XMM Optical Monitor

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XMM-OM (FM) INTEGRATED FUNCTIONAL TEST PROCEDURE

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CHANGE RECORD

Issue	Date	Comments
1	29 July '98	1st Issue
2	31 July '98	Corrected aliases Clarified f/w actions Clarified HV actions Updated currents
3	25 Aug '98	Updates to scripts Addition of EMC test procedure
4	16 Sept '98	Update to scripts Addition of thermal vacuum test procedure
5	04 Jan '99	Added EMC and TB/TV modules to Test Procedures table (paragraph 4) Added RBI suspend to Power Off Procedure Changed operational code words in basic mode test (section 5.1) Tidied up
6	5 Mar 99 11 Mar 99	Changed byte comparison values in section 5.1 (MSSL NCR 147, ref NCR XM-NC-DOR-0400) Added two new tables for secondary current comparisons in section 5.1 (MSSL NCR 147, ref NCR XM-NC-DOR-0400) Added Time Synchronisation section (MSSL NCR 141, ref NCR XM-NC-DOR-3059) Added DMA test Added DPU packet & parameter in Time Synchronisation Test
7	26 Mar 99	Updated HV ramp up sequence Modified table in Section 4 Updated Basic Mode Test Updated DMA Test

Contents

Tables

1. Scope

The test procedure is applicable to the flight model optical monitor test during the spacecraft integration and test phases.

The procedures will be conducted from the spacecraft EGSE, whereby the OM instrument station will follow the telecommand and telemetry transfer to and from the instrument. Analysis of science data will be performed on the OM instrument-station.

2. Documentation

1. Applicable documents
   XMM-OM User manual Part 3 (XMM-OM/MSSL/ML/0010)
   XMM-OM User manual Part 4 (XMM-OM/MSSL/ML/0011)

3. General requirements

1. Environmental conditions
   a) No specific environmental conditions are envisaged other than those applicable for the XMM satellite.
2. Safety precautions
   a) The High Voltage Unit should not be switched on without consultation with the OM team.
   b) All packets of type, subtype 3,2, 3,4, 4,2 and 4,3 should invalidate the test.
   c) The temperature of the CCD should be monitored (use HK), ensuring it does not exceed +43 ^{o}C.

4. Test Procedures

The table below provides an overview of the test procedure to be used for the tests at spacecraft level.

The procedures are applicable to the flight model of XMM-OM only and should be applied to both prime and redundant.

Description	To be performed	Test Sequence	Procedure
Interface test Estimated test time 30 minutes	AFT	Switch-on Boot mode test Switch to operational Filter wheel test[1] Heater test[1] Switch-off	5.0 5.1 5.2 (ehist_operation) 5.3 (ehist_fwl_test) 5.5 (ehist_htr_test) 5.8
Short Functional Test Estimated test time 30 minutes	IFT	Switch-on Boot mode test Switch to operational Filter wheel test Heater test Switch-off	5.0 5.1 5.2 (ehist_operation) 5.3 (ehist_fwl_test) 5.5 (ehist_htr_test) 5.8
Full Functional Test Estimated test time 240 minutes	IFT	Switch-on Boot mode test Switch to operational Filter wheel test Dichroic test[2] Heater test Image Test (multiple window) Image test (full frame) Switch-off	5.0 5.1 5.2 (ehist_operation) 5.3 (ehist_fwl_test) 5.4 (ehist_dic_test) 5.5 (ehist_htr_test) 5.6 (ehist_img_multi) 5.7 (ehist_img_full) 5.8
EMC Test	IFT	Switch-on Boot mode test Switch to operational Image test (full frame) Switch-off	5.0 5.1 5.2 (ehist_operation) 5.7 (ehist_img_full) 5.8
TB/TV Test	IFT	Switch-on Boot mode test Switch to operational	5.0 5.1 5.2 (ehist_operation)

[1] These steps should prompt operator interaction to run.
[2] The Dichroic mechanism is a limited life system and must not be rotated more than 50 times.

The following section provides a detailed description of the test sequences to be used for testing of the optical monitor instrument.

Pass/Fail criteria

The following pass/fail criteria are applicable for all the tests performed on the OM:

- If one of the TC error packets is received the test shall be halted followed by a review board.
- TM parameters mentioned in the procedure will be checked. If not correct the test will be halted followed by a review board
- The test will be stopped if any TM parameter exceeds the defined limits.
- If an unexpected event TM packet is received the test shall be halted followed by a review board.
- In the event of software hangs or crashes the 10 memory locations starting at 0xFC0 in operand space should be inspected.

5. Switch-on Test

WARNING
The Filter wheel is a limited life time device. Each rotation of the filter wheel (which occurs every time the OM is switched on) must be recorded in the instrument log book for the flight model.

Description
Switch-on procedure for the OM prime or redundant.
Switch-on the OM power and keep-alive line and check for HK data.

Initial state
The OM is switched off (KAL can be on).

Final State
The OM (prime or redundant) is switched on and in basic mode.

