

Appendix F FPP Command List

FPP commands which are sent from MDP to FPP-E are described in this appendix.

Revision Record of FPP command list:

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Rev. 1.0	2000.04.23	First version of preliminary FPP command list
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Rev. 3.0	2001.04.17	FPP command list for the proto-model test
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Rev. 4.1	2002.12.12	No change
Rev 5.0 (draft)	2005.04.12	FPP detailed command description document 2B00623 Rev.H This is the final version of FPP flight model.
Rev. 5.0	2005.06.12	FPP detailed command description document 2B00623 Rev.I. This is for making a correction.



SOLAR-B FOCAL PLANE PACKAGE PROGRAM

Command List

Contract Number: NAS8-01014
CAGE Code: 65113

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RECORD OF REVISIONS

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FPP Commands

1. INTRODUCTION

This document lists all the currently defined commands and status telemetry items for the Focal Plane Package instrument. The lists include field definitions and the descriptions of each command parameter.

2. FPP Tele-commands

This is the list of all currently defined FPP commands in alphabetical order. The op-codes for the status request commands, memory load commands and the macro commands were assigned by ISAS.

Except for the status request commands, all even numbered op-codes are processed by the FPP C&DH software. The odd numbered op-codes are executed by the SCIF firmware.

Most commands include a CMDLEN parameter. This is used to verify that the command is correctly formatted. The check is performed by both the firmware and the software. The software performs additional checks on the consistency of the command parameters.

3. List of FPP Commands

1. **FPP_ALL_OFF (OpCode: 016):**

All Power off.

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

2. **FPP_CCD_CFG (OpCode: 100):**

Set CCD Configuration parameter.

Number of Parameters: 4

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 5
2. **CAMNAME:** Camera Number
Field Size: 8 Bits
Range: 0 – 2 (0 – FG; 1 – SP; 2 – CT)
3. **FIELD:** Configuration field number
Field Size: 8 Bits
Range: 0 – 5
4. **VAL:** Configuration field value
Field Size: 8 Bits
Range: See Below;

Field Num	Values	Range	Description
0	Pre-Amp	0 – 1	Select Amplifiers; 0 = (A1 / B1); 1 = (A2 / B2) for FG and CT 1 = (A1 / B1); 0 = (A2 / B2) for SP Same for all cameras
1	Gain	0 – 3	Set CCD Gain
2	Serial Summing Mode	0 – 3	0 = 1x1; 1 = 2x1; 2 = 4x1; 3 = 8x1
3	Parallel Summing Mode	0 – 3	0 = 1x1; 1 = 1x2; 2 = 1x4; 3 = 1x8
4	Serial Clock	0 – 1	FG Camera: 0 = Normal Direction Move charge towards A1/B1 1 = Reverse Direction Move charge towards A2/B2 SP and CT cameras: 0 = Reverse Direction 1 = Normal Direction
5	Summing Mode	0 – 3	0 = 1x1; 1 = 2x2; 2 = 4x4; 3 = 8x8

3. FPP_CCD_DAC (OpCode: 102):

This command sets the DAC level for specified CCD. DAC level determines the base electronic level read from the CCD. Number of Parameters: 3 Parameters:

- CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 5
- CAMNAME:** This parameter identifies the camera system, as shown below;

0	1	2	3	4	5	6	7
							Camera Name

Values:
0 - Filtergraph Camera
1 - Spectro-Polarimeter Camera
2 - Correlation Tracker Camera

- OFFSETA:** The DAC level. This sets the base electronic signal level for segment A.
Field Size: 8 Bits
Range: 0 – 15 (Units are 300 DN)

0	1	2	3	4	5	6	7
							DAC Offset

- OFFSETB:** The DAC level. This sets the base electronic signal level for segment B.
Field Size: 8 Bits
Range: 0 – 15 (Units are 300 DN)

0	1	2	3	4	5	6	7
							DAC Offset

4. FPP_CCD_FLUSH (OpCode: 094):

Command CCD to "Flush" mode. In flush mode the charge is continuously transferred but not digitized. Number of Parameters: 2 Parameters:

- CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 4
- CAMNAME:** This parameter identifies the camera system, as shown below;

0	1	2	3	4	5	6	7
							Camera Name

Values: 0 - Filtergraph Camera
1 - Spectro-Polarimeter Camera

2 - Correlation Tracker Camera

- 3. **NUM:** Flush count. This number specifies the number of flushes performed.
Range: 0 – 3

5. FPP_CCD_INTEG (OpCode: 096):

Commands the CCD to integrate mode. In this mode, the clocks to transfer charge are stopped.

Number of Parameters: 3 Parameters:

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
- 2. **CAMNAME:** This parameter identifies the camera system, as shown below;
Field Size: 8 Bits
Range: 0 – 2

0	1	2	3	4	5	6	7
						Camera Name	

Values:
0 - Filtergraph Camera
1 - Spectro-Polarimeter Camera
2 - Correlation Tracker Camera

- 3. **INTEGCYC:** This parameter is not used. CCD stays in integrate state until another command is received.

6. FPP_CCD_RDOUT (OpCode: 098):

CCD Readout.

Number of Parameters: 2 Parameters:

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
- 2. **CAMNAME:** Camera Identifier; FG=0; SP=1; CT=2
Field Size: 8 Bits
Value: 0
Range: 0 - 2

7. FPP_CCD_RDROWS (OpCode: 104):

Set CCD rows to be readout.

Number of Parameters: 5

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 7
- 2. **CAMNAME:** Camera Identifier; FG=0; SP=1; CT=2
Field Size: 8 Bits
Value: 0
Range: 0 – 2
- 3. **STRTLINE:** First row to be read (0 – 1024)
Field Size: 16 Bits
Range: 0 – 1024
- 4. **STOPLINE:** Last row to be read (STRTLINE – 1025)
Field Size: 16 Bits
Range: STRTLINE – 1025

Notes:

- 1. The same row numbers are readout from both segments of the CCD. Hence, if STRTLINE = 100 and STOPLINE = 200, then rows, 100 – 200 (inclusive) and rows, 3895 – 3995 will be readout. Rows, 3895 – 3995 represent, rows, 200 – 100 of the second CCD segment. (4095 – 200) – (4095 – 100).
- 2. Specifying STOPLINE of 1024 or 1025 causes the full CCD to be readout.

8. FPP_CCD_RESET (OpCode: 090):

Reset specified CCD. Reset restores the CCD configuration register to power on state. Number of Parameters: 2

Parameters:

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3

- 2. **CAMNAME:** This parameter identifies the camera system, as shown below;

0	1	2	3	4	5	6	7	
							Camera Name	

- Values: 0 - Filtergraph Camera
- 1 - Spectro-Polarimeter Camera
- 2 - Correlation Tracker Camera

9. FPP_CCD_SETMODE (OpCode: 106):

Set CCD operational mode.

