FCMDIAR2	DS	0H	
018C02	FCMCSYNC+00BE	DCE7			ICR	R4,R7		
018C03	FCMCSYNC+00BF	0CE3			SR	R4,R3		
018C04-018C05	FCMCSYNC+00C0	24F3	81E8	0081E8	N	R4,X'81E8'	FCMBIT16	
018C06-018C07	FCMCSYNC+00C2	C4F3	8C02	018C02	BC	4,X'8C02'	BZ	FCMDIAR2
018C08	FCMCSYNC+00C4	DBEE			PC	R3,R6		
018C09	FCMCSYNC+00C5	DCE7			ICR	R4,R7		
018COA-018COB	FCMCSYNC+00C6	34F3	81FC	0081FC	ST	R4,X'81FC'	FCMCTTIM	
018COC-018COD	FCMCSYNC+00C8	A2F3	8200	008200	SHW	X'8200'	FCMCTFLG	
018COE	FCMCSYNC+00CA	1CE3			LR	R4,R3		
018COF	FCMCSYNC+00CB	F410			SLL	R4,4		
018C10	FCMCSYNC+00CC	73E4			XR	R3,R4		
018C11	FCMCSYNC+00CD	2AE3			OR	R2,R3		
018C12	FCMCSYNC+00CE	22E5			NR	R2,R5		
018C13	FCMCSYNC+00CF	DC28		018C1E	BCF	4,X'000A'	BZ	FCMCSLPE
018C14	FCMCSYNC+00D0	1BE2			LR	R3,R2		
018C15	FCMCSYNC+00D1	F320			SLL	R3,8		
018C16	FCMCSYNC+00D2	2AE3			OR	R2,R3		
018C17	FCMCSYNC+00D3	1BE0			LR	R3,R0		
018C18	FCMCSYNC+00D4	20E2			NR	R0,R2		
018C19	FCMCSYNC+00D5	73E0			XR	R3,R0		

018C01  
018C02  
018C02 desired address  
018C03 address

Verify that this is the correct version before use  
1.4-3

Figure 1.4-1. DAS page containing the starting address of each of the desired CSECT





## TITLE

ELECTRONIC FILE TRANSFER APPLICATIONS

## PURPOSE

The SDT, PDT, and TMBU database development is done by the respective managers and is not part of the datapack build process. This SCP describes procedures necessary to create the PASS SM and BFS SM FDA databases used by the TMBU program and the SDT and PDT databases used by the SDTPDT program. These programs, BSFTAPE, PASSTAPE, and SDTPDT can be run only in the Consolidated Development Environment (CDE) and can be accessed via DNAV DPS II Tools.

## INTERFACES

Four data files containing the BFS and PASS TMBU, SDT, and PDT information are the products used in creating the databases. These products are generated by the Reconfiguration Management Division. They are electronically transferred by the Section File Transfer Manager from the Software Production Facility (SPF) to the Ops environment for MCC flight controller use. These files are then ready for processing by the various DPS section software managers. The four input data files are placed in the /users/dps/rw\_common/dp directory. The structure of the file names are xxxbfs.y, xxxpass.y, xxxpdt.y, and xxxsdt2.y.

Two of the four input files are used by the PASSTAPE and BFSTAPE programs. The format of these deliverable products are described by the Mass Memory Integration Plan (MIP). Executing PASSTAPE and BFSTAPE generates the three input files required to execute the TMBU program: xxx\_\_sm.y, xxx.eu and xxx\_bfs.y, where xxx is the flight identifier (i.e., 071), and y is the reconfiguration identifier (i.e., "1" for recon1 and "f" for final). The PASSTAPE and BFSTAPE programs access the data files of the format xxxpass.y and xxxbfs.y, and the output files are placed in /users/dps/uncert\_apps/tmbu-data. A procedure to generate the EU file manually is also included.

The other two input files are used by the SDTPDT program. Executing SDTPDT generates five files. Two files are generated by SDTPDT, xxxySDT and xxxyPDT, and are used only by the SDTPDT program. The third file generated, xxxyflx.mdm, is used by the MDM BITE Read program. The fourth file, xxxy\_xxy.sdt, contains results from use of the program option to compare channelization from flight to flight. Both the third and fourth files are generated from the SDT database. The fifth file, xxxyFDF, is used by various disciplines to verify addresses located in the FDF and is generated from the PDT database. The SDTPDT program accesses /users/dps/rw\_common/dp for the data files of the formats xxxsdt2.y and xxxpdt.y. Four output files are placed in /users/dps/rw\_common/sdtpdt, and one, xxxyflx.mdm, is placed in /users/dps/rw\_common/cmdo directory. The SDTPDT program also requires two additional data files that process the PDT database that do not need to be modified

unless requirements change. These files are located in the /users/dps/rw\_common/sdtpdt directory under the names ref\_pages.dat and halstat.dat.

Note: The PDT databases are no longer transferred to the CDE directory. However, the capabilities still exist in SDTPDT to process the files if desired.

## **PROCEDURE**

### **A. PASSTAPE**

1. Log on to the CDE workstation.
2. Execute the PASSTAPE program by choosing PASSTAPE from the DNAV DPS II Tools menu.
3. After entering the flight and recon number, the program creates the database.
4. See Figure 1.5-1 for a sample run of PASSTAPE.

### **B. BFSTAPE**

1. Log on to the CDE workstation.
2. Execute the BFSTAPE program by choosing BFSTAPE from the DNAV DPS II Tools menu.
3. After entering the flight and recon number, the program creates the database.
4. See Figure 1.5-2 for a sample run of BFSTAPE.

### **C. SDTPDT**

1. Log on to the CDE workstation.
2. Execute the SDTPDT program by choosing SDTPDT from the DNAV DPS II Tools menu. Figure 1.5-3 contains the main menu displayed for SDTPDT.
3. To generate the SDT and flex output files, select the Create SDT File option. Enter the OI when prompted for the particular flight.
4. To generate the PDT database as well as generate the associated FDF reference pages, select the Create FDF Pages option.
5. If a flex file has been created, print out a copy and give to the datapack builder.

### **D. EU File**

The EU list is now automatically generated by PASSTAPE. This procedure describes how to create the EU list if PASSTAPE is not available.

1. Use the MASTER LISTING portion of the fiche for the applicable flight and recon.







LIST OF 0F09100.APPL.SRC.CSAPDT.LIT.T1072180 FT R09 V 001 PLACED ON SYSTEM 03/13/91  
 HAL/S FC-21.B OF090100.APPL.SRC(CSAPDT)RVL=A0 MARCH 13, 1991 18:8:35.28 PAGE 14

SRN	STMT	SOURCE	CURRENT SCOPE
007800	C  *****		CSA_PDT
A0			
007900	C  *		CSA_PDT
A0			
008000	C  * PREPROCESSOR GENERATED ENTRIES *		CSA_PDT
A0			
008100	C  *		CSA_PDT
A0			
008200	C  *****		CSA_PDT
A0			
008300	C  GEN		CSA_PDT
A0			
008400	C  ***		CSA_PDT
A0			
008500	C  *** V58T0169A - HYD SYS 1 BODY FLAP RTN LN T 1		CSA_PDT
A0			
008600	C  ***		CSA_PDT
A0			
008700	20 M  DECLARE CSAS_PDT_580169 CSAS_PDT_EU_ENTRY-STRUCTURE INITIAL(HEX'410D', NAME(CSAS SAT 4), 0.0),		CSA_PDT
A0			
008700	20 M  CSAS_PDT_580169_FDA CSAS_PDT_ANA_EU_FDA_INFO-STRUCTURE INITIAL(HEX'00', OFF, OFF, DEC'15'		CSA_PDT
A0			
008700	20 M  , DEC'1', DEC'0128', DEC'1', DEC'15'),		CSA_PDT
A0			
008700	20 M  CSAS_PDT_580169_LIM CSAS_PDT_EU_LIM_VALUES-STRUCTURE INITIAL(-99999.99, 99999.99);		CSA_PDT
A0			
009400	C  ***		CSA_PDT
A0			
009500	C  *** V58T0206A - HYD SYS 2 H2O BLR GN2 TANK TEMP 2		CSA_PDT
A0			
009600	C  ***		CSA_PDT
A0			
009700	21 M  DECLARE CSAS_PDT_580206 CSAS_PDT_EU_ENTRY-STRUCTURE INITIAL(HEX'400D', NAME(CSAS SAT 30), 0.0);		CSA_PDT
A0			
009900	C  ***		CSA_PDT
A0			
010000	C  *** V58T0264A - HYDR SYS 2 H2O BLR H2O TANK TEMP 2		CSA_PDT
A0			
010100	C  ***		CSA_PDT
A0			
010200	22 M  DECLARE CSAS_PDT_580264 CSAS_PDT_EU_ENTRY-STRUCTURE INITIAL(HEX'410D', NAME(CSAS SAT 30), 0.0);		CSA_PDT
A0			
010200	22 M  CSAS_PDT_580264_FDA CSAS_PDT_ANA_EU_FDA_INFO-STRUCTURE INITIAL(HEX'00', OFF, OFF, DEC'15'		CSA_PDT
A0			
010200	22 M  , DEC'1', DEC'0125', DEC'2', DEC'15')		CSA_PDT
A0			
010200	22 M  CSAS_PDT_580264_LIM CSAS_PDT_EU_LIM_VALUES-STRUCTURE(2) INITIAL(4.000000E+01,		CSA_PDT
A0			
010200	22 M  1.100000E+02, -99999.99, 99999.99);		CSA_PDT
A0			
011000	C1 ***		CSA_PDT
A0			

**Figure 1.5-4. APPL.SRC.CS4PDT application modules**

U71T1023A  
U76V0075A  
U76V0076A  
U90R2537D  
V45C0101A  
.  
.  
V92Q0318C  
V92Q2104C  
V92R4935C

*Figure 1.5-5. Partial listing of the EU.043 file*

## TITLE

SM I/O PROFILE

## PURPOSE

The purpose of this SCP is to provide a procedure that will assist the DPS operator in generating an SM INPUT/OUTPUT (I/O) PROFILE for a space shuttle mission. This SCP provides a background of the SM I/O interfaces, addresses the various products needed, contains step-by-step instructions to interpret the SM payload BYPASS BITS definition listing, and illustrates how to integrate the bit definition into the SM BCE BYPASS words. These data are then incorporated into the electronic DPS datapack word file that is generated for every Shuttle mission.

## BACKGROUND

Unlike the GNC GPC, the SM GPC interfaces with various I/O devices not used by the flight-critical system. These include payload MDMs (referred to as PL or PF MDMs), flex MDMs (FMDMs), and payload data interleaver (PDI) via the PL data buses; manipulator control interface unit (MCIU) via Launch Bus 1; and the pulse-code modulation master unit (PCMMU) via the IP data bus. Figure 1.6-1 reflects the “typical” SM I/O interfaces.

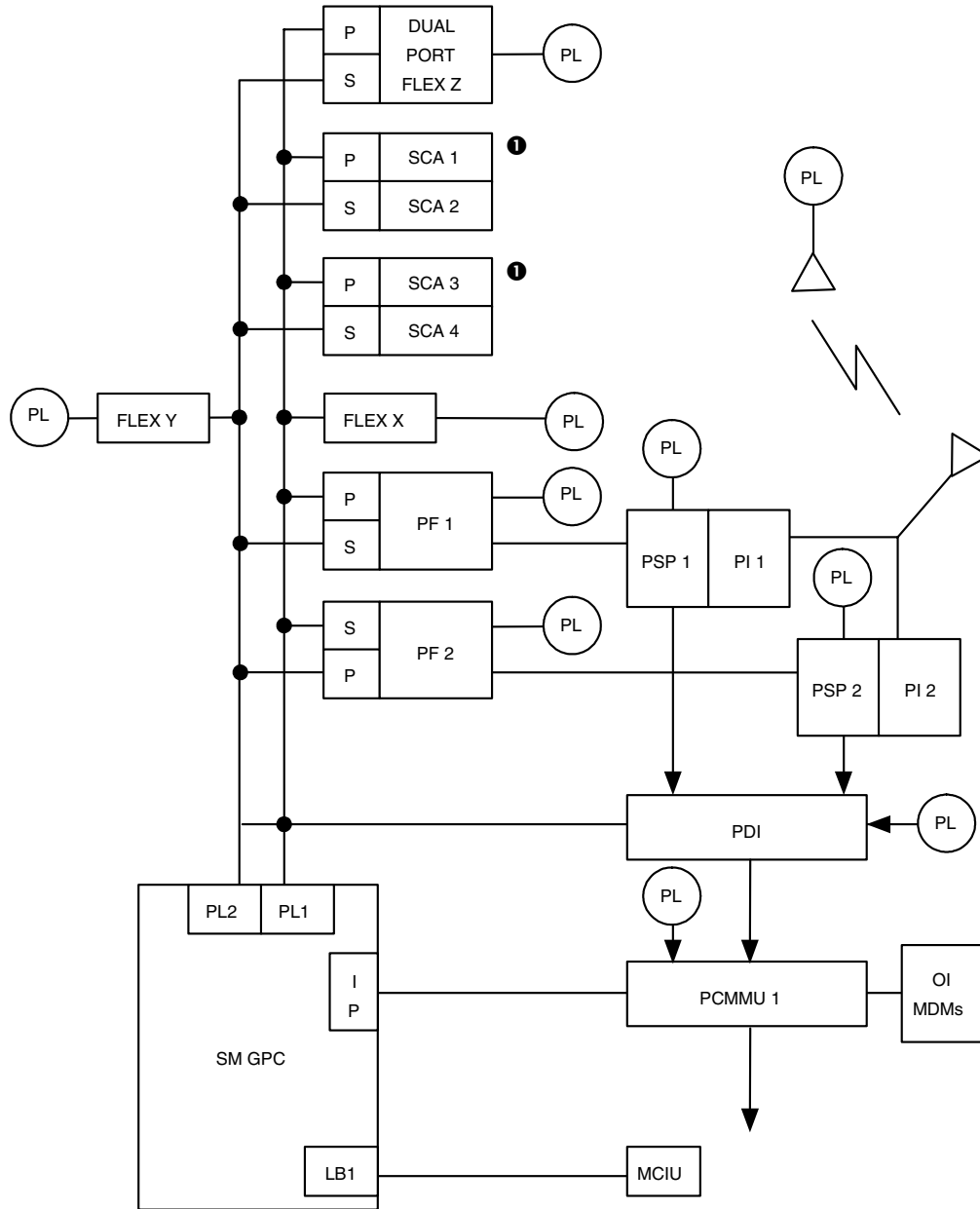
In addition to the standard PF MDMs, PSP, PDI, and mission-dependent Flex MDMs, it is interesting to note that Figure 1.6-1 illustrates some payload bus LRUs, referred to as SCAs (sequence control assemblies). These deserve some explanation. An SCA is an electronics unit designed to interface directly on the payload data buses in order to provide a command and telemetry interface with an upper stage deployable payload.

These upper stage payloads were longitudinal axis spin-stabilized, two-stage rockets used to place six-to-eight thousand-pound class satellites into synchronous orbit. These payloads were popular commercial payloads prior to the Challenger accident. However, it is unlikely the Shuttle Program will ever again manifest such payloads.

Nonetheless, the FSW still maintains the capability to support such payloads. For that reason, at least in theory, SCAs could be part of the SM I/O profile. Hence, they are illustrated as part of a “typical” SM I/O profile.

One unique aspect about mission-dependent payloads is whether or not such LRU interfaces (PF MDM, FMDM, PDI, MCIU, etc.) are actually active for a mission or not. This is dependent on the flight manifest; consequently, an SM I/O PROFILE needs to be determined on a flight-by-flight basis.

FCOS system software (SSW) was primarily written in an assembly language in which parameter, vector, and array addressing schemes strongly favored the utilization of the Word 0–Word 10 terminology. Our ‘I/O Error Monitoring’ SCP and the DPS Overview workstation application reflect this terminology since SSW documentation was originally utilized to develop the console documentation.



18819\_001

❶ ALTHOUGH SCAs ARE STILL A LEGAL SM I/O PROFILE ELEMENT, THE PAYLOADS THEY SUPPORT (PAM'S) ARE NO LONGER MANIFESTED BY THE PAYLOAD PROGRAM.

**Figure 1.6-1. "Typical" SM I/O interfaces**

On the other hand, PASS FSW applications, such as SM, were written exclusively in a HAL/S compiler language in which "0" (zero) is not a legal subscript variable. As such, FSW applications-oriented documentation tends to favor Word 1–Word 11 terminology. With a little mental gymnastics, an individual can convert back and forth between the two terminologies without too much difficulty.

Thus, one can utilize the reference material provided in our DPS Console Handbook SCP 4.2 to better understand the significance of the BCE BYPASS word information presented in the CD ROM's SM/PM Database product.

While not necessarily pertinent to the development of the SM I/O PROFILE product, some additional BCE bypass word background may be useful to the DPS datapack developer. The first three bypass words correspond to SSW (NSP and MTU) or GNC elements associated with bypassable flight critical or SRB I/O transactions. The remaining eight bypass words correspond to elements associated with bypassable payload bus I/O transactions. Of those eight bypass words, only the last seven (Word 5 through Word 11) reflect mission-dependent I/O read elements. Hence, only those seven bypass words are referenced in the SM/PM Database listing.

A PASS G9 GPC can perform cyclic payload bus I/O, as well as, flight critical and SRB MDM I/O. That's why the SM I/O PROFILE may identify G9 mission-dependent bypass elements in addition to SM mission-dependent I/O. However, GNC inflight software is not designed to support any cyclic payload bus I/O.

Likewise, other than NSP and MTU read I/O transactions, SM software is not designed to support any flight critical data bus I/O. Thus, the eleven BCE bypass words are effectively major function dependent inflight, the first three corresponding to GNC, and the remaining eight to SM.

## **DOCUMENTS/PRODUCTS NEEDED**

Flight Requirements Document (FRD)  
SM/PM DATABASE CD ROM  
Orbiter Command and Data Annex

## **PROCEDURE**

- A. Refer to the (FRD) for an overview of the requirements for a specific flight. All general cargo arrangements and space shuttle configuration requirements will be outlined including the mission and payload objectives (i.e., ISS/MPLM, ISS/OIU, TDRS/IUS, Spacehab, Spartan, etc.) and the required interfaces, if any (i.e., MDMs, PDI, MCIU, etc.). This information can be most useful in getting a start on the development of the I/O profile summary.
- B. Access the flight-specific PASS | SMPM.DAT file located on the CD ROM. The goal is to access the mission-dependent BYPASS BITS information with respect to the frames defined in Table 1.6-1. The order provided in this table corresponds to the sequential order in which these headers are allocated in the file.
- C. Use the 'Last Page' option on the CD ROM page menu to go to the last page of the file. Then, page upward (backward) until the headers defined in Table 1.6-1 are located. They usually start eight pages before the last page of the file. Generate hard copies of each of the eight BYPASS BITS frames for subsequent reference.

**Table 1.6-1. Frame Headers for SM I/O profile-related data (CD ROM)**

---

MDM Timer(High Rate) Read Bypass Bits
PF MDM Read Bypass Bits
Single Flex 1/2 Read Bypass Bits
Single Flex 3/4 Read Bypass Bits
Single Flex 5 Read Bypass Bits
Dual Flex 1/2 Read Bypass Bits
Dual Flex 3/4 Read Bypass Bits
Dual Flex 5 Read Bypass Bits

---

D. Table 1.6-2 defines each field in the BYPASS BITS header line. The data contents in each field designated with an "\*" next to them will be used to generate the SM I/O PROFILE product. Refer to Figure 1.6-2 for an example.

**Table 1.6-2. Header line field title definition (CD ROM)**

---

* SM2,SM4,GNC9	- Defines the software configuration
* BYPASS WD	- Defines the bypass word number (i.e., 4 through 11)
* BYPASS BIT	- Defines the bypass word bit number
MSID	- The MSID defines the parameter for that bypass word bit no.
* MDM	- Defines MDM type (i.e., PF1, PF2, FLEX1, etc.)
MIA	- Defines MIA IUA
* MOD	- Defines the MDM card number
* CHAN	- Defines the channel number
* LEN	- Length of I/O transaction (i.e., no. of consecutive channels)
* ELEM	- Defines element no. ( $\geq 105$ is a mission-dependent parameter)

---

- E. Evaluate the ELEM number for each of the required frames. An ELEM number greater than or equal to 105 defines a mission-dependent parameter. Refer to Figure 1.6-2 for an example. A subset of ELEM numbers for Bypass Word 5 is  $\geq 105$ , so these parameters can be flagged as mission dependent.
- F. Determine the I/O transaction ID for each ELEM number that is greater than or equal to 105. This is derived by determining the bypass word for each ELEM number. Refer to Table 1.6-3 to define the transaction ID associated with each bypass word. Determine the corresponding read element by referencing the MDM, MOD (card), and the Channel fields.

Example: In Figure 1.6-2, ELEM number 105 is associated with Bypass Word 5. According to Table 1.6-3, Bypass Word 5 has a transaction ID equal to 52. The corresponding read element for ELEM 105 is PF1 MDM, Card 01, Channel 00. Take note of the memory configuration in which these parameters are active (i.e., SM2, SM4, or GNC9). Repeat the same procedure for all  $ELEM \geq 105$ .

**Table 1.6-3. I/O Transaction identification cross-reference**

Bypass Word No.	I/O Transaction	ID
5	PF low rate	52
6	Single Flex 1/Flex 2	56
7	Single Flex 3/Flex 4	57
8	Single Flex 5	58
8	Dual port BTU 5	55
9	Dual port BTU1/BTU2	53
10	Dual port BTU3/BTU4	54
11	PF high rate	51

- G. To determine which payload is associated with each BTU, refer to the flight-specific Orbiter Command and Data Annex, Tables 2, 12, and 14. Scan each table and compile data on BTU (i.e., PF1 and PF2 MDMs) input and output transactions by identifying the particular PF MDM, the input (i.e., AID, DIL, etc.) and output (i.e., DOL, DOH, etc.) cards and the corresponding channels. Refer to Figure 1.6-3 for an example. Table 18 of the C&D Annex will identify PF MDM serial I/O interfaces.

Example: According to the BYPASS BITS file, ELEM 105 identifies PF1, Card 01, Channel 00 for the SM2 and GNC9 memory configurations. The file also identifies the length of the read transaction equal to 13. Data compiled from Tables 2, 12, and 14 identify input interfaces with PF1 MDM, Card 01, Channels 00 through 12. Notice that the total number of channels per MDM and card must be less than or equal to the length of the read transaction defined in the BYPASS BITS frames.

- H. Organize all the BTU input and output transaction information according to the format as illustrated in Table 1.6-4, which is a part of the DPS datapack template. The transaction IDs for BTU output transactions will default to the following values:
1. 46 and 47 respectively for PF1 and PF2 MDM Discrete Output cards
  2. 46 for Flex MDMs using Test Control Sequence (TCS) I/O
  3. 52 for PF1 or PF2 MDM low-rate inputs
  4. 59 for PF1/PF2 MDMs using table driven/standard serial output
  5. 68 or 69 for PL data bus 1,2 and/or Flex MDMs using TCS I/O
  6. Indicate which (if any) transaction IDs are applicable for SM2, SM4, or G9.
- I. Compile information with respect to the SM BCE BYPASS WORD - PL HI and LO word (refer to table 1.6-4).

Bits 3 through 15 and 19 through 31 for the BCE BYPASS WORD - PL HI and bits 7, 11 through 22, 24, 26, 28, 30, and 31 of the BCE BYPASS WORD - PL LO have been designated to track flight-specific elements.

Furthermore, bits 7, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, and 31 of the BCE BYPASS WORD - PL LO word (Figure 1.6-4) represent the logical "OR" of flight-specific LO rate read BCE bypass bits for bypass words 4 through 10.



Table 1.6-4. 'Typical' SM I/O Profile

SM/G9 MISSION DEPENDENT I/O PROFILE

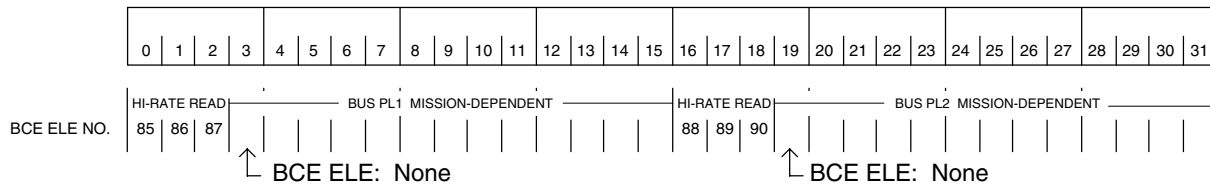
MEMORY CONFIGURATION: PASS - SM2/G9

I/O TRANS/ DEVICE ID	BCE BYP ELE No.	CORRESPONDING READ ELEMENT				AFFECTED PAYLOAD
		MDM	CARD TYPE●	CARD	CHAN	
46	---	PF1	DOL DOH	00 02	02 02	SPACEHAB SPACEHAB
47	---	PF2	DOH	02	02	SPACEHAB
52	105	PF1	AID	01	00-07	APCU1 (CH 00,02-07), OIU (CH 01)
	106	"	DIH	06	02	ODS
	107	"	AID	11	01-13	SPACEHAB
	108	"	DIL	13	02	SPACEHAB
52	109	PF2	AID	01	00-07	APCU2 (CH 00,02-07), OIU (CH 01)
	110	"	DIH	06	02	ODS
	111	"	DIL	13	02	SPACEHAB

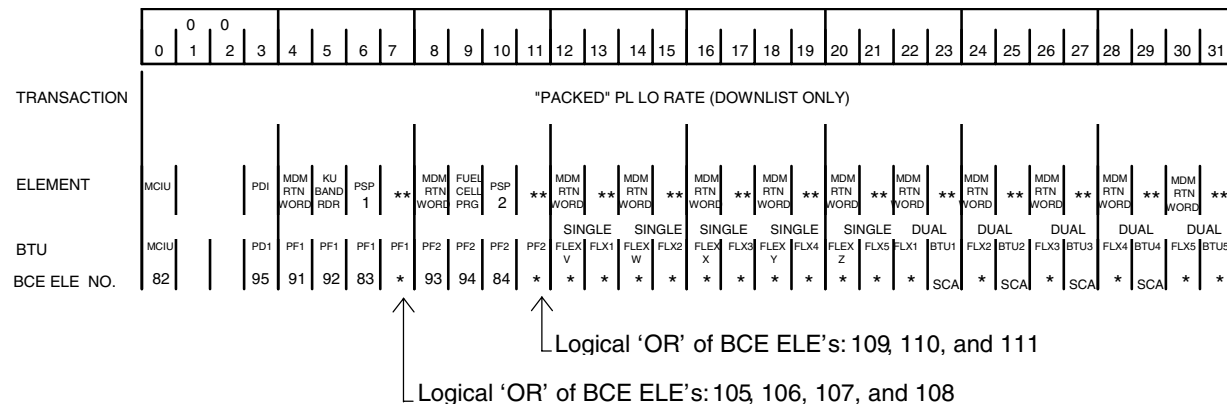
- Notes: AID = Analog input differential      DOL = Discrete output low      DIL = Discrete input low
- SIO = Serial input/output                      DOH = Discrete output high      DIH = Discrete input high

BCE BYPASS WD: PL HI (SM, ID = 51)

No 'HIGH RATE' Mission Dependent elements defined for STS-1XX (only standard PF1 and PF2 cards 03, 06, and 09).



BCE BYPASS WD: PL LO (SM)



- J. Compile information with respect to the SM BCE BYPASS WORD - PL HI and LO word (refer to table 1.6-4).

Bits 3 through 15 and 19 through 31 for the BCE BYPASS WORD - PL HI and bits 7, 11 through 22, 24, 26, 28, 30, and 31 of the BCE BYPASS WORD - PL LO have been designated to track flight-specific elements.

Furthermore, bits 7, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, and 31 of the BCE BYPASS WORD - PL LO word (Figure 1.6-4) represent the logical "OR" of flight-specific LO rate read BCE bypass bits for bypass words 4 through 10.

- K. Given the ELEM number, determine the BYPASS WORD and bit number associated with it. Then, use Table 1.6-5 to determine if the bit number associated with the SM BCE BYPASS WORD - PL LO would be set. Display results according to the general format previously illustrated in Table 1.6-4.

**Table 1.6-5. BCE bypass bit definition**

Bypass Word No.	Bypass Bits	Transaction ID	BCE Bypass Word
5	2-14	52	PL LO bit# 7
	18-30	52	PL LO bit# 11
6	1-14	56	PL LO bit# 13
	17-30	56	PL LO bit# 15
7	1-14	57	PL LO bit# 17
	17-30	57	PL LO bit# 19
8	1-14	58	PL LO bit# 21
	17-30	55	PL LO bit# 31
9	1-14	53	PL LO bit# 23
	17-30	53	PL LO bit# 25
10	1-14	54	PL LO bit# 27
	17-30	54	PL LO bit# 29
11	0-31	51	PL HI bit# 0→31

Example: Elements 105, 106, 107, and 108 fall within the bit-2 through 14 range for Bypass Word 5. If any of these bits were bypassed, bit 7 in SM BCE BYPASS WORD - PL LO would be set.

Also, if element 110 were bypassed, the I/O error log would reflect ID=52, EL=110, and the SM BCE BYPASS WORD - PL LO bit 11 would be set.

- L. Select the Existing Reports option under the File Menu to reestablish the Select Report screen.

**REFERENCES**

1. DF22/James B. Hill, PASS I/O Error SCP DPS - SM System Brief.

Memory Configurations

PF MDM READ BYPASS BITS      STS058 OI22 SPACELAB-LS02

BYPASS WD BIT	MSID	SM2					SM4					GNC9								
		MDM	MIA	MOD	CHAN	LEN	ELEM	MDM	MIA	MOD	CHAN	LEN	ELEM	MDM	MIA	MOD	CHAN	LEN	ELEM	
5	0	V91X2939X	PF01	10	RW									PF01	10	RW				91
5	1	V91X2943X	PF01	10		8	2	10	92					PF01	10		8	2	10	92
5	2	V95X5701X	PF01	10	1	0	13	105						PF01	10	1	0	13	105	
5	3	V95X5702X	PF01	10	5	1	2	106						PF01	10	5	1	2	106	
5	4	V95X5703X	PF01	10	11	0	9	107						PF01	10	11	0	9	107	
5	5	V95X5704X	PF01	10	13	2	1	108						PF01	10	13	2	1	108	
5	6	V95X5705X																		
5	7	V95X5706X																		
5	8	V95X5707X																		
5	9	V95X5708X																		
5	10	V95X5709X																		
5	11	V95X5710X																		
5	12	V95X5711X																		
5	13	V95X5712X																		
5	14	V95X5713X																		
5	16	V91X2944X	PF02	12	RW				93					PF02	12	RW				93
5	17	V95X5720X	PF02	12		6	1	1	94					PF02	12		6	1	1	94
5	18	V95X5721X	PF02	12	1	0	11	109						PF02	12	1	0	11	109	
5	19	V95X5722X	PF02	12	5	1	2	110						PF02	12	5	1	2	110	
5	20	V95X5723X	PF02	12	11	0	7	111						PF02	12	11	0	7	111	
5	21	V95X5724X	PF02	12	13	2	1	112						PF02	12	13	2	1	112	
5	22	V95X5725X																		
5	23	V95X5726X																		
5	24	V95X5727X																		
5	25	V95X5728X																		
5	26	V95X5729X																		
5	27	V95X5730X																		
5	28	V95X5731X																		
5	29	V95X5732X																		
5	30	V95X5733X																		

Mission - dependent parameters  
ELEM ≥ 105

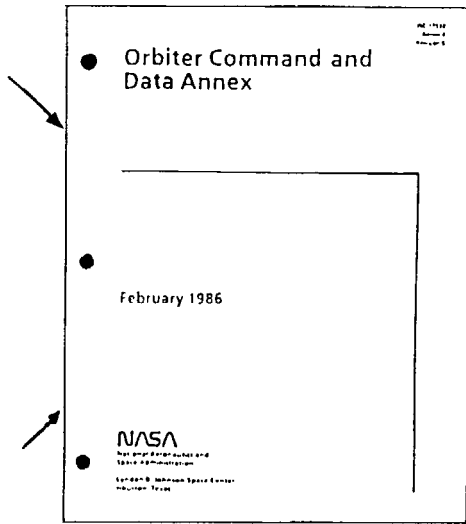
Figure 1.6-2. Sample of mission-dependent parameters

Verify that this is the correct version before use  
1.6-8

SPACE TRANSPORTATION AUTOMATED RECONFIGURATION SYSTEM  
ORBITER COMMAND & DATA ANNEX  
TABLE 02 -- HARDWARE MEASUREMENT CHANNELIZATION DATA(CH.PHEAS)

PAYLOAD NAME ==> S.L.PLM.MODULE.....002351.SLS.2.....  
DATE ==> 10/13/92  
MISSION ==> STS058

MSID (OCCURRENCE)	BTU NAME	BTU CARD TYPE	BTU CARD LOC	BTU CHAN NO	BTU HD NO	BTU STRT BIT	BTU END BITS	P S	REQ RATE	BTU CHD/ MIA	BTU DATA TYPE	BTU INV HDS	INV IND	HEAS	NOMENCLATURE
L01X1004Y	PF01	DIL	13	02		00	01	1	10	DD					AUX BUSES A OR B UNDERVOLTAGE
L01X1004YV	PF01	DIL	13	02		00	01	1	10	DD				BFS	AUX BUSES A OR B UNDERVOLTAGE
L01C1101V	PF02	AID	01	00		00	10	1	12	AHD					SS INVERTER INPUT CURRENT
L01C1101VV	PF02	AID	01	00		00	10	1	12	AHD				BFS	SS INVERTER INPUT CURRENT
L01X1102Y	PF02	DIL	13	02		15	01	1	12	DD					SS INVERTER STATUS
L01X1102YV	PF02	DIL	13	02		15	01	1	12	DD				BFS	SS INVERTER STATUS
L01X1104Y	PF01	DIL	13	02		01	01	1	10	DD					SS INVERTER OVERVOLT SHUTDOWN
L01X1104YV	PF01	DIL	13	02		01	01	1	10	DD				BFS	SS INVERTER OVERVOLT SHUTDOWN
L01T1118V	PF01	AID	01	00		00	10	1	10	AHD					SS INVERTER TEMP
L01T1118VV	PF01	AID	01	00		00	10	1	10	AHD				BFS	SS INVERTER TEMP
L01C1121V	PF02	AID	01	01		00	10	1	12	AHD					EXP INVERTER INPUT CURRENT
L01C1121VV	PF02	AID	01	01		00	10	1	12	AHD				BFS	EXP INVERTER INPUT CURRENT
L01X1122Y	PF02	DIL	13	02		13	01	1	12	DD					EXP INVERTER STATUS
L01X1122YV	PF02	DIL	13	02		13	01	1	12	DD				BFS	EXP INVERTER STATUS
L01X1124Y	PF01	DIL	13	02		02	01	1	10	DD					EXP INVERTER OVERVOLT SHUTDOWN
L01X1124YV	PF01	DIL	13	02		02	01	1	10	DD				BFS	EXP INVERTER OVERVOLT SHUTDOWN
L01T1138V	PF01	AID	01	01		00	10	1	10	AHD					EXP INVERTER TEMP



SPACE TRANSPORTATION AUTOMATED RECONFIGURATION SYSTEM  
ORBITER COMMAND & DATA ANNEX  
TABLE 12 -- ONBOARD GPC DISCRETE DATA

PAYLOAD NAME ==> S.L.PLM.MODULE.....002351.SLS.2.....  
DATE ==> 10/13/92  
MISSION ==> STS058

<===CD.PCMD===>

MSID (OCCURRENCE)	RST MASK	SET MASK	CMD TYPE	BTU NAME	BTU CARD TYPE	BTU CARD LOC	BTU CHAN NO	BTU MIA ADD	PARENT MSID	NOMENCLATURE
L01K2102J		0008	SP	PF01	DOL	00	01	10	L90H0601P	SS INV PHR ON/SS AC TO SS INV
L01K2103J		0004	SP	PF01	DOL	00	01	10	L90H0601P	SS INV PHR OFF
L01K2122J		0080	SP	PF02	DOL	00	01	12	L90H0604P	EXP INV PHR ON/EXP AC TO EXP INV
L01K2123J		0040	SP	PF02	DOL	00	01	12	L90H0604P	EXP INV PHR OFF
L01K2214J		0001	SP	PF01	DOL	00	01	10	L90H0601P	ALL SS DC+AC ON
L01K2316J		0010	SP	PF02	DOL	00	01	12	L90H0604P	SS AC TO EXP INV
L01K2318J		0002	SP	PF01	DOL	00	01	10	L90H0601P	EXP AC TO SS INV
L01K2401J		8000	SP	PF01	DOL	00	02	10	L90H0602P	EPDB 1 ALL DC+AC OUTPUTS ON
L01K2402J		4000	SP	PF01	DOL	00	02	10	L90H0602P	EPDB 1 ALL DC+AC OUTPUTS OFF
L01K2421J		2000	SP	PF01	DOL	00	02	10	L90H0602P	EPDB 2 ALL DC+AC OUTPUTS ON

Figure 1.6-3. Sample page of output channelization

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1.6-9

## TITLE

TEXT DECODING FOR PASS/BFS FAULT MESSAGES

## PURPOSE

This SCP describes a preferred method of obtaining a desired PASS/BFS fault message from the flight-specific software.

## PROCEDURE - PASS MAJOR AND MINOR FIELD ID/TEXT

PASS major and minor text messages are no longer required in the DPS datapack; however, the following procedure will remain in the SCP for reference in case a user needs to verify the existence of a specific message.

- A. Access the flight-specific Master Source Listing file.
- B. The goal is to identify a PASS major and minor fault message related to any one of the following system software modules: CDKANNUN (GNC list), CDQANNUN (PL list), CDSANNUN (SSW list), CDTANNUN (SM list), and CDZANNUN (VU list). Use the Ss Src Hal Module index under the Search Menu (F4 key) to find each of the modules. There is no "fool-proof" way to know in advance which module a specific message may reside in. (The user must take a reasonable approach; i.e., a payload-specific message probably resides in CDQANNUN; a PDRS-related message probably resides in SM, etc.) If the message ID does not provide a clue, the user must use a trial and error deductive method of search.

CDQANNUN contains all of the payload-specific major and minor fault messages. The IDs of all the payload-specific fault messages are greater than or equal to 700.

Note: The final load product contains only deltas from the recon 1 product. Therefore, look for the necessary module in the final load product and, if not found, go to the recon 1 product.

- C. For each one of these modules, the major fault messages are immediately followed by the minor fault messages. The following instructions will define the first file frame where the major fault messages are identified and the last file frame where the minor fault messages are identified for each module.

For any module found as a result of step B, select the Global option (F7 key) under the Search Menu and specify "Major-Structure" as the search string. Use the Next option (F6 key), if necessary, to find the occurrence defining the beginning of the major fault messages (Figure 1.7-1).

Figure 1.7-2 shows an example of the minor fault messages for module CDKANNUN.

SRN	STMT	SOURCE	CURRENT SCOPE
055400	145 M	1 FSD_SMMAJ_FCW5 BIT(16),	CDK_ANNUN
AA			
055400	145 M	1 FSD_SMMAJ_FCW6 BIT(16),	CDK_ANNUN
AA			
055400	145 M	1 FSD_SMMAJ_FCW7 BIT(16),	CDK_ANNUN
AA			
055400	145 M	1 FSD_SMMAJMSG_ID INTEGER;	CDK_ANNUN
AA			
056210	146 M	DECLARE CDKK_GN_MAJORS CDKK_GN_MAJOR-STRUCTURE(53) INITIAL( First Pass major fault message for this module	CDK_ANNUN
AL			
056220	C	Text	CDK_ANNUN
AL			
056700	C	# 1 MAJOR - 'ILLEGAL ENTRY ' ID=100	CDK_ANNUN
AL			
056210	146 M	HEX'E4CC', HEX'E645', HEX'E3C1', HEX'E620', HEX'E2CE', HEX'EA52', HEX'ECA0' 100 ← ID	CDK_ANNUN
AL			
057100	C	# 2 MAJOR - ' NAV EDIT ' ID=174	CDK_ANNUN
AL			
056210	146 M	HEX'D020', HEX'D020', HEX'E741', HEX'EB20', HEX'E2C4', HEX'E4D4', HEX'D020', 174,	CDK_ANNUN
AL			
057500	C	# 3 MAJOR - ' ME SHDN SW' ID=149	CDK_ANNUN
AL			
056210	146 M	HEX'D020', HEX'D020', HEX'E6C5', HEX'D053', HEX'E444', HEX'E720', HEX'E9D7', 149,	CDK_ANNUN
AL			
057900	C	# 4 MAJOR - ' DAP RECONF' ID=169	CDK_ANNUN
AL			
056210	146 M	HEX'D020', HEX'D020', HEX'E241', HEX'E820', HEX'E945', HEX'E1CF', HEX'E746', 169,	CDK_ANNUN
AL			
058300	C	# 5 MAJOR - ' BODY FLAP ' ID=135	CDK_ANNUN
AL			
056210	146 M	HEX'D020', HEX'D020', HEX'E14F', HEX'E259', HEX'D046', HEX'E641', HEX'E820', 135,	CDK_ANNUN
AL			
058700	C	# 6 MAJOR - ' SSME FAIL ' ID=161	CDK_ANNUN
AL			
056210	146 M	HEX'D020', HEX'D020', HEX'E9D3', HEX'E6C5', HEX'D046', HEX'E0C9', HEX'E620', 161,	CDK_ANNUN
AL			
059100	C	# 7 MAJOR - ' RCS PWR ' ID=147	CDK_ANNUN
AL			
056210	146 M	HEX'D020', HEX'D020', HEX'E943', HEX'E9A0', HEX'E857', HEX'E920', HEX'D020', 147,	CDK_ANNUN
AL			
059500	C	# 8 MAJOR - ' RM DLMA ' ID=138	CDK_ANNUN
AL			
056210	146 M	HEX'D020', HEX'D020', HEX'E94D', HEX'D044', HEX'E64D', HEX'E0A0', HEX'D020', 138,	CDK_ANNUN
AL			

System Software Module Name

First Pass major fault message for this module

Text

100 ← ID

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 1.7-2

Figure 1.7-1. PASS major field ID/TEXT

SRN	STMT	Module Name ↑	SOURCE	CURRENT SCOPE
075360	148 M	DECLARE CDKK_GN_MINORS CDKK_GN_MINOR-STRUCTURE(47) INITIAL(		CDK_ANNUN
	AL			
075370	C	<i>Beginning of PASS minor fault messages for this module</i>		CDK_ANNUN
075400	C	# 1 MINOR - ' ' ID=00		CDK_ANNUN
	AL			
075360	148 M	HEX'D020', HEX'D020', 0,		CDK_ANNUN
	AL			
075700	C	# 2 MINOR - [C] ← TEXT ID=08		CDK_ANNUN
	AL			
075360	148 M	HEX'E1A0', HEX'D020', [8] ← ID		CDK_ANNUN
	AL			
076000	C	# 3 MINOR - 'L ' ID=30		CDK_ANNUN
	AL			
075360	148 M	HEX'E620', HEX'D020', 48,		CDK_ANNUN
	AL			
076300	C	# 4 MINOR - 'R ' ID=31		CDK_ANNUN
	AL			
075360	148 M	HEX'E920', HEX'D020', 49,		CDK_ANNUN
	AL			
076600	C	# 5 MINOR - 'HOLD' ID=37		CDK_ANNUN
	AL			
075360	148 M	HEX'E44F', HEX'E644', 55,		CDK_ANNUN
	AL			
076900	C	# 6 MINOR - 'CYCL' ID=38		CDK_ANNUN
	AL			
075360	148 M	HEX'E1D9', HEX'E1CC', 56,		CDK_ANNUN
	AL			
077200	C	# 7 MINOR - 'FAIL' ID=86		CDK_ANNUN
	AL			
075360	148 M	HEX'E341', HEX'E4CC', 134,		CDK_ANNUN
	AL			
077500	C	# 8 MINOR - 'MANF' ID=32		CDK_ANNUN
	AL			
075360	148 M	HEX'E6C1', HEX'E746', 50,		CDK_ANNUN
	AL			
077800	C	# 9 MINOR - 'TAC ' ID=36		CDK_ANNUN
	AL			
075360	148 M	HEX'EA41', HEX'E1A0', 54,		CDK_ANNUN
	AL			
078100	C	# 10 MINOR - 'ALT ' ID=95		CDK_ANNUN
	AL			

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1.7-3

Figure 1.7-2. PASS minor field ID/TEXT

At this point, the user can perform a global search (F7 key) to search for a desired string associated with a given fault message within the above frames (annotated in step C). A user may have to use the Next option (F6 key) to get to the desired data.

- D. Use the F8 key to generate hard copies of the various frames of data applicable to the desired module.
- E. Figures 1.7-1 and 1.7-2 show how to identify the TEXT and ID data. For example, the ID for the major fault message "Illegal Entry" is equal to 100. Notice that IDs will be displayed according to their decimal value.

**PROCEDURE - BFS MAJOR AND MINOR FIELD ID/TEXT**

BFS major and minor fields must be verified only for new BFS OI releases using the CD ROM against the Shuttle Software Reconfiguration product (provided by Mike Bauman and/or Shirley Sassard or their successor). However, these messages are not required for the datapack.

- A. Use the applicable BFS OI optical fiche product.
- B. Select the Index option (F4 key) under the Search Menu. Use the LOC index to find string 30FD0. Select an entry in the list of Search results and press Go to Page to view the desired occurrence. If this is not the desired occurrence, select another by using the Search Results (F9 Key) under the Search menu. Pay attention to the note enclosed by asterisks at the top of this page. This note defines the BFS Class 2 and Class 3 messages for a particular OI by defining the ERRSET INDICES.

Move downward to determine the last frame containing fault messages data (approximately 13 frames from the first frame). Use the F8 key to print the various frames of data.

Starting with OI-21, the BFS fault message ID range was extended to 1024 to provide for class 2 fault message growth. The 1024 BFS message IDs and their classes are defined as follows:

<u>ID range</u>	<u>Alarm class</u>
000 - 127	2
128 - 831	3
832 - 1032	2

- C. The BFS listing contains both the Major and Minor fields together, unlike the PASS. The BFS fault messages are grouped into blocks of 16. These blocks are further divided into Major and Minor fields. Each Major field has up to four corresponding minor fields associated with it. If a Minor field contains a dash (-), it means the field is empty. An example of how to obtain the BFS fault messages is shown in Figure 1.7-3. The four Minor fields corresponding to the major field "R OMS" are: "-", "PC",



"TK P", and "GMBL". Recall that the "-" means an empty Minor field, so there are really only three Minor fields. The three messages we have just decoded are as follows:

1. R OMS PC
2. R OMS TK P
3. R OMS GMBL

While searching through the BFS Major/Minor field address tables in Figure 1.7-3, all four Minor fields for a particular Major field may show dashes ("-"). Typically, for these cases, only one of the four potential message IDs is valid. Furthermore, there is no way to identify the valid set from this BFS flight software listing. To determine the correct message ID, refer to Table A.5-1 "BFS CRT Messages" of the PASS/BFS Level C Displays & Control FSSR for the appropriate OI software release (STS 83-0020 Vol 3, Level C, Functional Subsystem Software Requirements, Displays and Controls), which is maintained in the Systems Division Library. However, these IDs will remain the same for every OI release.

- D. The next step is to obtain an ID for each fault message. At the beginning of each block is a message ID range. For our example it is 16 to 31 (Figure 1.7-3). The IDs of the 16 messages in this particular block are numbered from 16 to 31. To get the ID of a specific message, simply count from the beginning of the range until you come to the particular fault message. The IDs of our three messages are:

1. R OMS PC - 21
2. R OMS TK P- 22
3. R OMS GMBL - 23

- E. Generate a list of messages previously found and obtain a copy of the BFS fault message dataset from Shuttle Software Reconfiguration. Compare these two lists for any discrepancies. The list of OI-X CR's can provide additional information on the creation of new BFS message and/or changes/deletion of a message. If any discrepancies exist from the flight software generated messages (on the CD ROM) and the preexisting BFS fault message dataset obtained from Shuttle Reconfiguration, prepare a list outlining these differences and place it in the mission data pack. Inform the DPS team lead on this matter and circulate a memo to the flight community and Shuttle Software Reconfiguration Management outlining this information. Subsequently, the reconfiguration product **must** be updated electronically (by Shuttle Software Reconfiguration), to reflect this update, prior to flight (and preferably prior to the first simulation using the new OI training load).

LOC	OBJECT CODE	ADR1	ADR2	SOURCE STATEMENT	AP101S 3.0 07.04 08/09/91	PAGE 68	BASE TIME
				2388 *** BEGIN SMS B20571		00006410	
				2389 *****		00006500	
				2390 * NOTE THAT #INC IS CURRENTLY SET TO *7* DECIMAL, INDICATING TO FAM		* 00006600	
				2391 * THE LENGTH OF A SINGLE MINOR FIELD TEXT STRING (CURRENTLY, 7		* 00006700	
				2392 * HALFWORDS) -- #INC MUST BE UPDATED IF THIS LENGTH IS CHANGED.		* 00006800	
				2393 *****		00006900	
				2394 * CLASS 2 MESSAGES HAVE ERRSET INDICES ERRSET + 0 THROUGH ERRSET + 7		* 00007210	
				2395 * (MSG ID'S 0 - 127) AND ERRSET + 52 THROUGH ERRSET + 63 (MSG ID'S		* 00007220	
				2396 * 832 - 1023).		* 00007230	
				2397 *		* 00007240	
				2398 * CLASS 3 MESSAGES HAVE ERRSET INDICES ERRSET + 8 THROUGH ERRSET + 51		* 00007250	
				2399 * (MSG ID'S 128 - 831).		* 00007260	
				2400 *****		00007270	
				2401 *** END SMS B20571		00007271	
30FD0				2403 ERRFLD DS OF ADDR TABLE OF MAJOR ERROR TEXT STRINGS		00007290	
				2404 *SOURCE ADDRESS TABLES MAJOR FIELD MINOR FIELD		00007291	
				2406 * ASSOCIATED ERRSET INDEX = ERRSET + 0 (MSG ID'S 0 - 15)		00007400	
30FD0	91D7943F			2407 GNCSEQ ERRADDR MAJ#01,MIN#A C F RCS JET*,LEAK*,TK P*,-*		00007500	
				2408+ DC Y(MAJ#01),Y(MIN#A)		01-02358	
30FD2	91DE943F			2409 GNCSEQ ERRADDR MAJ#02,MIN#A C L RCS JET*,LEAK*,TK P*,-*		00007600	
				2410+ DC Y(MAJ#02),Y(MIN#A)		01-02358	
30FD4	91E5943F			2411 GNCSEQ ERRADDR MAJ#03,MIN#A C R RCS JET*,LEAK*,TK P*,-*		00007700	
				2412+ DC Y(MAJ#03),Y(MIN#A)		01-02358	
30FD6	91EC945B			2413 GAX ERRADDR MAJ#04,MIN#B C FCS SAT -,-,POS*,MOM*		00007800	
				2414+ DC Y(MAJ#04),Y(MIN#B)		01-02358	
				2416 * ASSOCIATED ERRSET INDEX = ERRSET + 1		00008000	
30FD8	91F3953B			2417 GAX ERRADDR MAJ#05,MIN#ZF C L OMS MSG ID'S 16 - 31		00008100	
				2418+ DC Y(MAJ#05),Y(MIN#ZF)		01-02358	
30FDA	91FA953B			2419 GAX ERRADDR MAJ#06,MIN#ZF C R OMS		00008200	
				2420+ DC Y(MAJ#06),Y(MIN#ZF)		01-02358	
30FDC	92019477			2421 GAX ERRADDR MAJ#07,MIN#C C FCS CH 1*,2*,3*,4*		00008300	
				2422+ DC Y(MAJ#07),Y(MIN#C)		01-02358	
30FDE	92089493			2423 GAX ERRADDR MAJ#08,MIN#D C MPS HE P -.L*,R*,C*,-		00008400	
				2424+ DC Y(MAJ#08),Y(MIN#D)		01-02358	
				2426 * ASSOCIATED ERRSET INDEX = ERRSET + 2 (MSG ID'S 32 - 47)		00008600	
30FE0	920F94AF			2427 GAX ERRADDR MAJ#09,MIN#E C MPS LH2/O2 MANF*,-,-,-	790514	00008700	
				2428+ DC Y(MAJ#09),Y(MIN#E)		01-02358	
30FE2	93B39493			2429 SPARE ERRADDR MAJ#69,MIN#D C SSME FAIL -.L*,R*,C*	B08279	00008800	
				2430+ DC Y(MAJ#69),Y(MIN#D)		01-02358	
30FE4	93AC945B			2431 PL ERRADDR MAJ#68,MIN#B C 206 PL CL 2 -*,-,-,-	B08356A	00008900	
				2432+ DC Y(MAJ#68),Y(MIN#B)		01-02358	
30FE6	9335951F			2433 GAX ERRADDR MAJ#51,MIN#I C RM FAIL XFER*,-,-,-	B20589	00009000	
				2434+ DC Y(MAJ#51),Y(MIN#I)		01-02358	
				2436 * ASSOCIATED ERRSET INDEX = ERRSET + 3 (MSG ID'S 48 - 63)		00009200	
30FE8	91D099EF			2437 SPARE ERRADDR MAJ#00,MIN#ZZ C		00009300	
				2438+ DC Y(MAJ#00),Y(MIN#ZZ)		01-02358	
				2439 SM ERRADDR MAJ#73,MIN#B C SM1 SMOKE ALRM -*,-,-,-	B20024	00009400	

Definition of Class 2 and Class 3 messages

Major Field

Id Range

Minor Fields

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Figure 1.7-3. BFS Class 2 and Class 3 TEXT/ID

## TITLE

## VARIABLE PARAMETERS

## PURPOSE

This SCP describes the procedure used to look up the addresses for the nominal sets of PASS and BFS variable parameters (VPs) used during the various phases of flight. The primary procedure for extracting this data to build the DPS datapack is documented in SCP 1.0, Datapack Process.

Any scaling parameters needed for a particular VP will be provided by the section which is requesting that slot.

## PROCEDURE - PASS VARIABLE PARAMETERS

- A. Access the flight-specific HALSTAT file.
- B. The VP templates may change between OI releases. Also, there may be flight-specific VP requests from the flight controller community. Contact the DPS section VP coordinator to find out if any changes and/or special requests need to be incorporated into the standard templates.
- C. Select the Index option (F4 key) under the Search Menu. Select the HAL\_Variable\_Name index and specify the various variable parameter HAL names. The search will locate the corresponding HAL names in the Global Symbol Dictionary area.
- D. Select the VP address indicated for the appropriate phase of flight as shown in Figure 1.8-1. Refer to Table 1.8-1 to define the applicable phase.

If the address is not specifically called out, then look for the TEMPLATE OFFSET value. Reference Figure 1.8-2. This value needs to be added to the address for the template HAL name specified. Look up the template HAL name and find its address. Add the offset value to that address.

There is one VP address that cannot be looked up in this way. The "GPC Sync Fail Pointer," FC\$\$FAIL (15th H/W), should be looked up as follows:

1. Access the DASS-SSW file.
2. Use the Global option (F7 key) under the Search Menu and look for the 'FCMSAVE' string. The search will locate the starting address of the FCMSAVE module in the Memory Map area (refer to Figure 1.8-3).
3. Select the Index option (F4 key) under the Search Menu. Use the Module\_AP101\_ADDR index to find the address (last five characters) defined in step 2. Select an entry in the list of search results and press Go to Page to view the desired

occurrence (i.e., FCMSAVE+0000). At this point, use the Global option to find 'FC\$SFALL' string (refer to Figure 1.8-4).

- To define the 15th H/W, add decimal (E in hex) to the starting value for FC\$SFALL.

**Table 1.8-1. PASS phase number summary for Mass Memory Phase Table (1)**

		Phase																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	
Memory configuration	IPL	X																	
	SSW		X										X						
	GNC		X	X	X														
	1																		
	GNC		X	X		X													
	2																		
	GNC		X	X			X												
	3																		
	GNC		X	X				X											
	8																		
GNC		X	X					X									X		
9																			
SM2		X												X	X				
PL9		X							X			X							

```

HALSTAT                                H180                                28 APR 93  32120 PM                                PAGE3513
GLOBAL SYMBOL DICTIONARY
  HAL name
  (CSECT: #PCGZFL3 OFFSET: 00003C) SIZE: 000003(3) PHASE 5 ADDR: 00E1A8 PHASE 6 ADDR: 00E618
  ...CGZ FL3_2                                0 0025
  ...CGOZ10                                2 0125 2 0142 2 0159
16220 CGZV_TFF                                SP SCALAR VARIABLE C O M P O O L CGZ_123_FLOAT
  SCALAR INITIAL()
  (CSECT: #PCGZ123 OFFSET: 000014) SIZE: 000002(2) PHASE 4 ADDR: 00F922 PHASE 5 ADDR: 00F356 PHASE 6 ADDR: 00EF8E
  ...CGZ_123_FLOAT                            0 0046
  ...CG3011                                  2 0215 2 0524
  ...DCD DG1                                2 0359
  ...DCD DG2                                2 0296
  ...GWB_ORB_MNVR_DIP                        4 0045
  ...GZD_DIP                                 4 0312 4 0352
  ...GZM_ASC_MNVR_DIP                        4 0446
  ...GZY_ENT_TAR                             4 0064 2 0066 4 0220
16221 CGZV_TFF_TRG                            SP SCALAR VARIABLE C O M P O O L CGZ_MC3_DISP
  SCALAR INITIAL()
  (CSECT: #PCGZMC3 OFFSET: 0005E2) SIZE: 000002(2) PHASE 6 ADDR: 00EDEC
  ...CGZ_MC3_DISP                            0 0048
  ...GZC_RNG_LS                              4 0059 4 0065
  ...GZY_ENT_TAR                             2 0064 4 0137 6 0176 4 0180 2 0220
16222 CGZV_TGPOS                            DP VECTOR VARIABLE C O M P O O L CGZ_20_COMMON
  VECTOR(3) DOUBLE INITIAL()
  (CSECT: #PCGZ28C OFFSET: 000060) SIZE: 00000C(12) BIAS: 000004(4) PHASE 3 ADDR: 005A8E
  ...CGZ_20_COMMON                          0 0041
  ...GRT_UNIV_PTNG_ITEM_PROC                4 0194 4 0195 4 0196
  ...GRT_UNIV_POINT_PROC                    2 0074
16223 CGZV_TGT_ALTITUDE_DISP                SP SCALAR VARIABLE C O M P O O L CGZ_COMMON
  SCALAR INITIAL()
  (CSECT: #PCGZCOM OFFSET: 000006) SIZE: 000002(2) PHASE 3 ADDR: 005880
  ...CGZ_COMMON                              0 0009
  ...CG3011                                  2 0427
  ...DCD DG1                                2 0658
  ...DCD DG3                                2 0457
  ...GKD_ASC_MNVR_KIP                       4 0382
  ...GKG_MNVR_KIP                           4 0383
  ...GTA_UPLINK_MFE                         4 0575
  ...GTB_UPLINK_MFE                         4 0254
  ...GTC_UPLINK_MFE                         4 0389
  ...GZM_ASC_MNVR_DIP                       4 0372
  ...GZY_ENT_TAR                             2 0107
  ...GZZ_ASC_TAR                             2 0088
16224 CGZV_TGT_HA                            SP SCALAR VARIABLE C O M P O O L CGZ_123_FLOAT
  SCALAR INITIAL()
  (CSECT: #PCGZ123 OFFSET: 00001A) SIZE: 000002(2) PHASE 4 ADDR: 00F928 PHASE 5 ADDR: 00F35C PHASE 6 ADDR: 00EF94
  ...CGZ_123_FLOAT                            0 0049
  ...CG3011                                  2 0499
  ...GWN_MNVR_ORB_TGT                       4 0101
  ...GZY_ENT_TAR                             4 0137 4 0170
  ...GZZ_ASC_TAR                             4 0109 4 0134
16225 CGZV_TGT_HP                            SP SCALAR VARIABLE C O M P O O L CGZ_123_FLOAT
  SCALAR INITIAL()
  (CSECT: #PCGZ123 OFFSET: 00001C) SIZE: 000002(2) PHASE 4 ADDR: 00F92A PHASE 5 ADDR: 00F35E PHASE 6 ADDR: 00EF96
  ...CGZ_123_FLOAT                            0 0050
  ...CG3011                                  2 0505
  ...GWN_MNVR_ORB_TGT                       4 0101
  
```

Ascent address

Figure 1.8-1. Sample Halstat page

HALSTAT	H180	28 APR 93	32120 PM	PAGE2341
GLOBAL SYMBOL DICTIONARY				
...GO3_ENTRY_OPS	4 0635	4 1009	4 1013	
...GO6_RTLS_OPS	4 0656	4 0660		
...GO8_ORBIT_CO_OPS	4 0670	4 0676		
...GPH_SBTC_RPTA_YAW_SOP	4 0109			
...GPT_SSME_SRB_RG_SOP	4 0335			
...GSC_VENT_DOOR	4 0127	4 0129	4 0155	4 0157
	4 0252	4 0253	4 0236	4 0238
...GSQ_ASC_VENT	4 0194	4 0196	4 0222	4 0224
	4 0319	4 0320	4 0303	4 0305
...GSZ_RCS_OUTPUT	4 0006	4 0007	4 0315	4 0316
...VOM_001_KIP	4 0036	4 0040		
5892 CGBB_OUT12_HFF_SEG3_DSCRT8	BIT STRING	TERMINAL	COMPOOL	CGB_OBF_OUTPUT_BUFFERS
BIT(16) RIGID				
(BELONGS TO TEMPLATE CGBV_HFE_OUTPUT1_2	UNIT/BLOCK: CGB_OBF_OUTPUT_BUFFERS)			
(SEE STRUCTURE CGBV_HFE_OUTPUT1_2	UNIT/BLOCK: CGB_OBF_OUTPUT_BUFFERS)			
TEMPLATE OFFSET: 00004E	SIZE: 000001(1)			
...CGB_OBF_OUTPUT_BUFFERS	0 0002	Template HAL name		
...DCD_DG1	2 0228	2 0249	2 0253	
...DCD_DG3	2 0205	2 0540	2 0575	2 0608
...DCD_DG8	2 0341	2 0373	2 0423	2 0481
...GCC_AERO_DAP_RECON	4 0095	4 0096	4 0097	4 0098
	4 0144	4 0145	4 0146	4 0147
	4 0195	4 0196	4 0197	4 0198
	4 0221	4 0222	4 0227	4 0228
	4 0242	4 0243	2 0285	2 0286
	4 0030	4 0031	4 0032	4 0033
	4 0046	4 0047	4 0048	4 0049
	4 0170	4 0171	4 0172	4 0173
	4 0263	4 0264	4 0265	4 0266
	4 0294	4 0295	2 0343	2 0344
	6 0116	6 0117	6 0120	6 0121
	4 0016	4 0017	4 0018	4 0019
	6 0020	6 0021	6 0022	6 0023
	6 0182	6 0183	6 0184	6 0185
	6 0163	6 0164	6 0165	6 0166
	2 0615	4 0971	4 0973	
	2 0635	4 0642		
	2 0635	6 0642	4 1010	4 1014
	4 0657	4 0661		
	4 0671	4 0677		
	4 0074	2 0075	4 0079	2 0090
	2 0025		4 0102	4 0105
	4 0334		2 0109	
	4 0124	4 0152	4 0233	4 0244
	4 0191	4 0219	4 0300	4 0311
	4 0004	4 0005	2 0006	2 0007
	4 0037	4 0041		
5893 CGBB_OUT12_HFF_SEG4_DSCRT1	BIT STRING	TERMINAL	COMPOOL	CGB_OBF_OUTPUT_BUFFERS
ARRAY(2) BIT(16) RIGID				
(BELONGS TO TEMPLATE CGBV_HFE_OUTPUT1_2	UNIT/BLOCK: CGB_OBF_OUTPUT_BUFFERS)			
(SEE STRUCTURE CGBV_HFE_OUTPUT1_2	UNIT/BLOCK: CGB_OBF_OUTPUT_BUFFERS)			
TEMPLATE OFFSET: 000050	SIZE: 000002(2) BIAS: 000001(1)			
...CGB_OBF_OUTPUT_BUFFERS	0 0002			
...GCF_AERO_DAP_PRL	6 0187	6 0188		
...GCI_GRTLS_RECON_6HZ	4 0063	4 0064		

Figure 1.8-2. Sample Halstat page

M A F G E N REL37.3	DASS SSW OF170104 87/08/22	22 AUG 87	1:56:31 PM	PAGE 11
MEMORY MAP --- DASSSSW				
A4DM9ITE 021062	A4VKISAC 013792	ASAIESIP 010A08	A5ARCGPC 01139C	A5DMPMM 014852
A6ARCSPC 01141C	A6DMPMM 0148F6	A6DMTERR 012AFE	A7ARCSPC 011442	A7DMPMM 0149A6
A8DMPMM 014A10	A9ARCGPC 011596	A9DMPMM 014A96	B0DMPMM 01483C	D1CMPMM 0148C4
B4DMPMM 014D92	B5DMPMM 014E16	B6DMPMM 014E52	B7DMPMM 014F1E	CASPV 0285C2
CPASP 028652	DACOS 028166	DEXP 028244	DLOG 0282DE	DMOD 028394
EPWRE 028428	EPWRI 028022	EXP 028488	FCNAOT 00809A	FCMASYNC 018052
FCMBMASK 0183D2	FCMBMTPS 00C534	FCMBUSCM 01857E	FCMBUSPC 019A98	FCMCLKS 008118
FCMINIOP 018CD0	FCMISYNC 018D7E	FCMLINIT 004AA2	FCMNGBOV 018E7E	FCMNGPOV 01907C
FCMPROTD 008100	FCMPSA 000000	FCMRSTFC 018294	FCMRTBLE 00919E	FCMSAVE 0091BA
FCMSFINT 0193EE	FCMSMAKS 019403	FCMSSYNC 019490	FCMSVC 019518	FCMSVOTE 01C48C
FOMTRACE 0195EA	FCMTRCLS 01C31C	FCMTSYNC 019580	FCMUPLOD 01960A	FCMZCONS 008B16
FIOADCNS 0095BA	FIOCBCLS 00883E	FIOCDATS 009D46	FIOEMPLT 01B04E	FIOCOUNT 01D274
FIODEUPS 0196AE	FIOERLRA 01976E	FIOERRLB 01978C	FIOERRLC 019802	FIOGNWPG 01DB34
FIOHISAM 030000	FIOICCPG 01970C	FIOIMUPS 01389A	FIOIDBPS 01972C	FIOISERR 019D8E
FIONMPPG 01E9F2	FIONMPPG 01E54A	FIONMFEFF 01D472	FIONMGCM 019DF8	FIONMGCV 019E42
FIONMTR 01A19C	FIONMSNC 01A213	FIONMSTR 01A2E0	FIONMTQE 01A3BA	FIONMGTG 01CB4E
				FIONMMS 01C51E
				FIONMUPG 01C52C

Figure 1.8-3. Sample of CSECT listing in memory map

M A F G E N REL37.3

DASS SSW OF170104 87/08/22

22 AUG 87 1:56:31 PM

PAGE 225

MEMORY AMP --- DASSSSW

0092DA	FCMSAVE +0120			FP\$FXMTU DS	0F
0092DA-0092F9	FCMSAVE +0120			DC	16F
0092FA-009309	FCMSAVE +0140			FP\$REL DC	8F
00930A	FCMSAVE +0150			FP\$ERLOG DS	0F
00930A-009319	FCMSAVE +0150			DC	8F
00931A	FCMSAVE +0160			FP\$IHPMS DS	0F
00931A-009329	FCMSAVE +0160			DC	8F
00932A	FCMSAVE +0170			FP\$SVC DS	0F
00932A-009339	FCMSAVE +0170			DC	8F
00933A-00933B	FCMSAVE +0180	0000	0000	FCMSRV7 DC	F
00933C	FCMSAVE +0182			FP\$FPSAV DS	0F
00933C-00934B	FCMSAVE +0182			DC	8E
00934C-00935B	FCMSAVE +0192			FP\$UPMTU DC	8F
00935C	FCMSAVE +01A2			FC\$INIOP DS	0F
00935C-00936B	FCMSAVE +01A2			DC	8F
00936C-00937B	FCMSAVE +01B2			FC\$MG20V DC	8F
00937C-00938B	FCMSAVE +01C2			FC\$MGPOV DC	8F
00938C-00939B	FCMSAVE +01D2			FIS\$GCMP DC	8F
00939C-0093AB	FCMSAVE +01E2			FIS\$MGCV DC	8F
0093AC-0093BB	FCMSAVE +01F2			FIS\$MGDSP DC	8F
0093BC-0093CB	FCMSAVE +0202			FIS\$MGERR DC	8F
0093CC-0093DB	FCMSAVE +0212			FIS\$MGMTR DC	8F
0093DC-0093EB	FCMSAVE +0222			FIS\$MGGNC DC	8F
0093EC-00940B	FCMSAVE +0232			FIS\$MGSTR DC	16F
00940C-00941B	FCMSAVE +0252			FIS\$MGTQE DC	8F
00941C-00942B	FCMSAVE +0262			FC\$BCEMD DC	8F
00942C-00942D	FCMSAVE +0272	0000	0000	FC\$PMOD0 DC	F
00942E-00942F	FCMSAVE +0274	0000	0000	FC\$PMOD7 DC	F
00943D-00943F	FCMSAVE +0276			FC\$OPSCN DC	8F
009440-00944F	FCMSAVE +0286			FC\$MTURM DC	8F
009450-00945F	FCMSAVE +0296			FC\$BUSCV DC	8F
009460-00946F	FCMSAVE +02A6			FC\$BMAN DC	8F
009470-00947F	FCMSAVE +02B6			FC\$BMASK DC	8F
009490-00948F	FCMSAVE +02C6			FC\$SFINT DC	8F
STARTING ADDRESS → 009490-00949F	FCMSAVE +02D6			FC\$SFFAIL DC	8F
0094A0-0094AF	FCMSAVE +02E6			FC\$SSYNC DC	8F
0094B0-0094BF	FCMSAVE +02F6			FC\$SMASK DC	8F
0094C0-0094CF	FCMSAVE +0306			FC\$BUSPC DC	8F
0094D0-0094DF	FCMSAVE +0316			FC\$LVLO1 DC	8F
0094E0-0094EF	FCMSAVE +0326			FC\$LVLO2 DC	8F
0094F0	FCMSAVE +0336	0000		FC\$CSYNS DC	H
0094F1	FCMSAVE +0337	0000		FC\$ASYNC DC	H
0094F2	FCMSAVE +0338	0000		FC\$TSYNC DC	H
0094F3	FCMSAVE +0339	C9FB			

Figure 1.8-4. Sample of variable listing in memory map

- E. Deliver the ascent and entry VP addresses to IBM Test and Operations (T&O) Support Group at least one week before the first simulation using that load. IBM T&O will incorporate these addresses into the ascent and entry reset points, so the VPs will be available during ascent and entry sims.
- F. Build the loads in the flight-specific workstation VP file (reference SCP 7.6). Variable parameter loads can be defined as prebuilt or real-time loads. Reference SCP 1.10 - Prebuilt/Real-Time Command Loads to label VP loads accordingly in the workstation.
- G. Select the Existing option under the Reports Menu to re-establish the Report Selection screen.

H. The following table comprises VP load design constraints for all new flights. The VPs listed below must correspond with the slots when building new datapacks/loads. These constraints are to minimize impacts to DPS's 'VP customers' as well as to DPS itself. Several disciplines (DPS, GNC, INCO, RNDZ) have hard-coded specific VP slot MSIDs into their workstation applications assuming their desired variable parameters will always be in those specific slots. These constraints could be restructured if necessary, but only on new-OI boundaries. The customers should be notified well in advance of any changes so they can restructure their applications.

**Table 1.8-2. Variable Parameter Load Design Constraints**

**23001 GNC NOM ASCENT VP**

<u>RQST</u>	<u>SLOT</u>	<u>ADRS</u>	<u>DESCRIPTION</u>	<u>HAL NAME</u>
DPS	1	XXXX	PRI/SEC PORT SEL	CZ2B_MODE
DPS	2	XXXX	CRT I/O ERROR FLAG	DMIB_ERR_MSG
DPS	3	XXXX	GPC SYNC FAIL POINTER	FC\$\$FAIL (15 <sup>TH</sup> WD)

**23002 GNC NOM ORBIT VP**

<u>RQST</u>	<u>SLOT</u>	<u>ADRS</u>	<u>DESCRIPTION</u>	<u>HAL NAME</u>
DPS	1	XXXX	PRI/SEC PORT SEL	CZ2B_MODE
DPS	2	XXXX	CRT I/O ERROR FLAG	DMIB_ERR_MSG
DPS	3	XXXX	GPC SYNC FAIL POINTER	FC\$\$FAIL (15 <sup>TH</sup> WD)
GNC	4	XXXX	-Z STKR MODE	CGYB_ST_MODE_IND (1 <sup>ST</sup> WD)
GNC	5	XXXX	-Y STKR MODE	CGYB_ST_MODE_IND (2 <sup>ND</sup> WD)

**23003 SM NOM ORBIT VP**

<u>RQST</u>	<u>SLOT</u>	<u>ADRS</u>	<u>DESCRIPTION</u>	<u>HAL NAME</u>
DPS	2	XXXX	CRT I/O ERROR FLAG	DMIB_ERR_MSG
DPS	3	XXXX	GPC SYNC FAIL POINTER	FC\$\$FAIL (15 <sup>TH</sup> WD)
INCO	4	XXXX	TMBU-SPEC 60 ACTIVE	CSTB_CONTROL_FLAGS
INCO	5	XXXX	PCM/PL-SPEC 62 ACTIVE	CSLB_PPCOMM_SPEC_ACT_FLG

**23004 GNC NOM ENTRY VP**

<u>RQST</u>	<u>SLOT</u>	<u>ADRS</u>	<u>DESCRIPTION</u>	<u>HAL NAME</u>
DPS	1	XXXX	PRI/SEC PORT SEL	CZ2B_MODE
DPS	2	XXXX	CRT I/O ERROR FLAG	DMIB_ERR_MSG
DPS	3	XXXX	GPC SYNC FAIL POINTER	FC\$\$FAIL (15 <sup>TH</sup> WD)

**23005 GNC ORB RNDZ VP**

<u>RQST</u>	<u>SLOT</u>	<u>ADRS</u>	<u>DESCRIPTION</u>	<u>HAL NAME</u>
RNDZ	7	XXXX	SPEC 34 DATA	CGZV_T_MAN (1 <sup>ST</sup> WD)
RNDZ	8	XXXX	SPEC 34 DATA	CGZV_T_MAN (2 <sup>ND</sup> WD)

**23006 GNC NOM DOCKED VP**

<u>RQST</u>	<u>SLOT</u>	<u>ADRS</u>	<u>DESCRIPTION</u>	<u>HAL NAME</u>
DPS	1	XXXX	PRI/SEC PORT SEL	CZ2B_MODE
DPS	2	XXXX	CRT I/O ERROR FLAG	DMIB_ERR_MSG
DPS	3	XXXX	GPC SYNC FAIL POINTER	FC\$\$FAIL (15 <sup>TH</sup> WD)
GNC	5	XXXX	-Y STKR MODE	CGYB_ST_MODE_IND (2 <sup>ND</sup> WD)



## REFERENCES

1. Mass Memory Unit (MMU) Program Release Notice (PRN). JSC-16764.
2. CR no. 90371A.

## PROCEDURE - BFS VARIABLE PARAMETERS

The purpose of this procedure is to aid the user in looking up GPC addresses (VPs) in the BFS that need to be monitored. The purpose of VPs is to allow the user the flexibility to observe any desired memory location via downlist. For OI-23, the VPs consist of a set of three user definable downlist parameters that may be defined in all memory (BFS) configurations and maintained across all OPS transitions. The parameters are to be initialized to a known memory location and can be individually selected to display any addressable memory location using the variable parameter function. Initialization is to an assembly language variable called "DLINIT" which is set to a hexadecimal pattern "FCFC." The following procedure outlines the necessary steps in locating the computer address and building the VP load.

- A. Locate the BFS OI Build file in the applicable PASS/BFS OI optical fiche product.
- B. Select the Index option (F4 key) under the Search Menu. Use the HAL\_Name index to find the particular BFS VPs (Figure 1.8-5). Use the F8 key to hard copy the frame(s) of data.
  1. When the HAL names and their respective memory addresses are found, they are documented in the flight-specific datapack.
  2. The BFS VP load needs to be built on the workstation (reference SCP 7.7).

## REFERENCES

1. Document MG038101, sec. 3.6.3.25, p. 268.
2. Document MG038101, sec. 3.67.2.3, p. 212.
3. SR no. 6995.
4. CR no. 89959C.

```

RELIST 2.1 BFS223XX LISTINGS                               SYSLIB HALSTAT 11 JUN 92 11:15:23 AM PAGE 12233
H A L S T A T                                             OI223 SOURCE PRODUCTION BUILD           9 AUG 91 11:39:25 AM PAGE 363
G L O B A L   S Y M B O L   D I R E C T O R Y
*** SYMBOL POSSIBLY NOT USED ***
430 ADI_3_E          SP SCALAR  VARIABLE      UNIT(BLOCK): D_DAP
    SCALAR
    (CSECT: #DDDAP  OFFSET: 0001AC) SIZE: 000002(2) ADDR: 00AE0C
    ...D_DAP          0 0266(000018+257)  4 1155(001349)  2 1158(001349)
                    2 1161(001349)
431 ADI_3_INCR      SP SCALAR  VARIABLE      UNIT(BLOCK): D_DAP
    SCALAR
    (CSECT: #DDDAP  OFFSET: 0001AE) SIZE: 000002(2) ADDR: 00AE0E
    ...D_DAP          0 0267(000018+258)  4 1158(001349)  2 1161(001349)
                    2 1161(001349)
432 ADI_3_LAST      SP SCALAR  VARIABLE      UNIT(BLOCK): D_DAP
    SCALAR
    (CSECT: #DDDAP  OFFSET: 0001B0) SIZE: 000002(2) ADDR: 00AE10
    ...D_DAP          0 0268(000018+259)  4 1152(001347)  2 1156(001349)
                    4 1159(001349)
433 ADI1DW          SP INTEGER  VARIABLE      C O M P O O L  BOS_IO
    ARRAY(14) INTEGER
    (CSECT: #PBOSIO OFFSET: 0004C4) SIZE: 00000E(14) BIAS: 000001(1) ADDR: 00675A
    ...BOS_IO          0 1038
                    *** SYMBOL POSSIBLY NOT USED ***
434 ADI2DW          SP INTEGER  VARIABLE      C O M P O O L  BOS_IO
    ARRAY(14) INTEGER
    (CSECT: #PBOSIO OFFSET: 0004E8) SIZE: 00000E(14) BIAS: 000001(1) ADDR: 00677E
    ...BOS_IO          0 1042
                    *** SYMBOL POSSIBLY NOT USED ***
435 ADPRDEP         BIT STRING  TERMINAL      C O M P O O L  GNC_IO POOL
    BIT(1) DENSE RIGID (BELONGS TO TEMPLATE # 70) (UNQUALIFIED - SEE STRUC # 3998)
    TEMPLATE OFFSET: 0000C2 SIZE: 000001(1)
    ...GNC_IO POOL    0 0002
    ...HIP_NAV        2 0159(000201)  2 0169(000206)
436 ADS_AIF         SP INTEGER  VARIABLE      UNIT(BLOCK): HIP_NAV
    ← HAL name
    INTEGER
    (CSECT: #DHIPNAV OFFSET: 000058) SIZE: 000001(1) ADDR: 00C61E
    ...HIP_NAV        0 0017(000011+5)  4 0041(000064)  2 0450(000416)
                    2 0469(000424)
    PILOT EQUATES FOR ADS_AIF IN HIP_NAV
                    L93J5014
437 ADS_CLOSE       STATEMENT  LABEL          UNIT(BLOCK): HIP_NAV(ADTA_HIP)
    ...HIP_NAV        0 0514(000442)
438 ADS_G           BIT STRING  VARIABLE      C O M P O O L  GNCPOOL
    BIT(1)
    (CSECT: #PGNCPOO OFFSET: 000040) SIZE: 000001(1) ADDR: 000340
    ...GNCPOOL        0 0031
    ...HIP_NAV        4 0032(000054)  4 0180(000216)  4 0182(000217)  2 0274(000233)
    ...NAVIGATION     2 0691(001092)  2 1714(002198)
    PILOT EQUATES FOR ADS_G IN GNCPOOL
                    ADSGOOD          ADSG
439 ADS_MJ          BIT STRING  VARIABLE      C O M P O O L  GNCPOOL
    BIT(1)
    (CSECT: #PGNCPOO OFFSET: 000046) SIZE: 000001(1) ADDR: 000346
    ...GNCPOOL        0 0034
    ...HIP_NAV        4 0057(000082)  2 0331(000289)  2 0386(000340)  4 0460(000421)

```

Figure 1.8-5. Sample CSECT listing in Memory Map

## TITLE

PDE ADDRESS LOOKUP

## PURPOSE

When a PASS GPC error is encountered, a 'Process Directory Entry' (PDE) address can be used to determine the software module that was being executed at the time of the failure. The Pointer field value (equivalent to a 'PDE' entry) on the DPS Overview workstation application serves to cross-reference GPC error with the PDE listing. The data to perform this on-console check is provided as part of the DPS datapack.

At one time, it was necessary to manually check the PDE address information for every datapack build. However, the electronic datapack generation process, as described via SCP 1.0, is now a certified process. Consequently, it is not necessary for the datapack builder and verifier to manually re-verify the DPS datapack PDE addresses table every datapack build, provided the datapack was generated electronically utilizing the certified DP.EXE executable program and certified word macro.

Nevertheless, it is a matter of corporate knowledge retention that the PDE address information can be manually recreated in the event there is ever a question regarding the validity of the datapack generation process (for example, recertification issues). This SCP serves to support that requirement.

Therefore, the purpose of this SCP is to define the procedure for manually looking up a list of PASS PDE addresses and associated modules for any flight software release.

## PROCEDURE

- A. Utilize the following procedure to access the desired DASS (disassembly) file(s):  
DASSGNC1.DAT, DASSGNC2.DAT, DASSGNC3.DAT, DASSGNC8.DAT,  
DASSGNC9.DAT, DASSSM2.DAT, DASSSM4.DAT, DASSPL9.DAT and  
DASSSSW.DAT.
- B. Load the desired CD ROM. Close the resulting window as it is no longer required. Next, start the 'DXR' executable program:
  1. Start | MOD Server Menu | MOD-Wide Applications | DXR
  2. Then, click on 'File | Open'. On the following pop-up window, click on 'Listing'.
  3. A pull-down window will appear; click on the flight-specific folder, and then select the subsequent DASS folder.
- C. Open the DASS folder and select the desired "DASS" file. Then, click on 'Page', select 'Select Page' on the pull-down menu, and then enter page "14". The page presents a part of an array of "FSW modules/starting address" entries (referred to as CSECTs). The complete array makes up a 'MEMORY MAP' for the specified DASS listing being viewed.

Visually scan the MEMORY MAP page for a series of CSECT entries formatted as “#EXXXXXX YYYYYY”. This is the format utilized to list the PDE address for any PASS FSW module. Figure 1.9-1 illustrates the typical pattern one can expect to observe on the DASS listing page.

If the PDE entries are not present, go back one page and then scan that page for the entries. Due to the way that DASS listings are organized/formatted, the PDE entries will start on either page 13 or 14, and may spill over to page 15 in some instances. Typically, the “GNC” PDE entries will occur on page 14 of the DASS listing, and the “SM”, “PL9”, and “SSW” entries will fall on page 13.

- D. If hard copies are desired, click on ‘File’ and then ‘Printer Setup’ on the pull-down menu. Select ‘Landscape’. Finally, click on the ‘print icon’ to make a hard copy of the displayed page.
- E. From an educational perspective, the “PDE Addresses” table in the DPS datapack provides ‘Module’, ‘OPS’, ‘Rate’, and ‘Description’ information, as well as the PDE addresses. Note that such information does not change from flight to flight. Only the PDE addresses change as part of the compilation process.

Furthermore, CSECTs found in the DASS SSW file will also be included as a part of the other DASS files. Therefore, they will be labeled with an ‘OPS’ equal to SSW. For example, RABIDLY is located in GNC 1 and SSW. On the other hand, there will be CSECT modules found in more than one DASS file, but with different addresses specified according to the OPS. Each of these CSECT occurrences will be listed with their individual OPS and addresses. For example, CSECT module HA-HA is applicable for both PL 9 and GNC 9 OPS.

- F. Repeat steps C through E for each desired DASS file.

MEMORY MAP --- GNC1

#DGABDIR 00AF86	#DGACLIM 00B508	#DGADHFE 000536	#DGAEASC 00624E	#DGAHRTL 00B6EE	#DGGCGSSM 00B0EA	#DGCHGRT 0068F4
#DGCIGRT 006A30	#DGCJASC 0067F0	#DGCKGCS 006EDA	#DGCLOPS 005F3C	#DGCMGCS 0069E2	#DGCOASC 006E1A	#DGCPCGS 006F68
#DGCUGCS 0069D0	#DGCVDBA 00055A	#DGCWQUA 004412	#DGCZDBA 000564	#DGDAASC 007C0C	#DGDEENT 007D58	#DGDJAMI 007388
#DGDMSPI 0070B0	#DGDORTL 00BFBA	#DGDRENT 007DA8	#DGDSSWP 00BC6A	#DGDTHUD 007322	#DGDWASC 00A4E0	#DGDXTAM 007530
#DGDYASC 007988	#DGDZAMI 0073BC	#DGEAASC 00C19C	#DGEBADH 007500	#DGECDRH 007592	#DGEEDAM 00B99C	#DGEFRDM 00BB0A
#DGEGASC 00C314	#DGEHRTL 00C474	#DGFBRCS 00AB2C	#DGFCREC 00A9F6	#DGFELHT 007FAA	#DGFHGRT 007F52	#DGFIGRT 00A1F4
#DGFJGRT 00A252	#DGFKGRG 00AA8E	#DGFNGRT 00AA22	#DGFRFHA 00730E	#DGGHACC 007E16	#DGGILTV 0074D0	#DGGJRTL 00BF6E
#DGGKASC 00A9D2	#DGGGLACC 00AA78	#DGGMGLI 00741C	#DGGNSSM 00B83A	#DGGOTGT 00ACC6	#DGGPRTL 00C0F4	#DGGQCOM 00B9F0
#DGGVPOS 007FA4	#DGGWVCO 00C0DE	#DGGXPGI 00760A	#DGGYHAC 007654	#DGGZPSP 00BF96	#DGG0THR 00BA8C	#DGG1ASC 007EB2
#DGG2ASC 00A9E2	#DGG31ST 00AD06	#DGG42ND 0072AE	#DGG5ORB 0076FC	#DGG6ABR 00BB5E	#DGG7PWR 00BBC0	#DGG8PWC 007ECA
#DGG9GLI 007428	#DGHBCMD 004556	#DGHFNRM 00B4B2	#DGHGREF 00E608	#DGHHPHA 004418	#DGHIPHA 004468	#DGHJRTL 00B6B8
#DGHKRTL 00B7D8	#DGHRLTL 00B7FC	#DGHMRTL 00B6C2	#DGHNDPR 00B542	#DGHQPEG 0062B4	#DGHRTAC 006254	#DGHSMNV 0043F2
#DGHZUPP 00B5C6	#DGH4RTL 00B684	#DGH6ABR 00C3EE	#DGH7UPP 00B620	#DGIHGCA 00457C	#DGIHM50 00AF56	#DGI3GS3 00B810
#DGHKASC 006ECA	#DGDASC 006790	#DGFHOR 00AF88	#DGLKENT 006F74	#DGKMRMS 0069FE	#DGKNRCS 006B60	#DGK26XT 005E5A
#DGK4TIM 00B240	#DGK5MNV 0005DA	#DGMBIMU 005AD2	#DGMACAC 005B0A	#DGMRES 0045D8	#DGMFGYO 005BB2	#DGMHACP 005B1A
#DGMKGYO 005B34	#DGMMLACP 005BC6	#DGMNLSF 007C90	#DGMQLSF 007A28	#DGMYRGM 005BD0	#DGM9MAS 007636	#DGMNPAR 005BE2
#DGNNEFT 007FF8	#DGNIMEA 007232	#DGNJEFT 007E0A	#DGNKCEO 00C064	#DGNLEFT 007FFA	#DGNMEFT 007D08	#DGNNANG 007CB0
#DGNPTAC 00A844	#DGNQNAV 007400	#DGNRSVI 007266	#DGNUSUP 00BCAE	#DGNUACC 0079AC	#DGNWATT 00A858	#DGNXATT 00A8CA
#DGNYATT 007CBC	#DGNZATT 007DDA	#DGN4RTL 00BF60	#DGN6COV 0075D4	#DGN8ASC 007A14	#DGN9ASC 007C9E	#DGO1ASC 00C24C
#DGO6RTL 00C4AC	#DGPABFS 0077C2	#DGPCAER 00BB8A	#DGPDAER 00BA9C	#DGPEELV 00744E	#DGPFORB 00780E	#DGPYAW 00795A
#DGPHSBT 007772	#DGPILAN 00BAA8	#DGPKOMS 0078E2	#DGPLOMS 00793C	#DGPN160 00BAF6	#DGPORUD 0075FC	#DGPVSRB 0078B4
#DGPQSP 00779A	#DGPMPSS 0077D6	#DGPASAC 00A95E	#DGPPTSM 00B89E	#DGPUMPS 007756	#DGPVSRB 007748	#DGPV3AX 00ACF6
#DGPXSRB 0078CC	#DGPYMEC 00767E	#DGP6MPS 007936	#DGP8HYD 007272	#DGOARRG 0063BC	#DGOBRBG 005E68	#DGOCCOM 00B4C8
#DQODHYD 000554	#DQOROR 005D04	#DGRASWI 004220	#DGRBSWI 0005E8	#DGRCSBT 005EBE	#DGRDORB 0045C8	#DGREAAF 0005FC
#DGRFAER 00B4C0	#DGRGFI 005B40	#DGRHIMU 004486	#DGRJIMU 00451C	#DGRKIMU 004594	#DGRLIMU 005CE8	#DGRMIMU 0044E2
#DGRNOMS 005D28	#DGRORCS 006C06	#DGRPBFC 005E76	#DGRQRHC 005F68	#DGRRRCS 00667E	#DGRSIMU 00459C	#DGRTFIX 005B7C
#DGRUFLO 00B516	#DGRVLAN 00B162	#DGRXADT 006C8A	#DGRYTAC 0062F0	#DGRZMLS 005D3E	#DGR1RMI 004452	#DGRSOMS 005D44
#DGR7SRB 005E92	#DGR8RCS 006374	#DGR9RCS 006686	#DGSAXFD 004530	#DGSDFIR 00AF72	#DGSERB 005D62	#DGSFABT 006F1A
#DGSIABT 006AD8	#DGSMPMS 005DCA	#DGSPPMS 005F4C	#DGSQASC 0066D8	#DGSRRSL 00B6F4	#DGSSSSM 00AFF2	#DGSTETS 006FAC
#DGSUQUA 00431A	#DGSXRCS 007094	#DGSYDSC 005D5C	#DGSZRCS 006B5A	#DGS5ASC 0068DC	#DGTCTUPL 00B64C	#DGHHRMR 00C462
#DGULHOR 00C456	#DGUPENT 00C3C2	#DGURRMS 00C240	#DGUSCSC 00A4BC	#DGVAMLS 00763C	#DGVBTAC 00A520	#DGVCBAR 00B898
#DGVDDRA 007258	#DGVFRVT 007FP6	#DGVGVUV 007806	#DGVQUA 0070CE	#DGVLHEL 00BC9E	#DGVVRE 0045D0	#DGVNCOV 007412
#DGVPRUN 00BB34	#DGVQSIT 00761C	#DGVSQUA 007314	#DGVTPRE 0075C0	#DGVWQUA 00731A	#DGVXQUA 00737E	#DGVYQUA 005BE4
#DGVZMAT 005BE6	#DGV2DEL 00BC64	#DGV3RTL 00C0C6	#DGV5STA 00C15C	#DGV7RTL 00C078	#DGWERMR 00BAD2	#DGWORMR 00BB82
#DGWZRCS 00A4A6	#DGYCADT 006D14	#DGYDNAV 0044EE	#DGYEADT 0063CE	#DGYFADT 006C3A	#DGYIADT 00666C	#DGYJADT 005EA2
#DGYLMLS 0005FA	#DGYMMLS 005D18	#DGYRRAD 004460	#DGYTTAC 006C50	#DGYUTAC 00632C	#DGYXADT 006D20	#DGYZADT 006356
#DGZGENT 006DB0	#DGZHDI 00B520	#DGZIASC 006290	#DGZJSTA 000556	#DGZKENT 006C6E	#DGZMASC 005F70	#DGZODIP 00B612
#DGZVVER 00B18A	#DGZX6XT 005EC6	#DGZZASC 00C108	#DVASSRB 001484	#DVJLSR 00C3CE	#DVKISAC 0012EA	#DVKRRES 001438
#DVK3GME 00145A	#EABGPC 000776	#EATESIP 0008F8	#EARAGPC 000B12	#EARIDL 000B78	#EARCGPC 000B9A	#EARKDOW 000D4E
#EASHRWC 000D6C	#EASMAUX 000DB6	#EASNGME 000E62	#EDCICYC 000770	#EDGILDB 001242	#EDGRGSE 0012A6	#EDIRIOR 000E88
#EDMCSUP 000EBC	#EDMIMCD 000EEE	#EDMTERR 000F6C	#EDUMULK 00111E	#EDUPNSP 00112A	#EGEAASC 007A42	#EGEGASC 00A52E
#EGEHRTL 00BCB8	#EGH6ABR 00B24C	#EGO1ASC 007E2C	#EGO6RTL 00C094	#EGUHRMR 00B952	#EGULHOR 00B84E	#EGUPENT 00A880
#EGURRMS 007D0E	#EGV5STA 0070D4	#EGZZASC 005FEC	#EVASSRB 00147E	#EVJLSR 00B122	#EVKISAC 0012E4	#EVKRRES 001432
#EVK3GME 001454	#LACOS 009D1C	#LCASPV 009D8C	#LCPAS 009D8E	#LDACOS 009D1E	#LDATAN2 00FD5A	#LDEXP 009D20
#LDDLOG 009D62	#LDMOD 009D64	#LDPWRD 009D66	#LDPWRI 00FD58	#LDSNCS 005C10	#LDSQRT 009D6A	#LEATAN2 00FD74
#LEMED 00FD56	#LEPWRE 009D72	#LEPWRI 009D18	#LEXP 009D76	#LIMOD 009D14	#LIREM 009D16	#LLOG 009D78
#LROUND 009D1A	#LSNCS 005BF4	#LSORT 009D7A	#LTAN 00FD4E	#LVV10D3 009D88	#LVV10S3 009D8A	#LWV5D3 00FD54
#LVV5S3 00FD52	#PCANNCO 030120	#PCDAP04 004168	#PCDB021 0286A6	#PCDCPHA 0300E4	#PCDD032 029656	#PCDF043 02965C
#PCDG044 02A9D2	#PCDH045 02A9D6	#PCDJRW 003218	#PCDKANN 030FD4	#PCDLANN 001D9C	#PCDMU1C 001F04	#PCDND03 029658
#PCDN004 02A976	#PCDN102 029616	#PCDQANN 030328	#PCDR04D 02A9DA	#PCDSANN 031326	#PCDTANN 030D3E	#PCDULNK 00328C
#PCDV59C 00334A	#PCDWDOW 003368	#PCDZANN 030F90	#PCD0001 0286FA	#PCD0002 0286A8	#PCD0003 0286D8	#PCD0010 02893A
#PCD0060 028C70	#PCD0990 0295C6	#PCGAGAX 00D57C	#PCGAMC1 00DC74	#PCG1MC 00D00A	#PCGBIH1 003C1E	#PCGBIH2 00F95C
#PCGBIM1 003DAE	#PCGBIM3 003508	#PCGBOBF 003EF6	#PCGCCOM 00460E	#PCGCF1L 00E140	#PCGCF13 00F70E	#PCGCUN1 00E7B6
#PCGEBFS 0048E4	#PCGEBIS 00C800	#PCGEBFLT 00CFB6	#PCGEGNC 002A4E	#PCGEIPA 00C7BA	#PCGEIPB 00CCDA	#PCGELPC 00CF4E
#PCGE1H1 00F0D8	#PCGE1H2 00F812	#PCGE1H3 00F896	#PCGE1H4 00F150	#PCGE1M1 00F06E	#PCGE1M2 00F7A2	#PCGGCOM 004718

Figure 1.9-1. Typical Memory map (GNC1)

Verify that this is the correct version before use 1.9-3

## TITLE

PREBUILT/REAL-TIME COMMAND LOADS

## PURPOSE

This procedure documents the difference between prebuilt and real-time command loads built by command applications and explains how to build the data file the Command Server uses to distinguish between the two types of loads.

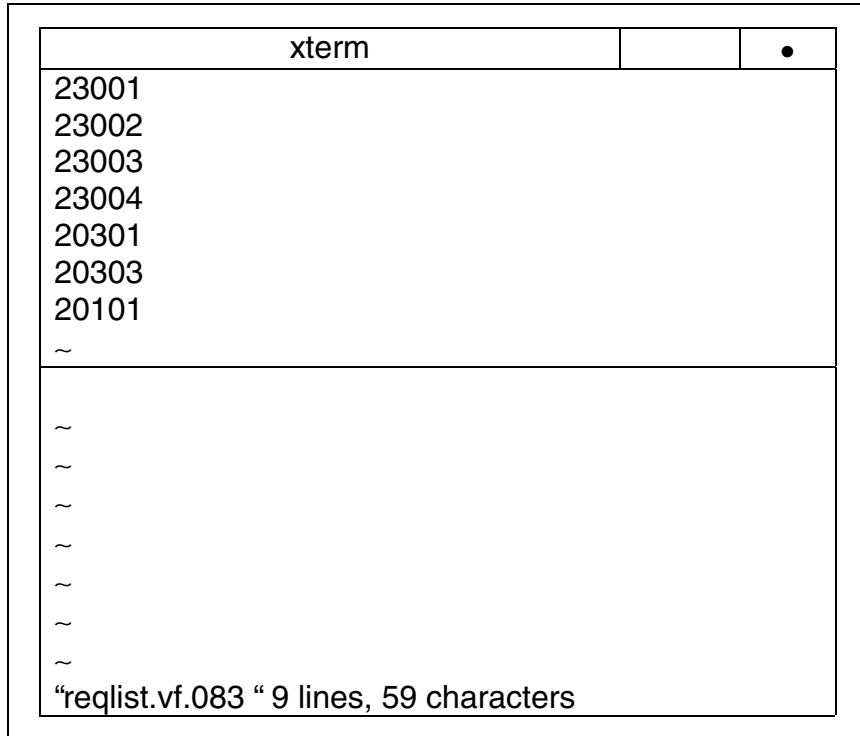
## BACKGROUND INFORMATION

Command loads built using the command applications are classified as either prebuilt or real-time loads. When deleting loads from the workstation, all loads available for deletion will appear in the window. Blue indicates that a load is prebuilt; red indicates that load is real-time. Prebuilt loads are those loads built prior to a mission as a result of the flight-specific data pack (i.e., VP loads, SCALING loads, DEU EQUIV loads). Real-time loads are those loads built during an actual mission.

Commando application determines which loads are designated as prebuilt loads by looking in a data file that must be created for each flight. This file is simply a list of all DSM numbers for the loads built in the flight-specific datapack and identifies real-time loads as those loads not existing in this file.

## PROCEDURES

- A. Log on to a console workstation.
- B. Pull up a development window. Type "`cd /users/dps/rw_common/CMDO`" at the command line.
- C. The naming convention for the data files containing the DSM numbers of the prebuilt loads is `reqlist.vy.xxx`, where `xxx` is the flight number and `y` is the version number (1 = recon version, f = final version). Create a data file for the current flight by typing "`vi reqlist.vf.083`" (for example) at the command line.
- D. Type "`i`" to get into the insert mode. Enter the DSM numbers for the prebuilt loads followed by `<RETURN>`, one per line. The order of the DSM numbers is not important. An example data file is shown in Figure 1.10-1.
- E. After all DSM numbers have been entered, exit the vi editor and save the data file. This is done by pressing F11 and then typing "`:wq <RETURN>`."



**Figure 1.10-1. Example data file**

## TITLE

GPC MEMORY (GMEM) READ/WRITE (R/W) CONSOLE DOCUMENTATION  
PREPARATION

## PURPOSE

The purpose of this procedure is to describe the configuration control process that must be completed for each flight to ensure the correctness of the FDF in order to support GMEM R/Ws.

## BACKGROUND

Prior to STS-26 there was no formal configuration control placed on the GMEM R/W FDF to ensure that the proper addresses were printed in the final FDF. The addresses for each GMEM R/W were looked up by several people throughout the Systems Division and submitted to DF32 personnel. This data was then passed on to the appropriate book manager for incorporation into the FDF. While preparing the FDF to support STS-26, several errors were found in the FDF. Hence, procedures similar to the formal configuration control procedures, as presented in this SCP, were developed and put into place. The procedures presented here have evolved as experience has been acquired with these procedures.

## DEFINITIONS

There is some terminology that must be understood before moving on. First, there are two degrees of verification that must be undertaken for each flight. Every flight has multiple software releases. Generally, there is one reconfiguration release, RECON 1, and a final release. However, there can be multiple reconfiguration releases for a particular flight. For the reconfiguration releases, Systems Division personnel are responsible only for looking up the GMEM write addresses. This is done to support the use of GMEM write activity in the SMS. For the final flight software, a formal configuration control procedure is used to verify the validity of the addresses for GMEM reads and writes.

For the configuration control procedures outlined below, the following terms will be used

DPS Flight Lead - A DF32/DPS person assigned all flight lead responsibilities for a specific flight.

DF Section Flight Lead - A person within each Systems Division section assigned flight lead responsibilities for a specific flight.

## PROCEDURE

- A. GMEM R/W FDF Address Verification for Final Flight Software Releases (Figure 1.11-1)



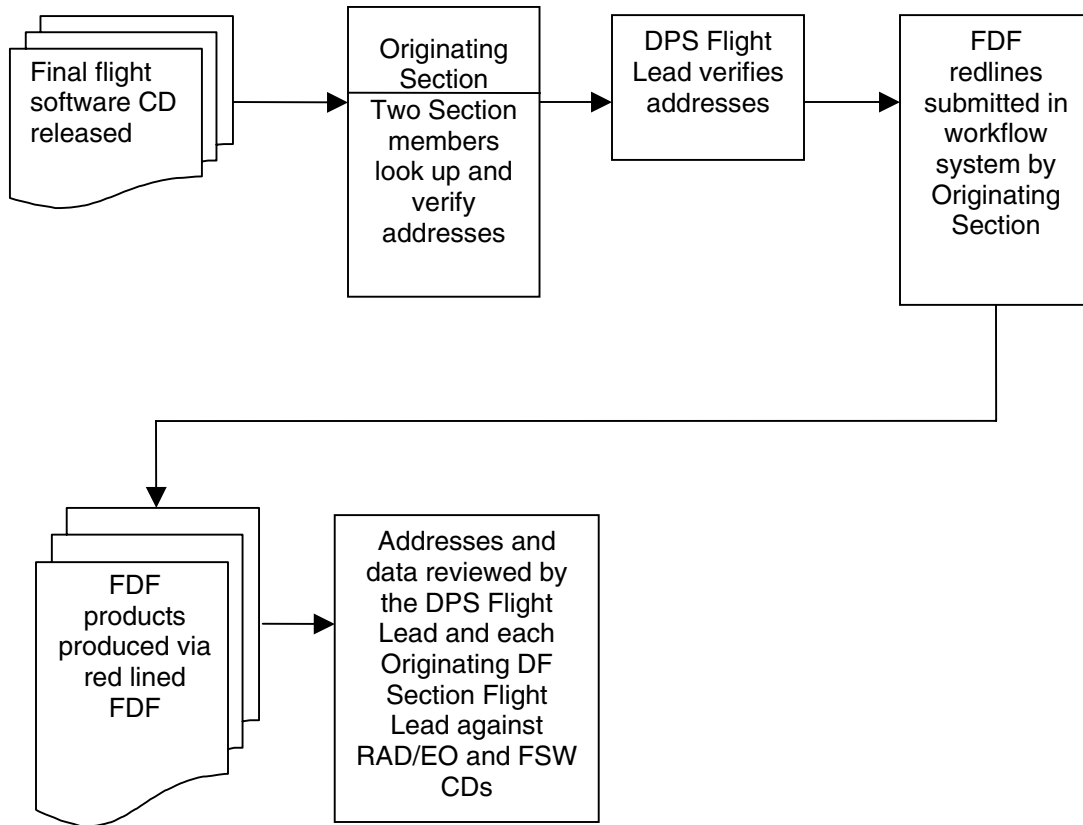
1. Each section Flight Lead verifies the addresses for which he/she is responsible and has another section member double check his/her work.
2. DPS Flight Lead verifies GMEM addresses.
3. The DF Section Flight Lead collects all FDF redlines and copies of flight software as required.
4. The DF Section Flight Lead submits redlines to the appropriate book managers utilizing the Workflow System to inform them of the changes to be made to the FDF. DPS should be selected as a reviewer.
5. When the FDF is finally released for each flight, the DF Flight Lead and the DPS Flight Lead will verify the FDF against the submitted changes and the official PASS and BFS documents for each GMEM R/W. For PASS, this document released by USA is called the Release Authorization Document (RAD). For BFS, this document is called the Version Description Document (VDD), which contains a separate Engineering Order (EO) for each BFS GMEM write and is released by Boeing.
6. The DPS Flight Lead makes copies of the RADs, VDD/EOs, and the release authorization signoff sheets (RASSs) for each of the sections not on distribution. Moreover, copies should be made for the DPS FCR and MPSR consoles.

**B. Miscellaneous DPS Flight Lead Responsibilities**

1. Responsible for negotiating any problems that are found with the NASA RASSs, USA RADs, and/or Boeing EOs. Issues are generally negotiated with SSD personnel or the release managers in DP. See the DPS Directory for more details on specific contacts.
2. Responsible for educating systems division personnel on the policies associated with GMEM R/Ws.
3. Responsible for informing management of problems that may affect GMEM R/W policies/implementation.

**C. GMEM R/W Release Documentation Summary**

The documentation that authorizes GMEM R/W activities is released at several levels of authorization. The lowest level of GMEM R/W documentation released is the documents produced by USA and Boeing. These documents explain in detail each GMEM R/W and provide addresses and data to accomplish the GMEM R/W. These documents by themselves are not official. They must be accompanied by a RASS. There are two types of RASSs. First, preflight RASSs are released with the associated RAD, MRAS, or VDD/EO in order for preflight GMEM R/Ws to be officially implemented in the vehicle or test facilities. Approximately 3 days before a scheduled launch, a flight RASS will be issued that authorizes the previously released RASSs.



**Figure 1.11-1. FDF GMEM R/W address/data configuration control**

**TITLE**

VERIFYING TMBU PARAMETERS FOR STATION ASSEMBLY FLIGHTS

**PURPOSE**

This procedure is used to verify that a complete list of parameters are being monitored during station assembly flights.

**BACKGROUND INFORMATION**

For station assembly flights, five displays are used to provide the shuttle crew with International Space Station (ISS) data. These displays have associated caution and warning tones and messages to inform the shuttle crew of ISS status. For each assembly flight, Table Maintenance Block Updates (TMBU) will be uplinked to inhibit ISS parameters monitored by the shuttle to prevent nuisance C&W tones and messages on the shuttle. TMBUs may also be uplinked to enable ISS parameters monitored by the shuttle when appropriate. The Shuttle and Station Flight Controllers Operations Handbook (FCOH) procedure 3.10 will be used to determine which parameters should be inhibited/enabled.

**PROCEDURE**

- A. Prior to the Integrated Load Checkout (ILC) of each shuttle flight to the ISS, and as part of the DPS datapack process, DPS will be responsible for verifying that Table 3.10-1 in procedure 3.10 in both the Shuttle Flight Controllers Handbook (FCOH) and the Station FCOH contains a complete list of parameters to be monitored.
- B. This table will be verified against the C&D Annex tables 8 and 9 for that particular flight. The parameter and MSID located on these tables should match that of those on Table 3.10-1.
- C. Both the DPS flight lead and the datapack builder will verify the parameters.
- D. In the event that there is a discrepancy between the tables in the C&D Annex and the list of parameters on Table 3.10-1, DPS will identify a shuttle and ISS discipline owner for that parameter and inform them of the discrepancy.
- E. The shuttle owner of the parameter will be responsible for updating the Shuttle and Station FCOH 3.10 procedures, with changes to Table 3.10-1, as appropriate.
- F. The DPS datapack builder will then build the TMBU for the ADCO and ODIN parameters per FCOH Table 3.10-1.

- G. The DPS datapack verifier will ensure that the TMBU is built correctly per FCOH Table 3.10-1.

## TITLE

CHANGE REQUEST (CR) AND DISCREPANCY REPORT (DR) REVIEW AND RESPONSIBILITIES

## DESCRIPTION

All changes made to the flight software must go through the Flight Software Integration group. Once the affected disciplines of these changes are identified, a flight software representative will generate reports along with evaluation forms and distribute them for review. Each affected discipline will provide a thorough evaluation of the changes. DF has a CR/DR Representative who will distribute the incoming evaluation forms along with the reports for both DF22/DPS and DF24/INCO.

## RESPONSIBILITIES

1. Flight Software Integration Representative
  - a) The Flight Software Integration representative drops evaluation forms in the CR/DR inbox (located in Bldg 4N, Rm 113) or sends them via e-mail to the CR/DR Coordinator.
  - b) The Flight Software Integration representative also determines which discipline is required to evaluate the review form and will indicate it on the form.
  
2. CR/DR Coordinator
  - a) The CR/DR Coordinator will distribute the incoming CR/DR forms for evaluation to members in the group. These will come either in the form of a hard copy or electronically via email.
  - b) The coordinator will spread the evaluation task among group members as evenly as possible. One criteria that can be used, but is not limited to, is choosing experts in specific systems (PASS, BFS, MEDS, CAU)
  - c) The coordinator will also distribute the CR/DR to flight leads if the CR/DR is flight specific.
  - d) If any flight software issues come out very close to flight, the coordinator will inform the affected flight lead so that they are aware of any issues that may impact the flight.
  - e) Once the CR/DR is completed and returned by the evaluator, the coordinator will log the impacts and return date in a database that will be

accessible to all group members. This will be located in the following location: S:\Divisions\DF\Private\DF22\CRDR

- f) Upon return of the completed evaluation forms, the coordinator will fax the forms over to the flight software integration department or send them electronically.
- g) The coordinator will save all CR/DRs in a binder and in an electronic folder for future reference. These records will be maintained for one year from their completion date.
- h) If DF24/INCO is required to evaluate a CR/DR, the same process above is performed.

3. DPS Evaluator

- a) It is the responsibility of group members to provide a thorough evaluation of DPS impacts for a CR, DR, or program note. This may include calling the originator of the CR/DR for clarification.
- b) When reviewing a CR/DR several points must be taken into consideration to provide a thorough evaluation. Some things to consider are listed below:
  - i) Does the CR/DR present technical/operational impact?
  - ii) Does the change impact mission success, safety of flight, training, current flight rules, MCC console procedures, or flight data file?
  - iii) Who is affected by the change (Crew, Ground controller)?
  - iv) What facilities are affected (MCC, SAIL, SMS, KSC, other)?
  - v) Are any SPECS or Displays affected?
  - vi) Are any DPS parameters affected by the change?
  - vii) Is the affected parameter downlinked/ downlisted?
  - viii) What flight or OI release is affected by change?
  - ix) Will MCC workstations need to be updated?
  - x) Will the change impact Launch Commit Criterias?
  - xi) Will the SMS model software be impacted?
  - xii) Is a workaround necessary until approval of CR?
  - xiii) Is an OPS Note or Waiver required?
- c) If recommending an update to a note the evaluator should call the originator of the CR/DR and inform them of the recommendation. In addition, the evaluator should document the recommendation on the evaluation form.

- d) It is also the group member's responsibility to inform the DPS group of any major CR/DR that is being worked that may impact flight (ie. Safety of flight, flight readiness, workstation applications, crew procedures, required workarounds, flight rules, crew displays, DPS documentation, etc.)

TITLE

RESERVED



## TITLE

CD ROM DATA RETRIEVE SYSTEM PROCEDURES

## PURPOSE

This SCP defines the capabilities available in the CD ROM Data Retrieve System.

## PROCEDURE

### A. CD ROM Loading Procedure

1. Insert the CD ROM. The drives and file servers are located in the DF2 branch office for access in the office and behind the DPS SPT console in the WMPSR for access in the CCC. In the CCC, drive CD 1 is used for the current flight or sim, and drive CD 2 is used for other flight software loads.
2. On the pc, drive D is used to access the ofswin software. This software is hard coded to look at drive E to read from the CD ROM drive.
3. If you need to add a new flight, this is done using the File Manager. Select drive D and double click on the ofswin directory. Then single click on ADDNEWFL.BAT. Under the File menu, select RUN. A window will pop up with ADDNEWFL.BAT selected. Add the flight name after this, using the naming convention of stsxxxxy, where xxx is the three-digit flight number, and yy is r1 or fl for recon 1 or final load. For MAST products, yy will be ec for engineering cycle or fc for flight cycle. The MAST products are used primarily by INCO. After adding the flight name, the box in the window should read ADDNEWFL.BAT stsxxxxy. Click on OK. Adding a new flight has to be done only the first time a new CD is loaded.
4. To run the ofswin software, use File Manager, select the D drive, single click on the ofswin directory, and double click on ofswin.exe to execute the ofswin software. When the login window appears, the user may enter anything for the user name. When this is done, click on OK. This will bring up the System Window. Seven pulldown menus will be displayed to the user that will allow manipulation of flight-specific data. The most useful options, as applicable to the routine analysis of flight software data, will be discussed next.
5. While viewing the files on the CD ROM, if the font is not correct, under Preferences in the ofswin software, select font and select F 6-13 Courier.

### B. File Management

1. Report Menu: This option allows the user to select flight-specific data.
  - a. Cluster option - First mandatory step for the user as it allows selection of a particular flight and reconfiguration cycle (i.e., R1, FL, EC, FC). Use the mouse to highlight the desired flight and click on "View Report" box or hit the <ENTER> key. The user is required to select the same flight reflected

on the disk label. All the flight-specific files will be displayed on the Report Selection screen for selection by the user.

Notice that for some optical products, the Report Selection screen will show filenames with a "(SIDE B)" pointer. This indicates that the file is only available on side B of the disk.

- b. Existing option - Used to display all filenames available under the selected cluster. The user will select this option when ready to access a file.
  - c. Previous option - Used to select the previous file relative to the file being accessed at the time. If the file currently being used is the last file identified on the Report Selection screen, then this option will not be available.
  - d. Next option - Used to select the next file relative to the file being accessed at the time. If the file currently being used is the last file identified on the Report Selection screen, then this option will not be available.
  - e. Exit option - Used to exit the OFSWIN v2.2a. Press the <ESC> key to exit the OFS panel.
2. Edit Menu: This menu is not applicable for optical fiche products due to configuration control restrictions that do not allow files to be edited and/or formatted in any way.
  3. GoFrame Menu: This menu will allow the user to select a particular frame of data in a file.
    - a. Frame number option - Allows the user to jump to a specific frame. The user can specify the particular frame number or move forward/backward relative to the current frame being displayed by using "+"/"-" with a number reflecting the desired shift. Use the status bar (refer to Preferences Menu) to find out the frame being accessed at any particular time.

If an invalid request is defined, the application will automatically jump to the first frame of the file.

- b. First Frame option - Allows the user to jump to the first frame of the file.
- c. Last Frame option - Allows the user to jump to the last frame of the file.
- d. Page Up option - Allows the user to move to the previous frame of the file relative to the frame being accessed at the time. This capability is also available by using the left arrow key in the status bar (refer to the Preferences Menu). This option is not available when processing the first frame of a file.
- e. Page Down option - Allows the user to move to the next frame of the file relative to the frame being accessed at the time. This capability is also available by using the right arrow key in the status bar (refer to the

Preferences Menu). This option is not available when processing the last frame of a file.

- f. Set Bookmark option - Allows the user to define up to 26 bookmarks per file. When the desired frame is found, access this option. An alphabetical menu will be displayed identifying the bookmark positions available. Select the desired bookmark and hit the OK key. As a result, the selected bookmark will reflect the corresponding frame number.
  - g. Go To Bookmark option - Allows the user to find a previously defined bookmark. When this option is selected, a listing of all bookmarks is displayed. Select the desired bookmark and hit the OK key. The application will automatically access the corresponding frame.
4. Search Menu: This menu provides the user with the capability to find certain data by defining specific search criteria. All occurrences found will appear highlighted in the particular frame if the highlight capability is enabled at the time. As a default, this option is always enabled at the beginning of a session. Use the F3 key to toggle this capability ON and OFF as desired.
- a. Single option (F4 key) - Allows the user to search for specific data within a file. Each file contains a number of indexes to facilitate the search process. All search requests will start from the first frame of data.

The system will announce the number of matches found satisfying search specifications. By clicking on the OK box or pressing the <ENTER> key, the application will access the frame where the first occurrence was found. The user will be responsible for looking through the frame(s) to find the highlighted area(s) defining the matching occurrence(s). Using the Next (F6) or Previous option will allow the user to jump to the following occurrence(s) as desired.

In addition to specifying the search query, the user will be able to select the window mode and/or specify a case-sensitive search. The window mode option will display all occurrences in a window format from which the user can select the desired occurrences. If the case-sensitive option is not selected, then all occurrences, caps and noncaps, will be displayed to the user.

Documentation on the implementation of indexes per file can be found in the Users Guides binder on console.

- b. Multiple option (F5 key) - Allows the user to execute a search on several files simultaneously as long as they have a common index requirement. All search requests will start from the first frame of each file.

The system will announce the number of matches found satisfying search specifications. By clicking in the OK box or pressing the <ENTER> key, the

application will access the frame where the first occurrence was found. The user will be responsible for looking through the frame(s) to find the highlighted area(s) defining the matching occurrence(s). Use of the Next (F6) or Previous option will allow the user to jump to the following occurrence(s) as desired.

In addition to specifying the search query, the user will be able to select the window mode option and/or specify a case-sensitive search. The window mode option will display all occurrences in a window format from which the user can select the desired occurrence. If the case-sensitive option is not selected, then all occurrences, caps and noncaps, will be displayed to the user.

Documentation on the implementation of indexes per file can be found in the User's Guide binder on console.

- c. Query option - Allows the user to look for information using a combination of search criteria. Enter the first field by clicking on the down arrow key. This allows the user to select one of the rapid index features. Select the beginning search criteria from the first box. Next move the mouse to the next arrow box and click to select the type of logic for the query search: such as # (number), < (less than), > (greater than), <= (less than or), >= (greater than or). Type the search criteria in the last field. Move down to the next field and repeat the process using another cross-reference index. Repeat the process until all desired cross-reference requirements have been entered.
- d. Previous option - Allows the user to access the previous occurrence of a search request. The Previous occurrence logic does not reverse when the reverse search option is selected.
- e. Next option (F6 key) - Allows the user to access the next occurrence of a search request. The Next occurrence logic does not reverse when the reverse search option is selected.
- f. Global option (F7 key) - This option does not use indexes; rather, it scans the frames for a text match anywhere in a frame. A search will be executed starting in the frame currently being accessed unless the user jumps to the first frame via the GoFrame menu. The search will occur in an incrementing order unless the reverse search option is selected. There is no window option available with global searches.

This type of search is slower than the index searches and, depending on the size of the report and how far the search goes, may take up to several minutes. The user has the capability to cancel the search at any time.

- g. Global Region option - Allows the user to specify a particular area to perform global searches. The area is selected by clicking on the right mouse button and shifting it to specify the search area. Basically, this is done by selecting a range of columns on the frame. Although this is still a global search, the total time needed for the query will be reduced given that the search is limited to a smaller area.
  - h. Window option - Displays the location of all the occurrences resulting from a search request in a window format.
5. Preferences Menu: This menu allows the user to change the default viewing/display characteristics.
- a. Fonts option - Allows the user to change the display font in order to facilitate data viewing. The user selects a smaller/larger font size and clicks on ZOOM OUT option to reduce/amplify the whole display. The user will be able to shift the file while maintaining the selected font by clicking on the right key of the mouse.
- The ZOOM IN option allows the user to view a selected area of the frame under a selected font. The right mouse button, when being held down, displays an icon representing a corner with a diagonal pointer line. This icon can be used as a floating left page corner and will be positioned in the particular area targeted to be ZOOMed IN. The frame will enlarge to the selected zoom-in font when the right mouse button is released. Clicking on the right mouse button again will zoom out of this option.
- The ZOOM option only applies for viewing purposes, not for printing.
- b. Colors option - Allows the user to change foreground and background colors for the report area, search hits, and the status bar. The values selected by the user will be maintained in memory such that they will be automatically enabled on future sessions.
  - c. Show Coordinates option - When selected, allows the user to see the mouse coordinates in the form of "row, column" pixel positions. This is useful when designing forms for use with reports. A checkmark will be displayed by this option when selected. This option is not saved permanently.
  - d. Show Status Info option - This option functions as a toggle switch. When the user selects the option, the status bar will appear providing frame number information, arrow keys to move between frames and the name of the file currently being accessed. When the option is enabled, a checkmark will be displayed by the option.
6. Print Menu: This menu provides various options to generate frame hard copies. Notice that certain files are configured such that the frame number is equal to the page

number plus 1. Be aware of this condition when using the Frame, Range, and Window Hits printing options as it may look like incorrect pages are being printed, when in reality the function is working as expected.

- a. Frame option (F8 key) - Allows the user to print a particular frame of data. The user has the capability to cancel a print request in progress.
  - b. Range option - Allows the user to print several consecutive frames of data. A template will appear requesting the first and last frame numbers defining the region to be printed. The user has capability to cancel a print request in progress.
  - c. Window Hits option - Allows the user to print the frame(s) where a matching occurrence has been found as applicable to Single and Multiple search options. Keep in mind that if the occurrence extends throughout various frames, this option will only print the first frame of a particular occurrence.
  - d. Print to File option - Allows the user to direct the printout to a disk file instead of a printer. If this option is selected, a standard DOS text file that can be imported to most word processors or spreadsheet programs should be used. Printing a disk file is an alternative to using the copy to clipboard function. This method, while more difficult, can be used to copy non-Windows programs that cannot read the clipboard or for data communications that send DOS files to other computers.
7. Help Menu: This menu provides online help on how to use the optical fiche system.
- Topic option - Allows the user to access a Help file explaining the various capabilities available in the system. The user needs only to click on the particular subject of interest.
8. Distribution
- For any problems concerning the CD ROM distribution, contact the DPS Optical Products manager. If this person is not available, contact Unisys personnel, B. O. Winkel at 282-3374 or Angie Gonzales at 282-4723.

## REFERENCES

1. Optical Fiche System Technical Guide. PSI Technologies Corp, 1001 Capitol of Texas Hwy. So., Bldg. K, Suite 200, Austin, TX 78746
2. Fiche indexing definitions.

**SECTION 2  
DPS CONSOLE MANAGEMENT INFORMATION**

**CONTENTS**

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## TITLE

MEMORANDUM OF UNDERSTANDING (MOU) FOR THE JOINT OWNERSHIP OF THE MODULAR MEMORY UNIT (MMU)

## PURPOSE

The Modular Memory Unit will store the Solid State Mass Memory (SSMM) as well as the Solid State Recorders (SSR). Because the MMU will house equipment that belongs to both the Data Processing Systems group and the Instrumentation and Communications (INCO) group, DPS and INCO will have joint ownership of the box. This SCP is a memorandum of understanding between the DPS and INCO Group Leads, the DF2 Branch Chief and the DF Division Chief. It contains the power cycle philosophy and responsibilities of each group should an anomaly occur with the MMU.

## DESCRIPTION

### Modular Memory Unit (MMU) Description

1. The MMU will replace the functions of the mass memory units, and the payload and ops recorders.
2. The MMU will be comprised of the Solid State Recorder (SSR), which replaces the functions of the payload and ops recorders, and the Solid State Mass Memory (SSMM), which replaces the functions of the mass memory units.

### MMU Ownership

DF has agreed that DPS and INCO will have a "joint" ownership of the box.

### Joint Ownership Power Cycle Philosophy

Powering off or power cycling the MMU will be coordinated between DPS and INCO.

1. Any procedure that calls for an MMU power cycle or to be powered off, the crew will need a "Go" from MCC, which will be coordinated by DPS and INCO.
2. The only exception to this power cycle philosophy would be in the case of power down procedures. For these cases, the crew does not need a go to power off the MMU.

### Power Cycle Responsibilities

1. A power cycle will be initiated by the discipline for which the power cycle is needed.
2. If the SSMM fails, DPS will initiate the power cycle if needed, after coordinating with INCO.
3. If the SSR fails, INCO will initiate the power cycle, after coordinating with DPS.



IFM Responsibilities

1. An IFM of the MMU to recover the SSMM function will be initiated by DPS with INCO's concurrence.
2. An IFM of the MMU to recover the SSR function will be initiated by INCO with DPS's concurrence.
3. An IFM procedure for the MMU will only be performed to:
  - a. Recover an MMU if the failure is due to the loss of orbiter power.
  - b. Swap a failed MMU with an operational MMU. This will be done only when one MMU hard failed internally and the other MMU failed externally (has bad data path).

**TITLE**

CONSOLE CONFIGURATION

**PURPOSE**

This SCP is designed to help the DPS and DPS SPT console operators prepare the console for simulation and flight operations.

**PROCEDURE**

A. Digital voice intercommunication subsystem (DVIS)

Plug in headset and select appropriate loops.

Suggested DPS loops

DPS MPSR  
MOCR DPS/CDMS  
FD  
A/G 1  
A/G 2  
A/G UHF

Suggested DPS SPT loops

DPS MPSR  
MOCR DPS/CDMS  
FD  
A/G 1  
A/G 2  
A/G UHF  
SSR1 (Do not use prelaunch.)

Reference SCP A.1, DVIS PANEL LAYOUTS, for the standard DVIS panel configurations and FCOH 1.4 for a listing of disciplines and associated call loops.

B. Workstation log on

The first operator to arrive should log into White FCR-3, located on the left in the FCR.

The DPS operator will also need to log into the White FCR-22, located on the right in the FCR. If the DPS SPT operator is the first to arrive, the DPS operator will also need to perform a shift handover for White FCR-3.

The DPS SPT operator will need to log into White MPSR-6, located in the MPSR.

If you cannot log on because of password problems, Access Control and Audit (ACA) in Bldg. 30S/ Rm 4312 can reset your passwords. For other workstation problems, contact WSS on the WSS CALL loop.

C. Activity selection (Figure 2.2-1)

After logging on, the operator should complete the activity selection. GC can help determine the proper activity to select if you are not sure.

The White FCR-3 console will automatically start the DPS background processes and the ISP Limit Manager. These processes and applications are started on White

FCR-3, since it is the more powerful CPU. Starting these processes and applications in the FCR also allows for reduced MPSR or FCR-only operations without any reconfiguration required.

If the FCR operator is sitting at a different console than White FCR-3, the flight controller must manually start the servers using DNAV DPS II Config I DPS INITIALIZE.

D. Limit set selection (Figure 2.2-2)

When the White FCR-3 operator or the operator to select DPS INITIALIZE completes activity selection, the ISP Limit Manager application will automatically start. Select the appropriate limit set and then iconify the window. The ISP Limit Manager must remain running for limit sensing to be performed.

<p><b>WARNING</b> Starting more than one ISP Limit Manager will give unpredictable results.</p>
---

E. Applications

Start applications required to monitor the DPS system.

Minimum configuration FCR and MPSR

DNAV DPS II Apps I	DPS Overview
	DTEX
	OFS
	SPECS
	DPS C&W

In addition, the FCR will need to start

DNAV DPS II Global I	IMGO
----------------------	------

If desired, clear the OFS and SPECS history logs.

F. Start DPS console log (SCP 3.1C).

**REFERENCES**

1. Flight Control Operations Handbook (FCOH), JSC-26843.

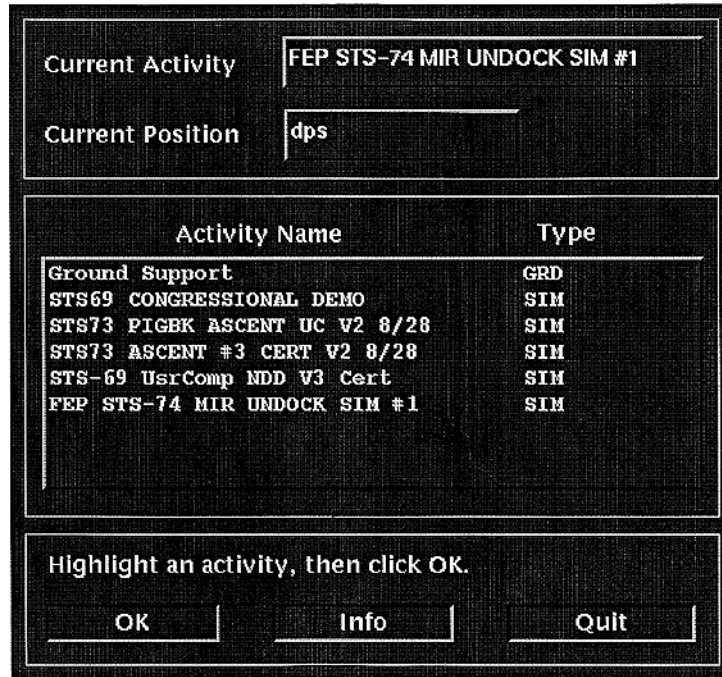


Figure 2.2-1. Activity selection

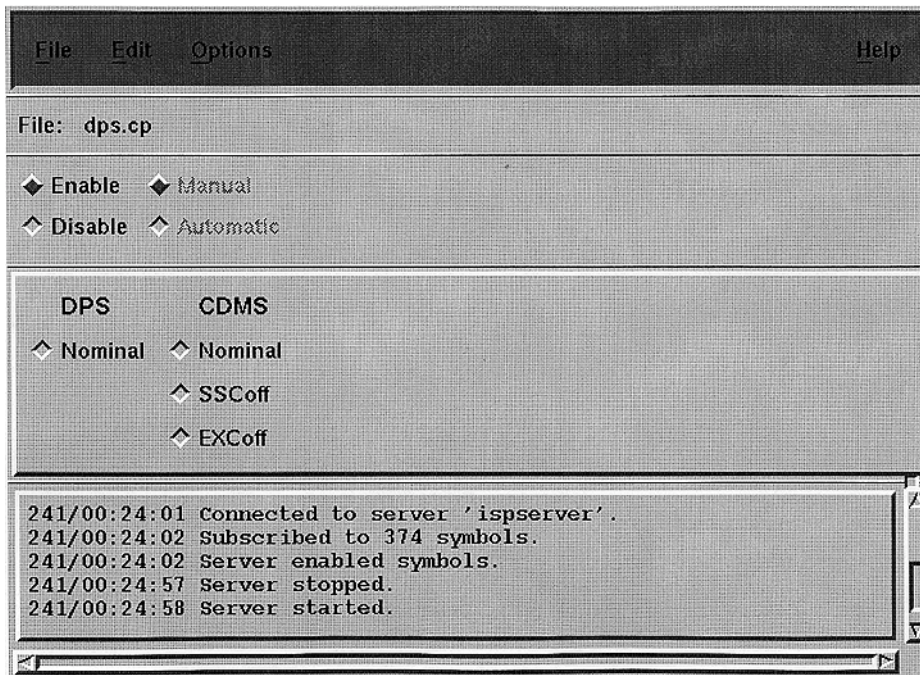


Figure 2.2-2. Limit set selection

**TITLE**

SIM PREPARATION

**PURPOSE**

This SCP is provided to help the DPS SPT operator prepare for simulation operations.

**PROCEDURE**

- A. Configure console per SCP 2.2, Console Configuration.
- B. Send command loads to the Command Server and verify them.

Reference Section 7, Command Load.

Typical loads sent for each mission phase

Ascent	Orbit	Entry
MECO + 5 BFS TMBUs	ORBIT S2 and G2 VPs	BFS ENTRY TMBUs
ASCENT G1 VPs	Scaling	ENTRY G3 VPs
ENTRY G1 VPs	ODIN/ADCO TMBUs	Scaling
OPS 901 PRO DEU equivalent		
Scaling		

Refer to S:\Divisions\DF\Private\DF32\Work Station Applications (Ws-apps) for more information on workstation programs that send command loads.

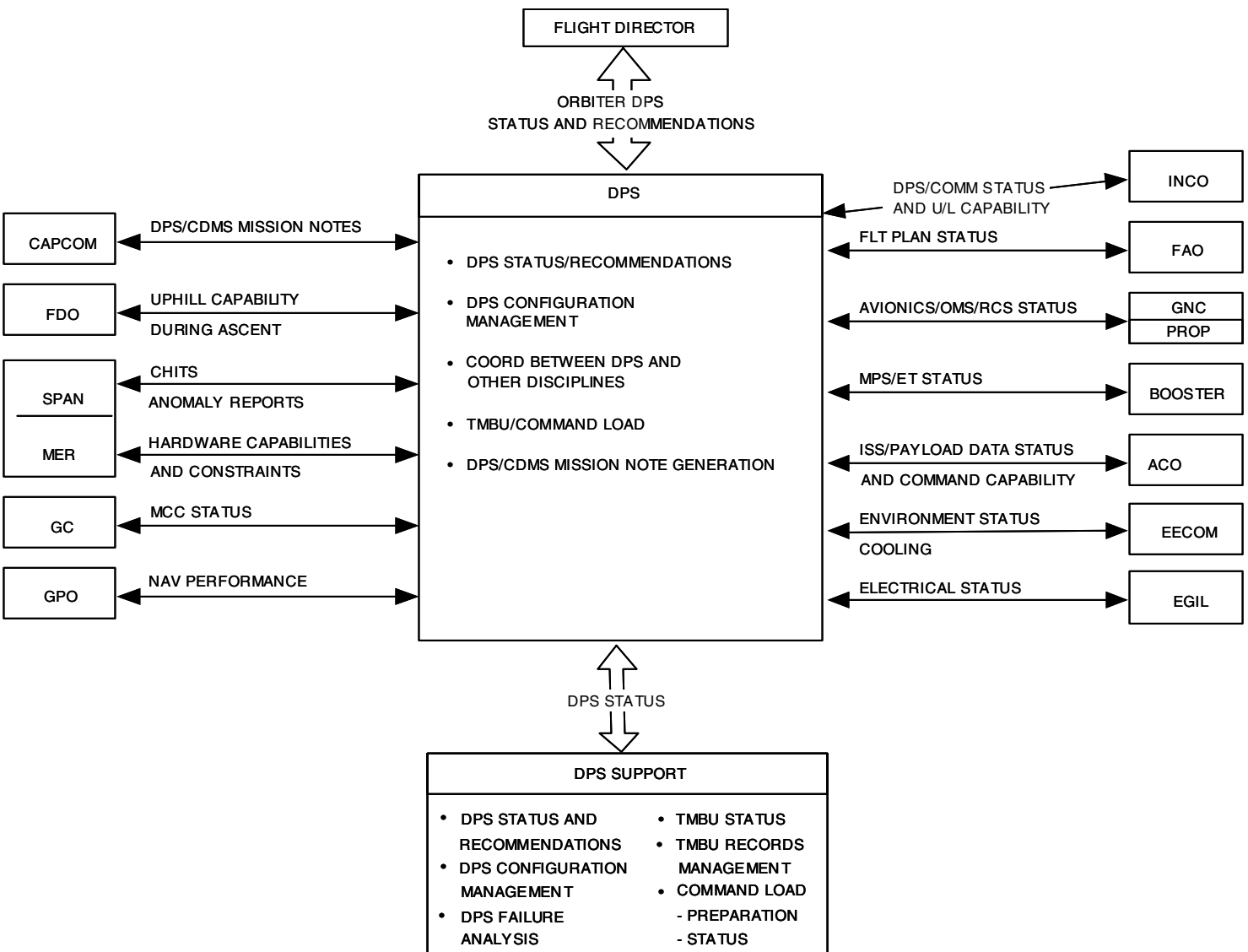
Verify all loads with the appropriate command applications, using DNAV DPS II Command and DNAV Master II Shuttle I INCO

- Chained load inventory
  - Load inventory
  - DEU equivalent loads
  - GMEMs
  - TMBUs
  - Variable parameters
  - VP scaling
- C. Inform INCO, by flight note, of the loads that need to be sent. This note should specify that the loads should be sent only on GO from DPS. Reference Section 7, DPS Command Loads, for flight note format.
  - D. When time permits
    - 1. Review common error signatures

2. Review Flight Rules
  3. Review FDF procedures
  4. Review training goals
  5. Review proper console log and paperwork procedures
- E. After run begins, verify the following:
1. Loads are received by the command server DNAV DPS II Global I Command Summary
  2. The GNC is driving the OFS application.
  3. The VPs are sent to correct major function; i.e., GNC or SM - DNAV DPS II Global I Command Summary
- F. After the simulation is complete, fill out the training roster using the Training Administration and Management System (TAMS).

**TITLE**

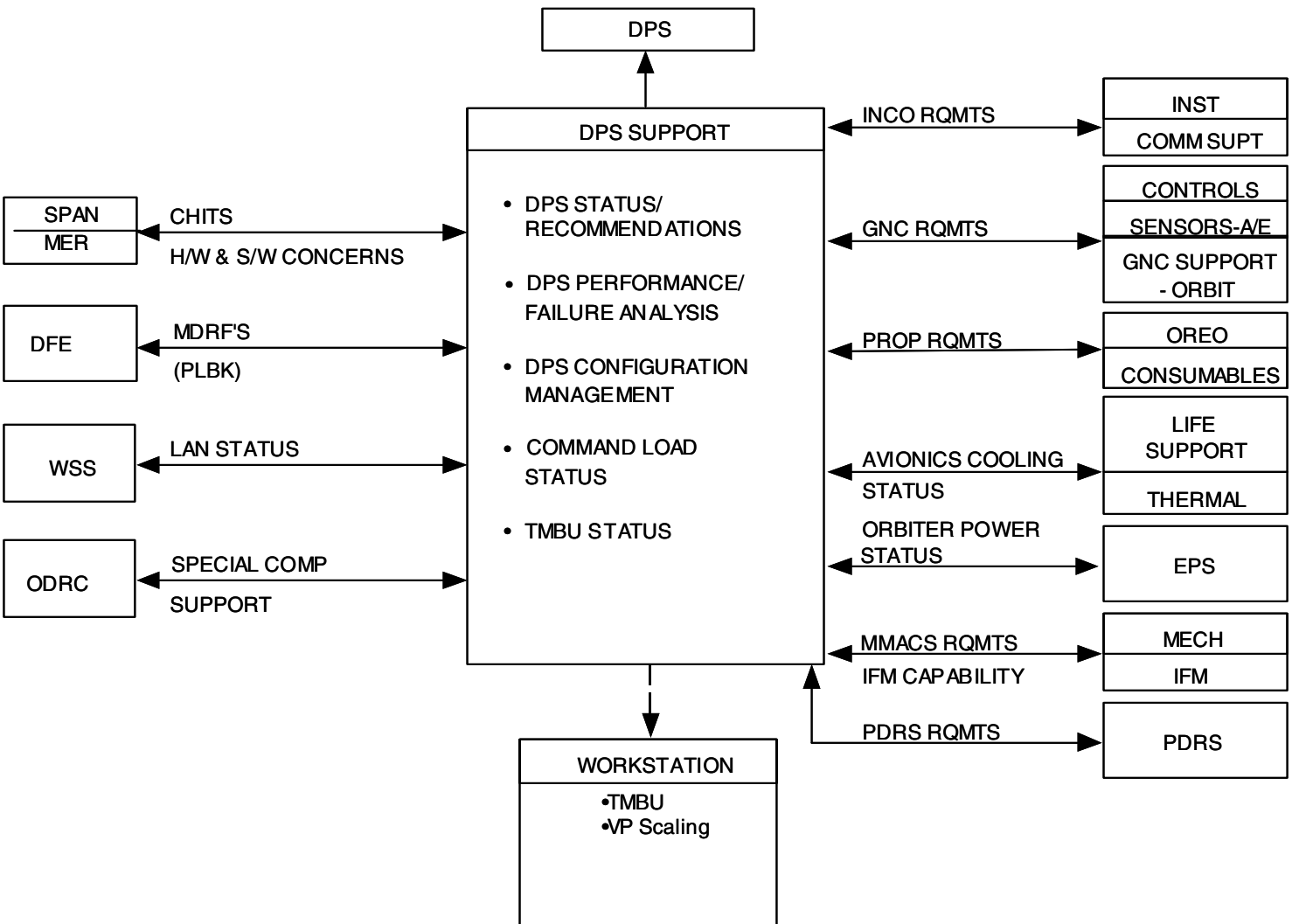
DPS INTERFACES



2.4-2

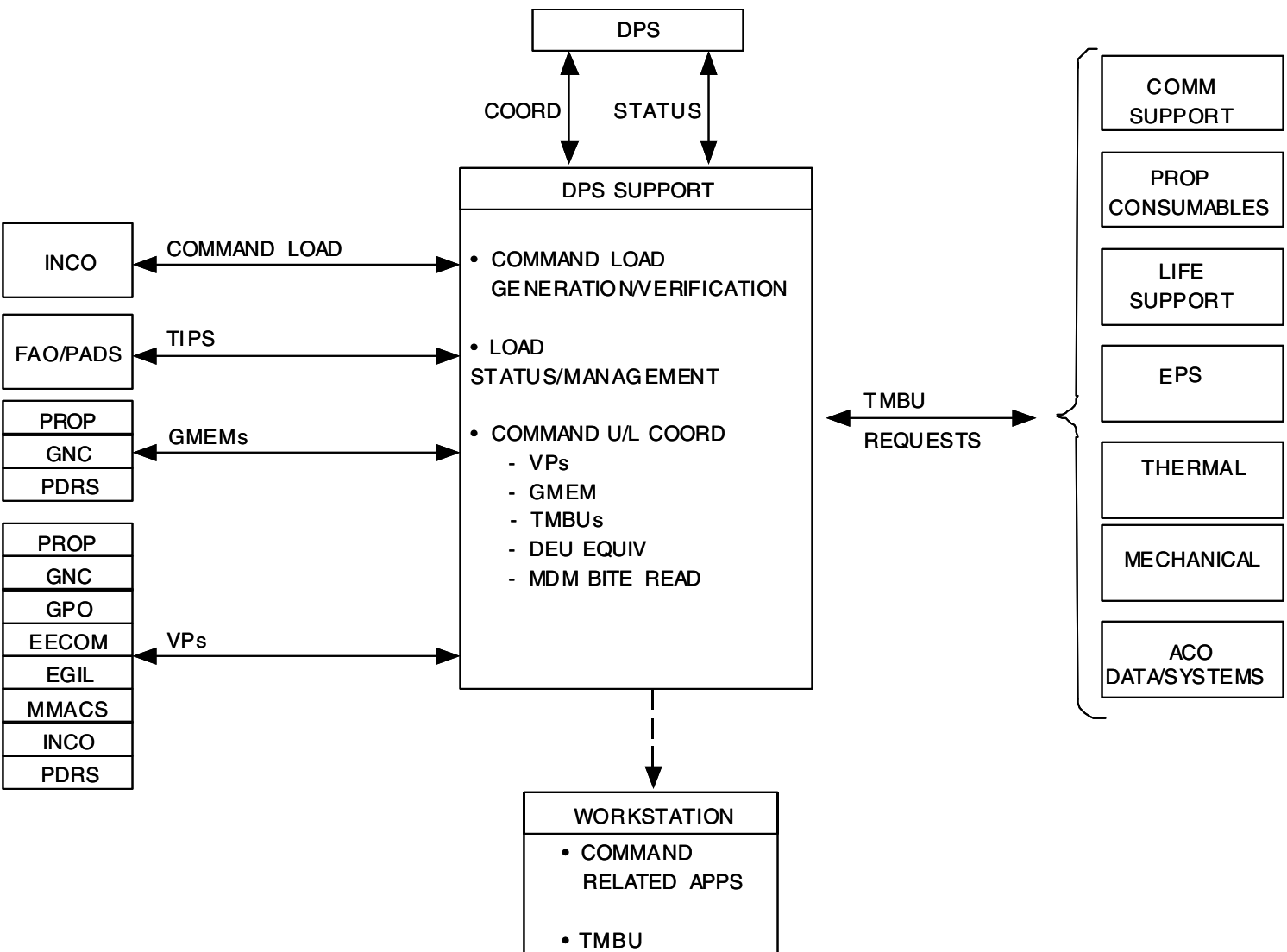
Verify that this is the correct version before use





2.4-3

Verify that this is the correct version before use



2.4-4  
Verify that this is the correct version before use

**TITLE**

DPS CONSOLE DOCUMENTATION AND OPERATOR RESPONSIBILITIES

**PURPOSE**

To provide a reference list of documentation required for preflight PAD TESTs, flight operations, and postlanding; additionally, this SCP identifies flight data file management policies.

**DOCUMENTATION**

<u>Document Name</u>	<u>FCR</u>	<u>MPSR</u>
Console NOIs		X
CPDS - Downlist/Uplink (140)		X
CPDS - LDB Software Interface (150)		X
CPDS - System Level A Requirements (170)	X	X
CPDS - Operational Requirements - SM (580)		X
CPDS - Functional Requirements - VU (550)		X
CPDS - Functional Requirements - GNC (510)		X
DDS - GNC, SM		X
DPS Console Handbook	X	X
DPS System Briefs	X	X
Inflight Anomaly	X	
Inflight Failure History	X	
FCOH	X	X
FDF	X	X
Flight Procedures Handbook		X
Flight Rules & Annex	X	X
IFM Picture Book	X	
Launch Commit Criteria	X	X
MMU PRN	X	X
OMIs - S00XX	X	X
OPS Notes and Waivers	X	X
PASS RADs and BFS EOs (included in datapack)	X	X
PASS, BFS CD ROM including I-Loads		X
PASS User's Guide	X	X
Postflight Reports	X	
MIS User's Guide	X	X
SSSH	X	X

## DPS FLIGHT DATA FILE (FDF) MANAGEMENT POLICIES

### A. FDF Libraries

The FDF libraries for FCR-3 and FCR-22 (DPS), MPSR-6 (DPS SPT) and MPSR-9 (CDMS) should support all unclassified missions. DPS receives three copies of the flight-specific and all vehicle documents and updates.

The classified FDF (flight-specific updates), if and when required, will be maintained by the section security officer; this will be his/her only duty for FDF maintenance. In his/her absence, the alternate security officer will maintain this classified library.

### B. Updates

There are four types of updates

1. SIM packs that are generic or flight-specific (will have subsequent PCNs that will incorporate them)
2. SIM packs that are SMS unique (no subsequent PCNs)
3. PCNs
4. Whole book updates

The generic SIM packs will be incorporated into the applicable books, and the SMS-unique SIM packs (in their entirety) will be put in front of their applicable books, instead of incorporating them into the book. The PCNs will, of course, be incorporated per the instructions on the PCN; the book updates (i.e., revisions) will take the place of the current edition, and the entire current book will be recycled.

Regardless of whether the update is a SIM pack, PCN, or entire book update, the updates should be done in chronological sequence to ensure consistency and validity of the FDF.

### C. Update History

The update history of a document will be maintained in the front of the document. The update history consists of the SIM pack cover sheets, PCN change record sheets (cover sheet of the PCN), and new covers for the entire book updates. In some cases there may be a SIM pack that completely replaces another SIM pack; please do not remove the replaced SIM packs cover sheet. This cover sheet is the only source the section can use to verify that the SIM pack was indeed incorporated in the first place; this thorough record keeping will greatly aid the section when the book is to be audited for correctness. Once the responsible section member has updated the book in the proper manner, he/she will go to the front cover of the book and write the name of the applicable update, the date of

incorporation, and his/her initials (Figure 2.5-1). If previous incorporations have been made, enter the next update underneath the most recent entry. If the update is a new edition, or no previous updates have been performed, start an update log in the form of Figure 2.5-1.

<u>Update</u>	<u>Date</u>	<u>Initial</u>
PCN-1	1-10-94	ABC
SMS-22	1-15-94	ABC
SMS-34	1-16-94	DEF

**Figure 2.5-1. Standard for update log**

This updating standard does not apply to the office library; see the OFFICE LIBRARY section of this SCP for further information.

D. Timeliness of Updates

The section usually receives updates the day before they are to be used. Therefore, as a rule, attempt to incorporate the updates into the library the date the update is received. Logistically, this may be impossible; if updating the libraries is not possible by the next day, examine the SIM schedule to determine if the update is actually needed. For instance, an update to the Ascent Checklist will probably not be used during an orbit SIM; therefore, immediate incorporation may not be necessary. If the book is necessary, find the SIM team affected and request the team to update the books for you. However, this should not become a regular procedure. Ultimately, each person is responsible for updating the FDF and maintaining the correct status of his/her assigned books.

Prelaunch team is responsible for verifying that all books are the latest version and have the latest PCNs incorporated. This can be verified using the FDF status sheet, which is in the errata package and available using EDP.

E. Flight Specific Books

Flight supplement books are updated based on flight assignments. The flight lead updates the FCR from which the mission will be flown. DPS SPT for the flight lead updates the corresponding MPSR.

Normally, DPS is in the position of having to support multiple missions and training loads simultaneously. This leads to multiple flight supplements to the generic books. Apparently, usage has shown that keeping these in a separate binder(s) for each flight is the best method of organizing the supplements.

F. Office Library

The DPS FDF manager will be the only person responsible for maintaining and updating the office library; he/she will also maintain the update logs for the office

library. The office library will also have the SIM packs incorporated into their applicable books.

The rules that apply for console libraries also apply for the office library with the following exception: flight-specific documents are always kept in a separate binder in the office library.

## **REFERENCES**

1. Flight Control Operations Handbook (FCOH), JSC-26843.
2. Data Processing System (DPS) Section Policy.

**TITLE**

CHANGE AND PROBLEM REPORT APPLICATION

TBD

**TITLE**

FDF GUIDES

See Figure 2.7-1.

**Table 2.7-1. FDF by DPS and DPS-related procedures**

<u>Flight Data File</u>	<u>Procedure</u>	<u>Section</u>
Ascent Checklist	PASS/BFS Transfer OPS1 Transition (PASS and BFS) C&W Memory Clear OMS Burn Monitor Cue Card	1, 2, 3
Systems AOA Procedures	AOA Procedures	All
AESP	DPS Asc/Ent Fail Procedures Cue Cards	A3, E3
Ascent Pocket Checklist	DPS Asc Failure Procedures Ascent Powerdowns	3 10
Post Insertion	DPS Orbit Configuration	All
Orbit Ops Checklist	Presleep, OPS Transitions, SM Checkpoint, Single G2 and Multi-G2 Ops	3, 4
Orbit Pocket Checklist	DPS Orbit Failure Procedure Orbit Powerdowns	3 10, 11
Malfunction Procedures	DPS MAL Procedures, FRPs, SSRs	5
Deorbit Prep	Nominal Deorbit Prep Deorbit Prep Backout BFS Deorbit Prep Notes Cont. Deltas to Nom. Deorbit Prep	1 2 4 5
Cont. Deorbit Prep	Launch Day Deorbit Prep,      Orbit 2 Orbit 3	1 2
	Loss of	
	Two FC Launch Day D/O Prep (Orbit 2/3)	4
	Two FC Deorbit Prep	5
	FES Deorbit Prep	7
	Two H <sub>2</sub> O Loops (On-orbit wait and Backout)	8
	Two H <sub>2</sub> O Loops - D/O Prep/Entry	9
	Two Freon Loops - D/O Prep/Entry	11
	Emergency Deorbit Prep/Entry	10



**Table 2.7-1. FDF by DPS and DPS-related procedures (concluded)**

<u>Flight Data File</u>	<u>Procedure</u>	<u>Section</u>
Entry Pocket Checklist	DPS Entry Failure Procedures	3
	Entry Powerdowns	10
Entry Checklist	D/O Burn Flight Rules	3
	Deorbit Burn Monitor Cue Cards (FS)	4
	Entry NO-GO Checklist	5
	Entry Maneuver Cue Card	5
Flight Rules	Postlanding Procedure	4
	RNDZ/PROX OPS	2-64
	DPS Flight Rules	2, 7
	Orbiter System GO/NO-GO	2-201
	DPS and DPS Systems Mgmt (FS)	3
Console Handbook	Orbiter Maneuver Criticality (FS)	3
	BFS GO/NO-GO	4

**Table 2.7-2. FDF usage by mission phase**

<u>Mission phase</u>	<u>Control article</u>	<u>Off-nominal article</u>
T-2:25:00 to Launch	Ascent Checklist (C/L)	Cue Cards
Launch to MM 104 (until ET SEP)	Ascent Cue Cards Ascent C/L	Cue Cards AESP
MM 104 to MM 201	Ascent C/L Ascent Cue Cards	Ascent Pocket C/L Cue Cards
MET 00:50: to 04:00	Post Insertion C/L	Orbit Pocket C/L Malfunction Procedures
MET 04:00 to TIG-03:30	Flight Plan - references the Orbit Ops C/L, support and reference articles On-orbit Cue Cards	Orbit Pocket C/L Malfunction Procedures
TIG-03:30 to TIG-00:50	Deorbit Preparation C/L	Entry Pocket C/L Orbit Pocket C/L Malfunction Procedures
TIG-00:50 to deorbit burn	Entry C/L	Entry Pocket C/L
Deorbit burn	Cue Cards for burns	Entry Pocket C/L Cue Cards
Postburn to EI-5 or MM 304	Entry C/L Entry Cue Cards	Entry Pocket C/L
EI-5 or MM 304 to rollout	Entry Cue Cards	Cue Cards AESP
Post rollout	Entry C/L	Cue Cards AESP

Note: All support articles and reference articles are used during the on-orbit mission phase.

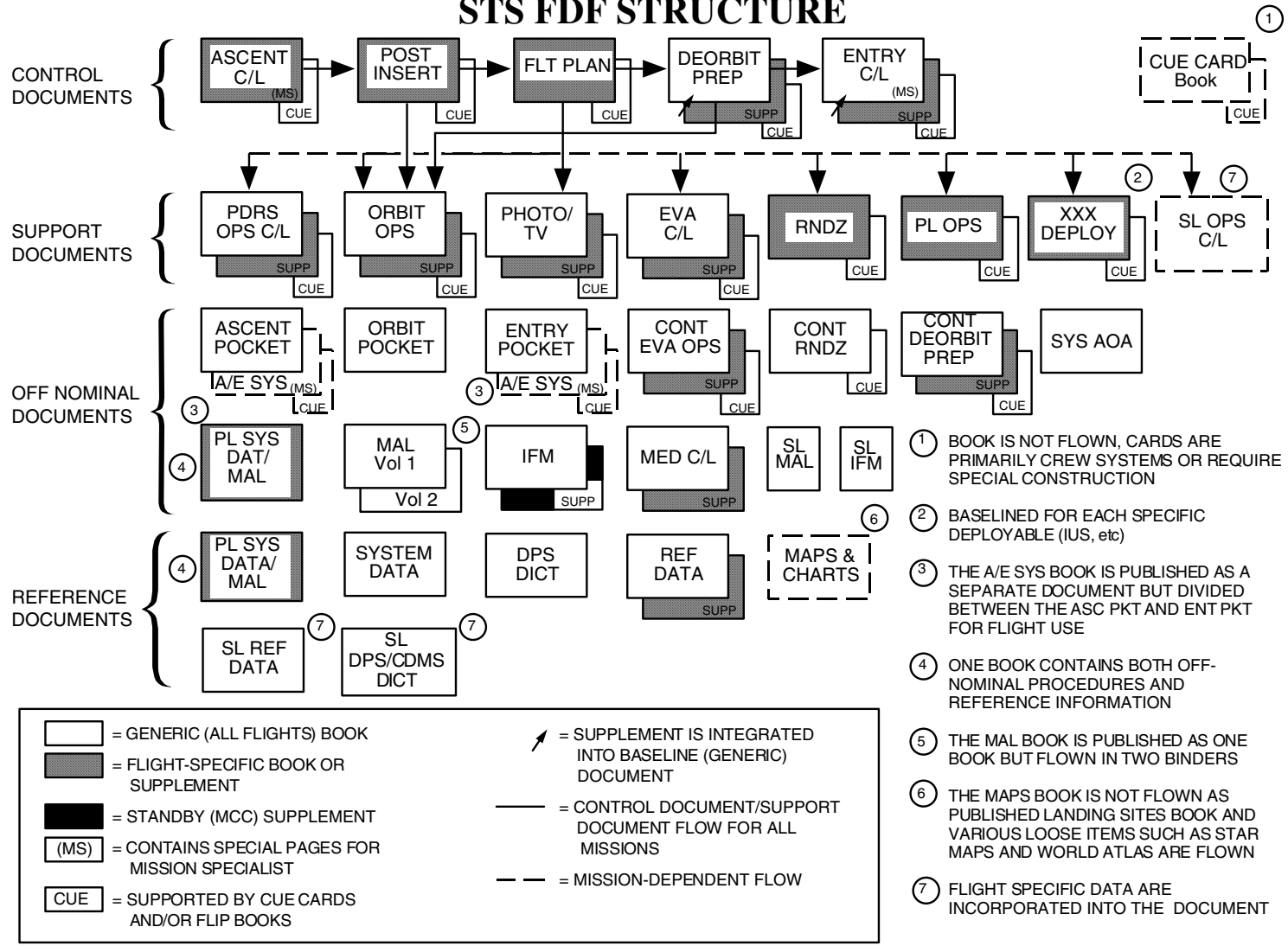
**Table 2.7-3. Procedure structures**

Checklists		Timelined procedures documents	Malfunction procedures
Timelined	Nontimelined		
Ascent C/L Entry C/L Payload Deploy C/L Payload Ops C/L	Orbit Ops C/L Cue Cards Photo/TV C/L EVA C/L	Flight Plan Post Insertion C/L Deorbit Preparation Contingency D/O Prep Contingency EVA Ops	Cue Cards Ascent Pocket C/L Orbit Pocket C/L Entry Pocket C/L AESP Malfunction Procedures

**REFERENCES**

1. Flight Data File 2102 Workbook, Nov. 1987.
2. ALT/OFT Crew Procedures Management Plan, JSC-08969, May 31, 1976.

### STS FDF STRUCTURE



Verify that this is the correct version before use  
2.7-4

Figure 2.7-1. STS FDF structure –typical books shown

## TITLE

DISCREPANCY REPORTING

## PURPOSE

The following procedure describes how to write a discrepancy report (DR) for the DPS console positions. This procedure is governed by FCOH SOP 1.7, MCC/SMS PROBLEM REPORTING. DRs should be written for hardware and MCC applications not managed within the DPS section. For DPS section-managed applications that experience problems, use the Change and Problem Report (CPR) Application, SCP 2.6 (TBD).

The form is shown in Figure 2.8-1.

## DR FORM PREPARATION

### A. ORIGINATOR

Print your name, mail code, and phone number in the upper left-hand corner of the DR form.

### B. AR TYPE

Check the D box to indicate that the type is DR. Use this type for all failures identified during the course of normal support activities.

### C. Block 1: DATE/LOCAL TIME OF FAILURE

Enter the date and local time when the discrepancy occurred, using the 24-hour clock format.

### D. Block 2: PROBLEM IMPACT

**CRITICAL:** The failure halts or significantly impacts facility operations or functional objectives. The problem is to be corrected immediately.

**MAJOR:** The failure impacts equipment or software performance. To be fixed as soon as possible.

**MINOR:** The failure may have a slight impact on equipment or software performance. The problem can be worked around or accepted in the short term. To be fixed as time permits.

### E. Block 3: Leave blank (Do not use)

**TIME STAMP (OPEN)** \_\_\_\_\_

ORIGINATOR: NAME				<b>ANOMALY REPORT</b>				NUMBER		AR TYPE (Check One)		
MAILCODE		PHONE NUMBER						<input type="checkbox"/> - D <input type="checkbox"/> - Q <input type="checkbox"/> - S <input type="checkbox"/> - N <input type="checkbox"/> - T <input type="checkbox"/> - P <input type="checkbox"/> - V				
DATE/LOCAL TIME OF FAILURE 1						PROBLEM IMPACT 2		(OPS. CENTER USE ONLY) 3			FAILURE CATEGORY 4	
MONTH	DAY	YEAR	HOUR	MINUTE	SECOND	<input type="checkbox"/> CRITICAL <input type="checkbox"/> MAJOR <input type="checkbox"/> MINOR	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5			<input type="checkbox"/> HARDWARE <input type="checkbox"/> SOFTWARE <input type="checkbox"/> ADMINISTRATIVE		
SYSTEM 5			APPLICATION/SUBSYSTEM ID 6			SUB-SUBSYSTEM 7		BUILDING/ROOM 8				
OS VERSION 9			SYSTEM VERSION/TRAINING LOAD 10				HOST 11		FLIGHT ID 12			
CORE DUMP TAPE NO. 13		I.C. TAPE DUMP NO. 14		LOG TAPE NO. 15		ACCT/RUN 16		ACTIVITY 17		DATABASE VERSION 18		
TITLE:												
PROPERTY/NASA TAG NUMBER						DATE/LOCAL TIME VENDOR CONTACTED 20				# OF ATTACHMENTS 21		
MONTH		DAY		YEAR		HOUR		MINUTE				
ACTION TAKEN/COMMENTS												
DEGRADED SUPPORT?						QAR/QAD STAMP			DATE			
<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> DOWN												
TOP ASSEMBLY NAME			MODEL NO.			SERIAL NO.			NEMS NO.			
REPAIR STARTED (Date) (Time)			PROBLEM CORRECTED (Date) (Time)						ACTIVE REPAIR TIME/MANHRS			
CORRECTED BY (Print)			SUPERVISOR (Print)			DATE			PRIMARY/SECONDARY STATUS			

USA 8900-A-9 New 6-96 (Flow) (JSC)

Working copy

**Figure 2.8-1. Anomaly Report**

**F. Block 4: FAILURE CATEGORY**

Check either **HARDWARE**, **SOFTWARE**, or **ADMINISTRATIVE**.  
**ADMINISTRATIVE** failures include procedural and human errors.

**G. Block 5: SYSTEM**

Block 6: **APPLICATION/SUBSYSTEM ID**

Block 7: **SUB-SYSTEM**

General DPS will use Table 2.8-1, DPS-specific system/subsystem/sub-subsystem listing to fill in blocks 5 through 7. If the originator cannot find the appropriate **APPLICATION/SUB-SUBSYSTEM DESCRIPTION** within the DPS-specific table, they should reference MCC Ops. Center (FACILITY = B30S) system/subsystem/sub-subsystem table listing, located in the DPS User's Guide binder.

**Table 2.8-1. DPS-specific system/subsystem/sub-subsystem listing**

<b>SYSTEM (BLOCK 5)</b>	<b>APPLICATION/ SUBSYSTEM ID (BLOCK 6)</b>	<b>SUB- SUBSYSTEM (BLOCK 7)</b>	<b>APPLICATION/ SUB-SUBSYSTEM DESCRIPTION</b>
CIS	DVIS		DVIS COMMUNICATION
EDP	EDP-HW		ELECTRONIC DOCUMENTATION PROJECT SYSTEM HARDWARE
EDP	EDP-OS		ELECTRONIC DOCUMENTATION PROJECT SYSTEM SOFTWARE
PS	CMD SW		COMMAND SW
PS	CMD SW	CMDWS	COMMAND WORKSTATION INTERFACE
PS	CMD SW	GENCMD	GENERIC COMMAND
PS	HOST-P	CMD	COMMAND
PS	HOST-P	EDTE	EMULATED DIGITAL TELEVISION EQUIPMENT
PS	HOST-P	EMED	EMULATED MANUAL ENTRY DEVICE
PS	HOST-P	MOC_WSA	MOC WORKSTATION APPLICATIONS
PS	HOST-P	WS APP	WORKSTATION APPLICATIONS
PS	PERIF	OPS WS/SER	OPS WORKSTATIONS/SERVERS
PS	PERIF	PRINTERS	PRINTERS
PS	SYS SW	ADSVCS	ADVISORY SERVICES
PS	SYS SW	DAQ	DATA ACQUISITION
PS	SYS SW	DNAV	DISPLAY NAVIGATION
PS	TIMSYS		TIMING SUBSYSTEM
PS	TIMSYS	GRPTD	GROUP TIME DISPLAY
PS	TIMSYS	GT S/W	GROUP TIMING SOFTWARE
PS	VIDSYS	RCD/PB/CP	RECORDING/PLAYBACK/HARDCOPY
PS	VIDSYS	RECPBK	RECORD AND PLAYBACK
PS	VIDSYS	TVWIND	TV WINDOWING
USER APPS	DNAV		DNAV POSITION GENERATED USER APPLICATIONS
USER APPS	DPSYS		DPSYS POSITION GENERATED USER APPLICATIONS
USER APPS	MIS		MISSION INFORMATION SYSTEM GENERATED USER APPS
WK STATION	B30SWS		B30S WORKSTATION HARDWARE
PS	CMD SW	SHUTCMD	GENERIC COMMAND SERVER

H. Block 8: BUILDING/ROOM

Enter your workstation location. DPS room numbers are listed below.

DPS WMP SR: 30S/2300      WFCR: 30S/2306

I. Block 9: OS VERSION

Obtain this information from WSS on the WSS CALL loop.

J. Block 10: SYSTEM VERSION/TRAINING LOAD

Obtain this information from WSS on the WSS CALL loop.

K. Block 11: HOST

Enter your Node Name/Position ID: WF3, WF22, WM6, or WM9/DPS

L. Block 12: FLIGHT ID

Enter the flight number associated with or impacted by the discrepancy. Possible entries in this block include the following:

STS-XX      Where xx represents the flight number.  
NON-FLT      For non-flight-related activities.  
ALL          For all flight-generic software support.

M. Block 13: CORE DUMP TAPE NO.

Leave blank (do not use)

N. Block 14: I.C. TAPE DUMP NO.

Enter "F" to indicate "Constraint to Flight-Specific SIM"  
Enter "G" to indicate "Constraint to Generic SIM"  
Enter "M" to indicate "Constraint Mission Support"  
Enter "NF" to indicate "Non-constraint/Fix Required"

O. Block 15: LOG TAPE NO.

Block 16: ACCT/RUN

Obtain this information from WSS on the WSS Call loop.

P. Block 17: ACTIVITY

Enter the activity that was in progress when the discrepancy was observed.  
(Mission, Sim, ILC, TCDT, ORT, etc.)

Q. Block 18: DATABASE VERSION

Obtain this information from WSS on the WSS Call loop.

R. Block 19: TITLE

Enter a title and a complete description of the discrepancy.

S. Block 20: DATE/LOCAL TIME VENDOR CONTACTED  
Block 21: # OF ATTACHMENTS

Leave blank (do not use)

### **DR FORM SUBMITTAL**

Turn in the yellow and white copies of the DR form to the GC console. Attach with it any relevant information, including a printout of the System Services display: DNAV Master II Shuttle I GC I CCS/C I 0006:System Service. Make a copy of the entire package and give to the DPS section coordinator. A computer-generated copy of the DR will be mailed to you within 5 days. Another computer-generated copy of the DR will be mailed to you after the DR has been closed.

### **REFERENCES**

Flight Control Operations Handbook (FCOH), JSC-26843.



## **TITLE**

ANOMALY REPORT PROCESSING

## **PURPOSE**

The purpose of this procedure is to provide the console operator with guidance in the generation and maintenance of anomaly reports in a consistent manner.

## **OVERVIEW**

Anomaly reports written by DPS are included in the MOD Inflight Anomaly Log. This log is the only official problem list to be recognized by the program during flight operations. The lead flight director will maintain accountability for the log until completion of the flightcrew debriefing (approximately 1 week after the flight). Anomalies discovered during this debrief will be added, and the previous entries will be screened/updated to arrive at the final inflight anomaly list. Once this process is complete, DA8 will initiate a memo transferring the log accountability and tracking to the NSTS program. See FCOH Procedure 1.7.1 for more details.

Anomaly reports can be reassigned (i.e., a suspect MDM card turns out to be an RCS jet problem instead) but cannot be withdrawn once submitted. In the event that an entry in the anomaly log turns out to be an explainable condition, the anomaly report will be updated accordingly.

Occasionally other disciplines have failures in their system that may be DPS related, but at the time, cannot be confirmed. For these cases, it is up to the other discipline to write the initial AR. If it is later confirmed that the problem was indeed caused by something in the DPS system, the AR will either be reassigned to DPS, or DPS will submit a new AR.

### **A. What constitutes an anomaly**

1. H/W failures - Any condition that results in a permanent loss of H/W capability. Recovery steps may or may not have been performed; not performing recovery steps should not delay the AR submission.
2. Transients - Any condition that was off nominal and is now nominal as a result of crew action or no crew/ground action. No permanent reconfiguration was performed.
3. Unexplained System Responses - Any off-nominal H/W or S/W conditions that, at the time, is not expected or is not explained by ops note, systems brief, or any other authoritative document/source.

### **B. Customers**

There are several different customers who use the AR information. However, not all customers use these reports for the same reasons. The following is a list of the customers and why they need the information.

1. Flight director - Responsible for overall direction of shuttle flights from SRB ignition until crew egress. Must be aware of any out of the ordinary activities. Detailed technical information not required. Needs to know only the problem, the impacts, and if workarounds exist.
2. Other flight controllers - Responsible for their own particular system. Need to be aware of failures in other areas that may impact their own system. Detailed information not required. Need to know only the problem and whether or not it impacts their own system.
3. Mission management team (MMT) - Responsible for near real-time policy decisions whenever operating outside of the standard shuttle operating base. Only high level overview of failure required.
4. Customer support room (CSR) personnel - Responsible for payload systems. Need to be aware of orbiter failures that impact their payload. Detailed information not required. Needs to know only the failure, if there are any payload impacts, and whether or not any science will be lost.
5. MER (both management and engineers) - Responsible as technical advisors to the flight control team. Any information that can assist in assessing the failure is desired (i.e., technical detail).
6. Project Office personnel - Responsible for the shuttle program. Need to be aware of failures that may impact the success of the program. Only high level overview of failure required.

## **PROCEDURES**

### **A. When to submit AR to MOIR (formerly known as SPAN)**

1. The preferred time is by the anomaly cutoff on the shift during which the problem occurred. Every feasible effort should be made to meet this deadline.
2. If for some reason the AR cannot be completed by the time indicated in step 1, the next priority is for the team on console at the time of the failure to submit it before leaving console.
3. Regardless of workload, the offgoing team must at least have written an electronic draft of the anomaly and leave it for the oncoming team to review and then submit. This is the least desirable option and should be avoided when at all possible.

### **B. Initial Copy**

1. Either DPS SPT or DPS initiates an electronic AR via the mission information system (MIS), according to the defined standards (see section on form description later in this SCP). If MIS is unavailable and cannot be recovered in a reasonable period of time, hand write the AR.

2. The alternate console position (either DPS or DPS SPT) reviews the AR electronically using MIS. If any modifications need to be made, the reviewing position does so electronically.
3. Both DPS and DPS SPT print out a copy of the electronic AR and file it in their console binders under the AR section.
4. DPS informs MOIR via the SPAN loop that the new AR is ready for MOIR review and processing. DPS also informs MOIR of the temporary control number associated with the report.
5. Once MOIR approves the AR, DPS will no longer be able to make any changes without submitting an official revision.

**C. Revisions**

The AR should be revised only for technical reasons. Each team has the authority to revise an existing AR, as long as there is technical reason to do so (i.e., correct/clarify erroneous information or include new information). If for any reason conflict arises as to whether or not a revision is needed, the DPS lead has the ultimate authority.

1. Either DPS SPT or DPS updates the electronic copy of the AR on MIS, based on the revision protocol defined above. If the person making the updates is different from the person who submitted the original copy, they must add their name to the AUTHOR portion of the form.
2. The alternate console position (either DPS or DPS SPT) reviews the AR electronically using MIS. If any modifications need to be made, the reviewing position does so electronically.
3. Both DPS and DPS SPT print out a copy of the revised electronic AR and file it in their console binders under the AR section. **DO NOT REMOVE PREVIOUS VERSIONS FROM THE BINDER.** All versions of DPS inputs are maintained for history purposes.
4. DPS informs MOIR via the SPAN loop that the revised AR is ready for MOIR review and processing. DPS also informs MOIR of the temporary control number associated with the revised report.
5. Once MOIR approves the anomaly report, DPS will no longer be able to make any further changes without submitting another official revision.

**FORM DESCRIPTION** (see Figure 2.9-1)

Discipline/No./Rev

The information for this field is generated automatically by the MIS system unless the originator is a subdiscipline (e.g., CDMS is a subdiscipline of DPS). For spacelab

anomalies, this field will need to be changed to CDMS. See the MIS User's Guide (located in the User's Guide binder in the MPSR) on how to do this.

#### Revision

Select "No" for the initial anomaly report. Select "Yes" for all revisions.

#### In-Flight Status

Select "Open" or "Closed." The AR should be open only if waiting for additional crew activities or a CHIT response. If the AR is open, the Resolution portion of the form needs to state why it is still open and any planned troubleshooting. If there is not further planned crew involvement in the troubleshooting, the AR should be closed. Just because the AR is closed does not mean it cannot be updated with new information.

#### Orbiter Impact

Select "Yes" if any orbiter equipment is affected. Explain all impacts under the Impact portion of the form. Note that at least one "Yes" needs to be selected for Orbiter or Payload. It is not acceptable to have "No" for both Orbiter and Payload.

#### Payload Impact

Select "Yes" if any payloads are affected. If unsure, check with Payloads. Explain all impacts under the impact portion of the form. Note that at least one "Yes" needs to be selected for Orbiter or Payload. It is not acceptable to have "No" for both Orbiter and Payload.

#### MER Problem No.

DPS does not fill in this portion of the form. MER assigns a tracking number to anomalies that they decide need to be worked postflight. If a number is assigned to a DPS anomaly, MOIR updates the form to include the MER Problem No.

#### Name

The first initial and last name of the originator should be entered. Any time the AR is revised by somebody else, their name must be added.

File Edit Options Reports Document State					Date Created		07/30/97	Help
PRELIMINARY		ANOMALY REPORT			Flight: STS-086 Vehicle ID: OV-104 (20)			
Discipline/No./Rev	Revision	In-Flight Status	Orbiter Impact	Payload Impact	MER Problem No.			
DPS	Yes <input checked="" type="radio"/> No	<input checked="" type="radio"/> Open Close	Yes <input checked="" type="radio"/> No	Yes <input checked="" type="radio"/> No	<input type="text"/>			
Author	<input type="text"/>				GMT	<input type="text"/>		
Title	<input type="text"/>				MET	<input type="text"/>		
Description	<input type="text"/>							
Impact	<input type="text"/>							
Resolution	<input type="text"/>							
NOTE: SIMs use SGMT/SMET. OPS use GMT/MET. (DDD:HH:MM:SS) If reference is made to instrumentation, please include MSID's.								
Edit Mode	Zoom	Activity	Discipline	0 graphical attachments. No MSID lists.				
ON	z Z	STS-086	DPS					

i\_18819\_008a.cvs

**Figure 2.9-1. MIS Anomaly Report Entry form**

GMT/MET

Enter either the GMT or MET that the anomaly occurred. For simulations, use SGMT instead of GMT. The program will automatically calculate the alternate time for the user. Do not enter GMT or MET for revisions, unless correcting the original times. However, the GMT or MET of any additional observations of the original anomaly or related activities should be included in the Description portion of the form.

Title

Enter a brief descriptive title of the problem. Acronyms and abbreviations are acceptable, but define any uncommon ones in the Description portion of the form. remember, no speculation is to be included in the report; therefore, do not include any in the title either.

### Description

Write a description paragraph form with English explanations at the flight director level. All technical data (i.e., ID/ELE, Discrete Word A, etc.), if appropriate, should be included in parentheses after the English statement describing the signature.

- Describe the anomaly in concise and technically complete terms. Do not speculate or guess. State the facts only. Just describe what happened and all relevant signatures.
- Include serial numbers of LRUs.
- Since the GMT is already listed above, do not include it here. However, if there was a sequence of events, then GMT should be included to show how the sequence unfolded. Also, if the same anomaly has repeated, include the times of the additional occurrences.
- If a reference is made to instrumentation, include the effected MSIDs.

### Impact

Specify the impact to the orbiter, payload, and/or mission success. Include any constraints to operations and flight rule-driven impacts (individual rule number not required). If there is no impact because of redundancy or alternative actions, identify the specific reason why there is not impact.

### Resolution

- Specify any actions that have been taken or need to be taken, configuration changes, and workarounds.
- Do not include individual MAL or block numbers. Instead, include an overview of the actions taken.
- If the AR is still open, explain why.
- N/A, if appropriate, is acceptable. An example of this is if nothing has yet been done to troubleshoot the anomaly.

**SECTION 3  
MISSION/PHASE CHECKLISTS (DPS VS. DPS SPT)**

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## TITLE

COMPREHENSIVE MISSION-WIDE DPS RESPONSIBILITIES

## PURPOSE

To provide a summary of on-console actions and responsibilities for DPS operators during flight.

## DESCRIPTION

This SCP is divided into the following areas:

- DPS operator's data gathering responsibilities
- DPS console log responsibilities
- Other DPS console responsibilities

### A. DPS Operator's Data Gathering Responsibilities

The console operator has several methods available for obtaining data on the vehicle system being monitored: real-time observations of data, ODRC runs, playbacks, hard copies, and crew observations. When a failure occurs, the following can be used to capture data related to the failure:

1. Hard copy displays.
2. Request relevant data via ODRC runs.
3. Perform a telemetry playback, if needed.
4. Request a voice playback, if needed, to capture any crew comments.
5. Perform a universal digital by accessing DNAV DPS II ISP I Universal Digitals.

Do not limit yourself to one source of data, assuming it will do the job. Use the resources available to ensure that a complete picture of the failure situation is obtained.

### B. DPS Console Log Responsibilities

1. General guidelines for log keeping are given in the FCOH procedure 1.1. Note that logs may be hand written or electronic. Electronic logs are stored on the MODM server V drive (Collectv) under DPS and a flight specific folder. File names are constructed of the flight #, GMT day, and shift (ie. 108\_350\_orb1\_log.doc).



2. Each operator must sign the log at the end of his/her shift before handing over. It is also helpful at the beginning of your shift to indicate the team coming on and who is on it.
3. FCR operators need to be sure to include orbiter problems or situations outside of the DPS area that affect our operation or the overall timeline. An example would be PL problems that force an early or out-of-sequence deployment. A common problem is mentioning a problem and then never telling what happens to it.
4. The FCOH specifies that the header information on each log sheet is to be filled in.
5. The FCOH specifies that log entry timetags may be in GMT. For sims, GMT is not the time to use. Use SGMT or MET. Certain phases of flight better lend themselves to one method over another; i.e., ascent. For ascent, it is convenient to reference actions to L/O; therefore, logs are kept in MET. Once the vehicle is safely in orbit, switch back to GMT.
6. A log entry should be specific in its description of a problem or event. Specifying that GPC 4 TB is failed does not help a lot. Is it the mode TB or the output TB? If you are confused, ask a team member. Besides reporting what is seen when an entry is made about a particular problem, we also need to log what should have been seen.

Log entries need to go beyond just a report of what is observed. The heart of the matter is the analysis that determines: what does it mean? How is this going to affect what we do? Is any followup activity required for this? Do not fall into the trap of just logging that I/Os have occurred; i.e., the error count has changed, with no explanation of why. Operators need to get in the habit of explaining why I/O errors or GPC errors are logged. If we get a cycle wrap, why did it happen? What module was the problem in (PDE address)? Was payload activity going on that caused the SCA to be powered off and the subsequent error logged? The reason may be obvious; it must be logged for others to reference. The analysis of problems is one of the most important things that a console operator does.

7. Log entries, in general, should reflect the ideas/problems being considered and the decision made, along with the reasons for them. An operator can almost never put too much in the log. Better to have too much than not enough.
8. If you put down conclusions in the log that later turn out to be wrong, go back later and add comments in the log margins (or opposite page) pointing out that the entry turned out to be wrong. When the shift summary is done at the end of the shift, it is a good idea to review your log for such entries and clean them up.

#### C. Other DPS Console Responsibilities

1. Chits are something that we do not worry about, except in long sims and flight. Therefore, chit writing skills can get a little rusty. The important thing to remember is to get the chit written and submitted as soon as possible. The data you get back in the answer to a chit may affect your planning and the operation of the DPS system. When

you write a chit and ask questions, be careful to not limit yourself as to the scope of the data you get back by asking questions that are too specific.

2. Remember to backup the SPECS and OFS logs daily.
3. Anomaly logs (ref. SCP 2.9) also provide a means of tracking the status of failures. These logs flag problems to groups outside of the immediate FCR area and also advise other FCR operators of problems in the DPS system. This means that the titles of the anomaly report need to convey the problem and not just the symptoms. Rather than the title of "MDM FF1 Failure," a title of "FF1 Transient" would be more descriptive of what happened. The "open/close status" should be approached from the standpoint of whether or not there will be any more activity related to recovery from the problem, not whether or not the original condition has been cleared. Closeout statements should indicate if the problem was transient. If there are any actions to be taken are different from standard operations because this problem has occurred, cover them in the impact statement.
4. Shift summaries will be completed by each team (not by each position). The purpose of the log is to provide a summary of the previous shift activities, outline any configuration changes, describe any open work, and document any decisions made. It is up to each team to decide which position will write the handover log; but once it has been completed, each position should put a hard copy in their console binder.

The shift handover log is in an electronic format, and the template is located on the share drive s:\df22\fltinfo.XXX\h\_o\_logs (XXX=flight #). The name of the template file is handover.doc. (Template also available on MODM V drive under DPS\handover) It is important to call the template up from the correct flight directory. This is because the template has a macro that automatically names the file and saves it in the same directory from which it was opened. When the template is called up, it will ask for several pieces of information. Use of the V drive is preferred because the MODM system has 24 hr support.

After the requested information has been input, the file will be automatically named and saved. The file naming convention is XXX\_YY\_Z.doc, where XXX = flight number (e.g., 070, 120, or Sim), YY = day of MET (01, 02, 03, etc.), and Z = sequential increment. This naming convention makes it possible for File Manager to list the handover logs in sequential order.

The file is now ready for the shift summary information.

## TITLE

LEAD DPS OPERATOR CHECKLIST

## PURPOSE

To provide a summary of actions and responsibilities for the Lead DPS Operator of a given flight.

## DESCRIPTION

This SCP defines the roles and responsibilities of the Lead DPS Operator for any given flight. These responsibilities are broken down into the following areas:

- Preflight Program Coordination
- Flight-Specific Rule and Procedure Development
- MCC Workstation Configuration
- Console Products
- DPS Team Coordination
- Realtime Flight Execution
- Postflight Duties

### A. Preflight Program Coordination

1. Beginning at approximately L-12 months (or as required), ensure DPS representation at flight techniques meetings, flight-specific team tagups, JOPs, etc. for DPS-related discussions. Although support at every meeting may not be required, be sure you are on distribution for agendas, minutes, etc.
2. Be aware of current issues being discussed in the various IPT/PRT forums (MEDS Software, GPC/MDM, MMU, etc.) for any impacts to your flight. Coordinate items with the section reps to these panels as needed.
3. Be aware of changes to the flight manifest affecting your flight. Although major changes are usually known via team tagups, etc. the SSP will reflect "official" manifest changes in the flight-specific Flight Requirements Document (NSTS 17462 - xxx, where 'xxx' is the flight number). This document will typically go through many revisions over the course of the flight planning process; the latest version can be found on the JSC web (<http://sspweb.jsc.nasa.gov/efrd/index.cfm>).
4. Track vehicle DPS-related hardware problems via Interim Problem Reports (IPRs). These are typically generated by KSC personnel as problems are uncovered during the

vehicle's ground processing flow. The DF TA homepage (<http://mod.jsc.nasa.gov/df/dfdiv/shuttle/index.html>) contains links to both the KSC Morning Reports and the IPR databases; the PRT/IPT forums are also a good source of info. Late-breaking IPRs, especially after the FRR timeframe, will be highly visible. As the DPS Lead you may be called upon to represent MOD's position in resolving issues - ensure that DF management and your Lead Flight Director are kept in the loop.

5. Track software changes - DRs, CRs, program notes and waivers, and new OI releases. If required, attend the Flight Software Readiness Review, or at least coordinate issues with the MOD rep to the SASCB (currently David Graham, x34382). As in (4) above, late breaking issues will receive extra attention and it is your responsibility to ensure the appropriate MOD personnel are notified.
6. At L - 4 weeks, provide inputs for the Flight Readiness Review (FRR) datapack and the Certificate of Flight Readiness (CoFR) to the DF technical assistant (DF TA) for Systems Integration. Inputs for the FRR may be acquired by reading the KSC status reports and contacting the lead KSC DPS or JSC Engineering personnel - and if you have been performing the steps above there should be no big surprises.

A Delta FRR will also be generated for issues occurring after the FRR itself. Delta FRR inputs are generally due by L - 3 days.

As part of the CoFR generation, the DPS lead is responsible for reviewing the flight-specific documents and drawings that are routed and maintained by the DF Division librarian; for DPS, this generally entails a cursory inspection of these items to ensure that any impacts/issues are addressed.

Use the format provided by the DF TA to produce both the FRR and the CoFR. Any questions concerning content should be addressed in the "instruct" folder located on the DF share drive (S:\Divisions\DF\Shared\Mission\Shuttle\COFR\_FRR\INSTRUCT). Generic templates for these files exist on the TA homepage (<http://mod.jsc.nasa.gov/df/dfdiv/shuttle/index.html>); however, the lead can also use the previous flight version as a baseline. As a minimum, entries into the FRR datapack should include the date of occurrence, the Problem Report (PR) or Interim Problem Report (IPR) number, the serial number of the units involved, whether the unit was removed/replaced or will be "flown as is," a brief history of the failure/anomaly, and the impact of this failure/anomaly. Previous flight FRR/CoFRs can also serve as a guideline for items that should be included.

The lead should adhere to the following standard for naming/saving the files (per the DF TA): the DPS inputs to the CoFR should be created in a file called dpscfrxxx.doc; the DPS inputs to the FRR statement should be created in a file called dpsfrrxx.doc; the DPS inputs to the delta FRR statements (if they exist) should be created in a file called dpsdelxxx.doc. The "xxx" refers to the flight number. After creation, these files should be stored in the folder set aside for that flight, also located in the TA subdirectory.

As soon as the CoFR is complete and signed off by the Group Lead and Branch Chief, the lead will send a copy of the signoff sheet to the DF TA (the DF TA will already have the entire CoFR inputs from DPS in electronic form if the lead followed the DF TA's

instructions appropriately). The lead will generate two complete hard copy sets (including the signed CoFR signoff sheet) of the DPS CoFR and FRR inputs; one copy will be placed in the flight binder to be used during flight, and one will be kept in the lead's files. If delta FRR inputs are required, process the inputs per the procedure mentioned above. One copy of the delta FRR should be put in the flight binder and another is kept in the lead's files.

7. Verify that PASS GPC dump and/or processing has been tested using SMS or SAIL by L - 2 weeks.

## B. Flight-Specific Flight Rule and Procedure Development

1. Develop initial (Basic version) flight-specific FDF procedures and Flight Rules as needed and submit to the appropriate book managers (deadlines are usually set in the team meetings).
2. Concurrent with the Flight Operations Review (FOR, see (3) below), the DF TA will provide the flight-specific Ascent Switchlist and the Launch Commit Criteria Minimum Equipment Listing (LCC MEL) for review (the review version is usually based on a previous mission of similar design). The Ascent Switchlist (Section 9 of the Ascent Checklist) documents the required configuration of Orbiter switch panels at crew ingress and at launch. DPS-specific inputs include Payload Timing Buffer (PTB), IDP, GPC, and payload-specific configurations.

The MEL is located in appendix H of the LCC; the MEL documents flight equipment and specifies the operational requirement of each item for launch. These may be, and usually are, flight specific; therefore, the lead must determine what these requirements are for his/her assigned flight. Previous similar missions should be used as a guide. The minimum requirements (others may exist) that the lead must address includes the following:

- a. MTU timing signal requirements: these include IRIG-B and frequency divider signals; contact the lead ACO for their requirements.
- b. Aft IDP/MDU/Keyboard requirements: These may or may not be required for launch; check with the lead ACO and/or other lead disciplines for mission usage.
- c. PL MDM requirements: For payloads that have a PL MDM interface, specific card/channel requirements may be reflected in the MEL.

When approaching the lead ACO concerning these requirements, ask specific questions. For example, for the timing signals, determine which signals the payloads are using and what the impact is if the signals are lost (i.e., "Is mission success lost?"). The real question is, "Can the payload community commit to launch if that timing signal is lost?"

3. After the Basic versions of the FDF/Flight Rules are released, review all DPS-related items for accuracy. Any desired changes must be submitted as a DN to be reviewed at the FOR, which occurs no later than L-4 months (but may occur earlier depending on the complexity of the flight - some flights may also have more than one FOR). Instructions for generating DNs will be distributed by the Operations Division (DO) of MOD. Approximately 1 week prior to the FOR, all submitted DNs will be made available for community review and an MOD-only tagup to coordinate the disposition of these DNs may occur. DPS support at this review is generally not mandatory but should be based on the number and extent of the DNs of interest to DPS. Since the individual book managers present the DNs for disposition, coordinate support with them if necessary.

The FOR itself is usually a multi-day event consisting of DN reviews of each flight-specific FDF article, including the Flight Rules. Splinter meetings may also be called to settle outstanding issues and may result in additional DNs, actions, etc. The DPS lead should be aware of the issues being discussed and plan to provide support as needed.

4. After the FOR, the DPS lead should verify that all DNs of interest were incorporated correctly in the next releases of the FDF/Flight Rules. Changes required after this point will require a 482 (for the FDF) or a CR (Flight Rules). The lead should track these as required and should coordinate with the book managers to ensure changes are incorporated correctly in simpacks (if required for sims) and/or book revisions.
5. Concurrent with flight-specific development, the DPS lead should be aware of any generic flight rule and/or procedure changes which will be implemented on their flight. These changes will generally be approved in the Flight Techniques forums where an implementation plan will be developed.
6. Verify Command Handbook procedures. At approximately L-1 month the INCO group will send an email listing the various disciplines' command procedures contained in the Handbook. The DPS Lead should verify that the email lists the latest version of the DPS command procedures.
7. Work ascent IDP configuration (coordinate this with the A/E DPS):
  - a. Coordinate with the A/E DPS, crew, and/or trainers to determine the crew's preferred A/E IDP config. Some crews may prefer an "alternate" T-9 IDP config where the BFS is given two forward CRTs and PASS is assigned CRT 4. If this is the case, steps should be added to the Ascent Checklist at the T-9 mark to accomplish this. Likewise, steps to reconfigure back to a more standard config will need to be added to the 'Post OMS-1' section of the checklist. Consult the STS-99 Ascent Checklist for an example of the "alternate" config.

b. The A/E Flight Director may have a crew tagup to discuss these and other items prior to flight-specific sims. Other A/E DPS topics of interest may include:

1. Do you want to hear Suspect BFS calls (as well as No-Go)?
2. For an Ascent Set Split, will you Engage or go with a PASS Set per the FRs?
3. For a Set Split, will you go with the best pair or only a pair that BFS is Tracking?
4. If there is only IDP 4 interface with a Set Split Pair, do you want to go with it or Engage?
5. How do you work a Set Split (order of Channels, GPCs, and Surf FB desels)?
6. Philosophy for BFS Self Engage?
7. If the BFS Fails, early SM versus re-IPL BFS into GPC 5 or another GPC?
8. Reach and Vis questions - What switches can you reach when (suited)? When can you take down a FTS GPC on Ascent?
9. MEDS config, also can discuss signatures where they would be go for an IDP power cycle (optional) and review hands off close to liftoff (optional)

c. Provide the MEDS Launch Configuration table to the Vehicle Integration and Test Team (VITT) lead for inclusion in the Ascent Checklist. Ideally this should be concurrent with rest of your pre-FOR inputs so that a DN or 482 does not need to be written. An example of the table is shown below:

**STS-114 MEDS Configuration for Ingress**

MDU	View Angle	Port Config	Selected Port	Flight Critical Bus	Display	Edgekey Menu
CRT1	positive	auto	primary	3	DPS	DPS
CRT2	positive	auto	primary	4	DPS	DPS
CRT3	positive	auto	primary	4	DPS	DPS
CRT4	negative	auto	primary	1	DPS	DPS
CDR1	positive	auto	primary	4	OMS/MPS	FLT INST
CDR2	positive	auto	primary	3	A/E PFD	DATA BUS
MFD1	positive	auto	primary	3	HYD/APU	SUBSYS STATUS
MFD2	positive	auto	primary	4	OMS/MPS	SUBSYS STATUS
PLT1	positive	auto	primary	4	A/E PFD	DATA BUS
PLT2	positive	auto	primary	4	HYD/APU	FLT INST
AFD1	negative	auto	n/a	n/a	n/a	n/a

**Figure 3.1a-1. MEDS Ascent Config Table**

C. MCC Workstation Configuration

1. Verify console tool status prior to the ILC.
  - a. Invalid fault summary messages, if any.
  - b. DPS datapack (SCP 1.0). Make sure datapack builder has been informed about any flight-specific loads (VPs, TMBU, etc.).
  - c. RAD and EOs.
  - d. GMEM status/verification sheet.
  - e. TMBU databases build.
  - f. VPs into T&O representative before first sim on load.
2. Be aware of updates to MCC application data files (ELOG, MSKVIEW, etc.) and/or new applications/comps being worked by the DPS group if they will be implemented for your flight. These may be tested during the ILC and subsequent flight-specific sims and must be certified and submitted by L-35 days. Coordinate with the section GA and/or other group members as appropriate.
3. Support the flight-specific ILC with DT counterparts (SCP 6.4). Track resulting issues as required to ensure the load can support the start of flight-specific sims.
4. Tag up with the Group Lead prior to flight to review any applicable SFOC, MCC, and/or discipline-specific console Ops Notes.

D. Console Products

1. Coordinate with the section book managers to ensure the console Systems Briefs, SSSH, and SCPs are the latest versions. Known SSSH errors should be documented in the DF Master List (link on <http://mod.jsc.nasa.gov/df/dfdiv/>).
  - a. Coordinate with the DPS webpage administrator to ensure links to these products are also up to date prior to flight.
  - b. Ensure the EMCC box (located in the Group Lead's office) is also updated.
2. Use the FDF Status Sheets (link on <http://mod.jsc.nasa.gov/do3/dfd/>) to ensure the required updates are on console for sims and flight. Binders containing the flight-specific FDF are located in the FCR and MPSR. Generic FDF should also be checked for updates prior to flight; contact the section reps for the individual books as required.



3. Prior to flight, provide binders in the FCR/MPSR for the console logs, hardcopies, anomaly reports, etc. These are usually recycled from previous flights so make sure all previous flight information has been removed. Suggested items to include in the binders:
  - a. DPS personnel phone and pager list (available in the FCR and MPSR).
  - b. Contact list for JSC MER and KSC DPS personnel.
  - c. Copies of console Ops Notes if applicable.
  - d. MCC shift schedule.
  - e. DPS preflight team briefing.
4. Verify the FSW CD is available in the MPSR cabinet.
5. Verify the flight-specific Data Pack is available in the FCR/MPSR.

E. DPS Team Coordination

1. Ensure team is included on all necessary distribution lists (email) for issues.
2. Conduct DPS team briefing prior to flight. At the Lead's discretion it may also be advantageous to give a briefing prior to the start of flight-specific sims - particularly if a long sim (spanning multiple teams) is part of the template. Briefings should include:
  - a. Flight overview; note special activities of interest to DPS.
  - b. Crew, Flight Director, and DPS team manning.
  - c. FSW OI (include pertinent CRs, user notes, etc.) as well as MCC workstation software version.
  - d. Hardware serial numbers as needed. Use the links from the "DPS Hardware" section of the DPS homepage to acquire this info.
  - e. MER Team shift schedule. The Lead should also ensure the MER has the DPS console shift schedule. The Lead may invite MER team members to the tagup if desired.
3. Update the DF Flight Roster located on the share drive (S:\Divisions\DF\Shared\Mission\Mission Manning SSP\_ISS).

F. Realtime Flight Execution

1. During the course of the flight, the Lead should maintain cognizance of all DPS-related anomalies, chit traffic, etc. Although all shifts are involved in these issues the Lead should ensure that by flight's end all DPS issues are closed out satisfactorily. Actions for postflight work should be noted.
2. Keep management informed as appropriate. Even if the mission is nominal from a DPS perspective an activity report input at the end of the week should summarize activities to date. Off-nominal situations may demand more immediate visibility.

G. Postflight Duties

1. Recommended immediate postlanding actions for the entry team:
  - a. Bring back associated reference materials/books back to the office.
  - b. Bring all flight paperwork (logs, hardcopies, etc.) back to the office; leave binders on console.
  - c. Move Flight Rules Annex and Post Insertion to FDF binder for ALL consoles. Move datapack to Post Flights datapack binder for ALL consoles.
2. Prepare a quick-look report for DF Systems Issues. As the name implies, this is not a detailed report but a one- or two-page summary of flight issues which is typically given on the first Systems Issues meeting after the flight. The report template can be found on the DF TA homepage (<http://mod.jsc.nasa.gov/df/dfdiv/shuttle/index.html>). Once completed, a copy should be saved on the DF32 share drive in the 'Quicklook' folder.
3. Complete Flight Director feedback form and ensure other DPS FCR shifts are doing the same. Submit forms to the Group Lead.
4. Prepare DPS post mission report and distribute as outlined in SCP 3.7
5. Give copies of DPS FRR and delta FRR datapacks to the postflight report book manager for inclusion in each of the postflight report binders.
6. Sort and compile logs and data from flight for archives.
  - a. The FCR and MPSR binder material can be combined into a single binder (with appropriate tabs) and placed in the DPS office file cabinet.
  - b. Place level C FSSR in section library for reference.

7. Follow up on DPS action items from flight. Actions or issues that affect the next flight should be discussed with that flight's Lead, as they will most likely be reflected in the CoFR/FRR. Issues may also be presented to the Ascent or Orbit Flight Techniques Panels at the panel chair's discretion - if in doubt, discuss the matter with the Group Lead..
8. Represent DPS at the crew debriefings. The crew will typically have a number of debriefings in the weeks following a flight; the Lead should support the Systems Debrief as it appears on the schedule. Check with the DF TA if you have not received a schedule a few days after landing. Anomaly reports will be dispositioned at debrief so be prepared to discuss and recommend closure actions as needed.
9. Submit list of training objectives covered during flight to training records personnel (signed by Group Lead) for any objectives not previously seen by operators.

**H. Consolidated Checklist**

The following table consolidates the items listed above into a roughly chronological order.

**Lead DPS Checklist**

<b>Approx Time</b>	<b>Section Ref</b>	<b>Item</b>	<b>Date Complete</b>
L-12 mo	A	Begin FCR Team Mtg, Fit Tech, JOP support	
	E	Create DPS Team distribution for necessary info	
	A	Track generic PRT/IPT issues	
	A	Track manifest changes	
	A	Track DPS IPRs	
	A	Track FSW changes and DRs	
	B	Submit Basic FDF and Flight Rule flight-specific inputs	
L-4.5 mo	B	Submit Asc Switchlist / MEL inputs to DF TA	
	B	Submit Ascent IDP config to VITT (work with A/E DPS)	
	B	Submit "alternate" Ascent CRT config inputs (work with A/E DPS)	
L-4.5 mo	B	Submit FOR DNs	
L-4 mo	B	Support FOR	
	B	Verify correct implementation of FOR DNs	
	B	Submit/track 482s as required (generic and/or flight-specific)	
L-4 mo	C	Verify DPS console ready to support ILC	
L-4 mo	C	Support ILC	

<b>Approx Time</b>	<b>Section Ref</b>	<b>Item</b>	<b>Date Complete</b>
	C	Track MCC application changes	
	C	Tagup with Group Lead to discuss MCC console issues	
L-3 mo	E	Conduct DPS Team pre-sim briefing (if req'd)	
L-1 mo	B	Verify Command Handbook inputs	
L-4 wk	A	Complete CoFR/FRR inputs	
L-2 wk	A	Verify PASS GPC dump processing	
L-2 wk	E	Conduct DPS Team pre-flight Briefing	
L-2 wk	E	Update DF Flight Roster	
	D	Ensure FDF updates incorporated on console	
	D	Provide console data binders	
	D	Ensure correct FSW CD in MPSR	
	D	Ensure Data Pack on console	
	D	Ensure updated SSSH, SCP's and Sys Briefs on console, web, and EMCC box	
L-3	A	Complete Delta FRR inputs (if required)	
L-0	F	Support flight	
	G	Postlanding archive of data (Entry Team)	
Land+1 wk	G	Brief DF Quicklook Report at Systems Issues	
Land+1 wk	G	Submit FD Feedback	
	G	Prepare DPS Postflight Report	
	G	Give DPS FRR datapacks to postflight report book mgr if req'd	
	G	Compile console logs and data	
	G	Brief DPS Team, AEFTP and/or OFTP on postflight issues	
Land + 2 wk	G	Support postflight crew systems debrief	
	G	Submit training objectives if required	

**TITLE**

PRELAUNCH TIMELINE

**PURPOSE**

The purpose of this SCP is to provide the DPS console operators with a prelaunch countdown timeline that contains important DPS events. Approximate times are used. For steps performed as part of the OMI sequence, reference OMI no. S0007 for exact times.

<u>Time</u>	<u>Description of sequence</u>
L - 2 weeks	JSC-DPS SPT will fax the prelaunch TMBU data and VPs to KSC BFS(407-861-0908).  JSC-DPS VP Rep will provide to MER Software the Ascent/Orbit/Entry VPs and flight manning. JSC-DPS places the LRU listing in the Anomaly Data section of the console data binder.
L - 3/5 days	JSC DPS will support the delta FRR, if changes since FRR.
L - 3 days	JSC ASC/ENT DPS and/or DPS SPT will have a short tagup on the phone with the lead CDPS to ensure that he/she received the data and to answer any questions he/she might have.
L - 1D 18h 30m (T - 43h 30m)	Orbiter powerup.
T - 43h 30m	KSC performs MMU compare tape check.
T - 41h 40m	KSC performs BFC TEST (DPS TO FMT 20).  Note: DPS will be configured to OPS 0. Polling will remain on, but all flight-critical strings will be deassigned.  Perform ORBITER Backup Flight Controller test per OMI (S0007-V4).
T - 40h 40m	KSC performs DPS transition to SINGLE G9 GPC(1).  Note: Flight-critical strings will be unmasked.  KSC to verify GMT update.
T - 40h 15m	KSC to perform DPS transition to DUAL G9 GPCs per OMI (S0007-V4, seq. 49).

- T - 39h 45m KSC to perform MMU DUMP/COMPARE per OMI.  
Note: If MMU patch required, patch will be performed at this time.
- T - 35h 30m KSC to perform DEU 1/2/4 LOAD per OMI and DEU MEMORY DUMP PREPS.
- T - 35h KSC to perform Orbiter MET INITIALIZATION per OMI (S0007-V4, seq. 50).
- T - 34h 50m KSC to LOAD BFS in GPC 5 per OMI (S0007-V4, seq. 49).
- T - 34h 30m KSC to perform MTU OSC frequency checks per OMI (S0007-V4, seq. 49).
- T - 34h 30m KSC to perform BFS data retrieval and DEU 3 DUMP.
- L - 1D 04h  
(T - 27h) KSC to perform DPS transition to G9 Redundant Set per OMI (S0007-V4, seq. 49).
- T - 11h  
(L - 24h 30m) Call to station L - 1 weather briefing. Ensure all documentation and flight software fiche are on console. Update OMIs if necessary.
- L - 11h Prelaunch team on console. For prelaunch team responsibilities, refer to SCP 1.1. Verify DOLILU address(es) with the Guidance officer. See Note 1.
- L - 4hr Ascent team on console. For ascent team responsibilities, refer to SCP 3.3.
- T - 3h KSC to perform MDM discrete check. Monitor loop-OTC-132 for any anomalies. KSC will fax an MDM BITE read discrepancy report to MCC-H/JSC. DPS will receive the fax, identify and coordinate with the owners of the discrepancies, and provide a response to the Flight Director as to whether or not the discrepancies are acceptable for launch.
- T - 3h Send GNC ASCENT NOMINAL V/P -- DSM 23001 per OMI step.  
Verify that MMU 1 is selected as prime for GNC.  
JSC DPS/DPS SPT to perform TMBU tagup with KSC-DPS; provide them information on BFS TMBUs built during prelaunch. Attempt to contact CDPS on loop 152; if no joy, call phone numbers 407-867-2748, -4367, -1781, -0442 for firing rooms 1, 2, 3, 4, respectively. Refer to JSC DPS Phone List cue card for current numbers.
- T - 2h 40m STS CREW to clear C/W memory. Note the SPEC 99 PRO on the scratch pad line.

- T - 2h 20m Monitor the GMT Delta adjustment performed by KSC per OMI, DPS SYSTEMS (Seq. 40). (Notice item entries on SPEC 2; the MTU BITE will reflect a status of 0001 or 8001 until GMT adjustment is complete.) Monitor loop CDPS 152 for GMT adjustment. Zero out MTU 1 and MTU 2 delta Ts using Delta T application.
- T - 2h 10m GPC 5 output switch to BACKUP. BFS DISC A = 4304.
- T - 1h 20m Launch polynomial updates. If required, one or two launch polynomial updates may be performed for either pitch or yaw polynomials. (Ref. S0017, vol. V, or S0007, vol. II.) Inform GPO and the Flight Director that the GPC dump can be displayed with the GPC Dump application. Report the dump quality to the Flight Director and wait for GPO launch target loads data verification before proceeding.
- T - 45m MDM discrete output check.  
GO/NO-GO to FLT based on LCC violations.
- T - 32m Perform PASS/BFS transfer prep - "ONE SHOT TRANSFER."
- T - 22m PASS - BFS TRANSFER (DEU EQUIV). Monitor A/G loop to verify item 25 has no asterisk (\*) by it.
- T - 20m **\*\* T - 20 MINUTE HOLD \*\***
- Last chance to leave console for break before getting into final count and ascent.
- Unsafe BFS VP (DSM 199xx).
- Copy PASS and BFS Fault messages (OFS application) and SPECS log.
- Optional VP uplink to change to ascent VPs if special VPs were needed only during prelaunch that were uplinked at T - 3 hr.
- Note: RS HOLD warning light on the DPS C&W application will remain on after coming out of hold until KSC resets it.
- Resume count.
- Monitor the G9-to-G1 transition. (Expect 6 I/O errors.) Check the G3 Archive status.
- Note: KSC performs a GPC dump and compare following the G9-to-G1 transition.
- T - 19m Take BFS to RUN. (Make sure to note any unexpected errors.)

Continue with BFS OPS 1 transition. Again, make sure to note any unexpected errors. Make sure BFS is tracking PASS FC strings 1 to 4 after BFS is in OPS 1.

T - 16m	Houston-MCC will uplink PRELAUNCH TMBU loads. (Watch for any unexpected errors or fault message annunciations.) Uplink of BFS VPs will also be done.  Calculate and input delta Ts for BFS and GNC via Delta T application.
T - 15m	Alternate CRT config performed (if required)
T - 9m	** T - 9 MINUTE HOLD ** Hold for 10 minutes.  Launch polynomial updates. If required, one or two launch polynomial updates may be performed for either pitch or yaw polynomials. (Ref. S0017, vol. V or S0007, vol. II) Inform GPO and the Flight Director that the GPC dump can be displayed with the GPC Dump application. Report the dump quality to the Flight Director and wait for GPO data verification before proceeding. For RNDZ launch, target loads are uplinked to BFS in manual mode. No GPC Dump is required.  GLS AUTO SEQUENCE activation.
T - 5m	APU START.
T - 2m 30s	Clear CAUTION AND WARNING memory and verify no unexpected errors.
T - 31s	RSLs - Go for auto sequence start. See Note 2.
T - 10s	GLS - Go for main engine start.
T - 7s	Main engine start.
T - 0	Liftoff - transition PASS102/BFS102. "LIFTOFF CONFIRMED," DPS call, on flight director's loop at 102 transition.

- Notes:
- ① For explained OPS 9 countdown errors and nominal OPS 1 errors, see MER note 1 distributed for each flight by the T&O Staff.
  - ② If a breakout or PAD Abort occurs at  $T \leq 31s$ , the Booster Officer will request a GO from Flight to unsafe MPS Commands. Upon a GO, all MPS commands including DSM 20101, GNC 901 PRO DEU Eq, will be unsafed. DPS or DPS SPT should monitor on the Command Voice Loop. Additional details will be found in FCOH 3.1.6, MPS safing procedure for loss of KSC LPS LDB capability.



**REFERENCES**

1. OMI no. S0007, vols. I through IV.
2. FCOH

## TITLE

DPS LAUNCH COMMIT CRITERIA SUMMARY

## PURPOSE

This SCP provides a summary of the DPS-related launch commit criteria (LCC) elements. The LCC outlines preplanned decisions designed to minimize the amount of real-time rationalization required when non-nominal situations occur. In general, the LCC become effective at "Go for start of external tank cryogenic loading" (approximately T - 6 hours) and terminates at solid rocket booster (SRB) ignition. Specific terminate time periods for the DPS elements are listed below. Violation of any LCC between T - 5 minutes (counting) (APU start) and SRB ignition without a predetermined, approved, and documented in-place contingency procedure will result in a launch scrub. The preapproved procedures are documented in Shuttle Countdown (Launch Processing System), OMI S0007, vol. 5. Furthermore, we have a Space Shuttle Operational Flight Rule (2-3) that states the following: "No MCC countdown hold will be called after T - 31 seconds." (Ref. Shuttle Launch Commit Criteria and Background.)

The ground launch sequencer (GLS) software will check all of the orbiter critical systems during the countdown and will automatically hold the countdown at specific milestones if there is a problem. The GLS begins at T - 2 hours and terminates at SRB ignition. The specific milestones for the holds are as follows (times shown as minutes/seconds):

- T - 9/ 0 - Prior to GLS activation
- T - 7/ 30- Prior to OAA retract
- T - 5/ 0 - Prior to APU start
- T - 4/ 0 - Prior to purge seq 4
- T - 2/ 55- Prior to ET LO<sub>2</sub> prepress
- T - 1/ 57- Prior to ET LH<sub>2</sub> prepress
- T - 0/ 31- Prior to auto seq start

There is no automatic GLS capability to hold after T - 31 seconds; it must be done manually at KSC (ref. Ground Launch Sequencer Description Document, Launch Countdown).

Critical orbiter system functions are controlled by the redundant set GPCs and associated software during launch countdown, ascent, orbit, entry, and aborts. These functions are referred to as the sequencing subsystem, which is a unique grouping of sequences that are packaged and scheduled during each phase of the mission. The redundant set launch sequencer (RSLs) starts when the GPCs are taken to OPS 101. At T - 31 seconds, the GLS sends a command to the RSLs to take control of the vehicle, which occurs at T - 28 seconds ("Auto Sequence Start") (ref. Redundant Computer Set Logic Flow Diagrams (Sequencing)). See Table 3.3-1 for a brief rationale description for each LCC.