Number of Parameters: 3 Parameters

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 4

- 2. **MODE:** CCD Operational mode
Field Size: 8 Bits

Mode is a bit field with bit assignments as shown below;

0	1	2	3	4	5	6	7	
					X	X	0	Shuttered Exposure Mode
					X	X	1	Shutterless Exposure Mode
					X	0	X	Start Integrate or Readout at PMU sync
					X	1	X	Start Integrate or Readout on command
					0	X	X	Science Readout (No header, BLS or overscan pixels)
					1	X	X	Engineering format Readout

- 3. **CAMNAME:** This parameter identifies the camera system, as shown below;
Field Size: 8 Bits
Values: 0 - Filtergraph Camera
- 1 - Spectro-Polarimeter Camera
- 2 - Correlation Tracker Camera

10. FPP_CCD_SUM_MODE (OpCode: 092):

Set CCD summing Mode in both parallel and serial directions.

Number of Parameters: 4 Parameters:

- 2. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 5

- 4. **CAMNAME:** This parameter identifies the camera system, as shown below;

0	1	2	3	4	5	6	7	
							Camera Name	

- Values: 0 - Filtergraph Camera
- 1 - Spectro-Polarimeter Camera
- 2 - Correlation Tracker Camera

- 5. **SERSUM:** Serial summing mode
Field Size: 2 Bits
Range: 0 - 3

0	1	2	3	4	5	6	7
						SERSUM	

Value	Summing Mode
0	No Summing
1	2X Summing
2	4X Summing
3	8X Summing

- 6. **PARSUM:** Parallel Summing mode
Field Size and range are same as for SERSUM parameter.

11. FPP_COPY_EEPROM_RAM (OpCode: 065):

Set PID's to copy EEPROM load image to RAM on CPU reset.

Number of Parameters: 1 Parameter:

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

12. FPP_CPU_RESET (OpCode: 055):

Reset Processor.

Number of Parameters: 1 Parameter:

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

13. FPP_CT_CAMERA_OFF (OpCode: 030):

Correlation Tracker Camera off.

Number of Parameters: 1 Parameter:

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

14. FPP_CT_CAMERA_ON (OpCode: 028):

Correlation Tracker Camera On.

Number of Parameters: 1 Parameter:

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

15. FPP_CT_CLR_ERROR (OpCode: 236):

Not Implemented.

Number of Parameters: 1 Parameter:

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

16. FPP_CT_DIAG_CHAN_SET (OpCode 238):

Adds a channel for monitoring while in diagnostic mode. A maximum of 16 channels can be monitored simultaneously. The channel selection remains valid over multiple diagnostic mode sessions. To unselect a channel, set channel number to 0xFFFF.

Number of Parameters: 3

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 5
2. **CHAN:** Channel Number
Field Size: 16 Bits
Range: 0x0000 – 0xffff
3. **INDEX:** Number in the list of channels to be monitored
Field Size: 8 Bits
Range: 0 - 15

17. FPP_CT_DIAG_MODE (OpCode: 234):

Turns Correlation Tracker diagnostic Mode on or off. While in diagnostic mode, the CT saves the angles and errors for each CT frame. This data is downlinked via the mission data interface when the data buffer is full. Thus the number of packets generated depends upon number of channels sampled and the rate of sampling.

Number of Parameters: 2 Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 4
2. **MODE:** Diagnostic Mode
Field Size: 8 Bits
Value: 0 – Diagnostic mode off
1 – Normal jitter mode
2 – Augmented jitter mode (More data sampled)
3 – Analog data samples (The analog channels are selected by the, FPP_DIAG_CHAN_SET command).
- 3.
4. **INTRVL:** Analog data sampling interval. Default value is 145, corresponding to a sampling interval of 1s.
Field Size: 8 Bits
Range: 0 – 255 (LSB is 6.9 milliseconds)

18. FPP_CT_MAKE_REF (OpCode: 220):

Command to CT camera to make new reference (S or R).

Number of Parameters: 2 Parameter

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **NUMFRM:** Number of frames to sum to make the reference frame
Field Size: 8 Bits
Range: 1 – 5

19. FPP_CT_PROC_FIELD (OpCode: 252):

Command to select the bit field used by the CT processor board to generate the sums.

Number of Parameters: 2

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
3. **PROC_FIELD:** Bit field number
Field Size: 8 Bits
Range: 0 - 4

PROC_FIELD NUMBER	Bit Field
0	0 to 7
1	1 to 8

2	3 to 10
3	4 to 11

20. FPP_CT_RUN (OpCode: 216):

Set CT camera in RUN mode. In this mode the CT camera generates 70 word data blocks at the rate of 580 Hz.

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

21. FPP_CT_SEND_LIVE (OpCode: 226):

Command to CT camera to send a live frame (S or R).

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

22. FPP_CT_SEND_REF (OpCode: 222):

Command to CT camera to send reference frame.

This command can be processed in both RUN and STDBY modes.

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

23. FPP_CT_STDBY (OpCode: 218):

Command CT camera to standby state

(CT camera must be in RUN mode).

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

24. FPP_CT_SWITCH_REF (OpCode: 224):

Command CT camera to switch to new reference

(This command is accepted in both RUN and STDBY modes).

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

25. FPP_CTM_ANG_SET (OpCode: 232):

Set Tip-Tilt mirror position.

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits

2. **X:** Value: 6
X Angle on sky (Sun)
Field Size: 16 Bits
Range: -32768 – 32767 (LSB is 0.0005 arcsec)
3. **Y:** Y Angle on sky (Sun)
Field Size: 16 Bits
Range: -32768 – 32767 (LSB is 0.0005 arcsec)

26. FPP_CTM_GO (OpCode: 240):

Start CTM operations
Handled by MEctrl task.

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

27. FPP_CTM_SERVO_OFF (OpCode: 228):

Send CTM_SVO_OFF command to CTM-E.
This command is handled by METask.

Number of Parameters: 1 Parameter:

2. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

28. FPP_CTM_SERVO_ON (OpCode: 230):

Send CTM_SVO_ON command to the CTM-E.
(Handled by METask)

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

29. FPP_DE_CONTAM_MODE (OpCode: 036):

Turn CCD decontamination mode on or off. Note that the decontamination mode is activated or deactivated for both cameras simultaneously.

Number of Parameters: 2

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **MODE:** Decontamination Mode; 0 – Off, 1 – On
Field Size: 8
Value: 0 (Decontamination Mode OFF) or 1 (Decontamination mode on)

30. FPP_DO_EXP (OpCode: 248):

Take a picture.

Number of Parameters: 4

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 5
2. **CAMNAME:** Camera and mode identifier fields as shown below.
Field Size: 8 Bits

Range: 0 – 255

Bit Field	Description
0 – 1	0 – S/P Camera; 1 – F/G Camera; 2 – CT Camera
2	0 – Shutterless Mode; 1 – Shuttered Mode
3	0 – Start camera operation at next PMU interrupt; 1 – Start when commaned
4	0 – Science Mode data (Only data readout); 1 – Engineering mode data
5 – 6	Shutter Mode; 0 – Shutterless; 1 – BFI; 2 – NFI
7	Smart memory buffer to use; 0 – Side 0; 1 – Side 1

3. **EXP:** Exposure Duration
Field Size: 8 Bits
Range: 0 – 255 (in 6.8 ms units)
4. **ACC:** Accumulate Flag
Field Size: 8 Bits
Range: 0 (No Accumulation) or 1 (Accumulate) data in smart memory

31. FPP_DUMP_MEM (OpCode: 008):

Memory Dump.

Number of Parameters: 4

Parameters:

5. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 7
2. **ADDR:** Address
Field Size: 24 Bits
Value: 0
Range: 0x0 – 0x7ffff
3. **NUMBYTES:** Number of Bytes
Field Size: 16
Value: 1024
Range: 0x0 – 0xffff

The values must be given by the formula, $(2 + 4N + 487P)$,Where, $0 \leq N \leq 121$ and $0 \leq P \leq 134$

(if P equals 134, then N must be less than 69)

32. FPP_DUMP_MEM_HIRATE (OpCode: 253):

Dumps processor memory via the mission data interface. Upto 65536 bytes may be dumped using this command. The number of bytes must be a multiple of 8 bytes.

Number of Parameters: 3 Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 8
2. **ADDR:** Starting address for the dump.
Field Size: 32 Bits
Range: 0 - 0x400000
3. **NUMWDS:** Number of 16 bit words to dump. This number must be between 0 and 0xFFFF. Since the hardware can only output data in multiples of 4 bytes, the acceptable values are in the series, 0x0000, 0x0007, 0x000F, 0x0017, 0x001F, 0x0027, ..., 0xFFEF, 0xFFF7, 0xFFFF.
Field Size: 16
Value: 0
Range: 0x0000 – 0xFFFF

33. FPP_EEPROM_RAM (OpCode 176):**** Critical Command ****

Copies data form EEPROM to RAM

Number of Parameters: 4 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.

- Field Size: 8 Bits
- Value: 11
- 2. **EEPROM_ADR:** Source address in EEPROM
 - Field Size: 24 Bits
 - Range: 0 – 0xfffff
- 3. **RAM_ADR:** Destination address in RAM
 - Field Size: 24 Bits
 - Range: 0 – 0xfffff
- 4. **COUNT:** Number of 32 bit words to copy.
 - Field Size: 24 Bits
 - Range: 0 – 0xffff

34. FPP_EMERGENCY_OFF (OpCode: 057):

Emergency Power Off. This command performs the same operations as FPP_ALL_OFF command.

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 - Field Size: 8 Bits
 - Value: 2

35. FPP_FG_CAMERA_OFF (OpCode: 022):

Filtergraph Camera Off.

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 - Field Size: 8 Bits
 - Value: 2

36. FPP_FG_CAMERA_ON (OpCode: 020):

Filtergraph Camera On.

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 - Field Size: 8 Bits
 - Value: 2

37. FPP_FG_MACRO_CMD (OpCode: 204)

Sends a command to generate data products to the Filtergraph subsystem.

See EICA, Chapter 6 for details of the parameters

38. FPP_FG_OPHTR_BAND (OpCode: 086):

Sets the operating temperature range for the Filtergraph operational heater.

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 - Field Size: 8 Bits
 - Value: 6
2. **DBHI:** - Dead Band High; The upper limit of the operating temperature range.
 - Field Size: 16 Bits
 - Range: -1000 C to +1000 C (units are 0.1 deg / DN)
3. **DBLO:** Dead Band Low; The lower limit of the operating temperature range.
 - Field Size: 16 Bits
 - Range: -1000 C to +1000 (units are 0.1 deg / DN)

39. FPP_FG_OPHTR_DIS (OpCode: 082):

Disables filter-graph CCD operational heater.

Parameters: 1

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

40. FPP_FG_OPHTR_DUTY (OpCode: 084):

The heater duty cycle while the temperature is within the operating range.
The duty cycle can be set in steps of 5%.

Number of Parameters: 2 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **PERCENT :** Duty cycle percentage.
Field Size: 8 Bits
Range: 0 - 100

41. FPP_FG_OPHTR_ENA (OpCode: 080):

Enables dead-band duty cycle control of filter-graph CCD operational heater.

Parameters: 1

2. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

42. FPP_FG_STOP (OpCode: 208):

Stops currently executing FG macro command.

Parameters: 1

3. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

43. FPP_FLAGS (OpCode: 186):

Not Implemented.

These flags select or unselect operational options.

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 7
2. **FLAG:** Flag Number
Field Size: 32 Bits
Range: 0 – 15

Bit #	Description
0	Doppler Velocity Update
1	CCD Readouts synchronization with PMU interrupts
2	Mechanism re-configuration while reading out from CCD
3	Simultaneous operation of F/G and S/P cameras
4 - 31	Not Assigned

3. **STATE:** State of flag
Field Size: 8 Bits
Range: 0 – 1 (1 = Disabled; 0 = Enable)

44. FPP_FM_SWH_OVERRIDE (OpCode: 144):

**** Critical Command ****

Allows focus motor to be moved beyond the limit switches.

Parameters: 2

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **DEVNUM:** Flag Number
Field Size: 8 Bits
Value: 7

45. FPP_FULL_RAM_TEST (OpCode: 67):

This is a SUROM command which performs a full memory test on startup.

Parameters: 2

2. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

46. FPP_HTR_CNV_OFF (OpCode: 34):

CCD Heater converter Off.

Number of Parameters: 1

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

47. FPP_HTR_CNV_ON (OpCode: 32):

CCD Heater converter On.

Number of Parameters: 1

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

48. FPP_LOADFIX (OpCode: 012):

Copies data from the default load buffer to the location specified by ADDR.

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 8
2. **ADDR:** Destination Address
Field Size: 32 Bits
Range: 0 - 0x3FFFFFF
3. **SIZE:** Size
Field Size: 16 Bits
Range: 0 - 0x3FFF

49. FPP_MIN_RAM_TEST (OpCode: 069):

SUROM command to test a small portion of the RAM.

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

50. FPP_MTR_DELAY (OpCode: 116):

Sets a motor operating parameter. This command will only be used during ground testing during instrument development phase.

Number of Parameters: 3

Parameters:

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 4
- 1. **DEVNAME:** Device ID
Field Size: 8 Bits
Range: 0 - 15

Device ID Table

Device ID	Device Name
16	Polarization Modulator Unit
0	NFI Mask Wheel
1	BFI Blocking Filter
2	BFI Shutter
3	Slit Scan Mechanism
4	Wedge Wheel
5	NFI Blocking Filter
6	NFI Shutter
7	Focus Mechanism
8	Tunable Filter Element 1 Motor
9	Tunable Filter Element 2 Motor
10	Tunable Filter Element 3 Motor
11	Tunable Filter Element 4 Motor
12	Tunable Filter Element 5 Motor
13	Tunable Filter Element 6 Motor
14	Tunable Filter Element 7 Motor
15	Tunable Filter Element 8 Motor

Table 1

- 2. **DELAY:** Delay Value
Field Size: 8 Bits
Range: 0 – 255 (LSB is 32 s)

51. FPP_MTR_MOVE (OpCode: 110):

Moves the motor to the position loaded previously.