**PASS**

<p><b>DPS-01</b></p> <p>PASS MCDS Anomalies: MCDS BITE Register I/O ERROR CRT CRT BITE Crew indication of failed CRT GPC Error 06 01</p>	<p>Monitored until T - 31 seconds.</p> <p>Failure of any forward CRT could result in either the commander and pilot having to share a CRT, or requiring one of the CRTs to be shared between PASS and BFS during ascent and entry. This off-nominal configuration could result in a reduction of insight into shuttle GNC and SM operations, cause confusion, or lead to mistakes. This LCC applies whether the failure is at the DU, DEU, or the GPC.</p> <p>If a single GPC error 06 01 is received and is the only anomaly, it may be due to a timing error; see User Note D019A.</p>
<p><b>DPS-01a</b></p> <p>PASS MEDS Anomalies: I/O ERROR CRT CRT BITE MEDS Status Wd 1, 2, 3 Crew indication of MEDS Anomaly</p>	<p>Monitored until T - 31 seconds.</p> <p>On the occurrence of an error, the MEDS function must be verified using the preplanned contingency procedures prior to continuing the count.</p> <p>Failure of any forward IDP could result in either the commander or pilot having to share a CRT, or requiring one of the CRTs to be shared between PASS and BFS during ascent and entry. IDP 4 and AFD 1 requirements are mission-dependent and will be specified in the MEL.</p> <p>For off-nominal Status Words, the LCC contains a list of conditions that are acceptable for launch.</p>
<p><b>DPS-02</b></p> <p>PASS GPC Fail Indicator (I-FAIL)</p>	<p>Monitored up to the OPS 1 Transition. (T - 20 minutes)</p> <p>Failure of a GPC would require assigning two strings to another GPC. Launching in this configuration and then experiencing a subsequent failure of the dual-string GPC would result in the loss of up to one-half of the redundant LRUs. Also, a dual-string GPC can have more authority over its FCS channels than a single-string GPC does. Therefore, an improperly functioning GPC can override the healthy GPC commands to the FCS channels.</p> <p>Preplanned contingency procedures allow the count to continue if troubleshooting indicates the failure is instrumentation only (i.e., I-fail light on, but GPC still in RS).</p>
<p><b>DPS-03</b></p> <p>MDM BCE Bypass FF/FA 1(2,3,4) FF/FA 1(2,3,4) A,B,C,D PF 1(2) FA 2,3,4 Hyd/OMS byp</p>	<p>Monitored until T - 31 seconds.</p> <p>When a GPC detects two consecutive input errors, a BCE bypass bit is set that indicates the input data from the LRU specified by the bit is no longer being processed by the GPC. Any unexpected BCE bypass means that the LRU redundancy has been compromised. This failure may be due to a failed LRU, an MDM, or an MDM card.</p> <p>LRU redundancy is mandatory. However, LRU redundancy may be regained if the alternate MDM port is selected. Therefore, if the failure is an MDM port-dependent anomaly, port redundancy will be sacrificed to regain LRU redundancy. Note that only one MDM is allowed to be recovered with a port mode for the count to continue (i.e., 19 of 20 ports required). If more than one MDM experiences a problem, it is assumed there may be a generic MDM problem and the count is held.</p> <p>The port mode can be accomplished down to T- 31.</p>
<p><b>DPS-04</b></p> <p>FF/FA 1(2,3,4) Bypass during GNC init</p>	<p>Snapshot after the OPS 1 transition has completed. (T - 19 minutes)</p> <p>During the OPS 1 GNC initialization task, the PASS GPCs interrogate the FF and FA MDMs for a status of the current command outputs. It uses this data to initialize the OPS 1 cyclic output buffer. If the GPCs cannot read the outputs from one of the MDMs, the output buffer will not get initialized properly for that MDM.</p>
<p><b>DPS-05</b></p> <p>GPC BITE</p>	<p>Monitored until T - 10 seconds.</p> <p>A GPC BITE signifies that a "force close" in GPC processing has occurred. A "force close" is the result of an error that does not allow the involved module to finish its processing task. If all GPCs within the redundant set experience the "force close", they will all annunciate the BITE, and may continue to operate. GPC BITE messages annunciated by the entire RS are most likely due to generic software errors.</p> <p>If only one GPC annunciates the BITE, that GPC may fail to sync. This type of signature is more likely due to a hardware error.</p> <p>Note: In either case, the count is held since, under no conditions would this error ever be expected.</p>

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<p><b>DPS-06</b>  MMU Error at OPS 1 Transition MMU 2 Ready Discrete I/O ERROR MMU1(2)</p>	<p>Monitored during the OPS 1 transition. (T - 20 minutes)</p> <p>No MMU I/O errors are expected during the OPS 1 transition. An I/O error message will be annunciated on the <u>first</u> detection of an error. If a single I/O error is experienced during the OPS transition, but the transition completes on MMU 1 (transient error), the count is allowed to continue. If the transition did not complete due to a tape related anomaly, the alternate area will be selected and the OPS transition retried. For tape-related failures, count will continue if each MMU has two good copies of software.</p> <p>If an I/O error is annunciated against MMU 2 on the transition, the GNC set will be transitioned back to G9 (MMU 2 will be made prime for the transition) to evaluate the health of the MMU. This checkout is important because if one MMU is failed, only one remains available for on-orbit operations.</p> <p>MMU 2 is monitored to ensure it goes to the OFF/BUSY state during preposition. This is to demonstrate its ability to receive and execute commands from the GPCs.</p> <p>Note: G3 archive is loaded into the GPCs during the OPS 1 transition. Therefore, the MMUs are not critical for a successful TAL transition assuming the OPS transition completed without error.</p>
<p><b>DPS-06a</b>  SSMM Error at OPS 1 Transition I/O ERROR MMU1(2)</p>	<p>Monitored during the OPS 1 transition. (T - 20 minutes)</p> <p>No MMU I/O errors are expected during the OPS 1 transition. An I/O error message will be annunciated on the <u>first</u> detection of an error. If a single I/O error is experienced during the OPS transition, but the transition completes on MMU 1 (transient error), the count is allowed to continue. If any overlay errors are logged against the backup MMU, or if an auto-switch from the primary to the backup MMU occurs, the LCC violation is confirmed and the launch is no-go.</p>
<p><b>DPS-07</b>  GPC 1(2,3,4) MMU 1(2)  Ready Discrete Anomaly</p>	<p>Monitored until T - 31 seconds.</p> <p>The MMU ready discrettes (input from the MMUs to each GPC) are redundancy managed (RM'd). The status of the MMU, from the GPC CS standpoint, is determined by the status of the discrettes that are held by the majority of GPCs. If there is no majority (tie vote), the last RM'd state will be used.</p> <p>Example: If one of the input discrettes has failed low, the majority state in the four GNC set will control the GPCs view of the MMUs (three of four GPCs will see the correct state). This configuration does not present any ascent or abort limitations. If there is a second discrete failure, then when the PASS set is commanded to preposition the MMU, the CS will see the MMU go OFF/BUSY (since the majority agrees it has gone busy) as expected. However, after the MMU goes back to the ready state only two of four GPCs will see the change. Therefore, the CS view of the MMU is that it remained busy. This would render that MMU unavailable for other MMU transactions until the tie could be broken. It is for this reason that three of four input discrettes per MMU are required for launch.</p>
<p><b>DPS-08</b>  IPL SELECT Discrete Anomaly</p>	<p>This requirement deleted as of OI-25.</p>
<p><b>DPS-09</b>  GPC 1 (2,3,4) Last GPC Error Count</p>	<p>Monitored until T - 10 seconds.</p> <p>All PASS GPC errors must be evaluated since none are expected during nominal software operation. However, due to software timing considerations and periods of high applications processing, there are some GPC errors that are acceptable for continuing the count. These exceptions are outlined in OPS and User Notes. Also consult the MER notes supplied by Loral to DPS lead immediately before flight.</p>

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<b>DPS-10</b>	Monitored until T - 31 seconds.
PASS Time Source Anomaly GPC 1(2,3,4) TMP(acc) GPC 1(2,3,4) Time Source (MTU/GPC)	The loss of one accumulator is acceptable to continue the count. If, however, the RS is unable to use accumulator 2 or 3, it is assumed there is a generic failure in the accumulators or the MTU and requires holding the count. This could be caused by a time difference between the accumulator and the GPC oscillator of greater than 800 microseconds, or a failed or commfaulted accumulator. TMP = Time Management Process  Also, all GPCs must be on MTU time to continue the count. If a GPC is on internal time, its internal oscillator may not be close enough to MTU time (800 microseconds) to allow the GPC to maintain RS and/or CS sync. The use of the GPC internal clock could also result in inaccurate navigation calculations.
<b>DPS-11</b>	Monitored until T - 31 seconds.
GPC 1(2,3,4) Engage Discrete Inputs 1,2,3	For the PASS to transition from BFS disengaged to engaged state, it must see all three engage discrete inputs equal to 1 and the I/O TERM B discrete input also equal to 1. If one GPC sustains a failure (fail on) of one BFS engage discrete it is most likely a singular failure of a discrete input hybrid receiver (and not of the BFC itself), and is therefore deemed acceptable for launch. If more than one discrete is failed on in any combination of GPCs or in a single GPC, it is assumed that the BFS engage logic "system" is questionable. Therefore, for more than one BFS engage discrete failure, the countdown is held.
<b>DPS-12</b>	Monitored up to the OPS 1 transition. (T - 20 minutes)
FF1(2,3) IMU Discrete or Data Bypass  For Data Bypasses: BCE STRG 1(2,3) IMU	Either of these failures indicate the associated IMU may not be available to provide inputs to the navigation software. GNC LRU redundancy requires three of three operational IMUs to continue the count.  These measurements are available in G9 only.
<b>DPS-13</b>	Monitored until T - 31 seconds.
FF1(2,3) IMU Bypass BCE STRG 1(2,3) IMU	GNC LRU redundancy requires three of three operational IMUs to continue count. Port moding is not tried for this failure. The assumption is that this would not be a port- dependent problem.
<b>DPS-14</b>	Monitored until T - 31 seconds.
FF1(3) NSP Discretes or Data Bypass  For Data Bypasses: BCE STRG 1(3) NSP	One of these two bypasses will always be set since only one NSP can be powered at a time. However, it should always be confirmed that any I/O errors on the NSPs were expected and the errors were a result of some action such as swapping the active NSP. Ability to acquire I/O with both NSPs is tested early in the countdown.
<b>DPS-15</b>	Monitored until T - 31 seconds.
FF1(2,3,4) ADTA Bypass BCE STRG 1(2,3,4) ADTA	GNC LRU redundancy requires four of four operational ADTAs to continue count. Loss of an ADTA makes it unavailable for sideslip (BETA) calculations. Port moding is not tried for this failure - the assumption is that this would not be a port-dependent problem.
<b>DPS-16</b>	Monitored until T - 31 seconds.
FF1(2,3) MTU Bypass BCE STRG 1(2,3) MTU	These discretes indicate the ability of PASS to acquire GMT and MET from the MTU accumulator. Two of three accumulators are required to continue the count. See DPS-10 for further discussion.
<b>DPS-17</b>	Monitored until T - 31 seconds.
FF1(2,3) TACAN/RA Bypass BCE STRG 1(2,3) TAC	Receipt of this message is indicative of a failure of the TACAN/RA card in the associated MDM, not a failure of the TACAN or the radar altimeter LRUs. GNC LRU redundancy requirements require two of three TACANs (FF1,FF2,FF3) and one of two radar altimeters (FF1/FF2) to continue the count.
<b>DPS-18</b>	Monitored up to the OPS 1 transition. (T - 20 minutes)
EIU1(2,3)/P1 Bypass	There is no fault summary message associated with this bypass; but will be downlisted in the I/O error log. This failure could result in the loss of EIU data to the GPCs and/or the loss of EIU command capability on one or more ports. There is no preplanned contingency procedure since its re-occurrence during ascent could significantly hinder efforts to maintain uphill capability.
<b>DPS-19</b>	Snapshot at T - 45 minutes.
FF/FA 1(2,3,4)/PF1(2)	The BITE status register (BSR) serves as an error accumulator for the MDM error checking and

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BITE Status Register	performance monitoring BITE circuitry. This BSR read verifies that no MDM detected hardware anomalies exist, and that the MDM is operating properly. Any bits set in the BSR must be evaluated and, if cannot be explained, the count will be held. If MDM port-related anomaly, count will continue if 19 of 20 ports available.
<b>DPS-20</b>	Monitored until T - 10 seconds.
MDM OUTPUT In G9: N/A for FC MDMs In G1: N/A for PF MDMs	This message indicates there is an error in either the commanding IOP or the MDM. The IOP sends out alternating pattern of ones and zeroes during each HFE cycle (FC MDMs) and PF low rate cycle (PF MDMs). The MDM echoes the pattern back to the IOP where it is compared once every major cycle. Two consecutive mismatches of the same pattern are required to announce the message. If the message is announced against an FC MDM and it is detected by only one GPC, the failure is assumed at the GPC. The danger in launching with an MDM output problem is that the MDM may be receiving (and therefore executing) faulty GPC commands.
<b>DPS-21</b>	Monitored until T - 10 seconds.
SUMWORD ICC	Indicates that three consecutive mismatches have occurred between the annunciating computer and the others on ICC transfer data. The annunciation may or may not have an immediate impact of the redundant set. It may cause an FTS of the faulted GPC. Also in a worst case scenario, the failure could prevent the redundant set from successfully transitioning to another OPS (TAL, for instance), forcing a BFS engage. This could happen if the data indicating the current OPS was corrupted. When the OPS 301 PRO was entered, the GPCs all "think" they are already in OPS 3 and, therefore, would not attempt to transition (i.e., would stay in OPS 1).
<b>DPS-22</b>	Monitored until T - 31 seconds.
PASS I/O Error Log Illegal OP Code Boundary Alignment Self-Test Error	Any of these errors indicate there may be a flight software problem affecting all GPCs. If any of these I/O errors are incurred, the count is held at the next available hold time to evaluate. The error must be understood and deemed acceptable for flight before the count can resume.  The count will be held for a single or multiple occurrence of these errors. If the entire set announces the error, the problem is most likely a flight software problem. If only one GPC announces the error, the problem could be software or hardware.
<b>DPS-23</b>	Monitored until T - 31 seconds.
DDU BITE Anomaly LH(RH) DDU Good	N/A for MEDS vehicles.  Houston DPS has no insight into this failure. Houston GNC monitors this parameter.  There is a preplanned procedure to determine whether the indication is real or instrumentation only. The count can continue if the failure is instrumentation.  Loss of the DDU good flag for two consecutive cycles constitutes a violation. The failure results in the loss of DDU processing and transmission of output data to the dedicated flight displays (ADI, AVVI, SPI, etc.). This results in the loss of one or more dedicated displays in the flight deck.
<b>DPS-24</b>	This requirement has been deleted.
DDU Power Supply Anomaly	
<b>DPS-25</b>	This requirement moved to EPDC, Section 26.
Does not exist	
<b>DPS-26</b>	Monitored until T - 31 seconds.
GPC 1(2,3,4) SEC	The LCC states that the count is allowed to continue if the soft error counter (SEC) is less than or equal to two counts per GPC. Therefore, theoretically, each GPC can have up to two SECs in the lower page and two in the upper page to continue the count.  The AP101S GPCs have CMOS technology main memory that is vulnerable to bit toggles caused by exposure to natural space radiation. To compensate for these expected errors, the AP101S is equipped with error detection and correction (EDAC), a hardware function that detects and corrects single-bit errors and detects multibit errors per halfword. When the CPU or IOP accesses the main memory, the location contents pass through the EDAC first. If a single-bit error is detected, it is corrected; if a multibit error is detected, the computer goes into the wait state and halts processing. Note that for IOP or CPU accesses, the SEC is not incremented nor is the

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	memory location corrected.
	Another user of the EDAC is the main memory scrub. The scrub is a hardware process that cycles through main memory to determine if an error has occurred since the last scrub (every 1.7 seconds). If a single-bit error is detected, it is corrected and the SEC is incremented. If a multibit error is detected, the SEC is incremented, the error is not corrected and it is red back into its location. This location will continue to have an error detected every 1.7 seconds. Note, if this address is accessed by the CPU or IOP as described above, the EDAC will again interrogate it for errors, but the computer will enter the wait state and fail.
<b>DPS-27</b>	Snapshot at the end of the OPS 1 transition. (T - 19 minutes)
GPC 1(2,3,4) Archive Status	In the event of an unsuccessful G3 archive, the count is held and the situation evaluated since the lack of the G3 archive is indicative of a GPC internal failure or a mass memory interface problem.  The AP101S GPC upper page of main memory (128K to 256K) is loaded with the G3 overlay software prelaunch to provide quick access to entry software in the event of a TAL abort. The G3 archive transition takes approximately 7 seconds; whereas, a nominal MMU G1 to G3 transition takes approximately 20 seconds.  Indication of a successful load will show 1, 2, or 3 in the archive status field for each GPC on DPS Overview. The 1, 2, or 3 indicates which MMU area copy of G3 overlay was archived and is acceptable for launch. A zero in the status field indicates an unsuccessful archive in the respective GPC and is unacceptable.

**INSTRUMENTATION**

<b>INS-01</b>	Monitored until T - 31 seconds.
MTU Good (PCM BSR)	The MTU Good bit in the PCM BITE Status Register (Houston INCO monitors this parameter) set to zero means that the PCM is on internal time. This is indicative that the 4.608 MHz interface between the PCM and the PCMMU has been lost. This could result in the loss of pseudo-sync.  Troubleshooting involves first checking for loss of pseudo-sync; if pseudo-sync is not lost, continue the count. If pseudo-sync is lost then swap PCMMUs, reload soft TFLs and check for pseudo-sync. If no loss of pseudo-sync, continue the count; otherwise hold the count.
<b>INS-03</b>	Monitored until T - 31 seconds.
MTU BITE bit indications	Requirements for launch include 1 of 2 MTU oscillators, 1 of 2 power supplies, and 2 of 3 accumulators.  IRIG B and frequency divider requirements are mission dependent; reference MEL.  Troubleshooting procedures require the count be held and the BITE indications be evaluated. If the failure can be shown to be instrumentation only, the count can continue. Also, if it can be confirmed that minimum redundancy (listed above) still remains, the count can continue.

**BFS**

<b>BFS-01</b>	Monitored from T - 2 hours (crew ingress) until T - 10 seconds.
I/O TERM B Anomaly	The I/O TERM B is a discrete signal input to the GPC that causes the GPCs flight-critical transmitters to be disabled when the discrete is high. The BFS GPC in its pre-engaged state has its I/O TERM B set high. To engage the BFS, the I/O TERM B discrete must be reset from 1 to 0 and BFS must see at least two of three engage discrettes set high (1).  The loss of the I/O TERM B can be attributed to multiple factors; loss of ESS 3AB power, GPC output switch failure, BFC failure, or a discrete input failure at GPC 5. Due to the uncertainty of the failure modes, the state of the I/O TERM B cannot be guaranteed at any GPC. If there has been an I/O TERM B anomaly and a BFS engage is attempted, it may result in the PASS set going to software halt, while BFS may not recognize the engage. This would result in a loss of vehicle control.
<b>BFS-02</b>	Monitored until T - 10 seconds.
BFS Engage Discrete Anomaly	All three of three engage discrettes must indicate they are low (0). This is because if any discrettes are failed high (1), the health of the backup flight controller and/or its interfaces must be considered suspect. Therefore, BFS would be considered questionable for flight since there is

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some doubt as to the health of the BFS BFC module and additional failure(s) could result in a premature BFS engage.

**BFS**

<b>BFS-03</b>	Monitored from BFS in OPS 101 until T - 31 seconds.
BFS Time Source Faultdown	<p>BFS is initialized to MTU GMT during the transition to major mode 101. BFS may come up on any of the three accumulators due to the mid value select logic. If BFS does not receive GMT from the MTU, it will fault to its internal time and initialize BFS GMT to day 1. The use of the BFS internal clock instead of an MTU accumulator may result in inaccurate navigation calculations.</p> <p>After initialization, BFS will receive GMT and MET from the MTU once per major cycle. BFS GMT and MET will be set equal to the MTU values in order to compensate for any internal oscillator drift as long as the difference between MTU time and BFS time is not greater than 800 microseconds (otherwise the BFS will go on internal time). If internal BFS time were not updated, GPC oscillator drift may cause GMT to be in error, resulting in decreased accuracy of BFS navigation.</p> <p>Note: Once the BFS goes on internal time, it will continually try to get back on an accumulator.</p>
<b>BFS-04</b>	Monitored until T - 10 seconds.
GPC BITE 5	<p>This indicates the BFS has had a software initiated restart that could have been caused by a BFS hardware or software anomaly. This message could be driven by one of 26 BFS GPC errors. If the BFS gets into continuous restarts, the BFS I-fail light will come on.</p> <p>Either way, BFS is questionable for flight and cannot be relied upon to take control of the vehicle if a BFS engage were to be required.</p>
<b>BFS-05</b>	Monitored until T - 10 seconds.
GPC Error Count	All BFS GPC errors must be evaluated, since none are expected during nominal software operation. However, due to software timing considerations and periods of high applications processing, there are some GPC errors that are acceptable for continuing the countdown. These exceptions are outlined in OPS and User Notes.
<b>BFS-06</b>	Monitored until T - 10 seconds.
BFS Tracking PASS Anomaly	<p>BFS is required to be able to track all four strings in order to acquire redundant LRU data. If BFS is unable to track one or more of the strings, it indicates that either BFS is unable to hear PASS listen command, BFS disagrees with PASS BCE bypass data, data on one string disagrees with data on the other three strings, or BFS has some other problem.</p> <p>This situation leaves PASS and/or BFS in a condition where there is limited flight-critical data and command capability - the countdown is held.</p>
<b>BFS-07</b>	This requirement was deleted.
Ascent DAP Anomaly	
<b>BFS-08</b>	Monitored until T - 10 seconds.
BFS GPC Fail Indication	<p>This LCC monitors the BFS downlist validity - not the GPC 5 I-fail indicator. It is assumed that if there is no valid BFS downlist, then either the BFS is failed or there is a failure in the BFS interface with the PCMMU. The count will be held if there is no valid BFS downlist.</p> <p>Note that while the BFS is on internal time (prior to OPS 1) one downlist frame will be lost approximately every 16 minutes due to timing differences between BFS internal clock and the PCMMU. This is not a violation of the LCC.</p>
<b>BFS-09</b>	Monitored from the time BFS is taken to RUN until T - 31 seconds.
BFS Payload MDM Bypass Indication	<p>BFS communicates with PF1 and PF2 over the payload data buses once it is taken to RUN. If one of them is bypassed, I/O ERROR PF1(2) is annunciated. The loss of a PF MDM results in the loss of one half of the command and feedback capability to open the payload bay doors once on orbit.</p> <p>There is a preplanned contingency procedure allowing the payload buses to be port moded in the PASS, BFS I/O RESET, and then verify recovery of the MDM. If the MDM is recovered, then it is assumed that the problem was a port-dependent problem at the MDM, and all functionality has</p>



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been regained.

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**BFS**

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<b>BFS-10</b>	Monitored until T - 31 seconds.
BFS MCDS Anomaly MCDS BITE Register I/O ERROR CRT CRT BITE Crew indication of failed CRT	Failure of any forward CRT could result in either the commander and pilot having to share a CRT, or requiring one of the CRTs to be shared between PASS and BFS during ascent and entry. This off-nominal configuration could result in a reduction of insight into shuttle GNC and SM operations, cause confusion, or lead to mistakes. This LCC applies whether the failure is at the DU, DEU, or the GPC.  This LCC also covers anomalies seen by the BFS and not seen by the PASS.  Troubleshooting procedures include getting input from crewmembers on what was seen on the effected CRT. If the error can be explained using a USER or OPS note, the count can continue. Otherwise, there is risk of losing that CRT during ascent.
<b>BFS-10a</b>	Monitored until T - 31 seconds.
BFS MEDS Anomaly	On the occurrence of an error, the MEDS function must be verified using the preplanned contingency procedures prior to continuing the count.  Failure of any forward IDP could result in either the commander or pilot having to share a CRT, or requiring one of the CRTs to be shared between PASS and BFS during ascent and entry. IDP 4 and AFD 1 requirements are mission-dependent and will be specified in the MEL.  For off-nominal Status Words, the LCC contains a list of conditions that are acceptable for launch.
<b>BFS-11</b>	Snapshot After BFS Nav Start (T - 3 minutes, 50 seconds)
BFS IMU Initialization Data Anomaly	At T - 4 minutes, the IMU platforms are released and PASS calculates the IMU alignment matrices. The PASS then transfers these matrices to the BFS. If these matrices do not pass a BFS reasonableness test, BFS will issue RM FAIL XFER message indicating that it did not incorporate these into its software. Therefore, the BFS has not been initialized properly and cannot be relied upon if a BFS engage were required.  This failure count be attributed to a PASS or BFS software problem.
<b>BFS-12</b>	Monitored until T - 31 seconds.
BFS I/O Error Log Illegal OP Code Boundary Alignment Self-Test Error	Any of these errors indicate there may be a BFS flight software problem. If any of these I/O errors are incurred, the count will be held at the next available hold time to evaluate. The error must be understood and deemed acceptable for flight before the countdown can resume.  The count will be held for a single or multiple occurrence of these errors.
<b>BFS-13</b>	This requirement deleted as of OI-22.
BFS Transmitter Anomaly	

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**BFS-14**

BFS SEC  
(lower memory)

Monitored until T - 31 seconds.

The LCC states that the count is allowed to continue if the soft error counter (SEC) for lower memory is less than or equal to two. (The SEC for upper memory is not monitored.)

The AP101S GPCs have CMOS technology main memory that is vulnerable to bit toggles caused by exposure to natural space radiation. To compensate for these expected errors, the AP101S is equipped with error detection and correction (EDAC), a hardware function that detects and corrects single bit errors and detects multibit errors per halfword. When the CPU or IOP accesses the main memory, the location contents pass through the EDAC first. If a single bit error is detected, it is corrected; if a multibit error is detected, the computer goes into the wait state and halts processing. Note that for IOP or CPU accesses, the SEC is not incremented nor is the memory location corrected.

Another user of the EDAC is the main memory scrub. The scrub is a hardware process that cycles through main memory to determine if an error has occurred since the last scrub (every 1.7 seconds). If a single bit error is detected, it is corrected and the SEC is incremented. If a multibit error is detected, the SEC is incremented, the error is not corrected and it is red back into its location. This location will continue to have an error detected every 1.7 seconds. Note, if this address is accessed by the CPU or IOP as described above, the EDAC will again interrogate it for errors, but the computer will enter the wait state and fail.

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**BFS-15**

I/O ERROR PCM

Monitored until T - 5 minutes.

Potential loss of BFS SM and PDI data to ground and crew displays. Troubleshooting procedure allows for a swap of the PCMMU as long as this is the only error annunciated (i.e., no GPC or MDM messages indicating there may be another problem). If the error is cleared with the PCM swap, the count can continue.

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The following is a brief summary of some DPS-related problems that could result in a countdown "hold/abort" as a result of either an LCC violation or an RSLs hold/abort (violation after main engine start) condition.

PRCB BASELINED LCC\*

<u>Time</u>	<u>LPS "DPS" hold conditions</u>	<u>RSLs "DPS" Hold*</u>
From T - 20 min	<ul style="list-style-type: none"> <li>• MMU I/O error on OPS transition (workarounds to continue count, including selection of alternate area)</li> <li>• FF/FA (GNC INIT) bypasses</li> <li>• FF/FA MDM return word bypasses (HFE)</li> <li>• FF/FA PROM SEG bypasses                             <ul style="list-style-type: none"> <li>- PROM SEQ 1-2 (MFE)</li> <li>- PROM SEQ 2-6 (HFE)</li> <li>- PROM SEQ 3-10 (HFE)</li> </ul> </li> <li>• Following avionics/system bypasses                             <ul style="list-style-type: none"> <li>- IMU</li> <li>- ADTA</li> <li>- TACAN/RA (2 TACANS required)</li> <li>- NSP</li> </ul> </li> <li>• MTU bypass or accumulator faultdown (2 of 3 accumulators required)</li> <li>• CRT failure (factors: I/O errors, crit bite, MCDS BITE status, crew assessment)</li> <li>• I/O errors possibly implicating FSW as a possible cause:                             <ul style="list-style-type: none"> <li>- Illegal OP code (stat reg bit 29)</li> <li>- Boundary align (stat reg bit 28)</li> <li>- Self-test error (stat reg bit 22)</li> </ul> </li> </ul> <p>See note 1 at bottom Note: Bits are counted starting with bit 0 (0-31 bits).</p> <p>Reference: PASS User's Guide, Section 2; Input/Output (I/O) Errors.</p>	<ul style="list-style-type: none"> <li>• NO</li> <li>• EIU (1-3) P1&amp;P4 HFE comm faults (2) (note 2)</li> <li>• NO</li> <li>• T - 15 sec to T - 0 (note 2)</li> <li>• NO</li> <li>• NO</li> <li>• Comm fault (PIC voltage) to T - 0</li> <li>• NO</li> <li>• NO</li> <li>• NO</li> <li>• NO</li> <li>• NO</li> <li>• NO</li> <li>• Not explicitly, but comm faults/bypasses as a result of I/O errors could result in a hold or abort to T - 0.</li> </ul>
T - 31 sec	<ul style="list-style-type: none"> <li>• GPC ERROR(s)</li> <li>• GPC BITE FSP message</li> <li>• MDM OUTPUT X FSP message (X=MDM)</li> <li>• SUMWORD X FSP message (X=ICC#)</li> </ul>	<ul style="list-style-type: none"> <li>• NO</li> <li>• NO</li> <li>• NO</li> <li>• NO</li> </ul>
T - 10 sec	<ul style="list-style-type: none"> <li>• LPS will not automatically monitor nor will it hold for any I/O errors, GPC errors, or FSP messages after T - 10</li> </ul>	
T - zero (launch)		

There are other "DPS-related" LCC (such as MM ready and BFS engage discrettes) that are monitored for failure indications, but they were not included in this summary since they are hardware-related and FSW does nothing more than D/L the measurements. Obviously, there are numerous other LCC and/or RSLs hold and abort conditions not indicated here (e.g., main engine condition, vent door conditions, etc.).

Note 1: The PRCB-baselined LCC was modified to add these three I/O error conditions as LCC violations down to T - 31 seconds. The probability of these errors is infinitesimal, but if one should occur it is a possible indication of an error in IOP (MSC/BCE) code, much of which is unprotected and does not get compared at the T - 20 dump and compare.

Note 2: User note for DR 101362 addresses a misleading abort indication; i.e., an MDM failure can be annunciated as a PAD data path fail abort.

**REFERENCES**

1. Shuttle Launch Commit Criteria and Background, NSTS 16007, Rev. F, May 1, 1992.
2. MER Support Note 3 provided by Loral.

**TITLE**

ASCENT TIMELINE

**PURPOSE**

The Ascent Checklist is designed to provide the DPS/DPS SPT ascent operators with an event timeline of the DPS-specific objectives/tasks that are required while in OPS 1. In addition, the checklist contains DPS failure cases and the cues that should be used to determine the failure mode and make the appropriate call. This section may be used pre-sim/flight for a quick review, or even real time to verify that all possible signatures have been examined.

**ASCENT TIMELINE**

T - 0	DPS - "Lift-off confirmed" call on FD loop FDF - CUE CARDS/AESP
T + 2:05	SRB sep - check PASS/BFS MM 103
MECO + 0:18	ET sep - check PASS/BFS MM 104
POST ET-SEP (MM104)	FDF-ASC PKT C/L
MECO + 5:00	TMBU LOADS (nom asc, ATO, AOA, and TAL only) DPS - Request go from flight for TMBU loads DPS SPT - Coordinate loads with Instrumentation (INST)
MET 00:50	FDF - Post-Insertion, Orbit OPS C/L, MALF PROC Configure workstation desktops, as appropriate Configure delta Ts per SCP 6.2 - Time Bias Adjustment

**REFERENCES**

1. Data Processing System Console Handbook, JSC-18819.

**FAILURE CUES**

**GPC FAIL**

- √Signature
- √Fail-to-sync/halt
- √GPC power/mode sw pos
- √RS/CS status

**PL MDM BYP**

- √BFS stby/run
- √PL power status
- √I/O term A

**MDM BYPASS**

- √Signature
- √GPC or MDM
  - MSC T/O, BFS string down - GPC
  - No MSC T/O, BFS same as PASS - MDM
- If @ MDM
  - √Power status

**LOSS OF BFS D/L**

- √PASS disc wd A
- √CMDR of PL buses

**BFS ENGAGE**

- √PASS GPCs halt

**OFF/BUSY MMU**

- √Power status

**PASS GPC FAIL TO INTERNAL TIME**

- Consider GPC failed, instruct crew to take GPC to STBY-HALT ASAP. (Reference CS/RS Sync SB on Sync Holes).

**PASS GPC I/O TERM B FAIL HIGH**

- Cycle output switch when crew is able; if restring required, call crew to not take GPC to STBY-HALT. Run PASS GPC FAIL procedure except GPC to STBY-HALT step.

**BFS DOWNMODES A STRING**

- √Erroring BCE
- Call other BCE on string recovered on BFS engage

**PASS STRING DOWNMODE**

- √GPC fail
- √I/O term B

**CRT FAIL**

- √Status words
- √Power
- √Poll header wd
- √Hung spec
- √Sel A and B discretes

**ASCENT PROCEDURES**

**LOSS OF OF1/OF2**

- Perform TPC time sub (ref. FCOH 8.3)
- Contact TELCOM on NIP SUP loop.

**IF OF1 FAILED**

- Request MTU-2 GMT and MET be substituted for MTU-1 OGMT and OMET

**IF OF2 FAILED as well:**

- Substitute GPC GMT and MET for MTU-1 OGMT and OMET

**TAL ABORT**

- OPS transition <68 sec else BFS engage
- PASS/BFS in MM 304
- Select OPS 0 fault page during transition (if available); select after MMU pre-positioning is complete if the MMU is used to get the OPS 3 overlay

**BFS NO/GO FOR ENGAGE**

- BFS GPC output switch to term

**BFS SELF ENGAGE**

- If single failure away, call to flight director
- If engages, call "Engage BFS and perform I/O reset"

Note: If two engage discretes, DO NOT take output to norm (causes engage)

**ABORT SELECTION**

- Verify BFS recognized the abort on DPS Overview

**RTL5 ABORT**

- "601 confirmed"
- Expect I/O reset for MLS upmode

## TITLE

ORBIT RESPONSIBILITIES

## PURPOSE

This procedure is intended to provide the DPS on-orbit console operator with an idea of what tasks are expected to be accomplished during the shift. The following is intended to be a minimum list of tasks that might be required to be done on-orbit. This is not intended to be a complete list, nor is it intended to imply that this is all that the on-orbit team may be required to perform. As our flights continue, this list will be updated to reflect any additions or deletions of tasks.

## BACKGROUND

The DPS system is the heart of the Space Shuttle data system. This requires the DPS operator to be knowledgeable of all on-orbit operations and to keep track of most data and configuration changes. The exact number of data and configuration changes will vary with the flight requirements. The following is an attempt to list some of the standard things that a DPS operator can be required to do.

## DESCRIPTION

### A. Time Bias Adjustment ( $\Delta T$ )

Time error measurement is accomplished via special computations that compare onboard Greenwich mean time (GMT) to a very accurate STDN GMT ( $\pm 25$  microseconds). The computations that DPS SPT adjusts during the orbit timeframe are displayed as MTU2 $\Delta T$ , GNC  $\Delta T$ , and SM  $\Delta T$ . DPS SPT enters the biases via the workstation and then transmits them to the MOC to take out any comparison errors between the site and onboard GMT. After the G2/S2 set is configured in post-insertion, DPS SPT should zero the MTU2 and GNC delta times on one Tracking and Data Relay Satellite (TDRS), and the SM delta time should be zeroed on the other. Any time pseudo-sync is lost (OPS transitions, telemetry format load (TFL) changes, PCMMU swaps, etc.), the GNC and SM delta times should be "re-zeroed" on the appropriate TDRS. This procedure is contained in SCP 6.2. Once the adjustment is made, the value is used by the  $\Delta T$  computation to compute the  $\Delta$  error between the ground and onboard GMT.

### B. SM Checkpoint

After sufficient uplinking to the vehicle has been accomplished, this information can be saved on the mass memory unit(s) (MMU). This is accomplished by the crew as part of the post-insertion FDF (approx. MET 2:30) and part of the presleep activity (ORB OPS C/L). This procedure writes specific data out to the MMU. This data includes such things as FDA parameters, which are changeable via a TMBU, and the TDRS state vector. However, it does not include the variable parameters (VPs).

The checkpoint is performed to both MMUs, one at a time, starting with MMU 2. After TMBUs are saved on an SM checkpoint, they should be deleted.

**C. Variable Parameters**

The SM and GNC major functions allow for the input of 10 GPC addresses, which are included as part of the downlist. The contents of these addresses change depending on which phase of flight is operational. The orbit DPS operator should ensure that the on-orbit VP addresses get onboard properly. At times during that orbit shift, other flight controllers may ask DPS for temporary changes to be made to the VP list for various reasons; i.e., COAS, GMEM, etc. The DPS operator should ensure that these changes are incorporated properly, and when no longer required, are deleted and the nominal VPs restored. This procedure is contained in SCP 7.6, PASS Variable Parameters.

**D. FCS Checkout**

Generally, the day before scheduled entry, the orbiter flight control surfaces are checked to ensure their operability for entry. This procedure is accomplished by transitioning to OPS 8. During this OPS transition and (after the checkout is complete) during the OPS 8 to OPS 2 transition, DPS should monitor the health of the DPS system. Problems such as mass memory read errors should be monitored to assist in successful OPS transitions. If the OPS 8 to OPS 2 transition cannot be accomplished, the G2FD will be used to place the DPS in a more desirable configuration than OPS 8.

**E. OFS and SPECS Backups**

Daily, during flights, the SPECS and OFS logs need to be saved to provide for a daily backup capability. The backups are to be performed during normal work hours; so the lead will assign this to the team on console during normal work hours for the particular flight. The SPECS log is saved by using DNAV DPS II Tools | SPECS Log Backup. The OFS logs are saved by using the save to file option under the OFS file menu or DNAV DPS II Tools | OFS Log Backup. These logs need to be printed out at the end of the flight by the entry team before leaving console. After that, the logs can be cleared out.

**ORBIT FLIGHT RULES**

A2.102	MISSION DURATION REQUIREMENTS
A2.104	DPS SYSTEM REDUNDANCY REQUIREMENTS
A2.105	IN-FLIGHT MAINTENANCE
A2.111	DPS COMMAND CRITERIA (GMEMS)
A2.117	RNDZ/PROX OPS GNC SYSTEMS MANAGEMENT
A2.120	RNDZ/PROX OPS DPS SYSTEMS MANAGEMENT
A2.301	CONTINGENCY ACTION SUMMARY
A2.1001	ORBITER SYSTEMS GO/NO-GO

A7.201	DPS REDUNDANCY REQUIREMENTS
A7.10	GNC GPC REACTIVATION PRIORITY
A7.11	GNC GPC REDUNDANCY REQUIREMENTS
A7.1	PASS DPS FAILURE
A7.2	UNRECOVERABLE GPC
A7.4	TRANSIENT GPC
A7.8	REDUNDANT SET FAILURE
A7.9	REDUNDANT SET SPLIT
A7.3	GPC FAILURE
A7.6	DATA PATH FAILURE
A7.13	GPC MAJOR FUNCTION CONFIGURATION
A7.16	GPC MEMORY WRITE CRITERIA
A7.17	GPC MEMORY DUMP CRITERIA
A7.102	PASS DATA BUS ASSIGNMENT CRITERIA
A7.103	I/O RESET
A7.101	POWER CYCLING/MANAGEMENT
A7.105	MDM PORT MODING
A7.106	MMU OPERATIONS
A7.107	TIME MANAGEMENT
A7.109	IN-FLIGHT MAINTENANCE (IFM)
A7.7	POWERED OFF GPC ACTION (101S)
A7.15	SM OPS 4 TRANSITION REQUIREMENTS
A7.104	NON-UNIVERSAL I/O ERROR ACTION
A7.14	GNC 3 ARCHIVE MANAGEMENT
A7.53	ON-ORBIT BFS MANAGEMENT GUIDELINES
A7.1001	DPS GO/NO-GO MATRIX
ANNEX	PAYLOAD SPECIFIC DPS FLIGHT RULES



**TITLE**

**ENTRY TIMELINE**

**PURPOSE**

This SCP gives the console operator a quick reference look at important events/information during the deorbit and entry periods.

**DEORBIT PREP**

<u>Timeline (approx. times)</u>	<u>Reminders</u>
TIG - 3:29 DPS config	- Checkout of BFS/CRT interface and set expansion to dual G2 config, if req'd
TIG - 3:12 Go for PLBD closing	
TIG - 2:40 PLBD closing	
TIG - 2:16 Go for OPS 3	- Limited dumps after G3 (no playbacks after T - 1 hr)
TIG - 2:18 Go to entry pocket C/L DPS config	- Check GPC 1 and 2 transition to GNC OPS 301/SM checkpoint/BFS to 301/all PASS GPCs to 301/reconfigure MC9 for postlanding
TIG - 2:05 Send entry VPs	- Entry VPs uplinked after G3 transition
TIG - 2:00 (301) Send BFS TMBUs	- No TMBUs after 302
TIG - 0:20 MCC Go for burn	- Deorbit burn rules → entry checklist

Notes: 1. BFS

- Move if: (time permitting)
  - Failed (no CRTs/GPC SUM/GPC BITE/CNTL CA1/I/O TERM B FAIL HIGH)
  - IP BCE failed
  - PL1 or PL2 BCE failed
  - One or more FC BCE failed

2. Engage considerations

BFS requires two of three engage discrettes and no I/O Term B to engage.  
BFC requires three of three discrettes from one hand controller to inhibit the I/O Term B to the BFS.

PASS requires three of three engage discrettes and I/O Term B to recognize engage.

If PASS GPC does not recognize engage, STBY/HALT.

**ENTRY**

**A. BFS Health**

1. NO GO for engage if:

Loss of BFS BFC CRT SEL discrettes and the BFS I/O Term B discrete simultaneously (Loss of I/O Term B causes BFS-engage to be suspect)  
 Lose track > 45 sec (while in MM 304, 305, 602, or 603)  
 No forward CRT interface  
 Loss of some LRUs (GNC call) -- consider port mode  
 Loss of CA1 (if BFS in GPC 3 or 5) or ESS 3AB (regardless which GPC BFS resides)  
 Loss of AB3 (if BFS resides in GPC 1,2, or 4)  
 BFS I/O TERM B fails high

2. If BFS IPL Sel fails on (BFS gives up CRT), use GPC/CRT option

**B. BFS Suspect After the Following Conditions:**

1. Transient HALT
2. IPL during ascent
3. Unexplained "GPC SUM," "GPC BITE," or "GPC PWR" fault message
4. BFS I/O TERM B fails Low
5. BFS I/O TERM A fails HIGH (until status of I/O TERM B can be verified)

**C. Orbiter LRU/Systems to Track**

<u>Discipline</u>	<u>LRU/system</u>	<u>Impacts</u>
MMACS	APU	Nosewheel steering Flight control surface channels
	Tires	Restraining for nosewheel steering
GNC	IMU	Keep separated
EECOM	Power	All equipment
INCO	PL MDMs	NSPs; BFS commanding

**D. PASS Health**

1. If GPC 1 or 4 down, give FD HUD recovery.
2. Consider need for nosewheel steering and/or vent door open capability during restraining recommendations.
3. Call to FD if PASS has problem, but BFS will pick up MDM on engage.

**E. Postlanding**

1. Look for postlanding procedure/NBAT changes.
2. Verify transition to OPS 901.
3. SSME repositioning if all FA MDMs are available and all other system constraints are met. (See Flight Rule A16.1.1-9.)
4. Print out the SPECs and OFS logs. After obtaining a satisfactory printout of the logs, delete the files.
5. Move flight-specific Post Insertion and Flight Rules Annex to FDF binder for ALL consoles. Move datapack to postflights datapack binder for all consoles.
6. Print a copy of the uplink status log for the postflight paperwork using DNAV DPS II Tools I Print Uplink Log.
7. Entry team responsible for return of office documentation.

**DEORBIT FLIGHT RULES**

A2.203	DEORBIT DELAY GUIDELINES
A2.257	DEORBIT BURN TERMINATION
A2.301	CONTINGENCY ACTION SUMMARY
A7.51	BFS DPS FAILURE
A7.17	GPC MEMORY DUMP CRITERIA
A7.102	PASS DATA BUS ASSIGNMENT CRITERIA
A7.5	PASS GPC BCE FAILURE MANAGEMENT
A7.1001	DPS GO/NO-GO CRITERIA
ENTRY C/L	DEORBIT BURN RULES

**ENTRY FLIGHT RULES**

A2.254	STRING REASSIGNMENT
A2.258	BFS ENGAGE
A2.261	ENTRY DTO/AUTO MODE GO/NO-GO
A7.12	PASS/BFS REDUNDANCY
A7.1	PASS DPS FAILURE
A7.51	BFS DPS FAILURE
A7.3	UNRECOVERABLE GPC
A7.4	TRANSIENT GPC
A7.8	REDUNDANT SET FAILURE
A7.9	REDUNDANT SET SPLIT
A7.3	GPC FAILURE
A7.6	DATA PATH FAILURE
A7.13	GPC MAJOR FUNCTION CONFIGURATION
A7.102	PASS DATA BUS ASSIGNMENT CRITERIA

A7.103 I/O RESET  
A7.5 PASS GPC BCE FAILURE MANAGEMENT  
A7.101 POWER CYCLING/MANAGEMENT  
A7.105 MDM PORT MODING  
A7.104 NON-UNIVERSAL I/O ERROR ACTION  
A7.52 ASCENT/ENTRY BFS MANAGEMENT GUIDELINES  
A7.1001 DPS GO/NO-GO MATRIX  
A8.56 BFS LRU REQUIREMENTS

**POSTLANDING FLIGHT RULES**

A16.9 SSME REPOSITIONING CONSTRAINT

**REFERENCES**

1. NSTS Flight Data File, Deorbit Prep, Generic, rev C.

## TITLE

POST-FLIGHT REPORTS

## PURPOSE

To provide guidelines for preparation of Shuttle DPS post-flight reports, including:

- A. Post-Flight Report Topics
- B. Timeline for Report Generation
- C. Miscellaneous Topics

## BACKGROUND INFORMATION

DPS post-flight reports have evolved over the years, but over time, have become fairly standardized. While DPS post-flight reports contain some general mission information, the focus is to provide detailed information pertinent to the Shuttle DPS subsystem and address problems/issues of historical interest to a DPS flight controller. The post-flight report documents system failures that occurred during a mission and should address the following areas:

- DPS anomalies or failures (document in detail).
- DPS system configurations utilized during the mission.
- DPS-related FDF problems needing corrections or improvements.
- DPS console documentation problems requiring corrections or clarification.
- Problems with flight rules that require updates.
- General mission data.
- Unique timelines or mission configurations.

## PROCEDURE

### A. Post-Flight Report Topics

This section identifies standard topics and establishes the general post-flight report requirements. The post-flight report format is not meant to constrain or limit the DPS Flight Lead. However, deviating from the general requirements should be coordinated with the DPS Group Lead.

The DPS Flight Lead may identify other types of data that are needed for a specific mission (e.g., track explainable error signatures for new DPS hardware). The DPS Flight Lead is expected to brief other team members prior to the mission to ensure everyone understands any requirements to collect appropriate mission data.

1. Front Cover Page - Include STS mission number and title (DPS Post-Flight Report). Although optional, current style is to include the mission patch (for consistency, near top of page, and approximately 3-¼ X 3-¼ image). This is followed by the names of the FCR team members supporting the flight. Only the DPS Flight Lead's signature is required on the original paper copy.

Historically, paper versions of DPS post-flight reports had included signatures of all FCR console officers. While there was no MOD requirement for this, it was carried forward from STS-1 as a historical precedent.

2. Table of Contents - Assists the reader in quickly identifying topics of interest.
3. Mission Summary - Include a general mission overview and a DPS perspective of mission overview. An optional mission daily summary may also be included.
  - (a) A general mission overview includes information as to which orbiter was flown, and at the option of the DPS Flight Lead, the number of missions it has flown. Also, include an overview of the major mission objectives, such as, ISS assembly or logistical missions, crew rotations, EVAs, and any satellite deploy and retrieval operations. The mission overview should also include information relative to any Shuttle launch scrub, mission extension, entry wave off, and the reason for those mission changes.
  - (b) A DPS perspective of the mission should provide a brief summary of DPS in-flight anomalies or DPS funnies, plus any in-flight issues pertinent to the DPS discipline. The intent is to allow the reader to quickly identify whether or not there were DPS issues during the mission.
  - (c) Although optional, the DPS Flight Lead is encouraged to include a brief summary of each day's events. This requires a minimal effort if performed daily during the mission.
4. Payload/Mission Objective - This is a statement defining the major mission objective and/or major payloads flown on the mission. Sub-sections should be included to provide a brief summary of the primary and secondary payloads. At the very least, the two sections should spell out payload acronyms.

Orbiter payloads tend to drive mission timelines and Execute Package content. A general knowledge of the payloads is helpful in understanding required DPS configurations and failure responses. In addition, a payload may occasionally be impacted by a DPS in-flight failure, or vice versa. If so, a brief description of the payload might provide additional insight into required mission actions.

The DPS Flight Lead may elect to provide a more extensive overview of a major payload, including interesting facts and/or images of the payload. Since secondary payloads rarely drive DPS configurations or require direct DPS interfaces, little benefit is derived by including their detailed descriptions.

Normally, such payload overview information is available well before a mission is scheduled to fly (data may be obtained from JSC and/or KSC PAO websites). Not only does such data provide useful post-flight report information (typically requiring only minor tweaks), the data serves as an informative pre-mission tool for bringing the assigned DPS Flight Control Team (FCT) up to speed.

5. Flight Design Profile - Include a brief tabulation summarizing various mission design parameters: Orbiter vehicle; launch and landing dates and times; and pre-mission planned and actual mission duration. While optional, planned launch inclination, insertion altitude, and rendezvous altitude may be included.
6. Shuttle Crew - Include a brief tabulation summarizing Shuttle crewmembers. If the flight crew worked dual shifts while on-orbit, the summary typically identifies both Red and Blue team members. For Shuttle missions supporting ISS crew rotations, the crew summary should note which crewmembers were rotated.
7. Flight Control Teams - Include a brief tabulation identifying the Shuttle Flight Directors and DPS team members supporting each FCT, including Prelaunch team. Identify Shuttle Lead Flight Director, DPS Flight Lead, and individuals officially assigned as FCR or MPSR OJTs. There is no requirement to identify unassigned OJTs. Identify any DPS FCR or MPSR personnel substitutions during the mission and any MPSR personnel "On Call" for one or more shifts during the mission.
8. PASS/BFS/MEDS Software Configuration - Include a brief tabulation identifying flight software versions, including MEDS IDP and MDU software, flown on the mission. This data may be found elsewhere, but it is not necessarily readily available. The post-flight report can serve as a useful tool when attempting to track flight software OI releases.
9. DPS Mission Statistics - Include summaries of PASS and BFS OPS transitions, DPS-related command uplinks, and PASS/BFS GPC errors logged at landing.
  - (a) The OPS transition summary provides a listing of all PASS and BFS OPS transitions, all PASS set expansion and set contraction times, and any GPC freeze dry times. The period of coverage ranges from the prelaunch G9-G1 OPS transition to the post-landing G9 set contraction. Only the GMT start time for the OPS transition is required (DDD/HH:MM:SS).

There is no requirement to track the actual time durations to complete an OPS transition. However, for any anomalous SSMM OPS transition, timing details should be reported in the write-up for the anomaly itself.

During early Shuttle missions, DPS teams maintained a log of the actual times required to complete pre-positioning and OPS overlays. However, such data is no longer tracked since there is no value added to the report.
  - (b) The uplinks summary attempts to capture the types and total number of DPS-related command loads uplinked, or loads uplinked by DPS on behalf of another discipline (i.e., ISS TMBUs) to the PASS and BFS. Experience has shown that the actual uplink times are rarely needed. If required, the DPS console logs or INCO's MCC uplink command history are available to identify a precise command load uplink time.

The DPS FCT serves as a point-of-contact for all DEU Equivalent loads, GMEM loads, and Variable Parameters. A list of these loads is included in the post-flight report. The DPS FCT also serves as the coordinator for all BFS TMBUs uplinked throughout a mission (prelaunch count, Ascent, or Entry timeframes); therefore, a list of those loads is also included.

The prelaunch DOLILU load is not tracked since it is not a DPS command load. Likewise, each individual discipline is responsible for management of their own PASS SM TMBU uplinks. Consequently, for non-ISS missions, the post-flight report has no requirement to track SM TMBU loads.

- (c) The PASS/BFS GPC errors summary captures GPC errors logged during post-landing. Although the number and type of errors are listed, there is no requirement to track time-tags associated with either PASS or BFS errors. The post-flight report should identify any error codes, and most probable reason for the occurrence for any unexpected errors. The DPS Flight Lead may want to include all GPC errors, including those that are explained by User/OPS Notes.

Historically, the post-flight report lists the BFS GPC errors at post-landing wheels stop. This captures data occurring only during the Entry timeframe. This is because the BFS GPC error logs are cleared as part of the System Reset function whenever the BFS is brought up from HALT. Consequently, BFS GPC errors occurring during the prelaunch and Ascent timeframes are lost. Traditionally, no attempt has been made to capture such data.

10. Flight Items of Interest - This is the main section of the post-flight report. It includes a variety of topics such as MCC workstation and DPS applications problems; DPS issues during vehicle turn-around period, prelaunch-count and Ascent timeframe; DPS in-flight anomalies and/or DPS issues; post-landing issues; and a summary of DPS LRUs flown during the mission.
  - (a) Post-Flight Actions and the DF Systems Issues 'Quick Look' are listed in this section and are normally provided as appendices. Although vehicle turnaround issues are covered as part of the Flight Readiness Review (FRR), at the discretion of the DPS Flight Lead, an abbreviated version of DPS FRR and Delta FRR input packages may be included as an appendix.
  - (b) MCC workstation and DPS application problems are documented in this section with a description of the problem, any procedural workarounds, and the associated MCC AR number.
  - (c) Include any issues that occurred during the prelaunch count (especially if it led to a launch scrub), at lift-off, or during the Ascent timeframe. Provide sufficient detail to understand the issue even if it does not directly impact the Shuttle DPS or the DPS flight controller discipline. Identify procedures supported, such as DOLILU (day-of-launch I-Load uplink).



- (d) Write-ups pertaining to DPS in-flight anomalies, issues, or DPS lessons learned should be covered in detail. Reference any IFA numbers and include all information provided in an anomaly report. Present anomaly write-ups in chronological order.

Each write-up should include the GMT time-tag of the occurrence, any crew observations and actions, error log entries, and any fault messages. If the anomaly was likely the result of a DPS hardware problem, include the LRU serial number. Avoid including only hexadecimal error data (provide a brief description of the pertinent data). If the anomaly is explained by an OPS or User Note, then reference the appropriate program note, the occurrence, and anomalous signature.

If the write-up presents a conclusion or most probable cause for the IFA, the use of engineering judgment is certainly acceptable. However, be sure to document your rationale and supporting data.

- (e) Most post-landing issues are typically identified by KSC. Their initial vehicle inspection and standard post-landing LRU testing occasionally uncover an anomaly (e.g., an unexpected MDM BITE read signature).

While such information will be covered as part of the vehicle turnaround for that Orbiter's next assigned mission, the post-flight report should provide sufficient detail to document the issue. Often our KSC DPS counterparts can provide useful follow-up information in a timely fashion to support the post-flight report write-up.

- (f) Include a tabular summary of DPS LRUs flown during the mission. Since this information needs to be made available to the FCT prior to the mission, its inclusion in the post-flight report should require little effort.

11. Crew Debrief Comments - This section of the report is intended to capture pertinent information provided by flight crewmembers during the MER/FCT Debrief. Occasionally, the crew will note something that they did not feel warranted an A/G comment during the mission but could be useful information for upcoming missions.

While reviewing/discussing DPS IFAs, a crewmember will occasionally note additional error signatures or provide personal insights that often help diagnose the problem. Such insights may assist KSC in post-mission troubleshooting.

12. Post-Mission Follow-up - Typically, MER Anomaly paperwork is generated that corresponds to IFAs. KSC will open an Interim Problem Report (IPR) based upon the MER paperwork to formally track subsequent troubleshooting of the issue. KSC will also open an IPR for any anomaly occurring post-landing. KSC follow-up investigation and testing will often yield valuable insights into an IFA. Therefore, it is recommended to document this in the post-flight report.

However, if there's a time delay of more than two months, it may not justify holding up the generation of the post-flight report. In this case, the DPS Flight Lead may choose to modify this section of the report to capture pertinent post-mission follow-up issues, testing, or analysis prior to the next mission and note that the issue has not been completely resolved.

Information relative to failed LRUs that are subsequently R&R'd is not normally captured in the write-up covering the post-mission follow-up. Such information will be captured as part of the vehicle turnaround information provided in the FRR for the Orbiter's next mission.

13. Appendices - This section includes a collection of appendices referenced elsewhere within the post-flight report. They provide pertinent details to the mission or to issues noted during the course of the mission. It is recommended one take time to browse through prior post-flight reports. Once viewed, the various appendix formats should be self-explanatory.

- (a) Appendix 1: As Worked DPS Shift Schedule

Information presented in this appendix is based upon the FCT schedule, including updated schedules as generated by the Lead Flight Director. It is recommended the on-console team capture any updates in the console log. Otherwise, it becomes difficult to reconstruct the info post-mission.

- (b) Appendix 2: Vehicle-Turnaround IPRs (optional)

An abbreviated version of the DPS FRR and Delta FRR inputs.

- (c) Appendix 3: Post-Flight Actions

During most missions, one or more items are identified by a FCT member addressing issues requiring some sort of post-mission follow-up action. These typically involve: (1) documenting lessons learned, correcting technical errors, or clarification of a topic of discussion in DPS console documentation; and (2) correcting procedural errors observed in the FDF.

- (d) Appendix 4: DF/Systems Division Quick Look Report (optional)

Captures the DPS Quick Look presentation.

## B. Timeline for Report Generation

The DPS Flight Lead should publish a signed-off post-flight report within five to six weeks after landing. A guideline for the publication schedule is as follows:

1. Ten to twelve working days after landing, the DPS Flight Lead should have a draft copy ready for DPS FCT review. If the formal Crew Debrief has not yet occurred, that section will be TBS. All required Post-Flight Actions should be identified, but due dates and assignees need not be identified. At a minimum, the report should be made available to all FCR console officers and the DPS Group Lead to review and provide comments.

2. FCR console officers are allowed up to ten working days to review the draft copy of the report. The purpose of the review is to ensure no big picture details are overlooked and to check for any erroneous/incomplete conclusions. After draft document reviews are completed, the DPS Flight Lead will evaluate all comments/redlines and incorporate as appropriate.
3. The DPS Flight Lead will consult the DPS Group Lead for a list of Post-Flight Action assignees and recommended due dates.
4. A final version of the post-flight report should be completed within ten working days. A paper original will be generated and signed-off by the DPS Flight Lead. An electronic version of the final report will be made available for posting on the DPS Homepage website.

C. Miscellaneous Topics

1. Mission Background Information - The JSC and KSC PAO websites for manned spaceflight serve as excellent sources for both mission and payload overviews. The mission-specific Flight Requirements Document, Mission Integration Plan, and FDF Flight Plan (the flight plan notes tab) documentation may also serve as a source for such information. A listing of links to obtain pertinent mission background data is provided on the DPS Homepage website.
2. Post-Flight Actions - Documented in an Appendix format, the DPS Flight Lead will coordinate assignments and projected completion date with the DPS Group Lead. At the Group Lead's discretion, the DPS Flight Lead may be utilized to track and monitor closeout of the post-flight actions. However, the Group Lead may elect to add such assignments to an overall task list and track completion in that manner.
3. Post-Flight Report Distribution - The completed post-flight report will be posted on the DPS Homepage website. Paper copies will also be placed in the DPS Post-Flight Report binders in the MCC: one copy in the WFCR, and one copy in the WMPSR.
4. Report Template - DPS has elected not to maintain a formal post-flight report template. The recommended approach is to browse through recent post-flight reports, select one that best seems to fit current the mission, then save a copy of that document for use as a baseline for development of the report.

**REFERENCES**

None

**SECTION 4  
DATA PROCESSING SYSTEM STATUS**

**CONTENTS**

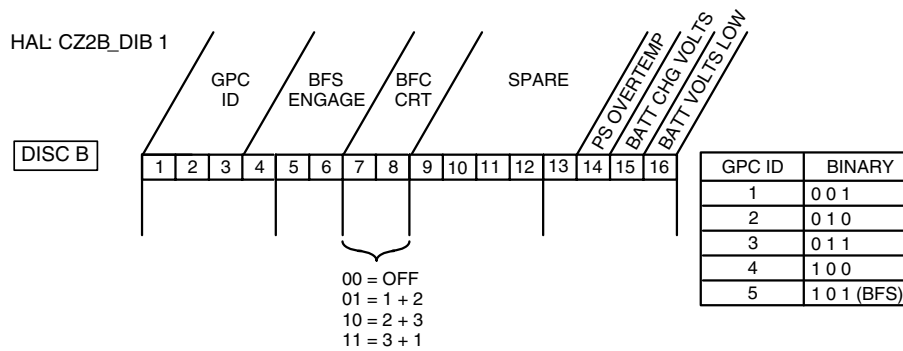
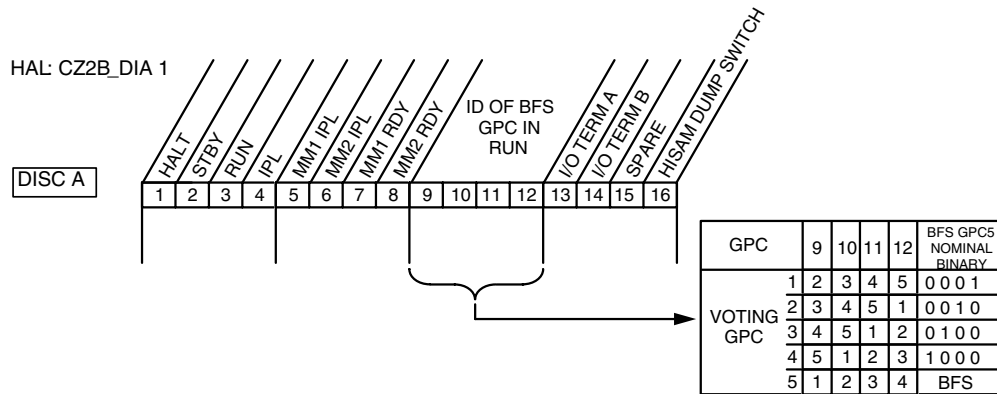
<b>Section</b>		<b>Page</b>
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**TITLE**

PASS STATUS

**PURPOSE**

This section provides a method for decoding various hex data that provide insight into the status of the PASS computers.



HAL: CZ2B\_ACT\_XMITR 1

PORT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BUS ID	IC1	IC2	IC3	IC4	IC5	DK1	DK2	DK3	DK4	PL1	PL2	LB1	LB2	FC5	FC6
BIT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

HAL: CZ2B\_ACT\_XMITR 2

PORT	16	17	18	19	20	21	22	23	24	SPARE						
BUS ID	FC7	FC8	MM1	MM2	FC1	FC2	FC3	FC4	P							
BIT	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

18819\_010

HAL: CZ2B\_BUS\_MASK 1

BUS MASK WD 1	PORT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	BUS ID		IC1	IC2	IC3	IC4	IC5	DK1	DK2	DK3	DK4	PL1	PL2	LB1	LB2	FC5	FC6
	BIT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

HAL: CZ2B\_BUS\_MASK 2

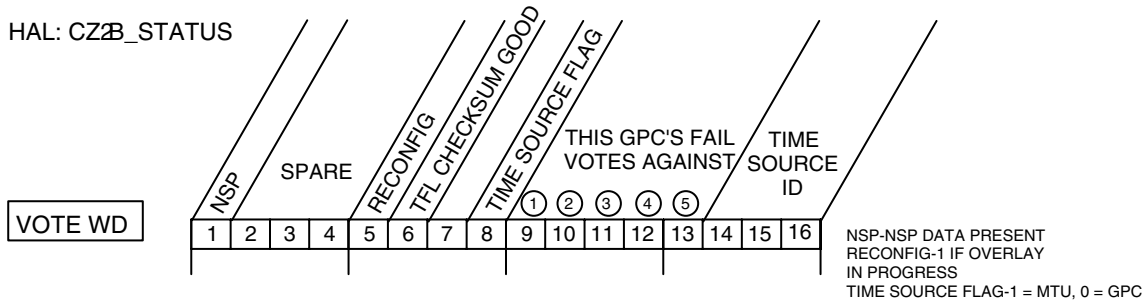
BUS MASK WD 2	PORT	16	17	18	19	20	21	22	23	24	SPARE						
	BUS ID	FC7	FC8	MM1	MM2	FC1	FC2	FC3	FC4	IP							
	BIT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

HAL: CZ2B\_CS & CZ2B\_RS

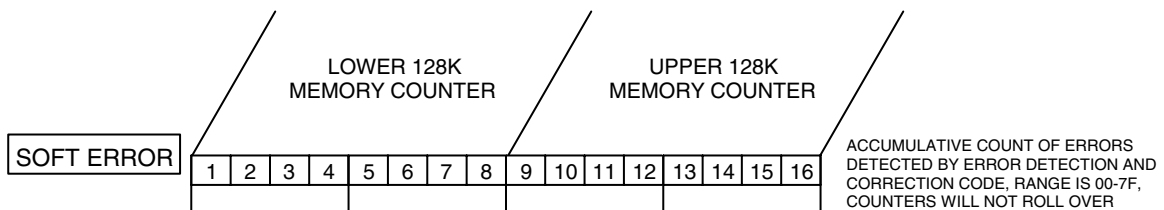
CS/RS MASK	GPC	SPARE										OTHER GPC'S IN SET					
	BIT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
												1	2	3	4	5	

SELF GPC ALWAYS 0  
1 - THAT GPC IN SET

HAL: CZ2B\_STATUS



HAL: CZ2V\_SOFT\_ERRORCOUNTER



18819\_011

## **REFERENCES**

1. NSTS Computer Program Development Specification (CPDS), System Level A Software Requirements, SS-P-0002-170, Table 6.4 (System Parameters).
2. PASS Flight Software Compool CZ2\_COMMON.

It should be noted that both reference sources are required to determine the formats identified in this SCP. The Level A CPDS defines parameters in terms of MSIDs and parameter description. The CZ2\_COMMON fiche defines parameters in terms of MSIDs and bit location/word copies. (Note that while the compool definition is in the form of "comment cards," it is, nevertheless, under configuration control since such data are interrelated with the downlist definition.) By matching MSIDs, it is possible to correlate parameter description and word/bit locations. Currently, there is no program-deliverable documentation that directly presents the data in the PASS status SCP format.



**TITLE**

PASS I/O ERROR MONITORING

**PURPOSE**

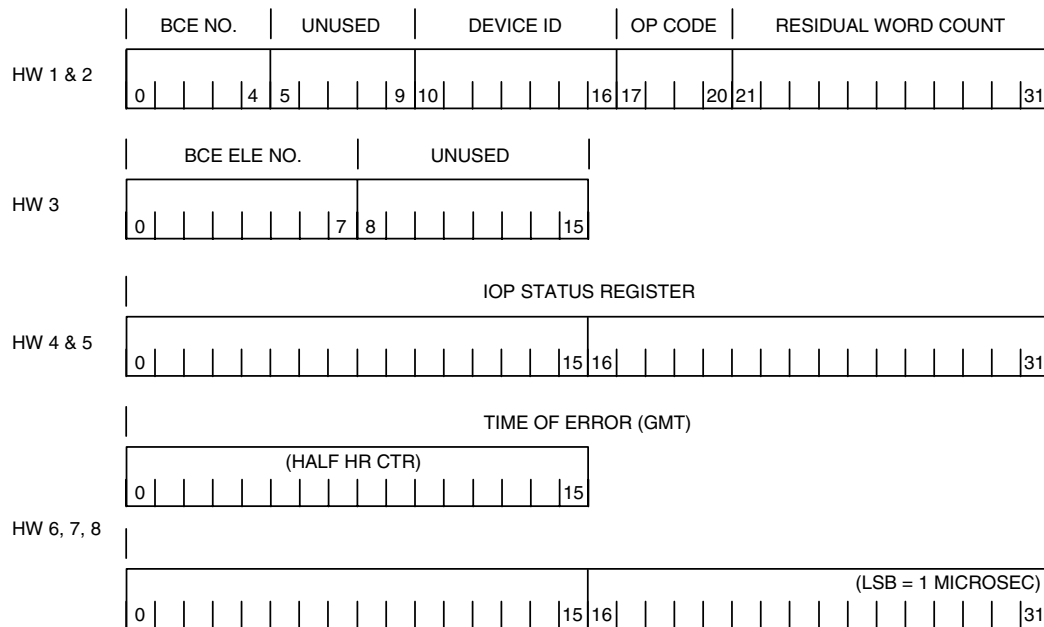
This procedure provides appropriate information useful in the real-time analysis of PASS I/O errors available on the DPS Overview application.

**DESCRIPTION**

The first part of this SCP defines each parameter associated with the I/O error monitoring and attempts to provide guidelines in assessing the I/O error monitoring data. A series of tables provided to permit the user to interpret and correlate the I/O error data (Tables 4.2-1 through 4.2-10) follows.

**A. Data Interpretation**

The I/O error logs provide the primary source of data available to support I/O error monitoring. The PASS I/O error logging is controlled by the FCOS LEVEL\_C\_I/O\_ERROR\_INTERRUPT-HANDLER (FIOERRLC), and updated via the I/O\_ERROR\_LOG\_ROUTINE (FIOLGERR). Each log entry consists of an array of eight halfwords as shown in Figure 4.2-1.



18819\_012

**Figure 4.2-1. I/O error log (single log entry)**

An additional halfword is included as part of the log entry that represents the last (most recent) I/O error for each GPC in the common set. The halfword is used to log the downlist total cumulative count of all I/O errors for the GPC and is displayed on DPS Overview. Upon execution of Item 48 on SPEC 0 (GPC MEMORY), the ERR LOG RESET clears the complete I/O Error Log, GPC error log, and DEU IPL error log, restarts (circular file) Sync Trace logging, and resets the CAM for the major function under which it is performed.

Note: In the event of an IOP hardware error that results in a software HALT condition, the I/O error log data will never be ICC'ed to the downlist GPC prior to the GPC F-T-S. In such a case, the I/O error condition cannot be identified until a memory dump has been executed for the sick GPC.

It should be noted that I/O error monitoring is intended to provide data to answer, "What happened?" rather than, "What do we do?" questions. The I/O error data, however, may be instrumental in assessing the health of the DPS and, thus, influence decisions affecting DPS downmoding and/or bus reconfiguration for both present and subsequent OPS modes.

In the event of a BCE bypass (DPS alerted via event light), I/O error assessment is fairly straightforward in that the GPC software has already taken action in response to repeated input transaction errors (that is, two consecutive I/O errors on the same transaction). In such cases, the primary responsibility of the DPS console position is to alert the MCC of present data and LRU losses; when appropriate, the MCC should be advised in a timely manner of the possibility of degraded capability during subsequent OPS modes. Table 4.2-5 defines each downlisted BCE BYPASS word in terms of input transaction and affected BTU. Should a PROM sequence be bypassed, the specific data loss may be determined via the MDM card channelization tables provided on console.

IOP-detected, timeout errors may provide insight to certain DPS failures. Such timeout signatures are summarized in Table 4.2-7.

In the event of a CRT-annunciated I/O error, it may be necessary to quickly summarize what happened (for example, status to Flight Director). Table 4.2-8 provides a summary of I/O errors versus annunciated message. Note that the following BCE elements may be bypassed within an OPS in which the element exists but without any corresponding fault message annunciation (ref. PASS user note 14403):

BCE Element	Active Ops					G9	P9
	G1/G6	G2	G3/G8	S2/S4			
IMU						X	
RR MFE		X				X	X
NSP discretetes	X	X	X	X	X	X	X
L,R OMS PC	X	X	X			X	X
Hyd Sys 3 Press C	X	X	X			X	X
GNC BITE 4 OPS init	X	X	X			X	
EIUs (MFE)	X					X	X
EIUs (HFE)	X						
SRB	X					X	X

1. I/O error log parameters

- Counter** Counter represents the algebraic decimal sum of the actual I/O Error Log cumulative counts logged against each GPC.
- ID** Transaction identifier identifies the unique device or transaction corresponding to the failed I/O transfer. A summary and brief description of all I/O device/transaction IDs is presented in Table 4.2-1. (The integer value of ID corresponds to bits 10 to 16 of first fullword of the I/O Error Log entry, Figure 4.2-1.)
- EL or Element** BCE element number uniquely identifies an LRU of PROM sequence that may be bypassed via software action within a particular input device/transaction ID. Table 4.2-2 presents a summary of all BCE elements including OPS availability. For all other I/O log errors, the value is set to zero. (Integer value corresponds to bits 0 to 7 of third halfword of the I/O Error Log entry, Figure 4.2-1.)
- BCE** BCE number identifies the type of I/O error (I/O transaction error, IOP hardware error, or memory-detected errors) summarized in Table 4.2-4. That is, the BCE number acts as a pointer to decode the contents of STAT data. (The integer value corresponds to bits 0 to 4 of first fullword of the I/O Error Log entry, Figure 4.2-1.) The BCE numbers are defined as follows:

1 to 24 - Identifies which BCE (IOP port number) detected a BCE NO-GO. Table 4.2-3 presents a summary of BCE number vs. data bus relationships.

25 -	Disabled, but would normally indicate IOP self-test failure. Also, cyclic IOP ALU self-test failures would be logged in the BCE 29 status word. However, both the data flow parity tests and the BCE 25 test are currently disabled and the shuttle community apparently has no plans to enable them.
26 -	Not used.
27 -	Indicates a PASS software-detected mass memory error (special MM error processing results).
28 -	Indicates an MSC timeout has occurred.
29 -	Indicates an IOP hardware level B interrupt has occurred (may result in a GPC software HALT).
30 -	Indicates an IOP hardware level A interrupt has occurred (may result in a GPC software HALT).
Status or Status WD	Status word (or IOP Status Register) provides detailed data pertinent to the failed I/O transaction. The hexadecimal value will be displayed in one of five formats depending on the type of error, which, in turn, is identified by the BCE number (hex value corresponds to the fourth and fifth halfwords of the I/O error log entry, Figure 4.2-1). Table 4.2-4 provides data to interpret the contents of Status word for BCEs 1 to 24, and BCEs 27 to 30, respectively.
OP	The OP code parameter associated with the device/transaction ID more completely defines the faulted I/O transaction. Although of limited usefulness to GNC type I/O transactions, the OP code may be useful for certain SM type I/O transactions. (The integer value corresponds to bits 17 to 20 of the first fullword of the I/O error log entry, Figure 4.2-1.) Table 4.2-1 identifies the OP CODE(s) corresponding to each ID. Those IDs without OP codes listed are basically single OP code IDs.
Time	GMT that I/O error was logged, in days:hrs:min:sec. (Value, which is based on the GPC "run time," not "clock time," corresponds to the last three halfwords of the I/O error log entry, Figure 4.2-1.) May be useful in correlating I/O errors with orbiter events (EMI-induced errors)

RWC Residual Word Count which identifies the number of response data words in an input transaction remaining to be processed by a BCE at the time of BCE NO-GO or MSC time-out. (The integer value corresponds to bits 21 to 31 of the first fullword of the I/O error log entry, Figure 4.2-1.) May be useful in isolating on I/O transaction failure to an MDM IOM card level.

2. BCE element bypass parameters

I/O errors are logged by FCOS on a device/transaction ID basis. The first I/O error on a BCE element within a device transaction ID causes a commfault to be registered on all the elements of the bus(es) that FCOS determines are in error. A commfault is an I/O transaction error counter value of 1. When two (or more) consecutive I/O transaction failures occur, FCOS logic will cause all erroring BCE elements or BTU segments during the second (or subsequent) I/O transaction to be bypassed (that is, chained out and no longer interrogated/pollled during that input transaction). Two points should be noted: (1) FCOS keeps track of which bus(es) were in error by comm-faulting all their BCE element(s) after the initial I/O error condition; (2) once the I/O transaction error counter value reaches two or more, erroring BCE element(s) will be bypassed every I/O transaction until some action causes an error-free I/O transaction.

This action is usually an I/O RESET command. However, if a hard failure has occurred, the bypass will be performed again. It should be noted that not all I/O transactions are bypassable; typically, FCOS bypass logic has been implemented only for the flight-critical, payload, and launch buses. In addition, the SM software has implemented a sort of BCE bypass logic to deal with PCMMU input I/O (P/L data RAM reads) errors. Although such bypasses are accomplished by SM applications software rather than by FCOS, the end result (that is, elimination of source of I/O errors) from a DPS point of view is very similar.

The bypass process is controlled by the LEVEL\_C\_I/O\_ERROR\_INTERRUPT HANDLER (FIOERRLC) and updated via the BCE\_ELEMENT\_BYPASS\_PROCESSOR (FCMBCEMD). A brief description of the BCE BYPASS words is presented below.

BCE BYPASS WORDS indicate which BCE elements and BTU segments have been chained out (corresponding bypass bit set) of an input transaction (time delays are inserted to keep the I/O transaction time the same), and can not be reinstated (bypass bit reset error counters set to zero) unless one of the following actions is performed:

- I/O RESET key
- OPS transition (with memory reconfiguration)

- OPS mode recall (with bus reassignment)
- Port moding (on affected string/buses only)

For certain memory configurations, some BCE elements may be initialized permanently bypassed (for that OPS). That is, the above actions will not reinstate those BCE elements.

**PASS BCE BYPASS** Three hexadecimal words (WD 0 to WD 2) present the bypass status for the GNC GPCs. Table 4.2-5 (A-C) defines each of the GNC BCE BYPASS words. These three words are located on DPS Overview.

**WD3 - WD9** Seven fullwords of memory (WD 3 to WD 9) define the low-rate (1.04 Hz) bypass status for the SM GPC. Table 4.2-6 (A-G) defines each bit of the bypass words. These words are maintained by FCOS. They are not downlisted, however. In order to conserve downlist bandwidth, the mission-dependent bypass bits contained within these bypass words have been logically OR'ed and packed by the SM applications software into one 3-bit PL LO bypass word (Table 4.2-5 (F)) for downlisting. If bypasses occur, and it is not possible to determine precisely what has happened using the downlisted data, the SM variable parameters may be used to look at specific BCE bypass words (WD 3 to WD 9).

The PL HI bypass word (Table 4.2-5 (E)) is one fullword of memory (WD 10) that defines the high-rate (6.25 Hz) bypass status for the SM GPC.

PCMMU PCMMU (0.52/1.04 Hz) bypass word downlisted by the SM GPC represents a summary of the PCMMU BCE bypasses maintained by the SM applications software. Table 4.2-5 (D) defines each bit of this bypass word. The actual PCMMU read OI/PL RAM data BCE bypass structure consists of an array of 30 halfwords partitioned in six 3-halfword bypass words (6 timer-initiated reads), and 6 fullword bypass words (up to 6 SVC-initiated reads). The BCE bypasses are mission-dependent and are defined on microfiche each flight software release via the BCE bypass bit definition. In order to conserve downlist bandwidth, these bypasses have been logically OR'ed by SM software at 0.52 rate and packed for downlisting. A detailed discussion of the PCMMU bypass structure and the transaction read rates (0.52 Hz or 1.04 Hz) is provided in the SM Systems Brief. This word is not on DPS Overview.

It should be noted that for most (perhaps all) Spacelab flights, the PDI will nominally be powered off. However, the PDI BITE status is routinely acquired every flight as an element of the SM OI/PL RAM data read. Thus, IP bus (BCE 24) E-bit type I/O errors will be detected by the SM GPC and the element will be bypassed. Spacelab uses the BCE BYP PL fault message, while the PDI has its own BCE BYP PDI fault message.

SM BYPASS PL Represented as High, the payload high-rate (6.25 Hz) bypass word downlisted by SM GPC. (This is the FCOS-maintained BCE Bypass WD 10.) Table 4.2-5 (E) defines each bit of this bypass word.

Represented by Low, the payload low-rate (1.04 Hz) bypass word downlisted by SM GPC represents a summary of the SM low-rate BCE bypasses (Bypass WD 3 to WD 9). Table 4.2-5 (F) defines each bit of this bypass word. These words are located on DPS Overview.

The BYPASS WORD and corresponding input transaction are as follows:

<u>Bypass word</u>	<u>I/O transaction</u>
WD 0	MFE
WD 1	HFE, G9 HDA
WD 2	MTU, NSP, GNC OPS Init, SRB, G9 IMU

PCMMU	"Packed" mission-dependent SM read PCMMU OI/PL RAM data
PL HI (WD 10)	PBD, data buses PL1 and PL2 mission-dependent high-rate read BTUs
PL LO	MCIU, PDI, PSPs, Ku-band radar, packed mission-dependent low-rate read (single flex MDMs or dual-port SCAs/flex MDM pairs)

It should be noted that the PASS contains special BCE bypass logic associated with the HFE input transaction (ID=13) MDM RETURN WORD elements. Should any MDM be bypassed, corresponding BCE string type elements for that MDM will also be bypassed for the following input transactions:

MFE input (ID=15): FF1 - FF4 and FA1 - FA4  
 MTU read (ID=22): FF1 - FF3 only  
 NSP read (ID=24): FF1 or FF3 only

This logic is unique for the PASS I/O error monitoring in that errors detected in one transaction can affect the structure of other I/O transactions (via manipulation of bypass delays). The implementation is advantageous in that I/O error processing overhead is reduced, and meaningless BCE STRG fault messages are suppressed.

Since a similar bypass structure across I/O transactions is not employed by the SM flight software, the total loss of a payload MDM (port failure) will result in a series of fault messages:

<u>Fault message</u>	<u>I/O transaction</u>	<u>Element(s) bypassed</u>
S62 BCE BYP PSP1(2)	PSP1 (PSP2) read	PSP
I/O ERROR PL1(2)	PL low-rate input	PF 1(2) MDM return word
BCE BYP PL1(2)	PL hi-rate input	MDM input cards (PBD discretetes)

The I/O ERROR PL1(2) and BCE BYP PL1(2) fault messages will always occur together in S2. In G9, however, only the I/O ERROR PL1(2) fault message will occur for the same MDM port failure. The PSP fault message will also occur in S2 if the PSP is currently being commanded via the affected MDM.

PCMMU-read I/O errors (all noninitial timeout I/O errors during OI/PL RAM data reads) may well result in repeated fault messages due to the low rate at which the BCE bypasses occur.



Note: Although I/O transactions are generally suspended during OPS transitions, the MTU read (at 1.04 Hz) and the NSP read (at 6.25 Hz) execute across the transition. BCE bypass logic is suppressed during this time, however. Thus, if MTU or NSP I/O transactions should encounter problems during an OPS transition, the I/O errors will be logged at the rate at which they occur.

3. DPS data bus configuration

Figure 4.2-2 presents the PRI/SEC MDM port relationships.

B. I/O ERROR TABLES 1-5

<u>Table no.</u>	<u>Title</u>	<u>Parameter</u>
Table 4.2-1	I/O device/transaction ID definition	ID, OP
Table 4.2-2	BCE element number vs. active OPS	EL or Element
Table 4.2-3	BCE/port numbers vs. bus/use	BCE
Table 4.2-4	BCE status words	Status
Table 4.2-5	BCE bypass words	PASS BCE BYPASS, SM BYPASS PL
Table 4.2-6	SM bypass words - not downlisted	WD 3-9
Table 4.2-7	I/O timeout signatures vs. DPS failures	
Table 4.2-8	Fault message annunciation of I/O errors	
Table 4.2-9	GPC discrettes "commonality"	
Table 4.2-10	MDM A/D (converter) bite status word	

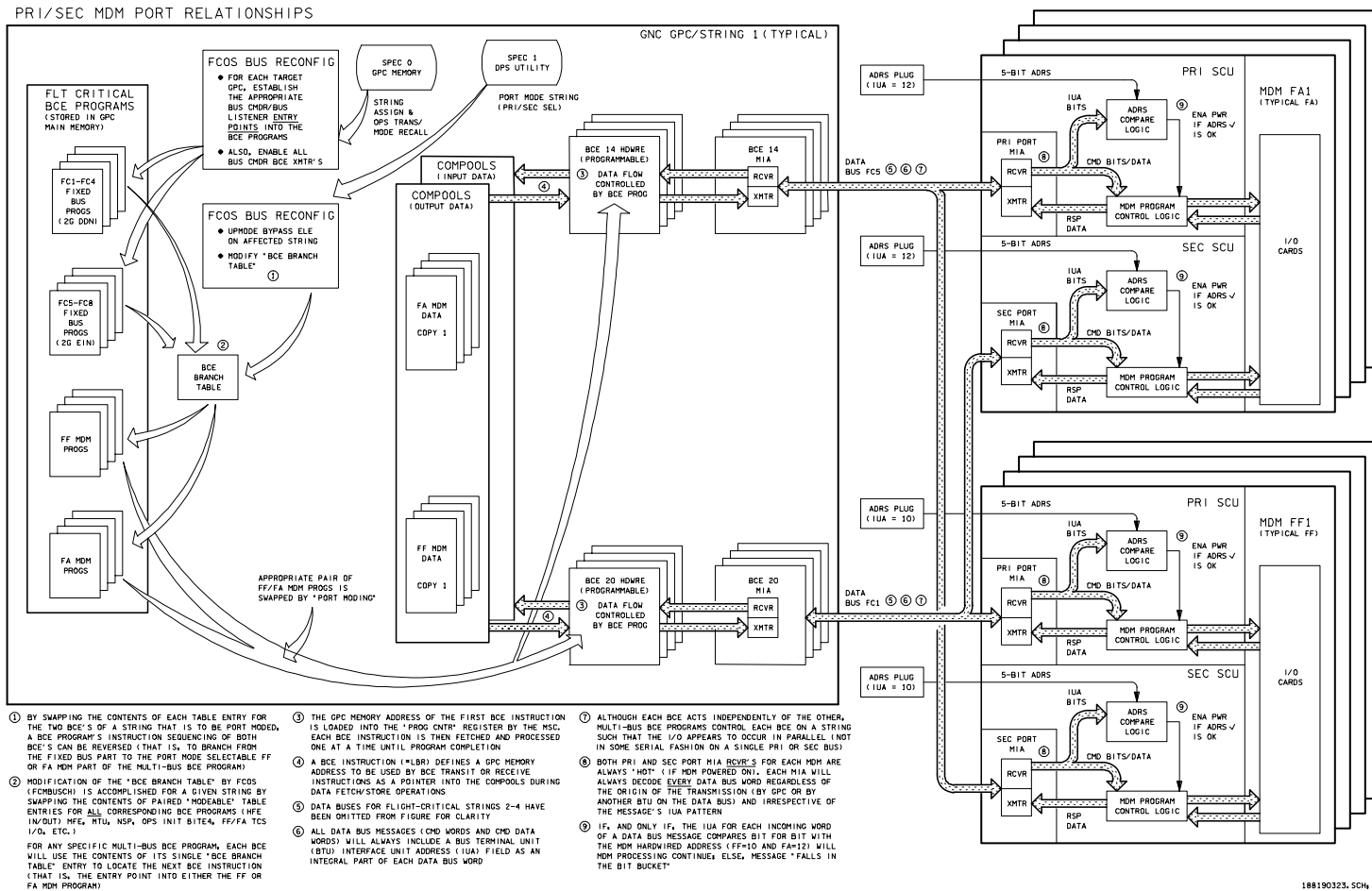


Figure 4.2-2. PRI/SEC MDM port relationships

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4.2-10

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Table 4.2-1. I/O device/transaction ID definition <sup>1</sup>

Device ID	OP Code <sup>a</sup>	Description	Buses	Active OPS <sup>b</sup>	Remarks
1		IPR	IC 1 to 5	All	Redundant set (immediate retry if transaction error). Same error handling as MMU overlay (bus select via SPEC 1). OP Codes: 1 = Write, 2 = Read; and 3 = No=OP
2	1 to 3	GPC-to-GPC OPS overlay	MM 1,2; LB 1,2	All	
3		SSIP ICC	IC 1 to 5	All	Common set communication (124 halfword message). SCA on-demand outputs. OP Codes: 1=Fill 2=Poll, time fill 3=IPL fill 4=Dump 5=BITE status 6=Reset SPL 7=Crit format fill 8=Remote fill (not used) 9=Remote dump
4		SCA output (mode 8)	PL 1,2	SM	
5,6,7,8	1 to 9	DEU 1,2,3,4	DK 1,2,3,4	All	
9	1,2	DDU Write	FC 1 to 4	VU	
10	1 to 12	PCMMU	IP 1 to 5		OP Codes: 1 = Write to all DDUs and 2 = Write to ADIs DDU outputs on demand (SPEC 100). OP Codes 1 and 10 support all OPS; all other OP Codes limited to SM and VU. OP Codes: 1 = D/L to toggle buffer 2 = Hi data rate (HDR) TFL 3 = Lo data rate (LDR) TFL 4 = Read HDR RAM for checksum 5 = Read LDR RAM for checksum 6 = Cyclic BITE status read 7 = Select hard format 8 = Select PRGM format 9 = SM read OI/PL RAM data 10 = TCS read variable adrs 11 = LDR TFL-restore sync word 12 = TCS read LDR/HDR progs
11	1 to 10	MMU	MM 1,2		OP Code 5 limited to SM and P9; OP Code 9 to P9; all other OP Codes support all OPS. OP Codes: 1 = Write with checksum 2 = Write w/o checksum 3 = Read with checksum 4 = Read w/o checksum 5 = MM utility write 6 = MM BITE status 7 = Read OPS overlay 8 = Position tape cmd 9 = MM utility read 10 = TCS MM BITE status
12		FC MDMs cyclic BSR read	FC 1 to 8	G9	FF and FA MDMs Bite Status Register cyclic read on demand (SPEC 112).
13		HFE input	FC 1 to 8	GNC	OPS-dependent cyclic inputs.
14		HFE output (and MFE output)	FC 1 to 8	GNC	OPS-dependent cyclic outputs, including C/W annunciation via FF MDMs.
15		MFE input	FC 1 to 8	GNC,VU	OPS-dependent cyclic inputs. P9 on demand (SPEC 100).
16		GNC OPS initialization BITE 4 read	FC 1 to 8		One-shot read at G9, G1, G2, and G3 OPS transition.
17		G9 IMU 1 to 3 cyclic read	FC 1 to 3	G9	Cyclic inputs.
18		G9 IMU 1 to 3 gyro torquing	FC 1 to 3	G9	On demand IMU gyro torquing (SPEC 104).
19,20, 21	1,2	MTU update accumulator 1,2,3; MTU reset	FC 1,2,3		OP Codes: 1 = Write to MTU accumulator; and 2 = MTU reset. MTU updates on demand (SPEC 2) in all OPS except G1, G6, and G3.
22		MTU read all accumulators	FC 1 to 3	All	Cyclic inputs.
23		G9 FC C/W annunciation (lights and tone)	FC 1 to 4	G9	Output C/W discretes via FF MDMs.
24		NSP 1 to 2 cyclic input	FC 1,3	All	Poll NSP status and uplink data.
25		FA MDMs output	FC 5 to 8	VU	SRB and MPS engine cmds, aerosurface cmds.
26		HDA FC cyclic input	FC 1 to 8	VU	Cyclic inputs (HFE equivalent except EIUs are not read). P9 on demand (SPEC 100). Housekeeping Data Acquisition (HDA). Send user-supplied command word to requested MDM(s). Test Control System (TCS).
27 to 36 37	1,2	TCS (FC MDMs, FC QUAD) RJD Cmd A toggler	FC 1 to 8	All (VU)	PRI/VERN jet toggle cmds to RJDs during RCS trickle test. On demand (SPEC 100).
38		Read nosewheel posn fdbk	FC 1,2,4 FC 5,6,7	G9	BFS initialization data on demand (SPEC 100).

<sup>a</sup>OP code: Those IDs without OP code may have a single OP code. See PASS User's Guide.

<sup>b</sup>Active OPS: VU = (G9, P9); GNC = (G1/G8, G2, G3/G8); SM = (S2, S4); All = (Post-IPL OPS 0, VU, SM, and GNC OPS modes).

Table 4.2-1. I/O device/transaction ID definition <sup>1</sup> (concluded)

Device ID	OP Code <sup>a</sup>	Description	Buses	Active OPS <sup>b</sup>	Remarks
39		G9 MEC FIRE2, FIRE3, output	FC 5 to 8	G9	MEC QUAD I/O outputs issued on demand via KSC LPS BFS initialization data on demand (SPEC 100).
40		G9 one-shot to BFS	FC 5 to 8	G9	
41	1,2	TCS port modeable	PL 1,2;	G9	
42	1,2	TCS multibus	FC 1 to 8; PL 1,2;	G9	
43		PF MDM cyclic BSR read	LB 1,2 PL 1,2	G9	Read PL MDMs BITE Status Register cyclic read on demand (SPEC 112).
44,45		PF1,PF2 C/W annunciation (lights and tone)	PL 1,2	SM, P9, OPS 0	Output C/W discretes via PF MDMs.
46,47	1,2	TCS (PF MDMs)	PL 1,2	All	Send user-supplied command word to requested MDM. Used extensively inflight by cargo control SPECS (output I/O; BITE4 reads).
48	1,2	SM: fixed outputs cyclic,PBD)	PL 1,2	SM	OP Codes: 1 = cyclic outputs; and 2 = Payload Bay Doors OPS.
49,50	1,2	SM: PSP PF1,2	PL 1,2	SM, VU	P/L signal processor; cyclic inputs once enabled; on-demand write (SPEC 62).
51		SM: PL Hi Rate read	PL 1,2	SM	BCE ELE nos. redefinable for each flight.
52		SM: PL Lo Rate read	PL 1,2	SM, VU <sup>c</sup>	BCE ELE nos. redefinable for each flight. <sup>c</sup>
53		SM: Dual-Port read no. 1	PL 1,2	SM	BCE Program availability flight dependent. <sup>c</sup>
54		SM: Dual-Port read no. 2	PL 1,2	SM	BCE Program availability flight dependent. <sup>c</sup>
55		SM: Dual-Port read no. 3	PL 1,(2)	SM	BCE Program availability flight dependent. <sup>c</sup>
56		SM: Single Flex 1/Flex 2 read	PL 1,2	SM	BCE Program availability flight dependent. <sup>c</sup>
57		SM: Single Flex 3/Flex 4 read	PL 1,2	SM	BCE Program availability flight dependent. <sup>c</sup>
58		SM: Single Flex 5 read	PL 1,(2)	SM	BCE Program availability flight dependent. <sup>c</sup>
59		SM table-driven outputs	PL 1,2	SM	On demand usage (future requirements).
60	1 to 13	SM: PDI	PL 1	SM, G9	P/L data interleaver; cyclic inputs once enabled; on-demand write (SPEC 62). OP Codes: 1 = Read BSR & SW Matrix (G9)    8 = Read Decom 3 DFL 2 = Read SW Matrix                    9 = Load Decom 3 DFL 3 = Load SW matrix                    10 = Read Decom 4 DFL 4 = Read Decom 1 DFL                  11 = Load Decom 4 DFL 5 = Load Decom 1 DFL                  12 = Read FPM 6 = Read Decom 2 DFL                  13 = Load FPM 7 = Load Decom 2 DFL
61	1 to 7	LDB	LB 1(2)	All (VU, G1)	Prelaunch GSE initiated via SPEC 100 or SPEC 1 (continuous I/O error logging if errors on both ports) OP Codes: 1 = Interrogate w/o data                5 = Request LPS status 2 = Interrogate with data              6 = Send status to LPS 3 = Go ahead                              7 = Wave off 4 = Transmit enable
62	1,2	TCS (LDB MDMs)	LB 1(2)	All (VU)	TCS-type I/O to LF or LA MDMs.
63		SRB input	LB 1(2)	G9, G1	Cyclic inputs (VU initiated via TCS/SACS LDB control operator; cyclic at G1 OPS initialization)
64	1,2	TCS (SRB MDMs)	LB 1(2)	VU	Send user-supplied command word to requested MDM.
65		MCIU cyclic read	LB 1	SM, VU	SM cyclic I/O upon SPEC 94 callup; VU cyclic inputs on demand (SPEC 100).
66		MCIU cyclic write	LB 1	SM, VU	SM cyclic I/O on demand (SPEC 94).
67	1,2	TCS (MCIU)	LB 1	All (VU)	Send user-supplied command to MCIU.
68 to 77	1,2	TCS (port specific PF, FC MDMs)	PL 1,2; FC 1 to 8	All (VU)	Send user-supplied command word to requested MDM via specified port (irrespective of FCOS assigned port moding).
80		TCS (MEC/EIU - QUAD I/O)	FC 5 to 8	All (VU)	Send user-supplied command to requested MEC or EIU via all four FC buses.

<sup>a</sup>OP code: Those IDs without OP code may have a single OP code. See PASS User's Guide.

<sup>b</sup>Active OPS: VU = (G9, P9); GNC = (G1/G8, G2, G3/G8); SM = (S2, S4); All = (Post-OPL OPS 0, VU, SM, and GNC OPS modes.)

<sup>c</sup>Mission-dependent inputs in G9 and in P9 are read as one transaction (ID = 52) as part of the HDA applications process.

**Table 4.2-2. BCE element number vs. active OPS<sup>1</sup>**

Device/Element ID	BCE element number	BCE Port (Pri/Sec)	BTU	Element	No. wds per element	Active OPS <sup>a</sup>			
						G1/6	G2	G3/8	VU <sup>b</sup>
ID = 13/HFE Input (GNC) ID = 26/HDA Input (VU)	1	14	EIU1	EIU1 (port 1)	6 <sup>c</sup>	X			
	2	15	EIU2	EIU22 (port 1)	6 <sup>c</sup>	X			
	3	16	EIU3	EIU23 (port 1)	6 <sup>c</sup>	X			
	4	17	EIU1	EIU21 (port 4)	6 <sup>c</sup>	X			
	5	17	EIU2	EIU22 (port 4)	6 <sup>c</sup>	X			
	6	17	EIU3	EIU2 (port 4)	6 <sup>c</sup>	X			
	7	20/14	FF1	MDM return word	1	X	X	X	X
	8	20/14	FF1	Payload sensor <sup>d</sup>					
	9	20/14	FF1	ADTA	6	X		X	X
	10	20/14	FF1	STRG 1B (PROM Seq 2,6)	36	X	X	X	X
	11	21/15	FF2	MDM return word	1	X	X	X	X
	12	21/15	FF2	ADTA	6	X		X	X
	13	21/15	FF2	STRG 2 B (PROM Seq 2,6)	36	X	X	X	X
	14	22/16	FF3	MDM return word	1	X	X	X	X
	15	22/16	FF3	ADTA	6	X		X	X
	16	22/16	FF3	STRG 3 B (PROM Seq 2,6)	36	X	X	X	X
	17	23/17	FF4	MDM return word	1	X	X	X	X
	18	23/17	FF4	ADTA	6	X		X	X
	19	23/17	FF4	STRG 4 B (PROM Seq 2,6)	36	X	X	X	X
	20	14/20	FA1	MDM return word	1	X	X	X	X
	21	14/20	FA1	STRG 1 D (PROM Seq 3,10)	54	X	X	X	X
	22	15/21	FA2	MDM return word	1	X	X	X	X
	23	15/21	FA2	HYD sys 3 press C	1	X	X	X	X
	24	15/21	FA2	STRG 2 D (PROM Seq 3,10)	54	X	X	X	X
	25	16/22	FA3	MDM return word	1	X	X	X	X
	26	16/22	FA3	L OMS chamber press	1	X	X	X	X
	27	16/22	FA3	STRG 3 D (PROM Seq 3,10)	54	X	X	X	X
	28	17/23	FA4	MDM return word	1	X	X	X	X
	29	17/23	FA4	R OMS chamber press	1	X	X	X	X
	30	17/23	FA4	STRG 4 D (PROM Seq 3,10)	54	X	X	X	X
ID = 15/MFE Input	31	20/14	FF1	STRG 1 A (PROM Seq 1,2)	21	X	X	X	X
	32	20/14	FF1	IMU	14	X	X	X	P9
	33	20/14	FF1	TACAN/RA	7	X	X	X	X
	34	20/14	FF1	MSBLS	3	X		X	X
	35	20/14	FF1	STU 1 (-Z star tkr)					
	36	21/15	FF2	STRG 2 A (PROM Seq 1,2)	21	X	X	X	X
	37	21/15	FF2	IMU	14	X	X	X	P9
	38	21/15	FF2	TACAN/RA	7	X	X	X	X
	39	21/15	FF2	MSBLS	3	X		X	X
	40	22/16	FF3	STRG 3 A (PROM Seq 1,2)	21	X	X	X	X
	41	22/16	FF3	IMU	14	X	X	X	P9
	42	22/16	FF3	TACAN/RA	7	X	X	X	X
	43	22/16	FF3	MSBLS	3	X		X	X
	44	22/16	FF3	STU 2 (-Y star tkr)	3		X	X	X
	45	22/16	FF3	Rendezvous radar	10		X		X
	46	23/17	FF4	STRG 4 A (PROM Seq 1,2)	21	X	X	X	X
	47	14/20	FA1	STRG 1 C (PROM Seq 1,2)	34	X	X	X	X
	48	15/21	FA2	STRG 2 C (PROM Seq 1,2)	34	X	X	X	X
	49	16/22	FA3	STRG 3 C (PROM Seq 1,2)	34	X	X	X	X
	50	17/23	FA4	STRG 4 C (PROM Seq 1,2)	34				X
	51	14	EIU1	EIU1 (port 1)	32				X
	52	15	EIU2	EIU2 (port 1)	32				X
	53	16	EIU3	EIU3 (port 1)	32				X

<sup>a</sup>Active OPS: VU = (G9, P9); GNC = (G1/G8, G2, G3/G8); SM = (S2, S4); All = (Post-IPL OPS 0, VU, SM, and GNC OPS modes).

<sup>b</sup>HDA and MFE inputs always active in G9, but are on-demand only in P9 (SPEC 100).

<sup>c</sup>First 6 words of 32-word EIU msg.

<sup>d</sup>Reserved to support future I/O interfaces.

**Table 4.2-2. BCE element number vs. active OPS <sup>1</sup> (concluded)**

Device/Element ID	BCE element number	BCE Port (Pri/Sec)	BTU	Element	No. wds per element	Active OPS <sup>a</sup>
ID = 22/MTU Read All	54	20/14	FF1	MTU accum 1	7	All OPS
	55	21/15	FF2	MTU accum 2	7	All OPS
	56	22/16	FF3	MTU accum 3	7	All OPS
ID = 17/G9 IMU Read	57	20/14	FF1	MDM return word	1	G9 only
	58	20/14	FF1	IMU serial data	14	G9 only
	59	20/14	FF1	IMU operate/BITE discretes	1	G9 only
	60	21/15	FF2	MDM return word	1	G9 only
	61	21/15	FF2	IMU serial data	14	G9 only
	62	21/15	FF2	IMU operate/BITE discretes	1	G9 only
	63	22/16	FF3	MDM return word	1	G9 only
	64	22/16	FF3	IMU serial data	14	G9 only
	65	22/16	FF3	IMU operate/BITE discretes	1	G9 only
ID = 24/NSP Cyclic Input	66	20/14	FF1	NSP1 pwr/GPC blk discretes	2	All OPS
	67	20/14	FF1	NSP1 serial data	32	All OPS
	68	22/16	FF3	NSP2 pwr/GPC blk discretes	2	All OPS
	69	22/16	FF3	NSP2 serial data	32	All OPS
ID = 63/SRB Input	70	12/13	LL1	SRB prom	35	G1, VU
	71	12/13	LL2	SRB prom	31	G1, VU
	72	12/13	LR1	SRB prom	41	G1, VU
	73	12/13	LR2	SRB prom	31	G1, VU
ID = 16/GNC OPS initialization BITE 4 Read	74	20/14	FF1	MDM Bite 4 read	30	G1, G2, G3, G9
	75	21/15	FF2	MDM Bite 4 read	30	G1, G2, G3, G9
	76	22/16	FF3	MDM Bite 4 read	30	G1, G2, G3, G9
	77	23/17	FF4	MDM Bite 4 read	30	G1, G2, G3, G9
	78	14/20	FA1	MDM Bite 4 read	26	G1, G2, G3, G9
	79	15/21	FA2	MDM Bite 4 read	26	G1, G2, G3, G9
	80	16/22	FA3	MDM Bite 4 read	26	G1, G2, G3, G9
	81	17/23	FA4	MDM Bite 4 read	26	G1, G2, G3, G9
ID = 65/MCIU Read	82	12	MCIU	MCIU data	45	SM, VU
ID = 49, 50/PSP	83	10/11	PF1	PSP 1		SM
	84	11/10	PF2	PSP 2		SM
ID = 51/PL Hi Rate Read	85	10/11	PF1	PBD discretes (CD3; CHO)	1	SM, VU
	86	10/11	PF1	PBD discretes (CD6; CHO)	1	SM, VU
	87	10/11	PF1	PBD discretes (CD9; CHO)	1	SM, VU
	88	11/10	PF2	PBD discretes (CD3; CHO)	1	SM, VU
	89	11/10	PF2	PBD discretes (CD6; CHO)	1	SM, VU
	90	11/10	PF2	PBD discretes (CD9; CHO)	1	SM, VU
ID = 52/PL Lo Rate Read	91	10/11	PF1	MDM return word	1	SM, VU
	92	10/11	PF1	KU-band radar	10	SM, VU
	93	11/10	PF2	MDM return word	1	SM, VU
	94	11/10	PF2	Fuel cell purge discretes	1	SM, VU
ID = 60/PDI Cyclic Read	95	10	PDI	PDI SW matrix status		SM, G9
	96	10	PDI	PDI BITE status register read		G9
	97-104 <sup>d</sup> 105-112 <sup>e</sup>					

<sup>a</sup>Active OPS: VU = (G9, P); All = (G1/G6, G2, G3/G8); Sm = (S2, S4); All = (Post-IPL OPS 0, VU, SM, and GNC OPS modes).

<sup>b</sup>HDA and MFE inputs always active in G9, but are on-demand only in P9 (SPEC 100).

<sup>d</sup>Reserved to support future I/O interfaces

<sup>e</sup>Payload-dependent reconfigurable.

*Table 4.2-3. BCE/port numbers vs. bus/use <sup>1</sup>*

<u>BCE/port</u>	<u>BUS/use</u>	<u>Pri ports</u>	<u>Sec ports</u>
1	IC1		
2	IC2		
3	IC3		
4	IC4		
5	IC5		
6	DK1		
7	DK2		
8	DK3		
9	DK4		
10	PL1	PF1	PF2
11	PL2	PF2	PF1
12	LB1		
13	LB2		
14	FC5	FA1	FF1
15	FC6	FA2	FF2
16	FC7	FA3	FF3
17	FC8	FA4	FF4
18	MM1		
19	MM2		
20	FC1	FF1	FA1
21	FC2	FF2	FA2
22	FC3	FF3	FA3
23	FC4	FF4	FA4
24	IP (1-5)		
25	Self-test (AP101S only - disabled)		
26	-		
27	MMU status		
28	MSC timeouts		
29	IOP level B interrupts		
30	IOP level A interrupts		

**Table 4.2-4. BCE status words**  
**BCE 1-24 Status Words<sup>1</sup>**

Status (hex)	Bit(s)	Error	I/O	Detected by <sup>a</sup>	Remarks
(b)	8 to 12	--	--	MIA	Interface unit address (BTU ADRS received by MIA). IUA meaningful only with respect to bits 3 to 7, 15 of status word.
10XX 0000	3	Signature mismatch	I	IOP logic	IOP logic detected mismatch between the expected IUA and the received IUA (possible noisy MIA or data bus, MDM failure, GPC will fail to sync).
08XX 0000	4	Bad parity	I	MIA	Possible noisy MIA or data bus, MDM failure.
04XX 0000	5	S-bit (reset)	I	IOP logic	SEV - Internal MDM power transient detected by MDM.
02XX 0000	6	E-bit (set)	I	IOP logic	SEV - Internal MDM serial I/O card has detected a data problem (no data, improper sync, invalid Manchester II data bits). PCMMU has detected a data problem (no OI MDM data).
01XX 0000	7	V-bit (reset)	I	IOP logic	SEV - MDM detected an internal problem causing data to be suspect/invalid.
00X1 0000 or 00X9 0000	15	Wrong Sync	I, O	Microcode	Microcode detected mismatch between the expected sync type (cmd or data) and the MIA-detected sync type. (MIA failure at either BCE or interface unit port--port moding might alleviate FC MDM failure).
0000 0400	21	Word gap	O	Microcode	BCE not able to maintain word gap of less than 5 microsec (#MOUT) or less than 20 microsec (#TDS, #TDL1, or #TDL) during message (possibly caused by heavy DMA activity from other I/O transactions).
0000 0200	22	Self-test		Microcode	Ground test only.
0000 0100	23	XMTR disabled or MIA busy	I, O	Microcode	Microcode detected mismatch between the 'transmit enable register' state (bus cmdr is not enabled) or MIA busy signal set (possible I/O terminate switch discrete present or MIA detected unexpected data bus traffic).
0000 0040	25	Initial timeout	I	Microcode	During time allotted by BCE, the MIA failed to detect any incoming word (no valid sync) or the first word invalid due to MIA detected error (too few bits or invalid Manchester II bits).
0000 0020	26	Timeout	I	Microcode	A data word, other than the first in a message, failed to arrive within time allotted by BCE.
0000 0010	27	MM block timeout	I	Microcode	Unique to BCE 18 or 19 (MM transaction); during time allotted by BCE, the MIA failed to detect the start of the next 512-word data block.
0000 0008	28	BCE instr format (boundary alignment error)	I	Microcode	BCE program encountered illegal BCE instruction format (long format instruction on an odd halfword boundary) (probably caused by faulty IPL).
0000 0004	29	Illegal BCE instr	I, O	Microcode	BCE program encountered illegal BCE instruction during execution or DMA instruction parity error detected. Could be indicative of an MDM A/D Converter failure.

<sup>a</sup> If an input transaction, all previously accepted data on the erroring BCE (or BCEs) are flagged as bad for this transaction. The data word causing the error is not stored, and no further data words are processed on the faulted BCE(s). Data associated with the BCEs not experiencing problems are accepted.  
<sup>b</sup> Detected IUA displayed in third and fourth hex digit positions. The following correlates displayed IUA (bits 8 to 12) to BTUs:



**Table 4.2-4. BCE status words (continued)**

Interface Unit Address (IUA)

Detected IUA displayed in third and fourth hex digit positions. The following correlates displayed IUA (bits 8 to 12) to BTUs:

<u>IUA (HEX)</u>	<u>IUA (DEC)</u>	<u>BTUs</u>
30	6	DDU1, LL2, mission-dependent FMDM or SCA
48	9	DDU2, LL1, mission-dependent FMDM or SCA
50	10	FF1-FF4, PF1, LF1, DEU1-DEU4
58	11	MMU1, MMU2
60	12	FA1-FA4, PF2, LA1
68	13 <sup>C</sup>	PCMMU 1(2)
70	14 <sup>C</sup>	PCMMU 1(2)
78	15 <sup>C</sup>	PCMMU 1(2), DDU3, LR1, mission-dependent FMDM or SCA
80	16 <sup>d</sup>	PDI
88	17 <sup>d</sup>	PDI, EIU1, GSE
90	18 <sup>d</sup>	PDI, MEC1, LR2
98	19 <sup>d</sup>	PDI
A0	20	MEC2, MCIU
B8	23	EIU2
C0	24	EIU3
E8	29	Mission-dependent FMDM or SCA
F0	30	Mission-dependent FMDM or SCA

FMDM IUA is determined premission (6, 9, 15, 29, or 30 dec).

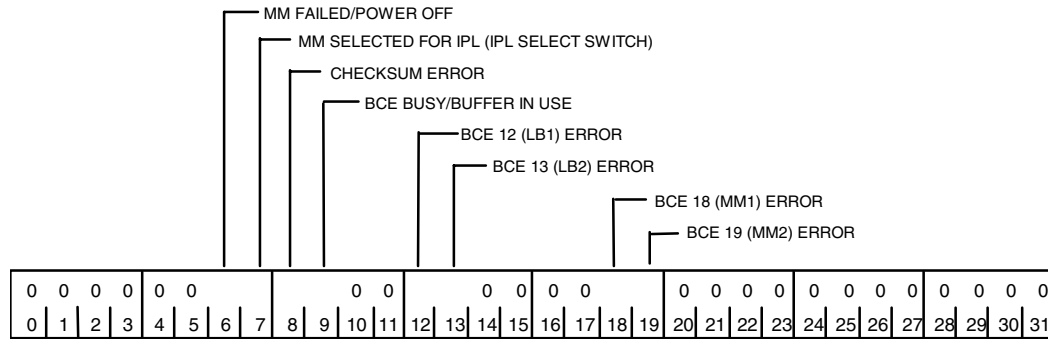
SCA IUA is determined premission (6, 9, 15, 29, or 30 dec).

<sup>C</sup> PCMMU has unique 3-bit binary address = 011. Transmitted IUA to PCMMU represents PCMMU adrs plus to two most significant bits of the PCMMU OP code. Thus, PCMMU "IUA" may range from 13 dec (binary 01101) to 15 dec (binary 01111).

<sup>d</sup> PDI has unique 3-bit binary address = 100. Transmitted IUA to PDI represents PDI adrs plus the two most significant bits of the PDI OP code. Thus, PDI "IUA" may range from 16 dec (binary 10000) to 19 dec (binary 10011).

**Table 4.2-4. BCE status words (continued)**

**BCE 27 - Mass Memory Status Register (MMU Status Register)**



18819\_014

Status <sup>a</sup> (hex)	Bit	Error	Detected by	Remarks <sup>b</sup>
020X X000	6	MMU failed/powering down	FCOS (MM_MGR)	MMU selected for transaction detected to be failed or powered down (MM Ready discrete indicated NOT READY).
010X X000	7	MMU doing an IPL	FCOS (MM_MGR)	MMU selected for transaction already selected for an IPL and discrete not masked per ITEM 38 on SPEC 1.
008X X000	8	Checksum	FCOS (MM_MGR)	MM transaction failed checksum verification software check.
004X X000	9	BCE busy/buffer reserved	FCOS (MM_MGR)	BCE busy or checksum buffer already in use at start of MM transaction.
000X 0000 0000 X000	12, 13 18, 19	BCE/Data Bus	MSC or BCEs	Any of BCE NO-GO conditions (see Table 4.2-5 or MSC timeout on indicated BCE - primarily indicates BCE or data bus problems).

<sup>a</sup> If XX = 80, MM transaction corresponds to LDB 1 (BCE 12) -GPC-to-GPC  
 XX = 40, MM transaction corresponds to LDB 2 (BCE 13) -GPC-to-GPC  
 XX = 02, MM transaction corresponds to MMU 1 (BCE 18)  
 XX = 01, MM transaction corresponds to MMU 2 (BCE 19)

<sup>b</sup> MM transaction error causes SM alert with fault messages 'I/O ERROR MMU 1(2)' or 'OFF/BUSY MMU 1 (2)'.

**NOTES/CONDITIONS**

If MM transaction is not for an OPS overlay, transaction must be reinitiated by crew (software treats transaction as if it never occurred).

If MM transaction is for an OPS overlay, an automatic retry is initiated via software. If retry is unsuccessful, an automatic retry is initiated using other MMU. After switch, if two consecutive OPS overlay failures occur, any successful GPC(s) will begin executing the new OPS; the erroring GPC(s) will fail to sync. If a simplex GPC or if all GPCs in a redundant set indicate consecutive errors, the MM transaction is terminated and OPS 0-00 is executed. The OPS overlay must then be reinitiated by the crew.

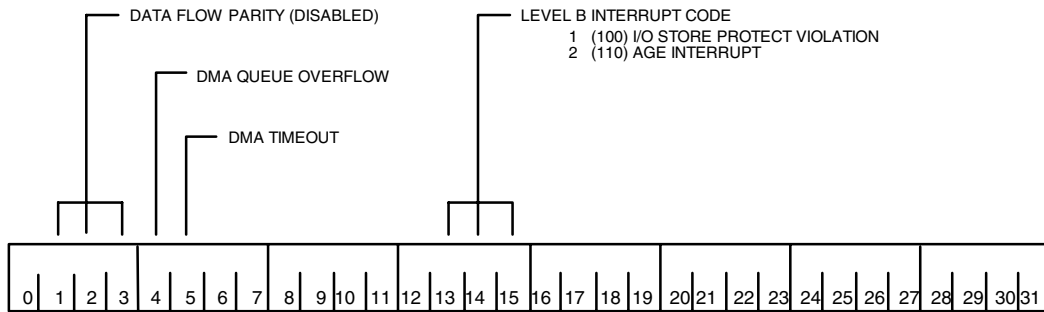
FCOS module MM/GTG\_I/O\_REQUEST\_PROCESSOR (FIOMGSTR), which fields all requests for MM I/O services, performs selected pre-MM I/O transaction checks (MM READY and MM IPL discrettes; if OPS overlay, then buffer availability checked).

If MM I/O transaction on BCEs 18 or 19 completed without error, FCOS module MM/GTG\_I/O\_SERVICE\_REQUEST\_MONITOR (FIOMGMTR) performs checksum processing.



**Table 4.2-4. BCE status words (continued)**

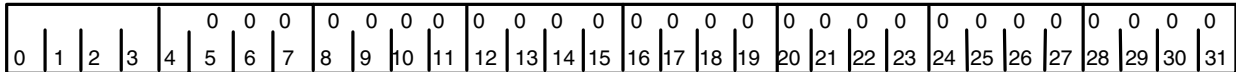
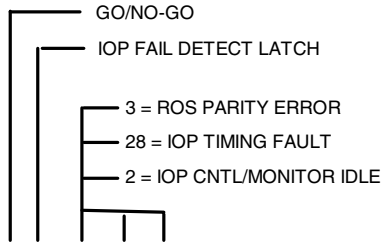
**BCE 29 - Level B hardware interrupt**



Status (hex)	Bits	Error	Software halt	Remarks
1000 0000 2000 0000	1-3	IOP Data Flow Parity	YES	Device out data error (lowest priority) R1, R2, R3 parity error
3000 0000				Flow bottom DMA address or data parity error
4000 0000				MC queue control parity error
5000 0000				MIA parity error
6000 0000				Diagnostic procedure 25 (self test) error (highest priority)
0800 0000	4	DMA queue overflow	YES	DMA queue capacity exceeded
0400 0000	5	DMA timeout	YES	DMA request not honored within 8 microseconds
0004 0000 0006 0000	13 14, 15	Interrupt Level B Interrupt Level B	NO	I/O store protect violation AGE interrupt

18819\_015

**Table 4.2-4. BCE status words (concluded)**  
**BCE 30 - Level A hardware interrupt**



18819\_016

Status (hex)	Bit(s)	Error	Detected by	Software halt <sup>a</sup>	Remarks
8000 0000	0	Watchdog timer (timeout latch)	IOP RM	--	Pass software to enable watchdog timer no longer exists.
4000 0000	1	IOP Fail detect latch (voter fail)	IOP RM	NO <sup>b</sup>	The IOP redundancy management logic has detected either of following conditions: at least two other common set GPCs have declared this GPC as FAILED; or this GPC has declared all other RS GPCs as FAILED. Signal originated in the IOP RM voter logic and not from a faulted I/O transaction.
3000 0000	3, 2	ROS parity	IOP micro decode logic	YES	Parity error detected during a micro-instruction transfer from the IOP Read Only Storage (ROS).
2800 0000	4, 2	IOP timing fault	IOP timing monitor	YES	IOP oscillator has stopped.
2000 0000	2	IOP control/monitor idle	IOP control monitor logic	--	Not a failure indicator per se; indicates that the IOP control/monitor hardware is in a reset condition--this occurs during IPL (FCOS initialization) and when GPC is transitioned RUN → STBY (interrupt logged) or HALT → STBY (interrupt not logged) (IOP master reset issued in either case). If GPC is transitioned from HALT → STBY → RUN, a Level A interrupt will be logged with a timetag of zero; if transitioned RUN → STBY → RUN, a Level A interrupt will be logged with an inaccurate, non-zero timetag (in the ballpark of GPC transition RUN → STBY). (Bit 2 will also be set in the event a Level A hardware failure occurs.)

<sup>a</sup> IOP is reset and CPU software takes GPC to HALT. (In such a case, I/O Error information probably will not get logged via ICC transaction before GPC goes to software halt).

<sup>b</sup> It should be noted, however, that the erroring GPC is no longer a part of the redundant set.

Table 4.2-5. BCE bypass words<sup>1,2</sup>

A. BCE BYPASS WD 0 (GNC)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
TRANSACTION	← MFE (ID = 15) →																															
ELEMENT	FF PROM SEQ 1, 2 (BCE STRG - A)				TACAN/RA			MSBLS			IMU			STU			RR			EIUs/PORT 1			FA PROM SEQ 1, 2 (BCE STRG - C)									
BTU BCE ELE NO.	FF1 31	FF2 36	FF3 40	FF4 46	FF1 33	FF2 38	FF3* 42	FF1 34	FF2 39	FF3 43	FF1 32	FF2 37	FF3 41					FF1 35	FF3 44	FF3 45				EIU1 51	EIU2 52	EIU3 53	FA1 47	FA2 48	FA3 49	FA4 50		
IOM CARD NO. AND CHAN NOS.	07 (AIS): 8-15 04 (DIH): 0-2 06 (DIL): 0, 1 09 (DIH): 0-2 12 (DIH): 0-2 15 (DIL): 0, 1				00 (TAC): 0-6  (7 WDS)			11 (SIO): 1  (3 WDS)			03 (SIO): 0  (14 WDS)			03 (SIO): 2  (3 WDS)			03 (SIO): 3  (10 WDS)			06 (AIS): 27,28 14 (AIS): 20-22  06 (AIS): 8-28 14 (AIS): 8-13 : 24-27 (34 WDS)												
	*TACAN ONLY																															

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B. BCE BYPASS WD 1 (GNC)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
TRANSACTION	← HFE (ID=13) →																															
	← G9 HDA (ID=26) →															← G9 HDA (ID=26) →																
ELEMENT	MDM RETURN WORD				FF PROM SEQ 2,6 (BCE STRG - B)				ADTA				MDM RETURN WORD				FA PROM SEQ 3,10 (BCE STRG - D)				EIUs/PORT				HYBOMS SYS L R							
BTU BCE ELE NO.	FF1 7	FF2 11	FF3 14	FF4 17	FF1 10	FF2 13	FF3* 16	FF4 19	FF1 9	FF2 12	FF3 15	FF4 18	FA1 20	FA2 22	FA3 25	FA4 28	FA1 21	FA2 24	FA3 27	FA4 30	EIU1 1	EIU1 4	EIU2 2	EIU2 5	EIU3 3	EIU3 6	FA2 23	FA3 26	FA4 29			
IOM CARD NO. AND CHAN NOS.					04 (DIH): 0-2 06 (DIL): 0, 1 09 (DIH): 0-2 12 (DIH): 0-2 15 (DIL): 0, 1 15 (DIL): 0, 1  07 (AIS): 0-7 01 (AID): 0-7 14 (AID): 0-6  (36 WDS)				11 (SIO): 0  (6 WDS)								14 (AIS): 14, 15 06 (AIS): 0-7 14 (AIS): 0-7 03 (DIH): 0-2 05 (DIL): 0 08 (DIH): 0 11 (DIH): 0-2  06 (AIS): 29 14 (AIS): 23 14 (AIS): 16-19 : 30,31 06 (AIS): 30,31  01 (AID): 0-6 09 (AID): 0-3 09 (AID): 4-10  (54 WDS)								14 (AIS): 28  06 (AIS): 10							

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Table 4.2-5. BCE bypass words<sup>1,2</sup> (continued)

C. BCE BYPASS WD 2 (GNC)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
TRANSACTION	← MTU (ID = 22) →			← NSP (ID = 24) →				← GNC OPS INIT (ID = 16) →								← SRB (ID = 63) →				← G9 IMU (ID = 17) →												
ELEMENT	MTU ACCUM			PWR/GPC BLK DISCRETES SIO DATA				FA MDM BITE 4 READ				FF MDM BITE 4 READ				SRB PROM				MDM RETURN WORD				OPER/BITE DISCRETES				SIO DATA				
BTU BCE ELE NO.	FF1 54	FF2 55	FF3 56	FF1 66	FF3 68	FF1 67	FF3 69	FA1 78	FA2 79	FA3 80	FA4 81	FF1 74	FF2 75	FF3 76	FF4 77	LL1 70	LL2 71	LR1 72	LR2 73	FF1 57	FF2 60	FF3 63	FF1 59	FF2 62	FF3 65	FF1 58	FF2 61	FF3 64				
IOM CARD NO. AND CHAN NOS.	03 (SIO) : 1  (7 WDS)			FF1-09 (DIH):1 FF3-12 (DIH):1  04 (DIH) : 0 11 (SIO) : 3 (34 WDS)												MISCELLANEOUS ANALOGS AND DISCRETES  LL1: (35 WDS) LL2: (31 WDS) LR1: (41 WDS) LR2: (31 WDS)				15 (DIL) : 0				03 (SIO) : 0  (14 WDS)								

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D. BCE BYPASS WD - PCMMU (SM)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
TRANSACTION	← 'PACKED' PCMMU (DOWNLIST ONLY) →												← READ ID (N/A) →			
ELEMENT*	READ CYCLE 1		READ CYCLE 2		READ CYCLE 3		READ CYCLE 4		READ CYCLE 5		READ CYCLE 6					
BTU ELE I/O	PMU TIO	PMU SVC	PMU TIO	PMU SVC	PMU TIO	PMU SVC	PMU TIO	PMU SVC	PMU TIO	PMU SVC	PMU TIO	PMU SVC				
PCMMU READ ERROR ID	1	2	3	4	5	6	7	8	9	10	11	12				

18819\_020

\*BCE ELE NO. IS FLIGHT SPECIFIC. USE SM I/O PROFILE, SCP 1.6.

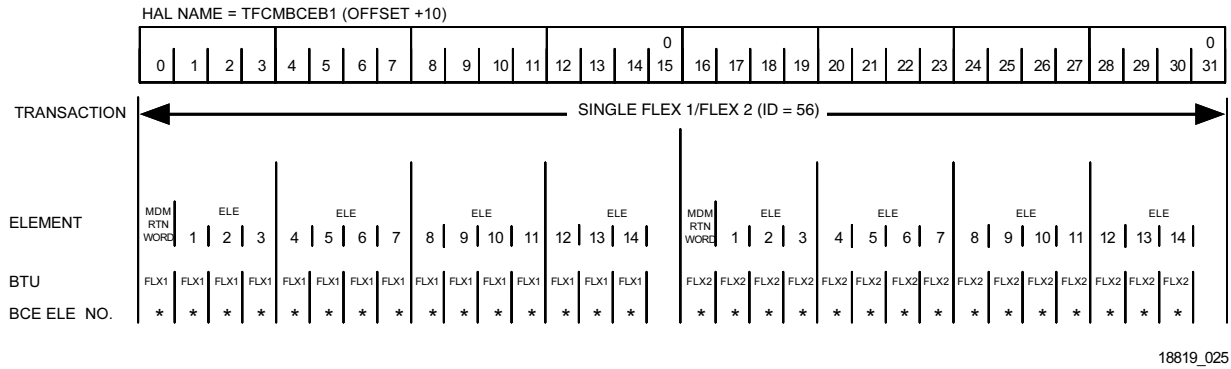




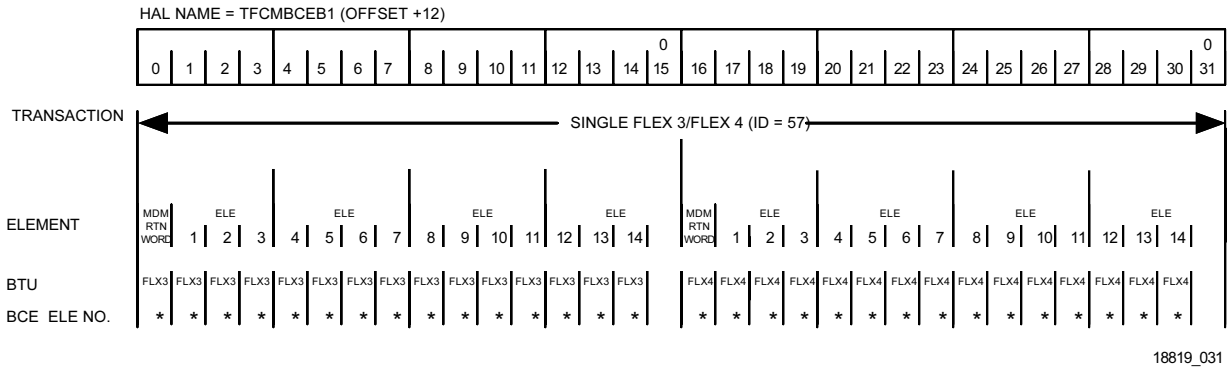


Table 4.2-6. SM bypass words - not downlisted <sup>1,2</sup> (continued)

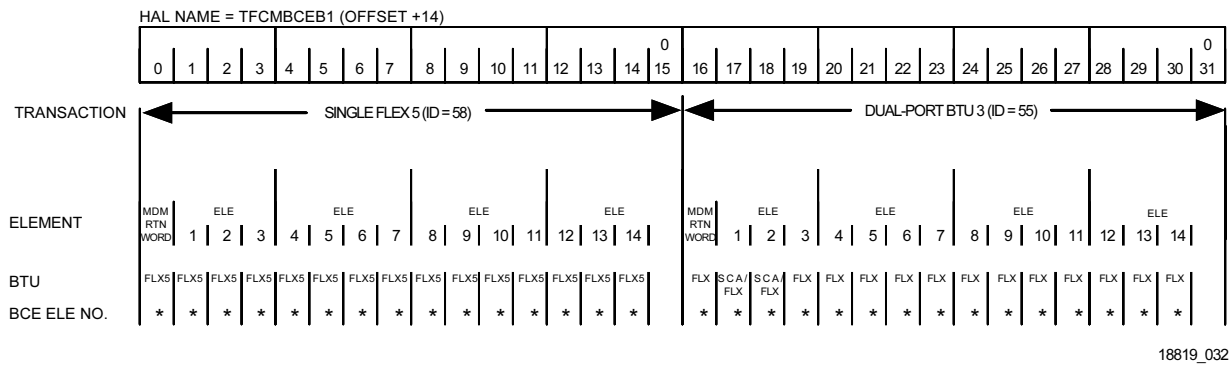
C. BCE BYPASS WD 5



D. BCE BYPASS WD 6



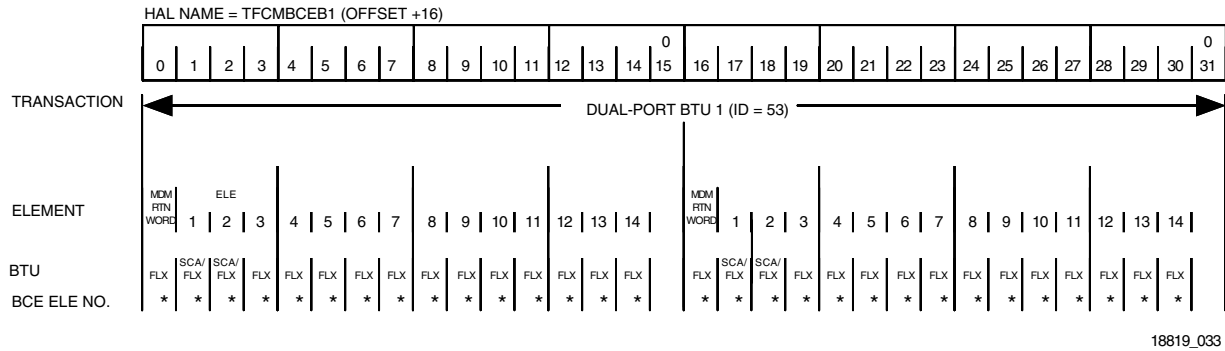
E. BCE BYPASS WD 7



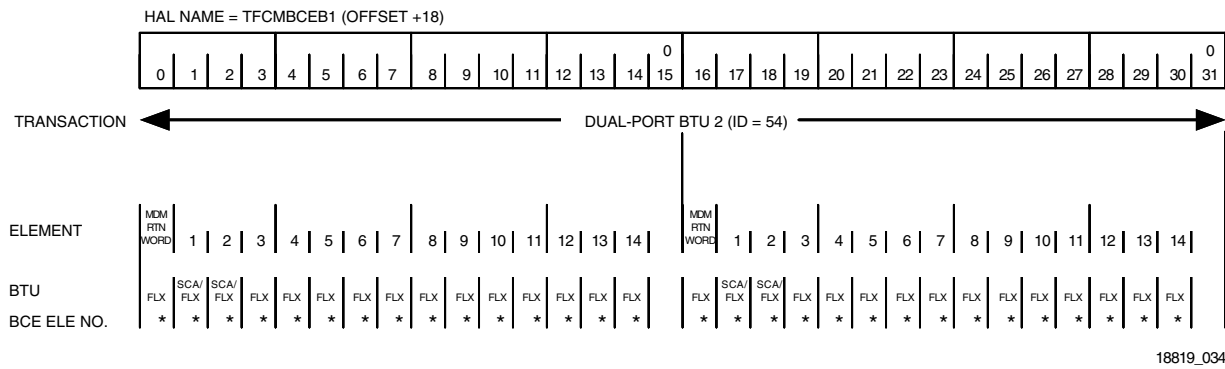
\*BCE ELE NO. IS FLIGHT SPECIFIC. USE SM I/O PROFILE, SCP 1.6.

Table 4.2-6. SM bypass words - not downlisted <sup>1,2</sup> (concluded)

F. BCE BYPASS WD 8



G. BCE BYPASS WD 9



\*BCE ELE NO. IS FLIGHT SPECIFIC. USE SM I/O PROFILE, SCP 1.6.

**Table 4.2-7. I/O timeout signatures vs. DPS failures <sup>4</sup>**

(a) FC Bus Failures

Fault message	DPS failure	PASS I/O error log <sup>a,b</sup>	
		Bus Cmdr	Bus Listener
I/O ERROR (FF1-FF4) I/O ERROR (FA1-FA4)	MDM/data bus failure (no MDM return word)	Initial T/O	Initial T/O (all)
<p>Note: Bus commander sends MDM return word cmd; Bus Listeners hear Bus Cmdr send MDM return word cmd; no one receives MDM return word-all GPCs will bypass failed MDM (or data bus) during subsequent input transactions.</p> <p>If BFS tracking PASS prior to failure, then BFS will also bypass failed MDM and continue to maintain track on affected FC string.</p>			
I/O ERROR (FF1-FF4) I/O ERROR (FA1-FA4)	FC Bus Cmdr transmitter failure (no MDM return word)	Initial T/O	MSC T/O (all)
<p>Note: Bus Listeners time out waiting to hear Bus Cmdr send the MDM return word cmd. Bus Cmdr (who thinks he sent MDM return word cmd) does not receive MDM return word - all GPCs will bypass failed MDM (or data bus) during subsequent input transactions; also, note that <u>no output commands</u> can be sent by Bus Commander as well. GPC does not fail to sync.</p> <p>If BFS tracking PASS prior to failure, then BFS will lose track on affected FC string. (If FF MDM, BFS GPC error log 'ERR' = 44; if FA MDM, 'ERR' = 45)</p>			
I/O ERROR (FF1-FF4) I/O ERROR (FA1-FA4)	I/O Term B discrete failure (high) or XMTR ENA failure	MSC T/O or MIA Busy/ no XMTR ENA	MSC T/O (all)
<p>Note: Presence of I/O Term B discrete removes XMTR ENA signal to Bus Cmdr's MIA. Thus, return word cmd is not transmitted on data bus. I/O term discrete also causes the Bus Cmdr's IOP microcode to branch to a "Listen" mode. Consequently, Bus Cmdr, as well as all Bus Listeners, times out waiting to hear the "return word cmd" that was never sent. GPC does not fail to sync.</p> <p>If BFS tracking PASS prior to failure, then BFS will lose track on affected FC string(s) (BFS GPC error log 'ERR' = 45).</p>			
GPC1-GPC5	FC Bus Listener receiver failure	--	Possible MSC T/O <sup>c</sup>
<p>Note: Rest of redundant set GPCs will exclude failed FC Bus Listener from redundant set after second I/O error.</p> <p>If BFS tracking PASS prior to failure, then BFS will lose track on FC string(s) commanded by affected GPC (BFS GPC error log 'ERR' = 45). (Exception: two-on-two string-wise split.)</p>			
GPC1-GPC5	FC Bus Cmdr's receiver failure	Possible Initial T/O <sup>c</sup> (first BCE element)	Possible MSC T/O <sup>c</sup> (several elements)
<p>Note: All GPCs, except the Bus Cmdr, hear the first Response Data Word(s) (or MDM return word). The Bus Cmdr times out waiting for initial RSP data word. Bus Listeners all time out waiting for Bus Cmdr to request next BCE element. At next transaction, process is repeated and all GPCs in the redundant set will bypass the <u>highest numbered</u> BCE element to have errored (i.e., BCE element on which all Bus Listeners timed out). Upon subsequent transactions, the bypass process is repeated until all elements of the chained input transaction have been sequentially bypassed-note that the initial BCE element will be the last element to be faulted since it is then the highest numbered element and is still "causing" the Bus Cmdr to fail the I/O transaction. At this time, the rest of the redundant set GPCs will exclude the failed Bus Cmdr from the set.</p> <p>If BFS tracking PASS prior to failure, then BFS will lose track on FC string(s) commanded by affected GPC (BFS GPC error log 'ERR' = 45). (Exception: two-on-two string-wise split.)</p>			

<sup>a</sup> Initial T/O -- IOP never received MDM return word or first response data word.

<sup>b</sup> MSC T/O -- BCE "BUSY/WAIT" flag still BUSY after maximum allotted processing time.

<sup>c</sup> If GPC with BCE receiver failure is GNC downlister, MSC T/O will appear in error logs.

If GPC is not the downlister, the MSC T/O signature may or may not appear as the most recent I/O error. Such data are ICC-transferred and GPC will probably force-fail-to-sync between SSIP ICC cycles.

**Table 4.2-7. I/O timeout signatures vs. DPS failures<sup>4</sup> (continued)**

(b) DK Bus Failure

Fault message	DPS failure	PASS I/O error log <sup>a,b</sup>	
		Bus Cmdr	Bus Listener
I/O ERROR CRT1-CRT4	CRT interface problem (DEU failed or powered off, DK bus failure) (no poll data)  If simplex GPC, possible GPC BCE XMTR/RCVR failure.	Initial T/O	Initial T/O (all)
<p>Note: DK Bus Commander sends DEU poll message (following Time Fill data transmission to DEU and BFS DK Listen index); no one receives poll response data -- all GPCs will announce fault message first time error is detected. Polling attempts will continue but I/O error logging will cease after second consecutive error (that is, no bypasses on DK buses).</p> <p>If DK bus or DEU receiver failure, big "X" and "POLL FAIL" message <u>will</u> appear on CRT. If DEU transmitter failure, CRT display will be correct. Also, this is DPS signature for a DEU that has been moded to STBY or OFF.</p>			
I/O ERROR CRT1-CRT4	DK Bus Cmdr transmitter failure (no poll data)	Initial T/O	MSC T/O (all)
<p>Note: DK Bus Listeners time out waiting to hear Bus Cmdr send the poll request command. Bus Cmdr (who thinks he sent poll request cmd word) does not receive poll response data -- all GPCs will announce fault message first time error is detected. I/O error logging will cease after second consecutive error (that is, no bypass on DK buses)</p> <p>Big "X" and "POLL FAIL" message will appear on CRT.</p>			
I/O ERROR CRT1-CRT4	CRT checksum error	None	None
<p>Note: Poll response received without I/O error detected on transaction. UI software (DMI_MCDS_IN) detects a miscompare between calculated checksum of poll response words 1 through 15 and the DEU computed checksum poll response word 16.</p> <p>No big "X" or "POLL FAIL" message will appear on CRT.</p>			

<sup>a</sup> Initial T/O -- IOP never received MDM return word or first response data word.

<sup>b</sup> MSC T/O -- BCE 'BUSY/WAIT flag still BUSY after maximum allotted processing time.

**Table 4.2-7. I/O timeout signatures vs. DPS failures <sup>4</sup> (concluded)**

(b) DK Bus Failure - Continued

Fault message	DPS failure	PASS I/O error log <sup>a,b,d</sup>	
		Bus Cmdr	Bus Listener
None	Probable unintentional DEU IPL request	T/O followed by an Initial T/O (most probable failure signature)	Same (all)
I/O ERROR CRT1-CRT4 (Annunciated on the second I/O error)	Probable unintentional DEU IPL request	T/O followed by a second T/O (a low-probability failure signature)	Same (all)
I/O ERROR CRT1-CRT4	Probable unintentional DEU IPL request	Initial T/O followed by a T/O (a low-probability failure signature)	Same (all)

Note: To confirm an inadvertent DEU load request: verify CRT "SW" = 0 on appropriate DPS high-speed display (DPS 1, 3, 4 if affected CRT assigned to GNC, SM, or OPS 0/PL9 MF, respectively). Next, confirm poll header word = '370X' hexadecimal.

When the DEU detects a DEU IPL request, the DEU initializes itself for a DEU load-ignoring all interrupts during this brief time interval. If a poll request occurs during this window, it will be 'locked out' by the DEU and the GPC(s) will log an Initial T/O. Upon completion of the IPL reconfiguration, the DEU will respond to the first DEU poll request, returning a single poll header response word (with the 'DEU initialization required' bit set). The IOP, however, is expecting a 16-word response and will therefore log a T/O.

When an I/O error is detected on a DEU poll, the UI software (DMI\_MCDS\_IN) checks for a DEU load request. If the 'DEU initialization required' bit is set (may be fresh or stale data in buffer), no fault message is annunciated. Otherwise, the "I/O ERROR CRT" message is annunciated (if not previously annunciated).

Although the UI software recognizes the DEU load request, the on-orbit GNC memory configuration does not support such requests, and instead continues to transmit the "time fill" and "poll requests" to the DEU. The DEU, however, has initialized itself to receive an IPL load and will treat the "time fill" data as DEU load data until the DEU memory is progressively scrambled/destroyed.

Thereafter, the DEU may or may not be capable of responding to DEU poll requests as its memory is destroyed. (If no response, I/O error will be logged as an Initial T/O; if response, the DEU will transmit a single poll header word with the 'DEU initialization required' bit reset which will be logged by the IOP as a T/O.) Following the second I/O error, FCOS ceases logging (until successful I/O transaction).

Note that the crew may or may not observe a "DEU LOAD" message on the CRT screen. The screen goes blank (no big "X" or "POLL FAIL" messages).

I/O ERROR CRT1-CRT4 followed by GPC1-GPC5	DK Bus Cmdr's receiver failure	Possible--Initial T/O <sup>e</sup>	--
--	--------------------------------	------------------------------------	----

Note: Only DK Bus Commander fails to receive poll response data, GPC will force fail-to-sync after second consecutive I/O error on DK bus.

Note that no big "X" or "POLL FAIL" message will appear on CRT.

I/O ERROR CRT1-CRT4 followed by GPC1-GPC5	DK Bus Listener receiver failure	--	Possible MSC T/O <sup>e</sup>
--	----------------------------------	----	-------------------------------

Note: Only single DK Bus Listener time out waiting to hear Bus Cmdr send the poll request command. GPC will force fail-to- sync after second consecutive I/O error on DK bus.

The CRT display is not affected by Bus Listener failure.

<sup>a</sup>Initial T/O -- IOP never received MDM return word or first response data word.

<sup>b</sup>MSC T/O -- BCE 'BUSY/WAIT' flag still BUSY after maximum allotted processing time.

<sup>d</sup>T/O -- IOP received first response data word (or MDM return word) but did not receive entire message (one or more words missing or did not return within maximum allotted time)

<sup>e</sup>Data may or may not appear as the most I/O error on high speed displays. Such data are ICC transferred and GPC will probably force-fail-to-sync between SSIP ICC cycles.

**Table 4.2-8. Fault message annunciation of I/O errors 3,4**

Fault Message	Remarks
I/O ERROR     (FF1 - FF4)     (FA1 - FA4)     (PL1, PL2)	BCE bypass on MDM return word for indicated MDM.
MDM OUTPUT     (FF1 - FF4)     (FA1 - FA4)     (PL1, PL2)	MDM single-point failure or IOP single-point failure for GPC commanding indicated MDM (based upon low-rate monitoring of MDM return word "contents").
I/O ERROR FLEX	BCE bypass on flex/flex pair MDM return word (msg can occur only if flex MDM(s) onboard for a given flight--that is, no nuisance alarms).
I/O ERROR LF1 I/O ERROR LA1	Second consecutive I/O error on launch MDMs (prelaunch only).
I/O ERROR (CRT1-CRT4)	First I/O transaction error or first checksum error for indicated DEU/CRT.
I/O ERROR PCM	Second consecutive <u>Initial Timeout</u> I/O error logged by FCOS during "SM read OI/PL RAM data" transactions. (All other I/O errors associated with this input transaction are treated as "SEV" type errors by the SM applications software and may result in 'S62 BCE BYP' type fault messages.)  Second consecutive I/O error on other PCMMU input transactions, such as "cyclic BITE status read".
I/O ERROR DL	Second consecutive I/O error <u>detected</u> by IOP during downlist write transactions. (Note that very few I/O error conditions are actually detectable for output transactions.)
I/O ERROR MMU1(2)	MM checksum or I/O transaction error--subsequent processing depends on several particulars (Table 4.2-4 notes).  If DEU I/O error during DEU IPL, annunciated via 'I/O ERROR MMU' (no MMU error actually involved).
OFF/BUSY MMU1(2)	MMU selected for transaction detected to be failed or powered down, or SM roll-in SPEC in progress.
S60 CHECKPT FAIL	Failure to complete SM checkpoint or SM checkpoint retrieve. On SPEC 60, a qualifier will identify the specific failure. "BOTH" refers to failure to complete both SM common and unique (not even attempted) compool operations, whereas "UNIQUE" refers to a failure to complete either S2 or S4 unique compool operations. Note that the "BOTH" text will occur if crew attempts to perform an SM CHKPT RTV to an S2 or S4 checkpoint area that has never been written to.
BCE STRG 1-4 A(B,C,D)       ADTA       IMU       MLS       MTU       NSP       STKR       TAC	BCE element bypass has occurred on indicated string. Minor field of BCE string fault message identifies the bypassed sequences or LRU.
CM BUF BSY (CRT 1 - CRT 4)	DEU IPL request when SM common buffer is currently busy. Wait for contending operation to complete, then retry the SM DEU IPL.

**Table 4.2-8. Fault message annunciation of I/O errors <sup>3,4</sup> (concluded)**

Fault Message		Remarks
BCE BYP KU		BCE bypasses on Ku-band radar.
BCE BYP PL1(2)		BCE bypass on PL buses.
BCE BYP FLEX		BCE bypass on flex/flex MDM pair element(s) (msg available only if flex MDM(s) onboard for a given flight).
BCE BYP MCIU		GPC detected loss of I/O with MCIU
BCE BYP SCA		BCE bypass on SCA
S62 BCE BYP	OFA OFB OA PSP1(2) PDI PL	OF1 or OF2 MDM or MDM card failure OF3 or OF4 MDM or MDM card failure OA1, OA2, or OA3 MDM or MDM card failure PSP1(2) to PL1(2) MDM serial I/O failure PDI interface to SM GPC failure PDI element, or Spacelab SSC or EXC serial interface to PCMMU failure
S96 PDRS GPC <sup>a</sup>		MCIU has alerted SM GPC via BITE status word of a data path communication failure on the LDB. (That is, the MCIU WATCHDOG TIMER has timed out since last detected MCIU poll or MCIU write.)
<p>GPC loss-of-sync may or may not be caused by I/O errors; any of the following I/O errors will result in GPC loss-of-sync:</p> <ul style="list-style-type: none"> <li>• Most IOP Level A or Level B interrupts (Table 4.2-4).</li> <li>• An IOP port designated as a bus listener has its transmitter enable logic set (transmitter failed on).</li> </ul>		
GPC (1-5)		<ul style="list-style-type: none"> <li>• Only one GPC in the redundant set logs two consecutive I/O errors on the indicated transaction (GPC will force fail-to-sync due to this nonuniversal I/O error condition) <ul style="list-style-type: none"> <li>(1) Standard I/O transaction (redundant set protected inputs)</li> <li>(2) NSP cyclic input (Device ID = 24)</li> <li>(3) LDB/GSE input (Device ID = 61)</li> <li>(4) DEU poll (Device ID = 5 to 8)</li> </ul> </li> <li>• Only one GPC in the common set detects errors on an ICC RETRY (SSIP ICC or IPR).</li> <li>• ICC problem after a RETRY and multiple GPC-reported errors: <ul style="list-style-type: none"> <li>(1) Reported errors agree on the faulted ICC bus--the Bus Commander will force fail-to-sync.</li> <li>(2) Reported errors disagree on the faulted ICC bus--each reporting GPC will force fail-to-sync.</li> </ul> </li> </ul>

<sup>a</sup> Although this fault message is defined for current PASS software, an MCIU/GPC software implementation problem normally precludes its annunciation to the crew.



**Table 4.2-9. GPC discretetes "commonality"**

Discrete Inputs				Discrete Inputs (Hardware RM)																														
Receiver	DI #	Discrete Function <sup>a</sup>	RM by PASS	Receiver	DRI #	Discrete Function <sup>a</sup>																												
1	0 <sup>b</sup>	HALT CMD		1	03	GPC 2 FAIL Vote																												
	1 <sup>b</sup>	STANDBY CMD			04	GPC 3 FAIL Vote																												
	2 <sup>b</sup>	RUN CMD				05	GPC 4 FAIL Vote																											
	3	IPL CMD					06	GPC 5 FAIL Vote																										
2	4 <sup>b</sup>	MMU 1 IPL CMD	X		<p style="text-align: center;">Discrete outputs</p> <table border="1"> <thead> <tr> <th>Buffer Driver</th> <th>DO #</th> <th>Discrete Function</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>07</td> <td>I/O Active Ind</td> </tr> <tr> <td>2</td> <td>09</td> <td>RUN Ind</td> </tr> <tr> <td>3</td> <td>20</td> <td>SELF SYNC1</td> </tr> <tr> <td>4</td> <td>22</td> <td>BFS RUN</td> </tr> <tr> <td>5</td> <td>24</td> <td>SELF SYNC2</td> </tr> <tr> <td>6</td> <td>28</td> <td>SELF SYNC3</td> </tr> <tr> <td>7</td> <td>30</td> <td>ID Source<sup>d</sup></td> </tr> <tr> <td>8</td> <td>31</td> <td>IPL Ind</td> </tr> </tbody> </table>			Buffer Driver	DO #	Discrete Function	1	07	I/O Active Ind	2	09	RUN Ind	3	20	SELF SYNC1	4	22	BFS RUN	5	24	SELF SYNC2	6	28	SELF SYNC3	7	30	ID Source <sup>d</sup>	8	31	IPL Ind
	Buffer Driver	DO #	Discrete Function																															
1	07	I/O Active Ind																																
2	09	RUN Ind																																
3	20	SELF SYNC1																																
4	22	BFS RUN																																
5	24	SELF SYNC2																																
6	28	SELF SYNC3																																
7	30	ID Source <sup>d</sup>																																
8	31	IPL Ind																																
	5 <sup>b</sup>	MMU 2 IPL CMD	X																															
	6 <sup>b</sup>	MMU 1 READY	X																															
	7 <sup>b</sup>	MMU 2 READY	X																															
3	8	GPC 2 BFS RUN	X																															
	9	GPC 3 BFS RUN	X																															
	10	GPC 4 BFS RUN	X																															
	11	GPC 5 BFS RUN	X																															
4	12	SPARE (I/O TERM A)																																
	13 <sup>b</sup>	I/O TERM B																																
	14	SPARE																																
	15 <sup>b</sup>	HARDWARE MEMORY DUMP (HISAM)																																
5	16	SPARE																																
	17	SPARE																																
	18	SPARE																																
	19	SPARE																																
6	20	GPC 2 SYNC1																																
	21	GPC 3 SYNC1																																
	22	GPC 4 SYNC1																																
	23	GPC 5 SYNC1																																
7	24	GPC 2 SYNC2																																
	25	GPC 3 SYNC2																																
	26	GPC 4 SYNC2																																
	27	GPC 5 SYNC2																																
8	28	GPC 2 SYNC3																																
	29	GPC 3 SYNC3																																
	30	GPC 4 SYNC3																																
	31	GPC 5 SYNC3																																
9	32	GPC ID BIT 0																																
	33	GPC ID BIT 1																																
	34	GPC ID BIT 2																																
	35	BFS ENGAGE 1	X <sup>c</sup>																															
10	36	BFS ENGAGE 2	X <sup>c</sup>																															
	37	BFS ENGAGE 3	X <sup>c</sup>																															
	38 <sup>b</sup>	CRT SEL A	X																															
	39 <sup>b</sup>	CRT SEL B	X																															

<sup>a</sup> These descriptions given for GPC 1. See note 1 on Shuttle Console Handbook Drawing 8.1 for other GPCs.

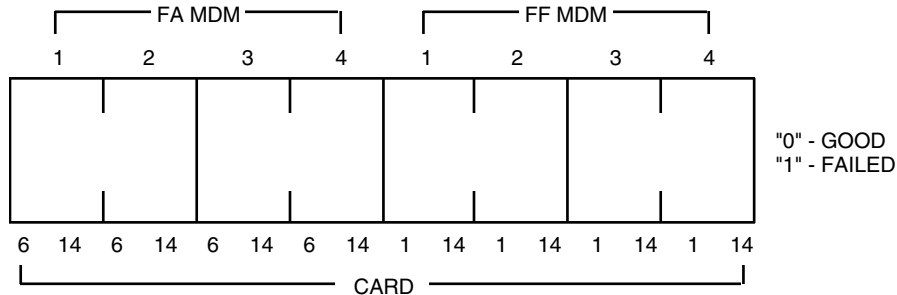
<sup>b</sup> If suspect, these discretetes may be tested.

<sup>c</sup> The engage discretetes are redundancy managed by PASS for disengage only.

<sup>d</sup> ID Source provides 'logic one' reference voltage to wiring harness connector where the GPC slot ID bit pattern is formed and then fed back to the IOP via discrete inputs DI #32 to 34.

**Table 4.2-10. MDM A/D (converter) bite status word**

[AVAILABLE IN HDR ONLY]



18819\_035

- One bit indicating a "1" is indicative of either an MDM card failure or a failure of one of the input measurements.
- Two bits on same MDM indicating a "1" is indicative of an MDM A/D Converter failure. For the A/D Converter failure, other indications are:
  - a. "BCE STRG X A & B" fault msgs (for FF MDMs)  
"BCE STRG X C & D" fault msgs (for FA MDMs)
  - b. BCE STATUS WORD "00000004" (Illegal BCE Instruction)
  - c. "BCE STRG X A & B" fault msgs (for FF MDMs)  
"BCE STRG X C & D" fault msgs (for FA MDMs) from BFS (if running)
- For the FF MDMs, Channels 12 and 13 are used on both cards 1 and 14.
- For the FA MDMs, Channels 15 and 16 are used on both cards 6 and 14.
- Individual MDM BITE STATUS words for A/D converter failures would be as follows:

FF1 - "00C0"	FA1 - "C000"
FF2 - "0030"	FA2 - "3000"
FF3 - "000C"	FA3 - "0C00"
FF4 - "0003"	FA4 - "0300"

[Reference DPS Systems Brief, MDM, Section 7.11.1, for more details.]

## **REFERENCES**

1. PASS User's Guide; NAS9-16920; 8.2 Input/Output (I/O) Errors.
2. Space Shuttle Computer Program Development Specifications (CPDS); SS-P-0002-580.
  - 4.1.1 PCMMU
  - 4.1.2 PL/Bus I/O Processing
3. Reference Data; JSC-48041.
4. PASS User's Guide, NAS9-16920; appendix F, I/O Error Messages; appendix G, FSP Messages.
5. IBM I/O Profile Document.
6. AP101S SPECS, Computer Central Purpose Orbiter, RI.
7. NSTS System Level A Software Requirements, SS-P-0002-170.
  - 4.6.3 I/O Management
  - 5.9.3.1.9 Error Log Reset

**TITLE**

PASS GPC ERRORS

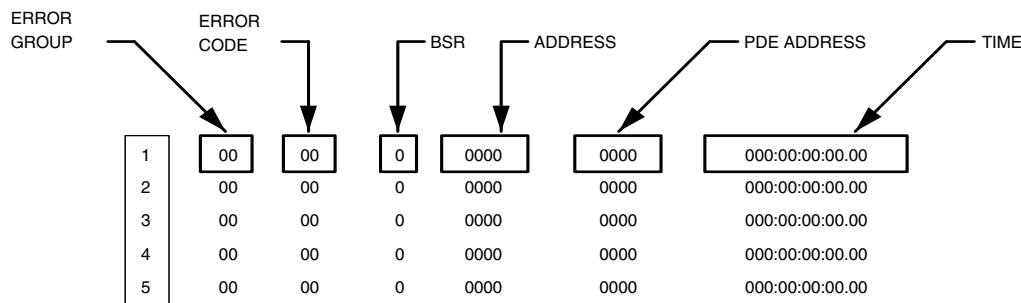
**PURPOSE**

The GPC Error Log (CZ2V\_GPC\_ERR\_LOG) includes the following:

- First five GPC errors
- Last five GPC errors
- Last error in each GPC
- Cumulative error count for each GPC

**BACKGROUND**

The GPC error log is a prime indicator of problems that can exist within the GPC software and the hardware. The error log is updated and controlled by the Process\_Error\_Logged (FPMERRLOG). The error log consists of a ten deep stack. The first five entries (slots 1 through 5) are the first five detected GPC errors. These slots remain static until an Error Log Reset (item 48) is performed. After the first five errors have occurred, slots 6 through 10 act as a five deep circular stack of the last five accumulated errors. An item 48 also clears out these slots. Each entry in the circular GPC error log consists of the following (Figure 4.3-1):



18819\_036

**Figure 4.3-1. Circular GPC error log**

Error group - A 6-bit indication (first two characters of "ERROR" indication) that specifies the group classification of an error.

Error code - A 6-bit indication (last two characters of "ERROR" indication) that specifies the particular error within the error group.

Branch Sector Register (BSR) - A 4-bit indication (first character of "ADDRESS" indicator) used with the error address for extended addressing (see Table 4.3-1).

**Table 4.3-1. Extended addressing to absolute addressing**

First digit word 6 <sup>a</sup>	BSR value					
	2	3	4	5	6	7
8	10	18	20	28	30	38
9	11	19	21	29	31	39
A	12	1A	22	2A	32	3A
B	13	1B	23	2B	33	3B
C	14	1C	24	2C	34	3C
D	15	1D	25	2D	35	3D
E	16	1E	26	2E	36	3E
F	17	1F	27	2F	37	3F

<sup>a</sup> If the most significant digit of the extended address is greater than 7; i.e., 8XXX, then replace that digit with the two digits as determined by the value of the BSR to derive the absolute address. [For a BSR of 0 or 1, use the four-digit address as given for the extended address; i.e., extended addresses 0000-FFFF are absolute addresses 00000-0FFFF.]

Address at the time of error - A 16-bit address (last four characters of "ADDRESS" indicator) of the next instruction to be executed when the error occurred. If the most significant bit is a 1, extended addressing is indicated (see Table 4.3-1)

Note: BSR and ADDRESS are available through ODRC and by dumping the GPCs. They are not viewable on DPS Overview.

PDE address - A 16-bit process directory entry (labeled as Pointer/Ptr) that indicates the address of the software module that was running when the error occurred.

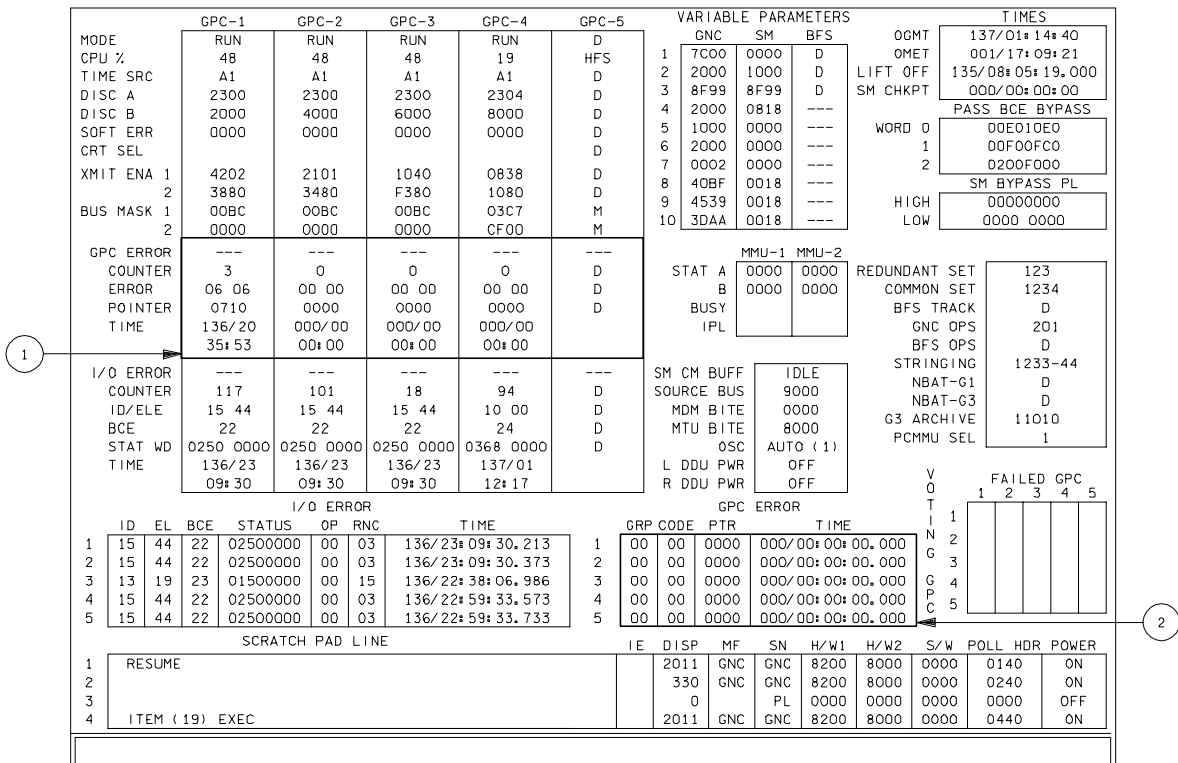
Time - A three-halfword indication of the time of occurrence of the error, based on runtime.

The five-deep stack of last GPC errors is viewable on DPS Overview (Figure 4.3-2).

Each entry in the last GPC error log corresponds to the entries in the circular GPC error log (slots 6 through 10), with the addition of the following:

Counter - A decimal counter displaying the cumulative count of errors logged by the indicated GPC. Counter is incremented upon the occurrence of any GPC error and is limited to a maximum value of 32,767. The counter does not roll over to zero upon reaching the maximum error count, thus effectively disabling the DPS critical alarm associated with the occurrence of a GPC error in the affected GPC(s). Each GPC maintains its own cumulative counter and transmits it to all other active GPCs via the ICC data buses. The GNC GPC that is selected as downlistener will transmit its last error status and the status of all CS members to the ground for use on the DPS display.

This information is displayed on DPS Overview (Figure 4.3-2).



188190432.CRT, 2

Figure 4.3-2. DPS overview

**Table 4.3-2. GPC errors - group/code**

Error <sup>a</sup> group/code	Error condition	System default action (application errors)	Error response for FCOS error
02 0D	Cycle Overrun (cycle Wrap) - attempt to start a new cycle of a cyclic process which is still executing	Skip cycle (ignore timer interrupt) and continue	N/A
03 00	Illegal Operation Code	GPC BITE force close process and continue <sup>b</sup>	Dispatch application process
01	Privileged Instruction - attempt to exec instructions legal only in FCOS	GPC BITE force close process and continue <sup>b</sup>	N/A
04 <sup>c</sup>	Fixed-Point Overflow	Masked	Masked
05 <sup>c</sup>	Significance - loss of significance was detected during floating point operations	Masked	Masked
07	CPU Protect Violation - attempt to write to protected memory	GPC BITE force close process and continue <sup>b</sup>	Dispatch application process
09 <sup>c</sup>	Exponent Underflow (Floating-Point)	Masked	Masked
OA	Overflow (Convert) - attempt to convert a value from floating to fixed point which is out of range	Ignore and continue	Ignore and continue
OB	Exponent Overflow	Ignore and continue	Ignore and continue
OC	Divided (Floating-Point) - divisor was equal to true zero	Ignore and continue	Ignore and continue
14	Instruction Monitor - attempt to execute information retrieved from unprotected storage	GPC BITE force close process and continue <sup>b</sup>	Dispatch application process

Error <sup>a</sup> group/code	Error condition	Standard fixup
04 04	Exponentiation of zero to power $\leq 0$	Result set equal to zero
05	Square root ARG < 0	Square root  ARG
06	Exp function ARG > 174.673	Result = max positive integer
07	Log function ARG $\leq 0$	If ARG = 0, result = max negative number; Else = log  ARG
08	Sin or Cos function  ARG  > (2.621 E5) $\pi$ (1.126 E15) $\pi$	For single or double precision; Result = $\frac{\sqrt{2}}{2}$
09	Sinh or Cosh funct ARG > 175,366	Result = max positive integer
OA	Arcsin or Arcos funct  ARG  > 1	Arcsin > 1 = $\frac{\pi}{2}$ ;    Arcsin < -1 = $-\frac{\pi}{2}$ Arcos > 1 = $\pi$ ;    Arcos < -1 = $\pi$
OB	Tan function  ARG  > 2.621 E5 1.126 E15	For single or double precision; result = 1
OC	Tan function ARG too close to $\frac{(2n+1)\pi}{2}$	Result = max positive number
OE	No RETURN statement in funct	None
OF	Scalar too large or too small for integer conversion	If too large; result = max positive integer If too small; result = max negative integer

<sup>a</sup>Downlisted as a four-digit hex word; bits 0-3 BSR, bits 4-9 Code, bits 10-15 Group

<sup>b</sup>If error is a result of any G-MEM write (crew input or uplink), the GPC BITE fault msg is not announced.

<sup>c</sup>GPC error is not logged.

**Table 4.3-2. GPC errors - group/code (continued)**

Error <sup>a</sup> group/code	Error condition	Standard fixup
10	In remainder (A,B); B = 0	Result = A
11	Illegal character subscript	Subscript set to first or last character
12	Length in LJUST or RJUST funct is > string length or is < 0	Truncation to the specified length occurs on the left (LJUST) or right (RJUST)
13	In A MOD B B = 0 and A < 0	Result = A
14	String not in standard format for character to scalar conv	Result = 0
16	String not in standard format for character to integer conv	Result = 0
18	A**B with A < 0 or A = 0 and B ≤ 0	Result =  A** B
19	Vector or matrix division by 0	Result = original vector or matrix
1B	ARG of inverse is singular	Result = identity matrix
1C	ARG of unit vector is null vector	Result = null vector
1D	Illegal bit string	Result = 0 bit string
1E	SUBBIT subscript exceeded bit length	Subscript takes the value exceeded limit
1F	BIT @ OCT - invalid character	Result = 0
20	BIT @ HEX - invalid character	Result = 0
3B	Arcosh ARG < 1	Result = 0
3C	Arctanh  ARG  ≥ 1	Result = 0
3E	Arctan2 function error X = SIN α Y = COS α Z = $\frac{\text{SIN } \alpha}{\text{COS } \alpha}$	If X = Y = 0; return = 0 If Y < 0 and Z < 16 <sup>-6</sup> return = ± Π (sign determined by SIN α) If X <> Y, Y = 0 or If X <> 0, Y <> 0 Z < 16 <sup>6</sup> return = ± Π (sign determined by 2 SIN) If Z < 16 <sup>-3</sup> return = Z

Error <sup>a</sup> group/code	Error condition	System default action (application errors)	Error response for FCOS error
05 00	I/O Error on IPR or SIPP ICC Retry (i.e., two consecutive errors on the same message from any GPC)	N/A	Fail to sync appropriate GPC
01	Disagreement in Transmitter Status	N/A	Wait state with interrupts disabled
04	I/O Store Protect Violation - attempt to write into protected memory loc during a DMA queue	GPC BITE force close process and continue <sup>b</sup>	Dispatch application process
05	Illegal Device ID	Sets/resets I/O events and return status (if necessary)	
06	Invalid Event Address	Ignore and continue	N/A
07	Checksum Error on ICC Retry - mismatch on variant data portion of ICC (2nd consecutive error)	N/A	Fail to sync appropriate GPC

<sup>a</sup> Downlisted as a four-digit hex word; bits 0-3 BSR, bits 4-9 Code, bits 10-15 Group.

<sup>b</sup> If error is a result of any G-MEM write (crew input or uplink), the GPC BITE fault msg is not annunciated.



**Table 4.3-2. GPC errors - group/code (concluded)**

Error <sup>a</sup> group/code	Error condition	System default action (application errors)	Error response for FCOS error
06 01	A DEU Response Message was received which contained the 'Message Ready' BIT ON, but the number of keystrokes indicated was zero	Ignore and continue	N/A
02	AIE-SIP received an ICC message which contained an invalid header	Ignore and continue	N/A
03	AIE-SIP received an ICC message which contained invalid data	Ignore and continue	N/A
05	Invalid SVC parameter list for MTU update	Ignore and continue	N/A
06	PMU Time invalid (during primary GPC init)	Runtime used instead of PCMMU time to calculate TSIP	N/A
07	Do Case Out-of-Range	Ignore and Continue	N/A
07 **	I/O Cycle Wraps Preinitialized IOQE busy for:		
01	HFE Input	Ignore and continue	N/A
02	HFE Output	Ignore and continue	N/A
03	MFE Input	Ignore and continue	N/A
04	NSP (Uplink) Input	Ignore and continue	N/A
05	Downlist	Ignore and continue	N/A
06	SRB Input	Ignore and continue	N/A
07	ICC	Ignore and continue	N/A
08	LDB	Ignore and continue	N/A
09	MCIU Input	Ignore and continue	N/A
OA	MCIU Output	Ignore and continue	N/A
OB	HDA Input	Ignore and continue	N/A
OC	PL High Rate	Ignore and continue	N/A
OD	PMU OI/PL RAM	Ignore and continue	N/A

<sup>a</sup>Downlisted as a four-digit hex word; bits 0-3 BSR, bits 4-9 Code, bits 10-15 Group.

<sup>b</sup>If error is a result of any G-MEM write (crew input or uplink), the GPC BITE fault msg is not annunciated.

## REFERENCES

1. PASS User's Guide, sec. 8.1, appendix D and E.
2. IBM.

**TITLE**

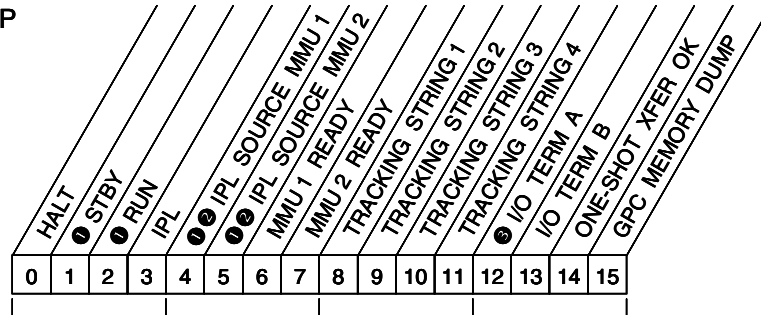
BFS STATUS

**PURPOSE**

This section provides a means for decoding various hex data that can be used to determine the status of the BFS computer.

MSID: V98M0590P

**DISC A**

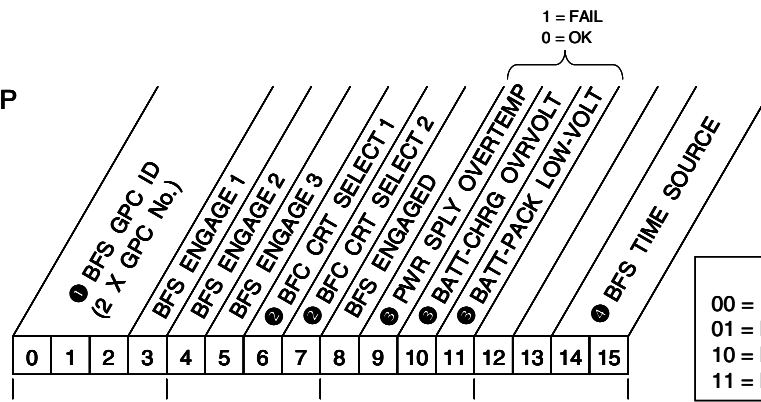


- ❶ If any STBY, RUN, or IPL SOURCE MMU bit is failed high, the BFS cannot enter the 'Sleep Mode'
- ❷ If IPL SOURCE MMU bit fails high, BFS will drop CRT assigned via BFC CRT SEL switch (first CRT if engaged)
- An IPL SOURCE MMU bit failed high will not prevent an inflight BFS IPL
- ❸ If I/O TERM A bit fails high (hybrid receiver), a BFS I/O RESET attempts to upmode the IOP XMIT ENA register PL buses

**BFS Status Word 2/Track PASS Status (V98M0590, version OI-30)**

MSID: V98M0600P

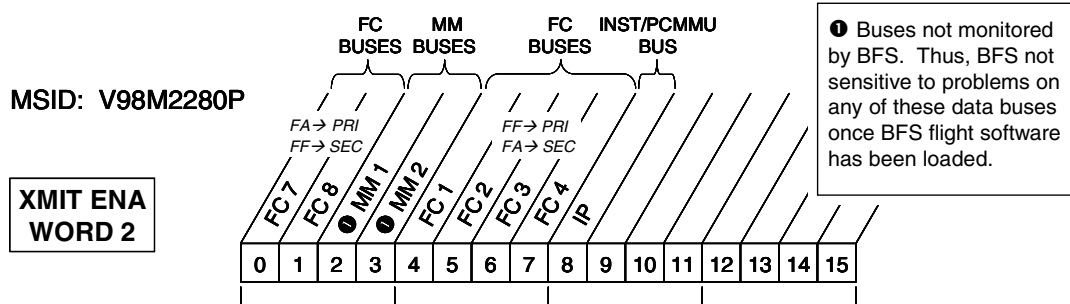
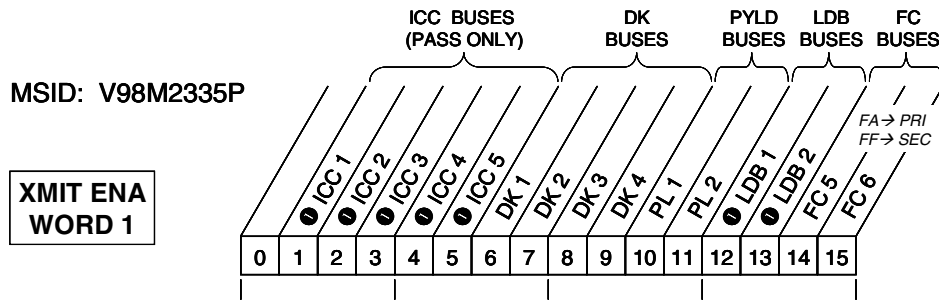
**DISC B**



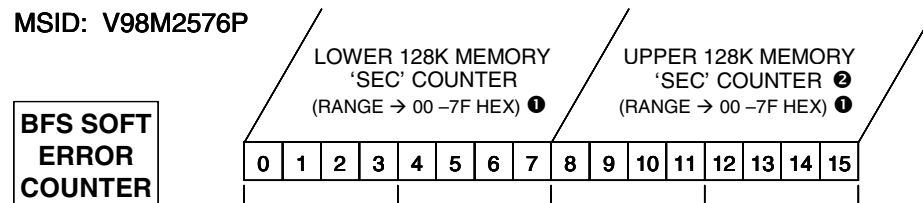
- ❶ GPC ID bit(s) failure no flight impact unless it is necessary to re-IPL the box
- ❷ BFC CRT SEL discretizes not RM'd by BFS
 

	Not ENG'd	ENGAGED
00	NONE	CRT 1 + 2
01	CRT 1	CRT 1 + 2
10	CRT 2	CRT 2 + 3
11	CRT 3	CRT 3 + 1
- ❸ PWR SUPPLY OVERTEMP > 190 ± 7° F (resets at ≈ 29° F below the actual trip limit)
- ❹ BATTERY CHARGER INPUT > 5 VDC at either GPC Battery Pack
- ❺ BATTERY OUTPUT < 3.2 VDC at either GPC Battery Pack

**BFS Status Word 3 (V98M0600, version OI-30)**



**MIA Transmitter Status 1 and Status 2 (XMTRSTAT, version OI-30)**



- GPC hardware SCRUB logic checks all 256K memory every 1.7 seconds.
- The 'SEC' counter is hardware reset at a GPC IPL, BFS memory 'store-protect' GPC Errors (04 or 97), or a GPC mode to RUN -> STBY or HALT -> STBY/RUN.
- ❶ SEC error count incremented by GPC EDAC (error detection and correction) hardware. Max value is '7F' hex (127 decimal). Counters do not rollover. BFS does not have an equivalent to the PASS "error log reset".
- ❷ BFS does not currently utilize GPC upper memory. Any 'scrub' hardware-detected failure (either single-bit or multi-bit error) does not impact the BFS capability. [Reference Flight Rule A7-4.B.]

**GPC Soft Error Counter (SERRCNTR, version OI-30)**

**REFERENCES**

BFS Backup System Services Program Requirements Document, MG038101 (OI-30 version of the BFS BSS PRD)

## TITLE

BFS - I/O ERROR

## PURPOSE

To indicate which data are available to support BFS I/O error monitoring, to define the data, and to provide additional data to assist in the assessment of BFS I/O errors.

## GENERAL

BFS I/O transaction monitoring (onboard) includes I/O error detection, annunciation, and bypassing of the element, if appropriate. I/O error detection is performed by the IOP. Annunciation and error source elimination are provided by BFS software.

### A. I/O Error Logging, Counting, Annunciation, and Bypassing

The annunciation of I/O errors is provided by fault messages and/or entries in the I/O Error Log. While output errors do not generate fault messages, input errors may under certain conditions:

1. FC and PL errors are logged/counted on each occurrence and bypassed/annunciated after the second consecutive occurrence. During ascent, note that no 'I/O error' type of annunciation is associated with a bypassed Engine Interface Unit (EIU).
2. BFS CRT and DK listen errors are logged, counted, and annunciated on the first occurrence. Thereafter, subsequent errors occurring on the same element are not logged or counted until an error-free I/O transaction resets the inhibit flag for that element.
3. IP errors are logged and counted on the first occurrence and annunciated after the second consecutive occurrence. Thereafter, subsequent errors occurring on the same element are not logged or counted until an error-free I/O transaction resets the inhibit flag for that element.

Figure 4.5-1 provides a summary.

FIRST OCCUR OF I/O ERROR				SECOND OCCUR OF I/O ERROR				OR	LOG ERROR		COUNT ERROR		ANNUN ERROR		BYPASS ELE	
LOG	COUNT	ANNUN	BYPASS	LOG	COUNT	ANNUN	BYPASS		OCCURRENCE FIRST	SEC	OCCURRENCE FIRST	SEC	OCCURRENCE FIRST	SEC	OCCURRENCE FIRST	SEC
X	X			X	X	X	X	FC	X	X	X	X		X		X
X	X			X	X	X	X	PL	X	X	X	X		X		X
X	X	X						BFS CRT	X		X		X			
X	X	X						DK LISTEN	X		X		X			
X	X					X		IP	X		X			X		
X	X							GPS	X		X					

**Figure 4.5-1. I/O logging, counting, annunciation, and bypasses**

**B. Flight-Critical and Payload Bus I/O Error Bypasses**

FC and PL error source elimination typically occurs after the second consecutive error on the same element and modifies the nominal I/O transaction configuration. The extent of the modification depends on the exact source of the error.

1. If a flight-critical bus I/O error represents a failure to receive a PASS HFE listen command, the entire string is downmoded, both BCEs are disabled, and all elements on the string are bypassed. Any condition, in fact, that results in an MSC timeout signature by the BFS will cause the BFS to downmode the affected FC string.
2. If the error represents a failed MDM (failed to receive MDM return word), all elements on all input transactions that use the particular MDM are bypassed.
3. If the error represents only a partial loss of data, only the failed element is bypassed.

These errors can be caused by a number of failures, including GPC bus control element (BCE) transmitter failures, BFS BCE receiver failures, bus noise, BFS software sync problems, MDM transmitter failures, total MDM failure, and PASS software problems.

In addition, in the disengaged state, the nominal configuration is modified with reference to the 24/MC (25-hz) BFS transfer data that the BFS receives on each PASS aft flight-critical string ("FA buses" only). Any string that provides unreliable BFS transfer data (determined by comparing the data from each of the strings) is downmoded. Using a reliable set of transfer data, the BFS verifies that the PASS and BFS agree on any bypassed elements and upmodes any element that the PASS has reinstated. If the PASS and BFS disagree on the bypass status of any element, the BFS downmodes the entire string (unless the disagreement is such that the PASS has bypassed an element and the BFS has detected an error but has not yet bypassed the element). In the ENGAGED state, modification occurs without reference to the PASS.

**C. IOP Failure Detection Processing and Annunciation**

It should be noted that the BFS processes and annunciates certain IOP-detected hardware failures/error conditions very differently than the PASS. Such failures/errors are associated with IOP "External 0" (EX0) and "External 1" (EX1) interrupts. The PASS software developer identifies such EX0 and EX1 error conditions as IOP "Level A" and "Level B" errors, and they are logged respectively

as BCE 30 and BCE 29 type I/O errors. Many such errors will cause the affected PASS GPC to enter a software wait state (a Fail-to-Halt condition). The BFS design, on the other hand, has a basic requirement to attempt recovery, if possible. Thus, such IOP failures/errors are handled as BFS GPC errors to use standardized recovery logic, including RESTARTs. Hence, any IOP EX0 or EX1 errors will be logged by the BFS as a GPC error, not an I/O error.

**BFS I/O ERROR DATA ANALYSIS**

A. Data Available for Error Analysis

BFS I/O error telemetry data is presented on two workstation applications - DPS Overview and DPS Ascent/Entry displays. Such data is summarized below.

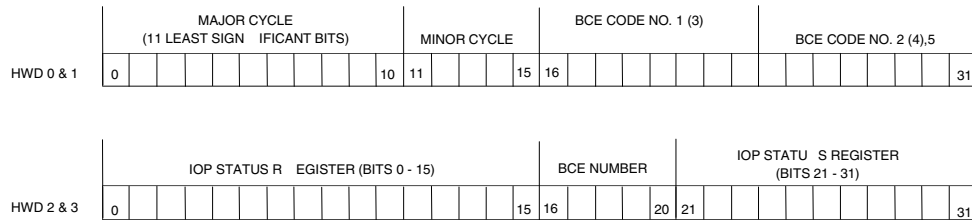
DPS Ascent/Entry	DPS Overview	Notes/Comments
BFS GPC hardware scans words:		
Cycle	Not displayed here	Major and minor cycle where error occurred
I/O ELE	ID/Element	Word 1 - BCE elements number
Stat	Stat Wd	Word 2 - IOP status register, bits 0-15
		Word 3 - IOP status register, bits 21-31
BCE	BCE	BCE number
I/O error counter:		
Not displayed here	Counter	Cumulative count of all I/O errors incurred
BFS BCE Element Bypass Words:		
BFS BCE BYP	Not displayed here	Words 1-5 (most recent 5 BFS I/O errors)
BFS tracking status		
Not displayed here	BFS Track	Flight Critical string tracking status

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B. Data Interpretation

1. BFS GPC hardware status words

The BFS I/O error data presented on the DPS Overview display represents the most recent entry in the I/O Error Log. The I/O Error Log is a ten-deep pushdown list and is represented by the I/O error data presented on the DPS Ascent/Entry display. Each entry in the I/O Error Log of the BFS is composed of four halfwords. The format is shown in Figure 4.5-2.



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**Figure 4.5-2. BFS I/O error data**

Note that while the BFS I/O error log maintains the 10 most recent errors logged, only the 5 most recent I/O errors are actually downlisted. The downlisted BFS I/O error log MSIDs are presented in Table 4.5-1.

**Table 4.5-1. BFS I/O Error Log downlist MSIDs**

	<b>HWD 0</b>	<b>HWD 1</b>	<b>HWD 2</b>	<b>HWD 3</b>
I/O error log entry #1	V98M2630P	V98M7375P	V98J2261C	V98M2636P
#2	V98M2654P	V98M7375P	V98J2265C	V98M2660P
#3	V98M2678P	V98M7378P	V98J2269C	V98M2684P
#4	V98M2702P	V98M7378P	V98J2273C	V98M2708P
#5	V98M2726P	V98J2276C	V98J2277C	V98M2732P

Each entry in the I/O Error Log is formatted and labeled for workstation display (refer to step A) as follows:

**Cycle** corresponds to the hexadecimal representation of the 11 least significant bits of the **major cycle** time (seconds) and the 5-bit **minor cycle** binary count (0-23) in which the I/O error occurred.

The **BCE code number** (hexadecimal) identifies the data lost as a result of the I/O error. Table 4.5-3 provides a cross reference of BCE code number versus BCE element data lost.

The **IOP status register** provides detailed information concerning the source of the I/O error. Table 4.5-4 provides a summary for the BCE status register for BCEs 1-24 and the data necessary to interpret the IOP status register contents.

The **BCE number** (decimal) identifies the BCE that detected the error. It has a range of 1 to 24.

- I/O error counter (MSID V98J2258C)

A decimal count of total number of I/O errors detected by the BFS is maintained.

3. BFS BCE element bypass words

The BFS element bypass status is maintained in ten halfwords, which are formatted into five fullwords. Table 4.5-5 provides the data necessary to interpret these words.

4. BFS track status (MSID V98M0590P)

While technically a BFS GPC error indication, it is, nevertheless, a potential measure of the health of the BFS/PASS flight-critical I/O interface. In conjunction with BFS I/O error information, I/O problems can be isolated to the BFS or to the PASS redundant set.

C. I/O Error Assessments

While the available BFS I/O error data is useful in monitoring the overall health of the BFS and the identification of BFS I/O hardware problems, its greatest value lies in its use as a tool to rapidly identify the health of the PASS redundant set and the condition of the PASS/BFS interface. That is, BFS element bypassing or BFS flight-critical string downmoding (BFS Track status) in response to PASS failures provides excellent cues to assist the flight controller in rapidly identifying problems at an LRU (MDM or EIU) or with a PASS computer/data bus interface. Because of the unique FC string tracking signatures generated, it is often faster to check BFS tracking/bypass status than it is to sort through PASS I/O error data to determine a PASS GPC problem.

1. If a flight-critical string has been downmoded, use the DTEX workstation application as the primary cue to evaluate the BFS/PASS failure signature. BFS GPC error log and BFS I/O error log data should also be used in conjunction with DTEX to confirm the failure. If no string downmode is indicated, or if BFS fault messages point to a non-flight-critical bus I/O error, then use the BFS I/O error information as presented below to assess the error.
2. Where applicable, BFS annunciated fault messages are one of the most valuable tools to quickly identify the I/O problem encountered by the BFS GPC. Table 4.5-2 lists the fault messages that may be associated with certain BFS-detected I/O errors.

**Table 4.5-2. BFS I/O error fault messages**

Message	No. of unique messages	Remarks
I/O ERROR (MDM ID)	10	BCE element bypass on MDM return word
I/O ERROR (CRT ID)	4	I/O error on indicated DEU/CRT
I/O ERROR PCM	1	Second consecutive I/O error on IP bus
BCE STRING (1-4) (ELE)	31	BCE element or sequence bypass on indicating string
BCE STRING (1-4) PASS	4	BFS unable to listen or disagrees with PASS on indicated string



3. If no BFS fault message has been annunciated, the I/O error was either a transient or the error condition is not supported by fault message annunciation (for example, GPS read errors). In that case, it will be necessary to evaluate the BFS I/O error log data as time permits. The following parameters provide the most useful information.

**Element** or **I/O ELE** - Identifies the BFS BCE element number corresponding to the I/O error encountered. Table 4.5-3 relates the element number to the type of data affected/lost as a result of the I/O error condition.

It should be noted that whereas the PASS BCE element number uniquely identifies the data type *and* specific LRU affected, the BFS BCE element number uniquely identifies only the data type. The BFS BCE number is required to uniquely identify the specific LRU (EIU, FF or FA MDM, OI MDM, etc.) associated with the I/O error.

**BCE** - Identifies the data bus/bus control element associated with the detected I/O error. The BCE number is used to identify which LRU was associated with the I/O error.

**Status Wd** or **Stat** - The IOP Status Register contents assist in identification of the cause of the I/O error. Table 4.5-4 provides the data necessary to decode the Status Word contents corresponding to the I/O error condition.

**Counter** - The I/O Err Counter provides the total accumulated I/O error count as detected by the BFS GPC.

4. The following parameters provide secondary information that may or may not be useful in further analysis of the I/O error condition.

**Cycle** - Identifies the least 11 significant bits of the major cycle time (in seconds) and the minor cycle during which the I/O error occurred. The parameter essentially represents a pseudo timetag for error analysis. While well suited for analysis by a BFS programmer/software analyst, it is not particularly well suited for real-time flight operations.

**BCE BYP** - The BCE bypass words identify the element bypass status associated with the BFS I/O configuration. Table 4.5-5 provides the data necessary to decode the *downlisted* BCE BYP words. It should be noted that the workstation application DTEX provides a dynamic, visual indication of the BFS element bypasses. Therefore, manually decoding the BFS bypass words essentially becomes an academic exercise.

While not an issue from a real-time data monitoring perspective, it should be noted that certain information provided in the BSS PRD (Table 3.1.8.1-1 of reference 1) is not downlisted and, thus, is not presented in Table 4.5-5 of this SCP. For example, bits 16-31 of "BYP WD 5" are not downlisted since IP bus elements are not bypassable.

For OI-25, Bypass Word 5, bit 12 (of most significant 0-15 bits) serves as a *placeholder* for the GPS read transaction (PL1C). In original requirements, GPS read I/O was to be bypassable, but final requirements defined the GPS I/O to be a non-bypassable element. Thus, the bit should never be set in the downlisted BCE BYP word 5 regardless of the health of the GPS data acquisition. The GPS commfault status is downlisted, however, as bit 10 (V98X7212X) of the BFS System Status Word 1 (V98M0560P) (a 0-15 bit packed word). If bit 10 is logic 1, the BFS is incurring continuing problems with the GPS data acquisition; if logic 0, the GPS read I/O is good.

Finally, as a matter of general interest, it should be noted that the BFS has no requirement to monitor or process I/O corresponding to the microwave scanning-beam landing system (MSBLS), the star tracker units (STUs), or the rendezvous radar (RDZ RDR). In the pre-engage state, their commfault status in the PASS/BFS 25-hz transfer data is ignored by the BFS, and no bypass indicators are set or downlisted by the BFS.

In the BFS-engage state, the BFS will automatically set bypass indicators for these elements. In addition, bypass indicators for the EIUs will be set if the BFS-engage occurs in G3. Upon BFS engage initialization, the BFS will initially upmode all other flight-critical bus BCE elements, whether data buses were downmoded or the BCE elements were bypassed.

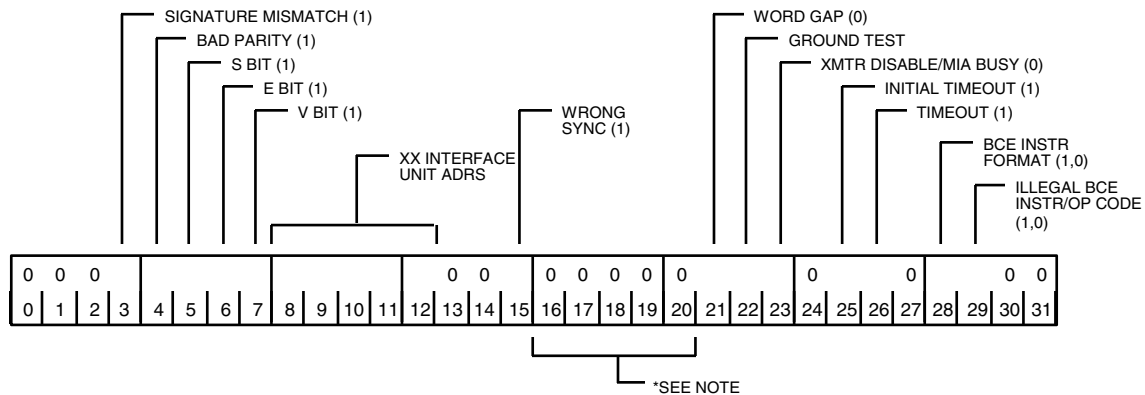
**Table 4.5-3. BCE element numbers**

BCE code	BCE element	Remarks
00	EIU 1	HFE IN: EIU 1
01	EIU 2	HFE IN: EIU 2
02	EIU 3	HFE IN: EIU 3
04	FA PROM - 24/MC	HFE IN: FA PROM D
05	FF PROM - 24/MC	HFE IN: FF PROM B
06	ADTA	HFE IN: ADTA
07	OMS/HYD	HFE IN: OMS PC/HYD PRESS
08	FF PROM - 6/MC	MFE IN: FF PROM A
09	TACAN/RA	MFE IN: TACAN/RA
0A	MSBLS ❶	
0B	IMU	MFE IN: IMU
0D	STAR TRACKER ❶	
0E	RNDZ RADAR ❶	
0F	FA PROM - 6/MC	MFE IN: FA PROM C
10	MTU	MTU IN: ACCUM
13	NSP DISCRETES	NSP IN: DISCRETES
14	NSP DATA	NSP IN: DATA
16	FF RETURN WORD	HFE IN: FF RTN WD
17	FA RETURN WORD	HFE IN: FA RTN WD
1F	XFER DATA	HI/LO XFER DATA
20	PF1	LO IN: PL 1 DATA
21	PF2	LO IN: PL 2 DATA
22	BCE OUT OF BOUNDS	ERROR CONDITION
23	GPS	PAYLOAD INPUT 1C
28	24/MC LSN CMD FC5-8	PRI PORT HFE IN: FA LSN CMD
29	24/MC LSN CMD FC1-4	PRI PORT HFE IN: FF LSN CMD
2B	6A/MC LSN CMD FC1-4	PRI PORT NSP IN: FF LSN CMD
2C	6B/MC LSN CMD FC5-8	PRI PORT MFE IN: FA LSN CMD
2D	6B/MC LSN CMD FC1-4	PRI PORT MFE IN: FF LSN CMD
2F	1B/MC LSN CMD FC1-4	PRI PORT MTU IN: FF LSN CMD
30	XFER LSN CMD FC5-8	PRI PORT HI/LO XFER IN: XFER LSN CMDS
32	24/MC LSN CMD FC5-8	SEC PORT HFE IN: FF LFN CMD
33	24/MC LSN CMD FC1-4	SEC PORT HFE IN: FA LSN CMD
34	6A/MC LSN CMD FC5-8	SEC PORT NSP IN: FF LSN CMD
36	6B/MC LSN CMD FC5-8	SEC PORT MFE IN: FF LSN CMD
37	6B/MC LSN CMD FC1-4	SEC PORT MFE IN: FA LSN CMD
38	1B/MCLSN CMD FC5-8	SEC PORT MTU IN: FF LSN CMD
3A	XFER LSN CMD FC5-8	SEC PORT HI/LO XFER IN: XFER LSN CMDS
3C	ONE SHOT XFER	PASS G9 ONE SHOT XFER DATA
3D	ENGAGE INIT INPUTS	INPUT FF/FA OUTPUT DISCRETES
3E	LDB POLL	LDB INPUTS
3F	DEU POLL	DEU INPUTS
40	24/MC FC OUTPUT (HFE)	HFE OUTPUTS
41	12/MC FC OUTPUT (DDU)	MFE DDU OUTPUTS (TWICE/MC)
42	6B/MC FC OUTPUT (SPI)	MFE SPI OUTPUTS
43	6B/MC PYLD OUTPUT	MFE PL OUTPUTS
44	UPLINK RTC PL OUTPUT	RTC OUTPUTS
45	UPLINK RTC PL OUTPUT	RTC PL OUTPUTS
46	6C/MC GPS OUTPUT	GPS OUTPUTS
50	PCM (NON OI)	PCM INPUTS
51	PCM OI -OA02	PCM INPUTS
52	PCM OI -OA03	PCM INPUTS
53	PCM OI -OA01	PCM INPUTS
54	PCM OI -OF01	PCM INPUTS
55	PCM OI -OF02	PCM INPUTS
56	PCM OI -OF03	PCM INPUTS
57	PCM OI -OF04	PCM INPUTS
58	PCM PDI	PCM INPUTS
66	PL FLEX - IUA 6	PAYLOAD RECONF INPUTS
69	PL FLEX - IUA 9	PAYLOAD RECONF INPUTS
6A	PF1 - IUA 10	PAYLOAD RECONF INPUTS
6C	PF2 - IUA 12	PAYLOAD RECONF INPUTS
6F	PL FLEX - IUA 15	PAYLOAD RECONF INPUTS
7D	PL FLEX - IUA 29	PAYLOAD RECONF INPUTS
7E	PL FLEX - IUA 30	PAYLOAD RECONF INPUTS

Ref: OI-26A, BSS PRD (reference 1).

❶ I/O for these flight-critical read elements is not supported by the BFS.

Table 4.5-4. BFS BCE 1 to 24 status words



\*NOTE: THESE 5 BITS REPRESENT THE BCE NUMBER. THEY ARE STRIPPED OUT OF THE WORD, FORCED TO ZERO, AND ARE DISPLAYED AS THE BCE NUMBER IN ANOTHER MSID.

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Status (hex)	Bit(s)	Error	I/O	Detected by <sup>a</sup>	Remarks <sup>b</sup>
10XX 0000	3	Signature mismatch	I	IOP logic	IOP logic detected mismatch between the expected IUA and the received IUA (possible noisy MIA or data bus, MDM failure, or IOP compare logic failure)
08XX 0000	4	Bad parity	I	MIA	Possible noisy MIA or data bus, MDM failure
04XX 0000	5	S-bit (reset)	I	IOP logic	SEV - Power transient detected by MDM
02XX 0000	6	E-bit (reset)	I	IOP logic	SEV - MDM serial I/O card has detected a data problem (no data, improper sync, invalid manchester data bits)
01XX 0000	7	V-bit (reset)	I	IOP logic	SEV - MDM detected an internal problem causing data to be suspect/invalid
b	8 to 12	--	I	MIA	Interface unit address (BTU ADRS) received by MIA. IUA meaningful only with respect to bits 3 to 7, 15 of status word
00X1 0000 or 00X9 0000	15	Wrong SYNC	--	Microcode	Microcode detected mismatch between the expected sync type (cad or data) and the MIA-detected sync type. (MIA failure at either BCE or interface unit port -- port moding might alleviate FC MDM failure)
0000 0400	21	Word gap	O	Microcode	BCE not able to maintain word gap of less than 5 microsec during message (possibly caused by heavy DMA activity from other I/O transactions)
0000 0200	22	Self-test		Microcode	Ground test only
0000 0100	23	XMTR disabled or MIA busy	O	Microcode	Microcode detected mismatch between the "transmit enable register" state (bus cmdr is not enabled) or MIA busy signal set (possible I/O terminate switch discrete present or MIA detected unexpected data bus traffic)
0000 0040	25	Initial timeout	I	Microcode	During time allotted by BCE, the MIA failed to detect any incoming word (no valid sync) or the first word invalid due to MIA detected error (too few bits or invalid manchester bits)
0000 0020	26	Timeout	I	Microcode	A data word, other than the first in a message, failed to arrive within the time allotted by BCE. See "Remarks" for initial timeout
0000 0008	28	BCE instr format (boundary alignment error)	I,O	Microcode	BCE encountered illegal instruction format (long format instruction on an odd halfword boundary) (probably caused by faulty IPL)
0000 0004	29	Illegal BCE instr or OP CODE	I,O	Microcode	BCE encountered illegal instruction/OP code during execution or MDA instruction parity error detected.

<sup>a</sup> If an input transaction, all previously accepted data on the erroring BCE (or BCEs) are flagged as bad for this transaction. The data word causing the error is not stored, and no further data words are processed on the faulted BCEs. Data associated with any BCEs not experiencing problems are accepted.  
<sup>b</sup> Detected IUA displayed in third and fourth hex digit positions. The following correlates displayed IUA (bits 8 to 12) to BTUs:

IUA (STATUS WD)	IUA (DEC)	BTUs	IUA (STATUS WD)	IUA (DEC)	BTUs
30	6	DDU1, LL2, PM1	88	17	EIU1, GSE
48	9	DDU2, LL1, PM2	90	18	MEC1, LR2
50	10	FF1-FF4, PF1, LF1, DEU1-DEU5	A0	20	MEC2, MCIU
			B8	23	EIU2
60	12	FA1-FA4, PF2, LA1	C0	24	EIU3
78	15	DDU3, LR1			

Reference: AP-101S POO, BCE Status Register (reference 4).

Table 4.5-5. BCE element bypass words

V98M0820P												V98M0840P												HYD SYS 3	OMS	PC													
EIU 1				EIU 2				EIU 3				PROM SEQ 3-10 (BCE STRG D)				PROM SEQ 2-6 (BCE STRG B)				ADTA					L	R													
P		P		P		P		P		P		F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F								
1		4		1		4		1		4		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	2	3	4	4	2	3	4	4				
WORD 1																								0															
V98M0860P												V98M0880P												RDZ RDR				PROM SEQ 1, 2 (BCE STRG C)											
PROM SEQ 1, 2 (BCE STRG A)				TACAN/RA				MSBLS <sup>1</sup>				IMU				STU <sup>1</sup>				RDZ RDR <sup>1</sup>				PROM SEQ 1, 2 (BCE STRG C)															
F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F				
1	2	3	4	1	2	3		1	2	3		1	2	3		1	3			1	3			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
WORD 2																								0	0	0													
V98M0920P												V98M0940P												MDM RTN WD				MDM RTN WD											
MTU												NSP DISCRETES				NSP DATA				GPS				MDM RTN WD				MDM RTN WD											
F	F	F										F	F			F	F			F	F	F		F	F	F	F	F	F	F	F	F	F	F	F				
1	2	3										1	3			1	3			1	2	3		1	2	3	4	1	2	3	4	1	2	3	4				
WORD 3																								0	0	0													
V98M1170P												V98M1210P												PASS/BFS XFER DATA															
PF/FLEX MISSION DEPENDENT PAYLOAD																								PASS/BFS XFER DATA															
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	F	F	F	F	C	C	C	C								
WORD 4																								0	0	0													
V98M0960P																																							
PROM SEQ 1, 2				PROM SEQ 1, 2																																			
P		P		P		P																																	
1		2		1		2																																	
WORD 5																								0	0	0													

<sup>1</sup> No requirement for BFS to monitor or process I/O for these read  
These bypass elements are ignored preengage and set at BFS

REFERENCES

1. Backup System Services Program Requirements Document, document no. MG038101-30, DRD-1.4.3.3-0, June 11, 2001.
2. DPS workstation applications: DPS Overview and DPS Ascent/Entry.
3. STS83-0020J, vol 1, Space Shuttle Orbiter Operational Flight Test, Level C, Functional Subsystem Software Requirements, Displays and Controls, June 16, 1994.
4. Space Shuttle model AP-101S Principles of Operation, May 1987, BCE Status Register.

## TITLE

BFS GPC ERROR MONITORING

## PURPOSE

This procedure provides appropriate information useful in the real-time analysis of the following BFS GPC errors:

- GPC error codes and recovery
- BSS error trap response

## BACKGROUND

The orbiter AP-101S flight computers are designed to respond to various GPC hardware and software detected conditions via a hardware interrupt structure. Due to fundamentally different requirements, the programmed responses to such interrupts differ drastically for the PASS and BFS flight computers. Even for certain "fatal" hardware error conditions, the BFS is programmed to attempt a recovery process, known as a RESTART, in order to accomplish its required tasks.

Certain hardware and software interrupt conditions occur normally and help redirect the BFS processing status; i.e., program counter, supervisory calls, and external 2 interrupts. Other GPC interrupt conditions, however, represent an abnormal hardware or software processing state. In certain instances, "anomalous" conditions may exist that are detectable only by software processing (that is, the condition by itself does not result in an interrupt to the CPU). In either case, the BFS software is designed to log such error conditions and then attempt appropriate software recovery and/or system reconfiguration.

## DESCRIPTION

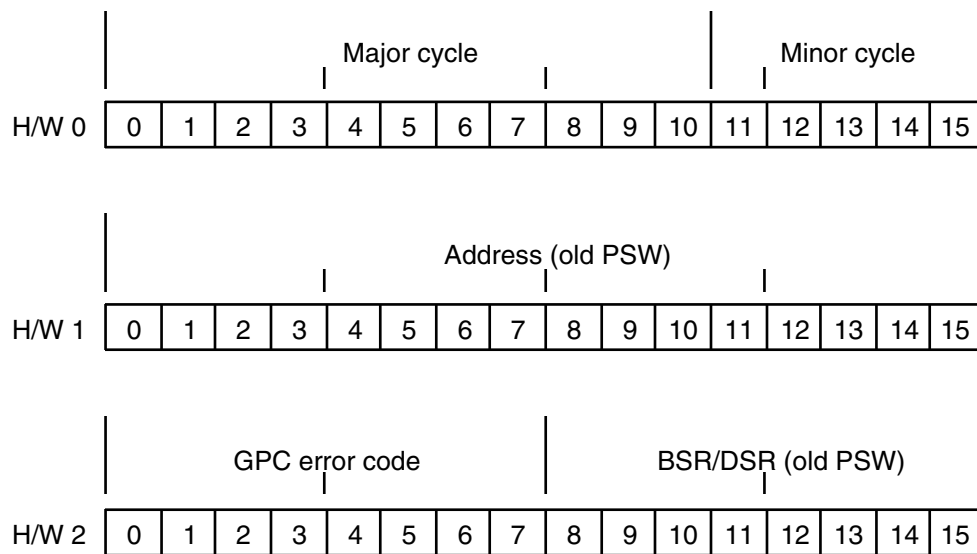
This SCP is divided into the following three areas:

- A. Data interpretation
- B. GPC error assessment
- C. BFS GPC error tables

Section A defines each parameter associated with the BFS GPC error monitoring. Section B provides information to better understand the programmed responses to the detected GPC error condition. Finally, tables are provided in Section C to permit the user to interpret and correlate the specific BFS GPC error data.

A. Data Interpretation

To accommodate the GPC error logging process, the BFS maintains a circular file consisting of the most recent 21 GPC errors detected. Only the five most recent error log entries are downlisted, however. In addition, the BFS maintains and downlists a total GPC error count. It should be noted that such error log data are not available to the crew (except via GMEM reads). Many GPC error conditions result in fault message annunciation to the crew, however. Each GPC error log entry consists of an array of three halfwords generally formatted as indicated in Figure 4.6-1. (Note that certain GPC error codes, specifically 43 through 47, format the H/W1 or H/W2 fields somewhat differently, as described in subsequent paragraphs.) In addition, Figure 4.6-1 provides a summary by MSID for each of the five most recent GPC error logs downlisted by the BFS.



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BFS GPC error log downlist MSIDs  
(ref. BFS PRD no. MG038101, Table 3.7.1.2.3-1):

	<u>H/W 0</u>	<u>H/W 1</u>	<u>H/W 2</u>
BFS error 1*	V98M2500P	V98U2301C	V98M2508P
2	V98M2516P	V98U2306C	V98M2524P
3	V98M2532P	V98U2311C	V98M2540P
4	V98M2548P	V98U2316C	V98M2556P
5	V98M2564P	V98U2321C	V98M2572P

\*Most recent BFS GPC error logged.

**Figure 4.6-1. BFS GPC error log (single log entry) and downlist MSIDs**

The first halfword provides a "time" pointer as to when the error was logged. (From a software dump analysis perspective, a knowledge of major and minor cycles may be more useful than a GMT or MET timetag in analyzing the GPC error condition.) With certain exceptions, the second halfword and lower 8 bits of the third halfword correspond to selected "old PSW" data from the interrupt preferred storage area (PSA). (These data point to the "next" address to be executed at time interrupt occurred.) The uppermost 8 bits of the third halfword correspond to the GPC error code which uniquely identifies the type of GPC error.

In many instances, the actual GPC error logging function is accomplished by utilization of a generalized BOS subroutine "GLOGERR." In other instances, the error detection software will directly log the GPC error. In either case, however, a BOS subroutine "GLOGERR1" is utilized to locate the correct offset within the circular file.

It should be noted that BFS GPC error logs are initialized/reinitialized by BOS as part of the BFS startup initialization process which is accomplished as part of the "System Reset" function (post IPL and BFS GPC mode transition from HALT to STBY or RUN). Thus, a successful BFS GPC failure recovery utilizing "System Reset" reinitialization will erase error log data potentially useful in analyzing the previous GPC failure. This is significant should a BFS GPC memory dump be required. In cases where the BFS has been moded to the halt state, a BFS HISAM memory dump is the only way to capture the I/O error and GPC error log contents. Attempting to utilize a GPC software memory dump once the BFS has been moded to halt will lose the error log contents, due to the system reset feature.

#### 1. GPC Error Log Parameters (GPC Err)

Counter        BFS GPC ERROR COUNTER represents the algebraic decimal sum of the actual GPC error log cumulative counts logged by the BFS GPC since the last (most recent) "System Reset" initialization.

Error<sup>1</sup>  
or GPC Err<sup>2</sup>    BFS GPC ERROR CODE and BSR/DSR is a packed hexadecimal halfword corresponding to the third halfword of the downlisted GPC error. Most important from a real-time DPS monitoring standpoint are the two left-hand digits which contain the BFS GPC error code (the GPC error code uniquely identifies the type of error logged).

The two right-hand digits define the branch/data sector register (BSR/DSR) to be used in determining the extended address associated with the interrupt "old PSW" (refer to PTR BFS below).

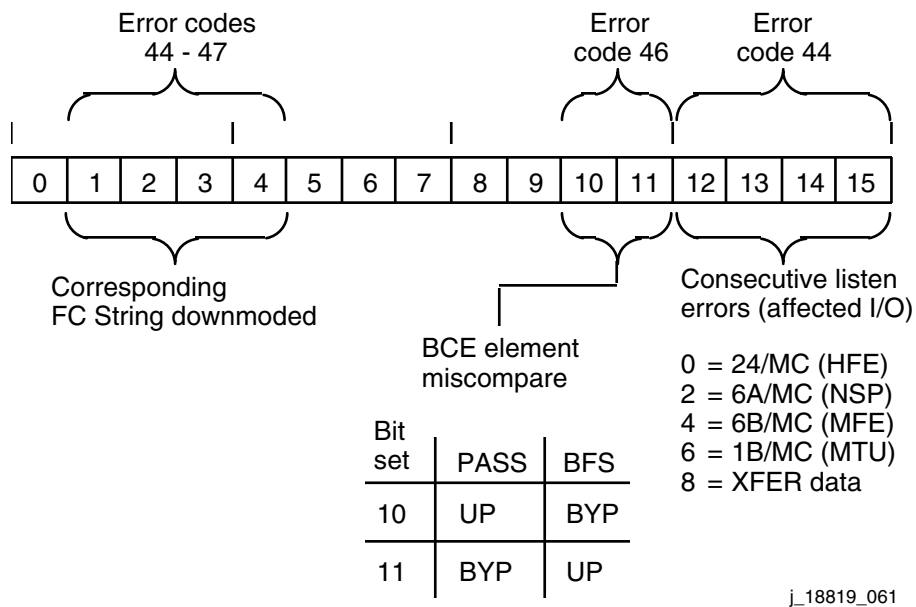


Pointer<sup>1</sup>  
or  
Addr<sup>2</sup>      BFS GPC ERROR POINTER/ADDRESS provides a hexadecimal display of the second halfword of the downlisted GPC error. Except as noted below, the parameter corresponds to the first halfword of the "old PSW" from the interrupt PSA (that is, the "next" address to be executed at the time the interrupt occurred). This address in conjunction with the BSR/DSR allows the software analyst to determine the corresponding extended address. Although potentially useful during software analysis (BFS software dump/post-flight analysis), such data is not particularly meaningful from a real-time DPS monitoring standpoint.

<sup>1</sup>DPS Overview application.

<sup>2</sup>DPS Ascent/Entry application.

Note that for BFS GPC error code 43, the BSR/DSR field is replaced by the BCE number of the affected data bus. Note also that for BFS GPC error codes 44, 45, 46, and 47, the "old PSW" data are not downlisted. Instead, the "PTR BFS" parameter provides detailed information regarding the FC string downmoding as detected by BOS and announced by one of these GPC error codes. The hexadecimal halfword is formatted as follows:



j\_18819\_061

Cycle<sup>2</sup> BFS MAJOR CYCLE/MINOR CYCLE COUNTER is a packed hexadecimal halfword corresponding to the first halfword of the downlisted GPC error. The first 11 binary bits correspond to the 11 least significant bits of the BOS major cycle counter at the time the GPC error was logged. Similarly, the five least significant binary bits of the downlisted parameter correspond to the minor cycle counter (range 0 to 23) when the error was logged.

As part of the "System Reset" initialization, the BFS major cycle counter is reset to a zero value. However, as part of the disengaged I/O initialization processing, the BOS major cycle counter is set equal to the PASS major cycle counter value (PASS/BFS XFER data), provided the BFS can successfully track at least two FC strings. Incidentally, while both PASS and BFS minor cycle counters range from 0 to 23, the relative minor cycle phasing between the PASS and BFS is such that the BFS minor cycle starts 7 milliseconds later than the PASS minor cycle.

<sup>2</sup>DPS Ascent/Entry application.

## B. GPC Error Assessment

It should be noted that real-time BFS GPC error log monitoring is intended to evaluate data only to the extent to answer "What happened?" rather than "What do we do?" type questions. The data, however, may be instrumental in assessing the health of the BFS, which in turn, will influence decisions affecting BFS GO/NO GO calls during ascent/entry and DPS reconfiguration/IFM decisions on-orbit.

Associated with each BFS GPC error is a predetermined software recovery action. From a DPS monitoring perspective, it is important that the operator understand what is implied by each of the various GPC "recovery" actions identified in Table 4.6-1 (GPC Error Codes Summary and Recovery Actions). The "recovery" actions are discussed in subsequent paragraphs.

### 1. Quick-Look Parameters

Error<sup>1</sup> Uniquely defines the type of BFS GPC error logged; that is, the basic hardware or software anomaly is identified (refer to Table 4.6-2). Note that the "quick look" should also identify the corresponding "recovery" action for the identified GPC error. In many instances, the software will attempt a RESTART which permits BFS recovery from many (but not all) anomalous hardware or software processing states.

Counter<sup>1</sup> Indicates the current BFS GPC total error count. If the value continues to increment, it signals a potentially nonrecoverable GPC hardware condition or a cyclic computational problem.

Note that the BFS is designed to accommodate a wide range of data inputs. Should the BFS perception of the environment differ radically from reality (bad NAV state, etc.), then computational difficulties can result (typically, program check violations, such as floating-point related exponent overflow or invalid divide - refer to GPC error codes 9A, 9B, and 9C).

## 2. Secondary Data

Pointer<sup>1</sup> or Addr<sup>2</sup> Typically, the parameter points to the "next" address to be executed at the time of the interrupt (interrupt "old PSW" data). In conjunction with the BSR/DSR, it allows the software analyst to determine the extended address being executed at the time of the CPU interrupt.

Cycle<sup>2</sup> Identifies the major and minor cycle counter values at the time the error was logged. In certain instances, the parameter indirectly provides a "timetag" for the GPC error.

<sup>1</sup>DPS Overview application.

<sup>2</sup>DPS Ascent/Entry application.

While the parameter set selected to comprise the BFS GPC error log entry appears well suited to support software dump analyses, such is not the case from a DPS monitoring perspective. On the other hand, considering the timeframe in which we as DPS operators monitor the BFS operation, it is apparent that we simply do not have the luxury of time to attempt a detailed analysis of each BFS GPC error (even if the GPC error log parameter set were better suited to our needs). Thus, with the possible exception of a GMT (or MET) timetag associated with the logging of the GPC error, the GPC error code generally represents a satisfactory level of data in assessing the BFS problem.

From a DPS monitoring perspective, a GMT/MET timetag associated with each GPC error logged would be most useful in attempting to correlate such error conditions with other Orbiter events. While such data are not directly available for BFS GPC errors, in many instances, a timetag can be readily determined. With many BFS GPC error conditions, the corresponding software recovery actions will include fault message annunciation to the crew. For such cases, the fault message timetag is more than adequate in supporting real-time GPC error analysis.

For those cases in which no fault message is annunciated as a result of the GPC error, the CYCLE BFS counter value may sometimes be used to calculate the time (to within 40 milliseconds) that the error was logged by the BFS. For

the technique to be successful, the occurrence of the GPC error must be known to within a half hour resolution. Recall that the GPC error log major cycle count corresponds to the 11 least significant bits of the BOS major cycle counter. As such, the 11-bit value will repeat every 2048 major cycles. Since each major cycle count corresponds to 960 milliseconds elapsed time and each minor cycle count to 40 milliseconds, one can extrapolate either backward or forward to another BFS GPC error or BFS I/O error in which the CYCLE BFS parameter value can be positively correlated to a fault message GMT (or MET) timetag. The 11-bit major cycle count will wrap around every 2048 counts or 1966.080 seconds (32 minutes:46.080 seconds). The technique is cumbersome and is in no way appropriate during the ascent/entry timeframe. However, on occasion, the DPS flight control team may find the approach useful in the analysis of BFS GPC errors while on-orbit or during precount operations. The ability to correlate events may be vital in assessing the health of the BFS GPC.

### 3. GPC "Recovery" Terminology

An important aspect of real-time BFS GPC error monitoring is to recognize what type of recovery action is associated with the indicated error condition. The tables that accompany this console procedure include such vital information. An explanation of the various recovery actions is provided below.

**RESTART** The term refers to both "software-initiated restarts" and "power transient restarts" (GPC error code "2F"). RESTART processing for the two cases differs only in the fault message annunciation text ("GPC BITE" vice "GPC PWR") and in the potential change in BFS inputs resulting from the GPC power transient. In either case, however, the RESTART software processing will perform BFS I/O initialization and minor cycle preparation. An overview of such RESTART activities is provided in Figure 4.6-2.

RESTART processing accomplishes dramatically different BFS I/O initialization (disengaged standalone, or disengaged tracking PASS, or engaged) depending upon BFS input data during the GPC error recovery process. Since a software-initiated restart is unlikely to alter BFS inputs, the BFS state should not change during the RESTART processing. The power transient restart, on the other hand, is unique in that the BFS engage discrettes are likely to be reset as a direct result of the power transient to the GPC/BFC hardware. In such cases, a previously engaged BFS could come up in the disengaged state following the RESTART recovery.

**CONTINUE** The term implies that the GPC recovery is limited to logging the GPC error and returning to the interrupted task at the point of interrupt.

CYCLE  
EXTEND

Under certain circumstances (typically, BOS GPC error and/or I/O error processing in conjunction with max rate jobs), alternate rate jobs (6.25 Hz) processing may not complete within the allotted 40-millisecond minor cycle. The GPC error logging and subsequent recovery action for such job overloads will depend upon the BFS state at the time of the error. If disengaged and tracking the PASS, then error code "C1" will be logged and a RESTART initiated. If either disengaged standalone or engaged, then error code "C2" will be logged and that minor cycle will be extended to 50 milliseconds. If the alt rate still has not finished by the end of the 10 millisecond CYCLE EXTEND period, then error code "C1" will be logged and a RESTART initiated.

RESTART I/O initialization

- Perform IOP master reset.
- Reinitialize IOP to support DK, FC, PL, and IP data bus I/O.
- Restore BCE programs and reset BCE bypass indicators. (FC and PL bus BCEs configured to MDM port mode status prior to RESTART.)
- Check BFS engage/TERM B discretes to determine BFS state:
  - If engaged:
    - ◆ Set BFS state to "engaged"
    - ◆ Put FC BCEs in "command" mode
  - If disengaged and standalone prior to RESTART:
    - ◆ Set BFS state to "standalone"
  - If disengaged and tracking PASS prior to RESTART, then attempt to resync with PASS:
    - ◆ Use PASS XFER data to establish new FC/PL bus port mode status
    - ◆ Downmode unsynchronized strings
    - ◆ If PASS/BFS resync successful (must track at least 2 FC strings):
      - Set BFS state to "tracking"
      - Put synchronized FC BCEs in "listen" mode
      - Set BOS major cycle counter to PASS value
    - ◆ If PASS/BFS resync not successful,
      - Set BFS state to "standalone"
- Put IP BCE in "command" mode.
- Disable all BCEs that are not in "command" or "listen" modes.
- Enable IOP MIA transmitters for all BCEs in "command" mode.

RESTART Minor Cycle preparation

- Update GMT and MET by amount of elapsed time since RESTART.
- If not in OPS 0, perform selected initialization jobs.
- If BFS state "tracking," wait until PASS minor cycle 23.
- Reinitialize minor cycle parameters such that minor cycle 0 is next.
- Resync downlist collector to minor cycle 0.

**Figure 4.6-2. Overview of BFS GPC error "RESTART" I/O initialization and 'Minor Cycle' preparation**

**ERROR TRAP** The term refers to the capability to direct BOS to perform different recovery actions depending on the BFS processing in progress at the time the GPC error condition occurred. For ERROR TRAP recovery, BOS determines whether or not a dispatched job was executing when the error occurred. If not, then BOS initiates a RESTART. If a dispatched job was executing, however, then BOS transfers control to the job's dispatch entry point minus one fullword. (This address will provide the branching necessary to complete the desired recovery actions.)

**ERROR TRAP\*** Similar to the above, except that BOS first checks bit 38 of the interrupted PSW. If bit 38 = 1 (has nothing to do with the EX3 interrupt), then BOS performs ERROR TRAP recovery as defined above. Otherwise, if bit 38 = 0, then BOS sets the overflow bit in the PSW and returns execution to the interrupted process. Currently, applicable only to BFS GPC error codes "94" (masked), "9A," "9B," and "9C."

It should be noted that ERROR TRAP responses vary depending upon the specific job in execution at the time the BFS GPC error occurred. These recovery responses essentially represent a temporary or permanent termination of the erroring job. An explanation of such ERROR TRAP responses is provided below.

**QUIT** The term refers to the manner in which one-shot and some cyclic jobs complete execution. Control is returned to the BOS dispatcher and directs the dispatcher to deactivate the task. (That is, some jobs possess internal logic to decide that they are no longer required.)

**NEXT** The term refers to the manner in which most cyclic jobs complete execution. Control is returned to the BOS dispatcher without modification of the task's active status. (That is, although the affected job is terminated for the minor cycle duration, such jobs will continue to remain active on a cyclic basis.)

Figure 4.6-3 provides a summary of the Backup System Services (BSS) responses to ERROR TRAP type recovery actions. BFS applications software (GNC, SM, and Sequencing) responses to ERROR TRAP recovery actions, although similar, are not currently included as part of this console procedure.

<u>BSS Function</u>	GPC Error	Dispatched	Dispatched	<u>Resultant Recovery Action</u> ②
BOS I/O	ERROR TRAP ↓	NO	N/A	RESTART
TFL		YES	QUIT	STD "QUIT"
Launch Data Bus		YES	QUIT	↓
Downlist		NO	N/A	RESTART
Uplink		YES	NEXT	Std "NEXT"
MTU RM		YES	NEXT	↓
Fault Msg Annunciation		YES	NEXT	
Payload Support		YES	NEXT	
Payload Bay Doors		YES	NEXT	Terminate PLBD OP/CL sequence, then std "NEXT"
Dedicated Displays		ERROR TRAP*	YES	NEXT
MCDS Interface	ERROR TRAP*	③	NEXT	If GRAPHICS DATA, display flashing "BAD DATA," then CONTINUE If TABULAR DATA, display "????", then CONTINUE If neither of the above, then CONTINUE

Notes: ① ERROR TRAP if PSW Bit 38 = 1; ERROR TRAP\* if PSW Bit 38 = 0.

② Standard "QUIT": BOS dispatcher will deactivate process (kill the on-demand or cyclic task), then CONTINUE

Standard "NEXT": BOS dispatcher will force close current process, then CONTINUE

③ MCDS outputs not dispatched, but MCDS inputs are dispatched.

**Figure 4.6-3. Backup System Services "ERROR TRAP" responses**

C. BFS GPC ERROR TABLES

Tables 4.6-1 and 4.6-2 provide a summary of all legal AP-101S BFS GPC error codes currently listed in the OI-25 BSS PRD. Table 4.6-1 provides a highly condensed summary of the BFS GPC error codes and recovery actions ("goodie book" quick reference version). Table 4.6-2 provides an expanded description and potential cause for each identified GPC error code. However, detailed descriptions of some of the MCK type interrupt error codes associated uniquely with the AP-101S development are very high-level due to a lack of available reference documentation. Finally, Table 4.6-3 provides a summary of data bus dependent BFS recovery actions following the detection of GPC error code "43" MIA transmit-enable mismatches. A discussion of the significance of this BFS GPC error condition will be presented in subsequent paragraphs.

Although of no major importance from a real-time DPS monitoring perspective, Tables 4.6 1 and 4.6-2 identify the CPU interrupt type associated with BFS GPC error condition. However, the BFS flight software is designed to respond to certain types of interrupts in a standardized fashion regardless of the specific GPC error condition that resulted in the interrupt. Thus, the user may find the data useful in relating the BFS GPC error logging process to the overall interrupt processing structure. Such AP-101S interrupts are identified below.





similarly been removed from this SCP in order to minimize confusion to personnel cross-referencing the documentation.

Note also that certain EX1 (level B) interrupts were defined to support IOP-detected hardware failure modes unique to the AP-101S GPC. A "GPC IOP" fault message was to be used to annunciate such failures. After the delivery of the AP-101S GPCs, the avionics community discovered that certain hardware failures external to the GPC (MDM, EIU, etc., inputs to the GPC with interword gap times between response data words approaching zero) could cause the IOP internal parity check logic to erroneously detect an IOP failure when, in fact, nothing was wrong with the GPC. Nevertheless, the failure had the potential to take the entire PASS set to the halt state. The external failure would also take a nonengaged BFS to the halt state. The bottom line was that a single failure could take out all five GPCs before the BFS could be engaged. In view of this credible failure mode from any number of data bus BTUs, the program elected to permanently disable the AP-101S GPC BCE self-test and IOP data flow internal parity checks in both PASS and BFS (BFS CR # 90130). Note, however, that BFS GPC error codes "08" (DMA timeout) and "09" (DMA queue overflow), should they occur, will still annunciate a "GPC IOP" fault message as well as a "GPC BITE" message (that occurs as a result of the software-initiated RESTART recovery).