Number of Parameters: 3

Parameters:

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 4
- 2. **DEVNAME:** Device to move
Field Size: 8 Bits
Range: 0-16
For device id's see above table
- 3. **DIR:** Direction of move
Field Size: 8 Bits
Range: 0 – 1
0 – Clockwise Move
1 – Counter Clockwise Move
2 – Shortest distance Move

52. FPP_MTR_POS (OpCode: 114):

Sets new motor target position

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 5
2. **DEVNAME:** Device to move
Field Size: 8 Bits
Range: 0-16
For device id's see above table
3. **TARPOS:** Target Position
Field Size: 16 Bits
Range: 0 – 239 (BFI and NFI Filter wheels; Devices 1 and 5)
0 – 179 (Wedge wheel (Device 0), Mask Wheel (Device 4))
0 – 167 (Tunable Filter motors - Devices 8 – 15)
0 – 1000 (Positive or negative) for Slit Scan motor

53. FPP_MTR_RESET (OpCode: 108):

Resets motor controller.

Number of Parameters: 2

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **DEVNAME:** Device to move
Field Size: 8 Bits
Range: 0-16
For device id's see above table

54. FPP_MTR_RST_SPINTMR (OpCode: 118)

Resets the motor spin timer and clears bit 7 in the motor status word. When the encoder has passed the index mark twice (once to start the spin timer and the second signifying a complete revolution) the Spin Timer Done bit is set again.

Number of Parameters: 2

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **DEVNAME:** Device Number (See table 1 for device numbers)
Field Size: 8 Bits
Range: 0 – 15

55. FPP_MTR_STEP (OpCode: 112):

Moves motor 1 step.

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 4
2. **DEVNAME:** Device to move
Field Size: 8 Bits
Range: 0-16
For device id's see above table
3. **DIR:** Direction to move
Field Size: 8 Bits
Range: 0-1
0 – Clockwise
1 – Counter Clockwise

56. FPP_NOOP (OpCode: 254):

NoOp.

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

57. FPP_OP_HTR1_BAND (OpCode: 046):

Sets the operating temperature range for the zone 1 operational heater.

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 6
2. **DBHI:** Dead Band High; The upper limit of the operating temperature range.
Field Size: 16 bits
Range: -1000C to +1000 in units of 0.1 deg / DN
3. **DBLO:** Dead Band Low; The lower limit of the operating temperature range.
Field Size: 16 Bits
Range: -1000 to +1000 in units of 0.1 deg / DN

58. FPP_OP_HTR1_DIS (OpCode: 042):

Enable duty cycle control of structure heater 1.

Number of parameters: 1

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

59. FPP_OP_HTR1_DUTY (OpCode: 044):

The heater duty cycle while the temperature is within the operating range.

The duty cycle can be set in steps of 1%.

Number of Parameters: 2

Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **PERCENT -** Duty cycle percentage.
Field Size: 8 Bits
Range: 0 – 100

60. FPP_OP_HTR1_ENA (OpCode: 040):

Enable duty cycle control of structure heater 1.

Number of parameters: 1

Parameters:

2. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

61. FPP_OP_HTR2_BAND (OpCode: 054):

Sets the operating temperature range for the zone 2 operational heater.

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 6

2. **DBHI:** Dead Band High; The upper limit of the operating temperature range
Field Size: 16 Bits
Range: -1000C to +1000 in units of 0.1 deg / DN
3. **DBLO:** Dead Band Low; The lower limit of the operating temperature range.
Field Size: 16 Bits
Range: -1000 to +1000 in units of 0.1 deg / DN

62. FPP_OP_HTR2_DIS (OpCode: 050):

Enable duty cycle control of structure heater 2.

Number of parameters: 1

Parameters:

3. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

63. FPP_OP_HTR2_DUTY (OpCode: 052):

The heater duty cycle while the temperature is within the operating range.

The duty cycle can be set in steps of 1%.

Number of Parameters: 2

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **PERCENT :** Duty cycle percentage.
Field Size: 8 Bits
Range: 0 – 100

64. FPP_OP_HTR2_ENA (OpCode: 048):

Enable duty cycle control of structure heater 2.

Number of parameters: 1

Parameters:

4. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

65. FPP_OP_HTR3_BAND (OpCode: 062):

Sets the operating temperature range for the zone 3 operational heater.

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 6
2. **DBHI:** Dead Band High; The upper limit of the operating temperature range
Field Size: 16 Bits
Range: -1000C to +1000 in units of 0.1 deg / DN
3. **DBLO:** Dead Band Low; The lower limit of the operating temperature range.
Field Size: 16 Bits
Range: -1000 to +1000 in units of 0.1 deg / DN

66. FPP_OP_HTR3_DIS (OpCode: 058):

Enable duty cycle control of structure heater 3.

Number of parameters: 1

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

67. FPP_OP_HTR3_DUTY (OpCode: 060):

The heater duty cycle while the temperature is within the operating range.
The duty cycle can be set in steps of 1%.

Number of Parameters: 2

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **PERCENT:** Duty cycle percentage.
Field Size: 8 Bits
Range: 0 – 100

68. FPP_OP_HTR3_ENA (OpCode: 056):

Enable duty cycle control of structure heater 3.

Number of parameters: 1

Parameters:

2. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

69. FPP_OP_HTR4_BAND (OpCode: 070):

Sets the operating temperature range for the zone 4 operational heater.

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 6
2. **DBHI:** Dead Band High; The upper limit of the operating temperature range
Field Size: 16 Bits
Range: -1000C to +1000 in units of 0.1 deg / DN
3. **DBLO:** Dead Band Low; The lower limit of the operating temperature range.
Field Size: 16 Bits
Range: -1000 to +1000 in units of 0.1 deg / DN

70. FPP_OP_HTR4_DIS (OpCode: 066):

Enable duty cycle control of structure heater 4.

Number of parameters: 1

Parameters:

3. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

71. FPP_OP_HTR4_DUTY (OpCode: 068):

The heater duty cycle while the temperature is within the operating range.
The duty cycle can be set in steps of 1%.