The CPU hardware also provides the capability to permanently mask certain machine check, program check, and system interrupts. When masked, system interrupts remain pending while machine check and program check interrupts are ignored. The BFS uses this feature to permanently mask selected fixed-point math operations (program check interrupts) since the software is designed to cope with such problems. Should hardware failures cause one of the masked interrupts to be processed despite masking, the GPC error will be logged (GPC error codes 94, 95, or 99) and the appropriate recovery action would occur (CONTINUE or ERROR TRAP).

## 2. GPC Error Code "43" Background Information

To appreciate the data summarized in Table 4.6-3, some rather detailed background information is desirable. First, it should be noted that the BFS I/O architectural approach was to utilize, as much as possible, common BCE programs that were designed to function in either pre-engage or post-engage environments. Not only do such compact BCE programs provide coding efficiency (an important consideration with the old AP-101B GPCs), they inherently function as "bus commander" programs or "bus listener" programs simply by using certain BCE instructions that provide conditional branching based upon the state of the associated MIA transit enable discrete (1 = BUS CMDR/0 = BUS LISTENER). Thus, assuming control of FC and DK buses at a BFS engage was considerably simplified by requiring the engage transition

software to simply reconfigure the MIA transmitter enable register (via use of a program-controlled output "PCO" command to the IOP).

The second important factor to note is that pre-engage, all FC buses and those DK buses controlled by the PASS use a BCE instruction, known as a WIX or "wait for index," which allows the BFS to monitor the data buses for "BFS listen commands" issued by the PASS redundant set. This feature permits, within certain constraints, the BFS to essentially "synchronize" the BFS I/O with respect to the PASS -- the heart of the BFS "tracking PASS" concept. The WIX instruction tests the MIA transmit enable discrete status to determine if the BCE is in the "listen mode" (XMIT ENA discrete = logic 0) or in the "command mode" (logic 1). If in the "listen mode" (as one would expect for a pre-engage condition), the WIX instruction enters a tight loop monitoring the MIA buffer for a valid "BFS listen command" from the PASS. If the WIX instruction detects that the BCE is in the "command mode," the WIX instruction enters the "wait state." Prior to the OI-22 flight software release, this was paramount to telling the BFS that it "owned" the data bus. This resulted in the BFS immediately commanding outputs on the associated data bus.

Under normal circumstances, this would be the desired effect since the MIA XMIT ENA discrete would be in the "command mode" state only if the BFS had, in fact, been engaged. What if, however, the XMIT ENA discrete was in the "command mode" state solely as a result of an IOP hardware failure in the MIA transmitter enable register logic? Performing such desktop analysis, Intermetrics Inc., personnel concluded that such IOP hardware failures while pre-engaged would result in erroneous BFS commanding on the affected FC or DK buses, which in turn, could potentially create dual bus commander scenarios leading to possible PASS set breakup (non-universal I/O errors) or vehicle LOC.

To determine if such credible IOP failures in the BFS could indeed affect the PASS in a detrimental fashion, shuttle program management elected to use the SAIL facility to test the theory, and in November 1990, a series of SAIL tests cases were performed. To support such tests, IOP hardware was actually modified to permit MIA XMIT ENA register discrettes to be turned ON/OFF via external switches, totally independent of BFS flight software timing. For certain test cases, the actual test results agreed closely with predictions, particularly on the DK buses. However, the test results for several of the FC bus failure cases were totally unexpected. On two of the SAIL runs, there was virtually no indication of dual bus commanders on the flight-critical buses even though multiple buses (FC1 - FC4) were affected. The BFS continued to track the PASS, and the PASS set remained intact. However, all three IMUs went out to lunch, and both PASS and BFS navigation states (state vector) were severely polluted by MECO. The bottom-line summary, as documented in BFS User Note B28597 (effective through OI-21), was that any of the following conditions were possible: BFS NO-GO due to bad NAV state; dual commanders on CRTs;

intermittent SSME fail indications; degradation of the PASS NAV state due to erroneous pulse torquing of the IMUs; and non-universal PASS I/O errors that could result in loss of PASS GPC(s) from the redundant set.

Not surprisingly, the avionics community adopted the stance that these were undesirable consequences for such BFS IOP hardware failures. Both KSC and JSC flight control teams were tasked by the shuttle program to monitor for BFS FC or DK MIA transmitter enable fail-on conditions until such time that a BFS software fix could be implemented. BFS flight software CR #90424, which provided for failure detection monitoring and corrective action in the event of IOP transmitter enable discrete hardware failures, was first implemented in the OI-22 flight software release. With onboard monitoring, the flight control teams were relieved of the responsibility of rapid detection of this BFS failure mode.

Summarizing the above discussion, undesired BFS commanding on the FC or DK buses while pre-engaged would occur if IOP hardware failures produced false "command mode" signatures, which were interpreted by the BCE programs using the WIX instruction to mean "we're engaged, the bus(buses) belong to the BFS." Such erroneous BFS output commanding could, in turn, lead to a variety of undesirable to potentially catastrophic dual bus commander failure scenarios.

The software fix was to decouple the WIX instruction from the BFS engaged bus commander function. Since OI-22, if the WIX instruction should detect the "command mode" state, the instruction enters the "wait" state as before. However, the next BCE instruction to be executed is a jump to an illegal BCE instruction ("0000" which corresponds to an out-of-bounds OP code for the IOP microcode), which results in an abnormal termination of the BCE program. The resulting I/O error processing (I/O error code "22" -- BCE instruction error) is designed to terminate all BCE program execution for the affected data bus; that is, kill all I/O on the affected data bus. Thus, BCE code runaways are effectively eliminated via this BCE program modification. Depending on one's perspective, the BCE has been "killed" or the data bus "dropped." For DK buses, this terminates any "DK listen" capability (obviously, a pre-engage function) as long as the CRT remains assigned to the PASS. For FC buses, the affected string is downmoded pre-engage.

It should be emphasized that as a result of the new BCE program mechanization, the FC or DK bus BCE itself detects the MIA XMIT ENA discrete(s) fail-on condition while in the pre-engaged state. The subsequent FC or DK bus downmoding occurs immediately as a direct consequence of the I/O error processing associated with the BCE out-of-bounds (I/O error code "22") failure signature. In addition, the I/O error processing logic sets FDA annunciation "flags" that result in fault message annunciation to alert the crew of actions taken by the BFS: "BCE STRG X PASS" for downmoded flight critical string(s); and "DK XMTR X" for downmoded DK buses. Also, as part of

the I/O error processing logic associated with the BCE out-of-bounds failure signature, a special mask word is updated that "alerts" BOS that something is wrong with the affected data bus. This, as we shall see, is to have subtle ramifications as far as IOP BCE hardware failures are concerned.

A requirement of CR #90424 was to provide low-rate, cyclic monitoring of the actual IOP FC and DK transmitter enable discrete status, including a provision to log GPC errors (GPC error code "43") to identify that FC or DK buses have been downmoded (dropped) as a result of BCE program-detected MIA XMIT ENA discrete failures. The specific implementation associated with the cyclic monitoring/error logging requirements was much broader in scope than required by the CR, however. The specific mechanization not only meets the requirements to monitor the FC and DK buses, it provides for monitoring of all 24 data buses (ICC, DK, PL, LDB, FC, MM, and IP data buses). Not only was this approach, perhaps, the most code efficient, it also identified any anomalous condition in the critical IOP transmitter enable register hardware.

The BFS flight software now maintains a running image of the desired state for all 24 data buses. Recall also, that the BFS maintains a special mask word that can be updated by BCE out-of-bounds I/O error processing logic to alert BOS that something is terribly wrong with one (or more) of the BCE programs. Per CR requirements, the BFS reads the IOP's actual MIA XMIT ENA register status once each major cycle (on BFS minor cycle 0). The actual transmitter enable register status is then compared bit-for-bit against the desired status for all 24 BCEs. These results are essentially OR'ed with the special mask word (used to force a miscompare when FC or DK buses are downmoded as a result of detected out-of-bounds conditions). If any miscompare is detected for any data bus, then a GPC error code "43" is logged, including error log data that points to the affected bus (BSR/DSR field is replaced by the BCE number of the affected data bus). The actual BFS GPC error recovery action following the error logging is to CONTINUE.

For non-FC/non-DK buses, "log GPC error and CONTINUE" is a fair assessment of the GPC recovery action for detected miscompares. However, this is not really the case for FC and DK buses for a pre-engage environment. Indeed, from an operational perspective, the "apparent" GPC error code "43" recovery action is to downmode the affected FC string or DK bus if the "BCE out-of-bounds" I/O error processing software and the IOP transmitter enable register monitoring/GPC error "43" logging software are perceived as integrated processes. This is, in fact the net GPC recovery action associated with the GPC error code "43" for these data buses (note that utilization of the "special mask word" does effectively link together these two distinct software logic functions). This can create a certain amount of "apples and oranges" confusion when comparing certain BFS GPC error descriptions in different reference sources. That is, strictly speaking, the GPC recovery action associated with GPC error code "43" is always to CONTINUE regardless of the bus

affected. (Often, the GPC error description itself acknowledges that certain actions have occurred, such as string or bus downmode.) However, in a more broad operational sense, the GPC recovery action for FC and DK buses when a GPC error code "43" occurs is to drop/downmode the affected bus. As real-time operations personnel, we need to be sufficiently flexible to deal with either approach, even though it may seem somewhat inconsistent.

By now it would seem safe to assume that this subject has been sufficiently overkilled. Unfortunately, this is not the case, although there is a light at the end of the tunnel. Since the implementation of CR #90424 in OI-22, desktop analysis and computer model simulations of the BFS software by Rockwell-Downey personnel have demonstrated that IOP hardware failures other than IOP transmitter enable register hardware failures can also result in BCE jump out-of-bounds conditions. A variety of failure signatures are possible and are dependent upon the specific IOP hardware failure mode. In many cases, but not all, the BCE jump out-of-bounds error condition resulted in BCE "out-of-bounds" I/O error processing (I/O error code "22"). Recall that this causes the "special mask word" to be updated. This, in turn, will force the IOP transmitter enable register monitor logic to log a GPC error code "43" irrespective of the actual MIA XMIT ENA discrete state. This, by definition, implies an IOP transmitter enable failure when, in fact, there is nothing wrong with that part of the IOP hardware.

What does all of this mean to us? Very little actually, except that IOP hardware failures other than MIA XMIT ENA discrete failures can mimic that particular failure signature. The BFS software has still responded to a potentially severe BCE problem and the action to downmode the affected data bus is the appropriate conservative approach. Only the error description of GPC error code "43" has taken on a somewhat expanded scope. BFS User Note B28681 alludes to this potential for "somewhat misleading" logging of GPC error code "43". Also, Table 4.6-3 attempts to distinguish between MIA transmitter enable failure signatures and BCE jump out-of-bounds signatures.

One final point should be noted. While the BCE program mechanization now physically isolates the BCE "listen mode" WIX'es from the BFS engaged "command mode" outputs BCE program (thus eliminating the potential for BCE code runaway), the BFS engage transition logic is essentially unaffected, except that a separate CPU 'PCO' command is now required to initially start the BFS output I/O BCE program. Furthermore, any FC or DK bus that had been downmoded will automatically be picked up at the BFS engage. This potentially provides maximum control authority of the vehicle. Buses downmoded as a result of MIA transmitter enable discrete failures will be recovered. Buses downmoded as a result of IOP hardware failures that resulted in BCE jump out-of-bounds failure signatures will most likely be downmoded again.

**Table 4.6-1. AP-101S GPC error codes summary and recovery actions**

Error code	Error condition	Detected by	Recovery	Fault msg annunciation
04	DMA store protect violation	hardware (EX1)	RESTART	GPC BITE
06	AGE (ground test interface)		CONTINUE	none
08	DMA fetch timeout		RESTART	GPC BITE and
09	DMA queue overflow			GPC IOP ❶
20	❷ Spare (Bad EX3 INTRUPT)	hardware (EX3)	CONTINUE	none
2F	GPC power transient	hardware (PRX)	RESTART	GPC PWR
30	❷ Spare (Bad EX4 INTRUPT)	hardware (EX4)	CONTINUE	none
41	Illegal engage/TERM B combo	software		none
43	❸ Data bus MIA XMIT-ENA register disagree (action is bus dependent): FC bus - string downmoded DK bus - bus downmoded Non DK/FC bus - log error		CONTINUE ❸	BCE STRG X PASS DK XMTR X none BCE STRG X PASS
44	❸ String(s) downmoded: two listen errors			
45	❸ String(s) downmoded: RS data check			
46	❸ String(s) downmoded: bypass miscompare			
47	❸ String downmoded: last remaining string			
82	DMA multibit err (IOP)	hardware (MCK)	ERROR TRAP	poss GPC BITE
83	CPU multibit err (CPU)			
85	CPU ROS microstore parity			
86	Interrupt page fault			
87	'ENDOP' timeout			
88	EA fault (effective addressing)			
89	CPU cannot continue			
90	Illegal CPU instruction or PCI/PCO cmd	hardware (PCK)		
91	Privileged instruction violation			
94	❷ Masked (FX/POINT overflow)		ERROR TRAP*	none
95	❷ Masked (FL/POINT significance)		CONTINUE	
97	CPU store-protect violation		ERROR TRAP	poss GPC BITE

❶ The "GPC IOP" fault message is associated with AP-101S GPC IOP-detected data flow errors (EX1 interrupts).

❷ Although legal BFS GPC error codes, those error codes identified as "spare" or "masked" have no program requirement (not utilized). Thus, error codes should not be expected to be logged. Nevertheless, should a GPC hardware failure actually result in such an unexpected "error" condition, the BFS software is coded to perform the indicated "Recovery action." Note: Certain EX1 hardware interrupts while no longer identified in the BSS PRD, if logged (an unexpected condition) would result in RESTART recovery and a GPC BITE fault message.

❸ Strictly speaking, "recovery action" associated with GPC errors 43 through 47 is to log GPC error and "CONTINUE." From an integrated BFS software perspective, however, the BFS "recovery action" is to downmode the affected data bus/flight-critical string.

**Table 4.6-1. AP-101S GPC error codes summary and recovery actions  
(concluded)**

Error code	Error condition	Detected by	Recovery	Fault msg annunciation
99	② Masked (exponent underflow)	hardware (PCK)	CONTINUE	none
9A	Exponent overflow during convert		ERROR TRAP*	poss GPC BITE
9B	Floating-point exponent overflow		ERROR TRAP*	↓
9C	Floating-point invalid divide by zero		ERROR TRAP*	↓
B0	Bad SVC (undefined SVC type)	software	CONTINUE	none
B1	Invalid inputs to HAL subroutine	↓	CONTINUE	↓
B2	'RESTART' SVC requested (software runaway)	↓	RESTART	GPC BITE
B3	CRT 'Display Error Handler' Invoked	↓	CONTINUE	none
C0	Max rate job overload	↓	RESTART	GPC BITE
C1	Alt rate job overload (initiate RESTART)	↓	↓	↓
C2	Alt rate job overload (minor cycle extend)	↓	CYCLE EXTEND	none
E0	Requested "instruction" not store protected	hardware (IMR)	ERROR TRAP	poss GPC BITE
F0	Watchdog timeout (I-fail illuminated)	hardware (EX0)	CONTINUE	none
F1	IOP "FAIL" latch (I-fail illuminated)	↓	↓	↓
F2	IOP control monitor idle (NON-START UP)	↓	RESTART	GPC BITE
F3	IOP ROS parity	↓	↓	↓
F4	IOP timing fault (oscillator failure)	↓	↓	↓

② Although legal BFS GPC error codes, those error codes identified as "spare" or "masked" have no program requirement (not utilized). Thus, error codes should not be expected to be logged. Nevertheless, should a GPC hardware failure actually result in such an unexpected "error" condition, the BFS software is coded to perform the indicated "Recovery action."



**Table 4.6-2. BFS AP-101S GPC error code description**

Error code(s) and error condition (interrupt type)	Error description	Possible causes	Fault message
04 DMA store protect violation (EX1)	The IOP attempted to do a DMA main memory store write into a store-protected location. Causes EX1 interrupt. Main store write will be inhibited. Error detected by CPU. BFS response is to log error and perform a software-initiated RESTART.	Error indicates erroneous address specification by IOP. Possible hardware failure in IOP or MSC/BCE software error.	GPC BITE
06 AGE	Interrupt line at CPU/AGE interface has been activated. Error detected by CPU. BFS response is to CONTINUE. GPC error is logged and interrupted task is resumed at point of interrupt.	Error indicates AGE interface signal has been detected by CPU. Possible hardware failure in CPU, AGE interface, or connector.	None
08 IOP DMA fetch timeout (EX1)	DMA transaction failed to complete within 8 microseconds. Possible PCIO contention that caused DMA not to complete on time. Error detected by IOP channel controller. BFS response is to log error and perform a software-initiated RESTART.	Error indicates that IOP I/O channel is busy or hung up. Possible IOP or CPU hardware failure.	GPC BITE and GPC IOP
09 IOP DMA queue overflow (EX1)	The DMA queue overflow circuitry has detected more than 64 requests in queue. Error detected by IOP. Multiple BCEs can potentially generate DMA requests simultaneously - there is only one DMA channel and it can handle only one request at a time. Buffer stack will queue up to 64 requests. BFS response is to log error and perform a software-initiated RESTART.	Error indicates DMA requests are stacking up. Possible hardware failure in IOP or BCE, or MSC/BCE software problem.	GPC BITE and GPC IOP
20 Spare (EX3)	There is no requirement for the BFS to utilize EX3 and EX4 interrupt capability. However, if a hardware failure should cause the error condition, the BFS response is to log the error and CONTINUE. (Note that PSW system mask bits 38 (EX3) and 39 (EX4) are utilized as control flags in job dispatching.)	Error should never occur. Possible IOP or CPU hardware failure if error code actually logged.	None
2F BFS GPC power transient (PRX)	GPC 28-V dc power has fallen below a set level of $17.5 \pm 0.5$ Vdc. Voltage drop causes power transient interrupt. Error detected by hardware (power transients less than 400 microsec are ignored). BFS response is to log error and perform a software-initiated RESTART.	Error indicates power supply or power bus problem. Error is expected when BFS GPC is powered on after having been powered off via MDM LF1.	GPC PWR
30 Spare (EX4)	See GPC error code "20".	Error should never occur. Possible IOP or CPU hardware failure if error code actually logged.	None
41 Illegal Engage/ Term B combination	One of two situations has occurred. Either [ I/O Term B = 1 and Engage Discretes A,B,C = (not 0)], or [I/O Term B = 0 and less than two Engage Discretes = 1]. BFS engage transition software monitors for changes in these discretes. Error is detected by software. BFS response is to log error and CONTINUE.	Error indicates unexpected state of engage indications to BFS GPC. Possible problem in BFC, GPC output switch, RHC, or GPC discrete inputs. Error is expected if BFS is IPL'd with output switch in NORM or if GPC output switch position is changed while BFS is in RUN or STBY mode (BKUP to NORM, or BKUP through NORM to TERM).	None

**Table 4.6-2. BFS AP-101S GPC error code description (continued)**

Error code(s) and error condition (interrupt type)	Error description	Possible causes	Fault message
43 Data bus MIA XMIT ENA fail ON/OFF	IOP BCE transmit enable register status disagrees with BFS software-maintained MIA bus commander/listener status. Error is detected by software. BFS response is dependent on affected data bus and pre/post engage status (FC string downmoded if pre-engage; DK bus dropped and "DK XMTR X" msg annunciated; other data buses, log GPC error and CONTINUE).	Error indicates IOP BCE transmit enable register altered outside BFS flight software control. Probable IOP hardware failure, esp., BCE XMIT ENA Register (reference BFS User Note # B28681).	FC: possible BCE STRG X PASS  DK: possible DK XMTR X
44 FC string(s) downmode from two consecutive listen errors	Two consecutive listen commands for a given I/O transaction did not arrive from PASS within the specified time. Listen commands are issued on FC bus by commanding GPC to signal all other GPCs to prepare to receive data. BFS expects particular listen commands at specific times during the minor cycle. If the times are missed twice in a row, BFS stops tracking on that FC string. Error detected by software. Bits 12 to 15 of halfword 1 of GPC error log will show which command was missed as follows:  0 = 24/major cycle inputs (HFE) 2 = 6A inputs (NSP) 4 = 6B inputs (MFE) 8 = transfer data inputs  BFS response is to downmode offending strings, annunciate error, and CONTINUE.	Possible problem in PASS/BFS I/O profile, PASS/BFS software error, cyclic overrun, FC bus, or IOP hardware failure. Error is expected if PASS OPS transition to GNC OPS 2, 8, or 9, or to OPS 0 when BFS is tracking.	BCE STRG X PASS
45 FC string(s) downmode from nonmatching RS transfer data check	BFS receives four copies of transfer data from PASS on FC buses 5 to 8. BFS compares the multiple copies of the data and expects them to be identical. Odd data will result in downmode of that string. Error detected by software. BFS response is to downmode string, annunciate error, and CONTINUE. Data labels are:  25 Hz Data    1B Data    1C Data XFERMX1    XFER1B1    XFER1C1 XFERMX2    XFER1B2    XFER1C2 XFERMX3    XFER1B3    XFER1C3 XFERMX4    XFER1B4    XFER1C4	Possible problem in PASS/BFS I/O profile, PASS/BFS software error, FC bus, or IOP hardware failure. Error is expected if PASS redundant set GPC fails-to-sync (FTS).	BCE STRG X PASS

**Table 4.6-2. BFS AP-101S GPC error code description (continued)**

Error code(s) and error condition (interrupt type)	Error description	Possible causes	Fault message
46 FC string(s) downmode from PASS/BFS BCE bypass element miscompare	PASS maintains a table of which BCE elements it believes to be active/bypassed and transfers these data to BFS every minor cycle. BFS also maintains an identical table which should agree with PASS. If BFS software detects a difference in bypass status for any element, it will cease tracking the associated FC string and CONTINUE. Bits 10 and 11 of halfword 1 of BFS GPC error log will identify the discrepancy as follows:  Bit 10 = 1 →PASS element up, BFS element bypassed  Bit 11 = 1 →PASS element bypassed, BFS element up  Look at PASS and BFS I/O errors to see what has been bypassed. Error detected by software.	Possible problem in PASS/BFS I/O profile, PASS/BFS software error, FC bus, or IOP hardware failure.	BCE STRG X PASS
47 FC string downmode the last remaining string	BFS will not track one FC string regardless of its data validity (deliberate software design to avoid pollution by PASS). If three strings have been downmoded for any reason, BFS will cease tracking the remaining string and CONTINUE in standalone mode. Error detected by software.	BFS has ceased tracking three strings and will not attempt to maintain tracking on less than two strings.	BCE STRG X PASS
82 DMA memory access multi-bit error (MCK)	ECC (error correction code) has detected a multi-bit error during an attempt by DMA to access GPC memory, which results in an IOP-generated machine check interrupt. BFS response is to log error and perform an ERROR TRAP recovery -- if a dispatched job was executing at the time of the error, the job is restarted one fullword before its initial entry point; otherwise, a software-initiated RESTART is done.	Error indicates a GPC memory page failure (ECC can detect multi-bit flip but cannot correct resultant error).	Possible GPC BITE
83 CPU memory access multi-bit error (MCK)	ECC (error correction code) has detected a multi-bit error during an attempt by CPU to access GPC memory, which results in a CPU-generated machine check interrupt. BFS response is to log error and perform an ERROR TRAP recovery -- if a dispatched job was executing at the time of the error, the job is restarted one fullword before its initial entry point; otherwise, a software-initiated RESTART is done.	Error indicates a GPC memory page failure (ECC can detect multi-bit flip but cannot correct resultant error).	Possible GPC BITE
85 CPU ROS parity (MCK)	The output of the CPU ROS data register did not have odd parity. ROS data register contains micro-instructions which are updated from PROM every 200 nanoseconds. The micro-instructions control all CPU functions. Error detected by hardware. BFS response is to log error and perform an ERROR TRAP recovery -- if a dispatched job was executing at the time of the error, the job is restarted one fullword before its initial entry point; otherwise, a software-initiated RESTART is done.	Error indicates CPU/ROS hardware failure.	Possible GPC BITE

**Table 4.6-2. BFS AP-101S GPC error code description (continued)**

Error code(s) and error condition (interrupt type)	Error description	Possible causes	Fault message
86 Interrupt Page fault (MCK)	The error indicates that a parity error occurred on the CPU interrupt page (a microcode read problem). BFS response is to log error and perform an ERROR TRAP recovery -- if a dispatched job was executing at the time of the error, the job is restarted one fullword before its initial entry point; otherwise, a software-initiated RESTART is done.	CPU hardware failure.	Possible GPC BITE
87 'END-OP' timeout (MCK)	The error indicates that a CPU instruction has not completed within the allotted 200 micro-sec ENDOP 'watchdog' timer limit. Error is indicative of a CPU instruction microcode hang (wait for 'acknowledge'), infinite microcode loop, or erroneous microcode branch. BFS response is to log error and perform an ERROR TRAP recovery -- if a dispatched job was executing at the time of the error, the job is restarted one fullword before its initial entry point; otherwise, a software-initiated RESTART is done.	CPU hardware failure.	Possible GPC BITE
88 'EA' fault (MCK)	The error indicates the CPU has detected a malfunction of the effective address unit logic (the effective address (EA) unit's decode of a CPU instruction resulted in an invalid instruction microcode branch offset). BFS response is to log error and perform an ERROR TRAP recovery -- if a dispatched job was executing at the time of the error, the job is restarted one fullword before its initial entry point; otherwise, a software-initiated RESTART is done.	CPU hardware failure.	Possible GPC BITE
89 CPU cannot continue (MCK)	The error indicates the CPU has detected a CPU memory protection error, an Execution Unit memory parity error, an illegal instruction error, or the loss of the instruction stream due to masking of the MCK interrupts. BFS response is to log error and perform an ERROR TRAP recovery -- if a dispatched job was executing at the time of the error, the job is restarted one fullword before its initial entry point; otherwise, a software-initiated RESTART is done.	CPU hardware failure.	Possible GPC BITE
90 Illegal CPU instruction or PCI/PCO command (PCK)	CPU has attempted to execute either an illegal program controlled I/O (PCI/PCO) command or an instruction with illegal or unspecified OP code. Error detected by hardware and causes a program check interrupt. BFS response is to log error and perform an ERROR TRAP recovery -- if a dispatched job was executing at the time of the error, the job is restarted one fullword before its initial entry point; otherwise, a software-initiated RESTART is done.	Possible erroneous interpretation of data as code or other software problem. Possible CPU hardware failure.	Possible GPC BITE

**Table 4.6-2. BFS AP-101S GPC error code description (continued)**

Error code(s) and error condition (interrupt type)	Error description	Possible causes	Fault message
91 Privileged instruction violation (PCK)	<p>CPU has attempted to execute a privileged instruction while it is in the problem state. Privileged instructions may not be executed until the CPU is taken to the supervisor state by executing a supervisor call (SVC) instruction. Privileged instructions are:</p> <ul style="list-style-type: none"> <li>• Insert Store Protect Bits (ISPB)</li> <li>• Load Program Status (LPS)</li> <li>• Set System Mask (SSM)</li> <li>• Internal Control (IC)</li> <li>• Programmed Controlled I/O (PCI/PCO)</li> </ul> <p>Supervisor state exists when bit 47 of PSW = 1. Error detected by hardware. BFS response is to log error and perform an ERROR TRAP recovery -- if dispatched job was executing at time of the error, the job is restarted one fullword before initial entry point; otherwise, a software-initiated RESTART is done.</p>	Possible CPU hardware failure. Possible bad branch or other software error.	Possible GPC BITE
94 Masked (fixed-point overflow permanently masked) (PCK)	<p>Error indicates the result of a fixed-point arithmetic operation was too large to fit in a 32-bit fullword. This error is permanently masked by BFS, however, (PSW bit 20 = 0) and its occurrence should never cause an interrupt or logging of an error. In the event a hardware failure does cause the error condition, the BFS response is to log error and then check bit 38 of PSW (system mask for EX3 interrupt). If bit is set, BFS will perform an ERROR TRAP recovery -- if a dispatched job was executing at time of the error, the job is restarted one fullword before initial entry point; otherwise, a software-initiated RESTART is done. If PSW bit 38 is off, overflow bit in interrupted PSW is set, and execution of interrupted process is resumed.</p>	Error should never occur. Occurrence indicates PSW mask has been altered or CPU failure.	None
95 Masked (significance permanently masked) (PCK)	<p>Error indicates the fraction resulting from a floating point operation is zero while the characteristic is not zero. This error is permanently masked by BFS, however, (PSW bit 23 = 0) and its occurrence should never cause an interrupt or logging of an error. BFS response is to log error and CONTINUE in the event a hardware failure does cause the error condition.</p>	Error should never occur. Occurrence indicates PSW mask has been altered or CPU failure.	None
97 CPU store protect violation (PCK)	<p>CPU has attempted to write to a store-protected location. The write will be inhibited. Error detected by hardware. BFS response is to log error and perform an ERROR TRAP recovery -- if a dispatched job was executing at the time of the error, the job is restarted one fullword before its initial entry point; otherwise, a software-initiated RESTART is done. A store protect error will also be logged if an EX2 interrupt occurs with undefined IOP status "Level C" register contents.</p>	Possible CPU hardware failure. Possible bad argument to base-relative address operation or other software error.	Possible GPC BITE

**Table 4.6-2. BFS AP-101S GPC error code description (continued)**

Error code(s) and error condition (interrupt type)	Error description	Possible causes	Fault message
99 Masked (floating- point exponent underflow permanently masked) (PCK)	The error indicates the result of a floating-point arithmetic operation produced a negative exponent less than zero with a non-zero fractional component (too negative to be expressed in the 7-bit exponent field). This error is permanently masked by BFS, however, (PSW bit 22 = 0) and its occurrence should never cause an interrupt or log an error. BFS response is to log error and CONTINUE in the event a hardware failure does cause the error condition.	Error should never occur. Occurrence indicates PSW mask has been altered or CPU failure.	None
9A Overflow during floating-point convert to fixed-point (PCK)	The error indicates the result of a convert floating-point value to fixed-point resulted in a value that was out of range for the instruction (exceeds fixed register length). Error detected by hardware and causes program check interrupt. BFS response is to log error and then check bit 38 of PSW (system mask for EX3 interrupt). If bit is set, BFS will perform an ERROR TRAP recovery -- if a dispatched job was executing at the time of error, the job is restarted one fullword before its initial entry point; otherwise, a software-initiated RESTART is done. If PSW bit 38 is off, overflow bit in interrupted PSW is set, and execution of interrupted process is resumed.	Possible use of uninitialized data, addressing, or other software error. Possible CPU hardware failure.	Possible GPC BITE
9B Floating-point exponent overflow (PCK)	A floating-point arithmetic operation has resulted in a number with hexadecimal exponent greater than 127 with a non-zero fraction. Error detected by hardware. BFS response is to log error and then check bit 38 of PSW (system mask for EX3 interrupt). If bit is set, BFS will perform an ERROR TRAP recovery -- if a dispatched job was executing at the time of error, the job is restarted one fullword before its initial entry point; otherwise, a software-initiated RESTART is done. If PSW bit 38 is off, overflow bit in interrupted PSW is set and execution of interrupted process is resumed.	Possible use of uninitialized data, addressing, or other software error. Possible CPU hardware failure.	Possible GPC BITE
9C Floating-point invalid divide ( $\div$ -by 0) (PCK)	The divisor in a floating-point divide (DE,DED DER,DEDR instruction) was zero. Error detected by hardware and causes program check interrupt. BFS response is to log error and then check bit 38 of PSW (system mask for EX3 interrupt). If bit is set, BFS will perform an ERROR TRAP recovery -- if a dispatched job was executing at the time of error, the job is restarted one fullword before its initial entry point; otherwise, a software-initiated RESTART is done. If PSW bit 38 is off, overflow bit in interrupt PSW is set, and execution of interrupted process is resumed.	Possible use of uninitialized data, addressing, or other software error. Possible CPU hardware failure.	Possible GPC BITE
B0 Bad SVC (undefined SVC type)	The argument of an SVC instruction is out of range. Legal values are 0000 (NEXT), 000F (RESTART), FFFF (QUIT), and 0010 to 001F inclusive. Error is detected by software. BFS response is to log error and CONTINUE.	Possible software error or erroneous alteration of protected memory location containing SVC argument. Possible CPU hardware failure.	None

**Table 4.6-2. BFS AP-101S GPC error code description (continued)**

Error code(s) and error condition (interrupt type)	Error description	Possible causes	Fault message
B1 HAL subroutine error	One of the BFS HAL library subroutines has detected an invalid input (example - cosine argument out of range). The specific fault depends upon which subroutine detected the error. This can be determined from address in downlisted instruction counter - should point to a RUNLIB routine location. Error detected by software. BFS response is to log error and CONTINUE.	Possible use of uninitialized data, addressing, or other software error. Possible CPU hardware failure.	None
B2 "RESTART" SVC requested	Restart supervisor calls are placed in each memory sector as protection against a bad branch (code runaway). Such SVCs should normally never be executed. Restart SVC indicates software took a bad branch or execution sequence has otherwise been disrupted. Error detected by software. BFS response is to log error and perform a software-initiated RESTART.	Possible erroneous alteration of protected memory location containing branch address/offset or other software error. Possible CPU hardware failure.	GPC BITE
B3 CRT 'Display Error Handler' Invoked	The BFS display code has four software CRT Display Control (CDC) buffers associated with the four onboard DEUs. When a request for a CRT display is made, a CDC buffer is required to support the request if display not already active. If no free CDC buffer or if logic erroneously determines the requested display to be active, then the Display Error Handler will be called to free a buffer or reset the number of users for the display to zero. Whenever the module is invoked, a software-detected GPC error is issued. BFS response is to log error and CONTINUE.	Error should never occur. Implementation of the Display Error Handler avoids the potential for a continuous RESTART scenario.	None
C0 Max Rate job overload	BFS I/O profile did not complete within the minor cycle. Error detected by PC1 interrupt handler. PC1 interrupt occurs every 40 milliseconds to start a new minor cycle. At this time, it checks if MSC has set MSCRUN flag indicating completion of the previous minor cycle max inputs. If not, overload is annunciated. Error detected by software. BFS response is to log error and perform a software-initiated RESTART.	Possible CPU or IOP/ MSC failure. Possible software error causing max rate jobs to run longer than expected or flag not to be set.	GPC BITE
C1 Alt Rate job overload (initiate RESTART)	If disengaged and tracking PASS, error indicates that alternate rate task foreground processing did not complete within the 40-millisecond minor cycle. If engaged or disengaged standalone, error indicates that the alternate rate processing has still not completed after minor cycle has been extended to 50 milliseconds (see error code "C2" below). Error detected by software. BFS response is to log error and perform a software-initiated RESTART.	Excessive I/O error and max rate job processing. Possible software error. Possible CPU or IOP hardware failure.	GPC BITE

**Table 4.6-2. BFS AP-101S GPC error code description (concluded)**

Error code(s) and error condition (interrupt type)	Error description	Possible causes	Fault message
C2 Alt Rate job overload (minor cycle extend)	If engaged or disengaged standalone, error indicates that alternate rate task foreground processing did not complete within the 40-millisecond minor cycle. Error detected by software. Response is to extend minor cycle by 10 milliseconds, log error, and and CONTINUE with interrupted process.	Possible CPU or IOP hardware failure. Possible software failure.	None
E0 Requested "instruction" not store-protected (IMR)	Instruction fetched from main storage was not store protected. Error causes instruction monitor interrupt. The halfword boundary on which an instruction is located must be store protected. Instruction will not be executed. Error detected by hardware. BFS response is to log error and perform an ERROR TRAP recovery -- if a dispatched job was executing at the time of the error, job is restarted one fullword before its initial entry point; otherwise, a software-initiated RESTART is done.	Possible misinterpretation of data as an instruction, erroneous branch, or other software error. Possible CPU hardware failure.	Possible GPC BITE
F0 Watchdog timeout (EX0)	Watchdog timer was not reinitialized within 3.7 seconds. Indicates software may have stopped executing, is looping, or hardware is hung up. Timer should be "set" every minor cycle by PC1 interrupt handler. If not, EX0 interrupt occurs. Watchdog timeout results in master reset of IOP, and a branch is taken to IOP initialization code. Error detected by hardware. BFS response is to log error and CONTINUE. (GPC I-fail CAM light will be illuminated.)	Possible CPU hardware failure, software looping, or stopped. Possible IOP watchdog timer logic failure. Cyclic GPC errors are indicative of BFS software problems or watchdog timer logic problems (rapid timeout). Other cues (BFS downlist dropouts and CRT Big X/Poll fail indications) may assist in determining health of BFS.	None
F1 IOP "VOTER-FAIL" latch (EX0)	IOP has set its RM hardware voter latch. Error expected if a PASS GPC fails to sync (FTS) out of common or redundant set, but does not really apply to BFS. Error detected by IOP. BFS response is to log error and CONTINUE. (GPC I-fail CAM light will be illuminated.)	Possible IOP hardware failure. (Error should never occur.)	None
F2 IOP control/ monitor idle (EX0)	Error is set as part of master reset of IOP, or if IOP fail signal is generated. Error detected by hardware and causes EX0 interrupt. BFS response is to log error and perform a software-initiated RESTART. Note that error is not logged for CM Idle interrupt during normal BFS startups (system reset).	Possible IOP hardware failure.	GPC BITE
F3 IOP ROS parity (EX0)	An IOP ROS microcode read showed contents not to have odd parity. Error detected by hardware and causes EX0 interrupt. BFS response is to log error and perform a software-initiated RESTART.	Possible IOP hardware failure.	GPC BITE
F4 IOP timing fault (EX0)	IOP timing stop detector has detected an oscillator failure. Error detected by hardware and causes EX0 interrupt. BFS response is to log error and perform a software-initiated RESTART.	Possible IOP hardware failure.	GPC BITE



**Table 4.6-3. BFS GPC error "43"/MIA XMIT-enable bus failure recovery**

Affected data bus		Hardware error	Miscompare detected ?	I/O error ?	GPC error ?	GPC recovery action	Fault MSG annunciation
FC buses	P R E A G E	MIA XMIT-ENA fail OFF	NO				
		MIA XMIT-ENA fail ON	YES ②	22	43, 44	Downmode affected FC STRING	"BCE STRG X PASS"
		BCE jump out-of-bounds	YES ②	22	43, 44	Downmode affected FC STRING	"BCE STRG X PASS"
FC buses	P O S T E	MIA XMIT-ENA fail OFF	YES ②	22 plus other errors ③	43	BCE disabled for affected FC STRING	"I/O ERROR FF(FA)" for affected MDM
		MIA XMIT-ENA fail ON	NO				
		BCE jump out-of-bounds	YES ②	22	43	BCE disabled for affected FC STRING	"I/O ERROR FF(FA)" for affected MDM
DK buses (BUS CMDR)		MIA XMIT-ENA fail OFF ④	YES	3F	43	CONTINUE	"I/O ERROR CRT X"
		MIA XMIT-ENA fail ON	NO				
		BCE jump out-of-bounds	some cases ⑤	22	43 ⑤	BCE disabled every 4th Major Cycle ⑤	"DK XMTR X" every 8th Major Cycle ⑥
DK buses (LISTENER)	P R E A G E	MIA XMIT-ENA fail OFF	NO				
		MIA XMIT-ENA fail ON	YES	22	43	BCE disabled for affected CRT	"DK XMTR X"
		BCE jump out-of-bounds ⑦	some cases ⑦	22	43 ⑦	BCE disabled for affected CRT	"DK XMTR X" possibly every 8th Major Cycle ⑥
PL buses (STBY)	P R E A G E	MIA XMIT-ENA fail OFF	NO				
		MIA XMIT-ENA fail ON	YES		43	CONTINUE	
		BCE jump out-of-bounds	N/A ⑧				
PL buses (RUN) or (STBY/engaged)		MIA XMIT-ENA fail OFF	YES	20 or 21	43	CONTINUE	"I/O ERROR PL X"
		MIA XMIT-ENA fail ON	NO				
		BCE jump out-of-bounds	N/A ①	22		BCE disabled for affected PL BUS	"I/O ERROR PL X"

- ① Note that only certain BCE "jump out-of-bounds" error conditions will mimic a MIA XMIT-ENA register miscompare error signature. BCE "jump out-of-bounds" conditions that do *not* result in a BFS GPC error code "43" are not included in this table. For additional information, refer to BFS User Note B28681.
- ② BFS I/O RESET or BFS engage actions will restore affected BCE program, resulting in subsequent error detection and fault message reannunciation, as appropriate for a non-transient hardware failure.
- ③ Multiple I/O errors may occur, depending upon affected data bus (00 - 02/EIUs, 16 - 17/FFs or FAs).
- ④ BFS "DK Listen" capability OK (assign affected CRT to PASS)
- ⑤ Cyclic error detection every 4th Major Cycle (software erroneously toggles MIA XMIT ENA bit OFF, then ON every 4th Major Cycle).
- ⑥ If fault message annunciation condition occurs every 4th Major Cycle, the Fault Message Repeat Lockout feature, which occurs at 5-Major Cycle rate, will inhibit every other fault annunciation for the same fault message type. Thus, actual fault message annunciation will only be observed every 8th Major Cycle.
- ⑦ Error detection dependent on nature of BCE "out-of-bounds" failure -- potential single occurrence detection, or potential cyclic error detection every 4th Major Cycle with subsequent fault message annunciation occurring every 8th Major Cycle.
- ⑧ The BFS does not perform I/O on the payload buses if in STBY and not engaged. Thus, no potential exists for BCE jump out-of-bounds failure.

**Table 4.6-3. BFS GPC error "43"/MIA XMIT-enable bus failure recovery (concluded)**

Affected data bus	Hardware error ❶	Miscompare detected ?	I/O error ?	GPC error ?	GPC recovery action	Fault MSG annunciation
IP buses	MIA XMIT-ENA fail OFF	YES	51-58	43	CONTINUE	"I/O ERROR PCM"
	MIA XMIT-ENA fail ON	NO				
	BCE jump out-of-bounds	N/A ❶	22		BCE disabled for affected bus ❷	"I/O ERROR PCM"
LDB buses	MIA XMIT-ENA fail OFF	YES if Prelaunch	3E	43	CONTINUE	
	MIA XMIT-ENA fail ON	YES		43	CONTINUE	
	BCE jump out-of-bounds	N/A ❶	22		BCE disabled for affected bus	
MM buses	MIA XMIT-ENA fail OFF	NO				
	MIA XMIT-ENA fail ON	YES		43	CONTINUE	
	BCE jump out-of-bounds	N/A ❶				
ICC buses	MIA XMIT-ENA fail OFF	NO				
	MIA XMIT-ENA fail ON	YES		43	CONTINUE	
	BCE jump out-of-bounds	N/A ❶				

❶ Note that only certain BCE "jump out-of-bounds" error conditions will mimic a MIA XMIT-ENA register miscompare error signature. BCE "jump out-of-bounds" conditions that do *not* result in a BFS GPC error code "43" are not included in this table. For additional information, refer to BFS User Note B28681.

❷ Disabling IP bus would result in immediate loss of BFS downlist.

❸ BFS does not perform I/O on these data buses. Thus, no potential exists for BCE "jump out-of-bounds" failures.

**REFERENCES**

1. Backup System Service Program Requirements Document, MG038101.
2. Space Shuttle Model AP-101S Principles of Operation, IBM #85-C67-001, Rev. C, May 1, 1987
3. Rockwell Software Error Description document, STS 81-0070A, OI-22, revised May 5, 1993.

The BSS PRD (reference 1) served as the official reference documentation. The AP-101S POO (reference 2), plus comments in the BFS "BOS" fiche product each served to provide supplemental information. Reference 3 was particularly useful in the development of Table 4.6-2.

## TITLE

BFS GO/NO-GO CRITERIA

## PURPOSE

This SCP provides information relevant to monitoring the BFS failure conditions and in determining the BFS failed, no-engage, or suspect status in accordance with flight rules.

### A. BFS FAILED

1. Loss of forward CRT interface - Without any CRT interface, the crew has no insight into the BFS status and no way to interface with it should an engage be needed (rule A7-51.A).
2. BFS self-fail light on CAM (when accompanied by loss of CRT interface, loss of BFS RUN discrete at PASS GPCs, and loss of BFS downlist).

Failures other than a failure of the BFS GPC itself could cause the CAM light to illuminate; therefore, a CAM by itself without other supporting indicators is not sufficient to call the BFS failed.

The self-fail light is driven by the BFS to indicate that the BFS software execution is unable to cycle, which allowed the watchdog timer (~3.15 sec) to time out, or two restarts have occurred within two consecutive major cycles (BSS PRD par. 3.1.2.1.9) (MG038101).

- a. The watchdog timer is reset at the beginning of each major cycle (960 ms).
- b. Failure to reset the timer before timeout (-3.15 sec) will allow the GPC self-fail latch to be set and the CAM light commanded on.
- c. Two restarts within two consecutive major cycles will immediately turn on the CAM light.

### B. BFS NO-GO for Engage - If the hardware will not support engaging the BFS, or after an engage if the BFS will not be able to control the vehicle, it is considered NO-GO for engage.

1. BFS standalone (loss of PASS tracking on all strings) for 10 seconds during ascent and for 45 seconds during entry. If tracking can be recovered, the BFS once again is GO for engage (flight rules A7-51.B. 1. a. and b).

If the flight-critical strings are not tracked by the BFS, it has no sensor data to update the vehicle state vector. In time, the actual state vector and the software-maintained vector will diverge to the point where the BFS will not be able to control the vehicle if the BFS is engaged. The times of 10 and 45 seconds are estimates and not exactly calculated times.

The loss of PASS Tracking ("BCE STRG 1,2,3,4 PASS" fault messages) indicates that the BFS cannot maintain synchronization (track listen commands) and/or disagrees with PASS transfer data (data bus status) for two consecutive minor cycles. Specifically, the message "BCE STRG X PASS" is annunciated when

- a. HFE listen cmd (EIU 1 listen cmd) is not detected within a 5-ms window for two consecutive minor cycles; e.g., PASS goes to software halt.
  - b. FF X or FA X listen cmd is not detected for two consecutive minor cycles; e.g., FC 1, 2, 3, 4, 5, 6, 7, or 8 XMIT failure.
  - c. PASS transfer data describing PASS status of element bypasses (bypassed or not bypassed) disagrees with BFS element bypass status; i.e., if PASS shows an element bypass, BFS must agree within two consecutive minor cycles. Also, if the BFS GPC has an FC RCVR failure, the BFS will have an element bypassed, but not the PASS.
  - d. BFS downmodes all strings when any of the above occurs two consecutive times on more than two strings; i.e., BFS cannot track tracking on only one PASS string. The BFS begins flashing the BFC light on panels F2 and F6 to indicate that BFS is standalone if it has the command of the PL buses.  
Note: An MSG RESET to BFS will turn this light off.
2. Control bus CA1 failure - Loss of this bus causes loss of engage discretes to GPCs 3 and 5. If an engage is attempted, the BFS would not respond, but PASS GPCs 1, 2, and 4 would go to software halt. This bus provides power to the hand controller engage drivers in the BFC modules for GPCs 3 and 5 (rule A7-51.B.2).
  3. Essential bus 3AB failure - Loss of this bus precludes any GPC from being selected as the BFS with the panel 06 switches. Also, without this bus, there is no power to provide a select off signal for each PASS GPC. Therefore, if an engage pushbutton is depressed, the PASS GPCs will go to software halt, but the BFS will not respond (rule A7-51.B.3).
  4. BFS I/O TERM B fails high - If this discrete fails high, the BFS cannot be engaged, since one of the conditions for an engage is for the I/O TERM B to be low. The PASS set would still go to software halt if an engage were attempted. Detection of this failure is difficult during the pre-engage state of ascent and entry when this discrete is normally set high. If the I/O TERM A discrete fails high, which is on the same half-hybrid discrete receiver chip, the I/O TERM B signal would be suspect (rule A7-51.B.4).
  5. BFC CRT select discretes and BFS I/O TERM B all fail low simultaneously - Such a failure is caused by loss of the 5-volt logic power within the BFC module for the BFS GPC. Loss of logic power renders the BFC module inoperative

and, therefore, no BFS engage is possible, although PASS GPCs would still go to software halt if an engage were attempted (rule A7-51.B.5).

6. MTU failed while BFS in HALT - The BFS must have a valid time in order to be a viable backup to PASS during entry. Without an MTU to furnish a current time, the BFS initializes to a GMT of day 1 and an MET of 0 (BSS PRD MG038101, par. 3.8. 1). The BFS time can be updated through the use of the time update entries on the BFS GPC memory display.

### C. BFS Declared Suspect

The cases listed below cause the BFS to be called suspect rather than failed or NO-GO. These conditions do not guarantee an unengageable BFS or a BFS that definitely cannot control the vehicle. Since the BFS is engaged as a last resort to control the vehicle, the BFS may still be able to function for these cases. A suspect BFS will affect dynamic restringing decisions for cases that require a BFS. For the purpose of restringing decisions, a suspect BFS is considered as no BFS.

1. BFS to HALT without a PRO to OPS 000 and then back to STBY/RUN - Without the proper software cleanup occurring with an OPS 000 PRO, a return to the running state will not necessarily initialize everything properly (user note B04524C) (rule A7-51.C.1).
2. BFS re-IPL'd into the same GPC during ascent - After failing once and without the proper dump analysis, the integrity of the BFS GPC and the BFS software is in question and is not to be relied on except where there is no other alternative. If the GPC IPLs, it is acceptable to use it for systems monitoring (e.g., PLBD operations) (rule A7-51.C.2). The BFS will be moved into another GPC postinsertion to ensure a good BFS for entry.
3. BFS low memory SEC maxed out at 7F or constantly incrementing -This indicates a hard memory location failure. Although a single bit failure in a word can be corrected by the error detection and correction routine, any subsequent second bit error in the word cannot be corrected, and any errors elsewhere in memory cannot be seen once the error counter is maxed out at 7F. Because of the lack of insight into subsequent errors and the inability to know which memory locations are affected, the overall software integrity is in question, and the box is declared suspect (rule A7-51.C.3).
4. GPC BITE fault summary message - This indicates that the BFS GPC execution encountered a condition requiring a software-initiated restart in an attempt to continue execution (see BSS PRD MG038101, Table 3.1.7-1). The software design/ground rules assume that all GPC errors are momentary and transient, rather than continuous (see Overview PRD MG038100, par. 3.2.4.2.4.1).

Approximately 80 percent of the GPC error types cause either a restart recovery or an error trap recovery, which can result in a restart, depending on the type of job executing when the error is encountered; i.e., dispatched or nondispatched job. The remaining 20 percent continues execution, ignoring the error condition. Restart and error trap recoveries involve the following:

- a. Restart recoveries perform I/O initialization (IOP master reset, tracking PASS or standalone I/O initialization, etc.) and minor cycle preparation (update GMT/MET, set minor cycle counter to zero, set downlist frame counter to zero, etc.).
- b. Error trap recoveries determine if the error condition occurred when a dispatched job was executing.
  - (1) If a dispatched job is executing: Return to job's dispatched entry point minus one full word (usually is an instruction to do the job (e.g., MTU RM, uplink, GNC) next cycle, or quit (discontinue LDB, TFL)).
  - (2) If a dispatched job is not executing: Initiate restart. Some error trap recoveries initiate restart when PSW bit 38 is 1 and continue job execution when bit 38 is 0.
5. GPC PWR fault message - Annunciation of this message means that the BFS GPC has experienced a power transient. After such an occurrence, the BFS may not function properly if engaged. The BFS executes a power transient restart, which includes an I/O initialization and minor cycle preparation and startup (rule A7-51.C.5).
6. BFS I/O TERM B input discrete fails low - The I/O TERM B signal starts with the panel 06 GPC output switches and the ESS 3AB power feed. It is processed by the BFC module. Loss of the discrete at the BFS casts doubt on the ability of the BFC to work properly in supporting a BFS engage operation or the panel 06 switches and power to be operating correctly. Therefore, the BFS is declared suspect for this failure (rule A7-51.C.6).
7. BFS I/O TERM A input discrete fails high - Failure of this discrete by itself would not directly impact the ability of the BFS to be engaged and to control the vehicle. It would only prevent the BFS from commanding the payload buses. It shares a discrete receiver hybrid with the I/O TERM B discrete, however, which does impact BFS engage. If the half-hybrid fails high, the BFS could not be engaged, and the PASS GPCs would go to software halt when the engage button is depressed. Because the normal pre-engaged state of the BFS I/O TERM B is high during ascent and entry, a failure of the discrete to the high state is not immediately evident. If the I/O TERM A fails high, the BFS must be considered suspect until the I/O TERM B can be verified (rule A7-51.C.7). The status of the I/O TERM B discrete may be verified by taking the BFS OUTPUT switch to NORM and checking the I/O TERM B to observe if it goes low.

D. Other BFS failure items:

1. BCE failed at BFS
  - a. BFS downmodes entire string.
  - b. Nonfailed BCE on downmoded string will be recovered, along with its associated MDM, upon engage. The crew has no insight into which BCE on a string is causing the string downmode. The I/O ERROR log entries provide information on which BCE is at fault. Therefore, the DPS operator should advise the crew which MDM is recovered on an engage.
  - c. If the MDM behind a failed BCE is desired over the other MDM on the same string, a PASS port mode and BFS I/O reset will effectively port mode the BFS. Hence, the MDM initially behind failed BCE will be recovered on engage.
  - d. You can also elect to port mode PASS, not I/O reset BFS, and have the BFS (on engage) be set to use the port opposite the one used by PASS.
2. GNC system items - If dual LRU failures occur, the failed LRUs must be deselected by the crew before the BFS can properly control the vehicle. LRU data have commfault flags, but flight control ignores them. Data are Interchangeable Mid-Value Select (IMVS) for computational purposes and can accommodate a dual null failure case, but not other cases without the crew deselecting the failed LRU.

**REFERENCES**

1. Backup Flight System (BFS) Program Requirements Document (PRD) Overview, MG038100.
2. Backup System Services (BSS) Program Requirements Document (PRD) Overview, MG038101.
3. Backup Flight System GN&C Interface Program Requirements Document (PRD) Overview, MG038106.

**TITLE**

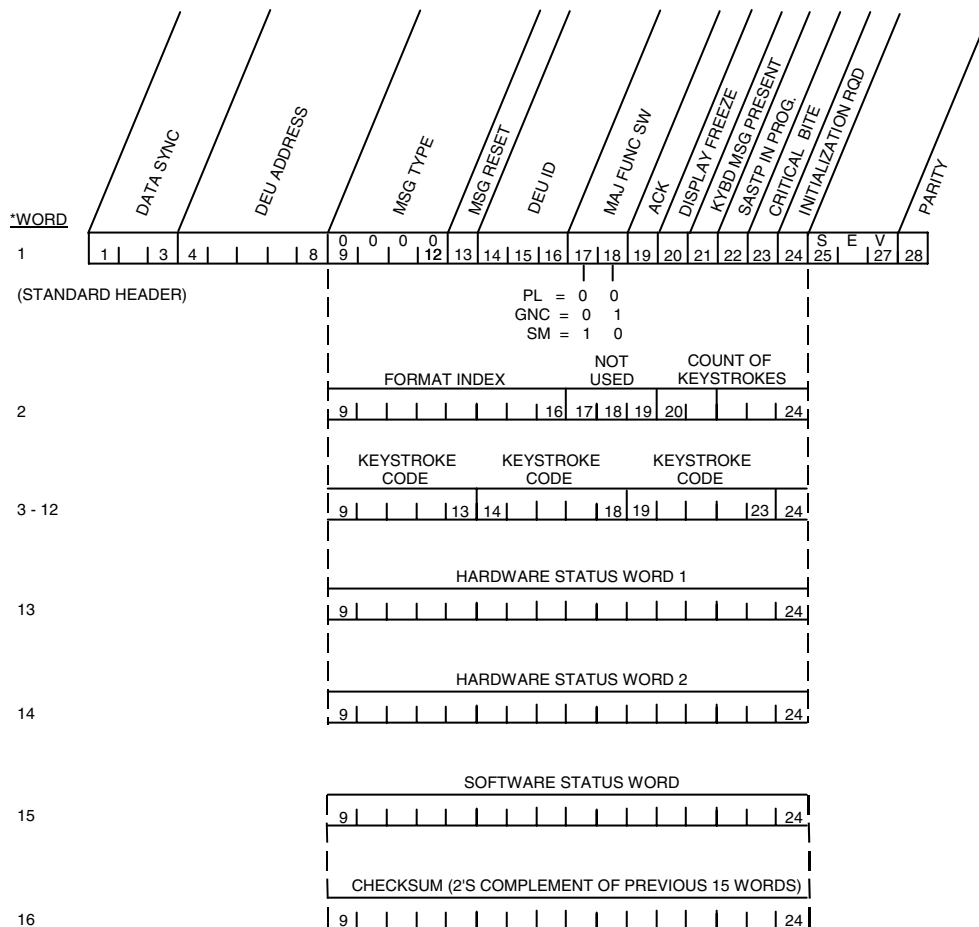
MCDS STATUS

**DESCRIPTION**

**A. Hardware/Software Status Words**

This SCP contains the following information to determine status of the DPS multifunction CRT display system, including hardware/software status words, poll header word detail, MCDS displays, "Illegal entry" error conditions, SPEC/DISP allocation, DK listen "item" entries, and DEU load.

**Table 4.8-1. MCDS status response**



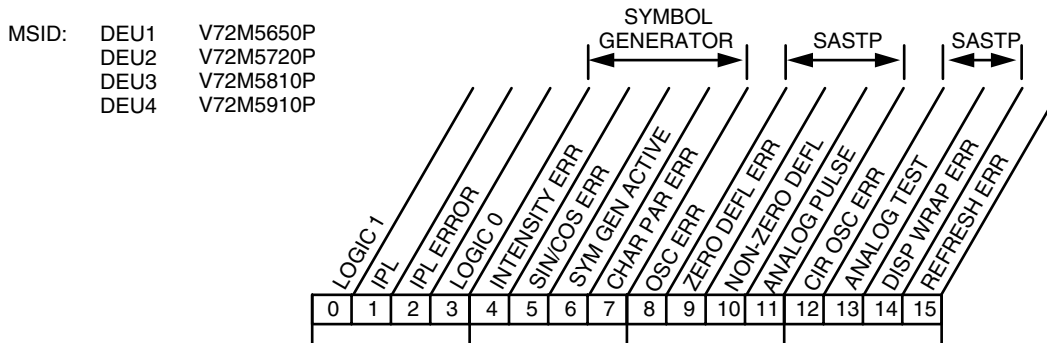
J.18819\_045

Note: Following DEU transmission of this response, bits 13, 19, 21, and 23 of the first data word are reset. Additionally, the count of keystrokes (word 2) and the hardware and software status words are reset.



**Table 4.8-2. Hardware status word 1**

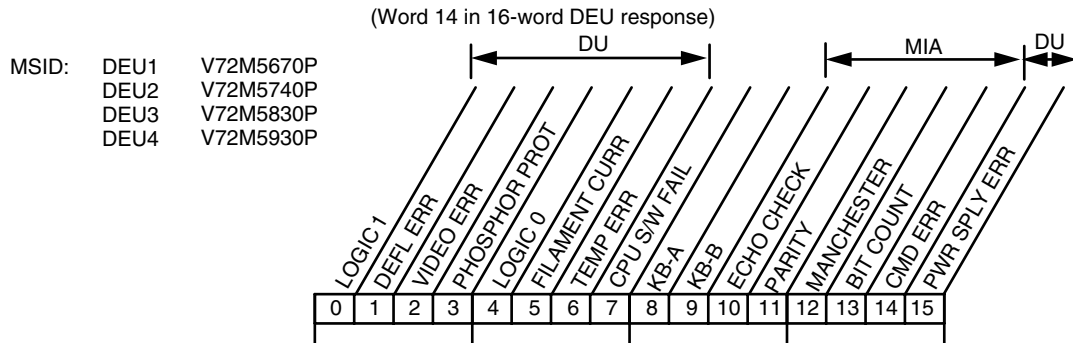
(Word 13 in 16-word DEU response)



j\_18819\_080

Bit	Description
0	<u>Logic 1</u> - Always set to 1.
1	<u>IPL has been performed</u> - IPL PROM is control of DEU.
2	<u>IPL error</u> - Error is detected during the parity check of the IPL PROM and the multiplexers. The error can occur as a result of an IPL, or as a result of the periodic IPL circuits error check initiated by DEU resident software.
3	<u>IPL circuit check error</u> - (Not currently implemented.)
4	<u>Symbol generator intensity parity error</u> - Parity error is detected on the intensity PROM. The check is performed every time the PROM is activated (i.e., for all symbols). The parity check is not performed when custom intensity is used (custom intensity is not currently being implemented).
5	<u>Symbol generator sine - cosine parity error</u> - Error is detected during the parity check of the sine-cosine ROM of the digital rotation circuit.
6	<u>Symbol generator active</u> - Symbol generator is processing the contents of the refresh buffer. This bit does not indicate the presence of an error condition.
7	<u>Symbol generator character parity error</u> - Error is detected during a parity check of the character generator ROM and data register. The check is performed each time the ROM is read.
8	<u>Oscillator error</u> - Error is detected in the oscillator and the associated countdown logic. The test is performed using a Resistor-Capacitance (R-C) circuit.
9	<u>SASTP: Symbol generator analog zero deflection test error</u> - Zero test of analog deflection is failed.
10	<u>SASTP: Symbol generator analog nonzero deflection test error</u> - Nonzero test of analog deflection is failed.
11	<u>SASTP: Symbol generator analog pulse test error</u> - Pulse has not been detected during an analog pulse test.
12	<u>Circle oscillator error</u> - Circle repetition rate goes to zero.
13	<u>SASTP: Symbol generator analog test error (or of bits 9, 10, 11)</u> - One of the failures signified by bits 9, 10, or 11 occurs.
14	<u>SASTP: Symbol generator display wrap error</u> - DEU software detects a no compare on display data that has been wrapped back into memory. The test and the setting of the bit is under software and (digital test) FCW control. The software repetitively issues a Direct Out Instruction to an R-C timing network to inhibit setting this bit.
15	<u>Symbol generator refresh error</u> - R-C timer indicates that the refresh is overdue by 18 ms.

**Table 4.8-3. Hardware status word 2 (H/W STAT REG 2, 3 combined)**



j\_18819\_081

Bit	Description
0	** <u>Logic one</u> - Always set to 1.
1	** <u>DU deflection error</u> - Improper beam position detected by comparing deflection signal versus yoke return. This error requires arming by the SASTP before it will trip the DU BITE flag.
2	** <u>DU video error</u> - Last stage video amplifier always ON. Circuitry requires performance of SASTP to be functional.
3	** <u>DU phosphor protect error</u> - (not used in OV-102 and subs). Following errors will result in disabling the electron beam (i.e., blank screen) via the G1 control grid: <ul style="list-style-type: none"> <li>a. Video signal detected with no X or Y beam deflection (small circles can sometimes cause this error).</li> <li>b. Excessive voltage detected in video signal.</li> <li>c. Loss of or steady X or Y deflection current detected.</li> <li>d. Deflection signal detected exceeding 5 percent of the 5-inch by 7-inch viewing range (i.e., offscreen beam positioning).</li> <li>e. Power supply error detected - same as bit 15.</li> </ul> <p>This error requires arming by the SASTP before it will trip the DU BITE flag.</p>
4	** Spare
5	** <u>DU filament current error</u> - Low filament current detected. This circuitry does not monitor the STBY filament warmup current. Also, this bit does not latch in the hardware BITE register. This error requires arming by the SASTP before it will trip the DU BITE flag.
6	** <u>DU temperature error</u> - One of the temp sensors on the DU deflection amplifiers (two sensors in each X and Y amplifier) or the voltage control page goes above 125 <sup>o</sup> C. This bit does not latch in the hardware BITE register, but will trip the DU mechanical flag (does not require arming by the SASTP).
7†	* <u>CPU software fail</u> - Software fails to issue a Direct Out Instruction to the GO/NO-GO timer because software is "hung up" or it skips the instruction. SASTP tests this BITE by momentarily inhibiting the instruction.
8†	* <u>Keyboard Channel A Fail</u> - BITE logic detects a failure in Keyboard Adapter Channel A. If a keyboard message is not transferred to DEU memory within 9 ms, the bit is set. The adapter will not send the keyboard message until it receives a strobe from the CPU.
9†	* <u>Keyboard Channel B Fail</u> - BITE logic detects a failure in Keyboard Adapter Channel B. If a keyboard message is not transferred to DEU memory within 9 ms, the bit is set. The adapter will not send the keyboard message until it receives a strobe from the CPU.
10	* <u>MIA echo check error</u> - Transmit NRZ data does not compare to the received NRZ data (on the interface between the Singer MIA and the MIA adapter). This check is performed on a bit-by-bit basis and only on words transmitted from the DEU to the IOP. The Singer MIA is in the wraparound mode for this error check.
11	* <u>MIA parity error</u> - MIA detects even parity on words detected on the DK bus. This is a Singer MIA-detected error.
12	* <u>MIA Manchester error</u> - Nonvalid Manchester condition occurs on words on the DK bus. This is a Singer MIA-detected error.
13	* <u>MIA bit count error</u> - Word with an incorrect number of bits is detected on the DK bus. This is a Singer MIA-detected error.
14	* <u>MIA command error</u> (or of bits 11, 12, 13) - One of the failures signified by bits 11, 12, or 13 occurs.
15	** <u>DU power supply error</u> - Out of tolerance condition detected in the ±80, ±25, -15, or +5 voltages supplied by the low-voltage power supply (voltages are summed then compared to a reference voltage). This error requires arming by the SASTP before it will trip the DU BITE Flag.

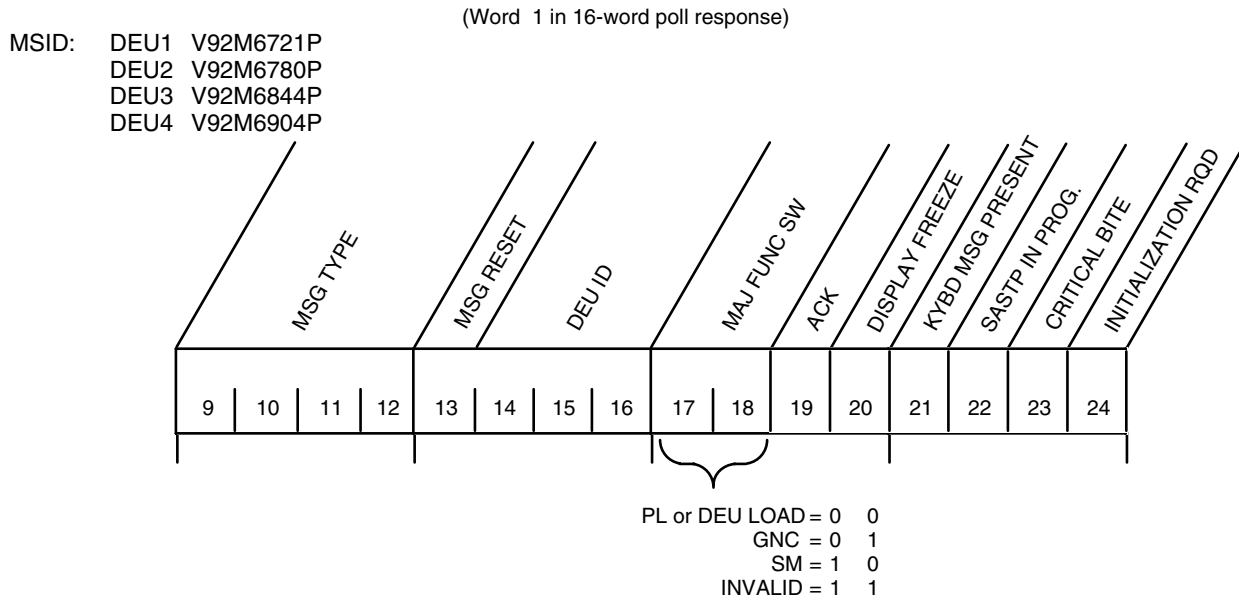
\*\* Hardware BITE Register 2.  
\* Hardware BITE Register 3.  
† Critical BITE error.



B. Poll Header Word Detail

The poll header word contains useful information not available in the HW/SW status words. The 16-bit word is stripped out of a 28-bit DEU-TO-IOP poll response (bits 9 through 24). Note that a pattern of 370X indicates that the DEU IPL PROM has been loaded and the DEU is expecting a load.

**Table 4.8-5. Poll header word**



j\_18819\_062

Bit	Description												
9-12	<u>Message-type indicator</u> . Four-bit code that defines the specific type of response to the GPC being provided by this or the following response data words. The codes are as follows:												
	<table border="1"> <thead> <tr> <th>MSG no.</th> <th>Bit indication</th> <th>Title</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0000</td> <td>MCDS STATUS RESPONSE (normal poll response)</td> </tr> <tr> <td>2</td> <td>0011</td> <td>IPL STATUS RESPONSE</td> </tr> <tr> <td>3</td> <td>0101</td> <td>IPL BITE STATUS RESPONSE</td> </tr> </tbody> </table>	MSG no.	Bit indication	Title	1	0000	MCDS STATUS RESPONSE (normal poll response)	2	0011	IPL STATUS RESPONSE	3	0101	IPL BITE STATUS RESPONSE
MSG no.	Bit indication	Title											
1	0000	MCDS STATUS RESPONSE (normal poll response)											
2	0011	IPL STATUS RESPONSE											
3	0101	IPL BITE STATUS RESPONSE											
13	MSG reset - A logic one indicates message reset. Note that this keystroke does not get packed in the keystroke codes (poll response words 3-12.)												
14-16	DEU identification - Three-bit code that identifies the responding DEU (1-4). This ID code is generated at DEU LOAD, resides in DEU memory, and does not appear to be used by the GPCs for processing. On flights when DEU IFM changeouts were performed, the DEU ID remained 4 (the spare) with no effect on the PASS or BFS keystroke processing.												
17-18	MAJ FUNC SW - The position of the CRT major function switch (00, 01, 10) or partial indication that a DEU load has been initiated (00).												
19	ACK. - A logic one indicates ACK key depressed. Note that this keystroke does not get packed in the keystroke codes (poll response words 3-12).												
20	DISPLAY FREEZE - A logic one indicates a display freeze condition. This bit is set when the SPEC key is depressed and is reset when any other key is depressed.												
21	KYBD MSG PRESENT - A logic one indicates a complete keyboard message is present in the keystroke codes (poll response words 3-12).												
22	SASTP IN PROG - A logic one indicates SASTP is in progress.												
23	<u>CRITICAL BITE</u> - A logic one indicates the presence of a critical BITE. The BFS will announce a CRT BITE message if the bit is set. The PASS first checks to see if the initialization performed bit is set (bit 2 of the software status word), and only announces CRT BITE if the initialization performed bit is not set.												
24	<u>INITIALIZATION RQD</u> - A logic one indicates that a load of the DEU is required. This bit results in the scheduling of the PASS (if available) or BFS (always available) loader software.												

C. MCDS Displays

Source = DEU/IDP

Note: These displays are commonly referred to as "critical formats."

Disp. no.	Title	Type	PASS									
			OPS 0	G1/G6	G2	G3	S2	S4	P9	G8	G9	
0/1	GPC MEMORY	OPS	X									
0/1	GPC MEMORY	SPEC	X	X/X	X	X	X	X	X	X	X	X
18/0	GNC SYS SUMM 1	DISP		X/X	X	X					X	
21/0	IMU ALIGN	SPEC			X	X						
22/0	S TRK/COAS CNTL	SPEC			X	X <sup>a</sup>						
23/0	RCS	SPEC		X/X	X	X					X	
50/0	HORIZ SIT	SPEC		X/X		X						
51/0	OVERRIDE	SPEC		X/X		X						
55/0	GPS STATUS	SPEC		X/X	X	X					X	X
99/0	FAULT	DISP	X	X/X	X	X	X	X	X	X	X	X
101/1	XXXXXX TRAJ	OPS		X/								
102/1	XXXXXX TRAJ	OPS		X/								
103/1	XXXXXX TRAJ	OPS		X/								
104/1	XXXXX MNVR YYYY	OPS		X/								
105/1	XXXXX MNVR YYYY	OPS		X/								
106/1	XXXXX MNVR YYYY	OPS		X/								
202/1	(ORBIT) MNVR (EXEC)	OPS			X							
301/1	XXXXX MNVR YYYY	OPS				X						
302/1	XXXXX MNVR YYYY	OPS				X						
303/1	XXXXX MNVR YYYY	OPS				X						
304/1	ENTRY TRAJ 1 (2-5)	OPS				X						
305/1	VERT SIT 1 (2)	OPS				X						
601/1	(RTL) TRAJ	OPS		/X								
602/1	VERT SIT 1	OPS		/X								
603/1	VERT SIT 1 (2)	OPS		/X								
901/1	GPC MEMORY	OPS										X

<sup>a</sup> MM 301 ONLY.

Source = MMU

SM "roll-in" displays

(Payload/Spacelab roll-in displays are flight dependent.)

Disp. no.	Title	Type	PASS SM
66/0	ENVIRONMENT	DISP	X
67/0	ELECTRIC	DISP	X
68/0	CRYO SYSTEM	DISP	X
69/0	FUEL CELLS	DISP	X
76/0	COMM/RCDR	DISP	X
77/0	EVA-MMU/FSS	DISP	X
86/0	APU/HYD	DISP	X
87/0	HYD THERMAL	DISP	X
88/0	APU/ENVIRON THERM	DISP	X
89/0	PRPLT THERMAL	DISP	X
96/0	PDRS STATUS	DISP	X
97/0	PL RETENTION	DISP	X
900/0 thru 999/0	CREW TEXT	DISP	X
167/0	DOCKING STATUS	DISP	X
168/0	SM CRYO PALLET	DISP	X
169/0	PDRS STATUS	DISP	X
177/0	EXTERNAL AIRLOCK	DISP	X
178/0	SM OIU	DISP	X

Source = PASS GPC

(GPC resident payload/Spacelab displays are flight dependent.)

Disp. no.	Title	Type	PASS									
			OPS 0	G1/G6	G2	G3	S2	S4	P9	G8	G9	
1/0	DPS UTILITY	SPEC	X <sup>a</sup>	X	X	X	X	X	X	X	X	X
2/0	TIME	SPEC	X <sup>a</sup>		X		X	X	X	X	X	X
6/0	GPC/BUS STATUS	SPEC	X <sup>a</sup>	X	X	X	X	X	X	X	X	X
19/0	GNC SYS SUMM 2	DISP			X						X	
20/0	DAP CONFIG	SPEC			X							
25/0	RM ORBIT	SPEC			X							
33/0	REL NAV	SPEC			X							
34/0	ORBIT TGT	SPEC			X							
40/0	SENSOR TEST	SPEC									X	
41/0	RGA/ADTA/RCS	SPEC									X	
42/0	SWITCH/SURF	SPEC									X	
43/0	CONTROLLERS	SPEC									X	
44/0	SWITCHES	SPEC									X	
45/0	NWS CHECK	SPEC									X	
53/0	CONTROLS	SPEC		X		X						
60/0	SM TABLE MAINT	SPEC						X	X			
62/0	PCMMU/PL COMM	SPEC						X	X			X
64/0	SM GROUND CHECKOUT	SPEC						X	X			
78/0	SM SYS SUMM 1	DISP						X	X			
79/0	SM SYS SUMM 2	DISP						X	X			
85/0	MASS MEMORY R/W	SPEC						X	X			
90/0	PCS CNTL	SPEC						X	X			
94/0	PDRS CONTROL	SPEC						X				
95/0	PDRS OVERRIDE	SPEC						X	X			
96/0	PDRS STATUS	DISP						X				
100/0	GTS DISPLAY	SPEC								X		X
101/0	SENSOR SELF-TEST	SPEC										X
102/0	RCS/RGA/ADTA TEST	SPEC										X
104/0	GND IMU CNTL/MON	SPEC										X
105/0	TCS CONTROL	SPEC										X
106/0	MANUAL CONTROLS	DISP										X
111/0	SL MEMORY DUMP	SPEC								X		
112/0	GPC/BTU I/F	SPEC										X
113/0	ACTUATOR CONTROL	SPEC										X
168/0	CRYO PALLET	DISP						X				
201/0	UNIV PTG	OPS			X							
201/1	ANTENNA	OPS						X				
202/1	PL BAY DOORS	OPS						X				
401/1	ANTENNA	OPS							X			
402/1	PL BAY DOORS	OPS							X			
801/1	FCS/DED DISP C/O	OPS									X	
901/1	MASS MEMORY R/W	OPS								X		

<sup>a</sup> Not available if GPC moded to OPS 0 from G1/G6 or G3.

Source = BFS GPC

Note: All BFS displays (SPECs, DISPs, etc.) are BFS GPC memory resident.

Disp. no.	Title	Type	BFS major mode			
			OPS 0	G1/G6	G3	SM
000/1	BFS MEMORY	OPS	X			
000/	BFS MEMORY	SPEC	X	X/X	X	X
000/1	THERMAL	OPS				X
018/	GNC SYS SUM 1	DISP		X/X	X	
019/	GNC SYS SUM 2	DISP		X/X	X	
050/	HORIZ SIT	SPEC		X/X	X	
051/	BFS OVERRIDE	SPEC		X/X	X	
055/	GPS STATUS	SPEC		X/X	X	
063/	PL BAY DOORS	SPEC				X
078/	SM SYS SUM 1	DISP				X
079/	SM SYS SUM 2	DISP				X
099/	FAULT	SPEC	X	X/X	X	X
101/1	XXXXXX TRAJ 1	OPS		X/		
102/1	XXXXXX TRAJ 1	OPS		X/		
103/1	XXXXXX TRAJ 2	OPS		X/		
104/1	XXXXXX MNVR YYYYY	OPS		X/		
105/1	XXXXXX MNVR YYYYY	OPS		X/		
106/1	XXXXXX MNVR YYYYY	OPS		X/		
301/1	XXXXXX MNVR YYYYY	OPS			X	
302/1	XXXXXX MNVR YYYYY	OPS			X	
303/1	XXXXXX MNVR YYYYY	OPS			X	
304/1	ENTRY TRAJ 1	OPS			X	
304/1	ENTRY TRAJ 2	OPS			X	
304/1	ENTRY TRAJ 3	OPS			X	
304/1	ENTRY TRAJ 4	OPS			X	
304/1	ENTRY TRAJ 5	OPS			X	
305/1	VERT SIT 1	OPS			X	
305/1	VERT SIT 2	OPS			X	
601/1	RTLS TRAJ	OPS		/X		
602/1	VERT SIT 1	OPS		/X		
603/1	VERT SIT 1	OPS		/X		
603/1	VERT SIT 2	OPS		/X		

XXXXXX = LAUNCH, ASCENT, OMS-1, OMS-2, or DEORB depending on the major mode and any abort mode selected.

YYYYY = EXEC or COAST depending on the major mode.



D. "ILLEGAL ENTRY" Error Conditions

PASS	BFS	Keystroke input errors
√	√	1. "PRO" not compatible with current format or step in control segment
√	√	2. "GPC/CRT" key entry with CRT ≠ 1-4, GPC ≠ 0-5
√	√	3. GPC-detected input MSG syntax error
		<u>"EXEC" KYBD inputs</u>
√	√	1. "EXEC" not compatible with current format or step in control segment
√	√	2. "EXEC" (or ITEM) when new format is being retrieved
√	√	3. "EXEC" load with no data
		<u>OPS transitions</u>
√	√	1. OPS request containing invalid mode number
√	√	2. OPS undefined OPS not resident and not an overlay initiator
√	√	3. Requested OPS not a legal transition
√	√	4. Inputs other than "MSG RESET," "CLEAR," "FAULT," or "ACK" in midst of an OPS transaction
√	√	5. OPS requested via a DEU not being commanded by a target GPC for that OPS
√	√	6. No target GPC in config table when OPS selected
√	√	7. Attempt to freeze dry load a GPC not in GPC OPS-0 or not listening to input DEU/KYBD
√	√	8. Attempt a BFS OPS trans without the commanding CRTs MF switch in "GNC"
√	√	9. Request redundant operations of simplex OPS (i.e., two SM2 GPCs)
		<u>SPECs/DISP</u> s
√		1. Selection of SPEC or DISP not associated with current OPS
√		2. "2 SPEC LIMIT" per MF violated - results from SPEC request when two are already active
√	√	3. Attempt to load data using DISP: data must be loaded via a SPEC
√	√	4. Invalid item no. for data load
√	√	5. "Reasonableness" test failed; external data input must be within acceptable limits
√	√	6. Attempt to call a SPEC that is currently underlying a DISP on the same CRT. The DISP must be resumed to get to the SPEC
		<u>Memory SPEC</u>
√	√	1. Address input exceeds memory size
√	√	2. No dump address specified
√	√	3. Wds/frame ≠ 16 or 32
√		4. Eng units scale code with BB >10 or A ≠ 1,2
√		5. "EXEC" load with no data
√		6. Attempt to write into protected memory when mode is not code
√		7. Insufficient digits entered for eng units
√		8. Addr ID on odd word boundary when 32-bit floating point option is selected
√		9. Seq read required with no addr ID

E. SPEC/DISP Allocation

The following table identifies whether a SPEC/DISP is retained (R) or cancelled (C) in the GPC software depending upon the user action:

User Action (1)	SPECs	DISPs
RESUME KEY	C	C
SPEC CALLED	C	C
DISP CALLED	R	C
GPC/CRT KEY REASSIGN - PASS	R	C
- BFS	C	C
BFC CRT SWITCH REASSIGN - PASS	R	C
- BFS	C	C
MF SWITCH CHANGE (2)	R	C
OPS TRANSITION	C	C
OPS MODE RECALL - PASS (3)	R	C
- BFS	R	R
MAJOR MODE TRANSITION (4)	R	R

1. Action/results apply to both PASS and BFS unless otherwise noted.
2. Table reflects effects of SM, GNC, and PL MF in the PASS; but only SM and GNC MF in the BFS. PL MF processing in the BFS results in the following:
  - MF from SM to PL while assigned to BFS - Previous display retained whether it is SPEC or DISP. Display remains when switch taken back to SM.
  - MF from GNC to PL while assigned to BFS - CRT display blanks except for the time fields, SPL, and msg line. OPS display is presented when switch taken back to GNC, so both SPECs and DISPs are cancelled for this case. There are other peculiarities about PASS and BFS processing of the PL MF switch position as follows:
    - In the PASS, when the PL MF position is selected and there is no PL 9 GPC in the common set, the GPC memory display is driven on the CRT (i.e., unsupported MF).
    - In the BFS, if a CRT has a PL MF when the BFS first polls the DEU, the CRT display is blank except for the time fields, SPL, and msg line.
3. If GPC target set is altered, it works like an OPS transition. DISPs are cancelled if there is any change in the NBAT (strings, CRTs, MMUs, launch, etc.) since the previous OPS transition/OPS mode recall. If no change, the DISP is retained.
4. SPEC/DISP retained only if supported in new major mode.

General Notes

1. Active SPEC/DISP<sub>s</sub> must be cancelled on each CRT they are being viewed on.
2. Keyboard ITEM entries apply only to the display currently on a CRT and, therefore, never affect underlying SPECs.
3. For PASS system level SPEC allocation, a GPC can support more than one MF at a time. However, the same SPEC cannot be called up in two different MFs for the same GPC. For example, if the MF switch for a GNC CRT is placed in PL and a systems-level SPEC (GPC MEMORY, DPS UTILITY, TIME) is called, the same SPEC can no longer be called on a GNC CRT. The result would be an "ILLEGAL ENTRY" fault message for exceeding the "2 SPEC per MF" limit. To clear the problem, the MF switch for the appropriate CRT must be returned to PL and the SPEC resumed. This scenario does not apply to the BFS.
4. For PASS processing of SPECs, an attempt to call a SPEC on a CRT which currently has the same SPEC underlying a DISP will result in "ILLEGAL ENTRY." The DISP must be resumed to get to the SPEC. This scenario does not apply to the BFS.

F. DK Listen Item Entries

The BFS will listen and react to certain item entries on specific PASS displays as defined below:

Display	Keyboard inputs	Remarks
HORIZ SIT	Items 3,4,5	Runway select
	Item 6	TAEM TGT (G&N)
	Item 7	MEP/NEP select
	Item 8	Aim point(headwind HI/LO)
	Item 9	Altimeter setting
	Items 40,41	TAL site select
XXXXX MNVR YYYYY	Items 1,2,3	OMS eng select
	Item 4	RCS eng select
	Items 6,7,8	TRIM loads
	Item 9	Vehicle weight
	Items 10-13	TIG (D,H,M,S)
	Items 14-18	PEG 4 TGTS
	Items 19-21	PEG 7 TGTS
	Item 22	'LOAD' CMD
	Item 23	Start CRT timer
	Items 24-26	Burn attitude data
	Items 28-33	GMBL select
	Item 35	Abort TGT/crew index
	"EXEC" CMD	Burn execute CMD

Display	Keyboard inputs	Remarks
ENTRY TRAJ 1(2,3,4,5)	Item 1	Drag reference bias
OVERRIDE	Item 1	Abort TAL/AOA
	Item 2	Abort ATO
	Item 3	Abort
	Item 4	Max throttle
	Item 5	Crossfeed interconnect
	Items 6-12	Propellant dump commands
	Items 13-14	Aft RCS
	Items 15-16	Forward RCS
	Items 17-18	Elevon select
	Items 20-21	Filter select
	Items 22-24	Atmospheric model select
	Items 43-44	Vent door control

The BFS will also DK LISTEN for other MCDS activities (e.g., manual major-mode transitions, GPC/CRT KYBD entries, etc.). For more detailed information on DK LISTEN, consult the DPS System Briefs, MCDS.

**G. DEU Load**

Loadblock	#1: DCP	#2: CRITICAL FORMATS	#3: SASTP
GPC software			
STP/RTP (GPC IPL)	Yes	Yes	Yes
PASS DEU loader (post GPC IPL OPS 0, SM OPS 2/4, and PL 9)	Yes	Yes	No
BFS DEU loader (all OPS)	Yes	No	No

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**REFERENCES**

1. Orbiter DEU SPEC, MC615-0008.
2. PASS Level A CPDS, SS-P-0002-170.
3. IPL User's Guide, MG077202.
4. PASS User's Guide.

## TITLE

MEDS STATUS

## PURPOSE

This reference is a collection of information from various MEDS documents for the purpose of providing quick access to commonly used information. This provides a consolidated cross mapping of MEDS errors and system responses / effects along with other useful information extracted from the more detailed MEDS requirements and design documentation. Also included are anomaly procedures which can be used to guide the user through recommended pre-defined actions for a set of pre-defined anomaly conditions.

For more detailed information refer to the appropriate MEDS or Orbiter documentation. The information in this SCP is condensed and assumes the reader is already knowledgeable about MEDS, it's general use, operations, functions, and integration with other Orbiter subsystems that it interfaces to.

## DESCRIPTION

This SCP is divided into the following six areas:

- A. Summary of Operations
- B. Display Information and Cross Reference
- C. Functional Problems and Cross Reference
- D. Downlist Information and Cross Reference
- E. Anomaly Procedure
- F. Miscellaneous Reference Information

### A. Summary of Operations

#### 1. Automated Operations

##### a. IDP

Any time the IDP is booting up, it will make up to two attempts to load a software program file. If both attempts have errors and the file was the CURRENT application program file, then the IDP will make up to two attempts to load the DEFAULT program file. Typically the CURRENT program file will be in EEPROM but can be on the MSU (user configurable) and the DEFAULT program file is always on the MSU. If both attempts fail and the file was the Operating System Kernel in EEPROM, then up to two attempts to load the Kernel from the MSU. If all attempts fail to load the

Kernel or both attempts fail to load the DEFAULT file, the IDP attempts to display the "IDP DEFAULT LOAD FAIL" on the CRT MDU that is connected to it's 1553 data bus.

An IDP continues to attempt communications with MDUs and ADCs at all times. At any time an IDP has communications with an MDU and the MDU is not being commanded, the IDP will automatically attempt to gain commandership of the MDU. An IDP will always send display data, process edgekey inputs and retrieve status and BITE data from an MDU it has commandership of. An IDP will never send display data to or process edgekeys from an MDU it does not have commandership of. An IDP will always retrieve analog data and BITE data from an ADC it has communications with.

For a graphics failure reported by an MDU, the IDP will attempt to blank and regenerate the display format that was on the MDU in an attempt to clear the cause of the graphics error. For displays that are activated by menus below the maintenance menu (in the menu tree hierarchy), the IDP will attempt to regenerate the MEDS System Status display.

For consecutive 1553 data bus communication problems (MEDS I/O ERROR MDUx) or heartbeat failures (PROCESSOR FAIL) an IDP will relinquish commandership of an MDU. This is done in an attempt to allow the MDU to switch ports in case the problem is port or data bus related and the problems may not reoccur if the MDU is operating on another 1553 bus with another IDP. Note that an MDU configured in the MANUAL port configuration mode will not switch since the manual configuration mode intentionally disables automatic port change operations.

For certain FC or DK data bus communication or data handling problems, the IDP may disable the FC or DK data bus interface channel to protect it's operations from the erroneous conditions. This will result in invalid data indications on any displays that utilize the data from the disabled channel. Disabled FC channels can be re-enabled by changing the selected FC bus or power cycling the IDP. Disabled DK channels can be re-enabled by power cycling the IDP.

For errors relating to receiving a keystroke from the Orbiter keyboards via the keyboard interface (DED card), the IDP will not process the keystroke and will provide error information to the user and to the GPC. The IDP will continue to process keystrokes and handles each keystroke separately. The interface to the keyboards is never disabled.

For an MDU edgekey failure, the IDP will display a red X over the associated edgekey legend and disable the edgekey on the MDU. Disabled edgekeys can be regained by power cycling the MDU, except for permanent failures. If a user holds an edgekey in for more than 3 seconds

the edgekey will be considered failed due to the inability to differentiate this from an actual stuck edgekey failure, however the edgekey can be regained via an MDU power cycle.

For fatal category A errors, the IDP software will allow the watchdog timer to timeout and halt the operation of the processor, thus halting software execution. However the IDP software will attempt to save error information in the VM and MSU error logs and support poll responses from the GPC for up to 1 second in order to allow some error information to get into GPC downlist before halting.

In order to prevent software execution that is unpredictable, the watchdog timer will halt operation of the processor (thus halting software execution) if the software fails to update the watchdog timer periodically.

b. MDU

Any time the MDU is booting up, it will make up to two attempts to load the software from EEPROM. If both attempts fail, then the MDU display remains blank and will not support display operations but will report the load error to the IDP.

For loss of communications on a 1553 data bus port, if the MDU is in AUTO port configuration mode, the MDU will switch ports in an attempt to gain communications and IDP commandership on the other port. The MDU will continue to switch between the both ports until communications and commandership occurs on one of the ports.

For some BITE detected failures (POST/OST) the main processor (R3000) halts all MDU display operations. The MDUF program terminates execution and goes to the Bootstrap Monitor (BSM) causing the display to go blank. This is done to remove any erroneous information that may be displayed. Other BITE detected failures (POST/OST) result in the MDU reporting the error to the IDP and continuing operations.

For errors detected in the graphics processing system of the MDU, the graphics system will be reset and operation of the graphics system is reset and restarted which may result in the blanking and redrawing of the graphics on the display. If the error is a checksum error of the graphics processor (34020) program code, the program will be reloaded by the main processor (R3000) and the graphics system operation is reset and restarted. After two retries to recover the graphics system, the main processor halts all MDU display operations. The MDUF program terminates execution and goes to the Bootstrap Monitor (BSM) causing the display to go blank. This is done to remove any erroneous information that may be displayed

In order to prevent software execution that is unpredictable, the watchdog timer for the main processor will halt operation of the processor (thus halting software execution) if the software fails to update the watchdog timer periodically.

c. ADC

For EDAC detected uncorrectable errors in the RAM, the ADC will reset and restart operations. This will cause a momentary loss of 1553 data bus communications and invalid indications of any display meters using data from the ADC which will last for no more than 2 seconds.

The ADC continuously reads in the analog signal values and provides them to the IDP even if (1) the analog signals are out of range, (2) there are analog channel failures or (3) any non-fatal BITE failure. However, the error information is provided to the IDP and the IDP will not use the data for generating displays while the error conditions exist.

The watchdog timer will reset the processor if the software fails to update the watchdog timer periodically. The reset causes a restart and reinitialization of the ADC in an attempt to recover operations.

2. Errors and Indications That Can Occur During Normal Operations

These are conditions that can occur during normal operations. Be aware that they can also occur due to failures or erroneous conditions which should not be ignored. Care must be taken to assure they are due to normal operations and not due to anomalies which should be investigated and documented.



Note: for MEDS FSMs, downlist data will contain the associated Error IDs and BITE data as applicable.

ERROR CONDITION OR DISPLAY INDICATION	NORMAL OPERATION THAT CAN OCCUR
I/O ERROR CRT (GPC FSM)	IDP Power Off IDP HW CST (not interactive portion) IDP Program Loading IDP LOAD was activated but GPC PASS software was not in an OPS mode to support the load.
MEDS I/O ERROR mdu (MEDS FSM) MEDS I/O ERROR adc (MEDS FSM)	MDU or ADC Power Off (one MEDS FSM per IDP) MDU CST ( two MEDS FSMs per IDP) ADC CST (one MEDS FSM per IDP) MDU Program Loading (one MEDS FSM per IDP) MDU or ADC was powered off when IDP was powered up (one FSM per IDP)
PORT CHANGE mdu (MEDS FSM)	MDU port moded while MDU was in AUTO port configuration mode (reported by IDP that acquires MDU) due to either user activated port mode or IDP Power Off (IDP was commanding the MDU)
MDU BITE FAIL (status word 3 bit 3,4,5,6,7 or 8 and BITE=1000) and Red X over edgekey legend	Edgekey held in for greater than 3 seconds.
MDU BITE FAIL (status word 3 bit 3,4,5,6,7 or 8 and BITE=0800 or 0400)	No cable connector or jumper connector on an unused primary or secondary 1553B port of MDU (lack of the 1553B address wiring causes a 1553B address parity error).
MDU CST = 1000xx (Edgekey Fail)	Edgekey test portion of MDU Interactive Self Test was not performed properly (each of the six edgekeys should be pressed once and only once and all six must be pressed).
ADC Analog Channel Fail (BITE=8000 and/or CST=800000)	Can be caused by transient noise in the analog signal lines or if analog signal voltages exceed the range of -5.3175 to +5.3175 volts DC. This may be more prevalent in ground facilities depending on the nature of the facility equipment connected to the ADC's analog inputs.
MDU Graphics Error (ID=3B) (very small timing window of exposure)	IDP Power Off (reported by IDP that acquires commandership of the MDU after this IDP Power Off occurred)
Message 1553B Fail (ID=4A) (very small timing window of exposure)	MDU Power On MDU Port Mode MDU Program Loading MDU CST
Message 1553B Fail (ID=4A) without a subsequent MSG COM Error (ID=4C) (very small timing window of exposure)	May occur if an IDP and MDU are powered on or off near simultaneously or an IDP and ADC are powered on or off near simultaneously.
Anomalous 1553B MSG Status (ID=4) (very small timing window of exposure)	MDU Power On MDU Port Mode MDU Program Loading MDU CST ADC Power On ADC CST
Status Change Que Overflow (ID=14)	More than 20 IDP Status Changes were queued to be included in POLL RESPONSES to the GPC during a period where the GPC was not sending POLL REQUESTS to the IDP (reminder: all edgekey activations are queued also)
DAS Long Foreground Cycle (ID=11)	Can occur intermittently due to momentary heavy IDP processing demands.

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ERROR CONDITION OR DISPLAY INDICATION	NORMAL OPERATION THAT CAN OCCUR
CST/MM In Use Error (ID=08)	User tried to activate CST and/or Memory Management capabilities on more than one MDU commanded by the same IDP.
FC Bus 1(2,3,4) I/O Fail (ID=18,19,1A,1B)	FC data bus error caused by GPC I/O Termination while data bus traffic was being transmitted. This can be caused by GPC Power Off, GPC Halt or PASS GPC I/O Termination due to BFS Engage or GPC OUTPUT switch changed from NORMAL to BACKUP or from NORMAL to TERMINATE. Could also be caused by multiple GPCs transmitting on the same FC data bus.
Display/Format Fill Error (Status Word 3 bit 0) or DK Data Bus errors / DPS Display Processing Errors (ID=2D, 2E, 30, 31, 32, 33, 34, 48, 49, 4B, 4E, 53, 54) (DK interface OST errors possible also including interface channel disable)	DK data bus error caused by GPC I/O Termination while data bus traffic was being transmitted. This can be caused by GPC Power Off, GPC Halt or PASS GPCs I/O Termination due to BFS Engage. This can also be caused by the starting or stopping of GPCs in simulation test facilities due to the use of Initial Condition (IC) loading and starting of GPCs. It may also occur at GPC start depending on the state the GPC was in when it was previously stopped. Can also be due to having two GPCs commanding the same IDP on the DK data bus or having multiple IDPs (or DEUs) on the same DK bus.
FC data bus errors and possible FC interface OST errors, including possible interface channel disable.	More than one GPC transmitting on the same FC data bus.
DPS display blank with time fields updating and Critical Format Read Error (ID=06)	Occurs at power up if Critical Formats have not been loaded into the IDPs EEPROM.
VM LOAD IN PROGRESS remains on display for extended period of time	IDP LOAD was activated but GPC PASS software was not in an OPS mode to support the load.
INVALID START ADDRESS (text on display)	User entered an address that is not valid for selected patch file.
REQUESTED OPERATION NOT ALLOWED FOR DEFAULT PROGRAM FILE (text on display)	User attempted to select the DEFAULT program file to be the CURRENT program file.
MDU IS AUTONOMOUS (text on display) may also have PRI PORT TIMEOUT, SEC PORT TIMEOUT or PRI/SEC PORT TIMEOUT	IDPs connected to the ports of the MDU are not powered up and operating. If MDU is in MANUAL port configuration mode then this applies only to the IDP connected to the selected port. If MDU is in AUTO port configuration mode then this applies to all IDPs connected to the MDU.
Invalid Flight Instruments	GPCs are not operating or are not driving flight instrument data in current OPS mode or on the selected FC bus.
Invalid Subsystem Meters	ADC that is source of the data is not powered on.
Big X and POLL FAIL on DPS display	GPCs are not operating or this IDP/CRT is not currently assigned to a GPC.
Errors related to MSU	IDP was not power cycled per recommended procedure.
More than 10 seconds between IDP power up and displays appearing on MDU	IDP CURRENT program is specified as a file on the MSU ("H: *.EXE" file) instead of a file in the EEPROM ("E: *.EXE" file), or IDP EEPROM was not loaded with a valid software load.
IDP or MDU fails to operate when powered on.	LRU may experience Power On Self Test (POST) errors if significant transient or off nominal power conditions occur during power up and may halt due to the POST detected errors. This may be due to rapid operation of the power switch. This may also be due to poor quality power ramp up conditions provided to the LRU (more likely to occur due to the use of non-Orbiter power control equipment).
IDP OST = 1008	Occurs when Ground Support Equipment (GSE) is connected and the Watchdog Timer is disabled when the IDP software loads and initiates operations.
IDP halts	Occurs when Ground Support Equipment (GSE) is connected and the Watchdog Timer was disabled when the IDP software loaded and initiated operations, then the Watchdog Timer is enabled while the IDP is operating.

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ERROR CONDITION OR DISPLAY INDICATION	NORMAL OPERATION THAT CAN OCCUR
OPERATOR REQUEST FAIL (ID=50) and Maintenance Error (ID=55)	May occur if a user initiated operation is attempted (requiring the MSU) before the MSU is spun up and ready (approximately the first 45 seconds after power up).
IDP or MDU EEPROM program loads corrupted. IDP loads software from MSU instead of EERPOM. MDU fails to operate.	IDP or MDU was powered off during a EERPOM program load operation, leaving the current load incomplete. IDP will load from MSU, then the EEPROM load should be performed again to completion. MDU must be reloaded via GSE (cannot be recovered while installed in a cockpit).

4.9-7

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**B. Display Information and Cross Reference**

This section provides a cross reference for various information that is displayed on the MEDS display that is an indication of a problem, including MEDS Fault Summary Message (FSM), GPC FSM, text messages that are not a FSM, and non-text indications. Cross reference information is listed as to what may potentially occur and be reported which indicates the underlying cause of the indication. Where multiple pieces of information are listed, it is a list of possibilities, however usually not all of the items will actually occur at the same time.

MEDS FSM are displayed only on one MDU per IDP. Which MDU the IDP displays the messages is based on MDU priority. The message is always displayed on DPS formats no matter which MDUs the DPS format is displayed. If no DPS format is being supported by that IDP, then the MDU which the messages are displayed on is per the following table and it must be an MDU the IDP has commandership of. Note that MEDS message line management can be done from any MDU commanded by the IDP, not just the MDU where the message is displayed.

IDP1		IDP2		IDP3		IDP4	
MDU#	NAME	MDU#	NAME	MDU#	NAME	MDU#	NAME
1	CRT1	1	CRT2	1	CRT3	1	CRT4
2	CDR1	2	PLT2	2	PLT2	2	AFD1
3	CDR2	3	PLT1	3	MFD2		
4	MFD2	4	MFD1	4	MFD1		
5	PLT1	5	CDR2	5	CDR1		
		6	AFD1				

Note: IDP BITE, MDU BITE and ADC BITE imply the applicable BITE FAIL bit in status word 3 and a BITE status change will occur in downlist data.

MEDS FSM	ERROR/POTENTIAL CAUSES	DOWNLIST INFORMATION (numerics in Hex)	MEDS FSM (additional)	GPC FSM
BITE FAIL idp	IDP POST error	IDP BITE , ID=27		I/O ERROR CRT
	IDP BIT error	IDP BITE , ID=23		I/O ERROR CRT
	IDP catastrophic BIT error	IDP BITE , ID=24		I/O ERROR CRT CRT BITE
BITE FAIL mdu	MDU POST error	MDU BITE, ID=46	MEDS I/O ERROR PORT CHANGE MDU	
	MDU BIT error	MDU BITE, ID=38	MEDS I/O ERROR PORT CHANGE MDU	
BITE FAIL adc	ADC POST error	ADC BITE, ID=3	MEDS I/O ERROR	
	ADC BIT error	ADC BITE, ID=1	MEDS I/O ERROR	
PROCESSOR FAIL mdu	MDU heartbeat error	ID=3C	PORT CHANGE MDU	
PROCESSOR FAIL adc	ADC heartbeat error	ID=02		
PORT CHANGE mdu	{ MDU CHANGED PORTS }			
	{ IDP/MDU 1553 BUS }			
	{ LOSS OF IDP }			
MEDS I/O ERROR mdu	{ MDU }			
	{ IDP/MDU 1553 BUS }			
MEDS I/O ERROR adc	{ ADC }			
	{ IDP/ADC 1553 BUS }			
OPERATOR REQUEST FAIL mdu	Operator request error	ID=4F		
	Operator request error MSU	ID=50		

4.9-9  
Verify that this is the correct version before use

MEDS FSM	ERROR/POTENTIAL CAUSES	DOWNLIST INFORMATION (numerics in Hex)	MEDS FSM (additional)	GPC FSM
	Operator request error 1553B	ID=51		
	MDU load memory write error	ID=40		
	MDU load BSM error	ID=3D		
	MDU load exit BSM error	ID=3F		
	MDU dump memory read error	ID=39		
	IDP load memory error	ID=25		
	File Patch MSU Close Error	ID=1C, 12, 4D		
	File Patch MSU Open Error	ID=1D, 12, 4D		
	Memory Manager Error	ID=47, 12, 4D		
	Maintenance Error	ID=55, 12, 4D		
MDU OVERTEMP mdu	MDU overtemp error	ID=43		
CHECKSUM FAIL idp	IDP POST EE checksum error	IDP BITE (bits 3 and 14), ID=26,		
MDU LOAD FAIL mdu	MDU load error	MDU BITE, ID=3E, 46	BITE FAIL MDU	
SOFTWARE FAIL idp	Fatal Software Error	ID=9, A, B, C, E, F, 10, 15, 20, 21, 22, 52		I/O ERROR CRT
I/O ERROR CRT	IDP failed			
	IDP halted	IDP BITE, ID=9, A, B, C, E, F, 10, 15, 20, 21, 22, 23, 24, 27, 52	BITE FAIL IDP	
	DK interface disabled	IDP BITE (bit 2, 8 or 9), ID=23	BITE FAIL IDP	
	IDP LOAD with PASS in a non-supporting OPS mode			
CRT BITE (NOTE 1)	Keyboard Channel A fail	IDP BITE, ID=35,23	BITE FAIL IDP	
	Keyboard Channel B fail	IDP BITE, ID=36,23	BITE FAIL IDP	
	keyboard stack under flow	ID=37		
	IDP BITE	IDP BITE (bit 2, 8 or 9)	BITE FAIL IDP	
	IDP POST	IDP BITE (any POST failure), ID=23,24,27	BITE FAIL IDP	

Note: "ERR" will appear on SPL. For PASS flight software will stop polling IDP. I/O ERROR CRT may not get enunciated by PASS GPC if PASS sees Critical Bite Bit set and stops polling before IDP halts operations.

Verify that this is the correct version before use  
4.9-10

NON-FSM TEXT INDICATION	ERROR/POTENTIAL CAUSES	DOWNLIST INFORMATION	MEDS FSM	GPC FSM
IDP DEFAULT LOAD FAIL (displayed only on CRT MDU)	IDP software failed to load (all retries)			
INVALID START ADDRESS (during patching)	Procedural error by user.			
REQUESTED OPERATION NOT ALLOWED FOR DEFAULT PROGRAM FILE	Procedural error by user.			
VM LOAD IN PROGRESS (unexpected)	Switch failure	POLL RESPONSE does not have SW1,2,3 (one word poll response during VM LOAD mode) Header word has initialization requested bit set.		I/O ERROR CRT
	IDP switch interface hardware failure	Possible IDP BITE error. POLL RESPONSE does not have SW1,2,3 (one word poll response during VM LOAD mode) Header word has initialization requested bit set.		I/O ERROR CRT
	Operator Error	POLL RESPONSE does not have SW1,2,3 (one word poll response during VM LOAD mode) Header word has initialization requested bit set.		I/O ERROR CRT
MDU IS AUTONOMOUS	{ MDU }			
BITE FAIL (autonomous MDU)	MDU BITE failure			
PRI PORT TIMEOUT (autonomous MDU)	No IDP communications (MDU in PRI MAN )			
SEC PORT TIMEOUT (autonomous MDU)	No IDP communications (MDU in SEC MAN)			
PRI/SEC PORT TIMEOUT (autonomous MDU)	No IDP communications (MDU in AUTO)			

4.9-11  
Verify that this is the correct version before use

NON-TEXT INDICATION	ERROR/POTENTIAL CAUSES	DOWNLIST INFORMATION	MEDS FSM	GPC FSM
Invalid Flight Instruments	{ IDP }			
	{ IDP/GPC FC BUS }			
	FC channel(s) disabled	IDP BITE (bit 1, 7 or 8), ID=23	BITE FAIL IDP	
Erroneous Flight Instruments	{ IDP }			
	{ IDP/GPC FC BUS }			
	IDP/MDU Software	Unpredictable		
Invalid Subsystem Meter(s)	{ ADC }			
	{ IDP/ADC 1553 BUS }			
	Analog signals out of range	ADC BITE, ID=1, 3		
	ADC analog input circuit			
	Wiring / Connector			
	Originating Subsystem			
Erroneous Subsystem Meter(s)	{ ADC }			
	{ IDP/ADC 1553 BUS }			
	ADC analog input circuit (not BITE detectable)			
	Wiring / Connector			
	Erroneous analog signals (but not invalid) from originating subsystem (OMS, MPS, APU, HYD DSCs or DPS MDMs)			
	IDP/MDU/ADC Software	Unpredictable		
Invalid DPS display (Big X and/or POLL FAIL)	{ IDP }			
	{ IDP/GPC DK BUS }			
	DK interface disabled	IDP BITE (bit 2, 8 or 9), ID=23	BITE FAIL IDP	
	Display Freeze condition			
Erroneous DPS display	FCW buffer processing error	ID=0D,16, 17, 2D, 2E, 30, 31, 32, 33, 34, 48, 49, 4B, 4E, 53, 54, SW3 bit 0		
	{ IDP }			
	{ IDP/GPC DK BUS }			
	IDP/MDU Software	Unpredictable		
	Checksum error (at time of Critical. Format. Loading)	ID=5, SW3 bit 11		

4.9-12

Verify that this is the correct version before use



NON-TEXT INDICATION	ERROR/POTENTIAL CAUSES	DOWNLIST INFORMATION	MEDS FSM	GPC FSM
	Critical Format read / write error	ID=6, 7		
	Critical Format not same OI as FSW running in GPC			
	Critical Formats not loaded into EEPROM.	ID=6		
MDU display readability or display behavior problem	{ MDU }			
	{ IDP/MDU 1553 BUS }			
	IDP/MDU software problem	Unpredictable		
	Graphics data problem	Unpredictable		
	FI, DPS or SS display data problem	Unpredictable		
	MDU graphics system problem not detectable by BITE			
Red X over MDU edgekey legend	{ MDU }			

4.9-13

Verify that this is the correct version before use

C. Functional Problems and Cross Reference

This area provides a cross reference of problems with the IDP, MDU, ADC, data bus communications and functions of the MEDS integrated system including MEDS being integrated with other Orbiter subsystems (e.g. DPS, OMS, MPS, APU, HYD) and Orbiter hardware (e.g. keyboards, panel switches and power sources).

IDP PROBLEMS	ERROR/POTENTIAL CAUSES	DOWNLIST INFORMATION (numerics in Hex)	MEDS FSM	GPC FSM
Loss of function	IDP software failure	IDP BITE, ID=9, A, B, C, E, F, 10, 15, 20, 21, 22, 52	BITE FAIL IDP	I/O ERROR CRT
	IDP POST error	IDP BITE, ID=27	BITE FAIL IDP	I/O ERROR CRT
	IDP catastrophic BIT error	IDP BITE, ID= 24	BITE FAIL IDP	I/O ERROR CRT
	IDP software load failure (all retries)			I/O ERROR CRT
	IDP hardware failure (non-bite detectable, totally non-functional)			
	Power loss / failure			
	Power deactivated			
	IDP ID wired address problem			
Slow response during power up	IDP startup retry error	ID=2C		
	IDP startup EK load error	ID=2B		
	IDP startup CP load error	ID=29		
	IDP loaded from MSU			
CST does not activate or execute successfully	CST program fails to load/run	ID=2A		
	MM/CST in Use Error	ID=8		
	Fatal hardware error		PORT CHANGE MDU	
	Operator Request Fail	ID = 50, 47, 55, 23, 12, 4D, IDP BITE	OPERATOR REQUEST FAIL BITE FAIL IDP	
Memory Management capabilities does not activate or execute successfully	Operator Request Fail	ID = 12, 1C, 1D, 23, 25, 39, 3D, 3F, 40, 47, 4D, 50, 51, 55, IDP BITE	OPERATOR REQUEST FAIL BITE FAIL IDP	
	MM/CST in Use Error	ID=8		

Verify that this is the correct version before use  
4.9-14

MDU PROBLEMS	ERROR/POTENTIAL CAUSES	DOWNLIST INFORMATION (numerics in Hex)	MEDS FSM	GPC FSM
No response to edgekey	CST MM IN USE error Edgekey stuck/failed (open) { Red X over edgekey legend }	ID=8		
Red X over edgekey legend	Edgekey failed/stuck (closed) or edgekey circuit failure Invalid Edgekey Received Error Edgekey held in for > 3 seconds	MDU BITE, ID=38, 46 ID=2F MDU BITE, ID=38		
Blank display	MDU Hardware Failure Software Load Failure (all retries) Power loss / failure Power deactivated User turned down display brightness 1553 bus wired address problem	MDU BITE, ID=4, 38, 3A, 3C, 3D, 3F, 40, 46 MDU BITE, ID= 3E, 46	BITE FAIL MDU BITE FAIL MDU	
Changed Ports	MDU port mode error PRI MDU port mode error SEC MDU heartbeat error MDU port failure MDU Graphics Error { LOSS OF IDP } { IDP/MDU 1553 BUS } User activated port change	ID=44 ID=45 ID=3C MDU BITE, ID=38, 46 ID=3B	PORT CHANGE MDU PORT CHANGE MDU PROCESSOR FAIL MDU BITE FAIL MDU	
Slow response during power up (only a few seconds)	MDU load retry error	ID=41		
CST does not activate or execute successfully	Corrupted CST program CST/MM in use error Fatal MDU hardware error Operator Request Fail			
Autonomous	{ Loss of IDP }	ID=50, 51, 40, 3D, 3F, 39, 47, 55, IDP BITE		

4.9-15  
Verify that this is the correct version before use

MDU PROBLEMS	ERROR/POTENTIAL CAUSES	DOWNLIST INFORMATION (numerics in Hex)	MEDS FSM	GPC FSM
	MDU port(s) failed (possible MDU BIT error)	MDU BITE, ID=38, 46	BITE FAIL MDU	
	MDU heartbeat error { IDP/MDU 1553 BUS }	ID=3C	PROCESSOR FAIL MDU	
Memory correctable errors	Radiation or single bit failures	none (category D error logged to VM and MSU)		

ADC PROBLEMS	ERROR/POTENTIAL CAUSES	DOWNLIST INFORMATION (numerics in Hex)	MEDS FSM	GPC FSM
LOSS OF ADC	ADC HW/SW failure	ADC BITE, ID= 1, 3, 4, 4A, 4C	BITE FAIL ADC, MEDS I/O ERROR ADC	
	ADC Heartbeat { IDP/ADC 1553 BUS }	ID=2	PROCESSOR FAIL	
	Power loss / failure			
	Power deactivated			
	1553 bus wired address problem			
CST does not activate or execute successfully	CST/MM in use error	ID=8		
	Fatal ADC hardware error			
	Operator Request Fail	ID=50, 51, 47, 55, IDP BITE		
Memory correctable errors	radiation or single bit failures	none (category D error, logged to VM & MSU)		

Verify that this is the correct version before use  
4.9-16

DATA BUS COMMUNICATION	ERROR/POTENTIAL CAUSES	DOWNLIST INFORMATION	MEDS FSM	GPC FSM
IDP/GPC DK BUS	IDP HW/SW failure	IDP BITE, ID=23, 9, A, B, C, E, F, 10, 15, 20, 21, 22, 27, 52	BITE FAIL IDP	I/O ERROR CRT
	DK data bus, GPC transceiver / IDP transceiver	IDP BITE, ID=23, 2D, 2E, 30, 31, 32, 33, 34, 48, 49, 4B, 4E, 53, 54, SW3 bit 0	BITE FAIL IDP	I/O ERROR CRT
	IDP DK channel disabled	IDP BITE (bit 2, 8 or 9), ID=23	BITE FAIL IDP	I/O ERROR CRT
	{ CRT BITE } (PASS GPC)			
	Loss of GPC			
	GPC bus assignment			
	Multiple GPC commanders	Unpredictable		
IDP/GPC FC BUS	IDP HW/SW failure	IDP BITE, ID=23, 27, 18, 19, 1A, 1B, 1E	BITE FAIL IDP	
	FC data bus / GPC transmitter / IDP receiver	IDP BITE, ID=23, 18, 19, 1A, 1B, 4B, SW3 bit 0	BITE FAIL IDP	
	IDP FC channel disabled	IDP BITE (bit 1, 7 or 8), ID=23	BITE FAIL IDP	
	Loss of GPC			
	GPC bus assignment			
	Multiple GPC commanders	Unpredictable		
IDP/MDU 1553 BUS	IDP HW/SW failure	IDP BITE, ID=23, 24, 9, A, B, C, E, F, 10, 15, 20, 21, 22, 27, 52	BITE FAIL IDP, MEDS I/O ERROR MDU, PORT CHANGE MDU	I/O ERROR CRT
	MDU HW/SW failure	MDU BITE, ID=4, 38, 46, 4C, 4A, 3C, 3B, 42, 44, 45	BITE FAIL MDU, MEDS I/O ERROR MDU, PORT CHANGE MDU	
	1553 data bus/ IDP transceiver / MDU transceiver	IDP BITE, ID=23, 24, 4, 4A, 4C, 3B, 42, 44, 45	BITE FAIL IDP, MEDS I/O ERROR MDU, PORT CHANGE MDU	I/O ERROR CRT
IDP/ADC 1553 BUS	IDP HW/SW failure	IDP BITE, ID=23, 24, 9, A, B, C, E, F, 10, 15, 20, 21, 22, 27, 52	BITE FAIL IDP, MEDS I/O ERROR ADC	I/O ERROR CRT
	ADC HW/SW failure	ADC BITE, ID= 1, 2, 3, 4, 4A, 4C	BITE FAIL ADC, MEDS I/O ERROR ADC	
	1553 data bus/ IDP transceiver / ADC transceiver	IDP BITE, ID=23, 24, 4, 4A, 4C,	BITE FAIL IDP, MEDS I/O ERROR ADC	I/O ERROR CRT

4.9-17

Verify that this is the correct version before use

INTERFACING SWITCHES AND KEYBOARDS	ERROR/POTENTIAL CAUSES	DOWNLIST INFORMATION	MEDS FSM	GPC FSM
KEYBOARD				
DPS keystrokes not being processed by GPC	{ CRT BITE }			
	IDP interface hardware	IDP BITE, ID-23, 27	I/O ERROR	CRT BITE
	IDP interface hardware (non-BITE detectable)			
	Keyboard failure	Keystroke buffer		
	{ Keyboard Selection }			
	wiring / connector			
Incorrect keystroke	IDP interface hardware	IDP BITE, ID-23, 27, Keystroke Buffer	I/O ERROR	CRT BITE
	IDP interface hardware (non-BITE detectable)			
	wiring / connector	Keystroke buffer		
KEYBOARD SELECTION		IDP BITE, ID-23, 27	I/O ERROR	
Selection does not work (can't select or can't deselect)	IDP interface hardware			
	IDP interface hardware (non-BITE detectable)			
	switch failure			
	wiring / connector			
MAJOR FUNCTION SELECTION				
Cannot change selection or selection incorrect	IDP interface hardware	IDP BITE, ID-23, 27	I/O ERROR	
	IDP interface hardware (non-BITE detectable)			
	switch failure			
	wiring / connector			
CRITICAL FORMAT LOAD VIA IDP LOAD SWITCH				
Load switch doesn't activate load process	IDP interface hardware	IDP BITE, ID-23, 27	I/O ERROR	
	IDP interface hardware (non-BITE detectable)			
	switch failure			
	wiring / connector			
Inadvertent load activated	IDP interface hardware	IDP BITE, ID-23, 27	I/O ERROR	

4.9-18

Verify that this is the correct version before use

<b>INTERFACING SWITCHES AND KEYBOARDS</b>	<b>ERROR/POTENTIAL CAUSES</b>	<b>DOWNLIST INFORMATION</b>	<b>MEDS FSM</b>	<b>GPC FSM</b>
	IDP interface hardware (non-BITE detectable)			
	switch failure			
	wiring / connector			
	User inadvertently activated switch			
Load does not complete	{ IDP/GPC DK BUS }			
	GPC not in valid OPS mode			
	CRT not assigned to GPC			

4.9-19

**Verify that this is the correct version before use**







WORD 3 BIT	NAME	DOWNLIST (additional) (numerics in Hex)
0 (MSB)	Display/Format Fill Error or DK Data Bus Error	ID=31, 33, 34, 48, 49, 4B
1	IDP BITE Failure	IDP BITE, ID= 23, 24, 27
2	Initialization Performed	
3	MDU 1 BITE Failure	MDU BITE, ID= 38, 46
4	MDU 2 BITE Failure	MDU BITE, ID= 38, 46
5	MDU 3 BITE Failure	MDU BITE, ID= 38, 46
6	MDU 4 BITE Failure	MDU BITE, ID= 38, 46
7	MDU 5 BITE Failure	MDU BITE, ID= 38, 46
8	MDU 6 BITE Failure	MDU BITE, ID= 38, 46
9	ADC 1 BITE Failure	ADC BITE, ID= 1, 3
10	ADC 2 BITE Failure	ADC BITE, ID= 1, 3
11	Critical Format Checksum Error	ID=5
12-15	LRU ID	

WORD 1 BITS 5-7	CONTENTS OF WORD 2
000	0000
001	Bits 0-7 IDP Software CSU ID (ref. Table) Bits 8-15 Error ID (ref. Table)
010	Bits 0-15 IDP, MDU or ADC BIT Summary Word (ref. Tables)
011	Bits 3-7 MENU ID (ref. Table) Bits 13-15 Edge Key No. (1-6)

LRU ID	LRU NAME
0	Reserved
1	IDP
2	CRT
3	CDR1
4	CDR2
5	PLT1
6	PLT2
7	MFD1
8	MFD2
9	AFD1
10	ADC1
11	ADC2
12-15	Spare

IDP1		IDP2		IDP3		IDP4	
MDU#	NAME	MDU#	NAME	MDU#	NAME	MDU#	NAME
1	CDR1	1	CDR2	1	CDR1	1	CRT4
2	CDR2	2	CRT2	2	CRT3	2	AFD1
3	CRT1	3	MFD1	3	MFD1	3	None
4	MFD2	4	PLT1	4	MFD2	4	None
5	PLT1	5	PLT2	5	PLT2	5	None
6	None	6	AFD1	6	None	6	None

Status Changes include WORD 1 bits 5-7, WORD 2 and WORD 3 bits 12-15 as a homogeneous set of data (BFS may downlist them as a non-homogeneous set due to a known User Note). Other bits are changed independently of status changes. Status

changes are queued by the IDP and are put into a POLL Response to the GPC one per second in chronological order. Up to 20 status changes can be queued at a time. Thus status changes can be delayed from the time they are queued until they are sent to the GPC and subsequently included in downlist (20 seconds before all 20 are included in POLL Responses and thus downlist). For bits referring to MDU1, MDU2, etc., refer to table above for each IDP.

Other bits in the status words are changed in real time and show the state of the bits at the time the status words are put into a POLL Response. Thus it is possible for these bits to change more than once between the transmission of POLL Responses. These bits will also not be time homogeneous with status changes. For example the LRU BITE failure bits and MDU commanded bits change when they occur but any status changes that may be associated with those events may show up in the status words later when they eventually get taken from the queue.

Status word 1, bit 8, is set for category D and E errors as follows.

CATEGORY	ERROR
D	ADC 1553 interface errors detected on the port not being used by this IDP. Detailed error reporting will be done by the IDP that is communicating on the other port if possible. ADC CST can be performed via this IDP to obtain detailed error information on the other ports status.
E	HDX Misuse Error (ID =1E) Loss of FC bus data. Continuous condition will result in invalid flight instruments. *** Error ID will not be included in status words (cat. E).
D	DAS Status Change Que Overflow (ID=14) More than 20 status changes were logged during a period that the GPC was not polling on the DK bus. *** Error ID will not be included in status words (cat. D). Status word 1 bit 8 will only reflect this error if GPC is polling at time error occurs (small timing window of possibility).

2. MEDS Error ID Table

Note: IDP BITE, MDU BITE and ADC BITE imply the applicable BITE FAIL bit in status word 3 and a BITE status change will also occur in downlist.

MEDS ERROR ID (hex)	ERROR NAME	CATEGORY	OTHER DOWNLIST INFORMATION OR ERROR EFFECTS/CONDITIONS	MEDS FSM	GPC FSM
1	ADC BIT ERROR	B,	ADC BITE, Loss of ADC or ADC data.	BITE FAIL ADC	
2	ADC HEARTBEAT ERROR	B	Loss of ADC or ADC data.	PROCESSOR FAIL ADC	
3	ADC POST ERROR	B,	ADC BITE, Loss of ADC or ADC data.	BITE FAIL ADC	
4	ANOMALOUS 1553B MSG STATUS	C	Transient condition, no direct effects. 1553 messages are retried.		
5	CHECKSUM ERROR	C	SW3 bit11, Critical Formats received are discarded.		
6	CRIT FORMAT READ ERROR	C	DPS display data corrupt / incomplete		
7	CRIT FORMAT WRITE ERROR	C	DPS display data corrupt / incomplete		
8	CST/MM IN USE ERROR	C	User requested action could not be performed. Procedural error.		
9	DAS 1553B CONSTRAINT ERROR	A	IDP HALT	SOFTWARE FAIL IDP	I/O ERROR CRT
A	DAS 1553B STATUS ERROR	A	IDP HALT	SOFTWARE FAIL IDP	I/O ERROR CRT
B	DAS 1553B USE ERROR	A	IDP HALT	SOFTWARE FAIL IDP	I/O ERROR CRT
C	DAS CANT ACCESS 1553B BUS	A	IDP HALT	SOFTWARE FAIL IDP	I/O ERROR CRT
D	DAS FCW BUFFER OVERFLOW	C	DPS display data corrupt / incomplete		
E	DAS FORGROUND OVERRUN	A	IDP HALT	SOFTWARE FAIL IDP	I/O ERROR CRT
F	DAS GO SERVICES ERROR	A	IDP HALT	SOFTWARE FAIL IDP	I/O ERROR CRT
10	DAS INCOMPLETE 1553B TRANSACTION	A	IDP HALT	SOFTWARE FAIL IDP	I/O ERROR CRT
11	DAS LONG FOREGROUND CYCLE	C	Transient condition, no effects on system.		
12	MSU SPINUP ERROR	C	MSU is not operational. Errors will not be logged. User cannot perform operations requiring MSU.		
13	(UNUSED1)	-			
14	DAS STATUS CHANGE QUEUE OVERFLOW	D	More than 20 status changes were logged during a period that the GPC was not polling on the DK bus. *** ID will not be included in status words (cat. D). Status word 1 bit 8 will only reflect this error if GPC is polling at time error occurs (small timing window of possibility).		

Verify that this is the correct version before use  
4.9-24

MEDS ERROR ID (hex)	ERROR NAME	CATEGORY	OTHER DOWNLIST INFORMATION OR ERROR EFFECTS/CONDITIONS	MEDS FSM	GPC FSM
15	DAS UNKNOWN TASKING ERROR	A	IDP HALT	SOFTWARE FAIL IDP	I/O ERROR CRT
16	DPS BUFFER OVERFLOW	C	DPS display data corrupt / incomplete		
17	DPS OUT OF GOS	C	DPS display data corrupt / incomplete		
18	FC BUS 1 I/O FAIL	C	Loss of FC bus data. Continuous condition will result in invalid flight instruments.		
19	FC BUS 2 I/O FAIL	C	Loss of FC bus data. Continuous condition will result in invalid flight instruments.		
1A	FC BUS 3 I/O FAIL	C	Loss of FC bus data. Continuous condition will result in invalid flight instruments.		
1B	FC BUS 4 I/O FAIL	C	Loss of FC bus data. Continuous condition will result in invalid flight instruments.		
1C	FILE PATCH MSU CLOSE ERROR	B	User requested action could not be completed due to error.	OPERATOR REQUEST FAIL MDU	
1D	FILE PATCH MSU OPEN ERROR	B	User requested action could not be completed due to error.	OPERATOR REQUEST FAIL MDU	
1E	HDX FC MISUSE ERROR	E	Loss of FC bus data. Continuous condition will result in invalid flight instruments. *** Error ID will not be included in status words (cat. E).		
1F	IDP DEFAULT INTERRUPT ERROR	C	Transient condition. No direct effects. If 3 occur in any 24 hour period, category A IDP CATASTROPHIC BIT ERROR (ID=24) is created.		
20	HDX SERVICE TIMEOUT ERROR	A	IDP HALT	SOFTWARE FAIL IDP	I/O ERROR CRT
21	HDX STATUS ERROR	A	IDP HALT	SOFTWARE FAIL IDP	I/O ERROR CRT
22	HDX USE ERROR	A	IDP HALT	SOFTWARE FAIL IDP	I/O ERROR CRT
23	IDP BIT ERROR	B,	IDP BITE / Critical Bite bit, various effects.	BITE FAIL IDP	
24	IDP CATASTROPHIC BIT ERROR	A	IDP BITE / Critical Bite bit, IDP HALT	BITE FAIL IDP	I/O ERROR CRT
25	IDP LOAD MEMORY ERROR	B	User requested action could not be completed due to error.	OPERATOR REQUEST FAIL MDU	
26	IDP POST EE CHECKSUM ERROR	B	IDP BITE, Possible loss of IDP or loss of IDP when subsequent power cycle, CST, software load or critical format load performed.	CHECKSUM FAIL IDP	
27	IDP POST ERROR	A,B,	IDP BITE / Critical Bite bit, IDP HALT (cat. A only)	BITE FAIL IDP	I/O ERROR CRT (cat. A only)
28	IDP SRAM ERROR	C	IDP SRAM experienced more than 1700 SEUs since power up. This applies separately to GPP, 1553, DED and FC cards. No effects on system.		

4.9-25

Verify that this is the correct version before use

MEDS ERROR ID (hex)	ERROR NAME	CATEGORY	OTHER DOWNLIST INFORMATION OR ERROR EFFECTS/CONDITIONS	MEDS FSM	GPC FSM
29	IDP STARTUP CP LOAD ERROR	C	IDP failed to load current application program.		
2A	IDP STARTUP CSTP LOAD ERROR	C	IDP failed to load CST software.		
2B	IDP STARTUP EK LOAD ERROR	C	IDP failed to load operating kernel software.		
2C	IDP STARTUP RETRY ERROR	C	IDP had to retry a software load (CP/CSTP/EK) but was successful.		
2D	INFINITE LOOP CONDITION	C	DPS display data corrupt / incomplete		
2E	INVALID BRANCH ADDRESS	C	DPS display data corrupt / incomplete		
2F	INVALID EDGEKEY RECEIVED ERROR	C	MDU hardware/software problem. Edgekey legend marked invalid (red X) and disabled.		
30	INVALID FCW OPCODE	C	DPS display data corrupt / incomplete		
31	INVALID MESSAGE RECEIVED	C	SW3 bit 0, DPS display data corrupt / incomplete		
32	INVALID REPEAT FCW	C	DPS display data corrupt / incomplete		
33	INVALID START ADDRESS	C	SW3 bit 0, DPS display data corrupt / incomplete		
34	INVALID WORD COUNT	C	SW3 bit 0, DPS display data corrupt / incomplete		
35	KEYBAORD CHANNEL A FAIL	C	Critical Bite bit, IDP BITE. Keystroke processing error.	BITE FAIL IDP	CRT BITE
36	KEYBOARD CHANNEL B FAIL	C	Critical Bite bit, IDP BITE. Keystroke processing error.	BITE FAIL IDP	CRT BITE
37	KEYBOARD STACK UNDERFLOW	C	Critical Bite bit. Keystroke processing error.		CRT BITE
38	MDU BIT ERROR	B,	MDU BITE, various effects.	BITE FAIL MDU	
39	MDU DUMP MEMORY READ ERROR	B	User requested action not completed due to error.	OPERATOR REQUEST FAIL MDU	
3A	MDU EEPROM ERROR	C	MDU BITE , MDU EEPROM is not reliable.	BITE FAIL MDU	
3B	MDU GRAPHICS ERROR	C	No immediate effects. IDP will automatically refresh graphics.		
3C	MDU HEARTBEAT ERROR	B	MDU software/hardware problem. Loss of MDU.	PROCESSOR FAIL MDU	
3D	MDU LOAD BSM ERROR	B	MDU failed to load software. Loss of MDU.	OPERATOR REQUEST FAIL MDU	
3E	MDU LOAD ERROR	B	MDU failed to load software. Loss of MDU	MDU LOAD FAIL	
3F	MDU LOAD EXIT BSM ERROR	B	MDU failed to execute software. Loss of MDU.	OPERATOR REQUEST FAIL MDU	
40	MDU LOAD MEMORY WRITE ERROR	B	User requested action not completed due to error.	OPERATOR REQUEST FAIL MDU	

4.9-26

Verify that this is the correct version before use

MEDS ERROR ID (hex)	ERROR NAME	CATEGORY	OTHER DOWNLIST INFORMATION OR ERROR EFFECTS/CONDITIONS	MEDS FSM	GPC FSM
41	MDU LOAD RETRY ERROR	C	MDU had to retry loading software but was successful.		
42	MDU NON GRAPHIC COMMAND ERROR	C	No immediate effects. IDP will automatically retry the commands.		
43	MDU OVERTEMP ERROR	B	MDU BITE , Possible loss of cooling air flow.	MDU OVERTEMP	
44	MDU PORT MODE ERROR PRI	B	MDU changed ports. Other errors may have been cause.	PORT CHANGE MDU	
45	MDU PORT MODE ERROR SEC	B	MDU changed ports. Other errors may have been cause.	PORT CHANGE MDU	
46	MDU POST ERROR	B,	MDU BITE, various effects.	BITE FAIL MDU	
47	MEMORY MANAGER ERROR	B	User requested action not completed due to error.	OPERATOR REQUEST FAIL MDU	
48	MESSAGE LENGTH ERROR	C	SW3 bit 0, Erroneous data from GPC DK bus.		
49	MESSAGE TIMEOUT ERROR	C	SW3 bit 0, Erroneous data from GPC DK bus.		
4A	MESSAGE 1553B FAIL	C	Transient condition. No immediate effects. 1553 messages are retried.		
4B	MIA WORD ERROR	C	SW3 bit 0 (if DK bus), DPS or FI display data corrupt / incomplete		
4C	MSG COM 1553B ERROR	B	Loss of MDU or ADC communications on that port.	MEDS I/O ERROR	
4D	MSU I/O ERROR	C	Error performing I/O to MSU. If during user requested action then action is not completed due to error.	OPERATOR REQUEST FAIL MDU	
4E	NESTED SUPPORT BRANCH	C	DPS display data corrupt / incomplete		
4F	OPERATOR REQUEST ERROR	B	User requested action not completed due to error.	OPERATOR REQUEST FAIL MDU	
50	OPERATOR REQUEST ERROR MSU	B	User requested action not completed due to error.	OPERATOR REQUEST FAIL MDU	
51	OPERATOR REQUEST ERROR 1553B	B	User requested action not completed due to error.	OPERATOR REQUEST FAIL MDU	
52	UNKNOWN ERROR	A	IDP HALT	SOFTWARE FAIL IDP	I/O ERROR CRT
53	DK DEVICE ERROR	C	DPS display data corrupt / incomplete		
54	INVALID FCW ADDRESS	C	DPS display data corrupt / incomplete		
55	MAINTENANCE ERROR	B	User requested action not completed due to error.	OPERATOR REQUEST FAIL MDU	

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CSU ID (hex)	CSU NAME	CSC NAME
1	DAS SCHEDULER	TASKING SERVICES SCS
2	DAS FORGROUND	
3	DAS BACKGROUND	
4	(SPARE 1)	
5	BUS 1553B C AND H ERRS	1553 CSC
6	BUS 1553B RESET NC MSG CTRL	
7	BUS 1553B QUEUE MGR	
8	GO DIO C AND H ERRS	GRAPHICS CSC
9	GO DIO LOAD	
A	GO DIO LOAD PARTIAL MSG	
B	GO DIO PUT	
C	GO MIO C AND H ERRS	
D	GO MIO QUEUE MGR	
E	(SPARE 2)	
F	MS UPDATE MDU STATUS	MDU STATUS CSC
10	(SPARE 3)	MDU MANAGEMENT CSC
11	MDU CC ISSUE SEND STATUS REQUESTS	
12	MDU CC MONITOR	
13	MDU C CHECK RESPONSES	
14	MDU CC DISPLAY ACTIVATE	
15	MDU CC DISPLAY MANAGER	
16	MDU CC GET RESPONSES	
17	FI MANAGER	FI CSC
18	FI VALIDATE DATA	
19	FI DISPLAY FORMATS	
1A	FI DETERMINE DATA NEEDED	
1B	FI FC BUS	
1C	FI ADI	
1D	FI ADI AVVI	
1E	FI AVVI SERVICES	
1F	FI HSI AMI	
20	(SPARE 4)	
21	FI COMP BUILD INIT	
22	FI COMP BUILD APPEND	
23	FI COMP BUILD UPDATE	
24	FI COMP SERVICES	
25	FI SPI	
26	SS MANAGER	SS CSC
27	SS OMS MPS	
28	SS OMS BUILD INIT	
29	SS OMS BUILD APPEND	
2A	SS OMS BUILD UPDATE	
2B	SS HYD APU	
2C	SS SYD BUILD INIT	
2D	SS HYD BUILD APPEND	
2E	SS HYD BUILD UPDATE	
2F	SS ISSUE SEND DATA REQ	
30	GET DATA	
31	PERFORM DPS UPDATE	DPS CSC
32	(SPARE 5)	
33	CREATE DPS GRAPHICS MESSAGE	
34	GENERATE DPS GO	
35	(SPARE 6)	
36	(SPARE 7)	
37	SEND DPS GRAPHICS MESSAGE	
38	DK BUS MGR	DK CSC
39	DK MESSAGE TASK	
3A	DPS DISPLAY EXECUTIVE	
3B	BUFFER SWITCH	
3C	(SPARE 8)	



CSU ID (hex)	CSU NAME	CSC NAME
3D	DK STATUS CHANGES	
3E	EE SERVER	
3F	BUFFER KEY	KYBD CSC
40	(SPARE 9)	
41	MONITOR KYBD EVENTS	
42	PROCESS KEYSTROKE	
43	VALIDATE FP KEYSTROKE	
44	VALIDATE DPS KEYSTROKE	
45	ECHO NON KYBD SEQUENCE	
46	ECHO KEYSTROKE	
47	FORMAT KEYBOARD DATA	
48	UPDATE KYBD POLLUT BUFFER	
49	GET DISPLAY SEQ	
4A	RESET SPL	
4B	GET FILE PATCHING SEQ	
4C	(SPARE 10)	EK COMMAND HANDLER CSC
4D	EK CMD HANDLER	
4E	MAINT UI	MAINT USER INTERFACE CSC
4F	MAINT MM MANAGER	
50	(SPARE 11)	
51	MAINT PROGRAM SELECT	
52	MAIN FILE PATCH	
53	(SPARE12)	
54	PROCESS DISPLAY MEDS STATUS	SYSTEM STATUS CSC
55	(SPARE 13)	MEMORY MANAGER CSC
56	(SPARE 14)	
57	(SPARE 15)	
58	INITIATE DUMP	
59	INITIATE LOAD	
5A	(SPARE 16)	
5B	GO MIO PUT	
5C	(SPARE 17)	
5D	(SPARE 18)	
5E	(SPARE 19)	
5F	CFS CHECK MSU IO	
60	LOAD IDP EE RAM	
61	LOAD IDP RAM	
62	LOAD MDU EE RAM	
63	DUMP IDP EE	
64	DUMP IDP RAM	
65	DUMP MDU EE	
66	DUMP MDU RAM	
67	DUMP ADC RAM	
68	PROCESS LRU MEM	
69	(SPARE 20)	HEARTBEAT CSC
6A	HB MONITOR	
6B	HB ISSUE ADC REQUEST	
6C	(SPARE 21)	OST CSC
6D	OST ADC HANDLER	
6E	OST IDP EVENT MGR	
6F	OST IDP HANDLER	
70	OST MDU HANDLER	
71	OST IDP POST HANDLER	
72	OST ISSUE ADC STATUS REQUESTS	
73	OST ISSUE MDU STATUS REQUESTS	
74	OST HANDLE ADC STATUS CHANGE	
75	(SPARE 22)	
76	OST HANDLE MDU STATUS CHANGE	
77	OST MONITOR ADC POST STATUS	
78	OST MONITOR IDP POST STATUS	

CSU ID (hex)	CSU NAME	CSC NAME
79	OST MONITOR MDU POST STATUS	
7A	OST MONITOR MISC MDU ERRORS	
7B	(SPARE 23)	
7C	INTERPRET EK	CST CSC
7D	UPDATE IDP	
7E	UPDATE IDP INTERACTIVE DISPLAY	
7F	(SPARE 24)	
80	UPDATE ADC OR MDU	
81	OBTAIN CST RESULTS FOR DISPLAY	
82	EXIT IDP	
83	(SPARE 25)	
84	MONITOR CST PROGRESS	
85	(SPARE 26)	
86	(SPARE 27)	ERROR HANDLER CSC
87	ME LOG TO MSU	
88	EH FAULT MANAGER	
89	PERFORM FAULT UPDATE	
8A	(SPARE 28)	

MENU ID	MENU NAME
1	MAIN
2	FI
3	FI ASCENT ENTRY
4	FI ORBIT
5	FI ASCENT ENTRY FC BUS SELECT
6	FI ORBIT FC BUS SELECT
7	SS
8	DPS
9	VIDEO
A	IDPX FAULT SUMMARY
B	IDPX INTERACTIVE CST
C	MAINTENANCE
D	MDU CONFIGURATION MENU
E	CST MENU SELECTION
F	MM SELECTION
10	XXXXX MM SELECTION
11	XXXX MEMORY LOADING
12	FILE PATCHING SELECTION
13	XXXXXXXXX FILE PATCHING

**IDP BIT (OST/POST) SUMMARY**

BIT	NAME	CATEGORY	DETAILS
0 (MSB)	1553 OST/POST Fail	A	EDAC Fail
		A	BCRTM Wrap Around
		A	SRAM Memory (POST)
		A	EDAC Memory (POST)
		A	Address Line (POST)
1	FC OST/POST Fail	A	Interface Fail
		A	EDAC Fail
		A	SRAM Memory (POST)
		A	EDAC Memory (POST)
		A	Address Line (POST)
2	DED OST/POST Fail	B	Interface Fail
		A	EDAC Fail
		A	SRAM Memory (POST)
		A	EDAC Memory (POST)
		A	Address Line (POST)
3	GPP OST/POST Fail	B	DK Bus Fail
		B	Keyboard Fail
		A	EDAC Fail
		A	Bus Exception NMI (POST)
		A	Real Time Clock (POST)
4	1553 EDAC / Memory Fail	B	EEPROM Checksum (POST)
		C	Watchdog Timeout
		C	Interrupt Fail
		C	EEPROM Exhausted
		C	SCSI Fail
5	1553 Data Overrun / POST BCRTM	C	MSU Fail
		A	Uncorrectable memory error (OST)
		A	Memory or EDAC Memory fail (POST)
		A	Data Overrun
		A	BCRTM fail (POST)
6	FC EDAC / Memory Fail	A	Uncorrectable memory error (OST)
		A	Memory or EDAC Memory fail (POST)
		B	data overrun (disables FC bus interface channel(s) ) (OST)
7	FC Interface Fail	A	Unknown API Exception (OST)
		A	1553 BC event queue, Timer A queue, Timer B queue, Fault queue
		B	FC or DK event queue (disables FC or DK channels)
		C	SCSI/MSU/KB event queue
8	DED DK Bus Failure	C	Data Overrun (disable DK bus interface) (OST)
		C	Transmit Overrun
		C	Ambiguous Event
		C	Wrap Around Miscompare
9	DED Keyboard	B	Keyboard Channel A or B fail (OST)
		A	Keyboard Channel A or B fail (OST)
10	DED EDAC / Memory Fail	A	Uncorrectable memory error (OST)
		A	Memory or EDAC Memory fail (POST)
		A	2 <sup>nd</sup> stage Watchdog timeout
11	GPP SW Watchdog Timeout, POST Bus Exception, or Real Time Clock Fail	A	Bus Exception (POST)
		A	Real Time Clock Fail

BIT	NAME	CATEGORY	DETAILS
		C	1 <sup>st</sup> stage Watchdog Timeout
13	GPP Interrupt Fail	A	Spurious Interrupt Occurred (OST)
14	GPP EEPROM Exhausted or EEPROM Checksum Fail	C B	EEPROM Exhausted (OST) EEPROM Checksum (POST)
		C	EEPROM Exhausted
15	SCSI / MSU Fail	C	MSU Fail
		C	SCSI Fail

NOTE: (POST) - reported only by POST. (OST) - reported only by OST. All others reported by both.

**IDP CST SUMMARY**

BIT	NAME
0 (MSB)	GPP EEPROM Checksum
1	GPP EEPROM Checksum Untested
2	GPP Memory
3	GPP Memory Untested
4	GPP Timers
5	GPP Timers Untested
6	GPP SCSI Interface Bit
7	GPP SCSI Interface Bit Untested
8	GPP MSU Bit
9	GPP MSU Bit Untested
10	DED DI Receiver Bit
11	DED DI Receiver Bit Untested
12	DED Gate Array Bit
13	DED Gate Array Bit Untested
14	DED Memory
15	DED Memory Untested
16	FC Bus Timeout Interrupt Bit
17	FC Bus Timeout Interrupt Bit Untested
18	FC Memory
19	FC Memory Untested
20	1553 BCRTM Wrap Around Bit
21	1553 BCRTM Wrap Around Bit Untested
22	1553 Memory
23	1553 Memory Untested

Note: If CST does not run completely, the Untested bits show which tests did or did not run.

**MDU BIT (OST/POST) SUMMARY**

BIT	NAME	CATEGORY	DETAILS
0 (MSB)	R3000 Processor Fail	B	Opcode / Floating Point
		B	R3000 Cache (POST)
1	R3000 RAM Fail	B	EDAC
		B	RAM (POST)
		C	Scrubber
2	EEPROM Fail	B	Checksum
		B	Write
3	Edgekey Fail	C	Stuck Fail
		C	Data Fail (POST)
4 (5)	Primary (Secondary) 1553B Interface Fail	B	EDAC (cmd port)
		B	RAM (cmd port) (POST)
		B	BCRTM (cmd port) (POST)
		C	EDAC (non-cmd port)
		C	RAM (non-cmd port) (POST)
		C	BCRTM (non-cmd port) (POST)
6	Graphics HW Fail	C	RAM Scrubber
		B	Host Interface
		B	Heartbeat
		B	Beamformer Access
		B	Pipeline Signature Fail
		B	GC CO-VG Register (POST)
7	Spare	C	VREF PROM
		C	VREF Gray Scale
		C	LCD Voltage Regulators
		C	Backlight Sensor
		C	Temperature Sensor
		C	Analog Ground
9	Graphics Controller (GC) Processor Fail	B	CPU Test
10	Graphics Controller RAM Fail	B	RAM Scrubber (OBIT) (OST)
		B	EDAC
		B	RAM (POST)
		B	RAM Bite Write Error
		B	CPU Push/Pop Fail
		C	RAM Scrubber (CBIT) (POST)
11	VRAM Fail	B	VRAM
		B	VRAM Bite Write Error (POST)
		C	Power Supply Voltages
		C	Backlight High Voltage
		C	Lamp TEC
12	Power Supply / Lamp Fail	C	Lamp Filament
		C	Luminance Control Loop
		B	Timer 2 (POST)
		B	Watchdog Timer (POST)
		C	Timer 1 (POST)
14	Miscellaneous HW Fail	B	Background Fail
		B	Unexpected Interrupt
		B	Watchdog Timer Interrupt Occurred
		B	Vector Generator Fault Interrupt Occurred
		B	R3000 Bus Fault Interrupt Occurred

BIT	NAME	CATEGORY	DETAILS
		B	Foreground Fail
		B	Bus Timeout Interrupt Fail (POST)
		B	Interrupt Controller Fail (POST)
		B	GC Invalid Drawlist Opcode
		B	GC Program Checksum Fail
		B	GC Invalid Interrupt
		B	GC Bus Fault
		B	GC Illegal Opcode
		B	GC NMI Error
		C	UDI Interface (POST)
		C	Dimmer Pot (POST)
15	Overtemperature Sensor Fail	C	LDC Temp Sensor
		C	Ambient Temp Sensor

Note: (POST) - reported only by POST. (OST) - reported only by OST. All others reported by both.  
Changes from non-zero to zero are reported.

**MDU CST SUMMARY**

BIT	NAME
0 (MSB)	R3000 Processor Fail
1	R3000 RAM Fail
2	EEPROM Fail
3	Edgekey Fail
4	Primary 1553B Interface Fail
5	Secondary 1553B Interface Fail
6	Graphics HW Fail
7	Spare
8	Data Acquisition Fail
9	Graphics Controller Processor Fail
10	Graphics Controller RAM Fail
11	VRAM Fail
12	Power Supply / Lamp Fail
13	Timer Fail
14	Miscellaneous HW Fail
15	Overtemperature Sensor Fail
16-23	Test Sequence Counter.

Test Sequence Counter reflects progress of CST. FF (hex) if all tests performed, otherwise number of test upon which CST stopped.

**ADC BIT (OST) SUMMARY**

Note: Bits 0-7 are common to both channels of the ADC, bits 8-15 are for the channel being communicated with by the reporting IDP.

BIT	NAME	CATEGORY
0 (MSB)	ADC Analog Channel Fail	C
1	Not Used - Set to 0	
2	Not Used - Set to 0	
3	Watchdog Timer	B
4	Power Supply / A/D Linearity	B
5	PROM Checksum	B
6	Internal 256 Byte RAM	B
7	CPU / ALU	B
8	Not Used - Set to 0	
9	Not Used - Set to 0	
10	Not Used - Set to 0	
11	Double Bit SRAM Error	B
12	1553B Controller IC	B
13	SRAM	B
14	Scrubber Circuitry	B
15	EDAC Circuitry	B

**ADC CST (and POST) SUMMARY**

Note: ST is automatically performed at power up and the results processed by the ADC POST processing capability in the IDP software. Error categorization is same as OST for bits 0 - 15. Bits 16 - 23 are category D (non-critical error, status word 1 bit 8). OST change from non-zero to zero are reported.

Note: Bits 0-7 are common to both channels of the ADC, bits 8-15 are for the channel being communicated with by the reporting IDP, bits 16-23 are for the channel not being communicated with by the reporting IDP.

<b>BIT</b>	<b>NAME</b>
0 (MSB)	ADC Analog Channel Fail
1	Not Used - Set to 0
2	Not Used - Set to 0
3	Watchdog Timer
4	Power Supply / A/D Linearity
5	PROM Checksum
6	Internal 256 Byte RAM
7	CPU / ALU
8	Not Used - Set to 0
9	Not Used - Set to 0
10	Not Used - Set to 0
11	Double Bit SRAM Error
12	1553B Controller IC
13	SRAM
14	Scrubber Circuitry
15	EDAC Circuitry
16	Not Used - Set to 0
17	Not Used - Set to 0
18	Not Used - Set to 0
19	Double Bit SRAM Error
20	1553B Controller IC
21	SRAM
22	Scrubber Circuitry
23	EDAC Circuitry

**E. Anomaly Procedures**

This section provides tables of visible / operational conditions and recommended user actions. Depending on whether downlist data is available or not can effect the decision process. When both visible and downlist conditions exist, the recommended actions for both must be considered. This section contains consolidated tables for recommended user actions since many of the visual and/or downlist conditions lead to the same user actions. This information can be utilized in ground facilities, vehicles on the ground or vehicles in flight/on-orbit.

The consolidated procedures take into account the need for immediate actions and delayed actions depending on potential priorities (e.g. flight safety, time required verses time available to perform actions). The consolidated tables are in recommended order to be performed (top to bottom in order per LRU). The first column is a condition to check for, each row provides recommended actions for the defined condition.

Currently there are no identified conditions that would result in the recommendation to perform an IDP, MDU or ADC memory dump or an IDP file patch operation.



1. ADC ANOMALY PROCEDURE

PROBLEM	IMMEDIATE USER RESPONSE	DELAYED USER RESPONSE
ADC Analog Channel Fail (BITE fail, OST=8000 and/or CST=800000)	Ignore unless recovery of lost data is required. Port Mode applicable MDU to recover lost data.	<ol style="list-style-type: none"> <li>1. Check applicable ADC failures (MEDS FSM, OST, CST, Error Logs and Downlist).</li> <li>2. Perform CST and check results (if possible).</li> <li>3. Power cycle applicable ADC and check for recovery.</li> <li>4. If problem remains and is localized to ADC, R&amp;R when possible.</li> </ol> NOTE: problem may be external to ADC (e.g. subsystem)
Invalid or erroneous subsystem meters or SPI	Ignore unless recovery of lost data is required. Port Mode applicable MDU to recover lost data.	<ol style="list-style-type: none"> <li>1. Check applicable ADC is powered on.</li> <li>2. Check applicable ADC failures (MEDS FSM, OST, CST, Error Logs and Downlist).</li> <li>3. Perform CST and check results (if possible).</li> <li>4. Power cycle applicable ADC and check for recovery.</li> <li>5. If ADC failed, power off and R&amp;R when possible.</li> </ol> NOTE: problem may be external to ADC (e.g. subsystems)
Errors reported or CST results not nominal, with no display effects.	Use as is.	<ol style="list-style-type: none"> <li>1. Check applicable ADC failures (MEDS FSM, OST, CST, Error Logs and Downlist).</li> <li>2. Perform CST and check results (if possible).</li> <li>3. Power cycle applicable ADC and check for recovery.</li> <li>4. If ADC failure still present, R&amp;R when possible.</li> </ol>

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## 2. MDU ANOMALY PROCEDURE

PROBLEM	IMMEDIATE USER RESPONSE	DELAYED USER RESPONSE
MDU Overtemp	Use as is for safety of flight, otherwise power off MDU and follow loss of cooling procedures.	1. Follow loss of cooling procedures.
MDU EEPROM Fail	Continue use, do not power off MDU, reload software or perform CST.	1. Continue use, do not power off MDU, reload software or perform CST.. 2. Error may clear by reloading MDU EEPROM however MDU may stop operating completely. 3. R&R to gain healthier MDU in required position.
MDU Edgekey Fail (no response, stuck fail, red X over edgekey legend)	Ignore unless recovery of capabilities is required. Power cycle MDU to attempt recovery. Use as is, possibly avoiding use of edgekeys to avoid getting stuck in a specific menu and with a specific display format.	1. Power cycle MDU to attempt recovery. 2. If failure remains, use as is, possibly avoiding use of edgekeys to avoid getting stuck in a specific menu and with a specific display format. 3. R&R to gain a healthier MDU in required position.
Single 1553 port problem	NOTE: MDU may automatically port mode to recover display. Ignore unless recovery of capabilities is required. Non-CRT MDUs - Port Mode MDU to utilize good port. CRT MDUs - power cycle to attempt recovery.	1. Check MDU failures (MEDS FSM, OST, CST, Error Logs and Downlist). 2. Perform CST and check results (if possible). 3. Power cycle MDU to attempt recovery. 4. If problem remains, use as is and R&R when possible and if necessary to gain a healthier LRU in required position.
Load Retry failure	Use as is.	1. Reload EEPROM to attempt to clear problem. 2. R&R to gain healthier LRU in required position.
MDU problem exists but MDU is still usable (acceptable display capability and performance)	Use as is.	1. Check MDU failures (MEDS FSM, OST, CST, Error Logs and Downlist). 2. Perform CST and check results (if possible). 3. Power cycle MDU to attempt recovery. 4. If problems remain, use as is and R&R when possible and if necessary to gain a healthier LRU in required position.
MDU problem exists and MDU is not usable (does not function or display capabilities not usable)	Ignore unless recovery of capabilities is required. Power cycle to attempt recovery. Power off if unusable and use other MDUs as needed.	1. Power cycle MDU to attempt recovery. 2. If problems remain, power off if unusable. 3. R&R when possible and if necessary to regain capabilities in required position (R&R may or may not clear problem).
MDU display blank	Ignore unless recovery of capabilities is required. Check power switch is on and brightness is turned up. If OK then power cycle MDU to attempt recovery. Power off if unusable and use other MDUs as needed.	1. Check power switches/circuit breakers are on and brightness is turned up. 2. Power cycle MDU to attempt recovery. 3. If problems remain, power off if unusable. 4. Use other MDUs as needed. 5. R&R when possible and if necessary to regain capabilities in required position (R&R may or may not clear problem). 6. If MDU was powered off during an EEPROM load, the MDU must be reloaded using GSE.

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<b>PROBLEM</b>	<b>IMMEDIATE USER RESPONSE</b>	<b>DELAYED USER RESPONSE</b>
MDU AUTONOMOUS	Ignore unless recovery of capabilities is required. Check at least one associated IDP is powered on and functioning and MDU is in AUTO port configuration mode. Power cycle to attempt recovery. Power off if unusable and use other MDUs as needed.	1. Check at least one associated IDP is powered on and functioning and MDU is in AUTO port configuration mode. 2. Check MDU failures (MEDS FSM, OST, CST, Error Logs and Downlist). 3. Perform CST and check results (if possible). 4. Power cycle MDU and check for recovery. 5. If problems remain, power off if unusable. 6. R&R when possible and if necessary to regain capabilities.

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### 3. IDP ANOMALY PROCEDURE

PROBLEM	IMMEDIATE USER RESPONSE	DELAYED USER RESPONSE
Non-critical error detected (status word 1 bit 8)	Ignore, use as is.	<ol style="list-style-type: none"> <li>1. Use as is.</li> <li>2. Check IDP failures (Error Logs).</li> </ol>
EEPROM Error (OST BITE bits 3 & 14) (EEPROM Checksum) and CHECKSUM FAIL {idp} FSM (ID=26)	Use as is and DO NOT power cycle IDP, perform CST, perform memory loading or perform critical format loading, otherwise IDP may be lost.	<ol style="list-style-type: none"> <li>1. Use as is and DO NOT power cycle IDP, perform CST, perform memory loading or perform critical format loading, otherwise IDP may be lost.</li> <li>2. R&amp;R IDP to gain healthier LRU in required position.</li> </ol>
EEPROM Error (OST BITE bits 3 & 14) (EEPROM Exhausted)	Use as is and DO NOT power cycle IDP, perform CST, perform memory loading or perform critical format loading, otherwise IDP may be lost.	<ol style="list-style-type: none"> <li>1. Use as is and DO NOT power cycle IDP, perform CST, perform memory loading or perform critical format loading, otherwise IDP may be lost.</li> <li>2. R&amp;R IDP to gain healthier LRU in required position.</li> </ol>
MSU Spinup Error (ID=12)	Ignore. Power cycle when convenient.	<ol style="list-style-type: none"> <li>1. Power cycle IDP when convenient, being sure to follow recommended power cycle timing.</li> </ol>
Display/Format Fill Error or any FCW processing errors	Use as is, or ignore DPS display. Recall or change GPC display (i.e. different SPEC). Power cycle IDP. Assign IDP/CRT to different GPC.	<ol style="list-style-type: none"> <li>1. Recall or change GPC display SPEC (i.e. different SPEC).</li> <li>1. Power cycle IDP.</li> <li>2. Assign IDP/CRT to different GPC.</li> <li>3. R&amp;R IDP to recover lost capabilities (problem may be internal or external to IDP (IDP R&amp;R may or may not clear problem)).</li> </ol>
Keyboard, keystroke or keyboard select problem	Avoid using affected keyboard. Use unaffected keyboards.	<ol style="list-style-type: none"> <li>1. Checkout keyboard and/or keyboard select switch via IDP Interactive CST.</li> <li>2. If problem remains, power cycle IDP.</li> <li>3. If problem remains, use other keyboards and/or move switch to position with less effects if possible.</li> <li>4. R&amp;R IDP to recover lost capabilities (problem may be internal or external to IDP (IDP R&amp;R may or may not clear problem)).</li> </ol>
Major Function Select problem	Use affected CRT is current major function that is selected. Use other CRTs as needed for desired major function.	<ol style="list-style-type: none"> <li>1. Checkout MF switch via IDP Interactive CST.</li> <li>2. If problem remains, power cycle IDP.</li> <li>3. If problem still remains, use other CRTs as needed for desired major functions.</li> <li>4. R&amp;R IDP to recover lost capabilities (problem may be internal or external to IDP (IDP R&amp;R may or may not clear problem)).</li> </ol>
IDP LOAD problem (stuck in VM LOAD MODE)	Verify GPC in supporting OPS mode if load was intentional. Use other CRTs as needed. Power cycle IDP to attempt clear problem.	<ol style="list-style-type: none"> <li>1. Verify GPC in supporting OPS mode.</li> <li>2. Verify IDP LOAD switch not stuck in active position (check physical switch and check switch logic state via IDP Interactive CST display).</li> <li>3. Power cycle IDP to attempt to clear problem.</li> <li>4. R&amp;R IDP to recover lost capabilities (problem may be internal or external to IDP (IDP R&amp;R may or may not clear problem)).</li> </ol>

Verify that this is the correct version before use

4.9-40

Verify that this is the correct version before use

4.9-41

PROBLEM	IMMEDIATE USER RESPONSE	DELAYED USER RESPONSE
Invalid or erroneous FI display	If problem is not due to loss of a GPC, then ... Select other FC buses to attempt to recover lost display. Can also port mode effected MDUs to other IDPs to recover lost displays or ignore and use Composit FI format.	If problem is not due to loss of a GPC, then... 1. Select other FC buses to attempt to clear problem. 2. If problem remains, power cycle IDP to attempt recovery. 3. If problem remains, port mode affected MDUs to other IDPs and/or use Composit FI format as necessary. 4. R&R IDP to recover lost capabilities (problem may be internal or external to IDP (IDP R&R may or may not clear problem)).
Critical Format Checksum error	Repeat operation, possibly with another GPC and/or MMU source. If problem remains, use as is.	1. Repeat operation, possibly with another GPC and/or MMU source. 2. R&R IDP to recover lost capabilities (problem may be internal or external to IDP (IDP R&R may or may not clear problem)).
Critical Format Write error	Repeat operation. If problem remains use as is, but do not power cycle IDP or critical formats in volatile memory will be lost and will have to be reloaded.	1. Repeat operation. If problem remains use as is, but do not power cycle IDP or critical formats in volatile memory will be lost and will have to be reloaded. 2. R&R IDP to recover lost capabilities.
Erroneous DPS Critical Formats, Critical Format Read error.	Ignore or use as is. Can power cycle IDP to attempt recovery.	1. Power cycle IDP to attempt recovery. 2. If problem remains, perform IDP LOAD with PASS GPC in supporting OPS mode. 3. If problem remains, use other CRTs. 4. R&R IDP to recover lost capabilities.
Invalid or erroneous DPS display	If problem is not due to loss of a GPC, then ... Ignore unless capability is needed. Power cycle IDP to attempt recovery. Assign IDP/CRT to another GPC. Use other CRT displays if unrecoverable.	If problem is not due to loss of a GPC, then... 1. Power cycle IDP to attempt recovery. 2. Assign IDP/CRT to another GPC. 2. If problem remains, use other CRTs. 3. R&R IDP to recover lost capability or gain healthier IDP in required position.
IDP MSU problem	Use as is.	1. Check IDP failures (MEDS FSM, OST, CST, Error Logs and Downlist). 2. Perform CST and check results (if possible). 3. Power cycle IDP and check for recovery. 4. If problem remain, use as is and R&R when possible to gain healthier IDP in required position.
IDP Load Fail or Load Retry Fail (Error IDs 29, 2A, 2B or 2C (hex)) and IDP is operating	Use as is.	1. If CURRENT program (CP Load Error, ID=29) and located in EEPROM, then can reload EEPROM to attempt to clear problem or use as is since IDP will still load DEFAULT from MSU. For all other load errors, use as is (no reloading available during mission). 2. R&R when possible to attain healthier IDP in required position. 3. If IDP had been powered off during an EEPROM load, power cycle the IDP and re-attempt the EEPROM load operation.

SHUTTLE OPS  
DPS/JSC-18819

04/22/05: BASIC, REV F

MEDS STAT  
SCP 4.9

<b>PROBLEM</b>	<b>IMMEDIATE USER RESPONSE</b>	<b>DELAYED USER RESPONSE</b>
IDP problem exists but IDP is still usable (capability and performance may be reduced such as loss of DPS or flight instrument function)	Use as is. Use other IDPs/MDUs and / or port mode MDUs as appropriate.	<ol style="list-style-type: none"> <li>1. Use as is. Use other IDPs/MDUs and / or port mode MDUs as appropriate.</li> <li>2. Check IDP failures (MEDS FSM, OST, CST, Error Logs and Downlist).</li> <li>3. Perform CST and check results (if possible).</li> <li>4. Power cycle IDP and check for recovery.</li> <li>5. If problem remain, use as is and R&amp;R when possible to gain healthier IDP in required position.</li> </ol>
IDP problem exists and IDP is not usable (does not support any display or keyboard capabilities)	<p>Ignore unless recovery of capabilities is required.</p> <p>Power cycle to attempt recovery, watching CRT MDU for IDP DEFAULT LOAD FAIL message. Power off if unusable and use other MDUs for required display functions. Port mode MDUs to other IDPs as needed.</p>	<ol style="list-style-type: none"> <li>1. Power cycle to attempt recovery, watching CRT MDU for IDP DEFAULT LOAD FAIL.</li> <li>2. Power off if unusable.</li> <li>3. R&amp;R when possible to gain a healthier IDP in required position.</li> </ol>

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**Verify that this is the correct version before use**

F. Miscellaneous Reference Information

1. meds/mcads displays

a. Source = DEU

Note: These displays are commonly referred to as “critical formats.”

Disp. No.	Title	Type	PASS									
			OPS 0	G1/G6	G2	G3	S2	S4	P9	G8	G9	
0/1	GPC MEMORY	OPS	X									
0/1	GPC MEMORY	SPEC	X	X/X	X	X	X	X	X	X	X	X
18/0	GNC SYS SUMM 1	DISP		X/X	X	X					X	
21/0	IMU ALIGN	SPEC			X	X						
22/0	S TRK/COAS CNTL	SPEC			X	X <sup>a</sup>						
23/0	RCS	SPEC		X/X	X	X					X	
50/0	HORIZ SIT	SPEC		X/X		X						
51/0	VERRIDE	SPEC		X/X		X						
99/0	FAULT	DISP	X	X/X	X	X	X	X	X	X	X	X
101/1	XXXXXX TRAJ	OPS		X/								
102/1	XXXXXX TRAJ	OPS		X/								
103/1	XXXXXX TRAJ	OPS		X/								
104/1	XXXXXX MNVR YYYY	OPS		X/								
105/1	XXXXXX MNVR YYYY	OPS		X/								
106/1	XXXXXX MNVR YYYY	OPS		X/								
202/1	(ORBIT) MNVR (EXEC)	OPS			X							
301/1	XXXXXX MNVR YYYY	OPS				X						
302/1	XXXXXX MNVR YYYY	OPS				X						
303/1	XXXXXX MNVR YYYY	OPS				X						
304/1	ENTRY TRAJ 1 (2-5)	OPS				X						
305/1	VERT SIT 1 (2)	OPS				X						
601/1	(RTLS) TRAJ	OPS		/X								
602/1	VERT SIT 1	OPS		/X								
603/1	VERT SIT 1 (2)	OPS		/X								
901/1	GPC MEMORY	OPS										X

<sup>a</sup> MM 301 only.

b. Source = MMU

SM “roll-in” displays

(Payload roll-in displays are flight dependent.)

<b>Disp No.</b>	<b>Title</b>	<b>Type</b>	<b>PASS SM</b>
66/0	ENVIRONMENT	DISP	X
67/0	ELECTRIC	DISP	X
68/0	CRYO SYSTEM	DISP	X
69/0	FUEL CELLS	DISP	X
76/0	COMM/RCDR	DISP	X
77/0	EVA-MMU/FSS	DISP	X
86/0	APU/HYD	DISP	X
87/0	HYD THERMAL	DISP	X
88/0	APU/ENVIRON THERM	DISP	X
89/0	PRPL THERMAL	DISP	X
96/0	PDRS STATUS	DISP	X
97/0	PL RETENTION	DISP	X
900/0 thru 999/0	CREW TEXT	DISP	X
167/0	DOCKING STATUS	DISP	X
168/0	SM CRYO PALLET	DISP	X
169/0	PDRS STATUS	DISP	X
177/0	EXTERNAL AIRLOCK	DISP	X
178/0	SM OIU	DISP	X



c. Source = PASS GPC

(GPC resident payload displays are flight dependent.)

Disp. No.	Title	Type	PASS									
			OPS 0	G1/G6	G2	G3	S2	S4	P9	G8	G9	
1/0	DPS UTILITY	SPEC	Xa	X	X	X	X	X	X	X	X	X
2/0	TIME	SPEC	Xa		X		X	X	X	X	X	X
6/0	GPC/BUS STATUS	SPEC	Xa	X	X	X	X	X	X	X	X	X
19/0	GNC SYS SUMM 2	DISP			X						X	
20/0	DAP CONFIG	SPEC			X							
25/0	RM ORBIT	SPEC			X							
33/0	REL NAV	SPEC			X							
34/0	ORBIT TGT	SPEC			X							
40/0	SENSOR TEST	SPEC									X	
41/0	RG/ADTA/RCS	SPEC									X	
42/0	SWITCH/SURF	SPEC									X	
43/0	CONTROLLERS	SPEC									X	
44/0	SWITCHES	SPEC									X	
45/0	NWS CHECK	SPEC									X	
53/0	CONTROLS	SPEC		X		X						
60/0	SM TABLE MAINT	SPEC					X	X				
62/0	PCMMU/PL COMM	SPEC					X	X				X
64/0	SM GROUND CHECKOUT	SPEC					X	X				
78/0	SM SYS SUMM 1	DISP					X	X				
79/0	SM SYS SUMM 2	DISP					X	X				
85/0	MASS MEMORY R/W	SPEC					X	X				
90/0	PCS CNTL	SPEC					X	X				
94/0	PDRS CONTROL	SPEC					X					
95/0	PDRS OVERRIDE	SPEC					X	X				
96/0	PDRS STATUS	DISP					X					
100/0	GTS DISPLAY	SPEC								X		X
101/0	SENSOR SELF-TEST	SPEC										X
102/0	RCS/RG/ADTA TEST	SPEC										X
104/0	GND IMU CNTL/MON	SPEC										X
105/0	TCS CONTROL	SPEC										X
106/0	MANUAL CONTROLS	DISP										X
111/0	SL MEMORY DUMP	SPEC								X		
112/0	GPC/BTU I/F	SPEC										X
113/0	ACTUATOR CONTROL	SPEC										X
168/0	CRYO PALLET	DISP					X					
201/0	UNIV PTG	OPS			X							
201/1	ANTENNA	OPS			X							
202/1	PL BAY DOORS	OPS			X							
401/1	ANTENNA	OPS				X						
402/1	PL BAY DOORS	OPS										
801/1	FCS/DED DISP C/O	OPS									X	
901/1	MASS MEMORY R/W	OPS								X		

d. Source = BFS GPC

Note: All BFS displays (SPECs, DISPs, etc.) are BFS GPC memory resident.

Disp.	Title	Type	OPS 0	BFS major mode G1/G6	G3	SM
000/1	BFS MEMORY	OPS	X			
000/	BFS MEMORY	SPEC	X	X/X	X	X
000/1	THERMAL	OPS				X
0/18/	GNC SYS SUM 1	DISP		X/X	X	
019/	GNC SYS SUM 2	DISP		X/X	X	
050/	HORIZ SIT	SPEC		X/X	X	
051/	BFS OVERRIDE	SPEC		X/X	X	
063/	PL BAY DOORS	SPEC				X
078/	SM SYS SUM 1	DISP				X
079/	SM SYS SUM 2	DISP				X
099/	FAULT	SPEC	X	X/X	X	X
101/1	XXXXXX TRAJ 1	OPS		X/		
102/1	XXXXXX TRAJ 1	OPS		X/		
103/1	XXXXXX TRAJ 2	OPS		X/		
104/1	XXXXXX MNVR YYYYY	OPS		X/		
105/1	XXXXXX MNVR YYYYY	OPS		X/		
106/1	XXXXXX MNVR YYYYY	OPS		X/		
301/1	XXXXXX MNVR YYYYY	OPS			X	
302/1	XXXXXX MNVR YYYYY	OPS			X	
303/1	XXXXXX MNVR YYYYY	OPS			X	
304/1	ENTRY TRAJ 1	OPS			X	
304/1	ENTRY TRAJ 2	OPS			X	
304/1	ENTRY TRAJ 3	OPS			X	
304/1	ENTRY TRAJ 4	OPS			X	
304/1	ENTRY TRAJ 5	OPS			X	
305/1	VERT SIT 1	OPS			X	
305/1	VERT SIT 2	OPS			X	
601/1	RTLS TRAJ	OPS		/X		
602/1	VERT SIT 1	OPS		/X		
603/1	VERT SIT 1	OPS		/X		
603/1	VERT SIT 2	OPS		/X		

XXXXXX = LAUNCH, ASCENT, OMS-1, OMS-2, or DEORB dependig on the major mode and any abort mode selected.

YYYYY = EXEC or COAST depending on the major mode.

2. "ILLEGAL ENTRY" Error Conditions

PASS	BFS	Keystroke input errors
√	√	1. "PRO" not compatible with current format or step in control segment
√	√	2. "GPC/CRT" key entry with CRT ≠ 1-4, GPC ≠ 0-5
√	√	3. GPC-detected input MSG syntax error
		<u>"EXEC" KYBD inputs</u>
√	√	1. "EXEC" not compatible with current format or step in control segment
√	√	2. "EXEC" (or ITEM) when new format is being retrieved
√	√	3. "EXEC" load with no data
		<u>OPS transitions</u>
√	√	1. OPS request containing invalid mode number
√	√	2. OPS undefined OPS not resident and not an overlay initiator
√	√	3. Requested OPS not a legal transition
√	√	4. Inputs other than "MSG RESET," "CLEAR," "FAULT," or "ACK" in midst of an OPS transaction
√	√	5. OPS requested via a DEU not being commanded by a target GPC for that OPS
√	√	6. No target GPC in config table when OPS selected
√	√	7. Attempt to freeze dry load a GPC not in GPC OPS-0 or not listening to input DEU/KYBD
√	√	8. Attempt a BFS OPS trans without the commanding CRTs MF switch in "GNC"
√	√	9. Request redundant operations of simplex OPS (i.e., two SM2 GPCs)
		<u>SPECs/DISPs</u>
√		1. Selection of SPEC or DISP not associated with current OPS
√		2. "2 SPEC LIMIT" per MF violated - results from SPEC request when two are already active
√	√	3. Attempt to load data using DISP: data must be loaded via a SPEC
√	√	4. Invalid item no. for data load
√	√	5. "Reasonableness" test failed; external data input must be within acceptable limits
√	√	6. Attempt to call a SPEC that is currently underlying a DISP on the same CRT. The DISP must be resumed to get to the SPEC
		<u>Memory SPEC</u>
√	√	1. Address input exceeds memory size
√	√	2. No dump address specified
√	√	3. Wds/frame ≠ 16 or 32
√		4. Eng units scale code with BB >10 or A ≠ 1,2
√		5. "EXEC" load with no data
√		6. Attempt to write into protected memory when mode is not code
√		7. Insufficient digits entered for eng units
√		8. Addr ID on odd word boundary when 32-bit floating point option is selected
√		9. Seq read required with no addr ID

3. SPEC/DISP Allocation

The following table identifies whether a SPEC/DISP is retained (R) or cancelled (C) in the GPC software depending upon the user action:

User Action (a)	SPECs	DISPs
RESUME KEY	C	C
SPEC CALLED	C	C
DISP CALLED	R	C
GPC/CRT KEY REASSIGN - PASS	R	C
- BFS	C	C
BFC CRT SWITCH REASSIGN - PASS	R	C
- BFS	C	C
MF SWITCH CHANGE (b)	R	C
OPS TRANSITION	C	C
OPS MODE RECALL - PASS (c)	R	C
- BFS	R	R
MAJOR MODE TRANSITION (d)	R	R

- A. Action/results apply to both PASS and BFS unless otherwise noted.
- B. Table reflects effects of SM, GNC, and PL MF in the PASS; but only SM and GNC MF in the BFS. PL MF processing in the BFS results in the following:
  - 1. MF from SM to PL while assigned to BFS - Previous display retained whether it is SPEC or DISP. Display remains when switch taken back to SM.
  - 2. MF from GNC to PL while assigned to BFS - MDU display blanks except for the time fields, SPL, and msg line. OPS display is presented when switch taken back to GNC, so both SPECs and DISPs are cancelled for this case. There are other peculiarities about PASS and BFS processing of the PL MF switch position as follows:
  - 3. In the PASS, when the PL MF position is selected and there is no PL 9 GPC in the common set, the GPC memory display is driven on the CRT (i.e., unsupported MF).
  - 4. In the BFS, if a CRT has a PL MF when the BFS first polls the IDP, the MDU display is blank except for the time fields, SPL, and msg line.
- C. If GPC target set is altered, it works like an OPS transition. DISPs are cancelled if there is any change in the NBAT (strings, MDUs, MMUs, launch, etc.) since the previous OPS transition/OPS mode recall. If no change, the DISP is retained.
- D. SPEC/DISP retained only if supported in new major mode.
- E. General Notes
  - 1. Active SPEC/DISPs must be cancelled on each MDU they are being viewed on.
  - 2. Keyboard ITEM entries apply only to the display currently on a MDU and, therefore, never affect underlying SPECs.
  - 3. For PASS system level SPEC allocation, a GPC can support more than one MF at a time. However, the same SPEC cannot be called up in two different MFs for the same GPC. For example, if the MF switch for a GNC MDU is placed in

PL and a systems-level SPEC (GPC MEMORY, DPS UTILITY, TIME) is called, the same SPEC can no longer be called on a GNC MDU. The result would be an "ILLEGAL ENTRY" fault message for exceeding the "2 SPEC per MF" limit. To clear the problem, the MF switch for the appropriate MDU must be returned to PL and the SPEC resumed. This scenario does not apply to the BFS.

4. For PASS processing of SPECS, an attempt to call a SPEC on a MDU which currently has the same SPEC underlying a DISP will result in "ILLEGAL ENTRY." The DISP must be resumed to get to the SPEC. This scenario does not apply to the BFS.

5. DK Listen Item Entries

The BFS will listen and react to certain item entries on specific PASS displays as defined below:

<b>Display</b>	<b>Keyboard inputs</b>	<b>Remarks</b>	
HORIZ SIT	Items 3,4,5	Runway select	
	Item 6	TAEM TGT (G&N)	
	Item 7	MEP/NEP select	
	Item 8	Aim point(headwind HI/LO)	
	Item 9	Altimeter setting	
	Items 40,41	TAL site select	
	XXXXX MNVR YYYYY	Items 1,2,3	OMS eng select
		Item 4	RCS eng select
		Items 6,7,8	TRIM loads
Item 9		Vehicle weight	
Items 10-13		TIG (D,H,M,S)	
Items 14-18		PEG 4 TGTS	
Items 19-21		PEG 7 TGTS	
Item 22		'LOAD' CMD	
Item 23		Start CRT timer	
Items 24-26		Burn attitude data	
ENTRY TRAJ 1(2,3,4,5) OVERRIDE	Items 28-33	GMBL select	
	Item 35	Abort TGT/crew index	
	"EXEC" CMD	Burn execute CMD	
	Item 1	Drag reference bias	
	Item 1	Abort TAL/AOA	
	Item 2	Abort ATO	
	Item 3	Abort	
	Item 4	Max throttle	
	Item 5	Crossfeed interconnect	
	Items 6-12	Propellant dump commands	
	Items 13-14	Aft RCS	
	Items 15-16	Forward RCS	
	Items 17-18	Elevon select	
	Items 20-21	Filter select	
	Items 22-24	Atmospheric model select	
	Items 43-44	Vent door control	

The BFS will also DK LISTEN for other MEDS activities (e.g., manual major-mode transitions, GPC/CRT KYBD entries, etc.). For more detailed information on DK LISTEN, consult the DPS System Briefs, MEDS.

**6. MEDS Subsystem Meters**

Loadblock	#1: DCP	#2: CRITICAL FORMATS	#3: SASTP
GPC software			
STP/RTP (GPC IPL)	Yes	Yes	Yes
PASS IOP loader (post GPC IPL OPS 0, SM OPS 2/4, and PL 9)	Yes	Yes	No
BFS IOP loader (all OPS)	Yes	No	No

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METER	VALID ENGINEERING UNIT RANGE (digital readout)	RANGE OF DISPLAYED BAR METER	ENGR. UNIT VALUES FOR TICK MARKS	COLOR AND RANGE COLOR IS VALID FOR
x OMS HE Tank Press	0..5000 PSIA	FULL RANGE	1500	RED 0<P<1500 GREEN P>=1500
x OMS N2 Tank Press	0.5000 PSIA	0.3000	1200	RED 0<P<1200 GREEN P>=1200
x OMS PC	0.160 %	0.120	80	BLACK 0<P<=3 RED 3<P<80 WHITE P>=80
MPS PNEU HE Tank Press	0.5000 PSIA	3000.5000	3800	RED 3000<=P<3800 GREEN P>=3800
MPS x Eng. HE Tank Press	0.5000 PSIA	1000.5000	1150	RED 1000<=P<1150 GREEN P>=1150
MPS PNEU HE Reg. Press	0.1.000 PSIA	600.900	680, 810	RED 600<=P<680 GREEN 680<=P<=810 RED P>810
MPS x Eng. HE Reg. Press	0.1.000 PSIA	600.900	680, 810	RED 600<=P<680 GREEN 680<=P<=810 RED P>810
MPS LO2 Eng. Manif. Press	0.300 PSIA	FULL RANGE	249	GREEN 0<P<=249 RED P>249
MPS LH2 Eng. Manif. Press	0.1.00 PSIA	FULL RANGE	65	GREEN 0<P<=65 RED P>65
MPS x Eng. PC	0.1.15 %	45.109	67, 104	RED 45<=P<65 WHITE P>=65
APU x Fuel Quantity	0.1.00 %	FULL RANGE	20	RED 0<FQ<20 GREEN FQ>=20
APU x Fuel Press	0.5.00 PSIA	FULL RANGE	NONE	GREEN 0.500
APU x H2O Quantity	0.1.00 %	FULL RANGE	40	RED 0<HQ<40 GREEN HQ>=40
APU x Oil Temp	0..500 Deg. F	FULL RANGE	45, 290	RED 0<OT<45 GREEN 45<=OT<=290 RED OT>290
HYD x Quantity	0.1.00 %	FULL RANGE	40, 95	RED 0<Q<40 GREEN 40<=Q<=95 RED Q>95
HYD x Pressure	0.4.000 PSIA	FULL RANGE	500, 1000, 2400	RED 0<P<=500 GREEN 500<P<1000 RED 1000<=P<2400 GREEN P>=2400

7. MEDS DPS DISPLAY Colors

ITEM	COLOR
BIG X	Orange
POLL FAIL	Orange
Overbright (when overbright bit set)	Yellow
GPC Message Line	Orange
All other characters / graphics that are part of CRT spec.	Green

8. MEDS Analog/ Digital Signal Input Channelization

ADC1A/ADC1B CHANNEL	SIGNAL	MSID	SOURCE
1	SPI Body Flap Position	V72H5130C	MDM FF2
2	SPI Aileron Position	V72H5131C	MDM FF2
3	SPI Left Inboard Elevon Pos.	V72H5110C	MDM FF1
4	SPI Left Outboard Elevon Pos.	V72H5112C	MDM FF1
5	SPI Right Inboard Elevon Pos.	V72H5120C	MDM FF1
6	SPI Right Outboard Elevon Pos.	V72H5122C	MDM FF1
7	SPI Speedbrake Pos.	V72H5105C	MDM FF1
8	SPI Rudder Pos.	V72H5100C	MDM FF1
9			
10	SPI Speedbrake Command Pos.	V72H5106C	MDM FF1
11	MPS Center Eng. Cham. Press.	V41P0040C	MDM FF1
12	MPS Left Eng. Chamber Press.	V41P0041C	MDM FF2
13	MPS Right Eng. Cham. Press.	V41P0042C	MDM FF3
14	MPS LH2 Eng. Manif. Press.	V41P1433C	DSC OA1
15	MPS Left Eng. He Tank Press.	V41P1250C	DSC OA1
16	MPS Left Eng. He Reg. Press.	V41P1254C	DSC OA1
17	MPS PNEU He Tank Press.	V41P1600A	DSC OA1
18	MPS PNEU He Reg. Press.	V41P1605A	DSC OA1
19	MPS LO2 Eng. Manif. Press.	V41P1533A	DSC OA2
20	MPS Center Eng. He Tank Press.	V41P1150C	DSC OA2
21	MPS Center Eng. He Reg. Press.	V41P1154A	DSC OA2
22	MPS Right Eng. He Tank Press.	V41P1350C	DSC OA3
23	MPS Right Eng. He Reg. Press.	V41P1354A	DSC OA3
24	Left OMS He Tank Press.	V43P4121C	DSC OL1
25	Left OMS N2 Tank Press.	V43P4547C	DSC OL2
26	Left OMS Chamber Press.	V43P4649C	DSC OL2
27	Left OMS Aux. He Tank Press.***	V43T4111C	DSC OL2
28	Right OMS He Tank Press.	V43P5121C	DSC OR1
29	Right OMS N2 Tank Press.	V43P5547C	DSC OR2
30	Right OMS Chamber Press.	V43P5649C	DSC OR2
31	Spare		
32	Spare		

\*\*\* Signals wired to ADCs but not currently displayed by MEDS.

ADC2A/ADC2B CHANNEL	SIGNAL	MSID	SOURCE
1	APU 1 Fuel Quantity	V72Q6001V	MDM PL2
2	APU 1 H2O Quantity	V72Q6040V	MDM PL2
3	APU 2 Fuel Quantity	V72Q6002V	MDM PL2
4	APU 2 H2O Quantity	V72Q6042V	MDM PL2
5	APU 3 H2O Quantity	V72Q6044V	MDM PL2
6	APU 3 Fuel Quantity	V72Q6003V	MDM PL2
7	APU 1 Fuel Press.	V46P0100A	DSC OA1
8	APU 1 Oil Temp.	V46T0150A	DSC OA1
9	APU 1 EGT ***	V46T0142A	DSC OA1
10	Hydraulic Subsystem 1 Press.	V58P0114C	DSC OA1
11	Hydraulic Subsystem 1 Quantity	V58Q0102A	DSC OA1
12	APU 2 Fuel Press.	V46P0200A	DSC OA2
13	APU 2 Oil Temp.	V46T0250A	DSC OA2
14	APU 2 EGT ***	V46T0242A	DSC OA2
15	Hydraulic Subsystem 2 Press.	V58P0214C	DSC OA2
16	Hydraulic Subsystem 2 Quantity	V58Q0202A	DSC OA2
17	APU 3 Fuel Press.	V46P0300A	DSC OA3
18	APU3 Oil Temp.	V46T0350A	DSC OA3
19	APU 3 EGT ***	V46T0342A	DSC OA3
20	Hydraulic Subsystem 3 Press.	V58P0314C	DSC OA3
21	Hydraulic Subsystem 3 Quantity	V58Q0302A	DSC OA3
22	Spare		
23	Spare		
24	Spare		
25	Spare		
26	Spare		
27	Spare		
28	Spare		
29	Spare		
30	Spare		
31	Spare		
32	Spare		

\*\*\* Signals wired to ADCs but not currently displayed by MEDS.

### 9. MEDS 1553 DATA BUS ADDRESSING

LRU	RT ADDR (Dec)	RT ADDR (Hex)		LRU	RT ADDR (Dec)	RT ADDR (Hex)
Spare	0	0		AFD1	16	10
IDP1	1	1		ADC2B	17	11
IDP2	2	2		ADC1B	18	12
Spare	3	3		MFD2	19	13
IDP3	4	4		ADC2A	20	14
Spare	5	5		CRT3	21	15
Spare	6	6		CRT1	22	16
CRT2	7	7		Spare	23	17
IDP4	8	8		ADC1A	24	18
Spare	9	9		CRT4	25	19
Spare	10	A		CDR1	26	1A
CDR2	11	B		Spare	27	1B
Spare	12	C		PLT1	28	1C
PLT2	13	D		Spare	29	1D
MFD1	14	E		Spare	30	1E
Spare	15	F		Spare	31	1F



1553 BUS 1		1553 BUS 2		1553 BUS 3		1553 BUS 4	
LRU	RT ADDR (Dec)	LRU	RT ADDR (Dec)	LRU	RT ADDR (Dec)	LRU	RT ADDR (Dec)
IDP1	1	IDP2	2	IDP3	4	IDP4	8
CDR2	11	CRT2	7	PLT2	13	AFD1	16
MFD2	19	CDR2	11	MFD1	14	ADC2B	17
CRT1	22	PLT2	13	ADC2B	17	ADC1B	18
ADC2A	20	MFD1	14	ADC1B	18	CRT4	25
ADC1A	24	AFD1	16	MFD2	19		
CDR1	26	ADC2A	20	CRT3	21		
PLT1	28	ADC1A	24	CDR1	26		
		PLT1	28				

### 10. MEDS POWER AND WEIGHT

DESCRIPTION	LRU QTY	WEIGHT per LRU	POWER per LRU (MAX)	POWER per LRU (TYPICAL)
IDP	4	30	140	50-55
MDU	11	17	110	66-72 (+12)*
ADC	4	3	8	3.7

\* Power consumption may increase by 12 watts during the lifetime of the backlight.

#### References:

1. Orbiter DEU SPEC, MC615-0008.
2. PASS Level A CPDS, SS-P-0002-170.
3. IPL User's Guide, MG077202.
4. PASS User's Guide.
5. Software Requirements Specification for the Hardware Dependent Executive +of the Multifunction Electronic Display Subsystem, MG07010003013E2.
6. Multifunction Electronic Display Subsystem Integrated Display Processor Avionics Audit, SSD95D0005
7. Multifunction Electronic Display Subsystem Multifunction Display Unit Avionics Audit, SSD95D0006
8. Multifunction Electronic Display Subsystem Analog to Digital Converter Avionics Audit, SSD95D0007

**TITLE**

TIME MANAGEMENT MONITORING

**PURPOSE**

To aid the operator with monitoring of MTU hardware, GPC timekeeping performance, and MCC time biases from the DPS and DPS SUPPORT consoles.

**GENERAL**

- A. For timekeeping reference, MTU hardware status, or GPC time management refer to DPS Overview or DTEX.
- B. MTU hardware status information is displayed as 'MTU BITE' (V75M3540P) on DPS Overview. Each bit of the status word is described in Table 4.10-1 and a console malfunction procedure flow for the MTU failures is provided in Figure 4.10-1.
- C. GPC time source information is displayed as 'Time Src' on DPS Overview and as a clock icon on DTEX. The first of the two digits will reflect either an "A" or "C" for accumulator or computer time source; the second digit will be numbers 1 to 3 for an accumulator or 1 to 5 for a computer source. On DPS Overview and DTEX, the source indicates the view of the time sources from the downlisting GPC. This information is downlisted as part of the GPC vote word (see SCP 4.1 and Table 4.10-2).

**Table 4.10-1. MTU bite**

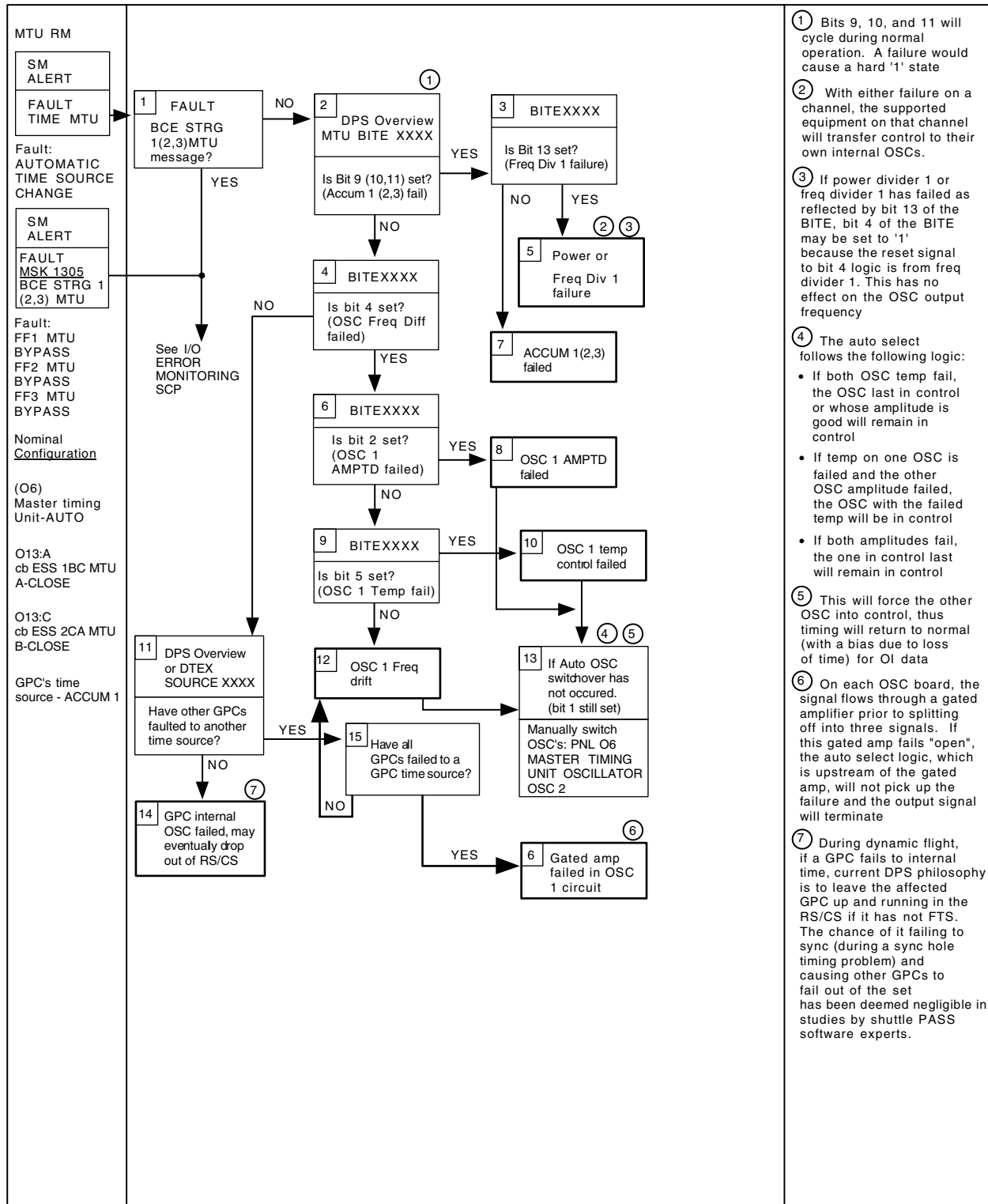
MSID: OIV75M3540P

			ACTIVE OSC: 1 = OSC #1 0 = OSC #2	OSC 1 AMPLITUDE FAIL	OSC 2 AMPLITUDE FAIL	OSC 1/2 FREQ DIFF	OSC 1 TEMP	OSC 2 TEMP	PWR SUPPLY #1	PWR SUPPLY #2	ACCUM #1 FAIL	ACCUM #2 FAIL	ACCUM #3 FAIL	IRIG B DIFF	FREQ DIV 1 FAIL	FREQ DIV 2 FAIL	FREQ DIV 3 FAIL	VALID UPDATE RECVD
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			

J\_18819\_042

**Bit Description**

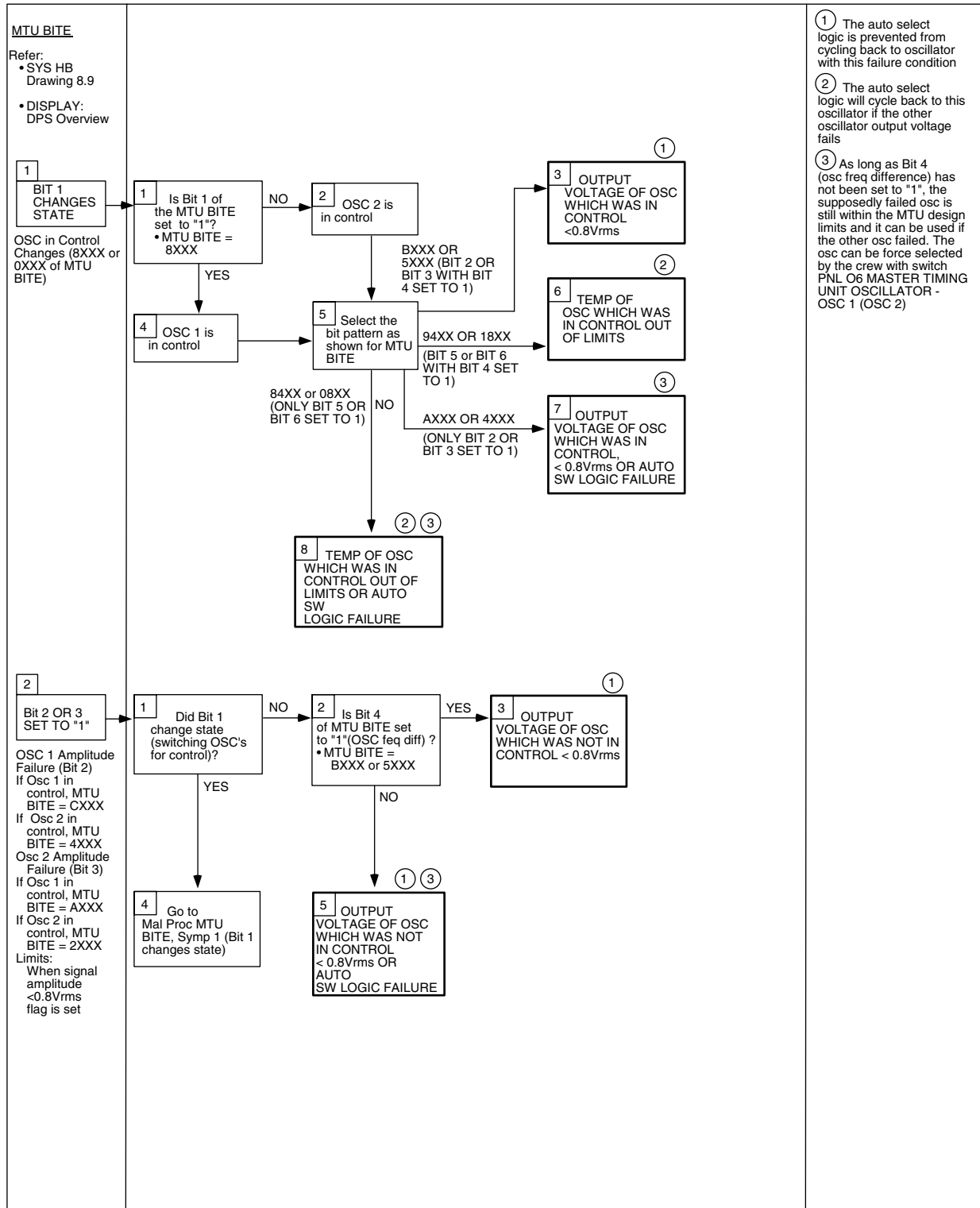
- 1 **OSC** - 1 = Oscillator no. 1 is used as the active driver of the MTU.  
0 = Oscillator no. 2 is used as the active driver of the MTU. Bits 2 through 15: 0 = Good, 1 = Failed
- 2 **OSC 1 Amplitude Fail** - The voltage output of OSC 1 is <0.8V RMS. This will cause the auto select logic, if switch "MASTER TIMING UNIT OSCILLATOR" is in the AUTO position PNL 06, to switch to OSC 2 if OSC 1 is the driver. Bit 1 will change state to reflect the change in OSC control.
- 3 **OSC 2 Amplitude Fail** - The voltage output of OSC 2 is <0.8V RMS. This will cause the auto select logic, if switch "MASTER TIMING UNIT OSCILLATOR" is in the AUTO position PNL 06, to switch to OSC 1 if OSC 2 is the driver. Bit 1 will change state to reflect the change in OSC control.
- 4 **OSC 1/2 Frequency Difference** - The output frequency of the oscillators are compared with each other and a flag is set if they should drift part by a relative frequency of 0.04 Hz in a 60-second period. This reflects that one of the oscillators is out of spec with a drift rate greater than  $1 \times 10^{-8}$ .
- 5 **OSC 1 Temperature** - Oscillator no. 1 oven temperature has exceeded the design limits of 75° to 85° C. This failure will cause the auto select logic, if switch "MASTER TIMING UNIT OSCILLATOR" is in the AUTO position PNL 06, to switch to OSC 2 if OSC 1 is the driver. Bit 1 will change state to reflect the change in OSC control.
- 6 **OSC 2 Temperature** - Oscillator no. 2 oven temperature has exceeded the design limits of 75° to 85° C. This failure will cause the auto select logic, if switch "MASTER TIMING UNIT OSCILLATOR" is in the AUTO position PNL 06, to switch to OSC 1 if OSC 2 is the driver. Bit 1 will change state to reflect the change in OSC control.
- 7 **Power Supply A** - Power Supply A output voltage (8 or 16 volts) is out of limits (not within 6.9 to 9.2V or 13.8 to 18.6V). No effect on BTU performance since power supply B is redundant. Power supply is on O13:A cb4, and powered through ESS1BC.
- 8 **Power Supply B** - Power Supply B output voltage (8 or 16 volts) is out of limits (not within 6.9 to 9.2V or 13.8 to 18.6V). No effect on BTU performance since power supply A is redundant. Power supply is on O13:C cb12, and powered through ESS2CA.
- 9 **Accumulator No. 1 Fail** - The output of accumulator no. 1 shift register pair 2 does not coincide with the outputs of accumulators 2 and 3 bit by bit). This may indicate an accumulator 1 problem. If the source selected by GPC is accumulator 1, then MTU RM may occur with the GPC selecting another accumulator.
- 10 **Accumulator No. 2 Fail** - The output of accumulator no. 2 shift register pair 2 does not coincide with the outputs of accumulators 1 and 3 bit by bit). This may indicate an accumulator 2 problem. If the source selected by GPC is accumulator 2, then MTU RM may occur with the GPC selecting another accumulator.
- 11 **Accumulator No. 3 Fail** - The output of accumulator no. 3 shift register pair 2 does not coincide with the outputs of accumulators 1 and 2 bit by bit). This may indicate an accumulator 3 problem. If the source selected by GPC is accumulator 3, then MTU RM may occur with the GPC selecting another accumulator.
- 12 **IRIG "B" Difference** - IRIG "B" format generator outputs are voted bit by bit. If one of three channels for GMT or MET is not the same, then this flag is set. This flag may coincide with bit 9, 10, or 11 being set.
- 13 **Frequency Divider 1 Fail** - The 1 Hz output of the frequency divider package no. 1 is compared to the 1 Hz outputs of frequency dividers no. 2 and no. 3. Both comparisons have to miscompare to set the flag. It is possible to get the flag and still have no effect on the MTU outputs. When it does affect the output, accumulator no. 1 time will vary from the other accumulators, causing bits 9 and 12 to set.
- 14 **Frequency Divider 2 Fail** - The 1 Hz output of the frequency divider package no. 2 is compared to the 1 Hz outputs of frequency dividers no. 1 and no. 3. Both comparisons have to miscompare to set the flag. It is possible to get the flag and still have no effect on the MTU outputs. When it does affect the output, accumulator no. 2 time will vary from the other accumulators, causing bits 10 and 12 to set.
- 15 **Frequency Divider 3 Fail** - The 1 Hz output of the frequency divider package no. 3 is compared to the 1 Hz outputs of frequency dividers no. 1 and no. 2. Both comparisons have to miscompare to set the flag. It is possible to get the flag and still have no effect on the MTU outputs. When it does affect the output, accumulator no. 3 time will vary from the other accumulators, causing bits 11 and 12 to set.
- 16 **Valid Update Received** - Occurs when an update other than a reset to the MTU is initiated. The flag represents a valid update (i.e., sync, parity, number of words) was received by the update logic. This flag will remain 1 until coincidence time has been reached (1 to 2 minutes). The change of state from a "1" to a "0" shows that the coincidence time has occurred and the update time has been strobed into the accumulator registers. It remains in this state during all periods except when an update is requested.



- Bits 9, 10, and 11 will cycle during normal operation. A failure would cause a hard '1' state
- With either failure on a channel, the supported equipment on that channel will transfer control to their own internal OSCs.
- If power divider 1 or freq divider 1 has failed as reflected by bit 13 of the BITE, bit 4 of the BITE may be set to '1' because the reset signal to bit 4 logic is from freq divider 1. This has no effect on the OSC output frequency
- The auto select follows the following logic:
  - If both OSC temp fail, the OSC last in control or whose amplitude is good will remain in control
  - If temp on one OSC is failed and the other OSC amplitude failed, the OSC with the failed temp will be in control
  - If both amplitudes fail, the one in control last will remain in control
- This will force the other OSC into control, thus timing will return to normal (with a bias due to loss of time) for OI data
- On each OSC board, the signal flows through a gated amplifier prior to splitting off into three signals. If this gated amp fails "open", the auto select logic, which is upstream of the gated amp, will not pick up the failure and the output signal will terminate
- During dynamic flight, if a GPC fails to internal time, current DPS philosophy is to leave the affected GPC up and running in the RS/CS if it has not FTS. The chance of it failing to sync (during a sync hole timing problem) and causing other GPCs to fail out of the set has been deemed negligible in studies by shuttle PASS software experts.

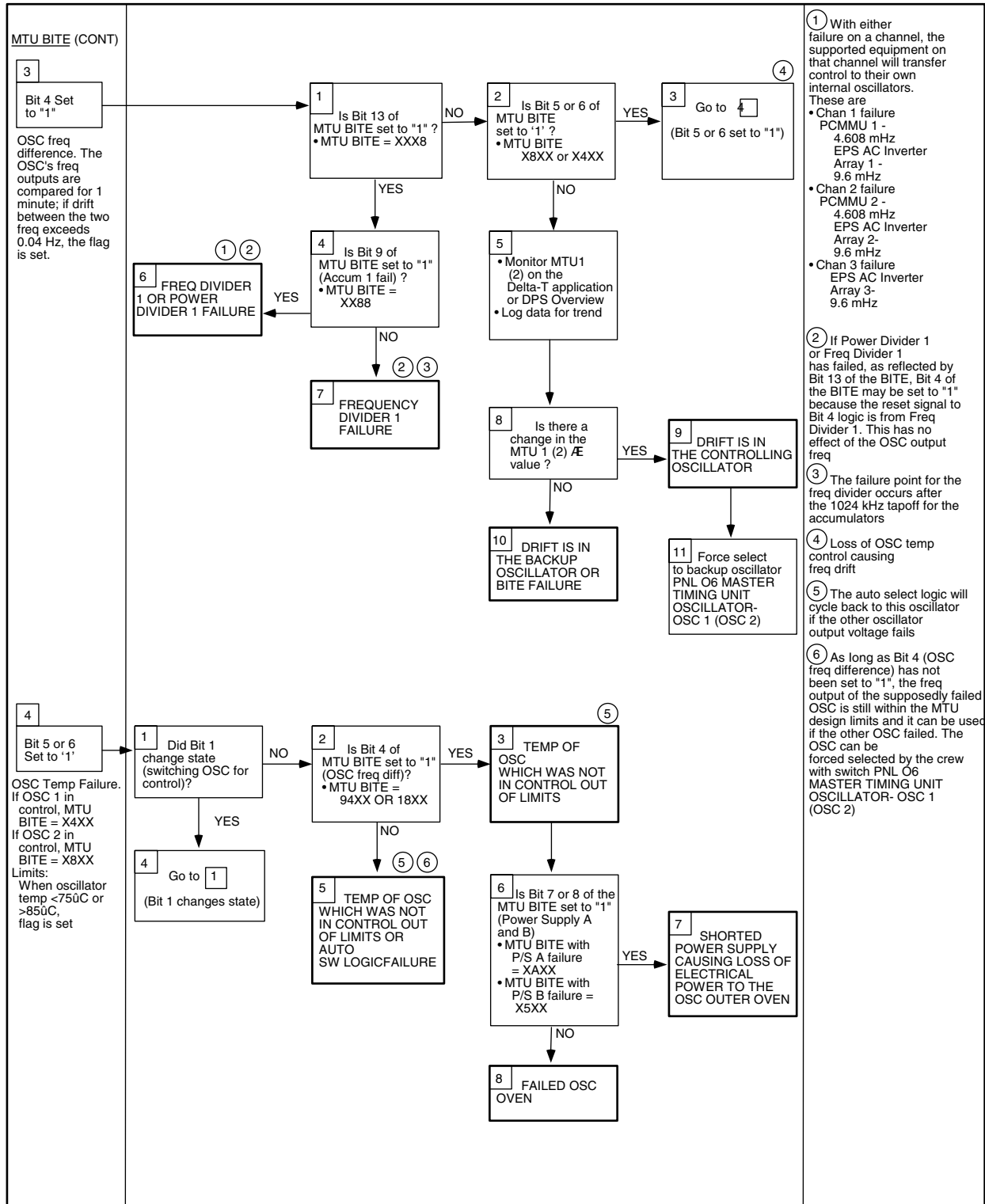
j\_18819\_002a.cvs

Figure 4.10-1. Malfunction procedure sheet



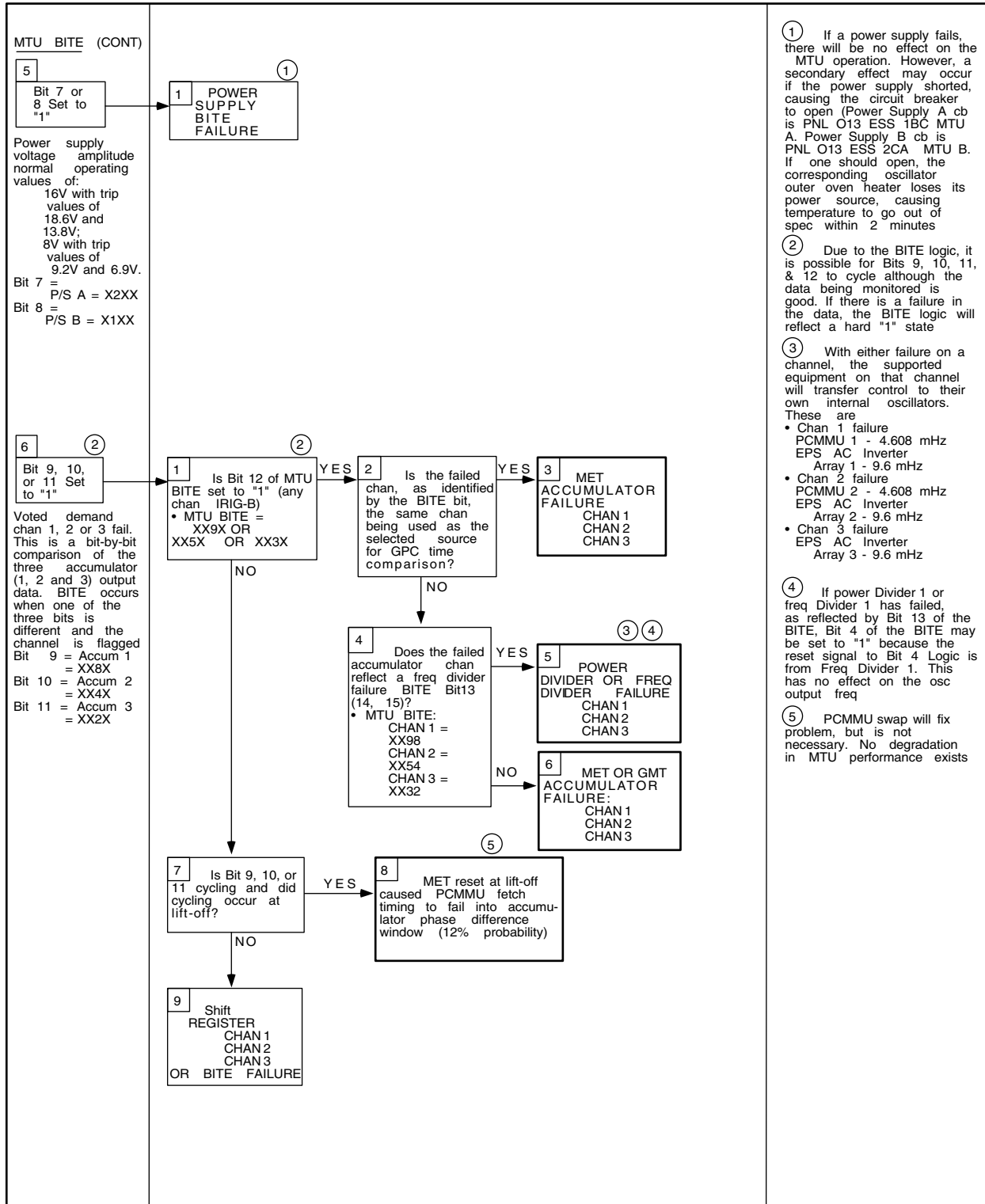
j\_18819\_056

Figure 4.10-1. Malfunction procedure sheet (2 of 5)



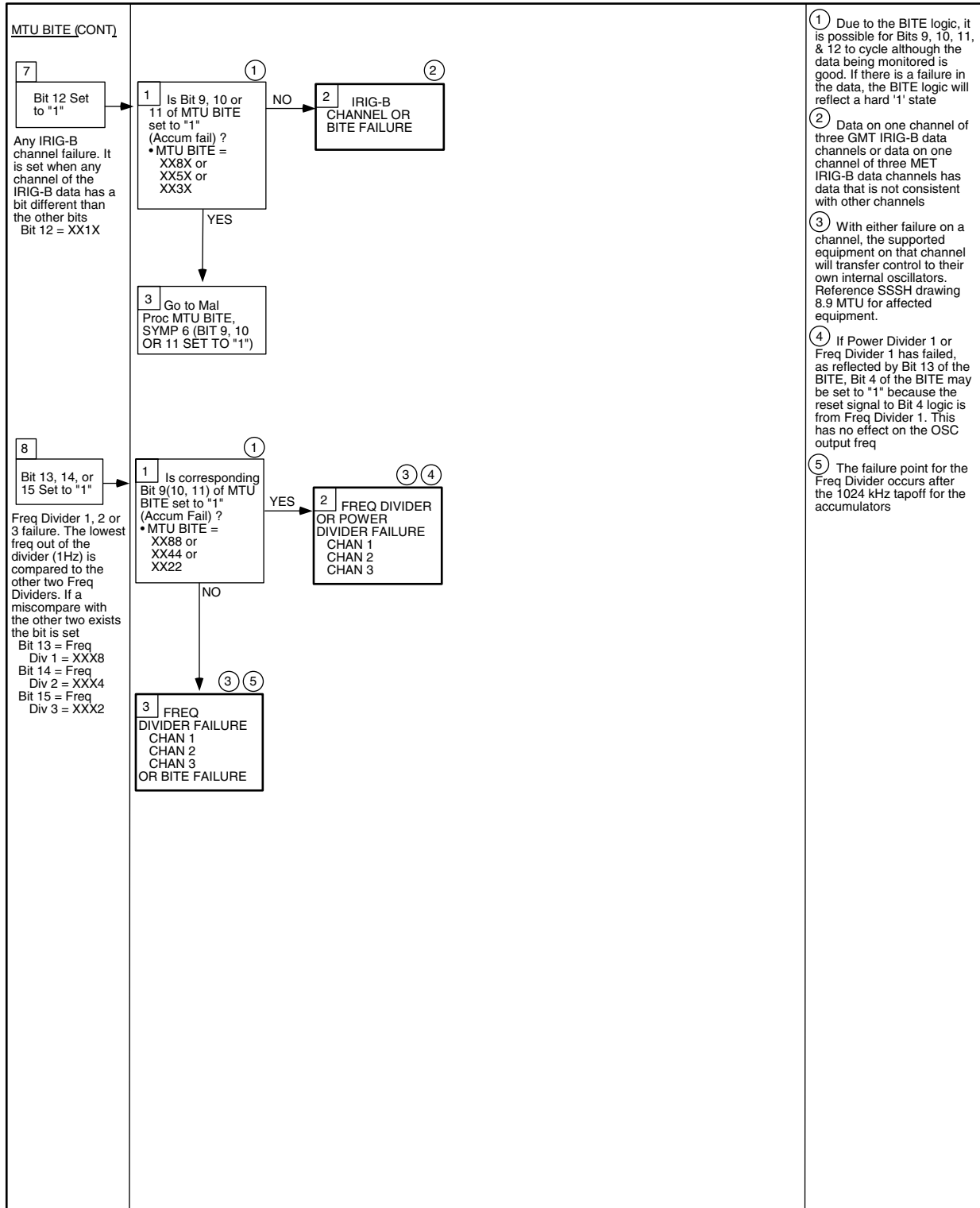
j\_18819\_054

Figure 4.10-1. Malfunction procedure sheet (3 of 5)



j\_18819\_055

Figure 4.10-1. Malfunction procedure sheet (4 of 5)



j\_18819\_058

**Figure 4.10-1. Malfunction procedure sheet (5 of 5)**

4.10-7  
**Verify that this is the correct version before use**



**Table 4.10-2. GPC vote word**

(See SCP 4.1, PASS Status for detailed bit decoding of the entire GPC vote word.)

GPC time source	GPC X VOTE WORD <sup>a</sup>
Accum 1	X*X1 or X*X9
Accum 2	X*X2 or X*XA
Accum 3	X*X3 or X*XB
GPC 1	X + X1 or X + X9
GPC 2	X + X2 or X + XA
GPC 3	X + X3 or X + XB
GPC 4	X + X4 or X + XC
GPC 5	X + X5 or X + XD

<sup>a</sup> Bit 13 of VOTE WORD concerns GPC fail votes and affects last digit of the GPC X VOTE WORD.

\* = 1, 5, 9 or D (LSB = 1)

+ = 0, 4, 8, or C (LSB = 0)

- D. Time error measurement is accomplished via special computations in the workstation that compare onboard GMT to a very accurate STDN GMT ( $\pm 25$  microseconds). These computations are made available for display as MTU 1  $\Delta T$ , MTU 2  $\Delta T$ , GNC  $\Delta T$ , SM  $\Delta T$ , OPS 0  $\Delta T$ , and BFS  $\Delta T$  (applications listed in step A). MTU 1  $\Delta T$  and MTU 2  $\Delta T$ , which are computed from the OI downlinked GMT, are prime for tracking MTU errors and updates. The other  $\Delta T$  comps are computed from downlisted GMT, which is GPC CLOCKTIME (see Table 4.10-3). CLOCKTIME is not updated by MTU GMT and may not reflect true GMT. Therefore, the GPC GMT parameters should not be considered reliable for tracking true GMT. (Note: GMT updates are not reflected in CLOCKTIME.)

**Table 4.10-3. Downlink times and associated ground times**

V91M1999PX	=	GNC GMT
V91M1999PY	=	SM GMT
V91M1999PZ	=	OP0 GMT
V98W0150C	=	BFS GMT
V75W3504D	=	MTU 1 GMT
V75W3604D	=	MTU 2 GMT
M40H0208J	=	Remote site time for GNC downlist
M40H0308J	=	Remote site time for SM downlist
M40H0508J	=	Remote site time for OP0/PL9 downlists
M40H0408J	=	Remote site time for BFS downlist
M40H0108J	=	Remote site time for OI downlink

The  $\Delta T$  computations use a scheme of adjusting downlink and downlist GMT to the start of the STDN's OD data cycle. This normalization provides a repeatable  $\Delta T$  comp (steady value) for each comp cycle. This procedure is contained in SCP 6.2.

- E. MTU MET is used by the GPCs during initialization to align the GPC MET register with the MTU MET accumulators. After initialization, should the MTU and GPC MET times disagree, both can be reset by selecting SPEC 2 - TIME and executing item 33. (Note: This cannot be done in OPS 1/6 or 3.) MET RESET resets the MET to 0 in both the MTU and the common set GPCs. MET RESET will align both systems so that an MET update can be performed to restore MET time. The GPC does not downlist MTU MET, but computes GPC MET (V91M7475P) by subtracting MET T-0 from GMT. At lift-off, the GMT is entered into MET T-0. It will not change until a GMT/MET update is executed. An MET update changes MET T-0 by the negative of the  $\Delta$  update (the opposite for a GMT update).
- F. Oscillator configuration can be monitored on DPS Overview. DPS Overview indicates auto or manual oscillator selection and which oscillator is actually selected. The automatic selection logic will be overridden if the switch is not in the AUTO position.
- G. BFS time source can be found on DPS Overview and DTEX; the source can also be decoded from BFS DISC WD B. Table 4.10-4 is used to explain how to determine the BFS GPC time source from this word.

**Table 4.10-4. BFS/GPC time source**

Time source	Disc B
Accum 1	XXX1
Accum 1	XXX2
Accum 1	XXX3
BFS Internal Time	XXX0

- H. BFS will not accept MTU GMT/MET from a failed accumulator/frequency divider during initialization. Failed accumulators/frequency dividers can be determined by examining MTU BITE bits as shown in Table 4.10-5.

**Table 4.10-5. MTU accum fail to BFS**

Accum failure	MTU BITE bit set = 1 a
1	9 or 13
2	10 or 14
3	11 or 15

<sup>a</sup> Any BITE bit set will result in the BFS failing the applicable accumulator.

- I. The GPC uses MTU GMT to correct its GMT clock at 1.04 times per second.
- J. GMT will be initialized in the MTU/GPCs approximately 70 hours prior to launch. A final update will be performed at T-75 minutes.
- K. GMT initialization can be performed when only one GPC is running (simplex OPS) and in OPS 000. Otherwise, the GMT update is constrained to a maximum of ±15 milliseconds. This constraint does not apply to MET updates. (GMT updates are performed in increments no smaller than 1 millisecond).
- L. During on-orbit operations, mission rules call for an update when GMT delta error exceeds ±100 milliseconds. The rationale for this value is to avoid having to update. Should drift exceed 100 milliseconds, an update will be performed to make a Δ error less than 100 milliseconds. This procedure is contained in SCP 6.2.
- M. With nominal operation of the MTU, the Δ GMT error should not violate the mission rule for any of the expected mission durations. The Δ GMT error that can be expected is demonstrated in the following equations:

$$E = (0 + \frac{D*N}{2}) S*N + I \quad \text{Where}$$

- E = total error in seconds
- S = number of seconds per day = 86,400
- N = number of days
- O = initial offset of oscillator (Spec: 1 x 10<sup>-9</sup> parts/day)
- D = drift rate per day (Spec: 1 x 10<sup>-9</sup> parts/day)
- I = initialization error (± 1 x 10<sup>-3</sup> sec)

This results in a worse case error of 1.1 milliseconds for 1 day, and 6.2 milliseconds for 10 days.

- N. MTU and PASS GPC MET will reflect GMT until lift-off, at which time MET will reset to zero (SRB ignition). The PASS GPC computes MET by (MET T-0) from GMT.

The PASS GPCs do not use MTU MET (except for GPC initialization). Onboard mission timers are driven directly by MTU GMT and MTU MET.

- O. The orbiter GMT (OGMT) and orbiter MET (OMET) times that appear in the header of the D/TV displays are MTU times that are downlinked via OI MDMs (OF1 and OF2). The nonvoted OI version of these times serves as a backup and the GPC version as a third backup.
- P. PASS GMT and MET updates can be performed either by the crew via SPEC 2 or by MCC-H uplink using DEU equivalents. This procedure is contained in SCP 6.2 or 7.8. Any update corrects both the GPC and MTU simultaneously. Time management controls are not available in GNC OPS 1/6 and 3. The TIME SPEC can be called in OPS 0 only when the previous memory configuration is contained in the SPEC. Time updates are legal via the SM time controls (SPEC 2) even if the GNC GPCs are in GNC 301. However, all updates should be initiated via a GNC RS GPC to avoid a possible fail to sync for a GMT update or a fail to update for an MET update.
- Q. BFS GMT is initialized to the MTU GMT at BFS transition to OPS 101 and OPS 301 and continues to reflect MTU GMT during these OPS. BFS MET is zeroed at BFS transition to OPS 101 and remains zero until SRB ignition, at which time it will count up. At BFS transition to OPS 301, the BFS GPC will initialize its GMT and MET to the MTU GMT and MET. Once initialized, MTU MET is not used by the BFS GPC. BFS MET correction is derived from the difference of MTU and BFS GPC GMT. With OI-24, the BFS can be updated via item entries on the BFS memory SPEC 0. Updates can be performed only in OPS 0 or OPS 301.
- R. GMT/MET updates are incorporated 1 to 2 minutes after crew/uplink execution. The update waits until the next whole minute is reached and then takes 1 minute after that before performing the update.
- S. The MTU data is a low frequency read element (once per major cycle) and is, thus, only read by PASS once a second. For PASS to bypass the MTU, it must first detect two consecutive errors against it. PASS uses what is known as an I/O transaction error counter for this process. This error counter is zeroed out every time I/O resets, port modes, OPS transitions, or OPS mode recalls are performed. When an I/O Reset is executed, PASS separately upmodes each string. This action takes several seconds to complete since it takes approximately 1 second per string. Once bypassed elements on string 3 are upmoded, both PASS and BFS will be looking for accumulator 3 input data (actual commanding accomplished by PASS string 3 bus commander). After two unsuccessful data acquisition attempts, the BFS will bypass the read element. As for PASS, one unsuccessful read will occur (transaction ID=22 error counter will be incremented to one). However, when string 4 is upmoded, all I/O transaction counters including the MTU read) will be cleared. Thus, two more read cycles will occur before the PASS bypasses MTU accumulator 3. In parallel with all of this I/O activity, the PASS is transferring data to the BFS

every 40 ms. Included in this PASS redundant set transfer data is the PASS BCE element bypass status, which the BFS compares against its own BCE bypass element status and its own element bypass status. Therefore, after the second consecutive read following string 3 upmode, the BFS detects a miscompare between the PASS redundant set transfer data BCE bypass element status and its own element bypass status. Since the MTU accumulator 3 bypass status disagree, the BFS will log a GPC error code 46 and downmode the affected string 3. Reference user notes B05284A and 35211.

This does not happen with higher frequency read elements because PASS will read these elements multiple times in the 1-second timeframe it has to upmode the string and, thus, will bypass the element before BFS can detect there is "disagreement." The crew action is to wait for the upmoding of all strings to complete (10 seconds after the PASS I/O Reset is requested is long enough) and then perform an I/O Reset to BFS to recover string 3.

The potential to drop string 3 in the BFS is not an impact to OPS transitions, since BFS already goes stand-alone per design. There is a small possibility for the BFS to drop string 3 during restrings when tracking PASS. This is because during OPS Mode Recalls, all buses are upmoded simultaneously. Since this type of upmoding is much quicker than that associated with an I/O Reset, the chance of dropping string 3 is significantly reduced.

## **REFERENCES**

1. Master Timing Unit Specification, MC 456-0051.
2. MCC Level B and C Requirements for Shuttle Telemetry Data Processing, Vol. 1 Shuttle Data Processing Complex (SDPC) Software.
3. National Space Transportation System Computer Program Development Specification (CPDS), SS-P-0002-170, sec. 5.9.2.



- 3 Retry ENA - If set, this indicates that the ops transition logic will automatically retry an overlay if there is an error on the first attempt. Note that this bit is hardcoded on and could be turned off only with a GMEM.

**Table 4.11-2. SSMM Status WD A**

	POWER INTERRUPT	INTER-BLOCK TIMER EXP	NOT USED	WRITE PROTECT VIOLATION	TMV OF CODE/MIA	LOOK UP TABLE CMD ERR	WATCHDOG TIMER ERROR	CHECKSUM TEST FAILED	FAILED SRAM PATTERN	FLSH 2 BNK 1	FLSH 1 BNK 1	FLSH 0 BNK 1	FLSH 2 BNK 0	FLSH 1 BNK 0	FLSH 0 BNK 0
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Bit    Description

- 0    Power-Up –This bit is set during power up and power transients.
- 1    Inter-Block Gap Timer Expired- This bit is set, if during a block transfer, the SSMM does not receive the entire block (512 words) within the allotted time.
- 2    Not Used
- 3    Write Protect Violation - This bit is set when Write is WRT PROTECT attempted under any of the following conditions:
  - Write command not preceded by a Write Enable.
  - Write Enable track and Write track do not compare.
  - Write Enable was reset before a write.
  - Write command received on an error bit set in status.



- 4 Invalid Opcode/MIA Command Error - This bit is set for any of the INV CMD/MIA ERROR following conditions:
  - Invalid Op Code
  - Command sync and MIA Manchester error
  - Command sync and MIA parity error
  - Command sync and MIA bit count error
  - BOF and EOF are both set to '1'
- 5 Triple Majority Voting (TMV) of Flash Error- This bit is set when there is a mismatch between any combination of two out of three copies of byte bits.
- 6 Look Up Table Make Failed-Memory Look up table was not created properly.
- 7 Watchdog Timer Failed- During powerup: indicates a problem with either the 800 KHZ clock from the FPGA or the internal counter operation of 8051. During READS and WRITES: indicates a problem with the data transfer operation.
- 8 Checksum Test Failed- Indicates a problem with EEPROM.
- 9 Failed SRAM Pattern Test/BIT- Indicates a problem with read/write access to SRAM
- 10 Flash 2 Bnk 1 Failed Pattern Test/BIT- Indicates a problem with Flash 2 Bank 1 memory.
- 11 Flash 1 Bnk 1 Failed Pattern Test/BIT- Indicates a problem with Flash 1 Bank 1 memory.
- 12 Flash 0 Bnk 1 Failed Pattern Test/BIT- Indicates a problem with Flash 0 Bank 1 memory.
- 13 Flash 2 Bnk 0 Failed Pattern Test/BIT- Indicates a problem with Flash 2 Bank 0 memory.
- 14 Flash 1 Bnk 0 Failed Pattern Test/BIT- Indicates a problem with Flash 1 Bank 0 memory.
- 15 Flash 0 Bnk 0 Failed Pattern Test/BIT- Indicates a problem with Flash 0 Bank 0 memory.

**Table 4.11-3. SSMM Status WD B**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
INVALID WORD COUNT	BAD CHECKSUM	TABLE GENERATION FAIL	LUT GENERATION FAIL	INVALID MANCHESTER	CMD RCVD /SSMM NOT RDY	EOF READ/WRITE	NOT USED	SSMM MALFUNCTION	MODIFY LUT W/ NO ENABLE	INVALID CHECKSUM CMPRE	NOT USED	MIA BIT COUNT	MIA PARITY	INVALID I/O CHECK	MIA DATA/ADRS ERROR

**Bit Description**

- 0 Invalid Word Count- This bit is set if there are less than 512 data words received in a block.
- 1 Manufacturer Bad Block Checksum Failed- This bit is set if during the Power on Self-test, there is a miscompare between the contents of the Manufacturer Bad Block Table in the Data EEPROM and the checksum value stored.
- 2 Manufacturer Bad Block Table Generation Failed- This bit is set when the number of bad addresses exceeds the limit required to generate a valid look up table.
- 3 Look Up Table Generation Failed- This bit is set when not enough good flash addresses can be found to genrat a complete look up table.
- 4 Invalid Manchester Received Word- This bit is set on detection of an invalid Manchester received data word during a Write operation.
- 5 Command received when SSMM not ready- Any command (SSMM addressed) received (last bit) with the SSMM MIA in receive enable and the Ready discrete not ready.
- 6 EOF Error for READ/WRITE- End of file is reached for a multiple block read/write operation and the block counter has not decremented to zero.
- 7 Not used
- 8 SSMM Malfunction- In test mode: bit is set if Bench Test fails or Flash Erase fails. In normal mode: set if anytime the Watchdog Timer expires or any of bits 6-15 are set in Status Register A.
- 9 Attempt to Modify LUT, with no Enable- This bit is set if an attempt is made to modify the look up table and the Write Mode flag is not enabled.

- 10 Invalid Checksum Comparison- This bit is set when there is a miscompare between the internal software checksum and its associated checksum value stored in the Data EEPROM.
- 11 Not used
- 12 MIA bit Count Error on Received Data- This bit is set on detection of an incorrect bit count by the MIA in any received data words.
- 13 MIA Parity Error on Received Data- This bit is set on detection of a parity error by the MIA on any received data words.
- 14 Invalid SEV Check on Received Data- An S or V bit set to zero is detected on a received data word.
- 15 MIA Data/Address Errors- This bit is set for any of the following conditions on a received 512 data word block:
  - MIA address non-compare
  - MIA bit count error (bit 12)
  - MIA parity error (bit 13)
  - Invalid 101 check (bit 14)
  - Invalid Manchester (bit 4)
  - Command sync (SSMM or non-SSMM addressed) within 512 word block

## REFERENCES

1. Operation and Maintenance Instructions, Odetics Inc., NAS9-14000.
2. Modular Memory Unit System Segment Document, Boeing.

**TITLE**

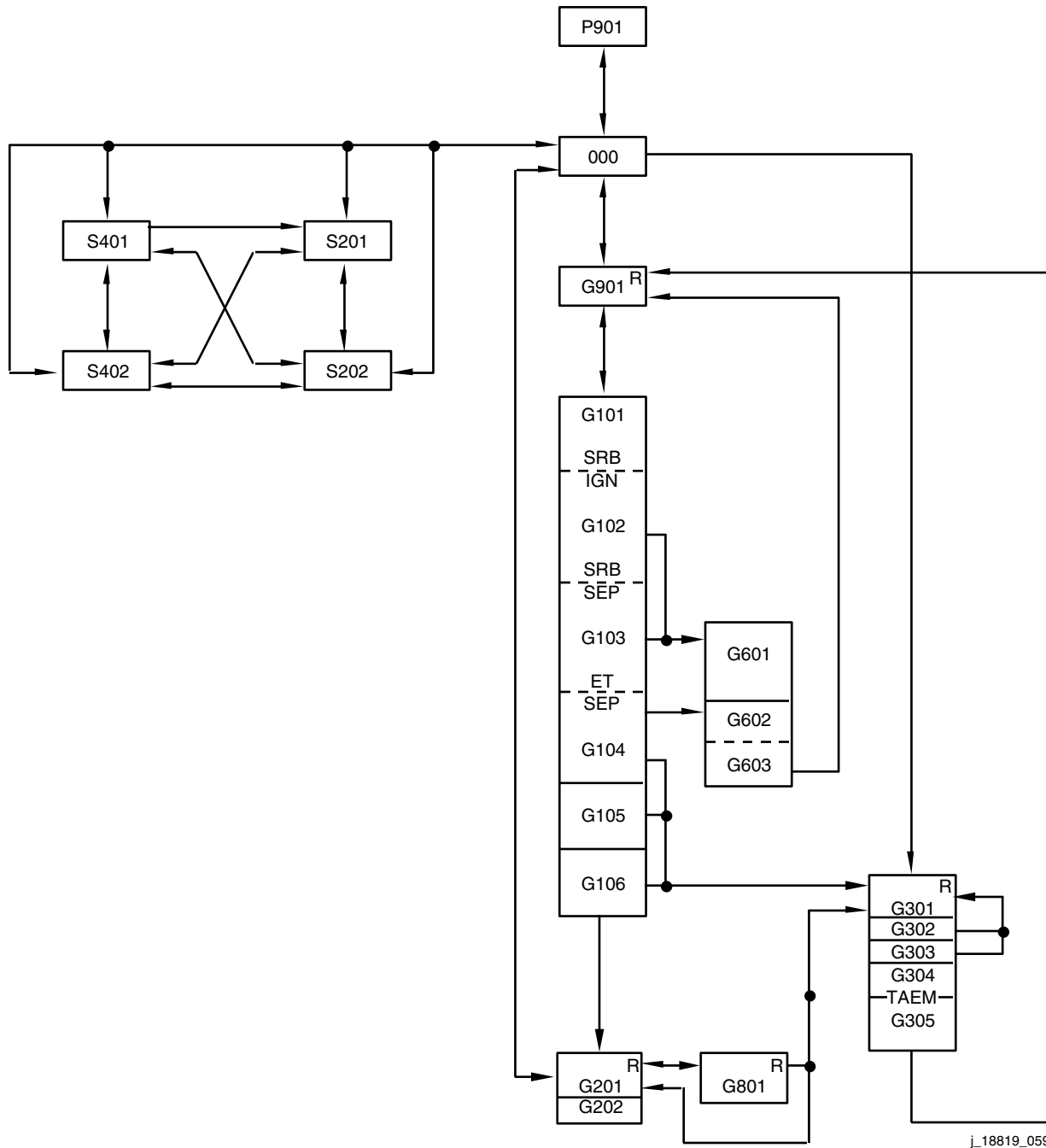
LEGAL OPS TRANSITIONS

**PURPOSE**

This section will present the legal ops transitions for both the PASS and BFS onboard software.

**SUMMARY**

The legal GNC ops transitions are summarized in Figure 4.12-1, and detail data is provided in Table 4.12-1. The legal SM and PL ops transitions are also shown in Figure 4.12-1. The legal BFS ops transitions are summarized in Figure 4.12-2, and detail data is provided in Table 4.12-2.



- MANUAL OPS TRANSITION
- ┌——┐ MANUAL MAJOR MODE TRANSITIONS
- ┆ - - ┆ AUTO MAJOR MODE TRANSITIONS
- - - ABORT OPS TRANSITIONS (DEPENDING UPON ABORT MODE,  
AUTOMATIC MAJOR MODE TRANSITIONS MAY OCCUR)
- R OPS/MODE RECALL POINT WHERE TARGET SET MAY BE CHANGED

**Figure 4.12-1. PASS legal OPS transitions**

4.12-2

**Verify that this is the correct version before use**

**Table 4.12-1. PASS major mode transition data**

Major mode transition From To		MAJ FUNC SW	Transition requirements	Input MDM element	RM	Comm fault protected
000	901	GNC	OPS 901 PRO	N/A	N/A	N/A
000	901	PL	OPS 901 PRO	N/A	N/A	N/A
000	201	SM	OPS XXX PRO	N/A	N/A	N/A
000	202	SM	where	N/A	N/A	N/A
000	401	SM	XXX = 201,202,401 or 402	N/A	N/A	N/A
000	402	SM		N/A	N/A	N/A
000	301	GNC	OPS 301 PRO	N/A	N/A	N/A
101	102	GNC	LPS GO FOR SSME START and Time base zero $\geq$ V97U9712C and All SSMEs $\geq$ V97U9714C RPL and No launch abort conditions	EIU 1, 2, 3		
102	103	GNC	Both SRB chamber pressure $\leq$ 50.0 psi within V97U9761C seconds or MET $\geq$ V97U9751C + a delay of U97U9753C seconds if no engine has failed or V99U7589C seconds if one engine has failed or V99U7676C seconds if two engines have failed and Attitude rates and dynamic pressure within limits or Manual switch ENABLED and CLOSED	FA1(D),FA4(D)     TBS  TBS		
102	601	GNC	Abort request = RTLS or OPS 601 PRO or Fast Sep request and Both SRB chamber pressure $\leq$ 50.0 psi within V97U9761C seconds or MET $\geq$ V97U9751C + a delay of V97U9753C seconds if no engine has failed or V99U7589C seconds if one engine has failed or V99U7676C seconds if two engines have failed and Attitude rates and dynamic pressure within limits or Manual switch ENABLED and CLOSED or ET separation occurs for a Fast Sep	FA1(D),FA4(D)          TBS		

**Table 4.12-1. PASS major mode transition data (continued)**

Major mode transition From To		MAJ FUNC SW	Transition requirements	Input MDM element	RM	Comm fault protected
103	104	GNC	OPS 104 PRO (expect "Illegal Entry" message if ET still attached - OPS note 40556) or TAL abort not declared and sep (-Z) velocity increment $\geq$ V97U2339C or TAL abort declared and sep (-Z) velocity increment $\geq$ V97U2339C + V97U7404C	FF 1, 2, 3		
103	601	GNC	Abort request = RTLS or OPS 601 PRO and TAL abort not declared and ATO abort not declared or Contingency 2-engine out start and No MECO command	N/A	N/A	N/A
104	105	GNC	OPS 105 PRO	N/A	N/A	N/A
104	301	GNC	OPS 301 PRO	FF 1, 2, 3		Yes
104	602	GNC	Abort request = RTLS or OPS 602 PRO and TAL abort not declared and sep (-Z) velocity increment $\geq$ V97U2339C fps or TAL abort declared and sep (-Z) velocity increment $\geq$ V97U2339C + V97U7404C fps and "OMS BURN ENABLE" has <u>NOT</u> been entered	FF 1, 2, 3		Yes
105	106	GNC	OPS 106 PRO	N/A	N/A	N/A
105	301	GNC	OPS 301 PRO	N/A	N/A	N/A
106	201	GNC	OPS 201 PRO	N/A	N/A	N/A
106	301	GNC	OPS 301 PRO	N/A	N/A	N/A
201	202	GNC	OPS 202 PRO	N/A	N/A	N/A
201	301	GNC	OPS 301 PRO	N/A	N/A	N/A
201	801	GNC	OPS 801 PRO	N/A	N/A	N/A
201	000	SM	OPS 000 PRO	N/A	N/A	N/A

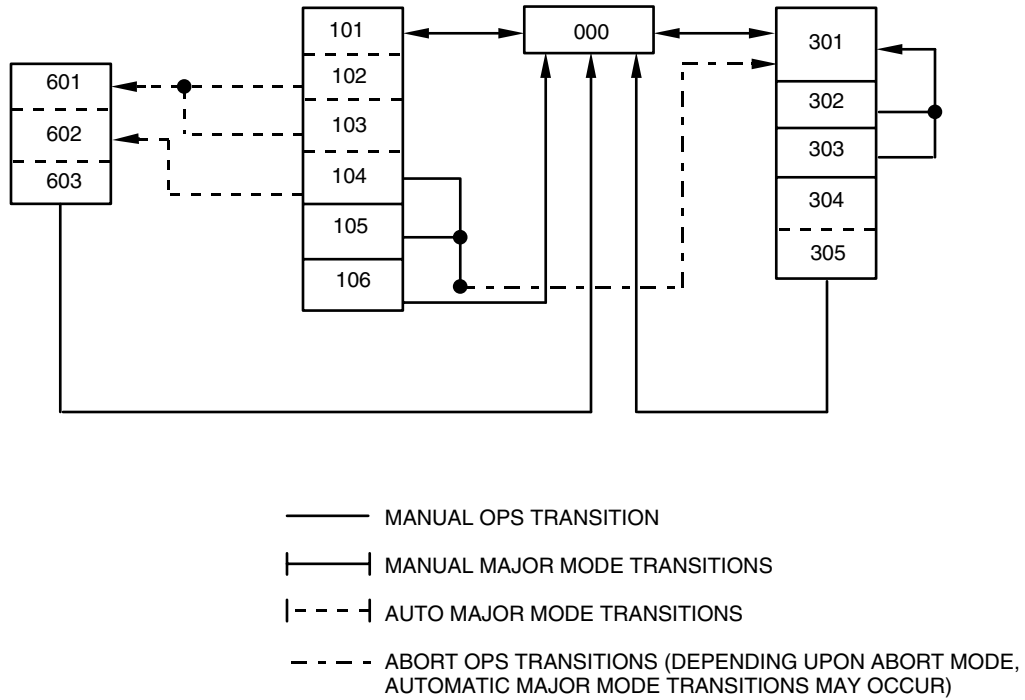
**Table 4.12-1. PASS major mode transition data (continued)**

Major mode transition		MAJ FUNC SW	Transition requirements	Input MDM element	RM	Comm fault protected
From	To					
201	202	SM	OPS 202 PRO	N/A	N/A	N/A
201	401	SM	OPS 401 PRO	N/A	N/A	N/A
201	402	SM	OPS 402 PRO	N/A	N/A	N/A
202	201	GNC	OPS 201 PRO	N/A	N/A	N/A
202	000	SM	OPS 000 PRO	N/A	N/A	N/A
202	201	SM	OPS 201 PRO	N/A	N/A	N/A
202	401	SM	OPS 401 PRO	N/A	N/A	N/A
202	402	SM	OPS 402 PRO	N/A	N/A	N/A
301	201	GNC	OPS 201 PRO	N/A	N/A	N/A
301	302	GNC	OPS 302 PRO or TAL auto advance	N/A	N/A	N/A
302	301	GNC	OPS 301 PRO			
302	303	GNC	OPS 303 PRO or TAL auto advance	N/A N/A	N/A N/A	N/A N/A
303	301	GNC	OPS 301 PRO	N/A	N/A	N/A
303	304	GNC	OPS 304 PRO or TAL auto advance	N/A N/A	N/A N/A	N/A N/A
304	305	GNC	OPS 305 PRO and Velocity ≤ V97U0420C fps (from Entry UPP) or Velocity ≤ V97U0420C fps (from Entry GUID)	FF 1, 2, 3 N/A FF 1, 2, 3	N/A	YES N/A YES
305	901	GNC	OPS 901 PRO	N/A	N/A	N/A
401	000	SM	OPS 000 PRO	N/A	N/A	N/A
401	201	SM	OPS 201 PRO	N/A	N/A	N/A
401	202	SM	OPS 202 PRO	N/A	N/A	N/A
401	402	SM	OPS 402 PRO	N/A	N/A	N/A
402	000	SM	OPS 000 PRO	N/A	N/A	N/A
402	201	SM	OPS 201 PRO	N/A	N/A	N/A
402	202	SM	OPS 202 PRO	N/A	N/A	N/A
402	401	SM	OPS 401 PRO	N/A	N/A	N/A



**Table 4.12-1. PASS major mode transition data (concluded)**

Major mode transition		MAJ FUNC	Transition requirements	Input MDM element	RM	Comm fault protected
From	To	SW				
601	602	GNC	<ul style="list-style-type: none"> <li>Contingency abort not declared and RTLS ET sep command + V98U9958C seconds</li> <li style="text-align: center;">or</li> <li>Contingency abort declared and contingency maneuver is complete and RTLS ET sep command + V97U8206CV</li> <li style="text-align: center;">and</li> <li>Nav angle of attack <math>\geq</math> V98U9959C</li> <li style="text-align: center;">and</li> <li>X-axis body frame relative velocity vector <math>&gt; 0</math></li> <li style="text-align: center;">or</li> <li>OPS 602 PRO</li> </ul>	N/A	N/A	N/A
602	603	GNC	<ul style="list-style-type: none"> <li>OPS 603 PRO</li> <li style="text-align: center;">and</li> <li>Velocity <math>\leq</math> V97U9688C</li> <li style="text-align: center;">or</li> <li>Velocity <math>\leq</math> V97U9688C</li> <li style="text-align: center;">and</li> <li>Vehicle is heading back to the launch site; i.e., the angle between the launch site heading vector and the vehicle velocity vector is less than 90°</li> </ul>	<ul style="list-style-type: none"> <li>FF 1, 2, 3</li> <li style="text-align: center;">N/A</li> <li>FF 1, 2, 3</li> </ul>	N/A	<ul style="list-style-type: none"> <li>YES</li> <li style="text-align: center;">N/A</li> <li>YES</li> </ul>
603	901	GNC	OPS 901 PRO	N/A	N/A	N/A
801	201	GNC	OPS 201 PRO	N/A	N/A	N/A
801	201	GNC	OPS 201 PRO	N/A	N/A	N/A
801	301	GNC	OPS 301 PRO	N/A	N/A	N/A
901	101	GNC	OPS 101 PRO	N/A	N/A	N/A
901	000	GNC	OPS 000 PRO	N/A	N/A	N/A
901	000	PL	OPS 000 PRO	N/A	N/A	N/A



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**Figure 4.12-2. BFS legal OPS transition**

**Table 4.12-2. BFS major mode transition data**

Major mode transition From To		Transition requirements	Input MDM (element)	RM	Comm fault protected
000	101	OPS 101 PRO (BFS KYBD only) and if BFS not engaged) PASS tracking established	N/A N/A	N/A N/A	N/A N/A
000	301	OPS 301 PRO (BFS KYBD only) and (if BFS not engaged) PASS tracking established	N/A N/A	N/A N/A	N/A N/A
101	102	L SRB P <sub>C</sub> A, B, C > 50 psia or R SRB P <sub>C</sub> A, B, C > 50 psia or 3.2 sec after ME (1, 2, 3) P <sub>C</sub> > 90%	FA 1, 2, 3 (D)  FA 1, 2, 3 (D)  EIU 1, 2, 3	MVS/3  MVS/3  3/3	NO  NO  NO
101	000	OPS 000 PRO (BFS KYBD only)	N/A	N/A	N/A
102	103	BFS not engaged and MET > 100 seconds  and <ul style="list-style-type: none"> <li>L SRB SEP IND A and R SRB SEP IND B</li> <li>or</li> <li>L SRB SEP IND B and R SRB SEP IND A</li> <li>or</li> <li>OPS 103 PRO*</li> <li>or</li> <li>BFS engaged**</li> <li>and</li> <li> <ul style="list-style-type: none"> <li>L SRB P<sub>C</sub> &lt; 50 psia and R SRB P<sub>C</sub> &lt; 50 psia and MET &gt; 100 sec</li> <li>or</li> <li>MET &gt; 134.5 sec</li> </ul> </li> </ul>	N/A  FA 1 (D)  FA 4 (D)  or  FA 3 (D)  FA 2 (D)  N/A  N/A  FA 1, 2, 3 (D)  FA 1, 2, 3 (D)  N/A	N/A  1/1  1/1  1/1  1/1  N/A  N/A  MVS/3  MVS/3  N/A	N/A  NO  NO  NO  NO  N/A  N/A  NO  NO  N/A

\*DK listen or BFS keyboard input

\*\*BFS would not be able to perform the SRB separation if engaged and OPS 103 PRO prior to SRB separation.

**Table 4.12-2. BFS major mode transition data (continued)**

Major mode transition From To		Transition requirements	Input MDM (element)	RM	Comm fault protected
102	601	BFS not engage and MET > 100 sec	N/A	N/A	N/A
		and			
		[ RTLS SW A, B, C	FF 1, 2, 3 (B)	2/3	NO
		or			
		OPS 601 PRO*	N/A	N/A	N/A
		and			
		[ L SRB SEP IND A	FA 1 (D)	1/1	NO
		and			
		R SRB SEP IND B	FA 4 (D)	1/1	NO
		or			
		[ L SRB SEP IND B	FA 3 (D)	1/1	NO
		and			
		R SRB SEP IND A	FA 2 (D)	1/1	NO
		or			
		BFS engaged	N/A	N/A	N/A
		and			
		[ RTLS SW A, B, C	FF 1, 2, 3 (B)	2/3	NO
		or			
		OPS 601 PRO*	N/A	N/A	N/A
		and			
		[ L SRB P <sub>C</sub> < 50 psia	FA 1, 3 (D)	1/2	NO
		and			
		R SRB P <sub>C</sub> < 50 psia	FA 2, 4 (D)	1/2	NO
		and			
		MET > 100 sec			
		or			
		MET > 134.5 sec	N/A	N/A	N/A

\*DK listen or BFS keyboard input

**Table 4.12-2. BFS major mode transition data (continued)**

Major mode transition From To		Transition requirements	Input MDM (element)	RM	Comm fault protected
103	104	<ul style="list-style-type: none"> <li>■ BFS not engaged</li> <li>■ and</li> <li>■ SSME PC 1, 2, 3 &lt; 30%</li> <li>■ or</li> <li>■ [ SSME PC 1, 2, 3 &lt; 30%</li> <li>■ and</li> <li>■ EIU 1, 2, 3 data path fail</li> <li>■ and</li> <li>■ [ ET SEP IND A</li> <li>■ and</li> <li>■ ET SEP IND C</li> <li>■ or</li> <li>■ [ ET SEP IND B</li> <li>■ and</li> <li>■ ET SEP IND D</li> <li>■ and</li> <li>■ <math>\Delta VZ &gt; 3.2 \text{ fps}</math> 10.2 fps (TAL or AOA)</li> <li>■ or</li> <li>■ OPS 104 PRO *</li> <li>■ or</li> <li>■ ■ BFS engaged</li> <li>■ and</li> <li>■ SSME PC 1, 2, 3 &lt; 30%</li> <li>■ or</li> <li>■ [ SSME PC 1, 2, 3 &lt; 30%</li> <li>■ and</li> <li>■ EIU 1, 2, 3 data path fail</li> <li>■ and</li> <li>■ ET SEP CMD</li> <li>■ and</li> <li>■ <math>\Delta VZ &gt; 4.0 \text{ fps}</math> 11.0 fps (TAL or AOA)</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> <li>EIU 1, 2, 3</li> <li>EIU 1, 2, 3</li> <li>EIU 1, 2, 3</li> <li>FA 1 (D)</li> <li>FA 3 (D)</li> <li>FA 2 (D)</li> <li>FA 4 (D)</li> <li>FF 1, 2, 3 (IMU)</li> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>EIU 1, 2, 3</li> <li>EIU 1, 2, 3</li> <li>EIU 1, 2, 3</li> <li>N/A</li> <li>FF 1, 2, 3 (IMU)</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> <li>3/3</li> <li>2/3</li> <li>1/3</li> <li>1/1</li> <li>1/1</li> <li>1/1</li> <li>1/1</li> <li>MVS/3 LOW ID/2, 1/1</li> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>3/3</li> <li>2/3</li> <li>1/3</li> <li>N/A</li> <li>MVS/3, LOW ID/2, 1/1</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> <li>NO</li> <li>NO</li> <li>NO</li> <li>NO</li> <li>NO</li> <li>NO</li> <li>NO</li> <li>YES</li> <li>N/A</li> <li>N/A</li> <li>N/A</li> <li>NO</li> <li>NO</li> <li>N/A</li> <li>YES</li> </ul>

\*DK listen or BFS keyboard input

**Table 4.12-2. BFS major mode transition data (continued)**

Major mode transition From To		Transition requirements	Input MDM (element)	RM	Comm fault protected
103	601	OPS 601 PRO*  or RTLS SW A, B, C	N/A  FF 1, 2, 3 (B)	N/A  2/3	N/A  NO
104	105	OPS 105 PRO*	N/A	N/A	N/A
104	301	OPS 301 PRO (BFS KYBD only)	N/A	N/A	N/A
104	602	RTLS SW A, B, C  or OPS 602 PRO* (PRE-OMS DUMP)	FF 1, 2, 3 (B)	2/3	NO
105	106	OPS 106 PRO*	N/A	N/A	N/A
105	301	OPS 301 PRO (BFS KYBD only)	N/A	N/A	N/A
106	301	OPS 301 PRO. (BFS KYBD only)	N/A	N/A	N/A
106	000	OPS 000 PRO (BFS KYBD only)	N/A	N/A	N/A
301	302	OPS 302 PRO (Auto transition for TAL)*	N/A	N/A	N/A
301	000	OPS 000 PRO (BFS KYBD only)	N/A	N/A	N/A
302	303	OPS 303 PRO (Auto transition for TAL)*	N/A	N/A	N/A
302	301	OPS 301 PRO*	N/A	N/A	N/A
303	301	OPS 301 PRO*	N/A	N/A	N/A
303	304	OPS 304 PRO (Auto transition for TAL)*	N/A	N/A	N/A
304	305	VREL < 2500 fps Transition occurs automatically at 2500 fps. PRO is illegal before 2500 fps	FF 1, 2, 3 (IMU)	MVS/3	YES

\*DK listen or BFS keyboard input

Table 4.12-2 BFS major mode transition data (continued)

Major mode transition From To	Transition Requirements	Input MDM (element)	RM	Comm fault protected
305 000	OPS 000 PRO (BFS KYBD only)	N/A	N/A	N/A
603 000	and			
	<ul style="list-style-type: none"> <li>┌ LG WOW①③</li> <li>└ or</li> <li>┌ RG WOW①④</li> <li>└ and</li> <li>┌ NG WOW 1②</li> <li>└ or</li> <li>┌ NG WOW 2 ②</li> <li>└ or</li> <li>┌ ET SEP SW A, B, C</li> <li>└ or</li> <li>┌ SRB SEP SW A, B, C</li> </ul>	<ul style="list-style-type: none"> <li>FF2, 3, 4 (B)</li> <li>FF2,3, 4 (B)</li> <li>FF3 (B)</li> <li>FF2 (B)</li> <li>FF1, 3, 4</li> <li>FF 1, 3, 4</li> </ul>	<ul style="list-style-type: none"> <li>2/3</li> <li>2/3</li> <li>1/1</li> <li>1/1</li> <li>2/3</li> <li>2/3</li> </ul>	<ul style="list-style-type: none"> <li>NO</li> <li>NO</li> <li>NO</li> <li>NO</li> <li>NO</li> <li>NO</li> </ul>
	and			
	local horizontal < 0	FF1, 2, 3 (IMU)	MVS/3, LOW ID/2,1/1	YES
	<p>① Must not have been detected as set before actual vehicle touchdown.</p> <p>② Must not be set before MG WOW.</p> <p>③ LG WOW determined from 2 of 3 of LMG WOW (FF2), LOB WOW (FF3), and LIB WOW (FF4).</p> <p>④ RG WOW determined from 2 of 3 of RMG WOW (FF3), RIB WOW (FF1), and ROB WOW (FF2)</p>			

**Table 4.12-2. BFS major mode transition data (continued)**

Major mode transition From To		Transition requirements	Input MDM (element)	RM	Comm fault protected
601	602	BFS not engaged	N/A	N/A	N/A
		and			
		SSME P <sub>C</sub> 1, 2, 3 < 30%	EIU 1, 2, 3	3/3	NO
		or			
		SSME P <sub>C</sub> 1, 2, 3 < 30%	EIU 1, 2, 3	2/3	NO
		and			
		EIU 1, 2, 3 data path fail	EIU 1, 2, 3	1/3	NO
		and			
		ET SEP IND A	FA1 (D)	1/1	NO
		and			
		ET SEP IND C	FA3 (D)	1/1	NO
		or			
		ET SEP IND B	FA2 (D)	1/1	NO
		and			
ET SEP IND D	FA4 (D)	1/1	NO		
and					
ΔVZ > 3.2 fps	FF 1, 2, 3 (IMU)	MVS/3	YES		
or		ID/2, 1/1			
OPS 602 PRO *		N/A	N/A		
or					
BFS engaged	N/A	N/A	N/A		
and					
SSME PC 1, 2, 3 < 30%	EIU 1, 2, 3	3/3	NO		
or					
SSME PC 1, 2, 3 < 30%	EIU 1, 2, 3	2/3	NO		
and					
EIU 1, 2, 3 data path fail	EIU 1, 2, 3	1/3	N/A		
and					
ET SEP command	N/A	N/A	N/A		
and					
ΔVZ > 4.0 fps	FF 1, 2, 3 (IMU)	MVS/3	YES		
		LOW ID/2,			
		1/1			
602	603	VREL < 3200 fps	FF 1, 2, 3 (IMU)	MVS/3,	YES
		or		LOW ID/2,	
		(OPS 603 PRO* and VREL < 3200 fps)	N/A	1/1	N/A

\*DK listen or BFS keyboard input



## REFERENCES

1. Backup Flight System (BFS) Sequencing Program Requirements Document.
2. NSTS Computer Program Design Specification Level A Requirements.
3. GN&C CPDS SS-P0002-510.
4. GN&C Detailed Design Specification.
5. PASS Flight Software Modules GGIASC and GGPRTL.
6. Backup Flight System (BFS) Sequencing Program Requirements document, MG038120-30, June 11,2001, Table 3.3.3-1; and MG038120, Table 3.3.1.15.2.

SECTION 5  
QUICK REFERENCE TABLES AND OPERATIONAL AIDS

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**TITLE**

PASS & BFS STATUS/OI TLM

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**PASS & BFS STATUS/OI TLM**

Revision: 01-29/O1-30 Revision Date: 8-11-04 [PASS & BFS Status\_OI Tlm O130.ppt]

PASS	(HALT)	STBY	•	•	IPL	MMU IPL SOURCE	1	2	MMU READY	1	2	BFS GPC ID IN RUN MODE	◆	(0 = BFS NOT IN 'RUN')	I/O TERM	A	B	GPC DUMP SW																																					
	(HALT)	STBY	•	•	IPL	MMU IPL SOURCE	1	2	MMU READY	1	2	BFS TRACKING FC STRING	1	2	3	4	I/O TERM	A	B	GPC DUMP SW																																			
BFS	(HALT)	STBY	•	•	IPL	MMU IPL SOURCE	1	2	MMU READY	1	2	BFS TRACKING FC STRING	1	2	3	4	I/O TERM	A	B	GPC DUMP SW																																			
	(HALT)	STBY	•	•	IPL	MMU IPL SOURCE	1	2	MMU READY	1	2	BFS TRACKING FC STRING	1	2	3	4	I/O TERM	A	B	GPC DUMP SW																																			
<p>• If ANY STBY, RUN or MMU IPL 1 (2) BIT is FAILED-HI, a GPC CANNOT ENTER the SLEEP MODE.</p> <p>MMU IPL BIT FAIL ON DOESN'T PREVENT a BFS IPL in FLIGHT.</p>																																																							
<p><b>MMU IPL</b> MASKED IN ALL PASS FLIGHT OPS NOT MASKED IN BFS. If a BIT FAILS ON, BFS DROPS CRT ASSIGN d via BFC CRT SEL sw (1<sup>st</sup> CRT if ENG'd).</p>																																																							
<p><b>BFS IN RUN MODE</b></p> <table border="1"> <tr> <td>BFS GPC</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td>GPC 5</td> <td>1</td> <td>2</td> <td>4</td> <td>8</td> <td></td> </tr> <tr> <td>GPC 4</td> <td>2</td> <td>4</td> <td>8</td> <td>1</td> <td></td> </tr> <tr> <td>GPC 3</td> <td>4</td> <td>8</td> <td>1</td> <td>2</td> <td></td> </tr> <tr> <td>GPC 2</td> <td>8</td> <td>1</td> <td>2</td> <td>4</td> <td></td> </tr> <tr> <td>GPC 1</td> <td>1</td> <td>2</td> <td>4</td> <td>8</td> <td></td> </tr> </table>																				BFS GPC	1	2	3	4	5	GPC 5	1	2	4	8		GPC 4	2	4	8	1		GPC 3	4	8	1	2		GPC 2	8	1	2	4		GPC 1	1	2	4	8	
BFS GPC	1	2	3	4	5																																																		
GPC 5	1	2	4	8																																																			
GPC 4	2	4	8	1																																																			
GPC 3	4	8	1	2																																																			
GPC 2	8	1	2	4																																																			
GPC 1	1	2	4	8																																																			
<p><b>I/O TERM A</b> If HYBRID RECEIVER BIT FAILS ON, IOP LOGIC INHIBITS ALL PL BUS and LDB I/O.</p>																																																							
PASS	PASS GPC ID (2 X GPC No.)										BFS ENG	1	2	3	BFC CRT SEL	1	2	AP-101S PS BATT BATT OVER CHRG VOLT TEMP VOLT LOW																																					
	BFS	BFS GPC ID (2 X GPC No.)										BFS ENG	1	2	3	BFC CRT SEL	1	2	AP-101S PS BATT BATT OVER CHRG VOLT LOW																																				
<p><b>AP-101S STATUS</b> (1 = FAIL) PWR SUPPLY OVERTEMP &gt; 190 ± 7° F (RESETS at = 29° F BELOW TRIP LIMIT). <b>CAUTION</b> If = ZERO COOLING to GPC, ONLY 12 MIN (at 14.7 PSI) or 9 MIN (at 10.2 PSI) AFTER the OVERTEMP BIT is SET UNTIL DERATING LIMIT EXCEEDED (4 MIN to SLEEP INCLUDED). BATTERY CHARGER INPUT &gt; 5 VDC at EITHER BATTERY PACK. BATTERY OUTPUT &lt; 3.2 VDC at EITHER BATTERY PACK.</p>																																																							
SECT	LOWER 128K MEMORY COUNTER (5) (RANGE → 00 -7F HEX)										UPPER 128K MEMORY COUNTER (5) (RANGE → 00 -7F HEX)																																												
	<p>ERROR LOG RESETS CLEAR SECs LCC: ✓ DPS-26, BFS-14</p>																																																						
XBUS	WORD 1										WORD 2																																												
	ICC BUSES (PASS)										DK BUSES				PL BUSES		LDB BUSES		FA → PRI		FF → SEC																																		
MANTA	ICC1 ICC2 ICC3 ICC4 ICC5										DK1	DK2	DK3	DK4	PL1	PL2	LDB1	LDB2	FA → PRI	FF → SEC																																			
	FA → PRI FF → SEC FC7 FC8										MM BUSES (5) MM1 MM2		FC1	FC2	FC3	FC4	IP BUS	FC5	FC6																																				
BIT	FA1 CARD	FA2 CARD	FA3 CARD	FA4 CARD	FF1 CARD	FF2 CARD	FF3 CARD	FF4 CARD																																															
	06 14	06 14	06 14	06 14	01 14	01 14	01 14	01 14																																															
<p>8000 4000 2000 1000 0800 0400 0200 0100 0080 0040 0020 0010 0008 0004 0002 0001 C000 3000 0C00 0300 00C0 0030 000C 000C</p>																																																							
BIT	ACTV OSC	AMPLITUDE FAILURE	FREQ DIFF	OVEN TEMP OUT OF LIMIT	PWR SPLY VOLTAGE OUT OF LIMIT	VOTED-DEMAND MTU ACCUM MISCOMPARE	ANY IRIG B CHAN FAIL	1hz FREQ-DIVIDER	VALID MTU UPDT																																														
	(1=#1)	(-0.8 V RMS)	OSC1	OSC2	OSC1	OSC2	PS A PS B	1 2 3	1 2 3																																														
MMU	PWR INT- RUP	R/W ADRS	PAST REQ	WRITE PROTECT ERR	BAD CMD OR MIA	TMV of FLSH	LOOK-UP TBL ERR	W'D TMR FAIL	SUM TEST FAIL	FLSH SRAM	FLSH 2 1	FLSH 0 2	FLSH 1 1	FLSH 2 0	FLSH 1 0	FLSH 0 0	FLSH 1 0	FLSH 2 0	FLSH 1 0																																				
	IB GAP TMR EXPRD	REQ	ADRS	ERR	ERR	FLSH	UP TBL	TMR FAIL	TEST SRAM	BNK1	BNK1	BNK2	BNK1	BNK2	BNK0	BNK0	BNK0	BNK0	BNK0	BNK0																																			
STAT	TAPES READ										TAPES WRITE																																												
	INVLD WORD	DROP CNT	BAD CLK CNT	BAD DET	WRITE INVLD MAN-CHSTR FMT	NOT FIN & NEW CMD	EOF BLK CNT	EOF ADRS MSG	TAPE BOT DET	EOT DET	ABORT R/W OPER	MIA BIT CNT	MIA DET	'101' PRTY	✓	✓	✓	✓	✓	✓																																			
SOURCES	OVERLAY or MFS SOURCE										KSC GROUND OPS																																												
	GPC via MM BUS	MMU via MM BUS	GPC via LDB BUS	RE-TRY ENA					SM GSE POLL INH	SM C/O ENA	GNC C/O ENA																																												

MDM	OI MDM TLM LOSS	OI MDM CARD/CHAN	MSID	OI PARAMETER
	54	00 (SIO) 01	V75W3504D	MTU1 VOTED GMT
OFF	MTU1 VOTED GMT	04 (DIH) 01	V75W3514D	↓ MET BITE
	IF OF1 is FAILED, CHANGE FEP's GMT/MET TIME REF (DFE via DFE LOOP) (2)	06 (DIH) 01	V76X4351E	RPC A: GPC 1
OFF	CICU: GPCs 1 -5 '1-FAIL'	12 (DIH) 01	V72X7015E	CICU: GPC 5 '1-FAIL'
	RPC A: GPCs 1 -5	14 (DIH) 01	V72X7012E	GPC 2 '1-FAIL'
OFF	MMU 1 PWR STATUS	02 (DIO) 01	V76X4355E	CICU: GPC 2 '1-FAIL'
	FF1 PWR STATUS (PS1)	02 (DIO) 01	V72S7981E	PCMMU 1 RPC
OFF	PCMMU 1 PWR STATUS	02 (DIO) 01	V76X4265E	FF1 PWR (PS1 RPC)
	PCMMU 2 ↓ ↓	02 (DIO) 01	V76X4272E	PCMMU 2 RPC
OFF	MTU2 NON-VOTED GMT	04 (DIH) 01	V72S7160E	CICU: GPC 3 '1-FAIL'
	RPC B: GPCs 1 -5	06 (DIH) 01	V76X4371E	GPC 1 sw SCAN Mm A (5)
OFF	MMU 2 PWR STATUS	12 (DIH) 01	V76X4361E	RPC A: GPC 3
	FF2 PWR STATUS (PS1)	14 (DIH) 01	V76X4371E	GPC 5
OFF	FF4 ↓ ↓ (PS1)	02 (DIO) 01	V72S7175E	GPC 4 sw SCAN Mm A (5)
	FF2 PWR STATUS (PS2)	02 (DIO) 01	V72S7185E	MMU 1 PWR STATUS
OFF	FF2 ↓ ↓ (PS1)	02 (DIO) 01	V76X4365E	RPC A: GPC 4
	FF2 ↓ ↓ (PS1)	02 (DIO) 01	V76X4372E	CICU: GPC 4 '1-FAIL'
OFF	MTU OSC 1 MAN SELECT	04 (DIH) 01	V75W3604D	MTU2 NON-VOTED GMT
	MTU OSC 2 ↓ ↓	04 (DIH) 01	V75W3614D	↓ MET BITE
OFF	RPC C: GPCs 1 -5	06 (DIH) 01	V75M3640P	FF4 PWR (PS1 RPC)
	MMU 2 PWR STATUS	12 (DIH) 01	V76X4362E	RPC B: GPC 3
OFF	FF3 PWR STATUS (PS1)	14 (DIH) 01	V76X4366E	GPC 4
	FF2 PWR STATUS (PS2)	14 (DIH) 01	V72S7166E	GPC 2 sw SCAN Mm B (5)
OFF	HISAM sw 'OFF' STATUS	14 (DIH) 01	V72S7172E	PF1 PWR (PS2 RPC)
		14 (DIH) 01	V72S7181E	PF2 PWR (PS1 RPC)
OFF	MTU OSC 1 MAN SELECT	04 (DIH) 01	V76X4353E	RPC B: GPC 1
	MTU OSC 2 ↓ ↓	06 (DIH) 01	V76X4357E	GPC 2
OFF	RPC C: GPCs 1 -5	10 (DIL) 01	V72S7150E	GPC 5
	FF3 PWR STATUS (PS1)	12 (DIH) 01	V75S2236E	HISAM sw 'OFF' STATUS
OFF	HISAM sw 'OFF' STATUS	14 (DIH) 01	V75S2237E	GPC 3 sw SCAN Mm C (5)
		14 (DIH) 01	V76X4363E	MTU: OSC 1 MAN SEL
OFF	CRTs 1-4: PWR STATUS	02 (DIH) 01	V76X4367E	RPC C: GPC 3
	STBY ↓	04 (DIH) 01	V72S7983E	GPC 4
OFF	PSP 1 PWR STATUS	07 (DIH) 01	V73S2012E	CRT 2: STBY STATUS
	PSP 2 ↓ ↓	10 (DIH) 01	V74X4890E	PSP 1: PWR
OFF	MCIU PWR STATUS	13 (DIH) 01	V73S2021E	CRT 3: PWR
		15 (DIH) 02	V73S2022E	STBY
OFF	FA1 PWR STATUS (PS1)	05 (DIH) 00	V74X4891E	PSP 2: PWR
	FA2 PWR STATUS (PS1)	05 (DIH) 00	V73S2051E	CRT 4: PWR
OFF	FA3 PWR STATUS (PS1)	05 (DIH) 00	V73S2052E	STBY
	FA4 PWR STATUS (PS1)	12 (DIH) 02	V73S2001E	CRT 1: PWR
OFF	NO DPS IMPACTS	0M1 0A1	V73S2002E	MCIU: PWR
	MTU: OSC 1 MAN SELECT	0M2 0A2	V73S2011E	CRT 1: STBY
OFF	NO DPS IMPACTS	0M3 0A3		CRT 2: PWR
	MTU: OSC 2 ↓ ↓	0L1 0R1		
OFF	NO DPS IMPACTS	0L2 0R2		

- 1 TLM DATA FOR a FAILED OI MDM WILL REMAIN STATIC UNTIL MDM IS RECOVERED or UNTIL AN ALTERNATE PCMMU IS SELECTED. IF PCMMU SWAP DOESN'T RECOVER MDM, THEN RANDOM, STATIC DATA (PCMMU CONTENTS) DOWNLINKED. IF MDM RECOVERED BY PCMMU SWAP BUT OTHER COMM/TLM PROBLEMS LATER FORCE INCO TO GO BACK TO PREVIOUS PCMMU (and FAILED OI MDM PORT). D/L WILL SHOW RANDOM, STATIC TLM (PCMMU WAS POWERED OFF).
- 2 IF OF1 is HARD-FAILED, ASAP CHANGE FEP TIME REF (BOTH GMT & MET), SELECT MTU2 (IF OF2 OK) or GROUND TIME FOR MET & GPC TIME FOR GMT (IF OF2 FAILED). NOTE FEP TIME-FLYWHEELS GMT to MCC, BUT MET GOES STATIC.
- 3 GPC SWITCH SCAN UTILIZED BY KSC DURING TURNAROUND OPS, BUT NOT IN-FLIGHT (AVAILABLE IF INCO/INST ASK ABOUT MSID'S).
- 4 ✓ BFS USER #B08127A if BFS ON INTERNAL TIME > ONE MINUTE.
- 5 SCRUB CHKS ALL 256K EVERY 1.7 SEC. SEC COUNTER is RESET at GPC MODE RUN → STBY, or HALT → STBY/RUN, GPC IPL, CERTAIN GPC ERRORS (03 07 or 05 04), AND AT SPEC 0 ERROR LOG RESETS.
- 6 LISTENER GPC WITH XMIT ENA BIT FAILED LOW WILL NOT COMPLETE OPS XITION, BUT WILL COMPLETE A SET EXPANSION (USER NOTE 106679).
- 7 MTU BITE CAUSES an IMMEDIATE OSC AUTO SWITCH.
- 8 MMU PWR CYCLE is REQUIRED FOR INDICATED BITE.

**TITLE**

PASS I/O ERROR

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ORBIT: PASS I/O ERROR

Revision: 01-29/01-30

Revision Date: 8-11-04

[Orb I/O Error 0130.ppt]

ID/ELE	PASS I/O ERROR DESCRIPTION																																									
1	RS IPR																																									
2	GPC-TO-GPC MFB/OPS OVERLAY																																									
3	SSIP ICC																																									
4	SM: UPPER-STAGE OUTPUT (not currently used)																																									
5	IDP/DEU 1 = BCE 6 (DK1)																																									
6	2 = BCE 7 (DK2)																																									
7	3 = BCE 8 (DK3)																																									
8	4 = BCE 9 (DK4)																																									
9	G9: IDP WRITE (DDUs) (SPEC 100)																																									
10	PCMMU 1 = D/L TO TOGGLE BUFFER 2 = LOAD HDR TFL 3 = LOAD LDR TFL 4 = READ HDR RAM FOR CHECKSUM 5 = READ LDR RAM FOR CHECKSUM 6 = BITE STATUS (WRAP WORD) 7 = SELECT HARD FORMAT 8 = SELECT PROGRAM FORMAT 9 = SM: READ OI/PL DATA RAM 10 = TCS READ OI/PL DATA RAM 11 = LDR TFL RESTORE SYNC WORD 12 = TCS READ HDR/LDR PROGRAMS																																									
11	MMU 1 = WRITE WITH CHECKSUM 2 = WRITE WITHOUT CHECKSUM 3 = READ WITH CHECKSUM 4 = READ WITHOUT CHECKSUM 5 = MMU UTILITY WRITE 6 = MMU BITE STATUS 7 = READ OPS OVERLAY 8 = POSITION-TAPE COMMAND 9 = MMU UTILITY READ 10 = TCS MMU BITE STATUS																																									
12	G9: BTU CYCLIC BITE (SPEC 112)																																									
13	HFE INPUT <table border="1"> <tr><td>EIU1</td><td>EIU2</td><td>EIU3</td></tr> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> </table> <table border="1"> <tr><td>FF1</td><td>FF2</td><td>FF3</td><td>FF4</td></tr> <tr><td>7</td><td>11</td><td>14</td><td>17</td></tr> <tr><td>9</td><td>12</td><td>15</td><td>18</td></tr> <tr><td>10</td><td>13</td><td>16</td><td>19</td></tr> </table> <table border="1"> <tr><td>FA1</td><td>FA2</td><td>FA3</td><td>FA4</td></tr> <tr><td>20</td><td>22</td><td>25</td><td>28</td></tr> <tr><td>23</td><td>26</td><td>29</td><td></td></tr> <tr><td>21</td><td>24</td><td>27</td><td>30</td></tr> </table> PORT 1 (PRI DATA) PORT 4 (ALT DATA) FF MDM RTN WORD ADTAs 1-4 FF PROM SEQ (STRG B) FA MDM RTN WORD ANALOG CARD FA PROM SEQ (STRG D)	EIU1	EIU2	EIU3	1	2	3	4	5	6	FF1	FF2	FF3	FF4	7	11	14	17	9	12	15	18	10	13	16	19	FA1	FA2	FA3	FA4	20	22	25	28	23	26	29		21	24	27	30
EIU1	EIU2	EIU3																																								
1	2	3																																								
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14	HFE OUTPUT																																									
15	MFE INPUT <table border="1"> <tr><td>FF1</td><td>FF2</td><td>FF3</td><td>FF4</td></tr> <tr><td>31</td><td>36</td><td>40</td><td>46</td></tr> <tr><td>32</td><td>37</td><td>41</td><td></td></tr> <tr><td>33</td><td>38</td><td>42</td><td></td></tr> <tr><td>34</td><td>39</td><td>43</td><td></td></tr> <tr><td>35</td><td>44</td><td>44</td><td></td></tr> </table> <table border="1"> <tr><td>FA1</td><td>FA2</td><td>FA3</td><td>FA4</td></tr> <tr><td>47</td><td>48</td><td>49</td><td>50</td></tr> <tr><td>51</td><td>52</td><td>53</td><td></td></tr> </table> FF PROM SEQ (STRG A) IMUs 1-3 (N/A in G9) TACAN/RA CARDS 1-3 MLS's 1-3 -Z STKR/-Y STKR KU RADAR (no FAULT msg) FA PROM SEQ (STRG C) PORT 1 (32 WORDS TLM ONLY)	FF1	FF2	FF3	FF4	31	36	40	46	32	37	41		33	38	42		34	39	43		35	44	44		FA1	FA2	FA3	FA4	47	48	49	50	51	52	53						
FF1	FF2	FF3	FF4																																							
31	36	40	46																																							
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FA1	FA2	FA3	FA4																																							
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16	GNC OPS INIT (ALL EXCEPT G8 TRANS) <table border="1"> <tr><td>FF1</td><td>FF2</td><td>FF3</td><td>FF4</td></tr> <tr><td>74</td><td>75</td><td>76</td><td>77</td></tr> </table> <table border="1"> <tr><td>FA1</td><td>FA2</td><td>FA3</td><td>FA4</td></tr> <tr><td>78</td><td>79</td><td>80</td><td>81</td></tr> </table> FF MDM BITE4 FA MDM BITE4	FF1	FF2	FF3	FF4	74	75	76	77	FA1	FA2	FA3	FA4	78	79	80	81																									
FF1	FF2	FF3	FF4																																							
74	75	76	77																																							
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17	G9: PRELAUNCH IMU (IMU HANGER CAL I/O) <table border="1"> <tr><td>FF1</td><td>FF2</td><td>FF3</td></tr> <tr><td>57</td><td>60</td><td>63</td></tr> <tr><td>58</td><td>61</td><td>64</td></tr> <tr><td>59</td><td>62</td><td>65</td></tr> </table> FF MDM RTN WORD G9 IMUs 1-3 IMU BITE/OPERATE DISCRETES	FF1	FF2	FF3	57	60	63	58	61	64	59	62	65																													
FF1	FF2	FF3																																								
57	60	63																																								
58	61	64																																								
59	62	65																																								
18	G9 IMU: GYRO TORQUE (SPEC 104)																																									
19-21	FF1-FF3 MTU GMT UPDATE or MET RESET																																									
22	MTU INPUT <table border="1"> <tr><td>FF1</td><td>FF2</td><td>FF3</td><td>FF4</td></tr> <tr><td>54</td><td>55</td><td>56</td><td></td></tr> </table> MTU ACCUMs 1-3	FF1	FF2	FF3	FF4	54	55	56																																		
FF1	FF2	FF3	FF4																																							
54	55	56																																								
23	G9: C/W ANNUN OUTPUT via FC MDMs																																									
24	NSP1 <table border="1"> <tr><td>FF1</td><td>FF3</td></tr> <tr><td>66</td><td>68</td></tr> <tr><td>67</td><td>69</td></tr> </table> NSP DISCRETE INPUTS NSP SERIAL I/O INPUTS	FF1	FF3	66	68	67	69																																			
FF1	FF3																																									
66	68																																									
67	69																																									

ID/ELE	PASS I/O ERROR DESCRIPTION																																																																																																																
25	G9: FA MDM OUTPUT (SRB/MPS/ASAs)																																																																																																																
26	G9: HDA INPUT (SPEC 100) (W/ENA DEFAULT) <table border="1"> <tr><td>FF1</td><td>FF2</td><td>FF3</td><td>FF4</td></tr> <tr><td>7</td><td>11</td><td>14</td><td>17</td></tr> <tr><td>9</td><td>12</td><td>15</td><td>18</td></tr> <tr><td>10</td><td>13</td><td>16</td><td>19</td></tr> </table> <table border="1"> <tr><td>FA1</td><td>FA2</td><td>FA3</td><td>FA4</td></tr> <tr><td>20</td><td>22</td><td>25</td><td>28</td></tr> <tr><td>23</td><td>26</td><td>29</td><td></td></tr> <tr><td>21</td><td>24</td><td>27</td><td>30</td></tr> </table> 1 = DATA FILL 2 = TIME FILL + POLL 3 = IPL FILL 4 = DUMP 5 = BITE STATUS 6 = RESET SPL 7 = CRIT FMT FILL 8 = REMOTE FILL 9 = REMOTE DUMP FF MDM RTN WORD ADTAs 1-4 FF PROM SEQ (STRG B) FA MDM RTN WORD ANALOG CARD FA PROM SEQ (STRG D)	FF1	FF2	FF3	FF4	7	11	14	17	9	12	15	18	10	13	16	19	FA1	FA2	FA3	FA4	20	22	25	28	23	26	29		21	24	27	30																																																																																
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38	G9: READ NOSEWHEEL POSITION FEEDBACK																																																																																																																
39	G9: MEC FIRE2/FIRE3 QUAD OUTPUT																																																																																																																
40	G9: ONE-SHOT TO BFS (SPEC 100)																																																																																																																
41	G9: TCS MODEABLE/NWS or GPS SPECIAL I/O																																																																																																																
42	G9: TCS MULTI-BUS																																																																																																																
43	G9: PF MDMs BSR READ (SPEC 112)																																																																																																																
44	SM/PL9: C/W ANNUN OUTPUT thru PF1																																																																																																																
45	SM/PL9: C/W ANNUN OUTPUT thru PF2																																																																																																																
46	SM/G9: PF1 or FLEX-PAIR TCS																																																																																																																
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49/83	SM/G9: PSP1 SERIAL I/O (SPEC 62)																																																																																																																
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51	SM: HI-RATE INPUT <table border="1"> <tr><td>PF1</td><td>PF2</td></tr> <tr><td>85</td><td>88</td></tr> <tr><td>86</td><td>89</td></tr> <tr><td>87</td><td>90</td></tr> <tr><td>XXX</td><td>XXX</td></tr> </table> CARD 03 CARD 06 CARD 09 MSN DEP	PF1	PF2	85	88	86	89	87	90	XXX	XXX																																																																																																						
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ID/ELE	PASS I/O ERROR DESCRIPTION								
59	SM: TABLE-DRIVEN or STD SERIAL OUTPUT								
60/95	SM/G9: PDI SW-MATRIX READ								
/96	G9: PDI BSR READ (supported in G9 only)								
/00	SM/G9: PDI CONTROLS (SPEC 62) 3 = LOAD SW MATRIX 4 = READ or 5 = LOAD → DECOM 1 6 = 7 8 = 9 10 = 11 12 = 13 FPM 5								
61	G9/G1: PRELAUNCH LDB 1 = INTERROGATE W/O DATA 2 = INTERROGATE WITH DATA 3 = GO AHEAD 4 = XMIT ENABLE 5 = REQUEST LPS STATUS 6 = SEND STATUS TO LPS 7 = WAVE-OFF								
62	G9/G1: LAUNCH DECODER MDM TCS I/O								
63	G9/G1/RTLs: SRB INPUT <table border="1"> <tr><td>L SRB</td><td>R SRB</td></tr> <tr><td>FWD AFT</td><td>FWD AFT</td></tr> <tr><td>LL1 LL2</td><td>LR1 LR2</td></tr> <tr><td>70 71</td><td>72 73</td></tr> </table> SRB TLM DATA	L SRB	R SRB	FWD AFT	FWD AFT	LL1 LL2	LR1 LR2	70 71	72 73
L SRB	R SRB								
FWD AFT	FWD AFT								
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64	G9: SRB MDMs TCS I/O								
65/82	SM: MCIU INPUT								
66	SM: MCIU OUTPUT								
67	G9: MCIU TCS I/O								
68	SM/G9: PL BUS or FLEX MDM TCS I/O → BCE #10								
69	SM/G9: PL BUS or FLEX MDM TCS I/O → BCE #11								
70-73	G9: FC BUS TCS I/O → BCE #14 - #17								
74-77	G9: FC BUS TCS I/O → BCE #20 - #23								
78	GPS OUTPUT [FF2 ONLY] (64 WDs at 6.25 Hz)								
79	GPS INPUT (32 WDs at 1.04 Hz) <table border="1"> <tr><td>FF1</td><td>FF2</td><td>FF3</td><td>FF4</td></tr> <tr><td></td><td>98</td><td></td><td></td></tr> </table> GPS 2 (Card 11, Chan 02)	FF1	FF2	FF3	FF4		98		
FF1	FF2	FF3	FF4						
	98								
80	G9: FC QUAD TCS I/O → MECs and EIUs								
1 XX/253	FCOS CAN'T DETERMINE BCE ELE No.								
1 XX/254	MTU or NSP ERRORS DURING OPS OVERLAY								
1 XX/255	G9: MULTI-BUS I/O (PROTECTED I/O, BUT A NON-COMMFAULTABLE I/O ERROR)								
1	ELE = 0 EXCEPT as NOTED, and XX = ANY I/O TRANSACTION ID (ID 1 THRU ID 80).								
2	IF MDM FA2 → HYD SYS 3 PRESS C or FA3/FA4 → L/R OMS Pc (TLM only)								
3	TWO I/O ERRORS PER GPS LOGGED WITH PWR-UP (CAPTURE START-UP SIGNATURE).								
4	PSP I/O RESET LOGIC NON-STD (SPEC 62, ITEMS 6 & 7). IF PSP I/O RESET 'NO JOY', MSG RECURS w/ ONE I/O ERROR LOGGED.								
<b>PASS USER/ OPS NOTES:</b>									
5	OPS #107971 FALSE 'OFF/BUSY MMU' w/ TFL or SM CKPT FAIL (UNIQ). or #33749 OK IF MMU ACCESS ATTEMPTED WITHIN 34-SEC OF MMU PWR-ON.								
6	#102825 MEC BITE-READ TIMING ISSUE.								
7	#35211 and #63682 NOTE BFS IMPACT if ANY PASS MTU ACCUM or GPS BYPASS. IF A GPS FAILED or PWR'd-OFF, MULT I/O ERRORS at I/O RESET.								
8	#37509 IF FF1-FF3, or MTU1-3, or ACTIVE NSP BYPASSED, BCE ELE '254' I/O ERRORS at OPS TRANSITION.								
9	#25074 TRANSIENT MFE COMMFAULTS → 'DISPLAY SW' or 'RCS PVT'.								
10	#100520 IF FF1-FF3 BYPASSED at G2/G3 OPS TRANS, 'ILLEGAL ENTRY' if ATTEMPT SPEC 21 IMU ALIGN.								
1	ERRORS DO NOT FORCE a GPC to HALT.								
2	CM IDLE OCCURS at HALT → STBY/RUN, or RUN → STBY/HALT, or AT a GPC IPL.								



**TITLE**

PASS GPC ERROR/OI NOTES



PASS GPC ERRORS & OI-29/30 NOTES

Revision Date: 8-11-04 [PASS GPC Errors OI30.ppt]

HEX CODE	GPC ERROR DESCRIPTION																
02 0D	GPC CYCLE WRAP (ASSOCIATED I/O ALSO SKIPPED)																
03 00	ILLEGAL OP CODE or PCI/PCO CMD → 'GPC BITE' ④																
03 01	PRIVILEGED INSTR (SUPV STATE) → 'GPC BITE' ④																
03 04	MASKED (FIXED-POINT OVERFLOW)																
03 05	MASKED (FLOATING-POINT SIGNIFICANCE)																
03 07	CPU STORE-PROTECT VIOLATION → 'GPC BITE' ④ ⑤																
03 09	MASKED (FLOATING-POINT EXPONENT UNDERFLOW)																
03 0A	FLOATING-PT CONVERT TO FIXED-POINT → OVERFLOW																
03 0B	FLOATING-PT EXPONENT OVERFLOW																
03 0C	FLOATING-PT DIVIDE-BY-ZERO																
03 14	INSTR MONITOR (TRY to EXQT DATA) → 'GPC BITE' ④																
04 04	EXPONENTIATION OF ZERO TO POWER 0																
04 05	SQ ROOT of NEGATIVE ARGUMENT																
04 06	ARGUMENT of EXPONENTIAL TOO BIG																
04 07	ARGUMENT of LOG < ZERO																
04 08	ARGUMENT of SIN or COS TOO BIG																
04 09	ARGUMENT of SINH or COSH TOO BIG																
04 0A	ARGUMENT of ARC SIN or ARC COS > 1																
04 0B	ARGUMENT of TANGENT TOO BIG																
04 0C	ARGUMENT of TANGENT APPROACHING ± PI/2																
04 0E	HAL STATEMENT; 'CLOSE' prior to 'RETURN'																
04 0F	SCALAR TOO BIG/TOO SMALL for INTEGER CONVERT																
04 10	INTEGER DIVIDE-BY-ZERO (BAD REMAINDER)																
04 11	ILLEGAL CHARACTER SUBSCRIPT																
04 12	TRUNCATION PROBLEM																
04 13	ATTEMPT MODULO ZERO of a NEGATIVE INTEGER																
04 14	NON-STD CHAR-STRING FORMAT at SCALAR CONVERT																
04 16	NON-STD CHAR-STRING FORMAT at INTEGER CONVERT																
04 18	'a' to EXPONENT 'x' w/ NEG 'a' or ['a'=0 & EXP 'x' 0]																
04 19	VECTOR or MATRIX DIVIDE-BY-ZERO																
04 1B	ARGUMENT of MATRIX INVERSE is SINGULAR																
04 1C	ARGUMENT of UNIT FUNCTION = 0's → NULL VECTOR																
04 1D	ILLEGAL BIT STRING																
04 1E	'SUBBIT' SUBSCRIPT > BIT LENGTH																
04 1F	BIT '@ OCT' = INVALID CHARACTER																
04 20	BIT '@ HEX' = INVALID CHARACTER																
04 3B	ARGUMENT of ARC COSH < 1																
04 3C	ARGUMENT of ARC TANH																
04 3E	ARGUMENT of ARC TAN2 FUNCTION ERROR																
05 00	I/O ERROR on ICC or IPR RETRY (FTS) → 'GPC'																
05 01	MIA XMTR STATUS DISAGREE (HALT) → 'GPC'																
05 04	DMA STORE-PROTECT VIOLATION → 'GPC BITE' ④ ⑤																
05 05	ILLEGAL I/O TRANSACTION/DEVICE ID																
05 06	INVALID EVENT QUEUE ADRS SPECIFIED																
05 07	ICC RETRY CHECKSUM ERROR (FTS) → 'GPC' ⑥																
05 08	XQE TABLE OVERFLOW (# D-RELATED)																
06 01	DEU POLL: 'MSG RDY' SET but NO KYBD INPUT																
06 02	AIESIP ICC MSG with INVALID HEADER																
06 03	AIESIP ICC MSG with INVALID DATA																
06 05	INVALID SVC PARAM LIST for MTU UPDATE																
06 06	INVALID PCMMU TIME at PRIMARY GPC INIT																
06 07	'DO CASE' OUT-OF-RANGE																
I/O WRAP	<table border="0"> <tr> <td>07 01 HFE INPUT I/O WRAP</td> <td>07 09 MCIU OUTPUT I/O WRAP</td> </tr> <tr> <td>07 02 HFE OUTPUT WRAP</td> <td>07 0A MCIU OUTPUT WRAP</td> </tr> <tr> <td>07 03 MFE INPUT</td> <td>07 0B HDA INPUT</td> </tr> <tr> <td>07 04 NSP INPUT WRAP</td> <td>07 0C P/L HI-RATE INPUT WRAP</td> </tr> <tr> <td>07 05 DOWNLIST WRAP</td> <td>07 0D PCMMU OI/PL RAM WRAP</td> </tr> <tr> <td>07 06 SRB INPUT WRAP</td> <td>07 0E GPS OUTPUT WRAP</td> </tr> <tr> <td>07 07 ICC I/O WRAP</td> <td>07 0F GPS INPUT WRAP</td> </tr> <tr> <td>07 08 LDB I/O WRAP</td> <td></td> </tr> </table>	07 01 HFE INPUT I/O WRAP	07 09 MCIU OUTPUT I/O WRAP	07 02 HFE OUTPUT WRAP	07 0A MCIU OUTPUT WRAP	07 03 MFE INPUT	07 0B HDA INPUT	07 04 NSP INPUT WRAP	07 0C P/L HI-RATE INPUT WRAP	07 05 DOWNLIST WRAP	07 0D PCMMU OI/PL RAM WRAP	07 06 SRB INPUT WRAP	07 0E GPS OUTPUT WRAP	07 07 ICC I/O WRAP	07 0F GPS INPUT WRAP	07 08 LDB I/O WRAP	
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HEX CODE	HEX CODE	OI-29/30 NOTE	ABBREVIATED DESCRIPTION
02 0D	AIE	25197	G9 OPS TRANS/OPS MODE RECALL: IF MULTIPLE LRUs are PWR'D OFF THEN SVC-INITIATED FC I/O CAN CAUSE CYCLE WRAP
		37533	CONSEQUENCE of a CYCLE WRAP, NOT A CAUSE
	DCI	33619	CONSEQUENCE of a CYCLE WRAP, NOT A CAUSE
		44391	HI-PRIORITY PROCESSES CAUSE HI-CPU, WHICH IN TURN, CAN RESULT IN A CYCLE WRAP
	DGI	46507	HEAVY I/O CAN CAUSE WRAP LO-PRIORITY CPU PROCESSES
		50278	RSLS HOLD/PAD ABORT (HI-PRIORITY MEC I/O)
	DGI or HDA	54091	PRELAUNCH: NEW GPC SELECTED AS LDB CMDR
		47311	G9: DURING HEAVY I/O, DISPATCHING HI-PRIORITY I/O COULD DELAY I/O COMPLETION of LOW PRIORITY I/O, WHICH IN TURN, CAN WRAP THOSE PROCESSES THAT WAIT FOR I/O
	many ①	39359	IOP MIA XMTR FAILURES CAN CAUSE HFE CYCLE WRAPS
	many ②	102432	CONSEQUENCE of a CYCLE WRAP, NOT A CAUSE
		103840	G9: SIMULTANEOUS LDB RESPONSE PROCESSING
03 07	0	52102	G9: GPC TOO BUSY (FCOS 'FPMSCHE'D' OVERLOAD)
03 0A	GEG or GEQ	51207	RTL5/G3: HUD OUTPUT PROCESSING QUIRK
03 0B	GEG	103828	MM601: LAST SSME SUSTAINED an EARLY SHUT-DOWN
	GER	45335	G3: IMU FAIL → BAD NAV STATE, CAUSING CYCLIC GPC ERRORS
	many ③	37528	BAD UPLINK LOADS CAN CAUSE GNC ARITHMETIC ERRORS
	many ④	110486	GPS ACTIVE: RATTY MAGR GPS RCVR INPUTS or PROCEDURAL ERROR CAUSES PROPOGATION of BAD GPS STATE VECTOR
03 0C	GEG	103828	MM601: LAST SSME SUSTAINED an EARLY SHUT-DOWN
	GK3 or GZY	41148	G2/G3: IF CURRENT GNC MFB LOADED OFF MMU's (VEH WT = 0), THEN, GPC WILL COMPUTE BAD MNVR TARGET
	GKG or GEQ	110486	RTL5/G3 and GPS ACTIVE: GPS UPP COMPS ATTEMPT TO USE a ZERO SV to COMPUTE, 'RNG', 'AZIMUTH', and 'ALT' FOR SPEC 50
	many ③	37528	BAD UPLINK LOADS CAN CAUSE GNC ARITHMETIC ERRORS
04 05	GEG or GEQ	46501	RTL5/G3: GPC ERRORS CAN OCCUR at 'ROCK-BACK' BRAKING AFTER ROLLOUT or WHEN ORBITER STOPPED ON RUNWAY
	GER	45335	G3: IMU FAIL → BAD NAV STATE, CAUSING CYCLIC GPC ERRORS
	many ④	110486	GPS ACTIVE: RATTY MAGR GPS RCVR INPUTS or PROCEDURAL ERROR CAUSES PROPOGATION of BAD GPS STATE VECTOR
04 06	many ④	110486	GPS ACTIVE: RATTY MAGR GPS RCVR INPUTS ... (see '04 05')
04 0A	GEG	106678	RTL5: 'FLT PATH ANG' CALCULATIONS → GPC ERRORS DURING FLYBACK PHASE IF NEAR-ZERO DOWN-RANGE VELOCITY
	GEG or GEQ	46501	RTL5/G3: GPC ERRORS CAN OCCUR at 'ROCK-BACK' BRAKING AFTER ROLLOUT or WHEN ORBITER STOPPED ON RUNWAY
	GEI	107352	G2/G8: IF DAP 'AUTO' and UNNORMALIZED DESIRED or CURRENT BODY ATT QUATERNIONS ≈ 180 DEG APART → GPC ERRORS ⑦
	GEK	110333	G2/G8: HI IMU GIMBAL RATES (HI ATT MNVR RATES + IMU PITCH GIMBAL ±90°) → ERRORS at QUATERNION to EULER CONVERT
04 0F	GEK or GEQ	110486	GPS ACTIVE: PROCEDURAL ERROR ALLOWS BAD GPS STATE TO BE INCORPORATED INTO THE NAV STATE VECTOR
04 11	GEG	55121	G1: CREW PRO'd to MM106 DURING an AOA
04 19	SSP	109201	EXECUTION OF SPEC 33 ITEM 2 PRIOR TO ITEM 1 → CYCLIC GPC ERRORS IN THE SM GPC (RE-ENTER ITEM 2 TO STOP ERRORS)
04 1C	GEK	53101	G2: IF UNIV PTG 'TARG TRK' SEL BEFORE ENABLE/RE-ENA RNDZ NAV, THEN CYCLIC GPC ERRORS CAN OCCUR
		58374	G2 to G8 OPS TRANS w/ RNDZ NAV ACTIVE: RNDZ NAV is DISABLED BUT 'TARG TRK' MODE CONTINUES → CYCLIC GPC ERRORS
		110477	UPON a FD GPC ACTIVATION, CYCLIC GPC ERRORS FOR ABOUT 8 SEC FOLLOWING THE G2/FD GPC's GNC JOBS TRANSITION
	GM7	35322	G9: IMU ALIGN QUIRK (POSSIBLE IMU PROBLEM)
	GKG or GEQ	110486	RTL5/G3 and GPS ACTIVE: GPS UPP COMPS ATTEMPT TO USE a ZERO SV to COMPUTE, 'RNG', 'AZIMUTH', and 'ALT' FOR SPEC 50
05 XX	0		NO APPLICABLE PROGRAM NOTES for FCOS-DETECTED ERRORS
06 01	DMI	D019A ②	DEU POLL HITS 14.5 μSEC DEU TIMING WINDOW. DATA AT NEXT POLL FAILS GPC KYBD PROCESSING (RE-ENTER KYBD INPUTS)
06 05	0	39065	BAD MTU UPDATE DATA (ICC POLLUTION ?)
		100897	SPEC 2: BAD MTU 'GMT/MET DELTA TIME' INPUTS
06 06	AIB	100710	BAD 'MTU VOTED-TIME' (MTU RESET REQUIRED)
07 05	0	25197	G9: AIESIP CYCLE WRAP or THE G9 BFS ONE-SHOT XFER CAN CAUSE a D/L I/O WRAP
		47311	G9: DURING HEAVY I/O, DISPATCHING HI-PRIO I/O COULD WRAP PROCESSES WAITING FOR LOW-PRIO I/O, CAUSING I/O WRAPS
		55053	G9: SPEC 100 DDU TESTING CAN CAUSE D/L I/O WRAPS
		55355	G9: MTU CUMULATIVE GMT UPDATES (±20 MILLISEC RANGE) CAN CAUSE 1 to 2 D/L I/O WRAPS at ALL OPS TRANS. MODE RECALLS (if TARG CHANGE), or WHEN a NEW GPC JOBS COMMON SET
		104125	G9: SPEC 102 TESTING CAN CAUSE D/L I/O WRAPS (→47311)
		105668	G9: BFS ONE-SHOT I/O CAN CAUSE a D/L or SRB I/O WRAP
		47311	G9: DURING HEAVY I/O, DISPATCHING HI-PRIO I/O COULD WRAP PROCESSES WAITING FOR LOW-PRIO I/O, CAUSING I/O WRAPS
		50278	G1: MEC I/O CMDs at RSLS HOLD CAN CAUSE an SRB I/O WRAP
		63450	G1: MEC I/O CMDs at PAD ABORT CAN CAUSE an SRB I/O WRAP
		65046	G1: MEC I/O CMDs at SRB IGN CAN CAUSE an SRB I/O WRAP
		103002	G1 OPS TRANS & MLS's PWR'D OFF, ANY HI CPU ACTIVITY (RSLS HOLD, SRB IGN), or SINGLE GPC to STBY CAUSE SRB I/O WRAP
		104125	G9: SPEC 102 TESTING CAN CAUSE D/L I/O WRAPS (→47311)
		105668	G9: BFS ONE-SHOT I/O CAN CAUSE a D/L or SRB I/O WRAP
		47311	G9: DURING HEAVY I/O, DISPATCHING HI-PRIO I/O COULD WRAP PROCESSES WAITING FOR LOW-PRIO I/O, CAUSING I/O WRAPS
07 0D		100572	G9: SPEC 100 DDU DRIVE TEST & HDA I/O CAUSE PCMMU WRAP
		100702	G9 OPS MODE RECALL: IF HDA ENA and MULTIPLE LRUs PWR'd OFF, MULTI-BUS I/O ERRORS CAN CAUSE PCMMU WRAP

- ① ODCR: NON-HOMOGENOUS GPC ERROR LOG TLM DURING HI-RATE ERROR LOGGING (✓PASS USER 25137).
- ② OI-29/30 FLT S/W PROGRAM NOTES and WAIVERS. ALL NOTES are 'PASS USER NOTES' EXCEPT for BFS USER NOTE D019A.
- ③ PERMANENTLY MASKED: SHOULD NEVER BE LOGGED.
- ④ GPC ERRORS THAT NORMALLY RESULT IN a 'GPC BITE' MSG WILL NOT ANNUNCIATE the MSG if ERROR CONDITION is DUE TO a GMEM WRITE (UPLINK or CREW-INITIATED).
- ⑤ STORE-PROTECT ERRORS SHARE COMMON HARDWARE LOGIC WITH H/W SYSTEM-RESET FUNCTION and SOME GPC 'MACHINE CHECK' INTERRUPTS. THIS CAUSES a SOFT ERROR COUNTER RESET WHEN a STORE-PROTECT VIOLATION OCCURS.
- ⑥ GPC ERROR '05 07' OCCURS with 'VARIABLE ICC DATA' ERROR 'SUMWORD ICC' MSG OCCURS with 'FIXED ICC DATA' ERROR.
- ⑦ If ERRORS PERSIST > 1 MIN, STOP ATT MNVR or SEL PRI JETS (COORDINATE: MCC 'CALL' BELONGS to PROP or GNC).
- ⑧ IF PDE = '0', THEN GPC ERROR WAS LOGGED BY FCOS. IF MULTIPLE PDES APPLY TO a USER NOTE:
  - ① 39359 or 102432 PDE → GEA/ GEI/ or GEP
  - ② 103840 PDE → VM1/ VM2/ VR1/ VUU/ or VWF
  - ③ 37528 PDE → GEA/ GEG/ GEK/ GEL/ GEP/ GEQ/ GER/ GH6/ GV5/ GZY/ or GZZ
  - ④ 110486 PDE → GEG/ GEH/ GEJ/ GEK/ GEL/ GEQ/ or GER

**TITLE**

ASCENT/ENTRY ORBIT BUS LOSS

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ASCENT/ENTRY BUS LOSS

Revision Date: 3/31/05 [AE Bus Loss OI30.ppt]

DC BUS	COMPONENT LOSS	REDUNDANCY LOSS	RESTRING CASE ?
MNA/ MNA DA1	MMU 1 IDP/CRT 1	FF1 & FF3 PF1 PCMMUs 1 & 2 GPCs 1 - 5 RPC A	✓ PROP ✓ VENTS ✓ NWS (HYD 1 ↓)
FPC 1	AC1 ✓ AC1 BUS	BOGUS SMS SIGNATURE NO GPC RPC A PWR LOSS	✓ VENTS ✓ STK-IN-BUCKET
INV			
FLC 1			
FMC 1			
O14	TIMERS: FWD MSN AFT EVENT		✓ NO NWS 1
R14	ADC 1A (IDPs 1 & 2) ADC 2A MDUs: MFD2, PLT1		
MPC1			✓ VENTS
AUXPLA			
CABPL1	PL TIMING BUFFER PWR is MSN DEP [* DPS DATAPACK]	CAB PL1,2,3 BUS PWR SOURCE SELECTABLE via SW on PNL R1A1	
CABPL2			
CABPL3			
APC 4		FA1, FA3, & FA4	
AMC 1			✓ NWS (HYD 1 ↓)
ALC 1			✓ OMS-1
APC 1			✓ OMS-1

DC BUS	COMPONENT LOSS	REDUNDANCY LOSS	RESTRING CASE ?
MNB/ MNB DA2	MMU 2 IDP/CRT 2	FF1, FF2, & FF4 PF1 & PF2 PCMMU 2 GPCs 1 - 5 RPC B	✓ PROP ✓ VENTS ✓ NWS (HYD 2 ↓)
FPC 2	AC2 ✓ AC2 BUS	BOGUS SMS SIGNATURE NO GPC RPC B PWR LOSS	✓ VENTS ✓ STK-IN-BUCKET
INV			
FLC 2	NSP 1		✓ PROP
FMC 2			
O15	TIMERS: FWD EVENT AFT MSN		✓ NO NWS 2
R14	ADC 1B (IDPs 3 & 4) ADC 2B MDUs: CDR2, MFD1		
MPC2			✓ VENTS
AUXPLB			
CABPL1	PL TIMING BUFFER PWR is MSN DEP [* DPS DATAPACK]	CAB PL1,2,3 BUS PWR SOURCE SELECTABLE via SW on PNL R1A1	
CABPL2			
CABPL3			
APC 5		FA1 & FA2	
AMC 2			✓ OMS-1, NWS (HYD 2 ↓)
ALC 2			✓ OMS-1
APC 2			✓ OMS-1

DC BUS	COMPONENT LOSS	REDUNDANCY LOSS	RESTRING CASE ?
MNC/ MNC DA3	IDP/CRT 3 IDP/CRT 4	FF2, FF3, & FF4 PF2 PCMMU 1 GPCs 1 - 5 RPC C	✓ PROP ✓ VENTS
FPC 3	AC3 ✓ AC3 BUS	BOGUS SMS SIGNATURE NO GPC RPC C PWR LOSS	✓ VENTS ✓ STK-IN-BUCKET
INV			
FLC 3	NSP 2		✓ PROP
FMC 3			
O16	ORB TIMING BUFFER		
R14	MDUs: CDR1, PLT2, & AFD1		
MPC3		FA2, FA3, & FA4	✓ VENTS
APC 6			✓ OMS-1
AMC 3			✓ OMS-1
ALC 3			✓ OMS-1
APC 3			✓ OMS-1

- TIMERS are 'OK' EXCEPT NO READOUT (AC Φ LOSS TAKES OUT 'LED' POWER).
- AV BAY FANS WILL START/RUN WITH a SINGLE Φ DOWN and STILL PROVIDE ADEQUATE COOLING (FAN is DEAD IF EITHER 2 Φ's ↓ or A Φ-to-Φ SHORT).
- FOR A CONFIRMED BUS SHORT, CNTL BUS WILL BE PWR'D OFF POST-MECO.
- PLACE BFS OUTPUT sw TO 'TERM' TO PREVENT AN INADVERTENT ENGAGE.
- PWR OFF a FTS GPC ('TERM' if CREW CAN'T REACH PWR sw). AVOIDS FCS CHAN FORCE-FIGHT and POSTURES FOR SUBSEQUENT RESTRING.
- EXPECT AN IMMEDIATE MTU BITE (P.S. 'A' → X200) or (P.S. 'B' → X100). AUTO OSC SWITCH OCCURS ONLY WHEN an 'OSC TEMP' BITE OCCURS (OSC #1 → 0A00) or (OSC #2 → 8500).
- TAKING BFS TO 'TERM' REDUCES POTENTIAL for BFS SELF-ENGAGE DUE TO BFC or BFS GPC H/W FAIL. ACTION AVOIDS DUAL BUS CMDRs and POSSIBLE LOC IF CREW DOES NOT HALT BFS QUICKLY ENOUGH.
- TAKING GPC OUTPUT sw's to 'TERM' or 'NORM' WON'T PROTECT PASS AGAINST a CREW's INADVERTENT ENGAGE. (PASS GOES to HALT, BUT BFS WON'T SEE THE ENGAGE).

AC BUS	AC1 BUS COMPONENT LOSS	AC2 BUS COMPONENT LOSS	AC3 BUS COMPONENT LOSS	RESTRING CASE ?
Φ a	RH KYBD lighting			
Φ b	FWD EVENT/MSN TIMERS		LH KYBD lighting AFT KYBD lighting	
Φ c		AFT EVENT/MSN TIMERS		
2 or 3 Φ's ↓	AV BAY 1 Fan A off AV BAY 3 Fan B on	AV BAY 2 Fan A on AV BAY 1 Fan B on	AV BAY 3 Fan A off AV BAY 2 Fan B off	✓ VENTS ✓ STK-IN-BUCKET

CONTROL BUS	COMPONENT LOSS	REDUNDANCY LOSS [Φ = no insight via TLM]	RESTRING CASE ?
CNTL AB1	IDP/CRT 1 (PNL C2A2) MMU 1: No HISAM Ind (PNL O14)	FA1 (PNL O6) PF1 ♦ PCMMUs 1 & 2	✓ OMS-1 ✓ NWS (HYD 2 ↓)
CNTL AB2	MMU 2 (PNL 015)	FF1 (PNL O6) FA1 ♦	✓ PROP ✓ OMS-1 ✓ NWS (HYD ↓ ?)
CNTL AB3	F6	<b>CAUTION</b> No CDR's BFS ENGAGE GPCs 1, 2, 4: Loss of ENGAGE discretes	FF1 ♦ PF1 (PNL O6) ✓ VENTS ✓ NWS (HYD 1 ↓)
CNTL BC1	NSP 1	FF4 & FA2 (PNL O6) PF2 (PNL O6) PCMMU 2	✓ NWS (HYD 2 ↓)
CNTL BC2	NSP 2 IDP/CRT 2 (PNL C2A2)	FF2 (PNL O6) FA2 ♦	✓ PROP ✓ NWS (HYD 2 ↓)
CNTL BC3		FF2 ♦ & FF4 ♦ PF2 ♦	✓ VENTS
CNTL CA1	F6 C2	<b>CAUTION</b> BFS NO-GO for ENGAGE (✓ GPC 5 OUTPUT -TERM) No PLT's BFS ENGAGE GPCs 3 & 5: Loss of ENGAGE discretes	FA3 ♦ & FA4 ♦ PCMMU 1 ✓ OMS-1 ✓ NWS (HYD 1 ↓)
CNTL CA2	IDP/CRT 3 (PNL C2A2)	FF3 ♦ FA3 (PNL O6)	✓ PROP ✓ OMS-1
CNTL CA3		FF3 & FA4 (PNL O6)	✓ PROP ✓ VENTS ✓ NWS (HYD 1 ↓)

ESSENTIAL BUS	FUNCTION LOSS	REDUNDANCY LOSS	RESTRING CASE ?
ESS 1BC/ ESS 1BC DA1	GPC 1 HALT Switch GPC 4 HALT Switch GPC 1 TERM Switch GPC 4 TERM Switch	GPCs 1 - 5 RPC A	
FD O13 & R14	MTU: PWR SUPPLY A and OSC #1 OUTER OVEN	EGIL: PRI C&W	
ESS 2CA/ ESS 2CA DA2	GPC 2 HALT Switch GPC 5 HALT Switch GPC 2 TERM Switch GPC 5 TERM Switch	GPCs 1 - 5 RPC B	
FD O13 & R14	MTU: PWR SUPPLY B and OSC #2 OUTER OVEN	EGIL: PRI C&W	
ESS 3AB/ ESS 3AB DA3	GPC 3 HALT Switch GPC 3 TERM Switch	GPCs 1 - 5 RPC C	
FD O13	<b>CAUTION</b> BFS NO-GO for ENGAGE (✓ GPC 5 OUTPUT -TERM) CICU: No GPC 'CAM' ('lamp test' if unsure) No GPC 'I-FAIL' TLM		

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ORBIT BUS LOSS

Revision Date: 3/31/05 [Orb Bus Loss OI30.ppt]

DC BUS	COMPONENT LOSS	REDUNDANCY LOSS	ORBIT IMPACT ?
MNA/ MNA DA1	MMU 1 IDP/CRT 1	FF1 & FF3 PF1 PCMMUs 1 & 2 GPCs 1 - 5 RPC A	
FPC 1			
INV	AC1 ✓ AC1 BUS		
FLC 1		BOGUS SMS SIGNATURE NO GPC RPC A PWR LOSS	
FMC 1			
O14	TIMERS: FWD MSN AFT EVENT		
R14	ADC 1A (IDPs 1 & 2) ADC 2A MDUs: MFD2, PLT1		
MPC1			
AUXPLA			
CABPL1	PL TIMING BUFFER PWR is MSN DEP [* DPS DATAPACK]	CAB PL1,2,3 BUS PWR SOURCE SELECTABLE via SW on PNL R1A1	
CABPL2			
CABPL3			
APC 4		FA1, FA3, & FA4	
AMC 1			
ALC 1			
APC 1			

DC BUS	COMPONENT LOSS	REDUNDANCY LOSS	ORBIT IMPACT ?
MNB/ MNB DA2	MMU 2 IDP/CRT 2	FF1, FF2, & FF4 PF1 & PF2 PCMMU 2 GPCs 1 - 5 RPC B	
FPC 2			
INV	AC2 ✓ AC2 BUS		
FLC 2	NSP 1	BOGUS SMS SIGNATURE NO GPC RPC B PWR LOSS	
FMC 2			
O15	TIMERS: FWD EVENT AFT MSN		
R14	ADC 1B (IDPs 3 & 4) ADC 2B MDUs: CDR2, MFD1		
MPC2			
AUXPLB			
CABPL1	PL TIMING BUFFER PWR is MSN DEP [* DPS DATAPACK]	CAB PL1,2,3 BUS PWR SOURCE SELECTABLE via SW on PNL R1A1	
CABPL2			
CABPL3			
APC 5		FA1 & FA2	
AMC 2			
ALC 2			
APC 2			

DC BUS	COMPONENT LOSS	REDUNDANCY LOSS	ORBIT IMPACT ?
MNC/ MNC DA3	IDP/CRT 3 IDP/CRT 4	FF2, FF3, & FF4 PF2 PCMMU 1 GPCs 1 - 5 RPC C	
FPC 3			
INV	AC3 ✓ AC3 BUS		
FLC 3	NSP 2	BOGUS SMS SIGNATURE NO GPC RPC C PWR LOSS	
FMC 3			
O16	ORB TIMING BUFFER		
R14	MDUs: CDR1, PLT2, & AFD1		
MPC3			
APC 6		FA2, FA3, & FA4	
AMC 3			
ALC 3			
APC 3			

- 1 TIMERS are 'OK' EXCEPT NO READOUT (AC  $\phi$  LOSS TAKES OUT 'LED' POWER).
- 2 AV BAY FANS WILL START/RUN WITH a SINGLE  $\phi$  DOWN and STILL PROVIDE ADEQUATE COOLING (FAN is DEAD IF EITHER 2  $\phi$ 's ↓ or A  $\phi$ -to- $\phi$  SHORT).
- 3 FOR A CONFIRMED BUS SHORT, ENTIRE CNTL BUS WILL BE PWR'D OFF for the REST of FLIGHT. ACTION AVOIDS THE POTENTIAL for ARC TRK'ing FIRES.
- 4 MOVE THE BFS if CNTL BUS FAILURE TAKES OUT BFS ENGAGE CAPABILITY.
- 5 USE 'BKUP' sw TO RESTORE 'I/O TERM' if SM GPC AFFECTED (N/A to GPC 3).
- 6 A PASS or BFS GPC in SLEEP MODE WILL WAKE-UP IMMEDIATELY. THE BFS WILL COME UP OK W/O a HALT DISCRETE, BUT a PASS GPC MAY or MAY NOT JOIN THE SET. ALSO, IT CAN'T BE IPL'd WITHOUT AN IFM TO RESTORE THE HALT DISCRETE.
- 7 EXPECT AN IMMEDIATE MTU BITE (P.S. 'A' - X200) or (P.S. 'B' - X100). AUTO OSC SWITCH OCCURS ONLY WHEN an 'OSC TEMP' BITE OCCURS (OSC #1 - 0A00) or (OSC #2 - 8500).
- 8 TAKING GPC OUTPUT sw's to 'TERM' or 'NORM' WON'T PROTECT PASS AGAINST a CREW's INADVERTENT ENGAGE. (PASS GOES to HALT, BUT BFS WON'T SEE THE ENGAGE).

AC BUS	AC1 BUS COMPONENT LOSS	AC2 BUS COMPONENT LOSS	AC3 BUS COMPONENT LOSS	ORBIT IMPACT ?
$\phi$ a	RH KYBD lighting			
$\phi$ b	FWD EVENT/MSN TIMERS 1		LH KYBD lighting AFT KYBD lighting	
$\phi$ c		AFT EVENT/MSN TIMERS 1		
2 or 3 $\phi$ 's ↓ e	AV BAY 1 Fan A off AV BAY 3 Fan B on	AV BAY 2 Fan A on AV BAY 1 Fan B on	AV BAY 3 Fan A off AV BAY 2 Fan B off	

CONTROL BUS	COMPONENT LOSS	REDUNDANCY LOSS	ORBIT IMPACT ?
CNTL AB1	IDP/CRT 1 (PNL C2A2) MMU 1: No HISAM Ind (PNL O14)	FA1 (PNL O6) PF1 PCMMUs 1 & 2	
CNTL AB2	MMU 2 (PNL 015)	FF1 (PNL O6) FA1	
CNTL AB3	F6	FF1 PF1 (PNL O6)	
<b>CAUTION</b> No CDR's BFS ENGAGE GPCs 1, 2, 4: Loss of ENGAGE discretes 4			
CNTL BC1	NSP 1	FF4 & FA2 (PNL O6) PF2 (PNL O6) PCMMU 2	
CNTL BC2	NSP 2 IDP/CRT 2 (PNL C2A2)	FF2 (PNL O6) FA2	
CNTL BC3		FF2 & FF4 PF2	
CNTL CA1	F6 C2	FA3 & FA4 PCMMU 1	
<b>CAUTION</b> BFS FUNCTION MUST BE MOVED FROM GPC 5 No PLT's BFS ENGAGE GPCs 3 & 5: Loss of ENGAGE discretes 4			
CNTL CA2	IDP/CRT 3 (PNL C2A2)		
CNTL CA2	IDP/CRT 4 (PNL R11A1)	FF3 FA3 (PNL O6)	
CNTL CA3		FF3 & FA4 (PNL O6)	

ESSENTIAL BUS	FUNCTION LOSS	REDUNDANCY LOSS	ORBIT IMPACT ?
ESS 1BC/ ESS 1BC DA1	GPC 1 HALT Switch 6 GPC 4 HALT Switch GPC 1 TERM Switch 5 GPC 4 TERM Switch O13 & R14	GPCs 1 - 5 RPC A EGIL: PRI C&W	
ESS 2CA/ ESS 2CA DA2	GPC 2 HALT Switch 6 GPC 5 HALT Switch GPC 2 TERM Switch 5 GPC 5 TERM Switch O13 & R14	GPCs 1 - 5 RPC B EGIL: PRI C&W	
ESS 3AB/ ESS 3AB DA3	GPC 3 HALT Switch 6 GPC 3 TERM Switch O13	GPCs 1 - 5 RPC C	
<b>CAUTION 3</b> NO BFS ENGAGE BY ANY GPC (IFM REQ'D) CICU: No GPC 'CAM' ('lamp test' if unsure) No GPC 'I-FAIL' TLM			



**TITLE**

MEDS STATUS/USER NOTES

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MEDS STATUS/USER NOTES

Revision: OI-30

Revision Date: 10-21-04

[MEDS Status\_User Notes OI30.ppt]

P O L L E A D E R	IDP MESSAGE TYPE		MSG RESET	IDP ID	MAJ FUNC SW	FREEZE ACK	DISP	KYBD MSG	SASTP ACTV	CRIT BITE	IDP LOAD REQ'd	
	RSP MSG TYPE		IDP ID	BINARY MF SW		GNC	SM	HEX FLAGS				
	0 = MCDS STATUS 3 = IDP LOAD REQ'D 5 = IDP LOAD BITE		1 = IDP 1 2 = IDP 2 3 = IDP 3 4 = IDP 4 7 = IDP LOAD	00 = PL MF or DEU LOAD REQST 01 = GNC MF 10 = SM MF 11 = ILLEGAL		60	A0	ACKNOWLEDGE				
						50	90	DISPLAY FREEZE				
N O T E S & W A I V E R S	ANOMALOUS CONDITION	SECONDARY CUES	APPLICABLE USER/OPS NOTES		ABBREVIATED DESCRIPTION							
	'ILLEGAL ENTRY' ANNUNCIATED BY PASS	OCCURRED AT 'ITEM 16 EXEC' ON SPEC 21	PASS USER 100520		OCCURS IF FF1-FF3 MDM BITE INIT I/O (ID=16) BYPASS at G2/G3 OPS TRANS.							
	IDP LOAD ERROR DETECTED DURING or FOLLOWING IDP LOAD		BFS OPS B28002		IDP/VM LOAD REQST TO A IDP ASSIGNED TO BFS WILL INITIATE A BFS IDP LOAD. AFTER IDP LOAD, IDP STATUS WORDS IMPLY LOAD PROBLEM, BUT IDP IS OK.							
		PASS I/O ERRORs AND/OR FAULT MSGs	PASS USER 37706 and PASS USER 33643		PASS I/O ERRORs AND FAULT MSGs ASSOCIATED WITH A IDP LOAD REQUEST OR WITH AN IDP LOAD FAILURE.							
	DEFAULT GPC IPL or BFS MENU-IPL RELATED	NO DEU RESPONSE' IDP MSG AT BFS IPL	BFS OPS B26015		IOP TIMING WINDOW CAN MISS AN IDP POLL DURING BFS GPC MENU IPL.							
	CREW-IDENTIFIED CRT DISPLAY 'FUNNYS'	MOMENTARY 'BIG X' ON CRT	PASS USER 35743		AT SM OPS TRANS- POINT RETRIEVE.							
		PASS USER 100750		DISPLAY ON ANOTHER CRT CHANGED.								

GPC SPEC & DISP RETENTION	PASS <sup>1</sup> CURRENT		BFS CURRENT	
	SPEC	DISP	SPEC	DISP
NEW DISP	R	C	R	C
NEW SPEC	C	C	C	C
RESUME	C	C	C	C
GPC/CRT ②	R	C	C	C
BFC CRT SW REASSIGNMENT	R	C	C	C
MAJ FUNC SW (GNC → SM → GNC)	R	C	R	C
(GNC → PL ④ → GNC)	R	C	R	C
(SM → GNC → SM)	R	C	R	C
(SM → PL ④ → SM)	R	C	R	C
MAJOR MODE TRANSITION ⑤	R	R	R	R
OPS TRANSITION ⑥	C	C	C	C
GPC MODE SW: RUN → STBY	C	C	R	R
OPS MODE RECALL:			R	R
ANY PASS TARGET SET ALTERATION	C	C		
ANY PASS NBAT CHANGE	R	R		
NO PASS NBAT CHANGE	R	R		

- ① PASS USER NOTE #33754 DOCUMENTS SOME, BUT NOT ALL, OF THE IDENTIFIED RESPONSES FOR A PASS 'DISP'.
- ② BFS SM SPEC 63 (PL BAY DOORS) HAS SOME UNIQUE REQ'MTS RELATIVE TO 'RESUME' ACTIONS (BFS USER NOTE #B03926C).
- ③ IF THE CREW REASSIGNS A FAILED CRT via GPC/CRT KEY, THEN AFFECTED CRT WILL BE 'LOCKED UP' UNTIL A GOOD DEU POLL OCCURS. FURTHERMORE, AN UPLINK DEU EQUIV LOAD CANNOT BE USED TO CLEAR A TRAPPED SPEC. AN OPS TRANSITION, A SET EXPANSION, or A SET CONTRACTION IS REQUIRED TO CLEAR THE TRAPPED SPEC.
- ④ PASS: IF PL9 NOT ACTIVE, SPEC 0 DRIVEN (UNSUPPORTED MF). BFS: CRT BLANKS EXCEPT for TIME FILL, SPL, and MSG LINE.
- ⑤ A SPEC AND/OR DISP IS RETAINED if SUPPORTED BY THE NEW MAJOR MODE. A 'FROZEN' SPEC, DISP, or OPS DISPLAY IS NOT AFFECTED by THE MM TRANSITION (EVEN if SUPPORTED).
- ⑥ AN OPS TRANSITION CANCELS ALL SPECs and DISP s FOR ALL THREE GNC/SM/PL MAJOR FUNCTIONS in THE TARGET GPCs.

PASS 'ILLEGAL ENTRY' QUIRKS

WHILE ANY PASS GPC CAN SUPPORT MORE THAN ONE MAJOR FUNCTION (MF) AT A TIME, THE SAME SYSTEM S/W SPEC CANNOT BE CALLED UP IN TWO DIFFERENT MFs SIMULTANEOUSLY FOR THE SAME GPC. OTHERWISE, WILL GET AN 'ILLEGAL ENTRY' MSG (✓ PASS USER NOTE #25396 FOR ADDITIONAL DETAILS).

BE AWARE OF POTENTIAL FOR STRANGE SCENARIOS INVOLVING A SYSTEM S/W SPEC BEING CALLED UP IN A MF NOT SUPPORTED BY THE PASS COMMON SET DURING A TIME THAT THE SPEC WAS CALLED-UP (e.g., SPEC 0 WAS CALLED IN THE 'SM' MF BY A GNC GPC PRIOR TO ESTABLISHING AN SM2 GPC).

KYBD INPUTs NEVER AFFECT UNDERLYING SPECs. IF A SPEC IS UNDERLYING A DISP, ANY ATTEMPT TO CALL UP THAT SPEC ON THE SAME CRT WILL RESULT IN AN ILLEGAL ENTRY MESSAGE. A 'RESUME' WILL UNCOVER THE DESIRED SPEC. ALTERNATELY, THE SPEC MAY INSTEAD BE CALLED UP ON ANOTHER CRT WITHOUT HAVING TO DROP THE DISP ON THE FIRST CRT.

SYSTEMS BRIEFS QUICK REFERENCE

KEY SWITCH CODES 4.6.8, TABLE 4.6-5  
 BFS DK-LISTEN 4.6.10  
 CRT MF SW LOGIC 4.6.11  
 DEU EQUIV UPLINK 4.6.12  
 ROLL-IN DISP's 4.6.13

MISCELLANEOUS PASS/BFS USER NOTES

- 36329 NO DEU EQUIV to ISOLATED CRT (DEASSIGN'd or BFC CRT SEL).
  - 52780 'ILLEGAL ENTRY' if DEU EQUIV to GPC NOT IN CMD of DK BUS.
  - 55006 NO FLT S/W SYNTAX-CHK of DEU EQUIV LOADS (??? RESULTS).
  - 37503 FAILED CRTs TRAPPED SPEC CNTs AGAINST MF 3-SPEC LIMIT.
  - 37507 'I/O ERROR CRT' NOT REANNUNCIATED if DEU IS HARD-FAILED.
  - 37511 CRT IS NOT REDISTRIBUTED if MF SW MISMATCH at OPS TRANS.
  - 37512 DEASSIGN'd CRT NOT PICKED UP WHEN BFC CRT SEL SW OFF.
- 
- B03973A NO 'ILLEGAL ENTRY' MSG if BFS REJECTS a 'DK LISTEN' ITEM.
  - B05290B NO ADD'L 'CRIT BITE' MSGs UNTIL a BFS POLL w/NO CRIT BITE.
  - B20512 'DK LISTEN' TOGGLE-TYPE ITEMS CAN GET OUT-OF-SYNC.

**TITLE**

ASCENT/ENTRY ERROR & BFS ERROR

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ASCENT/ENTRY ERROR

ID/ELE	PASS I/O ERROR DESCRIPTION																								
1	RS IPR																								
2	GPC-TO-GPC MFB/OVERLAY																								
3	SSIP ICC																								
5	IDP/DEU 1 = BCE 6 (DK1)																								
6	2 = BCE 7 (DK2)																								
7	3 = BCE 8 (DK3)																								
8	4 = BCE 9 (DK4)																								
10	PCMMU																								
11	MMU																								
13	<b>HFE INPUT</b>																								
	<table border="1"> <tr> <th>EIU1</th> <th>EIU2</th> <th>EIU3</th> </tr> <tr> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td>4</td> <td>5</td> <td>6</td> </tr> </table> PORT 1 (PRI DATA) PORT 4 (ALT DATA)	EIU1	EIU2	EIU3	1	2	3	4	5	6															
EIU1	EIU2	EIU3																							
1	2	3																							
4	5	6																							
	<table border="1"> <tr> <th>FF1</th> <th>FF2</th> <th>FF3</th> <th>FF4</th> </tr> <tr> <td>7</td> <td>11</td> <td>14</td> <td>17</td> </tr> <tr> <td>9</td> <td>12</td> <td>15</td> <td>18</td> </tr> <tr> <td>10</td> <td>13</td> <td>16</td> <td>19</td> </tr> </table> FF MDM RTN WORD ADTAs 1-4 FF PROM (STRG B)	FF1	FF2	FF3	FF4	7	11	14	17	9	12	15	18	10	13	16	19								
FF1	FF2	FF3	FF4																						
7	11	14	17																						
9	12	15	18																						
10	13	16	19																						
	<table border="1"> <tr> <th>FA1</th> <th>FA2</th> <th>FA3</th> <th>FA4</th> </tr> <tr> <td>20</td> <td>22</td> <td>25</td> <td>28</td> </tr> <tr> <td>23</td> <td>26</td> <td>29</td> <td></td> </tr> <tr> <td>21</td> <td>24</td> <td>27</td> <td>30</td> </tr> </table> FA MDM RTN WORD ANALOG CARD ② FA PROM (STRG D)	FA1	FA2	FA3	FA4	20	22	25	28	23	26	29		21	24	27	30								
FA1	FA2	FA3	FA4																						
20	22	25	28																						
23	26	29																							
21	24	27	30																						
14	HFE OUTPUT																								
15	<b>MFE INPUT</b>																								
	<table border="1"> <tr> <th>FF1</th> <th>FF2</th> <th>FF3</th> <th>FF4</th> </tr> <tr> <td>31</td> <td>36</td> <td>40</td> <td>46</td> </tr> <tr> <td>32</td> <td>37</td> <td>41</td> <td></td> </tr> <tr> <td>33</td> <td>38</td> <td>42</td> <td></td> </tr> <tr> <td>34</td> <td>39</td> <td>43</td> <td></td> </tr> <tr> <td>35</td> <td>44</td> <td></td> <td></td> </tr> </table> FF PROM (STRG A) IMUs 1-3 (N/A in G9) TACAN/RA CARDS 1-3 MLS's 1-3 -Z STKR/-Y STKR	FF1	FF2	FF3	FF4	31	36	40	46	32	37	41		33	38	42		34	39	43		35	44		
FF1	FF2	FF3	FF4																						
31	36	40	46																						
32	37	41																							
33	38	42																							
34	39	43																							
35	44																								
	<table border="1"> <tr> <th>FA1</th> <th>FA2</th> <th>FA3</th> <th>FA4</th> </tr> <tr> <td>47</td> <td>48</td> <td>49</td> <td>50</td> </tr> </table> FA PROM (STRG C)	FA1	FA2	FA3	FA4	47	48	49	50																
FA1	FA2	FA3	FA4																						
47	48	49	50																						
	<table border="1"> <tr> <th>EIU1</th> <th>EIU2</th> <th>EIU3</th> </tr> <tr> <td>51</td> <td>52</td> <td>53</td> </tr> </table> PORT 1 (TLM ONLY)	EIU1	EIU2	EIU3	51	52	53																		
EIU1	EIU2	EIU3																							
51	52	53																							
16	OPS INIT (ALL EXCEPT G8 TRANS)																								
	<table border="1"> <tr> <th>FF1</th> <th>FF2</th> <th>FF3</th> <th>FF4</th> </tr> <tr> <td>74</td> <td>75</td> <td>76</td> <td>77</td> </tr> </table> FF MDM BITE4 ④	FF1	FF2	FF3	FF4	74	75	76	77																
FF1	FF2	FF3	FF4																						
74	75	76	77																						
	<table border="1"> <tr> <th>FA1</th> <th>FA2</th> <th>FA3</th> <th>FA4</th> </tr> <tr> <td>78</td> <td>79</td> <td>80</td> <td>81</td> </tr> </table> FA MDM BITE4	FA1	FA2	FA3	FA4	78	79	80	81																
FA1	FA2	FA3	FA4																						
78	79	80	81																						
22	MTU INPUT																								
	<table border="1"> <tr> <th>FF1</th> <th>FF2</th> <th>FF3</th> <th>FF4</th> </tr> <tr> <td>54</td> <td>55</td> <td>56</td> <td></td> </tr> </table> MTU ACCUMS 1-3 ⑤	FF1	FF2	FF3	FF4	54	55	56																	
FF1	FF2	FF3	FF4																						
54	55	56																							
24	NSP1 NSP2																								
	<table border="1"> <tr> <th>FF1</th> <th>FF3</th> </tr> <tr> <td>66</td> <td>68</td> </tr> <tr> <td>67</td> <td>69</td> </tr> </table> NSP DISCRETE INPUTS NSP SERIAL I/O INPUTS	FF1	FF3	66	68	67	69																		
FF1	FF3																								
66	68																								
67	69																								
61	G9/G1: PRELAUNCH LDB																								
62	G9/G1: LAUNCH DECODER MDM TCS I/O ⑥																								
63	SRB TLM DATA ⑥																								
	<table border="1"> <tr> <th>L SRB</th> <th>R SRB</th> </tr> <tr> <th>LL1 LL2</th> <th>LR1 LR2</th> </tr> <tr> <td>70 71</td> <td>72 73</td> </tr> </table>	L SRB	R SRB	LL1 LL2	LR1 LR2	70 71	72 73																		
L SRB	R SRB																								
LL1 LL2	LR1 LR2																								
70 71	72 73																								
70-73	G9/G1: FC BUS TCS I/O → BCE's 14-17 ⑦																								
78	GPS OUTPUT (6.25 HZ to FF2 ONLY)																								
79	GPS INPUT																								
	<table border="1"> <tr> <th>FF1</th> <th>FF2</th> <th>FF3</th> <th>FF4</th> </tr> <tr> <td>98</td> <td></td> <td></td> <td></td> </tr> </table> GPS 2 ⑤ (Card 11, Chan 02)	FF1	FF2	FF3	FF4	98																			
FF1	FF2	FF3	FF4																						
98																									

- PASS ELE = 0 EXCEPT as NOTED. KU RADAR (ID 15/ELE 45) NOT APPLICABLE in G1/G3.
- IF MDM FA2 → HYD SYS 3 PRESS C or FA3/FA4 → L/R OMS Pc (TLM only)
- PASS USER NOTES:**
- #103439 EIU I/O ERRORS (0 to 18) at SSME CNTRL PWR-OFF (≈ MECO+10 MIN).
- #100520 IF IMU ALIGN REQ'D in G3 & FF 1-3 BUS CMDR FTS at TAL/G3 TRANS.
- #35211 If GPS or MTU BYPASS, BFS DOWNMODES STRING at PASS I/O RESET.
- #63682 and If a GPS is FAILED or PWR'd OFF, 4 PASS I/O ERRORS at I/O RESET.
- #29949 IGNORE SRB I/O ERRORS at SRB SEP.
- #102825 MEC BITE-READ TIMING WINDOW. (MEC 1 → 7010290 0000 & MEC 2 → 7102240 0000)
- IF a PAD ABORT, POSSIBLE ID = 62 'S-BIT' I/O ERROR (LF1 and LA1 ARE RE-POWERED).
- ERRORS DON'T FORCE PASS GPC TO HALT. NOTE THAT 'C/M IDLE' OCCURS at EITHER HALT → STBY/RUN or RUN → STBY/HALT.

Revision: OI-29/OI-30

Revision Date: 8-11-04

HEX CODE	BFS I/O ERROR DESCRIPTION
00	HFE (24/MC): EIU 1 BCE 14 EIU 1 PORT 1
01	EIU 2 15 EIU 2
02	EIU 3 16 EIU 3
04	FA PROM SEQ (STRG D)
05	FF PROM SEQ (STRG B)
06	ADTAs
07	ANALOG CARD ②
08	MFE (6/MC): FF PROM SEQ (STRG A)
09	TACAN/RA CARDS
0B	IMUs
0F	FA PROM SEQ (STRG C)
10	MTU (1/MC): MTU ACCUM ⑤
13	NSP (6/MC): NSP DISCRETE INPUTS
14	NSP SERIAL I/O DATA
15	GPS (1/MC): GPS's ⑤ (FF2, CARD 11, CHAN 02)
16	HFE (24/MC): FF MDM RTN WORD
17	FA ↓ ↓ ↓
1F	HFE OUTPUT: 25 Hz/1.04 Hz XFER DATA
20	PF1: MDM RTN WORD
21	PF2: ↓ ↓ ↓
22	BCE INSTR ERR (BCE 'OUT-OF-BOUNDS') ④
28	HFE FA
29	↓ FF
2B	LSN NSP FF
2C	CMD MFE FA
2D	ON ↓ FF
2F	PRI MTU FF
30	BFS 1-SHOT
31	GPS FF
32	XFER DATA
34	HFE FF
35	↓ FA
36	LSN NSP FF
38	CMD MFE FF
39	ON ↓ FA
3A	SEC MTU FF
3C	PORTS GPS FF
3E	XFER DATA
40	BFS ENGAGED OUTPUTS: HFE (24/MC)
41	↓ DDU (12/MC)
42	↓ SPI (6/MC)
43	PF MDM OUTPUTS (6/MC)
44	UPLINK RTCs: to FC MDMs
45	to PF MDMs
4C	PASS G9 ONE-SHOT XFER DATA
4D	ENGAGE INIT I/O (FF/FA MDM BITE4)
4E	PRELAUNCH LDB POLL
4F	DEU POLL ④
50	PCMMU: NON-OI MDM I/O
51	MDM OA2 INPUTS
52	OA3
53	OA1
54	OF1
55	OF2
56	OF3
57	OF4
58	PDI INPUTS
66	PAYLOAD INPUT: FLEX IUA 06
69	↓ 09
6A	↓ PF1 10
6C	↓ PF2 12
6F	↓ FLEX 15
7D	↓ 29
7E	↓ 30

- 'ERR TRAP' LOGS GPC ERROR and 'CONT' or ISSUES 'RESTART' (a 'GPC BITE' MSG).
- THESE BFS GPC ERRORS ANNUNCIATE BOTH 'GPC IOP' and 'GPC BITE' MSGS.
- BFS DOWNMODES ENTIRE FC STRING if FC XMIT ENA FAIL-ON and PRE-ENGAGE.
- BFS USER/OPS NOTES:**
- #B28681 IOP H/W FAILURE
- #B05284A If GPS or MTU FAIL, BFS DROPS STRING at PASS I/O RESET.
- #B28806 ERRORS AT POST-LANDING IF BUS 'PRO to OPS 0' DELAYED.
- INTERRUPT-TYPE DRIVES RECOVERY:
- ERROR CODES (INTERRUPT) BFS ACTION**
- 0X, 1X, or 2X (all EX1) RESTART
- 20 (EX3), 30 (EX4), or 95 (PCK) CONTINUE
- 8X (MCK) or 9X (PCK) ERROR TRAP
- 94, 95, 99 (PERMANENT MASK) NO LOG

[AscEnt IO Error OI30.ppt]

HEX CODE	BFS FSW ACTION	BFS GPC ERROR DESCRIPTION																
04	RESTART	DMA STORE-PROTECT VIOLATION																
08	↓	DMA TIMEOUT																
09	↓	DMA QUEUE OVERFLOW																
2F	↓	PWR TRANSIENT → 'GPC PWR' MSG																
41	CONT	BAD ENGAGE/ I/O TERM B COMBO																
43	CONT	NON-DK/FC XMIT-ENA FAIL ON/OFF																
44	DROP BUS	FC MIA XMIT-ENA FAIL ON/OFF																
	↓	DK MIA XMIT-ENA FAIL ON/OFF																
	↓	DK BUS → 'XMIT ENA FAIL' or 'BCE OUT OF BOUNDS'																
	↓	<table border="1"> <tr> <th>DK XMIT MSG?</th> <th>CURRENT CRT CMDR</th> <th>REASSIGN CRT TO</th> <th>DK LISTEN CAPABILITY</th> </tr> <tr> <td>YES</td> <td>PASS</td> <td>BFS</td> <td>NA (BFS CRT)</td> </tr> <tr> <td>YES</td> <td>BFS</td> <td>PASS</td> <td>LOST</td> </tr> <tr> <td>NO</td> <td>BFS</td> <td>PASS</td> <td>LISTEN OK</td> </tr> </table>	DK XMIT MSG?	CURRENT CRT CMDR	REASSIGN CRT TO	DK LISTEN CAPABILITY	YES	PASS	BFS	NA (BFS CRT)	YES	BFS	PASS	LOST	NO	BFS	PASS	LISTEN OK
DK XMIT MSG?	CURRENT CRT CMDR	REASSIGN CRT TO	DK LISTEN CAPABILITY															
YES	PASS	BFS	NA (BFS CRT)															
YES	BFS	PASS	LOST															
NO	BFS	PASS	LISTEN OK															
44	DOWNMODE	TWO PASS/BFS 'LSN' ERRORS																
45	FC STRING	PASS RS XFER-DATA MISCOMPARE																
46	↓	PASS/BFS ELE BYPASS																
47	↓	LAST REMAINING FC STRING																
82	ERR TRAP	DMA MULTI-BIT ERROR (IOP)																
83	↓	CPU ↓ (CPU)																
85	↓	CPU ROS MICROCODE PARITY																
86	↓	INTERRUPT PAGE FAULT																
87	↓	'END-OP' TIMEOUT																
88	↓	'EA' FAULT (EFFECTIVE ADDRESSING)																
89	↓	CPU CANNOT CONTINUE																
90	↓	ILLEGAL OP CODE or PCI/PCO CMD																
91	↓	PRIVILEGED INST (SUPV STATE)																
97	↓	CPU STORE-PROTECT VIOLATION																
9A	ERR TRAP*	CONVERT OVERFLOW (FL-PT → FIXED)																
9B	↓	FLOAT-PT EXPONENT OVERFLOW																
9C	↓	FLOAT-PT DIVIDE BY ZERO																
B0	CONT	BAD SVC or UNDEFINED SVC																
B1	↓	HAL SUBROUTINE ERROR																
B2	RESTART	'RESTART' SVC (CODE RUNAWAY)																
B3	CONT	DISPLAY ERROR HANDLER INVOKED																
C0	RESTART	MAX-RATE JOB OVERLOAD																
C1	↓	ALT-RATE ↓																
C2	CYC EXT'D	↓																
E0	ERR TRAP	INSTR MONITOR (TRY EXQT DATA)																
F0	CONT	IOP WATCHDOG TIMEOUT → I-FAIL LT																
F1	↓	'VOTER-FAIL' LATCH → I-FAIL LT																
F2	RESTART	C/M IDLE (NON START-UP)																
F3	↓	ROS MICROCODE PARITY																
F4	↓	TIMING FAULT																

BCE STAT (BCE's 1-24)				MSC T/O (BCE 28)			
10XX	0000	ADRS/IUAR MISMATCH	4000	0000	ICC	1	
08XX	0000	PARITY BIT	2000			2	
04XX	0000	S-BIT	1000			3	
03XX	0000	BOTH E-BIT and V-BIT	0800			4	
02XX	0000	E-BIT	0400			5	
01XX	0000	V-BIT					
00XY	0000	SYNC BIT (Y=9 or 1)	0200	0000	DK	1	
0000	0400	XMIT OUT WORD GAP	0100			2	
	0200	SELF-TEST (GND-ONLY)	0080			3	
	0100	XMITR DISAMIA BUSY	0040			4	
	0040	INITIAL TIME-OUT					
	0020	TIME-OUT	0020	0000	PL	1	
	0010	MMU BLOCK TIME-OUT	0010			2	
	0008	BCE INSTR FORMAT					
	0004	ILLEGAL BCE INSTR	0008	0000	LDB	1	
			0004			2	
<b>MMU STAT (PASS BCE 27)</b>							
0200	Y000	MMU OFF/FAILED	0002	0000	FC	5	
0100		IPL SOURCE/NO MASK	0001			6	
008X		CHECKSUM ERROR	0000	8000		7	
004X		SUM BUFFER TIED UP		4000		8	
000X		LDB (X) or MM (Y) BUS					
		If X=4(8) → LDB2(1), or Y=1(2) → MM2(1)	0000	2000	MM	1	
				1000		2	
<b>LEVEL B (PASS BCE 29) ①</b>							
0004	0000	DMA STORE PROTECT	0000	0800	FC	1	
				0400		2	
				0200		3	
				0100		4	
<b>LEVEL A (PASS BCE 30) ①</b>							
8000	0000	WATCHDOG TIMER					
4000		VOTER-FAIL LATCH					
2000		IOP C/M IDLE ⑩	0000	0080	IP1-IP5		

**TITLE**

ASCENT/ENTRY RESTRING

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ASCENT/ENTRY RESTRING

Revision Date: 8-11-04 [AE Restrng.ppt]

FLIGHT PHASE	FAILURE CONDITION	NEED BFS?	RESTRING CRITERIA	FLT RULE		
ENTIRE DYNAMIC ASCENT PHASE	LESS THAN CRITICAL VEHICLE CAPABILITY REMAINS (CAPABILITY LOST/DEGRADING)	NO	REGAIN CRIT FUNCTION	A2-63.E		
ASCENT PWR'D FLT ↓ MM102 MM103 or MM601 ↓ NON PWR'D DYNAMIC FLT ↓ MM104 MM105	PRE-MECO	SSME THROTTLE CMD-PATH FAILURE (STUCK IN THE BUCKET) DUE TO PASS GPC FTS/HALT/QUIT or PASS FC MIA XMTR FAILURE (BCes 14 - 17)	NO YES	AVOID ABORT CONTINGENCY AVOID an RTLS or TAL ABORT	A2-63.A.2 A2-63.A.1	
	POST-MECO but PRE-ET SEP	RTLS ANY PASS GPC FAIL or ANY PASS FC MIA XMTR FAIL (FC1 thru FC8)	NO	AVOID <b>LOC</b> * DURING MATED COAST & ET SEP	A2-63.B.1 A2-69	
	POST-ET SEP and RTLS	NON-RTLS INSUFFICIENT ET SEP JETS (TIME CRIT if TAL)	NO	AVOID RECONTACT	A2-63.B.1 GNC: A8-55	
	POST-ET SEP & TAL or AOA	GO TO <b>ENTRY RESTRING</b> (DYNAMIC FLT)				
POST-ET SEP	ANY PASS GPC FAILURE	RESTRING at the TAL OPS TRANSITION (CERTIFIED)	NO	ALL STRINGS at G3 OPS TRANS	A2-63.B.2.b	
POST-ET SEP	NEXT FAIL CAUSES LOSS OF PASS and BFS (NOT SINGLE-FAULT TOLERANT)		YES	SINGLE-FAULT TOLERANCE	A2-63.E	
RESTRING IS OK PRIOR TO ACHIEVING SAFE ORBIT	OMS-1 TIG is REQUIRED at MECO + 2 MIN And LESS THAN TWO OMS ENGINES		NO	SUPPORT the UNDERSPEED BURN		
RESTRING IS OK PRIOR TO ACHIEVING SAFE ORBIT	FAILED FC STRING(s) MASKING EXISTING CRITICAL SYSTEM PROBLEM (OMS/PROP)		NO	INSIGHT to OMS or PROP LEAK	A2-63.B.2.a	
ENTIRE ENTRY PHASE	CRITICAL ORBITER SYSTEM CAPABILITY LOST or LAST GNC/PROP LRU DEGRADING	NO	REGAIN CRIT ORBITER SYSTEM	A2-254.G		
NON DYNAMIC FLIGHT	NOMINAL DEORBIT/AOA to PRE-MM304	ANY SINGLE PASS GPC FAILURE	DON'T RESTRING AFTER EI - 5 MIN	YES	REGAIN FULL FAULT TOLERANCE	A2-254.A A2-254.E
DYNAMIC FLIGHT	ENTRY/GRTLS and PRE-HAC INTERCEPT	PRE-MM305/MM603: INSUFFICIENT VENT DOOR OPEN CAPABILITY ①	INSUFFICIENT ASA COMMAND CAPABILITY (2 ELVN/RUDDER/SPD BRK and 1 BDY FLAP)	NO	COMPARTMENT VENTING	A2-254.C.3
MM602 MM603 or MM304 MM305	RESTRING IS OK PRIOR TO ACHIEVING SAFE ORBIT	KNOWN DIRECTIONAL-CNTL PROBLEM ▼ or NO NWS, plus (RTLS, TAL, or AOA to KSC) ▼ ▼ PEAK CROSSWINDS > SURF-WIND LIMIT, TIRE PRESS PROBLEM, or UN-CMD'D BRAKE PRESS	RTLS/TAL: MPS LH <sub>2</sub> MANIFOLD ENTRY PRESSURIZATION	NO	AVOID NON-CERTIFIED FCS MODE NWS 1 or NWS 2	A2-254.C.2 A2-254.C.1 MMACS: A10-141.A
POST-HAC INTERCEPT	AVOID RESTRING: CREW WORKLOAD and SMALL EXPOSURE WINDOW to NEXT FAIL			N/A	N/A	A2-254.F

PASS GPC FAIL SIGNATURE	RS GPCs DETECT		FAIL MODE	
	GPC ERROR	I/O ERROR (ALL RS)		
GPC QUIT ②	NO	NO	LOOKS LIKE a 'MISS SYNC'	
CPU ≠ 0% F T S	'MISS SYNC' or NON-UNIV I/O ERROR	NO	✓ VP SYNC FAIL PTR ③	
	ICC BUS MIA XMTR/R/CVTR	05 00	NO	ICC RCVR at FTS GPC
	ICC RETRY ✓SUM FAIL	05 07	NO	VARIABLE PART BAD
CPU = 0% H A L T	FC MIA XMTR-ENA DISAGREE	05 01	NO	MIA XMTR FAIL-ON
	HALT/STBY	NO	NO	1 FC MSC T/O 1 ICC MSC T/O SYNC → 000

- ① MM TRANS OCCURS at MACH 2.5 FOR MM305 and at MACH 3.2 FOR MM603. VENTS OPEN at MACH 2.4
- ② MCC CANNOT DISTINGUISH BETWEEN a GPC FTS and GPC QUIT, BUT CREW CAN (via MODE tb/ CRT Status):  
HALT → CRT 'BIG X' and POLL FAIL  
QUIT → CRT 'BIG X' and POLL FAIL  
FTS → FTS GPC DRIVES CRTS  
MODE 'tb' CHANGES  
NO MODE 'tb' CHANGE  
NO MODE 'tb' CHANGE
- ③ NON-FTS GPCs WILL INDICATE 'MISS CS SYNC' FAIL PTR if GPC FTS WAS DUE TO NON-UNIVERSAL FC I/O ERROR.
- ④ CREW HAS ALREADY TAKEN FAILED GPC TO HALT if CPU = 0% BUT OTHER DATA INDICATES CPU ≠ 0%.

DYNAMIC RESTRING NBATS						
GPC FAIL	ASCENT NBAT	ENTRY NBAT			RTLS or NWS	
		VENTS ①				
X = AFF STRING		CLOSED	OPEN			
1 X234	4234	4234	A	2234		
2 1X34	1434	1434	N	1134		
3 12X4	1244	1244	Y	1244		
4 123X	1233	1233	V	1233		
1&2 XX34	4334	3434	A	3434		
1&3 X2X4	4224	2244	L	2244		
1&4 X23X	3232	3232 or 2233	I	2233		
2&3 1XX4	1414	1414 or 1144	D	1144		
2&4 1X3X	1331	1133		1133		
3&4 12XX	1221	1212		1212		

- VENTS & NWS NBATS ASSUME NO EXISTING PROP or AVIONICS FAILURES WHICH HAVE A HIGHER RESTRING PRIORITY (✓'LRU's REMAINING' BELOW):
- 2 ASAs | 2 Y-JETS | VENTS ③ | 4 ASAs
  - 2 RGAs | P-JETS ① | NWS ③ | 3 Y-JETS
  - 2 AAs | RHCS ② | 3 RGAs | 3 AAs
  - 2 IMUs | 3 ASAs | 3 AAs
- ① 1-FAULT TOLERANT (2/EACH UP FIRING GROUP & 2/EACH DOWN FIRING GROUP)  
② CONTACT-WISE ⇒ 1-FAULT TOLERANT  
③ KNOWN DIRECTIONAL CNTL PROBLEMS or ABORT LANDING (RTLS, TAL, AOA to KSC)
- DOUBLE STRING WITH BAD FCS CH if POSSIBLE | ASCENT 2-GPC NBATS PROTECT OMS TVC

ASCENT/ENTRY FAILURE COMBOS				
<b>STUCK IN THE BUCKET</b>				
← RESTRING for GPC/EIU/AC FAIL →				
STRG DOWN (FULL or 1/2)	2 <sup>nd</sup> STRING	or EIU (ID=13)	or AC BUS	
1 FC5	STRG 2	FC6	EIU3 P1 (ELE 3)	AC2 or AC3
2 FC6	STRG 3	FC7	EIU1 P1 (ELE 1)	AC1 or AC3
3 FC7	STRG 1	FC5	EIU2 P1 (ELE 2)	AC1 or AC2
<b>RTLS: LOC/ET SEP JETS</b>				
If an RTLS CASE, RESTRING FOR ANY PASS GPC FC XMTR FAIL (PORT MODING NO HELP) or FOR a FAILED PASS GPC (QUIT/HALT/FTS).				
* <b>LOC NOTE</b>				
ISSUE IS ABOUT 'CONTROL AUTHORITY' and NOT 'RECONTACT' PER SE SINCE POTENTIAL EXISTS for 'LOC' DURING MATED-COAST RATE DAMPING, at ET SEP, or IMMEDIATELY THEREAFTER (PULL UP MNWR/PITCH ATT) if INSUFFICIENT RCS JETS.				
ALL AFT MANF UP-FIRING (+2) JETS, ALL FWD and AFT MANF DOWN-FIRING (-2) JETS, ALL FWD and AFT MANF LEFT-FIRING (+Y) and RIGHT-FIRING (-Y) JETS REQ'D TO SUPPORT ET SEP. FAILED AFT-FIRING (+X) or FWD MANF UP-FIRING (+Z) & FWD-FIRING (-X) JETS are NO IMPACT.				
<b>UNDERSPEED OMS-1</b>				
← RESTRING for MDM/BUS FAIL →				
STRG DOWN	L/R OMS	MDM	DC BUS	CNTL BUS
1	L	FA2/FF2	MNB APC2	N/A
2	TVC	FA1/FF1	MNA APC1	N/A
3	R	FA4/FF4	MNC APC3	N/A
4	TVC	FA3/FF3	MNA APC1	N/A
1	L	FA4	MNA ALC1	AB1
2	L	FA3	FA2	AB2
3	L	FA2	MNB ALC2	AB2
4	L	FA1	FA1	AB2
1	R	FA3	MNC ALC3	CA1
2	R	FA4	FA2	CA2
3	R	FA1	MNA ALC1	CA2
4	R	FA2	FA2	CA2
FF MDM FAIL NO IMPACT ONCE IN MM104 (Exclude PWR FAIL)				
<b>VENTS</b>				
← RESTRING for MDM/BUS FAIL →				
STRG DOWN	MDM	DC BUS	AC BUS	CNTL BUS
1	N/A	MNC FPC3/MPC3	AC3	CA3
2	N/A	N/A	N/A	N/A
3	N/A	MNB FPC2/MPC2	AC2	BC3
4	N/A	MNA FPC1/MPC1	AC1	AB3
2 and FF3				
3 and FF2				
<b>BODY FLAPS</b>				
RESTRING if GPC & FAIL COMBOS TAKE OUT ALL 3 'BF CNTL PATHS'				
STRG DOWN	<b>BODY</b>			
1	FLAP #1 → FA1 or ASA 1 or APU/HYD 1			
2	CNTL #2 → FA2 or ASA 2 or APU/HYD 2			
3	PATH #3 → FA3 or ASA 3 or APU/HYD 3			
BODY FLAP FAIL: HARD OVER UP/DN (VERY BAD) TRAILING POSITION (SEMI-BAD)				
<b>NWS</b>				
STRG DOWN	AFF SYS	← RESTRING if NWS REQ'D →		
1	HYD 1	CNTL AB2 and HYD 2 DOWN		
1 or 2	NWS 1	NO NWS 1		
3 or 4	NWS 2	NO NWS 1		
◆ NO NWS 1	◆ NO NWS 2	NO HYD 1 (ANY of THESE)	NO HYD 2 (ANY of THESE)	
MNA O14	MNB O15	APU 1	APU 2	
MDM FF1 or FF2	MDM FF3 or FF4	MNA FPC1	MNB FPC2	
		MNA AMC1	MNB ALC2	
		CNTL AB3	CNTL AB1	
		CNTL CA1	CNTL BC1	
		CNTL CA3	CNTL BC2	
● NO PNL SW LG HYD SYS ISOL 'OPEN' if BOTH CNTL AB2 (HYD 1) & CNTL BC1 (HYD 2) FAILED. THUS, IF NWS REQ'D and BOTH CNTL AB2 & HYD SYS 2 ↓, MDM FA1 is REQ'D to OPEN 'LG EXTEND ISOL VLV' to ENA NWS HYD 1.				

## TITLE

BUS LOSS TABLES

## DESCRIPTION

- A. This SCP provides various tabular summaries of orbiter AC and DC electrical bus failure impacts on Shuttle avionics LRUs, including DPS equipment. Both single and double electrical bus failure impacts to DPS MDMs are included.
- B. Orbiter Control Bus Short Confirmation Rationale

The SCP also provides the following discussion of orbiter electrical control bus shorts, including the philosophical rationale behind an EGIL request to the MCC flight control team to assist in the confirmation of control bus shorts.

The orbiter electrical bus distribution system utilizes remote power controller (RPC) and circuit breaker (c/b) devices to isolate and protect against electrical faults. That is, with current overloads due either to electrical bus shorts or orbiter LRU internal shorts, the circuit protection devices are designed to trip. A subsequent crew action is required to reset the RPC or c/b device. This standard electrical bus isolation design works very well, with one notable exception – the orbiter control buses.

Nine control buses (CNTL AB1, AB2, AB3, BC1, BC2, BC3, CA1, CA2, and CA3) support low-current RPC and circuit breaker control signals via panel switches, located primarily on the orbiter flight deck. The control bus wiring is routed from panel to panel, although only three panels (O6, R2, and MA73C) are actually common to all nine control buses. This effective wire-jumpering from panel to panel is referred to as a “daisy chain”.

RPCs directly source-feed panels O6 and MA73C, the terminating panels for each daisy chain. Panel R2 serves as the mid-point for a daisy chain and is fed directly by a five-amp fuse, as well as, jumper connections between other panels within each control bus daisy chain.

If a control bus short is suspected, the EGIL flight control discipline will desire the panel number for all equipment impacted. This will help to pinpoint the source of the control bus short on the daisy chain, or help to isolate the problem to control bus current and/or voltage monitoring sensors. Our normal ‘goodie book’ Console Handbook documentation provides information that allows us to assist EGIL in the task of identifying possible control bus shorts (including panel number).

Due to the overall length of the orbiter control buses (approximately 500 feet long), it is possible to sustain a bus short and still maintain most or all of the equipment functions associated with the affected bus. Each control bus is source-fed by a five-amp fuse at the middle of the bus and by two five-amp RPCs, one at each end of the control bus. At most, only two of these three power-feed sources will trip/blow, depending on the location and severity of the bus short.

The severity of the bus short is a function of the existing load in combination with the naturally occurring resistance at the point of the electrical short. The remaining source will continue to feed the entire bus load to the point of the electrical short. The bus voltage will vary with the length of the control bus to the short and, thus, may or may not be sufficient to drive an RPC (control input ON signal is about 12 V dc) or to look like a bi-level "logic one" (6 to 10 V dc) for DPS or OI telemetry. Consequently, depending on the location of the bus short, equipment functions may or may not be lost.

The RPC and/or fuse in the region of the bus short will normally be tripped/blown because of an electrical short. The remaining control bus feed-source(s) will not trip because of current limiting caused by distributed resistance of the control bus wiring. Without crew action, the remaining power feed(s) will continue to feed the short indefinitely or until the shorted wire burns through (melts).

If left unchecked, two undesirable risks arise. First, if the control bus short occurs in an area where the bus is part of a wire bundle, localized heating at the point of the short could eventually build to levels that cause damage to adjacent wires in the bundle. This could potentially take out many different critical orbiter functions. Second, there exists the demonstrated concern for arc tracking fires, a condition in which the localized heat at the point of the short becomes sufficient to ignite the control bus wiring insulation (Kapton).

This Kapton ignition further destroys the wire insulation in the immediate area of the short, exposing additional wire to the electrical short, which continues to overheat and char insulation adjacent to the short. The net effect of this process is that once ignited, the Kapton insulation will continue to burn somewhat like a fuse, allowing the short to propagate up the bus to the first connector or to the point where the "hot" lead (current feed) and the ground return wires separate.

If the affected control bus is powered off, the electrical-short heat source for a potential arc tracking fire is killed, and destruction of the insulation will cease. If an arc tracking fire has occurred, the insulation will cease burning. However, the wires are still physically in contact with each other (short remains intact).

Should the control bus be repowered, the conditions for an arc tracking fire are restored. Furthermore, because of existing charring and carbonization of the damaged insulation in the area of the short, less heat is now required to start an arc tracking fire than prior to powering off the control bus. That is, the potential for an arc tracking fire is actually greater than before the bus was powered off.

For these reasons, EGIL will instruct the crew to power off the affected control bus as soon as practical. This action will take out redundancy in other control buses, but will not kill those buses unless additional electrical bus problems are present.

## **REFERENCES**

- A. The source for all bus loss information is a variety of old Rockwell drawings, which are now maintained in the Boeing electronic Shuttle Drawing System. Those used are as follows:
1. VS70-720209, Rev B, 04/16/87, Data Proc and Software, Flt Cont MDM PWR and CONT.
  2. VS70-720219, Rev B, 11/11/88, Mass Memory and Computer Interface Subsystem.
  3. VS70-720229, Rev D, 08/24/88, Computer Power and Controls Subsystem.
  4. VS70-720239, Rev A, 05/23/81, Computer Synchronization and Fail Status.
  5. VS70-720269, Rev E, 08/29/88, Back Up Flt Cont Computer Interface.
  6. VS70-730109, Rev D, 08/19/85, Displays and Controls (OV-103, OV-104, OV-105).
  7. VS70-730159, 04/15/80, Timers Subsystem.
  8. VS70-733519, Rev A, 09/25/84, Panel F6A5.
  9. VS70-750139, Rev M, 10/28/87, Master Timing Unit.
  10. VS70-750209, Rev K, 06/01/88, OI Power and Control.
  11. VS70-760309, Rev M, 12/01/93, Main DC Power Distribution Subsystem (OV-103, OV-104, OV-105).
  12. VS70-760503, Rev B, 04/07/88, Evcon Subsystem.
- B. Summary of Control Bus Repower Test, Engineering Directorate, prepared by Lockheed Engineering & Management Services Company, Houston, TX, May 1988.
- C. Various Notes of Interest.

**AC BUS LOSS SUMMARY**

DPS COMPONENTS	DC/AC BUS PATH	LOCATION	COMMENTS
Numeric Lighting: FWD EVENT TIMER AFT EVENT TIMER FWD MISSION TIMER AFT MISSION TIMER	MNA-FPC1-AC1 phase B MNB-FPC2-AC2 phase C MNA-FPC1-AC1 phase B MNB-FPC2-AC2 phase C	PNL L4:R c/b #123 PNL L4:Q c/b #105 PNL L4:R c/b #123 PNL L4:Q c/b #105	Timer is still running, LED power source lost. Timer is still running, LED power source lost. Timer is still running, LED power source lost. Timer is still running, LED power source lost.
Keyboard Lighting: LH KYBD RH KYBD AFT KYBD	MNC-FPC3-AC3 phase B MNA-FPC1-AC1 phase A MNC-FPC3-AC3 phase B	PNL L4:R c/b #125 PNL L4:R c/b #126 PNL L4:Q c/b #106	

**DC BUS LOSS SUMMARY**

	DC MAIN A						DC MAIN B						DC MAIN C						ESS BUSES			CONTROL BUSES										
	MNA	FPC1	FPC1	MPC1	APC1	O14	MNB	FPC2	FPC2	MPC2	APC2	O15	MNC	FPC3	FPC3	MPC3	APC3	O16	1B	2C	3A	AB1	AB2	AB3	BC1	BC2	BC3	CA1	CA2	CA3		
DBIA 1 RPC	A	X			X						X																			X		
DBIA 2 RPC	A	X			X						X																		X			
PCMMU 1 RPC	A	X	X										X	X								X								X		
PCMMU 2 RPC	A	X	X																							X						
GCIL / NSP 1	B						X	X	X																X							
GCIL / NSP 2	C												X	X	X											X						
IMU 1 RPC	A	X	X																			X										
IMU 2 RPC	B						X	X															X									
IMU 3 RPC	A	X	X										X	X															X		X	
ADTA 1 c/b	A	X				X																										
ADTA 2 c/b	B					X					X																					
ADTA 3 c/b	C											X						X														
ADTA 4 c/b	C											X						X														
LEFT DDU c/b	A	X				X																										
RIGHT DDU c/b	B					X						X																				
AFT DDU c/b	A	X				X							X																			
	C											X						X														

① RPC or circuit breaker (c/b) 'A', 'B', and 'C' designation infers MNA, MNB, or MNC power-feed, respectively.



**DOUBLE BUS LOSS MATRIX**

DC BUSES LOST		LRUs →		F	F	F	F	F	F	F	F	P	P	PYLD TIMING BUFFER	
		F	F	F	F	F	F	F	F	F	F	F			
		1	2	3	4	1	2	3	4	1	2	1	2		
MNA	MNB	X				X				X		X		X	
MNA	MNC		X					X			X		X		
MNB	MNC		X		X		X						X		
MNA	FPC1	MNB FPC2	X									X			
		MNC FPC3			X										
		CNTL AB3 CA3	X			X						X			
	MPC1	MNB MPC2													X
		ESS 2CA													X <sup>①</sup>
	APC4	MNB APC5 MNC APC6					X				X	X			
CNTL AB2 CA2 CA3							X			X		X			
											X				
MNB	FPC2	MNC FPC3		X		X							X		
		CNTL AB1 AB2 BC3	X									X			
	MPC2	ESS 1BC												X <sup>①</sup>	
	APC5	MNC APC6					X								
		CNTL AB1 BC2					X		X						
MNC	FPC3	CNTL BC1 BC2 CA2		X		X							X		
		APC6	CNTL BC1 CA1					X		X	X				
CNTL AB1 AB1 AB2		CNTL AB2 AB3 AB3					X					X			
CNTL BC1 BC1 BC2		BC2 BC3 BC3				X		X					X		
CNTL CA1 CA1 CA2		CA2 CA3 CA3							X		X				
ESS 1BC		ESS 2CA												X	

① Manually selectable alternate source (Panel R1 sw "Payload Cabin").

TITLE

DPS LCC SUMMARY

DPS LCC SUMMARY

PASS	MONITOR UNTIL	INFO	LCC SSID #
DESCRIPTION OF PROBLEM	T-MIN:SEC		
FF 1(2,3,4)/FA 1(2,3,4)/PL 1(2) port 1 and 2 bite status register (19 of 20 ports)	SS 45:00	TSA (DPS-03)	DPS-19
BCE STRING 1(2,3) IMU (FSM)	20:00		DPS-12
EIU 1(2,3)/P1 data bypass (MFE input)	20:00	R*(1)	DPS-18
FF 1(2,3) IMU disc bypass (IMU input)	20:00		DPS-12
GPC 1(2,3,4) failed indicator	20:00	G* R* (2) TSA	DPS-02
I/O ERROR MMU 1 (2) (FSM)	20:00	TSA	DPS-06a
FA 1(2,3,4) bypass (GNC init)	SS 19:00		DPS-04
FF 1(2,3,4) bypass (GNC init)	SS 19:00		DPS-04
GPC 1(2,3,4) archive status	SS 19:00		DPS-27
TMP source (accumulator) (2 of 3 accum)	00:31	G	DPS-10
BCE STRING 1(2,3,4) A (FSM)	00:31	G TSA	DPS-03
BCE STRING 1(2,3,4) B (FSM)	00:31	G TSA	DPS-03
BCE STRING 1(2,3,4) C (FSM)	00:31	G TSA	DPS-03
BCE STRING 1(2,3,4) D (FSM)	00:31	G R (2) TSA	DPS-03
BCE STRING 1(2,3,4) ADTA (FSM)	00:31	G	DPS-15
BCE STRING 1(2,3) IMU (FSM)	00:31	G	DPS-13
BCE STRING 1(2,3) MTU (2 of 3 accum) (FSM)	00:31	G	DPS-16
BCE STRING 1(3) NSP (FSM)	00:31	G	DPS-14
BCE STRING 1(2,3) TAC (2 of 3 TAC) (FSM)	00:31	G	DPS-17
BFS engage 1(2,3) (11 of 12) discrete	00:31	G	DPS-11
DDU Good (No DPS insight/GNC monitors)	00:31	G TSA	DPS-23
FA 2 hydr sys 3 press C bypass	00:31	G TSA	DPS-03
FA 3 OMS chamber press L bypass	00:31	G TSA	DPS-03
FA 4 OMS chamber press R bypass	00:31	G TSA	DPS-03
FF 1(3) NSP discretes bypass	00:31	G	DPS-14
GPC 1(2,3,4) SEC (2 cnts or less per area - upper/lower)	00:31		DPS-26
I/O ERROR FA 1(2,3,4) (19 of 20 ports) (FSM)	00:31	G R (2) TSA	DPS-03
I/O ERROR FF 1(2,3,4) (19 of 20 ports) (FSM)	00:31	G R (2) TSA	DPS-03
MMU 1 (2) ready (3 of 4 discretes per MMU)	00:31	G	DPS-07
MTU BITE bit indications (MTU-BSR)(1 of 2 OSC/ pwr supplies/cmd channel)	00:31	G TSA	INS-03
MTU good (INCO monitors) (PCM-BSR)	00:31	G TSA	INS-01
PASS I/O ERR LOG (single hit)	00:31	G	DPS-22
PF 1(2) MDM return word bypass	00:31	G TSA	DPS-03
Time source GPC/MTU (on MTU)	00:31	G	DPS-10
I/O ERROR CRT (MEDS) (1,2,3,4) (FSM)	00:31	TSA	DPS-01a
CRT BITE (MEDS) (1,2,3,4) (FSM)	00:31	TSA	DPS-01a
MEDS Status Word Error	00:31	TSA	DPS-01a
Crew indication of MEDS Anomaly (MDU/KYBD)	00:31	TSA	DPS-01a
NOTE: No MCC hold after 0/31 per Flight Rule 2-3			
GPC BITE (FSM)	00:10	G (3)	DPS-05
GPC 1(2,3,4) last GPC error count	00:10	G (3)	DPS-09
MDM OUTPUT(FC N/A for G9; PF N/A for G1) (FSM)	00:10	G (3)	DPS-20
SUMWORD ICC 1(2,3,4) (FSM)	00:10	G (3)	DPS-21
SRB MDM PROM BYPASS	00:00	G (2) TSA	BEI-04
Jote: See LCC page 31-03 for DPS LCC index; LCC page 33-03 for INS LCC index; LCC page 13-03 for BEI LCC index.			



DPS LCC SUMMARY

BFS DESCRIPTION OF PROBLEM		MONITOR UNTIL T-MIN:SEC	INFO	LCC SSID #
I/O ERROR PCM	(FSM)	5:00	G TSA	BFS-15
RM FAIL XFER	(FSM)	SS 3:50	G	BFS-11
BFS I/O ERR LOG (single hit)		00:31	G	BFS-12
GPC SEC 0 to 128K (lower memory) (2 cnts or less)		00:31		BFS-14
MTU accumulator source (must be on accum 1, 2, or 3)		00:31	G	BFS-03
I/O ERROR PL 1(2)	(FSM)	00:31	G TSA	BFS-09
I/O Error CRT 1 (2,3,4) (MEDS)	(FSM)	00:31	TSA	BFS-10a
CRT BITE 1 (2,3,4) (MEDS)	(FSM)	00:31	TSA	BFS-10a
MEDS Status Word Error		00:31	TSA	BFS-10a
Crew indication of MEDS Anomaly (MDU/KYBD)		00:31	TSA	BFS-10a
BFS Battery Backup Anomaly		00:31	TSA	BFS-16
Note: No MCC hold after 0/31 per Flight Rule 2-3				
BFS engage 1(2,3)		00:10	G	BFS-02
Downlist validity check area 2	(BFS downlist)	00:10	G	BFS-08
GPC 5 BITE	(FSM)	00:10	G (3)	BFS-04
GPC error count - BFS		00:10	G	BFS-05
I/O terminate B		00:10	G	BFS-01
Tracking pass status		00:10	G	BFS-06

Note: See LCC page 35-03 for BFS LCC index.

**NOTES:**

FSM - Fault Summary Message  
 SS - Snapshot at  
 TSA - Troubleshooting Available  
 G - GLS monitored item  
 G\* produces other GLS violations  
 R - RSLs checked item (LCC page 36-05)  
 R\* produces other RSLs violations

- (1) RSLs hold via ME data path failure T - 20 min to T - 0
- (2) GLS or RSLs hold via flight-critical MDM channel fail (GLS from T - 2 hr to T - 31 sec - RSLs from T - 15 sec to T - 0)
- (3) Parameters are monitored by the KSC DPS Console (C12).  
 An error occurrence causes an interrupt to be sent to GLS, where the error condition is checked for validity.

32:00 BFS Activation  
 20:00 OPS 1 Transition (PASS)  
 19:00 Completion of OPS 1 Transition  
 18:00 BFS Transition to OPS 101  
 00:31 Go for RSLs Start  
 00:10 Go for SSME Start

**GLS "HOLD" Milestones:**

T - 9:00	- Prior to GLS activation
T - 7:30	- Prior to OAA retract
T - 5:00	- Prior to APU start
T - 4:00	- Prior to Purge Seq 4
T - 2:55	- Prior to ET LO <sub>2</sub> prepress
T - 1:57	- Prior to ET LH <sub>2</sub> prepress
T - 00:31	- Prior to Auto Seq start

TITLE

VENT DOOR RESTRING MATRIX

VENT DOOR RESTRING MATRIX

	GPC1	GPC2	GPC3	GPC4	FF1	FF2	FF3	FF4	FA1	FA2	FA3	FA4	NOTES
GPC1		*		*		*		*				*	THIS CARD IS INTENDED FOR REFERENCE USE ONLY.
GPC2	*		*		*		*				*		
GPC3		*		*		*		*		*			
GPC4	*		*		*		*		*				
FF1		*		*		*		*					ALL VENT DOOR RESTRING DECISIONS SHOULD BE COORDINATED WITH MMACS PRIOR TO IMPLEMENTATION.
FF2	*		*		*		*						
FF3		*		*		*		*					
FF4	*		*		*		*						
FA1				*								*	Vent door open commands are issued at V <sub>REL</sub> = 2400 (prior to 70,000 feet altitude).
FA2			*								*		
FA3		*								*			
FA4	*								*				
MNA AMC1				*								*	One side of both fwd/aft vent groups, and four of six midbody vent groups are required for sufficient venting.
MNA APC4				*								*	
MNA DA1		*		X		*		X				*	
MNA FMC1				*				*					
MNA FPC1		*		X		*		X				*	MMC power buses are not reflected in this matrix. MMC losses only result in capability loss.
MNA MPC1		*		X		*		X					
MNB AMC2	*		*						*		*		
MNB APC5	*		*						*		*		
MNB DA2	*		X		*		X		*		*		MMC power buses are not reflected in this matrix. MMC losses only result in capability loss.
MNB FMC2	*		*		*		*						
MNB FPC2	*		X		*		X		*		*		
MNB MPC2			X				X						
MNC AMC3		*								*			MMC power buses are not reflected in this matrix. MMC losses only result in capability loss.
MNC APC6		*								*			
MNC DA3	X	*			X	*				*			
MNC FMC3		*				*							
MNC FPC3	X	*			X	*				*			MMC power buses are not reflected in this matrix. MMC losses only result in capability loss.
MNC MPC3	X	*			X	*							
CNTL AB3		*		X		*		X				*	
CNTL BC3	*		X		*		X		*		*		
CNTL CA3	X	*			X	*				*			MMC power buses are not reflected in this matrix. MMC losses only result in capability loss.
AC1		*		X		*		X				*	
AC1 AMC1				*								*	
AC1 FMC1				*				*					
AC2	*		X		*		X		*		*		MMC power buses are not reflected in this matrix. MMC losses only result in capability loss.
AC2 AMC2	*		*						*		*		
AC2 FMC2	*		*		*		*						
AC3	X	*			X	*				*			
AC3 AMC3		*								*			MMC power buses are not reflected in this matrix. MMC losses only result in capability loss.
AC3 FMC3		*				*							

X - Indicates a restrung is required.

\* - Indicates vent door capability has been lost. Multiple \*'s may require a restrung.

## REFERENCES

1. Space Shuttle Operational Flight Rules, NSTS-12820, A2-254.C.3.

TITLE

GPC DISCRETES "COMMONALITY"

**GPC DISCRETES "COMMONALITY"**

Discrete inputs				Discrete inputs (hardware RM)			
<u>Receiver</u>	<u>DI #</u>	<u>Discrete function</u> <sup>a</sup>	<u>RM by PASS</u>	<u>Receiver</u>	<u>DRI #</u>	<u>Discrete function</u> <sup>a</sup>	
1	0 <sup>b</sup>	HALT CMD		1	03	GPC 2 FAIL Vote	
	1 <sup>b</sup>	STANDBY CMD					
	2 <sup>b</sup>	RUN CMD					
3	IPL CMD						
4 <sup>b</sup>	MMU 1 IPL CMD	X					
2	5 <sup>b</sup>	MMU 2 IPL CMD	X	04	GPC 3 FAIL Vote		
	6 <sup>b</sup>	MMU 1 READY	X				
	7 <sup>b</sup>	MMU 2 READY	X			05	GPC 4 FAIL Vote
3	8	GPC 2 BFS RUN	X	06	GPC 5 FAIL Vote		
	9	GPC 3 BFS RUN	X				
	10	GPC 4 BFS RUN	X				
	11	GPC 5 BFS RUN	X				
4	12	SPARE (I/O TERM A)		Discrete outputs			
	13 <sup>b</sup>	I/O TERM B		<u>Buffer driver</u>	<u>DO #</u>	<u>Discrete function</u> <sup>a</sup>	
	14	SPARE		1	07	I/O Active Ind	
	15 <sup>b</sup>	HARDWARE MEMORY DUMP (HISAM)		2	09	RUN Ind	
5	16	SPARE		3	20	SELF SYNC1	
	17	SPARE		4	22	BFS RUN	
	18	SPARE		5	24	SELF SYNC2	
6	19	SPARE		6	28	SELF SYNC3	
	20	GPC 2 SYNC1		7	30	ID Source <sup>d</sup>	
	21	GPC 3 SYNC1		8	31	IPL Ind	
7	22	GPC 4 SYNC1					
		23	GPC 5 SYNC1		Discrete outputs (hardware RM)		
8	24	GPC 2 SYNC2		<u>Buffer driver</u>	<u>DRO #</u>	<u>Discrete function</u> <sup>a</sup>	
	25	GPC 3 SYNC2		1	00	GPC 1 FAIL Ind (I-Fail)	
9	26	GPC 4 SYNC2		2	07	GPC 2 FAIL Ind	
	27	GPC 5 SYNC2					
10	28	GPC 2 SYNC3					08
	29	GPC 3 SYNC3					
	30	GPC 4 SYNC3		09	GPC 4 FAIL Ind		
	31	GPC 5 SYNC3					
9	32	GPC ID BIT 0		10	GPC 5 FAIL Ind		
	33	GPC ID BIT 1					
10	34	GPC ID BIT 2					
	35	BFS ENGAGE 1	X <sup>c</sup>				
10	36	BFS ENGAGE 2	X <sup>c</sup>				
	37	BFS ENGAGE 3	X <sup>c</sup>				
	38 <sup>b</sup>	CRT SEL A	X				
	39 <sup>b</sup>	CRT SEL B	X				

<sup>a</sup> These descriptions given for GPC 1. See note on Shuttle System Handbook drawing 8.1 for other GPCs.

<sup>b</sup> If suspect, these discrettes may be tested.

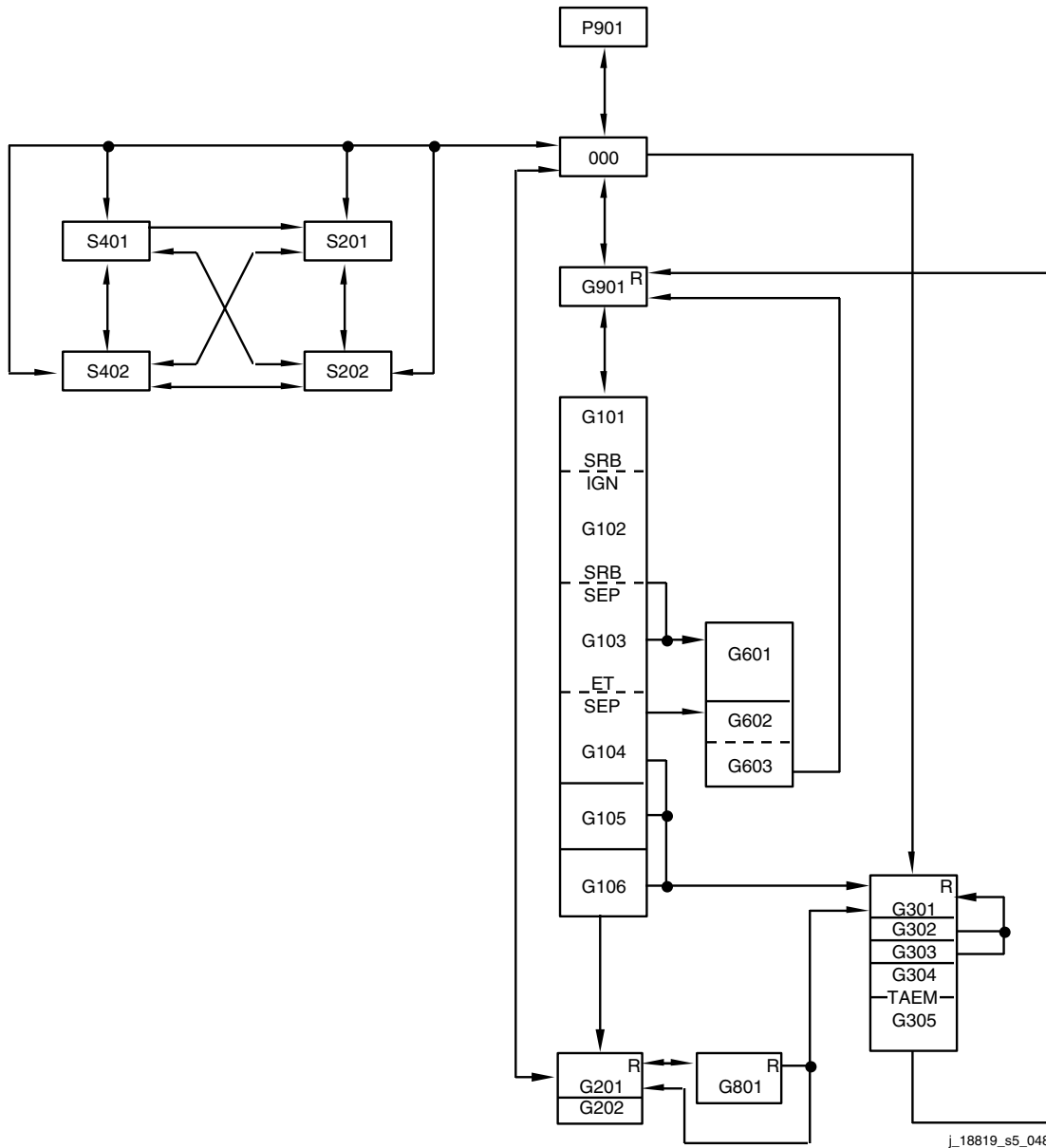
<sup>c</sup> The engage discrettes are redundancy managed by PASS for disengage only.

<sup>d</sup> ID source provides "logic one" reference voltage to wire harness connector where the GPC slot ID bit pattern is formed and then fed back to the IOP via discrete inputs DI #32 to 34.

TITLE

PASS LEGAL OPS TRANSITIONS

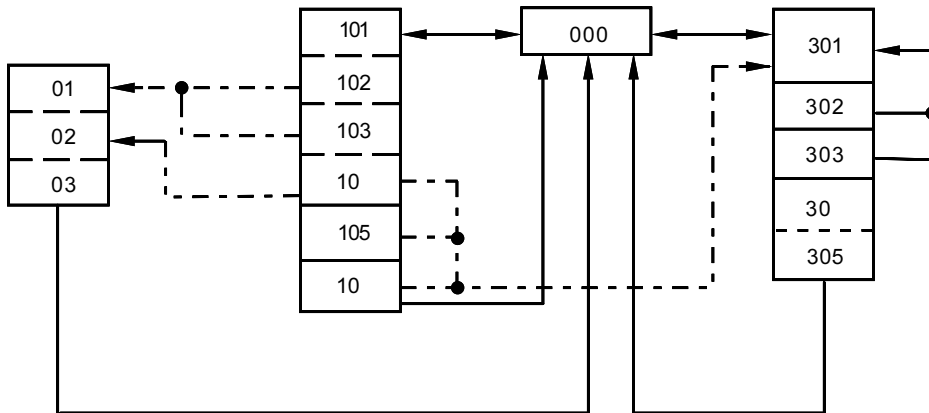
PASS LEGAL OPS TRANSITIONS



j\_18819\_s5\_048

- MANUAL OPS TRANSITION
- |—— MANUAL MAJOR MODE TRANSITIONS
- - - - AUTO MAJOR MODE TRANSITIONS
- - - - ABORT OPS TRANSITIONS (DEPENDING UPON ABORT MODE,  
AUTOMATIC MAJOR MODE TRANSITIONS MAY OCCUR)
- R OPS/MODE RECALL POINT WHERE TARGET SET MAY BE CHANGED

BFS LEGAL OPS TRANSITIONS



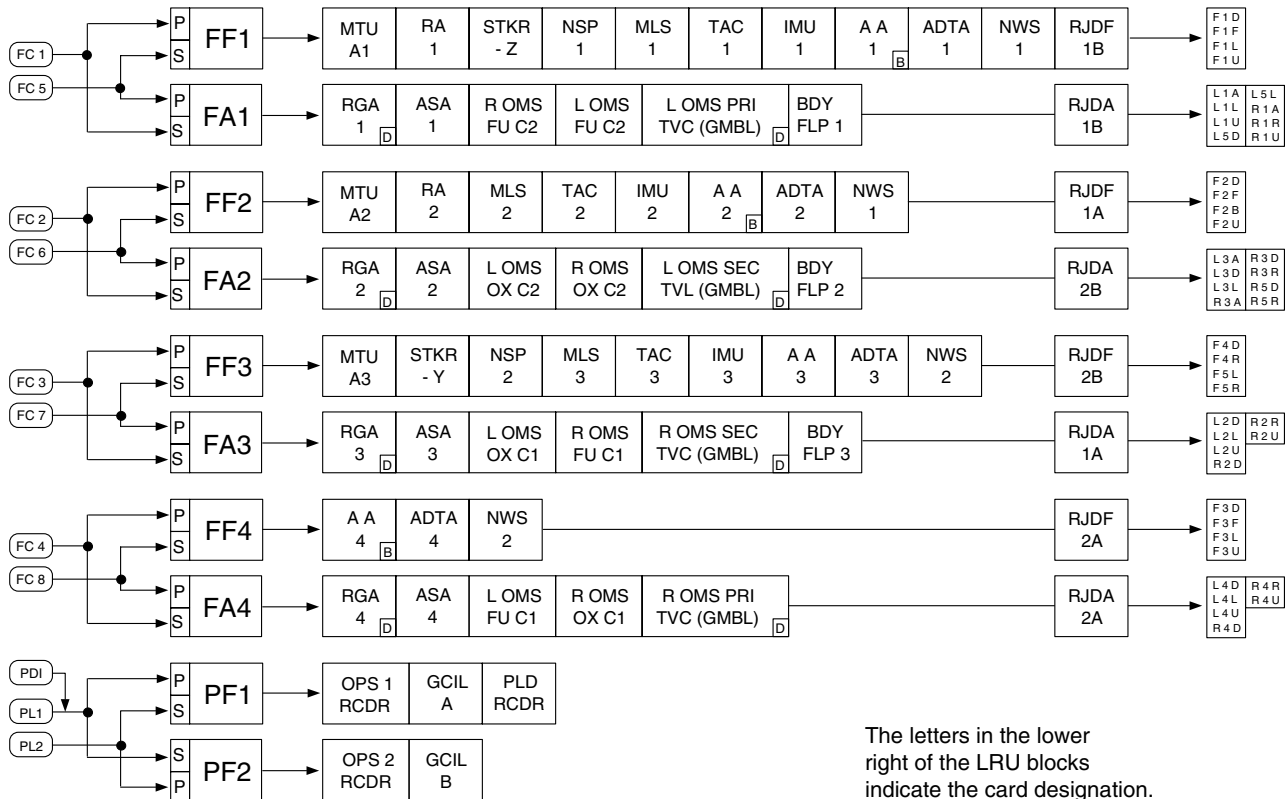
- MAN AL OPS T ANSITION
- ⊢——— MAN AL MA O MODE T ANSITIONS
- |-----| A TO MA O MODE T ANSITIONS
- ..... ABO T OPS T ANSITIONS (DEPENDING PON ABO T MODE, A TOMATIC MA O MODE T ANSITIONS MAY OCC )

j 1 1 s5 0

**TITLE**

DPS CONFIGURATION

## DPS CONFIG CHART



The letters in the lower right of the LRU blocks indicate the card designation. For more information on this, see the Reference Data Book.

j\_18819\_s5\_050

5.13-2

Verify that this is the correct version before use



TITLE

LRU LOSS

**ORBITER LRU LOSSES FOR NOMINAL ASCENT/ENTRY PHASE  
FLIGHT-CRITICAL STRING CONFIGURATION**

❶			GPC 1		GPC 2		GPC 3		GPC 4	
LRU			FF 1	FA 1	FF 2	FA 2	FF 3	FA 3	FF 4	FA 4
NWS ENA COMMANDS (OR'D)			NWS1		NWS1		NWS2		NWS2	
NWS STEERING COMMANDS					NWS1		NWS2			
NWS FEEDBACKS			A		B				C	
NSP			1				2			
IMU			1		2		3			
AA			1		2		3		4	
ADTA			1 (L)		2 (R)		3 (L)		4 (R)	
ADS PROBE-DEPLOY DISC			L-1		R-1		L-2		R-2	
TACAN			1		2		3			
GPS			1❷		2		3❷			
MLS			1		2		3			
RADAR ALTM			1		2					
STAR TRACKER			-Z				-Y			
C N T L R	L	RHC/RPTA/SBTC	A		B		C			
	R	RHC/RPTA/SBTC			A		B		C	
	A	RHC	A		B (P/YW)		C		B (ROLL)	
	FWD	THC	A		B		C			
	AFT	THC	A		B		C			
OMS ENABLE			LPRI		LSEC		RSEC		RPRI	
OMS TVC				LPRI		LSEC		RSEC		RPRI
OMS IGN	L	VALVE 1		COIL 2				COIL 1		COIL 1
	L	VALVE 2				COIL 2				
	R	VALVE 1		COIL 2				COIL 1		
	R	VALVE 2				COIL 2		COIL 1		COIL 1
ASA				1		2		3		4
RGA				1		2		3		4
FCS COMMANDS				1		2		3		4
FCS FEEDBACKS				1		2		3		4
FCS OVERRIDE COMMANDS			1B 3B 4C		1A 2A 3C		1C 2B 4B		2C 3A 4A	
RCS MANIFOLDS			F1	A1/A5	F2	A3/A5	F4/F5	A2	F3	A4
VERNIER RCS (ON-ORBIT)				L5L L5D		R5R R5D	F5L F5R			
P R I R C S J E T S	FWD JETS	LEFT	F1L						F3L	
		RIGHT			F2R		F4R			
		UP	F1U		F2U				F3U	
		FORWARD	F1F		F2F				F3F	
LEFT DOWN	RIGHT DOWN		F1D					F3D		
					F2D		F4D			
YAW JETS	LEFT			L1L		L3L		L2L		L4L
	RIGHT			R1R		R3R		R2R		R4R
PITCH JETS	LEFT DOWN					L3D		L2D		L4D
	RIGHT DOWN					R3D		R2D		R4D
	LEFT UP			L1U				L2U		L4U
RIGHT UP				R1U			R2U		R4U	
AFT JETS	LEFT			L1A		L3A				
	RIGHT			RIA		R3A				

❶ All data paths are for both command and feedback, unless otherwise noted.

❷ Three-string GPS as Orbiters are retrofitted (OMDP upgrades).

**TITLE**

DATA BUS LAYOUTS

**PURPOSE**

This SCP documents the physical order of placement of the LRUs for the given data buses.

**PROCEDURE**

See diagrams of bus layouts (figure 5.15-1).

**REFERENCE**

Integrated System Schematics, drawing no. VS70-971099, 5-8-87, rev A, seq 12.

ICC (Intercomputer Communications) sheet 116

FC (Flight Critical) sheets 158-174

DK (Display Keyboard) sheets 106-107

PL (Payload) sheet 108

IP (Instrumentation Payload) sheet 102

LB (Launch Bus) sheets 103-104

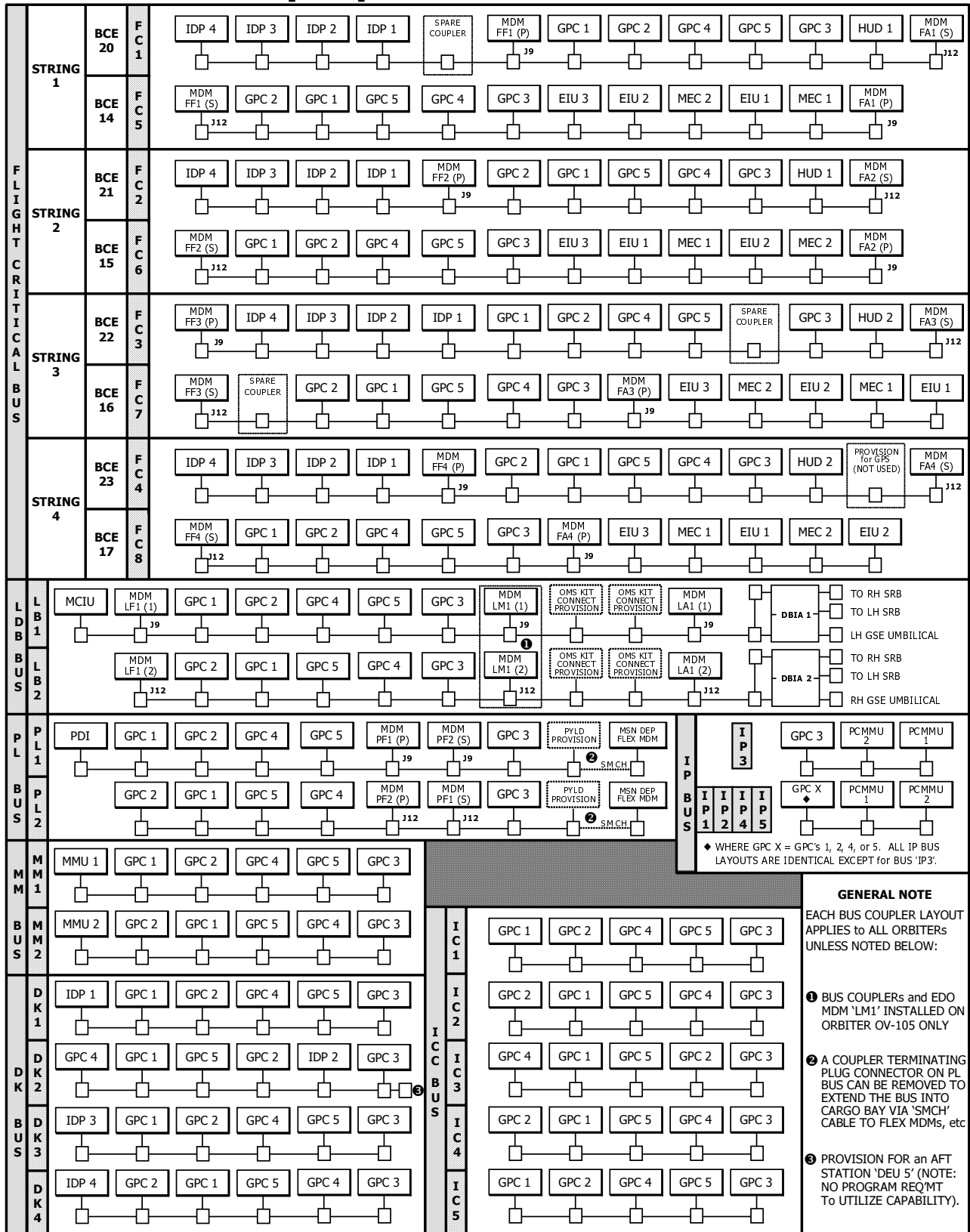
MM (Mass Memory) Sheets 114-115

Note that OV-103 and OV-104 are the closest to identical. OV-102 and OV-105 are similar in that they support EDO missions, and their configuration reflects that. The integrated schematics are separated into OV-102 and the three other vehicles (as OV-99), so be aware which of the two sets of drawings is being referenced.

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DATA BUS LAYOUT [MEDS]

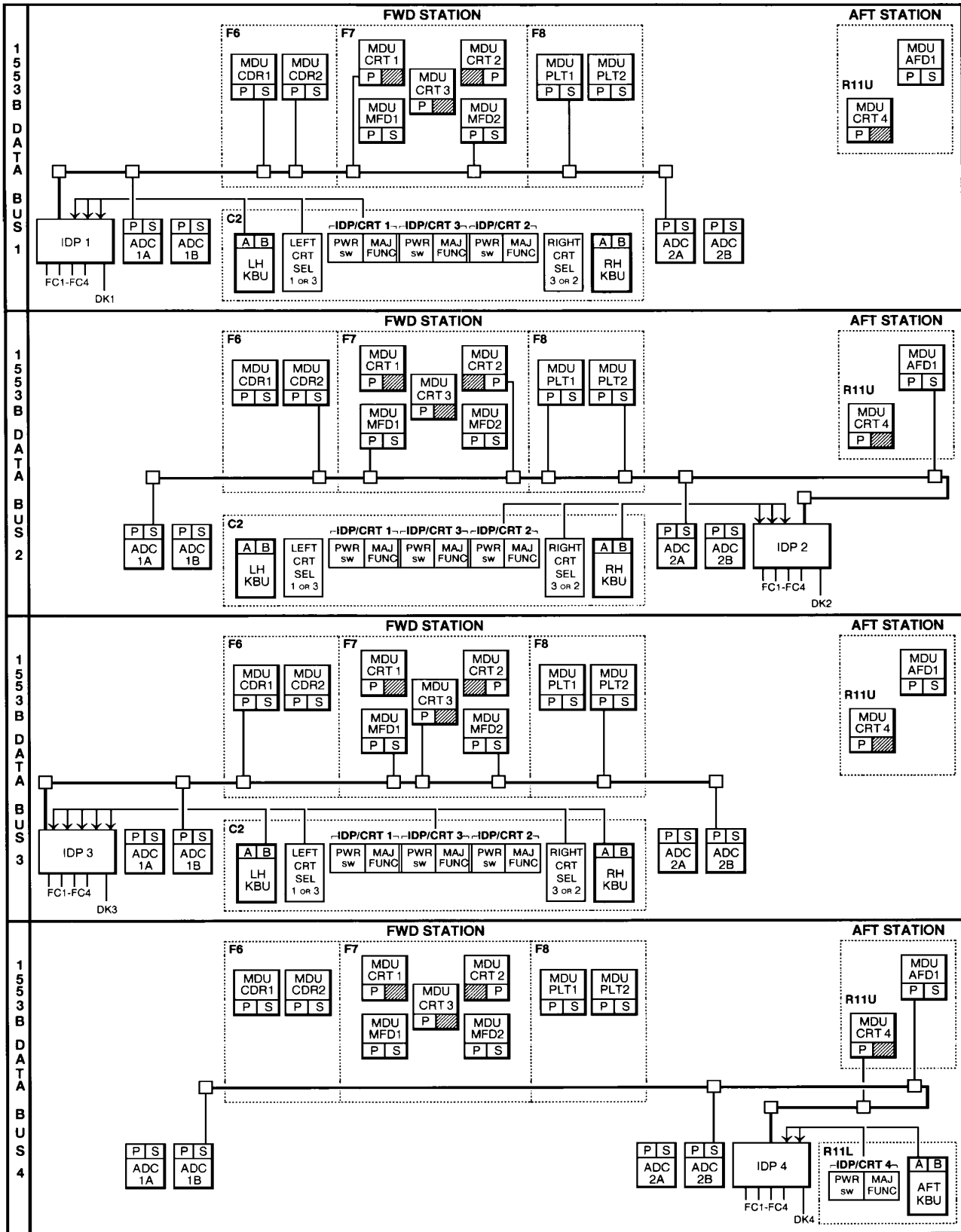
Revision Date: 2-28-03 [Data Bus Layout MEDS.ppt]



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MEDS INTERNAL BUS LAYOUT

REV DATE: 05-08-98 (MEDS\_LAY.DOC)

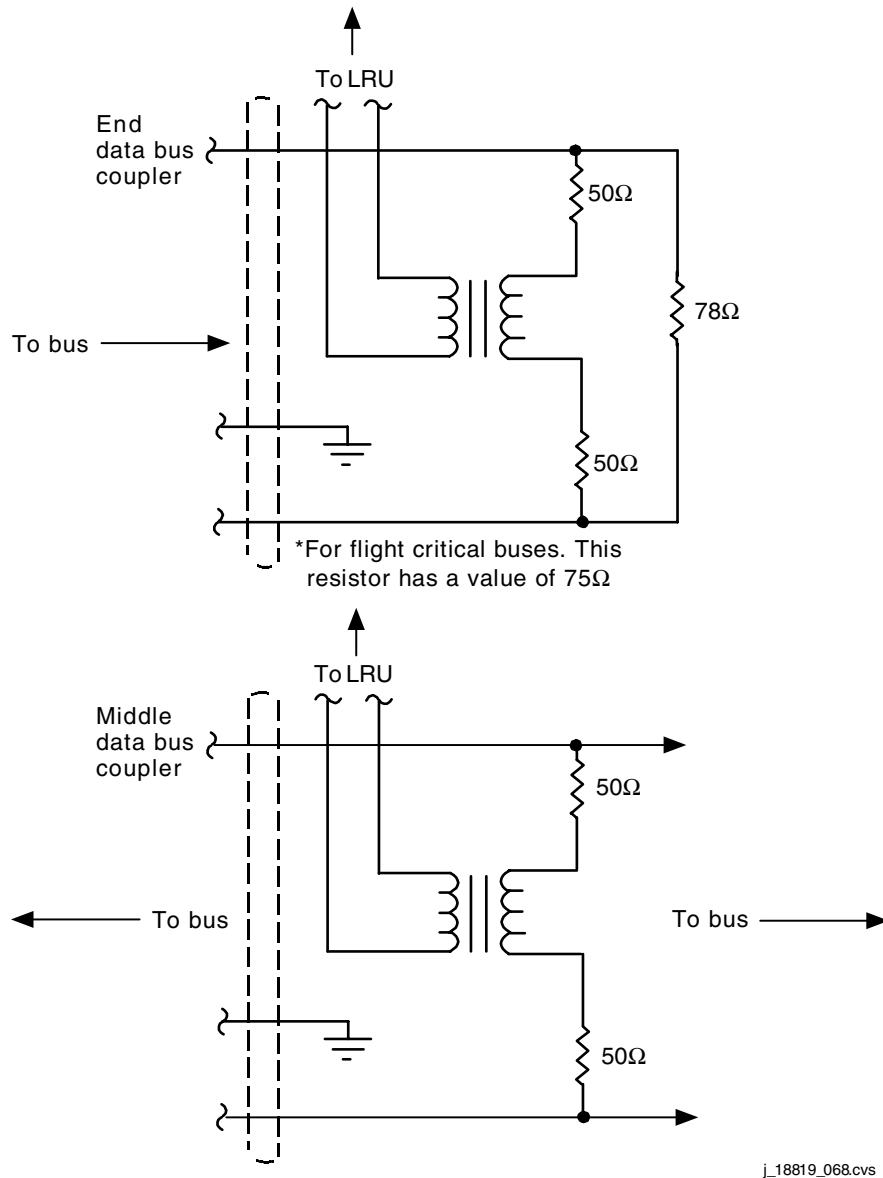


OI-27 & OI-28

5.15-7

Verify that this is the correct version before use

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**Figure 5.15-1. Data bus layouts**



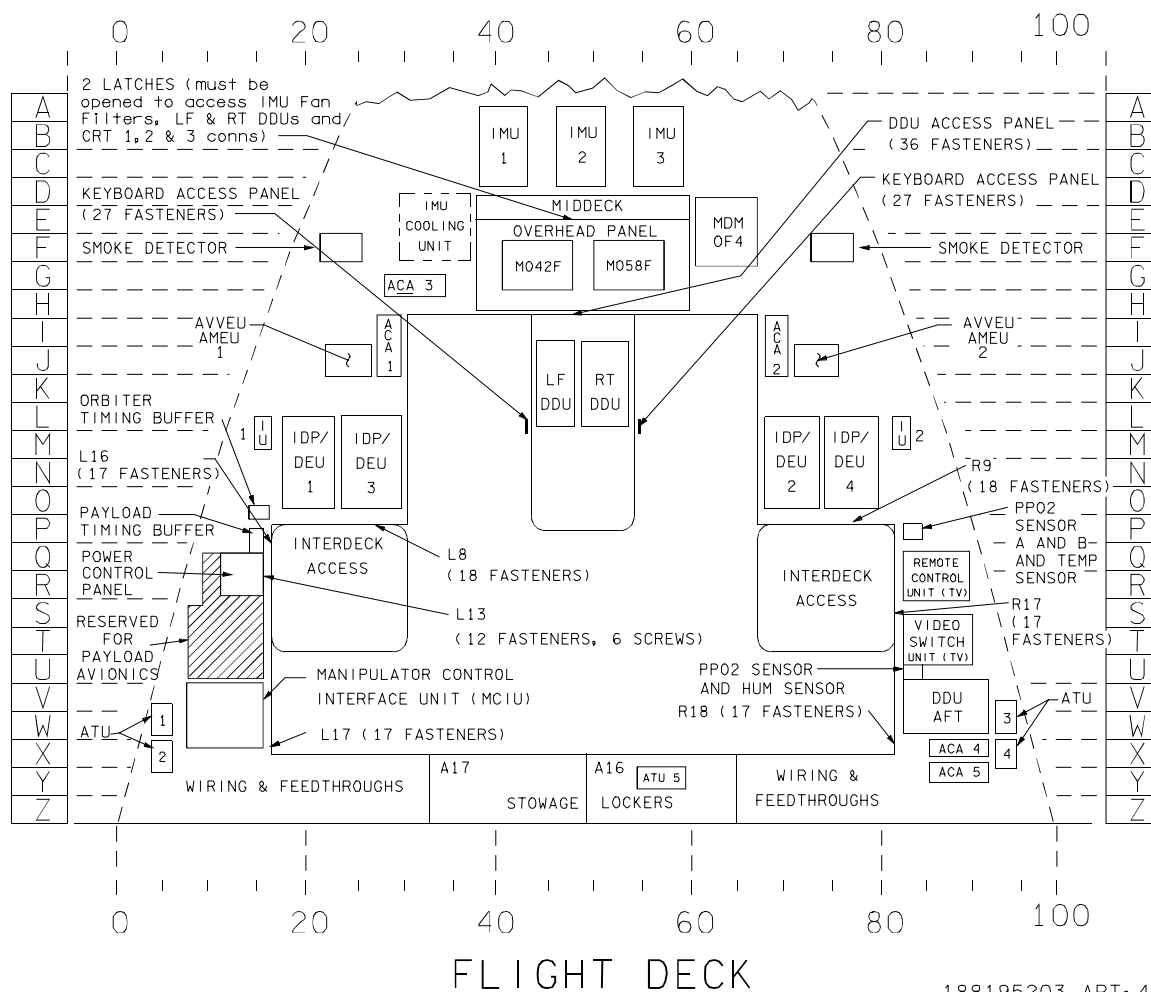
**TITLE**

ORBITER/DPS AVIONICS LOCATION GUIDE

**PURPOSE**

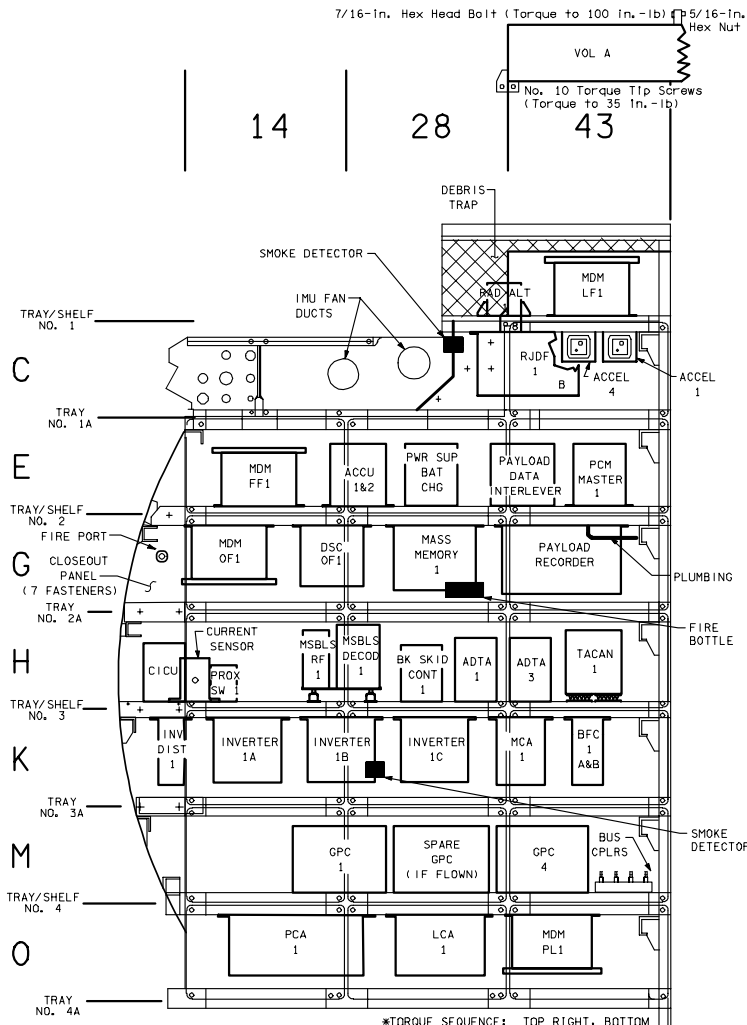
This SCP will provide a quick-look reference to the physical location of DPS components. Included are the following:

- Component location - flight deck
- Avionics bays 1, 2, 3A, 3B

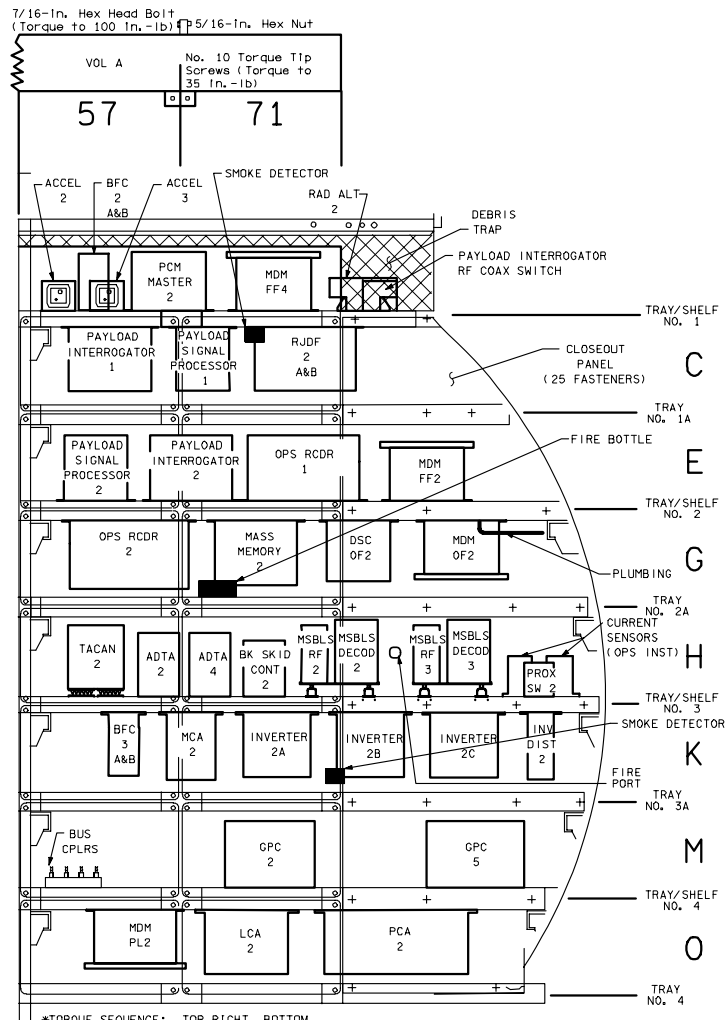


188195203, ART 4  
jsc\_18819\_5203.cv5

- Lower equipment bay pictorial



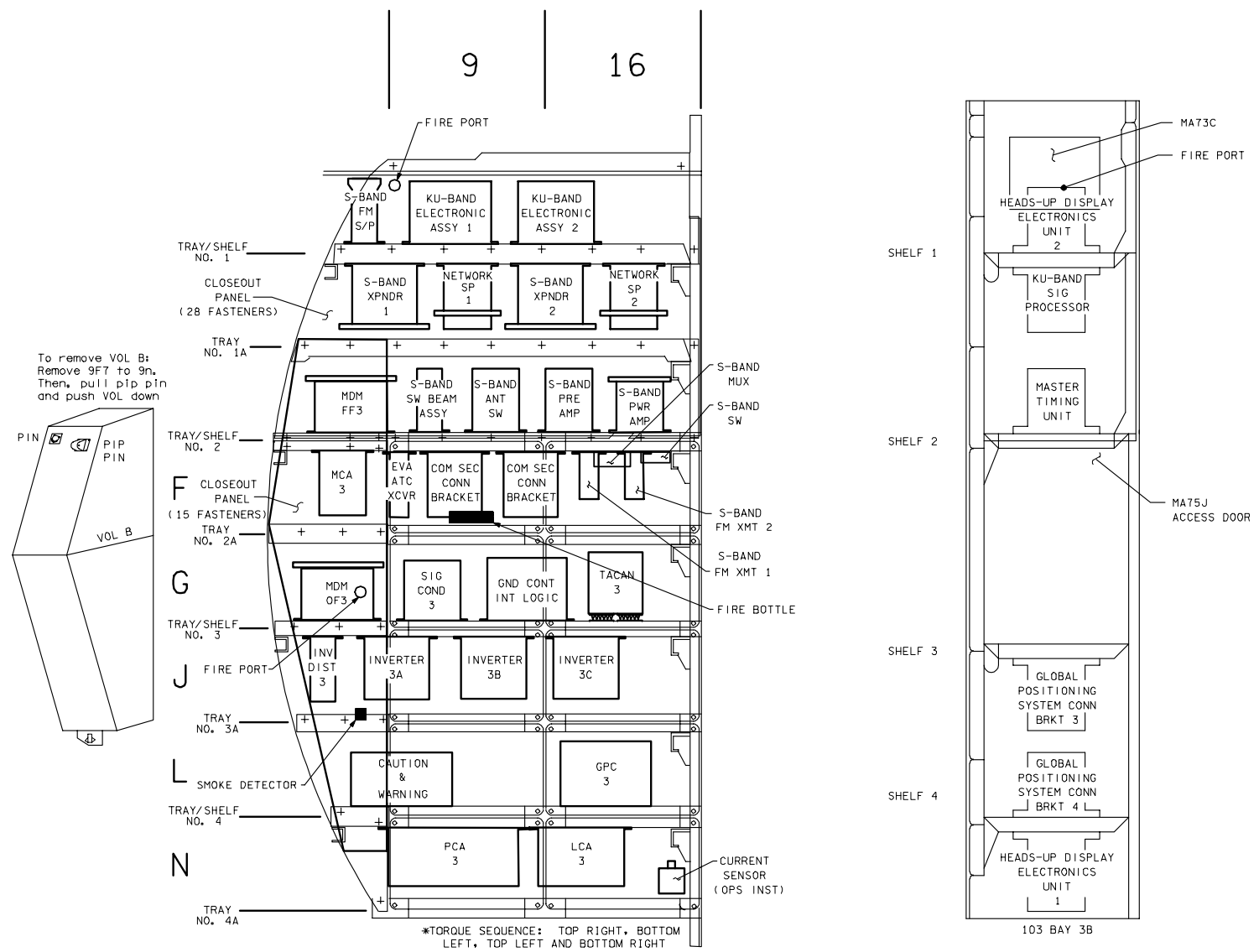
AV BAY 1



AV BAY 2

188195201, ART 5

5.16-2  
Verify that this is the correct version before use



5.16-3  
Verify that this is the correct version before use

**TITLE**

DPS/CREW CONTROLS

**DESCRIPTION**

This SCP provides a quick-look reference into the onboard controls used by the flightcrew to manipulate the DPS and MEDS systems. The following are included:

- DPS and MEDS switch/circuit breaker table
- Pictorials of orbiter panels O1, O6, F7, C2, C3, R11, and M042F
- Pictorials of standard onboard system software displays

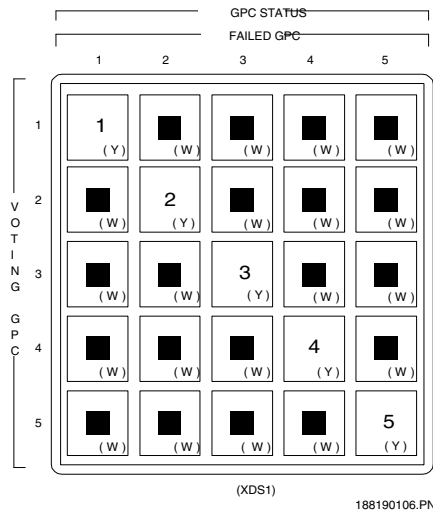
**A. DPS switches/circuit breakers**

Panel	Item		Panel	Item	
A4	M1	AFT MSN TIME	O6	S30-S34	GPC 1-5 POWER
A6	S38-S41	AFT EVENT TIMER		S35-S39	GPC 1-5 OUTPUT
C2	S9-S12	FWD EVENT TIMER		DS3-DS7	GPC 1-5 OUTPUT tb
	S1,S5,S3	IDP/CRT 1-3 POWER		S40-S44	GPC 1-5 IPL pb
	S2,S6,S4	IDP/CRT 1-3 MF		S46-S50	GPC 1-5 MODE (RUN lever locked)
	S7,S8	IDP/LEFT/RIGHT CRT SEL KYBD 1-2		DS8-DS12	GPC 1-5 MODE tb
C3	S17	BFC/CRT DISPLAY ON/OFF		S45	IPL SOURCE SEL
	S18	BFC/CRT CRT SEL (1+2) (2+3) (3+1)		S15	MTU/OSC SEL
F6	S6	BFS DISENGAGE CDR1, CDR2		S16-S19	IDP LOAD 1-4 (LOAD momentary)
F7		CRTs 1, 2, 3, C&W MATRIX MFD1, MFD2		S21-S24	FA 1-4 MDM POWER
F8		PLT1, PLT2		S26-S29	FF 1-4 MDM POWER
L4:R	CB125	INST L/CTR (LH KYBD LIGHT)	O13:A	CB4	MTU POWER SUPPLY A
L4:R	CB126	INST R (RH KYBD LIGHT)	O13:C	CB12	MTU POWER SUPPLY B
L4:Q	CB106	MS (KYBD LIGHT)			
L12	CB3*	PL TIMING BUFFER	O13:E	CB18	GPC STATUS
M042F	S12	GPC MEMORY DUMP	O14:F	S13	MMU 1-ON/OFF
O1		CAM	O14:B	CB12	FWD MSN TIME
O3	M13	FWD MSN TIME	O14:B	CB13	AFT EVENT TIME
			O15:F	S12	MMU 2-ON/OFF
			O15:B	CB12	AFT MSN TIME
			O15:B	CB13	FWD EVENT TIME
			O16:B	CB27	ORBITER TIMING BUFFER
			R11	S1	IDP/CRT 4 POWER
				S2	IDP/CRT 4 MF
				A1	KYBD 3
			R14:A		MNA ADC 1A/2A
					MDU MFD2
					MDU PLT1
					MNB ADC 1B/2B
					MDU MFD1
					MDU CDR2
					MNC MDU CDR1
					MDU PL72
					MDU AFD1

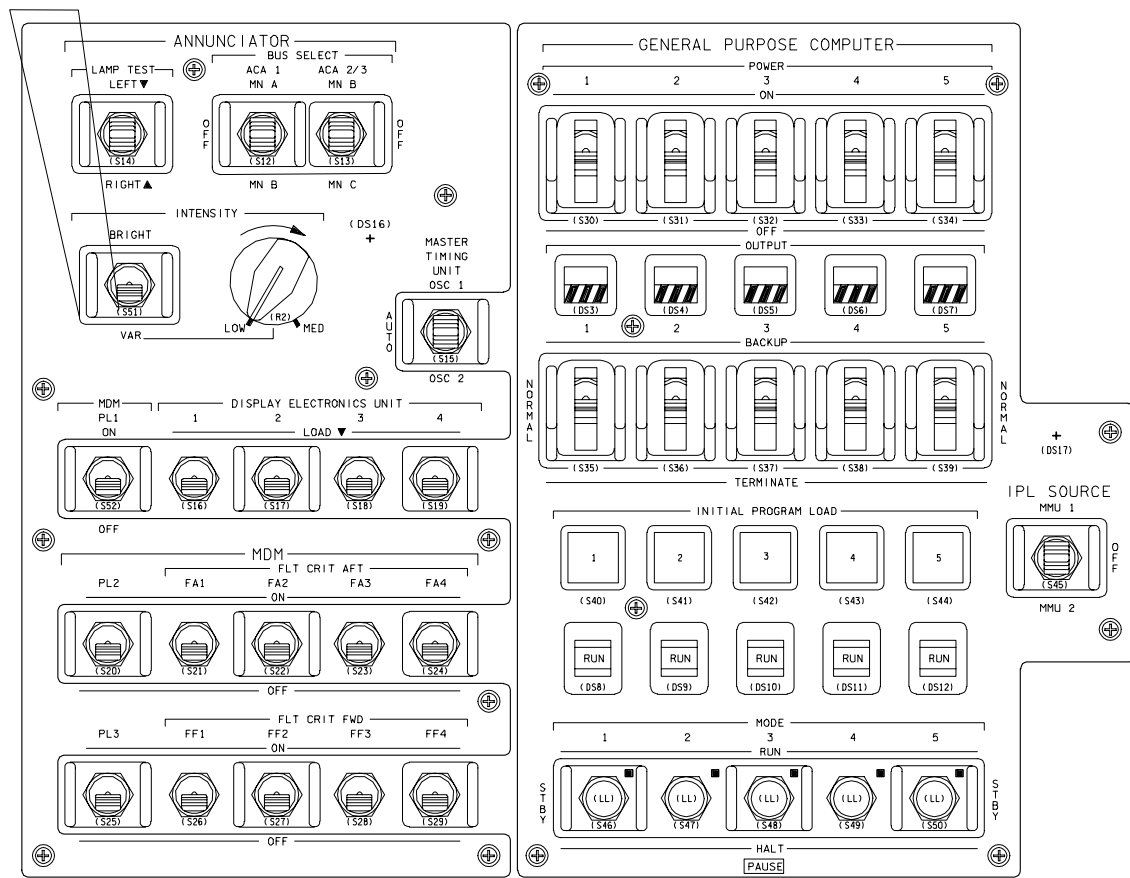
\*Mission configurable

B. Crew controls

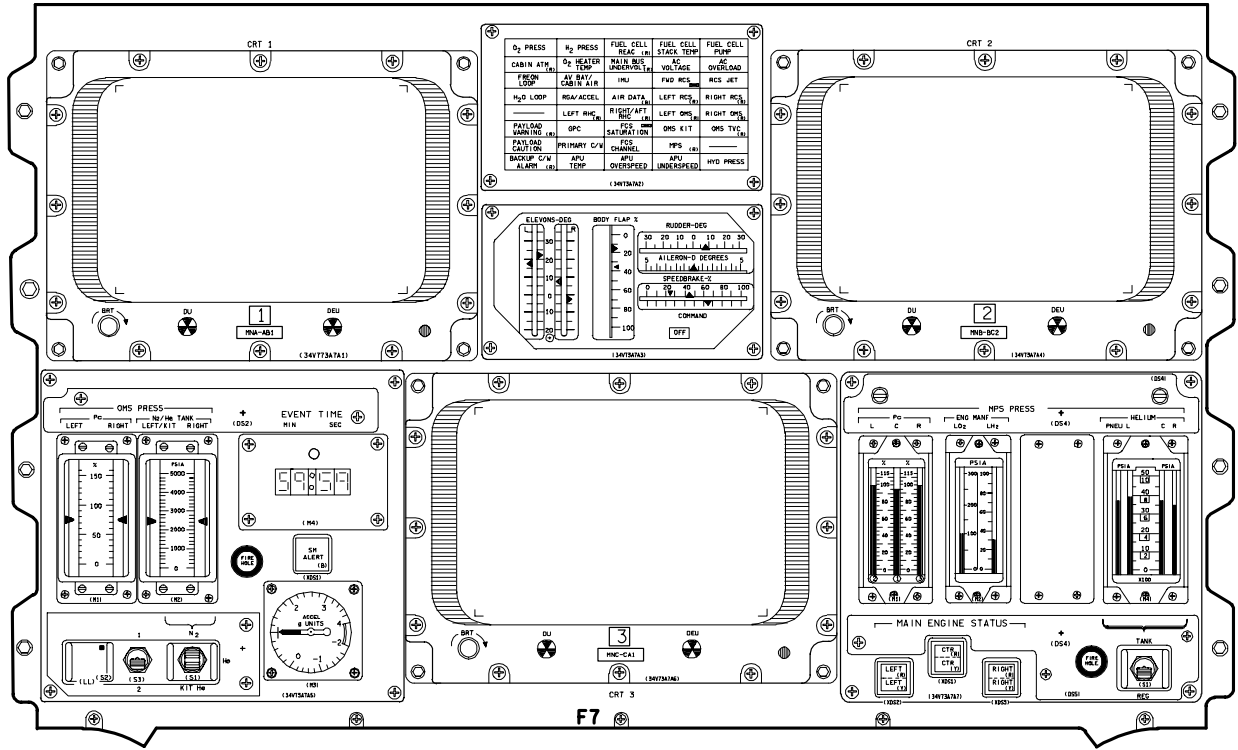
PANEL O1



PANEL O6

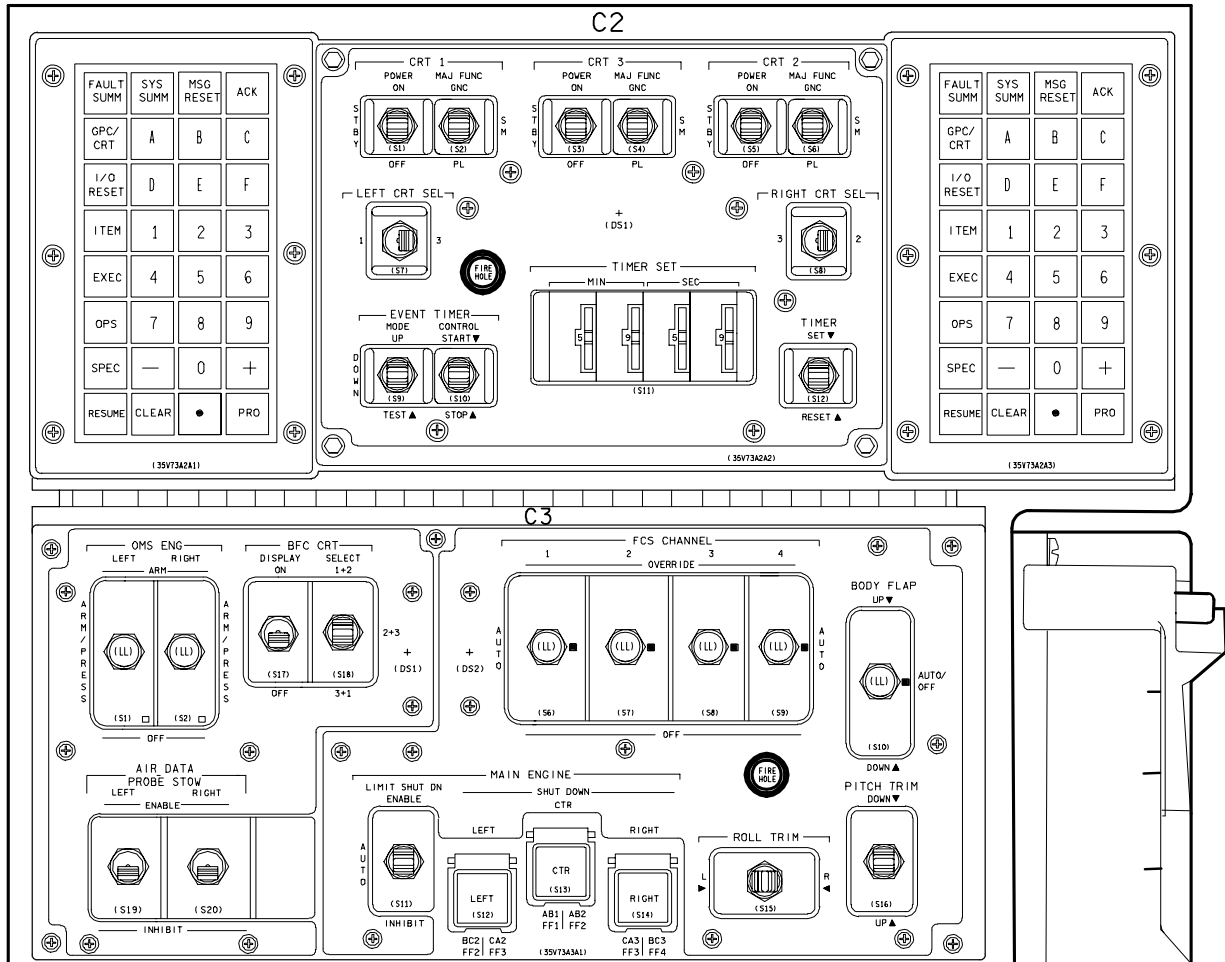


PANEL F7



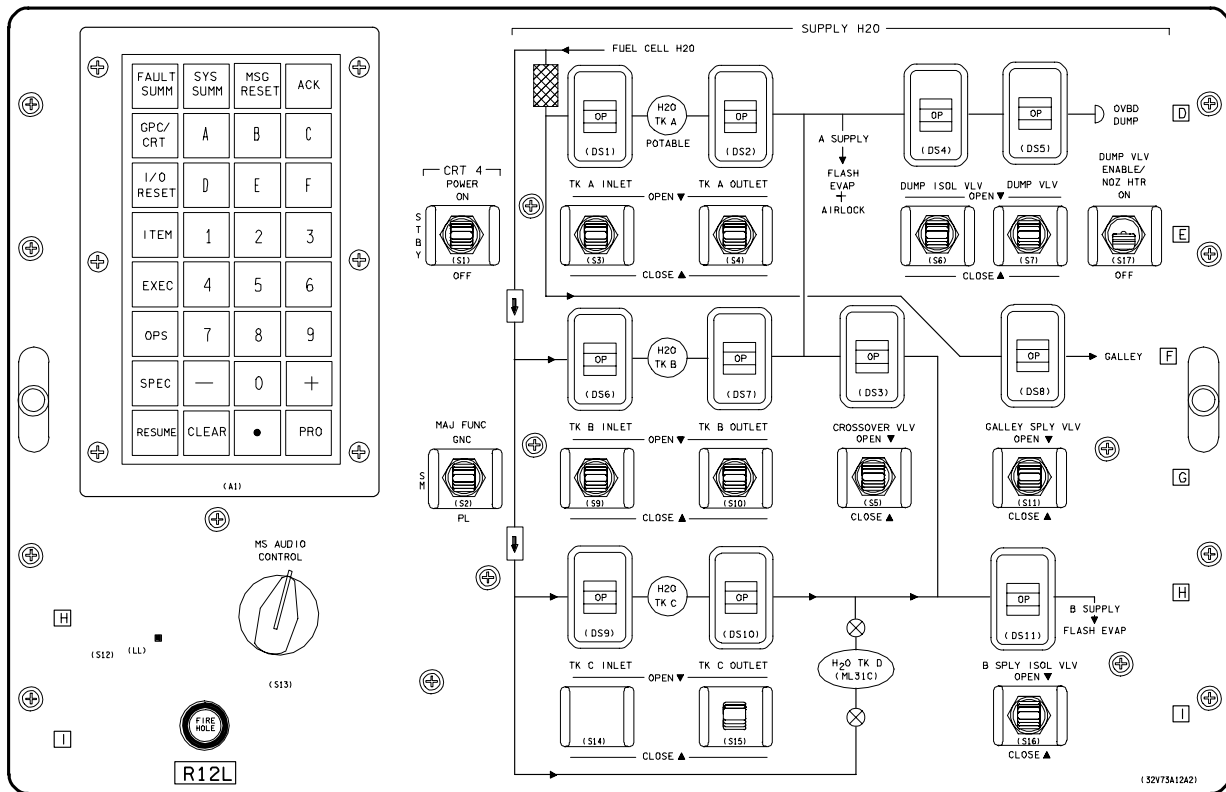
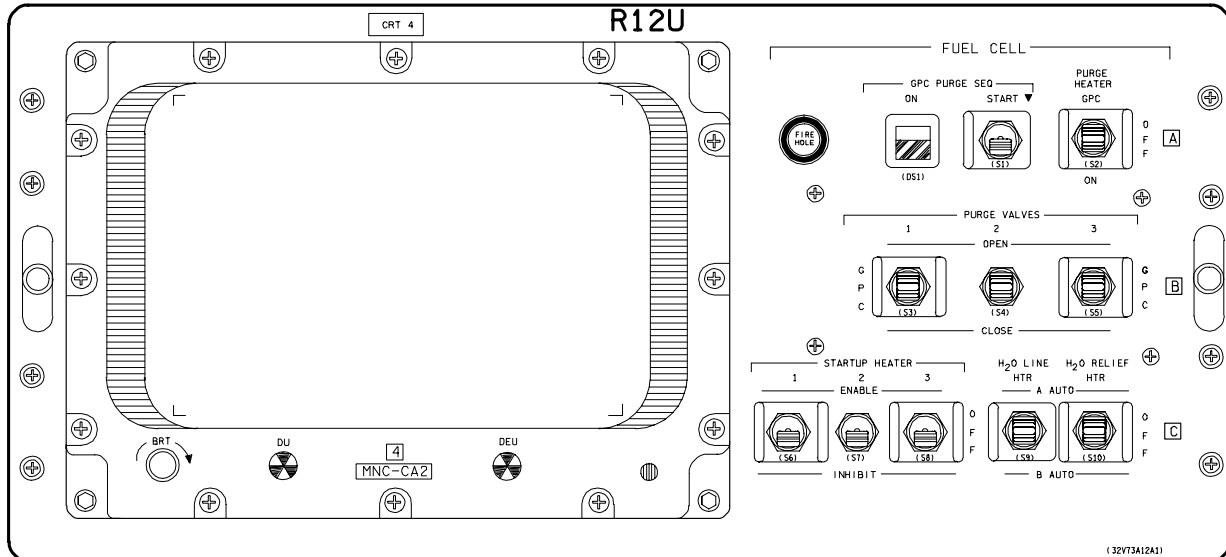
188190107.PNL 1

PANEL C2 AND C3



188195173. PNL 2

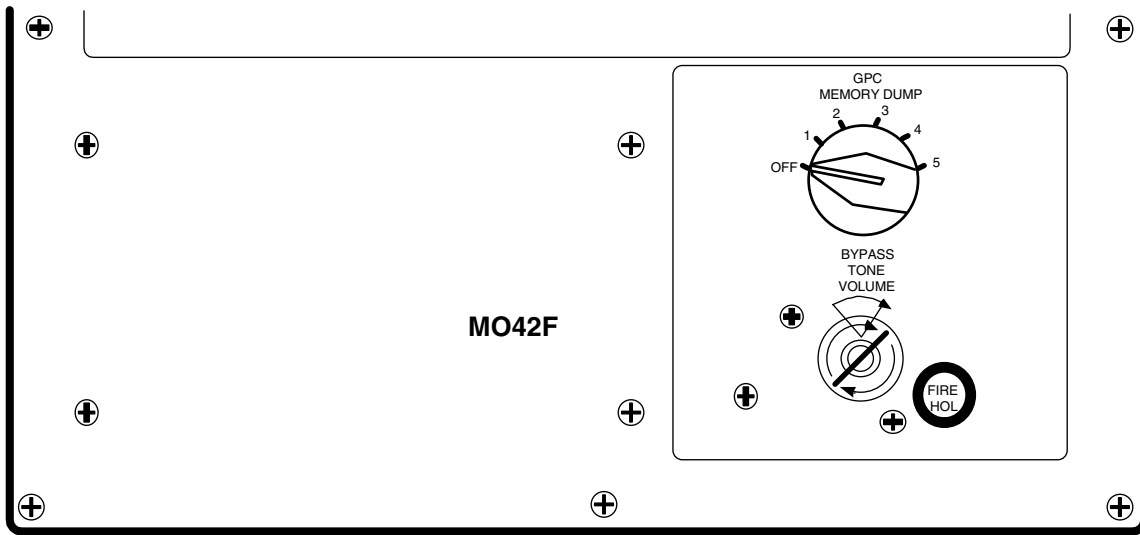
PANEL R11 (Systems on R11 were moved from R12)



188190108, PNL# 1



PANEL M042F



188195174.PNL:2

C. SYS S/W displays

The orbiter software displays which provide data and command access to DPS functions are:

	Function	Display title	Type no.
1.	SYS SFTWR	GPC MEMORY	SPEC 000
2.	SYS SFTWR	DPS UTILITY	SPEC 001
3.	SYS SFTWR	TIME	SPEC 002
4.	SYS SFTWR	GPC/BUS STATUS	DISP 006
5.	SM	SM TABLE MAINT	SPEC 060
6.	BFS	BFS MEMORY	SPEC 000
7.	GNC	GNC SYS SUMM 1	DISP 018
8.	GNC	CONTROLS	SPEC 053
9.	VU	GPC/BTU I/F	SPEC 112
10.	VU	MASS MEMORY R/W	SPEC 085
11.	SYS SFTWR	IPL MENU 1	N/A
12.	SYS SFTWR	GPCIPL MENU 2	N/A
13.	SM	PCMMU/PL COMM	SPEC 062

1

```

0001/000/      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 ±XXXXXXXXXXXX
3 9 X 30 XXXXX 31 XXXX ±XXXXXXXXXXXX
4 10 X 32 XXXXX 33 XXXX ±XXXXXXXXXXXX
PL 1/2 11 X 34 XXXXX 35 XXXX ±XXXXXXXXXXXX
36 XXXXX 37 XXXX ±XXXXXXXXXXXX
38 XXXXX 39 XXXX ±XXXXXXXXXXXX
CRT 1 12 X
2 13 X
3 14 X
4 15 X
LAUNCH 1 16 X
2 17 X
MM 1 18 X
2 19 X
OPS 3 UPLK 50X
OPS 3 INIT 51
                MEMORY DUMP      STORE MC=XX
40 START ID XXXXX 45 CONFIG XX
41 NO WORDS XXXXXX 46 GPC X
42 WDS/FRAME XXXX STORE 47
DUMP 43
44 DOWNLIST GPC X MM AREA
OPS 0 ENA 49 X PL 52 X
ERR LOG RESET 48 GNC 53 X
SM 54 X
                (XX)
    
```

18819531.CRT, 3

GPC MEMORY DISPLAY

2

```

XXXX/001/      DPS UTILITY      XX X DDD/HH:MM:SS
                DDD/HH:MM:SS
MMU ASSIGN      PORT ASSIGN
1 2 PRI 1 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
MMU STATUS      PL 1/2 23X 24X IPL SOURCE SW
1 XXX MASK 38X
2 XXX
                VAR PARAM ID LIST
25 XXXX
MMU SOURCE/BUS 26 XXXX
GPC/MMU 9X 27 XXXX
MMU/MMU 10X 28 XXXX
GPC/LDB 11X 29 XXXX
30 XXXX
CKPT RETRV      31 XXXX
ENA 12X 32 XXXX
33 XXXX
RTC 13 XXXX XXXX 34 XXXX
CMD 14
                G3 ARCHIVE
LOAD 48X
RETRIEVE 49X
                GROUND OPS
GSE POLL ENA 50X
SM CSE INH 51X
SM C/O ENA 52X
GNC C/O ENA 53X
BFC C/O ENA 54X
ALT PL9 TB 55X
                (XX)
    
```

188195211.CRT, 2

DPS UTILITY

3

```

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 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
MTU ACCUM 1 XXX/XX:XX:XX,XXXS [TRY] 1 XX
2 XXX/XX:XX:XX,XXXS 34 2 XX
3 XXX/XX:XX:XX,XXXS 35 3 XX
GPC XXX/XX:XX:XX,XXXS 36 4 XX
37 5 XX
TIME SYNC 38
    
```

18819533.CRT, 3

TIME

4

```

XXXX/XXX/006  GPC/BUS STATUS  XX X DDD/HH:MM:SS
                DDD/HH:MM:SS
GPC1 1S 2S 3S 4S 5S
MODE XXXX XXXX XXXX XXXX XXXX
STRING 1 FF XS XS XS XS XS
2 FF XS XS XS XS XS
3 FF XS XS XS XS XS
4 FF 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
3 XS XS XS XS XS
4 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)
    
```

18819534.CRT, 1

GPC/BUS STATUS

5

```

XXXX/060/      SM TABLE MAINT XX X DDD/HH:MM:SS
                DDD/HH:MM:SS
SM COM BUFF XXX
PARAM XXXXXX
1 ID XXXXXXXX
VALUE = XXXXXXXXXXXX
LIMITS
ALERT HI BACKUP C&W
2 XXXXXXXX 3 XXXXXX 11 XXXXXXXX 12 XXXXXX
4 XXXXXXXX 5 XXXXXX
6 XXXXXXXX 7 XXXXXX
8 FILTER XX 13 FILTER XX
ENA 9X ENA 14X
INH 10X INH 15X
CONSTANT
16 ID XXXXXXXX
17 VALUE = XXXXXXXXXXXXXXXX
CHECKPT XXX/XX:XX:XX FDA
INITIATE 18 ENA 19X
STATUS XXXX XXXX INH 20X
                (XX)
    
```

18819535.CRT, 1

SM TABLE MAINT

6

```

0001/ /      BFS MEMORY      XX X DDD/HH:MM:SS
                DDD/HH:MM:SS
READ/WRITE
DATA 1X BIT SET 3X SEQ ID 5
CODE 2X BIT RST 4X WRITE 6
7 ENG UNITS XXXX HEX 8X
ADD ID DESIRED ACTUAL
9 XXXXX 10 XXXX ±XXXXXXXXXXXX
11 XXXXX 12 XXXX ±XXXXXXXXXXXX
13 XXXXX 14 XXXX ±XXXXXXXXXXXX
15 XXXXX 16 XXXX ±XXXXXXXXXXXX
17 XXXXX 18 XXXX ±XXXXXXXXXXXX
19 XXXXX 20 XXXX ±XXXXXXXXXXXX
MEMORY DUMP      LAUNCH BUS 1 26X TFL ENA
21 START ID XXXXX 2 27X 29X
22 NUMBER WDS XXXXXX OFF 28X
23 WDS/FRAME XXXX
DUMP 24 PASS/BFS XFER ENA 25X
BFS TIME UPDATES UPDATE 38 MISSION TIME
30 GMT Δ [ ] XXX/XX:XX:XX,XXX GMT 39X
34 MET Δ [ ] XXX/XX:XX:XX,XXX MET 40X
    
```

18819536.CRT, 2

BFS MEMORY

7

```

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

RCS I JETI SOL
MANE F A I L L
1 XXXX XXS
2 XXXX XXS
3 XXXX XXS
4 XXXX XXS
5 XXXX XXS
6 XXXX XXS
7 XXXX XXS
8 XXXX XXS
9 XXXX XXS
0 XXXX XXS
1 XXXX XXS
2 XXXX XXS
3 XXXX XXS
4 XXXX XXS
5 XXXX XXS
6 XXXX XXS
7 XXXX XXS
8 XXXX XXS
9 XXXX XXS
0 XXXX XXS

SURF POS MOM
L OB XXX.XS XXS
IB XXX.XS XXS
R IB XXX.XS XXS
OB XXX.XS XXS
AIL XXX.X
RUD XXX.X
SPD BRK XXX.X
BDY FLP XXX.X
XXXXXX

DPS 1 2 3 4 5
GPC 5 5 5 5 5
MDM FF 5 5 5 5 5
FA 5 5 5 5 5
FCS CH 1 2 3 4
5 5 5 5 5

NAV 1 2 3 4
TMU 5 5 5 5 5
ACC 5 5 5 5 5
RGA 5 5 5 5 5
TAC 5 5 5 5 5
MLC 5 5 5 5 5
ADTA 5 5 5 5 5

CNTLR 1 2 3
RHC 5 5 5 5 5
R 5 5 5 5 5
A 5 5 5 5 5
L 5 5 5 5 5
THC 5 5 5 5 5
A 5 5 5 5 5
SBTC 5 5 5 5 5
L 5 5 5 5 5
R 5 5 5 5 5

(XX)
    
```

188190102, CRT1 1

GNC SYSTEM SUMMARY 1

8

```

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

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

NEG STIM    ACT/CH
ENA 7X      8 BYPASS XX
              9 RESET  22

LRU AA      RGA SURF FDBK
DES DES    DES DES
1 10X 5    14X 5    18X 5
2 11X 5    15X 5    19X 5
3 12X 5    16X 5    20X 5
4 13X 5    17X 5    21X 5

(XX)
    
```

18819551, CRT1 1

CONTROLS

9

```

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 MMU 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 EIUI 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)
    
```

188190104, CRT1 3

GPC/BTU INTERFACE

10

```

9011/ /  MASS MEMORY R/W  XX X DDD/HH:MM:SS
SM COM BUFF XXXX DDD/HH:MM:SS
DES RED 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 XX
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 XXXX
8 XXXX XXXX 28 XXXX XXXX 46 NUMBER XX
9 XXXX XXXX 29 XXXX XXXX 47 PATCH ID XXX
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 XXX
18 XXXX XXXX 38 XXXX XXXX B XXX
19 XXXX XXXX 39 XXXX XXXX MM VERSION XX.XX
20 XXXX XXXX CHECKSUM XXXX DUMP VIA DL 52X

(XX)
    
```

188190105, CRT1 2

MASS MEMORY READ/WRITE

11

```

PASS1 1X PASS5 9X XXXX IPL MENU (1) XX X DDD/HH:MM:SS
BFS1 2X BFS5 10X STP/PURGE CYC CNT XXXXX DDD/HH:MM:SS
PASS2 3X PASS6 11X ERROR/MSG CODE XXXX
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
SWSW XXXX

START GPC SELF TEST 18X
STOP GPC SELF TEST 19X
START DEU SELF TEST 20X
STOP STP ON ERROR 24X
CONTINUE STP ON ERR 25X
INHIBIT CKPT LOAD 26X

XXXXXXXXXXXXXXXXX
27 OPTION X
START 28X
STOP 29X

(XX)
    
```

18819550, CRT1 5

IPL MENU NO. 1 (PFS/BFS)

12

```

GPCIPL MENU (2) XX X DDD/HH:MM:SS
17 DEU FORMAT LOAD X STP/PURGE CYC CNT XXXXX
ERROR/MSG CODE XXXX
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
STOP STP ON ERROR 24X
CONTINUE STP ON ERR 25X MCDS BITE
INHIBIT CKPT LOAD 26X MODE XXXX
BSR1 XXXX
BSR2 XXXX
SWSW XXXX

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=XXXXXXX CLOCK1=XXXXX

(XX)
    
```

188190101, CRT1 5

GPCIPL MENU (2)

13

```

XXXX/062/          PCMMU/PL COMM  XX X DDD/HH:MM:SS
SM COM BUFF  XXX  DDD/HH:MM:SS
PCMMU              PDI
BITE WORD XXXX   I/O RESET 8XX
FMT               BITE WORD XXXXS
SEL FXD 1XS      9 SEL DECOM X
PGM 2XS          10 SEL FMT XXX
PGM ID 64 XXX    LOAD 11 XXXX
128 XXX         12 SEL INPUT X
3 SEL ID XXX     LOAD 13
LOAD 4 XXXX     DECOM INPUT FMT
I/O RESET       1 X XXS
PCM 5XX         2 X XXS
                3 X XXS
                4 X XXS
                5-FPM XX
                DECOM ENA ENA
PSP             FDA 1 14X 3 16X
I/O RESET      1 CHANNEL XXXS
                2 CHANNEL XXXS
PSP1 6XX       PHASE LOCK XXXS
PSP2 7XX       ERR ±XXS
SYNC           XMIT PWR XX.XXS
FRAME XXXS     PL SIG STR X.XXS
LOAD XXXX XXXX 18 TFL GPC SEL X
                DOWNLIST
                19 SEL FMT ID XX
                (XX)
    
```

188195177.CRT, 3

PCMMU/PL COMM

TITLE

GPC TALKBACK

To From	Halt	STBY	Run
Halt		<ul style="list-style-type: none"> <li>• Mode TB - run</li> <li>• Output TB - bp</li> </ul>	<ul style="list-style-type: none"> <li>• Mode TB - run</li> <li>• Output TB - gray</li> </ul>
STBY	<ul style="list-style-type: none"> <li>• Mode TB - bp</li> <li>• Output TB - bp</li> </ul>		<ul style="list-style-type: none"> <li>• Mode TB - run</li> <li>• Output TB - gray</li> </ul>
Run	<ul style="list-style-type: none"> <li>• Mode TB - bp</li> <li>• Output TB - bp</li> </ul>	<ul style="list-style-type: none"> <li>• Mode TB - bp*</li> <li>• Output TB - bp</li> </ul>	

\* BFS mode TB remains RUN

WITH SPECIAL OPTIONS:

In \ And	IPL pb depressed	Output switch		Output switch in backup	
		Normal	Terminate	Preengage	Postengage
Halt	<ul style="list-style-type: none"> <li>• Mode TB - IPL +2 min TB - bp</li> <li>• Output TB - bp</li> </ul>	No effect		No effect	
STBY	No effect	<ul style="list-style-type: none"> <li>• If IPL - Run STP, if no STP errors, mode TB - run</li> </ul>		<ul style="list-style-type: none"> <li>• Output TB - bp</li> </ul>	<ul style="list-style-type: none"> <li>• Output TB - gray</li> </ul>
Run	No effect	<ul style="list-style-type: none"> <li>• Output TB - gray</li> </ul>	<ul style="list-style-type: none"> <li>• Output TB - bp</li> </ul>	<ul style="list-style-type: none"> <li>• Output TB - bp</li> </ul>	<ul style="list-style-type: none"> <li>• Output TB - gray</li> </ul>

BFS

To From	Halt	STBY	Run	
			Preengage	Postengage
Halt		<ul style="list-style-type: none"> <li>• Mode TB - run</li> <li>• Output TB - bp</li> </ul>	<ul style="list-style-type: none"> <li>• Mode TB - run</li> <li>• Output TB - bp</li> </ul>	
STBY	<ul style="list-style-type: none"> <li>• Mode TB - bp</li> <li>• Output TB - bp</li> </ul>		BFS output TB - bp	BFS output TB - gray
Run	<ul style="list-style-type: none"> <li>• Mode TB - bp</li> <li>• Output TB - bp</li> </ul>	<ul style="list-style-type: none"> <li>• Mode TB - run</li> <li>• Output TB - bp</li> </ul>		BFS output TB - gray



B. DPS Equipment Cooling Matrix

Cooling	1	Avionics bay 2	3	Cabin
Forced air	GPC 1,4	GPC 2,5	GPC 3	CRT 1,2,3,4 DEU 1,2,3,4 IDP 1,2,3,4 All MDUs
Convective air	BFC 1 CICU	BFC 2,3		KYBD units Mission timers Event timers CAM
Water	MMU 1 MDM FF1 MDM PL1 OF1	MMU 2 MDM FF2 , 4 PL 2 OF 2	MTU MDM FF3 OF3	MDM OF4

Cooling	4	Avionics bay 5	6
Freon	MDM FA1 OA1	MDM FA2 OA2	MDM FA3,4 OA3

**C. DPS Component Operational Limits For Loss Of Cooling**

Component	Test sequence (a)	Ambient temp, (b) °F	Coldplate temp, °F	Coolant flowrate lb/min	Pressurized cabin		Depressurized cabin	
					Maximum operating time, min	Required cooldown time, hr.	Maximum operating time, min	Required cooldown time, hr.
GPC (j)	Unit initially powered ON. Following loss of cooling, unit allowed to operate until maximum allowable temperatures achieved, then powered OFF for cooldown (c)	80	N/A	3.1 2.62 4.0	25	4.5 1.0	17	1.5
	Unit initially powered OFF. Following loss of cooling, unit powered ON and allowed to operate until maximum allowable temperatures achieved (c)	80	N/A	3.1 2.62 4.0	45	3.0 (d)	45	3.5
	Unit initially powered ON. Following loss of cooling, unit immediately powered OFF for cooldown	80	N/A	3.1 2.62 4.0	No data	3.0	No data	No data
MEDS	Unit initially powered ON. Following loss of cooling, unit allowed to operate until maximum allowable temperatures achieved, then powered OFF for cooldown	85	N/A	0.39 (MDU) 0.55 (IDP)	30 (MDU) NO LIMIT (IDP)	No data	No data	No data
	Unit initially powered OFF. Following loss of cooling, unit powered ON and allowable temperatures achieved	85	N/A	0.39 (MDU) 0.55 (IDP)	60 (MDU) NO LIMIT (IDP)	No data	No data	No data
		70	N/A	0.39 (MDU) 0.55 (IDP)	90 (MDU) NO LIMIT (IDP)	No data	No data	No data
MDM	Unit initially powered ON. Following loss of cooling, unit allowed to operate	145	120	Unknown (f)	No limit (g)	N/A (h)	No data (i)	No data

- (a) Test sequences began with all conditions at steady state prior to loss of forced cooling.
- (b) Ambient temperatures apply to pressurized cabin cases only. For units which are forced air cooled (GPC, MCDS, MEDS), ambient temperature is also air inlet temperature.
- (c) Maximum allowable temperature defined as a component junction temperature limit of 125° C (257° F). This temperature reflects a component specification limit and not an actual component destructive limit.
- (d) Test sequence did not include a timed cooldown period. Required cooldown time for this case (unit initially powered OFF) is assumed to be the same as the test sequence with the unit initially powered ON because, in both cases, the unit is powered OFF when maximum temperatures achieved.
- (e) Maximum allowable temperature defined as a component junction temperature limit of 150° C (302° F). Actual testing was constrained to a junction temperature of 125 ° C (257° F), and data has been extrapolated to the 150° C (302° F) limit.
- (f) Flowrate as appropriate to maintain coldplate temperature of 120° F.
- (g) After 2.5 hours, unit stabilized 11° F below the maximum allowable Singer MIA mounting surface temperature limit of 196° F (91° C).
- (h) Although maximum temperatures were never achieved for this case, unit was powered OFF for cooldown. Temperatures stabilized in 2 hours.
- (i) Prior to the loss of forced cooling for this case, unit stabilized 11° F above the maximum allowable Singer MIA mounting surface temperature limit of 196° F (91° C). No further testing was done. Coldplate temperature was 125 ° F, and coolant flowrate was appropriate to maintain a constant coldplate temperature.
- (j) Reference Section D for special notes regarding operational limits for the AP101S.