Number of Parameters: 2

Parameters:

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
- 2. **PERCENT:** Duty cycle percentage.
Field Size: 8 Bits
Range: 0 – 100

72. FPP_OP_HTR4_ENA (OpCode: 064):

Enable duty cycle control of structure heater 4.
Number of parameters: 1
Parameters:

- 4. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

73. FPP_OP_MODE (OpCode: 250):

Not Implemented

Operational Mode

Number of Parameters: 2

Parameter:

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
- 2. **MODE -** Mode Bit mask. Each bit represents a different mode.
Field Size: 8 Bits
Mode Bit Definitions:

0 – 0: CT Clock Mode;	1: System Clock Mode
1 – 0: FM Memory Map;	1: PM Memory Map
2 – 0: Not Patch Mode;	1: Patch Mode
3 – 0: Not Diagnostic Mode;	1: Diagnostic Mode
4 – 0: Undefined	

74. FPP_OP_PARAM (OpCode: 188):

FPP Operational Parameters

Number of Parameters: 3

Parameters:

- 1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 7
- 2. **PARNO:** Parameter Number
Field Size: 8 Bits
Range: 0 – 32 (TBD)
Parameter Description

PARNO	Description	Default Value
0		
1		
2		
3		
4		
5	Hard limit count which triggers recovery	5
6	Out of Range count to trigger action	10
7	Absolute Deviation from Mean	0xffff
8	Low threshold for CT image sums	200
9	Low threshold for CT image data	200
10	High threshold for CT sums	2000
11	Scale factor	440

12	Maximum number of reference frame used for validation	2
13	Number of continuous live frames	
14	# of repeats to use with monitor flag for SP	10
15	Number of frames summed to generate a reference frame	1
16	Automatic Reference frame update interval (in seconds)	40
17	Enable automatic reference frame updates	0 (Disabled)
18	Sign of X error	0 (+ve)
19	Sign of Y Error	0 (+ve)
20	Swap X and Y Errors	0 (False)
21	Good Reference frame available (declared above)	
22	Default exposure for the FG (see macro cmd def)	30
23	Delay for the PMU signal to cameras, unit is 390 micro second	
24	Center position of focus scans, with 2048 the zero point	2048
25	Phase to use for FG mask-less macro commands	0
26	SP Spectral offset for zero velocity	56
27	Fake temperature	0
28	Ground Calibration Unit Configuration	0
29	Allow Slit Movement	1
30	PMU Phase Offset	1
31	Slit Direction	0 (to high address)
32	Laser Scan Limit	1
33	Laser Scan Delay	300
34	Checksum (LS word)	0
35	Checksum (MS word)	0
36	I Scan Phase	0
37	FG PMU Delay Count	16
38	DMA block size	8192
39	CTsend2ctme	1
40	Loop Flag (Internal FG Loops)	0
41	FG Pad Time	145
42	Loop Limit	10000
43	Allow Time1 Flag	1
44	Stop Packets Flag	0
45	Stop Smart Memory DMA	0
46	DMA Busy Bypass; Set to skip dmaMg whenever DMABusy is set	0
47	Test Pad Time	1
48	FG Checksum	0
49	CT Fake Flag	0
50	Turn watchdog timer on/off	0 (On)
51	SCIF Status Check during DMA	0
52	Stack Margin	25
53	Fake PMU	0
54	Clear Error Block (Error Code, Count and Parameters)	0

Table 2

3. **VALUE:** Parameter Value (None Defined yet)
Field Size: 32 Bits

75. FPP_PMU_ENC_SEL (OpCode: 122):

Select the encoder to be used for Polarization Modulator Unit Position sensor

Number of Parameters: 3

Parameters:

2. **CMDLEN:** Length of command in bytes, including opcode and this parameter.

- Field Size: 8 Bits
- Value: 4
- 3. **DEVNAM:**
 - Field Size: 8 Bits
 - Value: 16 (PMU device)
- 4. **ENC:** Encoder Identifier
 - Field Size: 8 Bits
 - Range: 0 – Encoder A
1 – Encoder B
2 – Average of A and B

76. FPP_PMU_GAIN (OpCode: 124):

Sets PMU motor gain.

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 - Field Size: 8 Bits
 - Value: 4
2. **DEVNAM:**
 - Field Size: 8 Bits
 - Value: 16 (PMU device)
3. **GAIN:** Motor Gain
 - Field Size: 8 Bits
 - Range: 0 – 15 (0 = Maximum; 4 = Default)

77. FPP_PMU_OFFSET (OpCode: 126):

Set the delay after which the position interrupt is generated.

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 - Field Size: 8 Bits
 - Value: 4
2. **DEVNAM:**
 - Field Size: 8 Bits
 - Value: 16 (PMU device)
3. **OFFSET:** This parameter controls the number of encoder steps between generating the position interrupt and the actual hexadecimal position, in units of 1/32 ths of a step.
 - Field Size: 8 Bits
 - Range: 0 – 15
0 = No Offset
4 = Default

78. FPP_PMU_LOOP_CTRL (OpCode: 128):

Sets PMU open / closed loop control mode.

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 - Field Size: 8 Bits
 - Value: 3
2. **MODE:**
 - Field Size: 8 Bits
 - Range: 0 – 1
0 – Closed Loop Operation
1 – Open Loop Operation

79. FPP_PMU_PWM_LIMIT (OpCode: 130):

Set the PMU encoder Pulse Width Modulation limit.

Number of Parameters: 4

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 5
2. **DEVNAM:**
Field Size: 8 Bits
Value: 16 (PMU device)
3. **LOW:** This parameter sets the low limit of the range over which the controller may vary the PWM duty cycle.

Field Size: 8 Bits
Range: 0 - 255
4. **HIGH:** This parameter sets the High limit of the range over which the controller may vary the PWM duty cycle.

Field Size: 8 Bits
Range: 0 - 255

Note: High limit must always be larger than Low limit. If not, the MC_INV_PRM_ERR is thrown.

80. FPP_PMU_RUN (OpCode: 120):

Sets PMU spinning in the clockwise direction.

Number of Parameters: 2

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **DEVNAM:**
Field Size: 8 Bits
Value: 16 (PMU device)

81. FPP_PWR_ON_ENA (OpCode: 18):

Sets critical command enable flag. Critical commands can now be accepted by FPP. The next command sent disables the flag. If no command is sent for 34 seconds, the flag is also disabled.

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

82. FPP_QHSS_LD_RAM (OpCode: 59):

Sets processor switches to load RAM via the QHSS port.

Number of parameters: 2

Parameters:

1. **CMDLEN:** Length of command in bytes
Field Size: 8 Bits
Value: 2

Note: The Processor Reset command must be set after this command for it to take effect.

83. FPP_QHSS_CMD (OpCode: 175):

Send a command via the QHSS port.

Number of parameters: Variable

Parameters:

Byte #	Description
0	OpCode (0xAE, 175)
1-4	SUROM Command Length
5-6	0xFFFF (SUROM Command Sync)
7-8	SUROM Command Length in 16 bit words)
9-N	Command Data (N <= 506)
N+1-N+2	Longitudinal Parity

84. FPP_RAM_EEPROM (OpCode 178)**** Critical Command ****

Copies data form RAM to EEPROM.

Number of Parameters: 4 Parameter:

5. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 11
6. **EEPROM_ADR:** Source address in EEPROM
Field Size: 24 Bits
Range: 0 – 0xfffff
7. **RAM_ADR:** Destination address in RAM
Field Size: 24 Bits
Range: 0 – 0xfffff
8. **COUNT:** Number of 32 bit words to copy.
Field Size: 24 Bits
Range: 0 – 0xffff

85. FPP_RD_MTR_POS (OpCode: 132):

Read the current position of specified motor.