D. Special Note

Based on memo EK5-90-48, the operational limits of the AP101S GPC under conditions which result in reducing cooling have been extended beyond those shown in 5.2.C. The extended limits are essentially a 30-minute increase.

The following lists the extended limits:

Loss of forced air cooling (1 ATM)

- Previously operating GPC- 55 minutes
- Cold soak GPC - 1.25 hours

Loss of cabin press

- Previously operating GPC- 47 minutes
- Cold soaked GPC - 1.25 hours

Note: Coldsoak time is 3.0 to 3.5 hours, depending on initial conditions; in most situations, two rev's (~3 hours) will suffice. Sleep mode is considered equivalent to a nonoperational soak. The numbers shown above should be used for contingency purposes only.

E. Avionics Cooling During a GPC IFM

Based on an Orbit Flight Techniques Panel Meeting #60 held on July 1, 1980, the following data were presented regarding avionic cooling when performing an AP-101S IFM.

1. With one GPC removed, the other active GPC's cooling capability in the AV bay is reduced 5 to 16 percent depending on which combination exists.
2. With anticipated avionics bay temperatures, the maximum outlet temperature of the remaining powered GPC is 115° F. The spec limit is 130° F.
3. There are no cooling problems associated with GPC changeout and leaving the GPC powered if the avionics bay temperatures are below 85° F.

This data should also be valid for AP101S machines; therefore, the conclusion is that we can change out GPCs without worrying about GPC cooling.

**REFERENCES**

1. Shuttle Operational Data Book, Vol. 1-A, Shuttle Systems Electrical Equipment List, JSC-08934.

**TITLE**

**DUMP INFORMATION FOR HISAM AND SOFTWARE DUMPS**

Acronyms: RT-Real-Time, SSR-Solid State Recorders, D/L-Downlist, W/F-Wds/Frame, DT-Dump Time (min:sec), TB-Toggle Buffer

- I. Ground Format
- A. Software (RT and RCDR):  
**HDR and LDR**  
**90** - BFS GPC dumps  
**91** - Mass Memory (MM) dump  
**93** - PASS GPC dumps
- B. HISAM (RT and RCDR):  
**HDR Only**  
**90** - BFS & IPL GPC dumps  
**93** - PASS GPC dumps
- II. FEP Configures Automatically  
(No coordination with NIPSUP required)
- III. Solid State Recorder Dumps Only  
**(Data Supplied by Crew)**
- Software and HISAM
1. RCDR number
  2. Dump Start/Stop Times

- PCMMU: Nominal Toggle Buffer (TB) D/L Assignments
- 1 - GNC
  - 2 - SM
  - 3 - Not Used
  - 4 - Non-prime OPS 0/PL9
  - 5 - BFS
- SSR Dumps (HDR Only)
- SSR dumps are downlinked via the FM/KU link and thus do not effect any RT DLs while the RCDR dump is in progress. However, the dump will have replaced the normal OPS downlist in the dump itself.

II. Downlist 16-Bit Wds/Frame

A. Software (RT and SSR):

<----HDR---->		OPS		<----LDR---->			
KBPS	DT	W/F	---	W/F	DT	KBPS	
51.2	1:51	<b>128</b>	G1/3/9	<b>64</b>	3:59	25.6	
44.8	2:08	<b>112</b>	G2/8	<b>56</b>	4:41	22.4	
19.2	5:38	<b>48</b>	SM2/4 MM	<b>24</b>	14:44	9.6	
12.8	9:34	<b>32</b>	OPS0	<b>16</b>	31:57	6.4	
12.8	9:34	<b>32</b>	PL9/MM	<b>16</b>	31:57	6.4	
12.8	7:39	<b>32</b>	BFS	<b>16</b>	25:33	6.4	

B. HISAM (RT and SSR):  
HDR ONLY

	KBPS	DT <sup>(1)</sup>	W/F	B/F
PASS	44.8	1:42	<b>112</b>	224
BFS & IPL	12.8	7:39	<b>32</b>	64

<sup>(1)</sup> For PASS, DT is doubled (3:24) to ensure capture of HISAM dump of all GPC memory. BFS is single dumped due to time constraints.

- Downlist (D/L) Info
- GPC software dumps replace the normal OPS or BFS D/L and use the PASS OPS or BFS D/L PCMMU TB assignment.
  - PASS GPC HISAM dumps use PCMMU TB 1, while BFS and post-IPL GPC HISAM dumps use PCMMU TB 5.
  - MM dumps replace the SM/PL9 downlist via its assigned PCMMU TB
- [SM has a 2k common buffer for MM dumps, and PL9 has a 16k common buffer for MM dumps. The MM dump size will determine whether to use SM or PL9.]
- RT Dumps (HDR and LDR)
- Normal OPS D/L is replaced as above, but other D/Ls (if available) are unaffected by the dump.
  - If LDR unencrypted, a HISAM dump can be done RT that will be captured on SSR for later FM downlink.

The area between address 0 and address 4FFFF (0-4FFFF) may be dumped. The area from 50000-7FFFF contains the G3 archive and is not nominally included in dumps.

**REFERENCES**

1. NSTS CPDS SS Downlist/Uplink Software Requirements, SS-P-0002-140.
2. Space Shuttle Telemetered and Recorded Data Format Requirements, JSC-10784.
3. INCO/COMM Systems Briefs, Section 40, 'Solid State Recorders', JSC-18611.
4. INCO/COMM Console Handbook, SCP 3.34, JSC-12829

**TITLE**

**TFL TABLES**

The following tables specify the generic (non-mission-specific) combinations of format loads. Refer to the Payload Management FSR, JSC 19478-XX for flight-specific information.

TFL no.	GNC TB1	SM TB2	OPS O/PL9 TB4	BFS TB5	OI	Payload PDI	Remarks
102*	25.6			6.4	32		Ascent/Entry, LDR
103*	22.4	11.2			30.4		On-orbit, LDR
129*	51.2			12.8	64		Asc/On-orb/Ent, HDR; Fixed Format
160*	51.2		12.8		64		C/O, T-50 MM write, HDR
161*	44.8	19.2			64		On-orbit, HDR
163*	44.8	19.2	12.8		51.2		PL9, MM dump, HDR
164*	51.2			12.8	64		Entry, HDR
166**	51.2			12.8	56	8	Ascent/Entry, HDR
171*	51.2			12.8	64		Prelaunch C/O, HDR
172*	51.2	19.2			57.6		Prelaunch C/O, HDR
179	44.8	19.2			25.6	38.4	On-orbit, HDR; LDR OI
180	51.2	19.2			28.8	28.8	Prelaunch payload C/O, HDR
183	22.4	9.6			25.6	70.4	On-orbit, HDR; LDR OI and GPC downlist
184	44.8	19.2			32	32	On-orbit, HDR
185	44.8	19.2			25.6	38.4	On-orbit, HDR; LDR OI
188	22.4	9.6			32	64	On-orbit, HDR; LDR GPC downlist
192	44.8	19.2			32	32	On-orbit, HDR
199	44.8	9.6			32	41.6	On-orbit, HDR; LDR SM GPC downlist
201	51.2			12.8	56	8	Ascent/Entry, HDR
203	44.8	19.2			25.6	38.4	On-orbit, HDR; LDR OI
204	22.4	9.6			25.6	70.4	On-orbit, HDR; LDR OI and GPC downlist
205	44.8	19.2			32	32	On-orbit, HDR
206	44.8	19.2			25.6	38.4	On-orbit, HDR; LDR OI
208	22.4	9.6			32	64	On-orbit, HDR; LDR GPC downlist
211	44.8	19.2			32	32	On-orbit, HDR
212	44.8	9.6			32	41.6	On-orbit, HDR; LDR SM GPC downlist

\*TFL common to all missions.

\*\*TFL166 is the prime launch format for EDO flights.

Note: GPCs can be S/W dumped or HISAM dumped in TFL 129.

**REFERENCES**

1. Space Shuttle Telemetered and Recorded Data Format Requirements, JSC-10784.
2. PASS User's Guide, 7.3.

FMT ID	HDR SIZE	WD/ FRM	LDR SIZE	WD/ FRM	OPS 0	MC1 G1	MC2 G2	MC3 G3	MC4 S2	MC5 S4	MC6 PL9	MC8 G8	MC9 G9	BFS	Description
12	12.8	32	6.4	16										X	Ascent BFS
13	12.8	32	6.4	16										X	Entry BFS
20	12.8	32	6.4	16	X										OPS 0 and OPS transitions
21	51.2	128	25.6	64		X									GNC ascent/abort
22	44.8	112	22.4	56			X								GNC on-orbit
23	51.2	128	25.6	64				X							GNC entry
24	19.2	48	9.6	24					X						SM2 on-orbit (PLBD) ❶
	19.2	48	8	20											
	19.2	48	11.2	28											
25	19.2	48	9.6	24						X					SM4 on-orbit, PL support ❶
	19.2	48	8	20											
	19.2	48	11.2	28											
26	19.2	48	19.2	48					X						Prelaunch RMS checkout/ ON-ORB RMS OPS
32	44.8	112	22.4	56								X			G8 on-orbit C/O
42	51.2	128											X		BTU I/F checkout
44	51.2	128											X		NOM G9 D/L countdown
46	51.2	128											X		FRT checkout
48	12.8	32	6.4	16							X				PL9 nonprime downlist
52	51.2	128									X				PL9 PRIME D/L
53	51.2	128											X		FCS checkout
60	51.2	128											X		P/L checkout
62	22.4	56					X								GNC on-orbit, LDR
64	9.6	24							X						SM2 on-orbit, LDR ❷
	8	20													
	11.2	28													
65	9.6	24								X					SM4 on-orbit, LDR ❷
	8	20													
	11.2	28													
72	22.4	56										X			GNC C/O LDR
90	12.8	32	6.4	16										X	BFS GPC memory dump
91									X	X	X				Mass memory dump ❸
92											X				S/L MM dump, PL9 GPC ❸
93	44.8	112			X	X	X	X	X	X	X	X	X	X	GPC HISAM, PASS GPC dump ❸
97	51.2	128											X		PCMMU C/O
98	51.2	128											X		PCMMU C/O
99	51.2	129											X		PCMMU C/O

Words/frame = kbps x 2.5

Notes:

- ❶ The bandwidth for the low data rate of formats 24 and 25 may vary.
- ❷ Formats 64 and 65 bandwidth may vary.
- ❸ Main memory, mass memory, and Spacelab dumps assume the window size of the downlist format at the time of initiation. The user specifies the number of words/frame via a SPEC 0 input. The 44.8 kbps listed with format 93 is for the HISAM only and is a 112 words/frame. The user must be aware of the TFL window for the appropriate toggle buffer for both cases.

TITLE

KEYSWITCH CODES

DEU KEYSWITCH CODES

Switch	Keyswitch	DEU KYBD adapter keycode	DEU/GPC keycode
1	ACK	FFF9	1C
2	MSG RESET	FFF1	1D
3	SYS SUMM	FFE9	10
4	FAULT SUMM	FFE1	13
5	C	FFD9	0C
6	B	FFD1	0B
7	A	FFC9	0A
8	GPC/CRT	FFC1	19
9	F	FFFA	0F
10	E	FFBA	0E
11	D	FF7A	0D
12	I/O RESET	FF3A	18
13	3	FEFA	03
14	2	FEBA	02
15	1	FE7A	01
16	ITEM	FE3A	14
17	6	FFFB	06
18	5	FDFB	05
19	4	FBFB	04
20	EXEC	F9FB	1E
21	9	F7FB	09
22	8	F5FB	08
23	7	F3FB	07
24	OPS	F1FB	11
25	+	FFFC	16
26	0	EFFC	00
27	-	DFFC	15
28	SPEC	CFFC	12
29	PRO	BFFC	1F
30	•	AFFC	17
31	CLEAR	9FFC	1A
32	RESUME	8FFC	1B

**TITLE**

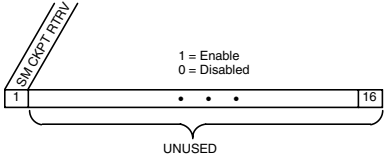
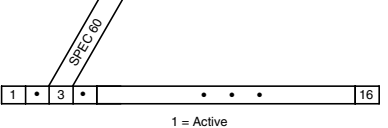
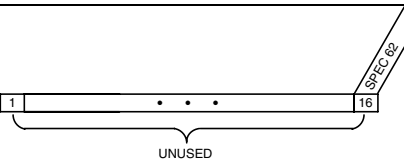
DPS VPs - DECODING

**PURPOSE**

The following parameters are used by DPS in the various phases of flight. The interpretation of these parameters is described below.

Parameter name	Description	Hex values
GPC sync fail PTR (FC\$SFAIL - 15th H/W)	Contains the return address for a routine being executed when a fail-to-sync occurs	Flight specific (see datapack)
CRT I/O ERROR FLAG (DMIB_ERR_MSG)		8000 - CRT1 I/O ERROR 4000 - CRT2 I/O ERROR 2000 - CRT3 I/O ERROR 1000 - CRT4 I/O ERROR  0100 - CRT1 CHECKSUM 0080 - CRT2 CHECKSUM 0040 - CRT3 CHECKSUM 0020 - CRT4 CHECKSUM
MMU ASSIGNED TO CURRENT MF (CZ2B_MM_MF- 2nd H/W (GNC)) - 3rd H/W (SM)		2000 - assigned to MMU 1 1000 - assigned to MMU 2
PRI/SEC PORT SEL (CZ2B_MODE)	<p>1 = Primary port 0 = Secondary port</p>	3C00 - only string 1 on sec ports 5C00 - only string 2 on sec ports 6C00 - only string 3 on sec ports 7400 - only string 4 on sec ports 7800 - only PL 1/2 on sec ports 7C00 - all on PRI ports

18819\_052

Parameter name	Description	Hex values
MMU UPLINK ERROR CODE (CDHV_PATCH_STAT)	Contains an error code for the failure of an MMU transaction initiated by the crew or via uplink.	0001 - "MM I/O ERROR" ON READ OR WRITE - possible transient 0002 - UNRESOLVED PHASE/LOAD BLOCK - phase or load block entered incorrect for entered system ID 0003 - CONFIGURATION CONTROL INFORMATION ERROR - system ID 0 or 7, or ... - all required entries not entered before a read, write, or merge entry, or ... - incompatible inputs entered for a merge 0004 - COMPARE FAILURE - compared blocks differ in contents between the two MMU units 0005 - MM CHECKSUM FAILURE ON READ 0006 - PHASE/LOAD BLOCK OF 0 ON MERGE - not allowed 0007 - LOAD BLOCK VIOLATION - load blocks too long for the configuration, or ... - offset too large for the load blocks and patch length 0008 - MM VERSION INCORRECT DURING MERGE OR WRITE
SM CHKPT RTRV ENABLED (CZ1B_CHKPT_RETRV_ENA)	 <p>18819_052B1.CVS</p>	8000 - ENABLED 0000 - DISABLED
TMBU SPEC 60 ACTIVE (CSTB_CONTROL_FLAGS)	 <p>18819_052B2.CVS</p>	2XXX - 3XXX - SPEC 60 ACTIVE AXXX - BXXX -
PCMMU/PL COMM SPEC 62 Active (CSLB_PPCOMM_SPEC_ACT_FLAG)	 <p>18819_052B3.CVS</p>	0001 - SPEC 62 ACTIVE 0000 - SPEC 62 NOT ACTIVE

18819\_052.b

## TITLE

REACH AND VISIBILITY

## PURPOSE

This procedure provides a table of all Data Processing System switches accessible to the commander and pilot in the cockpit during ascent through MECO and entry post-MM304.

## BACKGROUND

This data was derived from a reach and visibility study completed by the Systems Division on August 5, 1988, using the STS-26 crew. Even though this data is specific to this crew, it should provide a good basis for determining the crew's capabilities during these phases.

As of 1992, reach and visibility studies are not performed on a flight-to-flight basis if a pilot has flown previously; this study was stopped because experienced pilots and commanders are familiar with their reach and visibility. A study will be performed for new pilots, as required.

Updates will be based on the latest data available since 1992. It is appropriate to point out that, although no official study data were available, the mission specialist designated as no. 2 can assist the commander or pilot with switch location for overhead panels.



**Table 5.24-1. Ascent/entry reach and visibility constraints**

KEY: C=Commander P=Pilot

Panel	Switch	REACH	VIS	Comments
F6	BFC DISENGAGE	C	C	
F7	CRT 1	CP*	CP	
	CRT 2	CP*	CP	
	CRT 3	CP*	CP	Plt can reach right half of CRT.
	EVENT TIME		CP	
C2	LEFT KYBD	CP	CP*	Cdr cannot see one kybd spec, resume, clear.
	CRT 1 POWER	CP	CP	
	CRT 1 MAJ FUNC	CP	CP	
	CRT 3 POWER	CP	CP	
	CRT 3 MAJ FUNC	CP	CP	
	CRT 2 POWER	P	CP	
	CRT 2 MAJ FUNC	P	CP	
	LEFT CRT SEL	CP	CP	
	RIGHT CRT SEL	P	CP	
	EVENT TIMER MODE	CP	CP	
	EVENT TIMER CONTROL	CP	CP	
	TIMER SET	P	CP	Cdr can reach HR switches.
	TIMER	P	CP	
	RIGHT KEYBOARD	P	CP	Plt r kybd pro key marginal.
C3	BFC CRT SEL	CP	CP	
	BFC CRT DISP	CP	CP	
O1	GPC CAM MATRIX	C	C	
O3	MISSION TIMER SEL	P	P	
O6	GPC POWER 1	C*	C*	Cdr can reach by raising seat.
	GPC POWER 2	C*	C*	Cdr can reach by raising seat.
	GPC POWER 3	C*	C*	Cdr can reach by raising seat.
	GPC POWER 4	C*	C*	Cdr can reach by raising seat.
	GPC POWER 5	C*	C*	Cdr can reach by raising seat.
	MASTER TIMING UNIT	C*	C*	Cdr can reach by raising seat.
	GPC OUTPUT 1	C*	C*	Cdr can reach by raising seat.
	GPC OUTPUT 2	C*	C*	Cdr can reach by raising seat.
	GPC OUTPUT 3	C*	C*	Cdr can reach by raising seat.
	GPC OUTPUT 4	C*	C*	Cdr can reach by raising seat.
	GPC OUTPUT 5	C*	C*	Cdr can reach by raising seat.
	MDM PL1	C*	C*	Cdr can reach by raising seat.
	DEU 1 LOAD	C*	C*	Cdr can reach by raising seat.
	DEU 2 LOAD	C*	C*	Cdr can reach by raising seat.
	DEU 3 LOAD	C*	C*	Cdr can reach by raising seat.
	DEU 4 LOAD	C**	C*	Cdr can reach by raising seat.
	GPC 1 IPL PB	C*	C*	
	GPC 2 IPL PB	C*	C*	
	GPC 3 IPL PB	C*	C*	
	GPC 4 IPL PB	C*	C*	
	GPC 5 IPL PB	C*	C*	
	IPL SOURCE	C*	C*	
	MDM PL2	C*	C*	
	MDM FA1	C*	C*	

\*Commander or pilot may not see or reach if suit is inflated.

**Table 5.24-1. Ascent/entry reach and visibility constraints (concluded)**

KEY: C=Commander

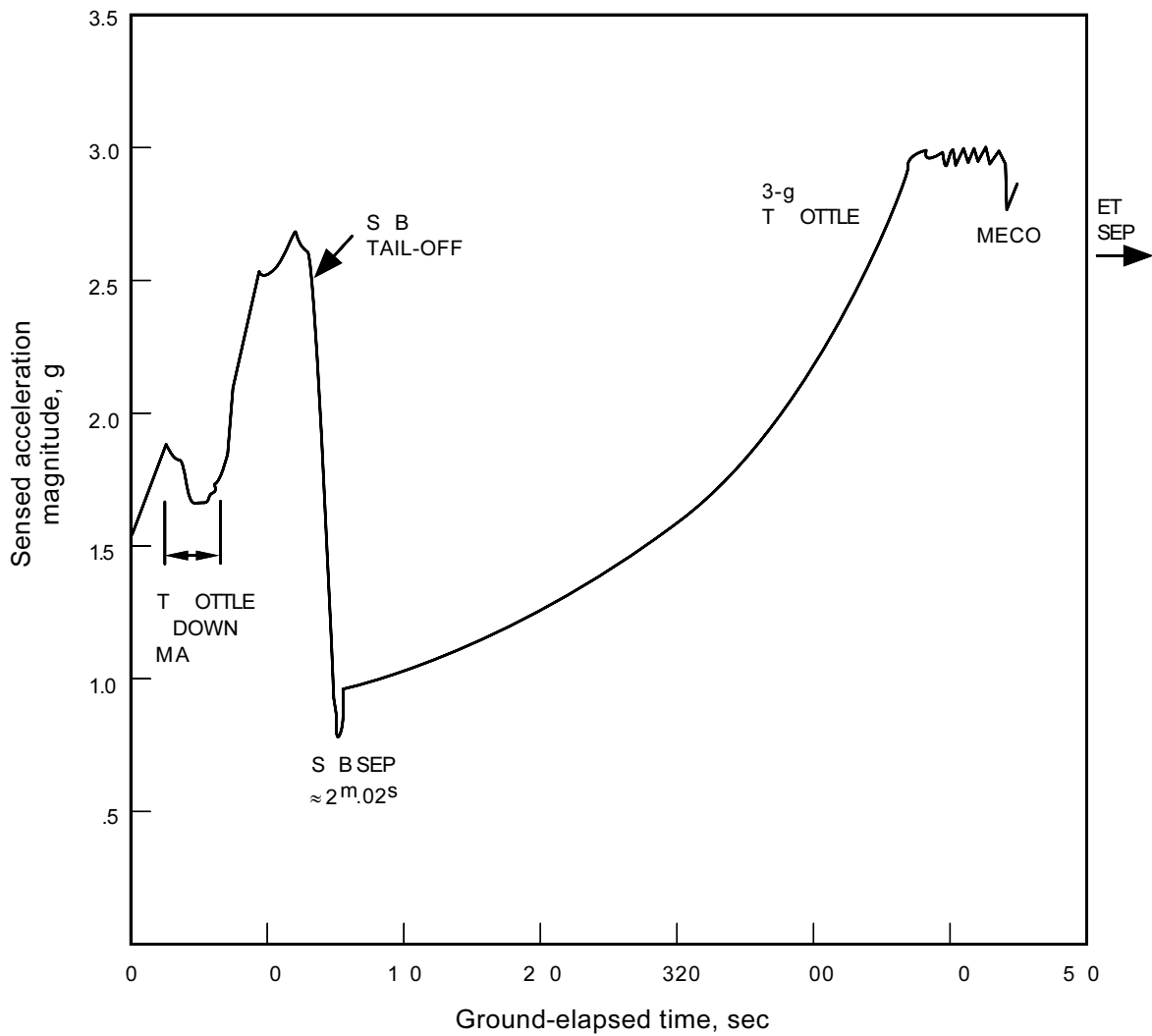
P=Pilot

<u>Panel</u>	<u>Switch</u>	<u>REACH</u>	<u>VIS</u>	<u>Comments</u>
	MDM FA2	C*	C*	
	MDM FA3	C*	C*	
	MDM FA4	C*	C*	
	MDM FF1	C	C	
	MDM FF2	C	C	
	MDM FF3	C	C	
	MDM FF4	C	C	
	GPC MODE 1	C	C	
	GPC MODE 2	C	C	
	GPC MODE 3	C	C	
	GPC MODE 4	C	C	
	GPC MODE 5	C	C	
	MDM PL3	C	C	
O13	cb ESS 1 BC MTU A			
	cb ESS 2 CA MTU B			
	cb ESS 3 AB GPC STATUS			
O14	cb MISSION TIMER FWD			
	cb EVENT TIMER AFT			
	MMU 1			
O15	cb MISSION TIMER AFT			
	cb EVENT TIMER FWD			
	MMU 2			

\*Commander or pilot may not see or reach if suit is inflated.

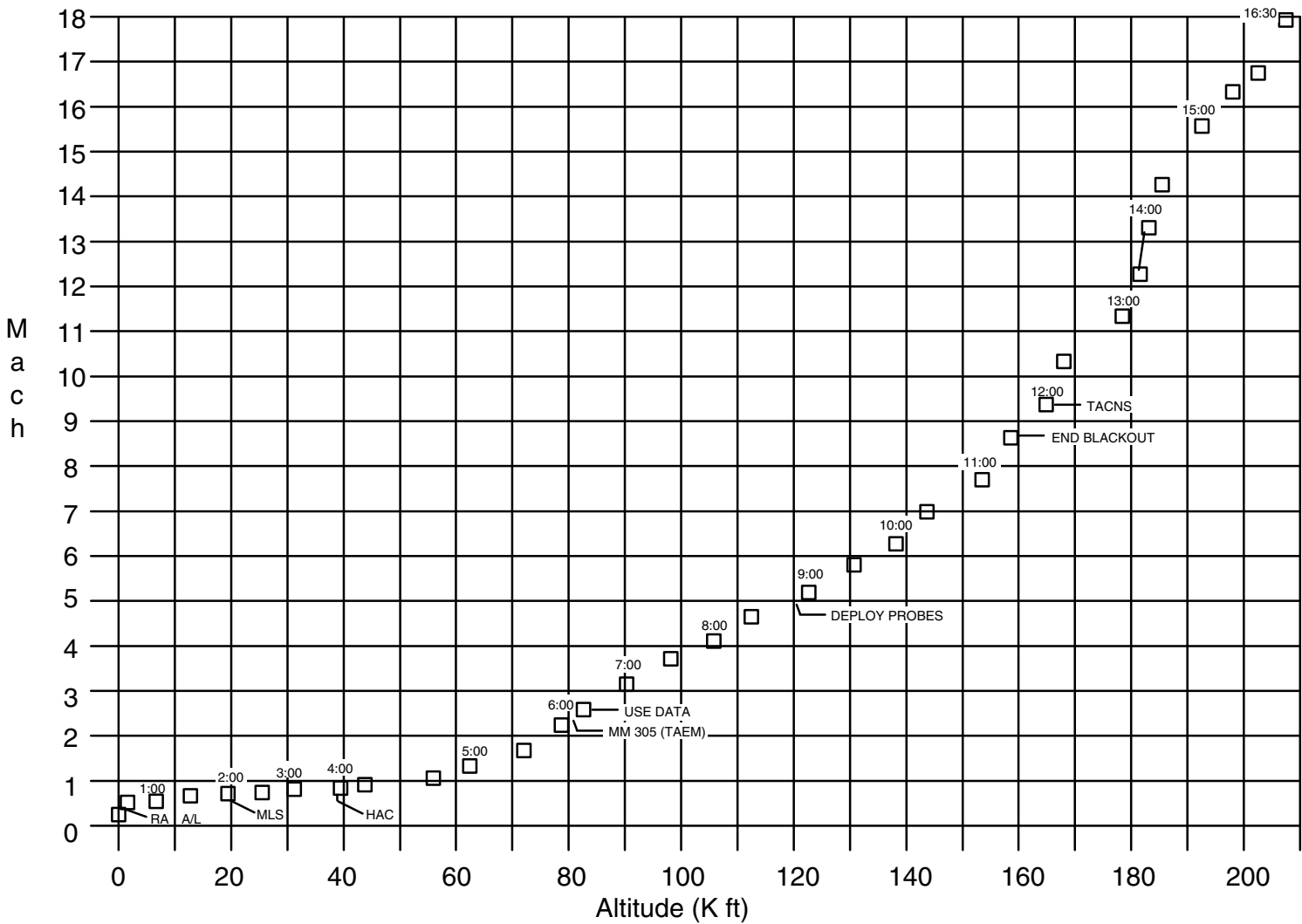
## REFERENCES

1. STS-26 Reach and Visibility Study, August 5, 1988.
2. STS-46, CDR and PLT Study, January 6, 1992.
3. STS-54, CDR and PLT Study, May 5, 1992.
4. STS-49, PLT Study, October 23, 1991.



j 1 1 s5 053

**Figure 5.24-1. Nominal ascent sensed acceleration**



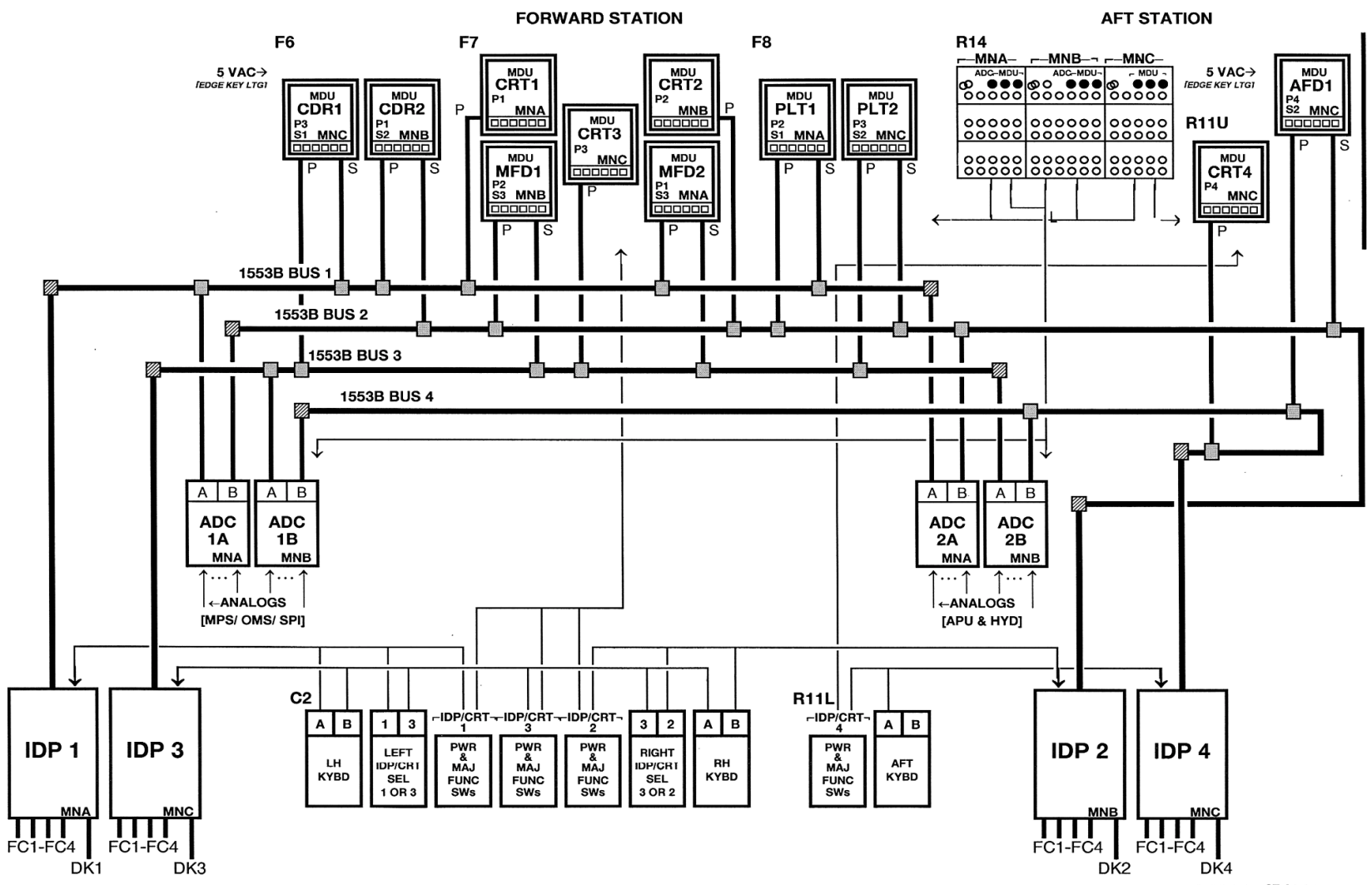
j\_18819\_s5\_051

Figure 5.24-2. Mach vs. altitude during entry

5.24-5  
Verify that this is the correct version before use

**TITLE**

MEDS OVERVIEW



MEDS OVERVIEW [POWER AND INTERNAL 1553B DATA BUS CONFIGURATION]

REV DATE: 07-21-98  
FILE NAME: MEDS\_OV1.DOC

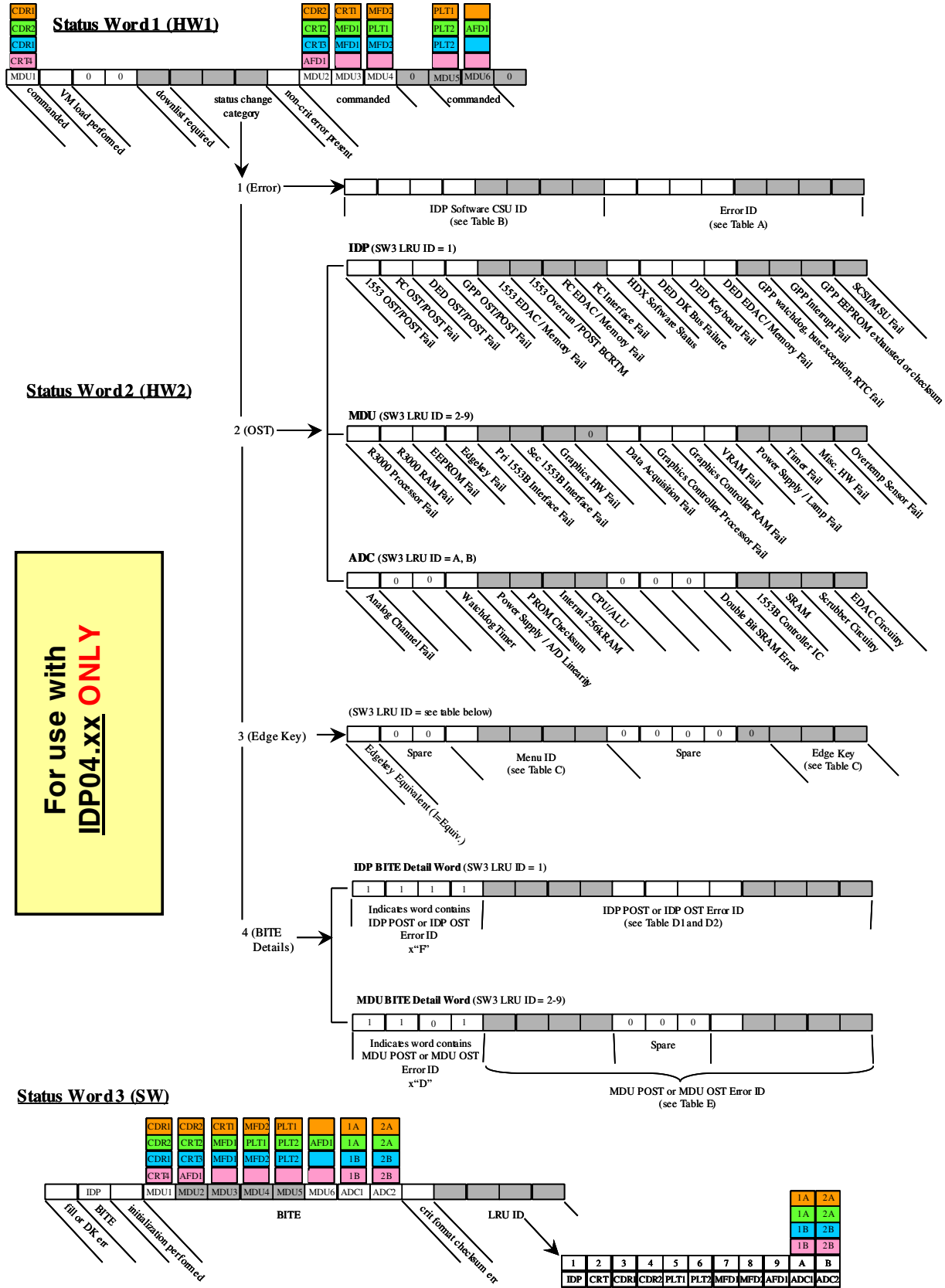
5.25-2  
Verify that this is the correct version before use

**TITLE**

MEDS TELEMETRY DECODING







**Table A –Error ID**

Error ID (HEX)	Error Name	Error ID (HEX)	Error Name	Error ID (HEX)	Error Name
01	ADC BIT ERROR	1E	HDX FC MISUSE ERROR	3A	MDU EEPROM ERROR
02	ADC HEARTBEAT ERROR	1F	IDP DEFAULT INTERRUPT ERROR	3B	MDU GRAPHICS ERROR
03	ADC POST ERROR	20	HDX SERVICE TIMEOUT ERROR	3C	MDU HEATBEAT ERROR
04	ANOMALOUS 1553B MSG STATUS	21	HDX STATUS ERROR	3D	MDU LOAD BSM ERROR
05	CHECKSUM ERROR	22	HDX USE ERROR	3E	MDU LOAD ERROR
06	CRIT FORMAT READ ERROR	23	IDP BIT ERROR	3F	MDU LOAD EXIT BSM ERROR
07	CRIT FORMAT WRITE ERROR	24	IDP CATASTROPHIC BIT ERROR	40	MDU LOAD MEMORY WRITE ERROR
08	CST/MM IN USE ERROR	25	IDP LOAD MEMORY ERROR	41	MDU LOAD RETRY ERROR
09	DAS 1553B CONSTRAINT ERROR	26	IDP POST EE CHECKSUM ERROR	42	MDU NON GRAPHIC COMMAND ERROR
0A	DAS 1553B STATUS ERROR	27	IDP POST ERROR	43	MDU OVERTEMP ERROR
0B	DAS 1553B USE ERROR	28	IDP SRAM ERROR	44	MDU PORT MODE ERROR PRI
0C	DAS CANT ACCESS 1553B BUS	29	IDP STARTUP CP LOAD ERROR	45	MDI PORT MODE ERROR SEC
0D	DAS FCW BUFFER OVERFLOW	2A	IDP STARTUP CSTP LOAD ERROR	46	MDU POST ERROR
0E	DAS FOREGROUND OVERRUN	2B	IDP STARTUP EK LOAD ERROR	47	MEMORY MANAGER ERROR
0F	DAS GO SERVICES ERROR	2C	IDP STARTUP RETRY ERROR	48	MESSAGE LENGTH ERROR
10	DAS INCOMPLETE 1553B TRANSACTION	2D	INFINITE LOOP CONDITION	49	MESSAGE TIMEOUT ERROR
11	DAS FOREGROUND EXTENDED	2E	INVALID BRANCH ADDRESS	4A	MESSAGE 1553B FAIL
12	MSU SPINUP ERROR	2F	INVALID EDGEKEY RECEIVED ERROR	4B	MIA WORD ERROR
13	EDGEKEY EQUIVALENT ERROR	30	INVALID FCW OPCODE	4C	MSG COMM 1553B ERROR
14	DAS STATUS CHANGE QUEUE OVERFLOW	31	INVALID MESSAGE RECEIVED	4D	MSU I/O ERROR
15	DAS UNKNOWN TASKING ERROR	32	INVALID REPEAT FCW	4E	NESTED SUPPORT BRANCH
16	DAS BUFFER OVERFLOW	33	INVALID START ADDRESS	4F	OPERATOR REQUEST ERROR
17	DPS OUT OF GOS	34	INVALID WORD COUNT	50	OPERATOR REQUEST ERROR MSU
18	FC BUS 1 I/O FAIL	35	KEYBOARD CHANNEL A FAIL	51	OPERATOR REQUEST ERROR 1553B
19	FC BUS 2 I/O FAIL	36	KEYBOARD CHANNEL B FAIL	52	UNKNOWN ERROR
1A	FC BUS 3 I/O FAIL	37	KEYBOARD STACK UNDERFLOW	53	DK DEVICE ERROR
1B	FC BUS 4 I/O FAIL	38	MDU BIT ERROR	54	INVALID FCW ADDRESS
1C	FILE PATCH MSU CLOSE ERROR	39	MDU DUMP MEMORY READ ERROR	55	MAINTENANCE ERROR
1D	FILE PATCH MSU OPEN ERROR				

**Table C –MENU ID and EDGE KEY**

Menu ID	Edge Key					
	1	2	3	4	5	6
01 Main		FLT INST	SUBSYS STATUS	DPS	MEDS MAINT	VIDEO
02 Flt Inst	Up	A/E PFD	ORBIT PFD	DATA BUS	MEDS MSG RST	MEDS MSG ACK
03 -- SPARE --						
04 -- SPARE --						
05 -- SPARE --						
06 Data Bus Select	Up	FC BUS 1	FC BUS 2	FC BUS 3	FC BUS 4	
07 Subsystem	Up	OMS/MPS	HYD/APU	SPI	PORT SELECT	MEDS MSG ACK
08 DPS	Up				MEDS MSG RST	MEDS MSG ACK
09 Video	Up					
0A Fault Summary	Up			CLEAR MSGS	MEDS MSG RST	MEDS MSG ACK
0B Interactive CST	Up					HDW CST
0C Maintenance	Up	FAULT SUMM	CONFIG STATUS	CST	MEMORY MGMT	
0D MDU Configuration	Up	PORT SELECT	AUTO MANUAL			CHANGE VIEW
0E CST	Up	START MDU	START IDP	START ADC1X	START ADC2X	
0F Mem Mgmt Selection	Up	IDP	MDU	ADCXX	ADCXX	FILE PATCH
10 XXXX Mem Mgmt Sel	Up	DUMP RAM	DUMP EEPROM	PROG LOAD		
11 XXXX Memory Loading	Up	PREV PROG	NEXT PROG	LOAD RAM	LOAD RAM/EE	SET CURRNT
12 File Patching Selection	Up	PREV FILE	NEXT FILE	SELECT		
13 XXXX File Patching	Up					

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Err ID (HEX)	Error Name	Err ID (HEX)	Error Name	Err ID (HEX)	Error Name
00	DEFAULT CSU	2F	SS ISSUE SEND DATA REQ	5D	(SPARE 18)
01	DAS SCHEDULER	30	GET DATA	5E	(SPARE 19)
02	DAS FOREGROUND	31	PERFORM DPS UPDATE	5F	CFS CHECK MSU IO
03	DAS BACKGROUND	32	(SPARE 5)	60	LOAD IDP EE RAM
04	(SPARE 1)	33	CREATE DPS GRAPHICS MESSAGE	61	LOAD IDP RAM
05	BUS 1553B C AND H ERRS	34	GENERATE DPS GO	62	LOAD MDU EE RAM
06	BUS 1553B RESET NC MSG CTRL	35	(SPARE 6)	63	DUMP IDP EE
07	BUS 1553B QUEUE MGR	36	(SPARE 7)	64	DUMP IDP RAM
08	GO DIO C AND H ERRS	37	SEND DPS GRAPHICS MESSAGE	65	DUMP MDU EE
09	GO DIO LOAD	38	DK BUS MGR	66	DUMP MDU RAM
0A	GO DIO LOAD PARTIAL MSG	39	DK MESSAGE TASK	67	DUMP ADC RAM
0B	GO DIO PUT	3A	DPS DISPLAY EXECUTIVE	68	PROCESS LRU MEM
0C	GO MIO C AND H ERRS	3B	BUFFER SWITCH	69	(SPARE 20)
0D	GO MIO QUEUE MGR	3C	(SPARE 8)	6A	HB MONITOR
0E	(SPARE 2)	3D	DK STATUS CHANGES	6B	HB ISSUE ADC REQUEST
0F	MS UPDATE MDU STATUS	3E	EE SERVER	6C	(SPARE 21)
10	(SPARE 3)	3F	BUFFER KEY	6D	OST ADC HANDLER
11	MDU CC ISSUE SEND STATUS REQUESTS	40	(SPARE 9)	6E	OST IDP EVENT MGR
12	MDU CC MONITOR	41	MONITOR KYBD EVENTS	6F	OST IDP HANDLER
13	MDU CC CHECK RESPONSES	42	PROCESS KEYSTROKE	70	OST MDU HANDLER
14	MDU CC DISPLAY ACTIVATE	43	VALIDATE FP KEYSTROKE	71	OST IDP POST HANDLER
15	MDU CC DISPLAY MANAGER	44	VALIDATE DPS KEYSTROKE	72	OST ISSUE ADC STATUS REQUESTS
16	MDU CC GET RESPONSES	45	ECHO NON KYBD SEQUENCE	73	OST ISSUE MDU STATUS REQUESTS
17	FI MANAGER	46	ECHO KEYSTROKE	74	OST HANDLE ADC STATUS CHANGE
18	FI VALIDATE DATA	47	FORMAT KEYBOARD DATA	75	(SPARE 22)
19	FI DISPLAY FORMATS	48	UPDATE KYBD POLLUT BUFFER	76	OST HANDLE MDU STATUS CHANGE
1A	FI DETERMINE DATA NEEDED	49	GET DISPLAY SEQ	77	OST MONITOR ADC POST STATUS
1B	FI FC BUS	4A	RESET SPL	78	OST MONITOR IDP POST STATUS
1C	FI ADI	4B	GET FILE PATCHING SEQ	79	OST MONITOR MDU POST STATUS
1D	FI MAJOR MODE SERVICES	4C	(SPARE 10)	7A	OST MONITOR MISC MDU ERRORS
1E	FI AVI SERVICES	4D	EK CMD HANDLER	7B	(SPARE 23)
1F	FI AE BLANKING SERVICES	4E	MAINT UI	7C	INTERPRET EK
20	(SPARE 4)	4F	MAINT MM MANAGER	7D	UPDATE IDP
21	FI COMP BUILD INIT	50	(SPARE 11)	7E	UPDATE IDP INTERACTIVE DISPLAY
22	FI COMP BUILD APPEND	51	MAINT PROGRAM SELECT	7F	(SPARE 24)
23	FI COMP BUILD UPDATE	52	MAIN FILE PATCH	80	UPDATE ADC OR MDU
24	FI COMP SERVICES	53	(SPARE 12)	81	OBTAIN CST RESULTS FOR DISPLAY
25	FI SPI	54	PROCESS DISPLAY MEDS STATUS	82	EXIT IDP
26	SS MANAGER	55	(SPARE 13)	83	(SPARE 25)
27	SS OMS MPS	56	(SPARE 14)	84	MONITOR CST PROGRESS
28	SS OMS BUILD INIT	57	(SPARE 15)	85	(SPARE 26)
29	SS OMS BUILD APPEND	58	INITIATE DUMP	86	(SPARE 27)
2A	SS OMS BUILD UPDATE	59	INITIATE LOAD	87	ME LOG TO MSU
2B	SS HYD APU	5A	(SPARE 16)	88	EH FAULT MANAGER
2C	SS HYD BUILD INIT	5B	GO MIO PUT	89	PERFROM FAULT UPDATE
2D	SS HYD BUILD APPEND	5C	(SPARE 17)	8A	(SPARE 28)
2E	SS HYD BUILD UPDATE				

Table B - CSU Name/ID

**Table D1 –IDP POST Detailed Errors**

Error ID (HEX)	Primitive Data Element Name	Error ID (HEX)	Primitive Data Element Name
60	GPP BUS EXCEPTION NMI	6D	1553 ED AC READ BIT NO ERROR
61	GPP SOFTWARE WATCHDOG TIMER	6E	1553 ED AC READ BIT CORR ERROR
62	GPP EEPROM CHECKSUM	6F	1553 ED AC READ BIT UNCORR ERROR
63	GPP REAL TIME CLOCK	70	DED SRAM ERROR
64	DED EDAC WRITE BIT ERROR	71	DED EDAC SRAM ERROR
65	DED EDAC READ BIT NO ERROR	72	DED SRAM ADDRESS LINE ERROR
66	DED EDAC READ BIT CORR ERROR	73	FC SRAM ERROR
67	DED EDAC READ BIT UNCORR ERROR	74	FC EDAC SRAM ERROR
68	FC EDAC WRITE BIT ERROR	75	FC SRAM ADDRESS LINE ERROR
69	FC EDAC READ BIT NO ERROR	76	1553 SRAM ERROR
6A	FC EDAC READ BIT CORR ERROR	77	1553 ED AC SRAM ERROR
6B	FC EDAC READ BIT UNCORR ERROR	78	1553 SR AM ADDRESS LINE ERROR
6C	1553 ED AC WRITE BIT ERROR	79	1553 BCRTM WRAPAROUND

**Table D2 –IDP OST Detailed Errors**

Error ID (HEX)	Primitive Data Element Name	Error ID (HEX)	Primitive Data Element Name
01	GPP EDAC WRITE BIT ERROR	1A	HDX UNKNOWN API EXCEPTION
02	GPP EDAC READ BIT NO ERROR	20	SOFTWARE WATCHDOG TIMEOUT
03	GPP EDAC READ BIT COOR ERROR	21	INTERRUPT FAILURE
04	GPP NON INTRUSIVE SCRUBBER BIT	22	EEPROM EXHAUSTED
05	DED EDAC WRITE BIT ERROR	23	SCSI FAILURE 1
06	DED EDAC READ BIT NO ERROR	24	SCSI FAILURE 2
07	DED EDAC READ BIT CORR ERROR	25	SCSI FAILURE 3
08	DED NON INTRUSIVE SCRUBBER BIT	26	MSU FAILURE
09	FC EDAC WRITE BIT ERROR	27	DED EDAC FAILURE
0A	FC EDAC READ BIT NO ERROR	28	DK DATA OVERRUN
0B	FC EDAC READ BIT CORR ERROR	29	DK TRANSMIT OVERRUN
0C	FC NON INTRUSIVE SCRUBBER BIT	2A	DK AMBIGUOUS EVENT
0D	1553B EDAC WRITE BIT ERROR	2B	DK WRAP AROUND MISCOMPARE
0E	1553B EDAC READ BIT NO ERROR	2C	DED KEYBOARD A ERROR
0F	1553B EDAC READ BIT CORR ERROR	2D	DED KEYBOARD B ERROR
10	1553B NON INTRUSIVE SCRUBBER BIT	2E	FC EDAC FAILURE
11	HDX BC EVENT QUEUE	2F	FC CH A DATA OVERRUN
12	HDX DK EVENT QUEUE	30	FC CH B DATA OVERRUN
13	HDX FC EVENT QUEUE	31	1553B EDAC FAILURE
14	HDX SCSI EVENT QUEUE	32	1553B DATA OVERRUN
15	HDX MSU EVENT QUEUE		
16	HDX KEYBOARD EVENT QUEUE		
17	HDX TIMER A EVENT QUEUE		
18	HDX TIMER B EVENT QUEUE		
19	HDX FAULT QUEUE		

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**Table E –MDU POST/OST Detailed Errors**

Error ID (HEX)	Primitive Data Element Name	Error ID (HEX)	Primitive Data Element Name
D002	POST R3000 CACHE FAIL	D719	POST SEC 1553B RAM RANDOM PATTERN FAIL
D004	ANALOG GROUND FAIL	D71A	POST GC CBIT CPU TEST FAIL
D102	FLOATING POINT FAIL (R3010)	D71B	GC OBIT CPU PUSH/POP FAIL
D104	AMBIENT TEMPERATURE SENSOR FAIL	D804	+10 VOLT FAIL
D11A	POST GC CBIT VRAM PATTERN TEST FAIL	D806	UNEXPECTED INTERRUPT OCCURRED
D11B	OST GC OBIT VRAM FAIL	D807	POST WATCHDOG TIMER ACCURACY FAIL
D204	LCD TEMPERATURE SENSOR FAIL	D809	OST EDGEKEY 2 STUCK FAIL
D21A	POST GC CBIT VRAM ADDRESS TEST FAIL	D812	POST SEC 1553B RAM EDAC DBL ERR DETECTION FAIL
D21B	GC OBIT EDAC ERROR	D81A	POST GC CBIT CO-VG REGISTER FAIL
D304	POST DIM POT FAIL	D81B	OST GC OBIT CPU TEST FAIL
D31A	POST GC CBIT SCRUBBER FAIL	D904	+5 VOLT FAIL
D31B	GC OBIT NMI ERROR	D905	LUMINANCE CONTROL LOOP FAIL
D402	R3000 COPROCESSOR OPCODES F FAIL	D906	BACKGROUND FAIL
D404	OST BACKLIGHT HIGH VOLTAGE FAIL	D907	POST WATCHDOG TIMER INTERRUPT FAIL
D409	OST EDGEKEY 6 STUCK FAIL	D909	OST EDGEKEY 1 STUCK FAIL
D419	POST GC RAM RANDOM PATTERN FAIL	D912	SEC 1553B RAM EDAC SINGLE ERR CORRECTION FAIL
D41A	POST GC CBIT EDAC FAIL	D91A	POST GC CBIT SRAM BYTE WRITE FAIL
D41B	GC OBIT ILLEGAL OPCODE	D91B	OST GC OBIT PROGRAM CHECKSUM FAIL
D502	R3000 JUMP/BRANCH OPCODES FAIL	DA03	POST SEC 1553B BCRTM ACCESS/CONTROL FAIL
D503	POST UDI INTERFACE FAIL	DA04	DATA ACQUISITION TEMPERATURE SENSOR FAIL
D504	+30 VOLT FAIL	DA05	LAMP FILAMENT FAIL
D507	POST INTERRUPT CONTROLLER FAIL	DA06	R3000 BUS FAULT INTERRUPT OCCURRED
D509	OST EDGEKEY 5 STUCK FAIL	DA07	POST TIMER 2 ACCURACY FAIL
D51A	POST GC CBIT EDAC SINGLE BIT TEST FAIL	DA08	POST EDGEKEY 6 DATA FAIL
D51B	GC OBIT BUS FAULT	DA12	PRI 1553B RAM SCRUBBER FAIL
D602	R3000 COMPUTATIONAL OPCODES FAIL	DA19	POST PRI 1553B RAM RANDOM PATTERN FAIL
D603	OST HEARTBEAT FAIL (TMS 34020)	DA1A	POST GC CBIT VRAM BYTE WRITE FAIL
D604	-15 VOLT FAIL	DA1B	OST GC OBIT INVALID DRAWLIST OPCODE
D605	PIPELINE SIGNATURE FAIL	DB03	POST SEC 1553B BCRTM INTERNAL BITE FAIL
D606	LOW POWER INTERRUPT OCCURRED	DB04	OST DATA ACQUISITION BACKLIGHT SENSOR FAIL
D609	OST EDGEKEY 4 STUCK FAIL	DB05	LAMP TEC FAIL
D61A	POST GC CBIT EDAC MULTI-BIT TEST FAIL	DB06	SEC 1553 EDAC INTERRUPT OCCURRED
D61B	GC OBIT INVALID INTERRUPT	DB07	POST TIMER 2 CONTROL FAIL
D702	R3000 LOAD/STORE OPCODES FAIL	DB08	POST EDGEKEY 5 DATA FAIL
D703	HOST INTERFACE FAIL (TMS 34020)	DB12	POST PRI 1553B RAM EDAC DBL ERR DETECTION FAIL
D704	+15 VOLT FAIL	DB1B	OST GC OBIT BYTE WRITE ERROR
D705	BEAMFORMER ACCESS FAIL	DC03	POST PRI 1553B BCRTM ACCESS/CONTROL FAIL
D706	OST BACKGROUND FAIL	DC06	PRI 1553 EDAC INTERRUPT OCCURRED
D707	POST BUS TIMEOUT INTERRUPT FAIL	DC07	POST TIMER 2 INTERRUPT FAIL
D709	OST EDGEKEY 3 STUCK FAIL	DC08	POST EDGEKEY 4 DATA FAIL
D712	SEC 1553B RAM SCRUBBER FAIL	DC12	PRI 1553B RAM EDAC SINGLE ERR CORRECTION FAIL

**Table E –Continued On Next Page**

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<b>Table E –MDU POST/OST Detailed Errors (Cont.)</b>			
<b>Error ID (HEX)</b>	<b>Primitive Data Element Name</b>	<b>Error ID (HEX)</b>	<b>Primitive Data Element Name</b>
DC1B	OST GC OBIT EDAC TEST ERROR	DE06	R3000 EDAC INTERRUPT OCCURRED
DD03	POST PRI 1553B BCRTM INTERNAL BITE FAIL	DE07	POST TIMER 1 CONTROL FAIL
DD04	DATA ACQ LCD VOLTAGE REGULATOR FAIL	DE08	POST EDGEKEY 2 DATA FAIL
DD06	VECTOR GENERATOR FAULT INTERRUPT OCCUR	DE12	POST R3000 RAM EDAC DOUBLE ERR DETECTION FAIL
DD07	POST TIMER 1 ACCURACY FAIL	DF03	EEPROM CHECKSUM FAIL
DD08	POST EDGEKEY 3 DATA FAIL	DF04	VREF PROM FAIL (CHECKSUM)
DD12	R3000 RAM SCRUBBER FAIL	DF06	WATCHDOG TIMER INTERRUPT OCCURRED
DD19	POST R3000 RAM RANDOM PATTERN FAIL	DF07	POST TIMER 1 INTERRUPT FAIL
DD1B	OST GC OBIT SCRUBBER ERROR	DF08	POST EDGEKEY 1 DATA FAIL
DE03	EEPROM WRITE FAIL	DF12	R3000 RAM EDAC SINGLE ERROR CORRECTION FAIL
DE04	DATA ACQUISITION VREF GRAY SCALE FAIL		

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**SECTION 6  
SPECIAL DPS CONSOLE OPERATIONS**

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## TITLE

GPC/MMU DUMP GROUND PROCESSING

*(Using the FEP and GPC Dump workstation application)*

## PURPOSE

The purpose of this SCP is to describe the ground processing involved in verifying the contents of the GPC memory configurations and the contents of the mass memory tapes on the shuttle using downlinked data from the vehicle. DEU dumps are not discussed in this SCP. Verification includes the comparison of dumped data with a reference standard readily accessible in a ground computer. The results of the comparisons will be used by the ground personnel to assess the health of the onboard GPC(s) or MMU(s).

This SCP contains the following information:

- General statement of capability
- Procedure for processing dumps
- Description of background data
  - GPC dump application
  - SPF memory compare processing

## GENERAL

### A. GPC Dumps

The capability exists to dump all or portions of GPC memory. Normal GNC downlist is lost during a dump. Previously, a GPC dump was recorded on the OPS recorders, as well as simultaneously received on the ground if the dump occurred during AOS. If the dump occurred during LOS, the data could then be acquired from the OPS recorders at a later time. Dump data sent via the OPS recorder uses the FM link, thereby allowing the dump without interruption of the real-time data. Once on the ground, the data is held at the remote site for playback until LOS, thus avoiding interference with the real-time data flow from the remote site.

Because we have almost full TDRS coverage, dumps should be performed only during AOS. If there is no other alternative, the procedures for performing an OPS recorder dump can be found in appendix G in the DPS Console Handbook. The OPS recorder procedures are not covered in the Flight Data File; therefore, procedures must be sent to the crew if there is a requirement to perform a GPC dump via the OPS recorders.



1. PASS HISAM and GNC dumps go to toggle buffer 1 in the PCMMU, SM goes to toggle buffer 2, nonprime OPS0/PL9 goes to toggle buffer 4, and BFS/post-IPL HISAM dumps go to toggle buffer 5.
2. It is also possible to dump only a portion of GPC memory.

#### B. MMU Dumps

MMU dumps are initiated onboard using the MASS MEMORY R/W display available as the OPS display in PL9 or SPEC 85 in SM2 and SM4. The SM2 major function permits 2048 16-bit words to be transferred at one time from the MMU through the SM GPC where the data is placed on the SM2 downlist for transmission to the ground. The normal SM2 downlist is replaced while the mass memory dump data is being sent to the ground. In a similar manner, the PL9 major function permits 16,384 16-bit words to be routed at one time through the SM GPC to the ground. Therefore, MMU dumps are limited in size and may result in only a partial dump of a loadblock, not the entire phase. Because of the small SM buffer space, flight rules require that MMU dumps be performed in PL9.

MMU dump procedures are not covered in the Flight Data File; therefore, procedures must be sent to the crew if there is a requirement to perform an MMU dump.

#### C. Dump Processing and File Transfer

GPC/MMU dumps are processed by the DPS workstation and are then transferred to the Software Production Facility (SPF) to be analyzed by Flight Software (FSW) personnel. There are two domains in the SPF which can perform this processing. The primary domain, as specified in the United Space Alliance PASS FSW Mission Support Plan, is the Software Development Facility (SDF-A). The SPF production domain (PRDS) is available as a backup.

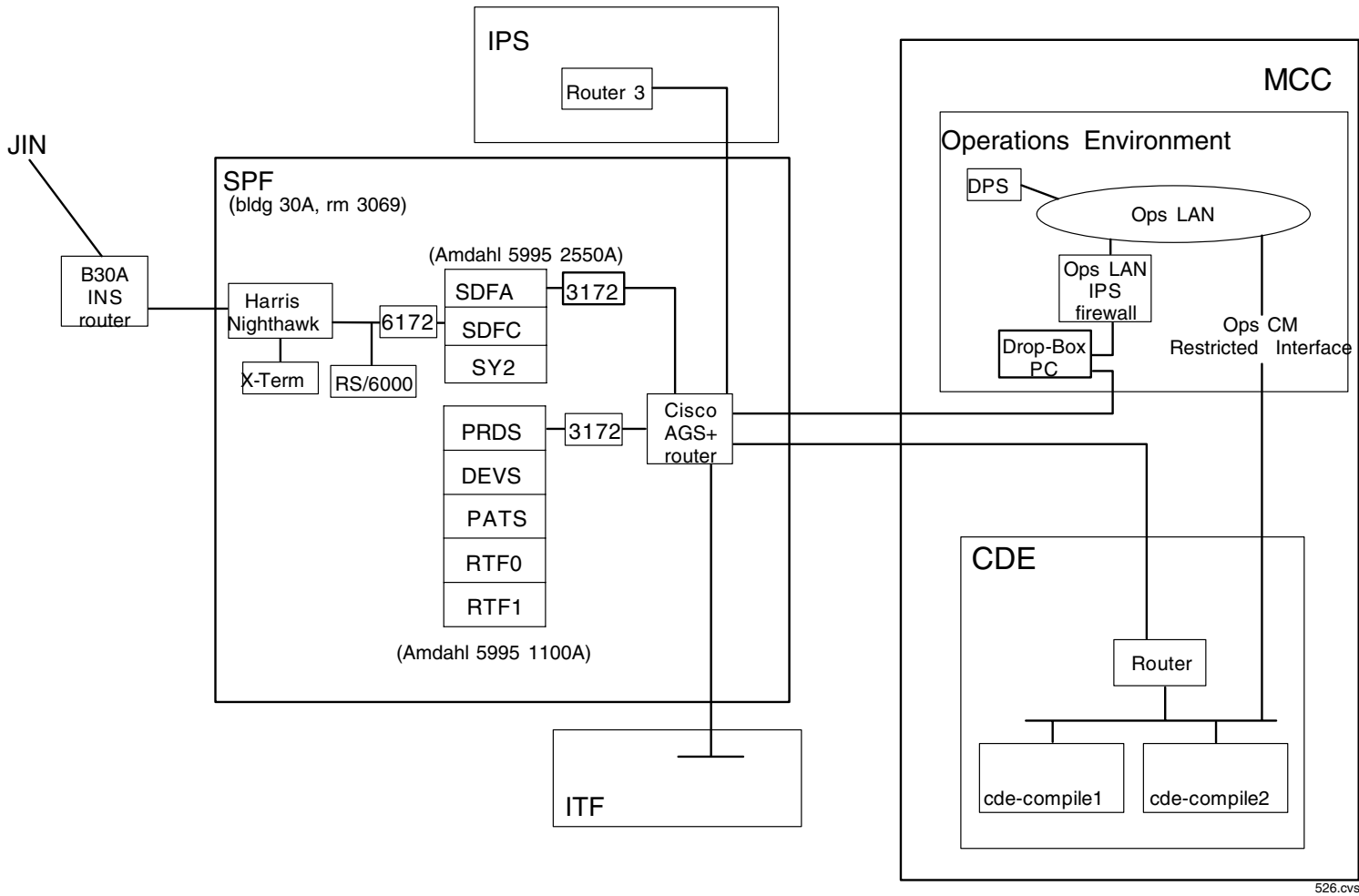
The method of transmitting these dumps to the SPF is via File Transfer Protocol (FTP). There are two distinct paths available for this file transfer. The primary path is through the GPC DUMP Drop Box, which is connected to the OPS LAN firewall. The backup path is through the Computer Development Environment (CDE) LAN, which is also connected to the OPS LAN. Both these paths are connected to the SPF Cisco Router (see Figure 6.1-1 for a diagram of these paths).

Once the dumps are resident on either the Drop Box or the CDE compile 1 or compile 2 servers, they can be retrieved for processing by FSW personnel on the SPF. As long as the primary path is used, the DPS workstation has all the necessary tools to perform the dump transfer. If there is a problem with the primary path and the backup path to the CDE servers must be used, manual intervention by one of the DPS Group Administrators is required. In order to use the backup path, a GA will have to be called in and they will have to copy the dump files from the DPS workstation to the CDE server. The path for these files on the CDE server is

/cde/rw1/mer01/mer/lramer/GPCDUMP (this is case sensitive). The only drawback to using the CDE is that it is supported only during normal working hours (7 a.m. - 5 p.m., Mon. - Fri.). The system is on line 24 hours a day, but support personnel are available only during these times should any problems be encountered. The CDE does not have any mission support requirements at this time.

Verify that this is the correct version before use

6.1-4



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Figure 6.1-1. SPF TCP/IP interfaces for electronic GPC dump delivery

## PROCEDURE

A. For crew to perform a mass memory dump (ref. OI User's Guide)

1. PL9 OPS page (MASS MEMORY R/W)
2. Select MMU to be dumped - ITEM 40(41) EXEC
3. Select software to be dumped - ITEM 42 + X EXEC,

where X =

- 1 - PASS Area 1
- 2 - PASS Area 2
- 3 - PASS Area 3
- 4 - BFS
- 5 - DEU
- 6 - SSME
- 7 - TCS Sequence
- 0 - Text and Graphics

4. Select phase to dump - ITEM 43 + XXX EXEC
5. Select load block to dump - ITEM 44 + XXX EXEC
6. Start Dump - ITEM 52 EXEC

Note: This will cause the downlist format to change to 91.

B. To perform a real-time memory dump

1. DPS/DPS SPT verifies the TFL compatibility with INCO/INST.
2. DPS/DPS SPT starts the Backup Dump Driver by selecting DPS II APPS I GPC DUMP DRIVER (BACKUP).
3. DPS/DPS SPT monitors the memory dump quality in real time, using the GPC Dump Display. To start the GPC Dump Display, choose DPS II Apps I GPC DUMP DISPLAY from the DNAV menu. The dump display does not have to be opened before the dump begins. If the dump display is opened during or after a dump, the most recent dump files will automatically be opened.
4. When the GPC Dump Display begins receiving dump data, the Dump Data Quality dialog box will appear, and the stop time and quality data (missing/invalid frames and frames with invalid checksums) will update continuously during the dump. *The GPC Dump Display of the first 512 words*

*will remain blank until the dump is complete/terminated. Once the dump is complete/terminated, the first 512 words of the dump data will be displayed.*

5. Once a satisfactory dump is obtained (i.e., no missing/invalid frames or invalid checksums or on the advisement of flight software personnel), DPS/DPS SPT will transfer the dump files (Dump Data and Dump Quality for each dump) to the Software Production Facility (SPF) drop box (see Section D) for offline memory dump processing by flight software personnel.
6. Each dump contains two files, a dump file and a dump quality file. The filename of the dump file (e.g., D303143117\_93RRGPC2\_STS069.prime) will be announced as the last advisory message (in Advisory Services, the GPC Dump Advisory Log, and on the GPC Dump Display above the Advisory Log) after dump completion/termination. The quality file for that dump will be the same filename, except starting with a Q vis D. The \*.prime filenames were captured by the prime driver and should be used, except in special circumstances. The \*.backup files were captured by the backup driver and could be used if workstation problems rendered the prime driver inoperable during the dump.

Notes:

1. BFS dumps do not have checksums; therefore, the Invalid Checksum field in the Quality Dialog box will remain blank during these dumps.
2. Additional features and advisory message explanations can be found in the GPC Memory Dump Processor User's Guide.
3. GPC dumps should not be performed during LOS unless there is no other alternative.

C. To obtain dump data from the OPS recorder

1. DPS/DPS SPT requests from INCO/INST that the dump data be dumped to the ground.
2. DPS/DPS SPT informs INCO/INST that we will need to have the dump data played back through the playback FEP. INCO/INST will work with TELCOM to set up the playback.
3. To view the playback of the dump data, DPS/DPS SPT need to select the playback telemetry stream on the GPC Dump application. This is done by selecting Stream | PB on the GPC Dump application.
4. At the completion of the dump, DPS/DPS SPT electronically transfers the dump and quality files to the FSW drop box (see Section D).

D. To obtain offline memory dump processing

1. DPS/DPS SPT generates a CHIT to MER requesting dump analysis. The CHIT should include the dump and quality filenames that will be electronically transferred to the SPF for processing.
2. Choose the "MCC File Transfer" from the DNAV Master II Tools menu to start the XFTP utility. The window on the left will be for the workstation you are using. The computer name (i.e., white-mps6) will be above the menu for this window. The window on the right will be the destination workstation.
3. From the menu in the left window, choose "Dir | Change Directory." In the directory field, type in "/users/dps/DATA/GDUMP" and choose OK. A list of dump files that exist in the GPC Dump directory will appear. The filenames beginning with D are dump files, and those beginning with Q are quality files.
4. Select the files to transfer to FSW by single clicking on the files in the left window. Always transfer the Dump and Quality files for each dump. The Prime copy should be used (\*.prime). If this file is corrupted, use the Backup files (\*.backup) for the transfer.
5. To connect to the FSW dropbox, choose "Connect | Connect to Remote" from the menu above the right window. Select "spf-db" in the Recently Referenced Hosts: list box and type "anonymous" in the user name field (this is in parenthesis next to the host name in the list as a reminder). If "spf-db" selection not available, type "spf-db" in the Hostname field and "anonymous" in the username field. Choose the connect button to connect to the FSW dropbox. Enter your workstation userid in the Type Password field and choose OK.
6. From the right window, choose "Dir | Change Directory" and type /GPC in the Directory: field. Choose OK to change to the GPC Dump Dropbox directory.
7. Click on the >>copy>> button and choose OK from the Verify Dialog box to transfer/copy the selected files to the FSW dropbox. The selected files will appear in the right window when the copy is complete. Note: Files are to be transferred in binary.
8. Notify FSW via SPAN that the files have been transferred to the GPC Dump dropbox.
9. Choose File | Quit from the Xftp menu to close the Xftp utility.

Note: As a cleanup, delete all old dump files from the /users/dps/DATA/GDUMP directory after every flight or activity. FSW will archive the files that are transferred to the GPC Dump dropbox for each flight.

E. Dump transfer path problems

In the event that a problem is encountered while transmitting a processed GPC/MMU dump, the following steps should be followed.

Primary path failure in connecting to the GPC Dump Drop Box.

1. Any problems encountered in connecting to the Drop Box from the DPS workstation should be reported to the MCC Workstation Support (WSS), and a DR should be written.
2. The WSS will contact the appropriate OS Support group to have the problem worked in a flight support mode.
3. When the problem is resolved, OS Support will notify WSS, who will, in turn, notify DPS.
4. If a GPC/MMU dump is waiting to be processed while the Drop Box is down, one of the DPS GA's should be called in to transfer the dump from the DPS workstation to the CDE server. If this path is used, it should be noted on the dump processing request CHIT so that FSW personnel will know which system to retrieve the dump from.

Secondary path failure in connecting to the CDE servers.

1. Any problems encountered in connecting to the CDE servers from the DPS workstation should be reported to the CDE Systems Administration desk, and a DR should be written.
2. The CDE Systems Administration desk will initiate the necessary steps to have the problem worked. The CDE has no defined mission support requirements and is only supported during normal business hours. If a problem is encountered during off-nominal hours and the primary path is also down, emphasis should be placed on the recovery of the primary path.

F. Points of contact

Phone numbers

1. WSS 244-6215
2. CDE Systems Administration Desk 244-6217
3. MOIR FSW console 483-3929 or 483-3935
4. Integrated Training Facility - FSW support 483-3775 or 483-5468
5. SPF Help Desk 483-6888

IP Addresses

1. GPC Dump Drop Box 192.160.82.50
2. CDE-Compile1 Server 134.118.10.116
3. CDE-Compile2 Server 134.118.10.112
4. SPF Router 130.196.203.99  
192.160.82.1  
192.160.82.2

**FTP COMMAND LINE PROGRAM PROCEDURES**

- A. Obtain the Xterm window and go to gdump directory.
  1. In the background area, click on the right mouse button to view a submenu. Under the "Applications" option, select Xterm. A xterm window will open.
  2. Type: `cd /users/dps/DATA/GDUMP` <return>. This command will get you to the gdump directory.
  3. Type: `ls` <return>. This will allow you to view all of the files in this directory, including the processed gdump files.
- B. Set up the ftp program for file transfer.
  1. Type: `ftp spf-db` <return>. This command will start the file transfer protocol (ftp) program and bring up the login prompt for the spf-db server.
  2. At the login prompt, type in "anonymous" as a username. Hit "enter" or "return" at the password prompt.
  3. Type: `type binary` <return>. This command sets up the ftp program for a binary file transfer. The ftp program will respond with "Type Set to l"
  4. To view the directory structure, type: `ls` <return>. The GPC directory should be listed. Type: `cd GPC` <return>. This command will change directories to the GPC directory. Type: `ls` <return>. This command will allow you to view the files located in the spf-db server.
- C. Perform file transfer and exit.
  1. Type: `mput *.prime` <return>. This command will allow you to transfer all gdump files with the ".prime" string in the title to the spf-db server. This command will result in confirmation to transfer each file with the ".prime" string. Answer "y" or "n" as appropriate. Note: The mput command stands for "multiple



put" or transfer of multiple files. For a single file transfer, type: put "filename"  
<return>.

2. Type: ls <return>. This command will allow you view the files located in the spf-db server. Verify that the gdump files that were transferred in the previous step are included in this listing.
3. To exit the ftp program, type: quit <return>.
4. Close the Xterm window or type: exit <return>.

## REFERENCES

1. PASS User's Guide.
2. NSTS Downlist Uplink Software Requirements, SS-P-0002-140.
3. Flight Control Operations Handbook sec. 4.5, JSC-26843.
4. Digital Magnetic Tape Recorder Specifications, SE-R-0095.
5. INCO/COMM Systems Briefs, sec. 40, Modular Memory Unit/Solid State Recorder Contents, JSC-18611.
6. INCO/COMM Console Handbook, SCP 3.34, JSC-12829.

## TITLE

TIME BIAS ADJUSTMENT ( $\Delta T$ )

## PURPOSE

The purpose of this SCP is to provide procedures to perform time bias adjustments and drift checks. Reference SCP 4.10 and DPS Systems Brief 6.16 for more details on delta time adjustments.

## PROCEDURE

- A. Select the Delta-t option under DNAV DPS II Apps menu. The Delta-t application, Figure 6.2-1, should appear.
- B. Select the Delta-t text in the upper left-hand corner of the application. Three options will be listed; Zero Out, Reset, and Exit.

Zero Out - This option allows the operator to zero out the desired  $\Delta T$ (s). The delta-t's available are MTU-1, MTU-2, GNC, SM BFS, OPS-0, SCOS, ECOS, and ALL. This program automatically calculates the required bias to zero out the  $\Delta T$ (s). For documentation purposes, the application subtracts the desired time (i.e., MTU-1) from the adjusted ground receipt time (AGRT) to determine the bias. The ALL option allows the user to zero out all the delta-t's simultaneously.

Reset - This option allows the operator to remove the bias from the desired  $\Delta T$ (s). The ALL option allows the user to remove all the biases entered.

Exit - This option allows the operator to exit from the application.

- C. Once the appropriate  $\Delta T$ (s) is zeroed out, it can be verified on the Delta-t application. Also, the Delta-t application displays the bias used to zero out the  $\Delta T$ (s) under the Bias column. This bias(es) should be recorded in the console log.

Delta -t		Help	
	Time	Delta t	Bias
MTU-1	137/01:14:16.651	-000/00:00:00.285	000/00:00:00.000
MTU-2	137/01:14:16.711	-000/00:00:00.345	000/00:00:00.000
GNC	137/01:14:16.245	000/00:00:00.121	000/00:00:00.000
SM	137/01:14:16.245	000/00:00:00.121	000/00:00:00.000
BFS	D	D	000/00:00:00.000
OPS-0	D	D	000/00:00:00.000
SCOS			000/00:00:00.000
ECOS			000/00:00:00.000
AGRT	137/01:14:16.366		
Liftoff	135/08:05:19.000		

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**Figure 6.2-1. Delta-t application**

**DELTA-T STANDARDS**

The following documents the standards that will be followed for monitoring and zeroing out of all the Delta times ( $\Delta T(s)$ ). These standards do not preclude the teams from zeroing the  $\Delta T(s)$  at their discretion whenever necessary as long as the changes are documented in the console log. The teams have the option of using the workstation application RTPLOT to monitor  $\Delta T(s)$ . The individual operator can use any number of plots (i.e., all  $\Delta T(s)$  on one plot, each  $\Delta T(s)$  on its own plot) per the operator's preference; FCR and MPSR do not have to be identical as long as the appropriate  $\Delta T(s)$  are monitored.

- A. After the final GMT alignment is complete during the prelaunch countdown, the operators will zero out the MTU 1 and MTU 2  $\Delta$ . Since these two times are OI driven, these  $\Delta T(s)$  should not change with PCMMU-related changes (e.g., OPS transitions, TFL changes, PCMMU swaps) as long as the data path from the orbiter to the MCC remains the same. In other words, if the data is downlisted through a GSTDN site instead of TDRS, the OI driven may change.
- B. After the G9-G1 transition and BFS is tracking PASS in OPS 101, the GNC and BFS  $\Delta T(s)$  will be zeroed out. This is usually performed around T - 18 minutes.
- C. After the G2/S2 set is configured in block 1 of Postinsertion, the GNC  $\Delta T$  will be zeroed out on one TDRS, and the SM  $\Delta T$  will be zeroed out on the other TDRS. Zero out the MTU 1 and MTU 2  $\Delta T(s)$  if necessary; zero out one on each TDRS. Zeroing out these delta times at the same time for every flight/sim is not critical as

long as the operator documents in the console log when/where the times were zeroed out. Some section members have found that zeroing out the  $\Delta T(s)$  at the nodal crossings is effective for monitoring purposes.

- D. Anytime pseudosync is lost (OPS transitions, TFL changes, PCMMU swaps, etc.), the GNC and SM  $\Delta T(s)$  will be "re-zeroed" out on the appropriate TDRS.
- E. At the Ascent team's discretion, the MTU 1, MTU 2, BFS, and GNC  $\Delta T(s)$  can be zeroed out after the handover from the GSTDN site (usually MILA) to TDRS. Because of the uncertainty of the workload of the ascent team, the operators may feel that re-zeroing out of the  $\Delta T(s)$  will prevent them from monitoring their data as effectively as possible. A point to be made is that flight rule A7-107, TIME MANAGEMENT, still applies during this timeframe, and accurate monitoring of the  $\Delta T(s)$  is required to correctly apply this rule.
- F. At the Entry team's discretion, MTU 1, MTU 2, BFS, and GNC  $\Delta T(s)$  can be zeroed out after the G2-G3 transition and after the handover from TDRS to GSTDN. The same rationale applies here as in item no. 5.

Values for the  $\Delta T(s)$  will be entered according to the procedure in step C. Bias values can be verified using the Delta-t application.

## DRIFT CHECKS

Drift checks should be made during the mission to verify performance of the MTU oscillators. This is done via GSTDN sites or the TDRS satellites.

- A. GSTDN drift checks should be taken at sites with high elevation angles. At the point of closest approach to the site (max. elevation), R delay due to slant range is negligible and any error should be due to drift. (Note: At max. slant range, which occurs at AOS/LOS, RF delay is 5 milliseconds for a 150-mile orbit.) TDRS drift checks can be done at any time and have been observed to vary  $\pm 15$  milliseconds.
- B. Use NEXT STATION CONTACTS display to monitor when max. elevation occurs and take measurement at this time. A log of measurements should be kept to show any trends in MTU oscillator performance.
- C. Should MTU/GPC drift exceed acceptable limits (Mission Rule allows  $\Delta T \leq 100$  milliseconds), update GMT per SCP 7.8.
- D. If excessive drift is suspected while on TDRS, request a hand-down to a ground station to verify  $\Delta T$  drift. A discrepancy between the MTU $\Delta T$  and the GNC $\Delta T$  may be explained by a loss of pseudosync (caused by a TFL change). Pseudosync can be reestablished by performing an OPS transitions or an OPS mode recall with a change in the target set. Pseudosync loss has been observed on several flights and has not caused any adverse effects.

**REFERENCES**

1. MCC Level Band C Requirements for Shuttle-Telemetry Data Processing, Volume 1  
- Shuttle Data Processing Complex (SDPC) Software.

## **TITLE**

ONBOARD FAULT SUMMARY APPLICATION

## **PURPOSE**

This SCP provides the steps to document the procedure for using the OFS application in the MCC.

## **BACKGROUND**

OFS displays a set of scrollable fault message lists that enable the user to track orbiter fault messages. The orbiter fault message lists maintained are PASS and BFS. Incoming fault messages enter at the top of the lists. Users can scroll through the lists and print a range of faults. During ascent, two instances of OFS could be used, one viewing PASS, the other instance viewing BFS. The view option is specific to the user and does not affect all instances in the MCC. DPS flight controllers have some unique capabilities to clear the fault message lists and to alter the source of fault messages by switching downlisters. These unique options selected by DPS affect every instance running in the MCC that are configured to the same flight activity. Only the DPS-unique options are discussed here. For more information on this application, see the DPS User's Guide binder.

## **PROCEDURE**

Select Onboard Fault Summary option under DNAV DPS II Apps menu. An OFS summary message will appear. After acknowledging it, the OFS application, Figure 6.3-1, should appear. Starting OFS using the DPS menu will allow DPS flight controllers to clear messages and to alter downlist selection. Other disciplines start OFS using Global Apps from the Master Menu, which does not allow the DPS-unique capabilities.

To clear a fault message list (only available to DPS flight controllers), select file option, and a pulldown window appears. Select Clear, which brings up another window for determining which fault history log to delete: PASS, BFS, and ALL. After acknowledging the confirmation window, this will clear the corresponding fault message list in every running instance for those that are configured to the same flight activity in the MCC.

To change downlist selection, select Downlister. This allows the DPS flight controller to switch downlisters to match the current downlister configuration onboard the orbiter. Possible downlister choices are GNC, SM, and OPS 0. The Auto Select option is currently unavailable and, therefore, grayed out. Switching downlisters alters which input parameters the computations examine for downlinked fault codes. This option affects every running instance for those who are configured to the same flight activity in the MCC.

<u>F</u> ile	<u>V</u> iew	<u>D</u> ownlister	<u>A</u> cknowledge	<u>T</u> imetag	<u>H</u> elp
PASS	Faults	(GNC Auto)	GPC	Time (GMT)	
37	S62	BCE BYP	PL	4	137/01:12:19.37
36	S88	APU FU LN	3	4	137/01:10:00.17
35		R OMS	PC	123	137/01:05:55.40
34	S62	BCE BYP	PL	4	137/01:00:44.33
33	S68	02 HTR TRP	5	4	137/00:58:01.16
32		R OMS	PC	123	137/00:55:56.34
31		R OMS	PC	123	137/00:45:55.38
30		TIME	TONE	1234	137/00:35:19.88
29		R OMS	PC	123	137/00:16:02.10

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**Figure 6.3-1. OFS application**

## TITLE

DPS INTEGRATED LOAD CHECKOUT (ILC) PROCEDURE

## PURPOSE

This SCP provides detailed instructions on conducting an ILC from the DPS console. The manner in which the ILC is performed is left up to the discretion of the team conducting the actual ILC. Only the consoles designated as prime for the mission are checked.

## BACKGROUND

An ILC is designed to verify that the various flight software loads, MCC, shuttle mission simulator (SMS), and orbiter flight software are ready to support a particular Space Transportation System (STS) mission and/or flight specific simulation. The flight control team must demonstrate this readiness by a thorough analysis of the MCC tools used for their specific flight control tasks.

An ILC report form/checklist is shown in Figure 6.4-1. This form is used to ensure completion of all ILC activities. As each activity described in the PROCEDURES section is completed, a check is placed next to the activity name. MCC anomaly reports should be officially submitted for any significant hardware and/or software problems, non-conformities, or errors observed during the ILC. At the end of the ILC, the ILC report form and any attachments (H/C's, AR's, etc) should be submitted to the designated DPS lead for the specific flight. Subsequently (if significant problems occur), the flight controller conducting the ILC, the flight lead, and the group lead will determine if the problems incurred should deem the load satisfactory/unsatisfactory for use (from a DPS perspective). The SIMSUP conducting the sim (looking at the "big picture") may also determine if the load is unsatisfactory for the team, due to significant problems from the various disciplines.

## PROCEDURES

### A. Prior to ILC

1. Confirm that the datapack for the flight is complete and on console.
2. Coordinate with the DPS sim monitor to determine any specific malfunctions that need to be exercised during the ILC.

### B. Console Checkout (see also: ILC Report form for list of applications and application's user's guides for more information on specific applications)

1. Log into the workstation and verify that the proper activity can be selected. Configure the console for the activity. Make sure the first operator to configure receives the "Limit Manager" window, makes the appropriate selection, and iconifies it.
2. Call up the appropriate applications for the activity. (See ILC Report form.)



3. Take a hard copy of an application screen.

C. Command Load Checkout

Send one of each of the following command loads and verify the correct transmission to the command host/server:

1. Variable Parameters

Select the VP application from the DNAV DPS II Command menu.  
If not available, build an appropriate load (VP loads should be previously built by the data pack builder) and transmit to the command manager.  
Verify the load. Uplink only where appropriate and verify the success of the uplink.

- 1a. VP Scaling

Select the VP Scaling application from the DNAV DPS II Apps menu.  
If not available, build a scaling load (scaling loads should be previously built by the datapack builder) and transmit it to the workstation.  
Verify that the scaling is appropriately viewable from the Variable Parameters application.

2. GMEM (if available)

Select the GMEM application from the DNAV DPS II Command menu.  
Build a "dummy" GMEM load and transmit it to the command manager.  
Verify the load. Do not uplink the GMEM, unless "safe" memory locations have been verified, prior to the ILC, by software experts in building 5 (could cause unexpected computer failure).

3. DEU Equivalent

Select the DEU Equivalent application from the DNAV DPS II Command menu.  
If not available, build an appropriate load and transmit it to the command manager.  
Verify the load.

4. MMU Operations

Select the MMU Operations application from the DNAV DPS II Command menu.  
Build an appropriate load and transmit it to the command manager.  
Verify the load.

5. MDM BITE Read

Select the MDM BITE Read application from the DNAV DPS II Command menu.

Build MDM BITE reads (BSR and BITE 4) and transmit them to the command manager. Verify the loads.

6. Load Manager

Select the Load Manager application from the DNAV DPS II Command menu. Verify proper operations of load deletion and chaining.

7. Fault page change (OFS)

In the instance of OFS/PASS already started, select the downlister to be (GNC/SM/OPS) and observe the validity of the data. Repeat the above two steps to verify appropriate data from each downlister.

8. Time Source Substitution

Coordinate with NIP SUP.  
See FCOH SOP 8.3.

9. Delta-t's

Select the Delta-t application from the DNAV DPS II Apps menu. Perform zeroing of  $\Delta$ -t's. Check that the  $\Delta$ t's were cleared on the Delta-T display.

10. ODRC Request

Select the ODRC application from the DNAV DPS II Global menu. Proceed as usual in making request(s), checking printouts.

11. Remove ILC-specific loads from workstation.

D. Data Checkout

1. If time permits and "DPS Trench" deems applicable, coordinate and perform a software dump of a GPC using the GPC Dump application. See FCOH 4.4-1 and the GPC Dump User's guide.
2. Verify the data on all DPS applications used, as feasible.

E. Load-specific Checkout

1. Exercise any malfunctions that were noted in step A.2.
2. Coordinate the uplink of any "standard" TMBUs (check with different disciplines for pre-built TMBU's). Insure that the respective discipline is comfortable with the end result (some end-item changes can be monitored and verified). All prelaunch and post-MECO TMBUs that will be needed for the flight must be sent during the load checkout to develop confidence in their correctness. If the actual values for the TMBU will not be known until later, the I-load values will be sent. This will permit verification of the parameter types and IDs.

F. Additional items

Check the CD-ROM reader and printer capability.

G. Generation and Submittal of Anomaly Reports (ARs)

1. An MCC AR should be submitted for any facility or non-user-application problems noted during load checkout using the electronic web-based DRTS system (see FCOH SOP 1.14 and/or DPS CHB SCP 2.8). For problems with user applications, notify both the DPS DTR and the DTR of whatever group owns the application.
2. Place a copy of all ARs written in the appropriate FCR and MPSR datapack.
3. A copy of the AR will automatically be E-mailed to the DF32 DTR.

DPS ILC REPORT FORM/CHECKLIST

Flight \_\_\_\_\_ OI Release \_\_\_\_\_ Date \_\_\_\_\_  
DPS Lead \_\_\_\_\_  
DPS FCR \_\_\_\_\_

**A. Prior to ILC**

- \_\_\_\_\_ 1. Confirm that the datapack for the flight is complete and on console.
- \_\_\_\_\_ 2. Coordinate with the DPS sim monitor to determine any specific malfunctions that need to be exercised during ILC.
- \_\_\_\_\_ 3. Confirm that TMBU data and EU files have been loaded onto workstation.

**B. Console Checkout**

- \_\_\_\_\_ 1. Log into and configure workstation
- \_\_\_\_\_ 2. Verify startup, correctness of display of all relevant applications/utilities (see user's guides df32\ws-apps)

- |                           |                      |
|---------------------------|----------------------|
| _____ DPS Overview        | _____ MMU Operations |
| _____ (GNC and SM)        | _____ Load Manager   |
| _____ DTEX                | _____ MDM BITE Read  |
| _____ DPS A/E             | _____ TMBU           |
| _____ DPS C&W             | _____ Delta-t        |
| _____ SPECS               | _____ Wall Clocks    |
| _____ OFS (1 PASS. 1 BFS) | _____ MIAMI          |
| _____ VP                  |                      |
| _____ VP Scaling          |                      |
| _____ GMEM                |                      |
| _____ DEU Equivalent      |                      |
| _____ MCD Display         |                      |
| _____ FLOG                |                      |

**C. Command Load Checkout**

- |  |                                     |
|--|-------------------------------------|
| _____ 1. VP (VP loads)                                   | _____ 6. Fault page change (OFS)    |
| _____ 1a. VP Scaling (scaling)                           | _____ 7. Time source substitution   |
| _____ 2. GMEM (if available)                             | _____ 8. Delta-t                    |
| _____ 3. DEU Equivalent                                  | _____ 9. ODRC request               |
| _____ 4. MMU Operations                                  | _____ 10. MDM BITE Read             |
| _____ 5. Generic Operations<br>(load chaining, deletion) | _____ 11. Remove ILC-specific loads |

**D. Data Checkout**

- \_\_\_\_\_ 1. Software dump
- \_\_\_\_\_ 2. Verify data. The following TFLs were used \_\_\_\_\_

**E. Load-specific Checkout**

- \_\_\_\_\_ 1. Exercise malfunctions
- \_\_\_\_\_ 2. Verify standard TMBUs \_\_\_\_\_

**F. Additional Items**

- \_\_\_\_\_ 1. CD-ROM reader

G. ARs Written (attach copies)

**Figure 6.4-1. DPS ILC Report Form/Checklist**

## **TITLE**

GPC MEMORY MAPS

## **PURPOSE**

This SCP outlines the steps required to be able to determine the protection status of any GPC memory location and whether it is located in system software, major function base, or the OPS application software.

## **DESCRIPTION**

In order to determine the status of a GPC memory location, the following are required:

1. Mass Memory Unit Program Release Notice (MMU PRN), USA003395 (OIXX) (located on-line only)
2. Flight specific CD ROM (PASS, BFS, MMU), containing the Mass Memory Build flight software

First, determine the phase for the OPS overlay, major function base, and system software for the memory configuration under consideration. This can be determined from the PASS Phase Number Summary for Mass Memory Phase Table (Figure 6.5-1), located in the MMU PRN. Be sure that the MMU PRN corresponds to the OI release for the load being used.

The Mass Memory Build Program –Phase Table (Figure 6.5-2), located on the flight specific MMU Build CD ROM , describes all the MMU phase and load blocks, the starting and ending GPC memory address of each load block, and the protection status of each load block.

Because of the multiple overlays of memory that may occur; i.e., a portion of the SSW may be overlaid by the OPS overlay, it is necessary to check the phases in the order opposite of which they were loaded.

To determine the status of a memory location, first determine the phase(s) of the OPS overlay of interest via the phase number summary table (if the overlay has an A and B section, start with the phase for Section B first). Find this phase number in the Mass Memory Build Program table and determine if the address exists within any of the load blocks. If it does, the location contains code/data belonging to this phase, and the storage status can be read directly from the table (under the “PROTECT STATUS” column). If the address does not exist in the OPS overlay phase, determine the phase of the major function base. Find this phase in the table and determine if the address exists in one of the load blocks. If the address isn't part of the major function base, determine the phase of the system software and then determine if the address exists in that phase. If the address does not exist at the SSW level, this location is not used in this memory configuration.

REFERENCES

1. Mass Memory Unit Program Release Notice (MMU PRN), JSC-16764.
2. Mass Memory Build Flight Software Microfiche.

Phase No.	Memory Config	Description
1*	N/A	GPC Bootstrap IPL Loader and Mini-Directory
2	ALL	Resident System Software
3	1, 2, 3, 8 9	GNC Major Function Base (GNC-FB) –GNC MFB
4	1	Ascent and Abort OPS (GNC-1/6) –G1/G6 OPS Overlay
5	2	On-Orbit OPS (GNC 2) –G2 OPS Overlay
6	3	Entry OPS (GNC 3) –G3 OPS Overlay
7	8	VU On-Orbit OPS (GNC 8) –G8 OPS Overlay
8	9	VU Pre-Count OPS (GNC 9) –G9 OPS Overlay
9	6	VU Checkout Function Base (VCO-FB) - PL9 MFB
10	N/A	GPC-STP/SSW Loaders (GPC-STP, SSL, LOAD TBL)
11	N/A	Unused
12	6	VU Mass Memory OPS (PL9) –PL9 OPS Overlay
13	ALL	Reconfigurable SSW
14	4, 5	SM Function Base (SM-FB) –SM MFB
15	4	Orbit-Doors OPS (SM2) –SM2 OPS Overlay
16	5	SM4
17	N/A	Unused
18	9	Reconfigurable VU Pre-Count OPS (GNC-9) – Reconfigurable G9 OPS Overlay
19	N/A	Unused
20	N/A	GPC Payload Command Filter (GPCF)
21	N/A	SM Data Checkpoint
22	N/A	IMU Calibration Checkpoint
23	N/A	PDI Decom Format Load (DFL)
24	N/A	PDI Fetch Pointer Memory Load (FPL)
25	N/A	Telemetry Format Load (TFL)
26	N/A	Unused
27-60	N/A	Roll-In-Displays

\*Not currently in the PASS Phase Table

**Figure 6.5-1. PASS Phase Number Summary for Mass Memory Phase Table<sup>1</sup>**

SDL MASS MEMORY BUILD PROGRAM - PHASE TABLE/LOADBLOCK

PHASE	LOAD BLK	PROTECT STATUS	AP-101 ADDRESS		MM ADDRESS (FTSBB)		- CHECKSUM -		LOADBLK (HEX)	LENGTH (DEC)
			FIRST	LAST	FIRST	LAST	OFFSET	VALUE		
1	1	PROT	000000	000719	44100	44231	0119	0000	00071A	1818
	2	PROT	006FBC	007287	44223	44224	00CB	0000	0002CC	716
	3	PROT	007C00	007F01	44230	44231	0101	0000	000302	770
TOTAL PHASE SIZE -			HEX = 000CE8		DEC = 3304.					
2	1		000000	0001A7	43000	43000	01A7	EE33	0001A8	424
	2	PROT	0001A8	000231	43001	43001	0089	EE43	00008A	138
	3	PROT	000478	0004F9	43002	43002	0081	22FF	000082	130
	4		0004FA	0005E9	43003	43003	00EF	7129	0000F0	240
	5	PROT	000602	000669	43004	43004	0067	32E4	000068	104
	6		00066A	00428B	43005	43103	0021	DB77	003C22	15394
	7		00428C	004AA1	43104	43108	0015	3D39	000816	2070
	8	PROT	004AA2	004C58	43109	43109	0189	F604	0001BA	442
	9		008000	008099	43110	43110	0099	0590	00009A	154
	10	PROT	00809A	008117	43111	43111	007D	8103	00007E	126
	11		008118	00A32D	43112	43129	0015	F025	002216	8726
	12		00A32E	00CA6B	43130	43217	013D	5D02	00273E	10046
	13	PROT	010000	013D75	43218	43316	0175	A1C4	003D76	15734
	14	PROT	013D76	01571B	43317	43329	01A5	049E	0019A6	6566
	15	PROT	018000	01976D	43330	43409	016D	DADD	00176E	5998
	16	PROT	01976E	01C315	43410	43431	01A7	67C5	002BA8	11176
	17		01C316	01CD33	43500	43505	001D	5D64	000A1E	2590
	18	PROT	01CD34	01D31B	43506	43508	01E7	3270	0005E8	1512
	19		01D31C	01E8E5	43509	43519	01C9	C98B	0015CA	5578
	20	PROT	01E8E6	01E9B9	43520	43520	00D3	BCC0	0000D4	212
	21	PROT	020000	0222B3	43521	43606	00B3	590E	0022B4	8884
	22	PROT	028000	028689	43607	43610	0089	FBF4	00068A	1674
	23		02868A	0298C1	43611	43620	0037	287D	001238	4664
	24	PROT	02BFF4	02BFFF	43621	43621	000B	C3BC	00000C	12
	25		030000	0308ED	43622	43626	00ED	9FF2	0008EE	2286
TOTAL PHASE SIZE -			HEX = 0199B0		DEC = 104880.					
3	1	PROT	000232	000245	51402	51402	0013	72C2	000014	20
	2		003C4E	004197	51403	51405	0149	B8CA	00054A	1354
	3		004A76	005F81	51406	51416	010B	55B9	00150C	5388
	4	PROT	013C82	013D6D	51417	51417	00EB	008D	0000EC	236
	5	PROT	01CD34	01CE5D	51418	51418	0129	62FA	00012A	298
	6	PROT	01E8E6	01F26B	51419	51423	0185	E945	000986	2438
	7		028984	028989	51424	51424	0005	C6C7	000006	6
TOTAL PHASE SIZE -			HEX = 00260C		DEC = 9740.					
4	1		009D46	00D299	54600	54626	0153	8375	003554	13652
	2		02898A	029681	54627	54701	00F7	6370	000CF8	3320
TOTAL PHASE SIZE -			HEX = 00424C		DEC = 16972.					
5	1		009D46	00D89B	50404	50501	0155	9368	003B56	15190
	2		0222B4	0223E9	50502	50502	0135	0725	000136	310
	3		02898A	02B483	50503	50524	00F9	8657	002AFA	11002
	4		03043E	0308ED	50525	50527	00AF	F61E	0004B0	1200

Figure 6.5-2. Mass memory build fiche

**REFERENCES**

1. Mass Memory Unit Program Release Notice (MMU PRN), USA 003395 (OI-30), March 13, 2003.
2. Flight specific CD ROM (PASS, BFS, MMU) containing Mass Memory Build Flight Software.



## **TITLE**

EMERGENCY MISSION CONTROL CENTER (EMCC)

## **PURPOSE**

This SCP provides a summary of the DPS responsibilities in executing the Emergency Mission Control Center (EMCC) procedures during a shuttle mission.

## **REFERENCES**

The EMCC procedures are documented in the Space Shuttle Program Emergency Mission Control Center Activation and Operations Procedure document (ref. 534-CAP-EMCC, dated July 1992) published by the Goddard Space Flight Center in Greenbelt, Maryland.

## **BACKGROUND**

The EMCC is located in the Launch Control Complex (LCC) at Kennedy Space Center (KSC) in Florida. The EMCC requirements were established as a contingency plan to protect against any incident which may jeopardize a space shuttle flight because the JSC Mission Control Center (MCC) cannot support the flight. These requirements were implemented with the philosophy of providing a safe flight termination capability to the primary or secondary landing site. The EMCC serves as a backup to the JSC MCC for Space Shuttle Program (SSP) or shuttle orbit and/or deorbit operations. However, it must be emphasized that the EMCC is in no way supposed to replace the JSC MCC because of its limited capabilities. It is believed that EMCC activation can occur at KSC approximately 6 hours from declaration of requirement for EMCC.

Early in the SSP, EMCC capabilities were very limited in that only crew communications were available. Flight controller support was limited to providing inputs to the crew on system monitoring based on system status reports from the crew itself. The development of the real-time data system (RTDS) as part of the INCO project then provided the SSP with the ability to monitor/process an extremely limited amount of orbiter system data compared to the MCC capabilities. At the time of the RTDS phase of the EMCC, the intent was to provide the crew the ability to consult with the flight controllers (located at NASA White Sands Test Facility ground terminal in New Mexico) on orbiter system management as required. The crew had the necessary Flight Data File (FDF) onboard to perform proper system management, including failure recovery.

At present, the EMCC has been relocated to KSC and uses the existing launch processing system (LPS). Since the purpose of EMCC is to provide the ability to terminate a space shuttle flight safely, the EMCC will be initially manned by flight controllers with deorbit/entry experience (the ascent/entry team for the particular flight if available). Depending on the on-orbit stay time after loss of the MCC, additional flight controllers may be needed at KSC for support of the flight.

## DESCRIPTION

For each space shuttle flight, the ascent/entry FCR operator will serve as the EMCC operator in case of necessary activation. In the event that this person is not available, any other FCR operator assigned to the flight may be required to support EMCC activation. Therefore, it is the responsibility of all FCR operators assigned to the flight to familiarize themselves with the guidelines and procedures of the EMCC as contained in the 534-EMC-CAP document.

The LPS is flexible enough to allow for most monitoring capabilities required to support orbiter systems. However, payload activity (i.e., CDMS) will not be supported at the EMCC and, therefore, no documentation in these areas will be available.

A summary of the DPS EMCC guidelines is as follows:

- A. Review the three DPS EMCC binders which contain the DPS Console Handbook, the DPS Systems Brief, and the DPS EMCC Data Book. These binders are located to the left of the FDF in room 1010. The EMCC Data Book contains the following:
  - 1. The EMCC Activation and Operations Procedure, 534-CAP-EMCC.
  - 2. MRAS: A copy of the RASS for the PASS preflight approved and verified GMEMs.
  - 3. EO's: A copy of the RASS's for the BFS preflight approved and verified GMEMs.
  - 4. A copy of the MDM Channelization sheets.
  - 5. A copy of the DPS directory.
  - 6. Copies of the DPS SSSH systems drawings.

It is the responsibility of the DPS EMCC person to ensure that all the documentation is up to date for each flight. The person supporting the EMCC is responsible for transporting these binders to KSC. Other documentation, such as the mission FDF and Flight Rules, is the responsibility of the Flight Director's office and ground controller (GC).

- B. The office copy of the DPS Datapack will also need to be transported to KSC by the person supporting the EMCC.
- C. Review the LPS procedures. In the event of EMCC activation, personnel from KSC will be present to assist in the operation of the consoles and to answer any questions regarding the system.
- D. The EMCC operator will be provided a headset upon arrival at KSC.

**EMCC ACTIVATION**

The timeline below shows the expected sequence of events. Keep in mind that this example assumes the EMCC operator has prepared his/her personal items (one small soft-sided gym bag containing toiletries and a change of clothes, not to exceed 12 lb) ahead of time and is easily reached via telephone/beeper.



\*These times are estimates only. Contact MCC for exact times.

## EMCC OPERATION

The DPS operator deployed on the EMCC team will be operating in a very different environment. Thus, the following section contains some reminders and hints regarding the EMCC environment in which the DPS operator will be expected to operate.

- A. The EMCC does support command capability. See Section 4.10 of the 534-CAP-EMCC document for details. Commands must be entered by hex word.
- B. FDF books will be taken care of already; don't worry about them.
- C. The LCC uses a reconfigurable voice loop system. The console to be used by DPS will be set up in the following manner. Loops can be repatched by technicians upon request. KSC will supply headsets, and any additional information can be found in Section 3.4 of the 534-CAP-EMCC document.

<u>Name</u>	<u>Capability</u>	
A/G-1	M	
A/G-2	M	
UHF	M	M = monitor only
		TLM = talk/listen/monitor
EMCC Flight Director	TLM	
FAO/PLO	TLM	
GC	TLM	
FDO/GPO	TLM	
PROP/GNC	TLM	
DPS/MMACS	TLM	
EGIL/EECOM	TLM	
INCO	TLM	

- D. There are several DPS-related displays available at KSC. A printer located at each console provides quick generation of hardcopies when required. There is also the capability to select specific MSIDs and to view them individually or in a group (DMON option). Personnel from KSC will be available to assist with display activation and operation.

**TITLE**

VCR RECORD/PLAYBACK PROCEDURES

**PURPOSE**

This procedure provides the ability to record and/or playback flight data.

**PROCEDURE**

A. Record

**WARNING**

Recording Sim data will use a significant amount of disk space allotted to DPS. Coordinate recording sessions with the group administrator (GA) to ensure that enough disk space is available for resultant files.

1. Login (Use a backroom console position).
  - a. Select the activity for the current sim activity. When selecting the activity not the type; i.e. SIM, MIS, or TST.
  - b. Configure the MCC workstation as you normally would, starting all relevant DPS applications. Verify that sim data is displayed.
2. Start the VCR application (DPS DNAV II Global Apps I Telemetry VCR)
  - a. Define the record file (File I Select File / Device.).
    - i. Select the dps/VCR-DATA directory and hit the Filter button. Specify the new file name in the "Enter filename" field at the end of the display directory path, and select OK.
  - b. Configure VCR (Stream I Select Stream)
    - i. Select "PTM" for standard downlist data or "NDM" for Gdump/DOLILU data stream.
    - ii. Select "RT" for Data type
    - iii. Under "Other Options" verify that the program and activity type match those noted in step 1.a.

- iv. Select OK
  - v. Select OK
3. Record simulation data
    - a. Press record button "REC" and verify that Cycle & Time fields begin to increment. Verify that the time stamp matches the sim time.
    - b. Press Stop button to stop data recording.
  4. Quit Telemetry VCR application (File | Quit).
  5. Use the VCR playback procedures to play recorded data.

When recorded files are no longer needed, coordinate with the GA to archive the recorded data files on a cd-rom disk. This will free up the allotted disk space for other DPS VCR activities and prevent the inadvertent deletion of important VCR files.

## B. Playback

1. Login (Use a backroom console position).
  - a. Select an activity that does not have the same flight number as the current sim activity. When selecting the activity not the type; i.e. SIM, MIS, or TST.
  - b. Using Autopanel (DPS DNAV II Global Apps | Autopanel ) deregister DPS affiliations by selecting one DPS affiliation with the right mouse button, and selecting "Deregister Affiliation". In the menu, select Refresh | Now. Note any remaining DPS affiliations and repeat as necessary. (Note: **DO NOT DEREGISTER** any other affiliation types).
2. Start VCR application (DPS DNAV II Global Apps | Telemetry VCR)
  - a. Select file (File | Select File / Device.).
    - i. Under the dps/VCR-DATA directory select a VCR data file. The following files are examples of VCR data files:

- MedsILC1.record
  - MedsILC3.record
  - MedsAsc1998-06-18-Run3
- b. Configure VCR (Stream | Select Stream)
- i. Select "PTM" for standard downlist data or "NDM" for Gdump/DOLILU data stream. (It is important to match the data stream for the specified file selected in step 2.a.i).
  - ii. Select "RT" for Data type.
  - iii. Under "Other Options" verify that the program and activity type match those in step 1.a.
  - iv. Select OK
  - v. Select OK
- c. Press the play button and verify that Cycle and Time fields start to increment.
3. Start local DPS Servers (DPS DNAV | Config | Initialize DPS)
- a. Select "yes" at the Alert Popup window. Note: Allow several minutes for all servers to start up.
4. Start DPS applications as you normally would.

## TITLE

PROCEDURE FOR EARLY SM ACTIVATION

## PURPOSE

To provide a procedure to obtain an alternative method of opening the Payload Bay Doors in case of a BFS failure.

## BACKGROUND

In a situation where the FES has failed and the BFS is unavailable (failed) to open the Payload Bay Doors, the SM GPC may be utilized. The following procedure will bring up an SM GPC prior to its normal activation during Post Insertion. Since running PASS OPS 1 and SM OPS 2 is not a certified configuration, we would only activate the SM early for a time critical situation. Current procedures have us attempt to recover the BFS by re-IPLing the BFS function into the same GPC. However, in the case that the BFS is unrecoverable there may not be enough time to do this as well as re-IPL the BFS into another GPC. In this case you may choose to bring up an early SM or try an initial re-IPL of the BFS into another GPC.

## PROCEDURE

### EARLY SM MACHINE IN OPS 1 (BFS FAILED)

1. S-BD PM ANT - MAN
2. √(BFS) GPC 5 MODE - HALT
3. Target GPC MODE - STBY (tb-bp)  
- RUN (tb-RUN)
4. Desired IDP/CRT MAJ FUNC- SM  
GPC/CRT Target GPC/X EXEC
5. SM GPC MEMORY  
CONFIG - ITEM 1+4 EXEC  
Assign Target GPC, PL 1/2, CRTs, LAUNCH 1, MMs  
SM, OPS 201 PRO

- Notes :
1. AUTO antenna not available
  2. INCO **should not** command P/Ls through GNC
  3. SM Data not available on the ground in Ascent TFL Config
  4. You will lose the string associated with the GPC that will be made the new SM; a restrung may be required
  5. Once P/L Bay Door opening, SM GPC- TERM.



SECTION 7  
DATA PROCESSING SYSTEM COMMAND LOADS

CONTENTS

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## TITLE

COMMAND LOAD GUIDE AND LOAD MANAGER APPLICATION (Command Server)

## PURPOSE

This procedure presents an overview of the uplink command services used by DPS. In addition, this procedure provides detailed guidelines for using the Load Manager software application.

## RESTRICTIONS/CONSTRAINTS

CMD CR# Baseline

Date: 09/30/98

Restrictions and constraints are noted in the SCP of the specific command load. Additionally, pertinent information for all command loads will be appropriately logged upon uplink in order to maintain tracking information and configuration control.

## DPS UPLINK COMMANDING

### A. Orbiter Two-Stage Uplink Command Overview

All DPS uplink commands are classified as Orbiter two-stage uplink load commands. A two-stage command is uplinked from the MCC and is stored in a two-stage buffer in the onboard software. The contents of the two-stage buffer are executed only when the onboard software receives an EXEC command from the MCC. The EXEC command will be uplinked after the command load has been successfully downlinked by the Orbiter and verified by the MCC. The MCC will compare the contents of the two-stage buffer with the original command load and issue the EXEC command only if the contents of the two-stage buffer and the command load are identical.

Each two-stage command consists of 1 to 33 forty eight-bit command words. The first 16 bits of each command word are supplied by the MCC uplink software and are described below. The remaining 32 bits (divided into two 16-bit half words) are specific to the function of the command and are described in the SCP of the specific command load. The onboard software stores the initial 16 bits of the first command word and both 16-bit half-words of each remaining command word up to a maximum of 67 half words (i.e., 33 command words) in the two-stage buffer. The first 16 bits of all but the first command word are discarded by the onboard software. The 67 half words actually used by the onboard software to process the command are identical to the command words exhibited in the MCC on the Command Data Words display. Note that the first command word displayed is incomplete because the MCC uplink software does not complete these 16 bits until the command is uplinked. For further information on Orbiter uplink commanding and command load composition, reference the Downlist/Uplink Software Requirements document (CPDS - SS-P-0002-140).

The first 16 bits of each 48 bit command word are identical and have the following format:

Bits 1-3	Vehicle ID (see description below)
Bits 4-7	Major Function (see description below)
Bits 8-14	OP Code specific for each load type
Bit 15	Set to 1 if first command word
*Bit 16	Set to 1 if last command word

\* Uplink software shall 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.

Vehicle ID		Major function <sup>(1)</sup>	
000	Illegal	0000	Illegal
001	OV-099	0001	GPC 1
010	102	0010	GPC 2
011	103	0011	GPC 3
100	104	0100	GPC 4
101	105	0101	GPC 5
110	106	0110	All active GPCs
111	107	0111	GNC
		1000	SM
		1001	PL
		1010	BFS
		1011-1111	Illegal

0001-0101 are illegal if the GPC is a member of the Redundant Set  
 (1) 0001-0110 are legal for GMEMs and DEU Equivalents  
 0001-0101 (GPC ID) must be used for a GPC in OPS 0

**B. Orbiter Uplink Command Access Controls**

The crew has two methods of controlling ground uplink commands: the uplink block switch on panel C3 and the uplink control logic on SPEC 1 (DPS UTILITY). The uplink block switch is a three-position switch: The 'NSP BLOCK' position blocks all commands at the NSP. The 'GPC BLOCK' position blocks all commands at the GPC, and the 'ENABLE' position allows all commands to be processed. The uplink control logic on SPEC 1 is controlled by three item numbers as long as the uplink block switch is in the 'ENABLE' position: AUTO (ITEM 35) allows all commands to be processed when AOS and no commands to be processed when LOS, ENA (ITEM 36) allows all commands to be processed both LOS and AOS, and INH (ITEM 37) inhibits all PASS commands (BFS commands will be processed). During ascent and entry, the crew can control uplink command access by selecting the ENABLE switch position when AOS and the GPC BLOCK position when LOS. During orbit operations, the uplink block switch is placed in the ENABLE position, ITEM 35 (AUTO) is selected on SPEC 1, and the SM software site-in-view flag is allowed to control uplink command access for AOS-LOS. This information is relayed to the other GPCs in the common set over the ICC buses. If the SM GPC fails during LOS when in this configuration, no PASS commands will be processed. The crew must call up SPEC 1 on a GNC GPC and select ENA (ITEM 36) to correct the situation. During simulation startup, when data are forced during LOS to complete initialization, ITEM 36 (ENA) must be selected on SPEC 1 with the uplink block switch in ENABLE before commands will be processed onboard.

## GENERAL COMMAND LOAD BUILD INFORMATION

The following table lists each type of command load or command function for which DPS is responsible. Included in the table are the DSM Numbers used for each load; the Command Application used to build the load and verify the Directive; and the OPS that support the uplink of the load. See the appropriate command SCP in Section 7 for detailed information regarding a specific command load.

<u>Command Load/Function</u>	<u>DSM (xx = 01-50)</u>	<u>Cmd Application</u>	<u>Directive ID</u>	<u>OPS available</u>
BFS Variable Parameters	199XX	Variable Parameter	Generic_Cmd_Gen_Add	BFS (ALL)
KYBD Equivalent	201XX	DEU Equivalent	GPC_DEU_Equiv_Add	PASS (ALL)
GMEM Contiguous	301XX	GMEM	GMEM_Contiguous_Add	G2,G8,G9,S2,S4,P9, BFS (ALL), post IPL OPS 0
GMEM Scatter	305XX	GMEM	GMEM_Scatter_Add	G2,G8,G9,S2,S4,P9, BFS (ALL), post IPL OPS 0
MDM BITE Read	199XX	MDM Bite Read	Generic_Cmd_Gen_Add	PASS (ALL)
MMU Read/Compare	309XX	MMU OPS	GPC_MM_RWM_Add	S2,S4,P9
MMU Merge	311XX	MMU OPS	GPC_MM_RWM_Add	S2,S4,P9
MMU Write	315XX	MMU OPS	GPC_MM_RWM_Add	S2,S4,P9
PASS Variable Parameters	230XX	Variable Parameter	Variable_Downlist_Sel_Add	PASS (ALL)
TMBU	123XX	TMBU	Sys_Mngmt_Tbl_Maint_Add	S2,S4,BFS(ALL)
Chaining	N/A	Load Manager	Add_Load_Chain	PASS(ALL) BFS(ALL)
Unchaining	N/A	Load Manager	Cmd_Chain_Delete	N/A
Command Delete	N/A	Load Manager	Cmd_Delete	N/A

Command legality tables in the PASS and BFS are based on Memory Configuration and OPS, respectively. Therefore, the resident OPS software determines the legality of uplink OP Codes in a PASS OPS 0 GPC. For example, the GMEM OP Code is not legal in an OPS 0 GPC with G3 resident.

## COMMAND LOAD VERIFICATION AND MANAGEMENT

Each individual command load is uniquely built using specific instructions provided in the applicable SCP based on the command function. Each load is verified via command server feedback information built into the program application logic and provided at the bottom of the each command display. Detailed verification procedures for each load type/function can be found in corresponding verification procedure in the corresponding SCP.

The following applications are useful when building and uplinking DPS command loads and are described in subsequent sections.

<u>Application</u>	<u>DNAV Menu</u>
Load Manager	Command->Command Server->Load Manager
Command Tracking	Global Apps->Command Server->TELCOM displays->PRIME
Command Inventory	Global Apps->Command Server->TELCOM displays->PRIME
Op Code Status	Global Apps->Command Server->TELCOM displays->PRIME
Chained Load Inventory	Global Apps->Command Server->TELCOM displays->PRIME
Safed Command Groups	Global Apps->Command Server->TELCOM displays->PRIME
Command Data Words	Global Apps->Command Server->TELCOM displays->PRIME

## LOAD MANAGER

The Load Manager command application provides the capability to manage DPS Command Loads using operations such as 'Delete', 'Copy', 'Chain' and 'Unchain'. DPS command loads built using Variable Parameters, DEU Equivalent, GMEM, MDM BITE Read, MMU OPS, and Spacelab command loads are available for load management.

When started, Load Manager will default to the flight that was selected during activity selection. Load Manager will default to 'XXX' if an Activity was not selected. The flight version is either 'recon 1' or 'final' and is derived from the 'flightlist' file. Load Manager will default to the 'final' version if both 'recon 1' and 'final' versions exist for a flight in the 'flightlist' file. The flight can always be changed using Load Manager's 'Modify Flight List' option (described below). The 'flightlist' file resides in the path: /users/dps/rw\_common/cmdo and is limited to a twenty flight maximum. The format of the 'flightlist' file is: 'XXX Y', where XXX is the flight number (i.e., 075), and Y is the version (i.e., '1' - recon 1, or 'f' - final or one-cycle-to-flight).



**Figure 7.1G-1. Load Manager Application Main Window**

A. Primary Display

File - a pulldown menu that contains an Exit option that closes the Load Manager application.

Help - a pulldown menu that contains a Help file.

Modify Flight List - a button that activates Add, Delete, and Modify flight list functions.

File Manager - a button that activates Copy and Delete file management services.

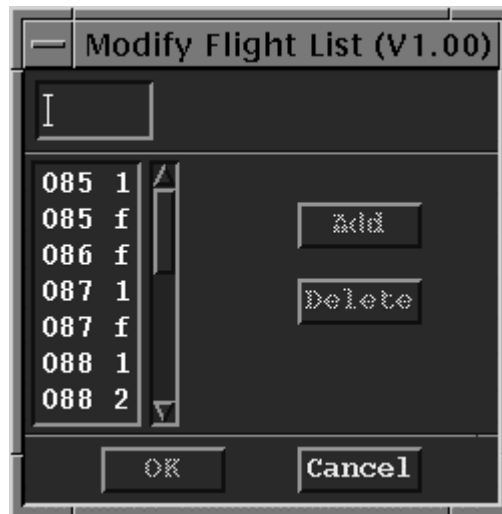
Delete Load (CMDSVR) - a button that activates a Delete Load from Command Server function. This button will be disabled if no DPS/CDMS command loads exist in the command server.

Chain/Unchain Loads - a button that activates command load chaining and Unchaining functions. This button will be disabled if no DPS command loads exist in the command server.

Advisory Window - displays user messages. In addition, this window displays the actual command text of a load sent to the command server. The maximum number of messages that can be displayed is 500. A scroll bar allows for scrolling of messages. The oldest message is removed from the list when the limit is reached. The right mouse button can be used to activate a pulldown menu that contains a Clear List option. Selection of 'Clear List' will clear the advisory area of all user messages. There is no capability to save advisory messages.

## B. Modify Flight List

The Modify Flight List function provides the capability to add, delete, or modify flights in the 'flightlist' file. The 'flightlist' file is used by all DPS command applications (i.e., Variable Parameters, DEU Equivalent, GMEM, etc.) to maintain the association between flights and DPS command loads.



**Figure 7.1G-2. Modify Flight List Dialog**

Adding a Flight - 1) select the Add button, 2) type the flight in the text box in the correct format, 3) Select the OK button to add the flight to the flightlist file and close the Modify Flight List window. The scroll bar may have to be used to view the flight. The correct format for the flight is 'XXX Y', where XXX is the flight number (i.e., 075), and Y is the version (i.e., '1' - recon 1, or 'f' - final or one-cycle-to-flight).

Deleting a Flight - 1) select the flight in the list, 2) select the Delete button, 3) select the OK button to delete the flight from the 'flightlist' file and close the Modify Flight List window.

Modifying a Flight - 1) select the flight in the list, 2) delete the flight from the list, 3) add the flight back in the list in the text box with the desired nomenclature and click the OK button to add it.

Exiting the Modify Flight List Function - selecting the Cancel button will cancel any operation and close the Modify Flight List window.

### C. File Manager

The File Manager function provides the capability to delete DPS command load files from the workstation and copy DPS command load files from one flight to another.



**Figure 7.1G-3. File Manager Dialog**

The default flight displayed in the 'From' list is always the currently selected activity. The default flight displayed in the 'To' list is generally the first flight in the *flightlist* file. However, if the currently selected activity is last in the *flightlist* file, the default flight displayed for the 'To' list will be the previous flight in the *flightlist* file.

Files in the 'From' list that are preceded with an asterisk are prebuilt commands. For a command to be marked as prebuilt, it must be listed in the *reqlist.y.xxx* file. Prebuilt commands are generally VPs and DEU Equivalents that are supported for every flight.

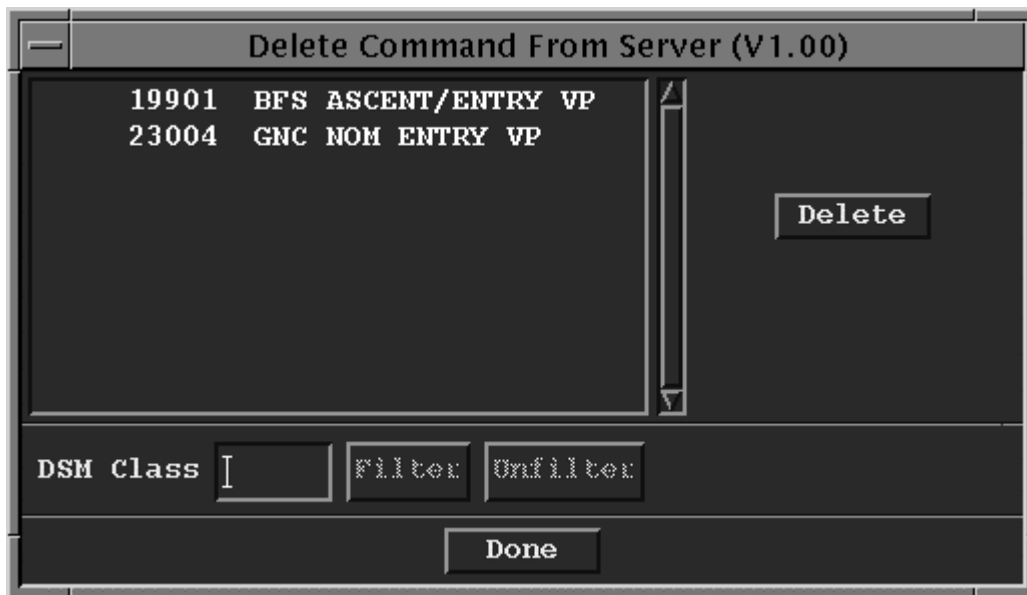
Copying Command Loads from One Flight to Another - 1) select a flight in the 'From' menu, 2) select a flight in the 'To' menu, 3) select the command load file(s) to be copied in the 'From' list, 4) select the 'Copy' button, 5) Answer 'Yes' when prompted to confirm the copy operation.

Note: Flight Software addresses are not copied for PASS and BFS VPs. However, command attributes for other DPS Command Applications (DEU Equivalent, MDM BITE Read, GMEM, and TMBU) are copied in their entirety.

Exiting the File Manager Operation - Selecting the Done button will exit the File Manager Operation.

D. Delete Load (CMD SVR)

The Delete Load (CMD SVR) function provides the capability to delete DPS command loads from the Command Server. This function will be disabled if no DPS command loads exist in the Command Server.



**Figure 7.1G-4. Picture of Delete Load (CMD SVR) Dialog**

Deleting Load(s) from Command Server - 1) select the desired DSM from the list or type in the first few digits of the DSM number and select filter to narrow down the list and then select the desired DSM 2) select the 'Delete' button, 3) answer yes when prompted to confirm the delete operation.

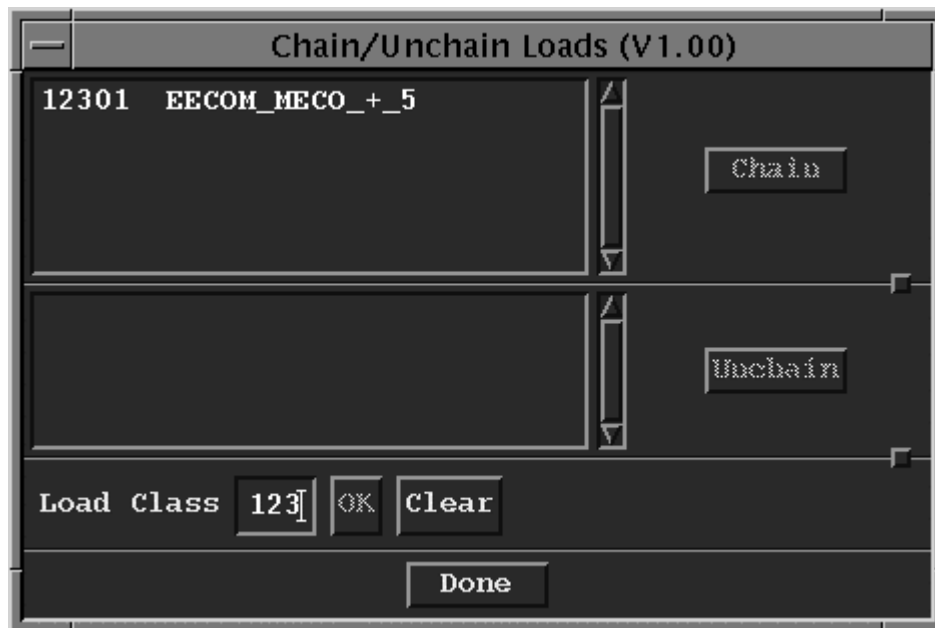
Exiting the Delete Command Operation - select the 'Done' button will exit the delete command operation.

Note: Loads displayed in the list that are preceded with an asterisk are prebuilt commands. For a command to be marked as prebuilt, it must be listed in the *reqlist.y.xxx* file. Prebuilt commands are generally VPs and DEU Equivalents that are supported for every flight.



## E. Chain/Unchain Loads

The Chain/Unchain Loads function provides the capability to chain (group) together a series of up to ten DPS command loads for automatic sequential uplink. When uplinking chained loads, only the first DSM number in the sequence has to be entered for uplink by INCO, all of the other loads in the sequence will be uplinked automatically in the order they are chained. This function also provides the capability to unchain loads that have been previously chained. Chain/Unchain will be disabled if no DPS command loads exist in the Command Server. Whenever uplinking chained loads, you must inform INCO that the loads are chained.



**Figure 7.1G-5. Chain/Unchain Load Dialog**

Chaining Command Loads - 1) enter the first three digits of the DSM load class in the text box, 2) select the 'OK' button, 3) select the command load(s) you wish to unchain in the Unchain window, 4) select the 'Chain' button, 5) answer yes when prompted to verify the chain operation. The chained loads will appear in the Chain window.

Unchaining Command Loads - 1) enter the first three digits of the DSM load class in the text box, 2) select the 'OK' button, 3) select the command load(s) you wish to unchain in the Chain window, 4) select the 'Unchain' button, 5) answer yes when prompted to confirm the unchain operation.

Clearing The Load Class - selecting the 'Clear' button will clear the selected load class. The load class can also be cleared by backspacing over the digits.

Exiting the Chain/Unchain Operation - selecting the 'Done' button will exit the Chain/Unchain Operation.

COMMAND TRACKING APPLICATION

CMD NDX	GMT		M F	DSM	Command Title	COMP Result	CAP	Position/Node	PLD ID/SRC
	Start	Complete							
51	201:14:25:00	201:14:25:04	GNC	4060	BUFFER EXECUTE	COMP	N/A	INCO/white-fcr5	
50	201:14:24:56	201:14:25:00	GNC	40401	Delta State	COMP	N/A	INCO/white-fcr5	
49	201:14:24:50	201:14:24:54	BFS	4060	BUFFER EXECUTE	COMP	N/A	RFCOMM/white-mpsrl3	
48	201:14:24:46	201:14:24:50	BFS	12438	INH 1,2,4,6,11	COMP	N/A	RFCOMM/white-mpsrl3	
47	201:14:21:29		BFS	4608	MADS FDM CAL - OFF	SNGL	N/A	INST/white-mpsrl5	
46	201:14:21:11		BFS	4607	MADS FDM CAL - ON	SNGL	N/A	INST/white-mpsrl5	
45	201:14:20:52		BFS	4603	MADS PCM ON	SNGL	N/A	INST/white-mpsrl5	
44	201:14:20:13		BFS	4601	MADS WB/ACIP ON	SNGL	N/A	INST/white-mpsrl5	
43	201:14:20:01		BFS	4609	MADS TRACK SEQ 3 ON	SNGL	N/A	INST/white-mpsrl5	
42	201:14:19:54		BFS	4415	OPS 2 RCD SERIAL A	SNGL	N/A	DATA COMM/white-mpsrl0	
41	201:14:19:53		BFS	4426	OPS 2 SPEED 24 IPS	SNGL	N/A	DATA COMM/white-mpsrl0	
40	201:14:19:52		BFS	4618	MADS RCDR PWR ON	SNGL	N/A	INST/white-mpsrl5	
39	201:14:19:49		BFS	4401	OPS 2 TRACK 1 - SEL	SNGL	N/A	DATA COMM/white-mpsrl0	
38	201:14:19:47		BFS	4451	OPS 2 STOP	SNGL	N/A	DATA COMM/white-mpsrl0	
37	201:14:19:39	201:14:19:43	BFS	4060	BUFFER EXECUTE	COMP	N/A	RFCOMM/white-mpsrl3	
36	201:14:19:36		BFS	4315	OPS 1 RCD SERIAL A	SNGL	N/A	DATA COMM/white-mpsrl0	
35	201:14:19:35		BFS	4326	OPS 1 SPEED 24 IPS	SNGL	N/A	DATA COMM/white-mpsrl0	
34	201:14:19:35		BFS	4301	OPS 1 TRACK 1 - SEL	SNGL	N/A	DATA COMM/white-mpsrl0	
33	201:14:19:34	201:14:19:39	BFS	12101	EDWARDS ENTRY MSPC	COMP	N/A	RFCOMM/white-mpsrl3	
32	201:14:19:27		BFS	4351	OPS 1 STOP	SNGL	N/A	DATA COMM/white-mpsrl0	

FLIGHT 088 VEHICLE OV105 ROLE prime TYPE SIM GMT 201:14:31:02.84 LOST HEARTBEAT Clear ALL

Figure 7.1G-6. Command Track Application

**CMD NDX** - provides a sequential number for reference to each command event.

**GMT Start/Complete** - shows the starting and ending GMT of the event.

**MF** - indicates a designated software major function or GPC ID destination of the command uplink (SM, GNC, or BFS).

**DSM** - DSM number of the command load being uplinked.

**Command Title** - title of the uplinked command.

**COMP Result** - provides completion status of the command event, which will be COMP, TSLO, DREJ, TMRJ, or SAFE.

- A. COMP - a two-stage buffer compare complete with no error.
- B. TSLO - a two-stage load was transmitted while the two-stage buffer was busy processing a previous load. Operator must clear the buffer before continuing.
- C. DREJ - a data reject has occurred. This can happen when the uplink and downlink do not compare for a specific load (first word must compare).
- D. TMRJ - a telemetry reject has occurred. This can happen when no telemetry downlink is available to compare against uplinked load (e.g., load sent at LOS or TFL does not have required downlink).
- E. SAFE - an attempt was made to uplink a safed load.

**CAP** - shows the site capability status. This will be VAL, GDR, NVL or N/A.

- A. VAL - Normal indication of valid site check (loads uplinked at IOS and QUI, Dakar, TDRSS, show blank in this column)
- B. GDR - Site ground reject
- C. NVL - Nonvalid site

**Position/Node** - Position and location of operator performing the uplink.

**COMMAND INVENTORY**



**Figure 7.1G-7. Command Inventory Application**

State - command safing status

- S - SAFE (disabled for uplink)
- U - UNSAFE (enabled for uplink)
- MF - A specific major function or GPC indicator in the MF/GPC column restricts the load from being sent to any other major function or GPC. A zero in this column allows the load to be sent to any major function/GPC. In general, loads built real time should show a zero in this column.

This display no longer displays the chaining status of each load in the inventory. However, the user can refer to the CHAINED LOAD INVENTORY display, which will display the DSM group (XXX) and each sequence number (YY) included in the chain (if applicable).

### OP CODE STATUS

Start the OP Code Status application by selecting Global Apps->Command Server->TELCOM Displays->OP Code Status

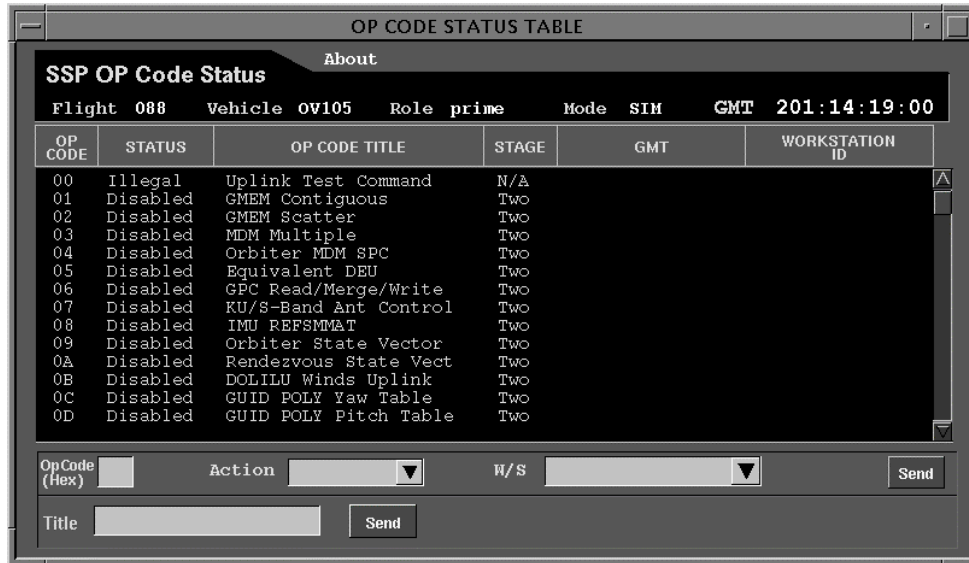


Figure 7.1G-8. Picture of OP Code Status

### CHAINED LOAD INVENTORY

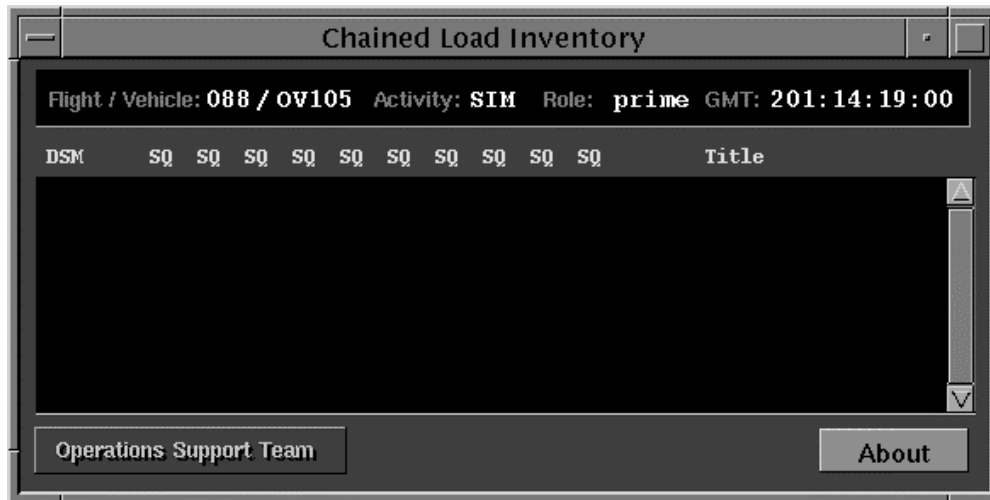


Figure 7.1G-9. Chained Load Inventory Application

Displays the DSM group (XXX) and each sequence number (YY) included in a chained set of commands. Chained Load Inventory shows the DSM numbers of the loads in the chain, grouped together horizontally with the load title of the first load in the chain.

SAFED COMMAND GROUPS

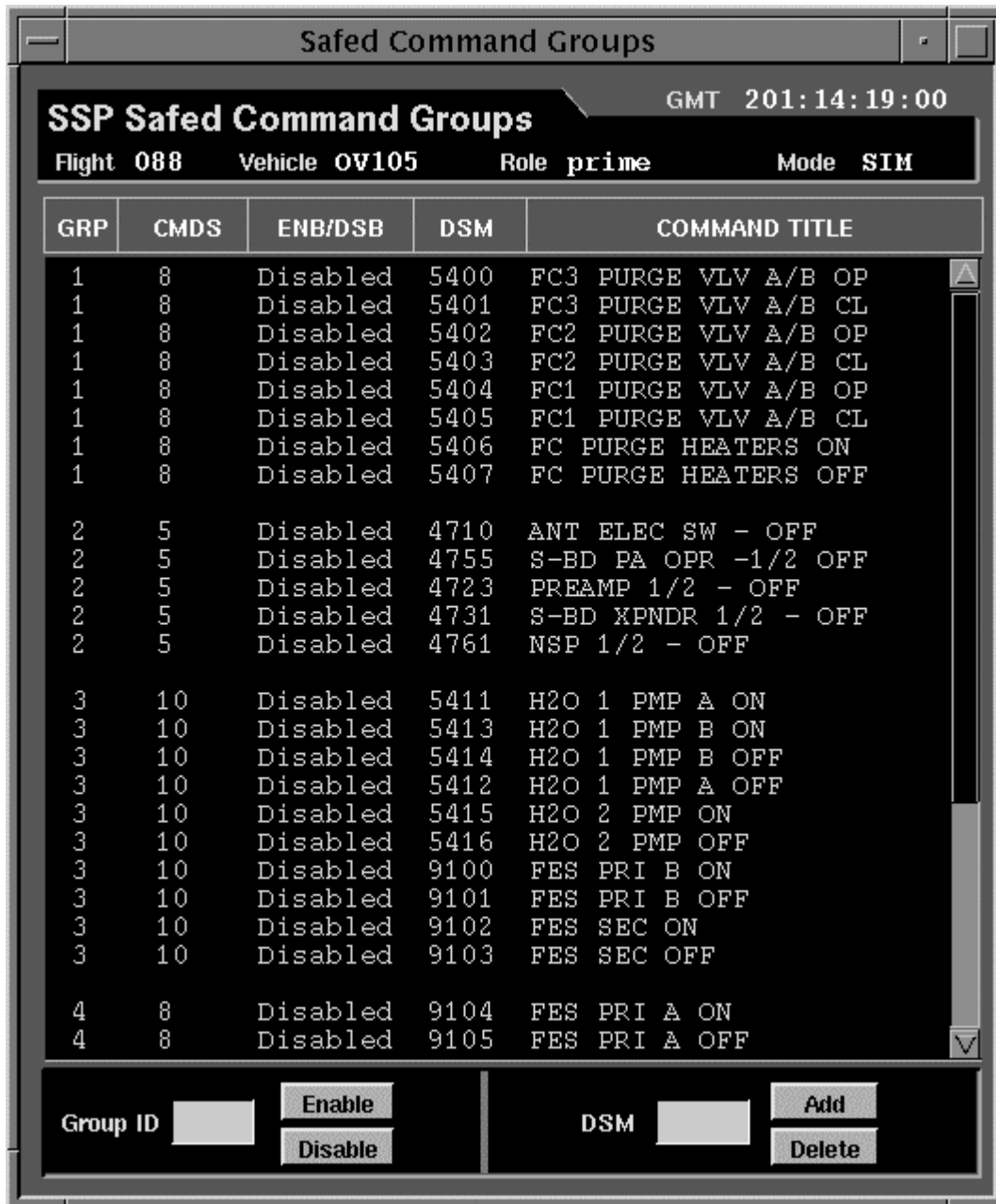


Figure 7.1G-10. Safed Command Groups Application

COMMAND DATA WORDS

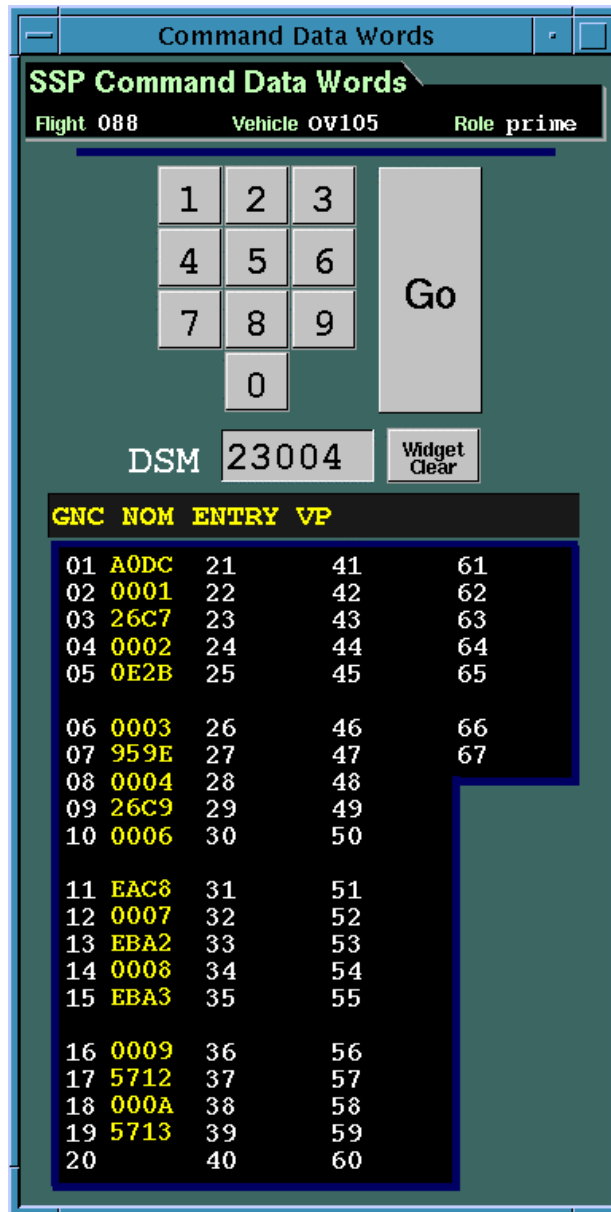


Figure 7.1G-11. Command Data Words Application

REFERENCES

1. NSTS DL/UL CPDS, SS-P-0002-140.
2. CCS Control User's Guide (Part 3: MED LIST), STSOC-UD-600315.

## TITLE

GMEM READ/WRITE IMPLEMENTATION (Command Server)

## PURPOSE

To provide the DPS and DPS SPT operators with the information necessary to process any GPC Memory (GMEM) read or write request.

## BACKGROUND INFORMATION

Contiguous and scatter GMEM writes are legal in all BFS memory configurations and in some PASS configurations (see RESTRICTIONS/CONSTRAINTS A.1). Each contiguous load is limited to 64 addresses, whereas each scatter load is limited to 32 addresses. Alternate methods of changing GPC memory include DEU equivalent writes (available in all PASS memory configurations - see SCP 7.3) and crew keyboard inputs to SPEC 0 (both PASS and BFS).

The following three options are available when altering the GPC main memory via a contiguous or scatter load:

For DATA areas of memory only

### A. Bit Set

All bit positions in the uplink data word (mask word) that are set to 1 will be set to 1 onboard; all other positions are unaffected.

### B. Bit reset

All bit positions in the uplink data word (mask word) that are set to 1 will be set to 0 onboard; all other positions are unaffected.

For DATA or CODE areas of memory

### C. Load

The onboard data will be replaced bit for bit with the uplinked data half word. Note that this is the only option which can be used for changing areas of code.

The contents of a contiguous GMEM write must be located in the same sector of memory. A scatter GMEM write can be implemented across boundaries of sectors 0/1, 2/3, etc., but is not done for reasons of consistency. That is, contiguous and scatter GMEM writes are both built without crossing sector address boundaries. The technical reason why contiguous loads are built in this manner is due to the way in which command words (CW) 2 and 3 are built. CW 2 contains the Most Significant Bit (MSB) of the starting address for the GMEM. CW 3 and all subsequent command words contain the lower 16 bits of the GMEM write address. Hence, GMEM writes cannot

cross boundaries where the MSB of the GMEM write address would change (refer to Downlist/Uplink CPDS, Section 6).

A Release Authorization Document (RAD) is the official paperwork which authorizes the use of a PASS GMEM write. An Engineering Order (EO) is the equivalent, but for a BFS GMEM write. For a preflight approved and verified GMEM, a Release Authorization Signature Sheet (RASS) will be attached to the front of the GMEM paperwork stating that the GMEM has been approved by the Shuttle Avionics Software Control Board (SASCB). The paperwork for all preflight approved and verified GMEMs will be placed on console in the DPS Datapack binder prior to each flight.

IF THE NEED FOR A GMEM ARISES DURING FLIGHT, UNITED SPACE ALLIANCE (PASS)/BOEING (BFS) WILL PROVIDE A COPY OF THE RAD/EO TO THE MCC VIA A CHIT. FOR THESE TYPES OF GMEMS, THERE WILL NOT BE A RASS.

The policy for implementation of GMEM writes was initially established for STS-1. The policy which was adopted at that time is outlined in two memos. The first memo was written by DF22/ Darrell Stamper for the Systems Division Chief, M.P. Frank, on March 23, 1981. The second memo was approved by the Orbiter Avionics Systems Manager, Arnold D. Aldrich, on April 6, 1981. The substance of these memos was incorporated into Flight Rules A2.1.3-12 and A7.1.3-6.

On May 19, 1988, a memo from WA/R.W. Moorehead substantially modified the GMEM write implementation process. This memo affected Flight Rule A7.1.3-6 and the preflight-approved GMEM Section 3.3.3 of the FCOH.

### **RESTRICTIONS/CONSTRAINTS**

**CAUTION**

This procedure is governed by FCOH 3.1 and 3.3.3 and is not to be changed in real-time without review and approval of the Flight Director or changed permission without review and approval of the FOIG.



A. Onboard Software Command Legality Tables

1. PASS

MC(MF/OPS) or GPC ID	CMD legal
MC0 (OPS 0)	X
MC1 (GNC 1/6)	
MC2 (GNC 2)	X
MC3 (GNC 3)	
MC4 (SM 2)	X
MC5 (SM 4)	X
MC6 (PL 9)	X
MC8 (GNC 8)	X
MC9 (GNC 9)	X
GPC ID	X

2. BFS

OPS	CMD legal
Prelaunch OPS 0	X
GNC 1	X
Predeorbit OPS 0	X
GNC 3	X
GNC 6	X

B. Valid OI Loads

All PASS and BFS.

C. Vehicle, LRU/Hardware Version Constraints

None.

D. Time Constraints, Crew Coordination Requirements

1. Crew should be cognizant of GMEM write use and avoid keyboard entries and switch throws where practical. Time constraint varies with each GMEM write but most are not time critical.
2. The preferred method of GMEM implementation is ground uplink. However, if the GMEM is part of a verified procedure contained in the crew's books, it is acceptable to allow the crew to implement the GMEM via keyboard entry.

E. Hazard/Safety Implications

GMEMs transmitted to the Command Server should be safed when not in use and deleted when no longer needed to prevent inadvertent uplink. To safe loads, refer to FCOH 3.1.4. To delete loads, reference the Load Manager Users Guide, SCP7.1.

F. Other Requirements

1. If a GPC is IPL'ed, it will lose all previous GMEM write updates unless the original GMEM was applied to the mass memory.
2. An OPS transition will overwrite a GMEM applied to an OPS overlay.
3. A major function reassignment will overwrite a GMEM applied to a major function base.
4. The only way to overwrite a GMEM applied to system software is via a backout GMEM or an IPL. In general, a GMEM write to system software should be sent to all major functions - GNC, SM, PL/OPS 0, and any freeze dried computers.
5. A GMEM write to protected memory locations will also require a change to the affected load block checksum. The new checksum value must be requested at the same time that the needed write operation is submitted. The following two areas of concern must be addressed:
  - a. If the change is being made to applications in the GNC major function base (MFB) or OPS overlay and the checksum is not updated, an attempt to add a subsequent GPC to the redundant set will cause the new GPC to fail the MFB or OPS overlay transaction.
  - b. If the change is being made to the systems software, a newly IPL'ed GPC must also receive the code and checksum change in order to be compatible with the operating common set.
6. All GMEM write procedures must have completed a software development level verification and a crew procedural verification before the write procedure can be implemented. Verification may be performed preflight or real time depending on the status of the memory write procedure.
7. For BFS GMEMs, BFS must be tracking PASS.
8. A PASS GMEM can be performed on addresses 00000-7FFFF. BFS GMEM addresses are currently restricted to 00000-3FFFF. BFS will have upper address GMEM capability implemented in the future.

## PROCEDURE - GMEM READ

- A. The FCOH procedure 3.3.3 on GPC Memory Read/Writes explains how to coordinate a real-time GMEM read with other flight controllers using the R/T Memory Read Worksheets.
- B. Requesting discipline fills out the R/T Memory Read Worksheet (see FORMS - R/T Memory Read Worksheet) in triplicate.
- C. The requesting discipline sends the original and one copy of the form to DPS SPT and retains the other.
- D. DPS SPT verifies the form and coordinates any changes with the requesting discipline as required.
- E. If more than six locations are to be read out, DPS SPT will recommend that either a variable parameter request (SCP 7.6 and 7.7) or a GPC dump (SCP 6.1) be done. The reason for this is that there are only six locations on SPEC 0 that can be used at one time. It may be more efficient use of the crew's time to pursue the alternative methods.
- F. DPS SPT prepares an electronic flight note to be eventually routed (FD, CAPCOM, FAO, requesting discipline, DPS, and DPS SPT) via the MOD MCCPC application explaining the purpose of the GMEM read, the desired results, the memory locations, whether any scaling/conversion is required, and specific item entries on SPEC 0.
- G. DPS SPT notifies DPS of the existence of the flight note and forwards a copy of the associated R/T Memory Read Worksheet to DPS for review.
- H. DPS reviews the work, provides any additional inputs and initiates the flight note to FD, CAPCOM, FAO, and the requesting discipline.
- I. DPS and the requesting discipline coordinate with FD an appropriate time to perform the GMEM read.
- J. If crew interface is desired for implementation of the GMEM, DPS and DPS SPT verify that CAPCOM reads up the correct information and then records what the crew reads back down for the memory location values.
- K. Otherwise, DPS coordinates the uplink of the GMEM with INCO upon the Flight Directors approval.

**PROCEDURE - PREFLIGHT APPROVED GMEM WRITE**

**CAUTION**

This procedure is SAFETY CRITICAL. The improper address value or data code bit specification can cause improper operation of the DPS system that could be a potential hazard to personnel and equipment.

A. DPS and the requesting discipline compare the present conditions with those conditions listed in the RAD for PASS or the EO for BFS. These will be contained in the DPS Datapack binder on console for reference.

B. If the present conditions are not the same as those outlined in the MRAS or EO, then the GMEM is considered a real-time GMEM and not preflight-approved. Go to the PROCEDURE - REAL-TIME GMEM WRITE for processing of real-time GMEMs. The following are examples of conditions which will require recertification:

1. The GMEM write is to be used in any GPC memory configuration to which any memory alteration procedure has already been invoked and is still active (i.e., another GMEM has already been implemented).
2. A hardware failure has occurred, other than the conditions explicitly defined in the original GMEM request, which impacts the area for which the GMEM is being implemented.
3. The same GMEM write has been entered once and has not been nullified by an approved backout technique. Examples of approved backout techniques are OPS transitions, changing the major function, re-IPL'ing the GPC, implementing an approved and verified GMEM write which cancels the initial GMEM, etc.
4. The original GMEM write request contained specific numerical values as data entries, and a change in the data values is necessary, or if numerical values are necessary data entries and none were specified in the original write request.

C. Although preflight-approved GMEMs have already been verified, they will be reverified prior to uplinking if there is time to do so. It is the DPS section's philosophy to only prebuild GMEMs which are considered time critical. If the GMEM is not time critical, it more than likely will not be prebuilt.

- D. For noncritical timeframes, the requesting discipline will initiate a CHIT requesting that the preflight-approved GMEM be reverified prior to uplink. The CHIT should contain the appropriate MRAS (PASS) or EO (BFS) number.
- E. The procedure for implementing a GMEM is: (1) verify that the contents of the memory locations to be changed are as expected via a variable parameter request, a GPC dump, or by crew readout, (2) implement the GMEM, and (3) verify that the contents of the memory addresses have changed to their desired value. A VP will be used if the memory locations are in sector 0 or 1 and if there are less than 10 locations. A partial GPC dump will be done if the first and last memory addresses are within 511 (decimal) of each other. If none of these apply, a full GPC dump will have to be done.
- F. DPS SPT builds the GMEM load and associated VP load using the GMEM application according to the specifications contained in the MRAS or EO and transmits the load to the Command Server (see BUILD LOAD section). They will also build the VP load (see SCP 7.6) if required and send it to the Command Server as well. DPS SPT will save all loads per FCOH procedure 3.1.
1. Code addresses are protected and data addresses (data, bit set, and bit reset options) are unprotected; i.e for data, bit set or bit reset options, unprotected should be selected. Likewise for the code option, protected should be selected.
  2. For contiguous loads, bit set and bit reset operations are limited by uplink software to one address. However, multiple bit set or bit reset options can be accomplished to sequential addresses using the scatter option.
  3. Only the load option can be used for changes to code (protected memory).
  4. For GMEMs that are one-half word in length, either a scatter or contiguous GMEM load can be utilized.
- G. DPS and the requesting discipline will then verify the loads in the Command Server using the bottom portion of the GMEM application. See the section on Verification of GMEM Loads for further details.
- H. Once load verification is complete, the requesting discipline will send a flight note to FD, CAPCOM, FAO, DPS, and INCO requesting uplink of the GMEM. If this is a non-time critical GMEM, this action will be delayed until the GMEM has been successfully reverified. The flight note should contain intent, rationale, method of implementation, the DSM number and the GPC/MF as a minimum.

- I. On FD GO, DPS SPT will unsafe the required loads and then DPS will coordinate with INCO on the INCO loop the uplink of the GMEM and a VP, if necessary. DPS will tell INCO the DSM number, the GPC/MF, and that FD has given a GO. If more than one load is required, DPS will give INCO an individual GO on each load. DPS SPT will monitor this conversation and verify all information is correct.
- J. DPS and DPS SPT will verify that all loads were sent to the right GPC/MF and that they successfully made it onboard by using the Command Tracking application.
- K. DPS informs FD and the requesting discipline that the GMEM is onboard.
- L. The requesting discipline is responsible for verifying that the GMEM was successful and will notify FD accordingly.
- M. As soon as practical after uplink, DPS informs MER that the GMEM has been implemented.
- N. If there was no time to reverify the preflight-approved GMEM, then the requesting discipline will initiate a CHIT after the uplink of the GMEM is complete to formally document what was done and why.

**PROCEDURE - REAL-TIME GMEM WRITE**

**CAUTION**

This procedure is SAFETY CRITICAL. The improper address value or data code bit specification can cause improper operation of the DPS system that could be a potential hazard to personnel and equipment.

- A. Any GMEM that has not been verified preflight is considered a real-time GMEM and must be verified prior to uplink. This includes any preflight-approved GMEMs which do not exactly meet the conditions outlined in the MRAS (PASS) or EO (BFS).
- B. The requesting discipline fills out one set of the R/T Memory Write Worksheet (see FORMS - REAL-TIME MEMORY WRITE) along with a CHIT. Separate forms should be submitted if similar GMEM writes are desired to both PASS and BFS.

- C. DPS verifies that the forms are filled out correctly and coordinates any changes with the requesting discipline if necessary. DPS also fills in Section VII, Applicable Configurations. Examples of applicable configurations are:

FLIGHT PHASE: G2

GPC	1	2	3	4	5
OPS	G2	G2	G2FD	SM	BFS
STRING	1,3	2,4	-	-	-
CRT	AS REQUIRED				
PL	-	-	-	1,2	-

FLIGHT PHASE: G2

GPC	1	2	3	4	5
OPS	G2	G2FD	G2FD	SM	BFS
STRING	1,2,3,4	-	-	-	-
CRT	AS REQUIRED				
PL	-	-	-	1,2	-

FLIGHT PHASE: G3

GPC	1	2	3	4	5
OPS	G3	G3	G3	G3	BFS
STRING	1	2	3	4	-
CRT	AS REQUIRED				
PL	1,2	-	-	-	1,2

- D. If the use of any special memory configurations is required to implement the GMEM, DPS generates a procedure to accommodate such actions using the known write operation restrictions defined in the CHIT. This procedure should contain information on any necessary OPS transitions, the write operation itself, and with the direct assistance of the initiator, any necessary subsystem actions.

- E. DPS returns the original copy of the worksheets to the requesting discipline and keeps two copies (one for DPS and one for DPS SPT).
- F. The requesting discipline submits the worksheets along with a CHIT to MER requesting that the GMEM be developed and verified.
- G. Once the GMEM has been developed and verified, MOIR will send copies of the CHIT authorizing the GMEM as well as the actual RASS to the requesting discipline, DPS, and DPS SPT.

- H. The procedure for implementing GMEMs is: (1) verify that the contents of the memory locations to be changed are as expected via a variable parameter request, a GPC dump, or by crew read out, (2) implement the GMEM, and (3) verify that the contents of the memory addresses have changed to their desired value. A VP will be used if the memory locations are in sector 0 or 1 and if there are less than 10 locations. A partial GPC dump will be done if the first and last memory addresses are within 511 (decimal) of each other (the display shows 512 contiguous memory addresses). If none of these apply, a full GPC dump will have to be done.
- I. DPS SPT builds the GMEM load using the GMEM application according to the specifications contained in the CHIT and transmits the load to the Command Server (see BUILD LOAD section). They will also build the VP load (see SCP 7.6) if required and send it to the Command Server as well. DPS SPT will save all loads per FCOH procedure 3.1.
  - 1. Code addresses are protected and data addresses are unprotected; i.e., for load, bit set or bit reset options, unprotected should be selected. Likewise, for the code option, protected should be selected.
  - 2. For contiguous loads, bit set and bit reset operations are limited by uplink software to one address. However, multiple bit set or bit reset options can be accomplished to sequential addresses using the scatter option.
  - 3. Only the load option can be used for changes to code (protected memory).
- J. DPS and the requesting discipline will then verify the loads in the Command Server using the bottom portion of the GMEM application. See the section on Verification of GMEM Loads for further details.
- K. DPS and the requesting discipline, with the assistance of FAO, generate the required crew procedures necessary to make the GMEM execute correctly.

- L. The requesting discipline will provide a flight note to FD, CAPCOM, DPS, FAO, and INCO stating the objective of the GMEM and the method of implementation. The flight note should contain the DSM number and GPC/MF as a minimum.

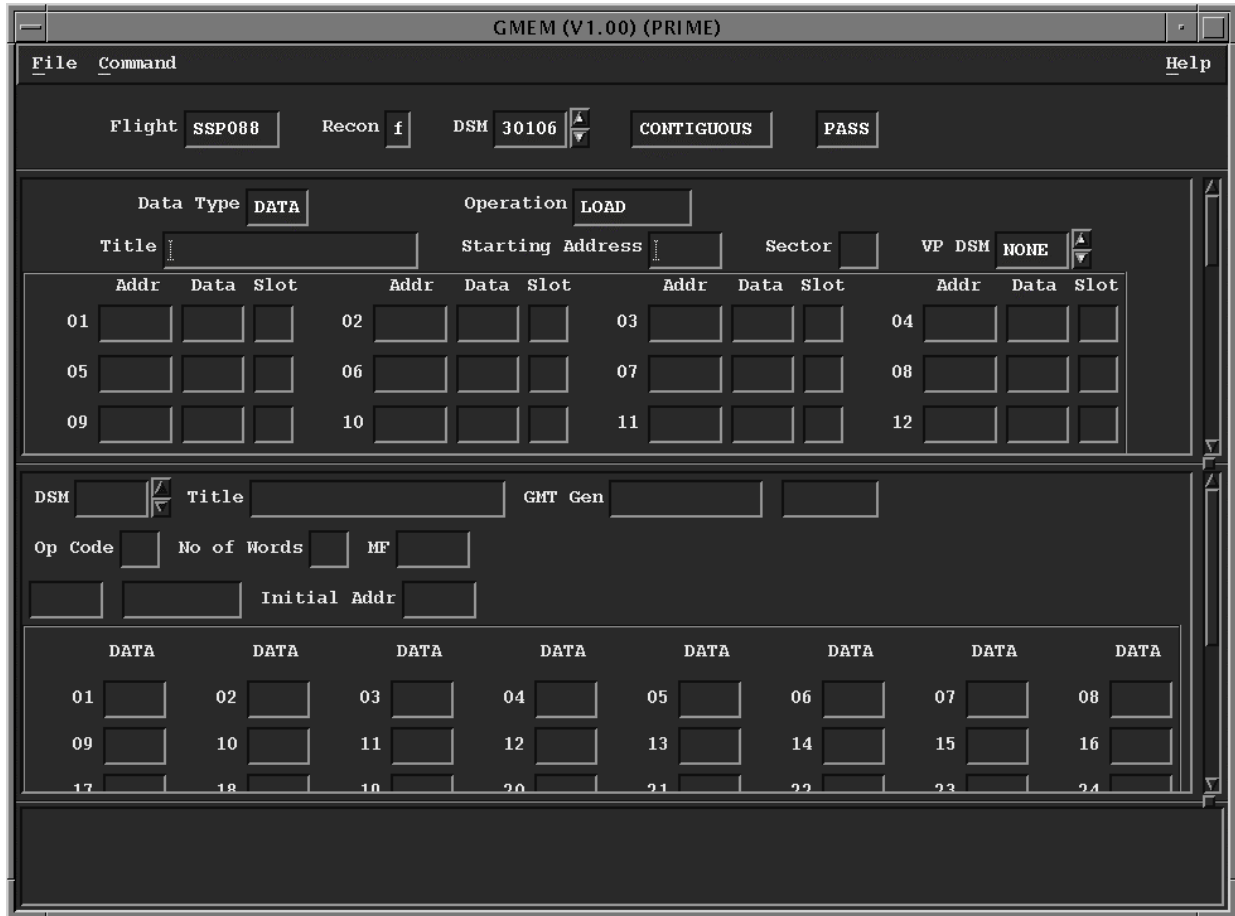


M. On FD GO, DPS will coordinate with INCO on the INCO loop the uplink of the GMEM and VP, if necessary. DPS will tell INCO the DSM number, the major function, and that FD has given a GO. If more than one load is required, DPS will give INCO an individual GO on each load. DPS SPT will monitor this conversation and verify all information is correct.

- N. DPS and DPS SPT will verify that all loads were sent to the right GPC and that they successfully made it onboard by using the Command Tracking display.
- O. DPS informs FD and the requesting discipline that the GMEM is onboard.
- P. The requesting discipline is responsible for verifying that the GMEM was completed and will notify the FD accordingly.
- Q. As soon as practical after uplink, DPS informs MER that the GMEM has been implemented.

### **BUILD LOADS**

- A. Start the GMEM application by selecting Command->Command Server->GMEM on the DPS DNAV. The initial screen for GMEM is shown in Figure 7.2G-1. Verify that the flight number and recon match the activity to which your workstation is configured. The application will initialize ready to build a new GMEM and will default to a Contiguous, PASS, Data, and Load type of GMEM. The DSM field will initialize to the next available DSM and will only scroll through available (not previously used) DSMs. The main window consists of four panes. From top to bottom they are: Header Area (non-editable information and application-generated area), Editing Area (editable information, user-generated), Verification Area (non-editable information, application and Command Server generated), and the Advisory Area (non-editable information, application and Command Server generated). Both nominal and off-nominal messages will appear in the Advisory Area. The mouse, the tab key or the enter key can be used to traverse through the Editing Area.



**Figure 7.2G-1. GMEM application**

- B. If you are building a new GMEM that matches the default initial mode you can proceed with entering the data, otherwise select File->New and continue making selections in the cascading menus that match the type of GMEM you are building. When selecting Code or Data, if Code is selected, then Load will be the only option available. However, if Data is selected, then the user must select either Load, Bit Set, or Bit Reset. Refer to the Background Information section of this procedure, page 7.2-1, for the definition of these terms.
- C. A suggested DSM number is automatically chosen - either use the defaulted DSM number or select another DSM number by using the arrow keys next to the DSM number in the Header Area.

LOAD	DSM (xx=01-50)
Contiguous GMEM	301xx
Scatter GMEM	305xx
PASS Variable Parameter	230xx

- D. Enter an appropriate title (i.e., GNC\_GMEM\_RGA4, SM\_GMEM\_RMS, etc.).
- E. For contiguous GMEMs, enter the starting address. All sequential addresses will automatically appear in the Addr locations of the Edit Area. For scatter GMEMs, after entering the starting address, the addresses will not automatically appear. For both contiguous and scatter, the sector number is automatically calculated and is not editable. VPs are only valid if the address is in sector 0 or 1. If a VP is desired, choose an available DSM by using the arrow keys. If 'None' is selected, the Slot field is not active for entry. Enter the Addr, Data and Slot as required.
- F. Save the load by selecting File->Save. This step is required before the load is sent to the Command Server.
- G. Transmit the command to the command server by selecting Send under the Command menu. If the DSM has already been sent to the Command Server, the program will not allow you to resend it. A message will appear notifying you that if you wish to resend a load with this DSM number, the load must be deleted in the Command Server first.
- H. Printout the command by selecting the Print option on the File menu and then once the cross-hair mouse pointer appears on the screen, place the mouse pointer over the GMEM application and depress the left mouse button. The extra step of selecting the window with the mouse pointer is necessary because the GMEM application uses the X-Window screen print utility for printouts. There is not a separate capability to print the advisories only; if the advisory list is longer than is visible in the window, multiple prints will be necessary.
- I. Exit the GMEM application by selecting the File->Exit menu option. A warning message will appear if you have unsaved data.

VERIFICATION OF GMEM LOADS



Figure 7.2G-2. GMEM application with load in verify mode

The bottom portion of the GMEM application (Figure 7.2G-2) is used to verify GMEM loads and is referred to as the verification area. Immediately after the load is sent to the Command Server, it will appear in the verification area. Additional GMEM loads in the command server can be viewed by scrolling to the desired DSM using the up and down arrow keys next to the DSM field of the verification area. The up/down arrows in the verification area are not active unless the GMEM application is in the Verify mode. To put the application in the Verify mode, select Verify under the Command menu. The items that must be verified are:

- A. **OP CODE** is always equal to 01 for CONTIGUOUS or 02 for SCATTER loads.
- B. **NO OF WORDS(SETS)** must equal the total number of DATA words that follow for Contiguous loads or the total number of Sets of ADDR DATA pairs that follow for SCATTER loads.
- C. **MF** must equal No\_MF for GMEM loads. The MF is automatically built into data word one based on the MF selected by INCO at the time of uplink.

- D. **LOAD(SET)(RESET)** must equal the Operation specified in the build.
- E. **PROTECTED(UNPROTECT)** will be Protected for Data Type CODE and Unprotect for Data Type DATA.
- F. **INITIAL ADDR** must equal the Starting Address for Contiguous loads. This field does not exist for Scatter loads.
- G. **DATA** must equal the contiguous data values specified for Contiguous loads.
- H. **ADDRESS DATA** must equal the Addr and Data values specified for Scatter loads.
- I. For GMEMs using Variable Parameters refer to SCP 7.6 PASS VARIABLE PARAMETERS or SCP 7.7 PASS VARIABLE PARAMETERS for verification.

The actual hex data words to be uplinked do not have to be verified but they can be if so desired by using the Command Data Words (CDW) application. For more information on starting and understanding the Command Data Words Application refer to SCP 7.1. Interpretation of the individual bits in the command words is as follows. For additional information on the bit definitions refer to the Space Shuttle Computer Program Development Specification (CPDS) SS Downlist/Uplink Software Requirements (SS-P-0002-140).

**COMMAND WORD 1**

Data words 1, 2 and 3 of the Command Data Word Application make up command word 1.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
VEH ADD			MF / GPC				OP CODE=0000101								1	0

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
MSB	SPARE		L/S/R	SP	PU	# OF WORDS/#ADDRESS PAIRS							MSB		

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
STARTING ADDRESS / SPARE													LSB		

<u>Bits</u>	<u>Description</u>
17	Upper Memory designator - MSB of starting address (bit 1 of 3). If 1, address is Upper Memory (above 3FFFF); if 0, Lower Memory. This bit is used in combination with bits 31 and 32.
18-19	Spare = 0

- 20 - 21 Load/Set/Reset - This field determines the way in which the data acts on the addressed memory locations as follows:
- 00 - Illegal
  - 01 - Set
  - 10 - Reset
  - 11 - Load
- 22 Spare = 0
- 23 Protect/Unprotect - The uplink software has no knowledge of whether or not a specified address is protected or unprotected; therefore, the status of this bit is not error checked.
- 24 - 30 For contiguous GMEM writes, this is the number of data words (this does not include the address) which will be between 1 and 63. The uplink software provides no error checking on this value.
- For scatter GMEM writes, this is the number of data word and address pairs and must not be greater than 32. The uplink software provides no error checking on this value.
- 31 - 32 Bits 2 and 3 of the first address. (see bit 17 above, for bit 1) These bits are used, in combination with bit 17, to define the sector of memory to be patched. The contents of a contiguous GMEM write must be in the same sector of memory. Scatter GMEM writes do not have this same restriction, but for consistency, it is a DPS philosophy that GMEM writes should not cross sector boundaries.
- Bit 17 Bits 31-32
- (0) 00 sector 0 (00000 - 07FFF)
  - (0) sector 1 (08000 - 0FFFF)
  - (0) 01 sector 2 (10000 - 17FFF)
  - (0) sector 3 (18000 - 1FFFF)

- (0) 10 sector 4 (20000 - 27FFF)
- (0) sector 5 (28000 - 2FFFF)
- (0) 11 sector 6 (30000 - 37FFF)
- (0) sector 7 (38000 - 3FFFF)
- (1) 00 sector 8 (40000 - 47FFF)
- (1) sector 9 (48000 - 4FFFF)
- (1) 01 sector A (50000 - 57FFF)
- (1) sector B (58000 - 5FFFF)
- (1) 10 sector C (60000 - 67FFF)
- (1) sector D (68000 - 6FFFF)
- (1) 11 sector E (70000 - 77FFF)
- (1) sector F (78000 - 7FFFF)

33 - 48 For contiguous GMEM writes - An 18-bit binary code identifying the starting address. The valid range is 0 - 7FFFF (hex) and is not error checked by the uplink software.

For scatter GMEM writes, these bits are spare and thus set to 0. The memory starting address is included in command word 2, bits 17-32.

**COMMAND WORDS (CW) 2 - X**

Data words 4 and 5 of the Command Data Word Application make up CW 2, words 6 and 7 make up CW 3, and so forth.

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
DATA WORD / MEMORY ADDRESS															
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
DATA WORD															

For contiguous loads, each data word (both even and odd) is a single command word to be patched into memory sequentially from the starting address as specified in data word 3.

For scatter loads, all even-numbered data words 4 to 66 are the extended address of memory to be changed. See SCP appendix H, Absolute Address Conversion to Extended Address, if you need to determine the extended address from the given absolute address. All odd numbered data words 5 to 67 are single data words to be patched into the memory address in the previous even-numbered data word.

## FORMS - R/T MEMORY READ WORKSHEET

- A. Two options are available for display format, Hex or Engineering Units. If engineering units are selected, then the Scaling and Conversion blocks must be filled out as well. Only a single scaling and conversion value can be selected for a readout at a time. Therefore, if different scaling and/or conversion factors are required, then a separate set of forms for each one will be required. An expected value of the memory location also needs to be included on the form. (see Figure 7.2.-4)

## FORMS - R/T MEMORY WRITE WORKSHEET

The R/T MEMORY WRITE WORKSHEET is available as a DF Form on the JSCMODM server.

- A. BLOCK I (see Figure 7.2-5)

GMEM TYPE is selected from (code load, data load, bit set, or bit reset). For code areas of memory, which are protected, only code load can be selected. Either bit set, bit reset, or data load can be done to data areas of memory.

MEMORY AREA is either systems software, major function base, or OPS overlay. If OPS overlay is selected the requesting discipline must define in Section III which OPS is desired. This section is only for PASS GMEMs.

DESIRED IMPLEMENTATION can be either via uplink or crew keyboard input. Uplink is the preferred method (Flight Rule A7-16) and should be selected if at all possible.

- B. BLOCK II (Figure 7.2G-3)

MEMORY SECTOR is required to help determine method of implementation. If the memory locations are in multiple sectors, then check each appropriate sector. The exact memory locations will be defined in Section IV.

- C. BLOCK III (Figure 7.2G-3)

OPS DESIRED is required if the GMEM is OPS dependent. If a specific OPS is not required, do not fill out this section.

- D. BLOCK IV (Figure 7.2G-3)

OBJECTIVE of why the GMEM is required. Explain what problem has occurred that requires a GMEM as well as how the GMEM will solve this problem.

- E. BLOCK V (Figure 7.2G-3)

OPERATIONAL CONSTRAINTS/REQUIREMENTS - The requesting discipline should define the necessary actions to set up the appropriate subsystem



configuration and software steps to accept the effects of the GMEM. Any limitations, restrictions, or peculiarities which can constrain the GMEM should be listed. The following is a list of possible constraints which should be considered:

- Define the mission interval that the results of this write operation are to be in effect within the GPC(s). Identify by major mode, flight events, duration in time, or by other significant software activities such as burns, etc.
- Is there any special flight environment (i.e., zero g, RNDZ tracking) required for the results of the GMEM to be observed?
- Are there any software configurations which must be avoided while the effects of this GMEM are active in the GPC(s)?
- Are there any crew procedures/activities (i.e., OPS transitions, switch settings, etc.) which must be performed in order for this GMEM to be effective?
- Are there any future crew procedures/activities which could interfere with the intent of this GMEM?
- When should this GMEM be backed out?
- If crew input is preferred over uplink, explain why and provide list of exact keystrokes required.

F. BLOCK VI (Figure 7.2G-3)

S/W NAME is the HAL-S or assembly name as defined in program listings.

PARAMETER name (i.e., RGA 4, IMU 2 X AXIS SCALE FACTOR).

ADDRESS - The 5-digit hexadecimal location in memory. See DPS Console Handbook Appendix H, Extended Address Conversion, if required.

DESIRED is what the value of the address will be after the write is completed. If a bit set or reset is selected, this column will contain the mask word instead. The mask word is a four-digit HEX word that defines which bit locations within a 16-bit memory word that are to be manipulated.

**EXAMPLE**

The address being changed is currently 1111 and is desired to be F711.

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

In order to accomplish this, bits 0, 1, 2, 5, and 6 must be set to a 1 in the mask word (i.e., mask word = E600). This could also be done by a load of F711, but a bit set or bit reset operation allows single bit manipulation where the state of the adjacent bits may not be known. All bits must be known to do a load.

INITIAL ACTUAL is the current contents of the memory location before the GMEM is implemented.

FINAL ACTUAL is what the memory location will show after the GMEM is implemented. Note that for a code or data load this value will equal the value in the desired column. Whereas, for a bit set or reset this value will most likely be different from the mask word.

G. BLOCK VII (Figure 7.2G-6)

APPLICABLE CONFIGURATIONS will not be filled out by the requesting discipline. It is up to DPS and DPS SPT to fill out this area. List any possible DPS system configurations which may be in effect once the GMEM is onboard.

R/T MEMORY READ WORKSHEET		
INITIATOR/LOOP	GMT	DATE
<b>I</b> <input type="checkbox"/> PASS <input type="checkbox"/> BFS		
<b>II</b> Major Function <input type="checkbox"/> GNC <input type="checkbox"/> SM <input type="checkbox"/> PL OPS      _____		
<b>III</b> Objective:		
<b>IV</b> Display Format: <input type="checkbox"/> ENGINEERING UNITS <input type="checkbox"/> HEX		
SCALING:      CONVERSION:		
<input type="checkbox"/> 1    16 Bit/Fixed <input type="checkbox"/> 2    32 Bit/Floating	<input type="checkbox"/> 00    Units in Memory <input type="checkbox"/> 06    °/SEC from Milli RAD/SEC <input type="checkbox"/> 01    NM from FT <input type="checkbox"/> 07    DEG from ARC SEC <input type="checkbox"/> 02    NM from KFT <input type="checkbox"/> 08    FT/SEC <sup>2</sup> from μG <input type="checkbox"/> 03    FT from NM <input type="checkbox"/> 09    DEG from RAD <input type="checkbox"/> 04    KFT from NM <input type="checkbox"/> 10    KFT from FT <input type="checkbox"/> 05    FT/SEC <sup>2</sup> from GS	
<b>I</b> ADD ID (HEX)	ADD NAME	EXPECTED CONTENTS
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

7.2G-21  
Verify that this is the correct version before use

<b>REAL TIME MEMORY WRITE WORKSHEET</b>		PAGE 1 OF 3
INITIATOR/LOOP:	GMT: / : :	DATE:

I. For each WRITE desired, select one item in each of the following columns:

PASS/BFS:    GMEM TYPE:    PASS ONLY –GMEM done to  
IMPLEMENTATION:

PASS	UPLINK
PASS	UPLINK
PASS	UPLINK
PASS	UPLINK

II. Select appropriate memory sector for GMEM implementation:

LOWER MEMORY                      UPPER MEMORY

III. For PASS only, select the OPS in which the desired GMEM must be implemented:  
Not OPS Dependent

IV. Objective:

V. Operational Constraints / Requirements (Initiator - See Suggested Topics in FCOH 3.3.3)

**Figure 7.2G-3. Real time memory write worksheet**



**REAL TIME MEMORY WRITE WORKSHEET**

VII. Applicable Configurations (DPS / DPS SPT Fills Out This Portion)

FLIGHT PHASE:

GPC	1	2	3	4	5
OPS					
STRING					
CRT					
PL					

FLIGHT PHASE:

GPC	1	2	3	4	5
OPS					
STRING					
CRT					
PL					

FLIGHT PHASE:

GPC	1	2	3	4	5
OPS					
STRING					
CRT					
PL					

FLIGHT PHASE:

GPC	1	2	3	4	5
OPS					
STRING					
CRT					
PL					

**Figure 7.2G-3. Real time memory write worksheet (concluded)**

**REFERENCES**

1. Downlist/Uplink Software Requirements, SS-P-0002-140.
2. Flight Control Operations Handbook, JSC-26843.

**TITLE**

SCP Verifier: \_\_\_\_\_  
Facility: \_\_\_\_\_ Date: \_\_\_\_\_

DEU EQUIVALENT LOADS (Command Server)

**PURPOSE**

This SCP provides the procedure on how to build, verify, and uplink DEU equivalent loads. This SCP serves as a supplement to FCOH 3.3 DEU EQUIVALENT COMMANDS, and must not conflict with that procedure.

**RESTRICTIONS/CONSTRAINTS**

CMD CR# Baseline

DATE: 11/12/87

**CAUTION**

This procedure is governed by FCOH SOP 3.1 and SOP 3.3 and is not to be changed in real time without review and approval of the Flight Director or changed premission without review and approval at the FOIG.

A. Onboard Software Command Legality Tables

1. PASS

MC (MF/OPS) or GPC ID	CMD legal
MC 0 (OPS 0)	X
MC 1 (GNC 1/6)	X
MC 2 (GNC 2)	X
MC 3 (GNC 3)	X
MC 4 (SM 2)	X
MC 5 (SM 4)	X
MC 6 (PL 9)	X
MC 8 (GNC 8)	X
MC 9 (GNC 9)	X
GPC ID	X*

\* See Paragraph F for more information regarding the use of GPC ID.

2. BFS - N/A

B. Valid OI Loads

All PASS, no BFS.



C. Vehicle, LRU/Hardware Version Constraints

None.

D. Time Constraints, Crew Coordination Requirements

1. DEU equivalent loads should avoid containing item entries which must be uplinked at a specific time or within a specific time interval.
2. The crew should be informed of upcoming DEU equivalent use and instructed not to use the associated IDP/CRT. However, there are no constraints utilizing the associated IDP to drive subsystem or flight instrument displays.
3. Do not call up a SPEC on an active IDP without crew coordination. If during crew sleep, do not call up the desired SPEC until required and then RESUME it as soon as practical.

E. Hazard/Safety Implications

CAUTION

The following is a list of possible conditions which could be hazardous to equipment or personnel.

1. Extreme care must be taken when building this command load because no syntax checks are performed by the Command Server, and limited syntax checks are performed by the onboard software (reference PASS user note 55006).
2. If a DEU equivalent command is sent to a GPC which is not communicating with the IDP specified in the command (i.e., not assigned), that GPC may still process the command which in turn may lead to undesirable results (reference PASS User Note 36329).
3. DEU equivalent loads will not be used to perform OPS transitions, OPS mode recalls, or MM transitions except for the contingency G1 to G9 transition required for MPS safing (following a pad abort).
4. Loads will not be chained because the successful execution of a load may not be verified before subsequent commands are executed.

F. Other Requirements/Information

1. DEU equivalent commanding during crew sleep will not be performed until all of the following requirements have been met. (See the flight specific annex for any additional flight unique constraints.)
  - a. Confirmed period of AOS and good comm through scheduled completion of the load.

- b. The MCC must be able to verify all DEU equivalent loads via methods other than scratchpad line response.
- c. If a series of loads are planned, the impact of not completing all uplinks must be evaluated and considered to be an acceptable risk.
- d. Need for crew alert SPCs has been evaluated by the MCC.
2. For DEU equivalent commanding during crew sleep, the MCC may or may not want to verify the functionality of the planned uplinks prior to crew sleep.
3. The Command Server restricts the following keystrokes from being in DEU equivalent loads: FAULT SUMM, SYS SUMM, MSG RESET, ACK, GPC/CRT, and CLEAR.
4. DEU equivalent loads should not be sent to a deassigned IDP, or to an IDP assigned via the BFC CRT SEL switch. DEU equivalent loads can be sent to a powered off IDP as long as the IDP is still assigned.
5. A DEU equivalent load is limited to 30 keystrokes because of a Command Server restriction, and not an onboard restriction.
6. DEU equivalent loads are valid following a failed OPS transition or freeze dry attempt.
7. An active downlist from the destination GPC or MF must be available for the Command Server to verify the uplink and to subsequently send the buffer execute command.
8. Load destination may be an individual GPC (if not an RS member), all GPCs, or a major function (GNC, SM, PL). Most DEU equivalent scenarios will involve uplinking to either the GNC or SM major function.
9. INCO controls the destination and IDP number via command panel inputs on the INCO/INST console when the load is uplinked.
10. The DEU equivalent load's built-in major function, the destination (entered by INCO), and the IDP number (also entered by INCO) must all be compatible; e.g., if SM is specified with GPC 4 and IDP 2 as the destination, then GPC 4 must be SM driving IDP 2. If this is violated the GPC will announce an 'ILLEGAL ENTRY' indication.
11. For an OPS 0 GPC(s), the payload major function destination will not work. Only a GPC ID type destination will work if the OPS 0 GPC is not an RS member. The all GPC destination would work, but OPS Note 43987 recommends against its use for RS of OPS 0.
12. If a DEU equivalent load is sent to an IDP that is powered off, the IDP status words will go to all zeros and remain all zeros until the IDP is powered on. When the IDP is powered on, the status words will be updated in the poll response. If a DEU equivalent is sent to an IDP that is powered on, the status words will go to all zeros when the command is processed by the GPC and then return to real values on the next poll response.

13. If an IDP that is powered off is reassigned, that IDP is not available for DEU Equivalent uplinks. Reassignment could be via the GPC/CRT key or via the BFC switch moving the IDP to/from the BFS. Attempting to uplink to such an IDP will result in an 'ILLEGAL ENTRY' flag being downlisted. An IDP in such a lockout condition may be identified through a software array CZ2V\_MF\_OLD that may be viewed by placing the array member of interest in a variable parameter slot. This is a four-word array, one for each IDP. If the content of the word for the IDP in question is FFFF, this IDP is locked out from receiving DEU equivalent uplinks. This condition will not clear until good polling resumes between the GPC and IDP. Normal values for this parameter would be 0000 for PL MF, 0001 for GNC MF, and 0002 for SM MF.

#### **PROCEDURE - NON MANEUVERS**

- A. The responsible console position completes a DEU Equivalent Form (Figure 7.3G-1, and available electronically via the DF32 Home Page) and submits it to DPS. See the section on Filling Out the DEU Equivalent Form for further details.
- B. DPS/DPS SPT review the form for completeness and adequacy of information, and completes the form accordingly. This may include adding any necessary "SPEC XXX PRO" or "RESUME" commands to the form as needed.
- C. DPS/DPS SPT build the required command load(s) using the DEU Equivalent application, transmits the loads to the Command Server, and safes them. See the section on Building DEU Equivalent Loads for further details.
- D. DPS provides the requesting discipline with a completed form.
- E. DPS, DPS SPT and the requesting discipline verify the load(s) in the Command Server using the bottom half of the DEU Equivalent build display. See the section on Verification of DEU Equivalent Loads for further details.
- F. After the load(s) are verified in the Command Server, DPS submits a flight note (with the completed form attached) to FD.
- G. Once FD gives a GO, CAPCOM, if necessary, informs the crew of the pending uplink and instructs them to avoid all keyboard entries on the targeted IDP until DEU equivalent uplink is complete. If a downlist or TFL change is required, DPS coordinates appropriately with FD and INCO.

- H. DPS coordinates the actual uplink with INCO on the FD loop (Note: the FD may decide to relegate this coordination to the INCO loop). INCO requires that DPS provide the DSM number, destination (GPC ID or MF ID), target IDP number, and that a GO from FD has been given. If the DEU equivalent consists of multiple loads, DPS is also required to give INCO a separate 'GO' for each specific load.
- I. After INCO reads back the information, DPS/DPS SPT verify the success of the uplink on the Command Track display and informs the requesting discipline that the DEU equivalent load is onboard.
- J. The requesting discipline verifies that the DEU equivalent uplink was successful via methods other than scratchpad line response. (Due to timing limitations of the downlist rates and the DK polling rates, the actual entries on the scratch pad line may not be seen for an IDP that is powered on). Scratchpad line entries should be seen for an IDP that is powered off.

## PROCEDURE - ATTITUDE MANEUVERS

- A. FAO/PTG develops the planned timeline and desired attitudes well enough in advance to allow ample time for the loads to be built and verified (24 hours is desired, but depending on the specific case, may be less).
1. For pre-flight approved maneuver plans, FAO/PTG will develop the baseline plan for pre-flight approval by DPS, INCO, GNC, FD, ACO/PAYLOADS, and the requesting discipline. During the flight, FAO/PTG will develop the specific planned attitude timeline (including bailout attitudes as required) for flight night (FN) X during the planning shift for FN X-1 (the night prior to the FN that requires the maneuvers). The specific timeline for maneuvers planned for FN 1 will be developed prelaunch, if possible.
- B. FAO/PTG completes a DEU Equivalent Form (fig. 7.3-1G, and available electronically via the DF32 Home Page) and submits it to DPS, GNC, INCO, ACO/PAYLOADS and the requesting discipline. See the section on Filling Out the DEU Equivalent Form for further details. Once FAO/PTG submits the baseline plan, DPS will be responsible for any required updates and redistribution.
- C. DPS/DPS SPT review the form for completeness and adequacy of information, and completes the form accordingly. This may include adding any necessary "SPEC XXX PRO" or "RESUME" commands to the form as needed.
- D. In parallel with the work DPS is doing, GNC and INCO evaluate the planned timeline and attitudes for technical correctness, comm coverage, crew alert SPC requirements, etc. as they do for any other type of maneuver. Any changes will be coordinated with FAO/PTG, ACO/PAYLOADS, and the requesting discipline. Once

coordinated, DPS/DPS SPT will incorporate the changes on the DEU Equivalent Form.

- E. DPS/DPS SPT build the required command loads using the DEU equivalent workstation application, transmits the loads to the Command Server, and safes them. See the section on Building DEU Equivalent Loads for further details.
  - F. DPS provides a completed form to FAO/PTG, GNC, INCO, ACO/PAYLOADS, and the requesting discipline.
  - G. DPS, DPS SPT, PTG, and GNC verify the loads in the Command Server using the bottom half of the DEU Equivalent build display. See the section on Verification of DEU Equivalent Loads for further details.
  - H. Once all affected disciplines have completed their responsibilities outlined above, DPS submits a flight note (with the completed form attached) to FD.
    - 1. For pre-flight approved FN X DEU maneuver plans, the Orbit 2 shift will typically review/approve the plan and uplink it, along with the bailout attitude, to the crew prior to crew sleep on the night the plan is to be executed.
  - I. Once FD gives a 'GO', CAPCOM, if necessary, informs the crew of the pending uplink and instructs them to avoid keyboard entries to the targeted IDP until DEU equivalent uplink is complete. If a downlist or TFL change is required, DPS coordinates appropriately with FD and INCO.
- J. DPS coordinates the actual uplink with INCO on the FD loop. INCO requires that DPS provide the DSM number, destination (GPC ID or MF ID), target IDP number, and that a GO from FD has been given. DPS must give INCO a separate 'GO' for each specific load.
  - K. After INCO reads back the information on the FD loop, DPS/DPS SPT verify the success of the uplink on the Command Track display.
  - L. For each load, GNC, FAO, and DPS give a 'GO' on the FD loop after having verified the success of the previous load using methods other than scratchpad line response. Additionally, FD gives a separate 'GO' prior to initiating any actual maneuver (i.e., ITEM 18, 19, or 20 on UNIV PTG).
  - M. If part of a series of maneuvers, prior to the MET of the next sequence DPS will acquire a GO from FD to proceed.

#### CLEANUP

- A. DEU equivalent loads will be deleted from the Command Server if not planned to be used again.

- B. DEU equivalent loads will be safed in the Command Server when not in use. See FCOH SOP 3.1.4 for details on safing.

DEU EQUIVALENT REQUEST ❶				RESERVED FOR DPS		
DISCIPLINE:	FLIGHT ID: STS -	ORIGINATOR:	DATE (MM/DD/YYYY):	MISSION GMT: (DD/HH:MM)	GMT Form Received:	
PASS MAJOR FUNCTION <input type="checkbox"/> GNC <input type="checkbox"/> SM <input type="checkbox"/> PL		REQUESTED UPLINK TIME: <input type="checkbox"/> Real-time call <input type="checkbox"/> At event: <input type="checkbox"/> At specified GMT/MET (specify below)		RATIONALE / OBJECTIVE:		
PASS MAJOR MODE				Approved By:		
L O A D	UPLINK TIME (DD/HH:MM)	RESERVED FOR DPS		OPS or SPEC No. ❷	KEYSTROKES ❸ (MAX 30)	COMMENTS
	<input type="checkbox"/> GMT <input type="checkbox"/> MET	DSM No.	TITLE (MAX 23 CHARACTERS)			
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

- ❶ PASS uplink feature only (DEU Equivalent capability not valid for BFS).
- ❷ Specify 'SPEC No.' (XXX) or 'OPS DISPLAY' (XXXX).
- ❸ 'SPEC', 'OPS', 'PRO', 'ITEM', 'EXEC', 'I/O RESET', and 'RESUME' each count as a single keystroke. Invalid keystrokes [ 'ACK', 'MSG RESET', 'GPC/CRT', 'FAULT SUMM', 'SYS SUMM', and 'CLEAR' ].

Figure 7.3G-1. DEU Equivalent Request Form

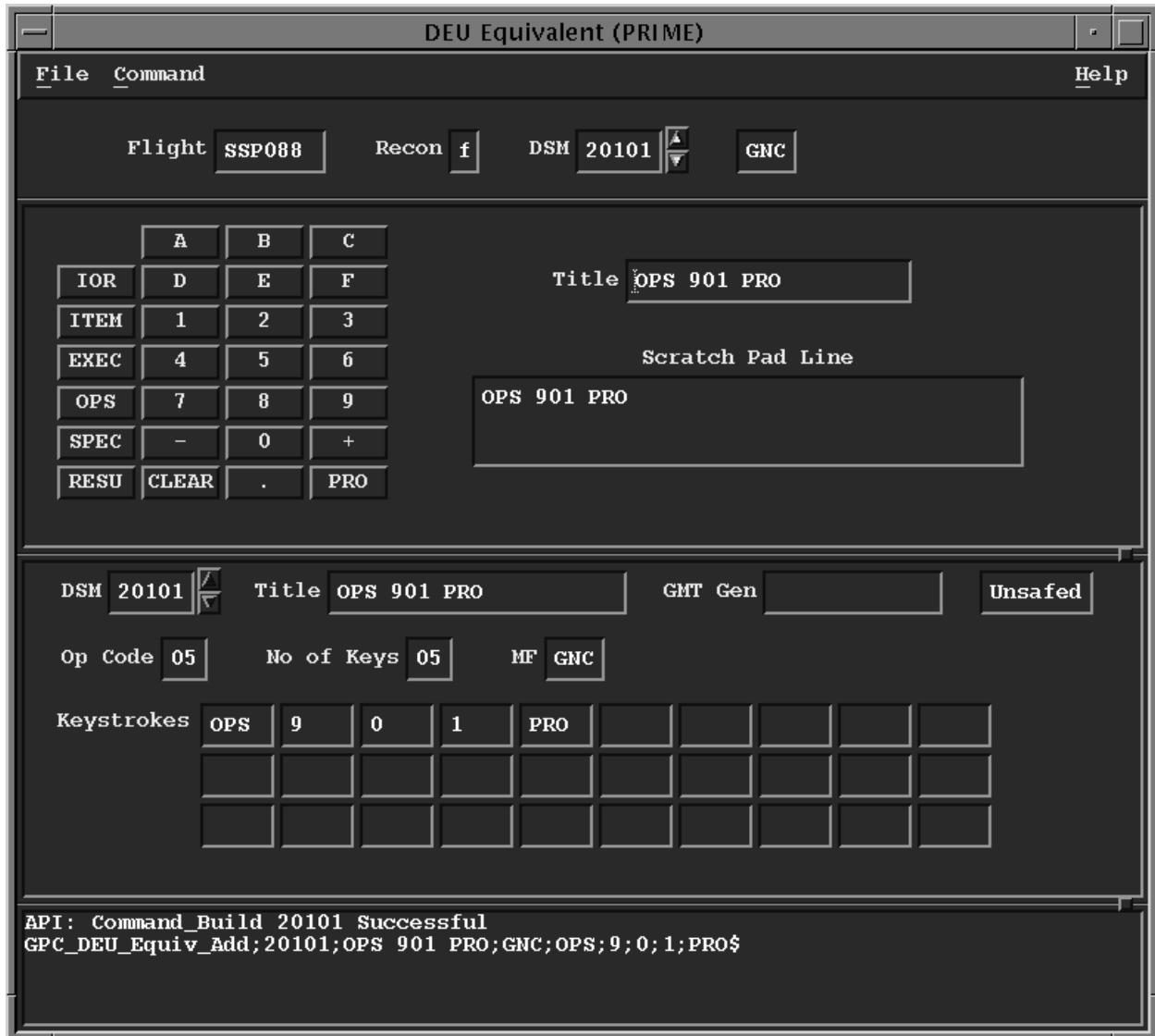
7.3G-8  
Verify that this is the correct version before use

### FILLING OUT THE DEU EQUIVALENT FORM (Figure 7.3G-1)

- A. Discipline and Originator - The FCOH acronym for the console position represented and the name of the requester.
- B. Flight ID - Specify numeric flight number.
- C. Date and Mission GMT - Specify calendar date and GMT at the time of request. If this is a pre-mission request (i.e., prior to prelaunch console manning), GMT is not required.
- B. PASS Major Function - Specify which major function will be affected by the DEU equivalents. DEU equivalents are not legal in BFS.
- C. PASS Major Mode - The major mode which is to be present (e.g., GNC 201; the major function is GNC, and the major mode here is 201).
- D. Requested Uplink Time - The desired uplink time or cueing mission event at which the user needs the DEU equivalent to be completed.
- E. Rationale / Objective - Explain what the DEU equivalent is intended to do (e.g., update master timing unit (MTU) MET; perform a dump which will be used in troubleshooting, etc.).
- F. Lines 1 through 15 - For each individual load, the requester should fill out the desired uplink GMT or MET (if applicable), the three- or four-digit SPEC number or major mode page to which the DEU equivalent is to be sent, and the keystroke groups in the manner they would be performed by a crew member. Thus, the requester must have a complete and syntactically correct keyboard statement. The maximum number of keystrokes which can be uplinked is 30. For example, a single keystroke would be "1," "OPS," or "ITEM." The Comments column should be used to clarify what the particular load is doing (i.e., loads an attitude, executes a maneuver, deselects an LRU, etc.).
- G. GMT Form Received/Approval By (**DPS completes**) - Self-explanatory.
- H. Target IDP (**DPS completes**) - IDP number to which the DEU equivalent is to be sent.
- I. DSM No. (**DPS completes**) - Each individual command load is assigned a specific DSM number in accordance with the appropriate format.
- J. Title (**DPS completes**) - Title to which each specific DEU load is given.



**BUILDING DEU EQUIVALENT LOADS**



**Figure 7.3G-2. DEU equivalent application**

- A. Start the DEU Equivalent application by selecting Command->Command Server->DEU Eq on the DPS DNAV. The DEU Equivalent application is shown in Figure 7.3G-2.
- B. Select File->New and GNC or SM as appropriate.
- C. The program displays the next available DSM number. If desired the user can select a different DSM number (201XX, where XX is 01 - 50).
- D. Enter a descriptive title in the Title text box. The title assigned usually includes the keyboard input for that DEU equivalent command.

- E. Use the graphical keypad in the DEU Equivalent application to enter the desired keystrokes. Use the 'Clear' key of the keypad to back up and erase any erroneous entries. Long sets of keystrokes will wrap around the scratch pad line window to the next line. If you enter too many items, you will not be able to place the terminator keystroke at the end of the entry. If this happens use the Clear key to shorten the scratchpad line, thus allowing room for the terminator key.
- F. Save the command by selecting File->Save and then send the load to the Command Server by selecting the Command->Send. The load must be saved before it can be transmitted to the Command Server.

### VERIFICATION OF DEU EQUIVALENT LOADS

The bottom half of the DEU Equivalent build page is used to verify DEU equivalent loads. Immediately after the load is sent to the Command Server, it will appear on the bottom half of the display (verification area). Additional DEU Equivalent loads in the command server can be viewed by scrolling to the desired DSM using the up and down arrow keys next to the DSM field of the verification area. The up/down arrows in the verification area are not active unless DEU Equivalent is in the 'Verify' mode. To put the application in the 'Verify' mode, select Command->Verify. The items that must be verified are:

- A. **OP CODE** is always equal to '05'.
- B. **NO OF KEYS** must equal the total number of keyboard pad entries entered.
- C. **MF** must equal the desired major function (GNC, SM, PL).
- D. **KEYSTROKES** match those requested on the DEU equivalent form.
- E. Verify that keystrokes are syntactically correct.
  - 1. Verify individual item entries are valid for the desired SPEC.
  - 2. Verify all ITEM entries are terminated by an EXEC.
  - 3. Verify all SPEC requests and OPS series are terminated by a PRO and that they only use three digits for the OPS MODE number.