Number of Parameters: 2

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **DEVNAM:** Device ID (See Table 1)
Field Size: 8 Bits
Range: 0 - 16

86. FPP_RD_MTR_STATUS (OpCode: 134):

Read the status of specified motor.

Number of Parameters: 2 Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **DEVNAM:** Device ID (See Table 1)
Field Size: 8 Bits
Range: 0 - 16

87. FPP_RD_PMU_DELAY (OpCode: 144):

Read PMU delay.

Number of Parameters: 2 Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits

- Value: 3
- 2. **DEVNAM:** Device ID (See Table 1)
- Field Size: 8 Bits
- Value: 16

88. FPP_RD_PMU_GAIN_OFF (OpCode: 140):

Read PMU motor gain and encoder offset.

Number of Parameters: 2 Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **DEVNAM:** Device ID (See Table 1)
Field Size: 8 Bits
Value: 16

89. FPP_RD_PMU_PWM (OpCode: 136):

Read PMU encoder Pulse Width Modulation range.

Number of Parameters: 2 Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **DEVNAM:** Device ID (See Table 1)
Field Size: 8 Bits
Value: 16

90. FPP_RD_SPIN_TIME (OpCode: 138):

Read motor spin duration.

Number of Parameters: 2

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
2. **DEVNAM:** Device ID (See Table 1)
Field Size: 8 Bits
Range: 0 – 16

91. FPP_RESET_CMD_ERR (OpCode: 73):

Resets command error bi-level.

Number of Parameters: 2

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

92. FPP_SET_TIME (OpCode: 10):

Sets FPP Local Clock. This clock is updated at system ticks and reset upon receipt of a status request command (which contains a time field in units of 1/512 sec.).

Number of Parameters: 2

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 6
2. **SEC:** Universal Time Seconds

93. FPP_SS_CENTER (OpCode: 180)

Moves the Slit Scan Mechanism to the center position and resets it. This can take several minutes.

Number of Parameters: 1

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2
2. **DEVNUM:** Slit Scan Device number
Field Size: 8 Bits
Value: 3

94. FPP_SS_SWH_OVERRIDE (OpCode: 144): ** Critical Command **

Allows Slit Scan mechanism to be moved beyond the limit switches.

Parameters: 2

3. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 3
3. **DEVNUM:** Flag Number
Field Size: 8 Bits
Value: 2

95. FPP_SHT_DIS (OpCode 156):

Disables specified shutter. After this command is sent the shutter can only be operated in step mode.

Number of Parameters: 3

1. **CMDLEN:** Length of command in bytes
Field Size: 8 Bits
Value: 3
2. **DEVNAME:** Shutter identifier (Narrow band or Broadband filtergraph shutter).
Field Size: 8 Bits
Values: 2 (Broadband) or 6 (Narrowband) filtergraph

96. FPP_SHT_EXP (OpCode: 146):

Move shutter to expose the CCD for (preloaded) duration. Shutter is moved in the direction specified by the DIR parameter. Note that if a clockwise exposure is followed by a clockwise exposure, the CCD is *not* exposed. The shutter merely moves to the position from which a counterclockwise exposure can be performed. The same is true if a clockwise exposure follows a counterclockwise exposure.

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 4
2. **DEVNAM:** Shutter Device number (2 = BFI; 6 = NFI)
Field Size: 8 Bits
Range: 6 – 7
3. **DIR:** Shutter exposure direction (0 = Clockwise; 1 = Counterclockwise)
Field Size: 8 Bits
Range: 0 - 1

97. FPP_SHT_CLS (OpCode 154):

Moves specified shutter so that the CCD is obscured by the blade.

Number of Parameters: 3

1. **CMDLEN:** Length of command in bytes
Field Size: 8 Bits
Value: 3

2. **DEVNAME:** Shutter identifier (Narrow band or Broadband filtergraph shutter).
Field Size: 8 Bits
Values: 2 (Broadband) or 6 (Narrowband) filtergraph

98. FPP_SHT_OPN (OpCode: 152):

Sets opening of the specified shutter in front of the CCD.

Number of Parameters: 3

1. **CMDLEN:** Length of command in bytes
Field Size: 8 Bits
Value: 3
2. **DEVNAME:** Shutter identifier (Narrow band or Broadband filtergraph shutter).
Field Size: 8 Bits
Values: 2 (Broadband) or 6 (Narrowband) filtergraph

99. FPP_SHT_LOAD_EXP (OpCode: 150):

Shutter Load Exposure.

Number of Parameters: 3 Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 5
2. **DEVNAME:** Shutter device number (2 = BFI; 6 = NFI)
Field Size: 8 Bits
Value: 0
Range: 6 – 7
3. **HIGH:** Most significant byte of exposure value
Field Size: 8 Bits
Value: 0
Range: 0 – 255 (LSB is 262.144 ms)
4. **LOW:** Least significant byte of exposure value
Field Size: 8 Bits
Value: 0
Range: 0 – 255 (LSB is 1.024 ms).

100. FPP_SHT_SPIN (OpCode: 148):

Set shutter spinning.

Number of Parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 4
2. **DEVNAME:** Shutter device number (2 = BFI; 6 = NFI)
Field Size: 8 Bits
Value: 0
Range: 0 - 1
3. **DIR:** Direction(0 = CW; 1 = CCW)
Field Size: 8 Bits
Value: 0
Range: 0 - 1

101. FPP_SM_CFG (OpCode: 246)

This command sets smart memory configuration. The smart memory can be divided into upto 4 pages. This command specifies how new data written to a smart memory page is to be processed. The smart memory controller can perform the following operations with the new data being written; Write or Write Complement to memory, Add or subtract data from existing data in memory. In addition the new data can be scaled prior to applying one of the four operations.

Number of Parameters: 4

Parameters:

1. CMDLEN:
Field Size: 8 Bits
Value: 6
Description: Length of the command in bytes, including the opcode.
2. CAMNAME:
Field Size: 8 Bits
Range: 0 – 1 (0 = Filtergraph; 1 = Spectro-Polarimeter)
Description: Selects either Filtergraph or Spectro-Polarimeter smart memory
3. SIDE:
Field Size: 8 Bits
Range: 0 – 1
Description: Data from each camera can be written to two alternate smart memory banks (to allow double buffering. This field selects the memory bank to be configured.
4. VAL:
Field Size: 16 Bits
Range: 0x0000 – 0xffff
Description: This field specifies the configuration of all 4 pages.
Page configuration is specified as shown below;

Bit Field in VAL	Value	Description
0 – 1	0	Write data to Page 0
	1	Write complement of data to page 0
	2	Add data to page 0 data
	3	Subtract data from page 0 data
2		Not Used
3	0	No scaling applied
	1	Shift data by 1 bit before write operation
4 – 5	0	Write data to Page 1
	1	Write complement of data to page 1
	2	Add data to page 1 data
	3	Subtract data from page 1 data
6		Not Used
7	0	No scaling applied
	1	Shift data by 1 bit before write operation
8 – 9	0	Write data to Page 2
	1	Write complement of data to page 2
	2	Add data to page 2 data
	3	Subtract data from page 2 data
10		Not Used
11	0	No scaling applied
	1	Shift data by 1 bit before write operation
12 – 13	0	Write data to Page 3
	1	Write complement of data to page 3
	2	Add data to page 3 data
	3	Subtract data from page 3 data
14		Not Used
15	0	No scaling applied
	1	Shift data by 1 bit before write operation

102. FPP_SM_READ (OpCode: 244)

This command reads the specified smart memory bank.