The actual hex data words to be uplinked do not have to be verified but they can be if so desired by using the Command Data Words (CDW) application. For more information on starting and understanding the Command Data Words Application refer to SCP 7.1G.

- F. Interpretation of the individual bits in the command words is as follows. For additional information on the bit definitions, refer to the Space Shuttle Computer Program Development Specification (CPDS) SS Downlist/Uplink Software Requirements (SS-P-0002-140).

**COMMAND WORD 1**

Data words 1, 2 and 3 of the Command Data Word Application make up command word 1.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
VEH ADD			MF / GPC				OP CODE=0000101							1	0
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
MSG TYPE				K1	DEU ID			MODE	K2	RES	KB	SPARE			
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
SPARE										# OF KEYSTROKES					

- Bits 17-20 MESSAGE TYPE = 0000
- Bit 21 K1 = MESSAGE RESET = 0
- Bits 22-24 DEU ID = 001 (DEU 1), 010 (DEU 2), 011 (DEU 3), 100 (DEU 4)
- Bits 25-26 MODE SWITCH = 00 (PL), 01 (GNC), 10 (SM), 11 (illegal)
- Bit 27 K2 = ACKNOWLEDGE = 0
- Bit 28 Spare = 0
- Bit 29 KB = Keyboard data in message = 1
- Bits 30-32 Spare = 000
- Bits 33-42 Spare = 0000000000
- Bits 43-48 Number of keystrokes ≤ 30

**G. COMMAND WORDS (CW) 2 - 6**

Data words 4 and 5 of the Command Data Word Application make up CW 2, words 6 and 7 make up CW 3, and so forth.

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
KEYSTROKE CODE					KEYSTROKE CODE					KEYSTROKE CODE					0
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
KEYSTROKE CODE					KEYSTROKE CODE					KEYSTROKE CODE					0

- Bits 17-31 5-bit keystroke representations (see Space Shuttle Telemetry and Command Data Characteristics Handbook, vol. II, or the DPS Systems Brief on the MCDS. The number of these codes that are valid for a message is defined in bits 43 through 48 of command word 1. Unused keystroke codes must be filled with zeros.

32 Spare = 0

Bits 33-47 5-bit keystroke representations (see Space Shuttle Telemetry and Command Data Characteristics Handbook, vol. II, or the DPS Systems Brief on the MCDS. The number of these codes that are valid for a message is defined in bits 43 through 48 of command word 1. Unused keystroke codes must be filled with zeros.

48 Spare = 0

## **REFERENCES**

1. NSTS DL/UL CPDS, SS-P-0002-140.

TITLE

RESERVED

**TITLE**

SCP Verifier: \_\_\_\_\_  
Facility: \_\_\_\_\_ Date: \_\_\_\_\_

MMU OPS (READ/MERGE/WRITE, COMPARE, DUMP) (Command Server)

**PURPOSE**

This procedure contains the instructions for DPS to build MMU command loads. The MMU read, merge, and write loads are used to change the data on the MMUs, perform MMU 1 and MMU 2 compares, and perform MMU dumps. These loads are legal only in PASS S2, S4, and PL9. These MMU loads are not valid via BFS uplink; however, BFS software can be patched on the MMU in S2, S4, or PL9 if necessary.

The capability exists to read and/or write data to and from the orbiter mass memory unit (MMU) in MMU blocks of 512 words. Therefore, whenever it is necessary to modify the contents of the MMU, a minimum of 512 words must be read from the MMU and subsequently written back to the MMU. Thus, additional capabilities exist to facilitate the operation of writing less than 512 words to the MMU. These capabilities are reflected in the following procedures. The write to the MMU is accomplished in the following manner: 512 words are read into the modification buffer. The data to be patched (<512 words) is "merged" into the data within the mod buffer (overwriting only the data to be patched with new data). The new set of 512 words is then written from the mod buffer to the MMU. The same block is then read from the MMU into another buffer, and the two buffers are compared for a verification of a "good" write. The read, merge, and write commands are contained in separate command loads. To date an MMU patch has never been performed in flight.

**RESTRICTIONS/CONSTRAINTS**

**CAUTION**

This procedure is governed by FCOH 3.1, 3.2.2, 3.2.3, and 3.3.3 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

A. PASS Onboard Software Command Legality Tables

MC (MF/OPS) or GPC ID	CMD Legal
MC0 (OPS 0)	
MC1 (GNC 1/6)	
MC2 (GNC 2)	
MC3 (GNC 3)	
MC4 (SM 2)	X
MC5 (SM 4)	X
MC6 (PL9)	X
MC8 (GNC 8)	
MC9 (GNC 9)	

B. Valid OI Loads

All PASS, no BFS.

C. Vehicle and LRU/Hardware Version Constraints

None.

D. Time Constraints And Crew Coordination Requirements

The crew should not use the MMUs (SM checkpoints, roll-in displays, TFL/DFL changes, OPS transitions) while these loads are being uplinked and processed onboard.

E. Hazard/Safety Implications

Although procedures for MMU patch uplink capability exist, this feature currently is prohibited by STS Operations Flight Rules (JSC-12820, Flight Rule A7.1.3-6E). Improper application of this procedure could pollute the MMU contents in real time because of lack of appropriate time to permit verification and testing.

F. Other Requirements

Only contiguous patches can be included in a specific uplink load; i.e., separate merge loads must be built for "scatter" patches. If the patch or dump is  $\leq 2048$  words, then either an SM GPC or PL9 GPC can be utilized to perform the patch or dump. If a patch or dump is  $> 2048$  words, only a PL9 GPC can be utilized. Note that a crewmember can use the MASS MEMORY R/W display (SPEC 85) to perform a MMU scatter patch.

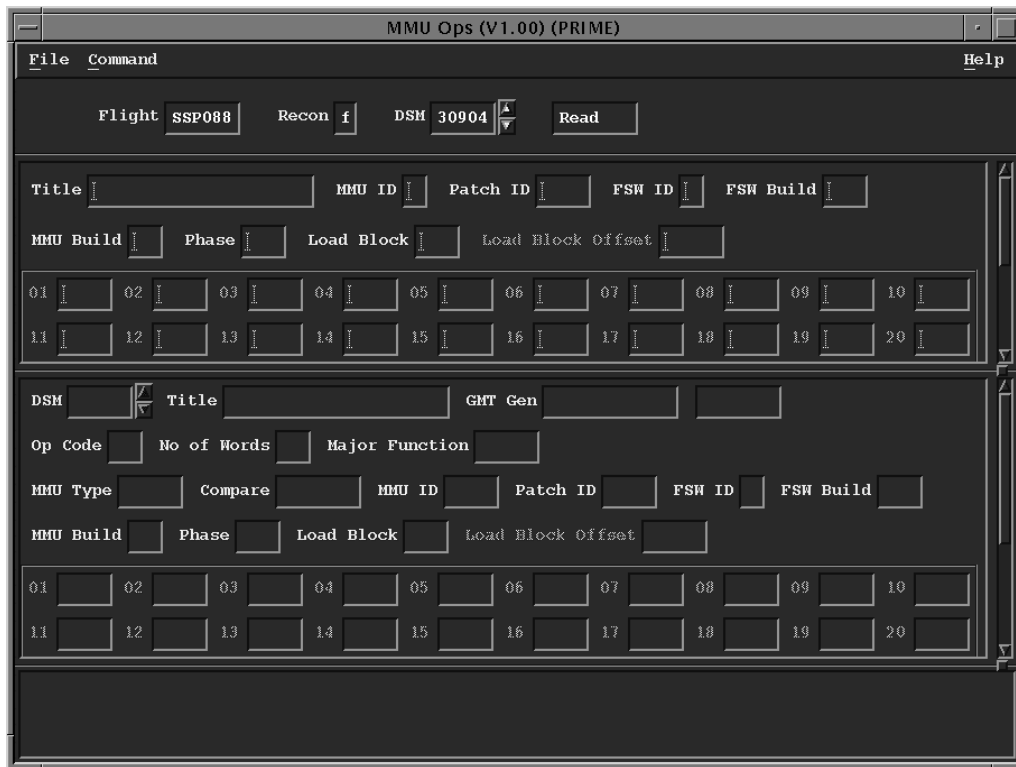
**PROCEDURE**

Permission for any MMU modifications must be authorized by the Flight Director and other appropriate management per FCOH SOP 3.3.2. Recommendations for such

operations must be coordinated between the DPS Officer, SPAN, and the MER and requires an official MAR (CHIT). DPS, SPAN, and the MER jointly develop software patch requirements. The MER coordinates patch generation with SAIL or SPF (see FCOH 3.3.2). The patch details can be provided in a memorandum utilizing the Universal Patch Format (UPF) listing with the necessary authorization clearly indicated. The official MMU patch is provided to DPS via a paper copy of the UPF listing. Downey personnel are usually given the task of writing the UPF listing. SPF UPF tapes are no longer utilized.

For MMU patches and any single operation:

- A. DPS builds the patch via the MMU Ops application. Due to inability for transferring MMU patches via UPF tapes, DPS will build the MMU patches via a paper copy of the UPF formatted memo regardless of the size of the patch.



**Figure 7.5G-1. MMU OPS display**

- B. Command Server processing converts this information to uplink load format that is displayed on the bottom portion of the MMU Ops display.
- C. DPS/DPS SPT verify the MMU command load contents via a comparison of the MMU load paperwork and the MMU Ops display.



- D. DPS and INCO coordinate the uplink of the required loads to the orbiter.
  - 1. DPS generates a flight note for all command load uplinks (submit to INCO and FD).
  - 2. DPS obtains a GO for command uplink from the flight director.
  - 3. If required, the loads are unsafed in the Command Server.
  - 4. DPS coordinates command uplink with INCO.
    - DPS gives a separate GO for each load and INCO uplinks the load on DPS GO
    - DPS reads major function and DSM number(s) to INCO
    - INCO provides a read back of all information to verify proper communication
  - 5. DPS/DPS Support verifies uplink using the Command Tracking application.
- E. Only a single MMU should be patched until after verification of a successful patch.

**GENERAL**

A. General Information

DSM Numbers

<u>Load</u>	<u>DSM</u>	<u>Directive ID</u>	<u>OPS Available</u>
MMU-READ	30901-30950	GPC_MM_RWM_Add	S2,S4,PL9
MMU-MERGE	31101-31150	GPC_MM_RWM_Add	S2,S4,PL9
MMU-WRITE	31501-31550	GPC_MM_RWM_Add	S2,S4,PL9

LOAD TYPE (READ/WRITE/MERGE/COMPARE/DUMP)

The type of load will be displayed to the right of the DSM number in the header portion of the MMU Ops application. The type of command load being built should be selected via the DPS Command (DPS CMD) MMU Ops menu. If a load is being verified, the type of load can be determined by the Op Code.

MMU ID - 1 or 2

PATCH ID - PATCH ID is hex and is placed on each patch for ground configuration control tracking. The patch ID is written onto the MMU tape after the entire patch is completed. Each merge and write command within a read/merge/write patch operation must contain the same PATCH FSW ID (SYSTEM ID on UPF).



- Phase and load block information found in MM BUILD LISTINGS flight software CD
- System 4
  - BFS
  - 2 phases that represent 2 copies
  - Each phase has 15 load blocks
  - Contact MM build managers for details of phase and load block CSETs; a load map listing will provide these details
- System 5
  - DEU
  - P1/LB1 is the DCP (copy 1)
  - P1/LB2 is the SASTP (copy 1)
  - P1/LB3 is the CF (copy 1)
  - P2/LB1 is the DCP (copy 2)
  - P2/LB2 is the SASTP (copy 2)
  - P2/LB3 is the CF (copy 2)
  - P3/LB1 is the DCP (copy 3)
  - P3/LB2 is the CF (copy 3)
- System 6
  - SSME (ILLEGAL OI-28 and SUBS)
  - One phase representing one copy
- System 7
  - TCS sequences
  - One phase
  - 26 load blocks

LOAD BLOCK OFFSET - Used for merge commanding only. LOAD BLOCK OFFSET is a decimal input that specifies the point in the load block to start incorporating the patch. Range is 0 to 16382 (decimal) for PL9 and 0 to 2046 (decimal) for SM2 and SM4. The first word in a load block is defined as an offset of zero.

LOAD WORDS (01 - 60) - This is the data to be written onto the MMU provided in hexadecimal. There is a maximum of 60 words per load. Only 20 of the 60 words are visible on the MMU Ops display at a given time. Use the vertical scroll bar to view the remainder of the MMU load words.

## B. Load Descriptions

### 1. Read/merge/write loads

Read/merge/write loads should be sent to both MMUs; hence, a set of read/merge/write loads for each MMU must be generated using the information on the UPF listing and/or on the patch memorandum. These loads are legal only in S2, S4, and PL9. It should be noted that these loads have not been utilized up through STS-91 and will have extremely high visibility in the operational environment if ever uplinked.

FCOH SOP 3.3.2 explains the coordination involved for a real-time MMU patch.

• DSM NUMBER -	Refer to list in GENERAL INFORMATION section.
• Title -	SEQ # - #: MMU # <i>CMD TYPE</i> (ex. SEQ 05-121: MMU 1 WRITE)
• MMU ID -	1 or 2 as desired (N/A for merge commands)
• Patch ID -	Refer to UPF line type B
• FSW ID -	Refer to UPF line type C
• FSW Build -	Refer to UPF line type C
• MMU Build -	Refer to UPF line type C
• Phase -	Refer to UPF line type C
• Load Block -	Applicable for merge commands only
• Load Block Offset -	Refer to UPF line type E (Applicable for merge commands only)

See Figure 7.5G-2 for an example of a typical UPF and reference Appendix I.

When an MMU read load is processed, the GPC ships the requested data from the MMU into the SM common buffer. The merge load is then processed, and the patch data is “merged” with the data (modifies the pertinent data) in the common buffer. The write load is then processed, writing the merged data back to the MMU.

2. Compare Loads

If a compare of the data on MMU 1 and on MMU 2 is desired, the DPS/DPS Support operator must determine the parameters without using the UPF listing.

• DSM NUMBER -	Refer to list in GENERAL INFORMATION section.
• Title -	SEQ # - #: MMU # COMPARE (ex. SEQ 05-121: MMU 1 COMPARE)
• MMU ID -	1 or 2 as desired (N/A for merge commands)
• Patch ID -	Not Applicable
• FSW ID -	Refer to the GENERAL LOAD BUILD INFORMATION section in SCP 7.1 or Flight specific MMU Program Release Notice (PRN); MMU PRN identifies FSW ID as UPF SYS ID
• FSW Build -	Not Applicable
• MMU Build -	Not Applicable
• Phase -	Refer to the GENERAL INFORMATION section
• Load Block -	Refer to the GENERAL INFORMATION section
• Load Block Offset -	Not Applicable

3. Dump Loads

When only an MMU dump is desired, the DPS/DPS Support operator must determine the parameters for the MMU Ops display without the UPF listing.

• DSM NUMBER -	Refer to list in GENERAL INFORMATION section.
• Title -	SEQ # - #: MMU # DUMP (ex. SEQ 05-121: MMU 1 DUMP)
• MMU ID -	1 or 2 as desired (N/A for merge commands)
• Patch ID -	Not Applicable
• FSW ID -	Refer to the flight specific MMU Program Release Notice (PRN); MMU PRN identifies FSW ID as UPF SYS ID
• FSW Build -	Not Applicable
• MMU Build -	Not Applicable
• Phase -	Refer to the GENERAL LOAD BUILD INFORMATION section in SCP 7.1
• Load Block -	Refer to the GENERAL LOAD BUILD INFORMATION section in SCP 7.1
• Load Block Offset -	Not Applicable

Immediately following the dump load process by SM 2/4 or PL9 GPC, the data will be shipped to the ground via SM or PL downlist. The DPS/DPS Support operator should check with INCO/INST to ensure that the telemetry format load (TFL) will support such a dump. The dump data can be viewed via the GPC DUMP application.

**VERIFICATION OF MMU LOADS**

A. MMU OPS Command Verification

For MMU OPS command verification. The load must be saved on the workstation and subsequently sent to the command server. Once in the command server, it can be verified via the bottom portion of the appropriate MMU Read, MMU Write, MMU Merge, MMU Compare, or MMU dump application window. If all of the values in the bottom window match the values input in the top half of the window, the load is accurate.

In addition, all DPS operators are responsible to ensure that the information utilized for building the load matches the UPF listing. Not all of the fields are valid for every load. Only verify the fields that are applicable to the type of MMU OPS command being verified.

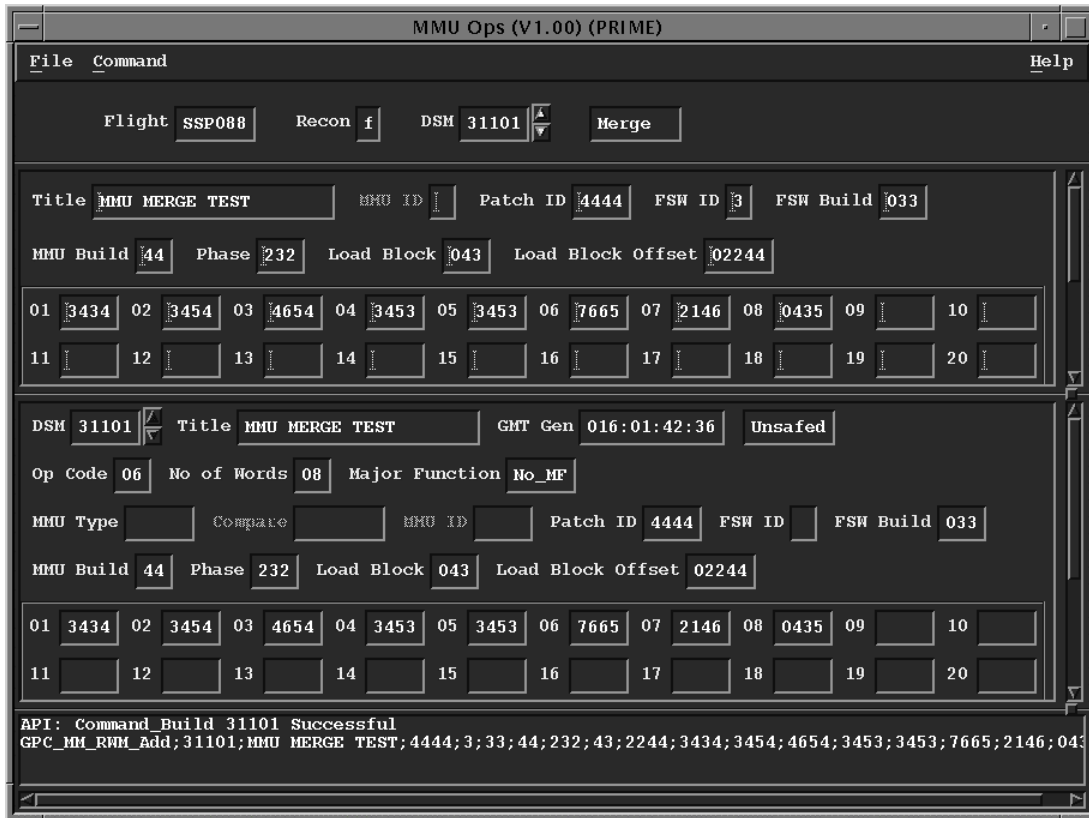
1. TITLE: (User defined)
2. MMU ID: Targeted MMU for command (1 or 2)
3. PATCH ID: See PATCH ID number on UPF.

The PATCH ID should match exactly what is indicated in the UPF listing. For instance, if the PATCH ID on the UPF is 1026, the PATCH ID word should also be 1026; these values are both in hex.

4. FSW ID: Reflects flight S/W ID; see FSW system number on UPF.

0 - Display text and graphics	4 - BFS
1 - PASS 1	5 - DEU
2 - PASS 2	6 - SSME (ILLEGAL OI-28 AND SUBS)
3 - PASS 3	7 - TCS sequences

5. FSW BUILD: This decimal number should match the MM VER on the UPF.
6. MMU BUILD: This decimal number should match the MM VER on the UPF.
7. PHASE: First 3 decimal digits (before .) of the PHASE.LB number on the UPF.
8. LOAD BLOCK: Last 3 decimal digits (after .) of the PHASE.LB number on the UPF.
9. LOAD BLOCK OFFSET: Matches exactly the hexadecimal OFFSET value on the UPF.
10. DATA WORDS: Match exactly the hexadecimal data words on the UPF listing.



**Figure 7.5G-3. MMU OPS Application in Verify Mode**

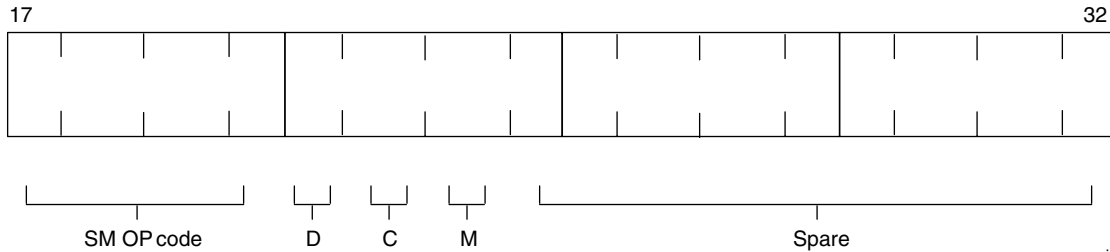
**B. Command Server Word/Bit Definitions**

If bit level verification of the command procedure is required, utilize the Command Data Words application. The Command Data Words application can be found under the Global Apps/Command Server/TELCOM/Prime menu for verification. Verify utilizing the following bit definitions:

The following information describes how to decode and verify the MMU ID, PATCH ID, MMU BUILD, and PHASE/BLOCK words on the MMU read/write/merge MSKs or Command Data Words Application. The decoding for the two additional command words on the MMU merge MSKs (namely, BLOCK OFFSET, and NO WORDS) are also included. Words 08 - 67 on the MMU command on the Command Data Words application merge window are the contents of the merged data and should match the CONTENTS words on the UPF.

For a merge load, CW 1's MM ID (bit 23) will remain zero because the onboard merge software was coded to not care about this bit. Only the read and write software utilize this bit. From a historical perspective, this unexpected condition resulted because IBM wrote both the onboard and the ground software; knowing the implementation of both, IBM optimized the code accordingly. Although you expect the dump option (bit 21) and the compare option (bit 22) to be zero for a merge operation, it should be noted that these bits are also not considered by the onboard merge software.

1. MMU ID (defined in bits 17-32 of CW 1)



j\_18819\_17

SM OP code      1010 for read load block  
                   1011 for merge data into load block  
                   1100 for MMU write

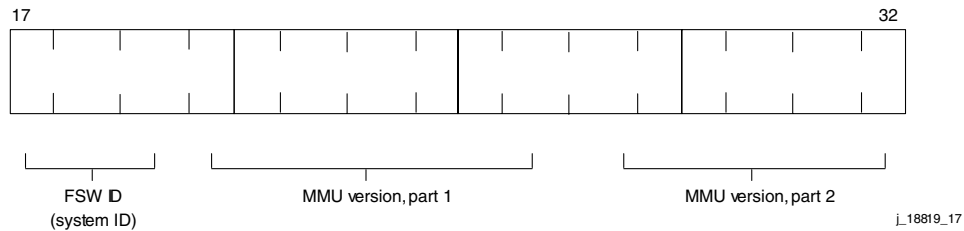
D : 1 if MMU dump is desired; otherwise, 0.  
 C : 1 if MMU compare is desired (SM OP code must be 1010); otherwise, 0.  
 M : Indicates which MMU is affected - (0 for MMU 1, 1 for MMU 2).

2. PATCH ID (defined in bits 33-48 in CW 1)

The PATCH ID should match exactly what is indicated in the UPF listing. For instance, if the PATCH ID on the UPF is 1026, the PATCH ID word should also be 1026; these values are both in hex.



3. MMU Build (defined in bits 17-32 of CW 2)

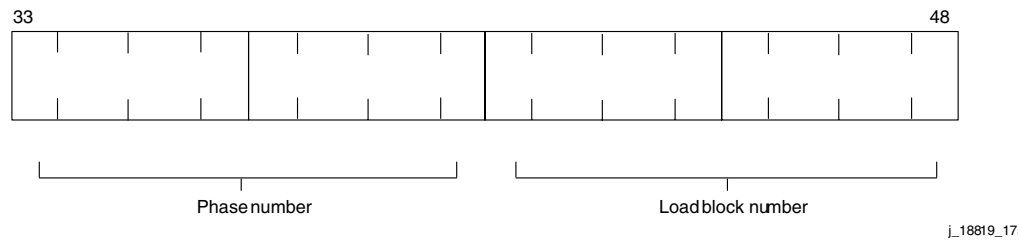


FSW ID: Reflects flight S/W ID; see FSW system number of UPF.

000	-	Display text and graphics	100	-	BFS
001	-	PASS 1	101	-	DEU
010	-	PASS 2	110	-	SSME (ILLEGALOI-28 AND SUBS)
011	-	PASS 3	111	-	TCS sequences

MMU versions: Reflect MMU version numbers; see MMU ver number on UPF. This number is in the format XXX.YY. XXX is the part 1 number; YY is the part 2 number.

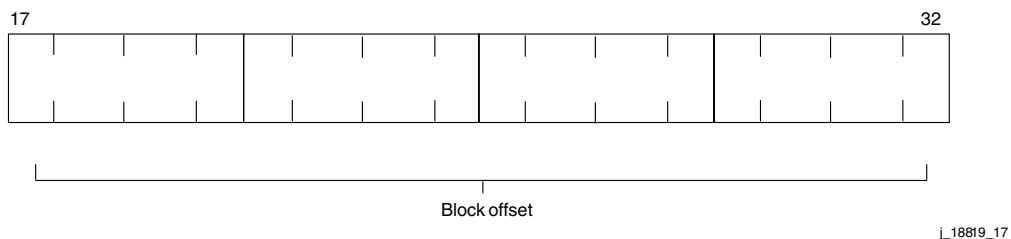
4. PHASE/BLOCK (defined in bits 33-48 of CW 2)



Phase number: In hex, matches phase number on the UPF.

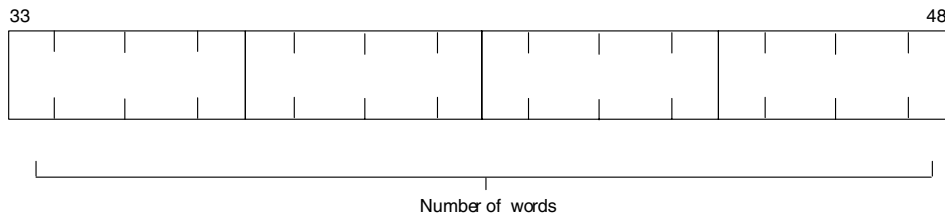
Load block number: In hex, matches load block number on the UPF.

5. BLOCK OFFSET (defined in bits 17-32 of CW 3)



Block offset: In hex, this number specifies the point in the load block to start incorporating the patch. Range is 0 to 16382<sub>10</sub> for PL 9, and 0 to 2046<sub>10</sub> for SM 2/4 (the first word in a load block is defined as an offset of zero). This number matches the offset number on the UPF.

6. NO WORDS (defined in bits 33-48 of CW 3)



j\_18819\_17

Number of words: In hex, this is the number of patch data words within the merge load; this number matches the NUMBER value on the UPF. The total number of words in an uplink load shall not exceed the size of the two-stage buffer.

### COMMAND SERVER CLEAN UP

After completion and verification of the MMU command load operations and if not expected to be used again, all associated loads should be deleted from the Command Server by DPS/DPS SPT.

### REFERENCES

1. **(update this reference)** Command and Control Subsystem (CCS) Control User's Guide (part 3: MEDLIST), STSOC-UD-600315, contract NAS9-18000, IRD-E-1329T.
2. Flight Control Operations Handbook (FCOH), Shuttle Operations Support, Final, rev B, sec. 3.3.2, July 31, 1996.
3. Uplink/Downlist Computer Program Development Specifications (CPDS), S-P-0002-140T, OI-25, secs. 5.5.4, and 6.3.4, Oct. 1995.
4. Data Processing Systems Console Handbook, appendix I, Universal Patch Format.

**TITLE**

SCP Verifier: \_\_\_\_\_  
Facility: \_\_\_\_\_ Date: \_\_\_\_\_

PASS VARIABLE PARAMETERS (Command Server)

**PURPOSE**

This SCP provides information relevant to Variable Parameter (VP) processing both onboard and in the MCC. For general information regarding commanding, refer to FCOH 3.2.2. For additional information regarding GPC memory read/write, refer to FCOH 3.3.4.

**RESTRICTIONS/CONSTRAINTS**

CMD CR# Baseline

DATE: 11/12/87

**CAUTION**

This procedure is governed by FCOH procedures 3.1 and 4.8, and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

A. Onboard Software Command Legality Tables<sup>1</sup>

1. PASS

MC (MF/OPS) or GPC ID	CMD legal
MC0 (OPS0)	X
MC1 (GNC1/6)	X
MC2 (GNC2)	X
MC3 (GNC3)	X
MC4 (SM2)	X
MC5 (SM4)	X
MC6 (PL9)	X
MC8 (GNC8)	X
MC9 (GNC9)	X
GPC ID	X

2. BFS - N/A

B. Valid OI Loads

All.

C. Vehicle, LRU/Hardware Version Constraints

None.

**D. Time Constraints, Crew Coordination Requirements**

None.

**E. Hazard/Safety Implications**

1. Flight controllers occasionally use VPs to aid them in assessing the health of their systems, verification of the VP addresses are critical.

**F. Other Requirements**

1. VP addresses are stored in systems software in each GPC. When changing downlisters, the VPs seen on the ground reflect the new downlist GPC image.
2. All GPCs in a Redundant Set (RS) will receive a VP update. However, a GPC added to the RS after a VP update will not have the update resident.
3. An IPL'd GPC has fill data in the VP slots (C6C6).
4. Only addresses in memory sectors 0 and 1 (i.e., five-digit addresses with a leading digit of zero) can be put into the VP downlist.

- |   |
|---|
| <ol style="list-style-type: none"><li>5. Chaining loads will cause all loads in the chain to go to the same major function.</li></ol> |
|---|

**DESCRIPTION**

Each major function has an array of 10 half words dedicated to the variable downlist. Each entry in the array is a 16-bit memory address. The contents of these addresses will be downlisted for MCC consideration. Because the address is only 16 bits, only memory locations in sectors 0 and 1 can be accessed through the variable downlist.

The individual VP slots are not all downlisted in the same frame. Slots 1 and 8 are downlisted in frame 7. Slots 2 and 7 are in frame 8; 3 and 6 in frame 11; and slots 4 and 5 in frame 10. VP slot 9 is in frame 6, and slot 10 is in frame 5. The above is true for GNC, SM, and Ops 0. Consideration might be given to keep very dynamic data grouped together to ensure a time homogenous sample. That is, a 32-bit parameter could use slots 7 and 8 to ensure that all the data is in the same downlink frame.

The 10-element VP array exists in two places in GPC memory: in the downlist compool for downlisting and in the display area of SPEC 1 for display purposes. Both of these locations exist in systems software. Therefore, VP addresses are carried forward across OPS transitions. The addresses themselves may reference a location in systems software, major function base, or OPS overlay. Although the address itself does not change with an OPS transition, the parameter that the address is referencing may change.

The VPs are not initialized by systems software. This means the address in a VP slot must be manually changed in one of two ways: via uplink or via crew inputs to SPEC 1.

The DPS console position has the authority to allocate the 10 VP slots among the MCC disciplines, as necessary.

For further information on crew and MCC displays as well as details on VP scaling, see the Displays and Variable Parameter Scaling sections at the end of this SCP.

**PROCEDURE** (For additional information, see FCOH 4.8.)

**CAUTION**

Safety-critical steps are outlined with boxes.

- A. DPS/DPS SPT receive **three copies** of the Variable Parameter Display Request form (Figure 7.6-1) from the requesting discipline.
- B. It is the requesting discipline's responsibility to provide any required scaling coefficients. If work load permits, DPS SPT can provide some assistance.
- C. DPS and DPS SPT notify each other that a VP is in work on DPS MPSR.
- D. Verify address in the memory map and/or global symbol dictionary (refer to SCP 1.8 for more information). Only addresses in memory sector 0 and 1 (i.e., four hex digits) can be VP'd.
- E. DPS and DPS SPT determine which VP slot(s) to use. Coordinate with other users and/or Flight to resolve competition for use of VP slots.  
  
\*Note: All slots may be used to scale floating point numbers.
- F. DPS SPT completes the VP form (Figure 7.6G-1) with the following information:
  - 1. Slot number(s)
  - 2. Title

VARIABLE PARAMETER DISPLAY REQUEST (Submit 3 copies to DPS SPT)					
REQUESTING DISCIPLINE:	NAME:	GMT: _____			
MAJOR FUNCTION/OPS: <input type="checkbox"/> GNC 1 <input type="checkbox"/> GNC 8 <input type="checkbox"/> SM 2 <input type="checkbox"/> BFS <input type="checkbox"/> GNC 2 <input type="checkbox"/> GNC 9 <input type="checkbox"/> SM 4 <input type="checkbox"/> GNC 3		COVERAGE: <input type="checkbox"/> SNAPSHOT(S) OF DATA <input type="checkbox"/> MONITOR FOR A SPAN OF TIME		RETENTION: <input type="checkbox"/> CURRENT FLIGHT/SIM ONLY <input type="checkbox"/> ALL FLIGHT/SIMS	
SPECIFY COVERAGE: (Reference specific events or GMT's)					
FROM: _____			TO: _____		
HAL NAME	ADDRESS	MSK 1352 (1)			SLOT (3)
		K	BIAS	TYPE (2)	
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
RATIONALE:					
TITLE: (3) _____					DSM: (3) _____
NOTES:					DPS SIGNATURE: (3)
(1) Optional Fields - required for viewing on MSK 1352. (2) Type is FXS (fixed-point) or FLS (floating-point) (3) DPS usage only					_____
JSC Form 1401 (Rev Mar 93)					NASA-JSC

Figure 7.6G-1. Variable parameter display request form

7.6G-4  
Verify that this is the correct version before use

3. DSM number (230xx)
4. Signature

Send one copy to DPS and one copy to the originator of the request.

**G. Build and verify the VP load**

1. Start the Variable Parameters application by selecting Command->Variable Parameter on the DPS DNAV. The Variable Parameter application is shown in Figure 7.6G-2.
2. When started, the Variable Parameter application will automatically select the flight ID for the activity that was selected during activity selection. If the flight selected is not the desired flight, change it via the File->Change Flight pull down menu.
3. To build a new VP, select new from the File menu and then select PASS. The next available DSM number will be automatically selected. If the desired DSM number does not appear, you may type it in. If a modification to an existing load is desired, select File->Open and then, using the arrow buttons next to the DSM number, select the DSM number of the load you wish to modify.
4. Enter a title and then for each desired VP slot (1 through 10), enter the following

RQST - requesting discipline  
Address  
Description  
HAL name

5. Save the load by selecting Save from the File menu

Variable Parameters (PRIME)

File Command Help

Flight  Recon  DSM

Title

Rqst	Slot	Address	Description	HAL Name
<input type="text" value="DPS"/>	<input type="text" value="01"/>	<input type="text" value="26C7"/>	<input type="text" value="PRI/SEC PORT SEL"/>	<input type="text" value="CZ2B_MODE"/>
<input type="text" value=""/>	<input type="text" value="02"/>	<input type="text" value="0E2B"/>	<input type="text" value="CRT I/O ERROR FLAG"/>	<input type="text" value="DMIB_ERR_MSG"/>
<input type="text" value=""/>	<input type="text" value="03"/>	<input type="text" value="959E"/>	<input type="text" value="GPC SYNC FAIL POINTER"/>	<input type="text" value="FC\$\$FAIL (15TH WD)"/>
<input type="text" value=""/>	<input type="text" value="04"/>	<input type="text" value="26C9"/>	<input type="text" value="MMU ASSIGN GNC MF"/>	<input type="text" value="CZ2B_MM_MF (2ND WD)"/>
<input type="text" value=""/>	<input type="text" value="05"/>	<input type="text" value=""/>	<input type="text" value="OPEN"/>	<input type="text" value=""/>
<input type="text" value="PROP"/>	<input type="text" value="06"/>	<input type="text" value="F208"/>	<input type="text" value="OMS FLAG"/>	<input type="text" value="CGRB_OMS_FDI_FLAGS"/>
<input type="text" value="GPO"/>	<input type="text" value="07"/>	<input type="text" value="F3D0"/>	<input type="text" value="COMPUTED TARGET HP"/>	<input type="text" value="CGZV_TGT_HP (1ST WD)"/>
<input type="text" value=""/>	<input type="text" value="08"/>	<input type="text" value="F3D1"/>	<input type="text" value="COMPUTED TARGET HP"/>	<input type="text" value="CGZV_TGT_HP (2ND WD)"/>
<input type="text" value=""/>	<input type="text" value="09"/>	<input type="text" value="5712"/>	<input type="text" value="IGHT_DISP (2ND WD)"/>	<input type="text" value="CGZV_WEIGHT_DISP (1ST WD)"/>
<input type="text" value=""/>	<input type="text" value="10"/>	<input type="text" value="5713"/>	<input type="text" value="VEHICLE WEIGHT"/>	<input type="text" value="CGZV_WEIGHT_DISP (2ND WD)"/>

DSM  Title  GMT Gen

Op Code  No of Words

01 02 03 04 05 06 07 08 09 10

Addr

Figure 7.6G-2. Variable parameters application

7.6G-6  
Verify that this is the correct version before use



- H. If the slots needed for the new parameter are currently in use, notify the appropriate disciplines that the data in those slots will no longer be valid.
- I. Transmit VP load to the command server by selecting Send on the Command menu.

DPS and DPS SPT verify the load by using the bottom half of the Variable Parameter application. Immediately after the load is sent to the Command server, it will appear on the bottom portion of the display (verification area). Additional VP loads in the command server can be viewed by scrolling to the desired DSM using the up and down arrow keys next to the DSM field of the verification area. The up/down arrows in the verification area are not active unless the Variable Parameters application is in the Verify mode. To put the application in the Verify mode, select Command->Verify.

Verify that the addresses are correct and that they are listed under the appropriate VP slot number. Although not required, the actual hex data words to be uplinked can be verified by using the Command Data Words (CDW) application. For more information on starting and understanding the Command Data Words Application refer to SCP 7.1G. Interpretation of the individual bits in the command words is as follows. For additional information on the bit definitions refer to the Space Shuttle Computer Program Development Specification (CPDS) SS Downlist/Uplink Software Requirements (SS-P-0002-140).

If the load will not be uplinked in the near future, save the load in the command server (refer to FCOH 3.1.4 for details).



Data words 4-21: (repeat words 2 and 3 successively)

- J. Generate and distribute a Flight Note to INCO and FLIGHT DIRECTOR specifying:
1. PASS VP
  2. DSM number
  3. Major function
  4. Rationale for load
- K. DPS get a GO from Flight to uplink the VP. If the load had been previously safed, then unsafe the load.
- DPS coordinates uplink with INCO for prelaunch VPs, and VPs associated with GMEMs. Otherwise, DPS SPT coordinates uplink with INST.
- During coordination, inform INCO/INST that a GO has been given by the Flight Director, provide the load type (VP), DSM number (230xx), and major function (SM, GNC) and require a readback for verification.
- L. Verify that the uplink completed successfully and went to the correct major function by monitoring the Command Tracking application. For more information on starting and understanding the Command Tracking application refer to SCP 7.1G. Also monitor the appropriate loop for uplink verification from INCO/INST.
- M. Build VP scaling for required slot(s).
1. Start the Variable Parameter (VP) Scaling application selecting VP scaling from the Apps menu on the DPS DNAV. The VP Scaling application is shown in Figure 7.6G-3.
  2. If a file that contains the desired scaling already exists, retrieve and transmit it to the appropriate major function:
    - a. Select Open under the File menu and a file selection dialog will appear.
    - b. Select the desired file, then select OK (or double click on the file name).
    - c. After verifying the data, select Transmit under the File pulldown menu, then select the desired major function.

3. If a file with the desired scaling does not exist, build and transmit a new one.
  - a. Select New under the View pulldown menu. An empty input screen will appear (Figure 7.6G-4).
  - b. Enter the parameter description (or the requesting discipline) in the nomenclature column.
  - c. Enter the appropriate conversion type, signed or unsigned integer, 32- or 64-bit float (Figure 7.6G-5).

Signed and unsigned integers require one or two VP slots to be selected, one slot if a 16-bit word and two slots if a 32-bit word. Thirty-two-bit floating point numbers require two VP slots to be selected. Sixty-four-bit floating point numbers require four VP slots to be selected.

- d. Select the desired VP slots that contain the data to be scaled (highlighted white). For a 16-bit signed or unsigned integer, select "none" in the leftmost highlighted column and the VP slot to be scaled in the rightmost. For 32-bit signed, unsigned, or floating point, enter the first VP slot in the leftmost highlighted column and second VP slot in the rightmost. For 64-bit floating point, enter the VP slots in the sequence from left to right.
- e. Enter K ( $A_1$ ) and bias ( $A_0$ ) for each affected slot.
- f. Transmit the load.
  - (1) Select Transmit from the File menu.
  - (2) Select the desired major function.
  - (3) After the load has been transmitted to the appropriate major function, select the major function from the View menu to verify the VP load and its associated scaling (Figure 7.6G-3).

N. Notify the requester that the VP has been uplinked.

#### CLEANUP

- A. If the VP load will not be used again, delete it from the command server but leave on the workstation.
- B. If the VP load might be used again, save the load (refer to FCOH 3.1.4) and leave it in the command server.

SSP088 VARIABLE PARAMETER SCALING v01.03.00						
File View Transmit Help						
Selection	OGMT	OMET	GNC	SH	OI	
GNC	346/19:36:33S	009/09:52:30S	22S	24S	188S	
Raw VP	Nomenclature	Cnv Type	Slot Input	K (A1)	Bias (A0)	Eng Units
1	7C00S PRI/SEC Port Select			0.0000E+00	0.0000E+00	0.0000E+00S
2	0000S MMU Assigned GNC MF			0.0000E+00	0.0000E+00	0.0000E+00S
3	8F9FS GPC SYNC Fail Pointer			0.0000E+00	0.0000E+00	0.0000E+00S
4	4000S -Z Star Tracker			0.0000E+00	0.0000E+00	0.0000E+00S
5	4000S -Y Star Tracker			0.0000E+00	0.0000E+00	0.0000E+00S
6	0000S OMS FDI Flag			0.0000E+00	0.0000E+00	0.0000E+00S
7	2000S CRT I/O Error Flag			0.0000E+00	0.0000E+00	0.0000E+00S
8	0016S OPEN			0.0000E+00	0.0000E+00	0.0000E+00S
9	453AS Vehicle Weight	32 bit f	9:10:0:0	1.0000E+00	0.0000E+00	2.4029E+05S
10	A9EAS Vehicle Weight			0.0000E+00	0.0000E+00	0.0000E+00S

Figure 7.6G-3. VP scaling display screen (GNC)

SSP088 VARIABLE PARAMETER SCALING v01.03.00								
File View Transmit Help								
	Nomenclature	Conversion Type	VP Slot Inputs				K (A1)	Bias (A0)
			MSB's	LSB's				
1		none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>		
2		none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>		
3		none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>		
4		none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>		
5		none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>		
6		none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>		
7		none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>		
8		none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>		
9		none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>		
10		none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>		

Figure 7.6G-4. Blank VP scaling input screen

SSP088 VARIABLE PARAMETER SCALING v01.03.00									
File View Transmit Help									
Nomenclature		Conversion	VP Slot Inputs				K(A1)	Bias(A0)	
		Type	MSB's		LSB's				
1	PRI/SEC Port Select	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>			
2	MMU Assigned GNC MF	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>			
3	GPC SYNC Fail Pointer	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>			
4	-Z Star Tracker	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>			
5	-Y Star Tracker	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>			
6	OMS FDI Flag	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>			
7	CRT I/O Error Flag	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>			
8	OPEN	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>			
9	Vehicle Weight	32 bit float <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	1.000000	0.000000	
10	Vehicle Weight	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>	none <input type="checkbox"/>			

**Figure 7.6G-5. Completed VP scaling input screen**

## DISPLAYS

### A. DPS UTILITY SPEC - SPEC 1

The crew may change the VPs via inputs to the DPS UTILITY SPEC (items 25-34 on SPEC 1).

The VAR PARAM ID LIST on SPEC 1 displays the ten 16-bit memory addresses used for variable downlist. It does not display the contents of the memory locations. However, the crew can view the contents of any memory location via SPEC 0.

### B. VARIABLE PARAMETERS View Screen

The 10 variable parameters for GNC, SM, and OPS 0 are output to a single display (Figure 7.6-3G). The MSIDs used to downlist each VP slot are listed in Table 7.6-1G. The variable parameters display is found by selecting Apps on the DPS DNAV, then by selecting the VP Scaling application. It can also be found by using the Master DNAV menu; Master/Shuttle/DPS/Real-Time (Data from DPS)/VP Scaling. The Variable Parameters view screen displays the raw VP data, description, conversion type, the VPs being converted, K values, biases, and the engineering units (EUs) for each of the 10 variable parameters. This information is displayed for each major function by selecting the desired major function under the View pulldown menu.

1. Raw VPs - The raw hexadecimal values downlisted for each slot. The four-digit hex values shown represent the contents of the memory addresses that were either uplinked or input (via SPEC 1) by the crew. Refer to Table 7.6G-1 for the corresponding MSIDs.
2. Nomenclature - This is the description of the variable parameter. This is typically used to indicate which VP is in which slot. This is input using the VP Scaling Input screen.
3. Conversion Type/VP Slot Inputs - Delineates which type of conversion is performed on the parameters listed in the VP Slots Input column. The choices are: none, signed integer, unsigned integer, 32-bit floating point number, or 64-bit floating point number. When a selection is made in the Conversion Type column, the VP Scaling application automatically indicates how many slots are required to perform the scaling. These columns will be highlighted white; the user will select which VP slots hold the raw hex data to be scaled.
  - a. None - No scaling will be performed; therefore, the data in the Engineering Units column of the display will show 0.0000E+00(zero). No slots in the VP Slot Inputs column will be highlighted.
  - b. Signed or unsigned integer - Two VP slot selections are required to do a 32-bit conversion. The two rightmost columns on the VP Slot Inputs section of the VP input screen will automatically be highlighted white. Of these two columns, the leftmost represents the most significant data bits (MSDBs) of

the parameter to be scaled, and the rightmost represents the least significant data bits (LSDBs). Note: If the parameter to be scaled is 16 bits instead of 32 bits long, in the rightmost highlighted column, select the parameter slot to be scaled, and select "none" in the leftmost column.

- c. Thirty-two-bit floating point number - Two VP slots are required to do the conversion. The two leftmost columns in the VP Slot Inputs section of the VP input screen will automatically be highlighted white. Of those two columns, the leftmost represents the MSBs of the parameter to be scaled, and the right one represents the LSBs.
- d. Sixty-four-bit floating point number - Four VP slots are required to do the conversion. All four slots in the VP Slot Inputs section of the VP input screen will automatically be highlighted white. The leftmost column represents the MSBs, and the rightmost column represents the LSBs.

See the Variable Parameter Scaling section of this SCP for more details on selecting the conversion type.

- 4.  $K(A_1)$  and Bias ( $A_0$ ) - Constants, input by DPS/DPS SPT via the VP input screen in the VP Scaling application. These constants are initialized to zero by the VP Scaling application and are used to compute an EU using the equation:

$$EUs = K * (\text{variable parameter value}) + \text{Bias}$$

K - Constant that defines the slope of the calibration curve for each VP slot

Bias - Constant that defines the Y-intercept of the calibration curve for each VP slot

- 5. EUs - Floating point value of the downlisted parameter displayed in scientific notation. The scaling factors K and bias help to convert hex values into EUs.

**Table 7.6G-1. MSIDs**

		HEX (Downlisted)
<b>GNC</b>	1	V92U5500CX
	2	V92U5502CX
	3	V92U5504CX
	4	V92U5506CX
	5	V92U5508CX
	6	V92U5510CX
	7	V92U5512CX
	8	V92U5514CX
	9	V92U5516CX
	10	V92U5518CX
<b>SM</b>	1	V92U5500CY
	2	V92U5502CY
	3	V92U5504CY
	4	V92U5506CY
	5	V92U5508CY
	6	V92U5510CY
	7	V92U5512CY
	8	V92U5514CY
	9	V92U5516CY
	10	V92U5518CY
<b>OPS0</b>	1	V92U5500CZ
	2	V92U5502CZ
	3	V92U5504CZ
	4	V92U5506CZ
	5	V92U5508CZ
	6	V92U5510CZ
	7	V92U5512CZ
	8	V92U5514CZ
	9	V92U5516CZ
	10	V92U5518CZ

**VARIABLE PARAMETER SCALING**

A. Description

Scaling is a method of converting raw hexadecimal VP values into EUs. This task is accomplished by the VP Scaling application computation, using a K and bias input from DPS/DPS SPT with the results being displayed on the VP Scaling application View screen. Not all VPs require scaling (discretes, for example). This section describes how to select appropriate slots for a VP and how to determine the correct K and bias input to the Variable Parameter Scaling application.

Note: The bit numbering convention for this section has bit 0 as the most significant bit and bit 1 as the next most significant bit, etc.

B. Selecting Appropriate Slots for VPs

VPs of any type can be put in any slot in any order whether scaling is required or not. Therefore, the restriction that forced floating point numbers to be in slots 7 and 8 or 9 and 10 is no longer a concern.

C. Scaling/Conversion Types



1. Signed Integer - A signed integer that is either 16 or 32 bits long can be scaled using this conversion type.
  - a. If the parameter is a 16-bit word, after selecting Signed Integer as the conversion type, the VP Scaling application will automatically highlight two columns in the VP Slots Input section of the input screen. The way to indicate that it is a 16-bit parameter (vice a 32-bit parameter) is to select "none" in the leftmost highlighted column of the input screen, and select the VP slot to be scaled in the rightmost.

Sixteen-bit words that can be scaled using this conversion type must have the following word format:

Sign	MSDB*	Magnitude													LSDB*
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

\* MSDB and LSDB are the most and least significant data bits, respectively.

The sign bit is 1 for negative numbers and zero for positive numbers. It is important to note that negative numbers are expected to be in 2's complement.

- b. If the parameter is a 32-bit word, the VP Scaling application will require two VP slots to be selected. Note: these slots do not have to be consecutive (i.e., slots 5 and 6 for example; they could be slots 2 and 8), nor do they have to be in any particular order (i.e., slot 8 could hold the most significant bits, and slot 2 could hold the least significant bits). Enter the first halfword address into the leftmost highlighted column and the second halfword address into the rightmost.

Thirty-two-bit words that can be scaled using this conversion type must have the following word format:

Sign	MSDB*	Magnitude																											LSDB*
0	1	2	3	4	5	.	.	.	.	.	27	28	29	30	31														

\* MSDB and LSDB are the most and least significant data bits, respectively.

The sign bit is 1 for negative numbers and zero for positive numbers. It is important to note that negative numbers are expected to be in 2's complement.

Note that not all signed integer values can be scaled using this conversion type. For instance, halfword fixed-point overflow (FXU) data types have an overflow indicator in bit 1. Even though this is an integer data type, it is incompatible with the computation.

2. Unsigned Integer - An integer data type that does not have a sign bit imbedded in the word can be converted using this conversion type. The parameter to be scaled can be either a 16- or 32-bit word.
  - a. If the parameter is a 16-bit word after selecting Unsigned Integer as the conversion type, the VP Scaling application will automatically highlight two columns in the VP Slots Input section of the input screen. The way to indicate that it is a 16-bit parameter (vice a 32-bit parameter) is to select "none" in the leftmost highlighted column of the input screen, and select the VP slot to be scaled in the rightmost.

Sixteen-bit words that can be scaled using this conversion type must have the following word format:

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

\* MSDB and LSDB are the most and least significant data bits, respectively.

- b. If the parameter is a 32-bit word, the VP Scaling applications will require two VP slots to be selected. Note: these slots do not have to be consecutive (i.e., slots 5 and 6 for example; they could be slots 2 and 8), nor do they have to be in any particular order (i.e., slot 8 could hold the most significant bits, and slot 2 could hold the least significant bits). Enter the first half word address into the leftmost highlighted column and the second half word address into the rightmost.

Thirty-two-bit words that can be scaled using this conversion type must have the following word format:

MSDB*	Magnitude																								LSDB*
0	1	2	3	4	.	.	.	.	.	27	28	29	30	31											

3. Thirty-Two-Bit Floating Point - Words that are 32 bits long and in IBM floating point format can be scaled, using this conversion type. For the number to be interpreted correctly, the high-order bits (0-15) must be in the leftmost of the two highlighted columns, and the next most high-order bits (16-31) must be in the rightmost highlighted column.

Floating point numbers that are less than 32 bits long, such as half word precision floating point (HLP), cannot be scaled since they do not fill up the entire format. Some floating point parameters larger than 32 bits, but less than 64 bits, can be scaled using the conversion type by having the high-order 32 bits in the two slots allowed. Since the additional bits beyond 31 are used to increase the size of the fraction, the larger floating point numbers still meet the format described below. Some precision will be lost if these parameters are

scaled, but for most cases, it will be negligible. Refer to the Data Types section to determine if a given data type can be scaled.

Thirty-two bit words that can be scaled using the conversion type must have the following word format:

Sign	Characteristic							Fraction					
0	1	2	3	4	5	6	7	8	.	.	.	31	

The sign bit is 1 for negative numbers and zero for positive numbers. The exponent, which represents a power of 16, is derived by subtracting 64 from the characteristic. Therefore, the range of the exponent is -64 to +63. The fraction is a binary number less than 1 with the binary floating point to the left of the high-order digit (between bits 7 and 8).

4. Sixty-Four-Bit Floating Point - Words that are 64 bits long and in IBM floating point format can be scaled using this conversion type. For the number to be interpreted correctly, the high-order bits (0-15) must be in the leftmost of the two highlighted columns, and the next most high order bits (16-31) must be in the rightmost highlighted column, and so on for all four VP Slot Inputs columns on the VP Scaling Input display.

Thirty-two-bit words that can be scaled using this conversion type must have the following word format:

Sign	Characteristic							Fraction					
0	1	2	3	4	5	6	7	8	.	.	.	64	

The sign bit is 1 for negative numbers and zero for positive numbers. The exponent, which represents a power of 16, is derived by subtracting 64 from the characteristic. Therefore, the range of the exponent is -64 to +63. The fraction is a binary number less than 1 with the binary floating point to the left of the high-order digit (between bits 7 and 8).

#### D. Determining Correct K and bias

The Variable Parameter Scaling application converts a VP into an EU using the equation

$$EU = K * \text{Variable-Parameter} + \text{bias}$$

where K and bias are Variable Parameter Scaling application constant input by DPS/DPS SPT which represent the slope and Y-intercept, respectively, of a linear equation. With the proper selection of K and bias, it is possible to calibrate and/or convert the units of a given VP. For example, calibrating a voltage into a temperature or converting radians to degrees. In its simplest form, with K = 1 and bias = 0, the Variable Parameter Scaling application simply scales the VPs as integers or floats (depending on their slot) and displays the corresponding value as a base 10 float with no calibration.

Calculating the correct K and bias is not a straightforward task since there are several factors to consider. This section does not attempt to provide instructions for every potential scaling situation since the number of possibilities are endless, but rather provides a list of items to consider when selecting a K and bias.

- A. Is the parameter contained in at least one downlist format?

If so, SCAP can be used to obtain the parameter data type, calibration curve, length, and start bit. If the parameter is not in at least one downlist format, then this information will not be available from SCAP, and you will have to rely on the requesting discipline or the MER for scaling information.

- B. Does the parameter have a calibration curve?

Calibration curves are in the form  $A_0 + A_1X + A_2X^2 \dots A_nX^n$ . If the parameter is available in at least one downlist format, the coefficients of this equation can be obtained by using SCAP. If a parameter has a calibration curve, then  $K = A_1$  and  $\text{bias} = A_0$ .

- C. In what unit does the requesting discipline want the parameter?

If the value is being calibrated to units other than what the requesting discipline wants, then the K and bias will have to be changed accordingly. For example, if the parameter is calibrated in degrees and the user wants radians, then you will have to multiply K by 0.01745.

- D. How long (in bits) is the parameter and where in the 16-bit VP slot is the parameter embedded?

If the parameter is an integer value less than 16 bits, it may still be possible to scale it if the value is signed with negative values in 2's complement, is located in the high-order (bits 0-n) bits of the VP, and has trailing zeroes in the remaining low-order bits. For example, if the parameter is only 12 bits long but is contained in bits 0-11 of the VP, then the scaled VP will appear too large unless the magnitude bits are shifted to the right by 4 bits. This can be accomplished by setting the K value to 0.0625 ( $1/2^4$ ). One way to determine where a parameter is embedded with a 16-bit addressable area is to find out its start bit. This information is available through SCAP if the parameter is available in at least one downlist format. Determining whether or not a parameter has trailing zeroes may require information from the MER.

- E. Data Types

Since a parameter can have peculiar characteristics with respect to how it is stored in GPC memory, it is helpful to know more than if a parameter is an integer or float. The data types listed here are downlist data types and may or may not reflect how a particular parameter is stored in GPC memory. The types are applicable only to parameters which are available in at least one downlist format and can be helpful in

determining how to interpret a VP slot but do not necessarily guarantee that contents of the VP will conform to these standards. This is because parameters can be stored in GPC memory in one fashion and then packed together for downlist purposes in another. For example, the BFS GPC discrete word B contains two bits dedicated to showing which time source the GPC is using. However, if you use a VP to downlist the contents of GPC memory which contain the discrete word B, it will not contain the time source information since these bits are packed into the discrete word B for downlist purposes only. The ability to determine if a particular parameter is downlisted in the same fashion as it is used by GPC software applications is not readily available to DPS. The scaling recommendations listed after each data type assume that the downlist data types matches the format of how the parameter is stored in GPC memory.

1. Downlist Start Bit (TC 02)

A two-digit number defining the data start bit in the downlinked data stream. The range value is 00 to 07. OI/DFI/MDM data in the MDM bits 8-15 are downlink word N+1, where word N is the 8-bit downlinked word assigned to the MDM parent word and to the first 8 bits of the imbedded signals. Also the EIU 60 kbs and ET OI measurements are assigned to this field.

There should be no reason to scale these parameters.

2. Analog MDM Bipolar (AMB)

A 10-bit bipolar signal (may vary from 0 up to +5.11 volts or from 0 to -5.12 volts). Negative parameters (bit 0 = 1) have a magnitude in the 2's complement form.

Bit 0 designates sign: 0 = Positive, 1 = Negative

Bit 1-9 are data bits

Bit 1 is most significant data bit for positive numbers

Bit 9 is most significant data bit

To scale these parameters, use slot 1-6. Set  $K = A_1 / 64$  and bias =  $A_0$  if a cal curve exists or set  $K = 0.015625$  and bias = 0.0 if no cal curve exists.

3. Analog MDM Unipolar (AMU)

A 10-bit unipolar signal (may vary from 0 up to +5.11 volts).

Bit 0 designates sign; but in the case of unipolar signals, it is always positive.

Bit 1 designates the MSB. (Bits 1-9 are data bits.)

Bit 9 designates the LSB.

Set  $K = A_1 / 64$  and bias =  $A_0$  if a cal curve exists or set  $K = 0.015625$  and bias = 0.0 if no cal curve exists.

4. Binary Coded Decimal (BCD)

A 4-bit signal that defines a decimal number in accordance with the following codes. There should be no reason to scale these parameters.

<u>Binary code</u>	<u>Decimal number</u>
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9

5. Binary Coded Hexadecimal (BCH)

A 4-bit signal that defines a hexadecimal number in accordance with the following codes. There should be no reason to scale these parameters.

<u>Binary code</u>	<u>Hexadecimal number</u>	<u>Decimal equivalent</u>
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	A	10
1011	B	11
1100	C	12
1101	D	13
1110	E	14
1111	F	15

6. Binary Discrete (BD)

A VP that utilizes one binary bit, either 1 or 0. The location of the parameter within the 16-bit word is specified by the start bit. There should be no reason to scale these parameters.

7. Packed Bit String, Mixed Data (BMD)

A contiguous bit string that contains various information. The start bit will be from 0 to 63. The number of bits will be from 2 to 64. Not scalable.

8. Bit String, Magnitude, and Sign (BMS)

A parameter that contains a sign bit and 1 to 63 magnitude bits. The MSB is the bit immediately to the right of the start bit. The start bit defines the location of the sign bit within the parent word. The start bit may designate any individual any individual bit within the parent bit as the sign bit. Parameter length (number of bits) specifies the length of the parameter including the sign bit.

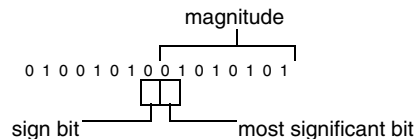
Bit XX = sign: 0 = Positive, 1 = Negative

Where: XX 00-63

If sign is negative, the magnitude is **not** in 2's complement form.

Bit XX + 1 designates the MSB

Example: start bit is bit 7



These parameters are not scalable since the negative values are not in 2's complement.

9. Packed Bit String, Signed (BSS)

The most significant data bits will be the bit following the sign bit; a parameter that contains a sign bit and 1 to 63 magnitude bits. The start bit will specify the location of the sign bit within the parent word. Parameter length (number of bits) will specify the length of the parameter including the sign bit.

Bit XX = sign: 0 = Positive, 1 = Negative

Where: XX 00-63

If sign is negative, the magnitude is in 2's complement form.

Bit XX + 1 designates the MSB

Refer to paragraph C.3 of the Variable Parameter Scaling section for scaling information.

10. Packed Bit String, Unsigned (BSU)

Parameter that contains 2 to 63 magnitude bits. The start bit will specify the location of the MSB within the parent word. The number of bits will specify the

length of the parameter from 02 to 64. Refer to paragraph C.3 of the Variable Parameter Scaling section for scaling information.

11. Double Word, Mixed Data (DMD)

A 48-bit word that contains various information. It may also be referred to as a 48-bit parent word that contains one or more imbedded signals of less than 48 bits parameter length. Refer to paragraph C.3 of the Variable Parameter Scaling section for scaling information.

12. Double Precision Floating Point (DPF 64 bits)

A floating-point number consisting of an unsigned characteristic and a signed fraction. The quantity expressed by this number is the product of the fraction, and the number 16 raised to the power of the exponent.

Bit 0 designates the sign of the fraction: 0 = Positive, 1 = Negative

Bits 1-7 designate the characteristic. A binary number with a range of 0 through 127. The exponent is derived by subtracting 64 from the characteristic. Therefore, the range of the exponent is -64 through +63.

Bits 8-63 designate the fraction. A binary number less than 1 with the binary point to the left of the high-order digit (between bits 7 and 8).

Set  $K = A_1$  and bias =  $A_0$  if a cal curve exists or set  $K = 1.0$  and bias = 0.0 if no cal curve exists.

13. Digital Uplink Command (DUC)

Identifies a digital uplink command as defined by an MSID and unique digital encoded data. Not known if these parameters are scalable.

14. Extended Word, Mixed Data (EMD)

A 64-bit word that contains various information. It may also be referred to as a 64-bit parent word that contains one or more imbedded signals of less than 64 bits parameter length. Refer to paragraph C.3 of the Variable Parameter Scaling section for scaling information.

15. Extended Precision Floating Point (EPL 48 bits)

A floating-point number consisting of an unsigned characteristic and a signed fraction. The quantity expressed by this number is the product of the fraction, and the number 16 raised to the power of the exponent.

Bit 0 designates the sign of the fraction: 0 = Positive, 1 = Negative



Bits 1-7 designate the characteristic-A binary number with a range of 0 through 127. The exponent is derived by subtracting 64 from the characteristic. Therefore, the range of the exponent is -64 through +63.

Bits 8-47 designate the fraction-A binary number less than 1 with the binary point to the left of the high-order digit (between bits 7 and 8).

Set  $K = A_1$  and bias =  $A_0$  if a cal curve exists or set  $K = 1.0$  and bias = 0.0 if no cal curve exists. The low-order 16 bits will be truncated but these are precision bits only and the effect should be negligible.

16. Frequency Modulated (FM)

FM data is derived from analog signals that are frequency modulated in the frequency division multiplexer (FDM) and recorded on a wideband recorder. Frequency responses of 500 Hz, 2 KHz, and 8 KHz are available. Not known whether or not these parameters are scalable.

17. Full Word, Mixed Data (FMD)

A 32-bit word that contains various information. It may also be referred to as a 32-bit parent word that contains one or more imbedded signals of less than 32 bits parameter length. Refer to paragraph C.3 of the Variable Parameter Scaling section for scaling information.

18. Full Word, Fixed Point, Signed (FXS)

A 32-bit word containing a signed, fixed-point number of 32 bits parameter length.

Bit 0 designates sign: 0 = Positive, 1 = Negative  
If sign is negative, the magnitude is in the 2's complement form.

Bit 1 designates the MSB.

Bit 31 designates the LSB.

19. Full Word, Fixed Point, Unsigned (FXU)

A 32-bit word containing an unsigned, fixed-point number of 32 bits parameter length.

Bit 1 designates the MSB.

Bit 31 designates the LSB.

20. Half Word, Fixed Point Overflow, Signed (HFS)

A 16-bit word containing a sign bit, an overflow bit, and 10 magnitude bits. This data type is very rare. The overflow bit indicates if the value for the parameter has become too large. When the overflow bit equals 1, the data becomes inaccurate and attempts should be made to return the overflow bit to a value of 0.

Bit 0 designates the sign bit: 0 = Positive, 1 = Negative

Bit 1 designates the overflow bit: 0 = No overflow, 1 = Overflow

Bit 2 designates the MSB.

Bit 11 designates the LSB.

\*\*\*Bits 2-11 are magnitude only: the sign bit indicates polarity.

These parameters are not scalable because of the overflow bit.

21. Half Word, Mixed Data (HMD)

A 16-bit word that contains various information. It may also be referred to as a 16-bit parent word that contains one or more imbedded signals of less than 16 bits parameter length. Refer to paragraph C.3 of the Variable Parameter Scaling section for scaling information.

22. Half Word, Magnitude and Sign (HMS)

A 16-bit word containing a sign bit and 15 magnitude bits.

Bit 0 designates sign: 0 = Positive, 1 = Negative

Bit 1 designates the MSB.

Bit 15 designates the LSB.

To scale these parameters, use any of slots 1-6. Set  $K = A_1$  and bias =  $A_0$  if a cal curve exists or set  $K = 1.0$  and bias = 0.0 if no cal curve exists.

23. Half Word, Precision Floating Point (HPL 16 bits)

A floating-point number consisting of an unsigned characteristic and a signed fraction. The quantity expressed by this number is the product of the fraction, and the number 16 raised to the power of the exponent.

Bit 0 designates the sign of the fraction: 0 = Positive, 1 = Negative

Bits 1-7 designate the characteristic-A binary number with a range of 0 through 127. The exponent is derived by subtracting 64 from the characteristic. Therefore, the range of the exponent is -64 through +63.

Bits 8-15 designate the fraction-A binary number less than 1 with the binary point to the left of the high-order digit (between bits 7 and 8).

These parameters are not scalable since the Variable Parameter Scaling application computation requires floating-point numbers to be at least 32 bits in length.

24. Half Word, Fixed Point, Signed (HXS)

A 16-bit word containing a signed, fixed-point number of 16 bits parameter length. Bits 1-15 designate magnitude.

Bit 0 designates sign: 0 = Positive, 1 = Negative

If sign is negative, the magnitude is in the 2's complement form.

Bit 1 designates the MSB.

Bit 15 designates the LSB.

To scale these parameters, use any of slots 1-6. Set  $K = A_1$  and bias =  $A_0$  if a cal curve exists or set  $K = 1.0$  and bias = 0.0 if no cal curve exists.

25. Half Word, Fixed Point, Unsigned (HXU)

A 16-bit word containing a signed, fixed-point number of 16 bits parameter length.

Bit 1 designates the MSB.

Bit 15 designates the LSB.

Set  $K = A_1$  and bias =  $A_0$  if a cal curve exists or set  $K = 1.0$  and bias = 0.0 if no cal curve exists.

26. Quarter Word, Mixed Data (QMD)

An 8-bit word that contains various information. It may also be referred to as an 8-bit parent word that contains one or more imbedded signals of less than 8 bits parameter length. Refer to paragraph C.3 of the Variable Parameter Scaling section for scaling information.

27. Single Precision Floating Point (SPL)

A floating-point number consisting of an unsigned characteristic (or exponent) and a signed fraction. The quantity expressed by this number is the product of the fraction, and the number 16 raised to the power of the exponent.

Bit 0 designates the sign of the fraction: 0 = Positive, 1 = Negative

Bits 1-7 designate the characteristic-A binary number with a range of 0 through 127. The exponent is derived by subtracting 64 from the characteristic.

Therefore, the range of the exponent is -64 through +63.

Bits 8-31 designate the fraction-A binary number less than 1 with the binary point to the left of the high-order digit (between bits 7 and 8).

Set  $K = A_1$  and bias =  $A_0$  if a cal curve exists or set  $K = 1.0$  and bias = 0.0 if no cal curve exists.

28. Variable Data (VAR)

A 16-bit parameter that is utilized to downlist multiplexed data or data with variable content. These are the VPs. There should never be a reason to downlist the VPs in the VP slots and thus no reason to scale parameters of this type.

29. EBCDIC Character Data (CHE)

Measurements contain 8 bits of EBCDIC. Character data measurements are sub-measurements (associated with parent/grandparent measurements) which can be assembled to define message text from the character data string. These parameters are not known to be scaleable.

30. European ASCII Character Data (CHU)

Measurements contains 8 bits of European ASCII. Character data measurements are sub-measurements (associated with parent/grandparent measurements) which can be assembled to define message text from the character data string. These parameters are not known to be scaleable.

## **REFERENCES**

1. Downlist/Uplink Software Requirements, SS-P-0002-140M.
2. Flight Control Operations Handbook, JSC-12805.
3. COMMANDO User's Guide, Version 3.0.
4. Display and Controls FSSR, STS83-0020D.

**TITLE**

SCP Verifier: \_\_\_\_\_  
Facility: \_\_\_\_\_ Date: \_\_\_\_\_

BFS VARIABLE PARAMETERS (Command Server)

**PURPOSE**

The BFS VP load consists of three user definable downlist parameters which provide the capability to downlist the contents of any memory location across all memory configurations. It is maintained across OPS transitions. This gives the ground controllers more insight into BFS, and allows pre- and post-verification of memory writes. The parameters are initialized to a known memory location by an assembly language variable called DLINIT, and set to the pattern FCFC.

The MSIDs associated with the three slots located on MSK 1302 and 1350 are:

Slot 1: V98U1280C

Slot 2: V98U1281C

Slot 3: V98U1282C

The four-digit hex values shown in the downlist represent the contents of the memory addresses that were uplinked.

The BFS VP uses the generic command load. For all flights prior to OI-23, only one VP can be sent at a time (reference BFS DR number 106173). For OI-23 and subs, one, two, or three VPs can be uplinked with a single command. The BFS VP cannot be scaled like the PASS VP. This SCP describes coordinating a BFS VP for uplink, building a BFS VP load using the Variable Parameters application and interpreting the load once it has been sent to the command server. The BFS VP requires coordination between six MCC console positions: DPS, DPS SPT, the FCR/MPSR requesting the uplink, FLIGHT DIRECTOR, COMMAND, and INCO.

**RESTRICTIONS/CONSTRAINTS**

**CAUTION**

This procedure is governed by FCOH procedures 3.1, 3.2.2, 3.2.2.1, and 4.10, and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**A. Onboard Software Legality Tables**

1. PASS - N/A
2. BFS

OPS	CMD legal
OPS 0	X
GNC 1	X
GNC 3	X
GNC 6	X

B. Valid OI Loads

BFS version 23.43.B (OI-22) and subsequent.

C. Vehicle, LRU/Hardware Version Constraints

None.

D. Time Constraints, Crew Coordination Requirements

Uplink after BFS is active post-OPS 101 transition during prelaunch or during OPS 3 for entry.

E. Hazard/Safety Implications

Orbiter generic command loads have the capability of uplinking any command sequence and are inherently hazardous. Acceptance by the command server or vehicle requires only a valid OP Code, and by design, there are no command server or onboard restrictions on the executable bit pattern in the command string. **Uplink of an incorrect bit pattern can have unpredictable results, including loss of BFS, unexpected alarms, and corruption/loss of onboard systems.**

F. Other Requirements

Use of C99 Orbiter Universal Load menu from Megadata or MED Emulation is prohibited. Use of the C99 is via workstation application program only.

BFS is required to track PASS because the load is uplinked through the NSP that is commanded by the PASS computer.

## PROCEDURES

### A. Building a BFS VP

**WARNING**

This operation utilizes an orbiter universal load (C99). Uplink of an incorrect bit pattern can have unpredictable results, including loss of BFS, unexpected alarms, and corruption/loss of onboard systems.

**CAUTION**

The use of the TELCOM Generic Command Load application to generate this load is prohibited. Workstation application software specifically designed to build BFS VPs is required.

1. DPS/DPS SPT receives **three copies** of the Variable Parameter Display Request form (Figure 7.6G-1) from the requesting discipline and determine criticality.
2. DPS SPT notifies DPS that a VP is in work on DPS MPSR loop.
3. DPS SPT verifies address in the BFS Listings section of the flight software (optical disk) under the HALSTAT section (reference SCP 1.8).

**CAUTION**

Coordinate with the appropriate discipline if their VP slot will be replaced with a new BFS VP. If this coordination is not performed, the discipline may begin troubleshooting erroneous data.

4. DPS coordinates with originator which slot to use.
5. DPS SPT completes the VP form with the following information:
  - a. Slot number, Title, DSM number, and Signature
  - b. Send one copy to DPS for verification.
  - c. Upon DPS verification, send one copy to the originator.
6. Build the VP.
  - a. Start the Variable Parameters application by selecting Command->Command Server->Variable Parameter on the DPS DNAV. The Variable Parameter application is shown in Figure 7.7G-1.

- b. Upon initialization, the Variable Parameter application will select the flight ID for the activity that was selected during activity selection. If the flight selected is not the desired flight, change it via the File->Change Flight pull down menu.
- c. To build a new VP, select new from the File menu and then select BFS. The next available DSM number will be automatically selected. If the desired DSM number does not appear, you may type it in. If a modification to an existing load is desired, select File->Open and then, using the arrow buttons next to the DSM number, select the DSM number of the load you wish to modify.
- d. Input the appropriate fields (Figure 7.7G-1): Rqst, Address, Description and HAL Name. The address must be within the range 0- 3FFFF, the DSM number must be within the range 19901-19925

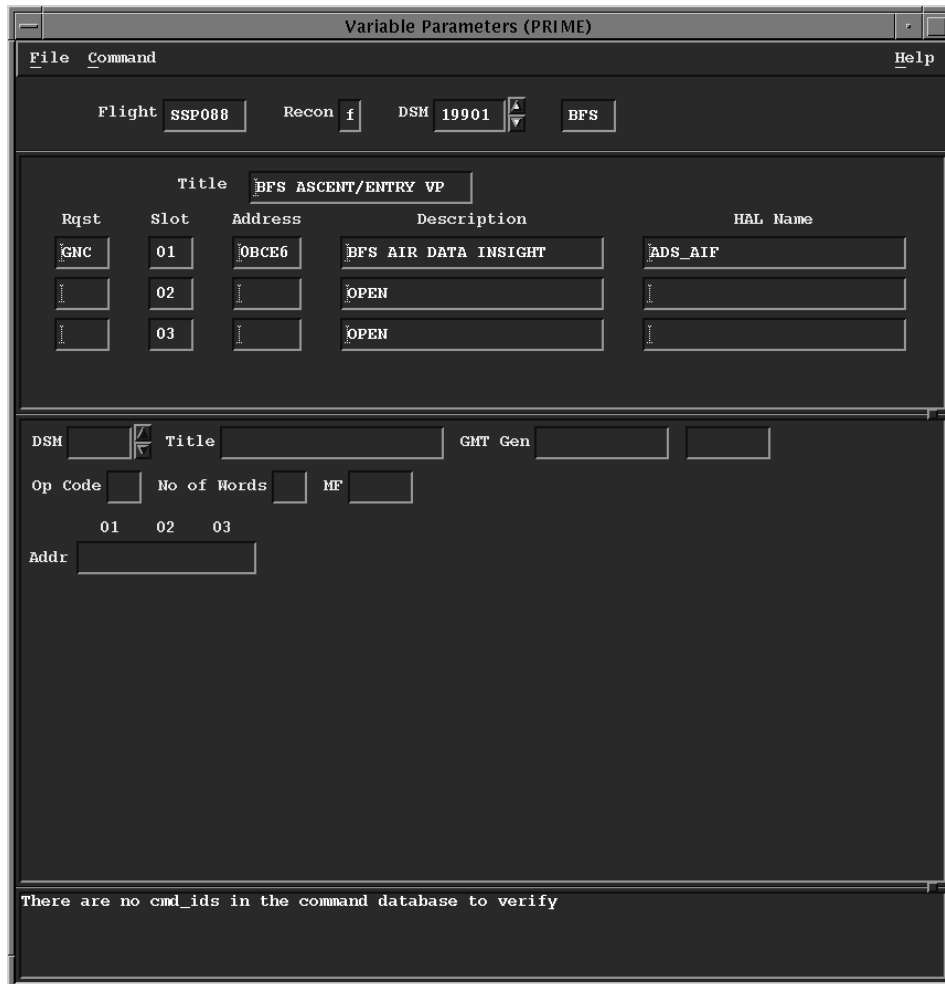


Figure 7.7G-1. Variable Parameters Application

7.7G-4  
Verify that this is the correct version before use



B. Load Build Coordination

To send the load to the command server, perform the following steps:

1. Obtain Flight Director approval to enable generic commanding.

2. Have COMMAND enable generic commanding on the workstation. Provide COMMAND with the following information over the COMMAND Loop:

- a. OP Code - 37
- b. Terminal/Position Auth ID - DPS
- c. Destination Node Name - FCR = WF3 or WF22  
MPSR = WM6 or WM9

3. Send the load to the command server by selecting Send under the Command menu.

4. Verify the load using the bottom portion of the Variable Parameters application, Figure 7.7G-1. See Command Load Verification Section C.

5. Have COMMAND disable op code 37 and generic commanding.

C. Verifying a BFS VP

1. DPS and DPS SPT verify the load by using the bottom half of the Variable Parameter application. Immediately after the load is sent to the Command server, it will appear on the bottom portion of the display (verification area). Additional VP loads in the command server can be viewed by scrolling to the desired DSM using the up and down arrow keys next to the DSM field of the verification area. The up/down arrows in the verification area are not active unless the Variable Parameters application is in the Verify mode. To put the application in the Verify mode, select Command->Verify.

Verify that the addresses are correct and that they are listed under the appropriate VP slot number.

Verify the DSM number range is between 19901 and 19925.

Verify that the OP CODE is 37 (hex).

Verify the MF is **BFCS**.

Verify that the title is correct.

Verify the load is safed in the command server, indicated by "Safed" in the field next to the GMT Gen.

Although not required, the actual hex data words to be uplinked can be verified by using the Command Data Words (CDW) application. For more information on starting and understanding the Command Data Words Application refer to SCP 7.1G. Interpretation of the individual bits in the command words is shown in the following sections. For additional information on the bit definitions refer to the Space Shuttle Computer Program Development Specification (CPDS) SS Downlist/Uplink Software Requirements (SS-P-0002-140).

2. Command Data Word 01 - contains the vehicle ID, MF, and Op Code. Bits 1 through 16 are formatted as follows:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Veh ID			MF				Op Code						FCW	LCW	

- a. Vehicle ID

The Veh ID will show zeros in the command server, and the vehicle ID is inserted upon uplink. However, the load sent to the command server must process and include the correct vehicle ID so the command server can place the load in the correct load storage array for the particular vehicle.

- b. Major function

A four-bit code that identifies major function to which the command is addressed. Verify this field is for the BFS major function - **1010**.

- c. Op code

A seven-bit code that identifies the type of command. Verify the BFS VP Op Code - **0110111** (37 hex).

- d. FCW and LCW

A two-bit code that identifies the command word as the first, intermediate, or last command in a chained command string. Verify that these bits are 10, indicating the first command word in a multiword command.

3. Command Data Words 02 and 03 - Bits 17 through 48 are formatted as follows:

Bits 17 - 24	Bits 25 - 28	Bits 29 - 48
Spare	VP Slot	Addr

- a. Bits 17-24: Spare

Verify these eight bits contain **0**.

b. Bits 25-28: VP Slot

Four-bit code which represents the ID of the slot the VP will be displayed.  
Verify correct slot:

**VP Slot 1 - 0001**

**VP Slot 2 - 0010**

**VP Slot 3 - 0011**

c. Bits 29-48: Address

Verify the correct memory address. The possible format range is 00000 to FFFFF. However, the valid **range for the BFS memory is 0-3FFFF**. Since this is a generic command load any address is valid but only addresses in the range 0-3FFFF are allowed by the Variable Parameters application.

d. Command Data Words 04, 05, 06, 07 - The Command Data Words 04/05 and 06/07 pairs are formatted the same as the Command Data Words 02/03 pair.

D. Uplink Coordination

Note: If uplinking a prebuilt BFS VP, **refer to Procedures under B, Load Build Coordination, page 7.7G-5**. Load build coordination must be done prior to this procedure.

1. DPS generates a Flight Note to the Flight Director and INCO identifying the DSM number and the desired major function.
2. Obtain Flight Director approval for command uplink.
3. DPS SPT calls COMMAND on the COMMAND loop to unsafe the command.
4. DPS coordinates with INCO/INST on INCO/INST COORD loop to uplink the command. (Standard coordination shall include reading the DSM number, the MF, and that the Flight Director has given a GO for uplink, as well as a read back by INCO (or INST) of the information for verbal verification.)
5. DPS (or DPS SPT) should monitor the Command Tracking application to verify a successful uplink. Verify that the load is uplinked to the BFS major function. For more information on starting and understanding the Command Tracking application refer to SCP 7.1G.
6. DPS/DPS SPT informs the requester their BFS VP is onboard.
7. Once the command is uplinked, DPS SPT calls COMMAND to safe the load in the command server. If the command is no longer required, the load will be deleted from the command server.

**TITLE**

SCP Verifier: \_\_\_\_\_  
Facility: \_\_\_\_\_ Date: \_\_\_\_\_

ONBOARD GMT/MET UPDATES (Command Server)

**PURPOSE**

This SCP outlines procedures to perform the following:

- MTU update when error exceeds 100 milliseconds
- GMT/MET recovery from MTU/GPC powerdown
- MTU reinitialization after year-end rollover
- MET update

**BACKGROUND INFORMATION**

None.

**RESTRICTIONS/CONSTRAINTS**

**CAUTION**

If the updates are performed via DEU equivalent uplink, all of the restrictions associated with DEU-equivalent loads still apply (FCOH 3.1 and 3.3.1 and SCP 7.3) in addition to the restrictions and constraints listed below.

A. Onboard Software Command Legality Tables

1. PASS

**CAUTION**

DEU-equivalent loads are valid in MC0, MC1, and MC3 as well; however, SPEC 2 TIME is not a valid SPEC in these memory configurations. Therefore, since SPEC 2 is required for the onboard GMT/MET updates, these updates cannot be performed in MC0, MC1, and MC3.

MC (MF/OPS) or GPC ID	CMD legal
MC0 (Post-IPL OPS 0)	X
MC1 (GNC1/6)	
MC2 (GNC2)	X
MC3 (GNC3)	
MC4 (SM2)	X
MC5 (SM4)	X
MC6 (PL9)	X
MC8 (GNC8)	X
MC9 (GNC9)	X
GPC ID	X

2. BFS

N/A

B. Valid OI Loads

All PASS, no BFS.

C. Vehicle, LRU/Hardware Version Constraints

None.

D. Time Constraints, Crew Coordination Constraints

**CAUTION**

1. Crew should be cognizant of DEU-equivalent use and avoid associated DEU/CRT access.
2. SPEC 2 TIME will have to be up on an active CRT.
3. Unless the update is being performed to a simplex GPC in OPS 0, the maximum update that can be implemented at one time is 15 milliseconds. No limit exists for an update to a simplex GPC in OPS 0.

E. Hazard/Safety Implications

<p><b>WARNING</b></p> <ol style="list-style-type: none"><li>1. Do not perform the following actions until the update is complete. Violating these restrictions could cause GPCs to fail and/or fault to internal time. These restrictions apply if the update is performed by the crew, or if the update is performed via uplink. Note that once the update is initiated via item 32 on SPEC 2 TIME, the update can take up to 2 minutes to complete.<ol style="list-style-type: none"><li>a. OPS transitions or mode recalls</li><li>b. I/O resets</li><li>c. GPC output switch changes</li><li>d. Manual accumulator selection</li></ol></li><li>2. Do not chain the required DEU-equivalent loads together; chaining invalid or incorrect DEU equivalent loads can cause unpredictable results.</li></ol>
--

F. Other Requirements

MTU GMT updates may only be performed if the error exceeds 100 milliseconds or MTU year-end rollover occurs. This limitation is defined and documented in Flight Rule 7-33, TIME MANAGEMENT. No programmatic limitations exist on MTU MET updates; MET updates may be performed at anytime contingent upon Flight Director's approval and according to the flight control team's requirements.

**PROCEDURE**

A. MTU/GPC Update When Error Exceeds 100 Milliseconds

1. GMT update via crew input

DPS should prepare **four** copies (DPS, DPS SPT, FD, and CAPCOM) of a Flight Note detailing crew actions. In general, crew actions are as follows:

- a. GNC SPEC 2 PRO.
- b. ITEM 27 + .015 EXEC or ITEM 27 - .015 EXEC (depending on which way the error is).
- c. ITEM 32 EXEC (update can take up to 2 minutes).

<p><b>WARNING</b></p> <p>Do not perform the following actions until the update is complete:</p> <ul style="list-style-type: none"><li>OPS transitions or mode recalls</li><li>I/O resets</li><li>I/O terminate switch change</li><li>Accumulator select</li></ul>
---

2. GMT update via uplink

DPS/DPS SPT will build, verify, and coordinate the uplink of DEU-equivalent loads in accordance with DPS SCP 7.3, DEU EQUIVALENT LOADS, and FCOH SOP 3.3.1, DEU EQUIVALENT COMMANDS.

B. GMT/MET Recovery From MTU and GPC Powerdown

1. Power up the MTU.

- Notes:
- a. MTU oscillators should be stable enough to support GPC time management after an hour warmup.
  - b. At powerup, the MTU will reflect a GMT of 1 day and an MET of zero. Upon powerup of the MTU, BSR bits 9, 10, 11, and 12 will be unpredictable until the MTU is initialized by resetting GMT and MET.

2. Power up and mode a single GPC to RUN.

- Notes:
- a. The selected GPC's overlay must contain the TIME SPEC  
2. If no GPC has this SPEC, an IPL will be necessary.
  - b. The following GPC time management logic occurs during initialization.

MTU GMT → GPC MET  
MTU GMT - MTU MET → MET REF  
GPC GMT - MET REF → GPC MET

result: GPC MET = MTU MET  
(Note: This logic syncs GPC and MTU MET.)

3. ΔGMT update is displayed as MTU 1 ΔT (MTU 2 ΔT) on MSK 1301 DPS 1- GNC/BFS.

4. Execute initial GMT update using the following procedure to the single GPC in OPS 0:
  - a. SPEC 2 PRO
  - b. ITEM 24 + DDD + HH + MM + SS.SSS EXEC
  - c. ITEM 32 EXEC

Note: Update can take up to 2 minutes. There is no 15-msec limit for a single GPC in OPS 0

**WARNING**

Do not perform any actions or keyboard inputs until the update is complete.

The following logic occurs:

GPC GMT +  $\Delta$ GMT UPDATE  $\rightarrow$  GPC GMT and MTU GMT  
GPC GMT  $\rightarrow$  MET REF (GPC MET = 0)  
GPC reset to MTU MET counter (MTU MET = GPC MET = 0)

5. Compute  $\Delta$ MET update.

For nominal MET time base:

GMT OF SRB IGN - MET REF =  $\Delta$ MET UPDATE

6. Execute  $\Delta$ MET update using the following procedure:
  - a. SPEC 2 PRO
  - b. ITEM 28 + DDD + HH + MM + SS.SSS EXEC
  - c. ITEM 32 EXEC

Note: BFS GMT/MET will be updated from the MTU when the BFS GPC is transitioned to OPS 301.

7. Mode remaining PASS GPCs to RUN.

C. MTU Reinitialization After Year-End Rollover

1. The MTU is designed such that it resets to GMT day 1 at day 366, 367, 376, 377, and 400 while the GPCs continue to increment.
2. The Flight Rules require the MTU to be reinitialized to the incorrect GPC GMT.



3. At year's end, DPS should immediately direct the crew to perform DPS SSR-17 MTU YEAR END ROLLOVER RECOVERY, which is in Appendix G.

**D. MET Update**

1. DPS determines the requirement to perform a MET update and determines whether it is to be performed by crew input or ground uplink. DPS will notify the Flight Director and flight control team of the impending time change.

2. MET update via crew input

DPS should prepare four copies (DPS, DPS SPT, FD, and CAPCOM) of a Flight Note detailing crew actions. In general, crew actions are as follows:

- a. GNC SPEC 2 PRO
- b. ITEM 28 + DDD + HH + MM + SS.SSS EXEC
- c. ITEM 32 EXEC

3. MET update via uplink

DPS/DPS SPT will build, verify, and coordinate the uplink of DEU-equivalent loads in accordance with DPS SCP 7.3, DEU-EQUIVALENT LOADS, and FCOH SOP 3.3.1, DEU EQUIVALENT COMMANDS.

**REFERENCES**

1. PASS Users Guide.
2. NSTS Computer Program Development Specification (CPDS), SS-P-0002-170J.

**TITLE**

SCP Verifier: \_\_\_\_\_  
Facility: \_\_\_\_\_ Date: \_\_\_\_\_

DAY OF LAUNCH I-LOAD UPDATE (Command Server)

**PURPOSE**

This SCP outlines the activities that take place during the Day Of Launch I-Load update for the Guidance Polynomial Update procedure and specifies activities of interest to the DPS Officer. This procedure is written to supplement the GPO procedure in the Flight Control Operations Handbook (FCOH). Refer to SOP 3.2.4.1, DOLILU II.

**RESTRICTIONS/CONSTRAINTS**

CAUTION

This procedure is governed by FCOH 3.2.4.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

**GENERAL**

This procedure normally takes place approximately 1.5 hours before launch and is titled Launch Polynomial Update in S0007 Launch Countdown Operational Maintenance Instruction (OMI), volumes I and II.

**PROCEDURE**

This procedure is general in nature and may vary in the actual OMI.

- A. GPO prebuilds and verifies the approved alternate I-loads. The loads will be authorized via Release Authorization for Signature Sheet (RASS).
- B. The Mission Management Team (MMT) makes the decision to load an alternate set of I-loads.
- C. To display and process GPC Dump data, DPS will use the GPC Dump workstation application. Other disciplines can access the GPC Dump display off the master DNAV Master II Shuttle I DPS I Real-Time (data from DPS) I GPC Dump Display. See SCP 6.1, GPC/MMU Dump - Ground Processing, for more information on GPC dumps.
- D. GPO coordinates the uplink of the approved set of alternate set of I-loads to the PASS G9 set with INCO. Since STS-27, the load is uplinked in the manual mode and verified by INCO, Guidance, and the MER. Once the load is verified in the buffer, INCO switches to AUTO mode and executes the two-stage buffer.

- E. KSC performs a DEU-equivalent software dump. The starting address for the dump is the first address of CGGS\_T\_GMTLO\_REF, which is GMT of lift-off with the desired I-loads following.  
  
These parameters are in HALSTAT and the dump extends for at least 50 frames.  
  
These addresses are also defined in the RASS. DPS maintains a copy of the RAD/RASS containing the address on console. KSC will perform an alternate yaw or an alternate pitch dump only if those I-loads were changed via uplink.
- F. Once the dump is performed, DPS SPT views the dump quality report on the GPC Dump workstation application. DPS SPT informs DPS.
- G. DPS reports the results of the quality of the dump to the Flight Director on the FLIGHT voice loop. The dump will be reaccomplished as necessary to verify a valid dump (this assumes an MCC dump processing problem because of a momentary loss of data).
- H. GPO and MER verifies the contents of the software dump using the GPC Dump workstation application.
- I. DPS should maintain hard copies of the GPC Dump application display.
- J. Later in the countdown, a PASS/BFS One Shot Transfer is performed which, among other things, transfers the new I-loads from the PASS to the BFS.
- K. The alternate I-loads may be changed after the OPS 1 transition by going back to OPS 9, uplinking the new I-loads, transitioning back to OPS 1, and then dumping the I-loads.

## **REFERENCES**

1. Operational Maintenance Instruction; S0017 Countdown Demonstration Test; S0007 Shuttle Launch Countdown, volumes I and II.
2. Flight Control Operations Handbook, JSC-26843.
3. NSTS Downlist Uplink Software Requirements, SS-P-0002-140.

## TITLE

MDM BITE READ VARIABLE PARAMETER DECODING

## PURPOSE

This section of the SCP provides information needed to decode and, possibly, interpret the contents of the TLM data associated with the MDM uplink BITE Read. Since the procedure does not deal specifically with command load build, load verification, or uplink coordination, there is no requirement to maintain this section under formal configuration control.

## BACKGROUND INFORMATION

In the event of a hard failure (MDM port or I/O module), the MDM may be physically unable to support the BITE Read I/O request. In such cases, the GPC(s) performing the MDM BITE Read will log a single I/O error (I/O transaction ID 27 thru 34 for flight critical MDM's, ID 46 or 47 for payload MDM's or for flex pairs, and ID 68 or 69 for single flex MDM's). There are no bypass bits set and no fault messages annunciated (totally transparent to the flight crew).

For initial timeout (ITO) signatures, the VP contents will be "0000" hex for each response word since the two-halfword BITE read buffer is cleared prior to the actual I/O request. If a V-bit error signature (actually, any SEV bit) is observed, the MDM has detected a problem while performing the BITE read (essentially confirming a hard-failure condition). If two response data words are expected and the error is detected on the first RDW, the IOP will terminate the BCE program before any data is moved to the input buffer. Also, the second RDW will "fall in the bit bucket." Thus, no response data will be stored in the BITE Read buffer and the VP contents will be "0000" hex for each response word. If the first RDW is successful but the second RDW has a V-bit error, then the first VP slot will contain some data, but not necessarily the expected pattern. The second VP slot will be "0000" since no data was transferred to the input buffer. The residual word count can be used if it is unclear what's going on.

It should be noted that the SMS has no requirement to model the MDM BITE capability. Even though the flight software can support MDM BITE Reads, the MDM model responds with one and only one RDW, the contents of which have no correlation to expected data (VP contents will normally be "0000" hex). If the expected number of RDWs is two, then an I/O error will be logged. For simulation purposes, ignore the I/O error and "go" with the green card signature.

**PROCEDURE**

A. BSR Read Option

The BSR Read command will return only one response word (one VP slot). The BSR hexadecimal data format is summarized below (MSB is bit 1, of 1 to 15 bits):

PWR INT	DATA ERR	INVAL CHL	NO IOM RPLY	TOO MANY DATA WDS	LAST CMD NOT CMPT	BOTH SCU'S ON	INVAL MODE	INTL ERR	GAP TIME ERR	GOOD BITE TEST	DON'T CARE	DON'T CARE	DON'T CARE	DON'T CARE	DON'T CARE
---------	----------	-----------	-------------	-------------------	-------------------	---------------	------------	----------	--------------	----------------	------------	------------	------------	------------	------------

Note that the BITE Status Register (BSR) is cleared ("0000" hexadecimal) at both MDM power-up (also, bit 1 is set) and upon completion of a BSR Read. However, reading the BSR on one MDM port does not affect the contents of the BSR on the other port (they are totally uncoupled). Any bits set in the BSR may have occurred at any time since the MDM was last power cycled or the BSR was most recently read. Since there is no time-tagging associated with the setting of the bits, it may or may not be possible to correlate the occurrence of a BSR bit-set action with an observed MDM anomaly. Note also that a successful BSR Read or BITE 4 Read will *not* set the "Good BITE Test" bit.

It may be possible to detect certain hard-failures by performing back-to-back MDM BSR reads. The first BSR Read command is primarily intended to initialize the BSR, although the contents on that first read may also provide valuable data. The suspect hardware is then exercised, followed by a second BSR Read command to determine if a hardware problem is, in fact, indicated.

The following provides a description of each bit of the 16-bit BSR:

- Bit 1     **Power Applied/Power Interrupt** - This bit is set in only two instances: during the powerup sequence and 100 microseconds prior to MDM shutdown. This bit indicates that all analog and discrete outputs have been, or about to be, reset to 0 VDC.

Note that whenever an MDM is powered on or power cycled, the BSR's power interrupt bit for each MDM port will be set and remain set until a BSR read. The first BSR read on an MDM port since the poweron condition should nominally indicate an "8000" hex value. The BSR power interrupt bit is reset upon completion of the BSR read. Any subsequent BSR read should nominally indicate a "0000" hex value.

- Bit 2     **Incoming Data Error** - This bit indicates that an incoming data bus command word or command data word was detected to have an error. The error is either an invalid Manchester format, a bit-count error, or a bad parity. Also, an expected command data word with an invalid MDM address, an invalid Manchester format, bit-count error, bad parity, or incorrect "101" check pattern will set this bit.
- Bit 3     **Operation Requested on a Nonexistent Channel** - This bit is set when a nonexistent I/O channel is addressed. The data will continue to be processed. For MDM response words, the V-Bit reflects that the data word is invalid on a word-by-word basis. If this error occurs, bit 4 is also set (Unable to Transfer Data To/From IOM).
- Bit 4     **Unable to Transfer Data To/From IOM** - This bit is set when the I/O module fails to reply to the SCU with a "data transferred (operation completed)" signal. However, the data is still processed. For the MDM response words, the V-Bit is reset (logical 0) to reflect that an error was detected on a word-by-word basis.

A description of each bit of the 16-bit BSR is continued below:

- Bit 5     **Too Many Words in Last Message** - This bit is set if more words were received in a message than specified by the command word. The extra data words are ignored and the MDM waits to receive a new command.
- Bit 6     **Last Command Not Completed** - This bit is set when a new command is received before the previous command was completed. Processing of the old command is terminated and the new command is processed.
- Bit 7     **Simultaneous Execution on Primary and Backup Data Bus** - This bit is set if both SCUs attempt to operate simultaneously (i.e., a command word is received by one SCU while the other SCU is "busy"). This condition will cause an immediate, temporary, halt of both SCUs until either SCU receives a new command.
- Bit 8     **Illegal Mode Commanded** - This bit is set if an illegal or ambiguous mode has been commanded: accessing a "mode" field identified as "spare", receiving command data words without a command word, the SCU PROM program attempting to execute both input and output operations in the same program, incompatibility between the mode control and the module address fields, or addressing a module classed as "not present" or "spare."

- Bit 9     **Internal Error Detected** - This bit is set in four instances: when the SCU has detected a parity error for any of the 512-word block of the sequence memory PROM; an unexpected "IOM Reply" (IOM reply line is a logical 1 prior to the "channel present" time slot); an unexpected "A/D Reply" (A/D reply line is a logical 1 prior to the "data transferred (operation completed)" time slot); or the SCU In Bus "check bits" contain an invalid pattern.
- Bit 10    **Gap Time Error** - This bit is set when the detected interword gap time between either the command word and the first command data word or between command data words is outside the acceptable limits:  
          gap time < 4 microseconds or gap time > 10 microseconds.
- Bit 11    **Successful BITE Completion** - This bit indicates the commanded SCU BITE test, the A/D Converter BITE test, or the MDM Power Supply BITE test was executed successfully (G9 testing).
- Bits 12 through 16   **BITE Test** - This field indicates progression through a specified MDM BITE test, which is not performed in flight. The field is applicable only for SCU, power supply, and A/D BITE tests (G9 testing). At all other times, these bits stay reset (logical 0) and physically reside in the Register File.

B. BITE 4 Read Option

The number of response data words (RDW's), either one or two, for the BITE 4 Read command is dependent on the card chosen for the BITE test. If two response words are returned, two consecutive VP slots are required. The workstation logic will not permit slot 10 to be selected (for the first RDW) since the onboard software does not wrap the second RDW to VP slot 1.

Raw BITE 4 Read data acquired from analog input modules (AIS or AID) or analog output modules (AOD) are encoded in PCM counts in a two's complement format and will require conversion to engineering units to determine whether or not the analog channel is valid. A procedure to accomplish the required conversion will be provided in subsequent paragraphs.

Raw BITE 4 Read data acquired from discrete input modules (DIL or DIH), from Tacan modules (TAC), and from serial input/output modules (SIO) will be manually compared against a set of predetermined, expected hexadecimal patterns. If the actual response data is in agreement with the expected patterns, then it is reasonably certain that any suspect parameter interfaces are the result of failures external to the MDM.

Raw BITE 4 Read data from discrete output modules (DOL or DOH) should actually correspond to the theoretical MDM bilevel discrete command patterns. However,

since such command patterns may actually vary from instant to instant, it will be necessary to capture an image of the GPC command "set mask," as well as the BITE 4 response data.

The following sections either provide information with which the acquired MDM BITE 4 Read data may be compared, or an approach to calculate the results for comparison against a reference value.

1. Discrete Input Low/Discrete Input High (DIL/DIH)

The DIL and DIH cards provide two response words for the BITE 4 test. A fixed set of inputs are generated within the IOM when it is chosen for the BITE 4 Read. Note that the actual bilevel discrete inputs are electronically switched out of the discrete receiver circuits during the time the BITE patterns are generated. Thus, a predetermined BITE bit-pattern, totally independent of the instantaneous inputs is possible. By design, the resultant inputs are dependent on the channel selected as illustrated in Table 7.10B-1. These 16 bits are sent back to the GPC in the first MDM response word. The original test inputs are then "inverted" and sent back to the GPC in the second response word. The nominal variable parameter data is shown in Table 7.10B-2.

**Table 7.10B-1. DIL/DIH BITE 4 test inputs**

Bits	Test inputs 1			Test inputs 2		
	Ch 0	Ch 1	Ch 2	Ch 0	Ch 1	Ch 2
0-3	0	0	1	1	1	0
4-7	1	1	0	0	0	1
8-11	1	0	1	0	1	0
12-15	0	1	0	1	0	1

**Table 7.10B-2. Nominal DIL/DIH VP patterns**

Channel Adrs	RWD 1 (hex)	RWD 2 (hex)
00	"0FF0"	"F00F"
01	"0F0F"	"F0F0"
02	"F0F0"	"0F0F"

If the downlisted discrete input card BITE 4 response data does not agree with the expected patterns, then either the MDM has sustained a BITE circuit failure, or there is a failure at the bilevel receiver, the 18-bit parallel to serial shift register, or possibly the channel select logic. Since the BITE 4 Read was most likely performed to isolate a bilevel discrete parameter problem, it is a safe bet the BITE circuitry is OK. Unless power cycling clears up the problem, the input parameter is lost for the duration of the mission. In any event, the MDM is a good candidate for R&R postlanding.



2. Analog Input Differential/Analog Single-Ended (AID/AIS)

The AID/AIS cards provide two response words for the BITE 4 test. The first response word is formed by algebraically adding a "Reference BITE Voltage" to  $\frac{1}{2}$  of the actual instantaneous input signal. Rescaling of the actual analog input is accomplished via modification of the input receiver scaling and feedback resistors. The Reference BITE Voltage is either approximately +2 V dc or -2 V dc, dependent on the analog channel selected. Table 7.10B-3 provides BITE voltage for each AID/AIS channel. This data is sent back to the GPC in the first MDM response word.

**Table 7.10B-3. BITE voltage reference table**

Ch 00 +	Ch 08 -	Ch 16 -	Ch 24 +	BITE voltage notation: + = +2.0 VDC - = -2.0 VDC
Ch 01 -	Ch 09 +	Ch 17 +	Ch 25 -	
Ch 02 -	Ch 10 +	Ch 18 +	Ch 26 -	
Ch 03 +	Ch 11 -	Ch 19 -	Ch 27 +	
Ch 04 -	Ch 12 +	Ch 20 +	Ch 28 -	
Ch 05 +	Ch 13 -	Ch 21 -	Ch 29 +	
Ch 06 +	Ch 14 -	Ch 22 -	Ch 30 +	
Ch 07 -	Ch 15 +	Ch 23 +	Ch 31 -	

The second response word corresponds to the actual input analog signal. Note that each analog input receiver uses an RC filter to block the high frequency noise (>40 Hz) component in the input signal. Therefore, even a dynamically changing analog signal will not change sufficiently to affect the BITE Read results since the two RDW's are read so closely together (within 34 microseconds of each other).

An inherent assumption associated with the analog input card BITE test capability is that the input signal associated with the channel to be tested is within the conversion range of the A/D Converter; that is, from -5.12 V dc to +5.11 V dc. While an analog input receiver can handle input voltages far in excess of these values, the A/D Converter is limited in its conversion to a magnitude of 5.12 V dc. This is because the A/D converter design uses only a sign ( $\pm$ ) bit plus 9 data bits (least significant bit corresponding to 10 millivolts dc) to express the digitized voltage. If the actual analog differential input voltage magnitude is greater than 5.12 V dc (AID line-to-line input, AIS line to analog ground), the A/D converter will effectively "clip" the input at the maximum magnitude (+5.11 V dc or -5.12 V dc) due to the 10-bit conversion design limit requirements of the A/D converter logic.

*While it is not intuitively obvious at first glance, this condition, should it occur, will invalidate the analog input card BITE test. This factor should always be kept in mind when assessing the results of a BITE 4 Read to an AIS or AID card. This is not meant to imply the BITE test is of no value, but only that one*

*should not jump to conclusions should the actual BITE 4 Read calculations compare poorly with the predicted value.*

This is best illustrated via an example. Assume the input signal is *hard-failed* at +6.00 V dc and that the BITE Reference Voltage for the affected analog channel is +2.00 V dc. The first BITE measurement corresponds to the algebraic sum of the BITE Reference Voltage plus  $\frac{1}{2}$  of the input signal:

$$\text{RDW 1} = [+2.00 \text{ V dc} + \frac{1}{2} (+6.00 \text{ V dc})] = +5.00 \text{ V dc}$$

This value is well within the conversion range of the A/D converter. The second BITE measurement corresponds to the actual analog input signal, +6.00 V dc. However, conversion by the A/D converter will "clip" (or limit) the resultant value to +5.11 V dc. That is, the closest value the A/D converter can approximate the input within the 10-bit digital conversion limitations:

$$\text{RDW 2} = +5.11 \text{ V dc}$$

Now, when the input data is manipulated according to our equation, one obtains the following calculated BITE Reference Voltage:

$$\begin{aligned} \text{BITE Reference Voltage} &= [\text{RDW 1} - (\frac{1}{2} \text{ RDW 2})] \\ &= [+5.00 \text{ V dc} - \frac{1}{2} (+5.11 \text{ V dc})] = +2.45 \text{ V dc.} \end{aligned}$$

This calculated value miscompares with the actual value of +2.00 V dc by a whopping 22.5 percent! This results from nonlinearities introduced into the BITE equations due to analog input signals that fail outside the conversion range of the A/D converter.

As previously stated, the BITE 4 Read data acquired from an analog input module (AIS or AID) is encoded in PCM counts in a two's complement format, and, thus, will require conversion to engineering units to determine whether or not the analog channel is valid. There are various ways to convert the raw hex data to engineering units (EU). Most certainly, the easiest way is to let the Variable Parameter application do the dirty work. Otherwise, the conversion will have to be performed the old-fashioned way; that is, manually. It is assumed the console operator will utilize the Variable Parameter application because of its relative ease and less chance for error in the conversion from hexadecimal to EU. However, for illustrative purposes, as well as, retention of corporate knowledge, the manual calculation approach is also presented in this SCP. In the following pages, several manual approaches will be presented that illustrate the conversion of raw hex data to EU.

**Semi-Automatic Calculation of BITE Voltage (Variable Parameters application):**

As previously stated, the BITE 4 Read data acquired from an analog input module (AIS or AID) is encoded in PCM counts in a two's complement format, and, thus, will require conversion to engineering units in order to determine whether or not the analog channel is valid. The easiest way is to let the Variable Parameters application perform the conversions.

While the following procedure is not fully automated, the difficult conversion of raw hex data from two's complement format to signed (plus or minus) decimal values is performed automatically by the application. By performing a manual two-step process of entering scaling (K value and bias value), the analog "BITE Reference Voltage" will be obtained.

Recall the following:  $RDW\ 1 = [(BITE\ Ref\ Voltage) + \frac{1}{2} (Actual\ Analog\ Value)]$   
 $RDW\ 2 = [Actual\ Analog\ Value]$

Since these response words are raw MDM parameters, they represent 16-bit words of which the ten left-hand bits are expressed in a two's complement format the most significant bit is the sign bit (logical 0 = "+" and logical 1 = "-") and the next 9 bits are data in "powers of two" representation, with the least significant data bit (LSB) scaled at 10 millivolts DC]. The remaining least significant six bits of the 16-bit response word are simply filler bits required to satisfy data bus transmission format standards. Think of them as being formatted essentially in a "PCM count \* 64" type notation (much like BFS TMBU FDA limits). Since the Variable Parameter application will convert them as a whole number, it will be necessary to divide the resultant application-converted value by "64" decimal to convert to "PCM counts". Next, since the LSB has a weighting of 10-millivolts DC (10 mV dc) per "PCM count", it will also be necessary to further rescale by [(10 mV dc per PCM count) divided by (1000 mV dc per V dc)] = [1/100 V dc per PCM count]. For the Variable Parameter application, this is accomplished by entering the desired "K Value" to the MOC.

Observe now that if we were to also rescale RDW 2 by a value of "minus  $\frac{1}{2}$ " then the resultant application's engineering units value for RDW 2 would correspond to a value of [ $-\frac{1}{2} (Actual\ Analog\ Value)$ ]. Furthermore, if that value, once known, is subsequently added as a "bias value" to the converted value of RDW 1, then the resultant Variable Parameter application's EU value would correspond to the "BITE Ref Voltage", which is the end-item value one is attempting to calculate. The above discussion is summarized below.

- a. Initially, enter the following information for VP scaling:

$$RDW\ 1: K\ value = [1/64 * 1/100] = 1/6400 = +0.00015625$$

$$RDW\ 1: bias\ value = 0$$

$$\begin{aligned} \text{RDW 2: K value} &= [(-1/2 * (1/64 * 1/100))] \\ &= [-1/2 * 1/6400] = -1/12800 = -0.000078125 \end{aligned}$$

RDW 2: bias value = 0

- b. Once the BITE 4 Read load is uplinked, values corresponding to RDW 1 and RDW 2 will be displayed in engineering units on Variable Parameter application. Next, change RDW 1 "bias value" to equal the RDW 2 "EU value". The resultant RDW 1 "EU value" will then represent the computed BITE voltage.

### Manual Calculation of BITE Voltage:

With the EU scaling capability associated with the "Variable Parameter" application, there is little need for the console operator to manually compute analog input card BITE 4 test results. It was decided, however, that this SCP should retain such information in case one wishes to exercise the capability. For example, the manual calculation of analog BITE voltage will be required anytime the Variable Parameter application software undergoes recertification testing. It could also be required as an exercise for DPS Support console certification. In any event, the SCP shall serve as a repository for corporate knowledge for the subject.

The following procedure assumes the availability of a PC running under Microsoft windows. The windows "scientific calculator" will be utilized to perform any necessary two's complement conversions and hex-to-decimal conversions, as well as, arithmetic manipulations of the resultant decimal data. All of these conversions can be done by hand, but it obviously takes much, much longer to reach the final results.

- a. Call up "ACCESSORIES", double click on "Calculator," and select View option "scientific."
- b. Next, determine if either, or both of the raw hex VP analog response words are "negative." If the first hex digit is in the range "0" through "7," then the value is positive (MSB = 0) and no two's complement conversion is required (in fact, you will not get the correct results if you do complement the value). If the first hex digit is in the range "8" through "F," then the value is negative (MSB = 1) and a two's complement conversion *must* be performed. To maintain the "signed" ( $\pm$ ) nature of the hexadecimal data, the following procedure is recommended:

If raw hex data is "positive"(first hex digit is in the range of "0" and "7"), perform steps a through c (below). Otherwise, raw hex data is "negative" (first hex digit is in the range of "8" and "F"), perform steps a through d :

- a. Select "Hex" and "Dword" display options, and then enter the raw hex value.
- b. Now, select "Dec" option to convert the intermediate results to a signed decimal.
- c. Next, divide by 64 (decimal) to convert to PCM counts (somewhat similar to what we do when manually calculating BFS TMBU limits). Finally, multiply the PCM count by "0.010" (scaling is 10 millivolts per PCM count) to convert to V dc.
- d. Subtract 10.24 (decimal).

Finally, using the "signed" ( $\pm$ ) converted voltage measurements, calculate the analog BITE Reference Voltage (nominally, +2 V dc or -2 V dc) using the following equation:

$$\text{BITE Reference Voltage} = (\text{Response Word 1}) \text{ minus } \frac{1}{2} (\text{Response Word 2})$$

FYI: If one desires to convert a "negative" hex value by hand, the following approach is suggested. Express the hex data as a 16-bit binary string. Then complement the binary string bit-for-bit. This is known as the one's complement of the value. Probably, the least confusing approach is to express the resultant 16-bit binary string as a hexadecimal number. Now, add a hex one "1" to the hex number and ignore any overflow to the "fifth" most significant hex digit. Consider the following examples:

"DC80" hex converts to a "1101 1100 1000 0000" binary string pattern. The one's complement is "0010 0011 0111 1111" which equals "237F" hex. The hexadecimal sum of "237F" plus "1" (that is, "0001" hex) is equal to "2380" hex.

Keep in mind that this is actually "*minus*" 2380 hex, and when converted to decimal should be expressed as a negative algebraic number (otherwise, you're not going to get the correct results).

#### **Analog Input Card (AID or AIS) BITE Voltage Calculations:**

A couple of examples of manual calculations are provided below. The first example is a hypothetical case that illustrates the "classical hand calculation" approach using positive hex data. This approach may be used if no calculator

exists to convert from hexadecimal to decimal. The second example actually resulted from an STS-68 MDM BITE Read test and assumes the availability of a PC running in Microsoft windows.

Analog Input Differential (AID) Example No. 1:

**Equations**

RDW 1 = BITE signal +  $\frac{1}{2}$  (actual value)

RDW 2 = Actual value

**Given**

FF2, Card 14 (AID), Channel 04

"Actual" input value = 5 V dc (Note: "Actual" value arbitrarily chosen for this example.)

**Calculations**

FF2 Card 14 is an AID card.

Channel 04 will have a -2 V dc BITE signal added in RDW 1.

VP downlist will show the following:

VP 1 = RDW 1 = "0C80" hex

VP 2 = RDW 2 = "7D00" hex

Convert RDW 1 to engineering units:

RDW 1 = "0C80" = 0000 1100 1000 0000 binary = 3200 in decimal

Remember, because this is an MDM parameter, the pertinent data is in the first 10 bits. The last 6 bits are fillers so the GPC can store the information in 16-bit half words. Therefore, the decimal value must be divided by 64.

RDW 1 (PCM) = 3200/64 = 50 PCM counts, where each PCM count = 10 mV dc

RDW 1 (EU) = 50 \* 10 = 500 mV dc = 0.5 V dc

RDW 2 = "7D00" = 0111 1101 0000 0000 binary = 32000 in decimal

RDW 2 (PCM) = 32000/64 = 500 PCM counts, where each PCM count = 10 mV dc

RDW 2 (EU) = 500 \* 10 = 5000 mVDC = 5.0 V dc

Therefore:

RDW 1 = BITE signal +  $\frac{1}{2}$  (RDW 2)

0.5 V dc = BITE signal +  $\frac{1}{2}$  (5.0 V dc)

0.5 V dc = BITE signal + 2.5 V dc

Thus, BITE signal = 0.5 V dc - 2.5 V dc = -2.0 V dc

Analog Single-Ended Input (AIS) Example #2:

During STS-68, a PROP vernier jet parameter (MSID V42T2525C) failed erratically causing RCS jet RM to downmode the verniers, a significant operational hit to the mission. The problem was ultimately corrected by a real-time GMEM. From a DPS perspective, it was unclear if the problem was external to the MDM (PROP transducer) or the result of a single analog input channel failure. While the end result was the same on orbit (GMEM was required), isolation of the failure could potentially be significant to KSC turnaround operations should the failure have cleared once the orbiter was on the ground.

The failed parameter was channelized via MDM FA1, Card 14 (AIS), Channel 07 (Left RCS Jet L5D Oxidizer Injection Temperature indication).

VP slots 9 and 10 were selected to support the BITE 4 Read to this analog interface, since they were essentially "unused VP slots" in the GNC downlist. While convenient, their choice prohibited use of the MSK 1352 special comp to convert the raw hex data to engineering units. Such constraints, of course, no longer apply in the CCC environment with the availability of the "Variable Parameters" application.

The resultant MDM BITE 4 Read command load yielded the following raw hex data:

VP slot 9: "DC80" hex, corresponding to RDW 1  
VP slot 10: "1D00" hex, corresponding to RDW 2

**Calculations:**

- a. By inspection, it was determined that RDW 1 was "negative" and, thus, required a two's complement conversion. Since RDW 2 was "positive", conversion was not required.
- b. Using the PC "scientific calculator" (*Hex* and *Dword* options), RDW 1 was converted to volts as indicated below:

"DC80" minus "10000" equals "FFFFDC80" (intermediate value). The *Dec* option was selected and the intermediate value was converted to "-9088" decimal. This value, in turn was divided by 64 decimal to yield "-142" (in PCM counts). Further scaling by multiplying this result by "0.010" yielded a final value of "-1.42 VDC" for RDW 1.

- c. Using the PC "scientific calculator" (*Hex* and *Dword* options), RDW 2 was converted to volts as indicated below:

"1D00" was entered. The *Dec* option was selected and the intermediate value was converted to "7424" decimal. This value, in turn was divided by 64 decimal to yield "116" (PCM counts). Further scaling by multiplying this

result by "0.010" yielded a final value of "1.16 V dc" for RDW 2. Likewise, multiplying by "0.50" yielded a value of 0.58 V dc for  $\frac{1}{2}$  RDW 2.

- d. Using these results in the equation to calculate the BITE Reference Voltage:

BITE Reference Voltage: "-1.42 V dc" minus "0.58 V dc" equals "-2.00 V dc"

Per Table 7.10B-3, the expected BITE Reference Voltage for "Channel 07" of an analog input card (either AIS or AID) is a "-2 V dc." Since the actual calculated BITE Reference Voltage was in close agreement with the predicted value, it was concluded that the MDM was, in fact, performing properly and the failure was indeed external to the MDM (a PROP transducer failure).

3. Analog Output Differential (AOD)

The AOD card provides one response word for the BITE 4 test. The actual output voltage is sent back to the GPC in one MDM response word. Therefore, the nominal value must be known as a voltage or the actual commanded value must be known. This may be accomplished by using the standard Variable Parameters capability (prior to the uplink of the MDM BITE Read command) to monitor the contents of the PASS GNC (or SM) output compool that corresponds to the desired analog command channel. Once the data is obtained:

- a. Convert the hex data into its decimal equivalent.
- b. Divide the decimal equivalent by 64 to obtain the PCM count.
- c. Multiply the PCM count by 10 mV dc.

Remember, as with analog inputs, if the raw hexadecimal data is observed to be "negative" (that is, the most significant hex digit is "8" through "F"), then it will be necessary to perform a "two's complement conversion" prior to converting the raw hex value to its decimal equivalent.

#### **Analog Output BITE Voltage Calculations:**

An example of a manual calculation for a hypothetical AOD card follows:

#### **Given:**

FF2, Card 08 (AOD), Channel 01

"Actual" output = 3.0 V dc (Note: "Actual" value arbitrarily chosen for this example.)



Measured input value also = 3.0 V dc

**Calculations:**

FF2 Card 08 is an AOD card.

VP Downlist will show the following:

$$VP = RDW = "4B00" \text{ hex}$$

Convert RDW to engineering units:

$$RDW = "4B00" = 0100 \ 1011 \ 0000 \ 0000 \text{ binary} = 19200 \text{ in decimal}$$

Remember, because this is an MDM analog parameter, the pertinent data is in the first 10 bits. The last 6 bits are fillers so that the GPC can store the information as 16-bit half words. Therefore, the decimal value must be divided by 64.

$$RDW \text{ (PCM)} = 19200/64 = 300 \text{ PCM counts, where each PCM count} = 10 \text{ mVDC}$$

$$RDW \text{ (EU)} = 300 * 10 = 3000 \text{ mVDC} = 3.0 \text{ VDC}$$

The Variable Parameter application may be used to calculate the AOD channel value in EUs:

$$\text{Response word K value} = 1/64 * A1$$

$$\text{Response word bias value} = A0$$

Where A0 and A1 are the cal coefficients in the standard linear equation:

$$EU = A0 + A1 * (\text{PCM})$$

The responsible discipline will be required to provide such data or the DPS discipline will be unable to effectively troubleshoot the affected AOD channel.

4. Discrete Output Low/Discrete Output High (DOL/DOH)

The DOL and DOH cards provide one response word for the BITE 4 test. The actual discrete output for the entire channel is sent back to the GPC in one MDM response word. Therefore, the nominal value of the desired bilevel discrete (or discrettes) must be known. The data is downlisted in hex, where the MSB is bit 0. As an added note, it is possible to use standard VPs to look at GPC output compool Set Mask and Reset Mask words to determine "command status." (Reference MDM channelization HFE output transaction overview or SM payload MDM I/O transaction overview to cross reference HAL names.)

5. Serial Input/Output (SIO)

The SIO card generates two response words for the BITE 4 test. A fixed binary test pattern of "1010101010101010" is generated in the IOM. This pattern is sent back to the GPC in RDW 1. A second fixed pattern is then generated, "0101010101010101". This pattern makes up RDW 2. The nominal VP patterns are as follows:

RDW 1 = "AAAA" hex  
RDW 2 = "5555" hex

Each BITE pattern is converted to a Manchester II format and transmitted on the dedicated serial I/O data bus for that channel. Simultaneously, the input receiver interface (party-line receiver) is enabled and the Manchester-encoded signal on the serial I/O data bus is subsequently decoded and transmitted by the SIO module back to the GPC via the MDM sequence control unit. During the BITE 4 test, the message and word discrete drivers are not enabled. Thus, the LRU will be unaware (hence, unaffected) of the serial digital "data" on the serial I/O data bus.

If the input decoder logic does not detect any response, it will result in an E-bit error signature for that response word. If this occurs on the first response word, no input data will be stored in the BITE Read input buffer. If the error occurs on the second response data word, only the first pattern (nominally "AAAA" hex) will be downlisted. The second VP slot will be "0000" hex since the input buffer is cleared prior to the actual I/O transaction.

It is important to note that the MDM BITE 4 test for SIO cards does not check the discrete line drivers (MSG IN, MSG OUT, and Word Discrete) for any of the LRU interfaces. Thus, the SIO card interface with an LRU can be failed at the MDM, and the BITE 4 test will still complete successfully. In fact, SIO card failure history indicates discrete line driver failures to be the most likely failure mode. To date, there is not sufficient failure history on EMDM's to indicate whether or not they will exhibit the same failure patterns.

6. TACAN (TAC or TRA)

The TACAN card provides one response word for the BITE 4 test. A fixed test pattern is generated in the IOM. This test pattern is somewhat dependent on the channel selected. That is, for channels 00-06, the binary pattern is "1010100110101010," and channel 07 is "1010xxx110101010," where the "x's" are don't care bits. The generated test pattern is sent back to the GPC and downlisted in hex. The nominal VP patterns are as follows:

Channels 00-06 - "A9AA" hex  
Channel 07 - "AxA A" hex, where x is an odd hex number

**REFERENCES**

1. SS Downlist/Uplink Software Requirements, CPDS, SS-P-0002-140.
2. SS Functional Level Requirements, Vehicle Utility, CPDS, SS-P-0002-550.
3. CCS Control User's Guide (Part 3: MED LIST), STSOC-UD-600315.

**TITLE**

SCP Verifier: \_\_\_\_\_  
Facility: \_\_\_\_\_ Date: \_\_\_\_\_

MDM BITE READ LOADS (Command Server)

**PURPOSE**

This SCP provides information necessary to implement an Uplink MDM built-in test equipment (BITE) Read command load. Since this command uses generic commanding, the build capability is available only via the MDM BITE Read application.

This SCP is partitioned into two sections: Section 7.10G provides all steps required to build, verify, and provide uplink coordination of an MDM BITE Read command load, and is under configuration control; Section 7.10B provides information to decode and interpret the resultant telemetry data associated with the uplinked MDM BITE Read load.

It should be emphasized that *if* the suspect MDM avionics input or output signals are very dynamic, the likelihood of trapping the signal is remote. Examples are: PASS commands that are essentially short duration pulses (such as RCS jet commands) or high rate toggling of a suspect input parameter. Thus, even though the MDM BITE circuitry and the workstation software will support uplink MDM BITE Read loads, the uncertainty in interpreting the results of such BITE reads effectively causes such activity to be a useless exercise, unless the anomalous condition is actually present at the instant the MDM BITE test is performed. Such factors should be well understood prior to committing to the MDM BITE 4 Read process.

**BACKGROUND INFORMATION**

The MDM BITE Read command allows the DPS operator to acquire information to troubleshoot/isolate an MDM problem in flight. This additional information may assist in the post flight analysis and potential MDM removal and replacement actions. There are two types of MDM BITE Read commands:

- A. BITE Status Register (BSR) Read: Allows the operator to read the BSR contents to determine if an internal MDM problem had been detected by the MDM's BITE circuitry.
- B. BITE 4 Read: Allows the operator to read any single input/output module (IOM) channel to test the channel's performance. (The results may help exonerate a suspect MDM.)

For both options, the requested data is downlisted via a variable parameter (VP), which is assigned as part of the command load format. Therefore, a separate VP load is not required in conjunction with this command load. Note, however, that this automatic downlist option may be inhibited if it is inconvenient to allocate any VP slots at the time the MDM BITE Read is to be performed. (For example, all VP slots are being used to support a specific GNC, FDO, or payload monitoring activity.)

Since the uplink MDM BITE Read feature was designed to support a contingency situation, the use of VPs instead of dedicated downlist words help to minimize the impacts to a limited downlist bandwidth, particularly the low data rate TFLs.

The MDM I/O corresponding to the desired uplink BITE Read command is essentially "one-shot" in nature. That is, there is only one attempt to acquire the data for each uplink command, whether successful or not. The associated variable parameter logic, on the other hand, will downlist the contents of the "BITE Read data input buffer" indefinitely.

The MDM BITE Read software is designed such that the data input buffer consists of *only* two halfwords. This is important to remember when multiple BITE Read command loads are to be issued to the same major function (whether to same or different MDMs). The software is designed to initialize (or clear) each buffer halfword to "0000" hexadecimal prior to attempting to acquire the desired input data. Thus, any BITE data from previous uplink BITE Reads to that same major function will be overwritten, whether or not the actual BITE data acquisition is successful. For this reason, there is no advantage in assigning different variable parameter slots for each command load.

While the MDM Uplink BITE Read capability is supported in all OPS, the feature would not normally be used during dynamic flight. For certain memory configurations, such as, MC1 (GNC 1/6), MC3 (GNC 3), MC6 (PL 9), and MC9 (GNC 9), the capability is intended primarily to support postlanding or ground checkout operations.

Depending upon the card type and channel address of the I/O module selected during an MDM BITE 4 Read, the contents of the response data (RDW's) may or may not correspond to a pre-determined pattern, independent of the actual I/O associated with that I/O card. For example, the nominal data patterns for discrete input cards (DIL or DIH) and serial I/O cards (SIO) are predictable. While analog input cards (AID or AIS) employ BITE circuitry that utilizes the raw analog inputs in the response data, the net effect is that such dynamic data is factored out in the BITE results, provided the raw analog input data is within the quantization range of the A/D Converter (-5.12 VDC to +5.11 VDC). Thus, even the calculated BITE reference voltages for analog input cards are predictable. The net effect for all of the above input type cards (analog, discrete, and serial I/O) is that the MDM BITE Read response data is generally sufficient to analyze the problem at hand.

This is not true, however, for analog output (AOD) and discrete output (DOL and DOH) cards. A design requirement for all MDMs requires that BITE circuitry not alter any MDM outputs. Thus, MDM BITE 4 Read command loads to any AOD, DOL, or DOH type card will correspond only a read of the actual channel output at the instant the channel is read. Thus, for the flight controller to correctly analyze the contents of the response data, knowledge of the commanded outputs is necessary.

This may be accomplished in a variety of ways. First, the affected discipline will frequently know what the PASS applications software is commanding (via downlist telemetry). If not, an alternate approach is to read the contents of the GNC (or SM) Output Compool buffers associated with the affected MDM card and channel (see PASS Variable Parameters, Section 7.6G). For AOD type cards, a single halfword will

correspond to the desired analog output channel. For DOL or DOH type cards, two separate halfwords will correspond to the desired bilevel discrete output channel - the "Reset Mask" and the "Set Mask" words.

The difficult part of this activity is to correctly identify the corresponding GPC memory addresses for the desired MDM output parameter. It is recommended that the MDM channelization "overviews" be used to derive the corresponding flight software HAL Name (remember there are multiple copies in the flight software, one per like MDM). Once identified, it should not be too difficult for the flight controller to determine the desired addresses using the Flight Software CD ROM.

Finally, it should be noted that the desired output compool locations should be monitored at the instant the uplink MDM BITE Read occurs. As a result, such VP loads should be uplinked (and downlisted VP contents confirmed as expected) prior to uplinking the actual MDM BITE 4 Read command load.

One final point should be reemphasized, although such a decision should have been made prior to committing to the MDM BITE 4 Read process. When analog or discrete outputs are very dynamic, or the PASS commands are short duration pulses, the likelihood of trapping the signal is very remote (for example, RCS jet commanding, unless the crewman is known to be commanding a hot fire test at the very instant the load is uplinked, which requires precise crew-MCC coordination). Thus, even though the MDM BITE circuitry and the workstation software will support such MDM BITE 4 Read loads, the uncertainty of the results of the BITE Reads essentially cause such activity to be a useless exercise.

## **RESTRICTIONS/CONSTRAINTS**

**CAUTION**

This procedure (7.10G) is governed by FCOH 3.1, 3.2.2, and 3.2.2.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

A. Onboard Software Command Legality Tables

1. PASS

MC (MF/OPS)/GPC ID	CMD legal
MC0 (OPS 0)	X
MC1 (GNC 1/6)	X
MC2 (GNC 2)	X
MC3 (GNC 3)	X
MC4 (SM 2)	X
MC5 (SM 4)	X
MC6 (PL 9)	X
MC8 (GNC 8)	X
MC9 (GNC 9)	X
GPC ID	

2. BFS - N/A

B. Valid OI Loads

All PASS  
No BFS

C. Vehicle, LRU/Hardware Version Constraints

None.

D. Time Constraints/Crew Coordination Requirements

None.

E. Hazard/Safety Implications

MDM BITE command loads alter only selected PASS GPC VP contents and essentially use MDM single-stage commands to read MDM BITE status (MDM outputs and inputs are not affected by these command loads). The flight software is insensitive to MDM BITE Read loads to the point that a load could be erroneously uplinked to the wrong major function without any impacts whatsoever to that flight software, other than altering the contents of the VP slot specified by the command load. If this were to occur, it may be necessary to re-uplink the desired VP load, however, no GPC software dumps are required, and it is not necessary to re-IPL the affected GPC.

F. Other Requirements

1. Immediate, back-to-back MDM BITE Read requests, such as chained loads, to the same major function (MF) should be procedurally avoided because a subsequent load will overwrite the first load. The buffer is cleared when the command is sent. This situation could cause a loss of data and/or misinterpretation of the results (each GPC within the MF maintains a single two-halfword I/O buffer to store all MDM BITE Read inputs). Once the BITE data has been captured on the ground, there are no constraints in uplinking

additional BITE Read commands to the same MF, provided, of course, they are not back-to-back uplinks.

2. The MCC should be cognizant of when MDM BITE Read loads are uplinked, since in theory they could cause a jitter in the cyclic input I/O during the BITE data acquisition. In certain situations, this jitter could cause a single-occurrence GPC error (i.e., a cycle wrap "02 0D' hex). While this is not in itself a cause for concern, it is recommended that these uplink command loads be used during relatively quiescent time periods. Examples of non-quiescent times are ascent/entry, rendezvous (applicable to flight critical MDM BITE Read loads while PASS GNC set in "target track" mode), and deploys (applicable to payload MDM BITE Read loads).
3. If an MDM or I/O module is bypassed by the flight software, BITE Reads to that MDM may or may not be successful. Since the BITE Read capability is totally uncoupled with the BCE Element Bypass feature, it is unnecessary to request an I/O RESET prior to executing the BITE Read command. However, if a particular MDM port (PRI or SEC) is to be tested, then the crew needs to have selected that interface via port moding prior to uplinking the command load. This is particularly true of BSR Reads, since each MDM sequence control unit (SCU) contains its own BITE status register, and there is no cross coupling of the BSRs. If the interface between an SCU and an I/O module is suspect, then the BITE 4 Read must be performed via the corresponding MDM port. If, however, a channel on an I/O module is suspect, then the BITE 4 Read may normally be performed on either MDM port (analog input and analog output cards could be port-sensitive, however). Finally, if the affected MDM port or I/O module is, in fact, hard-failed, then issuing the MDM BITE Read command will result in an I/O error (single error logged), which is transparent to the flightcrew.
4. Whenever an MDM is powered on or power cycled, the BSR's "power interrupt bit" on each MDM port will be set and remain set until that specific BSR is read. The first BSR read on an MDM port since the power-on condition should nominally indicate an "8000' hex value.

## PROCEDURES

WARNING

This operation utilizes a generic command load. Uplink of an incorrect bit pattern can have unpredictable results, including loss of PASS, loss of vehicle control, unexpected alarms, and corruption/loss of onboard systems.

It should be noted that the MDM BITE Read command load utilizes the generic command load capability. The MDM BITE Read application's software incorporates logic to avoid selection of invalid MDM addresses, invalid I/O card and channel address combinations, and invalid transfer counts. Since there was a deliberate "no requirement" for



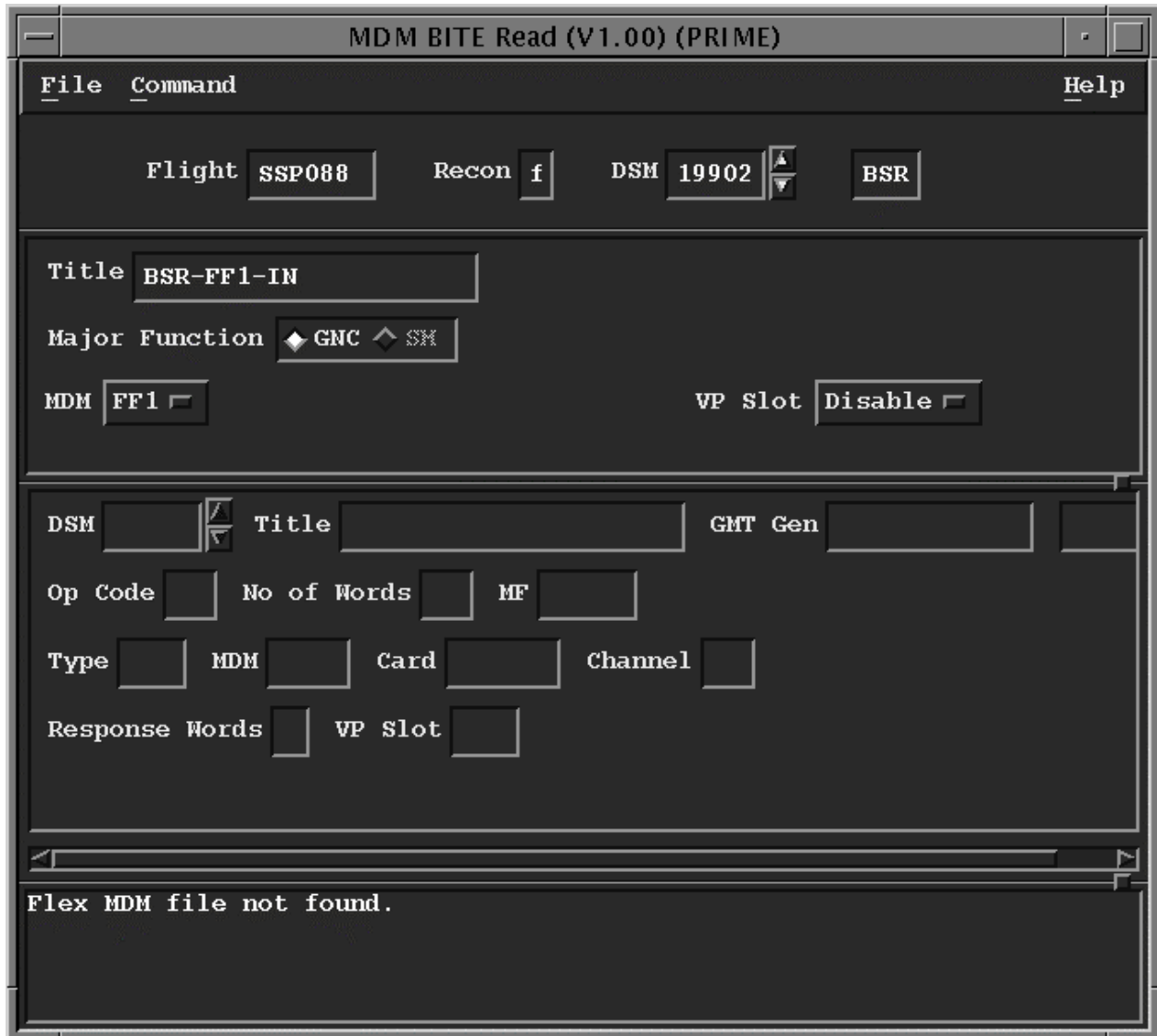
the flight software to provide such checks in order to simplify the onboard mechanization, the burden for such checks was intended to be a ground workstation software function. However, the worst possible condition that could result from an inadvertent uplink of a command with an invalid MDM address or an invalid MDM I/O card and channel address combination is a nuisance GPC error or I/O error.

Indeed, the only critical parameter associated with use of the generic command capability is the uplink OP code ("2C" hex or "0101100" binary). This uplink OP code is hard coded in the MDM BITE Read workstation software, thus, the console operator cannot enter any other OP code.

Furthermore, as an additional safeguard, the COMMAND console will enable only the requested uplink OP code at the time the generic command capability is enabled.

#### A. Building MDM BITE Read Command Loads

1. Start the MDM BITE Read (MBR) application by selecting Command->Command Server->MDM BITE Read on the DPS DNAV. MBR is shown in Figure 7.10G-1.
2. When started, the MDM BITE Read application will automatically select the flight ID for the activity that was selected during activity selection. If the flight ID or recon selected is not the one desired, change it via the File->Change Flight pull down menu.



**Figure 7.10G-1. MDM BITE Read Application**

3. For new loads, select File->New and then either MDM BSR or MDM BITE 4. The next available DSM number will be automatically selected. If the desired DSM number does not appear, you may type it in. To modify an existing load, select File->Open and then, using the arrow buttons next to the DSM number, select the DSM number of the load you wish to modify.
4. If performing a BSR Read:
  - a. Using the MDM option button menu, select the MDM you wish to perform the BSR Read on. The menu contains options for selecting Flight Critical, Payload, and Flex MDMs. If no Flex MDM data is manifested, Flex MDMs will not be displayed as an available option.

- b. Using the VP Slot option button menu, select the VP Slot to be used for downlisting the BSR Read results. BSR Reads acquire only a single response data word (RDW) for downlisting and thus only one VP slot is required. Select inhibit for the VP Slot if you do not want to use the VPs to downlist the results. If the VP Slot option is inhibited, a separate VP load must be built to obtain the BSR Read information. The flight software HAL name of the location in memory that will contain the results is CDJB\_BITE\_IO\_IN.

**CAUTION**

Coordinate with the appropriate discipline if their VP slot will be used for the MDM BITE Read. If this coordination is not performed, the discipline may begin troubleshooting erroneous data.

An appropriate title for the command will be automatically chosen according to the parameters selected.

5. If performing a BITE 4 Read:
  - a. Using the MDM, Card and Channel option buttons, select the MDM, card and channel you wish to perform the BITE 4 Read on. The menu contains options for selecting Flight Critical, Payload, and Flex MDMs. If no Flex MDM data is manifested, Flex MDMs will not be displayed as an available option.
  - b. Using the VP Slot option button menu, select the starting VP Slot to be used for downlisting the BSR Read results.

**CAUTION**

Coordinate with the appropriate discipline if their VP slot will be used for the MDM BITE Read. If this coordination is not performed, the discipline may begin troubleshooting erroneous data.

Depending upon the type of I/O module to be tested, the BITE 4 Read will acquire either one or two response data words (RDWs). AOD, DOL, DOH and TAC modules acquire one RDW. AID, AIS, DIL, DIH and SIO modules acquire two RDWs. Reference Table 7.10G-1 for the number of response words acquired for each card and channel.

The workstation application will not allow the selection of VP slot 10 if the BITE 4 Read command will return two response data words. Select inhibit for the VP Slot if you do not want to use the VPs to downlist the results. If the VP Slot option is inhibited, a separate VP load must be built to obtain the BSR Read information. The flight software HAL name of the location in memory that will contain the results is CDJB\_BITE\_IO\_IN.

The raw BITE 4 Read data acquired from discrete modules (DOL or DOH and DIL or DIH), from Tacan modules (TAC), and from serial input/output modules (SIO) will be manually compared against expected hexadecimal patterns (and manually decoded if the actual BITE data does not agree with expected patterns). Thus, there is no requirement to convert to engineering units.

The raw BITE 4 Read data acquired from analog modules (AOD, AIS, or AID) are encoded in PCM counts in a two's complement format and will require conversion to engineering units to determine whether or not the analog channel is valid.

An appropriate title for the command will be automatically chosen according to the parameters selected.

6. Save the load on the workstation by selecting File->Save.

**Table 7.10G-1. MDM BITE Read valid channel range/RDW counts**

Card adrs	FF MDM			FA MDM			PF MDM			Flex MDM		
	Card type	Chan range	No. RDW	Card type	Chan range	No. RDW	Card type	Chan range	No. RDW	Card type	Chan range	No. RDW
00	TAC	00-07	1	AOD	00-15	1	DOL	00-02	1	Flex MDM I/O module configuration is mission dependent  ↓ ----- N/A N/A N/A N/A N/A N/A N/A N/A N/A		
01	AID	00-15	2	AID	00-15	2	AID	00-15	2			
02	DOH	00-02	1	DOL	00-02	1	DOH	00-02	1			
03	SIO	00-03	2	DIH	00-02	2	DIH	00-02	2			
04	DIH	00-02	2	AOD	00-15	1	AID	00-15	2			
05	DOL	00-02	1	DIL	00-02	2	DIL	00-02	2			
06	DIL	00-02	2	AIS	00-31	2	DIH	00-02	2			
07	AIS	00-31	2	DOH	00-02	1	DOH	00-02	1			
08	AOD	00-15	1	DIH	00-02	2	SIO	00-03	2			
09	DIH	00-02	2	AID	00-15	2	DIH	00-02	2			
10	DOH	00-02	1	DOL	00-02	1	DOL	00-02	1			
11	SIO	00-03	2	DIH	00-02	2	AID	00-15	2			
12	DIH	00-02	2	DOH	00-02	1	AOD	00-15	1			
13	DOL	00-02	1	DIL	00-02	2	DIL	00-02	2			
14	AID	00-15	2	AIS	00-31	2	DOH	00-02	1			
15	DIL	00-02	2	DOH	00-02	1	SIO	00-03	2			

Notes: Regardless of MDM type (FF, FA, PF, or Flex), an invalid I/O card or channel address specification will result in a PASS-detected I/O error (V-BIT). Also, an invalid XFER COUNT specification will result in one of the following conditions: A loss of BITE 4 Read data (second RDW gets "bit-bucketed"); or a PASS-detected I/O error (timeout waiting for a nonexistent second RDW).

A conscious decision was made in the design requirements stage to place the burden for error checks on the ground workstation software. The workstation MDM BITE Read applications does, in fact, provide such error checks to prevent the generation of command loads with invalid MDM address specification and card type/channel address configurations.

Flex MDMs are physically different as compared to "regular" orbiter MDMs in several respects. First, only an I/O card address specification in the range of 00-07 is valid for Flex MDMs. Second, the card type is mission-dependent, since I/O card configuration is field-reconfigurable. Allowable Flex MDM card type and associated channel range and number of RDW's are identified below. Note that Flex MDM's may use a unique I/O module, referred to as a "Pulsed Output Card" (POH). However, since no useful information can generally be derived from a BITE 4 Read to this type of card, the workstation MDM BITE 4 Read software does *not* implement any logic to test a POH card.

	Card type	Chan range	No. RDW	Card type	Chan range	No. RDW
F						
L	AID	00-31	2	AOD	00-15	1
E	DIL	00-02	2	DOL	00-02	1
X	DIH	00-02	2	DOH	00-02	1
	SIO	00-03	2	POH	N/A	N/A

**B. Transmitting MDM BITE Reads to the Command Server**

1. Obtain Flight Director approval to enable Generic Command capability.

2. Have COMMAND enable generic command for your workstation. Provide COMMAND with the following information over the COMMAND Loop:
  - a. OP Code - 2C
  - b. Terminal/Position Auth ID - DPS
  - c. Destination Node Name - FCR = WF3 or WF22  
- MPSR= WM6 or WM9

The OP Code Status application may be monitored to check the enabled/disabled OP code status for all authorized generic command loads. For more information on starting or interpreting the OP Code Status application refer to SCP 7.1G.

3. Send the load to the command server by selecting Send on the Command menu.
4. Have COMMAND disable generic command capability for your workstation.

#### C. Verifying MDM BITE Read Commands

The bottom portion of the MDM BITE Read application, referred to as the verification area, is used to verify MDM BITE Read loads (Figure 7.10G-2). Immediately after the load is sent to the command server, it will appear in the verification area. Additional MDM BITE Read loads in the command server can be viewed by scrolling to the desired DSM using the up and down arrow keys next to the DSM field of the verification area. The up/down arrows in the verification area are not active unless MDM BITE Read is in the Verify mode. To put the application in the Verify mode, select Command->Verify.

**Figure 7.10G-2. MDM BITE Read Application**

BSR Loads

1. **DSM = 199XX** - This DSM number is a five-digit number, with the first three digits always of the form "199". Each load is accountable by a DSM number and should be verified to ensure that the proper load is being uplinked.
2. **OP CODE = 2C** - The OP Code will always be **2C** for MDM BITE reads.
3. **MF = GNC or SM** - This designates the appropriate PASS set major function to which the load must be sent.
4. **TITLE** - The title describes the function of the MDM BITE Read load.

5. **SAFED/UNSAFED** - This indicates whether or not the command is safed in the command server.
6. **NO of WORDS = 3** - This is the total number of words in the command load. For BSR loads this number will always be 3.
7. Type = BSR
8. **MDM** - Indicates the MDM that the BSR load will check.
4. **Response Words = 1** - Indicates number of response words expected. For BSR reads this number will always be 1.
5. **VP Slot** - Indicates the VP slots selected to view the response.

BITE 4 Loads

1. **DSM = 199XX** - This DSM number is a five-digit number, with the first three digits always of the form "199". Each load is accountable by a DSM number and should be verified to ensure that the proper load is being uplinked.
2. **OP CODE = 2C** - The OP Code will always be **2C** for MDM BITE reads.
3. **MF = GNC/SM** - This designates the appropriate PASS set *major function* to which the load must be sent.
4. **TITLE** - The title describes the function of the MDM BITE Read load.
5. **SAFED /UNSAFED** - This indicates whether the command is/is not safed in the Command Server.
6. **NO of WORDS = 3** - This is the total number of words in the load. For BITE 4 READs, this number will always be 3.
7. **Type = B4R** - Indicates type of BITE read.
8. **MDM** - Indicates the MDM that the B4R load will check.
9. **CARD** - Indicates the card that the B4R will check
10. **Channel** - Indicates the channel that the B4R will check
11. **Response Words** - indicates whether 1 or 2 responses are expected. Verify that this matches Table 7.10G-1.



12. **VP Slot** - Indicates the VP slots selected to view the response.

The actual hex data words to be uplinked do not have to be verified but they can be if so desired by using the Command Data Words (CDW) application. For more information on starting and understanding the Command Data Words Application refer to SCP 7.1G. Interpretation of the individual bits in the command words is as follows. For additional information on the bit definitions refer to the Space Shuttle Computer Program Development Specification (CPDS) SS Downlist/Uplink Software Requirements (SS-P-0002-140). Command Load Verification

1. **Command Data Word 01**

a. **Vehicle ID - Bits 1-3:**

- b. **Major Function - Bits 4-7:** These bits identify the major function to which this command will be sent.

GNC - 0111 (Primarily for FC MDMs)

SM - 1000 (Primarily for PL and Flex MDMs)

- c. **OP Code - Bits 8-14:** These bits identify the type of *uplink command*. For the MDM BITE Read, both BSR and BITE 4 options, the OP Code is "0101100" ("2C" hexadecimal). [This is how the flight software determines that the two-stage uplink command is an "MDM BITE Read" type command load.]

- d. **FCW and LCW - Bits 15 and 16:** These bits together indicate a single-stage command word or the first, intermediate, and last command words in a two-stage command. These bits will not be set when looking at the command in the command server. They will be added at the time of uplink and will be a binary "11" (decimal 3) to indicate that this is both the first and last command word of the command.

2. **Command Data Word 02** - Identifies whether this is a "BSR Read" option or a "BITE 4 Read" option.

a. "BSR Read" Option

Bits 17-25 = 111111111, indicating the BSR Read is being requested.

Bits 26-32 indicate the MDM being addressed. See Table 7.10G-2 for the list of MDM uplink address numbers.

b. "BITE 4 Read" Option

Bits 17-20 identify the I/O module where the desired BITE data is to be read. See Table 7.10G-1 for the available cards.

Bits 21-25 identify the desired channel for which the BITE 4 Read is to be performed. See Table 7.10G-1 for the valid channel ranges for each IOM.

Bits 26-32 indicate the MDM being addressed. See Table 7.10G-2 for the list of MDM uplink address numbers.

**Table 7.10G-2. MDM address numbers**

FF/FA MDMs		Payload MDMs		Non-Flight MDMs	
FF1	0000001	PF1	0001001	LF1 <sup>b</sup>	0001011
FF2	0000010	PF2	0001010	LA1 <sup>b</sup>	0001100
FF3	0000011			LM1 <sup>b</sup>	0010010
FF4	0000100				
		FLX1-BCE 10 <sup>a</sup>	0001101		
FA1	0000101	FLX2-BCE 11 <sup>a</sup>	0001110		
FA2	0000110	FLX3 <sup>a</sup>	0001111		
FA3	0000111	FLX4 <sup>a</sup>	0010000		
FA4	0001000	FLX5 <sup>a</sup>	0010001		

NOTES: <sup>a</sup> Flex MDMs are mission dependent. Note that a Flex MDM will represent a "valid option" by the workstation software only if the MDM is a part of the payload manifest for a specific shuttle flight.

<sup>b</sup> Although LF1, LA1, and LM1 are legal from a flight software perspective, workstation software treats them as "illegal" for this OP code. Since these MDMs are powered off in flight, issuance of either MDM BITE 4 Read or MDM BSR Read commands to them would always result in a PASS GPC-detected I/O error (Initial T/O).

- Command Data Word 03** - Identifies the number of response words expected and the VP slot specified (first slot if two consecutive slots are required).

Bit 33 identifies the number of response words expected. A value of "0" indicates only one response word is expected, whereas, "1" indicates two response words. (Note that the uplink MDM BITE Read will always return at least one response word. Therefore, bit 33 identifies the number of *additional* response words expected.)

Bits 34-44 are spare bits that are forced to zeros.

Bits 45-48 identify the VP slot selected. If the auto VP downlist capability is inhibited, these bits will be all zeros.

**D. Uplinking MDM BITE Read Command Loads**

1. DPS generates a Flight Note to the Flight Director, CAPCOM, FAO, and INCO identifying the DSM number and the desired major function.
2. DPS obtains Flight Director approval for command uplink.
3. DPS SPT calls COMMAND on the COMMAND loop to unsafe the command (see FCOH 3.1.4 on how to unsafe loads).
4. DPS coordinates with INCO on INCO loop to uplink the command.

Standard coordination shall include: reading the DSM number, the MF, and a confirmation that the Flight Director has given a 'GO' for uplink, as well as a read-back by INCO of the information for verification.

5. While the MDM BITE Reads have no critical timing or sequencing constraints, DPS (or DPS SPT) should monitor the Command Track application to verify the uplink in the event the MDM BITE Read is unsuccessful and an I/O error ensues. For more information on starting or interpreting the Command Track application refer to SCP 7.1G.
6. Once the command is uplinked, DPS SPT calls COMMAND to safe the load in the command server. If the command is no longer required, the load will be deleted from the command server.

**E. Variable Parameter Decoding**

Once the MDM BITE Read command load has been uplinked, the next step is to assess the acquired BITE Read data. SCP 7.10B provides information for decoding the contents of the variable parameters supporting the BITE Read function.

**REFERENCES**

1. SS Downlist/Uplink Software Requirements, CPDS, SS-P-0002-140.
2. SS Functional Level Requirements, Vehicle Utility, CPDS, SS-P-0002-550.
3. CCS Control User's Guide (Part 3: MED LIST), STSOC-UD-600315.

**TITLE**

SCP Verifier: \_\_\_\_\_  
Facility: \_\_\_\_\_ Date: \_\_\_\_\_

SM TABLE MAINTENANCE OPERATIONS (Command Server)

**PURPOSE**

The Table Maintenance Block Update (TMBU) command load is used by the MCC to update fault detection and annunciation (FDA) analog parameter limits, discrete values, and special constant values in the BFS SM and PASS SM FDA tables. During on-orbit PASS SM operations, the TMBU uplink provides ground access to the same FDA capabilities provided to the crew via SPEC 60 (Table Maintenance). Since no such SPEC exists in the BFS, a BFS TMBU provides the only access to FDA other than a change request (CR) to the software tape build process.

A TMBU request is initiated by the responsible MCC position in order to manipulate parameter limits, constant values, noise filters, enable/inhibit parameters, and update select cal coefficients. These updates may be required to provide consumables leak detection, to accommodate erratic/failed subsystem behavior or sensor shifts, to implement late requirements defined by CR, or to initialize onboard comps. The DPS SPT position has the responsibility for coordination of TMBU operations in a backup capacity only. If the discipline desiring to build/transmit a TMBU cannot do so due to equipment failure (LAN, W/S, etc.), then DPS SPT will process the TMBU.

**BACKGROUND INFORMATION**

The TMBU load is a 2-stage command load which uplinks a maximum of 10 table maintenance data set changes. Each data set is composed of a parameter ID, a data set type, and the desired new value. Figure 7.11G-1 reflects the TMBU request form (a similar form is automatically generated by the TMBU program if it is used). Figure 7.11G-2 shows the TMBU application form and verification window when the load is sent to the Generic Command Server (GCS) The data that is actually uplinked is the portion of the form in the lower right-hand box of the TMBU form. The data set type is an 8-bit integer field, the parameter ID is a 24-bit integer field, and the new value is a 64-bit double-precision floating-point field. Each data set, therefore, is six 16-bit words.

The actual hex data words uplinked do not have to be verified, but they can be by using the Command Data Words (CDW) application. For more information on starting and understanding the Command Data Words application refer to SCP 7.1G.

A TMBU load can be sent to the PASS or BFS, but the software designs are different and, consequently, the loads are different. PASS SM TMBUs are saved on the MMU each time a checkpoint is completed by the crew.

T M B U   R E Q U E S T											
<input type="checkbox"/> SM2 <input type="checkbox"/> BFS <input type="checkbox"/> SL SSC <input type="checkbox"/> SL EXC <input type="checkbox"/> SL ASC II <small>(RI 33)   (RI 4E)</small>					REQUESTED BY		POS MOCR/SSR		(S) GMT		
NO.	MSID/SID	CLASS	SET	LIM/ CONST	OLD VALUE	NEW VALUE	REFERENCE DATA NAME		PAGE NO.		
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
RETENTION:				REQ'D BY:			DATA SET	TYPE/ SL MODE	PARAMETER ID/SID	NEW VALUE	SL DSM
RATIONALE:							01				
							02				
							03				
							04				
							05				
							06				
							07				
							08				
							09				
							10				
TITLE (Completed by DPS/CDMS): T M B U _____							DPS/CDMS		DPS DSM		

JSC Form 457 (Rev Oct 83)

Figure 7.11G-1. TMBU request form

7.11G-2  
Verify that this is the correct version before use

Table Maintenance Block Update (v 01.02.00)

File Command Options Help

Uplink log last updated: 98/286:19:56:29

Flight  Recon  DSM  Title  PASS

Rationale

MSID

Nomenclature	MSID	Class	Set	Limit	Type	Param ID	Previous	New
MAIN BUS C CONT BUS BC3/CA3 RP	V76X0326E	3	1	UDS	2	760326	0	0.000000
MAIN BUS C CONT BUS BC3/CA3 RP	V76X0326E	3	0	NF	8	760326	2	1.000000
MAIN BUS C CONT BUS BC3/CA3 RP	V76X0326E	3	0	ENA	9	760326	ENA	1.000000
AC BUS 3 OVERLOAD	V76X1706E	2	1	UDS	11	761706	1	0.000000
AC BUS 3 OVERLOAD	V76X1706E	2	0	NF	13	761706	2	4.000000
AC BUS 3 OVERLOAD	V76X1706E	2	0	INH	15	761706	ENA	1.000000

DSM  Title  GMT Gen

Opcode  No. of Datasets  Uplink State

Type	Param ID	New Value
2	760326	0.0000000000
8	760326	1.0000000000
9	760326	1.0000000000
11	761706	0.0000000000
13	761706	4.0000000000
15	761706	1.0000000000

Command\_Build 12305 Successful

Figure 7.11G-2. TMBU Application

RESTRICTIONS/CONSTRAINTS

CMD CR#

DATE:

CAUTION

This procedure is governed by FCOH 3.1 and 3.3.1 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

A. Onboard Software Command Legality Tables

1. PASS

MC(MF/OPS) or GPC ID	CMD legal
MC0 (OPS 0)	
MC1 (GNC 1/6)	
MC2 (GNC 2)	
MC3 (GNC 3)	
MC4 (SM 2)	X
MC5 (SM 4)	X
MC6 (PL 9)	
MC8 (GNC 8)	
MC9 (GNC 9)	
GPC ID	

2. BFS - **MUST** be tracking PASS.

OPS	CMD legal
Prelaunch OPS 0	X
GNC 1	X
Predeorbit OPS 0	X
GNC 3	X
GNC 6	X

B. Valid OI Loads

All PASS and BFS.

C. Vehicle, LRU/Hardware Version Constraints

None.

**D. Time Constraints, Crew Coordination Requirements**

1. TMBUs are generally non-time-critical. However, there is the potential for mission/payload-dependent, time-critical TMBUs.
2. A TMBU REJECT will result if PASS SPEC 60 (SM TABLE MAINT) is active at the time a PASS SM TMBU is uplinked. An active SPEC 60 can be detected via downlisted (variable parameter) data.

**E. Hazard/Safety Implications**

Fuel cell valve purge could be hazardous if uplinked wrong. Other implications to uplinking an incorrect TMBU could be setting off an immediate alarm or setting the limits such that a true out-of-limits condition would not be annunciated and, therefore, would be missed.

**F. Other Requirements**

1. Separate forms are required for SM and BFS TMBUs.
2. Each discipline has an allocated group of DSM numbers to use. These are documented in the FCOH TMBU procedure (SOP. 3.3.1).

**PASS TMBU**

**A. Data Set Type**

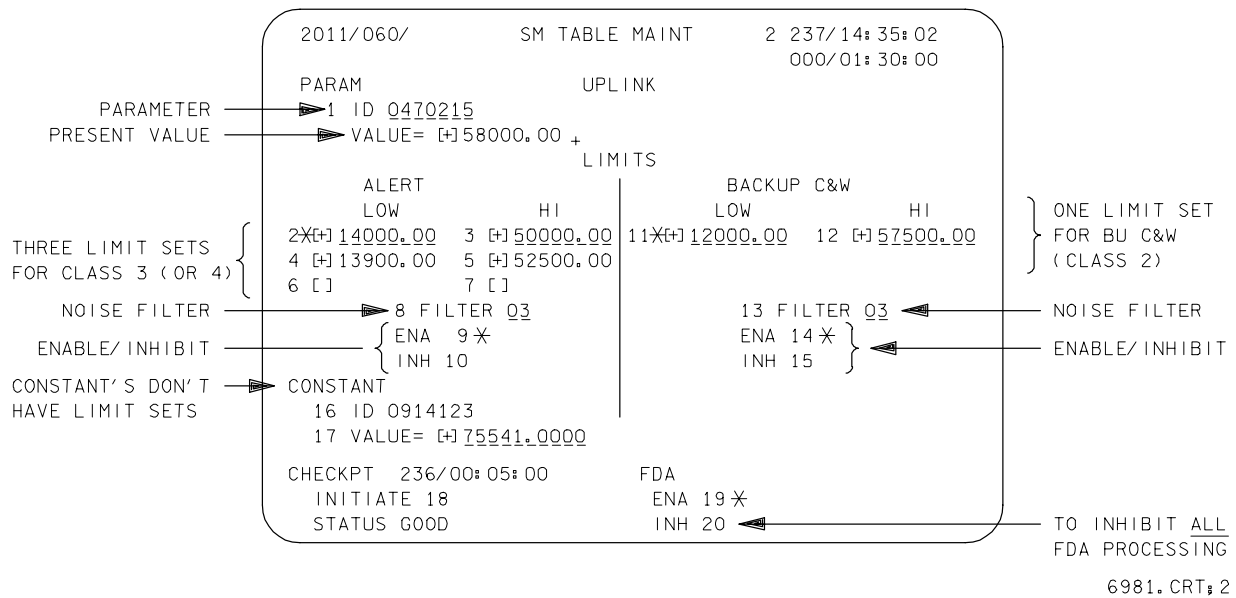
The data set type is a two-digit decimal number which defines the update as a constant, an enable/inhibit, a noise filter, or one of eight FDA limit changes (Table 7.11G-1). By referring to the PASS SM SPEC 60 (Figure 7.11G-3), it is seen that these codes correspond to item numbers on that display.

**Table 7.11G-1. PASS data set types**

Parameter	Class	Limit	Type code
Alert limit set 1	3*.c	Low	02
		High	03
Alert limit set 2	3*	Low	04
		High	05
Alert limit set 3	3*	Low	06
		High	07
Alert noise filter	3*		08
Alert enable	3*		09
Alert inhibit	3*		10
Backup C&W limit	2	Low	11
		High	12
BU C&W noise filter	2		13
BU C&W enable	2		14
BU C&W inhibit	2		15
Constant	N/A	Constant	17

\* Can also have class 0 or 4 parameters





**Figure 7.11G-3. PASS Table Maintenance SPEC 60**

1. Alert Limit Sets

Alert limit sets correspond to SM alert indications (class 3 alerts as well as some class 0 and class 4 alerts) and can be used to modify both analog high and low limit annunciation points, in addition to bi-level discrete values.

Alert limit set parameters are preconditioned, which means that one of up to three sets of limits can be selected for use depending upon the conditions present; i.e., if the APU is in high speed, use limit set 1; if it is not in high speed, use limit set 2. Three limit sets are available for conditional FDA processing.

2. Backup Caution and Warning

Backup caution and warning (BU C&W) limits correspond to software C&W (class 2 alert). BU C&W does not support multiple limit sets as alert limit sets do, but does support both high- and low-limit annunciation points and bi-level discrettes.

3. Discrettes

Both alert limit sets and BU C&W support bilevel discrettes. The discrete is changed using the low limit option, with the undesired state being entered, such that the appropriate alarm annunciates when the current state changes to the undesired FDA state.

4. Noise Filters

Both alert and BU C&W support noise filters. A noise filter specifies how many consecutive measurements must be out of limits before FDA will annunciate the out-of-limit condition. The possible range of noise filter values is from 1 to 15, with 2 being the nominal I-loaded value.

5. Inhibit/Enable

Individual alert or BU C&W parameters can be inhibited or enabled via the TMBU function. This function is equivalent to taking a parameter lower limit off-scale low and the upper limit off-scale high (a new value of 1.0 should be entered when doing an enable or inhibit).

6. Constants

Constants are values that are used for purposes such as computations and special processes. A constant does not have a corresponding alarm class as do alert limit sets and BU C&W.

B. Parameter ID

In SM OPS 2, the parameter ID is formed from the MSID (MML number) by converting the first alphabetic field to a one-digit decimal number (see Table 7.11G - 2) and dropping subsequent alphabetic fields.

Example: V45C0100A = 0450100.

**Table 7.11G-2. PASS parameter ID conversion**

V	0	Orbiter vehicle
A	1	Ground test article
B	2	SRB
E	3	SSME
F	4	FSE
G	5	GSE
P	6	Payload
T	7	ET
U	8	SSUS (IUS)
L	9	Spacelab

## C. New value

The new value is the new desired value of the limit or constant specified. This value must not exceed the software range of that parameter as specified by the calculated off-scale high and low values. PASS parameters with first order (linear) positively sloped cal curves are uplinked in EUs and stored in PCM counts. Nonlinear or negatively sloped cal curve parameters and constants are uplinked and stored in EUs.

Enable/inhibits require a value of 1.0 be entered for the new value. All other dataset types use the desired value specified on the TMBU form.

The calibration curve for each transducer reflects the relationship between the physical measurement (temp, pressure) and the voltage provided to the MDM by the signal conditioner. The MDM generates an integer called PCM count that corresponds to an analog measurement. The conversion of PCM to EU is given by the equation below, where  $A_0$ ,  $A_1$ ,  $A_2$ , and  $A_3$  are the coefficients of the cal curve. Usually, this equation is no more than third order.

$$EU = A_0 + A_1 (PCM) + A_2 (PCM)^2 + A_3 (PCM)^3$$

The cal curve for each transducer and the associated parameters is located in the SM/PM Database Information Listing (DBIL) (Figure 7.11G-4).

**TMBU REJECT**

The primary indicator available in the MCC to monitor PASS TMBU operations is the TMBU reject word (V92J0660C) in both latching and nonlatching forms. Whenever the value of the word is greater than zero, the TMBU REJECT event light is illuminated on the DPS C&W application. The light is reset as soon as a valid TMBU load is received. A TMBU RUN discrete (V92X0661X) is also available in the downlink but it is not currently believed to be useful. It is set to 1 while SM is processing the uplink. See Table

7.11G-3 for the meaning of the TMBU reject word.

Monitoring the parameter CSTB-CONTROL-FLAGS via the SM variable parameter downlist can prevent a TMBU REJECT that results from SPEC 60 being active or underlying. Within the CSTB-CONTROL-FLAGS is a flag CSTB-TM-SPEC-ACTIVE that is set if SPEC 60 is active. As shown in Table 7.11G-4, if the first digit of the hex value is a 2, 3, A, or B, then SPEC 60 is active and a TMBU should not be sent.

.100 setgray printDraft "

STS-26A RECON1 OI8A

DATA BASE INFORMATION LISTING 7/22/87

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V58T0161A

HYDR SYS 1 H2O BLR TANK TEMP

SUB SYSTEM = 000 PARMID = 580161

SM INPUTS

ACQ RATE	SOURCE	ADDRESS		PARAMETER TYPE	START BIT	LENGTH	PARENT PARMID
		RAM	OI MDM				
0.52		2414	OA03	UNIPOLAR	0	10	0

CURVE ORDER	IND VAR	UNITS	COEFFICIENTS				CALB PAGE
			A 0	A 1	A 2	A 3	
3	PCM	DEGF	3.1444793E+01	4.0713894E-01	-1.2221299E-03	2.3371694E-04	97

NOISE COUNT	CL	IND	FSP MESSAGE MAJOR	MINOR	ID	LOW	LIMITS HIGH	OSL	OSH
15	3		S86 APU/HYD	W/B	31256	40.00	221.00	-99999.99	99999.99

GROUP ID	DELAY COUNT	PRECONDITION EQUATIONS	
17	300	(1)	580149 = 1
		(2)	580149 = 0

DISPLAY

LOC DISP	X	Y	TYPE	SIZE	UPD (SEC)	S T	BLVL 1	TEXT 0	UNITS
86	35	15	DEC	4.0	2	*			DEG

L18819\_170

Figure 7.11G-4. SM/PM DBIL

7.11G-9  
Verify that this is the correct version before use

**Table 7.11G-3. PASS TMBU reject values**

Reject value	Reason for reject
0	Last load received by SM was executed with no errors
1 through 10	Last dataset which was rejected for one of the following reasons:
	a. If class 2 limit change is requested and no class 2 limit set is defined for FDA parameter.
	b. If class 0, 3, 4 limit change is requested and no class 0, 3, 4 limits are defined for FDA parameter.
	c. If class 0, 3, 4 limit change is requested and specified limit set does not exist.
	d. If requested change is high limit and changed parameter is a discrete.
	e. If parameter of a limit change is not processed by FDA.
	f. If analog or EU limit value exceeds allowable range.
	g. If parameter of a constant change is not a valid constant parameter.
11	Entire load was rejected for either of the following reasons:
	a. If TM SPEC is active when the load reaches the application.
	b. If the number of datasets is less than 1 or greater than 10.

**Table 7.11G-4. SPEC 60 active variable parameter**

CSTB_CONTROL_FLAGS	2XXX 3XXX AXXX BXXX	} CSTB_TM_SPEC_ACTIVE
--------------------	------------------------------	-----------------------

**BFS TMBU**

The BFS TMBU design is different. The PASS SM TMBU design was made to take advantage of programming already in place to support the PASS SM Table Maintenance SPEC. The SM FDA design allowed use of a parameter ID to identify the FDA parameter, as well as an indexing system into the scaling process, so that a new limit could be entered as an EU value and then automatically back-scaled to PCM count that is the storage format of most limits. The BFS, on the other hand, had no such related processing. First, the parameter ID, instead of being MML derived, represents an offset in one of seven tables. Also, there is no EU to PCM conversion capability in the BFS. All new values are input for uplink in the format in which they are stored. This means that all FDA limits must be input in a specialized decimal PCM count form, which is uplinked in the double-precision floating point format. Lastly, the data set type will indicate which of the seven tables contain the value being updated. The following items illustrate the details of this structure.

The BFS TMBU design also differs from PASS in that parameter inhibit/enable is not available. Comprehensive verification of table maintenance activities may be performed with a main memory dump or variable parameter downlink.

A. Dataset Type

The dataset type indicates in which of seven tables the value of interest is located (see Table 7.11G-5).

**Table 7.11G-5. BFS dataset types**

Data set type	BFS table*
255	FDA high limits
254	FDA low limits
253	SM and special processes constants
252	Sequencing constants
251	Payload FDA high-limit set
250	Payload FDA low-limit set
249	Payload constant values
248	Invalid

\*CR - 89962

B. Parameter ID

The parameter ID for a BFS parameter is a decimal number that represents the offset (index) into the appropriate table (array) of limit, constant, or discrete values. The parameter type (integer, scalar, etc.) determines the format of its ID based upon how many halfwords are required to store its limit value in the array. See Table 7.11G-6 for these definitions. Specifically, a parameter which occupies one 16-bit halfword will have an ID created by decimally adding the array offset to 1114112 (1114112 decimal is equivalent to 110000 hex). The parameter type is apparent from the 11 in the left two places (11XXXX), where XXXX is the array offset. Parameters which occupy a full word (32-bit floating point) are represented by an ID that is the direct array offset (since the offset is implicitly added to 0000000, which can be thought of as the decimal equivalent to 00XXXX hex).

**Table 7.11G-6. BFS parameter ID**

Parameter type	No. halfwords for array data type	ID hex format	ID decimal format
Single-precision integers	1	110000	1114112 + Offset
Double-precision integers	2	000000	Offset
Single-precision scalars	2	000000	Offset
Double-precision scalars	4	000000	Offset
Bit string variables	1 or 2	110000 or 000000	(Either method)
Boolean (1 bit)	1	110000	1114112 + Offset

C. New Value

1. Discretes (1 or 0) are stored as 16-bit integer 1 or 0 value and may be entered into the uplink system as 1 or 0.
2. Analog FDA limits (nonpayload) are stored in PCM \* 64 format. The GPC left-justifies the 10-bit parameter (9 bits plus sign) in a 16-bit word. This shift-left is accomplished by multiplying the PCM value by 64. Since BFS FDA processing of integers directly converts the uplink double-precision floating-point value to the integer format, the uplinked value must be multiplied by 64 prior to uplink.

FDA parameters are received from an MDM as 10-bit binary numbers that are left-justified within a 16-bit word. In order to save GPC processing, the values are not right-justified; i.e., divided by 64. Therefore, ground-initiated changes have to be uplinked as PCM x 64.

The following formula, derived from the cal curve equation, is used for linear analog parameters to convert the desired EU value to PCM counts:

$$\text{PCM} = \frac{(\text{Desired value} - A_0)}{A_1 \times 64}$$

The A1 coefficient must also be multiplied by 64. The value of A<sub>1</sub> (which is the value that is listed on the fiche) is predivided by 64. When BFS displays a parameter on a CRT, the PCM counts must be converted to EU. Since PCM is stored as PCM x 64, predivision of the A<sub>1</sub> coefficients has the effect of dividing PCM by 64. Therefore, the PCM count is adjusted to the correct value without an additional division operation.

This PCM value must be rounded to a whole PCM count before multiplying by 64. This ensures that the remaining 6 bits (least significant) are all zero. The rule for rounding is for an upper limit, round down to the next integer; for a lower limit, round up to the next integer.

Linear analog parameters are set off-scale high (OSH) by using OSH = +32,704 PCM counts or off-scale low (OSL) by using OSL = -32,768 PCM counts (see Table 7.11G-7).

**Table 7.11G-7. BFS off-scale values**

Analog FDA  (Linear and constants)	OSH = +32,704 (Stored PCM * 64)	<p>Sign bit</p> <p>↓ 2<sup>14</sup></p> <p>X 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 = +32,704</p> <p>X = 0 = POS</p> <p>SHL 6 bits</p>
	OSL = -32,768 (Stored PCM * 64)	<p>Sign bit</p> <p>↓ 2<sup>14</sup></p> <p>X 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 = -32,768</p> <p>X = 1 = NEG</p> <p>SHL 6 bits</p>
PYLD -APP-FUNC * type 251, 250	OSH = +511 (Stored PCM)	<p>Sign bit</p> <p>↓ 2<sup>8</sup></p> <p>0 0 0 0 0 0 X 1 1 1 1 1 1 1 1 1 1 = +511</p> <p>X = 0 = POS</p>
	OSL = -512 (Stored PCM)	<p>Sign bit</p> <p>↓ 2<sup>8</sup></p> <p>0 0 0 0 0 0 X 0 0 0 0 0 0 0 0 0 0 = -512</p> <p>X = 1 = NEG</p>

\* Payload analog parameters are 10-bit signed 2's complement, 8-bit signed 2's complement, or 8-bit unsigned.



3. Analog nonlinear parameters are handled the same way as linear parameters, except that the increased complexity of trying to solve a cubic equation for PCM has been done already and the PCM versus EU values are given in tabular form in the back of the DBIL. For a lower limit, select the PCM count value that corresponds to the EU value just above the desired EU value. For an upper limit, select the PCM count value that corresponds to the EU value just below the desired EU value.
4. Analog constants are most often stored as single-precision floating-point values and are entered into the uplink system in EUs; some are stored as integers.

#### D. Payload Parameters

BFS software release 09.21 (STS-9) introduced a new module, PYLD\_APP\_FUNC, which performs downlist processing, FDA, and scaling for display for up to 50 payload-dependent parameters. The parameters are restricted to two types: discretetes and linear analogs, whose limit values are contained in either the upper limit table (data type 251) or low limit table (data type 250).

Since only 25 halfwords of the BFS downlist are allocated to payloads, this dictates the possible combination of analog and discrete parameters. An analog equals 1 halfword, and 16 discretetes equal 1 halfword. Therefore, maximum content could be 50 discretetes (although 400 discretetes could be packed into 25 H/Ws) or 25 analogs, or some combination thereof that does not exceed 50 parameters (TMBU storage locations) or 25 halfwords.

This module differs from other BFS FDA processing. The analog limits are stored in PCM counts (not PCM \* 64) since the 10-bit parameter has already been shifted right 6 bits. The off-scale range, however, is still -512/+511 PCM counts.

1. Payload parameters which are processed by PYLD\_APP\_FUNC are already shifted right and are stored in PCM counts (not PCM \* 64). Therefore, it is not necessary to multiply the rounded PCM value by 64 prior to uplink. The new value for uplink is calculated using the following equation.

$$\text{PCM} = \frac{(\text{Desired value} - A_0)}{A_1}$$

2. The A1 coefficient is not predivided by 64; therefore, multiplication by 64 is not required. The same rounding technique (used for non-payload parameters) is used, and the whole PCM value is then uplinked.
3. The cal curve for each transducer and the associated parameters is located in the BFS TMBU TABLES (Figure 7.11G-5). In most cases, these cal curves are identical to the identical parameter in PASS.

BFS DATABASE LISTING

DATE 06-15-87

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V46T0204A

APU 2 FUEL LINE TEMP NO 2

ANALOG

BFS REL 26 RECON

COEFFICIENTS

CURVE ORDER	UNITS	A0	A1	A2	A3
1	DEG F	-7.9581155E-01	7.8100415E-03	0.0	0.0

LIMIT TYPE	LIMITS (EU)	PCM X64	I LOAD MSID	HAL/S LABEL	AL CL	DATA SET TYPE	DATA TYPE	PARMID
UPPER	120.000	15424	V96U8864C	ORB_UPPER_LIMIT (29)	3	255	11	1114310
LOWER	45.000	5888	V96U8797C	ORB_LOWER_LIMIT (29)	3	254	11	1114310

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Figure 7.11G-5. BFS TMBU tables

7.11G-15  
Verify that this is the correct version before use

## PRIMARY PROCEDURE

Note: DPS/DPS SPT will not process PASS SM TMBUs and BFS real-time TMBUs unless the individual users experience workstation failures (see BACKUP PROCEDURE).

This procedure is to be followed for all PASS SM TMBUs (including SM initialization TMBUs) and BFS real-time TMBUs. DPS handles coordination for BFS prelaunch, MECO +5 and entry initialization. However, DPS is not required to verify these loads against flight software.

DPS-coordinated TMBUs are performed over SSR CONF. The procedure that the requester should follow in order to process a TMBU is as follows:

- A. After the user has identified the need for a TMBU, the user will invoke the TMBU program on the user's workstation, build the load, transmit the load and verify the load in the GCS. If the requester has questions concerning the program's function, DPS/DPS SPT is responsible for supporting their questions. If a discrepancy report (DR) condition exists, the requester is to fill out a DR documenting the problem, and the DR will eventually be sent back to the DPS office for resolution.
- B. After the discipline's FCR operator has verified the load and signed off on the forms, the user distributes copies of the completed forms as follows:

If the TMBU is for PASS SM or for real-time BFS:

- Two copies for self (FCR and MPSR)
- One copy to SPAN MGR after uplink

If the TMBU is for BFS prelaunch, BFS MECO +5, or BFS entry initialization:

- Two copies for self (FCR and MPSR)
- Three copies to DPS or DPS SPT who will in turn distribute them as follows:
  - One copy to SPAN MGR after uplink
  - One copy to DPS
  - One copy to DPS SPT

- C. DPS-coordinated TMBUs are the BFS TMBUs that are uplinked at prelaunch, MECO +5, and entry initialization. If more than one TMBU will be required for any of these phases, DPS SPT will chain them together.
- D. The appropriate FCR operator will obtain a GO from the FD to uplink the TMBU(s).

- E. The requesting discipline (or DPS/DPS SPT for DPS-coordinated TMBUs) will contact INCO/INST over the INCO/INST COORD loop and provide them with the DSM number, the MF, and state that they have a GO from the FD. INCO/INST will then read back the information for verification and uplink the TMBU.
- F. INCO or INST will inform the requester (or DPS/DPS SPT for DPS coordinated TMBUs) that the TMBU is onboard. The F/C is responsible for verifying that the load was successfully uplinked to the appropriate system (PASS or BFS) by monitoring the Command Tracking application.
- G. The requesting discipline (or DPS/DPS SPT for DPS-coordinated TMBUs) records the uplink time of the load on the TMBU request form. This time can be found on the Command Tracking application next to the BUFFER EXECUTE command for the particular TMBU. The requester (or DPS/DPS SPT for DPS-coordinated TMBUs) will then forward a copy of the TMBU request form to the SPAN Manager.

**CLEANUP** (for DPS coordinated TMBUs only)

- A. If the TMBU will not be used again, delete it from the GCS.
- B. If the TMBU might be used again, safe the load (refer to FCOH 3.1.4) in the GCS.

**REFERENCES**

- 1. Downlist/Uplink Software Requirements, SS-P-0002-140M.
- 2. Display and Controls FSSR, STS83-0020D.
- 3. TMBU User's Guide, version 5.3.
- 4. Flight Software, BFS TMBU tables, SM/PM Database (PASS).
- 5. Backup System Services Program Requirements, MG038101.
- 6. Backup Flight System Systems Management/Special Processes and Payloads Requirements Document, MG038119.
- 7. Backup Flight System Payload Preprocessor Software Requirements Specification, MG018102.

**TITLE**

SCP Verifier: \_\_\_\_\_  
Facility: \_\_\_\_\_ Date: \_\_\_\_\_

COMMAND LOAD CHAINING/UNCHAINING (Command Server)

**PURPOSE**

This procedure outlines the steps required to "chain" (or group) a series of loads together for automatic and quick sequential uplink. This technique allows 10 loads to be sequentially uplinked with the onboard two-stage buffer executed automatically after a compare on each load. Steps to unchain a series of loads are also described.

**RESTRICTIONS/CONSTRAINTS**

CAUTION

This procedure is governed by FCOH SOP 3.1, 3.2.1, 3.2.2 and is not to be changed in real time without review and approval of the Flight Director or changed permission without review and approval at the FOIG.

A. Onboard Software Command Legality Tables

1. PASS

MC(MF/OPS) or GPC ID	CMD legal
MC0 (OPS 0)	X
MC1 (GNC 1/6)	X
MC2 (GNC 2)	X
MC3 (GNC 3)	X
MC4 (SM 2)	X
MC5 (SM 4)	X
MC6 (PL 9)	X
MC8 (GNC 8)	X
MC9 (GNC 9)	X
GPC ID	X

2. BFS

OPS	CMD legal
OPS 0	X
SM OPS 0	X
GNC 1	X
GNC 3	X
GNC 6	X

B. Valid OI Loads

All PASS and BFS.

C. Vehicle, LRU/Hardware Version Constraints

None.

D. Time Constraints, Crew Coordination Requirements

Chained commanding should be reserved for those operations requiring no crew coordination or integration from the first command to the last.

E. Hazard/Safety Implications

<p><b>WARNING</b></p> <p>Improper use of this operation can lead to unexpected results. These results may be hazardous to equipment or personnel.</p>
---

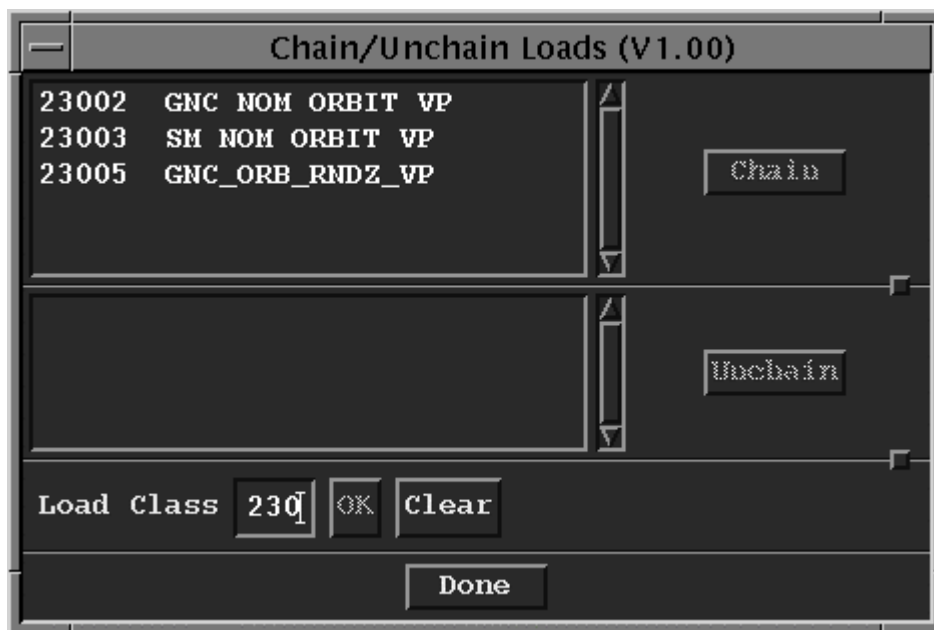
F. Other Requirements

1. The first three digits of each DSM number contained within the same chain must be the same (i.e., 123XX, 123XY, 123XZ is valid; but 123XX, 201XX, ... is not valid).
2. All loads within the same chain must be targeted for the same major function. Failure to adhere to this criteria may cause a load to be uplinked to the wrong MF.
3. Chained loads must be unchained in the command server before they can be deleted from the command server via the Load Manager application.
4. Chained loads will be uplinked in the order in which they are specified in the chain (regardless of the numerical sequence).
5. In order to modify an existing chained load (add a new load/delete an intermediate load), the existing load must first be totally unchained.

## PROCEDURE

### A. Load Chaining - Workstation Option

1. Transmit each load that is to be placed in the chain to the command server. For example, if variable parameter loads 23001 and 23002 were to be placed in a chain, they would each be transmitted to the command server separately.
2. Once all of the desired loads are verified to be correct in the command server, start the Load Manager, if it is not already running, and select the Chain/Unchain function (see Figure 7.12G-1). For more information on starting or using the Load Manager application, refer to SCP 7.1G. The detailed procedures for verification of individual command loads are covered in dedicated SCPs for each type of command load and therefore not contained in this SCP.



**Figure 7.12G-1. Load Manager Chain/Unchain Dialog**

3. Enter the first three digits of the DSMs to be chained and select OK. The first three digits of all loads within any chain must be the same. A list of DSM's residing in the command server that match the three digits will be displayed.
4. Select the DSMs to be chained from the displayed list.
5. Transmit the chain to the command server by selecting the CHAIN button. If no DSMs are selected for chaining then the CHAIN button will be insensitive.
6. Use the Command Inventory application (Figure 7.12G-2) or the or Chained Load Inventory application (Figure 7.12G-3) to verify that the loads are chained correctly in the command server displays.

- The actual uplink procedures for the chain are not contained in this SCP but in the dedicated SCP for each particular load type. If the loads are not to be uplinked immediately, they shall be safed in the command server per FCOH SOP 3.1.4.

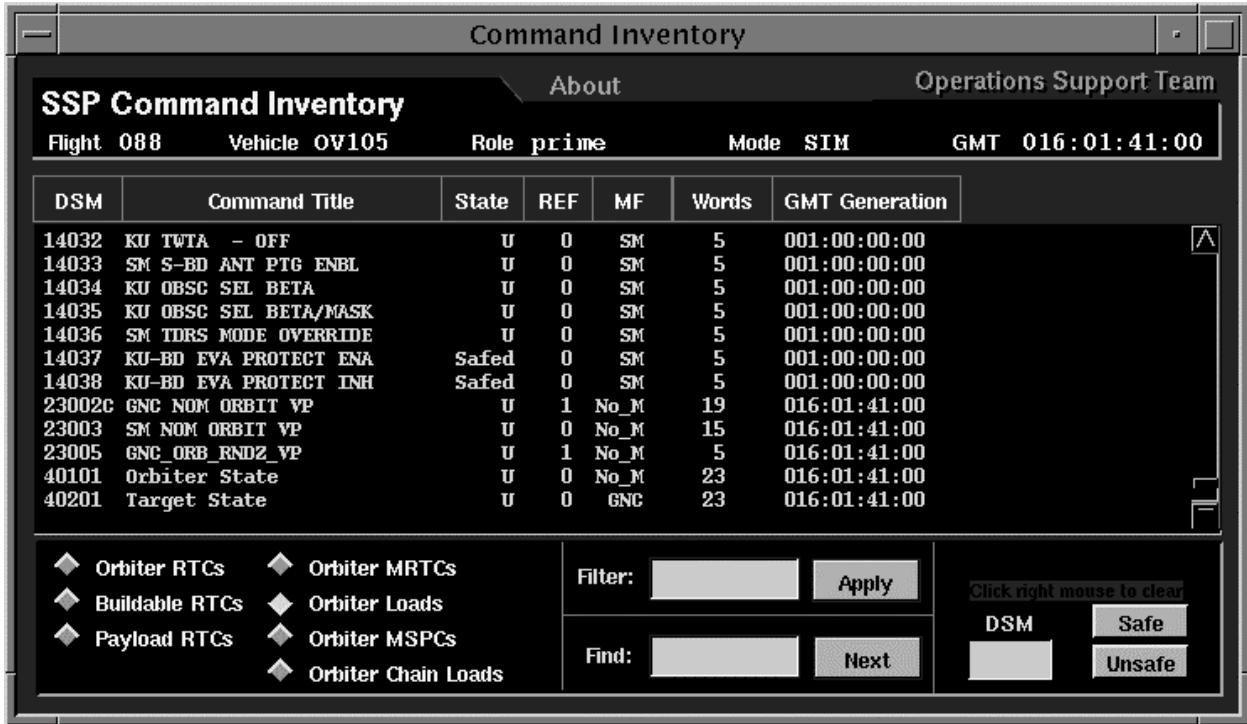


Figure 7.12G-2. Command Inventory application with 23002 and 23003 chained

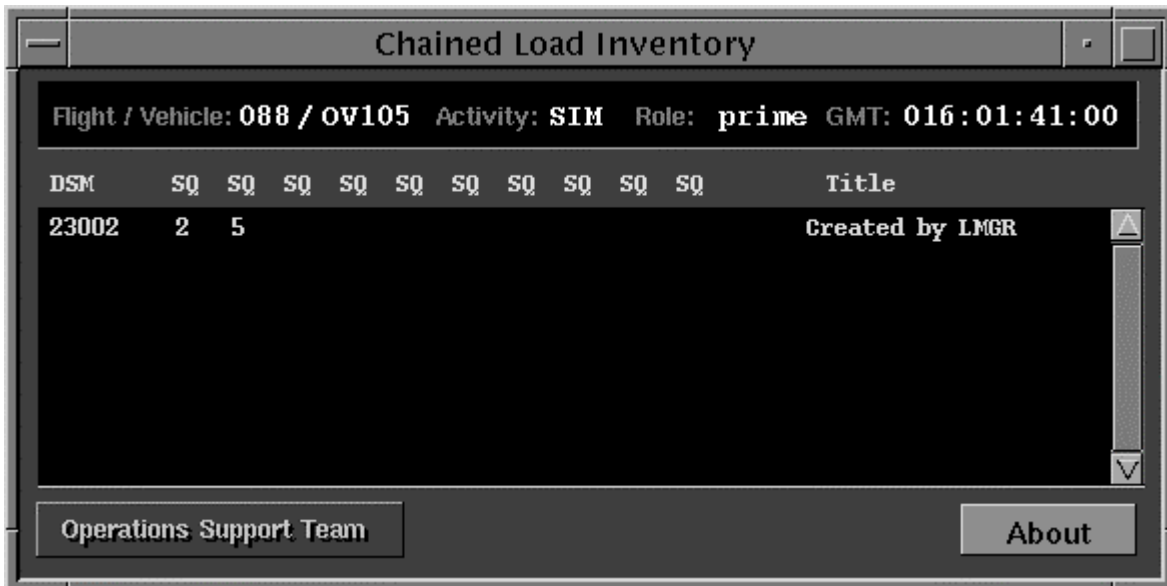
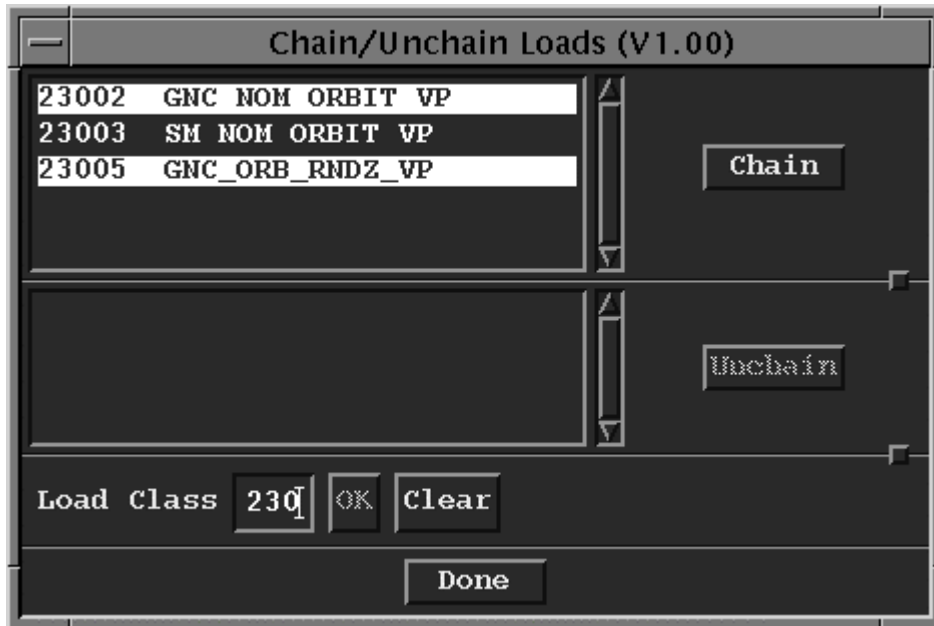


Figure 7.12G-3. Chained Load Inventory application with 23002 and 23003 chained



B. Unchaining Loads

1. To unchain a group of chained loads, select the CHAIN/UNCHAIN option from the LOAD MANAGER application (Figure 7.12G-2).
2. Enter the first three digits of the DSM's to be unchained in the "Load Class" field and then select OK. A list of loads matching the entered load class which are chained in the GCS will be displayed.
3. Selecte the DSMs to be unchained and then select the Unchain button. The Unchain button will be insensitive until a DSM has been selected. (Figure 7.12G-4).



**Figure 7.12G-4. Load manager Chain/Unchain dialog**

4. Verify that the chain has been broken via the Command Inventory or Chain Load Inventory displays (Figure 7.12G-2 and 7.12G-3, respectively).

# DATA PROCESSING SYSTEM CONSOLE HANDBOOK

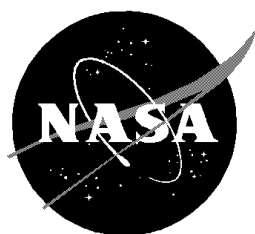
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## Appendixes

Systems Division  
Data Systems Branch

Basic, Rev F  
April 22, 2005

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National Aeronautics and  
Space Administration

**Lyndon B. Johnson Space Center**  
Houston, Texas

DVIS AND DDD GUIDE	<b>A</b>
DPS APPLICATIONS	<b>B</b>
DPS SPECIAL COMPUTATIONS	<b>C</b>
DPS PARAMETERS	<b>D</b>
MEWS TAB FORMAT PARAMETERS	<b>E</b>
TEXT DECODING FOR PASS/BFS FAULT MESSAGES	<b>F</b>
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NUMBER CONVERSION	<b>J</b>
POWERDOWN SUMMARIES	<b>K</b>

DATA PROCESSING SYSTEMS CONSOLE HANDBOOK

APPENDIXES

BASIC, REV F

April 22, 2005

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NATIONAL AERONAUTICAL AND SPACE ADMINISTRATION  
LYNDON B. JOHNSON SPACE CENTER  
HOUSTON, TEXAS

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APPENDIXES

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**TITLE**

DPS/CDMS DIGITAL VOICE INTERCOMMUNICATION SUBSYSTEM (DVIS) PANEL CONFIGURATIONS

**PURPOSE**

The purpose of this SCP is to document the standard DVIS panel configurations that the DPS and DPS SUPPORT are to use during flights and simulations. This SCP also documents certain policies governing the use of these DVIS panels.

**BASIC INFORMATION**

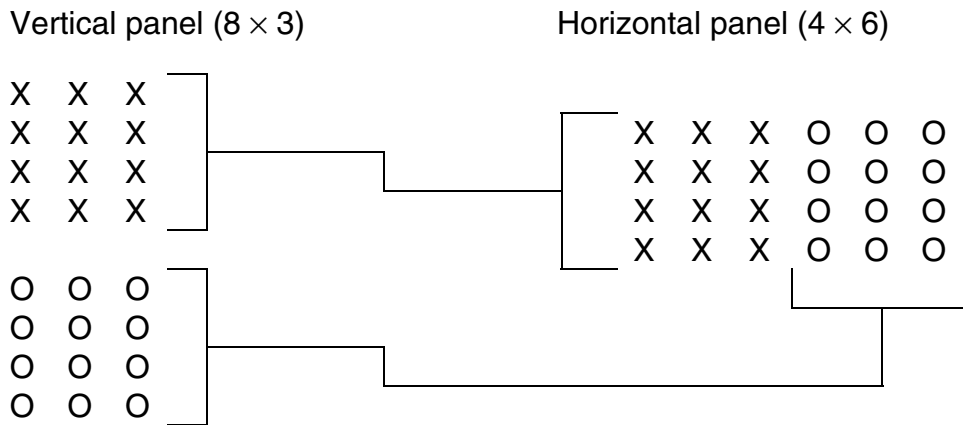
- A. For details on how to operate/adjust parameters on the DVIS panels, refer to the DVIS User's Guide located on console (see References section).
- B. The DIAL CALL loops are used to contact another operator via the panel unique position ID of each DVIS panel. The following table lists the position IDs for all of the DPS/DPS SUPPORT/CDMS consoles:

Console	Side	ID no.
FCR	Left	4225
	Right	4226
MPSR	Left	4263
	Right	4264
CDMS	Left	4267
	Right	4268
Spare	Spare	8225
		8226

All loops that are selected on DVIS panels that are logged on to position IDs 4225 and 4226 are recorded; conversations on the MOCR DPS/CDMS 1 and MOCR DPS/CDMS 2 loops are always recorded. Therefore, please invoke proper loop protocol whenever possible.

- C. DVIS pages 1 through 5 are designated for series 1 loops, and pages 5 through 10 are designated for series 2 loops.
- D. In order to maintain consistency and standards, operators are not to reconfigure pages 1 through 4 and pages 6 through 9.
- E. Pages 1 and 6 are the NOMINAL pages; i.e., these pages are configured for the loops that DPS/DPS SUPPORT use most often during flights/sims.
- F. Pages 2 and 7 are the DIAGNOSTICS pages; these pages are configured for the loops that DPS/DPS SUPPORT use for various diagnostic tasks (e.g., GPC dump monitoring, workstation problems, and console/room hardware problems).

- G. Pages 3 and 8 are replicas of page 1 and 6 and are to be used during shuttle and station assembly simulations.
- H. Pages 4 and 9 are the PRELAUNCH pages; these pages are configured for the loops used most often during the prelaunch timeframe.
- I. Pages 5 and 10 have been configured for the basic loops only (e.g., FD, A/Gs, DPS MPSR, MOCR DPS/CDMS). Pages 5 and 10 are used by individuals who wish to configure their own unique DVIS panels or in those extremely rare instances when an operator needs to configure a DVIS panel to access a DVIS loop that is not on one of the existing configured pages (pages 1 through 4 and 6 through 9). Only the bottom three rows on pages 5 and 10 can be reconfigured.
- J. Personal Access Business eXchange (PABX) extension for the second floor DPS/CDMS consoles is 35681.
- K. All vertical DVIS panels are eight rows by three columns. All horizontal DVIS panels are four rows by six columns. To determine what loops are in what position on the horizontal panels, take the bottom four rows of the vertical panel and append them to the end of the top four rows of the vertical panel as outlined below



- L. The “P” in the upper right-hand corner of each DVIS loop means that this particular loop is protected.

**DVIS PANEL LAYOUTS**

A. Within the DVIS panel layouts, the following acronyms/abbreviations refer to the following:

- HM - High monitor
- I. C. - INSTR COORD loop
- M - Monitor
- TLM - Talk/listen/monitor
- TLM(M) - Talk/listen/monitor for FCRs, monitor for MPSRs

B. For the DVIS panel squares that have two loops listed within the same square, the loop not in parentheses is configured on the FCR DVIS panels and the loop in parentheses is configured on the MPSR DVIS panels.

C. Actual DPS/CDMS DVIS panel layouts (only vertical panels depicted)

**NOMINAL**  
(PAGE 1,6)

			<u>Loop</u>	<u>Purpose/description</u>			
TLM FD 1(2)	P	HM DPS MPSR 1(2)	P	TLM DPS MPSR 1(2)	P	A/G 1 A/G 2 A/G UHF	Air/ground 1 Air/ground 2 Air/ground UHF
HM FD 1(2)	P	TLM AFD CONF 1(2)	P	TLM MOCR DPS/CDMS 1(2)	P	AFD CONF ASMBLY OPS DPD COORD DPS MPSR	Shift/sim briefings DPS/ACO interface DPS/Engineering support interface DPS/DPS SPT interface
M 1(2) A/G 1	P	M 1(2) A/G 2	P	M A/G UHF 1(2)	P	FAO FD INCO	DPS/FAO interface Flight Director interface DPS/INCO interface
TLM DPS COORD 1(2)	P	TLM MOCR SYS 1(2)	P	TLM MOCR GNC/PROP 1(2)	P	INSTR COORD ISS FD MER	DPS SPT/INST interface - VPs, TMBUs ISS Flight Director interface DPS/MER Interface
TLM INCO 1(2)	P	TLM FAO 1(2)	P	TLM MOCR SPEC 1(2)	P	MOCR DPS/CDMS MOCR DYN MOCR GNC/PROP MOCR SPEC	DPS/FCR Interface DPS/FDO, DPS/GDO, DPS/RNDZ interfaces DPS/GNC, DPS PROP interfaces DPS/PDRS, DPS/EVA, DPS/BOOST interfaces
TLM SPAN 1(2)	P	TLM MER 1(2)	P	TLM MOCR DYN 1(2)	P	MOCR SYS	DPS/EGIL, DPS/EECOM, DPS/MMACS interfaces
TLM ISS FD 1(2)	P	TLM SSR 1(2)	P	TLM ASMBLY OPS 1(2)	P	PABX SPAN S/G 1 S/G 2	PABX extension SPAN interface Space/ground 1 Space /ground 2
M 1(2) S/G 1	P	M 1(2) S/G2	P	TLM PABX	P	SSR CONF	JSC MPSR interface

**DIAGNOSTICS**

(PAGE 2,7)

						<u>Loop</u>	<u>Purpose/description</u>	
TLM FD 1(2)	P		HM DPS MPSR 1(2)	P		TLM DPS MPSR 1(2)	A/G 1 A/G 2 A/G UHF AFD CONF COMMAND	Air/ground 1 Air/ground 2 Air/ground UHF Shift/sim briefings DPS SPT/COMMAND interface: -Safe/unsafe loads
HM FD 1(2)	P		TLM AFD CONF 1(2)	P		TLM MOCR DPS/CDMS 1(2)		
M 1(2) A/G 1	P		M 1(2) A/G 2	P		M A/G UHF 1(2)	DFE	DPS SPT/Data Flow Engineer interface: - time source substitution
TLM DPS COORD 1(2)	P		TLM ODRC 1(2)	P		TLM PAYLOAD 1(2)	DPS COORD DPS MPSR FD	DPS/Engineering support interface DPS/DPS SPT interface Flight Director interface
TLM VOICE CONTROL 1(2)	P		TLM WSS CALL 1(2)	P		TLM INSTR COORD 1(2)	GC CALL  IFM COORD INSTR COORD	Ground controller interface: - Console init DPS/IFM interface DPS SPT/ INST interface
TLM IFM COORD 1(2)	P		TLM ODIN 1	P		TLM COMMAND 1(2)	ISS FD MOCR DPS/CDMS ODCR ODIN PAYLOAD	ISS Flight Director interface DPS/FCR interface DPS/ODRC interface DPS/ODIN interface DPS/Payload interface
TLM ISS FD 1(2)	P		M GC CALL 1(2)	P		M DFE 1(2)	PABX S/G 1 S/G 2	PABX extension Space/ground 1 Space/ground 2
TLM 1(2) S/G 1	P		TLM 1(2) S/G 2	P		TLM PABX	VOICE CONTROL WSS CALL	DVIS problems DPS/Workstation Support interface



**CDMS**  
(PAGE 3,8)

			<u>Loop</u>	<u>Purpose/description</u>			
TLM FD 1(2)	P	HM DPS MPSR 1(2)	P	TLM DPS MPSR 1(2)	P	A/G 1 A/G 2 A/G UHF	Air/ground 1 Air/ground 2 Air/ground UHF
HM FD 1(2)	P	TLM AFD CONF 1(2)	P	TLM MOCR DPS/CDMS 1(2)	P	AFD CONF ASMBLY OPS DPS COORD DPS MPSR	Shift/sim briefings DPS/ACO interface DPS/Engineering support interface DPS/DPS SPT interface
M 1(2) A/G 1	P	M 1(2) A/G 2	P	M A/G UHF 1(2)	P	FAO FD GC CALL	DPS/FAO interface Flight Director interface Ground controller interface: - Console init
TLM DPS COORD 1(2)	P	TLM MOCR SYS 1(2)	P	TLM MOCR GNC/PROP 1(2)	P	INCO INSTR COORD	DPS/INCO interface DPS SPT/INST interface: - VPs, TMBUs
TLM INCO 1(2)	P	TLM FAO 1(2)	P	TLM MOCR SPEC 1(2)	P	ISS FD MOCR DPS/CDMS MOCR DYN	ISS Flight Director interface DPS/FCR interface DPS/FDO, DPS/GDO, DPS/RNDZ interfaces
						MOCR GNC/PROP	DPS/GNC, DPS PROP interfaces
TLM SYS COORD 2(1)	P	TLM ODIN 2 1(2)	P	TLM MOCR DYN 1(2)	P	MOCR SPEC MOCR SYS	DPS/PDRS, DPS/EVA, DPS/BOOST interfaces DPS/EGIL, DPS/EECOM, DPS/MMACS interfaces
TLM ISS FD 2(1)	P	TLM SSR CONF 1(2)	P	TLM ASMBLY OPS 2(1)	P	ODIN PABX	DPS/ODIN interface PABX extension
TLM 2(1) S/G 1	P	TLM 2(1) S/G 2	P	TLM PABX	P	S/G 1 S/G 2 SSR CONF SYS COORD	Space/ground 1 Space/ground 2 JSC MPSR interface DPS SPT interface with station backroom support

**PRELAUNCH**  
(PAGE 4,9)

TLM FD 1(2)	P	HM DPS MPSR 1(2)	P	TLM DPS MPSR 1(2)	P
HM FD 1(2)	P	TLM AFD CONF 1(2)	P	TLM MOCR DPS/CDMS 1(2)	P
M 1(2) A/G 1	P	M 1(2) A/G 2	P	M A/G UHF 1(2)	P
TLM DPS COORD 1(2)	P	TLM MOCR SYS 1(2)	P	TLM MOCR GNC/PROP 1(2)	P
M OIS 132 OTC	P	M OIS 232 NTD	P	TLM OIS 152 DPS	P
TLM SPAN	P	TLM MER 1(2)	P	TLM MOCR DYN 1(2)	P
TLM OIS 252 INST SYS B/U	P	TLM OIS 161 PE-1	P	M OIS 231 WX TRBL	P
TLM GC CALL 1(2)	P	TLM INCO 1(2)	P	TLM PABX	P

Loop

A/G 1  
A/G 2  
A/G UHF  
AFD CONF  
DPS MPSR  
FD  
GC CALL  
  
INCO  
INSTR COORD  
  
MER  
MOCR DPS/CDMS  
MOCR DYN  
  
MOCR GNC/PROP  
MOCR SYS  
  
OIS 152 DPS  
OIS 232 NTD  
OIS 132 OTC  
  
OIS 161 PE-1  
  
OIS 231 WX  
OIS 252 INST SYS  
B/U  
PABX  
SPAN  
SSR CONF

Purpose/description

Air/ground 1  
Air/ground 2  
Air/ground UHF  
Shift/sim briefings  
DPS/DPS SPT interface  
Flight Dir interface  
Ground controller interface:  
- Console init  
  
DPS/INCO interface  
DPS SPT/INST interface:  
  
- VPs, TMBUs  
DPS/MER interface  
DPS/FCR interface  
DPS/FDO, DPS GDO,  
DPS/RNDZ interfaces  
DPS/GNC, DPS/PROP interfaces  
DPS/EECOM, DPS/EGIL,  
DPS/MMACS interfaces  
JSC DPS/KSC DPS interface  
KSC NASA Test Director interface  
KSC Operational Test Conductor  
interface  
Project Engineer interface KSC LCC  
with JSC MOIR  
Weather briefings  
B/U channel for Instrumentation  
Systems  
PABX extension  
DPS/SPAN Interface  
JSC MPSR interface

**DVIS  
(PAGE 5, 10)**

TLM FD 1(2)	P	HM DPS MPSR 1(2)	P	TLM DPS MPSR 1(2)	P
HM FD 1(2)	P	TLM AFD CONF 1(2)	P	TLM MOCR DPS/CDMS 1(2)	P
M 1(2) A/G 1	P	M 1(2) A/G 2	P	M 1 A/G UHF 1(2)	P
TLM DPS COORD 1(2)	P	M 1 PLBK 1(2)	P	TLM A/P COORD 1(2)	P
TLM OPS ACTION 1(2)	P	TLM OPS SUPPORT 1(2)	P	TLM CREW OPS 1(2)	P

**LOOP ID TABLE**

Loop	Loop ID
A/G 1	2011
A/G 2	2012
A/G UHF	2013
AFD CONF	2002
CDMS/IPS	2121
COMM MAINT INT	7005
COMMAND	7201
CREW OPS	2102
DATA	7304
DATA PLBK	7306
DATA SYS SUPV	7603
DFE	7307
DISPLAY	7404
DPS MPSR	2911
FAO	2101
FD	2001
GC CALL	2022
IFM COORD	2823
INCO	2301
INSTR COORD	2311
MER	2088
MOCR DPS/CDMS	2915
MOCR DYN	2707
MOCR GNC/PROP	2402
MOCR SPEC	2811
MOCR SYS	2507
MPSR 1	2091
MPSR 2	3091
NIP SUPV	7503
OIS 132 OTC	2093
OIS 152 DPS	2913
OIS 232 NTD	2191
OIS 161 PE	2067
Ois 252 INST SYS B/U	2419
OPS ACTION	2005
OPS SUPPORT	2204
PAYLOAD	2201
PLBK 1	2094
PLBK 2	2095
PRIME OPS	2203
PROP SUPPORT	2621
S/G 1	4311
S/G 2	4312
SDP INT 2	7212
SPAN	2081
SSR CONF	2035
TLM/MITS COORD	7331
TV DEMOD MON	2070
VOICE CONTROL	7019
WEATHER NET	2071

## DVIS-KEY RECONFIGURATION PROCEDURE

- (1) Select "PAGE" with DVIS key to be modified.
- (2) Press "CONFIGURE" key, then select DVIS key to be reconfigured [a Key Pad (12-key, 3X4 matrix) will pop up on DVIS screen].
- (3) Press "PRIME DIR" key (the keypad '8' key):

If there has been no prior key reconfiguration since DVIS was signed-on, a 'menu' display will pop up. This includes "CANCEL" and "SET LIST MODE" keys at the top right-hand corner, and "LIST START POINT", "SELECT PARTITION", "SELECT ALPHA LIST", and "SELECT NUMERIC LIST" keys at the lower right-hand side of the display.

If a key has been configured, the previously selected 'alpha' or 'numeric' list will pop up.
- (4) Press "SELECT PARTITION" key [a list will show up with the following 'options' – "MCC" (the default case), "SMS", "SSC", and "SST"].
- (5) Select "MCC" for a list of 'Shuttle' loops; or select "SSC" for a list of 'Space Station' loops. Then press the "ENTER" key at the bottom of the matrix.
- (6) Next, press the "SELECT ALPHA LIST" key (or, if preferred, the "SELECT NUMERIC LIST" key), followed by the "ENTER" key [a listing of DVIS Comm Loops will pop up].
- (7) Scroll thru list using "PAGE FWD" key (or "PAGE BACK key as required) until desired DVIS loop appears. Use 'up' and 'down' arrows to highlight the desired DVIS loop.
- (8) Next, select the desired monitor and/or talk/listen mode key – "SELECT M", "SELECT HM", "SELECT TL", or "SELECT TLM" key [the Keypad (the 12-key, 3X4 matrix) will pop up].
- (9) Press the "ENTER" key. This completes the DVIS key reconfiguration.
- (10) If no further DVIS reconfiguration is required, press the highlighted "CONFIGURE" key. Otherwise, select the next appropriate "PAGE" and DVIS key to be reconfigured, and repeat procedure.

On PAGE to be reconfigured:

- (1) CONFIGURE, then desired key
- (2) PRIME DIR (the keypad '8' key)
- (3) SELECT PARTITION
- (4) Highlight 'MCC' (Shuttle loops) or 'SSC' (Station loops), then ENTER
- (5) SELECT ALPHA LIST, then ENTER
- (6) Scroll thru list and highlight desired DVIS loop
- (7) SELECT TLM (or M, HM, TL option), then ENTER

**REFERENCES**

Digital Voice Intercommunication Subsystem (DVIS) Keypad User's Guide, by Ford Aerospace, FAC-UG1432, Sept. 28, 1990.

**TITLE**

DPS VARIABLE EVENT FORMATS

**PURPOSE**

This guide describes format overlays previously used by the DPS FCR and DPS support consoles. This SCP is being retained only as a reference.

**DESCRIPTION**

A. Each format contains the nomenclature and MSID, which is laid out in its position on the overlay. In the bottom left corner of each position is the color of the overlay (A-amber, B-blue, G-green, R-red, and W-white). The bottom right corner contains information pertaining to the logic driving the light (L-latched and R-reversed).

B. Console Configuration

The following figure shows the recommended formats to be used during the appropriate phases of flight.

431	434	436	438	446	447	440
432	435	437 <sup>†</sup>	439			*
442	ORBIT				441	
443					445	**
442	ENTRY				451	
433					435	449

\*Format 450 optional during A/E (PASS GPCs not in RS)

\*\*Format 457 optional (GPC to STBY/HALT)

<sup>†</sup>Format 477 during Spacelab missions (FCR only)

C. DDD Special Controls

Shown below are some special control codes for DDDs that are provided to facilitate system operation. See FCOH Appendix A for a complete description of these codes.

- 0000 Console event module release.
- 000N Individual module release.
- XXXN Activate module N with FMT XXX.
- 2220 Event reset LEFT ENTER for OPER events.
- RIGHT ENTER for CRIT events.
- 4440 Variable event modules data type change - all modules this console.
- 777N Lamp Test individual module.

431

LH SRB FWD LL1  V91X2831XX A 01	RH SRB FWD LR1  V91X2835XX A 02	EIU1/P1 (C SSME)  V91X2928XX A 03	FA1 PWR LATCH  V72S7991E W R,L 04	FA1 MDM RTN WD  V91X2920XX R 05	FA1 PROM STRG C  V91X2802XX A 06	FA1 PROM STRG D  V91X2806XX A 07	08	FF1 SIO G9 IMU1  V91X2911XX A 09
LH SRB AFT LL2  V91X2833XX A 10	RH SRB AFT LR2  V91X2837XX A 11	EIU2/P1 (L SSME)  V91X2931XX A 12	FA2 PWR LATCH  V72S7993E W R,L 13	FA2 MDM RTN WD  V91X2921XX R 14	FA2 PROM STRG C  V91X2803XX A 15	FA2 PROM STRG D  V91X2807XX A 16	17	FF2 SIO G9 IMU2  V91X2912XX A 18
		EIU3/P1 (R SSME)  V91X2934XX A 21	FA3 PWR LATCH  V72S7995E W R,L 22	FA3 MDM RTN WD  V91X2922XX R 23	FA3 PROM STRG C  V91X2804XX A 24	FA3 PROM STRG D  V91X2808XX A 25	26	FF3 SIO G9 IMU3  V91X2913XX A 27
EIU1/P4 (C SSME)  V91X2813XX A 28	EIU2/P4 (L SSME)  V91X2817XX A 29	EIU3/P4 (R SSME)  V91X2821XX A 30	FA4 PWR LATCH  V72S7997E W R,L 31	FA4 MDM RTN WD  V91X2923XX R 32	FA4 PROM STRG C  V91X2805XX A 33	FA4 PROM STRG D  V91X2809XX A 34	35	DDD RT  M10H3000D W 36

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PF1 PWR LATCH  V72S7972E W R,L 01	BFS PF1 RTN WD  V98X0961X R 02	EIU1/P1 (C SSME)  V98X0821X A 03	04	FA1 MDM RTN WD  V98X0953X R 05	FA1 PROM STRG C  V98X0893X A 06	FA1 PROM STRG D  V98X0841X A 07	08	NO TRACK STRING 1  V98X2752X R R 09
PF2 PWR LATCH  V72S7973E W R,L 10	BFS PF2 RTN WD  V98X0965X R 11	EIU2/P1 (L SSME)  V98X0826X A 12	13	FA2 MDM RTN WD  V98X0954X R 14	FA2 PROM STRG C  V98X0894X A 15	FA2 PROM STRG D  V98X0842X A 16	17	NO TRACK STRING 2  V98X2753X R R 18
19	BFS STBY  V98X0582X A 20	EIU3/P1 (R SSME)  V98X0831X A 21	22	FA3 MDM RTN WD  V98X0955X R 23	FA3 PROM STRG C  V98X0895X A 24	FA3 PROM STRG D  V98X0843X A 25	26	NO TRACK STRING 3  V98X2754X R R 27
EIU1/P4 (C SSME)  V98X0824X A 28	EIU2/P4 (L SSME)  V98X0828X A 29	EIU3/P4 (R SSME)  V98X0832X A 30	DDD RT  M10H3000D W 31	FA4 MDM RTN WD  V98X0956X R 32	FA4 PROM STRG C  V98X0896X A 33	FA4 PROM STRG D  V98X0844X A 34	35	NO TRACK STRING 4  V98X2755X R R 36

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PF1 PWR LATCH V72S7972E W R,L 01	BFS PF1 RTN WD V98X0961X R 02	03	04	FA1 MDM RTN WD V98X0953X R 05	FA1 PROM STRG C V98X0893X A 06	FA1 PROM STRG D V98X0841X A 07	08	NO TRACK STRING 1 V98X2752X R 09
PF2 PWR LATCH V72S7973E W R,L 10	BFS PF2 RTN WD V98X0965X R 11	12	13	FA2 MDM RTN WD V98X0954X R 14	FA2 PROM STRG C V98X0894X A 15	FA2 PROM STRG D V98X0842X A 16	17	NO TRACK STRING 2 V98X2753X R 18
19	BFS STBY V98X0582X A 20	21	22	FA3 MDM RTN WD V98X0955X R 23	FA3 PROM STRG C V98X0895X A 24	FA3 PROM STRG D V98X0843X A 25	26	NO TRACK STRING 3 V98X2754X R 27
DDD RT M10H3000D W 28	29	30	31	FA4 MDM RTN WD V98X0956X R 32	FA4 PROM STRG C V98X0896X A 33	FA4 PROM STRG D V98X0844X A 34	35	NO TRACK STRING 4 V98X2755X R 36

434

FF1 PWR LATCH V72S7981E W R,L 01	FF1 MDM RTN WD V91X2904XX R 02	FF1 PROM STRG A V91X2242XX A 03	FF1 PROM STRG B V91X2246XX A 04	FF1 TACAN/RA1 V91X2253XX A 05	FF1 IMU 1 V91X2273XX A 06	FF1 MTU ACCUM 1 V91X2277XX A 07	FF1 ADTA1 V91X2261XX A 08	FF1 SIO NSP 1 V91X2902XX A 09
FF2 PWR LATCH V72S7983E W R,L 10	FF2 MDM RTN WD V91X2905XX R 11	FF2 PROM STRG A V91X2243XX A 12	FF2 PROM STRG B V91X2247XX A 13	FF2 TACAN/RA2 V91X2254XX A 14	FF2 IMU 2 V91X2274XX A 15	FF2 MTU ACCUM 2 V91X2278XX A 16	FF2 ADTA 2 V91X2262XX A 17	* V91X2905XX A 18
FF3 PWR LATCH V72S7985E W R,L 19	FF3 MDM RTN WD V91X2906XX R 20	FF3 PROM STRG A V91X2244XX A 21	FF3 PROM STRG B V91X2248XX A 22	FF3 TACAN 3 V91X2255XX A 23	FF3 IMU 3 V91X2275XX A 24	FF3 MTU ACCUM 3 V91X2279XX A 25	FF3 ADTA 3 V91X2263XX A 26	FF3 SIO NSP 2 V91X2903XX A 27
FF4 PWR LATCH V72S7987E W R,L 28	FF4 MDM RTN WD V91X2907XX R 29	FF4 PROM STRG A V91X2245XX A 30	FF4 PROM STRG B V91X2249XX A 31	* V91X2907XX A 32	* V91X2907XX A 33	* V91X2907XX A 34	FF4 ADTA 4 V91X2264XX A 35	DDD RT M10H3000D W 36



**435**

01	FF1 MDM RTN WD  V98X0949X R 02	FF1 PROM STRG A  V98X0861X A 03	FF1 PROM STRG B  V98X0845X A 04	FF1 TACAN/RA1  V98X0865X A 05	FF1 IMU 1  V98X0873X A 06	FF1 MTU ACCUM 1  V98X0921X A 07	FF1 ADTA 1  V98X0849X A 08	FF1 SIO NSP 1  V98X0941X A 09
10	FF2 MDM RTN WD  V98X0950X R 11	FF2 PROM STRG A  V98X0862X A 12	FF2 PROM STRG B  V98X0846X A 13	FF2 TACAN/RA2  V98X0866X A 14	FF2 IMU 2  V98X0874X A 15	FF2 MTU ACCUM 2  V98X0922X A 16	FF2 ADTA 2  V98X0850X A 17	#  V98X0950X A 18
19	FF3 MDM RTN WD  V98X0951X R 20	FF3 PROM STRG A  V98X0863X A 21	FF3 PROM STRG B  V98X0847X A 22	FF3 TACAN 3  V98X0867X A 23	FF3 IMU 3  V98X0875X A 24	FF3 MTU ACCUM 3  V98X0923X A 25	FF3 ADTA 3  V98X0851X A 26	FF3 SIO NSP 2  V98X0943X A 27
28	FF4 MDM RTN WD  V98X0952X R 29	FF4 PROM STRG A  V98X0864X A 30	FF4 PROM STRG B  V98X0848X A 31	#  V98X0952X A 32	#  V98X0952X A 33	#  V98X0952X A 34	FF4 ADTA 4  V98X0852X A 35	DDD RT  M10H3000D W 36

**436**

FF1 MLS 1  V91X2270XX A 01		GPC1 FAIL H/W (OF1)  V72X7011E R 03	GPC2 FAIL BY GPC1  V91X1562XX R 04	GPC3 FAIL BY GPC1  V91X1563XX R 05	GPC4 FAIL BY GPC1  V91X1564XX R 06	GPC5 FAIL BY GPC1  V91X1565XX R 07	08	BFS I/O TERM OFF  V98X0594X R R 09
FF2 MLS 2  V91X2271XX A 10	11	GPC1 FAIL BY GPC2  V91X1566XX R 12	GPC2 FAIL H/W (OF1)  V72X7012E R 13	GPC3 FAIL BY GPC2  V91X1568XX R 14	GPC4 FAIL BY GPC2  V91X1569XX R 15	GPC5 FAIL BY GPC2  V91X1570XX R 16	17	BFS S/W ENGAGE 1  V98X0604X R 18
FF3 MLS 3  V91X2272XX A 19	20	GPC1 FAIL BY GPC3  V91X1571XX R 21	GPC2 FAIL BY GPC3  V91X1572XX R 22	GPC3 FAIL H/W (OF1)  V72X7013E R 23	GPC4 FAIL BY GPC3  V91X1574XX R 24	GPC5 FAIL BY GPC3  V91X1575XX R 25	26	BFS S/W ENGAGE 2  V98X0605X R 27
DDD RT  M10H3000D W 28	29	GPC1 FAIL BY GPC4  V91X1576XX R 30	GPC2 FAIL BY GPC4  V91X1577XX R 31	GPC3 FAIL BY GPC4  V91X1578XX R 32	GPC4 FAIL H/W (OF1)  V72X7014E R 33	GPC5 FAIL BY GPC4  V91X1580XX R 34	35	BFS S/W ENGAGE 3  V98X0606X R 36

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		GPC1 FAIL BY GPC5  V91X1664XX R	GPC2 FAIL BY GPC5  V91X1665XX R	GPC3 FAIL BY GPC5  V91X1666XX R	GPC4 FAIL BY GPC5  V91X1667XX R	GPC5 FAIL H/W (OF1)  V72X7015E R		BFS ENGAGED  V98X0643X R
01	02	03	04	05	06	07	08	09
		GPC1 RUN  V92X7364XX G	GPC2 RUN  V92X7424XX G	GPC3 RUN  V92X7484XX G	GPC4 RUN  V92X7544XX G	GPC5 RUN  V92X7604XX G		BFS RUN  V98X0583X G
10	11	12	13	14	15	16	17	18
		GPC1 STBY  V92X7363XX A	GPC2 STBY  V92X7423XX A	GPC3 STBY  V92X7483XX A	GPC4 STBY  V92X7543XX A	GPC5 STBY  V92X7603XX A		BFS STBY  V98X0582X A
19	20	21	22	23	24	25	26	27
		GPC1 I/O TERM B  V92X7375XX R	GPC2 I/O TERM B  V92X7435XX R	GPC3 I/O TERM B  V92X7495XX R	GPC4 I/O TERM B  V92X7555XX R	GPC5 I/O TERM B  V92X7615XX R		
28	29	30	31	32	33	34	35	36

438

DK1 ENA TO BFS  V98X2806X G	CRT1 PWR LATCH  V73S2001E W R,L	DK1 ENA TO GPC1  V91X8712XX G	DK1 ENA TO GPC2  V91X8746XX G	DK1 ENA TO GPC3  V91X8780XX G	DK1 ENA TO GPC4  V91X8812XX G	DK1 ENA TO GPC5  V91X8847XX G	CRT1 STBY  V73S2002E A	CRT1 ON CNTL AB1  V73S2001E G
01	02	03	04	05	06	07	08	09
DK2 ENA TO BFS  V98X2807X G	CRT2 PWR LATCH  V73S2011E W R,L	DK2 ENA TO GPC1  V91X8713XX G	DK2 ENA TO GPC2  V91X8747XX G	DK2 ENA TO GPC3  V91X8781XX G	DK2 ENA TO GPC4  V91X8813XX G	DK2 ENA TO GPC5  V91X8848XX G	CRT2 STBY  V73S2012E A	CRT2 ON CNTL BC2  V73S2011E G
10	11	12	13	14	15	16	17	18
DK3 ENA TO BFS  V98X2808X G	CRT3 PWR LATCH  V73S2021E W R,L	DK3 ENA TO GPC1  V91X8714XX G	DK3 ENA TO GPC2  V91X8748XX G	DK3 ENA TO GPC3  V91X8782XX G	DK3 ENA TO GPC4  V91X8814XX G	DK3 ENA TO GPC5  V91X8849XX G	CRT3 STBY  V73S2022E A	CRT3 ON CNTL CA1  V73S2021E G
19	20	21	22	23	24	25	26	27
DK4 ENA TO BFS  V98X2809X G	CRT4 PWR LATCH  V73S2051E W R,L	DK4 ENA TO GPC1  V91X8715XX G	DK4 ENA TO GPC2  V91X8749XX G	DK4 ENA TO GPC3  V91X8783XX G	DK4 ENA TO GPC4  V91X8815XX G	DK4 ENA TO GPC5  V91X8850XX G	CRT4 STBY  V73S2052E A	CRT4 ON CNTL CA2  V73S2051E G
28	29	30	31	32	33	34	35	36

439

BFS MM1 IPL V98X0585X A 01	BFS CRT SEL A V98X0607X G 02	GPC1 CRT SEL A V92X7384XX G 03	GPC2 CRT SEL A V92X7444XX G 04	GPC3 CRT SEL A V92X7504XX G 05	GPC4 CRT SEL A V92X7564XX G 06	GPC5 CRT SEL A V92X7624XX G 07	SM ALERT (GNC) V91X7462XX A 08	SM ALERT (BFS) V98X1269X A 09
BFS MM2 IPL V98X0586X A 10	BFS CRT SEL B V98X0608X G 11	GPC1 CRT SEL B V92X7385XX G 12	GPC2 CRT SEL B V92X7445XX G 13	GPC3 CRT SEL B V92X7505XX G 14	GPC4 CRT SEL B V92X7565XX G 15	GPC5 CRT SEL B V92X7625XX G 16	SM ALERT (SM) V91X7462XY A 17	MASTER ALARM V73X1567E A 18
PASS I/O ERROR M02G1501E R 19	BFS I/O ERROR M04G1501E R 20		MTU 0SC1 MAN SEL V75S2236E A 22	MTU 0SC2 MAN SEL V75S2237E A 23	RS HOLD V90X8667X R 24	SM COMMON BUFF BUSY V92X0077X A 25	REAL TIME M10H3000D G 26	TMBU REJ LATCH V92J0660C R L 27
PASS GPC ERROR M01G1501E R 28	BFS GPC ERROR M03G1501E R 29		MTU OSC1 AUTO CNTL V75X3541D G 31	MTU OSC2 AUTO CNTL V75X3541D G R 32		HISAM DUMP SW V72S7150E A R 34	MEM DUMP LIVE M40H0634D G 35	TMBU REJECT V92J0660C R 36

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	GPC 2 IN RS 1 V91X2071XX G 02	GPC 3 IN RS 1 V91X2072XX G 02	GPC 4 IN RS 1 V91X2073XX G 02	GPC 5 IN RS 1 V91X2074XX G 02	06
GPC 1 IN RS 2 V91X2105XX G 07		GPC 3 IN RS 2 V91X2106XX G 09	GPC 4 IN RS 2 V91X2107XX G 10	GPC 5 IN RS 2 V91X2108XX G 11	12
GPC 1 IN RS 3 V91X2139XX G 13	GPC 2 IN RS 3 V91X2140XX G 14		GPC 4 IN RS 3 V91X2141XX G 16	GPC 5 IN RS 3 V91X2142XX G 17	18
GPC 1 IN RS 4 V91X2173XX G 19	GPC 2 IN RS 4 V91X2174XX G 20	GPC 3 IN RS 4 V91X2175XX G 21		GPC 5 IN RS 4 V91X2176XX G 23	24
GPC 1 IN RS 5 V91X2226XX G 25	GPC 2 IN RS 5 V91X2227XX G 26	GPC 3 IN RS 5 V91X2228XX G 27	GPC 4 IN RS 5 V91X2229XX G 28		30
					36

441

	GPC 2 IN CS 1 V91X2088XX G 02	GPC 3 IN CS 1 V91X2089XX G 03	GPC 4 IN CS 1 V91X2090XX G 04	GPC 5 IN CS 1 V91X2091XX G 05		06
GPC 1 IN CS 2 V91X2122XX G 07		GPC 3 IN CS 2 V91X2123XX G 09	GPC 4 IN CS 2 V91X2124XX G 10	GPC 5 IN CS 2 V91X2125XX G 11	OI STATIC M40H0134D W 12	
GPC 1 IN CS 3 V91X2156XX G 13	GPC 2 IN CS 3 V91X2157XX G 14		GPC 4 IN CS 3 V91X2158XX G 16	GPC 5 IN CS 3 V91X2159XX G 17	GNC STATIC M40H0234D W 18	
GPC 1 IN CS 4 V91X2221XX G 19	GPC 2 IN CS 4 V91X2222XX G 20	GPC 3 IN CS 4 V91X2223XX G 21		GPC 5 IN CS 4 V91X2224XX G 23	SM STATIC M40H0334D W 24	
GPC 1 IN CS 5 V91X2231XX G 25	GPC 2 IN CS 5 V91X2232XX G 26	GPC 3 IN CS 5 V91X2233XX G 27	GPC 4 IN CS 5 V91X2234XX G 28		OPS 0 STATIC M40H0534D W 30	
DTE H/W SAT M01D2164I W 31					BFS STATIC M40H0434D W 36	

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FA1 SEC PORT FAIL V92X7729XX R 01	FF1 SEC PORT FAIL V92X7725XX R 02		FA1 PWR LATCH V72S7991E W R,L 04	FA1 MDM RTN WD V91X2920XX R 05	FA1 PROM STRG C V91X2802XX A 06	FA1 PROM STRG D V91X2806XX A 07		FF1 -Z STKR V91X2259XX A 09
FA2 SEC PORT FAIL V92X7730XX R 10	FF2 SEC PORT FAIL V92X7726XX R 11		FA2 PWR LATCH V72S7993E W R,L 13	FA2 MDM RTN WD V91X2921XX R 14	FA2 PROM STRG C V91X2803XX A 15	FA2 PROM STRG D V91X2807XX A 16	RDZ NAV ENABLED V90X4765X G 17	
FA3 SEC PORT FAIL V92X7731XX R 19	FF3 SEC PORT FAIL V92X7727XX R 20		FA3 PWR LATCH V72S7995E W R,L 22	FA3 MDM RTN WD V91X2922XX R 23	FA3 PROM STRG C V91X2804XX A 24	FA3 PROM STRG D V91X2808XX A 25	FF3 GNC KU RADAR V91X2256XX A 26	FF3 -Y STKR V91X2260XX A 27
FA4 SEC PORT FAIL V92X7732XX R 28	FF4 SEC PORT FAIL V92X7728XX R 29		FA4 PWR LATCH V72S7997E W R,L 31	FA4 MDM RTN WD V91X2923XX R 32	FA4 PROM STRG C V91X2805XX A 33	FA4 PROM STRG D V91X2809XX A 34		DDD RT M10H3000D W 36

**443**

PF1 PWR LATCH V72S7972E W R,L 01	PF1 MDM RTN WD V92X0323X R 02	PF1 PBD CARD 3 V91X2940X A 03	PF1 PBD CARD 6 V91X2941X A 04	PF1 PBD CARD 9 V91X2942X A 05	PSP 1 CARD 8 V92X0325X A 06	PSP 1 PWR ON (GCIL) V74X4890E G 07	KU COMM CARD 8 V92X0324X A 08	PF1 LO RT "OR" ELE V92X0326X A 09
PF2 PWR LATCH V72S7973E W R,L 10	PF2 MDM RTN WD V92X0327X R 11	PF2 PBD CARD 3 V91X2945X A 12	PF2 PBD CARD 6 V91X2946X A 13	PF2 PBD CARD 9 V91X2947X A 14	PSP 2 CARD 8 V92X0329X A 15	PSP 2 PWR ON (GCIL) V74X4891E G 16	FC PURGE CARD 6 V92X0328X A 17	PF2 LO RT "OR" ELE V92X0330X A 18
BUS PL1 HI RT 04 V95X5904X A 19	BUS PL1 HI RT 05 V95X5905X A 20	BUS PL1 HI RT 06 V95X5906X A 21	BUS PL1 HI RT 07 V95X5907X A 22	BUS PL1 HI RT 08 V95X5908X A 23	BUS PL1 HI RT 09 V95X5909X A 24	BUS PL1 HI RT 10 V95X5910X A 25	BUS PL1 HI RT 11 V95X5911X A 26	BUS PL1 HI RT 12 V95X5912X A 27
BUS PL2 HI RT 04 V95X5920X A 28	BUS PL2 HI RT 05 V95X5921X A 29	BUS PL2 HI RT 06 V95X5922X A 30	BUS PL2 HI RT 07 V95X5923X A 31	BUS PL2 HI RT 08 V95X5924X A 32	BUS PL2 HI RT 09 V95X5925X A 33	BUS PL2 HI RT 10 V95X5926X A 34	BUS PL2 HI RT 11 V95X5927X A 35	BUS PL2 HI RT 12 V95X5928X A 36

**445**

PDI SW MATRIX V92X0908X A 01	MCIU V92X0322X A 02	MCIU SPEC I/O ON V92X3835X G 03		FLEX V RTN WD V92X0331X R 05	FLEX W RTN WD V92X0333X R 06	FLEX X RTN WD V92X0336X R 07	FLEX Y RTN WD V92X0338X R 08	FLEX Z RTN WD V92X0340X R 09
DDD RT M10H3000D W 10		MCIU PWR ON (OF4) V54S0600E G 12		FLEX V "OR" ELE V92X0332X A 14	FLEX W "OR" ELE V92X0334X A 15	FLEX X "OR" ELE V92X0337X A 16	FLEX Y "OR" ELE V92X0339X A 17	FLEX Z "OR" ELE V92X0341X A 18
BUS PL1 HI RT 13 V95X5913X A 19	BUS PL1 HI RT 14 V95X5914X A 20	BUS PL1 HI RT 15 V95X5915X A 21	BUS PL1 HI RT 16 V95X5916X A 22	FLX PR A RTN WD V92X0342X R 23	FLX PR B RTN WD V92X0344X R 24	FLX PR C RTN WD V92X0346X R 25	FLX PR D RTN WD V92X0348X R 26	FLX PR E RTN WD V92X0350X R 27
BUS PL2 HI RT 13 V95X5929X A 28	BUS PL2 HI RT 14 V95X5930X A 29	BUS PL2 HI RT 15 V95X5931X A 30	BUS PL2 HI RT 16 V95X5932X A 31	FLX/PAM A "OR" ELE V92X0343X R 32	FLX/PAM B "OR" ELE V92X0345X R 33	FLX/PAM C "OR" ELE V92X0347X R 34	FLX/PAM D "OR" ELE V92X0349X R 35	FLX/PAM E "OR" ELE V92X0351X R 36

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GPC 1 STRING 1 V91X8728XX G 01	GPC 2 STRING 1 V91X8762XX G 02	GPC 3 STRING 1 V91X8796XX G 03	GPC 4 STRING 1 V91X8831XX G 04	GPC 5 STRING 1 V91X8863XX G 05	06
GPC 1 STRING 2 V91X8729XX G 07	GPC 2 STRING 2 V91X8763XX G 08	GPC 3 STRING 2 V91X8797XX G 09	GPC 4 STRING 2 V91X8833XX G 10	GPC 5 STRING 2 V91X8864XX G 11	12
GPC 1 STRING 3 V91X8730XX G 13	GPC 2 STRING 3 V91X8764XX G 14	GPC 3 STRING 3 V91X8798XX G 15	GPC 4 STRING 3 V91X8834XX G 16	GPC 5 STRING 3 V91X8865XX G 17	18
GPC 1 STRING 4 V91X8731XX G 19	GPC 2 STRING 4 V91X8765XX G 20	GPC 3 STRING 4 V91X8799XX G 21	GPC 4 STRING 4 V91X8835XX G 22	GPC 5 STRING 4 V91X8866XX G 23	24
GPC 1 PL V91X8716XX G 25	GPC 2 PL V91X8750X G 26	GPC 3 PL V91X8784XX G 27	GPC 4 PL V91X8816XX G 28	GPC 5 PL V91X8851XX G 29	BFS NOT ENA PL1 V98X2810X A R 30
GPC 1 ENA LB1 V91X8718XX G 31	GPC 2 ENA LB1 V91X8752XX G 32	GPC 3 ENA LB1 V91X8786XX G 33	GPC 4 ENA LB1 V91X8818XX G 34	GPC 5 ENA LB1 V91X8853XX G 35	BFS NOT ENA PL2 V98X2811X A R 36

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MMU 1 PWR CNTL AB1 V72S7185E A R 01	GPC 1 MM1 BUSY V92X7368XX A R 02	GPC 2 MM1 BUSY V92X7428XX A R 03	GPC 3 MM1 BUSY V92X7488XX A R 04	GPC 4 MM1 BUSY V92X7548XX A R 05	GPC 5 MM1 BUSY V92X7608XX A R 06
MMU 2 PWR CNTL AB2 V72S7186E A R 07	GPC 1 MM2 BUSY V92X7369XX A R 08	GPC 2 MM2 BUSY V92X7429XX A R 09	GPC 3 MM2 BUSY V92X7489X A R 10	GPC 4 MM2 BUSY V92X7549XX A R 11	GPC 5 MM2 BUSY V92X7609XX A R 12
MMU 1 PWR LATCH V72S7185E W R,L 13	GPC 1 MM1 IPL V92X7366XX A 14	GPC 2 MM1 IPL V92X7426XX A 15	GPC 3 MM1 IPL V92X7486XX A 16	GPC 4 MM1 IPL V92X7546XX A 17	GPC 5 MM1 IPL V92X7606XX A 18
MMU 2 PWR LATCH V72S7186E W R,L 19	GPC 1 MM2 IPL V92X7367XX A 20	GPC 2 MM2 IPL V92X7427XX A 21	GPC 3 MM2 IPL V92X7487XX A 22	GPC 4 MM2 IPL V92X7547XX A 23	GPC 5 MM2 IPL V92X7607XX A 24
BFS MM1 BUSY V98X0587X A R 25	GPC 1 ENA LB1 V91X8718XX G 26	GPC 2 ENA LB1 V91X8752XX G 27	GPC 3 ENA LB1 V91X8786XX G 28	GPC 4 ENA LB1 V91X8818XX G 29	GPC 5 ENA LB1 V91X8853XX G 30
BFS MM2 BUSY V98X0588X A R 31	GPC 1 ENA LB2 V91X8719XX G 32	GPC 2 ENA LB2 V91X8753XX G 33	GPC 3 ENA LB2 V91X8787XX G 34	GPC 4 ENA LB2 V91X8819XX G 35	GPC 5 ENA LB2 V91X8854XX G 36

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FA1 PWR CNTL AB1 V72S7991E A R 01	FA1 PWR LATCH V72S7991E W R,L 02	FF1 PWR CNTL AB2 V72S7981E A R 03	FF1 PWR LATCH V72S7981E W R,L 04	05	PCMMU 1 PWR (OF1) V76X4265E G 06
FA2 PWR CNTL BC1 V72S7993E A R 07	FA2 PWR LATCH V72S7993E W R,L 08	FF2 PWR CNTL BC2 V72S7983E A R 09	FF2 PWR LATCH V72S7983E W R,L 10	11	PCMMU 2 PWR (OF1) V76X4272E G 12
FA3 PWR CNTL CA2 V72S7995E A R 13	FA3 PWR LATCH V72S7995E W R,L 14	FF3 PWR CNTL CA3 V72S7985E A R 15	FF3 PWR LATCH V72S7985E W R,L 16	17	18
FA4 PWR CNTL CA3 V72S7997E A R 19	FA4 PWR LATCH V72S7997E W R,L 20	FF4 PWR CNTL BC1 V72S7987E A R 21	FF4 PWR LATCH V72S7987E W R,L 22	23	24
PF1 PWR CNTL AB3 V72S7972E A R 25	PF1 PWR LATCH V72S7972E W R,L 26	27	L DDU 1 PWR A V73X3001X A R 28	L DDU 1 PWR B V73X3002X A R 29	L DDU 1 PWR C V73X3003X A R 30
PF2 PWR CNTL BC1 V72S7973E A R 31	PF2 PWR LATCH V72S7973E W R,L 32	DDD RT M10H3000D W 33	R DDU 2 PWR A V73X3011X A R 34	R DDU 2 PWR B V73X3012X A R 35	R DDU 2 PWR C V73X3013X A R 36

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01	GPC2 NOT IN RS 1 V91X2071XX A R 02	GPC3 NOT IN RS 1 V91X2072XX A R 03	GPC4 NOT IN RS 1 V91X2073XX A R 04	05	06
GPC1 NOT IN RS 2 V91X2105XX A R 07	08	GPC3 NOT IN RS 2 V91X2106XX A R 09	GPC4 NOT IN RS 2 V91X2107XX A R 10	11	12
GPC1 NOT IN RS 3 V91X2139XX A R 13	GPC2 NOT IN RS 3 V91X2140XX A R 14	15	GPC4 NOT IN RS 3 V91X2141XX A R 16	17	18
GPC1 NOT IN RS 4 V91X2173XX A R 19	GPC2 NOT IN RS 4 V91X2174XX A R 20	GPC3 NOT IN RS 4 V91X2175XX A R 21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	DDD RT M10H3000D W 36

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GPC1 RPCA MNA/ES1BC V76X4351E A R 01	GPC2 RPCA MNA/ES1BC V76X4355E A R 02	GPC3 RPCA MNA/ES1BC V76X4361E A R 03	GPC4 RPCA MNA/ES1BC V76X4365E A R 04	GPC5 RPCA MNA/ES1BC V76X4371E A R 05	06
GPC1 RPCB MNB/ES2CA V76X4352E A R 07	GPC2 RPCB MNB/ES2CA V76X4356E A R 08	GPC3 RPCB MNB/ES2CA V76X4362E A R 09	GPC4 RPCB MNB/ES2CA V76X4366E A R 10	GPC5 RPCB MNB/ES2CA V76X4372E A R 11	12
GPC1 RPCC MNC/ES3AB V76X4353E A R 13	GPC2 RPCC MNC/ES3AB V76X4357E A R 14	GPC3 RPCC MNC/ES3AB V76X4363E A R 15	GPC4 RPCC MNC/ES3AB V76X4367E A R 16	GPC5 RPCC MNC/ES3AB V76X4373E A R 17	18
19	20	21	22	23	24
GNC GPC1 TEMP BITE V92X4358XX R 25	GNC GPC2 TEMP BITE V92X4361XX R 26	GNC GPC3 TEMP BITE V92X4364XX R 27	GNC GPC4 TEMP BITE V92X4367XX R 28	GNC GPC5 TEMP BITE V92X4370XX R 29	BFS GPC TEMP BITE V98X2568X R 30
SM GPC1 TEMP BITE V92X4358XY R 31	SM GPC2 TEMP BITE V92X4361XY R 32	SM GPC3 TEMP BITE V92X4364XY R 33	SM GPC4 TEMP BITE V92X4367XY R 34	SM GPC5 TEMP BITE V92X4370XY R 35	DDD RT M10H3000D W 36

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01	02	GPC1 FAIL BY GPC5 V91X1664XX R 03	GPC2 FAIL BY GPC5 V91X1665XX R 04	GPC3 FAIL BY GPC5 V91X1666XX R 05	GPC4 FAIL BY GPC5 V91X1667XX R 06	GPC5 FAIL H/W (OF1) V72X7015E R 07	08	BFS ENGAGED V98X0643X R 09
10	11	GPC1 RUN V92X7364XX G 12	GPC2 RUN V92X7424XX G 13	GPC3 RUN V92X7484XX G 14	GPC4 RUN V92X7544XX G 15	GPC5 RUN V92X7604XX G 16	17	BFS RUN V98X0583X G 18
19	20	GPC1 FAIL STBY/HALT V91Q1586CX A 21	GPC2 FAIL STBY/HALT V91Q1587CX A 22	GPC3 FAIL STBY/HALT V91Q1588CX A 23	GPC4 FAIL STBY/HALT V91Q1589CX A 24	GPC5 FAIL STBY/HALT V91Q1590CX A 25	26	BFS STBY V98X0582X A 27
28	29	GPC1 I/O TERM B V92X7375XX R 30	GPC2 I/O TERM B V92X7435XX R 31	GPC3 I/O TERM B V92X7495XX R 32	GPC4 I/O TERM B V92X7555XX R 33	GPC5 I/O TERM B V92X7615XX R 34	35	36



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01	02	GPC1 FAIL BY GPC5 V91X1664XX R 03	GPC2 FAIL BY GPC5 V91X1665XX R 04	GPC3 FAIL BY GPC5 V91X1666XX R 05	GPC4 FAIL BY GPC5 V91X1667XX R 06	GPC5 FAIL H/W (OF1) V72X7015E R 07	08	BFS ENGAGED V98X0643X R 09
10	11	GPC1 RUN V92X7364XX G 12	GPC2 RUN V92X7424XX G 13	GPC3 RUN V92X7484XX G 14	GPC4 RUN V92X7544XX G 15	GPC5 RUN V92X7604XX G 16	17	BFS RUN V98X0583X G 18
SCOS FSP COUNTER M01S2101E W 19	ECOS FSP COUNTER M01S2102E W 20	GPC1 STBY V92X7363XX A 21	GPC2 STBY V92X7423XX A 22	GPC3 STBY V92X7483XX A 23	GPC4 STBY V91X7543XX A 24	GPC5 STBY V92X7603XX A 25	26	BFS STBY V98X0582X A 27
SOE COUNTER M01S2201E W 28	LOE COUNTER M01S2202E W 29	GPC1 I/O TERM B V92X7375XX R 30	GPC2 I/O TERM B V92X7435XX R 31	GPC3 I/O TERM B V92X7495XX R 32	GPC4 I/O TERM B V92X7555XX R 33	GPC5 I/O TERM B V92X7615XX R 34	35	36

**REFERENCE**

1. VEO Format Detail Retrieval and Update (RDOS), STS-66 version.

## TITLE

DPS APPLICATIONS/DISPLAYS

## GENERAL

This information is supplemental to the DPS W/S S/W User's Guides. It does not provide instruction on how to use the applications, but rather information on the data displayed by DPS Overview, DTEX, and OFS.

### **DPS Overview (please also see DPS overview User's Guide)**

DPS Overview (DPS OV) replaces information previously displayed on a variety of DPS MSKs. It is one of the primary applications used to monitor the DPS system (Figure B-1).

The application consists of a single window with three different views, one for each of the PASS GPC downlists (GNC, SM, and OPS-0). The appearance of each view is the same, but the telemetry used to drive major portions of the application are different, depending on which downlister has been selected. Blocks 1, 2, and 5 in Figure B-1 are the areas of the display that are affected by the choice of downlister selection.

In many cases, the user can obtain the MSID that is driving a displayed value by double clicking the mouse on the displayed value. The MSID, its nomenclature, and the timetag of when the value last changed (including reacquisition of telemetry after data dropouts) are displayed in the area marked Block 10 on Figure B-1, at the bottom of the application's display window.

Data on the display is highlighted (bright white box) when it changes. This highlighting currently also takes place when data is lost and reacquired, which can cause a great deal of highlighting during periods of ratty comm. An "S" is used to indicate static data, a "D" to indicate dead data (not being downlisted), and an "M" to indicate missing data. Data that is static is changed to a light blue color as opposed to the nominal white. For example, when returning from an LOS, the displayed data will be highlighted, changed to white in color, and the "S" will be removed.

### **Figure B-1 details**

#### **Block 1 (upper left box), affected by downlister selection)**

Mode: RUN, STBY

CPU %: Percentage of time for which the GPC's CPU was active over the most recent 4-second cycle. This is an indication of the GPC mode. The following are typical display values:

- 45-80 - Normal GNC ops or, with failed votes against GPC, shows F-T-S GPC. Note that SM ops may be lower than this, unless utilization is high.
- 10-12 - OPS-0 or GPC is in STBY mode.
- 0 - With failed votes against GPC, shows an F-T-H GPC; will turn yellow and show a < symbol next to the 0 (0<).

**Note:** During targeting situations, CPU usage can max. out at 100. This may show as follows (in yellow) 100>.

BLOCK 1										BLOCK 3			BLOCK 4		BLOCK 7		BLOCK 8		BLOCK 9																				
GPC-1					GPC-2					GPC-3					GPC-4					GPC-5					Variable Parameters			TIMES											
Mode	RDM	RDM	RDM	RDM	D	1	7C00	0000	D	OGMT	137/01:14:34	BLOCK 4	2	2000	1000	D	OMST	001/17:09:15	BLOCK 7	3	8F99	8F99	D	Lift Off	135/08:05:19.000	BLOCK 8	4	2000	0818	---	SM CKPT	000/00:00:00	BLOCK 9	5	1000	0000	---	Word 0	00E010E0
CPU %	48	48	48	19	BFS	6 <td>2000 <td>0000 <td>--- <td>Word 1</td> <td>00F00F00</td> </td></td></td>	2000 <td>0000 <td>--- <td>Word 1</td> <td>00F00F00</td> </td></td>	0000 <td>--- <td>Word 1</td> <td>00F00F00</td> </td>	--- <td>Word 1</td> <td>00F00F00</td>	Word 1	00F00F00																												
Time Src	A1	A1	A1	A1	D	7 <td>0002</td> <td>0000</td> <td>--- <td>Word 2</td> <td>0200F000</td> </td>	0002	0000	--- <td>Word 2</td> <td>0200F000</td>	Word 2	0200F000																												
Disc A	2300	2300	2300	2304	D	8 <td>408F</td> <td>0018</td> <td>--- <td>High</td> <td>00000000</td> </td>	408F	0018	--- <td>High</td> <td>00000000</td>	High	00000000																												
Disc B	2000	4000	6000	8000	D	9 <td>4539</td> <td>0018</td> <td>--- <td>Low</td> <td>0000 0000</td> </td>	4539	0018	--- <td>Low</td> <td>0000 0000</td>	Low	0000 0000																												
Soft Err	0000	0000	0000	0000	D	10 <td>3DAA</td> <td>0018</td> <td>--- <td colspan="2">SM BYPASS PL</td> </td>	3DAA	0018	--- <td colspan="2">SM BYPASS PL</td>	SM BYPASS PL																													
CRT Sel					D	MMU-1 MMU-2				Redundant Set		123																											
Xmt Ena 1	4202	2101	1040	0838	D	STAT A	0000	0000	BUSY		Common Set	1234																											
Xmt Ena 2	3880	3480	F380	1080	D	B	0000	0000	IPL		BFS Track	D																											
Bus Msk 1	008C	008C	008C	03C7	M	SM Cm Buff		Idle		GNC Ops	201																												
Bus Msk 2	0000	0000	0000	CF00	M	Source Bus	9000		BFS Ops		D																												
GPC Error	---	---	---	---	---	MDM BITE	0000		Stringing		1233-44																												
Counter	3	0	0	0	D	MTU BITE	8000		MBAT-G1		D																												
Error	06 06	00 00	00 00	00 00	D	OSC	Auto (1)		MBAT-G3		D																												
Pointer	0710	0000	0000	0000	D	L DDU PWR	off		G3 Archive		11010																												
Time	136/20	000/00	000/00	000/00	D	R DDU PWR	off		PCMMU Sel		1																												
I/O Error	---	---	---	---	---	Failed GPC					1 2 3 4 5																												
Counter	117	101	18	94	D	I/O Error					1 2 3 4 5																												
ID/Ele	15 44	15 44	15 44	10 00	D	I/O Error					1 2 3 4 5																												
BCE	22	22	22	24	D	I/O Error					1 2 3 4 5																												
Stat Wd	0250 0000	0250 0000	0250 0000	0368 0000	D	I/O Error					1 2 3 4 5																												
Time	136/23	136/23	136/23	137/01	D	I/O Error					1 2 3 4 5																												
09:30	09:30	09:30	09:30	12:17	D	I/O Error					1 2 3 4 5																												
I/O Error										GPC Error																													
ID	EL	BCE	Status	OP	RWC	Time	Grp Code	Ptr	Time	Failed GPC																													
1	15	44	22	02500000	00	03	136/23:09:30.213	1	00 00	0000	000/00:00:00.000	1 2 3 4 5																											
2	15	44	22	02500000	00	03	136/23:09:30.373	2	00 00	0000	000/00:00:00.000	1 2 3 4 5																											
3	13	19	23	01500000	00	15	136/22:38:06.986	3	00 00	0000	000/00:00:00.000	1 2 3 4 5																											
4	15	44	22	02500000	00	03	136/22:59:33.573	4	00 00	0000	000/00:00:00.000	1 2 3 4 5																											
5	15	44	22	02500000	00	03	136/22:59:33.733	5	00 00	0000	000/00:00:00.000	1 2 3 4 5																											
Scratch Pad Line										IE	Disp	MF	SW	H/W1	H/W2	S/W	Poll	Hdr	Power																				
1 RESUME											2011	GNC	GNC	8200	8000	0000	0140	ON																					
2											330	GNC	GNC	8200	8000	0000	0240	ON																					
3											0		PL	0000	0000	0000	0000	OFF																					
4 ITEM (19) EXEC											2011	GNC	GNC	8200	8000	0000	0440	ON																					

Figure B-1. DPS Overview

Time Src: Accumulator or internal time used by GPC (e.g., Ax = accumulator x, where x = 1, 2, or 3; Cx = internal time, where x = 1, 2, 3, 4, 5).

Disc A/B: The discrete A and B words contain information about the status of the GPCs, MMUs, BFC CRT SEL switch (also in CRT Select row, below), etc. This information is represented by discretets (SCP 4.1). The information available in these words is also available in other areas of DPS applications.

STBY, RUN: Available on DPS OV, Block 1.

MM1/2 IPL, MM1/2 BUSY: Available in DPS OV MMU box, Block 5.

I/O Term B: Available on DTEX (shows up red if off nominal).

BFS Eng 1/2/3: Available on DTEX (shows up red if off nominal).

BFC CRT: Available on DPS OV, Block 1.

Soft Err: Four-digit hex field that contains the accumulative count of errors detected by error detection and correction code; upper two digits are counter for lower memory, lower two digits are counter for upper memory (SCP 4.1).

CRT Sel: Shows the position of the BFC CRT Select switch when the switch is ON.

Xmt Ena 1/2: Shows whether the GPC data bus transmitters are on or off (SCP 4.1).

Bus Msk 1/2: The bus mask words are similar in presentation to the Xmit Ena words; however, masking a bus neutralizes it, blocking transmission and preventing the GPC from listening on that bus. When a GPC fails sync with the redundant set, the buses it commands are masked by the other RS GPCs. Also, when a DEU has a GNC commander and an SM commander, the DK bus will be masked by the GPC whose major function base does not match the MF switch setting (SCP 4.1).

**Note:** The bits in the Xmit Ena words are set (1) to indicate transmitters, but a set bit in the Bus Mask word indicates *inhibited* transmission and reception.

#### GPC Error section (see also SCP 4.3)

Counter: Cumulative decimal counter for each GPC's error log.

Error: The error group (first two characters) and error code (last two characters).

Pointer: Points to memory address in GPC where error occurred (PDE address).

Time: GMT at which error occurred.

#### I/O Error section (see also SCP 4.2)

Counter: Decimal sum of the actual I/O error log cumulative counts logged against each GPC.

ID/El: ID is the unique device/transaction corresponding to the failed I/O transaction. Element is the BCE Element number that uniquely identifies an LRU that may be bypassed via software action within a particular input transaction.

BCE: BCE number that identifies the type of I/O error (I/O transaction error, IOP hardware error, or mass memory detected errors).

Status Wd: STATUS word or IOP status register that provides detailed data pertinent to the failed I/O transaction.

Time: GMT at which the I/O error was logged.

## **Block 2 (lower left - partially affected by downlister selection)**

### I/O Error 5 deep stack

This listing contains the last five I/O errors logged. It shows the ID, EL, BCE, and Status Word information available in Block 1; it also contains the OP code and RWC (residual word count) for each error. The stack is driven by the current user-selected PASS downlist.

### GPC Error 5 deep stack

This section contains the last five GPC errors logged. It shows the error group, error code, pointer, and GMT of error, as also displayed in Block 1.

### Scratch Pad Line

This portion of the display is a compilation of information received from the downlist PASS GPCs. It is driven by the *ospl* comp, which also drives the scratch pad line portion of the SPECS application. It presents data from all the active PASS-assigned DEUs. The BFS-assigned DEUs will show their most recent PASS assignments with a static indication.

DEU number (1-4): The PASS-assigned DEU driving that line of the display.

Scratch Pad line (text field): This field is an image of the keystrokes sent to the GPC by the DEU. It will be an image of the scratch pad line on the associated CRT, with the exception that erroneous keystrokes that result in the "ERR" message will not be seen on the ground display. The "POLL FAIL" message will also not be displayed on the ground display. However, an "I" will appear to the left of the DISP column if an "illegal entry" message is received on that CRT.

IE: will show "I" in the field if an illegal entry message was received by the crew on that CRT. Clears when crew clears the message onboard.

DISP: A four-digit field identifying the OPS, SPEC, or DISP being presented on the respective CRT.

MF: Identifies the major function of the GPC to which the respective DEU is assigned (may be GNC, SM, or PL). It may display OP0 for those DEUs that are assigned to a GPC that has been moded to OPS-0. This field does not necessarily reflect the position of the CRT MAJ FUNC switch.

SW: Represents the position of the CRT MAJ FUNC switch (GNC, SM, PL).

H/W1, H/W2, S/W: Represent the hardware and software BITE words (SCP 4.8).

Poll Hdr: Contains additional information not available in the H/W or S/W words (SCP 4.8).

Power: Indicates whether the CRT is powered on or not.

### **Block 3 (upper right of center, VPs)**

This section shows the raw data currently being downlisted in each of the VP slots. (SCPs 7.6, 7.7). Note that this data has not been converted to EU. To view scaled data, use the VP DPS application.

### **Block 4 (upper right corner, TIMES)**

OGMT: Orbiter GMT. The time source for this time is selectable, and the time is fed through the ground MSID M50Q0027HP. The initial default source (no failures) is MTU-1 Voted GMT, which is taken from MSID V75W3504D. For more information on time source substitution, see FCOH SOP 8.3.

OMET: Orbiter MET. The time source for this time is selectable, and the time is fed through the ground MSID M50Q0030HP. The initial default source (no failures) is MTU-1 MET, which is taken from MSID V75W3514D. For more information on time source substitution, see FCOH SOP 8.3.

Lift-off: GMT of lift-off.

SM CHKPT: MET of last SM checkpoint.

### **Block 5 (middle right of center, MMUs affected by downlister selection)**

Each piece of information is displayed for MMU 1 and MMU 2.

STAT A: Status word A (SCP 4.10).

STAT B: Status word B (SCP 4.10).

BUSY: Shows the ID of any GPC currently attempting use of the MMU.

IPL: Shows the ID of any GPC currently attempting to use the MMU for IPL.

### **Block 6 (lower middle right of center, MDM BITE)**

SM Cm Buff: Shows whether the SM Comm Buffer is busy or idle.

Source Bus: Represents source of overlays (GPC, MMU, LDB) (SCP 4.10).

MDM BITE: Represents the flight-critical MDM's A/D BITE status word (SCP 4.2).

MTU BITE: Status word of the Master Timing Unit (SCP 4.9).

OSC: Represents which oscillator the MTU is using and whether the oscillator was auto selected or manually selected.

L DDU PWR/R DDU PWR: Indicates power supply (A, B, C) on or off.

### **Block 7 (far right second block down, PASS BCE BYPASS)**

Word 0/1/2: Indicates what elements are bypassed (SCP 4.2).

SM BYPASS PL High/Low: The PCMMU payload high and low rate bypass word downlisted by the SM GPC that represents a summary of the PCMMU BCE bypasses maintained by the SM applications software.

### **Block 8 (far right middle, RS, CS)**

Redundant/Common Set: Indicates which GPCs are currently in the redundant and common sets. This information is also available through color coding on the DTEX application display: CS boxes are white (BFS stays white even when off), and RS boxes are light blue.

BFS Track: Which PASS strings the BFS is tracking.

GNC/BFS Ops: Which OPS the GPCs are currently in.

Stringing: The current stringing configuration of the GPCs. This information is also available on DTEX as the GPC ID on top of each string. The first four digits are the GPC commanders of FC strings (1-4, which represent FC pairs FC1/5, FC2/6, FC3/7, FC4/8, respectively); the fifth digit is the GPC commanding the PL buses; the sixth is the GPC commanding LDB buses (1 and 2). (LDB1/2 can be strung separately. This will be reflected in the next version of DPS Overview.)

NBAT - G1: The G1 NBAT that was loaded, not necessarily what was invoked.

NBAT - G3: The G3 NBAT that was loaded, not necessarily what was invoked.

G3 Archive: Indicates which GPCs have a G3 archive; 1/2/3 indicates archive was taken from that area (1/2/3) on the MMU; 0 indicates archive is not loaded in that GPC.

PCMMU Select: Indicates which Pulse Code Modulation Master Unit is in use (SCP 4.2).

**Block 9 (far right lower, CAM matrix)**

Indications of GPC fail votes occur here. Both U-fail and I-fail votes are displayed with a red "X!".

**Block 10 (bottom of display, bar with MSID information)**

This is where information on MSIDs that drive some of the displayed values is displayed when the user double clicks on the value field. The information provided includes MSID, nomenclature, and the last time of update. The update times will include time of reacquisition from data dropouts and AOS; users should be aware of those factors in using the "last updated" time.



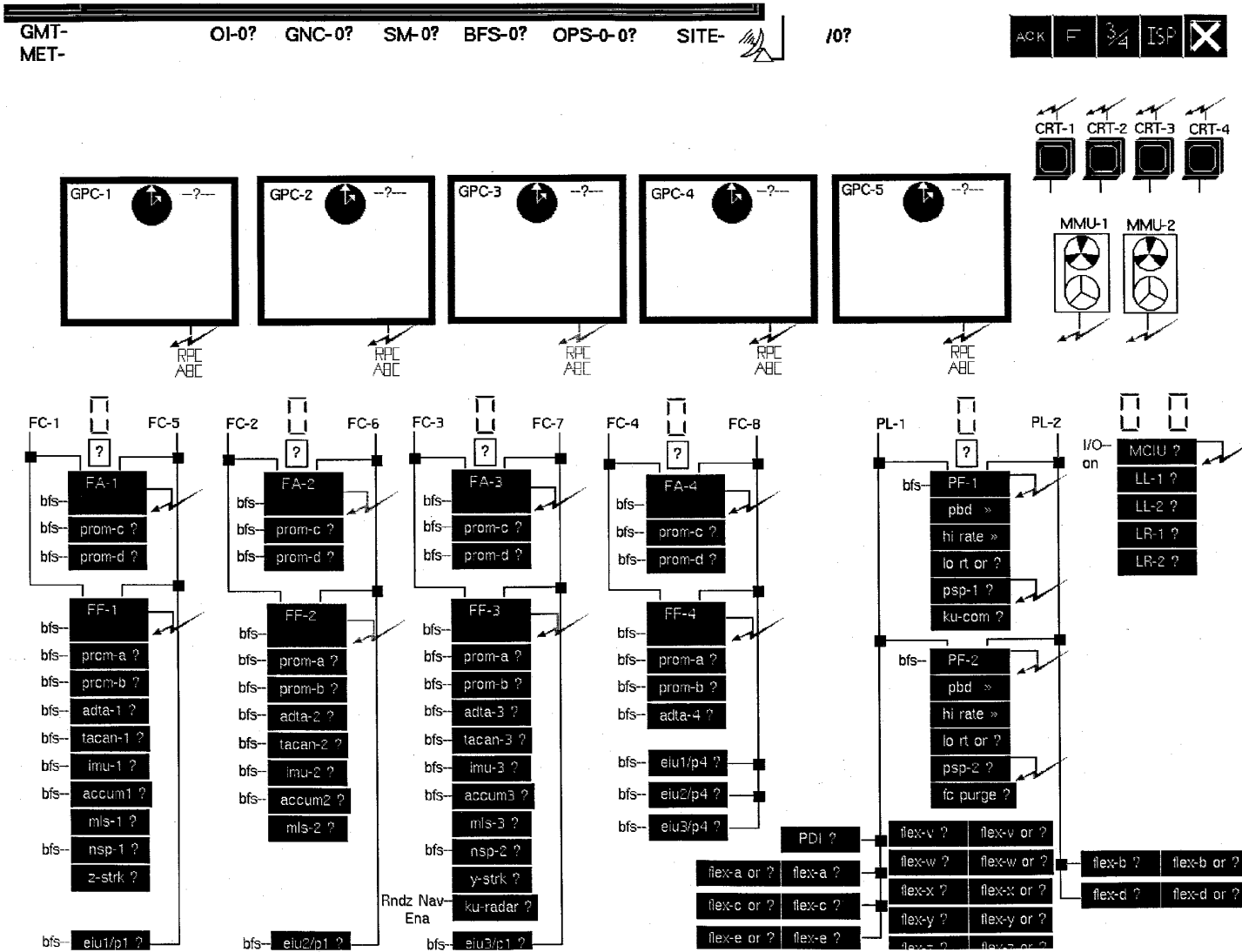


Figure B-2. DTEX –top level page

Verify that this is the correct version before use

B-8

## **DTEX (DPS Real-Time Expert) (please see DTEX User's Guide)**

DTEX provides a graphical representation of the DPS system and its current state (Figure B-2). There is a single top-level display and several low-level displays that are available on demand. Some of the information presented by DTEX is available in the DPS Overview application as well, but is presented by DTEX in a graphical, rather than numerical, fashion. DTEX was developed using a commercial off-the-shelf product called G2™ and requires a program called G2isp that serves as an interface with the ISP servers.

### General User Notes

The buttons in the upper right corner of the display allow the user to perform some display management functions. The ACK button, discussed in the LRU section that follows, allows the user to acknowledge recognized failures to improve subsequent failure recognition. The "F" button sizes DTEX to fit the entire monitor on which it is being displayed. The "3/4" button sizes DTEX to 3/4 of the monitor size. Selecting "3/4" requires the user to resize the window border. Moving from 3/4 to full size also requires the user to resize the window border. Size changes may necessitate moving the DTEX window position on the monitor as well. Most users will not need the ISP button. The ISP button provides information to experienced users on the interface between the DTEX application and its server. The "X" button terminates the DTEX application.

Telemetry status indicators (s and d) are provided in multiple locations on the display, including the GMT/MET clocks, OI/GN/SM/BFS/OPS0 format IDs, GPC IDs, and LRUs.

### Description of Displays and Features

#### Power

The absence of power is generically indicated by a lightning bolt icon immediately next to/on top of the affected equipment. A lightning bolt icon is not used for GPCs since they have three RPC power indications. The loss of each individual power source for a GPC is indicated by a label placed just below the affected GPC. The label consists of RPC with the letter(s) A, B, C, depending on which RPCs show no power. If the RPC label is not present, the GPC has good power on all three RPCs.

#### GPCs

The GPC icons show various information on the GPCs, including common/redundant set membership, time source, I/O Term A/B, and GNC major mode. Redundant set membership is indicated by a light blue GPC box and common set membership by a white box. Note that the BFS box stays white even when that GPC is powered off. Time source is indicated by the circular clock icon inside each GPC box (e.g., A1 means the GPC is on accumulator 1 time Cx where x = 1/2/3/4/5 means the GPC is on computer time of the given GPC ID). GNC major mode is indicated to the right of the clock icon within the GPC box of the GNC GPCs. The major mode is also displayed for the BFS machine but not for SM. An SM indicator is displayed, but as the only mode

used for SM is 201, the major mode is not displayed. The GPC acting as downlister is indicated by an antenna below the GPC box.

### LRUs

Each bypassable element is shown using a schematic layout at the bottom of the top level display. Bypassable elements turn red whenever they are bypassed by PASS. BFS bypass is indicated by a yellow "bfs" label placed immediately to the left of the bypassed element. Bypassed elements can be subdued by selecting the ACK button at the upper right corner of the top level display. Selecting the ACK button changes the existing PASS and BFS bypass indications, which annunciate red to dim gray. This allows any subsequent bypasses, which will annunciate red, to be more readily apparent. Bypassed LRUs also have a dot to the left of the name of the LRU. Some LRUs have lower level displays that provide additional information. Those LRUs have a double arrow indicator to the right of the LRU name.

### CRTs

Each CRT is shown using a computer terminal icon. The icons are animated and move to the top of the PASS GPC that is commanding them. The CRT(s) assigned to BFS will be visible on top of the BFS GPC, while a "shadow CRT" will be visible on top of the underlying PASS GPC commander of that same CRT. An active CRT will have a label of the form CRT-n. A "shadow CRT" will have a label of the form CRT\_n. For example, given a nominal ascent configuration, the CRT3 icon will sit atop GPC5, and a "shadow" CRT3 will sit atop GPC3, indicating that GPC3 will assume control of CRT3 if the BFC CRT DISPLAY switch is turned off. If no GPC is commanding a CRT, the icon will move to a neutral area at the far right of the display. A detailed telemetry display is available for each CRT by clicking the mouse on the desired CRT icon.

### I/O Term B

DTEX is coded such that it can determine whether the I/O Term B is in a nominal situation. It uses reverse logic for the SM and BFS GPCs and positive logic for all other GPCs. In other words, nominally the I/O Term B will not show for the SM machine even though it is set. The TERM B indicator will appear under the SM GPC if the I/O Term B goes low (the off-nominal status). If the I/O Term B (or A) for a GNC GPC became set, DTEX would show the appropriate indicator, as that is considered off-nominal status.

### Stringing

DTEX provides a quick visual cue of stringing for FC1-8 (strings 1-4), PL1&2, and LDB 1 and 2. DTEX also shows (in a small box directly under the ID of the commanding GPC) whether the string is on primary (P) or secondary (S) ports. DTEX also has supplemental logic to determine whether the FC is down at the GPC or at the MDM and to display the result of that logic in the MDM box. At present, certain timing situations exist that have the possibility of disrupting the logic and showing the wrong result, so

operators are urged to confirm where the FC is down on another display (DPS OV) before making a call.

### MMUs

MMUs have two indications: power and activity. The poweroff signature (lightning bolt) is the same as that for the other LRUs. Activity is demonstrated by the slow movement of the reel-to-reel tape heads within the MMU icon when the MMU is busy. This is a helpful cue for crew usage or failure recognition.

### CRT status (Figure B-3)

The "CRT-x STATUS" low-level display provides insight into the health and activity of a particular CRT. It is reached by double-clicking the left mouse button on the appropriate CRT icon. The H/W1, H/W2, DEU S/W, and Poll Header Word are broken down into bits and decoded, facilitating quicker problem recognition and easier analysis. There is logic in place to turn a bit box red if the bit is off-nominal. Detailed subpages of the H/W1, H/W2, and S/W words are available by double clicking on the "book" appearing under the appropriate title (see Figure(s) B-3). The display management functions in the upper corner perform the same function as the ones in the upper right corner of the DTEX upper-level display (see General User Notes), with the exception that 'X' closes the lower-level display but does not terminate DTEX. The "up arrow" box in the subpages moves the view up one level of displays.

### **OFS (Onboard Fault Summary) (please see OFS User's Guide)**

OFS provides a scrollable history list of Orbiter and Spacelab fault messages, as well as real-time annunciation of fault messages. The user may select PASS, BFS, or Spacelab views of fault messages. The views are mutually exclusive; i.e., to view PASS and BFS messages simultaneously, the user must run two instances of OFS (same for GNC and SM). OFS is intended to replace the fault area on MSK 1301, as well as the FAULT display on MSK 1305-1314 and MSK 1300. In the BFS view, OFS replaces the respective BFS MSKs.

The Spacelab view contains Spacelab faults only. PASS faults can be obtained by running a separate instance of OFS and selecting PASS view.

Each line of the PASS OFS display will contain:

**# text                      GPC (if PASS)              Time (GMT)**

where

# signifies that the message is the #th message received since the log was cleared.

**text** is the decoded error message (e.g., I/O ERROR CRT 2).

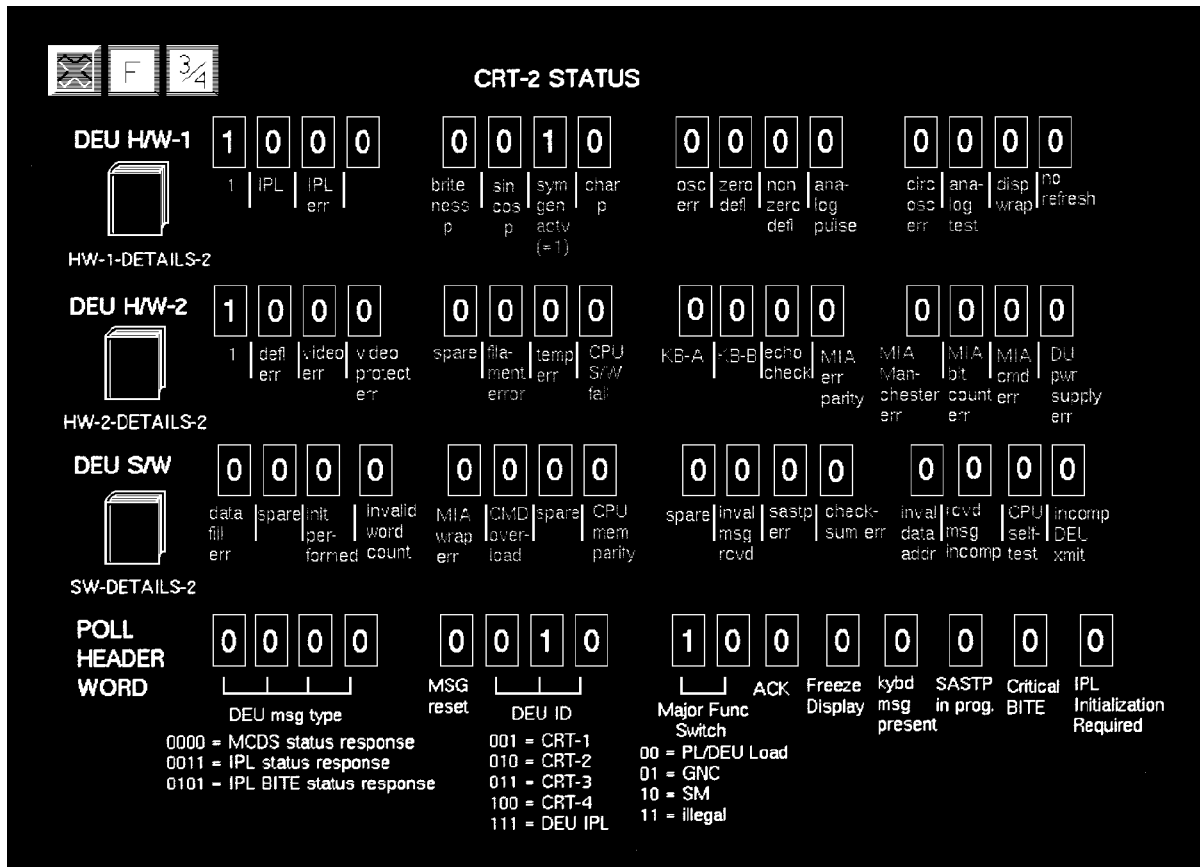
**GPC** is the GPC annunciating the message.

**Time (GMT)** is the time the fault was annunciated.

The BFS OFS display is the same, except the annunciating GPC is not specified, as it is understood to be BFS.

**Note:** The DPS operator has control of downlister changes (GNC/SM/OPS-0) for all MCC. If other disciplines want to see the change of downlister on their instance of OFS, they must be connected to the DPS server and not running locally. (See the OFS User's Guide for more detail on running locally, and why it is not the first choice for non-DPS disciplines.)

The DPS operator also has control of fault history log clears for all of MCC. (See the OFS User's Guide for more detail on clearing the log.) The log, unless cleared, will retain the faults from the last use of OFS on the same activity; (e.g., STS-69 sim on Wednesday may show faults from STS-69 sim on previous Monday unless the log is cleared.) For sims, it is suggested that the log be cleared prior to run start. For flights, log clearing will be handled in the prelaunch time frame, and procedures will instruct the DPS operator on when to perform this action. During flights, backups of the OFS logs will be made by one of the FC team shifts (lead discretion) on a daily basis.





(a) CRT status low-level display

Figure B-3. DTEX

CRT-2 HARDWARE STATUS WORD-1		
Bit	Value	
0	1	<b>Logic 1</b> Always set to 1.
1	0	<b>IPL has been performed</b> IPL PROM is in control of DEU.
2	0	<b>IPL Error</b> Error is detected during the parity check of the IPL PROM and the multiplexers. The error can occur as a result of an IPL, or as a result of the periodic IPL circuits error check initiated by DEU resident software.
3	0	<b>IPL Circuit Check Error (not implemented)</b> Error is detected during the parity check of the IPL PROM. The error can occur as a result of the periodic IPL circuits error check initiated by DEU resident software.
4	0	<b>Symbol Generator Intensity Parity Error</b> Parity error is detected on the intensity PROM. The check is performed every time the PROM is activated (i.e., for all symbols). The parity check is not performed when custom intensity is used (custom intensity is not currently being implemented).
5	0	<b>Symbol Generator Sine-Cosine Parity Error</b> Error is detected during the parity check of the sine-cosine ROM of the digital rotation circuit.
6	1	<b>Symbol Generator Active</b> Symbol generator is processing the contents of the refresh buffer. This bit does not indicate the presence of an error condition.
7	0	<b>Symbol Generator Character Parity Error</b> Error is detected during a parity check of the character generator ROM and data register. The check is performed each time the ROM is read.
8	0	<b>Oscillator Error</b> Error is detected in the oscillator and the associated countdown logic. The test is performed using a Resistor-Capacitance (R-C) circuit.
9	0	<b>SASTP: Symbol Generator Analog Zero Deflection Test Error</b> Zero test of analog deflection is failed.
10	0	<b>SASTP: Symbol Generator Analog Non-Zero Deflection Test Error</b> Non-zero test of analog deflection is failed.
11	0	<b>SASTP: Symbol Generator Analog Pulse Test Error</b> Pulse has not been detected during an analog pulse test.
12	0	<b>Circle Oscillator Error</b> Circle repetition rate goes to zero.
13	0	<b>SASTP: Symbol Generator Analog Test Error (or of bits 9, 10, 11)</b> One of the failures signified by bits 9, 10, or 11 occurs.
14	0	<b>SASTP: Symbol Generator Display Wrap Error</b> DEU software detects a no compare on display data that has been wrapped back into memory. The test and the setting of the bit is under software and (digital test) FCW control. The software repetitively issues a Direct Out Instruction to an R-C timing network to inhibit setting this bit.
15	0	<b>Symbol Generator Refresh Error</b> R-C timer indicates that the refresh is overdue by 18 ms.

(b) DEU H/W1 detailed subpage

Figure B-3. Continued

Bit	Value	CRT-2 HARDWARE STATUS WORD-2		
0	1	<b>Logic 1</b> Always set to 1.		
1	0	<b>DU Deflection Error</b> Improper beam position detected by comparing deflection signal versus yoke return.		
2	0	<b>DU Video Error</b> Last stage video amplifier always on. Circuitry requires performance of SASTP to be functional.		
3	0	<b>DU Phosphor Protect Error</b> Not used in OV-102 and subs.		
4	0	<b>Spare</b>		
5	0	<b>DU Filament Current Error</b> Low filament current detected. This error requires arming by the SASTP before it will trip the DU BITE flag.		
6	0	<b>DU Temperature Error</b> One of the temp sensors on the DU deflection amplifiers or the voltage control page goes above 125 degrees Celsius.		
7	0	<b>CPU Software Fail</b> Software fails to issue a Direct Out Instruction to the go/no-go timer because software is "hung-up" or it skips the instruction.		
8	0	<b>Keyboard Channel A Fail</b> BITE logic detects a failure in Keyboard Adapter Channel A. If a keyboard message is not transferred to DEU memory within 9 ms, the bit is set.		
9	0	<b>Keyboard Channel B Fail</b> Same as bit 9 above, except failure detected at Channel B.		
10	0	<b>MIA Echo Check Error</b> Transmit NRZ data does not compare to the received NRZ data (on the interface between the Singer MIA and MIA adapter). The Singer MIA is in the wraparound mode for this error check.		
11	0	<b>MIA Parity Check</b> MIA detects even parity on words detected on the DK bus. This is a Singer MIA-detected error.		
12	0	<b>MIA Manchester Error</b> Nonvalid Manchester condition occurs on words on the DK bus. This is a Singer MIA-detected error.		
13	0	<b>MIA Bit Count Error</b> One of the failures signified by bits 9, 10, or 11 occurs.		
14	0	<b>MIA Command Error (or of bits 11, 12, 13)</b> One of the failures signified by bits 11, 12, or 13 occurs.		
15	0	<b>DU Power Supply Error</b> Out of tolerance condition detected in the +/- 80, +/- 25, -15, or +5 voltages supplied by the low-voltage power supply (voltages are summed then compared to a reference voltage).		

(c) DEU H/W2 detailed subpage

Figure B-3. Continued

Bit	Value	CRT-2 SOFTWARE STATUS WORD
0	0	<b>Display/Format Data Fill Error</b> Presence of a data fill error including MIA errors encountered during fill, invalid word count (bit 3), invalid address (bit 12), and received message incomplete (bit 13).
1	0	<b>Spare</b>
2	0	<b>Initialization Performed</b> DCP startup performed. Startup is initiated by an IPL, ITEM A EXEC, or a power transient of less than 15 volts for greater than 400 microseconds.
3	0	<b>Invalid Fill/Dump Word Count</b> Actual number of fill words received does not agree with specified word count or word count not valid for specified buffer (i.e., <0 or >510 for display buffer). Word count in dump command is invalid (i.e., <0 or > 510).
4	0	<b>MIA Wrap Word Error</b> For every MIA transmission (DEU to GPC), the header word transmitted to MIA from DEU memory is wrapped back for comparison. The comparison is made following the MIA transmission, and bit is set for a noncompare.
5	0	<b>Command Overload</b> A command interrupt received before a last-word-stored interrupt (associated with previous command) received.
6	0	<b>Spare</b>
7	0	<b>CPU Memory Parity Error</b> Parity error on memory readout. Parity is checked on each word accessed from memory. Also set (along with bit 14) when keycode compare fails.
8	0	<b>Spare</b>
9	0	<b>Invalid Message Received</b> Message OP code in command header word invalid.
10	0	<b>SASTP: Ripple Test Error</b> During SASTP, parity is checked for all memory locations. This bit is set for a parity error when selected locations are written back into memory.
11	0	<b>Checksum Error</b> Memory "checksum" error during DCP startup (bit 2) or critical format load.
12	0	<b>Invalid Fill/Dump Data Address</b> Starting address is not in allocated buffer or fill goes past end of allocated buffer. Address in dump command not in DEU memory.
13	0	<b>Received Message Incomplete</b> The bit is set when the last-word-stored interrupt (indicating GPC to DEU msg completion) does not occur within 38 ms following a cmd interrupt.
14	0	<b>CPU Self-Test Error</b> Computed data noncompare to precomputed values in arithmetic logic unit. Also set (along with bit 7) when keycode compare fails.
15	0	<b>Incomplete DEU Transmission</b> New GPC command received before the last word of a DEU response (DEU to GPC) sent to MIA.

(d) DEU S/W detailed subpage

Figure B-3. Concluded



TITLE

DPS DISP

**BFS Ascent (BFS downlist format 12)**

V98J2258C	IOP ERROR COUNT BFS	CW, OV
V98J2272C	IOP ERROR LOG 4 BCE ELEMENT NO BFS	AE
V98J2276C	IOP RTTOT LOH 5 NVR RLRMRNY NO NGD	AE
V98J2299C	BPC ERROR COUNT BFS	CW, OV
V98J2709C	IOP ERROR LOG 4-BCE NUMBER BFS	AE
V98J2733C	IOP ERROR LOG 5-BCE NUMBER BFS	AE
V98M1170P	ELEMENT_BYPASS_WD4_(LSB'S) BFS	AE
V98M1210P	ELEMENT_BYPASS_WD4_(LSM'S) BFS	AE
V98M2280P	MIA TRANS STAT 2 BFS	OV
V98M2335P	MIA TRANS STAT 1 BFS	SP, OS, OV
V98M2532P	GPC ERROR LOG 3 MAJ/MIN CYCLE BFS	AE
V98M2540P	GPC ERROR LOG 3 ERROR/BSR/DSR BFS	AE
V98M2548P	GPC ERROR LOG 4 MAJ/MIN CYCLE BFS	AE
V98M2556P	GPC ERROR LOG 4 ERROR/BSR/DSR BFS	AE
V98M2564P	GPC ERROR LOG 5 MAJ/MIN CYCLE BFS	AE
V98M2572P	GPC ERROR LOG 5 ERROR/BSR/DSR BFS	AE
V98M2576P	GPC SOFT ERROR COUNTER BFS	OV
V98M2702P	IOP ERROR LOG 4 MAJ/MIN CYCLE BFS	AE
V98M2726P	IOP ERROR LOG 5 MAJ/MIN CYCLE BFS	AE
V98M3960P	KEYBOARD MSG HEADER-DATA WD 1 BFS	SP, OS
V98M3961P	KEYBOARD MSG DATA WORD 2 BFS	SP, OS
V98M3972P	KEYBOARD MSG BITE STATUS WD1 BFS	SP, OS
V98M3973P	KEYBOARD MSG BITE STATUS WD2 BFS	SP, OS
V98M3974P	KEYBOARD S/W STATUS WORD BFS	SP, OS
V98U1281C	BFS VP 2	VP, OV
V98U1282C	BFS VP 3	VP, OV
V98U2273C	IOP ERROR LOG 4 BCE STAT BFS	AE
V98U2277C	IOP ERROR LOG 5 BCE STAT BFS	AE
V98U2311C	GPC ERROR LOG 3 INSTR CTR BFS	AE
V98U2316C	GPC ERROR LOG 4 INSTR CTR BFS	AE
V98U2321C	GPC ERROR LOG 5 INSTR CTR BFS	AE
V98U2711C	BCE STATUS REG BITS 21-31 LOG4 BFS	AE
V98U2735C	BCE STATUS REG BITS 21-31 LOG5 BFS	AE
V98U3962C	DEU MSG DATA WD3 (KYSTRK1-3) BFS	OS, SP
V98U3963C	DEU MSG DATA WD4 (KYSTRK4-6) BFS	OS, SP
V98U3964C	DEU MSG DATA WD5 (KYSTRK7-9) BFS	OS, SP
V98U3965C	DEU MSG DATA WD6 (KYSTRK10-12) BFS	OS, SP
V98U3966C	DEU MSG DATA WD7 (KYSTRK13-15) BFS	OS, SP
V98U3967C	DEU MSG DATA WD8 (KYSTRK16-18) BFS	OS, SP
V98U3968C	DEU MSG DATA WD9 (KYSTRK19-21) BFS	OS, SP

V98U3969C	DEU MSG DATA WD10 (KYSTRK 22-24) BFS	OS, SP
V98U3970C	DEU MSG DATA WD11 (KYSTRK 25-27) BFS	OS, SP
V98U3971C	DEU MSG DATA WD12 (KYSTRK28-30) BFS	OS, SP
V98U3975C	KEYBOARD MSG CHECKSUM BFS	OS, SP
V98X2806X	MIA 6 ENABLED (DK 1) BFS	DX
V98X2807X	MIA 7 ENABLED (DK 2) BFS	DX
V98X2808X	MIA 8 ENABLED (DK 3) BFS	DX
V98X2809X	MIA 9 ENABLED (DK 4) BFS	DX

**BFS Entry (BFS Downlist format 13)**

V98J2258C	IOP ERROR COUNT BFS	CW, OV
V98J2272C	IOP ERROR LOG 4 BCE ELEMENT NO BFS	AE
V98J2276C	IOP ERROR LOG 5 BCE ELEMENT NO BFS	AE
V98J2299C	GPC ERROR COUNT BFS	CW, OV
V98J2709C	IOP ERROR LOG 4-BCE NUMBER BFS	AE
V98J2733C	IOP ERROR LOG 5-BCE NUMBER BFS	AE
V98M1170P	ELEMENT_BYPASS_WD4_(LSB'S) BFS	AE
V98M1210P	ELEMENT_BYPASS_WD4_(LSM'S) BFS	AE
V98M2280P	MIA TRANS STAT 2 BFS	OV
V98M2335P	MIA TRANS STAT 1 BFS	SP, OS, OV
V98M2532P	GPC ERROR LOG 3 MAJ/MIN CYCLE BFS	AE
V98M2540P	GPC ERROR LOG 3 ERROR/BSR/DSR BFS	AE
V98M2548P	GPC ERROR LOG 4 MAJ/MIN CYCLE BFS	AE
V98M2556P	GPC ERROR LOG 4 ERROR/BSR/DSR BFS	AE
V98M2564P	GPC ERROR LOG 5 MAJ/MIN CYCLE BFS	AE
V98M2572P	GPC ERROR LOG 5 ERROR/BSR/DSR BFS	AE
V98M2576P	GPC SOFT ERROR COUNTER BFS	OV
V98M2702P	IOP ERROR LOG 4 MAJ/MIN CYCLE BFS	AE
V98M2726P	IOP ERROR LOG 5 MAJ/MIN CYCLE BFA	AE
V98M3960P	KEYBOARD MSG HEADER-DAT WD 1 BFS	SP, OS
V98M3961P	KEYBOARD MSG DATA WORD 2 BFS	SP, OS
V98M3972P	KEYBOARD MSG BITE STATUS WD1 BFS	SP, OS
V98M3973P	KEYBOARD MSG BITE STATUS WD2 BFS	SP, OS
V98M3974P	KEYBOARD S/W STATUS WORD BFS	SP, OS
V98U1281C	BFS VP 2	VP, OV
V98U1282C	BFS VP 3	VP, OV
V98U2273C	IOP ERROR LOG 4 BCE STAT BFS	AE
V98U2277C	IOP ERRPR LOG 5 BCE STAT BFS	AE
V98U2311C	GPC ERROR LOG 3 INSTR CTR BFS	AE
V98U2316C	GPC ERROR LOG 4 INSTR CTR BFS	AE
V98U2321C	GPC ERROR LOG 5 INSTR CTR BFS	AE
V98U2711C	BCE STATUS REG BITS 21-31 LOG4 BFS	AE
V98U2735C	BCE STATUS REG BITS 21-31 LOG5 BFS	AE
V98U3962C	DEU MSG DATA WD3 (KYSTRK1-3) BFS	OS, SP
V98U3963C	DEU MSG DATA WD4 (KYSTRK4-6) BFS	OS, SP
V98U3964C	DEU MSG DATA WD5 (KYSTRK7-9) BFS	OS, SP
V98U3965C	DEU MSG DATA WD6 (KYSTRK10-12) BFS	OS, SP
V98U3966C	DEU MSG DATA WD7 (KYSTRK13-15) BFS	OS, SP
V98U3967C	DEU MSG DATA WD8 (KYSTRK16-18) BFS	OS, SP
V98U3968C	DEU MSG DATA WD9 (KYSTRK19-21) BFS	OS, SP
V98U3969C	DEU MSG DATA WD10 (KYSTRK 22-24) BFS	OS, SP
V98U3970C	DEU MSG DATA WD11 (KYSTRK25-27) BFS	OS, SP
V98U3971C	DEU MSG DATA WD12 (KYSTRK28-30) BFS	OS, SP
V98U3975C	KEYBOARD MSG CHECKSUM BFS	OS, SP

V98X2806X	MIA 6 ENABLED (DK 1) BFS	DX
V98X2807X	MIA 7 ENABLED (DK 2) BFS	DX
V98X2808X	MIA 8 ENABLED (DK 3) BFS	DX
V98X2809X	MIA 9 ENABLED (DK 4) BFS	DX

**OPS 0 (Pass Downlist format 20)**

V72M5650PZ	DEU 1-MCDS STATUS WORD 1	DX, OS, SP
V72M5670PZ	DEU 1-MCDS STATUS WORD 2	DX, OS, SP
V72M5680PZ	DEU 1-MCDS STATUS WORD 3	DX, OS, SP
V72M5720PZ	DEU 2-MCDS STATUS WORD 1	DX, OS, SP
V72M5740PZ	DEU 2-MCDS STATUS WORD 2	DX, OS, SP
V72M5750PZ	DEU 2-MCDS STATUS WORD 3	DX, OS, SP
V72M5810PZ	DEU 3-MCDS STATUS WORD 1	DX, OS, SP
V72M5830PZ	DEU 3-MCDS STATUS WORD 2	DX, OS, SP
V72M5840PZ	DEU 3-MCDS STATUS WORD 3	DX, OS, SP
V92J4706CZ	GPC 1 LAST I/O ERR STATUS REG	OV
V92J4779CZ	GPC 2 LAST I/O ERR BCE ELEMENT	OV
V92J4780CZ	GPC 2 LAST I/O ERR DEVICE ID	OV
V92J4783CZ	GPC 2 LAST I/O ERR STATUS REG	OV
V92J4784CZ	GPC 2 LAST I/O ERR BCE NUMBER	DX, OV
V92J4852CZ	GPC 3 LAST I/O ERR BCE ELEMENT	OV
V92J4853CZ	GPC 3 LAST I/O ERR DEVICE ID	OV
V92J4856CZ	GPC 3 LAST I/O ERR STATUS REG	OV
V92J4857CZ	GPC 3 LAST I/O ERR BCE NUMBER	DX, OV
V92J4929CZ	GPC 4 LAST I/O ERR BCE ELEMENT	OV
V92J4930CZ	GPC 4 LAST I/O ERR DEVICE ID	OV
V92J4933CZ	GPC 4 LAST I/O ERR STATUS REG	OV
V92J4934CZ	GPC 4 LAST I/O ERR BCE NUMBER	DX, OV
V92J4989CZ	GPC 5 LAST I/O ERR BCE NUMBER	DX, OV
V92J4992CZ	GPC 5 LAST I/O ERR BCE ELEMENT	OV
V92J4993CZ	GPC 5 LAST I/O ERR DEVICE ID	OV
V92J4996CZ	GPC 5 LAST I/O ERR STATUS REG	OV
V92M2919P	G3 ARCHIVE STATUS	OV
V92M4767PZ	GPC 1 LAST I/O ERR TIME	OV
V92M4844PZ	GPC 2 LAST I/O ERR TIME	OV
V92M4917PZ	GPC 3 LAST I/O ERR TIME	OV
V92M4999PZ	GPC 5 LAST I/O ERR TIME	OV
V92M5004PZ	GPC 4 LAST I/O ERR TIME	OV
V92M6037PZ	GPC 1 LAST GPC ERR TIME	OV
V92M6047PZ	GPC 2 LAST GPC ERR TIME	OV
V92M6057PZ	GPC 3 LAST GPC ERR TIME	OV
V92H6067PZ	GPC 4 LAST GPC ERR TIME	OV
V92M6077PZ	GPC 5 LAST GPC ERR TIME	OV
V92M7080PZ	CLASS5/DEUMSG IND	OV
V92Q4770CZ	GPC 1 CUM I/O ERR COUNT	CW, OV
V92Q4847CZ	GPC 2 CUM I/O ERR COUNT	CW, OV
V92Q4920CZ	GPC 3 CUM I/O ERR COUNT	CW, OV
V92Q4998CZ	GPC 5 CUM I/O ERR COUNT	CW, OV
V92Q5007CZ	GPC 4 CUM I/O ERR COUNT	CW, OV
V92Q6036CZ	GPC 1 LAST GPC ERR COUNT	CW, OV

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V92Q6046CZ	GPC 2 LAST GPC ERR COUNT	CW, OV
V92Q6056CZ	GPC 3 LAST GPC ERR COUNT	CW, OV
V92Q6066CZ	GPC 4 LAST GPC ERR COUNT	CW, OV
V92Q6076CZ	GPC 5 LAST GPC ERR COUNT	CW, OV
V92U4340CZ	GPC ERR 1 PDE PNTR	OV
V92U4341CZ	GPC ERR 2 PDE PNTR	OV
V92U4342CZ	GPC ERR 3 PDE PNTR	OV
V92U4343CZ	GPC ERR 4 PDE PNTR	OV
V92U4344CZ	GPC ERR 5 PDE PNTR	OV
V92U4350CZ	GPC ERR 1 LAST GPC ERR PDE	OV
V92U4351CZ	GPC ERR 2 LAST GPC ERR PDE	OV
V92U4352CZ	GPC ERR 3 LAST GPC ERR PDE	OV
V92U4353CZ	GPC ERR 4 LAST GPC ERR PDE	OV
V92U4354CZ	GPC ERR 5 LAST GPC ERR PDE	OV
V92U6032CZ	GPC 1 LAST GPC ERR CODE	OV
V92U6033CZ	GPC 1 LAST GPC ERR GROUP	OV
V92U6042CZ	GPC 2 LAST GPC ERR CODE	OV
V92U6043CZ	GPC 2 LAST GPC ERR GROUP	OV
V92U6052CZ	GPC 3 LAST GPC ERR CODE	OV
V92U6053CZ	GPC 3 LAST GPC ERR GROUP	OV
V92U6062CZ	GPC 4 LAST GPC ERR CODE	OV
V92U6063CZ	GPC 4 LAST GPC ERR GROUP	OV
V92U6072CZ	GPC 5 LAST GPC ERR CODE	OV
V92U6073CZ	GPC 5 LAST GPC ERR GROUP	OV
V92U6073CZ	GPC 5 LAST GPC ERR GROUP	OV

**DPS Low Data Rate Losses**

**G1 (Pass Downlist format 21)**

V90Q8001C	MAJOR MODE CODE	DX, OS, OV, SP
V90W8380C	COUNTDOWN TIME (TBO TIME)	AE
V90X8667X	RS COUNTDOWN HOLD FLAG	CW
V92M2907P	MDM A/D BITE FAIL STATUS	OV
V92M2919P	G3 ARCHIVE STATUS	OV
V92M2920P	MC1/FC STRING ASSIGNMENTS	OV
V92M2921P	MC3/FC STRING ASSIGNMENTS	OV
V92M7080PX	CLASS5/DEUMSG IND	OV
V94H3810C	CURRENT APOGEE ALTITUDE	AE
V94H3811C	CURRENT PERIGEE ALTITUDE	AE
V95L3029C	GNC MACH NUMBER	AE
V95L3029C	GNC MACH NUMBER	AE

**G2 (Pass Downlist format 22)**

V72M5910PX	DEU 4-MCDS STATUS WORD 1	DX, OS, SP
V72M5930PX	DEU 4-MCDS STATUS WORD 2	DX, OS, SP
V72M5940PX	DEU 4-MCDS STATUS WORD 3	DX, OS, SP
V92M2252PX	BCE ELEM BYPASS IND WD1	OV
V92M2907P	MDM A/D BITE FAIL STATUS	OV
V92M2919P	G3 ARCHIVE STATUS	OV
V92M7080PX	CLASS5/DEUMSG IND	OV



**G3 (Pass Downlist format 23)**

V90Q8001C	MAJOR MODE CODE	DX, OS, OV. SP
V92M2907P	MDM A/D BITE FAIL STATUS	OV
V92M2921P	MC3/FC STRING ASSIGNMENTS	OV
V92M7080PX	CLASS5/DEUMSG IND	OV
V94H3810C	CURRENT APOGEE ALTITUDE	AE

**SM (Pass Downlist format 24)**

V72M5650PY	DEU 1-MCDS STATUS WORD 1	DX, OS, SP
V72M5670PY	DEU 1-MCDS STATUS WORD 2	DX, OS, SP
V72M5680PY	DEU 1-MCDS STATUS WORD 3	DX, OS, SP
V72M5720PY	DEU 2-MCDS STATUS WORD 1	DX, OS, SP
V72M5740PY	DEU 2-MCDS STATUS WORD 2	DX, OS, SP
V72M5750PY	DEU 2-MCDS STATUS WORD 3	DX, OS, SP
V72M5810PY	DEU 3-MCDS STATUS WORD 1	DX, OS, SP
V72M5830PY	DEU 3-MCDS STATUS WORD 2	DX, OS, SP
V72M5840PY	DEU 3-MCDS STATUS WORD 3	DX, OS, SP
V72M5910PY	DEU 4-MCDS STATUS WORD 1	DX, OS, SP
V72M5930PY	DEU 4-MCDS STATUS WORD 2	DX, OS, SP
V72M5940PY	DEU 4-MCDS STATUS WORD 3	DX, OS, SP
V91M1592PY	MEMORY SOURCE	OV
V91M2070PY	GPC 1 RS MASK WORD	DX, OS, OV, SP
V91M2104PY	GPC 2 RS MASK WORD	DX, OS, OV, SP
V91M2138PY	GPC 3 RS MASK WORD	DX, OS, OV, SP
V91M2172PY	GPC 4 RS MASK WORD	DX, OS, OV, SP
V91M2203PY	GPC 5 RS MASK WORD	DX, OS, OV, SP
V91M2252PY	BCE ELEM BYPASS IND WD1	OV
V91M2269PY	BCE ELEM BYPASS IND WD2	OV
V91Q1586CY	DPS CONFIG MON-GPC 1 CPU DUTY CYC	DX, OV
V91Q1587CY	DPS CONFIG MON-GPC 2 CPU DUTY CYC	DX, OV
V91Q1588CY	DPS CONFIG MON-GPC 3 CPU DUTY CYC	DX, OV
V91Q1589CY	DPS CONFIG MON-GPC 4 CPU DUTY CYC	DX, OV
V91Q1590CY	DPS CONFIG MON-GPC 5 CPU DUTY CYC	DX, OV
V91Q1710CY	GPC 1 TMP SOURCE	DX, OV
V91Q1711CY	GPC 2 TMP SOURCE	DX, OV
V91Q1712CY	GPC 3 TMP SOURCE	DX, OV
V91Q1713CY	GPC 4 TMP SOURCE	DX, OV
V91Q1714CY	GPC 5 TMP SOURCE	DX, OV
V91M2060PY	GPC 1 FAIL STATUS WORD	OV
V91M2062PY	GPC 2 FAIL STATUS WORD	OV
V91M2064PY	GPC 3 FAIL STATUS WORD	OV
V91M2066PY	GPC 4 FAIL STATUS WORD	OV
V91M2068PY	GPC 5 FAIL STATUS WORD	OV
V92J4702CY	GPC 1 LAST I/O ERR BCE ELEMENT	OV
V92J4703CY	GPC 1 LAST I/O ERR DEVICE ID	OV
V92J4706CY	GPC 1 LAST I/O ERR STATUS REG	OV
V92J4707CY	GPC 1 LAST I/O ERR BCE NUMBER	DX, OV
V92J4779CY	GPC 2 LAST I/O ERR BCE ELEMENT	OV
V92J4780CY	GPC 2 LAST I/O ERR DEVICE ID	OV
V92J4783CY	GPC 2 LAST I/O ERR STATUS REG	OV
V92J4784CY	GPC 2 LAST I/O ERR BCE NUMBER	DX, OV
V92J4852CY	GPC 3 LAST I/O ERR BCE ELEMENT	OV

V92J4853CY	GPC 3 LAST I/O ERR DEVICE ID	OV
V92J4856CY	GPC 3 LAST I/O ERR STATUS REG	OV
V92J4857CY	GPC 3 LAST I/O ERR BCE NUMBER	DX, OV
V92J4929CY	GPC 4 LAST I/O ERR BCE ELEMENT	OV
V92J4930CY	GPC 4 LAST I/O ERR DEVICE ID	OV
V92J4933CY	GPC 4 LAST I/O ERR STATUS REG	OV
V92J4934CY	GPC 4 LAST I/O ERR BCE NUMBER	DX, OV
V92J4989CY	GPC 5 LAST I/O ERR BCE NUMBER	DX, OV
V92J4992CY	GPC 5 LAST I/O ERR BCE ELEMENT	OV
V92J4993CY	GPC 5 LAST I/O ERR DEVICE ID	OV
V92J4996CY	GPC 5 LAST I/O ERR STATUS REG	OV
V92M4767PY	GPC 1 LAST I/O ERR TIME	OV
V92M4844PY	GPC 2 LAST I/O ERR TIME	OV
V92M4917PY	GPC 3 LAST I/O ERR TIME	OV
V92M4999PY	GPC 5 LAST I/O ERR TIME	OV
V92M5004PY	GPC 4 LAST I/O ERR TIME	OV
V92M6037PY	GPC 1 LAST GPC ERR TIME	OV
V92M6047PY	GPC 2 LAST GPC ERR TIME	OV
V92M6057PY	GPC 3 LAST GPC ERR TIME	OV
V92H6067PY	GPC 4 LAST GPC ERR TIME	OV
V92M6077PY	GPC 5 LAST GPC ERR TIME	OV
V92M7080PY	CLASS5/DEUMSG IND	OV
V92M7380PY	GPC 1 DISCRETE INPUT B WD 1	OV
V92M7440PY	GPC 2 DISCRETE INPUT B WD 1	OV
V92M7500PY	GPC 3 DISCRETE INPUT B WD 1	OV
V92M7560PY	GPC 4 DISCRETE INPUT B WD 1	OV
V92M7620PY	GPC 5 DISCRETE INPUT B WD 1	OV
V92Q4770CY	GPC 1 CUM I/O ERR COUNT	CW, OV
V92Q4847CY	GPC 2 CUM I/O ERR COUNT	CW, OV
V92Q4920CY	GPC 3 CUM I/O ERR COUNT	CW, OV
V92Q4998CY	GPC 5 CUM I/O ERR COUNT	CW, OV
V92Q5007CY	GPC 4 CUM I/O ERR COUNT	CW, OV
V92Q6036CY	GPC 1 LAST GPC ERR COUNT	CW, OV
V92Q6046CY	GPC 2 LAST GPC ERR COUNT	CW, OV
V92Q6056CY	GPC 3 LAST GPC ERR COUNT	CW, OV
V92Q6066CY	GPC 4 LAST GPC ERR COUNT	CW, OV
V92Q6076CY	GPC 5 LAST GPC ERR COUNT	CW, OV
V92U4340CY	GPC ERR 1 PDE PNTR	OV
V92U4341CY	GPC ERR 2 PDE PNTR	OV
V92U4342CY	GPC ERR 3 PDE PNTR	OV
V92U4343CY	GPC ERR 4 PDE PNTR	OV
V92U4344CY	GPC ERR 5 PDE PNTR	OV
V92U4350CY	GPC ERR 1 LAST GPC ERR PDE	OV
V92U4351CY	GPC ERR 2 LAST GPC ERR PDE	OV
V92U4352CY	GPC ERR 3 LAST GPC ERR PDE	OV

V92U4353CY	GPC ERR 4 LAST GPC ERR PDE	OV
V92U4354CY	GPC ERR 5 LAST GPC ERR PDE	OV
V92U6032CY	GPC 1 LAST GPC ERR CODE	OV
V92U6033CY	GPC 1 LAST GPC ERR GROUP	OV
V92U6042CY	GPC 2 LAST GPC ERR CODE	OV
V92U6043CY	GPC 2 LAST GPC ERR GROUP	OV
V92U6052CY	GPC 3 LAST GPC ERR CODE	OV
V92U6053CY	GPC 3 LAST GPC ERR GROUP	OV
V92U6062CY	GPC 4 LAST GPC ERR CODE	OV
V92U6063CY	GPC 4 LAST GPC ERR GROUP	OV
V92U6072CY	GPC 5 LAST GPC ERR CODE	OV
V9206073CY	GPC 5 LAST GPC ERR GROUP	OV
V93W4887C	TIME OF LAST COMMON CKPT	OV

**G8 (Pass Downlist format 32)**

V72M5910PX	DEU 4-MCDS STATUS WORD 1	DX, OS, SP
V72M5930PX	DEU 4-MCDS STATUS WORD 2	DX, OS, SP
V72M5940PX	DEU 4-MCDS STATUS WORD 3	DX, OS, SP
V90Q8001C	MAJOR MODE CODE	DX, OS, OV, SP
V91M2252PX	BCE ELEM BYPASS IND WD 1	OV
V92M2907P	MDM A/D BITE FAIL STATUS	OV
V92M7080PX	CLASS5/DEUMSG IND	OV

**TITLE**

DPS SPECIAL COMPUTATIONS

**PURPOSE**

This SCP represents a comprehensive listing of MCC special computations used by the DPS applications. This SCP describes two basic types of DPS special computations:

- DPS Console Critical Alarms - Special computations that drive an audible Caution and Warning tone/alarm
- DPS Special Comps - The remaining group of special computations which alone do not drive an audible alarm, but may drive a visual (displayed) output

**DESCRIPTION**

A. Critical alarms

An audible alarm will be sounded for 3 seconds when a "critical event" light is driven. There will be no alarm unless a critical out-of-limits condition is detected. There are five events in dps\_cw that annunciate a tone. Following are the MSIDs associated with each event on dps\_cw that drives the tone.

Event	MSID	Nomenclature
PASS I/O Error	V92Q4770CXYZ	GPC 1 CUM I/O ERR COUNT
	V92Q4847CXYZ	GPC 2 CUM I/O ERR COUNT
	V92Q4920CXYZ	GPC 3 CUM I/O ERR COUNT
	V92Q5007CXYZ	GPC 4 CUM I/O ERR COUNT
	V92Q4998CXYZ	GPC 5 CUM I/O ERR COUNT
PASS GPC Error	V92Q6036CXYZ	GPC 1 LAST GPC ERROR COUNT
	V92Q6046CXYZ	GPC 2 LAST GPC ERROR COUNT
	V92Q6056CXYZ	GPC 3 LAST GPC ERROR COUNT
	V92Q6066CXYZ	GPC 4 LAST GPC ERROR COUNT
	V92Q6076CXYZ	GPC 5 LAST GPC ERROR COUNT
BFS I/O Error	V98J2258C	BFS I/O ERROR COUNT
BFS GPC Error	V98J2299C	BFS GPC ERROR COUNT
GPC Fail	V72X7011E	GPC 1 FAIL INDICATOR
	V72X7012E	GPC 2 FAIL INDICATOR
	V72X7013E	GPC 3 FAIL INDICATOR
	V72X7014E	GPC 4 FAIL INDICATOR
	V72X7015E	GPC 5 FAIL INDICATOR

The alarm will only be sounded once, regardless of how many critical lights are driven in a given output cycle. If a critical light is driven while the alarm is still being sounded because of a critical light in a previous cycle, the alarm length will not be extended. When lights are extinguished by the manual reset procedure and then are illuminated because the out-of-limits or event condition still exists, the alarm will not be sounded.

B. DPS special comps

Table C-1 is a listing of the nonaudible special computations which are used by the DPS section. The headings in the table are described below.

Symbol	- Symbol names used in CCC Applications.
MSID	- The MSIDs that are used as input to derive the special computations.
Nomenclature	- The description of the input MSID.
Application	- DPS Application that the symbol is generated in.

**Table C-1. MOC special computations**

Symbol	MSID	Nomenclature	Application
BFS_BIAS	M50Q0027HP V98W0150C	GRND RCPT-BFCS DATA SET GREENWICH MEAN TIME	delta-t
CRT1_DISPLAY	V92U5086CXYZ	DEU 1 DISPLAY ID	ospl
CRT2_DISPLAY	V92U5088CXYZ	DEU 2 DISPLAY ID	ospl
CRT3_DISPLAY	V92U5090CXYZ	DEU 3 DISPLAY ID	ospl
CRT4_DISPLAY	V92U5092CXYZ	DEU 4 DISPLAY ID	ospl
OFS_BFS_FSM_Msg_1	V98M1300P	SM-FSP 1 MSG WORD 1	ofs
OFS_BFS_FSM_Time_1	V98W1330C	SM FSP MSG 1 TIME BFS	ofs
OFS_PASS_FSM_GPC_1	V92U7004CXYZ V92U7005CXYZ V92U7006CXYZ V92U7007CXYZ V92U7008CXYZ	FSP MSG1 SOURCE GPC 1 FSP MSG1 SOURCE GPC 2 FSP MSG1 SOURCE GPC 3 FSP MSG1 SOURCE GPC 4 FSP MSG1 SOURCE GPC 5	ofs
OFS_PASS_FSM_Msg_1	V92U7001CXYZ V92U7003CXYZ	FSP MSG1 MAJOR ID FSP MSG1 MINOR ID	ofs
OFS_PASS_FSM_Time_1	V92M7009PXYZ	FSP MSG1 TIME	ofs
OFS_BFS_FSM_Msg_2	V98M1305P	SM FSP MSG WORD 2	ofs
OFS_BFS_FSM_Time_2	V98W1331C	SM FSP MSG 2 TIME BFS	ofs
OFS_PASS_FSM_GPC_2	V92U7019CXYZ V92U7020CXYZ V92U7021CXYZ V92U7022CXYZ V92U7023CXYZ	FSP MSG2 SOURCE GPC 1 FSP MSG2 SOURCE GPC 2 FSP MSG2 SOURCE GPC 3 FSP MSG2 SOURCE GPC 4 FSP MSG2 SOURCE GPC 5	ofs
OFS_PASS_FSM_Msg_2	V92U7016CXYZ V92U7018CXYZ	FSP MSG2 MAJOR ID FSP MSG2 MINOR ID	ofs
OFS_PASS_FSM_Time_2	V92M7024PXYZ	FSP MSG2 TIME	ofs
OFS_BFS_FSM_Msg_3	V98M1310P	SM FSP MSG WORD 3	ofs
OFS_BFS_FSM_Time_3	V98W1332C	SM FSP MSG 3 TIME BFS	ofs
OFS_PASS_FSM_GPC_3	V92U7033CXYZ V92U7034CXYZ V92U7035CXYZ V92U7036CXYZ V92U7037CXYZ	FSP MSG3 SOURCE GPC 1 FSP MSG3 SOURCE GPC 2 FSP MSG3 SOURCE GPC 3 FSP MSG3 SOURCE GPC 4 FSP MSG3 SOURCE GPC 5	ofs
OFS_PASS_FSM_Msg_3	V92U7030CXYZ V92U7032CXYZ	FSP MSG3 MAJOR ID FSP MSG3 MINOR ID	ofs
OFS_PASS_FSM_Time_3	V92M7038PXYZ	FSP MSG3 TIME	ofs
OFS_BFS_FSM_Msg_4	V98M1315P	SM FSP MSG WORD 4	ofs
OFS_BFS_FSM_Time_4	V98W1333C	SM FSP MSG 4 TIME BFS	ofs
OFS_PASS_FSM_GPC_4	V92U7048CXYZ V92U7049CXYZ V92U7050CXYZ V92U7051CXYZ V92U7052CXYZ	FSP MSG4 SOURCE GPC 1 FSP MSG4 SOURCE GPC 2 FSP MSG4 SOURCE GPC 3 FSP MSG4 SOURCE GPC 4 FSP MSG4 SOURCE GPC 5	ofs
OFS_PASS_FSM_Msg_4	V92U7045CXYZ V92U7047CXYZ	FSP MSG4 MAJOR ID FSP MSG4 MINOR ID	ofs



**Table C-1. Continued**

Symbol	MSID	Nomenclature	Application
OFS_PASS_FSM_Time_4	V92M7053PXYZ	FSP MSG4 TIME	ofs
OFS_BFS_FSM_Msg_5	V98M1320P	SM FSP MSG WORD 5	ofs
OFS_BFS_FSM_Time_5	V98W1334C	SM FSP MSG 5 TIME BFS	ofs
OFS_PASS_FSM_GPC_5	V92U7063CXYZ V92U7064CXYZ V92U7065CXYZ V92U7066CXYZ V92U7067CXYZ	FSP MSG5 SOURCE GPC 1 FSP MSG5 SOURCE GPC 2 FSP MSG5 SOURCE GPC 3 FSP MSG5 SOURCE GPC 4 FSP MSG5 SOURCE GPC 5	ofs
OFS_PASS_FSM_Msg_5	V92U7060CXYZ V92U7062CXYZ	FSP MSG5 MAJOR ID FSP MSG5 MINOR ID	ofs
OFS_PASS_FSM_Time_5	V92M7068PXYZ	FSP MSG5 TIME	ofs
GNC_BIAS	M50Q0027HP V91M1999PX	GRND RCPT-GN DATA SET GREENWICH MEAN TIME	delta-t
CRT1_MAJOR_FUNCTION	V91M2070PXYZ V91M2104PXYZ V91M2138PXYZ V91M2172PXYZ V91M2203PXYZ V91X8712XXYZ V91X8746XXYZ V91X8780XXYZ V91X8812XXYZ V91X8847XXYZ V93Q0018CXYZ	GPC 1 RS MASK WORD GPC 2 RS MASK WORD GPC 3 RS MASK WORD GPC 4 RS MASK WORD GPC 5 RS MASK WORD GPC 1 BUS 6 GPC 2 BUS 6 GPC 3 BUS 6 GPC 4 BUS 6 GPC 5 BUS 6 GPC D/L GPC ID	ospl
CRT2_MAJOR_FUNCTION	V91M2070PXYZ V91M2104PXYZ V91M2138PXYZ V91M2172PXYZ V91M2203PXYZ V91X8713XXYZ V91X8747XXYZ V91X8781XXYZ V91X8813XXYZ V91X8848XXYZ V93Q0018CXYZ	GPC 1 RS MASK WORD GPC 2 RS MASK WORD GPC 3 RS MASK WORD GPC 4 RS MASK WORD GPC 5 RS MASK WORD GPC 1 BUS 7 GPC 2 BUS 7 GPC 3 BUS 7 GPC 4 BUS 7 GPC 5 BUS 7 GPC D/L GPC ID	ospl
CRT3_MAJOR_FUNCTION	V91M2070PXYZ V91M2104PXYZ V91M2138PXYZ V91M2172PXYZ V91M2203PXYZ V91X8714XXYZ V91X8748XXYZ V91X8782XXYZ V91X8814XXYZ V91X8849XXYZ V93Q0018CXYZ	GPC 1 RS MASK WORD GPC 2 RS MASK WORD GPC 3 RS MASK WORD GPC 4 RS MASK WORD GPC 5 RS MASK WORD GPC 1 BUS 8 GPC 2 BUS 8 GPC 3 BUS 8 GPC 4 BUS 8 GPC 5 BUS 8 GPC D/L GPC ID	ospl
CRT4_MAJOR_FUNCTION	V91M2070PXYZ	GPC 1 RS MASK WORD	ospl

**Table C-1. Continued**

Symbol	MSID	Nomenclature	Application
	V91M2104PXYZ V91M2138PXYZ V91M2172PXYZ V91M2203PXYZ V91X8715XXYZ V91X8749XXYZ V91X8783XXYZ V91X8815XXYZ V91X8850XXYZ V93Q0018CXYZ	GPC 2 RS MASK WORD GPC 3 RS MASK WORD GPC 4 RS MASK WORD GPC 5 RS MASK WORD GPC 1 BUS 9 GPC 2 BUS 9 GPC 3 BUS 9 GPC 4 BUS 9 GPC 5 BUS 9 GPC D/L GPC ID	
CRT1_HW_WORD_1	V72M5650PXYZ	DEU 1-MCDS STATUS WORD 1	ospl
CRT1_HW_WORD_2	V72M5670PXYZ	DEU 1-MCDS STATUS WORD 2	ospl
CRT1_SW_WORD_1	V72M5680PXYZ	DEU 1-MCDS STATUS WORD 3	ospl
CRT2_HW_WORD_1	V72M5720PXYZ	DEU 2-MCDS STATUS WORD 1	ospl
CRT2_HW_WORD_2	V72M5740PXYZ	DEU 2-MCDS STATUS WORD 2	ospl
CRT2_SW_WORD_1	V72M5750PXYZ	DEU 2-MCDS STATUS WORD 3	ospl
CRT3_HW_WORD_1	V72M5810PXYZ	DEU 3-MCDS STATUS WORD 1	ospl
CRT3_HW_WORD_2	V72M5830PXYZ	DEU 3-MCDS STATUS WORD 2	ospl
CRT3_SW_WORD_1	V72M5840PXYZ	DEU 3-MCDS STATUS WORD 3	ospl
CRT4_HW_WORD_1	V72M5910PXYZ	DEU 4-MCDS STATUS WORD 1	ospl
CRT4_HW_WORD_2	V72M5930PXYZ	DEU 4-MCDS STATUS WORD 2	ospl
CRT4_SW_WORD_1	V72M5940PXYZ	DEU 4-MCDS STATUS WORD 3	ospl
CRT1_POLL_HEADER	V92M6721PXYZ	DEU 1 RESPONSE WD 1 (HEADER)	ospl
CRT2_POLL_HEADER	V92M6780PXYZ	DEU 2 RESPONSE WD 1 (HEADER)	ospl
CRT3_POLL_HEADER	V92M6844PXYZ	DEU 3 RESPONSE WD 1 (HEADER)	ospl
CRT4_POLL_HEADER	V92M6904PXYZ	DEU 4 RESPONSE WD 1 (HEADER)	ospl
CRT1_COMMANDER	V91X8712XXYZ V91X8746XXYZ V91X8780XXYZ V91X8812XXYZ V91X8847XXYZ	GPC 1 BUS 6 (DK 1) GPC 2 BUS 6 (DK 1) GPC 3 BUS 6 (DK 1) GPC 4 BUS 6 (DK 1) GPC 5 BUS 6 (DK 1)	
CRT2_COMMANDER	V91X8713XXYZ V91X8747XXYZ V91X8781XXYZ V91X8813XXYZ V91X8848XXYZ	GPC 1 BUS 7 (DK 2) GPC 2 BUS 7 (DK 2) GPC 3 BUS 7 (DK 2) GPC 4 BUS 7 (DK 2) GPC 5 BUS 7 (DK 2)	ospl
CRT3_COMMANDER	V91X8714XXYZ V91X8748XXYZ V91X8782XXYZ V91X8814XXYZ V91X8849XXYZ	GPC 1 BUS 8 (DK 3) GPC 2 BUS 8 (DK 3) GPC 3 BUS 8 (DK 3) GPC 4 BUS 8 (DK 3) GPC 5 BUS 8 (DK 3)	ospl
CRT4_COMMANDER	V91X8715XXYZ V91X8749XXYZ V91X8783XXYZ V91X8815XXYZ V91X8850XXYZ	GPC 1 BUS 9 (DK 4) GPC 2 BUS 9 (DK 4) GPC 3 BUS 9 (DK 4) GPC 4 BUS 9 (DK 4) GPC 5 BUS 9 (DK 4)	ospl

**Table C-1. Continued**

Symbol	MSID	Nomenclature	Application
MTU1_BIAS	M50Q0027HP V75W3504D	GRND RCPT ADJUSTED MTU-PCM VOTED GMT TOTAL	delta-t
MTU2_BIAS	M50Q0027HP V75W3604D	GRND RCPT ADJUSTED MTU-PCM NONVOTED GMT	delta-t
OGMT	M50Q0027HP	ORB GMT	
OMET	M50Q0030HP	ORB MET	
OPS0_BIAS	M50Q0027HP V91M1999PZ	GRND RCPT OP-0 DATA SET GREENWICH MEAN TIME	delta-t
CRT1_SPL_UNPARSED	V91M2070PXZ V91M2104PXZ V91M2138PXZ V91M2172PXZ V91M2203PXZ V91X8712XXYZ V91X8746XXYZ V91X8780XXYZ V91X8812XXYZ V91X8847XXYZ V92M6721PXYZ V92U6725CXYZ V92J6728CXYZ V92J6732CXYZ V92J6736CXYZ V92J6740CXYZ V92J6744CXYZ V92J6748CXYZ V92J6752CXYZ V92J6756CXYZ V92J6760CXYZ V92J6764CXYZ V93Q0018CXYZ V98M3960P V98M3961P V98U3962C V98U3963C	GPC 1 RS MASK WORD GPC 2 RS MASK WORD GPC 3 RS MASK WORD GPC 4 RS MASK WORD GPC 5 RS MASK WORD GPC 1 BUS 6 GPC 2 BUS 6 GPC 3 BUS 6 GPC 4 BUS 6 GPC 5 BUS 6 DEU 1 RESPONSE WORD 1 (PASS) DEU 1 RESPONSE WORD 2 (PASS) DEU 1 RESPONSE WORD 3 (PASS) DEU 1 RESPONSE WORD 4 (PASS) DEU 1 RESPONSE WORD 5 (PASS) DEU 1 RESPONSE WORD 6 (PASS) DEU 1 RESPONSE WORD 7 (PASS) DEU 1 RESPONSE WORD 8 (PASS) DEU 1 RESPONSE WORD 9 (PASS) DEU 1 RESPONSE WORD 10 (PASS) DEU 1 RESPONSE WORD 11 (PASS) DEU 1 RESPONSE WORD 12 (PASS) GPC D/L GPC ID RESPONSE WORD 1 (BFS) RESPONSE WORD 2 (BFS) RESPONSE WORD 3 (BFS) RESPONSE WORD 4 (BFS)	ospl
	V98U3964C V98U3965C V98U3966C V98U3967C V98U3968C V98U3969C V98U3970C V98U3971C V98M2335P V91X7928XXZ V91X7963XXZ V91X8017XXZ V91X8061XXZ V91X8132XXZ	RESPONSE WORD 5 (BFS) RESPONSE WORD 6 (BFS) RESPONSE WORD 7 (BFS) RESPONSE WORD 8 (BFS) RESPONSE WORD 9 (BFS) RESPONSE WORD 10 (BFS) RESPONSE WORD 11 (BFS) RESPONSE WORD 12 (BFS) BFS BUS CONFIGURATION GPC 1 BUS MASK GPC 2 BUS MASK GPC 3 BUS MASK GPC 4 BUS MASK GPC 5 BUS MASK	

**Table C-1. Continued**

Symbol	MSID	Nomenclature	Application
CRT2_SPL_UNPARSED	V91M2070PXZ	GPC 1 RS MASK WORD	ospl
	V91M2104PXZ	GPC 2 RS MASK WORD	
	V91M2138PXZ	GPC 3 RS MASK WORD	
	V91M2172PXZ	GPC 4 RS MASK WORD	
	V91M2203PXZ	GPC 5 RS MASK WORD	
	V91X8713XXYZ	GPC 1 BUS 7	
	V91X8747XXYZ	GPC 2 BUS 7	
	V91X8781XXYZ	GPC 3 BUS 7	
	V91X8813XXYZ	GPC 4 BUS 7	
	V91X8848XXYZ	GPC 5 BUS 7	
	V92M6780PXYZ	DEU 2 RESPONSE WORD 1 (PASS)	
	V92U6784CXYZ	DEU 2 RESPONSE WORD 2 (PASS)	
	V92J6792CXYZ	DEU 2 RESPONSE WORD 3 (PASS)	
	V92J6796CXYZ	DEU 2 RESPONSE WORD 4 (PASS)	
	V92J6800CXYZ	DEU 2 RESPONSE WORD 5 (PASS)	
	V92J6804CXYZ	DEU 2 RESPONSE WORD 6 (PASS)	
	V92J6808CXYZ	DEU 2 RESPONSE WORD 7 (PASS)	
	V92J6812CXYZ	DEU 2 RESPONSE WORD 8 (PASS)	
	V92J6816CXYZ	DEU 2 RESPONSE WORD 9 (PASS)	
	V92J6820CXYZ	DEU 2 RESPONSE WORD 10 (PASS)	
	V92J6824CXYZ	DEU 2 RESPONSE WORD 11 (PASS)	
	V92J6828CXYZ	DEU 2 RESPONSE WORD 12 (PASS)	
	V93Q0018CXYZ	GPC D/L GPC ID	
	V98M3960P	RESPONSE WORD 1 (BFS)	
	V98M3961P	RESPONSE WORD 2 (BFS)	
	V98U3962C	RESPONSE WORD 3 (BFS)	
	V98U3963C	RESPONSE WORD 4 (BFS)	
	V98U3964C	RESPONSE WORD 5 (BFS)	
	V98U3965C	RESPONSE WORD 6 (BFS)	
	V98U3966C	RESPONSE WORD 7 (BFS)	
	V98U3967C	RESPONSE WORD 8 (BFS)	
	V98U3968C	RESPONSE WORD 9 (BFS)	
	V98U3969C	RESPONSE WORD 10 (BFS)	
	V98U3970C	RESPONSE WORD 11 (BFS)	
	V98U3971C	RESPONSE WORD 12 (BFS)	
	V98M2335P	BFS BUS CONFIGURATION	
	V91X7929XXZ	GPC 1 BUS MASK	
	V91X7964XXZ	GPC 2 BUS MASK	
	V91X8018XXZ	GPC 3 BUS MASK	
	V91X8062XXZ	GPC 4 BUS MASK	
	V91X8133XXZ	GPC 5 BUS MASK	
CRT3_SPL_UNPARSED	V91M2070PXZ	GPC 1 RS MASK WORD	ospl
	V91M2104PXZ	GPC 2 RS MASK WORD	
	V91M2138PXZ	GPC 3 RS MASK WORD	
	V91M2172PXZ	GPC 4 RS MASK WORD	
	V91M2203PXZ	GPC 5 RS MASK WORD	
	V91X8714XXYZ	GPC 1 BUS 8	

**Table C-1. Continued**

Symbol	MSID	Nomenclature	Application
	V91X8748XXYZ	GPC 2 BUS 8	
	V91X8782XXYZ	GPC 3 BUS 8	
	V91X8814XXYZ	GPC 4 BUS 8	
	V91X8849XXYZ	GPC 5 BUS 8	
	V92M6844PXYZ	DEU 3 RESPONSE WORD 1 (PASS)	
	V92U6848CXYZ	DEU 3 RESPONSE WORD 2 (PASS)	
	V92J6852CXYZ	DEU 3 RESPONSE WORD 3 (PASS)	
	V92J6856CXYZ	DEU 3 RESPONSE WORD 4 (PASS)	
	V92J6860CXYZ	DEU 3 RESPONSE WORD 5 (PASS)	
	V92J6864CXYZ	DEU 3 RESPONSE WORD 6 (PASS)	
	V92J6868CXYZ	DEU 3 RESPONSE WORD 7 (PASS)	
	V92J6872CXYZ	DEU 3 RESPONSE WORD 8 (PASS)	
	V92J6876CXYZ	DEU 3 RESPONSE WORD 9 (PASS)	
	V92J6880CXYZ	DEU 3 RESPONSE WORD 10 (PASS)	
	V92J6884CXYZ	DEU 3 RESPONSE WORD 11 (PASS)	
	V92J6888CXYZ	DEU 3 RESPONSE WORD 12 (PASS)	
	V93Q0018CXYZ	GPC D/L GPC ID	
	V98M3960P	RESPONSE WORD 1 (BFS)	
	V98M3961P	RESPONSE WORD 2 (BFS)	
	V98U3962C	RESPONSE WORD 3 (BFS)	
	V98U3963C	RESPONSE WORD 4 (BFS)	
	V98U3964C	RESPONSE WORD 5 (BFS)	
	V98U3965C	RESPONSE WORD 6 (BFS)	
	V98U3966C	RESPONSE WORD 7 (BFS)	
	V98U3967C	RESPONSE WORD 8 (BFS)	
	V98U3968C	RESPONSE WORD 9 (BFS)	
	V98U3969C	RESPONSE WORD 10 (BFS)	
	V98U3970C	RESPONSE WORD 11 (BFS)	
	V98U3971C	RESPONSE WORD 12 (BFS)	
	V98M2335P	BFS BUS CONFIGURATION	
	V91X7930XXZ	GPC 1 BUS MASK	
	V91X7965XXZ	GPC 2 BUS MASK	
	V91X8019XXZ	GPC 3 BUS MASK	
	V91X8063XXZ	GPC 4 BUS MASK	
	V91X8134XXZ	GPC 5 BUS MASK	

**Table C-1. Concluded**

Symbol	MSID	Nomenclature	Application
CRT4_SPL_UNPARSED	V91M2070PXZ	GPC 1 RS MASK WORD	ospl
	V91M2104PXZ	GPC 2 RS MASK WORD	
	V91M2138PXZ	GPC 3 RS MASK WORD	
	V91M2172PXZ	GPC 4 RS MASK WORD	
	V91M2203PXZ	GPC 5 RS MASK WORD	
	V91X8715XXYZ	GPC 1 BUS 9	
	V91X8749XXYZ	GPC 2 BUS 9	
	V91X8783XXYZ	GPC 3 BUS 9	
	V91X8815XXYZ	GPC 4 BUS 9	
	V91X8850XXYZ	GPC 5 BUS 9	
	V92M6904PXYZ	DEU 4 RESPONSE WORD 1 (PASS)	
	V92U6908CXYZ	DEU 4 RESPONSE WORD 2 (PASS)	
	V92J6912CXYZ	DEU 4 RESPONSE WORD 3 (PASS)	
	V92J6916CXYZ	DEU 4 RESPONSE WORD 4 (PASS)	
	V92J6920CXYZ	DEU 4 RESPONSE WORD 5 (PASS)	
	V92J6924CXYZ	DEU 4 RESPONSE WORD 6 (PASS)	
	V92J6928CXYZ	DEU 4 RESPONSE WORD 7 (PASS)	
	V92J6932CXYZ	DEU 4 RESPONSE WORD 8 (PASS)	
	V92J6936CXYZ	DEU 4 RESPONSE WORD 9 (PASS)	
	V92J6940CXYZ	DEU 4 RESPONSE WORD 10 (PASS)	
	V92J6944CXYZ	DEU 4 RESPONSE WORD 11 (PASS)	
	V92J6948CXYZ	DEU 4 RESPONSE WORD 12 (PASS)	
	V93Q0018CXYZ	GPC D/L GPC ID	
	V98M3960P	RESPONSE WORD 1 (BFS)	
	V98M3961P	RESPONSE WORD 2 (BFS)	
	V98U3962C	RESPONSE WORD 3 (BFS)	
	V98U3963C	RESPONSE WORD 4 (BFS)	
	V98U3964C	RESPONSE WORD 5 (BFS)	
	V98U3965C	RESPONSE WORD 6 (BFS)	
	V98U3966C	RESPONSE WORD 7 (BFS)	
	V98U3967C	RESPONSE WORD 8 (BFS)	
	V98U3968C	RESPONSE WORD 9 (BFS)	
	V98U3969C	RESPONSE WORD 10 (BFS)	
	V98U3970C	RESPONSE WORD 11 (BFS)	
	V98U3971C	RESPONSE WORD 12 (BFS)	
	V98M2335P	BFS BUS CONFIGURATION	
	V91X7931XXZ	GPC 1 BUS MASK	
	V91X7966XXZ	GPC 2 BUS MASK	
	V91X8020XXZ	GPC 3 BUS MASK	
	V91X8064XXZ	GPC 4 BUS MASK	
V91X8135XXZ	GPC 5 BUS MASK		
SM_BIAS	M50Q0027HP	GRND RCPT-SM DATA SET	delta-t
	V91M1999PY	GREENWICH MEAN TIME	
VEHICLE ID	M50Q0005HP	VEHICLE ID	
FLIGHT ID	M50Q0003HP	FLIGHT ID	

## TITLE

DPS PARAMETERS

## DESCRIPTION

The information in this SCP identifies the format utilized to uniquely identify all Shuttle master measurement stimulus parameters. The actual parameters utilized to drive DPS workstation applications may be viewed on the website DPS home page.

Table column definitions:

MSID - A unique Measurement and Stimulus IDentification associated with each parameter.

Nomenclature - An abbreviated form or description of the title of the parameter.

Application definitions:

DPS Overview	-	OV
DPS C&W	-	CW
SPECs	-	SP
MEDS	-	MI
OFS	-	OF
DTEX	-	DX
DPS A&E	-	AE
Delta-t	-	DT
VP Scaling	-	VP
OSPL	-	OS

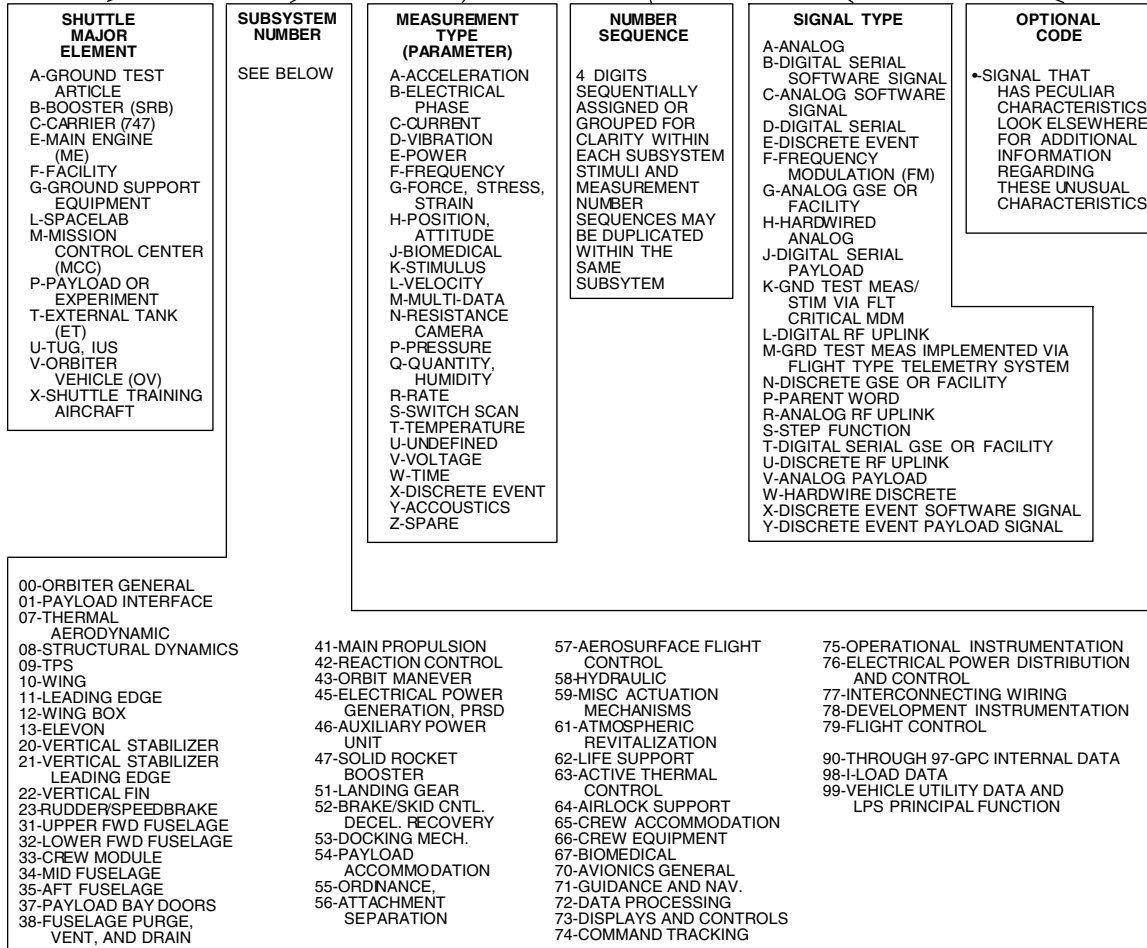
This SCP includes a complete definition and description of what alphanumeric character represents in the MSID. The actual data parameters are listed in an Excel spreadsheet accessible via weblink on the DPS home page.

Notes:

1. CAM Counter MSIDs deleted for OI-8A, CR-79734C.
2. MSIDs whose nomenclature ended in IPL deleted for OI-8F, DCR 1592, SCR 89772.
3. Any MSID that has the word "DEU" in its nomenclature should be understood in terms of "IDP" (i.e. equate the word "DEU" to "IDP")."

SHUTTLE PROGRAM  
MEASUREMENT/STIMULUS NUMBER FORMAT AND DEFINITION

V 41 P I260 A \*



j\_18819\_092

SOURCES

Integrated Schematic Index, Measurements and Stimuli, rev. A, 8-8-86, DWG. No. VS72-900099.

Integrated Schematic Index, Measurements and Stimuli, rev. A, 7-26-87, DWG. No. VS72-900102.

MCC Level B and C Requirements for Shuttle-Telemetry Data Processing, Vol. I, book 5.



**TITLE**

**MEWS TAB FORMAT PARAMETERS**

BFRAWFLT	V98M1300P	RAW_WD_1	(continued)	V91M8038PX	GPC3_BSMK2
	V98M1305P	RAW_WD_2		V91M8055PX	GPC4_BSMK1
	V98M1310P	RAW_WD_3		V91M8072PX	GPC4_BSMK2
	V98M1315P	RAW_WD_4		V91M8126PX	GPC5_BSMK1
	V98M1320P	RAW_WD_5		V91M8143PX	GPC5_BSMK2
			BUSMSKPL	V91M7922PZ	GPC1_BSMK1
BFSFAIL	V76X4321E	RPC5_A_CPU		V91M7940PZ	GPC1_BSMK2
	V76X4322E	RPC5_B_CPU		V91M7957PZ	GPC2_BSMK1
	V76X4323E	RPC5_C_CPU		V91M7974PZ	GPC2_BSMK2
	V76X4371E	RPC5_A_IOP		V91M8011PZ	GPC3_BSMK1
	V76X4372E	RPC5_B_IOP		V91M8038PZ	GPC3_BSMK2
	V76X4373E	RPC5_C_IOP		V91M8055PZ	GPC4_BSMK1
	V98M0590P	DISC_WD_A		V91M8072PZ	GPC4_BSMK2
	V98M0600P	DISC_WD_B		V91M8126PZ	GPC5_BSMK1
	V98M2335P	GNC_XMIT_1		V91M8143PZ	GPC5_BSMK2
	V98M2280P	GNC_XMIT_2			
			BYPASS	V91M2252PX	BYPWD1_GNC
BFSIOER	V98J2258C	COUNT		V91M2269PX	BYPWD2_GNC
	V98J2260C	ELEMENT		V91M2801PX	BYPWD3_GNC
	V98U2261C	STAT_1		V95M5903P	PL_HI_SM
	V98U2639C	STAT_2		V92M0321P	PL_LOW1_SM
	V98M2630P	CYCLE		V92M0335P	PL_LOW2_SM
				V92M0584P	BYP_PCM_SM
BFS_VPS	V98U1280C	VP_1			
	V98U1281C	VP_2	BYP_BFS	V98M0820P	BYP_WD_1
	V98U1282C	VP_3		V98M0840P	BYP_WD_1
				V98M0860P	BYP_WD_2
BFS_DEU	V98J4349C	DEU1_MF_SW		V98M0880P	BYP_WD_2
	V98J4359C	DEU2_MF_SW		V98M0920P	BYP_WD_3
	V98J4369C	DEU3_MF_SW		V98M0940P	BYP_WD_3
	V98J4379C	DEU4_MF_SW		V98M0960P	BYP_WD_4
BFS_STAT	V98M2752X	BFS_TRACK_STG1	CPU_USE	V91Q1586CX	CPU1_%_GNC
	V98M2753X	BFS_TRACK_STG2		V91Q1587CX	CPU2_%_GNC
	V98M2754X	BFS_TRACK_STG3		V91Q1588CX	CPU3_%_GNC
	V98M2755X	BFS_TRACK_STG4		V91Q1589CX	CPU4_%_GNC
	V98U2408C	BFS_MODE		V91Q1590CX	CPU5_%_GNC
	V98M1260P	BFS_FDA			
			CRT1_BFS	V73S2001E	CRT_1_ON
BFS_XMIT	V98M2335P	BFS_XMIT1		V73S2002E	CRT_1_STBY
	V98M2280P	BFS_XMIT2		V98J4349C	DEU1_MF_SW
				V98M4864P	HDWR_WD_1
BUSMSKGN	V91M7922PX	GPC1_BSMK1		V98M4862P	HDWR_WD_2
	V91M7940PX	GPC1_BSMK2		V98M4863P	SW_WORD
	V91M7957PX	GPC2_BSMK1		V98M3974P	POLL_WORD
	V91M7974PX	GPC2_BSMK2	CRT1_GNC	V73S2001E	CRT_1_ON
BUSMSKGN	V91M8011PX	GPC3_BSMK1		V73S2002E	CRT_1_STBY

	V92U6717CX	CRT_MF_SW		V72M5740PZ	HDWR_WD_2
	V92U5086CX	DISP_NUMBR		V72M5750PZ	SW_WORD
	V92X7081XX	ILL_ENTRY		V92M6780PZ	POLL_WORD
	V72M5650PX	HDWR_WD_1			
	V72M5670PX	HDWR_WD_2	CRT2_SM	V73S2011E	CRT_2_ON
	V72M5680PX	SW_WORD		V73S2012E	CRT_2_STBY
				V92U6776CY	CRT_MF_SW
CRT1_OP0	V92M6721PX	POLL_WORD		V92U5088CY	DISP_NUMBR
	V73S2001E	CRT_1_ON		V92X7082XY	ILL_ENTRY
	V73S2002E	CRT_1_STBY		V72M5720PY	HDWR_WD_1
	V92U6717CZ	CRT_MF_SW		V72M5740PY	HDWR_WD_2
	V92U5086CZ	DISP_NUMBR		V72M5750PY	SW_WORD
	V92X7081XZ	ILL_ENTRY		V92M6780PY	POLL_WORD
	V72M5650PZ	HDWR_WD_1			
	V72M5670PZ	HDWR_WD_2	CRT3_BFS	V73S2022E	CRT_3_ON
	V72M5680PZ	SW_WORD		V73S2021E	CRT_3_STBY
	V92M6721PZ	POLL_WORD		V98J4349C	DEU1_MF_SW
				V98M4864P	HDWR_WD_1
CRT1_SM	V73S2001E	CRT_1_ON		V98M4862P	HDWR_WD_2
	V73S2002E	CRT_1_STBY		V98M4863P	SW_WORD
	V92U6717CY	CRT_MF_SW		V98M3974P	POLL_WORD
	V92U5086CY	DISP_NUMBR			
	V92X7081XY	ILL_ENTRY	CRT3_GNC	V73S2022E	CRT_3_ON
	V72M5650PY	HDWR_WD_1		V73S2021E	CRT_3_STBY
	V72M5670PY	HDWR_WD_2		V92U6840CX	CRT_MF_SW
	V72M5680PY	SW_WORD		V92U5090CX	DISP_NUMBR
	V92M6721PY	POLL_WORD		V92X7083XX	ILL_ENTRY
				V72M5810PX	HDWR_WD_1
CRT2_BFS	V73S2011E	CRT_2_ON		V72M5830PX	HDWR_WD_2
	V73S2012E	CRT_2_STBY		V72M5840PX	SW_WORD
	V98J4349C	DEU1_MF_SW		V92M6844PX	POLL_WORD
	V98M4864P	HDWR_WD_1			
	V98M4862P	HDWR_WD_2	CRT3_OP0	V73S2022E	CRT_3_ON
	V98M4863P	SW_WORD		V73S2021E	CRT_3_STBY
	V98M3974P	POLL_WORD		V92U6840CZ	CRT_MF_SW
				V92U5090CZ	DISP_NUMBR
CRT2_GNC	V73S2011E	CRT_2_ON		V92X7083XZ	ILL_ENTRY
	V73S2012E	CRT_2_STBY		V72M5810PZ	HDWR_WD_1
	V92U6776CX	CRT_MF_SW		V72M5830PZ	HDWR_WD_2
	V92U5088CX	DISP_NUMBR		V72M5840PZ	SW_WORD
	V92X7082XX	ILL_ENTRY		V92M6844PZ	POLL_WORD
	V72M5720PX	HDWR_WD_1			
	V72M5740PX	HDWR_WD_2	CRT3_SM	V73S2022E	CRT_3_ON
	V72M5750PX	SW_WORD		V73S2021E	CRT_3_STBY
	V92M6780PX	POLL_WORD		V92U6840CY	CRT_MF_SW
	V73S2011E	CRT_2_ON		V92U5090CY	DISP_NUMBR
				V92X7083XY	ILL_ENTRY
CRT2_OP0	V73S2012E	CRT_2_STBY		V72M5810PY	HDWR_WD_1
	V92U6776CZ	CRT_MF_SW		V72M5830PY	HDWR_WD_2
	V92U5088CZ	DISP_NUMBR	CRT3_SM	V72M5840PY	SW_WORD
CRT2_OP0 (continued)	V92X7082XZ	ILL_ENTRY	(continued)	V92M6844PY	POLL_WORD
	V72M5720PZ	HDWR_WD_1			

CRT4_GNC	V73S2051E	CRT_4_ON		M19G2501R	WORD_1
	V73S2052E	CRT_4_STBY			
	V92U6900CX	CRT_MF_SW	DISC_AB_BFS	V98M0590P	BFS_WD_A
	V92U5092CX	DISP_NUMBR		V98M0600P	BFS_WD_B
	V92X7084XX	ILL_ENTRY			
	V72M5910PX	HDWR_WD_1	DISC_AB_GN	V92M7361PX	GPC_1_WD_A
	V72M5930PX	HDWR_WD_2		V92M7380PX	GPC_1_WD_B
	V72M5940PX	SW_WORD		V92M7421PX	GPC_2_WD_A
CRT4_OP0	V92M6904PX	POLL_WORD		V92M7440PX	GPC_2_WD_B
				V92M7481PX	GPC_3_WD_A
	V73S2051E	CRT_4_ON		V92M7500PX	GPC_3_WD_B
	V73S2052E	CRT_4_STBY		V92M7541PX	GPC_4_WD_A
	V92U6900CZ	CRT_MF_SW		V92M7560PX	GPC_4_WD_B
	V92U5092CZ	DISP_NUMBR		V92M7601PX	GPC_5_WD_A
	V92X7084XZ	ILL_ENTRY		V92M7620PX	GPC_5_WD_B
	V72M5910PZ	HDWR_WD_1			
CRT4_SM	V72M5930PZ	HDWR_WD_2	DISC_AB_PL	V92M7361PZ	GPC_1_WD_A
	V72M5940PZ	SW_WORD		V92M7380PZ	GPC_1_WD_B
	V92M6904PZ	POLL_WORD		V92M7421PZ	GPC_2_WD_A
				V92M7440PZ	GPC_2_WD_B
	V73S2051E	CRT_4_ON		V92M7481PZ	GPC_3_WD_A
	V73S2052E	CRT_4_STBY		V92M7500PZ	GPC_3_WD_B
	V92U6900CY	CRT_MF_SW		V92M7541PZ	GPC_4_WD_A
	V92U5092CY	DISP_NUMBR		V92M7560PZ	GPC_4_WD_B
CRT_POWER	V92X7084XY	ILL_ENTRY		V92M7601PZ	GPC_5_WD_A
	V72M5910PY	HDWR_WD_1		V92M7620PZ	GPC_5_WD_B
	V72M5930PY	HDWR_WD_2			
	V72M5940PY	SW_WORD	DISC_AB_SM	V92M7361PY	GPC_1_WD_A
	V92M6904PY	POLL_WORD		V92M7380PY	GPC_1_WD_B
				V92M7421PY	GPC_2_WD_A
	V73S2001E	CRT1_ON		V92M7440PY	GPC_2_WD_B
	V73S2002E	CRT1_STBY		V92M7481PY	GPC_3_WD_A
DEU1_SPL	V73S2011E	CRT2_ON		V92M7500PY	GPC_3_WD_B
	V73S2012E	CRT2_STBY		V92M7541PY	GPC_4_WD_A
	V73S2021E	CRT3_ON		V92M7560PY	GPC_4_WD_B
	V73S2022E	CRT3_STBY		V92M7601PY	GPC_5_WD_A
	V73S2051E	CRT4_ON		V92M7620PY	GPC_5_WD_B
	V73S2052E	CRT4_STBY			
	M29G2501L	DISPLAY	FA1_FAIL	V72S7991E	POWER
	M25G2501R	MAJ_FUNC		V92U5510CX	PORT_VP
DEU2_SPL	M01G2501R	WORD_1		V92M2907P	A/D_CONV
				V91M2252PX	BYP_WD1
				V91M2269PX	BYP_WD2
DEU3_SPL	M30G2501L	DISPLAY		V91M2801PX	BYP_WD3
	M26G2501R	MAJ_FUNC			
	M07G2501R	WORD_1	FA2_FAIL	V72S7993E	POWER
DEU4_SPL				V92U5510CX	PORT_VP
	M31G2501L	DISPLAY		V92M2907P	A/D_CONV
	M27G2501R	MAJ_FUNC		V91M2252PX	BYP_WD1
DEU4_SPL	M13G2501R	WORD_1	FA2_FAIL	V91M2269PX	BYP_WD2
	M32G2501L	DISPLAY	(continued)	V91M2801PX	BYP_WD3
	M28G2501R	MAJ_FUNC			

FA3_FAIL	V72S7995E	POWER	V91M2801PX	BYP_WD3
	V92U5510CX	PORT_VP		
	V92M2907P	A/D_CONV	FF2_FAIL	V72S7983E
	V91M2252PX	BYP_WD1		V92U5510CX
	V91M2269PX	BYP_WD2		V92M2907P
	V91M2801PX	BYP_WD3		V91M2252PX
				V91M2269PX
				V91M2801PX
FA4_FAIL	V72S7997E	POWER		
	V92U5510CX	PORT_VP		
	V92M2907P	A/D_CONV	FF3_FAIL	V72S7985E
	V91M2252PX	BYP_WD1		V92U5510CX
	V91M2269PX	BYP_WD2		V92M2907P
	V91M2801PX	BYP_WD3		V91M2252PX
				V91M2269PX
				V91M2801PX
FAIL_VT_GN	V72X7011E	GPC1_I_FL		
	V72X7012E	GPC2_I_FL	FF4_FAIL	V72S7987E
	V72X7013E	GPC3_I_FL		V92U5510CX
	V72X7014E	GPC4_I_FL		V92M2907P
	V72X7015E	GPC5_I_FL		V91M2252PX
	V91M2060PX	GPC1_VT_GN		V91M2269PX
	V91M2062PX	GPC2_VT_GN		V91M2801PX
	V91M2064PX	GPC3_VT_GN		
	V91M2066PX	GPC4_VT_GN	FLT_RAW_GN	V93Q0018CX
	V91M2068PX	GPC5_VT_GN		V92M7002PX
				V92M7009PX
FAIL_VT_OP	V72X7011E	GPC1_I_FL		V92M7017PX
	V72X7012E	GPC2_I_FL		V92M7024PX
	V72X7013E	GPC3_I_FL		V92M7031PX
	V72X7014E	GPC4_I_FL		V92M7038PX
	V72X7015E	GPC5_I_FL		V92M7046PX
	V91M2060PZ	GPC1_VT_OP		V92M7053PX
	V91M2062PZ	GPC2_VT_OP		V92M7061PX
	V91M2064PZ	GPC3_VT_OP		V92M7068PX
	V91M2066PZ	GPC4_VT_OP		
	V91M2068PZ	GPC5_VT_OP		
			FLT_RAW_OP0	V93Q0018CZ
				V92M7002PZ
FAIL_VT_SM	V72X7011E	GPC1_I_FL		V92M7009PZ
	V72X7012E	GPC2_I_FL		V92M7017PZ
	V72X7013E	GPC3_I_FL		V92M7024PZ
	V72X7014E	GPC4_I_FL		V92M7031PZ
	V72X7015E	GPC5_I_FL		V92M7038PZ
	V91M2060PY	GPC1_VT_SM		V92M7046PZ
	V91M2062PY	GPC2_VT_SM		V92M7053PZ
	V91M2064PY	GPC3_VT_SM		V92M7060PZ
	V91M2066PY	GPC4_VT_SM		V92M7067PZ
	V91M2068PY	GPC5_VT_SM		
			FLT_RAW_SM	V93Q0018CY
FF1_FAIL	V72S7981E	POWER		V92M7002PY
	V92U5510CX	PORT_VP		V92M7009PY
FF1_FAIL	V92M2907P	A/D_CONV	FLT_RAW_SM	V92M7017PY
(continued)	V91M2252PX	BYP_WD1	(continued)	V92M7024PY
	V91M2269PX	BYP_WD2		

	V92M7031PY	MSG_3		V91M8757PX	GNC_XMIT_2
	V92M7038PY	MSG_3_TIME		V91X1562XX	FAIL_BY_1
	V92M7046PY	MSG_4		V72X7012E	FAIL_BY_ME
	V92M7053PY	MSG_4_TIME		V91X1572XX	FAIL_BY_3
	V92M7060PZ	MSG_5		V91X1577XX	FAIL_BY_4
	V92M7067PZ	MSG_5_TIME		V91X1665XX	FAIL_BY_5
				V92U5512CX	FTS_PTR
GNC_XMIT	V91M8706PX	GPC1_XMIT1			
	V91M8723PX	GPC1_XMIT2	GPC2_IO_ERR	V92Q4847CX	COUNT
	V91M8740PX	GPC2_XMIT1		V92J4779CX	ELEMENT
	V91M8757PX	GPC2_XMIT2		V92J4780CX	DEVICE_ID
	V91M8774PX	GPC3_XMIT1		V92J4784CX	BCE_NUMBER
	V91M8791PX	GPC3_XMIT2		V92J4783CX	STATUS
	V91M8808PX	GPC4_XMIT1		V92J4781CX	OP_CODE
	V91M8822PX	GPC4_XMIT2			
	V91M8841PX	GPC5_XMIT1	GPC2_RPC	V76X4305E	RPC_A_CPU
	V91M8858PX	GPC5_XMIT2		V76X4306E	RPC_B_CPU
				V76X4307E	RPC_C_CPU
GPC1_FAIL	V76X4351E	RPC_A_IOP		V76X4355E	RPC_A_IOP
	V76X4352E	RPC_B_IOP		V76X4356E	RPC_B_IOP
	V76X4353E	RPC_C_IOP		V76X4357E	RPC_C_IOP
	V92M7361PX	DISC_WD_A			
	V92M7380PX	DISC_WD_B	GPC3_FAIL	V76X4361E	RPC_A_IOP
	V91M8706PX	GNC_XMIT_1		V76X4362E	RPC_B_IOP
	V91M8723PX	GNC_XMIT_2		V76X4363E	RPC_C_IOP
	V72X7011E	FAIL_BY_ME		V92M7481PX	GPC_3_WD_A
	V91X1566XX	FAIL_BY_2		V92M7500PX	GPC_3_WD_B
	V91X1571XX	FAIL_BY_3		V91M8774PX	GNC_XMIT_1
	V91X1576XX	FAIL_BY_4		V91M8791PX	GNC_XMIT_2
	V91X1664XX	FAIL_BY_5		V91X1563XX	FAILS_BY_1
	V92U5512CX	FTS_PTR		V91X1568XX	FAILS_BY_2
				V72X7013E	I_FAIL_IND
GPC1_IO_ERR	V92Q4770CX	COUNT		V91X1578XX	FAILS_BY_4
	V92J4702CX	ELEMENT		V91X1666XX	FAILS_BY_5
	V92J4703CX	DEVICE_ID		V92U5512CX	FTS_PTR
	V92J4707CX	BCE_NUMBER			
	V92J4706CX	STATUS	GPC3_IO_ERR	V92Q4920CX	COUNT
	V92J4704CX	OP_CODE		V92J4852CX	ELEMENT
				V92J4853CX	DEVICE_ID
GPC1_RPC	V76X4301E	RPC_A_CPU		V92J4857CX	BCE_NUMBER
	V76X4302E	RPC_B_CPU		V92J4856CX	STATUS
	V76X4303E	RPC_C_CPU		V92J4854CX	OP_CODE
	V76X4351E	RPC_A_IOP	GPC3_RPC	V76X4311E	RPC_A_CPU
	V76X4352E	RPC_B_IOP		V76X4312E	RPC_B_CPU
	V76X4353E	RPC_C_IOP		V76X4313E	RPC_C_CPU
				V76X4361E	RPC_A_IOP
GPC2_FAIL	V76X4355E	RPC_A_IOP		V76X4362E	RPC_B_IOP
	V76X4356E	RPC_B_IOP		V76X4363E	RPC_C_IOP
	V76X4357E	RPC_C_IOP			
GPC2_FAIL	V92M7421PX	DISC_WD_A	GPC4_FAIL	V76X4365E	RPC_A_IOP
(continued)	V92M7440PX	DISC_WD_B		V76X4366E	RPC_B_IOP
	V91M8740PX	GNC_XMIT_1		V76X4367E	RPC_C_IOP

	V92M7541PX	DISC_WD_A			
	V92M7560PX	DISC_WD_B	GPC_ERROR	V92Q6036CX	GPC1_CTR
	V91M8808PX	GNC_XMIT_1		V92U6033CX	GPC1_GRP
	V91M8822PX	GNC_XMIT_2		V92U6032CX	GPC1_CODE
	V91X1564XX	FAILS_BY_1		V92U4350CX	GPC1_PTR
	V91X1569XX	FAILS_BY_2		V92Q6046CX	GPC2_CTR
	V91X1574XX	FAILS_BY_3		V92U6043CX	GPC2_GRP
	V72X7014E	I_FAIL_IND		V92U6042CX	GPC2_CODE
	V91X1667XX	FAILS_BY_5		V92U4351CX	GPC2_PTR
	V92U5512CX	FTS_PTR		V92Q6056CX	GPC3_CTR
				V92U6053CX	GPC3_GRP
GPC4_IO_ERR	V92Q5007CX	COUNT		V92U6052CX	GPC3_CODE
	V92J4929CX	ELEMENT		V92U4352CX	GPC3_PTR
	V92J4930CX	DEVICE_ID		V92Q6066CX	GPC4_CTR
	V92J4934CX	BCE_NUMBER		V92U6063CX	GPC4_GRP
	V92J4933CX	STATUS		V92U6062CX	GPC4_CODE
	V92J4931CX	OP_CODE		V92U4353CX	GPC4_PTR
				V98J2299C	BFS_CTR
GPC4_RPC	V76X4315E	RPC_A_CPU		V98M2508P	BFS_ERR
	V76X4316E	RPC_B_CPU		V98U2301C	BFS_PTR
	V76X4317E	RPC_C_CPU			
	V76X4365E	RPC_A_IOP	IO_ERROR_1-3	V92Q4770CX	GPC1_COUNT
	V76X4366E	RPC_B_IOP		V92J4702CX	GPC1_ELE
	V76X4367E	RPC_C_IOP		V92J4703CX	GPC1_ID
				V92J4707CX	GPC1_BCE
GPC5_FAIL	V76X4371E	RPC_A_IOP		V92J4706CX	GPC1_STAT
	V76X4372E	RPC_B_IOP		V92J4704CX	GPC1_OPDE
	V76X4373E	RPC_C_IOP		V92J4705CX	GPC1_RESWD
	V92M7601PX	DISC_WD_A		V92Q4847CX	GPC2_COUNT
	V92M7620PX	DISC_WD_B		V92J4779CX	GPC2_ELE
	V91M8841PX	GNC_XMIT_1		V92J4780CX	GPC2_ID
	V91M8858PX	GNC_XMIT_2		V92J4784CX	GPC2_BCE
	V91X1565XX	FAILS_BY_1		V92J4783CX	GPC2_STAT
	V91X1570XX	FAILS_BY_2		V92J4781CX	GPC2_OPDE
	V91X1575XX	FAILS_BY_3		V92J4782CX	GPC2_RESWD
	V91X1580XX	FAILS_BY_4		V92Q4920CX	GPC3_COUNT
	V72X7015E	I_FAIL_IND		V92J4852CX	GPC3_ELE
	V92U5512CX	FTS_PTR		V92J4853CX	GPC3_ID
				V92J4857CX	GPC3_BCE
GPC5_IO_ERR	V92Q4998CX	COUNT		V92J4856CX	GPC3_STAT
	V92J4992CX	ELEMENT		V92J4854CX	GPC3_OPDE
	V92J4993CX	DEVICE_ID		V92J4857CX	GPC3_RESWD
	V92J4989CX	BCE_NUMBER	IO_ERROR_4-5	V92Q5007CX	GPC4_COUNT
	V92J4996CX	STATUS		V92J4929CX	GPC4_ELE
	V92J4994CX	OP_CODE		V92J4930CX	GPC4_ID
				V92J4934CX	GPC4_BCE
GPC5_RPC	V76X4321E	RPC_A_CPU		V92J4933CX	GPC4_STAT
	V76X4322E	RPC_B_CPU		V92J4932CX	GPC4_OPDE
	V76X4323E	RPC_C_CPU		V92J4931CX	GPC4_RESWD
GPC5_RPC	V76X4371E	RPC_A_IOP	IO_ERROR_4-5	V92Q4998CX	GPC5_COUNT
(continued)	V76X4372E	RPC_B_IOP	(continued)	V92J4992CX	GPC5_ELE
	V76X4373E	RPC_C_IOP		V92J4993CX	GPC5_ID

	V92J4989CX	GPC5_BCE		V92J4479CY	ERR_3_EL
	V92J4996CX	GPC5_STAT		V92J4480CY	ERR_3_ID
	V92J4994CX	GPC5_OPDCDE		V92U4483CY	ERR_3_STAT
	V92J4995CX	GPC5_RESWD		V92J4482CY	ERR_3_CNT
				V92M4544PY	ERR_3_TIME
IOLOGGNC_1-3	V93Q0018CX	GPC_ID			
	V92J4330CX	ERR_1_BCE	IOLOGSM_4-5	V92J4557CY	ERR_4_BCE
	V92J4325CX	ERR_1_EL		V92J4552CY	ERR_4_EL
	V92J4326CX	ERR_1_ID		V92J4553CY	ERR_4_ID
	V92U4329CX	ERR_1_STAT		V92U4556CY	ERR_4_STAT
	V92J4328CX	ERR_1_CNT		V92J4555CY	ERR_4_CNT
	V92M4389PX	ERR_1_TIME		V92M4617PY	ERR_4_TIME
	V92J4407CX	ERR_2_BCE		V92J4627CY	ERR_5_BCE
	V92J4402CX	ERR_2_EL		V92J4622CY	ERR_5_EL
	V92J4403CX	ERR_2_ID		V92J4623CY	ERR_5_ID
	V92U4406CX	ERR_2_STAT		V92U4626CY	ERR_5_STAT
	V92J4405CX	ERR_2_CNT		V92J4625CY	ERR_5_CNT
	V92M4467PX	ERR_2_TIME		V92M4697PY	ERR_5_TIME
	V92J4484CX	ERR_3_BCE			
	V92J4479CX	ERR_3_EL	LAST5_BFS	V98J2637C	ERR1_BCE
	V92J4480CX	ERR_3_ID		V98J2260C	ERR1_ELEM
	V92U4483CX	ERR_3_STAT		V98U2261C	ERR1_STAT
	V92J4482CX	ERR_3_CNT		V98U2639C	ERR1_STAT2
	V92M4544PX	ERR_3_TIME		V98J2661C	ERR2_BCE
				V98J2264C	ERR2_ELEM
IOLOGGNC_4-5	V92J4557CX	ERR_4_BCE		V98U2265C	ERR2_STAT1
	V92J4552CX	ERR_4_EL		V98U2663C	ERR2_STAT2
	V92J4553CX	ERR_4_ID		V98J2685C	ERR3_BCE
	V92U4556CX	ERR_4_STAT		V98J2268C	ERR3_ELEM
	V92J4555CX	ERR_4_CNT		V98U2269C	ERR3_STAT1
	V92M4617PX	ERR_4_TIME		V98U2687C	ERR3_STAT2
	V92J4627CX	ERR_5_BCE		V98J2709C	ERR4_BCE
	V92J4622CX	ERR_5_EL		V98J2272C	ERR4_ELEM
	V92J4623CX	ERR_5_ID		V98U2273C	ERR4_STAT1
	V92U4626CX	ERR_5_STAT		V98U2711C	ERR4_STAT2
	V92J4625CX	ERR_5_CNT		V98J2733C	ERR5_BCE
	V92M4697PX	ERR_5_TIME		V98J2276C	ERR5_ELEM
				V98U2277C	ERR5_STAT1
				V98U2735C	ERR5_STAT2
IOLOGSM_1-3	V93Q0018CY	GPC_ID			
	V92J4330CY	ERR_1_BCE	MDM_RPC	V72S7981E	FF1_RPC_1
	V92J4325CY	ERR_1_EL		V72S7983E	FF2_RPC_1
	V92J4326CY	ERR_1_ID		V72S7985E	FF3_RPC_1
	V92U4329CY	ERR_1_STAT		V72S7987E	FF4_RPC_1
	V92J4328CY	ERR_1_CNT		V72S7991E	FA1_RPC_1
	V92M4389PY	ERR_1_TIME		V72S7993E	FA2_RPC_1
	V92J4407CY	ERR_2_BCE		V72S7995E	FA3_RPC_1
	V92J4402CY	ERR_2_EL		V72S7997E	FA4_RPC_1
	V92J4403CY	ERR_2_ID			
	V92U4406CY	ERR_2_STAT	MDM_RPC	V72S7972E	PF1_RPC_2
IOLOGSM_1-3	V92J4405CY	ERR_2_CNT	(continued)	V72S7973E	PF2_RPC_1
(continued)	V92M4467PY	ERR_2_TIME			
	V92J4484CY	ERR_3_BCE	MMU1_DISC	V92X7368XX	MM1RDY_GP1

	V92X7428XX	MM1RDY_GP2		V92M7361PX	GPC_1_WD_A
	V92X7488XX	MM1RDY_GP3		V92M7421PX	GPC_2_WD_A
	V92X7548XX	MM1RDY_GP4		V92M7541PY	GPC_4_WD_A
	V92X7608XX	MM1RDY_GP5		V98M0590P	BFS_WD_A
	V92X7366XX	IPLSEL_GP1			
	V92X7426XX	IPLSEL_GP2	PCMMU	V76X4265E	PCMMU1_PWR
	V92X7486XX	IPLSEL_GP3		V76X4272E	PCMMU2_PWR
	V92X7546XX	IPLSEL_GP4			
	V92X7606XX	IPLSEL_GP5	PF1_FAIL	V72S7972E	POWER
				V92U5510CX	PORT_VP
MMU1_STAT	V72M7320PX	GNC_MMU1_A		V91M2252PX	BYP_WD1
	V72M7330PX	GNC_MMU1_B		V91M2269PX	BYP_WD2
	V72M7320PY	SM_MMU1_A		V91M2801PX	BYP_WD3
	V72M7330PY	SM_MMU1_B			
	V72M7320PZ	OP0_MMU1_A	PF2_FAIL	V72S7973E	POWER
	V72M7330PZ	OP0_MMU1_B		V92U5510CX	PORT_VP
				V91M2252PX	BYP_WD1
MMU2_DISC	V92X7369XX	MM2RDY_GP1		V91M2269PX	BYP_WD2
	V92X7429XX	MM2RDY_GP2		V91M2801PX	BYP_WD3
	V92X7489XX	MM2RDY_GP3			
	V92X7549XX	MM2RDY_GP4	PL9_XMIT	V91M8706PZ	GPC1_XMIT1
	V92X7609XX	MM2RDY_GP5		V91M8723PZ	GPC1_XMIT2
	V92X7367XX	IPLSEL_GP1		V91M8740PZ	GPC2_XMIT1
	V92X7427XX	IPLSEL_GP2		V91M8757PZ	GPC2_XMIT2
	V92X7487XX	IPLSEL_GP3		V91M8774PZ	GPC3_XMIT1
	V92X7547XX	IPLSEL_GP4		V91M8791PZ	GPC3_XMIT2
	V92X7607XX	IPLSEL_GP5		V91M8808PZ	GPC4_XMIT1
				V91M8822PZ	GPC4_XMIT2
MMU2_STAT	V72M7370PX	GNC_MMU2_A		V91M8841PZ	GPC5_XMIT1
	V72M7380PX	GNC_MMU2_B		V91M8858PZ	GPC5_XMIT2
	V72M7370PY	SM_MMU2_A			
	V72M7380PY	SM_MMU2_B	RS_CS_MSKG	V91M2070PX	GPC_1_RS
	V72M7370PZ	OP0_MMU2_A		V91M2087PX	GPC_1_CS
	V72M7380PZ	OP0_MMU2_B		V91M2104PX	GPC_2_RS
				V91M2121PX	GPC_2_CS
MMU_POWER	V72S7185E	MMU1_PWR		V91M2138PX	GPC_3_RS
	V72S7186E	MMU2_PWR		V91M2155PX	GPC_3_CS
				V91M2172PX	GPC_4_RS
MST_ALARM	V73X1567E	MSTRALRM		V91M2200PX	GPC_4_CS
				V91M2203PX	GPC_5_RS
MTU_BITE	V75M3540P	MTU_BITE		V91M2204PX	GPC_5_CS
	V75S2236E	OSC1_MAN			
	V75S2237E	OSC2_MAN	SM_XMIT	V91M8706PY	GPC1_XMIT1
	V75X3541D	CONT_OSC1		V91M8723PY	GPC1_XMIT2
				V91M8740PY	GPC2_XMIT1
NSP2_SYNC	V74X5189E	NSP2BIT		V91M8757PY	GPC2_XMIT2
	V74X5177E	NSP2FRAME		V91M8774PY	GPC3_XMIT1
	V74X5020E	NSP2COM		V91M8791PY	GPC3_XMIT2
OPS_TRANS	V90Q8001C	GNC_OPS	SM_XMIT	V91M8808PY	GPC4_XMIT1
	M01G2500R	SPL_WORD_1	(continued)	V91M8822PY	GPC4_XMIT2
	M02G2500R	SPL_WORD_2		V91M8841PY	GPC5_XMIT1
	M03G2500R	SPL_WORD_3		V91M8858PY	GPC5_XMIT2



SOFT_ERR	V92M2909PX	GPC1_SEC
	V92M2910PX	GPC2_SEC
	V92M2911PX	GPC3_SEC
	V92M2912PX	GPC4_SEC
	V92M2913PX	GPC5_SEC
	V98M2576P	BFS_SEC
	TIME_SRC	V91Q1710CX
V91X1716XX		GP1SRC_0=A
V91Q1711CX		GPC2_SRC_#
V91X1717XX		GP2SRC_0=A
V91Q1712CX		GPC3_SRC_#
V91X1718XX		GP3SRC_0=A
V91Q1713CX		GPC4_SRC_#
V91X1719XX		GP4SRC_0=A
V91Q1714CX		GPC5_SRC_#
V91X1720XX		GP5SRC_0=A
TMBU_REJ		V92J0660C
VP_GNC	V92U5500CX	VP_SLOT_1
	V92U5502CX	VP_SLOT_2
	V92U5504CX	VP_SLOT_3
	V92U5506CX	VP_SLOT_4
	V92U5508CX	VP_SLOT_5
	V92U5510CX	VP_SLOT_6
	V92U5512CX	VP_SLOT_7
	V92U5514CX	VP_SLOT_8
	V92U5516CX	VP_SLOT_9
	V92U5518CX	VP_SLOT_10
VP_SM	V92U5500CY	VP_SLOT_1
	V92U5502CY	VP_SLOT_2
	V92U5504CY	VP_SLOT_3
	V92U5506CY	VP_SLOT_4
	V92U5508CY	VP_SLOT_5
	V92U5510CY	VP_SLOT_6
	V92U5512CY	VP_SLOT_7
	V92U5514CY	VP_SLOT_8
	V92U5516CY	VP_SLOT_9
	V92U5518CY	VP_SLOT_10

## TITLE

TEXT DECODING FOR PASS/BFS FAULT MESSAGES

## PURPOSE

To explain how to obtain the error message data from flight software deliverable CD ROM products for each mission. It also covers how to decode the error message from the bit structure contained in the PCMMU telemetry data.

PASS fault messages are defined in the following software modules available on compact disk.

- A. CDK-ANNUN (GNC list)
- B. CDQ-ANNUN (PL list)
- C. CDS-ANNUN (SSW list)
- D. CDT-ANNUN (SM list)
- E. CDZ-ANNUN (VU list)

BFS fault messages are defined in the FAULT software module.

Detailed instructions for locating PASS/BFS fault messages can be found in SCP 1.7.

Within these modules, two-line entries for each message contain the following data (see example in SCP 1.7):

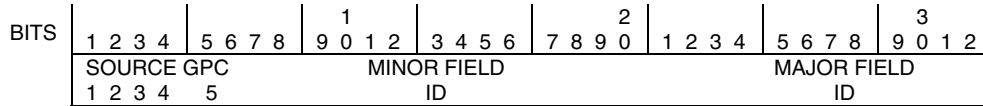
- A. Sequential listing (numerically; e.g., #1, #2, #3, etc.)
- B. Major field text
- C. Message code number
- D. Text structure in hex for 14-ASCII title length

A separate field list follows the major field segment containing similar data as described for the major fields (see example in SCP 1.7).

**BACKGROUND**

**A. PASS FAULT DISPLAY PROCESSING**

**1. PASS Message Format**



A 32-bit word will be downlisted for each message.

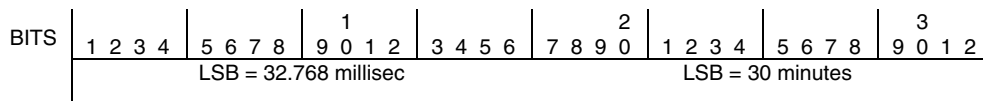
Bits 1-5 correspond to GPCs 1-5, and identify the source of a fault. For example, if bit 3 is set, GPC 3 is the one which detected the fault. Multiple bits can be set.

Bits 6-16 hex represent a decimal number which is the minor field ID.

Bits 17-32 hex represent a decimal number which is the major field ID.

The message IDs and corresponding text are predefined and stored in the MCC.

**2. PASS Time Format (GMT)**



Each fault summary message shall be timetagged with a 32-bit measurement. The timetags are composed of two 16-bit words; one with a least significant bit (LSB) of 30 minutes and the other with an LSB of 32.768 milliseconds, GMT.

**PASS Measurement Inputs**

**3. The following MML MSIDs identify the PCMMU downlist data for the PASS fault messages:**

DOWNLIST	<u>GNC</u>	<u>SM</u>	<u>OPS-0</u>
MSG #	1	V92M7002PX	V92M7002PY
	2	V92M7017PX	V92M7017PY
	3	V92M7031PX	V92M7031PY
	4	V92M7046PX	V92M7046PY
	5	V92M7061PX	V92M7061PY
GMT	V92M7009PX	V92M7009PY	V92M7009PZ
	V92M7024PX	V92M7024PY	V92M7024PZ
	V92M7038PX	V92M7038PY	V92M7038PZ
	V92M7053PX	V92M7053PY	V92M7053PZ
	V92M7068PX	V92M7068PY	V92M7068PZ
GPC ID	V93Q0018CX	V93Q0018CY	V93Q0018CZ

If the console operators desire to look at the PCMMU data for the fault message downlists, the data of the above MML numbers can be viewed via a DNAV DPS || ISP CONTROLS | Utilities | Universal Digital as specified in FCOH SOP 4.4.2.

**4. MCC PASS Message Output**

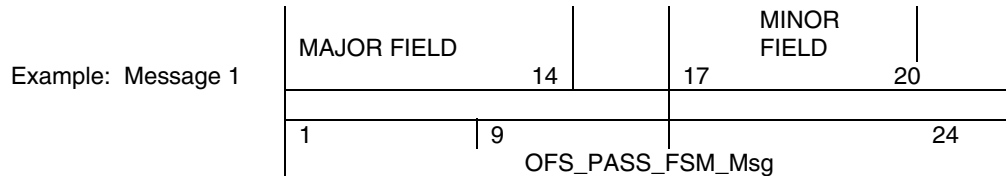
Computation numbers are provided to enable display of information from the special comps onto any workstation application. Only the five most recent fault message lines from the special display will be available to other displays.

a. Data set selection: OFS\_PASS\_Downlist is a three-character text output that indicates which downlist (GNC, SM, or OPS-00) is the selected source of fault summary data.

b. Major field and minor field text

- Message 1: OFS\_PASS\_FSM\_Msg\_1
- 2: OFS\_PASS\_FSM\_Msg\_2
- 3: OFS\_PASS\_FSM\_Msg\_3
- 4: OFS\_PASS\_FSM\_Msg\_4
- 5: OFS\_PASS\_FSM\_Msg\_5

The major field text has a maximum of 14 characters, and the minor field text has a maximum of 4 characters, for a total of 18. Two spaces will be left blank between the fields. One computation symbol is necessary for display of 20 characters, as illustrated.



c. GPC fault source: This is a five-character field associated with each message which will display the number (1-5) of each GPC which detected a particular fault.

- Measurement numbers: 1: OFS\_PASS\_FSM\_GPC\_1
- 2: OFS\_PASS\_FSM\_GPC\_2
- 3: OFS\_PASS\_FSM\_GPC\_3
- 4: OFS\_PASS\_FSM\_GPC\_4
- 5: OFS\_PASS\_FSM\_GPC\_5

Example: Most recent fault is detected by GPCs 1, 2, and 5.  
Then OFS\_PASS\_FSM\_GPC\_1 = 12\_\_5.

- d. The following computation outputs will contain the fault message timetags from the data set that is selected for processing:

Timetag for message	1: OFS_PASS_FSM_Time_1
	2: OFS_PASS_FSM_Time_2
	3: OFS_PASS_FSM_Time_3
	4: OFS_PASS_FSM_Time_4
	5: OFS_PASS_FSM_Time_5

#### 5. MCC PASS Fault Display Logic

The GNC, SM, and OPS-00 downlists all contain fault summary parameters and timetags. The data from each set have unique measurement numbers, but are otherwise identical in structure. The MCC will be initialized to process the GNC downlist.

An indication of which downlist is selected for processing is based on the setting of OFS\_PASS\_Downlister.

It is required to reconstruct the 1000 most recent fault summary display messages for OFS display. Inputs will be GPC downlist parameters which describe the five most recent messages, plus timetags which will give time of fault occurrence. A given timetag will be in GMT. Fault data are loaded in the downlisted parameters so as to form a pushdown list. The message 1 slots and the associated timetag always contain data pertaining to the most recent message. Each succeeding message will be loaded in the message 1 slots, and previous data in those slots will be pushed down to the message 2 slots, and so on.

The message description parameter will contain the following information:

- a. Major Field ID - Identifies an alphanumeric message with a maximum length of 14 characters.
- b. Minor Field ID - Identifies alphanumeric text with a maximum of four characters.
- c. Source ID - Indicates the number of the GPC which detected the fault. If other GPC's subsequently detect the same fault, their numbers will also be indicated.

Each fault message for OFS display shall occupy one line composed of major field text, minor field text, a number from 1 to 5 for each GPC which detected the fault, and a timetag. The major field text will be placed in the first 14 spaces on the left. Two spaces will be skipped, then the minor field text will be placed in the next four spaces.

Initially, the message lines on OFS will be blank. Each new fault message will be placed on the top line. As each new message is added, older messages will be pushed down on the display.

For any downlisted PASS IDs not found in the fault message text tables, there is a requirement to drive the PASS FAULT display with the following message text: "INVALID - XXXYY," where XXX is the decimal equivalent of the downlisted major field ID, and YY is the decimal equivalent of the downlisted minor field ID. The timetag of this message in normal scaled form will also be displayed. The console operator then would solve the code and determine the message text. This provides more flexibility in that it allows message texts not tabled in the MCC to be displayed in a coded form.

**B. BFS FAULT DISPLAY PROCESSING**

**1. BFS Message Format**

BITS	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6
	SPARE				MESSAGE ID											

The message ID is a number which is right-justified in bits 6-16. It identifies a text message. The message ID's and corresponding text are predefined and stored in the MCC.

**2. BFS Time Format (MET)**

There are five lines reserved for time format.

The timetags are 32 bits long. They are scaled with a least significant bit value of 32.768 milliseconds.

**3. BFS Measurement Inputs**

The following MML MSIDs define the PCMMU data for the BFS fault messages:

MSG	1-V98M1300P
	2-V98M1305P
	3-V98M1310P
	4-V98M1315P
	5-V98M1320P
TIME	1-V98W1330C
	2-V98W1331C
	3-V98W1332C
	4-V98W1333C
	5-V98W1334C
GPC ID	V98Q0012C

If the console operators desire to look at the raw data for the fault message downlists from the BFS, the data of the above MML numbers can be viewed via DNAV DPS II ISP Controls | Utilities | Universal Digital as specified in FCOH SOP 4.4.2.

#### 4. MCC BFS Message Output

Computation numbers are provided to enable display of information from the special comps onto any workstation application. Only the five most recent fault message lines will be available to other displays.

- a. Major field and minor field text (one computation symbol is required to display each message).

Message	1: OFS_BFS_FSM_Msg_1
	2: OFS_BFS_FSM_Msg_2
	3: OFS_BFS_FSM_Msg_3
	4: OFS_BFS_FSM_Msg_4
	5: OFS_BFS_FSM_Msg_5

- b. Fault message timetags and GPC ID (the number of the GPC driving the BFS data set) may be displayed directly from telemetry inputs.

Timetag for message:	1: V98W1330C
	2: V98W1331C
	3: V98W1332C
	4: V98W1333C
	5: V98W1334C
GPC ID:	V98Q0012C

#### 5. BFS Fault Display Logic

It is required to reconstruct and save the 1000 most recent fault messages for output on OFS. The most recent five messages will be received in the BFS downlist, in the same pushdown list arrangement described earlier. A given timetag will be in MET. Only three messages will be received in low bit rate formats, but processing will continue, using these three messages.

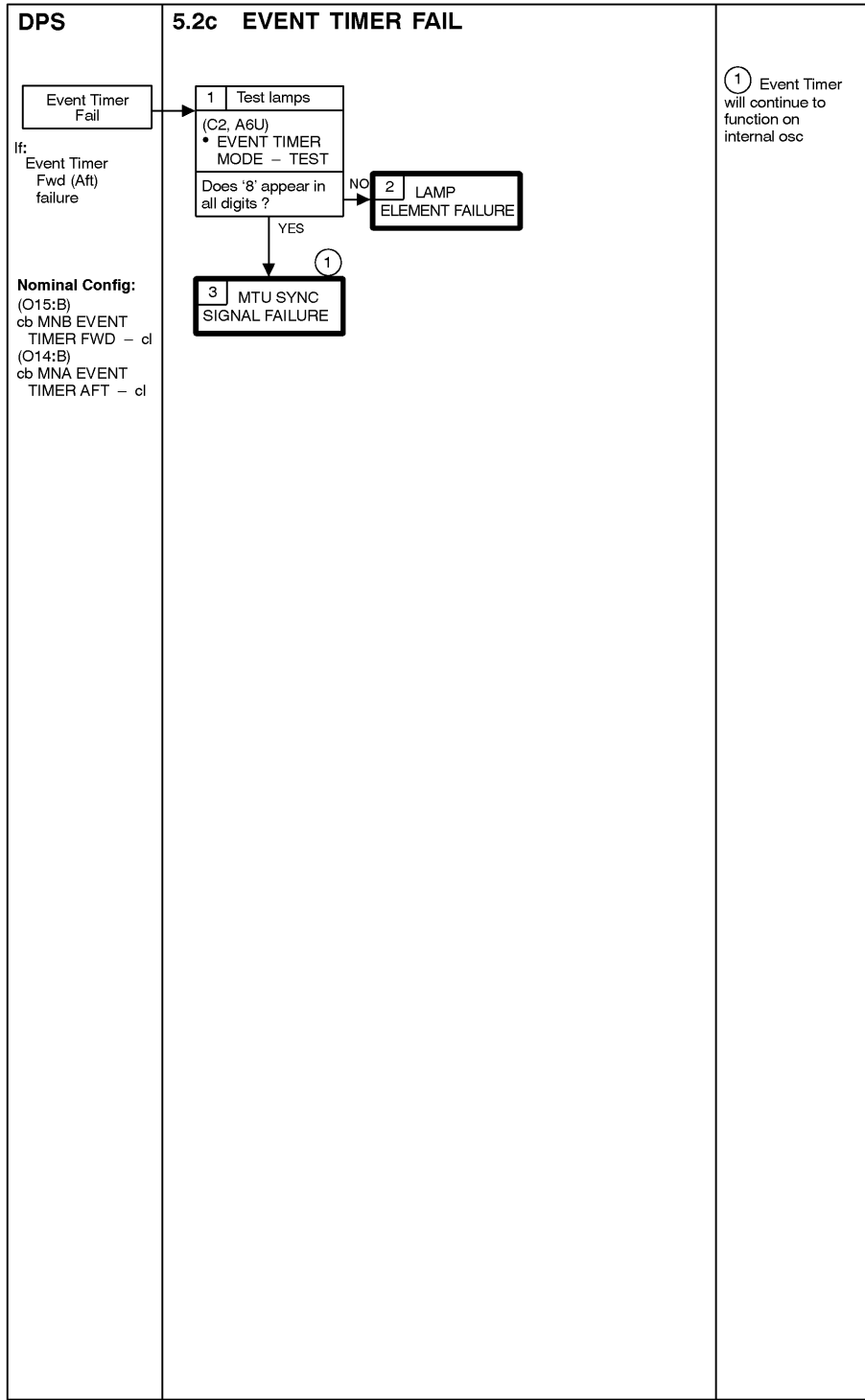
Each fault message for OFS display shall occupy one line, composed of message text and timetag. the first part of the text (14 characters maximum) is called the major field. The second part (four characters maximum) is called the minor field. Allowing 2 spaces between the major and minor fields makes a total field length of 20 spaces which are required for display of the text.

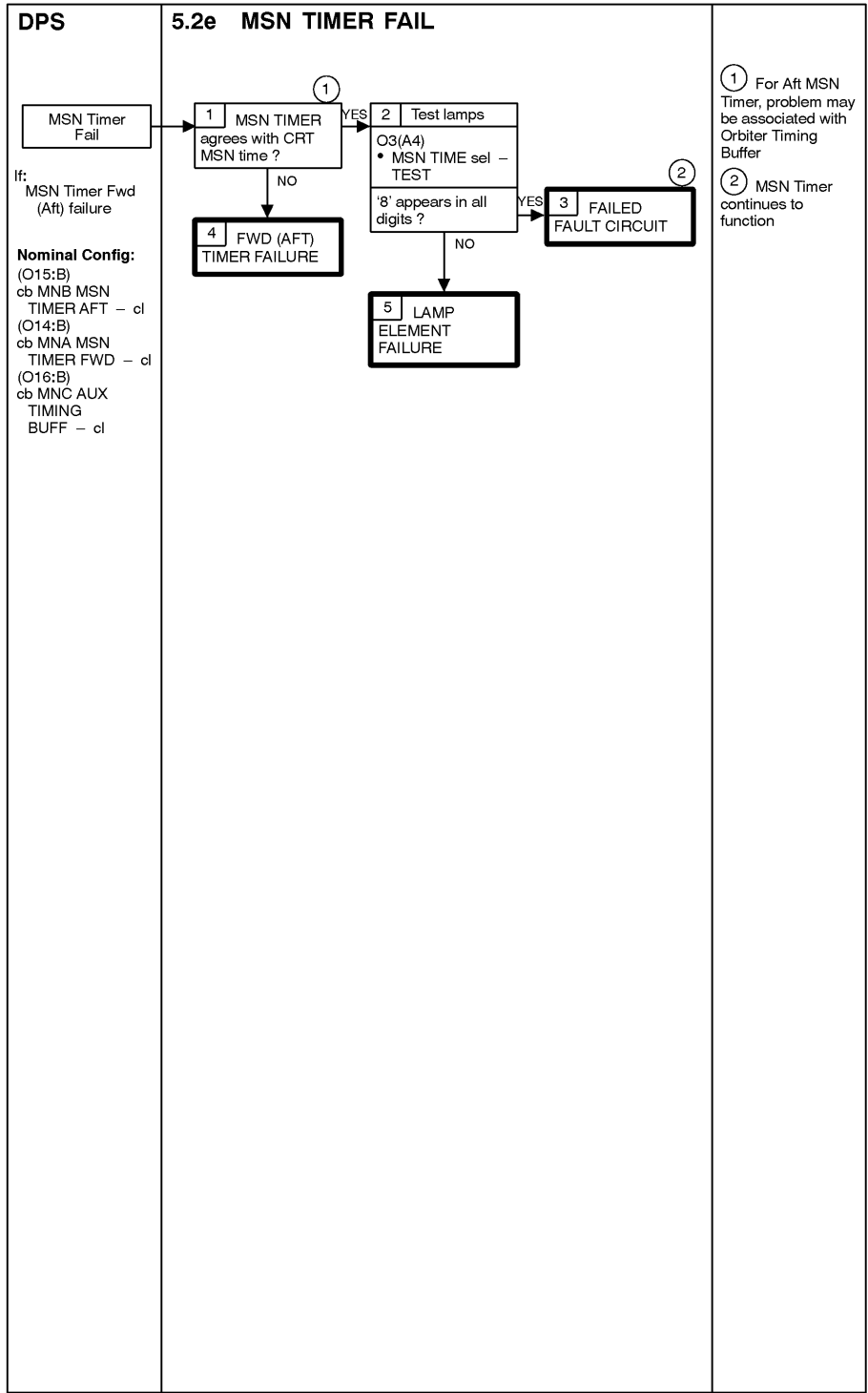
Initially, the message lines on the OFS will be blank. Each new fault message will be placed on the top line. As each new message is added, older messages will be pushed down.

For any downlisted BFS IDs not found in the fault message text tables, there is a requirement to drive to the BFS FAULT display the following message text: "INVALID - ZZZ," where ZZZ is the decimal equivalent of the downlisted three-digit ID. The timetag of this message in normal scaled form will also be displayed. The console operator then would solve the code and determine the message text. This allows more flexibility in that it allows undefined MCC message texts to be displayed in a coded form.

Because of the long lead time required to define fault message tests and IDs in the MCC, and because payload-unique fault messages change each flight, there is a set of payload fault messages that are not defined in the MCC and will appear as "INVALID-XXXXXX," where XXXXXX is the major and minor field IDs. It is up to the POCC and the Payloads Officer to decode and interpret them, though the DPS officer may be called upon to assist.



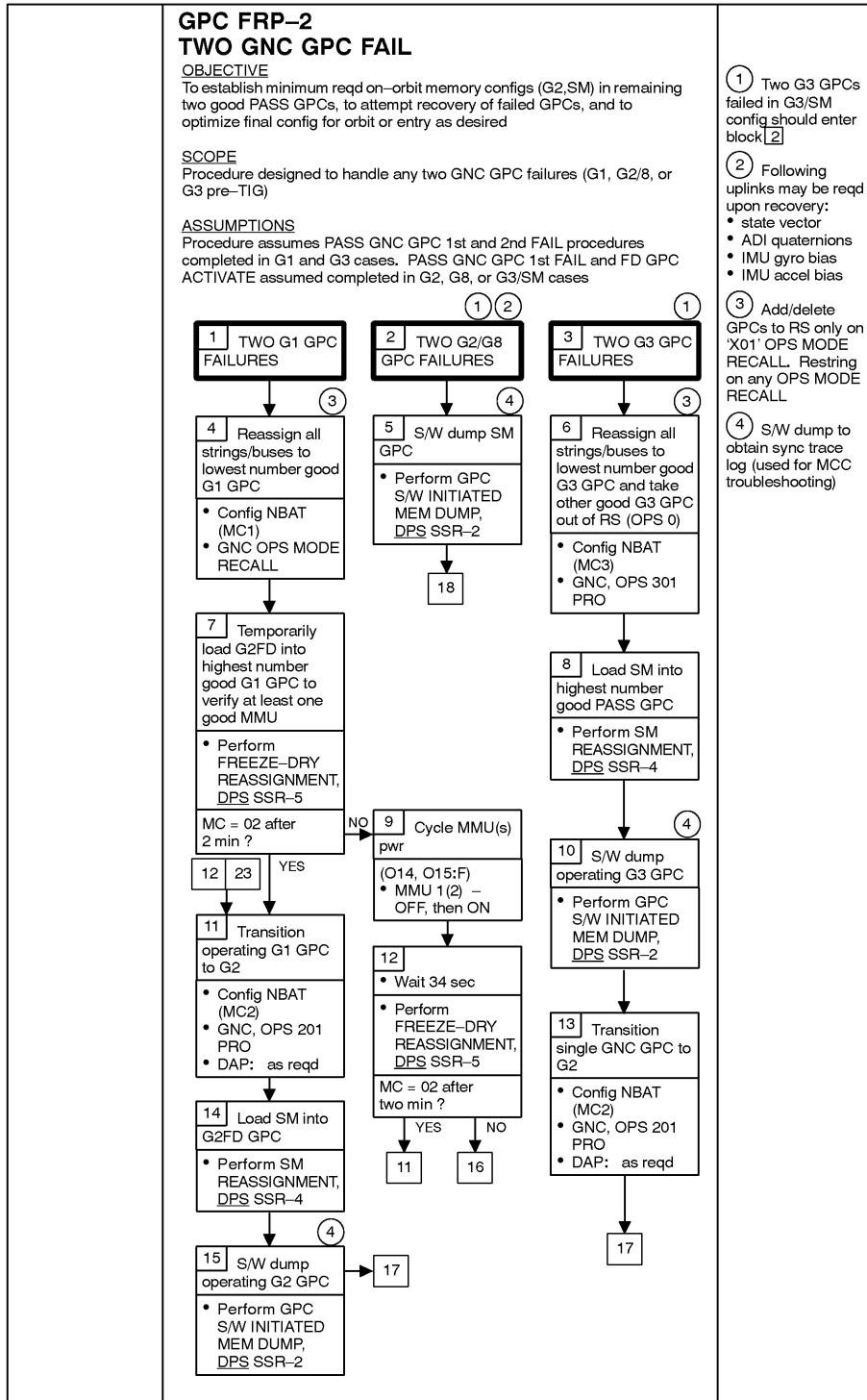


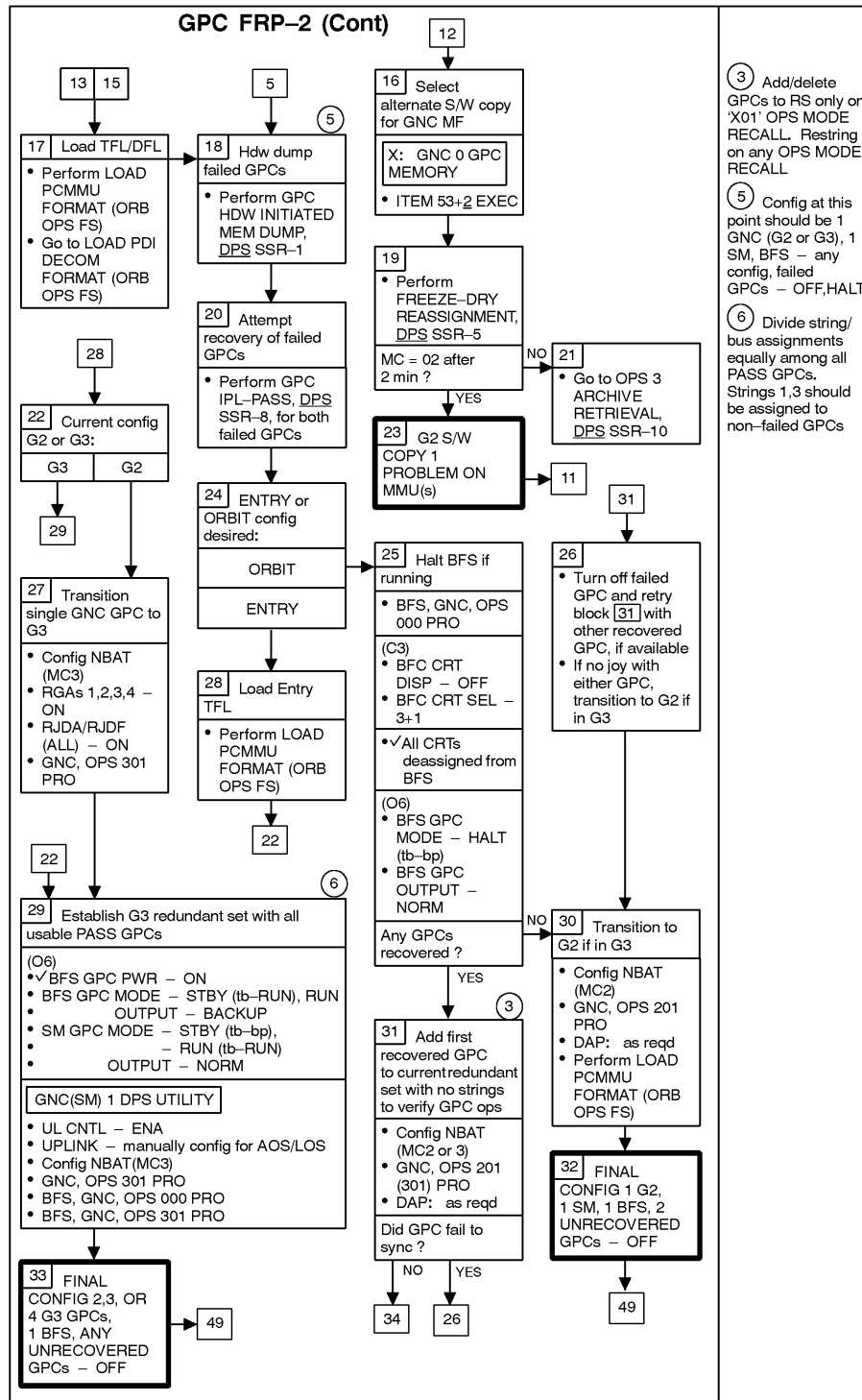


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MAL/ALL/GEN C





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MAL/ALL/GEN C, 11



DPS SSR

**DPS SSR-1  
GPC HDW INITIATED MEM DUMP**

NOTE

If no SM, dump must be performed AOS

- O6 1. ✓ GPC MODE 1(2,3,4,5) — HALT  
PWR 1(2,3,4,5) — ON  
OUTPUT 1(2,3,4,5) — TERM

- MO42F 2. GPC MEM DUMP — 1(2,3,4,5)

3. SM 76 COMM/RCDR

NOTE

If all verification steps below are not met, do not proceed. ✓MCC

- ✓ OPS RCDR 1(2) MODE — RCDA  
✓ TAPE — RUN  
✓ NSP DATA XMIT — HI

or

- ✓ NSP DATA XMIT — LO and  
NSP ENCRYPTION MODE — SEL

A1L

4. SM 62 PCMMU/PL COMM

- ✓ TFL is compatible with dump using GPC DUMP/TFL  
COMPATIBILITY table, LOAD PCMMU FORMAT (ORB OPS FS)  
If TFL not compatible, ✓MCC before changing TFL

SM 76 COMM/RCDR

5. If PASS:  
If OPS RCDR 1(2) DIR — FWD and TAPE — 5% to 75%, or  
If OPS RCDR 1(2) DIR — REV and TAPE — 95% to 25%, OK to perform dump  
If BFS:  
If OPS RCDR 1(2) DIR — FWD and TAPE — 5% to 55%, or  
If OPS RCDR 1(2) DIR — REV and TAPE — 45% to 95%, OK to perform dump  
If % tape outside limits, wait until within limits to perform dump  
Record: OPS RCDR \_\_\_\_\_ TRK \_\_\_\_\_  
% TAPE \_\_\_\_\_ MET \_\_\_\_\_  
(Voice to gnd when AOS)

6. If PASS:  
Select failed GPC X as downlister (avoids downlist contention)  
SM(GNC) 0 GPC MEMORY  
DOWNLIST GPC — ITEM 44 +X EXEC

- O6 7. GPC MODE 1(2,3,4,5) — STBY (starts dump)  
Wait: Double dump of PASS GPC complete after 4 min; single dump of BFS complete after 8 min

- O6 GPC MODE 1(2,3,4,5) — HALT (stops dump)  
OUTPUT 1(2,3,4,5) — NORM

8. If PASS:  
Select lowest ID GNC GPC X as downlister  
SM(GNC) 0 GPC MEMORY  
DOWNLIST GPC — ITEM 44 +X EXEC

- MO42F 9. GPC MEM DUMP — OFF

- C3 10. If in FXD format, go back to soft formats:  
✓ OI PCMMU FORMAT — GPC  
SM 62 PCMMU/PL COMM  
✓ FMT PGM — ITEM 2 (\*) >>  
If reqd, load TFL best suited to current GPC config:  
LOAD PCMMU FORMAT (ORB OPS FS)

DPS SSR-2  
GPC S/W INITIATED MEM DUMP

NOTE

If no SM, dump must be performed AOS

1. SM 76 COMM/RCDR

NOTE

If all verification steps below are not met, do not proceed. ✓MCC

- ✓ OPS RCDR 1(2) MODE – RCDA
- ✓ TAPE – RUN

If NSP DATA XMIT – HI, use DUMP HDR in all tables and steps below

If NSP DATA XMIT – LO, use DUMP LDR in all tables and steps below

2. SM 62 PCMMU/PL COMM

- ✓ TFL is compatible with dump using GPC DUMP/TFL COMPATIBILITY table – LOAD PCMMU FORMAT (ORB OPS FS)
- If TFL not compatible, ✓MCC before changing TFL

SM 76 COMM/RCDR

OK to perform dump if OPS RCDR 1(2) TAPE % is as follows:

DIR	DUMP HDR	DUMP LDR
FWD	5% to 55%	5% to 13%
REV	45% to 95%	87% to 95%

If tape outside limits, wait until within limits to perform dump

3. If PASS:

- a. On CRT assigned to GPC to be dumped,

GNC(SM,PL) 0 GPC MEMORY

If GNC GPC to be dumped, ✓DOWNLIST GPC – ITEM 44 = GNC GPC to be dumped  
If OPS 0/PL9 GPC to be dumped, OPS 0 ENA – ITEM 49 EXEC (\*) (✓TFL 163)

- b. MEMORY DUMP (setup):

START ID – ITEM 40 + 0 0 0 0 0 EXEC

NUMBER WDS – ITEM 41 + 2 6 2 1 4 4 EXEC

WDS/FRAME – ITEM 42 + X X X EXEC

(DUMP HDR – 128 if G1/G3, 112 if G2/G8, 32 if OPS 0/PL9, 48 if SM)

(DUMP LDR – 64 if G1/G3, 56 if G2/G8, 16 if OPS 0/PL9, 24 if SM)

SM 76 COMM/RCDR

Record: OPS RCDR \_\_\_\_\_ TRK \_\_\_\_\_

% Tape \_\_\_\_\_ MET \_\_\_\_\_

(Voice to ground when AOS)

- c. MEMORY DUMP (start):

GNC(SM,PL) 0 GPC MEMORY

DUMP – ITEM 43 EXEC (ITEM 40,41 entries begin counting)

Dump complete when ITEM 40,41 blank

Dump time (in min):

Rate	GNC	SM	OPS 0/PL9
DUMP HDR	1.8	4.5	8
DUMP LDR	3.8	12	26

If GNC GPC was dumped,

✓DOWNLIST GPC – ITEM 44 = lowest id GNC GPC

If OPS 0/PL9 GPC was dumped,

OPS 0 ENA – ITEM 49 EXEC (no \*)

- d. Perform step 5

DPS SSR-2 (Cont)

4. If BFS:
- a. MEMORY DUMP (setup):  
 GNC 0 BFS MEMORY  
START ID - ITEM 21 +0 0 0 0 EXEC  
NUMBER WDS - ITEM 22 +2 6 2 1 4 4 EXEC  
WDS/FRAME - ITEM 23 +X X EXEC (HDR-32, LDR-16)  
On PASS SM CRT:  
 SM 76 COMM/RCDR:  
Record: OPS RCDR \_\_\_\_\_ TRK \_\_\_\_\_  
% Tape \_\_\_\_\_ MET \_\_\_\_\_  
(Voice to ground when AOS)
  - b. MEMORY DUMP (start):  
 GNC 0 BFS MEMORY  
DUMP - ITEM 24 EXEC (ITEM 21,22 entries begin counting)  
Dump complete when ITEM 21,22 blank (after 8 min - HDR, 26 min - LDR)
  - c. Perform step 5
- C3
5. If dump performed because of GPC failure that came from DPS GPC FRP-1,FRP-2:  
TFL change may be reqd for SSR-1 HDW dump >>
- If not dumping because of GPC failure:  
If in FXD format, go back to soft formats:
- ✓OI PCMMU FORMAT - GPC  
 SM 62 PCMMU/PL COMM  
✓FMT PGM - ITEM 2 (\*) >>
- If reqd, load TFL best suited to current GPC config:  
LOAD PCMMU FORMAT (ORB OPS FS)
- C3



**DPS SSR-16  
PL MDM CHECKOUT**

NOTE

One or more of the following fault msgs may be annunciated at I/O RESET or port moding steps:

'I/O ERROR FLEX'  
'BCE BYP FLEX'  
'BCE BYP SCA'  
'BCE BYP KU'  
'S62 BCE BYP PSP1(2)'  
'S62 BCE BYP PL'  
'S62 BCE BYP PDI'

If unexpected fault msg occurs for aff MDM, record fault msg and continue

- O6
1. MDM PL1,PL2 - ON  
 FAULT  
 SM CRT - I/O RESET  
 Observe fault msgs for aff MDMs:  
 ✓No 'I/O ERROR PL1(2)'  
 ✓No 'MDM OUTPUT PL1(2)'
  2.  SM1 DPS UTILITY  
 Select SEC ports on aff MDMs:  
 PORT ASSIGN SEC - ITEM 24 EXEC (\*)  
 FAULT  
 Observe fault msgs for aff MDMs:  
 ✓No 'I/O ERROR PL1(2)'  
 ✓No 'MDM OUTPUT PL1(2)'
  3.  SM1 DPS UTILITY  
 Reselect PRI ports on aff MDMs:  
 PORT ASSIGN SEC - ITEM 23 EXEC (\*)
  4. Return to MDM CHANGEOUT (IFM)  
 ✓MCC for additional MDM/LRU checkout

**DPS SSR-17  
MTU YEAR-END ROLLOVER RECOVERY**

NOTE

Complete procedure immediately. Procedure recovers MTU faultdown caused by year-end rollover occurring at 1 sec past GMT 365:23:59:59 and again at 1 sec past GMT 366:23:59:59 (375:23:59:59, 376:23:59:59)

- O6
1.  SM(GNC) 2 TIME (not available in G1/G3 or OPS 0 from G1/G3)  
 ✓Down arrows on MTU ACCUM 1,2,3 and GMT Day 1  
 ✓GPC GMT reflect day 366 (367)  
 ✓All active GPCs reflect GPC GMT source  
 TIME SYNC - ITEM 38 EXEC

NOTE

MTU ACCUM 1,2,3 will reflect 000:00:0X:XX until TIME SYNC complete (1-2 min),

GPC will falsely annunciate 'TIME MTU' msg if it has performed TFL LOAD or if it has outstanding fail votes against another GPC,

Disregard ↓ arrows next to MTU ACCUM 2,3

2. ✓MTU ACCUM 1,2,3 aligned to GPC GMT  
 ✓All active GPCs reflect MTU ACCUM time source
3. Perform manual trys on Accumulators 2 and 3 to clear down arrows:  
 Try MTU ACCUM 2 - ITEM 35 EXEC  
 Try MTU ACCUM 3 - ITEM 36 EXEC
4. Reselect Accumulator 1:  
 Try MTU ACCUM 1 - ITEM 34 EXEC

DPS SSR-20  
SET EXPANSION USING LDB OPTION

1. Confirm LDB DBIAs unpowered:  
  ✓MEC 1 – OFF (wait 2 sec)  
  ✓2 – OFF
  2. If RMS onboard and PWRD:  
  Expect GPC DATA It – on after SM OPS mode recall  
  SM 94 PDRS CONTROL  
  Note WR range, PL ID, PL INIT ID, EE ID, SPEC 95
  3. Deassign LDBs from SM:  
  SM 0 GPC MEMORY  
  If SM GPC active:  
    Config – ITEM 1 +4(5) EXEC  
    Launch 1/2 – ITEM 16 +0 +0 EXEC  
    SM, OPS 201(401) PRO
- C2
4. If RNDZ NAV enabled and UNIV PTG in TRK with TGT ID = 1:  
  DAP: FREE  
  UNIV PTG  
  CNCL – ITEM 21 EXEC
  5. GNC 1 DPS UTILITY  
  MMU SOURCE/BUS GPC/LDB – ITEM 11 EXEC (\*)
  6. If target GPC MODE – HALT:  
  ✓TARGET GPC PWR – ON  
  MODE – STBY (tb-RUN), RUN
  7. ✓Target GPC OUTPUT – NORM
  8. ✓All GPCs being added to current redundant set in OPS 0. If new GPC is  
  in simplex ops (SM or PL), select OPS 0 via OPS 000 PRO
  9. GNC 0 GPC MEMORY  
  Config NBAT as reqd  
  ✓BFS CRT DISP – OFF
- C2      Using CRT commanded by a current redundant set GNC GPC, GNC, OPS 201 (301, 801) PRO

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DPS SSR-20 (Cont)

10. When transition complete:  
If PASS and BFS in G3:  
BFS CRT - I/O RESET
11. GNC 1 DPS UTILITY  
MMU SOURCE/BUS GPC/MMU ITEM 9 EXEC (\*)
12. If SM GPC active:  
SM 0 GPC MEMORY  
Reassign LDBs to SM GPC:  
Config - ITEM 1 +4(5) EXEC  
Launch 1 - ITEM 16 +X EXEC  
SM, OPS 201 (401) PRO
13. If resuming RNDZ ops:  
Perform RNDZ NAV RECOVERY (RNDZ, CONTINGENCY OPERATIONS)
14. If RMS onboard, config PWR as reqd:  
SM 94 PDRS CONTROL (MA, GPC DATA It - on)  
✓RMS PWR - PRI  
I/O ON - ITEM 5 EXEC (\*) (GPC DATA It - off)  
SAFING - CANCEL (tb-gray if arm selected)  
Update as needed:  
WR range, PL ID, PL INIT, EE ID, SPEC 95

DPS SSR-21  
BFS GMT/MET RECOVERY

Proper procedure execution requires all of the following:

1. Presence of PASS driven CRT with acceptable GMT/MET
2. Presence of BFS driven CRT with keyboard input capability
3. BFS time (GMT and/or MET) is in error beyond acceptable limits

If BFS GMT update reqd:

: GNC 0 BFS MEMORY

NOTE

BFS must be in OPS 0 before GMT update can be successfully performed; if BFS is not in OPS 0, √MCC before proceeding

1. Select GMT for BFS mission time display  
MISSION TIME GMT – ITEM 39 EXEC (\*)
2. Record GMT at which update is to occur (If necessary, √MCC)

\_\_\_\_ : \_\_\_\_ : \_\_\_\_ : \_\_\_\_  
Day Hr Min Sec

3. Input desired GMT (from step 2)

BFS TIME UPDATES GMT – ITEM 30 + \_\_\_\_ + \_\_\_\_ + \_\_\_\_ + \_\_\_\_ EXEC

4. Select GMT for PASS mission time display  
If TIME display not available (PASS in G1/G6/G3), √MCC

: GNC(SM) 2 TIME

MISSION TIME GMT – ITEM 1 EXEC (\*)

5. Arm update mechanism

: GNC 0 BFS MEMORY

CAUTION

Do not perform 'EXEC' until step 6

UPDATE – ITEM 38

6. On PASS CRT, monitor GMT:  
When PASS GMT = desired GMT – 1 sec  
On BFS CRT, perform update:  
EXEC
7. MCC will verify that BFS GMT updated correctly
8. Reselect MET for PASS mission time display  
MISSION TIME MET – ITEM 2 EXEC (\*)

DPS SSR-21 (Cont)

**CAUTION**  
If BFS is subsequently deactivated after GMT update is accomplished, BFS GMT will again be in error upon BFS reactivation. Update will have to be performed again

If BFS MET update reqd:

: GNC 0 BFS MEMORY

**NOTE**  
BFS must be in OPS 301 before MET update can be successfully performed; if BFS is not in OPS 301, √MCC before proceeding. Also, consideration should be given to performing MET update after the entire PASS G3 redundant set is formed. BFS is transitioned to OPS 0 during forming of the entire PASS G3 redundant set; anytime BFS is transitioned to OPS 0, MET ceases to update

1. Select MET for BFS mission time display  
MISSION TIME MET – ITEM 40 EXEC (\*)
2. Record MET at which update is to occur (If necessary, √MCC )

\_\_\_\_ : \_\_\_\_ : \_\_\_\_  
Day    Hr    Min    Sec

3. Input desired MET (from step 2)

BFS TIME UPDATES MET – ITEM 34 + \_\_\_\_ + \_\_\_\_ + \_\_\_\_ + \_\_\_\_ EXEC

4.  MET is selected for PASS mission time display  
If TIME display not available (PASS in G1/G6/G3), √MCC

: GNC(SM) 2 TIME

MISSION TIME MET – ITEM 2 EXEC (\*)

5. Arm update mechanism

: GNC 0 BFS MEMORY

**CAUTION**  
Do not perform 'EXEC' until step 6

UPDATE – ITEM 38

6. On PASS CRT, monitor MET:  
When PASS MET = desired MET – 1 sec  
On BFS CRT, perform update:  
EXEC
7. MCC will verify that BFS MET is updated correctly

**NOTE**  
If BFS is subsequently deactivated or transitioned to OPS 0 after MET update is accomplished, BFS MET will again be in error upon BFS reactivation or transition from OPS 0. Update may have to be performed again

DPS SSR-22  
G3FD GPC ACTIVATE

NOTE

This procedure assumes FD GPC ACTIVATE (ORB PKT) procedure has been performed prior to entry into this SSR

- O14 1. ✓RGAs (four) – ON
- O6 2. (G3FD) ✓GPC MODE – HALT  
           ✓OUTPUT – NORM  
           GPC PWR – ON  
           GPC MODE – STBY (tb-RUN), RUN
- C2 3. CRTX MAJ FUNC – GNC  
       GPC/CRT – G3FD/X EXEC
- 4. If G3FD activation fails:  
       (G3FD) GPC PWR – OFF  
       Go to DPS, [5.1], BFS ENGAGE
- 5. GNC 0 GPC MEMORY  
    Assign target GPC (G3FD) all strings, CRTs, and MMs in MC3  
    ✓ PL 1/2 and LAUNCH 1,2 deassigned  
    DOWNLIST GPC – ITEM 44 + (G3FD) EXEC  
    O14,O15, ✓PRI RJDS LOGIC,DRIVER (sixteen) – ON  
    O16  
           GNC, OPS 301 PRO (G3FD CRT)  
    C3     DAP: as reqd  
           SM 2 TIME TRY – ITEM 34 EXEC
- 6. If RMS powered and SM GPC MODE transitioned to STBY then RUN:  
       SM 94 PDRS CONTROL (MA, GPC DATA It on)  
       I/O ON – ITEM 5 EXEC (\*) (GPC DATA It off)  
    A8U     SAFING – CANCEL
- 7. SM 62 PCMMU/PL COMM  
    C3     PCMMU FMT: SEL FXD – ITEM 1 EXEC (\*)  
           Perform LOAD PCMMU FORMAT; use format for LOSS OF 2 GNC  
           GPC (ORB OPS FS, COMM/INST), then:  
           If no comm at AOS, sel best S-BD PM ANT  
           Go to DPS, GPC FRP-2

GPC FRP-5  
PL9 ASSIGNMENT (DEU IPL-PASS OR MMU READ/WRITE)

**NOTE**

Procedure assumes nominal ORBIT config

- O6  
L1  
O6
- a. Prepare for PL9 assignment:
- Perform LOAD PCMMU FORMAT (ORB OPS FS, COMMANST)
- If GPC 2 in HALT:
- ✓ GPC MODE 2 - HALT
  - ✓ AV BAY 2 FAN A(B) - ON
  - ✓ GPC PWR 2 - ON
  - MODE 2 - STBY (to-RUN), then RUN
  - If reqd, perform GNC REASSIGNMENT (G2) ..... DPS SSR-3

CONFIG GPC	2
	10000
STR 1	1
2	1
3	1
4	1
PL 1/2	0
CRT 1	1
2	1
3	0
4	1
L 1	0
2	0
MM 1	1
2	1

- C2
- b. Establish PL9 in GPC 2
- CRT X MAJ FUNC - PL (where X = 1,2,3, or 4 as appropriate)
  - GPC/CRT 2 X EXEC
- X: PL 0 GPC MEMORY
- CONFIG - ITEM 1 to EXEC
  - Assign desired GPC, CRTs, and MMs to GPC 2
  - PL OPS 901 PRO

CONFIG GPC	8
	02000
STR 1	0
2	0
3	0
4	0
PL 1/2	0
CRT 1	2
2	2
3	0
4	2
L 1	0
2	0
MM 1	2
2	2

- c. Perform DEU IPL-PASS/BFS, DPS SSR-8 or MMU Dump Read/Write as desired

- d. Reassign GNC to current PL9 GPC
- CRT - PL OPS 000 PRO
  - Perform GNC - REASSIGNMENT (G2) ..... DPS SSR-3
  - Perform LOAD PCMMU FORMAT (ORB OPS FS, COMMANST)

CONFIG GPC	2
	12000
STR 1	1
2	2
3	1
4	2
PL 1/2	0
CRT 1	1
2	2
3	0
4	2
L 1	0
2	0
MM 1	1
2	2

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GPC FRP-5 (Cont)

• If single GNC GPC config desired, perform step e

Final Config					
GPC OPS	1	2	3	4	5
	G2	G2	G2FD	SM	BFS
POWER OUTPUT MODE	ON NORM RUN	ON NORM RUN	ON NORM HALT	ON TERM RUN	ON NORM HALT
CONFIG GPC	2 12000	4(5) 00040			
STR 1	1	0			
2	2	0			
3	1	0			
4	2	0			
PL 1/2	0	4			
CRT 1	1	4			
2	2	4			
3	0	0			
4	2	4			
L 1	0	4			
2	0	0			
MM 1	1	4			
2	2	4			

e. Establish single GNC GPC config

- Perform GNC REASSIGNMENT (G2) ..... DPS SSR-3 →
- CRT X MAJ FUNC - PL
- GPC/CRT 2X EXEC

X: PL 0 GPC MEMORY

- CONFIG - ITEM 45 +2 EXEC
- GPC - ITEM 46 +2 EXEC
- STORE - ITEM 47 EXEC
- Store complete when MC = 02 (-22 sec)
- GPC MODE 2 - STBY (tb-bp), then HALT
- - STBY (tb-RUN)
- - HALT (tb-bp)
- Put AV BAY 2 FAN A(B) into pre-FRP-5 config

O6

L1

CONFIG GPC	2 10000
STR 1	1
2	1
3	1
4	1
PL 1/2	0
CRT 1	1
2	1
3	0
4	1
L 1	0
2	0
MM 1	1
2	1

Final Config Single GNC GPC					
GPC OPS	1	2	3	4	5
	G2	G2FD	G2FD	SM	BFS
POWER OUTPUT MODE	ON NORM RUN	ON NORM HALT	ON NORM HALT	ON TERM RUN	ON NORM HALT
CONFIG GPC	2 10000	4(5) 00040			
STR 1	1	0			
2	1	0			
3	1	0			
4	1	0			
PL 1/2	0	4			
CRT 1	1	4			
2	1	4			
3	0	0			
4	1	4			
L 1	0	4			
2	0	0			
MM 1	1	4			
2	1	4			

JSC\_18819\_558.tif



**TITLE**

ABSOLUTE ADDRESS CONVERSION TO EXTENDED ADDRESS

**PURPOSE**

To assist the DPS operator in converting absolute CPU memory addresses to extended CPU memory addresses by providing the background necessary to interpret the address conversion table.

**BACKGROUND**

For certain applications, it is necessary to convert the five-digit absolute CPU memory address to a four-digit address. This process is described in detail in the book referenced at the end of this appendix. Here, it is only necessary to understand the address map and the need for extended addressing.

The CPU absolute memory addresses for the AP101S GPC's range from 00000 to 7FFFF. This range is divided into 15 sectors as follows:

SECTOR 0	0000 - 7FFF	SECTOR 8	40000 - 47FFF
SECTOR 1	8000 - FFFF	SECTOR 9	48000 - 4FFFF
SECTOR 2	10000 - 17FFF	SECTOR 10	50000 - 57FFF
SECTOR 3	18000 - 1FFFF	SECTOR 11	58000 - 5FFFF
SECTOR 4	20000 - 27FFF	SECTOR 12	60000 - 67FFF
SECTOR 5	28000 - 2FFFF	SECTOR 13	68000 - 6FFFF
SECTOR 6	30000 - 37FFF	SECTOR 14	70000 - 77FFF
SECTOR 7	38000 - 3FFFF	SECTOR 15	78000 - 7FFFF

As shown, only sectors 1 and 0 contain four-digit memory addresses. Therefore, due to the size of the CPU address registers, sectors 2 through 15 must be accessed using a four-digit extended address along with a one-digit branch sector register (BSR). The extended address can be derived from the absolute address by using the following table to replace the first two digits of the absolute address with the corresponding digit to arrive at the extended address for sectors 2 through 15 only:

	Replace	8	9	A	B	C	D	E	F	
Sector										
2	10	11	12	13	14	15	16	17	17	First
3	18	19	1A	1B	1C	1D	1E	1F	1F	
4	20	21	22	23	24	25	26	27	27	two
5	28	29	2A	2B	2C	2D	2E	2F	2F	
6	30	31	32	33	34	35	36	37	37	digits
7	38	39	3A	3B	3C	3D	3E	3F	3F	
8	40	41	42	43	44	45	46	47	47	of
9	48	49	4A	4B	4C	4D	4E	4F	4F	
10	50	51	52	53	54	55	56	57	57	absolute
11	58	59	5A	5B	5C	5D	5E	5F	5F	
12	60	61	62	63	64	65	66	67	67	memory
13	68	69	6A	6B	6C	6D	6E	6F	6F	
14	70	71	72	73	74	75	76	77	77	address
15	78	79	7A	7B	7C	7D	7E	7F	7F	

For example, from the table, an absolute address of 1B2CA would convert to an extended address of B2CA.

**REFERENCES**

1. Space Shuttle Advanced System/4 PI Model AP-101 Central Processor Unit Technical Description.
2. International Business Machines, Space Shuttle GPC M4J7XMA-483019, March 31, 1977.

**TITLE**

UNIVERSAL PATCH FORMAT

**PURPOSE**

To aid in the decoding of the universal patch format (UPF).

**BACKGROUND**

The UPF is utilized for passing patches between the various facilities and the software processing facility (SPF). The format basis is either self-documenting cards which can be printed or card images placed on tape by SSD personnel. The format is geared to communicate patch contents only, and each facility is required to provide the appropriate interactive LDB or uplink commands to accomplish the update. The UPF patchset does not include a change to the mass memory load block checksum (the last halfword in the load block). The checksum is obtained from Loral personnel.

**DESCRIPTION**

Below is a complete description of each UPF line entry. The data which is important to DPS SPT has been highlighted. Note in the example that leading zeros for all numerical data must be included. Moreover, the data shown in the example data column corresponds to the first five lines of Figure I-1. Some of the information may or may not be used by a facility; however, any facility can use the format, including the MCC.

Universal Patch Format

<u>Column</u>	<u>Description</u>	<u>Example data</u>
<u>Line type A - (begin patch)</u>		
1-11	Begin patch discriminator	BEGIN PATCH
12-19	Blank	
20-63	Optional comments	DR36948M
64	Blank	
65-69	Line number - decimal (always 00001 for type A)	00001
70	Blank	
71	Line type - A	A
72	Blank	
73-80	Reserved for SPF	

<u>Column</u>	<u>Description</u>	<u>Example data</u>
<u>Line type B - (patch ID)</u>		
1-8	"Patch ID"	PATCH ID
9-13	Blank	
14-17	Patch ID in hexadecimal (0000-FFFF)	1A5F
18-19	Blank	
20-63	Optional comments field	SACS INOPERATIVE
64	Blank	IN OPS 0
65-69	Line number - decimal (always 00002 for type B)	
70	Blank	00002
71	Line type - B	
72	Blank	B
73-80	Reserved for SPF	
<u>Line type C - (system ID/MM REV/phase load block)</u>		
<b>1-10</b>	<b>"FSW System"</b>	<b>FSW SYSTEM</b>
11	Blank	
<b>12</b>	<b>System ID - Decimal (0-7)</b>	<b>1</b>
13-19	Blank	
<b>20-25</b>	<b>"MM VER"</b>	<b>MM VER</b>
26	Blank	
<b>27-31</b>	<b>MM version number (i.e, RPL Lock ID) - decimal (XX.XX) (Number prior to decimal equals part 1, number after decimal equals part 2)</b>	<b>15.03</b>
32-35	Blank	
<b>36-43</b>	<b>Phase.LB</b>	<b>PHASE.LB</b>
44-45	Blank	
<b>46-48</b>	<b>Phase in decimal (000-255)</b>	<b>002</b>
<b>49</b>	<b>"."</b>	<b>.</b>
<b>50-52</b>	<b>Load block in decimal (000-255)</b>	<b>019</b>
53-64	Blank	
65-69	Line number - decimal (always 00003 for type C)	
70	Blank	
71	Line type - C	C
72	Blank	
73-80	Reserved for SPF	

<u>Column</u>	<u>Description</u>	<u>Example data</u>
<u>Line type D - (offset/num)</u>		
<b>1-6</b>	<b>OFFSET</b>	<b>OFFSET</b>
7-11	Blank	
<b>12-16</b>	<b>Offset in load block (decimal 0-16,384)</b>	<b>09857</b>
17-19	Blank	
<b>20-25</b>	<b>NUMBER</b>	<b>NUMBER</b>
26	Blank	
<b>27-29</b>	<b>Decimal number of patch words (001-512)</b>	<b>013</b>
30-35	Blank	
<b>36-45</b>	<b>AP101 ADDR - Optional for MM only patches. (00000-33FFF)</b>	<b>AP101 ADDR</b>
46	Blank	
<b>47-51</b>	<b>Main memory address (hexadecimal) - Optional for MM only patches.</b>	<b>1643F</b>
52-54	Blank	
<b>55-56</b>	<b>SP - Optional for MM only patches.</b>	<b>SP</b>
57	Blank	
<b>58</b>	<b>Store protect indicator (0-non protect, 1-protected)-Optional for MM only patches.</b>	<b>1</b>
59-64	Blank	
65-69	Line number (decimal 00004-16,384)	00004
70	Blank	
71	Line type - D	D
72	Blank	
73-80	Reserved for SPF	
<u>Line type E - (patch contents)</u>		
<b>1-8</b>	<b>CONTENTS</b>	<b>CONTENTS</b>
9-13	Blank	
<b>14-17</b>	<b>Contents of patch at OFFSET (hexadecimal)</b>	<b>DC0C</b>
18-20	Blank	
<b>21-24</b>	<b>Contents at OFFSET + 1 (hexadecimal)</b>	<b>9DF3</b>
25-27	Blank	
<b>28-31</b>	<b>Contents at OFFSET + 2 (hexadecimal)</b>	<b>A08E</b>
32-34	Blank	
<b>35-38</b>	<b>Contents at OFFSET + 3 (hexadecimal)</b>	<b>DC14</b>
39-41	Blank	
<b>42-45</b>	<b>Contents at OFFSET + 4 (hexadecimal)</b>	<b>1EF3</b>
46-64	Blank	
65-69	Line number (decimal)	00005
70	Blank	
71	Line type - E	E
72	Blank	
73-80	Reserved for SPF	

There are as many "E" lines as necessary to specify the contents associated with a given offset. The contents are in contiguous locations, and leading zeros within the contents must be specified. The line numbers for "D" and "E" lines are incremented by one for each line, starting with line 00004.

For example, if three contiguous areas (a,b,c) are to be patched (same load block, system ID, and patch ID), the line sequence would appear as A (00001), B (00002), C (00003), D (00004), E (00005), E 2(00006), E 3(00007), E 4(00008), D (00009), E (00010), E 2(00011), E 3(00012), D (00013), E (00014), E 2(00015), E 3(00016), E 4(00017). The second subscript of the "E" lines indicates the number of content lines in each contiguous area. The number in parentheses represents the line number which increments sequentially.

If load block, system ID, or patch ID is required to be different, the sequence is started fresh with line "A." Line numbers always start over with line "A."

Figure I-1 is an example of a UPF worksheet. The example has four separate patch sets identified by four separate "A" lines. The first patch set has 3 "E" lines containing 13 contiguous halfwords to be patched beginning at the offset identified in the "D" line. The second set patches one halfword in a different phase/LB. The third patch set has two patches with the same phase/LB defined on line C. Each patch contains two contiguous halfwords, but each patch has a different offset specified on the "D" lines. The fourth patch set contains one patch of two contiguous halfwords.

This format shall be utilized for passing patches (sometimes the UPF sheet is accompanied by a UPF tape) between the various facilities and the SDL. The format is geared to PASS patch contents only, and each facility is required to provide the appropriate uplink commands to accomplish the update. The format is also geared such that inputs can be derived for input via GPC MEMORY SPEC, MASS MEMORY READ/WRITE SPEC, UPLINK G MEM, or MMU READ/MERGE/WRITE. The SDL must resolve and add the main memory address and store protect status to the information

## **REFERENCES**

Orbiter Avionics Mass Memory Unit Computer Program Integration Plan (MIP), appendixes A and B, Controlled Tape Formats, revision F, PCN-1.

JSC-08338, NAS9-18000, Spacecraft Software Division, April 30, 1986, Section 15, pp. A-52 through A-57.

DATE 9-30-87  
FACILITY ALL  
PROGRAMMER \_\_\_\_\_

UNIVERSAL PATCH FORMAT (UPF)  
WORKSHEET

PAGE 1 OF 2  
FW REL/VER R15V03

	8	10	14	16	20	25	30	35	40	45	50	55	60	65	71	73	80			
BEGIN PA T CH							D R3694	8M							0	0001	A			
PATCH ID		1	A	F5	S	ACS	1	NOPER	ATIVE	IN	0	PS	0		0	0002	B			
FSW SYST	E	M	1			M	M	VER	15.0	3		PHASE	.LB	002.0	19		0	0003	C	
OFFSET			098	5	7	N	UMBER		013		AP101	ADDR	1643	F	S	P	1	0	0004	D
CONTENTS			D	C	0C		9DF3		A08	E	D	C14	1EF3					0	0005	E
CONTENTS			1	9	10		F67A		260	5	F	640	CPF9					0	0006	E
CONTENTS			0	0	0C		DC88		DF0	0								0	0007	E
BEGIN PA T CH							S	AS	15	-038					0	0001	A			
PATCH ID		1	A	60	S	YSTEM		VERS	ION	I	D	:	15.03A	.01D				0	0002	B
FSW SYST	E	M	1			M	M	VER	15.0	3		PHASE	.LB	0002.0	01			0	0003	C
OFFSET			000	3	1	N	UMBER		001		AP101	ADDR	0001	F	S	P	0	0	0004	D
CONTENTS			F	1	C4													0	0005	E
BEGIN PA T CH							D	R3600	8M						0	0001	A			
PATCH ID		1	A	5C	S	PBK	&	RUDD	ER	MO	DE	0	TOLER	ANCE	VALUE	S		0	0002	B
FSW SYST	E	M	1			M	M	VER	15.0	3		PHASE	.LB	008.0	07			0	0003	C
OFFSET			007	9	8	N	UMBER		002		AP101	ADDR	07D7	0	S	P	O	0	0004	D
CONTENTS			F	E	E5		0018											0	0005	E
OFFSET			008	15		N	UMBER		002		AP101	ADDR	07D8	1	S	P	O	0	0006	D
CONTENTS			F	E	A1		FFE8											0	0007	E
BEGIN PA T CH							D	R3600	8M						0	0001	A			
PATCH ID		1	A	5D	S	PBK	&	RUDD	ER	MO	DE	0	TOLER	ANCE	VALUE	S		0	0002	B
FSW SYST	E	M	1			M	M	VER	15.0	3		PHASE	.LB	013.0	05			0	0003	C
OFFSET			144	0	2	N	UMBER		002		AP101	ADDR	06BD	2	S	P	O	0	0004	D
CONTENTS			F	E	E5		0018											0	0005	E

**Figure I-1. UPF worksheet**

**TITLE**

NUMBER SYSTEM CONVERSIONS

**PURPOSE**

To aid in dealing with number systems.