Number of Parameters: 4

Parameters:

1. CMDLEN:
Field Size: 8 Bits
Value: 4
Description: Length of the command in bytes, including the opcode.

2. CAMNAME:
 - Field Size: 8 Bits
 - Range: 0 – 1 (0 = Filtergraph; 1 = Spectro-Polarimeter)
 - Description: Selects either Filtergraph or Spectro-Polarimeter smart memory
3. SIDE:
 - Field Size: 8 Bits
 - Range: 0 – 1
 - Description: Selects smart memory bank to be read

103. FPP_SP_CAMERA_OFF (OpCode: 026):

Spectro-Polarimeter Camera Off.

Number of Parameters: 1 Parameter:

2. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 - Field Size: 8 Bits
 - Value: 2

104. FPP_SP_CAMERA_ON (OpCode: 024):

Spectro-Polarimeter Camera On.

Number of Parameters: 1 Parameter:

2. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 - Field Size: 8 Bits
 - Value: 2

105. FPP_SP_MACRO_CMD (OpCode: 206)

Sends a command to the Spectro-Polarimeter subsystem to initiate a set of Stokes spectra.
For details of the parameters, see, EICA, chapter 6.

106. FPP_SP_OPHTR_BAND (OpCode: 078):

SP CCD Operational Heater Range.

Number of Parameters: 3 Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 - Field Size: 8 Bits
 - Value: 6
2. **DBHI:** Dead band high
 - Field Size: 16 Bits
 - Range: -1000 to +1000 in units of 0.1 deg / DN
3. **DBLO:** Dead band low
 - Field Size: 16 Bits
 - Range: -1000 to +1000 in units of 0.1 deg / DN

107. FPP_SP_OPHTR_DUTY (OpCode: 076):

SP CCD Operational Heater Level. The duty cycle can be set in steps of 5%.

Number of Parameters: 2 Parameters:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 - Field Size: 8 Bits
 - Value: 3
2. **PERCENT:** Percent
 - Field Size: 8 Bits
 - Value: 0
 - Range: 0 - 100

108. FPP_STATRQ1 (OpCode: 1):

Request FPP 0.25 status packet.

Number of parameters: 3

Parameters:

1. **CMDLEN:** Length of command in bytes
Field Size: 8 Bits
Value: 8
2. **TIME:** MDP time in (1/512) seconds
Field Size: 32 Bits
Range: 0 – 0xFFFFFFFF
3. **VEL:** Composite spacecraft velocity in meters/sec
Field Size: 16 Bits
Range: - TBD to +TBD

109. FPP_STATRQ2 (OpCode: 2):

Request FPP 2 - second status packet.

Number of parameters: 3

Parameters:

4. **CMDLEN:** Length of command in bytes
Field Size: 8 Bits
Value: 8
5. **TIME:** MDP time in (1/512) seconds
Field Size: 32 Bits
Range: 0 – 0xFFFFFFFF
6. **VEL:** Composite spacecraft velocity in meters/sec
Field Size: 16 Bits
Range: - TBD to +TBD

110. FPP_STATRQ3 (OpCode: 3):

Request FPP 10 – second status packet.

Number of parameters: 3

Parameters:

7. **CMDLEN:** Length of command in bytes
Field Size: 8 Bits
Value: 8
8. **TIME:** MDP time in (1/512) seconds
Field Size: 32 Bits
Range: 0 – 0xFFFFFFFF
9. **VEL:** Composite spacecraft velocity in meters/sec
Field Size: 16 Bits
Range: - TBD to +TBD

111. FPP_STATRQ4 (OpCode: 4):

Request FPP 0.25 status packet with memory dump.

Number of parameters: 3

Parameters:

10. **CMDLEN:** Length of command in bytes
Field Size: 8 Bits
Value: 8
11. **TIME:** MDP time in (1/512) seconds
Field Size: 32 Bits
Range: 0 – 0xFFFFFFFF

12. **VEL:** Composite spacecraft velocity in meters/sec
 Field Size: 16 Bits
 Range: - TBD to +TBD

112. FPP_RESET_SCIF (OpCode: 071):

Reset Spacecraft Interface.

Number of Parameters: 1 Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 Field Size: 8 Bits
 Value: 2

113. FPP_SP_OPHTR_DIS (OpCode: 074):

SP CCD Operational heater Off.

Number of Parameters: 1

Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 Field Size: 8 Bits
 Value: 2

114. FPP_SP_OPHTR_ENA (OpCode: 072):

SP CCD Operational heater On.

Number of Parameters: 1

Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 Field Size: 8 Bits
 Value: 2

115. FPP_SP_PAUSE (OpCode: 212):

Pause SP.

Number of Parameters: 1

Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 Field Size: 8 Bits
 Value: 2

116. FPP_SP_RESUME (OpCode: 214):

Resume SP.

Number of Parameters: 1

Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
 Field Size: 8 Bits
 Value: 2

117. FPP_SP_STOP (OpCode: 210):

Stop SP.

Number of Parameters: 1

Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.

Field Size: 8 Bits
Value: 2

118. FPP_UART_LD_RAM (OpCode: 61):

Set PID's to allow loading of RAM via the UART interface.

Number of Parameters: 1

Parameter:

1. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

119. FPP_UART_LD_EEPROM (OpCode: 63):

Set PID's to allow loading of EEPROM via the UART interface.

Number of Parameters: 1

Parameter:

2. **CMDLEN:** Length of command in bytes, including opcode and this parameter.
Field Size: 8 Bits
Value: 2

120. FPP_UPLOAD_MEM (OpCode 160):

This command loads up to 128 bytes of data to FPP memory.

This is a generic memory load command. Normally one of the commands below would be used for uploading data to FPP.

Number of Parameters: Variable (5 - 133)

Parameters:

1. **ADDR:** The address of the location in RAM to load data.
Field Size: 24 Bits (MS bit is not used)
Range: 0 - 0x7FFFFFFF
2. **LEN:** Number of Bytes to load
Field Size: 8 Bits
Range: 1 - 128

121. FPP_XRT_PAUSE (OpCode: 6):

This command is issued by the MDP when XRT filter wheels are moving. FPP does not take any action in response. It merely serves to indicate the times when XRT devices are in motion.