**INTRODUCTION**

Any positive number system can be defined by its base (radix). The base is the number of unique symbols that can occupy a position in the number system. As an example, the decimal system has a base of 10 because the symbols (numbers in this case) 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9 can occupy a position in the number system. In the binary system, there are two symbols, 0 and 1, that can occupy a position. In the hexadecimal system, symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F can occupy a position; therefore, it is a base 16 system. In converting from binary or hexadecimal to decimal, the symbol represents a coefficient, and its position in the number represents the exponent of the base. Examples of this are given below.

**NUMBER SYSTEMS**

A. Decimal number system

Given a decimal number of 159, state it as a function of its base. The number 159 can be restated as 100 plus 50 plus 9, or  $1*(10^2) + 5*(10^1) + 9*(10^0) = 159$ .

B. Binary number system

Given the binary number 1011, convert it to decimal.

$$1*(2^3) + 0*(2^2) + 1*(2^1) + 1*(2^0) = 11$$

Given the binary numbers 0 through 15, convert to hexadecimal numbers. See Table J-1.

**Table J-1. Binary-to-hexadecimal conversion**

Binary	Hexidecimal	Decimal
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8



Binary	Hexidecimal	Decimal
1001	9	9
1010	A	10
1011	B	11
1100	C	12
1101	D	13
1110	E	14
1111	F	15

C. Hexadecimal number system

Given the hexadecimal number 4F2, convert it to decimal.

$$4 \cdot (16^2) + F \cdot (16^1) + 2 \cdot (16^0) = 1266$$

Hexadecimal	Decimal
1000	4096
2000	8192
3000	12288
4000	16384
5000	20480
6000	24576
7000	28672
8000	32768
9000	36864
A000	40960
B000	45056
C000	49152
D000	53248
E000	57344
F000	61440

D. ADDITION IN HEXADECIMAL

To add two hexadecimal numbers, use a method comparable to decimal addition.

$$\begin{array}{r} \text{Example: } 6800 \\ + 63D \\ \hline 6E3D \end{array}$$

In this case, you need only remember that hex 8 plus 6 equals hex E with no carry.

$$\begin{array}{r} \text{Example: } \underline{6E88} \\ + \underline{1D3} \end{array}$$

For the first column, hex 8 is added to hex 3 giving HEX B.

If necessary, you may convert both numbers to decimal, add them, and convert back to hex. Thus, hex 8 plus hex 3 is decimal 8 plus decimal 3. This is equal to decimal 11, which is hex B.

For the second column, a carry is involved:

$$\begin{array}{r} 1 \\ 6E88 \\ + 1D3 \\ \hline 5B \end{array}$$

Converting to decimal, it is 8 plus 13 equals 21. Converting to hex, the result is 15 (hex 10 has a value of 16; hex 5 has a value of 5:  $16 + 5 = 21$ ). So, 5 is written below the second column and 1 is carried to the third column. For the third column, it is 1 plus E plus 1 resulting in another carry:

$$\begin{array}{r} 1 \\ 6E88 \\ + 1D3 \\ \hline 05B \end{array}$$

Hex E is decimal 14 plus 1 plus 1 is 16. Since 16 is hex 10, the 1 is carried.

The fourth column is simply 6 plus 1, so the problem is complete as follows:

$$\begin{array}{r} 6E88 \\ + 1D3 \\ \hline 705B \end{array}$$

#### E. Subtraction in hexadecimal

There are a couple of ways of subtracting one hex number from another, but the most efficient way is to do it in the same way you would do decimal subtraction:

Example: 
$$\begin{array}{r} 689A \\ -6800 \\ \hline 9A \end{array}$$

Start with the right column of digits and move left. Hex 0 from hex A is hex A; hex 0 from hex 9 is hex 9; hex 68 from hex 68 is 0.

Example: 
$$\begin{array}{r} 5C3C \\ -4D88 \\ \hline \end{array}$$

The first column is hex C minus hex 8. With practice, you will eventually learn the hex subtraction tables and immediately know that the answer is hex 4. At the start, however, you will probably find it easiest to convert both values to decimal, subtract, and convert the result back to hex. Thus, hex C is decimal 12; hex 8 is decimal 8; 12 minus 8 is decimal 4; and decimal 4 is hex 4.

For the second column of digit, you must "borrow," since 8 can't be subtracted from 3:

$$\begin{array}{r} 5C3C \\ -4D88 \\ \hline 4 \end{array}$$

To borrow, you reduce the digit to the left by 1, and increase the number being subtracted from by hex 10. Thus, the second column becomes hex 13 minus hex 8. Since hex 13 is the same as hex 10 (decimal 16) plus 3, the decimal value of hex 13 is 19. Then, 19 minus 8 is 11. Converting back to hex, decimal 11 equals hex B.

The third column again involves borrowing:

$$\begin{array}{r} B \\ 5/3C \\ -4D88 \\ \hline B4 \end{array}$$

Since 1 was borrowed from C, the problem is hex B minus hex D, which can't be done. After borrowing, it becomes hex 1B minus hex D. Converting to decimal, it is 27 (16 + 11) minus 13 equals 14. Converting back to hex, The result is E. Since the fourth column has been borrowed from, it now has a value of 4.

$$\begin{array}{r} 4B \\ //3C \\ -4D88 \\ \hline 0EB4 \end{array}$$

Hex 4 minus hex 4 is 0, so the final result is hex 0EB4.

## F. BINARY TO HEX CONVERSION

For conversions from binary to hexadecimal or from binary to octal, we simply separate the binary bits into groups of four for hexadecimal and into groups of three for octal. After grouping the bits for hexadecimal conversion, start with the rightmost "ON" bit of each 4-bit field, adding the weight of each "ON" bit as a power of 2 as you move to the left of each 4-bit field. To acquire the weight of each "ON" binary bit let its position in the 4-bit field represent the exponent of the base, and let the symbol represent the coefficient. (In binary, the symbol will always be 1 or 0.)

Example

:

(1) 16-bit binary word 1010111011111011

  | 3 2 1 0 | 3 2 1 0 | 3 2 1 0 | 3 2 1 0 | Bit positions  
  | 1 0 1 0 | 1 1 1 0 | 1 1 1 1 | 1 0 1 1 | Coefficient

4-bit fields

$$1(2^3)+0(2^2)+1(2^1)+0(2^0) + 1(2^3)+1(2^2)+1(2^1)+0(2^0) + 1(2^3)+1(2^2)+1(2^1)+1(2^0) + 1(2^3)+0(2^2)+1(2^1)+1(2^0)$$

Conversion to hexadecimal

Decimal 10 bit weight equals hex "A"

Decimal 14 bit weight equals hex "E"

Decimal 15 bit weight equals hex "F"

Decimal 11 bit weight equals hex "B"

So, conversion is hex number "AEFB."

After grouping the bits for octal conversion, start with rightmost "ON" bit of each 3-bit field and repeat above.

Example:

(1) 16-bit binary word 1010111011111011

  | 2 1 0 | 2 1 0 | 2 1 0 | 2 1 0 | 2 1 0 | Bit positions  
  1 | 0 1 0 | 1 1 1 | 0 1 1 | 1 1 1 | 0 1 1 | Coefficient

Sign bit

1 = Minus

0 = Positive

3-bit fields

$$0(2^2)+1(2^1)+0(2^0) + 1(2^2)+1(2^1)+0(2^0) + 0(2^2)+1(2^1)+1(2^0) + 1(2^2)+1(2^1)+1(2^0) + 0(2^2)+1(2^1)+1(2^0)$$

Conversion to octal

Decimal 2 bit weight equals octal "2"

Decimal 7 bit weight equals octal "7"

Decimal 3 bit weight equals octal "3"

So, conversion is octal number - 27373.

## **TITLE**

POWERDOWN SUMMARIES

## **PURPOSE**

This procedure provides a summary of DPS configurations during the various powerdown procedures. It also provides an overview of the vehicle cooling systems.

## **BACKGROUND**

The powerdown procedures are contingency procedures used to cope with system failures that cause loss of some cooling capability or loss of some power production. These procedures are located in the flight data file in the following places:

1. Cue Cards
2. Pocket Checklists (always section 10)
3. Contingency Deorbit Prep Book
4. Deorbit Prep Book (Contingency Deltas Section)
5. Systems AOA

The air revitalization system (ARS) circulates the air and heat in the cabin environment. Water loops, fans, and cold plates are the primary components of the ARS, as shown in Figure K-1. There are two separate water loops, but normally only one is active at a time. The heat accumulated in the active water loop is passed on to the freon loops in the ATCS via a heat exchanger.

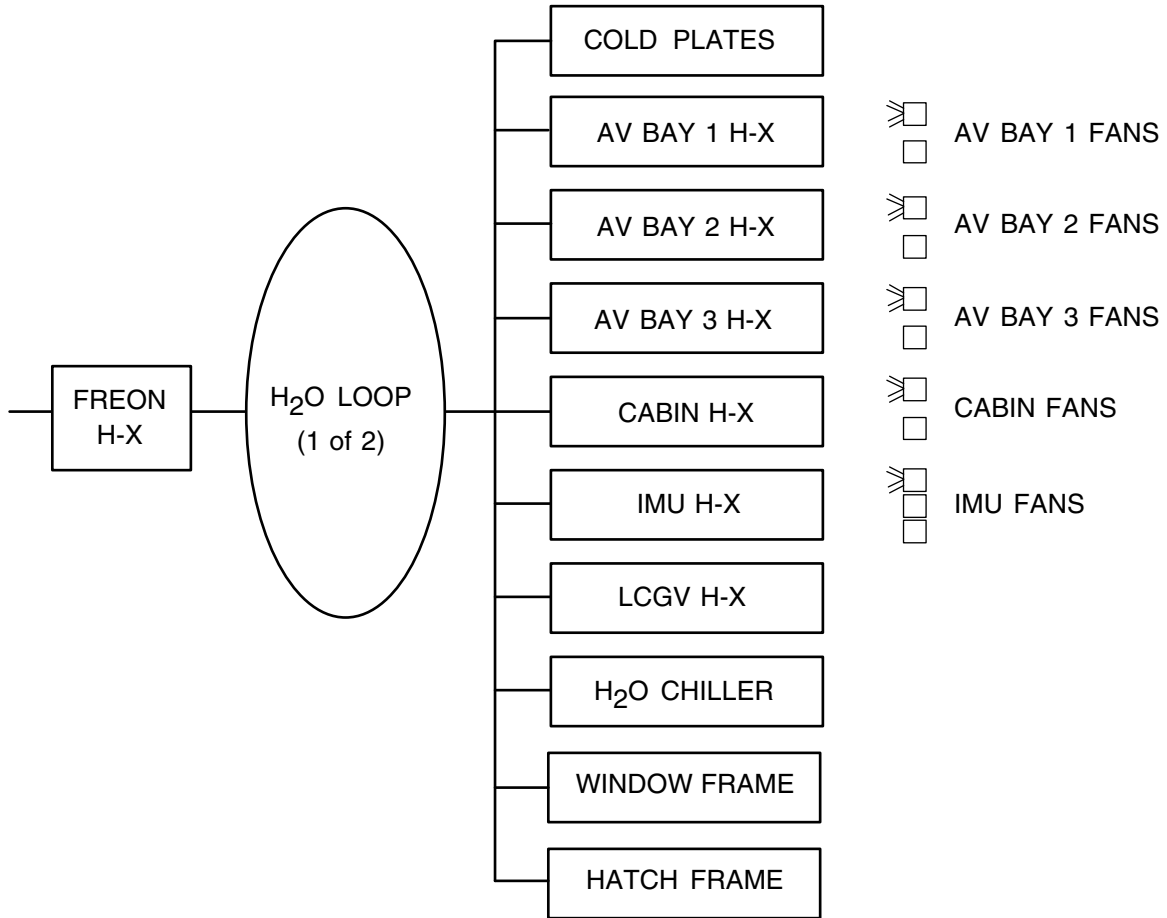
The active thermal control system (ATCS) removes heat from the water loops and the fuel cells, as well as cold-plated equipment located in the mid-body or the aft section of the vehicle. Figure K-2 shows an overview of the ATCS. There are two freon coolant loops that allow for the redistribution of heat. The primary heat sources are the water loops, fuel cells, and aft and mid-body cold plates. The primary heat sinks are as follows:

- **RADIATOR PANELS**

The Freon loops pass through the radiators for heat removal. There are normally 8 panels; however, 6 panels are used for the Spacelab configuration. The forward two panels deploy away from the payload bay doors, so they radiate heat from both sides of the panel.

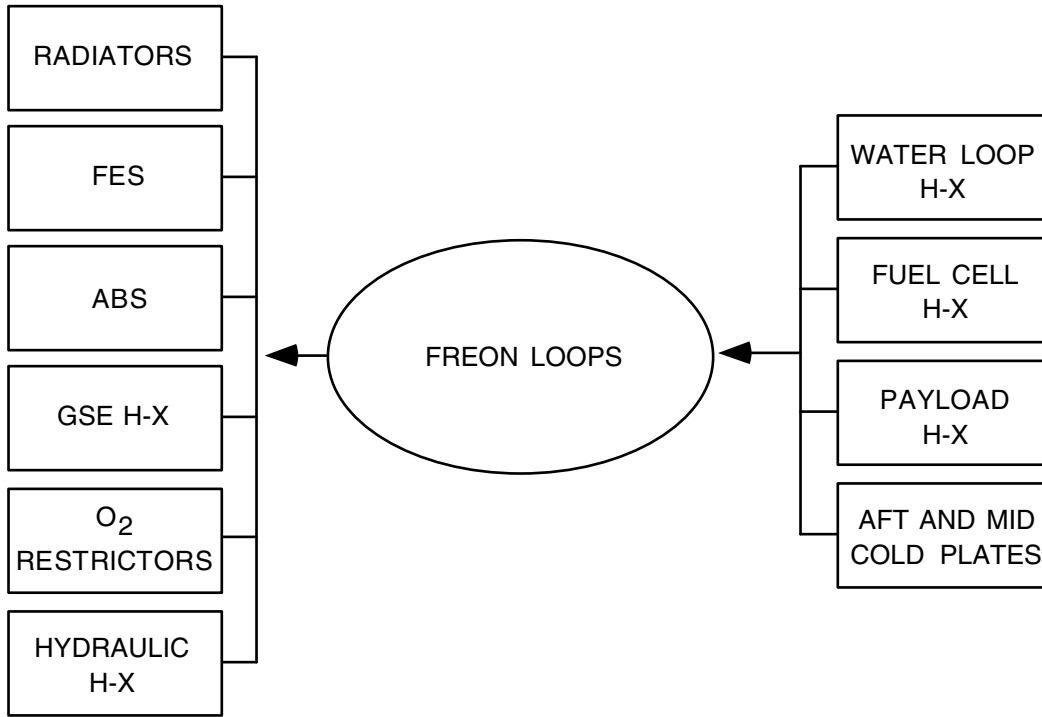
- **GROUND SUPPORT EQUIPMENT (GSE)**

Orbiter heat is rejected to a ground freon loop through the GSE heat exchanger. The GSE service lines go to the T-0 umbilical panel, and are disconnected at liftoff.



18819\_076

**Figure K-1. Air revitalization system (ARS)**



18819\_077

**Figure K-2. Active thermal control system**

- **FLASH EVAPORATOR SYSTEM (FES)**

The FES consists of two evaporators contained in one envelope. The hi-load evap removes larger amounts of heat, while the topping evap provides finer control of the freon temperature. The FES operates by spraying water which quickly vaporizes into the core, removing heat from the surrounding core during the state change. The FES works in low pressures, above 100,000 feet.

- **AMMONIA BOILER SYSTEM (ABS)**

There are two complete ammonia systems. The ABS operates by evaporating liquid anhydrous ammonia and dumping the vapor overboard. The ABS only works in gravity, below 100,000 feet.

- **O<sub>2</sub> RESTRICTORS and HYDRAULIC HEAT EXCHANGER**

Cryogenic oxygen is warmed via the O<sub>2</sub> restrictors, and the hydraulic fluid is warmed via the hydraulic heat exchanger.

Each of the above heat sinks are used at different times and in different combinations during the various phases of flight. Figure K-3 shows a timeline of when the various heat sinks are used.

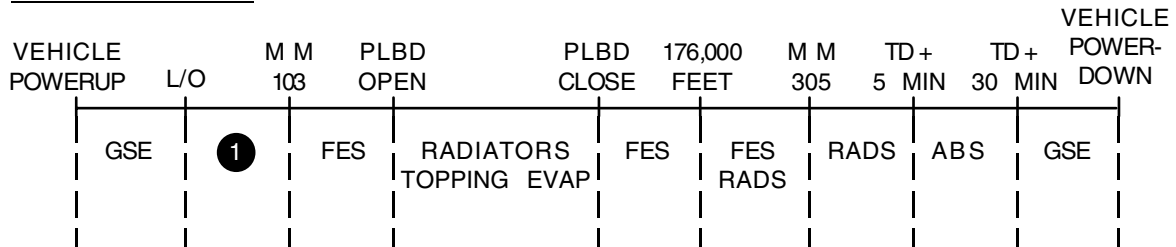
## **DESCRIPTION**

This section provides a summary of the concerns, flight data file usage, and DPS configurations for each of the major powerdowns. The configuration summaries are intended to provide an overview that conveys the overall philosophy of the powerdown. Exact procedures and steps can be found in the referenced flight data file. Powerdown descriptions are provided for each of the following subjects.

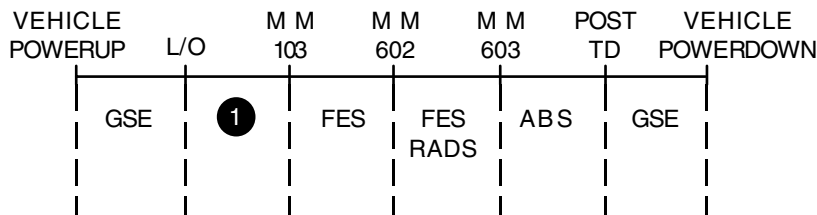
- Loss of two Freon loops
- Loss of two water loops
- Loss of two fuel cells
- Loss of cabin pressure
- Loss of FES
- Loss of two cabin fans
- Loss of AV bay air conditioning
- AV bay fires



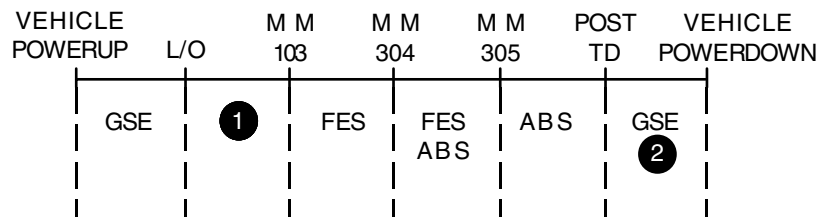
NOMINAL MISSION



RTLS



TAL/AOA



FES - FLASH EVAP SYSTEM  
 GSE - GROUND SUPPORT EQUIPMENT  
 ABS - AMMONIA BOILER SYSTEM  
 RADS - RADIATORS

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1 No active cooling during first stage. Orbiter water loop and Freon loop utilize the residual heat sink reservoir from GSE cooling. The 'ABS' is not utilized, and 'FES' is not activated until second stage.

2 If available.

**Figure K-3. Vehicle cooling timelines**

**TITLE**

LOSS OF TWO FREON LOOPS

**CONCERNS:**

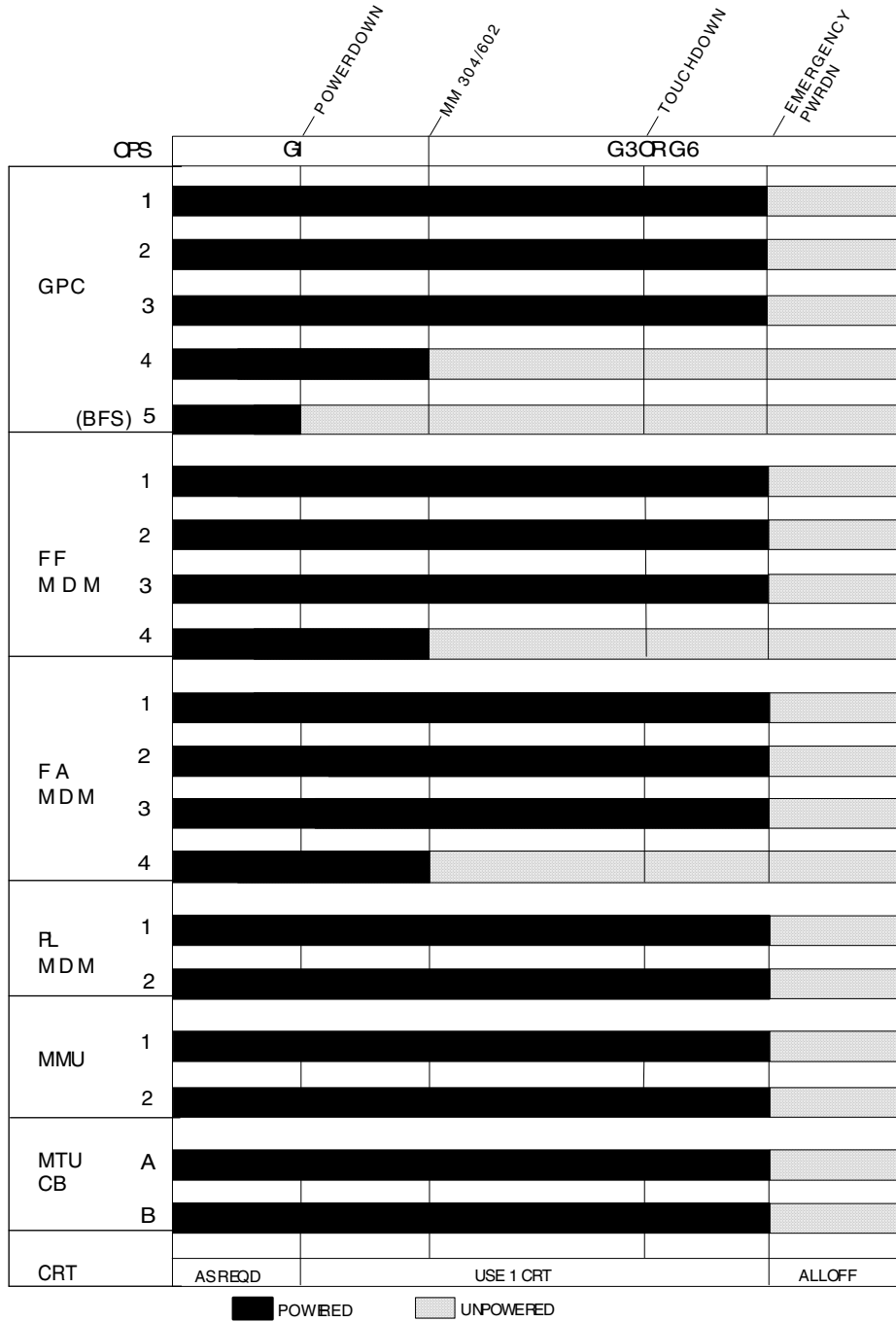
Loss of both freon coolant loops results in the loss of all cooling to the vehicle, which, in turn, results in the flooding of all three fuel cells and the overheating of critical equipment.

The primary concern is the survival of the fuel cells. The fuel cells will overheat resulting in a reactant crossover due to loosening of the tie rods that hold the fuel cell stack together. This can occur within as few as 6 minutes, according to the SODB. The SODB also states that, within 110 amp-hours, the reactant sites will be covered with water. The fuel cells will probably last longer with continuous purges. How much longer is not known, but the EECOM's estimate 50 to 100 minutes (1:40).

Also of major concern is the overheating of critical equipment. All freon cooled equipment, including the water loops, will lose cooling. Water and air cooled equipment will receive degraded cooling as the water loops and air heat up.

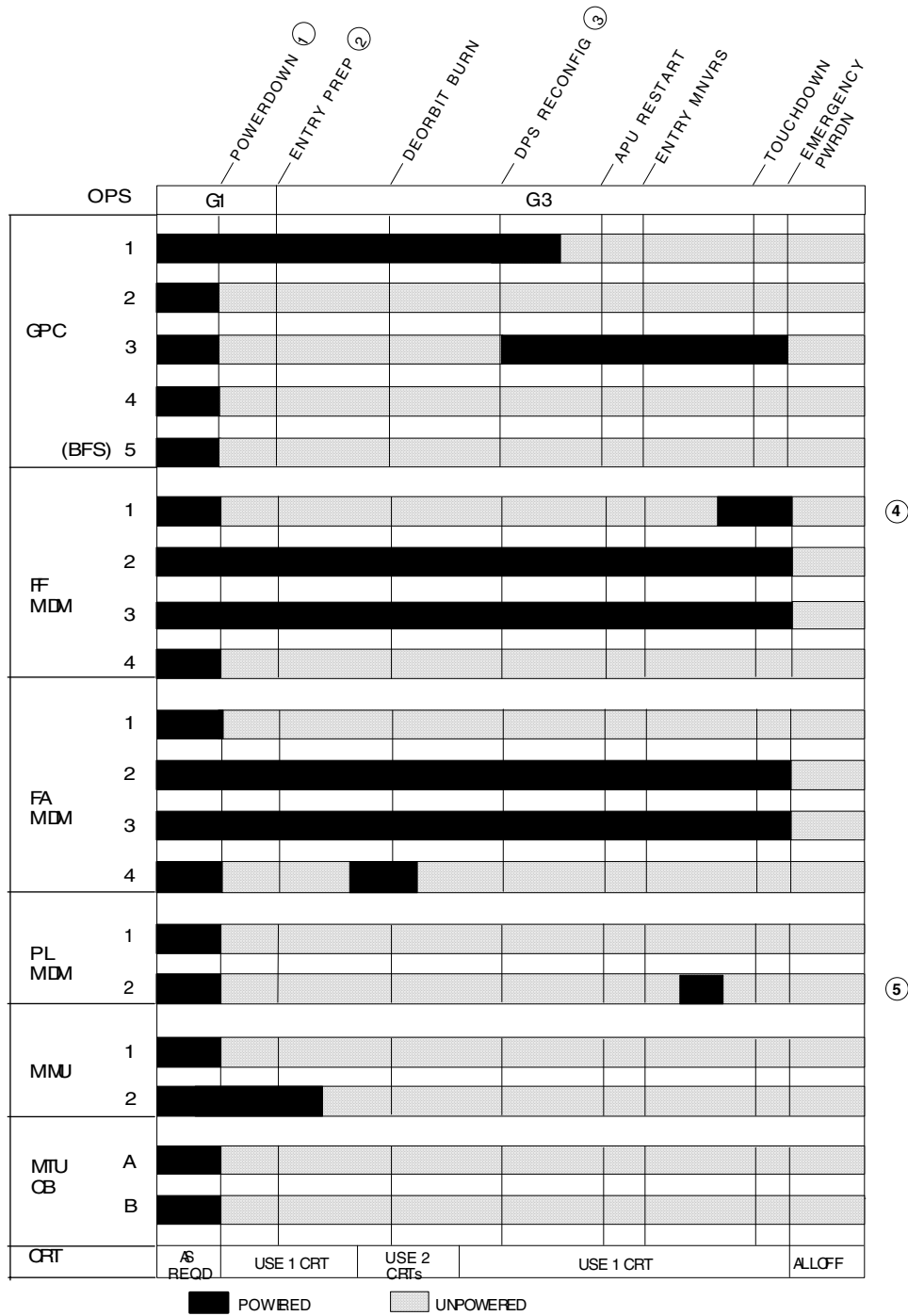
**FLIGHT DATA FILE:**

Flight phase	Procedure name	Book
1. Ascent: a. RTLS/TAL	FREON FLOW LOW LOSS OF 2 FREON LOOPS RTLS/TAL TIMELINE EMERGENCY POWERDOWN	AESP AESP ASC AESP
b. AOA	FREON FLOW LOW LOSS OF 2 FREON LOOPS (AOA) EMERGENCY POWERDOWN	APCL SYS AOA ENT
c. Post OMS 2	FREON FLOW LOW LOSS OF 2 FREON (POST OMS 2) LOSS OF 2 FREON (ORBIT) LOSS OF 2 FREON D/O PREP/ENTRY EMERGENCY POWERDOWN	APCL APCL OPCL CONT D/O AESP
2. Orbit:	FREON FLOW LOW LOSS OF 2 FREON LOOPS LOSS OF 2 FREON D/O PREP/ENTRY EMERGENCY POWERDOWN	OPCL OPCL CONT D/O AESP
3. Entry: a. Pre-304	FREON FLOW LOW LOSS OF 2 FREON LOOPS LOSS OF 2 FREON D/O PREP/ENTRY	EPCL EPCL CONT D/O
b. Post-304	FREON FLOW LOW LOSS OF 2 FREON LOOPS EMERGENCY POWERDOWN	AESP AESP AESP



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**Figure K-4. Loss of Two Freon Loops (RTLS/TAL)**



- ① CABIN FANS OFF. AV BAYS 2 AND 3 FANS OFF. CABIN FAN A ON AT TIG - 15
- ② CABIN FAN A ON AT TIG - 15
- ③ AV BAY 1 FAN OFF AV BAY 3 FAN ON.
- ④ IF NWS REQD FF1 ON AT M = 2.9
- ⑤ IF CMD/DATA REQD PF2 ON AT V = 12K

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Figure K-5. Loss of Two Freon Loops (AOA)

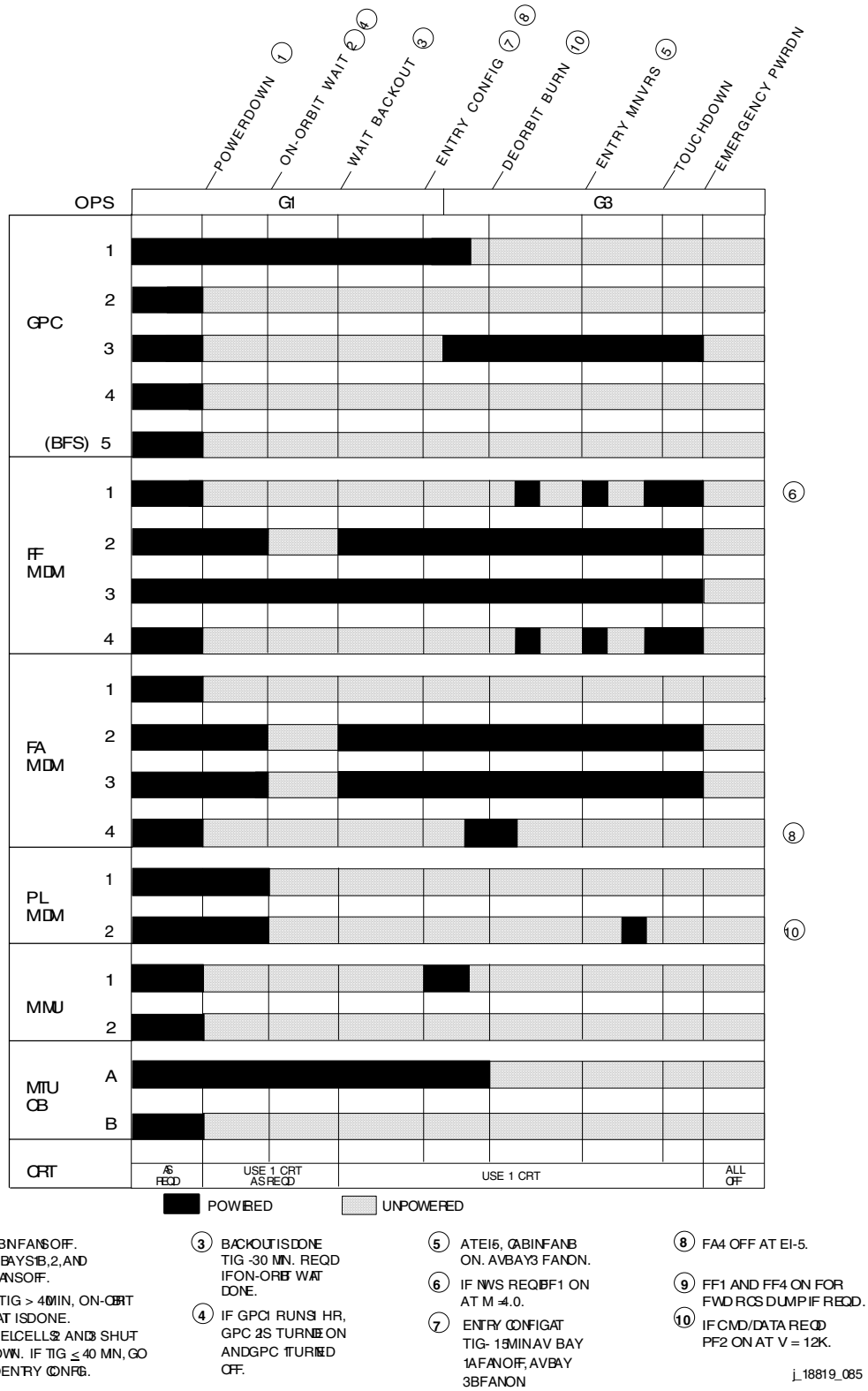


Figure K-6. Loss of Two Freon Loops (Post-OMS 2)

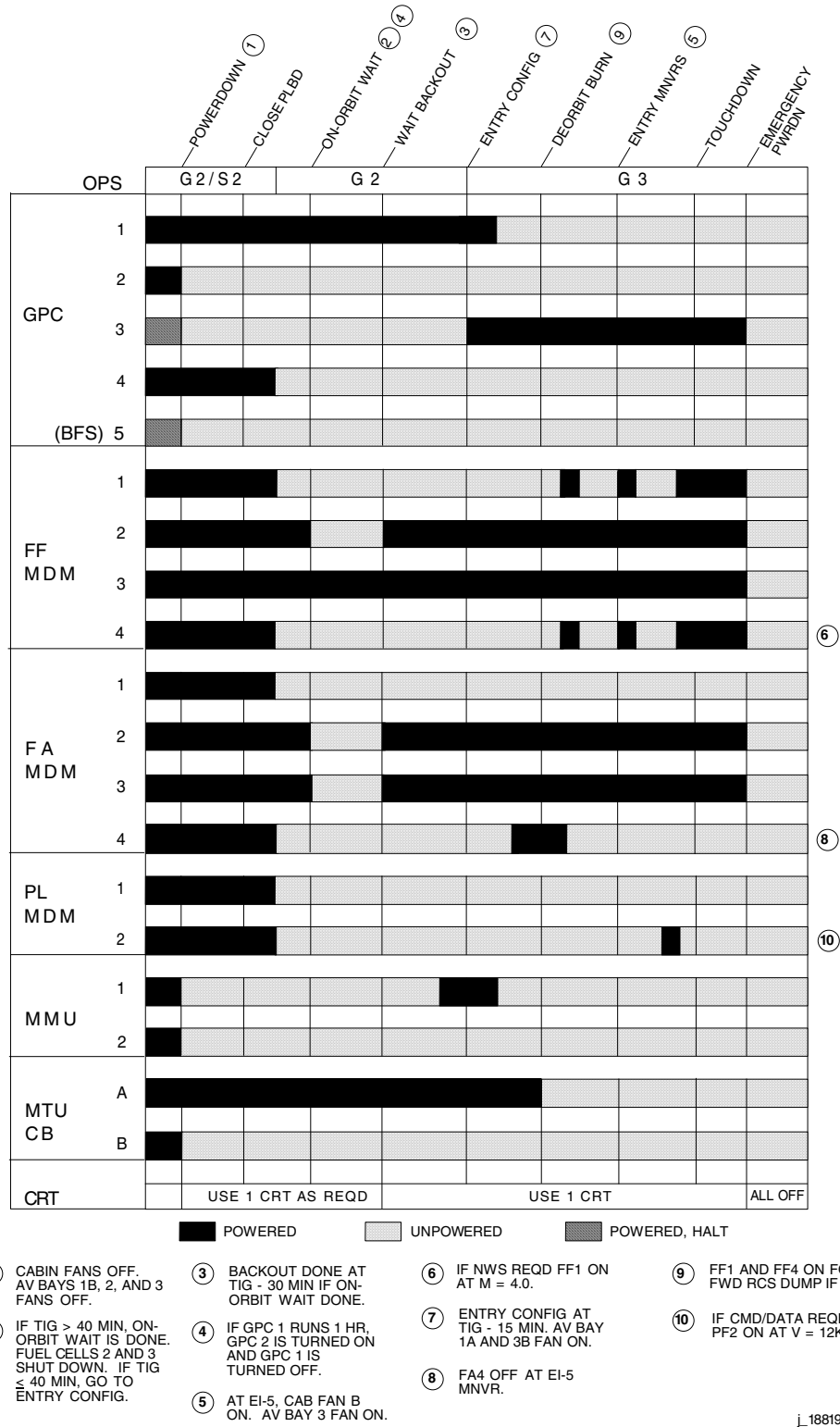
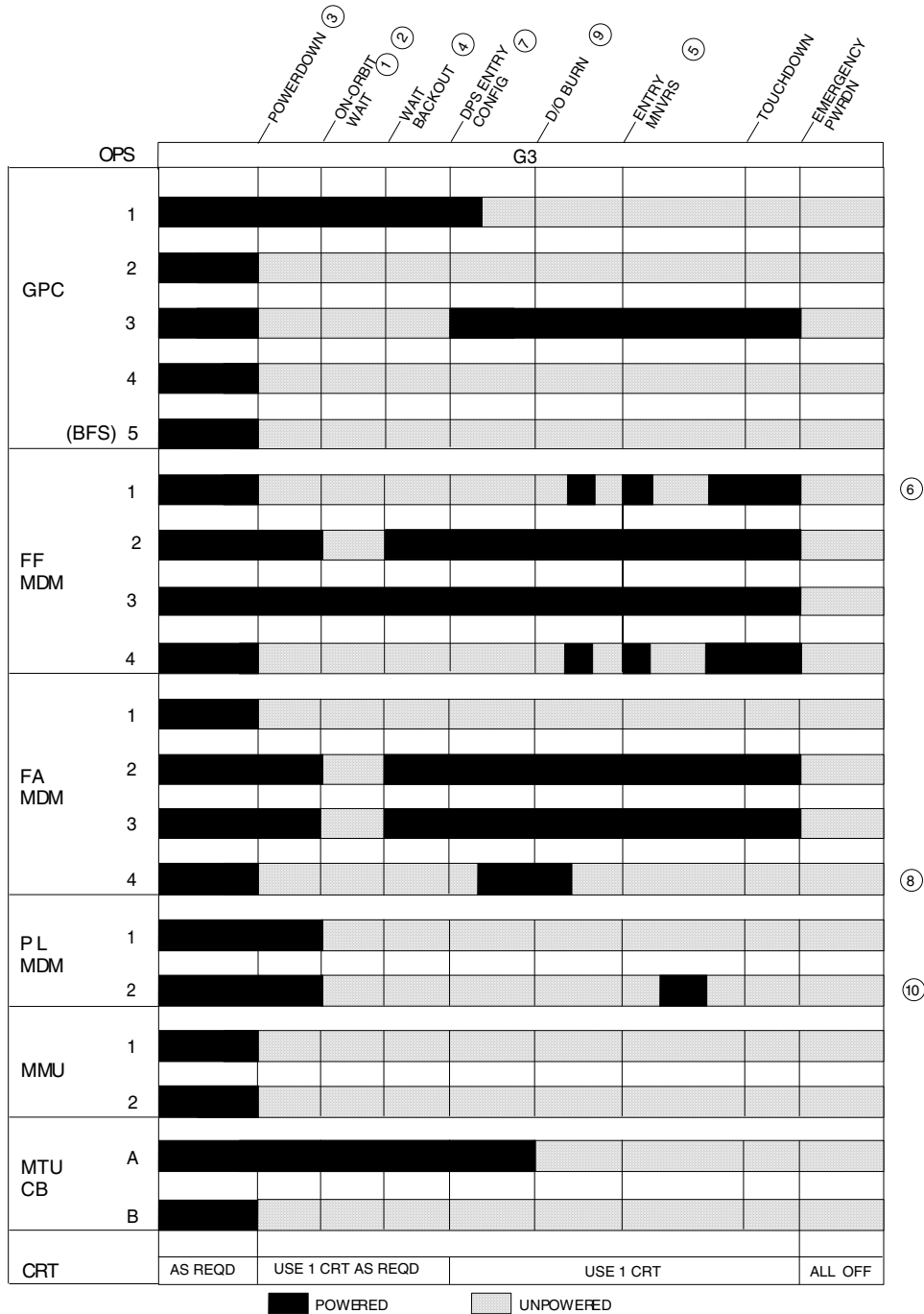


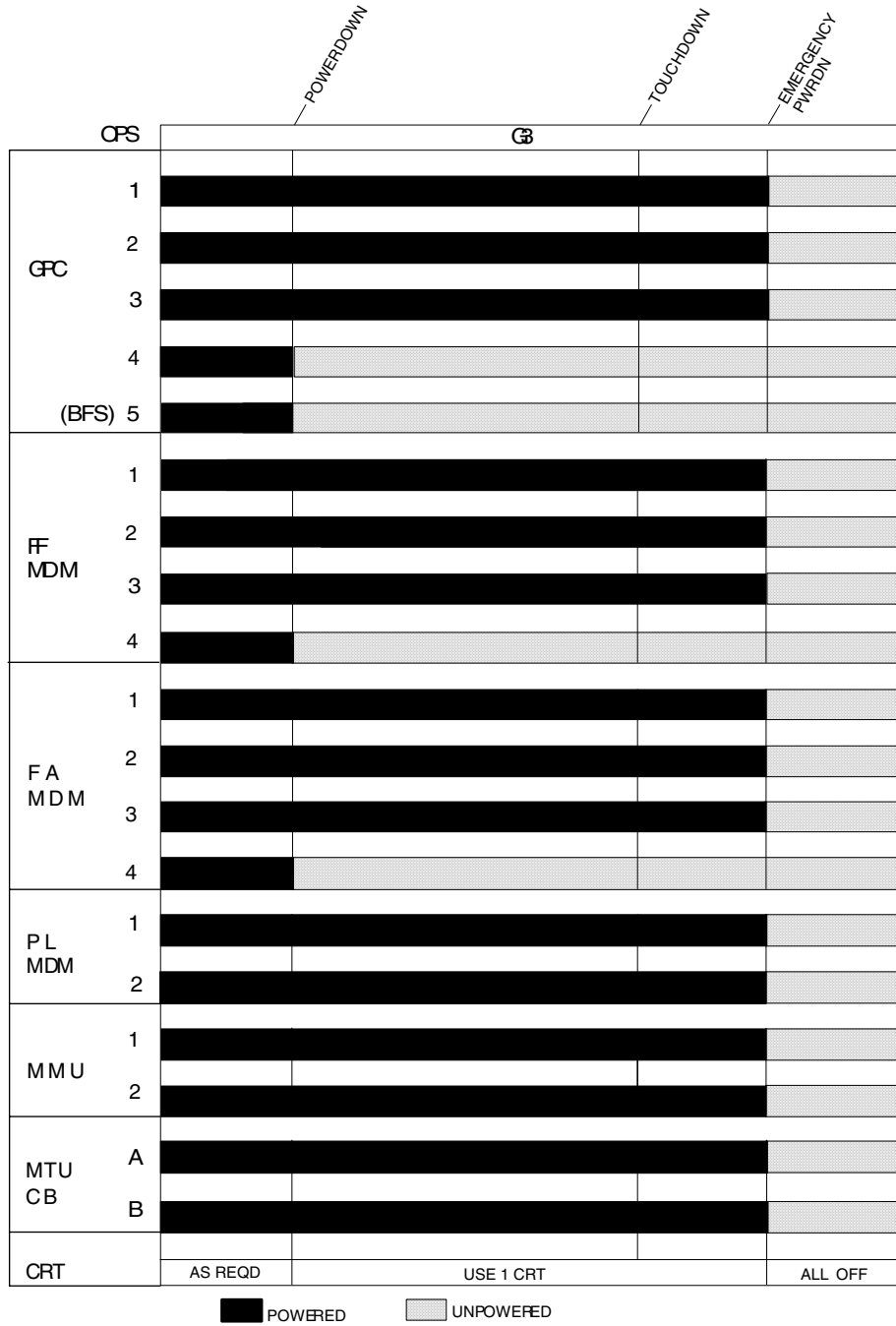
Figure K-7. Loss of Two Freon Loops (Orbit)



- ① IF TIG > 40 MIN, FUEL CELLS 2 AND 3 ARE SHUTDOWN. IF TIG ≤ 40 MIN, NO ON-ORBIT WAIT. IF TIG > 15 MIN, GO TO ENTRY CONFIG. IF TIG < 15 MIN, OPEN MTU A cb, PWR FA4 ON FOR D/O BURN AND OFF POSTBURN. PRIOR TO 304, PWR ON GPC 3 PWR OFF GPC 1. PWR ON FF1 AND FF4 IF FWD RCS DUMP REQD.
- ② IF GPC 1 RUNS 1 HR, PWR GPC 2 ON AND PWR GPC 1 OFF.
- ③ CABIN FANS OFF. AV BAY FANS OFF.
- ④ ONLY DONE IF ON-ORBIT WAIT PERFORMED.
- ⑤ IF NWS REQD, FF1 ON AT M = 4.0.
- ⑥ IF NWS REQD, FF1 ON AT M = 4.0.
- ⑦ AV BAY 1A FAN OFF AND AV BAY 3B FAN ON. ENTRY CONFIG AT TIG-15 MIN.
- ⑧ FA4 OFF AT EI-5 ATT MNVR.
- ⑨ FF1 AND 4 ON IF FWD RCS DUMP REQD.
- ⑩ IF CMD/DATA REQD, PF2 ON AT V = 12K.

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Figure K-8. Loss of Two Freon Loops (Entry, Pre-304)



**Figure K-9. Loss of Two Freon Loops (Entry, Post-304)**



**TITLE**

LOSS OF TWO WATER LOOPS

**CONCERNS:**

Loss of both water loops results in the loss of cooling to the cabin, which, in turn, results in the overheating of critical equipment. The water loops provide cooling to avionics bays and the cabin, both directly via coldplates and indirectly by cooling recirculated air. The primary concern is to prevent overheating of the GPC's. Equipment should be powered down to reduce the thermal load.

The thermal analysis shows that the cabin environment can adversely affect crew performance, as temperatures can reach over 100 degrees Fahrenheit and humidity can reach 100 percent. Therefore, there is a major concern for crew health as well.

**FLIGHT DATA FILE:**

Flight phase	Procedure name	Book
1. Ascent: a. AOA (TIG >15 and TIG <15)	H <sub>2</sub> O LOOP PRESS LOW (HIGH) LOSS OF TWO H <sub>2</sub> O LOOPS EMERGENCY POWERDOWN	APCL SYS AOA AESP
b. Post OMS 2 Rev 2	H <sub>2</sub> O LOOP PRESS LOW (HIGH) LOSS OF 2 H <sub>2</sub> O LOOPS POST OMS 2 LOSS OF 2 H <sub>2</sub> O LOOPS D/O PREP/ENTRY EMERGENCY POWERDOWN	APCL APCL CONT D/O AESP
c. Post OMS 2 not Rev 2	H <sub>2</sub> O LOOP PRESS LOW (HIGH) LOSS OF 2 H <sub>2</sub> O LOOPS POST OMS 2 LOSS OF 2 H <sub>2</sub> O LOOPS LOSS OF 2 H <sub>2</sub> O LOOPS D/O PREP/ENTRY EMERGENCY POWERDOWN	APCL APCL CONT D/O CONT D/O AESP
2. Orbit: a. CONUS TIG < 2.5 hr	H <sub>2</sub> O PUMP P 1(2) LOSS OF 2 H <sub>2</sub> O LOOPS, PARTS 1 and 2 LOSS OF 2 H <sub>2</sub> O LOOPS D/O PREP/ENTRY EMERGENCY POWERDOWN	MALF OPCL CONT D/O AESP
b. CONUS TIG > 2.5 hr	H <sub>2</sub> O PUMP P 1(2) LOSS OF 2 H <sub>2</sub> O LOOPS, PARTS 1, 2, 3 LOSS OF 2 H <sub>2</sub> O LOOPS LOSS OF 2 H <sub>2</sub> O LOOPS D/O PREP ENTRY EMERGENCY POWERDOWN	MALF OPCL CONT D/O CONT D/O AESP
3. Entry:	H <sub>2</sub> O LOOP PRESS LOW (HIGH) LOSS OF 2 H <sub>2</sub> O LOOPS (ENTRY) EMERGENCY POWERDOWN	EPCL EPCL AESP

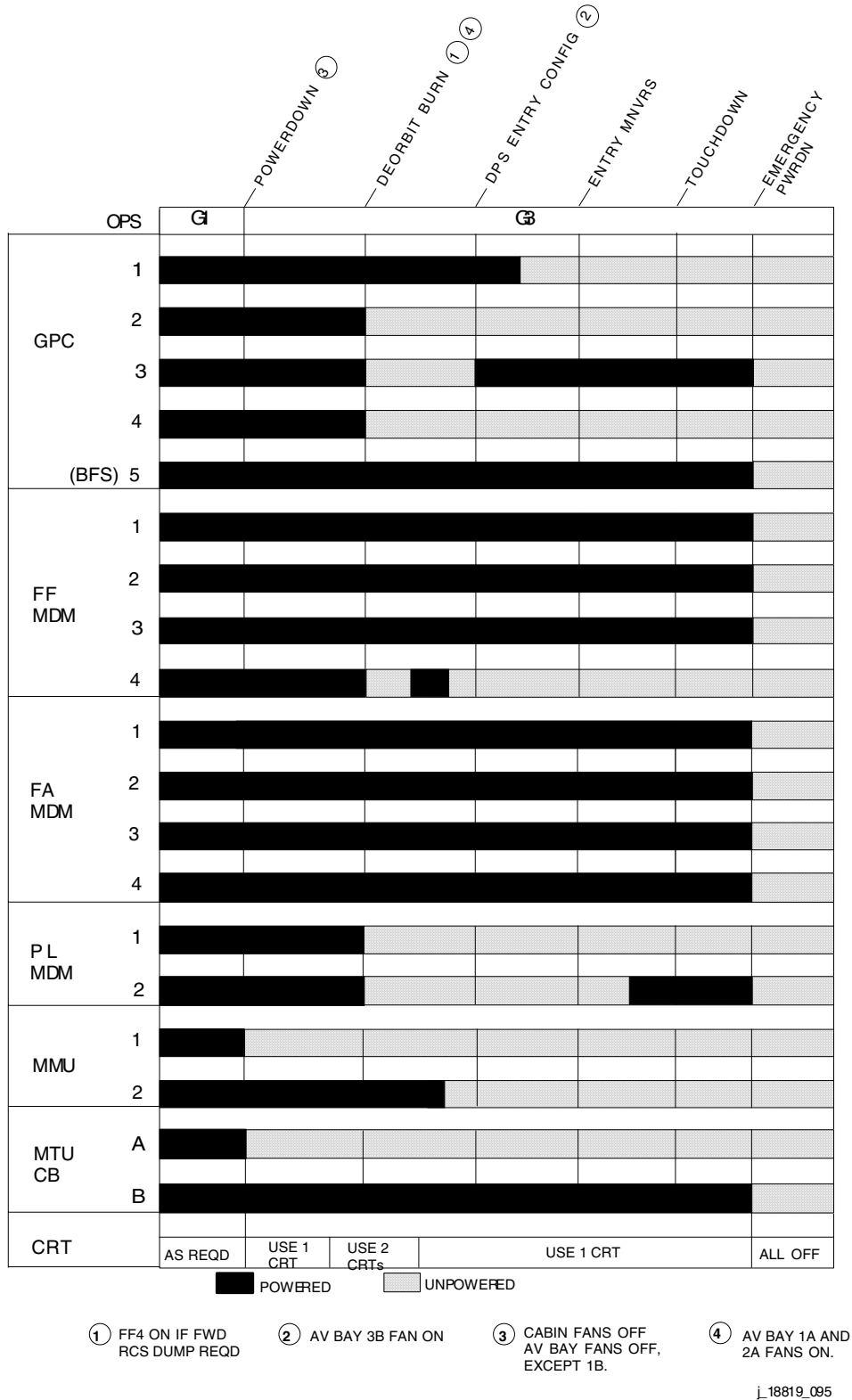


Figure K-10. Loss of Two H<sub>2</sub>O Loops (AOA, TIG < 15 min)

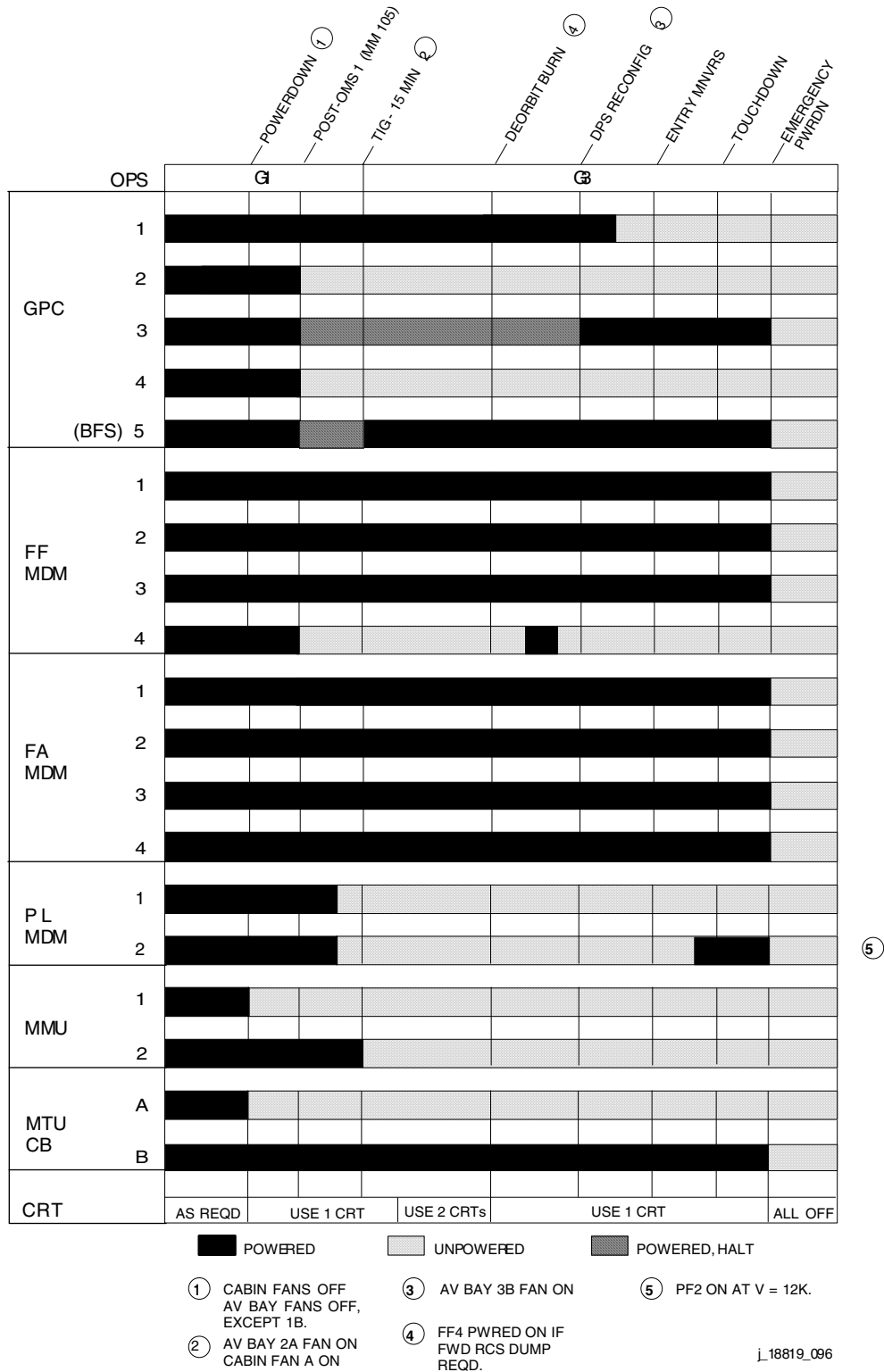


Figure K-11. Loss of Two H<sub>2</sub>O Loops (AOA, TIG > 15 min)

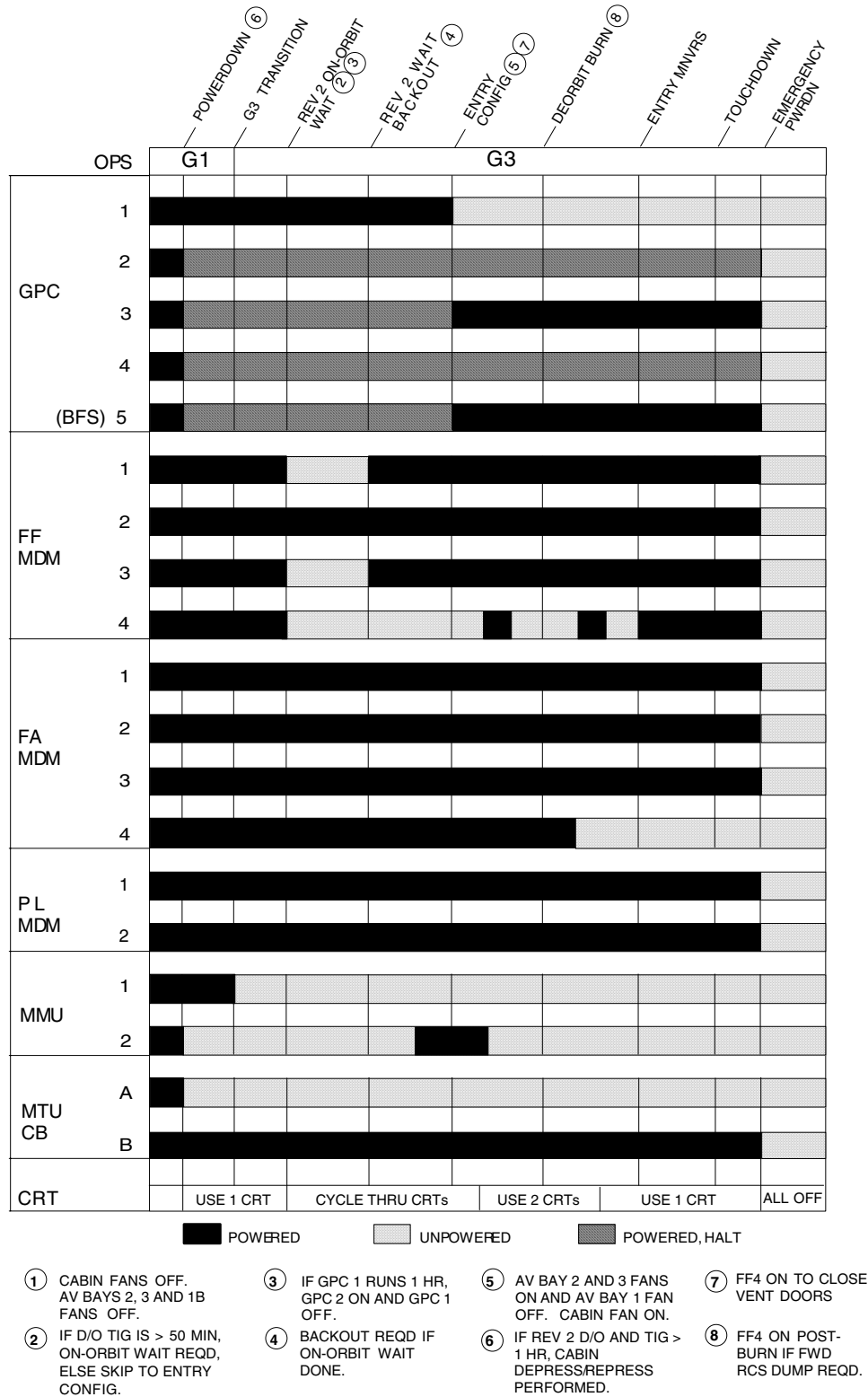
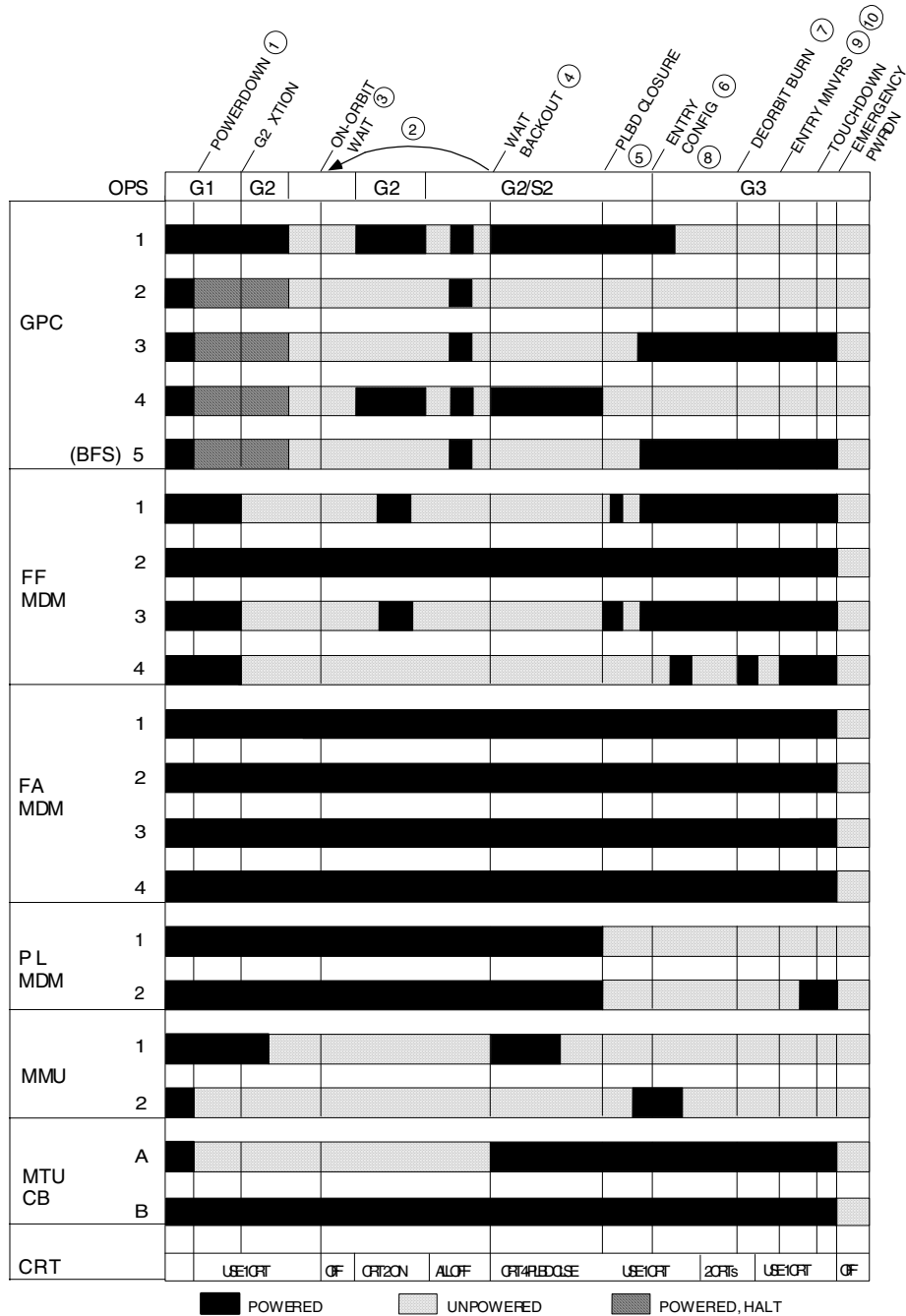


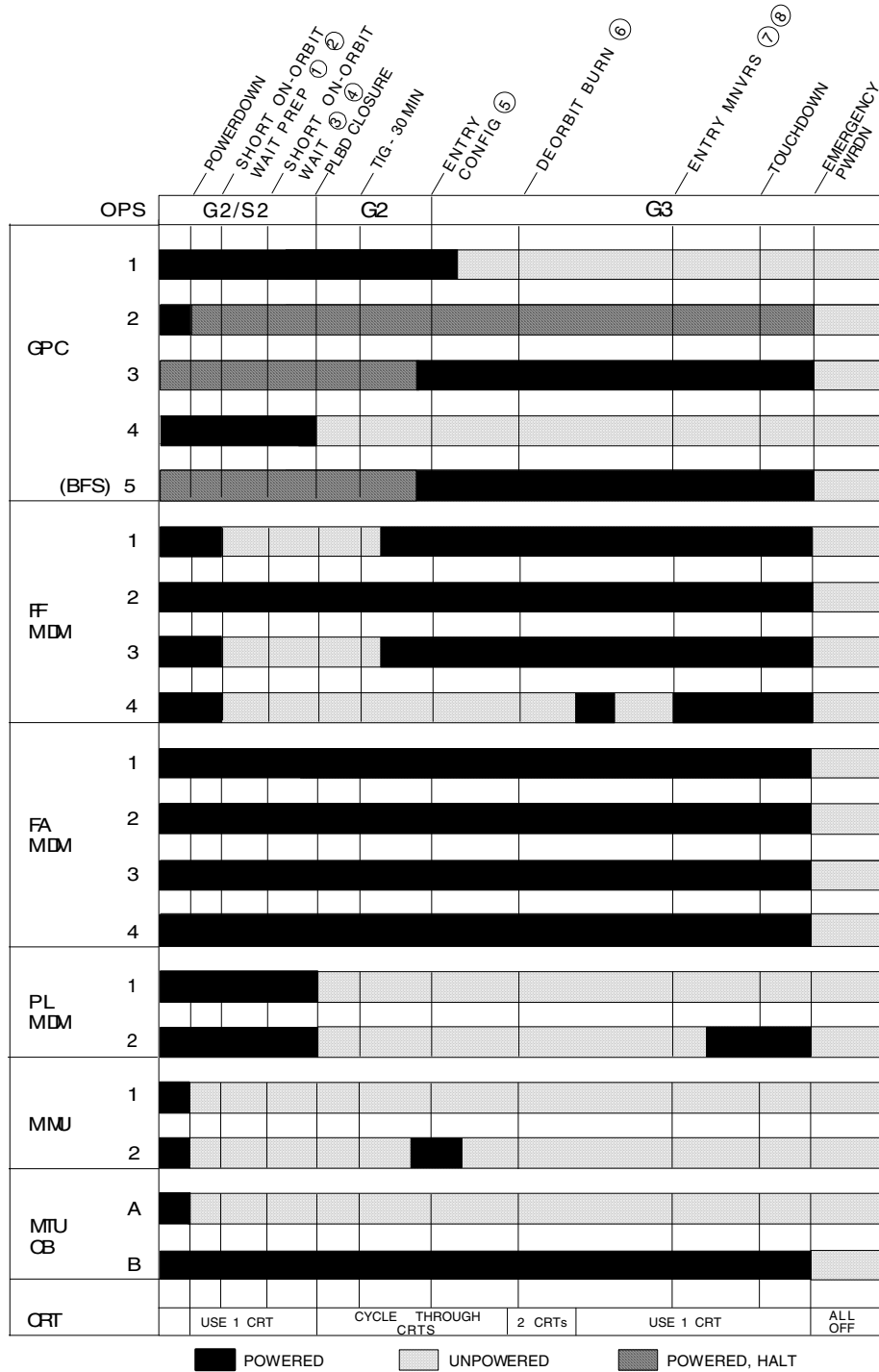
Figure K-12. Loss of Two H<sub>2</sub>O Loops (Post-OMS 2, Rev 2)



- ① CABIN FANS OFF. AV BAYS 1B, 2 AND 3 FANS OFF.
- ② ALTERNATE BETWEEN GPCs 1 & 4 FOR EACH IMU ALIGN/CABIN DEPRESS/REPRESS CYCLE. EACH GPC IS PWRED UP FOR 2 SEC EACH CYCLE TO SCRUB MEMORY OF ANY ACCUM. ERRORS.
- ③ AV BAY 1 FAN ON DURING IMU ALIGN/CABIN DEPRESS/REPRESS CYCLE.
- ④ TIG - 1:30
- ⑤ IF NO DATA REQD, PF2 OFF. FF1 AND 3 ON FOR IMU ALIGN.
- ⑥ AV BAY 2 AND 3 FANS ON.
- ⑦ FF1, 2, 3 AND 4 ON FOR FWD RCS DUMP IF REQD.
- ⑧ FF4 ON FOR VENT DOOR CLOSURE.
- ⑨ FF4 ON AT EI-5.
- ⑩ PF2 ON FOR ENTRY COMM AT V = 12K.

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**Figure K-13. Loss of Two H<sub>2</sub>O Loops (Post-OMS 2)**



- ① CABIN FANS OFF. AV BAYS 1B, 2, AND 3 FANS OFF.
- ② IF TIG < 50 MIN, GO TO SHORT ON-ORBIT WAIT.
- ③ IF GPC 1 RUNS 1 HR, USE GPC 2 AND PWR OFF GPC 1
- ④ IF TIG < 50. AT TIG - 30 GO TO TIG - 30 CONFIG.
- ⑤ AV BAY 2 AND 3 FANS ON.
- ⑥ FF4 ON IF FWD RCS DUMP REQD.
- ⑦ PF2 ON FOR ENTRY COMM AT V = 12K.
- ⑧ FF4 ON AT EI-5

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**Figure K-14. Loss of Two H<sub>2</sub>O Loops (Orbit, TIG < 2.5 hr)**

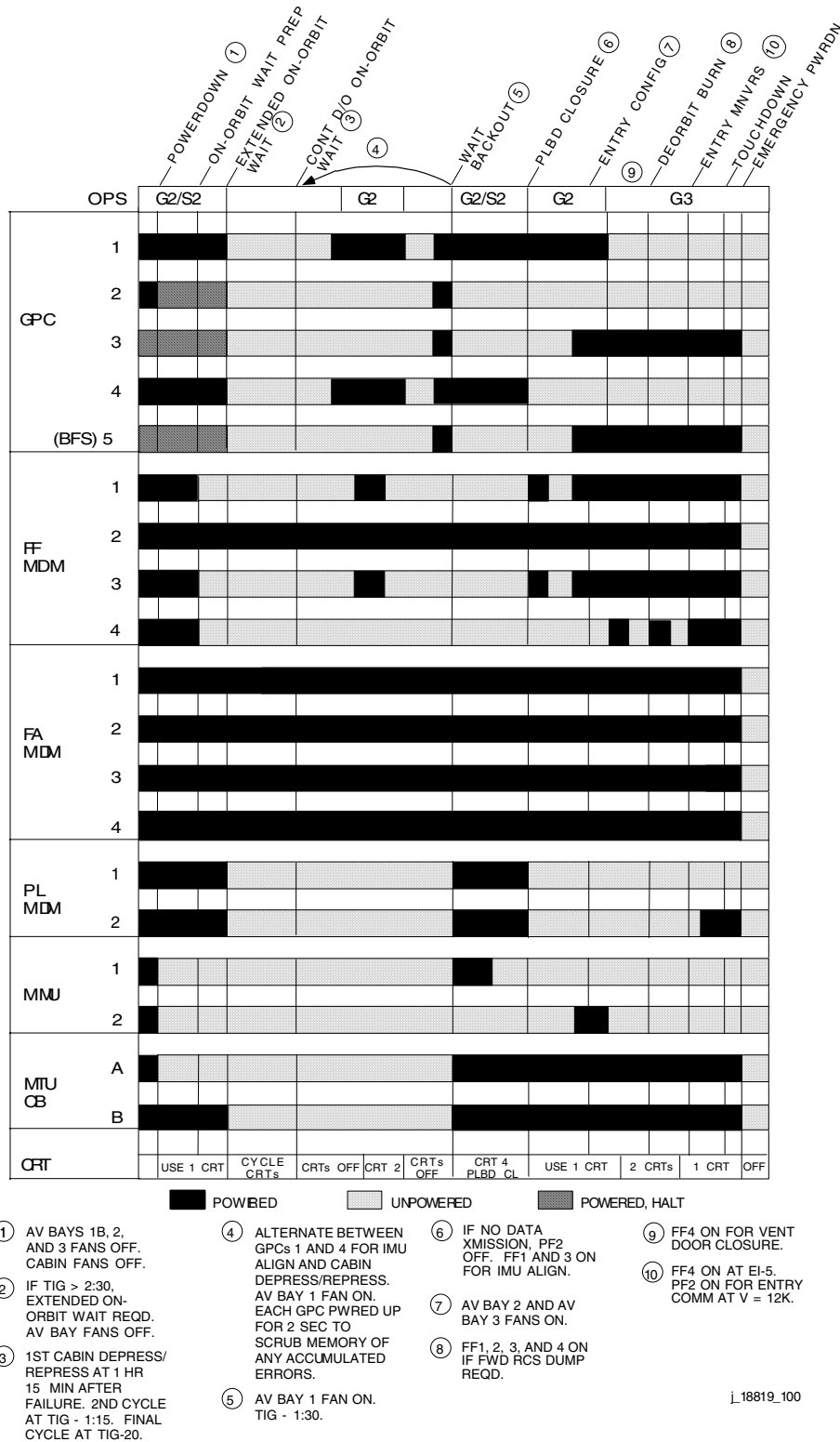
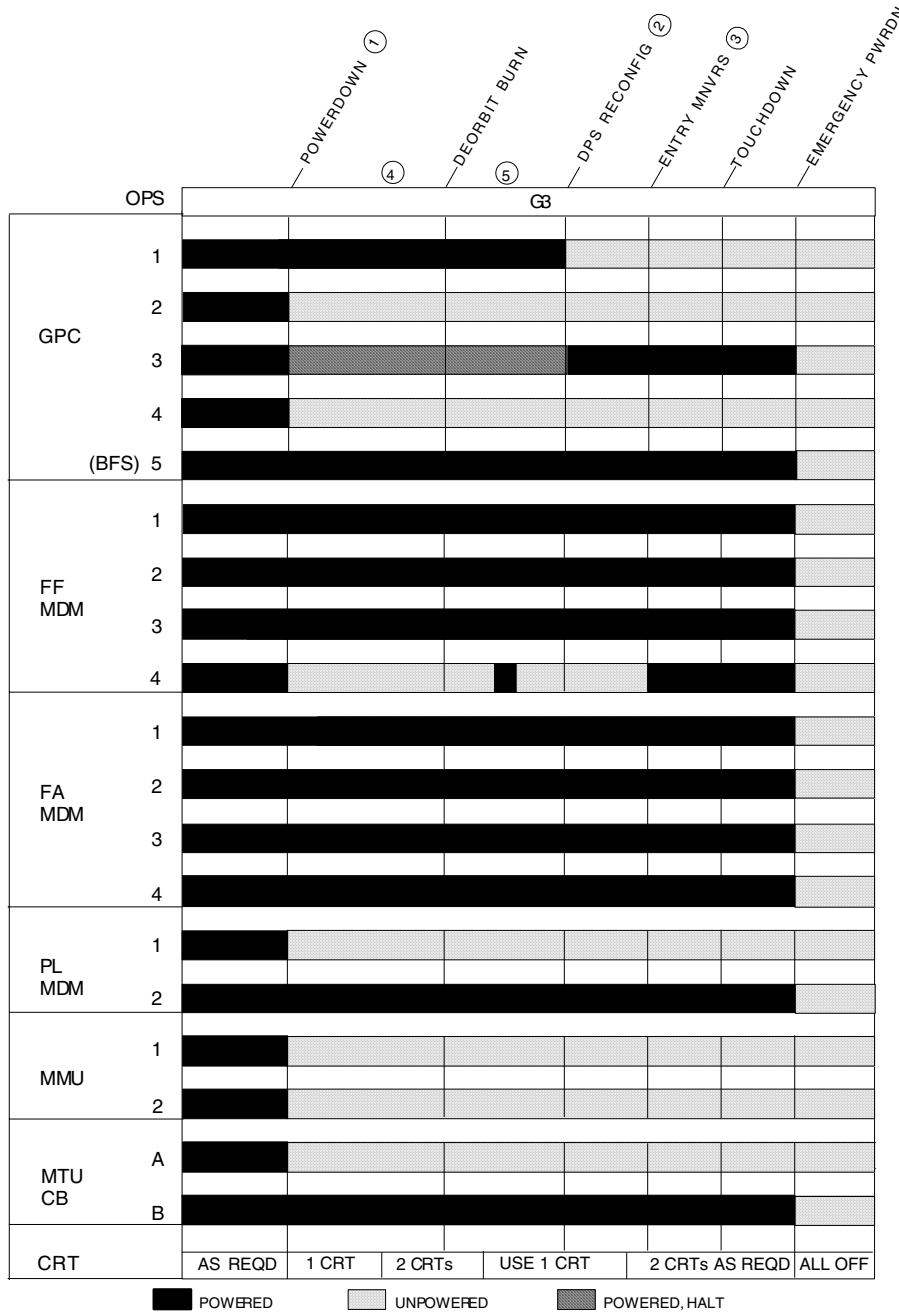


Figure K-15. Loss of Two H<sub>2</sub>O Loops (Orbit, TIG > 2.5 hr)



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**Figure K-16. Loss of Two H<sub>2</sub>O Loops (Entry, TIG < 45 min)**



**TITLE**

LOSS OF TWO FUEL CELLS

**CONCERNS:**

A powerdown is required to conserve the power from the remaining good fuel cell. (There are no thermal concerns.) The remaining fuel cell can supply enough power during orbit, but the entry phase requires more equipment. The entry phase puts more of a load on the fuel cell, and could cause undervoltages on some equipment. We attempt to avoid undervoltages by powering off certain equipment (such as av bay fans) for a short time during times of peak power loads (such as when the vent doors move, landing aids turned on, etc.).

For all cases, except entry, the entry flight phase is performed with 3 main buses powered. For the entry case, only 2 main buses are powered due to lack of time for a more extensive powerdown and reconfiguration.

**FLIGHT DATA FILE:**

Flight phase	Procedure name	Book
1. Ascent: a. RTLS/TAL	2ND FC SHUTDN (ASCENT) LOSS OF 2ND FC PWRDN (ASCENT) RTLS/TAL TIMELINE	AESP AESP ASC
b. REV 2(3)	2ND FC SHUTDN (ASCENT) LOSS OF 2ND FC PWRDN (ASCENT) LOSS OF 2 FC LAUNCH DAY D/O	AESP/APCL AESP/APCL CONT D/O
2. Orbit: a. TIG < 4 hr	2ND FC SHUTDN LOSS OF 2ND FC (TIG < 4 HR) LOSS OF 2 FC D/O PREP	OPCL OPCL CONT D/O
b. TIG > 4 hr	2ND FC SHUTDN LOSS OF 2ND FC (TIG > 4 HR) LOSS OF 2 FC D/O PREP	OPCL OPCL CONT D/O
3. Entry: a. Pre-304	2ND FC SHUTDN LOSS OF 2ND FC PWRDN	EPCL EPCL
b. Post-304	2ND FC SHUTDN (ENTRY) LOSS OF 2ND FC PWRDN (ENTRY)	AESP AESP

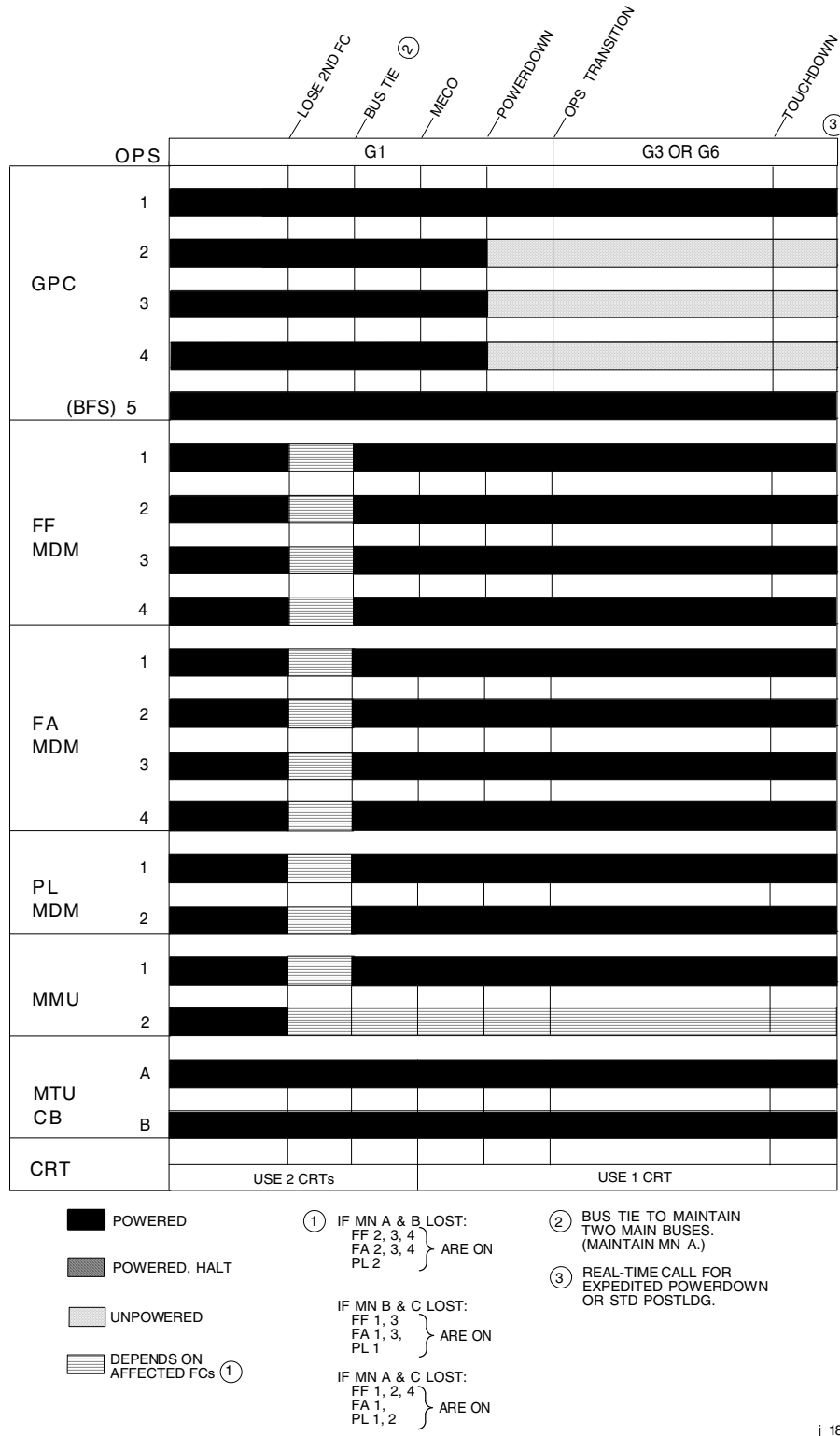
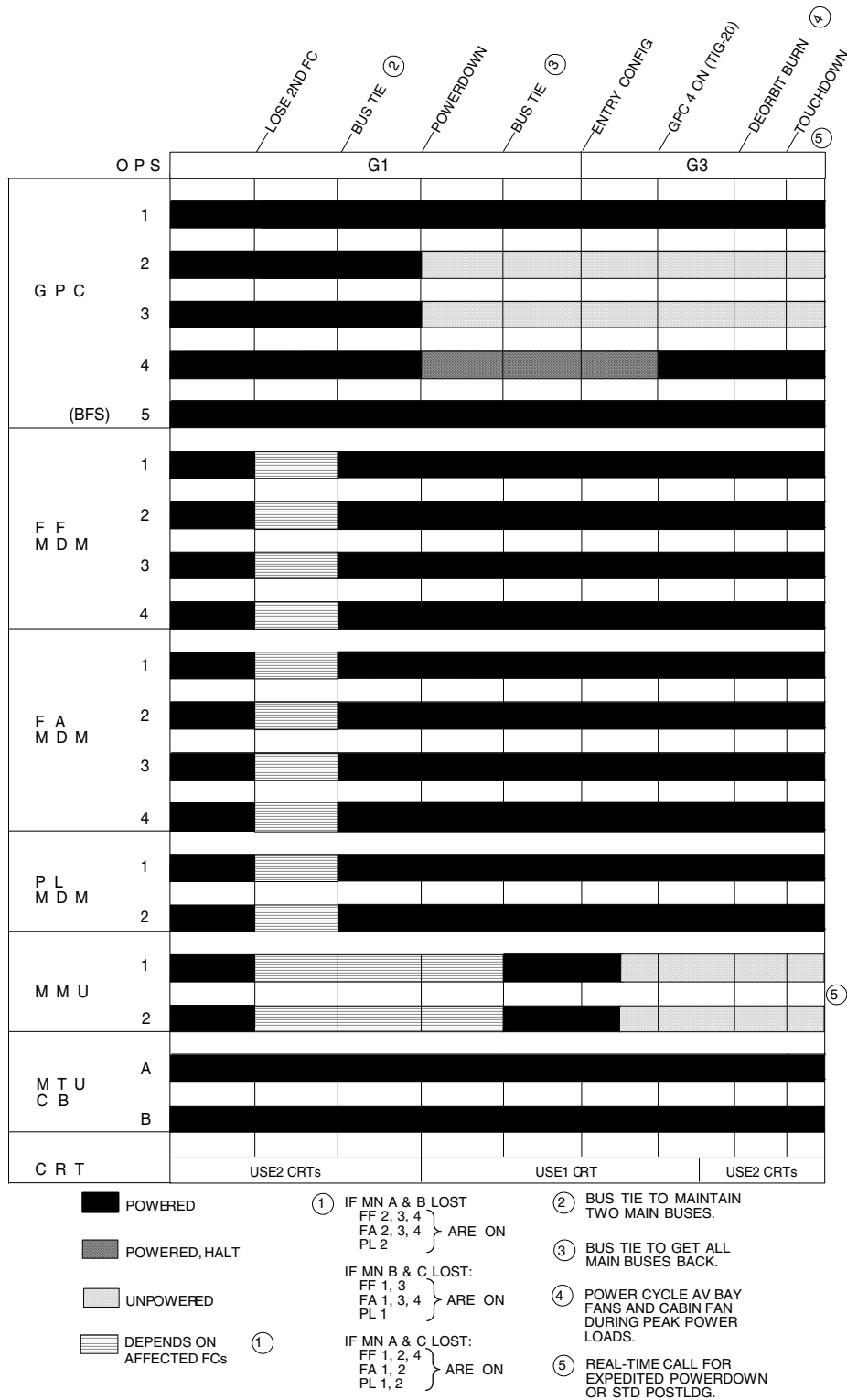
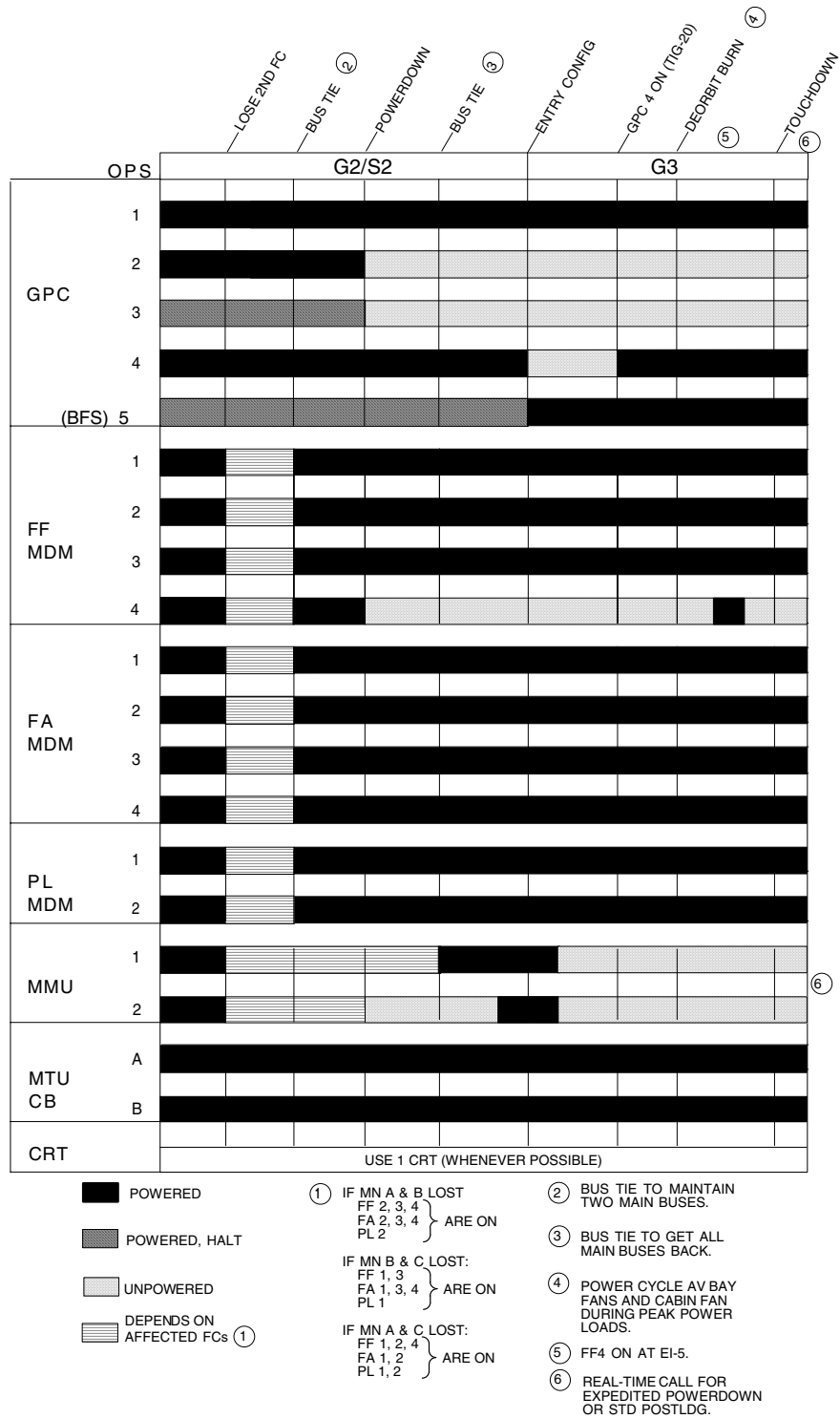


Figure K-17. Loss of Two Fuel Cells (RTLS/TAL)



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Figure K-18. Loss of Two Fuel Cells (Rev 2/3)



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Figure K-19. Loss of Two Fuel Cells (Orbit, 1.5 hr < TIG < 4 hr)

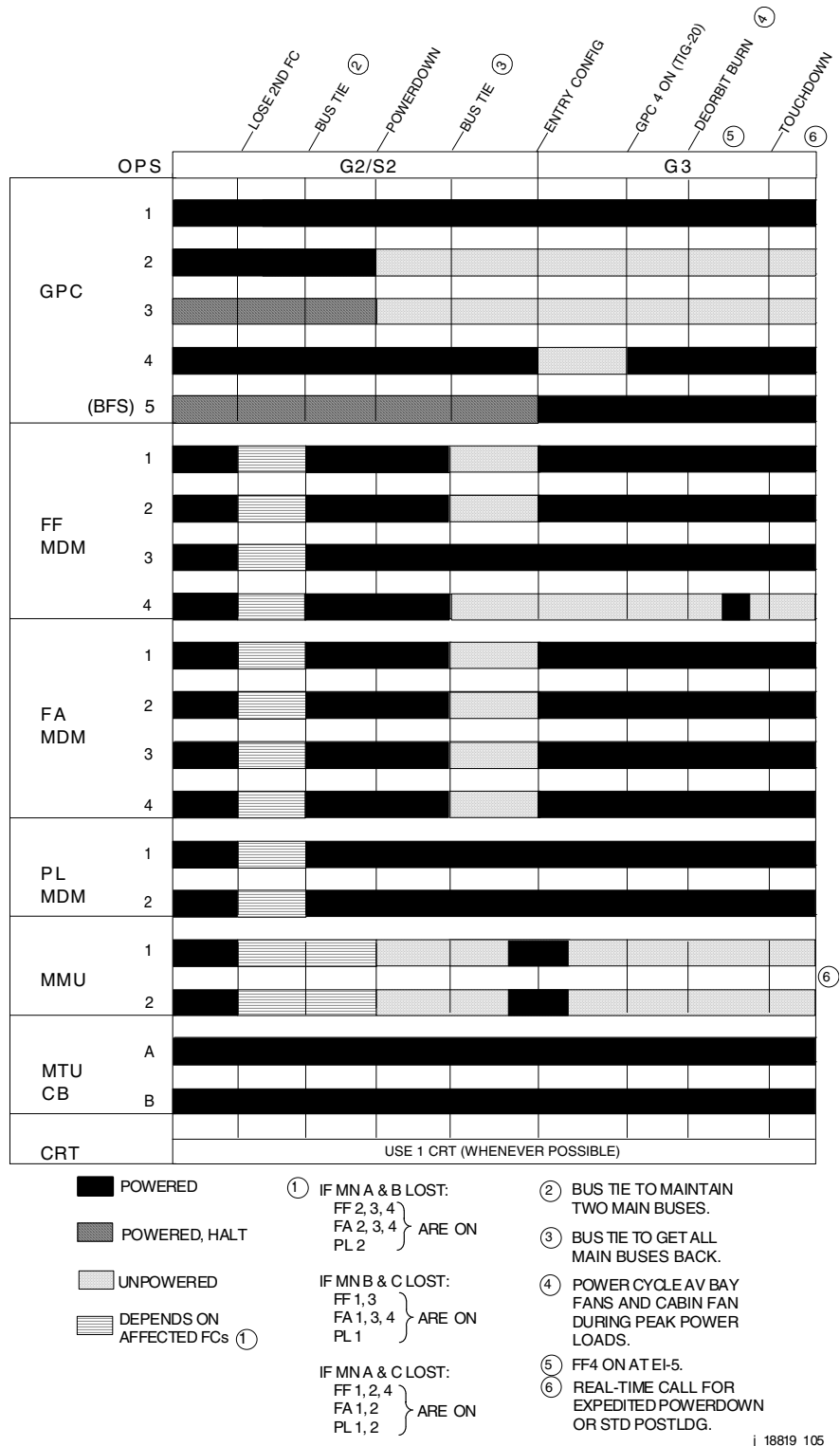


Figure K-20. Loss of Two Fuel Cells (Orbit, TIG < 4 hr)

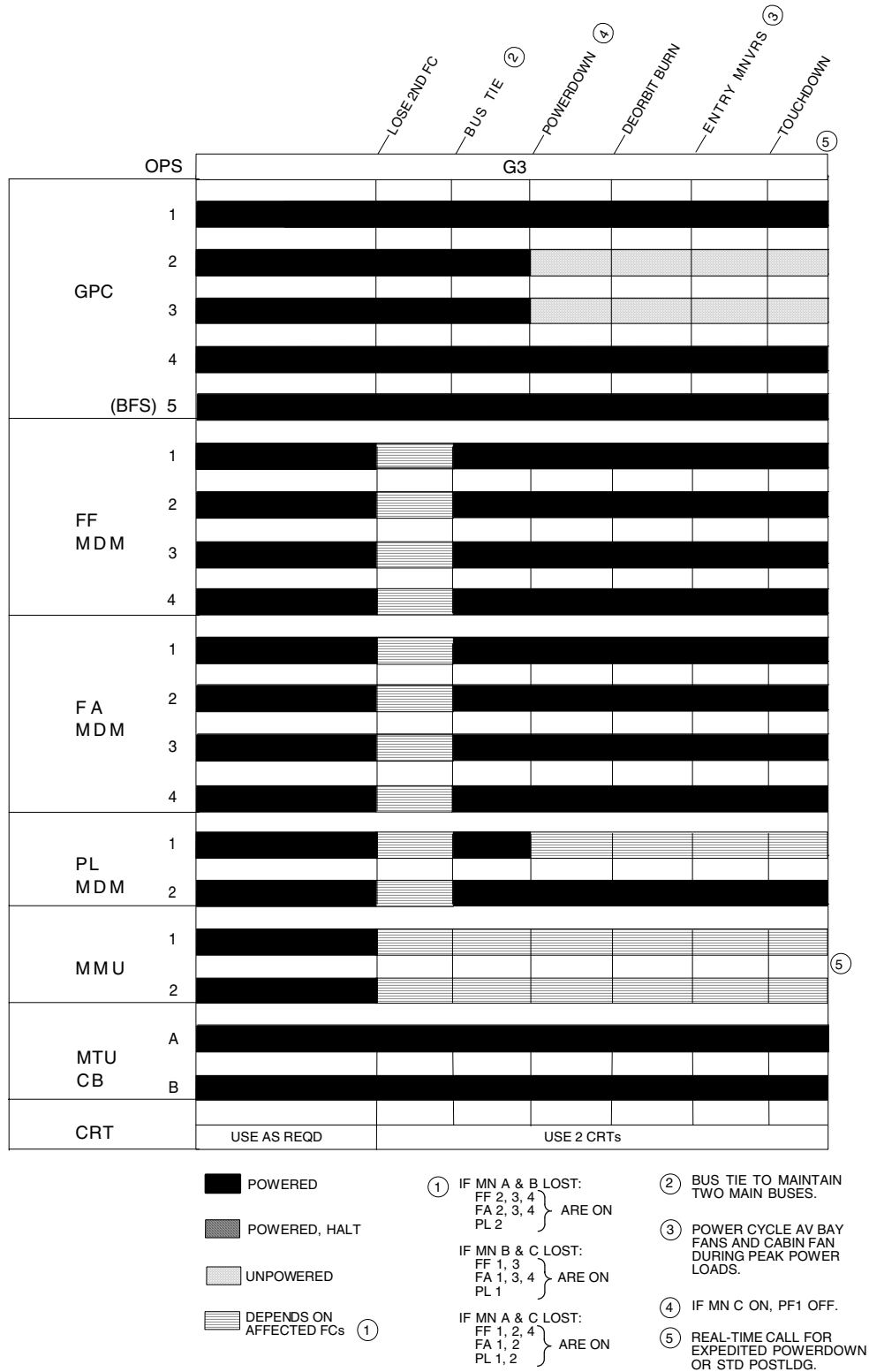


Figure K-21. Loss of Two Fuel Cells (Entry, Pre-304)

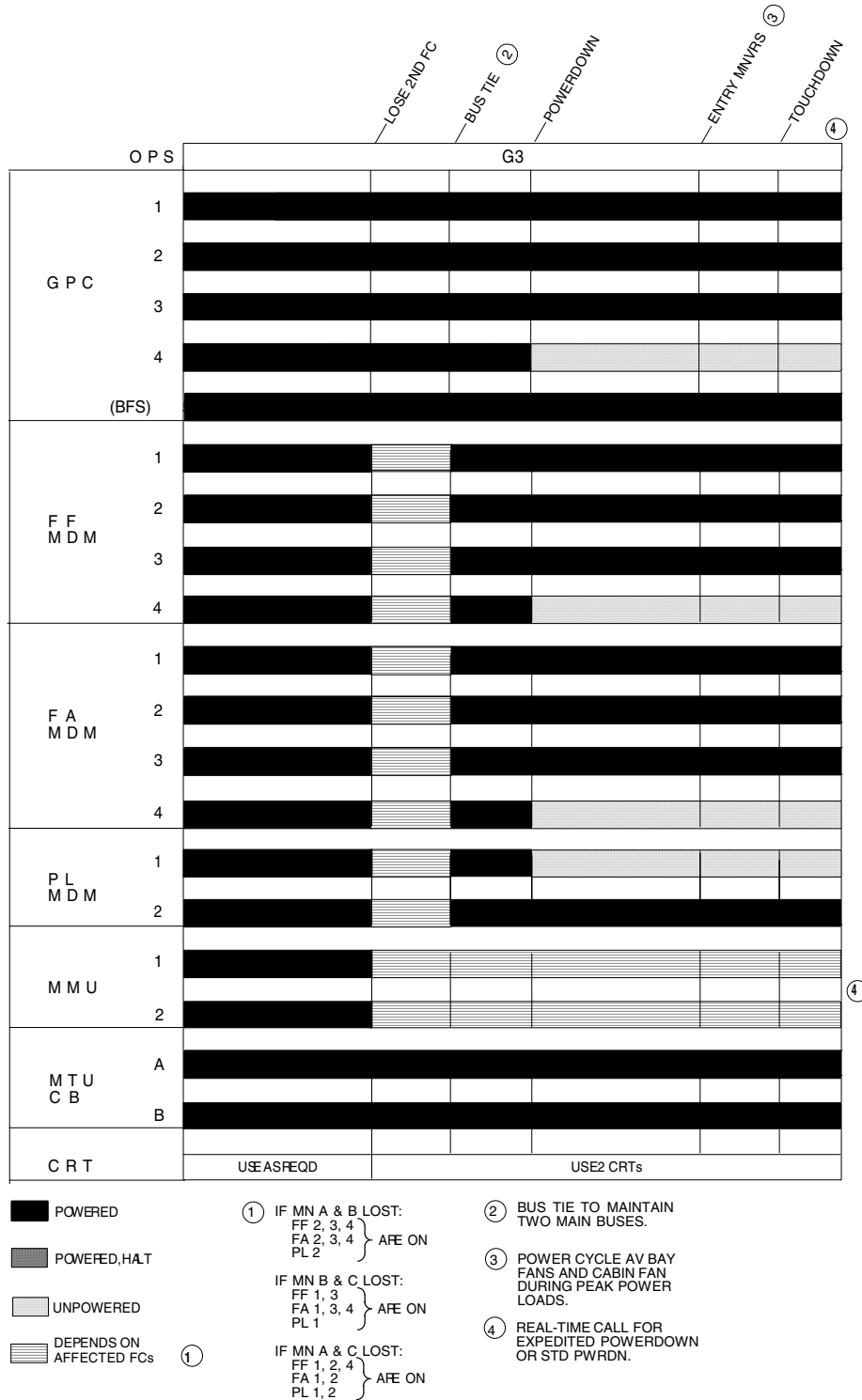


Figure K-22. Loss of Two Fuel Cells (Entry, Post-304)

**TITLE**

LOSS OF CABIN PRESSURE

**CONCERNS:**

The two primary concerns associated with a cabin pressure leak are depletion of breathing oxygen for the crew and loss of gas for thermal control of the air-cooled equipment. A human being cannot survive at low atmospheric pressures. (A human being is predicted to survive only a short time in air pressure as low as 3.5 psia.) Therefore, an abort site is chosen such that the cabin pressure is predicted to stay at 8 psia.

On ascent, an abort decision is made based on the change in pressure (dp/dt). Depending on the value of the dp/dt, an AOA, RTLS, TAL, or late TAL may be required. Once on orbit, the decision to deorbit is based on how long the remaining nitrogen supply can support the leak. Based on nitrogen supply and TIG time, a PLS, ELS, or bailout is chosen.

As cabin pressure drops, the air that is flowing must be colder to remove the same amount of heat. This results in degraded cooling to air cooled equipment. A powerdown is required to help offload the amount of heat poured into the air. However, the thermal analysis results for a 4-psia cabin indicated that all 5 GPCs may be left powered.

**FLIGHT DATA FILE:**

Flight phase	Procedure name	Book
1. Ascent: AOA or REV 2(3)	CAB PRESS LEAK LOSS OF CAB PRESS (MAJOR/MINOR) AOA TIMELINE or LAUNCH DAY DEORBIT PREP POSTLANDING PROCEDURES	APCL APCL ASC/CONT D/O ENT
2. Orbit: a. TIG < 2 hr 40 min	O <sub>2</sub> (N <sub>2</sub> ) FLOW HIGH/CAB P LOW/DP LOSS OF CAB PRESS EMERGENCY DEORBIT PREP/ENTRY	OPCL OPCL CONT D/O
b. TIG > 2 hr 40 min	O <sub>2</sub> (N <sub>2</sub> ) FLOW HIGH/CAB/P LOW/DP LOSS OF CAB PRESS 8 PSI D/O PREP CONT DELTAS	OPCL OPCL D/O PREP
3. Entry:	O <sub>2</sub> (N <sub>2</sub> ) FLOW HIGH/CAB P LOW/DP LOSS OF CAB PRESS	EPCL EPCL

\* Depending on dP/dt, major or minor powerdown is performed



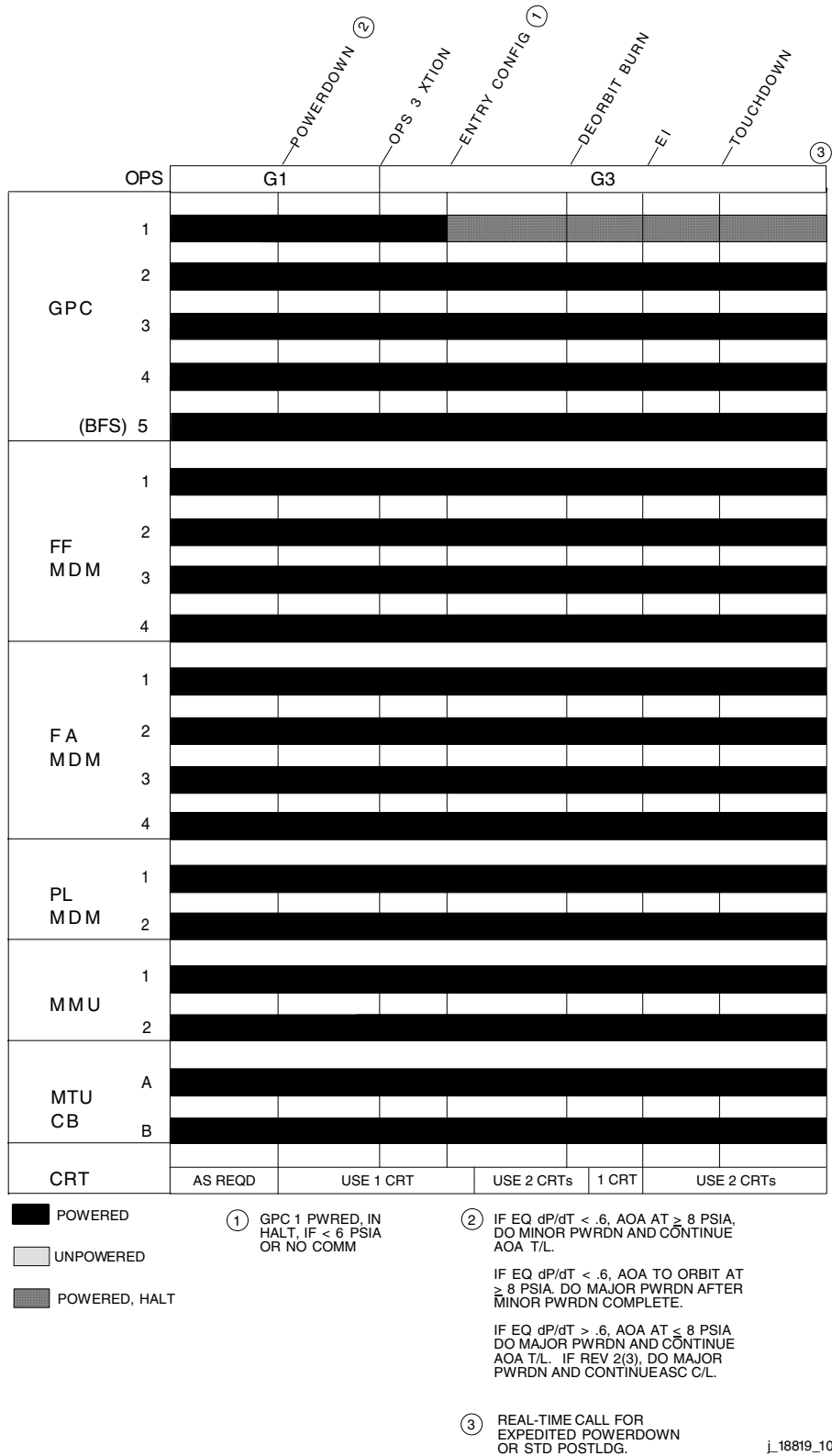
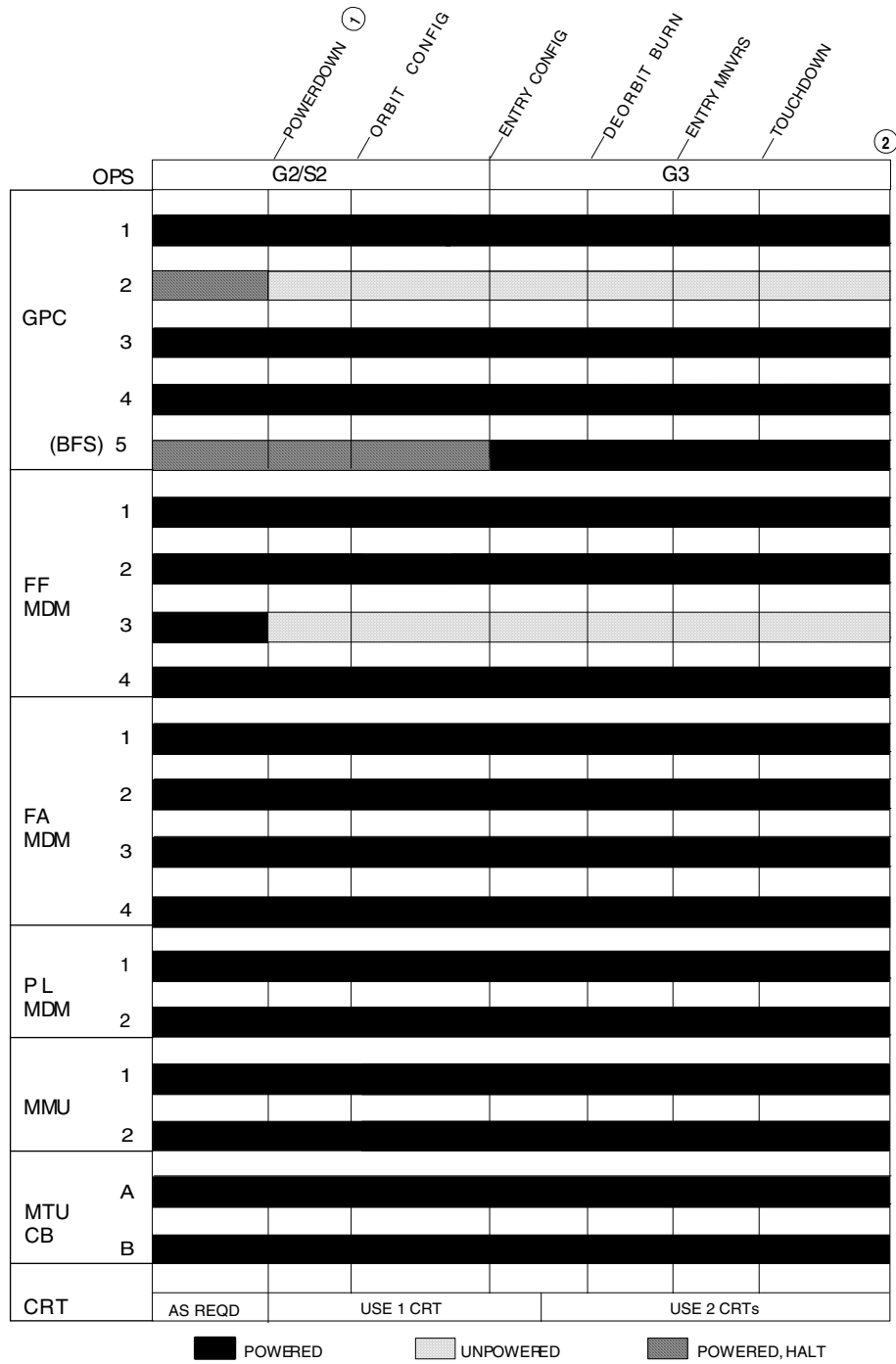


Figure K-23. Loss of Cabin Pressure (Ascent, AOA, or Rev 2/3)



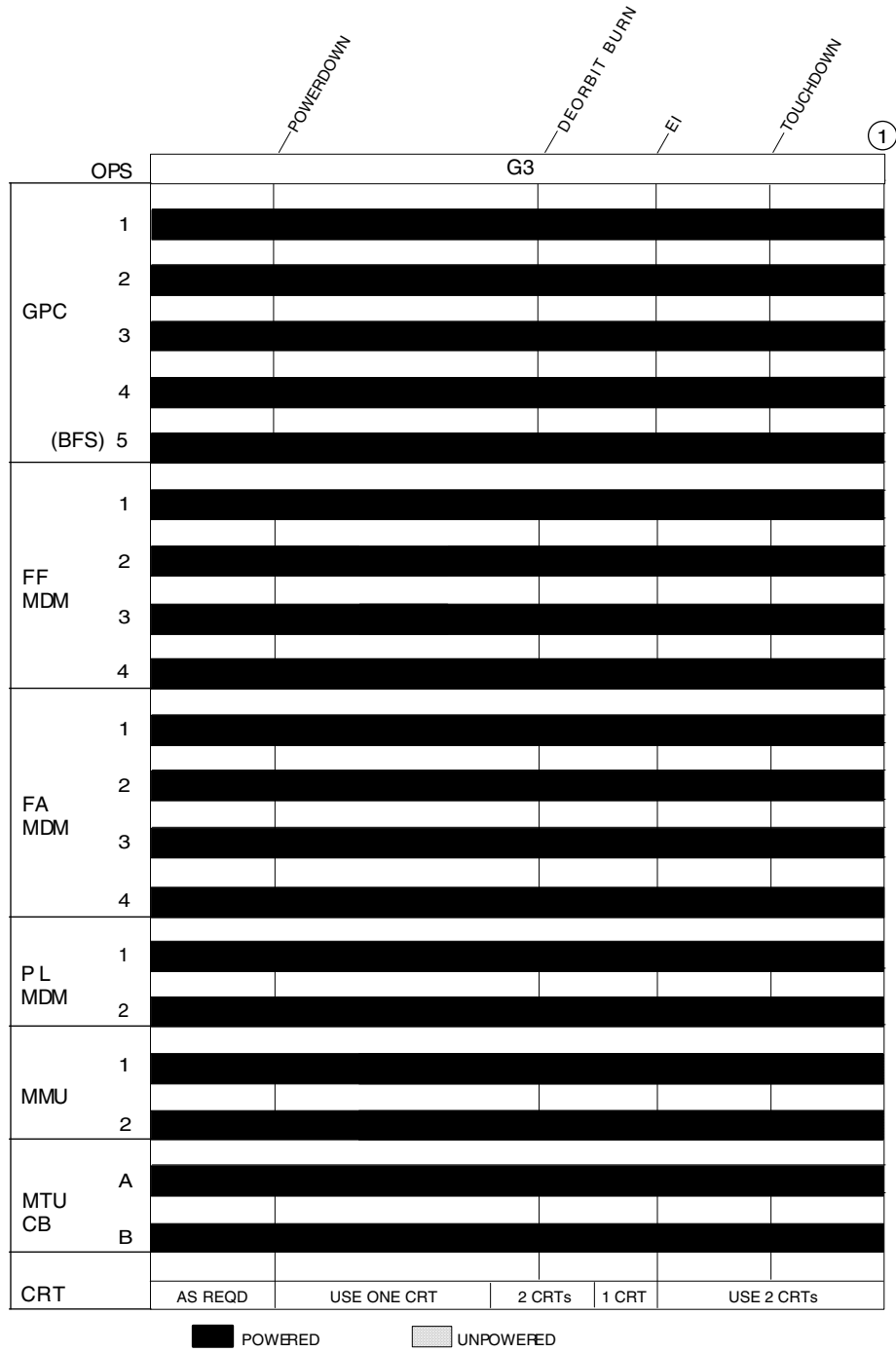


① IF TIG < HR, DO NOT PWR GPC 1 OFF, THEN PERFORM 8 PSI CONT. DELTAS IN D/O PREP EXCEPT THE DPS DELTAS.

② REAL-TIME CALL FOR EXPEDITED POWERDOWN OR STD POSTLDG.

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Figure K-25. Loss of Cabin Pressure (Orbit, TIG > 2 hr 40 min)



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**Figure K-26. Loss of Cabin Pressure (Entry)**

**TITLE**

LOSS OF FES

**CONCERNS:**

The flash evaporator system (FES) is used during ascent and entry to provide systems cooling between approximately 120,000 feet and orbit when the payload bay doors can be opened. On orbit, the FES is used only to keep thermal spikes within limits, while the primary thermal control is provided by the radiators.

When the FES is lost, thermal loads must be reduced during periods when the FES is used. On orbit, heat removal of the radiators allows for normal on-orbit power levels. Prior to deorbit, the radiators are cold soaked alternately. This technique allows the radiators to act as a heat sink until the ammonia boiler system (ABS) is activated at entry interface (EI). The ABS cannot be activated sooner, because it was not designed to operate in zero G. However, the quality of the cold soak is reduced due to the fact that the rads are still cooling the Orbiter during the cold soak. Therefore, a powerdown is performed prior to payload bay door closing.

**FLIGHT DATA FILE:**

Flight phase	Procedure name	Book
1. Ascent:	EVAP OUT T HIGH LOSS OF FES/1 FC ECLS, SSR-2	APCL APCL MALF
2. Deorbit Prep:	EVAP OUT T HIGH LOSS OF FES LOSS OF FES DEORBIT PREP EXPEDITED POWERDOWN	OPCL OPCL CONT D/O ENT
3. Entry:	EVAP OUT T HIGH LOSS OF FES EXPEDITED POWERDOWN	EPCL EPCL ENT

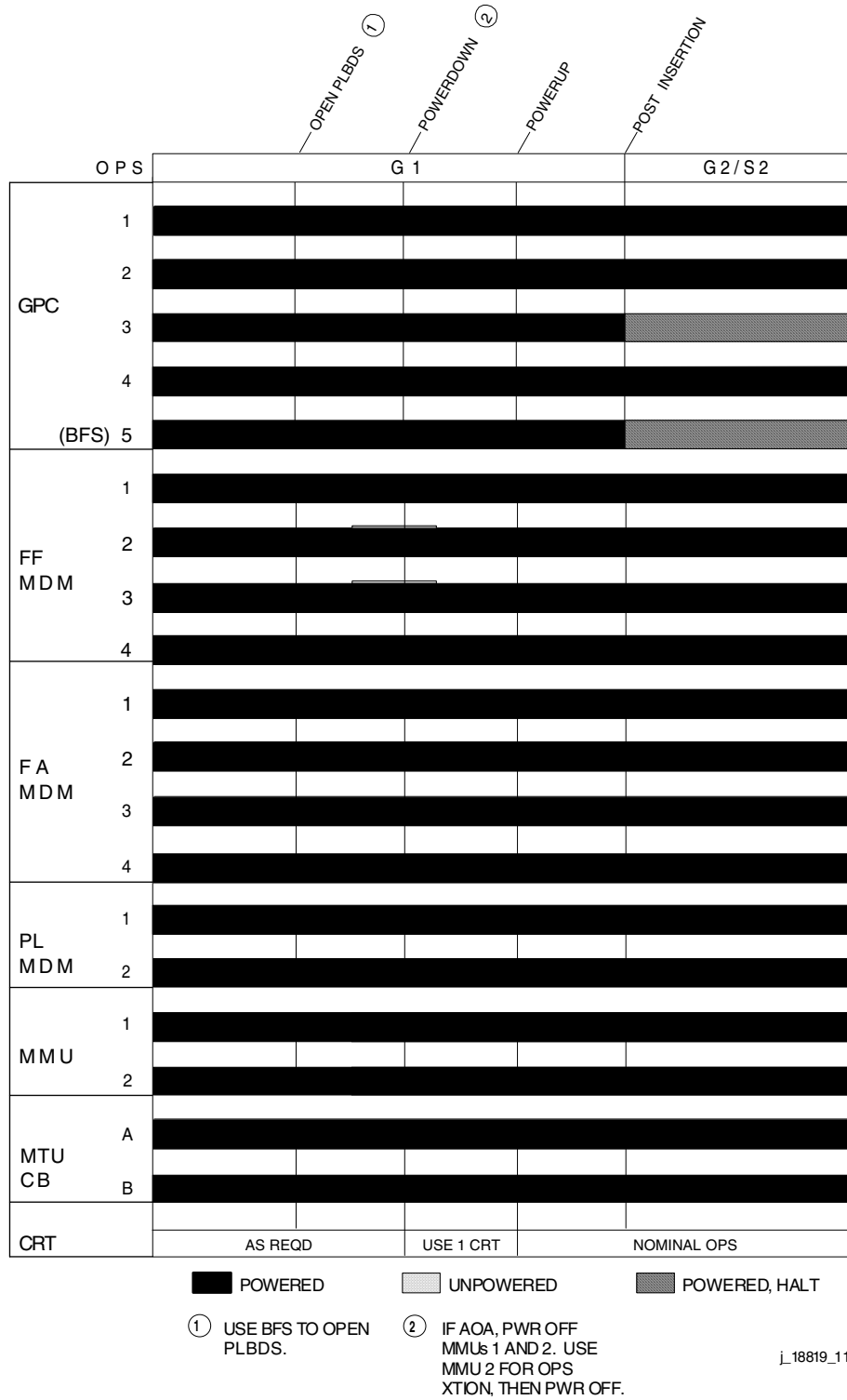


Figure K-27. Loss of FES (Ascent)

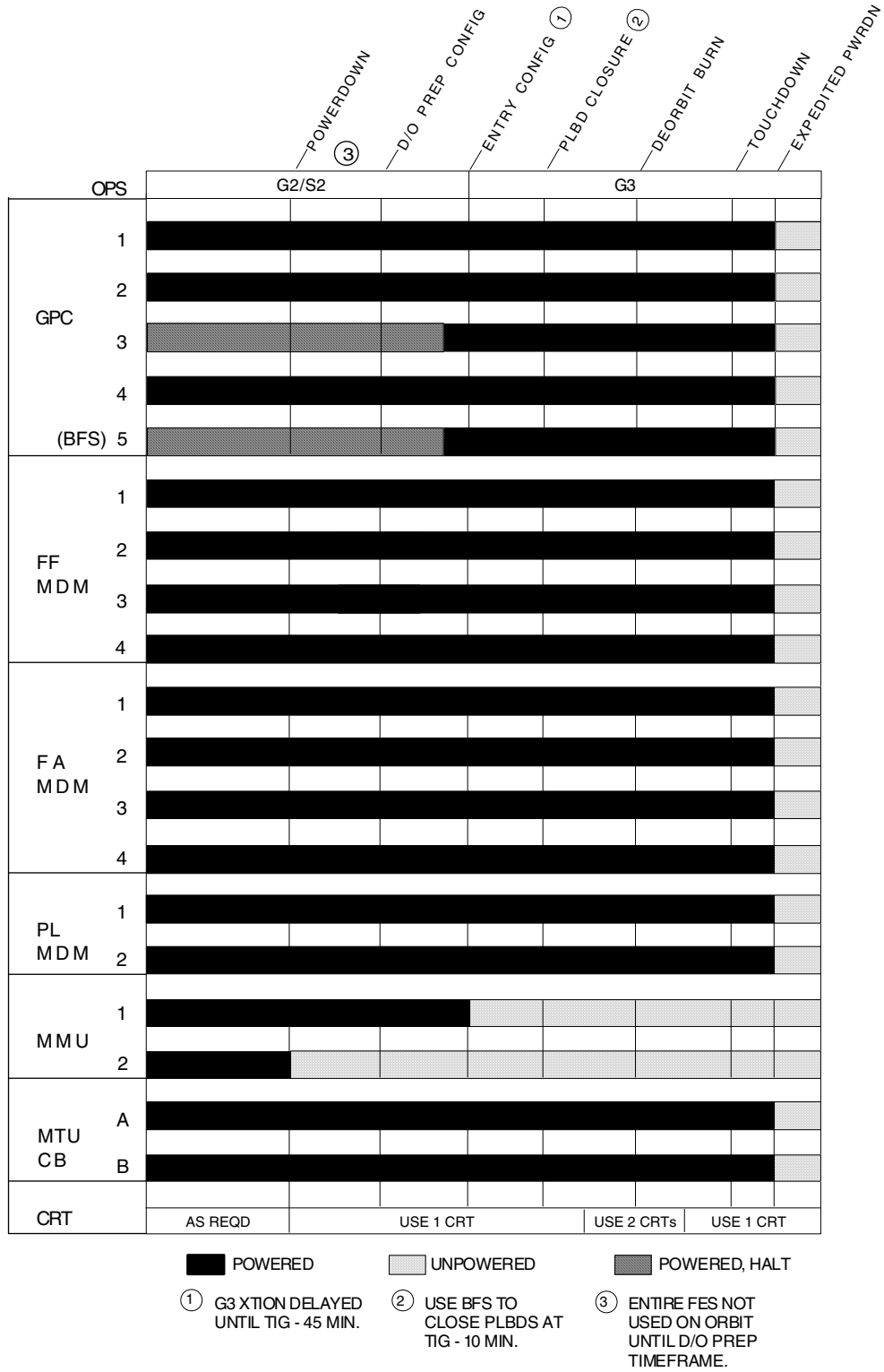


Figure K-28. Loss of FES (Deorb Prep)

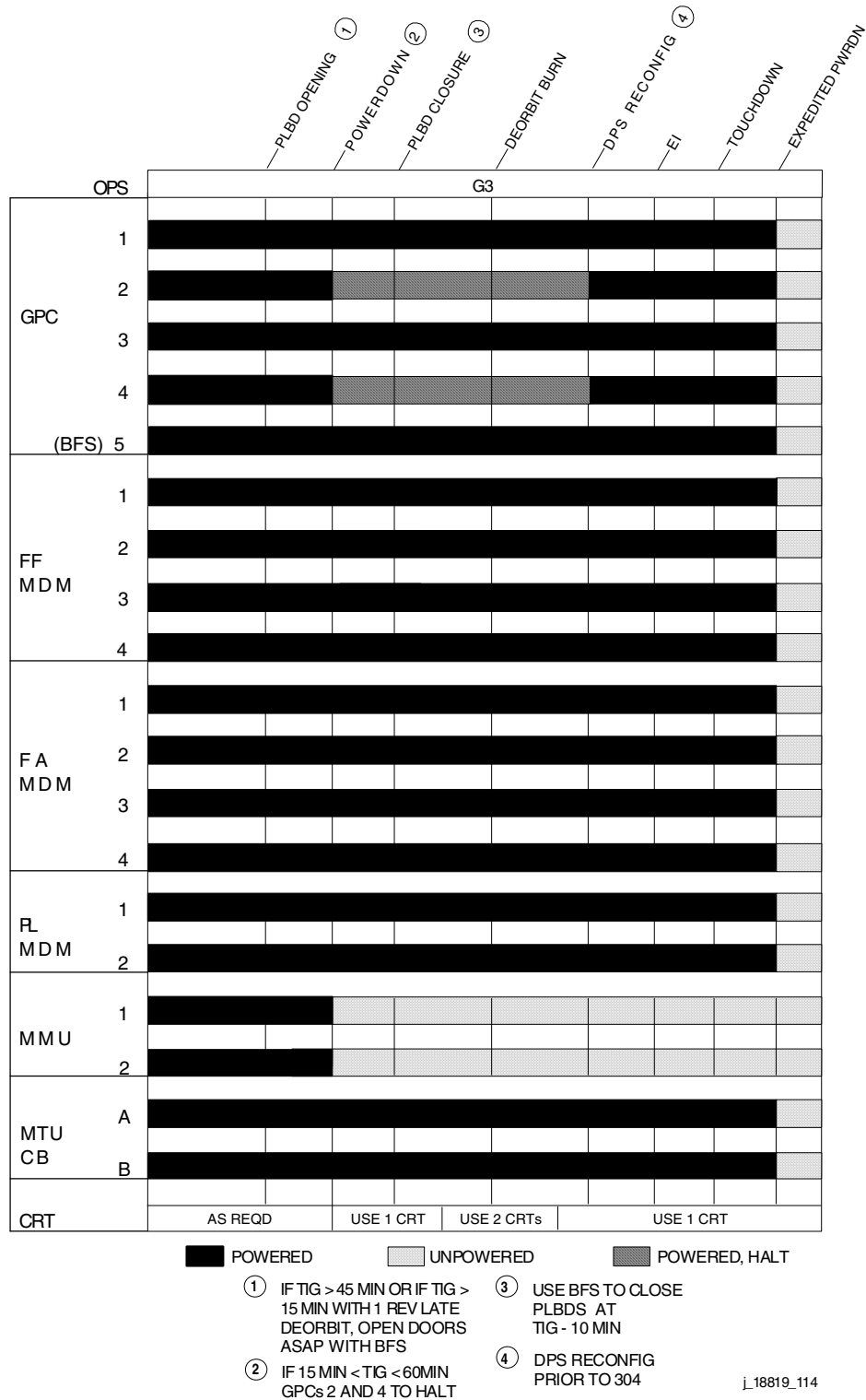


Figure K-29. Loss of FES (Entry)



**TITLE**

LOSS OF TWO CABIN FANS

**CONCERNS:**

Loss of both cabin fans results in the loss of cooling to air-cooled equipment in the cabin and to the crew. It is important to expedite the powerdown of air-cooled equipment in the cabin. The CRT's and DEU's are the major heat sources in the cabin, besides the crew.

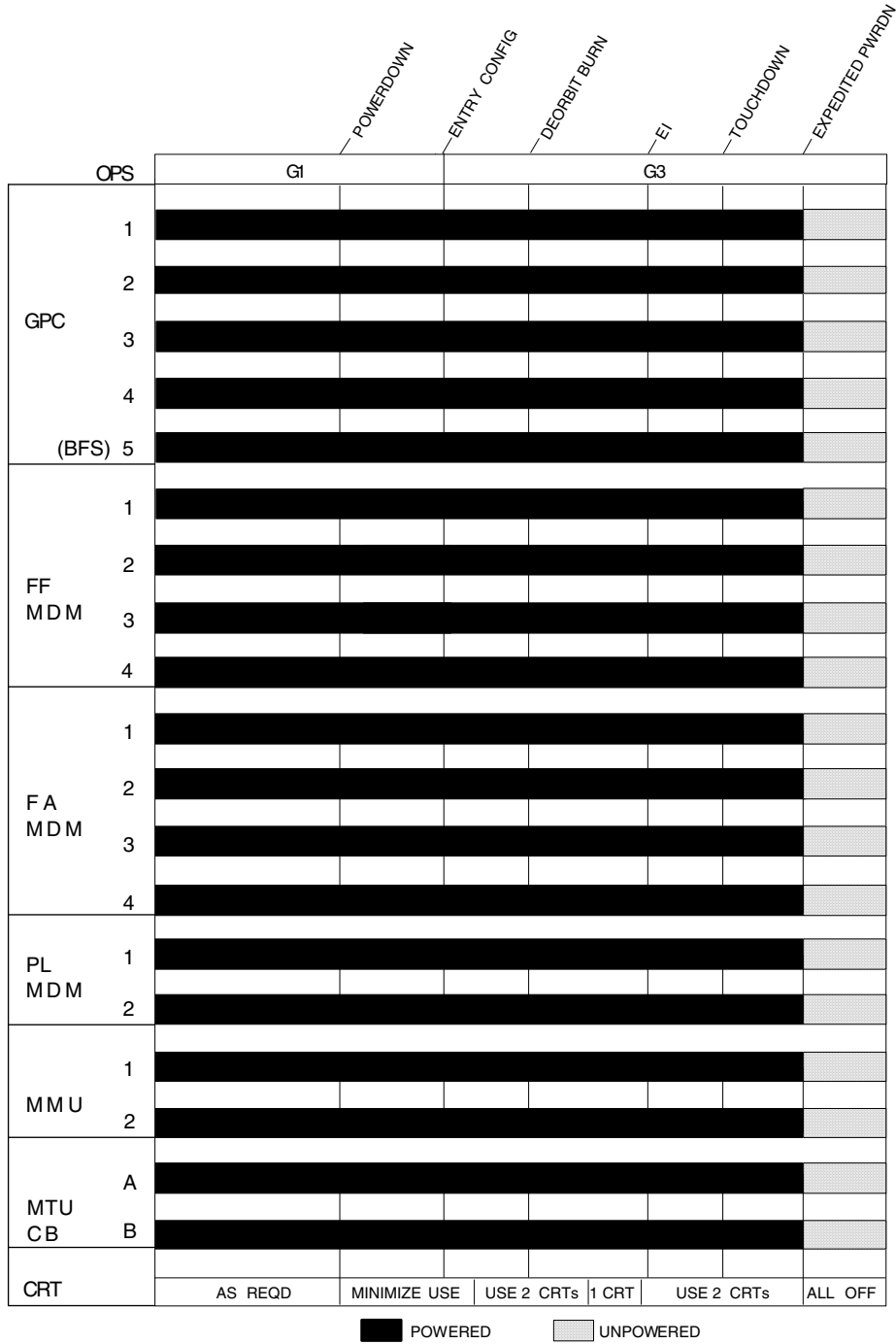
Thermal analysis of this case indicated three major areas of concern:

1. IMU operation - The IMU cooling air loop is predicted to remove heat from the cabin causing significant condensation on the IMU heat exchanger.
2. Carbon dioxide concentration - The CO<sub>2</sub> concentration is predicted to climb above the maximum acceptable level in the orbit case.
3. Crew health - The cabin temperature and humidity reach an intolerable level in the orbit case, and a marginal level in the Rev 3 case.

Cabin depressurization/repressurization cycles, cabin purges, and cool, dry oxygen to the crew via helmets are three techniques that are used to improve the cabin environment.

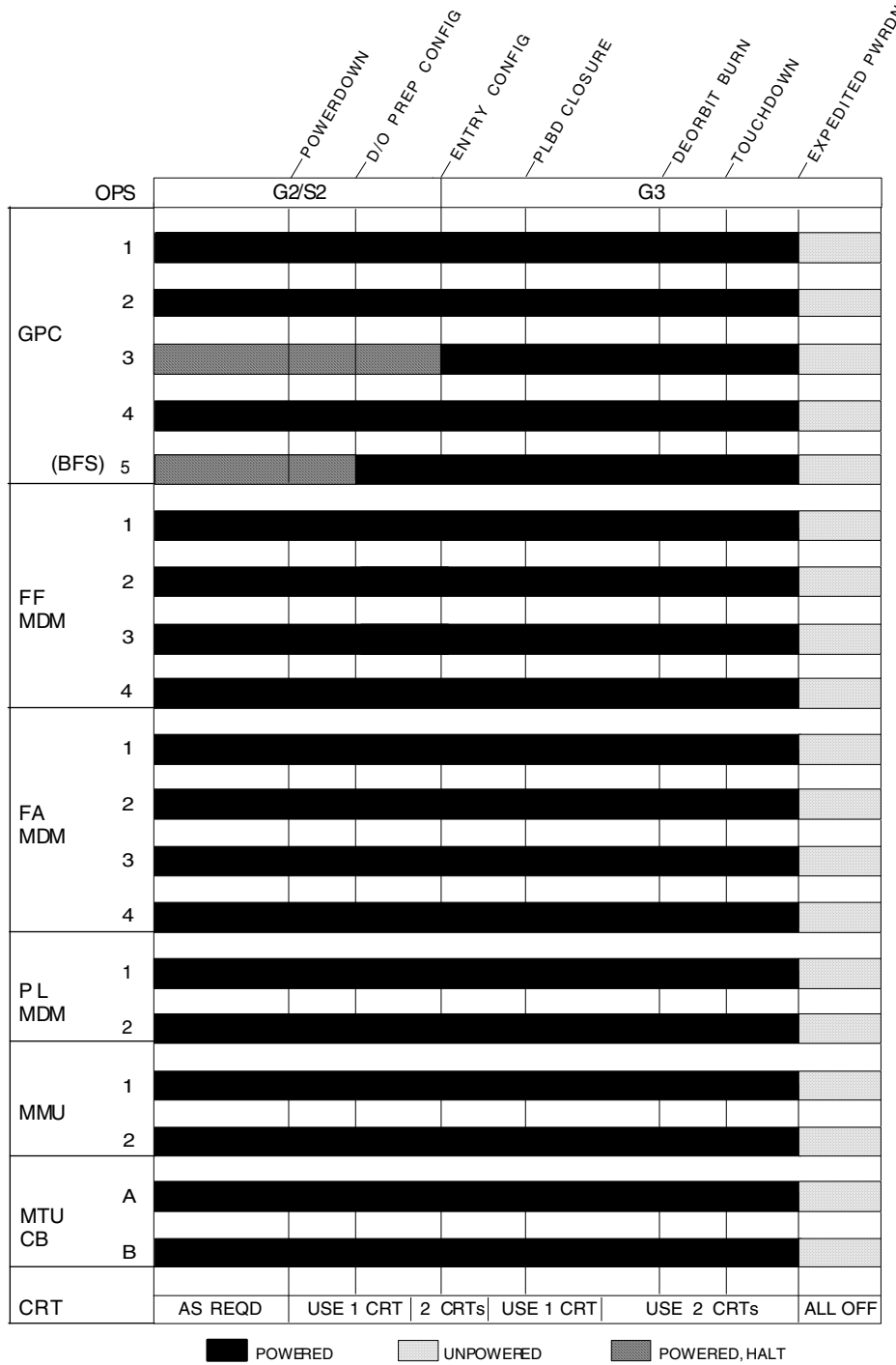
**FLIGHT DATA FILE:**

Flight phase	Procedure name	Book
1. Ascent: REV 2(3)	CAB FAN FAIL LOSS OF 2 CAB FANS EXPEDITED POWERDOWN	APCL APCL ENT
2. Orbit:	LOSS OF 2 CAB FANS LOSS OF 2 CAB FANS, DELTAS LOSS OF 2 CAB FANS, DELTAS EXPEDITED POWERDOWN	OPCL D/O PREP EPCL ENT
3. Entry:	CAB FAN FAIL LOSS OF 2 CAB FANS EXPEDITED POWERDOWN	EPCL EPCL ENT



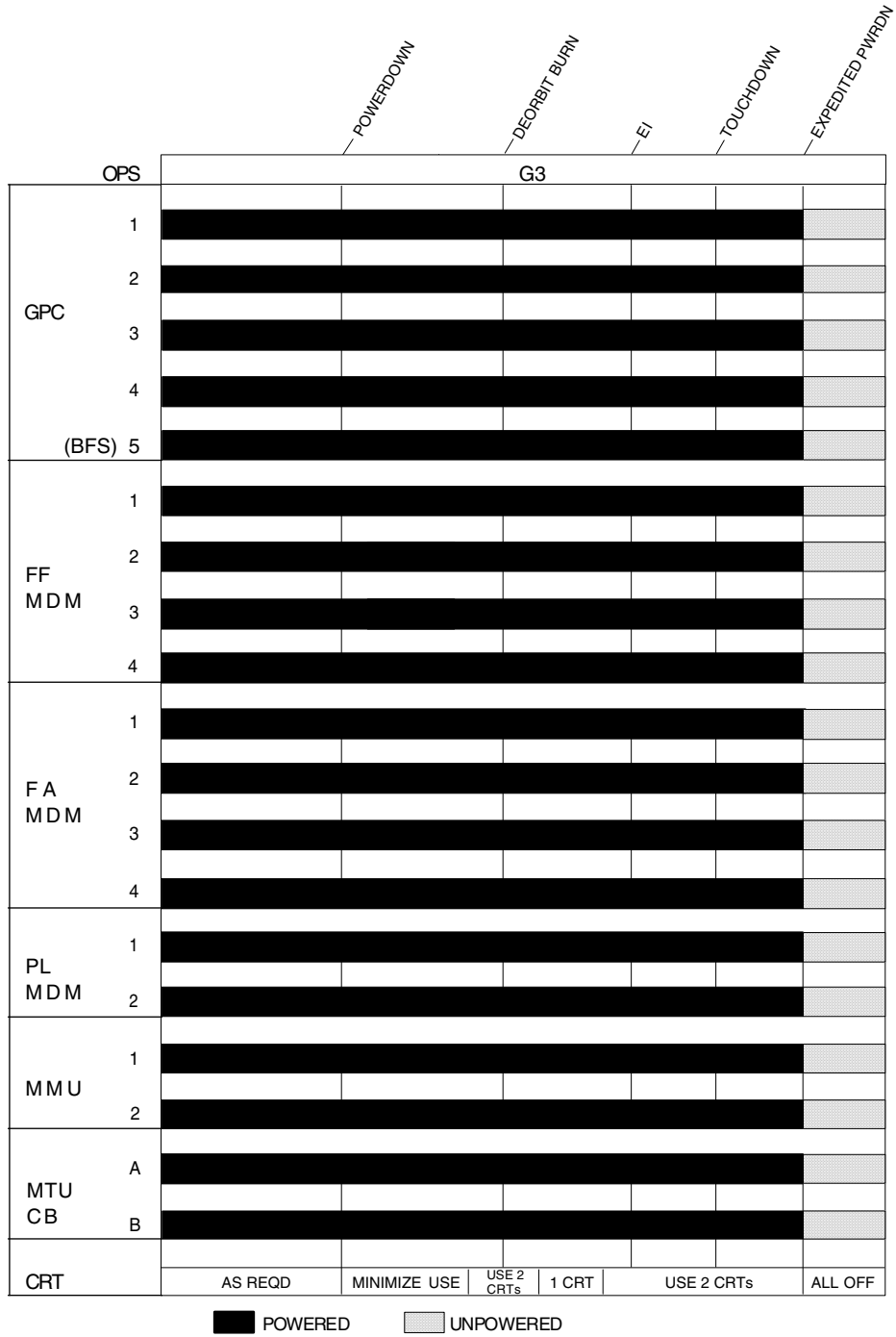
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**Figure K-30. Loss of Cabin Fans (Rev 2/3)**



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**Figure K-31. Loss of Cabin Fans (Orbit)**



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Figure K-32. Loss of Cabin Fans (Entry)

**TITLE**

**LOSS OF AV BAY AIR COOLING**

**CONCERNS:**

Loss of both AV bay fans in one avionics bay requires powering down GPC's and some navigational equipment in that bay. If the fans in that bay cannot be recovered, entry will be performed with the air-cooled equipment in that bay remaining off.

Flight Rule 2-200 states that, for AV bays 1 or 2, deorbit may be delayed up to 24 hours, if necessary, to attempt recovery of AV bay cooling (IFM) and to reconfigure DPS for entry. For AV bay 3, deorbit may be delayed up to one orbit, if needed, to reconfigure DPS.

**FLIGHT DATA FILE:**

Flight phase	Procedure name	Book
1. Ascent:	AV BAY TEMP HIGH or AV BAY FAN ΔP LOSS OF AV BAY 1(2,3) COOLING/AV BAY 1(2,3) FIRE DPS GPC FRP-7 LOSS OF AV BAY COOLING, DELTAS	AESP/APCL APCL MALF D/O PREP
2. Orbit/Deorbit Prep		
a. TIG > 2 hr ①	AV BAY TEMP or AV BAY FAN ΔP (ECLS 6.1b/c) DPS, GPC FRP-7 LOSS OF AV BAY COOLING, DELTAS	MALF MALF D/O PREP
b. 5 min < TIG < 2 hr ②	AV BAY TEMP HIGH or AV BAY FAN ΔP LOSS OF AV BAY 1(2,3) COOLING If AV BAY 2: DPS, SSR-7 EXPEDITED PWRDN (affected AV BAY)	EPCL EPCL MALF ENT
3. Entry:		
a. Pre-304 (TIG < 5 min)	AV BAY TEMP HIGH or AV BAY FAN ΔP LOSS OF AV BAY 1(2,3) COOLING EXPEDITED PWRDN (affected AV BAY)	EPCL EPCL ENT
b. Post-304	AV BAY TEMP HIGH or AV BAY FAN ΔP LOSS OF AV BAY COOLING PWRDN	AESP AESP

① Assumes wave-off, if required, to perform necessary GPC reconfiguration and potential EECOM IFM.

② Assumes no wave-off required to accomplish necessary GPC reconfiguration.

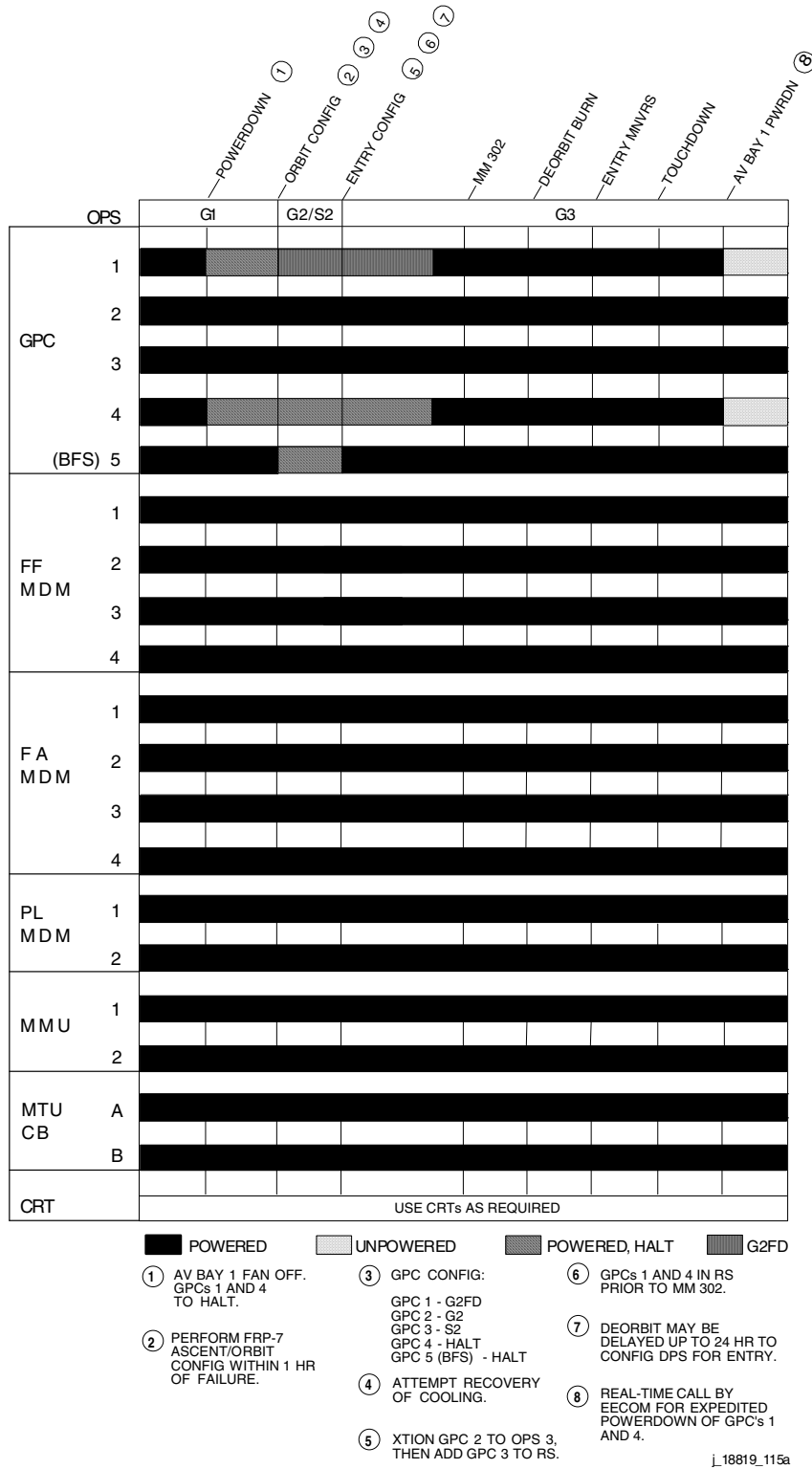


Figure K-33. Loss of AV Bay 1 Cooling (Ascent)

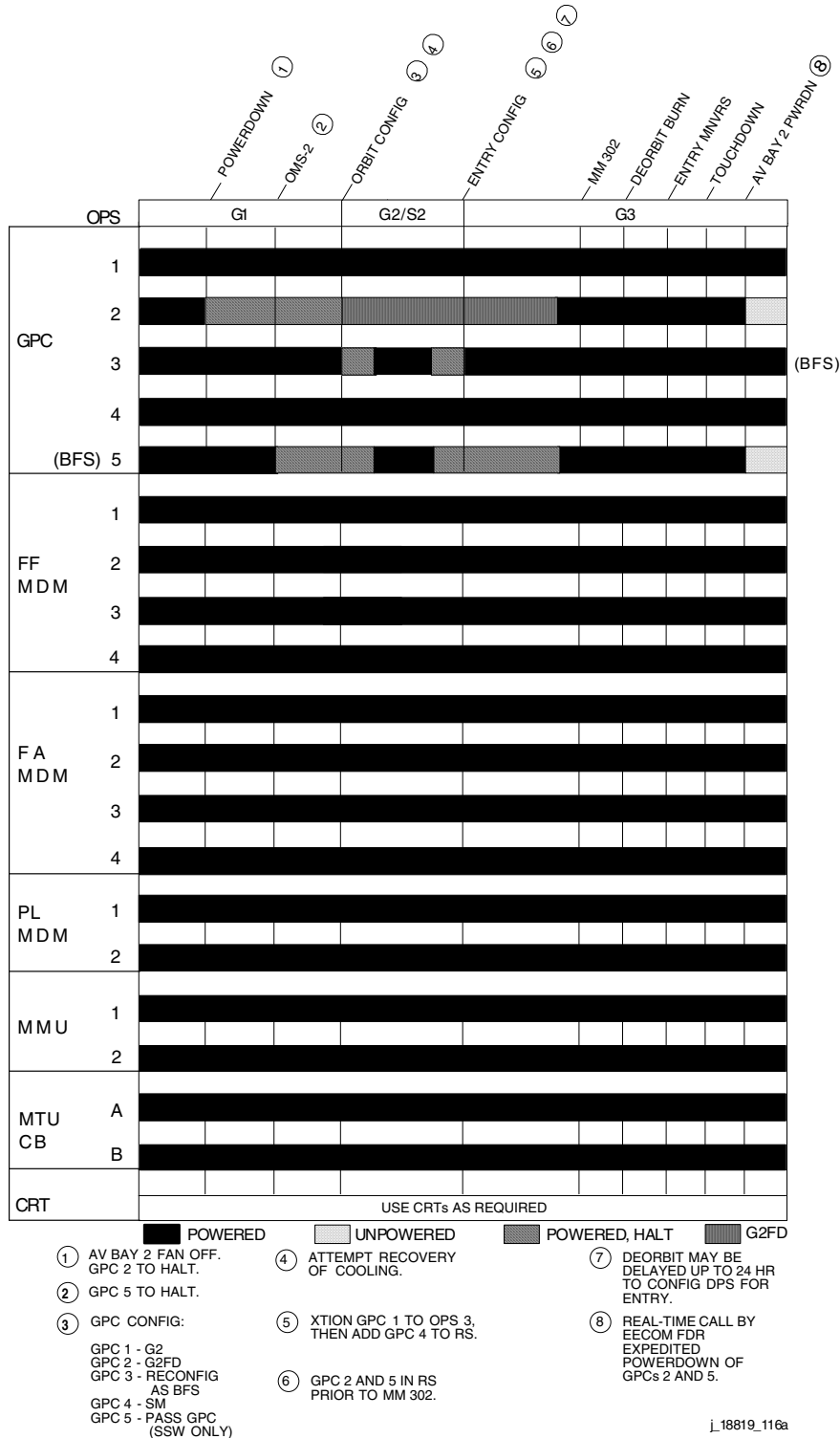


Figure K-34. Loss of AV Bay 2 Cooling (Ascent)

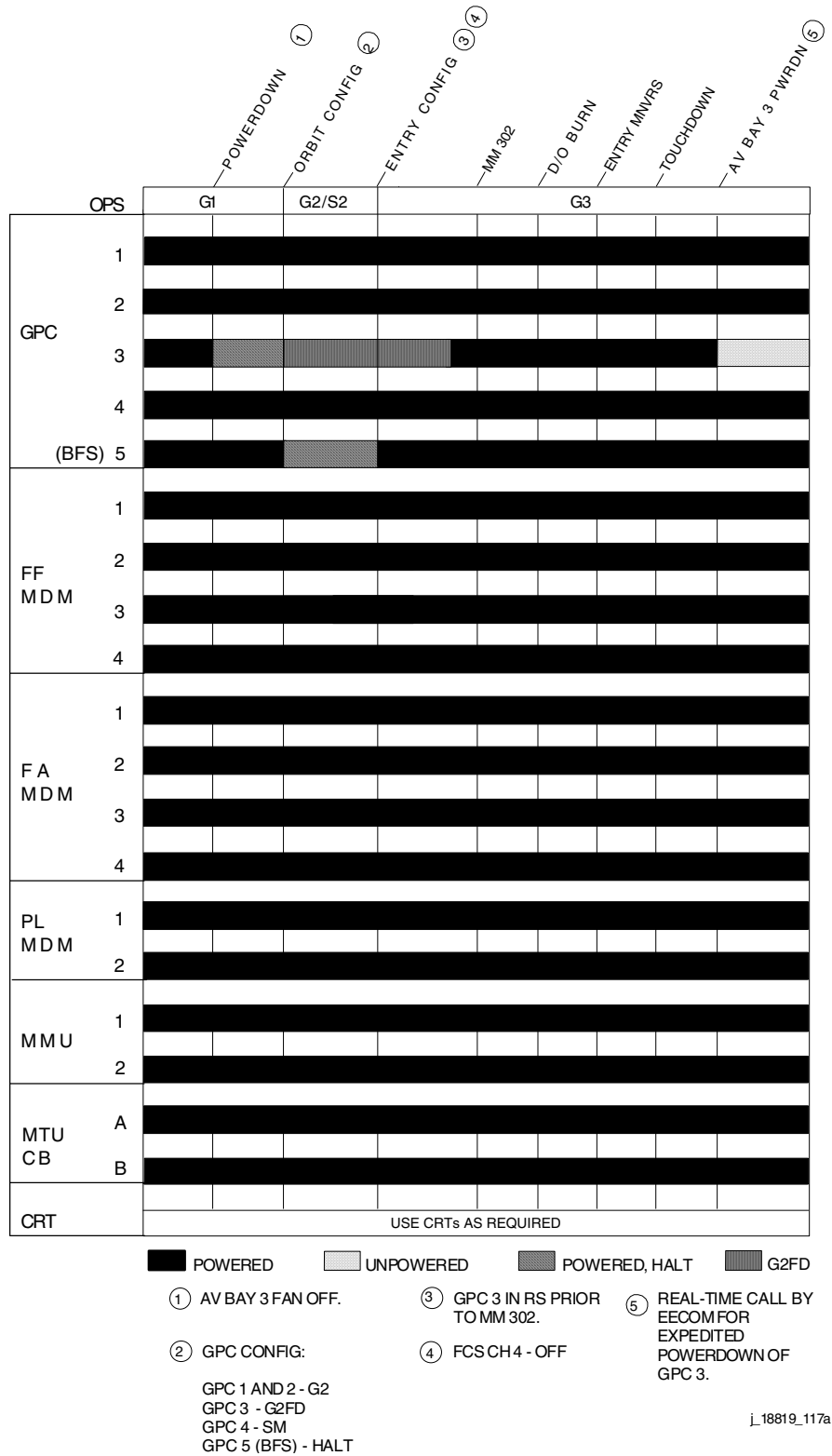


Figure K-35. Loss of AV Bay 3A Cooling (Ascent)



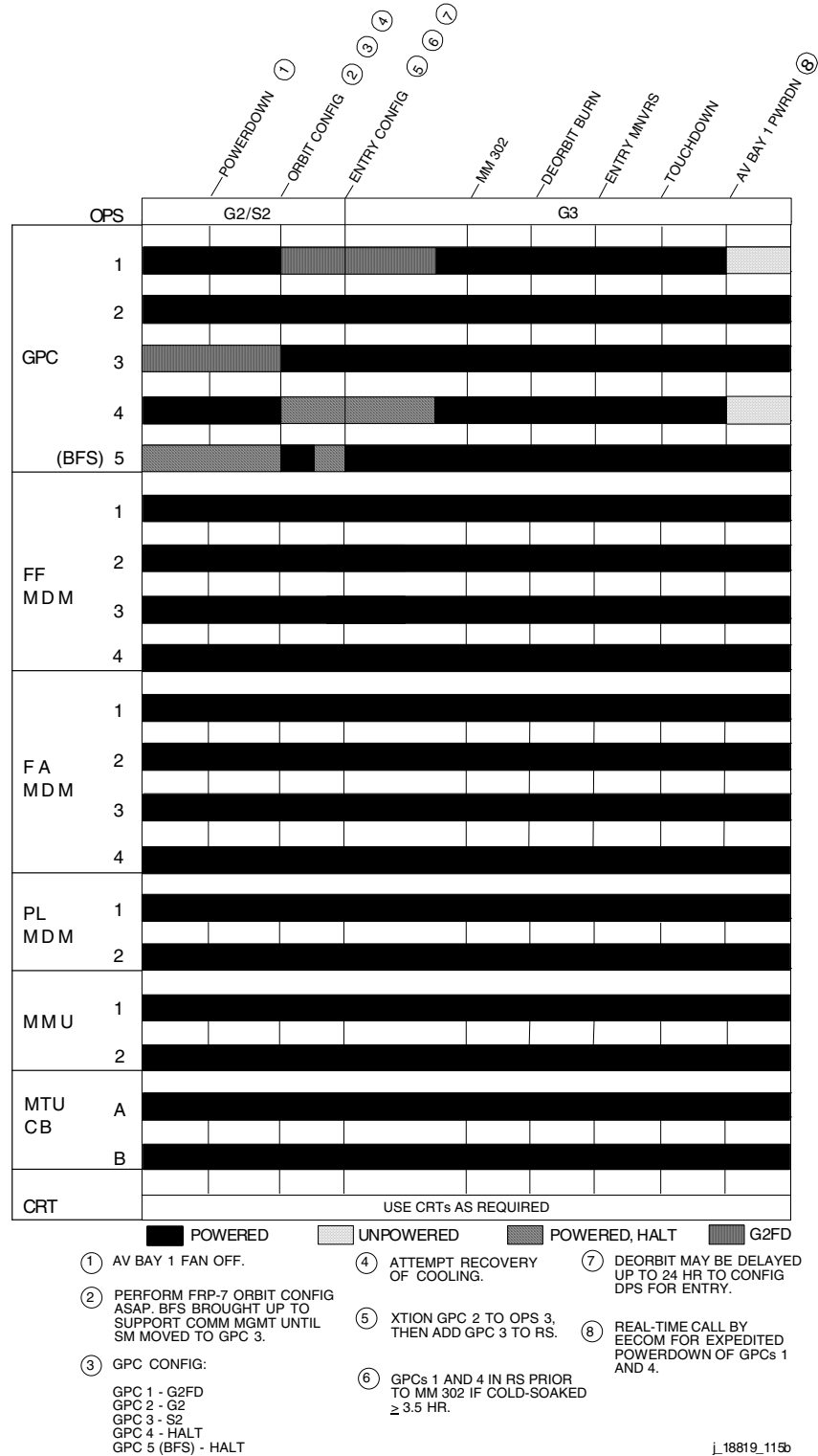


Figure K-36. Loss of AV Bay 1 Cooling (Orbit, TIG > 2 hr)

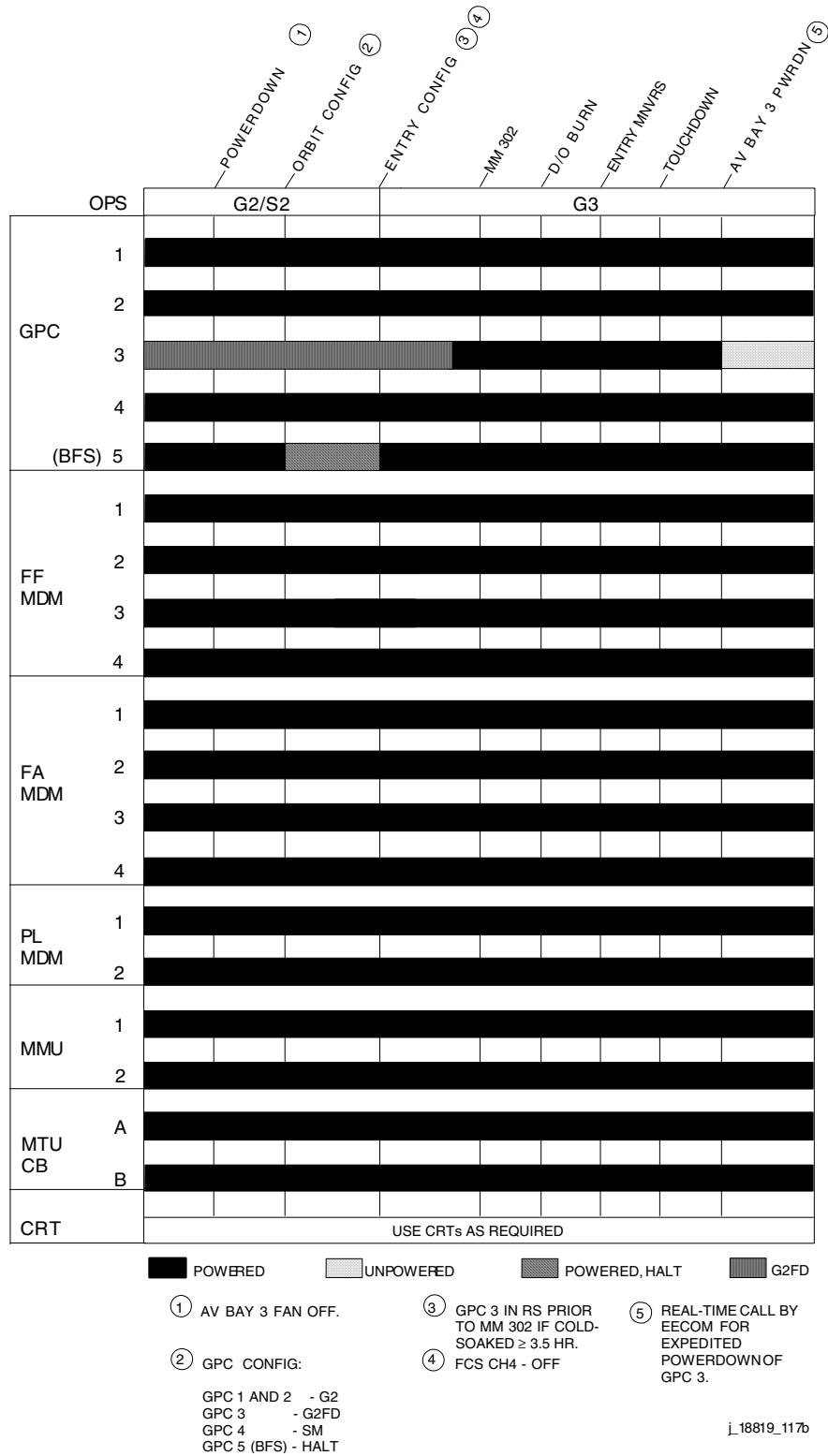


Figure K-37. Loss of AV Bay 3A Cooling (Orbit, TIG > 2 hr)

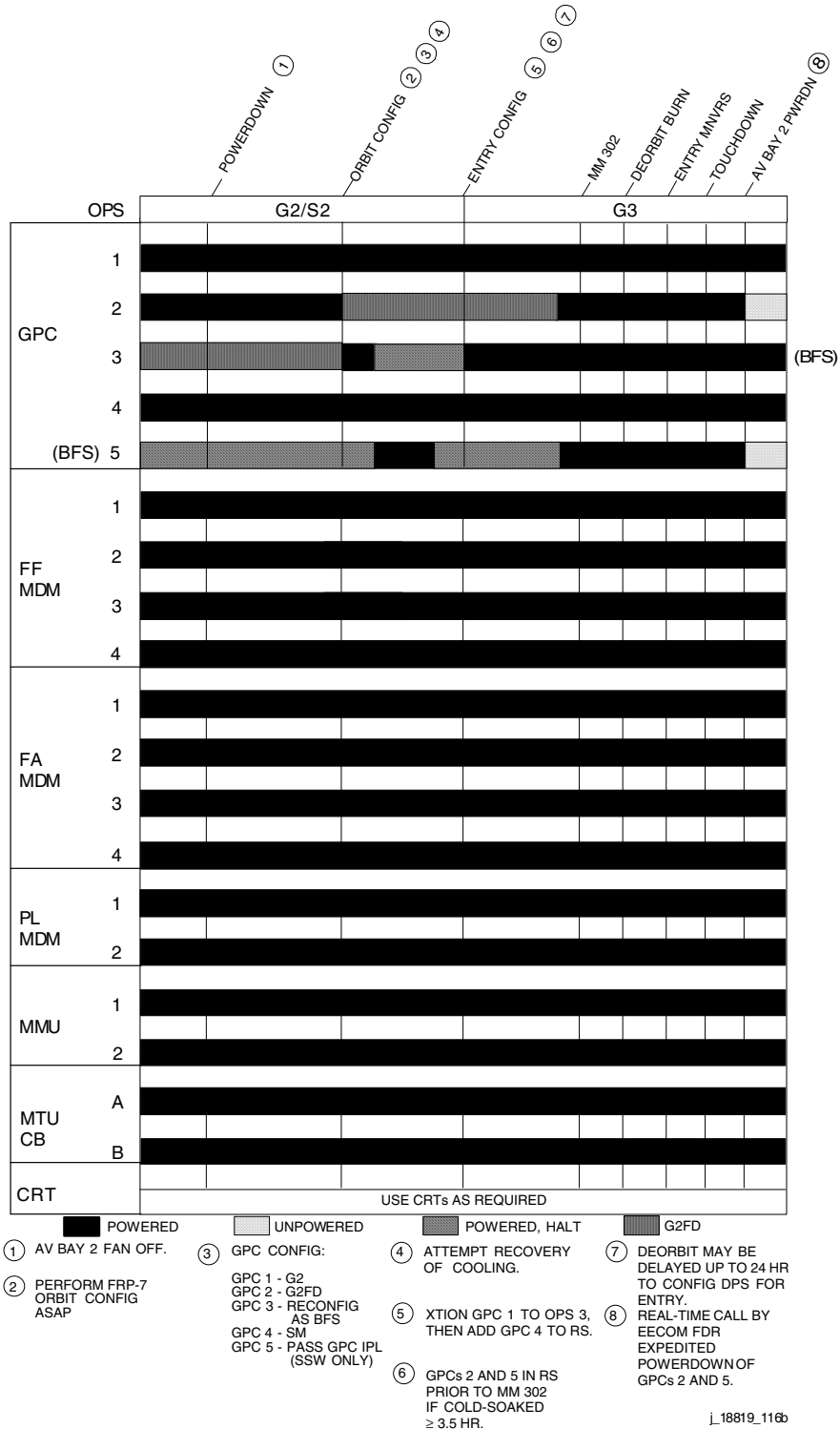


Figure K-38. Loss of AV Bay 2 Cooling (Orbit, TIG > 2 hr)

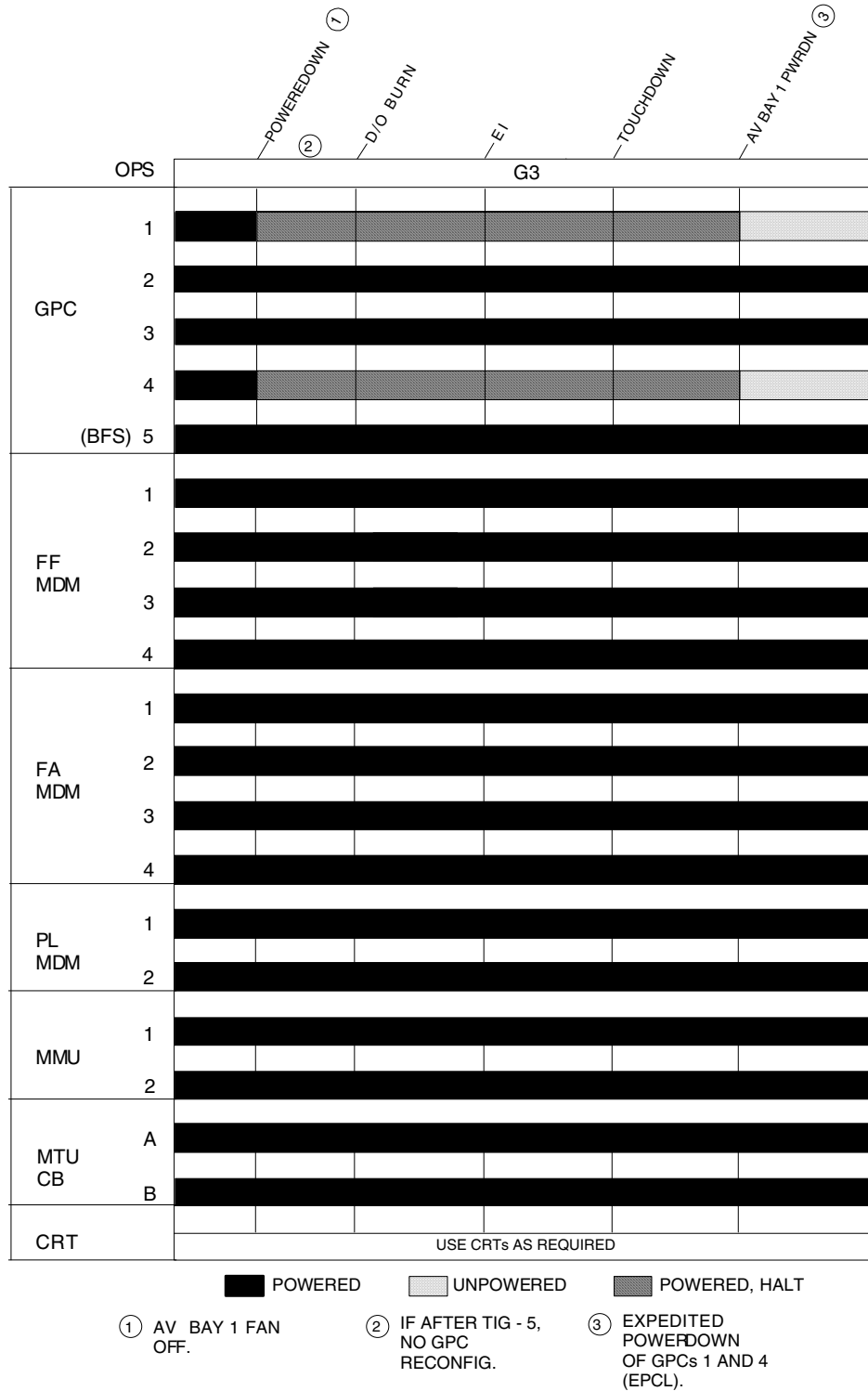
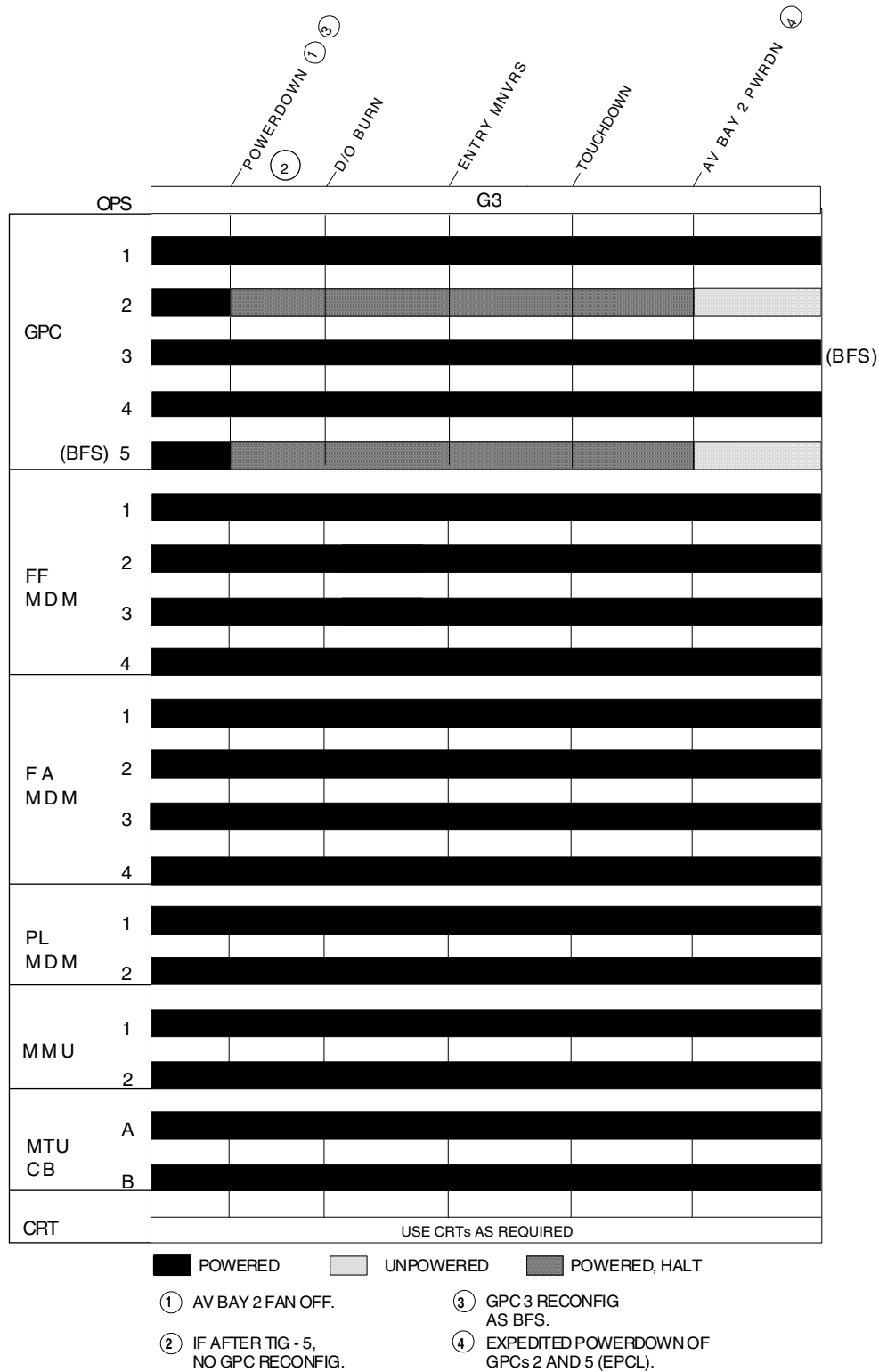
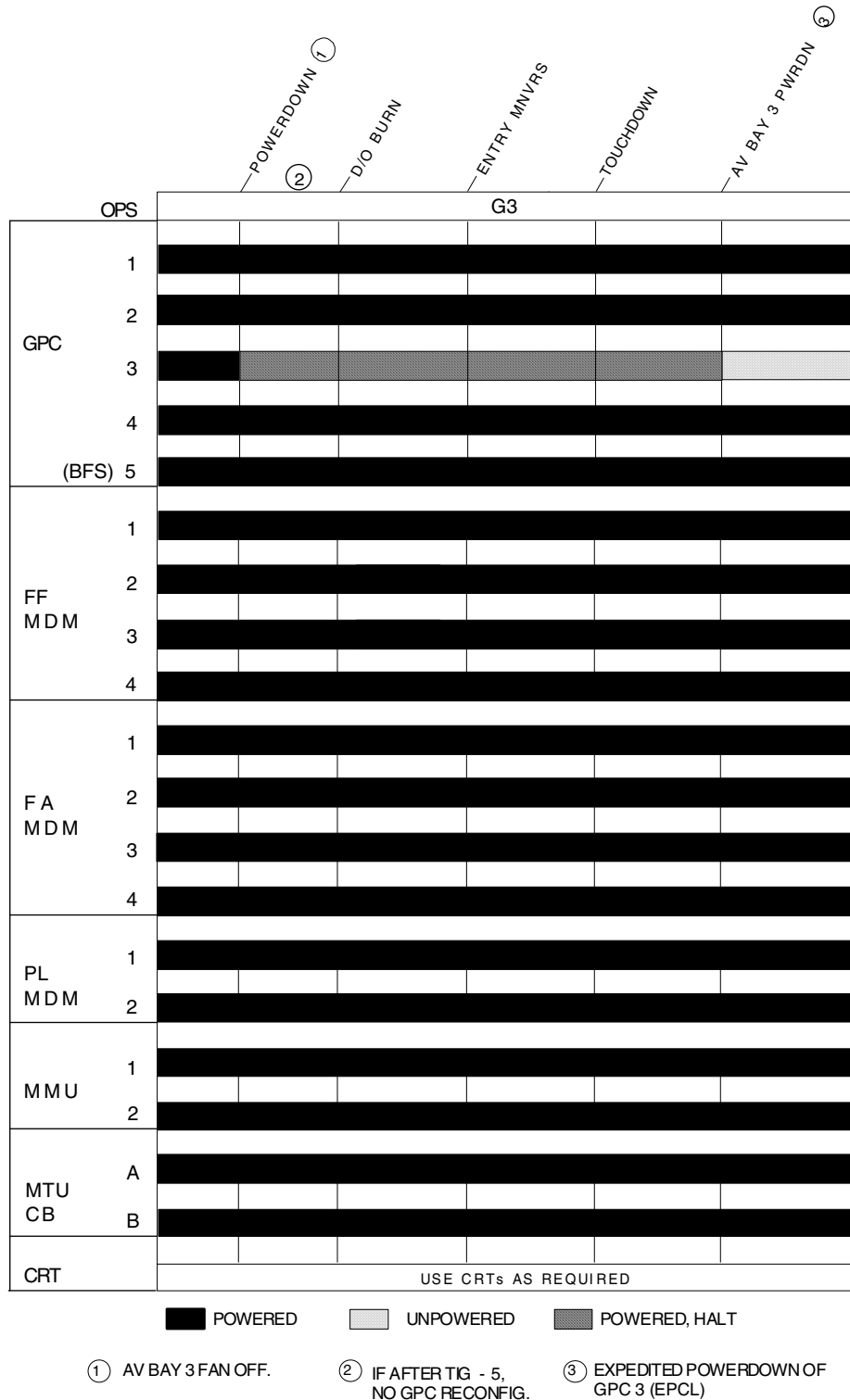


Figure K-39. Loss of AV Bay 1 Cooling (Deorbit Prep, 5 min < TIG < 2 hr)



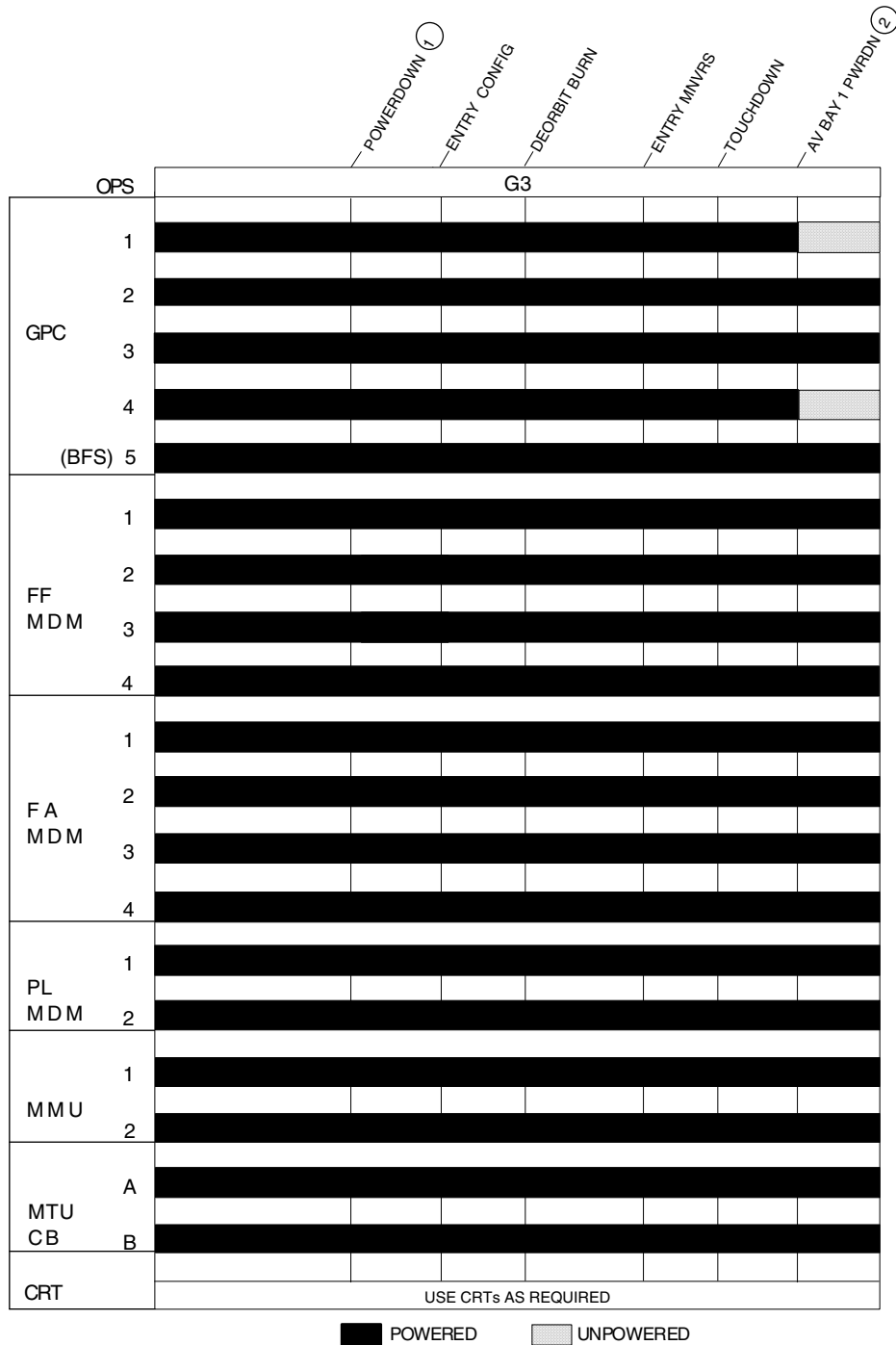
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Figure K-40. Loss of AV Bay 2 Cooling (Deorbit Prep, 5 min < TIG < 2 hr)



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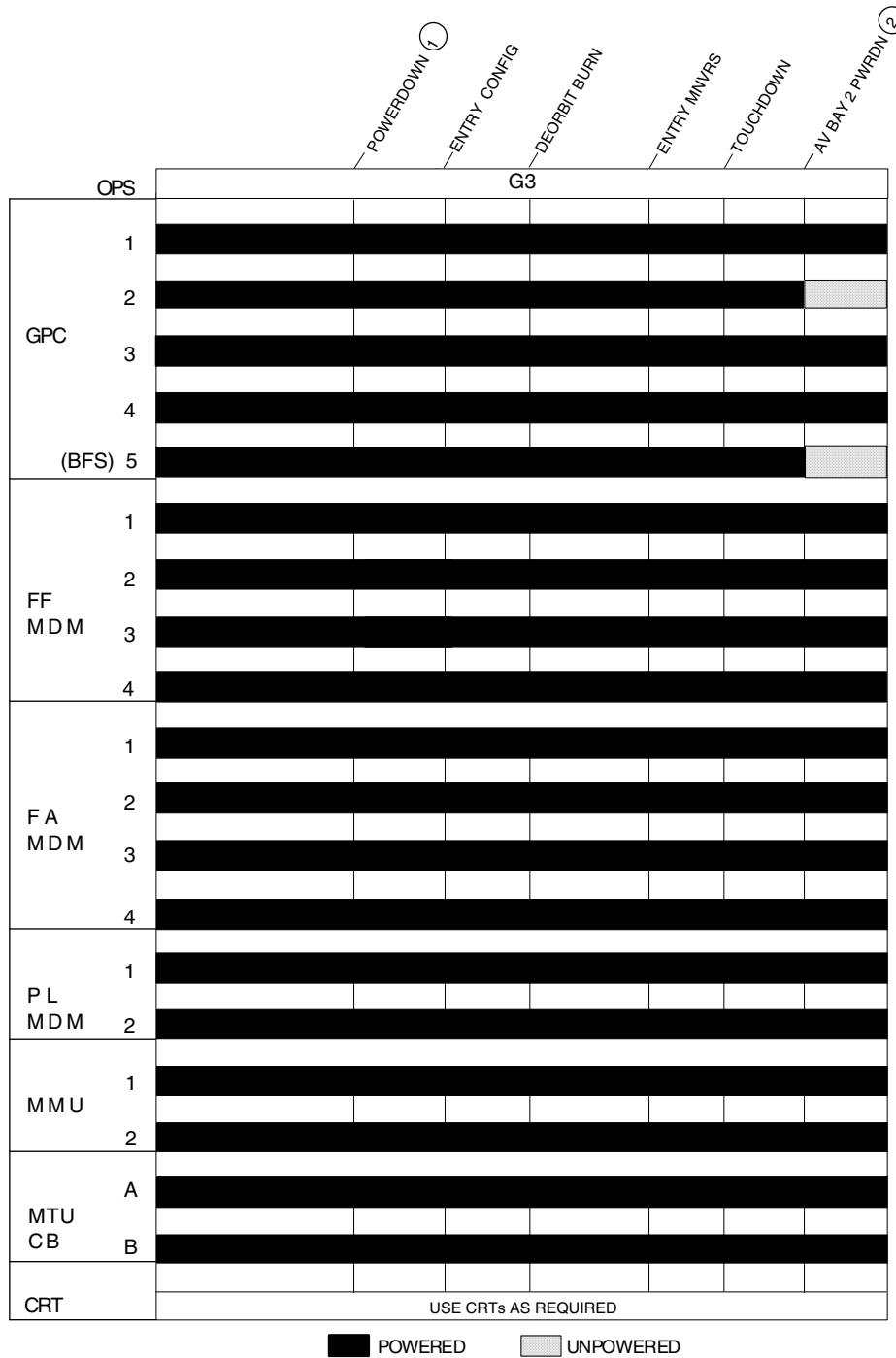
Figure K-41. Loss of AV Bay 3A Cooling (Deorbit Prep, 5 min < TIG < 2 hr)



- ① AV BAY 1 FAN OFF.
- ② EXPEDITED POWERDOWN OF GPCs 1 AND 4 (EPCL).

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**Figure K-42. Loss of AV Bay 1 Cooling (Entry, TIG < 5 min)**



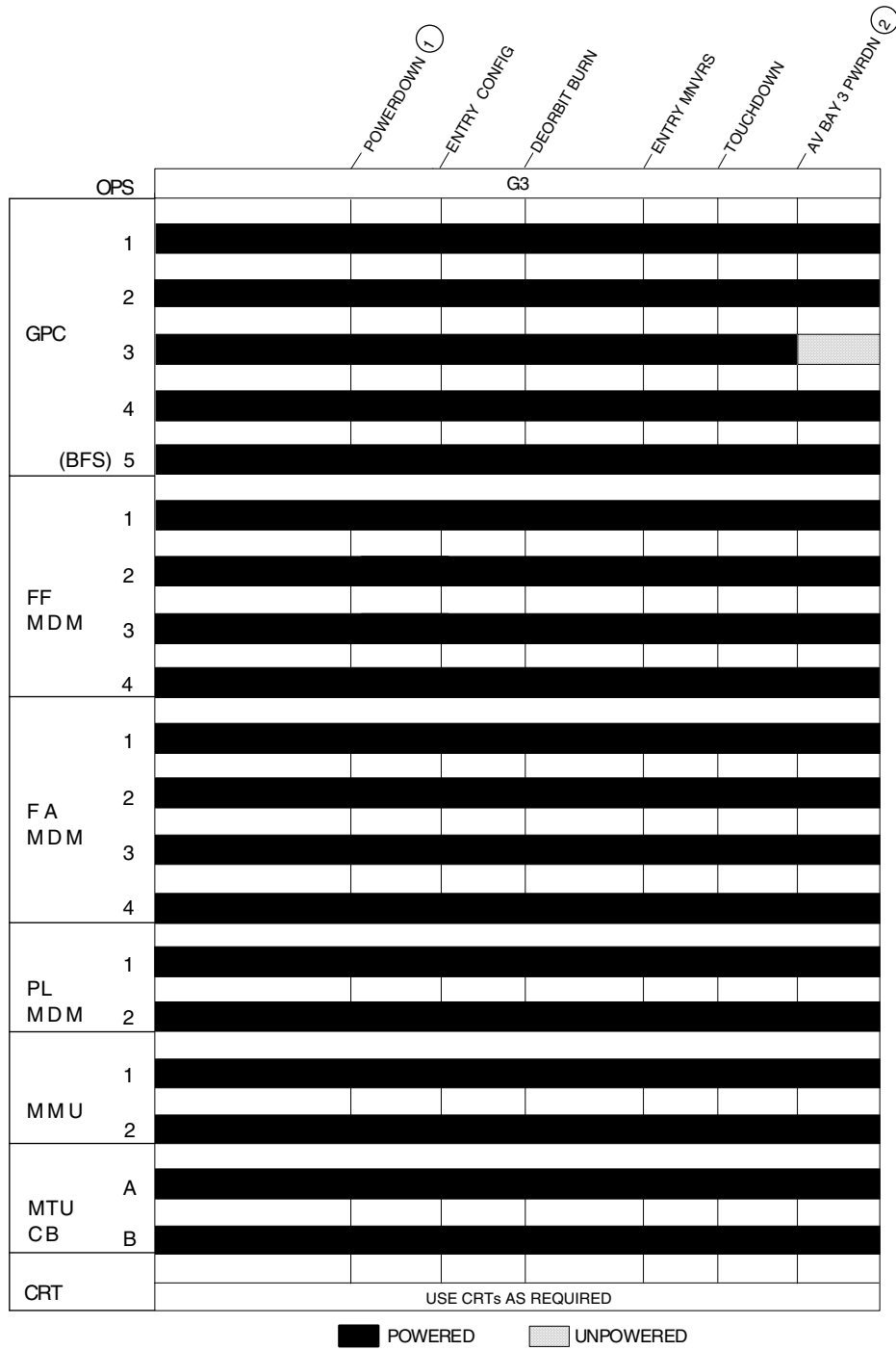
① AV BAY 2 FAN OFF.

② EXPEDITED POWERDOWN OF GPCs 2 AND 5 (EPCL).

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**Figure K-43. Loss of AV Bay 2 Cooling (Entry, TIG < 5 min)**





- ① AV BAY 3 FAN OFF.
- ② EXPEDITED POWERDOWN OF GPC 3 (EPCL).

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**Figure K-44. Loss of AV Bay 3A Cooling (Entry, TIG < 5 min)**

**TITLE**

AV BAY FIRES

**CONCERNS**

When a fire is confirmed to have occurred in an avionics bay (AV bay), to the degree that is practical, all electrical equipment in that AV bay will be powered off. While it is not possible (in a practical sense) to isolate ac and dc electrical power distribution and control/essential buses, virtually all of the avionics and orbiter system LRUs can be powered off providing the crew is not constrained by reach/visibility restrictions of dynamic flight.

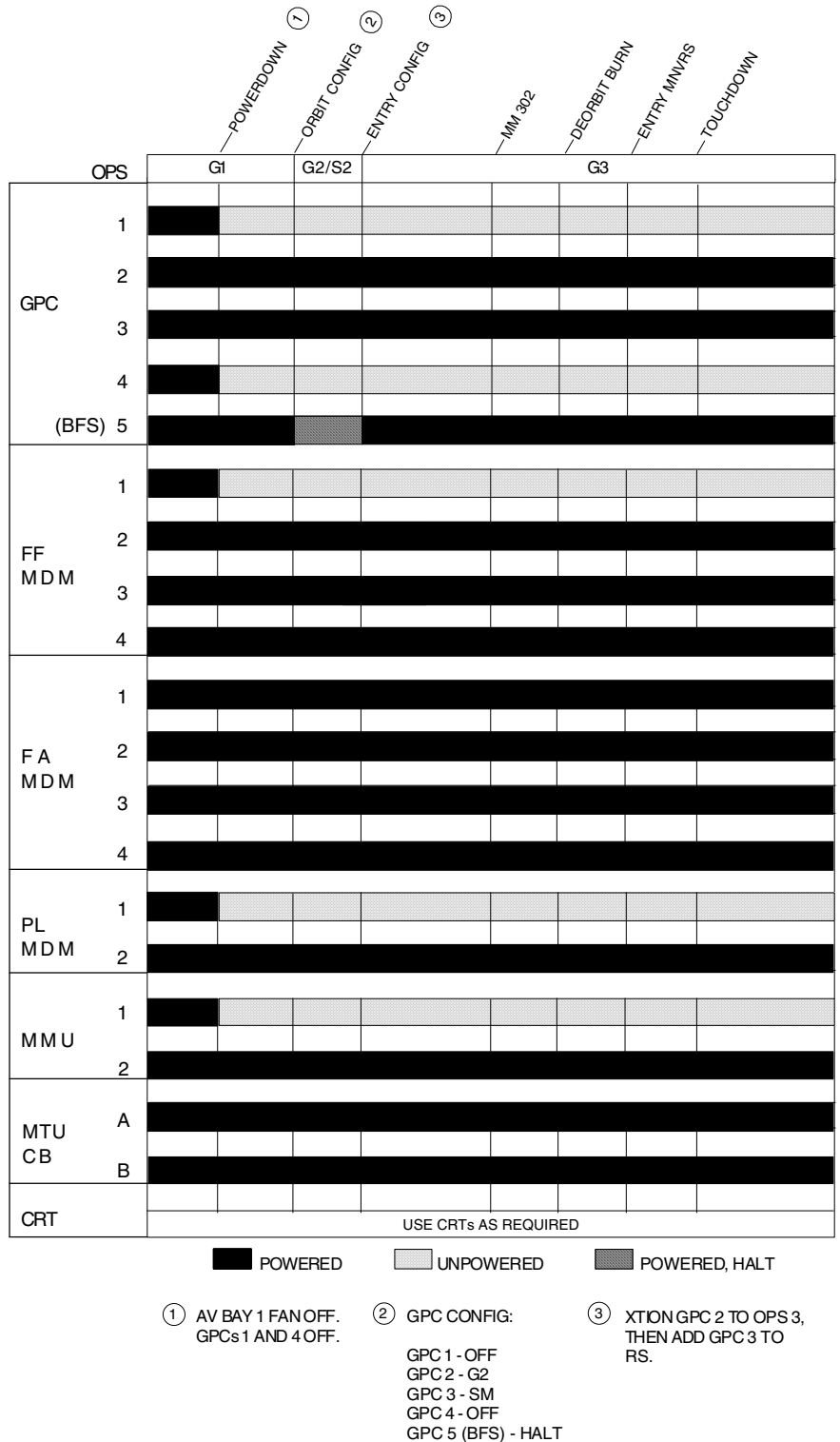
DPS impacts include powering off any GPCs, MDMs, and MMUs that might reside in the affected AV bay. Because the extent of fire damage cannot be assessed until a physical inspection of the AV bay occurs (during vehicle turnaround activities), as a precaution, this equipment will remain off for the duration of the flight. Per flight rules, we are PLS due to the AV bay fire. If other DPS failures make us less and 3 of 5 GPCs, less than 3 of 4 FF MDMs, or less than 1 of 2 PF MDMs, EECOM may be GO to repower one of the corresponding LRUs in the affected AV bay, as there is no longer single-fault tolerance.

Note that AV bay fire powerdown procedures are applicable to AV bays 1, 2, and 3A only. Since there are no AV bay fans or smoke detectors in AV bay 3B, the crew would have to detect smoke disseminating from the AV bay. It would then be treated as cabin fire, using a hand-held fire extinguisher to combat the smoke source. EECOM would then request assistance in determining off equipment in AV bay 3B. DPS is impacted since the MTU is located in that AV bay. MTU power is provided by essential bus power via circuit breakers located on panel O13:A and O13:C.

Similarly, the aft compartment AV bays 4, 5, and 6 have no smoke detection capability since all equipment for those AV bays is designed to operate in the vacuum of space (cold-plate cooling). Thus, no AV bay 4, 5, or 6 fire powerdown procedures exist.

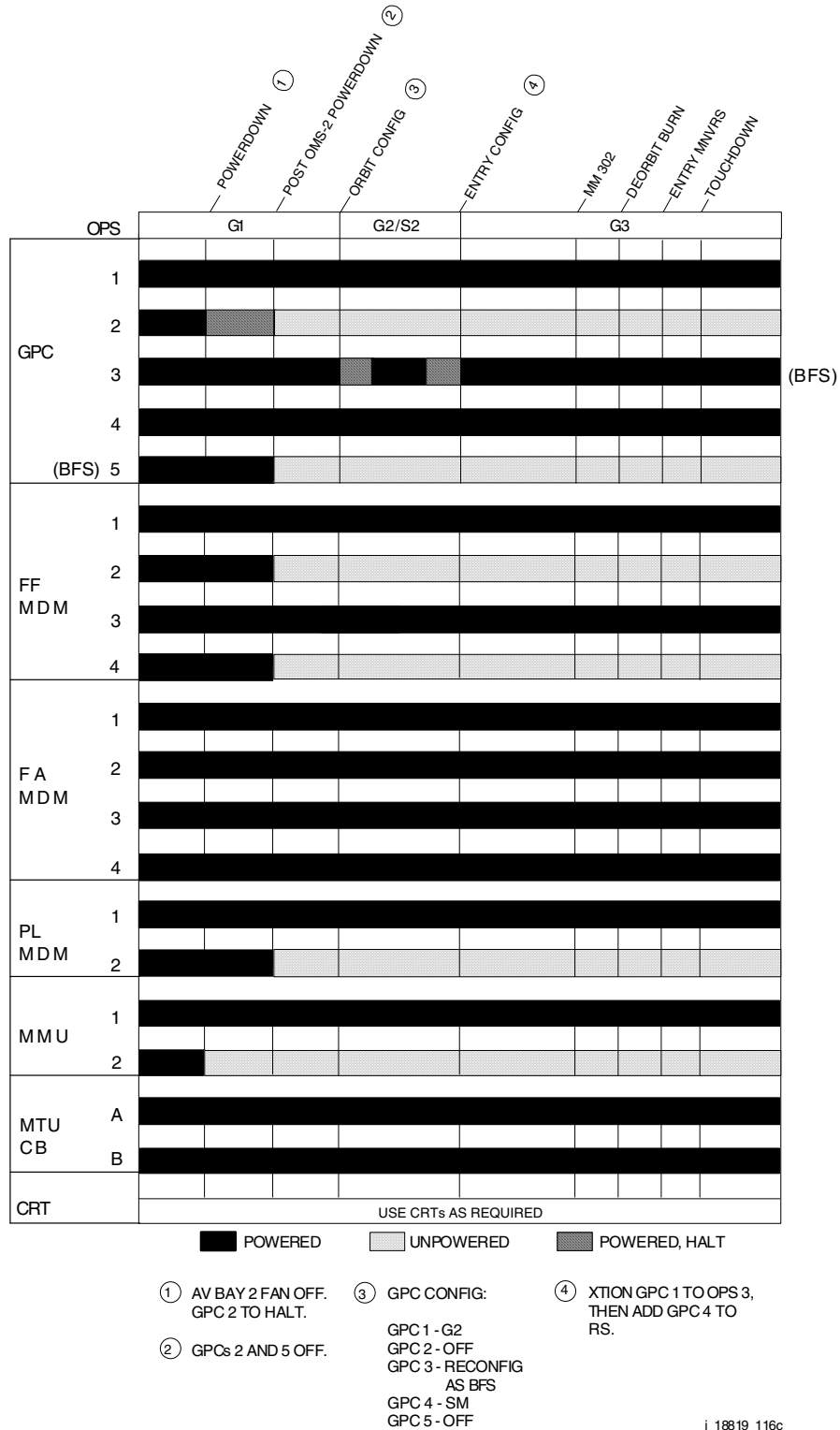
**FLIGHT DATA FILE**

Flight phase	Procedure name	Book
1. Ascent:	FIRE/SMOKE (ASCENT/ENTRY) cue card POST-FIRE CABIN CLEANUP LOSS OF AV BAY 1(2,3) COOLING /AV BAY 1(2,3) FIRE AV BAY 1(2,3) FIRE AV BAY FIRE, DELTAS	CUE or AESP APCL ACPL OPCL D/O PREP
2. Orbit or Deorbit Prep	FIRE/SMOKE (ORBIT) cue card AV BAY 1(2,3) FIRE AV BAY FIRE, DELTAS	CUE OPCL D/O PREP
3. Entry:	FIRE/SMOKE (ASCENT/ENTRY) CUE CARD EXPEDITED POWERDOWN	CUE OR AESP ENT



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**Figure K-45. AV Bay 1 Fire (Ascent)**



**Figure K-46. AV Bay 2 Fire (Ascent)**

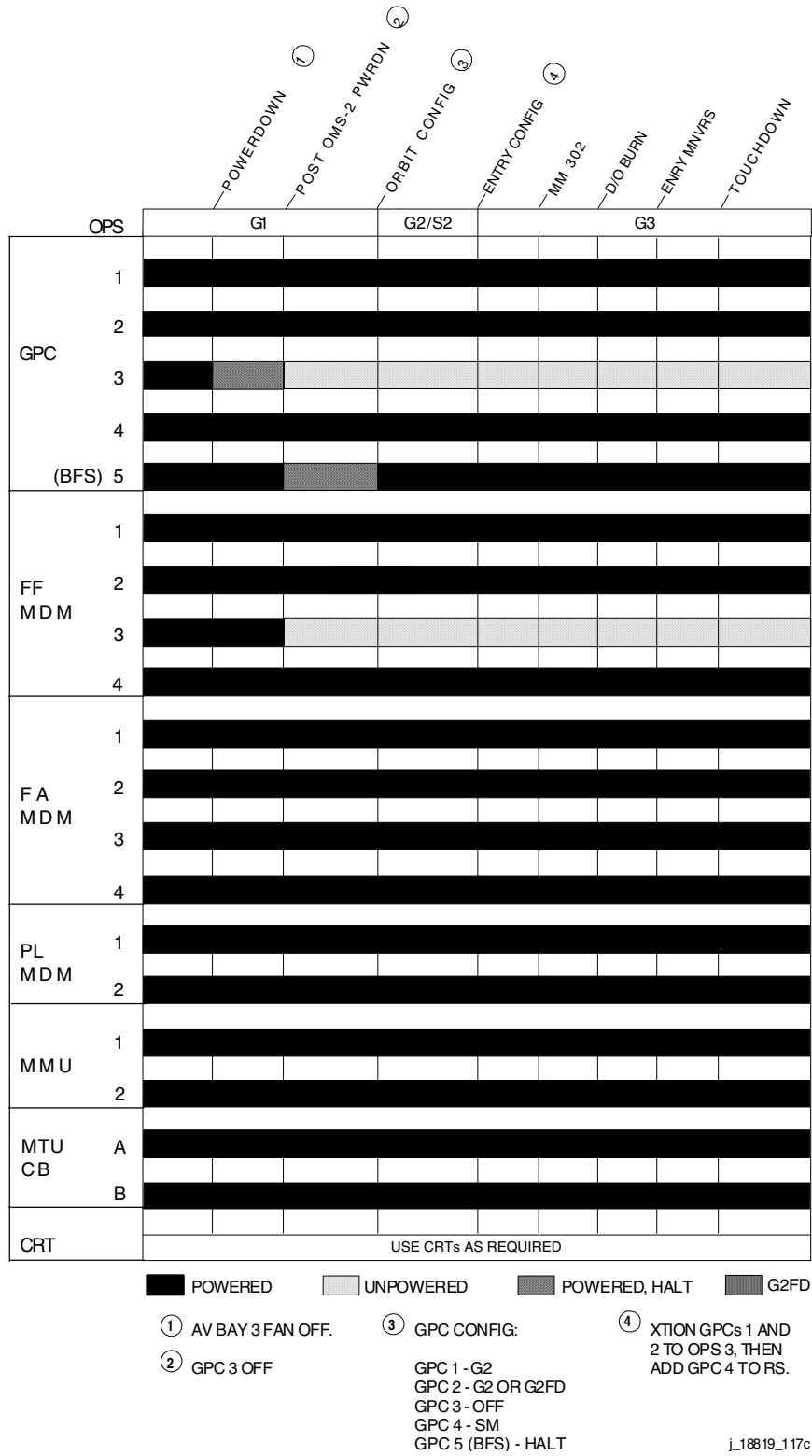
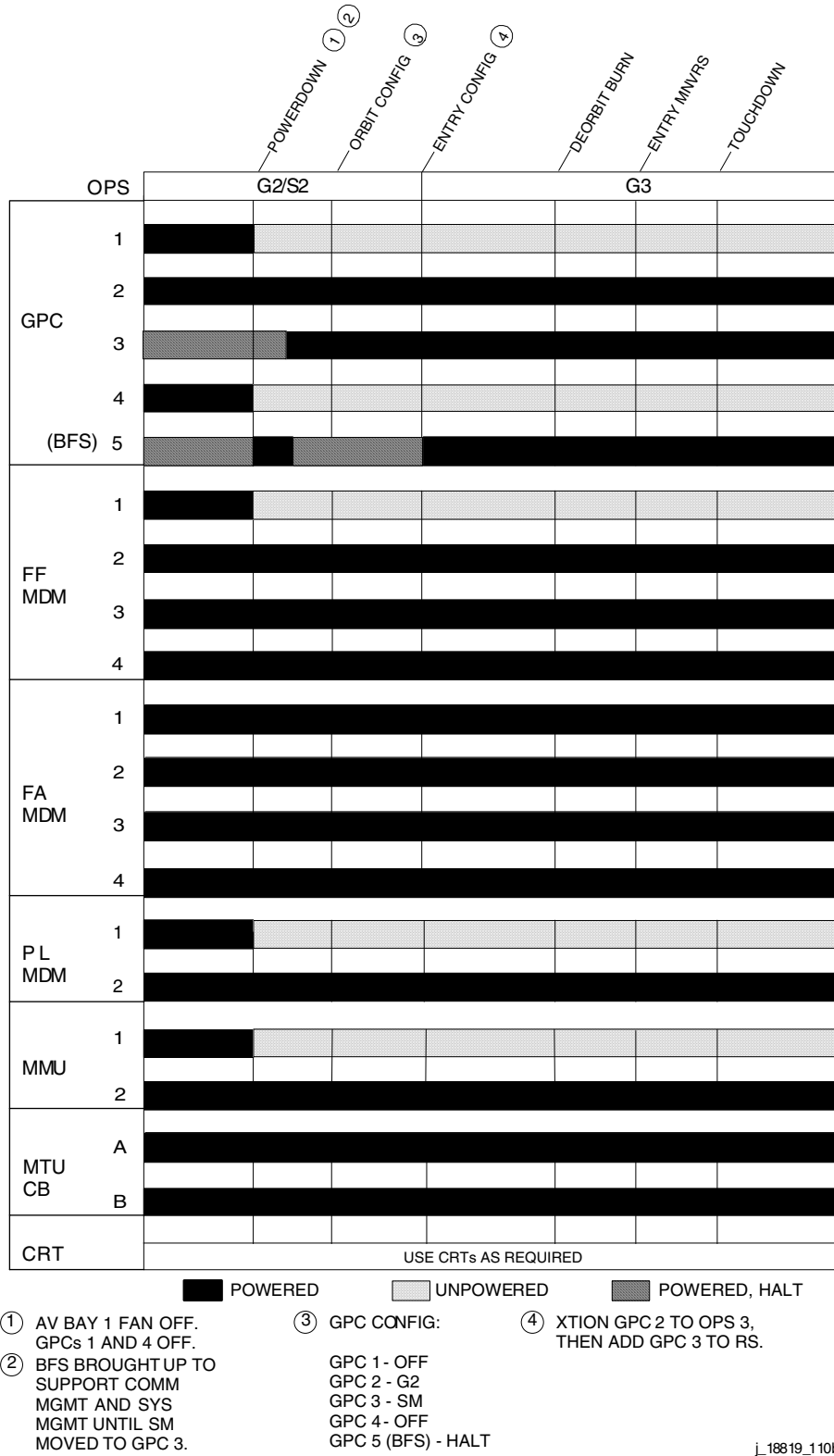


Figure K-47. AV Bay 3A Fire (Ascent)



**Figure K-48. AV Bay 1 Fire (Orbit or Deorbit Prep)**

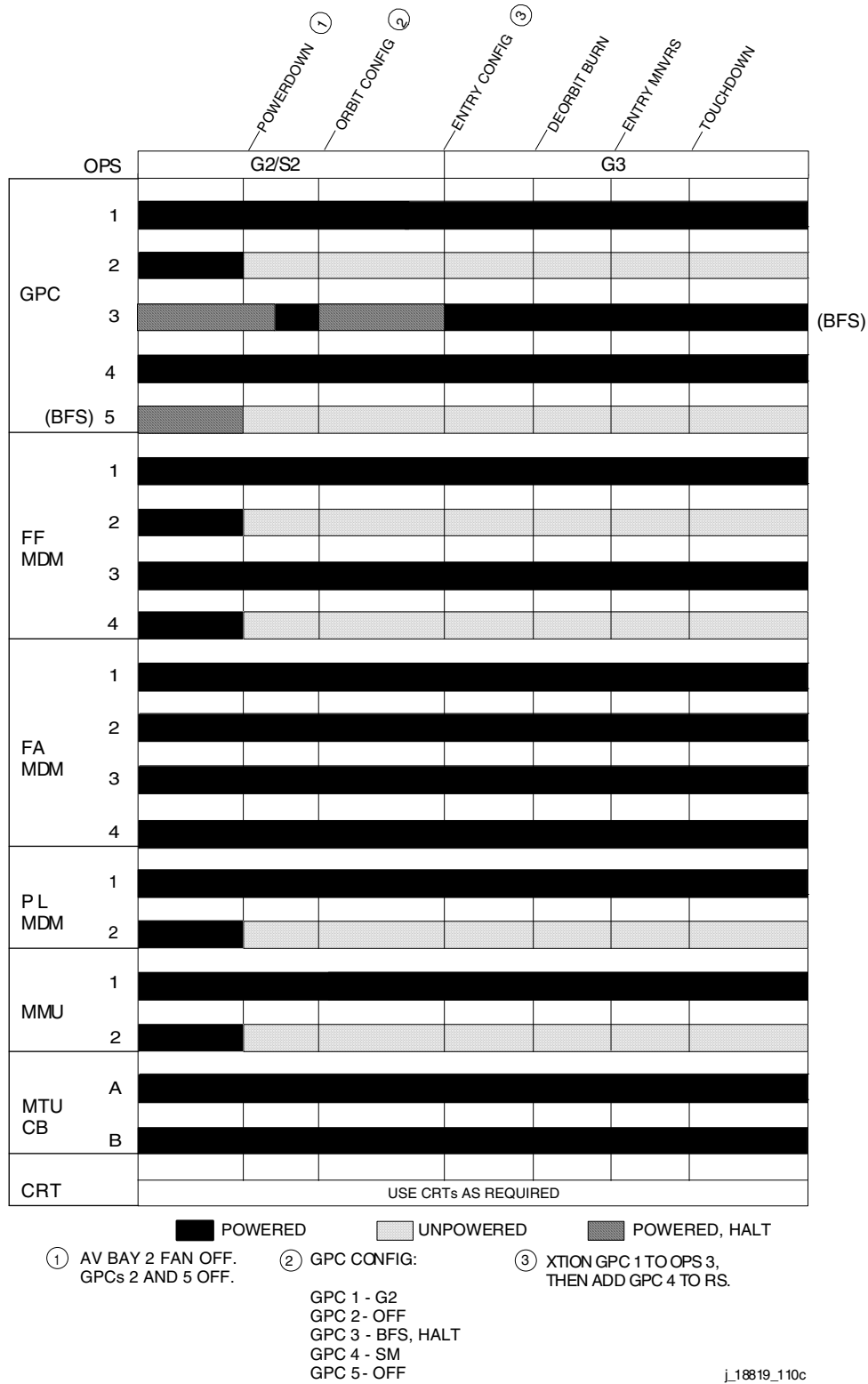


Figure K-49. AV Bay 2 Fire (Orbit or Deorbit Prep)

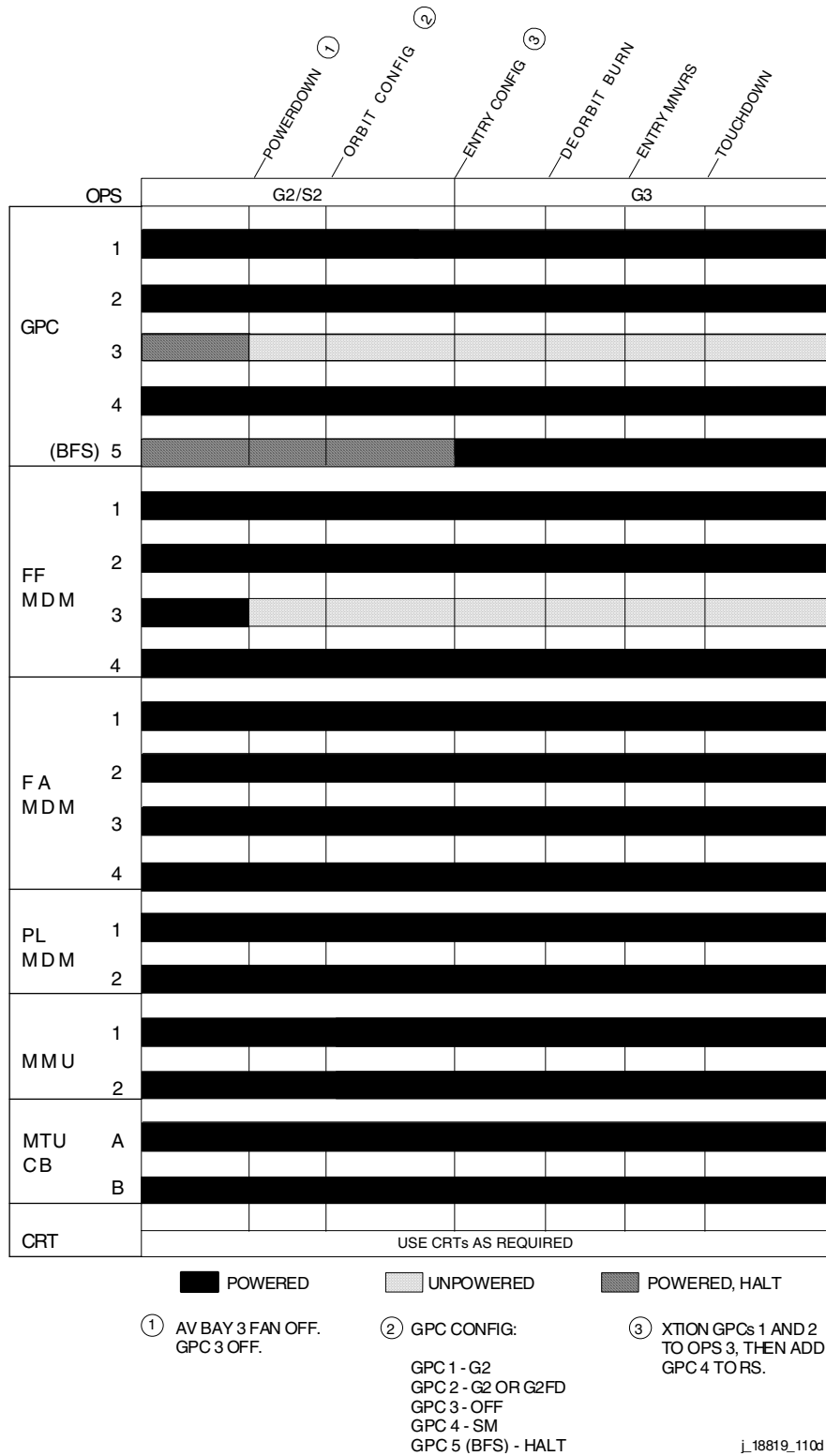
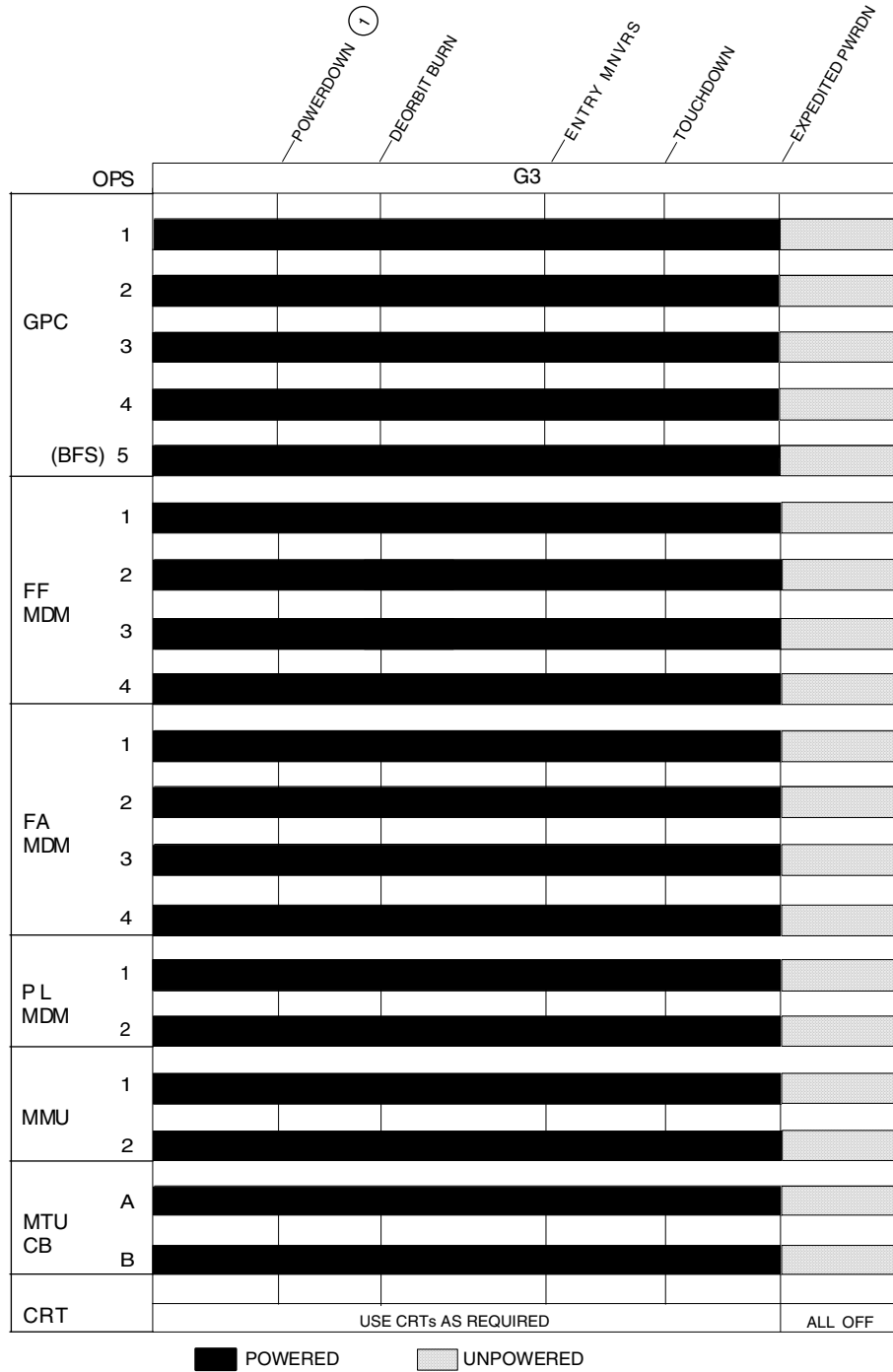


Figure K-50. AV Bay 3A Fire (Orbit or Deorbit Prep)





① AV BAY 1 (2, 3) FAN OFF FOR AFFECTED AV BAY.

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**Figure K-51. AV Bay 1(2, 3) Fire (Entry)**