Number of parameters:

Parameters:

1. **CMDLEN:** Length of command.
Field Size: 8 bits
Value: 6
2. **DELAY:** Time, in units of 10ms, until XRT filter wheel starts to move.
Field Size: 8 Bits
Range: 0 – 255
3. **RESERVED:** Reserved
Field Size: 8 Bits
Value: 0
4. **Pause Duration:** Expected duration of XRT wheel movement.
Field Size: 16 Bits
Range: 0 – 65535 (in 10 ms units)

Appendix A: Diagnostic Channel ID's

Diagnostic Channel ID's

Channel ID	Description
0	Mask Wheel Encoder
1	Mask Wheel Status
2	Mask Wheel Spin Timer B0 (LS Byte)
3	Mask Wheel Spin Timer B1 (MS Byte)
4	WB Filterwheel Encoder
5	WB Filterwheel Status
6	WB Filterwheel Spin Timer B0 (LS Byte)
7	WB Filterwheel Spin Timer B1 (MS Byte)
8	WB Shutter Status
9	WB Shutter Encoder
10	WB Shutter Close Time B0
11	WB Shutter Open Time B0
12	WB Shutter Close Time B1
13	WB Shutter Open Time B1
14	WB Shutter Close Time B2
15	WB Shutter Open Time B2
16	WB Shutter Spin Timer B0
17	WB Shutter Spin Timer B1
18	Slit Position B0
19	Slit Position B1
20	Slit Status
21	Wedge Wheel Encoder
22	Wedge Wheel Status
23	Wedge Wheel Spin Timer B0
24	Wedge Wheel Spin Timer B1
25	NB Filterwheel Encoder
26	NB Filterwheel Status
27	NB Filterwheel Spin Timer B0
28	NB Filterwheel Spin Timer B1
29	NB Shutter Status
30	NB Shutter Encoder
31	NB Shutter Close Time B0
32	NB Shutter Open Time B0
33	NB Shutter Close Time B1
34	NB Shutter Open Time B1
35	NB Shutter Close Time B2
36	NB Shutter Open Time B2
37	NB Shutter Spin Timer B0
38	NB Shutter Spin Timer B1

39	Focus Position B0
40	Focus Position B1
41	Focus Status
42	TF Motor 1 Encoder
43	TF Motor 1 Status
44	TF Motor 1 Spin Timer B0
45	TF Motor 1 Spin Timer B1
46	TF Motor 2 Encoder
47	TF Motor 2 Status
48	TF Motor 2 Spin Timer B0
49	TF Motor 2 Spin Timer B1
50	TF Motor 3 Encoder
51	TF Motor 3 Status
52	TF Motor 3 Spin Timer B0
53	TF Motor 3 Spin Timer B1
54	TF Motor 4 Encoder
55	TF Motor 4 Status
56	TF Motor 4 Spin Timer B0
57	TF Motor 4 Spin Timer B1
58	TF Motor 5 Encoder
59	TF Motor 5 Status
60	TF Motor 5 Spin Timer B0
61	TF Motor 5 Spin Timer B1
62	TF Motor 6 Encoder
63	TF Motor 6 Status
64	TF Motor 6 Spin Timer B0
65	TF Motor 6 Spin Timer B1
66	TF Motor 7 Encoder
67	TF Motor 7 Status
68	TF Motor 7 Spin Timer B0
69	TF Motor 7 Spin Timer B1
70	TF Motor 8 Encoder
71	TF Motor 8 Status
72	TF Motor 8 Spin Timer B0
73	TF Motor 8 Spin Timer B1
74	Analog Ground
75	+5V Housekeeping board Monitor
76	+15V Housekeeping board Monitor
77	-15 V Housekeeping Board Monitor
78	5 V Power Module Monitor
79	+15V Power Module Monitor
80	-15 V Power Module Monitor
81	3.3 V power Module Monitor
82	+15 V Motor Monitor
83	15 V Motor Current Monitor
84	5 V CCD Monitor
85	+15 V CCD Monitor
86	-15 V CCD Monitor

87	36 V CCD Monitor
88	30 V Heater Monitor
89	28 V Current Monitor
90	Focus Monitor
91	Scan Monitor
92	30 V Heater Current Monitor
93	SP Camera low temperature
94	FG Camera low temperature
95	CT Camera low temperature
96	FPP PWR HTCP low temperature
97	FPP PWR IF low temperature
98	FPPE Hot Wall low temperature
99	FPP PWR Hot wall low temperature
100	FPPE CPU Board low temperature
101	FPPE IF low temperature
102	SP Camera high temperature
103	FG Camera high temperature
104	CT Camera high temperature
105	FPP PWR HTCP high temperature
106	FPP PWR IF high temperature
107	FPPE Hot Wall high temperature
108	FPP PWR Hot wall high temperature
109	FPPE CPU Board high temperature
110	FPPE IF high temperature
111	FPP STRUCTURE 1 low temp.
112	FPP STRUCTURE 2 low temp.
113	FPP STRUCTURE 3 low temp.
114	FPP STUCTURE 4 low temp.
115	FPP STRUCTURE Y1+ low temp.
116	FPP STRUCTURE Y2+ low temp.
117	FPP STRUCTURE Y1- low temp.
118	FPP STRUCTURE Y2- low temp.
119	FPP STRUCTURE 1 high temp.
120	FPP STRUCTURE 2 high temp.
121	FPP STRUCTURE 3 high temp.
122	FPP STUCTURE 4 high temp.
123	FPP STRUCTURE Y1+ high temp.
124	FPP STRUCTURE Y2+ high temp.
125	FPP STRUCTURE Y1- high temp.
126	FPP STRUCTURE Y2- high temp.
127	SP CCD HEADER (TL type PRT sensor)
128	FG CCD HEADER (TL type PRT sensor)
129	CT CCD HEADER (TL type PRT sensor)
130	TUNABLE FILTER 1 low temp. range
131	TUNABLE FILTER 2 low temp. range
132	TUNABLE FILTER 3 low temp. range
133	TUNABLE FILTER 4 low temp. range
134	TUNABLE FILTER 5 low temp. range

135	TUNABLE FILTER 6 low temp. range
136	TUNABLE FLTER 7 low temp. range
137	TUNABLE FILTER 8 low temp. range
138	TUNABLE FILTER 1 high temp. range
139	TUNABLE FILTER 2 high temp. range
140	TUNABLE FILTER 3 high temp. range
141	TUNABLE FILTER 4 high temp. range
142	TUNABLE FILTER 5 high temp. range
143	TUNABLE FILTER 6 high temp. range
144	TUNABLE FLTER 7 high temp. range
145	TUNABLE FILTER 8 high temp. range
146	MECHANISM ELECTR. Low temp.
147	FG FILTERWHEEL 1 low temp.
148	FG FILTERWHEEL 2 low temp.
149	REIMAGING LENS ASSY low temp.
150	HEAT DUMP1 low temp.
151	SP SLIT low temp.
152	SP BS low temp.
153	MECHANISM ELECTR. High temp.
154	FG FILTERWHEEL 1 high temp.
155	FG FILTERWHEEL 2 high temp.
156	REIMAGING LENS ASSY high temp.
157	HEAT DUMP1 high temp.
158	SP SLIT high temp.
159	SP BS high temp.