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial State: OM 28V power switched off KAL line on				
1 1.1 1.2 1.3	Switch-on OM power Switch-off the S/C heater (if not switched off before) Switch-on 28V Switch-on KAL (if not switched on before)		Filter wheel to coarse S/C procedure S/C procedure S/C procedure		
2 2.1 2.2 2.3	Check Housekeeping Ensure HK monitor prog working Verify basic mode is operational Verify heaters are on Secondaries disabled	 90000	(HK Valid after 15 second) pref H5395 = 'Initial' pref H5240 ='ononoffoff' pref H5255 = 'Disabled'		
3 3.1 3.2 3.3	OM power measure OM +28V voltage and current Measure OM KAL voltage and current Compare with table 5.0-1		 S/C procedure report: voltage and current S/C procedure report: voltage and current		
4	Exit				

Power line	Voltage	Current
+28V main power	+28V +/- 2V	1880mA +/- 50mA
Keep Alive Line	+8V +/- 1V	<18mA

Table 5.0-1 OM power consumption (basic mode)

5.1 Basic Mode Test

Description
The function of the OM is tested in the basic mode test without loading the main application software (operational mode).
Dump IC memory and verify the operation of the KAL memory.

Initial state
The OM (prime or redundant) is switched on and is in basic mode.

Final state
The OM (prime or redundant) is switched on and is in basic mode.

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial State: OM is switched on and in basic mode KAL power line is on				
1 1.1 1.2 1.3 1.4 1.5 1.6 1.7	Check test command Send invalid command *(tc_send)* Check packet response Check HK (bad TC counter) Send valid command *(tc_test)* Check packet response Check HK Send invalid sub-type (5,15) Send wrong checksum Perform Time Synchronisation test	 TC(0,0) 91202 90000 H1 91100 90000 TC(5,15)	 TM (3,2) Pref H5390 = 1 TM (3,1) Pref H5385 = 1 TM 91203 TM91201		
 2 2.1 2.2 2.3 2.4	Prompt operator to perform test : Dump and verify KAL is OK Dump instruction space Address 0x3800 = Start Length = 20 (14 Hex) Words Compare contents: 85D0, **, 8320, 0906, B122 4820, 400E, 4800, 4009, 8520, DD40, 4820, 2000, 4810, 2002, B700, 0D00, 0D02, 0D04, 85F0	 H4101 94201	 H500 = 0x3800 H510 = 0x14		
3	IF memory contents is O.K the goto section 5.2, step 1.3. If memory contents is incorrect goto section 5.2, step 1.1.		If KAL OK skip ICU load IF KAL bad re-load ICU		

** This word is 4964 (hex) for ICU software release 5, 496C (hex) for ICU software release 7, 4A04 (hex) for ICU software release 8.

5.2 DMA Test

Initial state
The OM (prime or redundant) is switched on and is in basic mode.

Final state
The OM (prime or redundant) is switched on and is in basic mode.

Step	Action	TC/TM	Remarks	Pass	Notes
0 0.1	Initial state: OM switched on and KAL power line is on Disable watchdog in preparation for RBI suspend	 H6510			
1	Ensure that telecommand checksumming is disabled		EGSE procedure		
2 2.1 2.2	Check command reception Send tc test command Check packet response	 H1 91201	 Incorrect checksum		
3 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.8	Upload patch software Send RBI suspend command Load patch 5.2-1 Dump and compare patch 5.2-1 Load patch 5.2-2 Dump and compare patch 5.2-2 Send RBI go command Dump & compare patch 5.2-1 Dump & compare patch 5.2-2	 D7200 D???? H4101 H4101	 S/C procedure[1] S/C procedure[2] S/C procedure[3] S/C procedure[4] Address = 3729 (hex) Length = 10 (dec) Address = 1E0C (hex) Length = 2		
4 4.1 4.2 4.3 4.4	Check command reception Send tc test command Check packet response Enable watchdog Check packet response	 H1 91100 H5510 91100	 Packet accepted Packet accepted		
5	Exit				

VALUE
E522
800D
0003
4A07
3000
7503
7200
0655
7070
1E0E
7070
3729

Table 5.2-1 Non-volatile Patch

VALUE
7070
3729

Table 5.2-2 Volatile Patch

Notes: S/C procedures

The values for the commands for the spacecraft procedures are as follows:

1. TC(6,1), APID 129, MID = 2, Address =0007 6E52 (hex)
2. TC(6,2), APID 129, MID = 2, Address = 0007 6E52 (hex), length = 10 (dec)
3. TC(6,1), APID 129, MID = 2, Address = 0007 3C18 (hex)
4. TC(6,2), APID 129, MID = 2, Address = 0007 3C18 (hex), length = 2

5.3 Time Synchronisation Test

Initial state
The OM (prime or redundant) is switched on and is in either basic mode or operational mode.

Final state
The OM (prime or redundant) is switched on and is in the same mode as in the initial state.

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and KAL power line is on				
1 1.1	Check Housekeeping Check that time synchronisation is disabled and time is invalid	 90000	 pref H5330 = 'disabled' pref H5335 = 'invalid'		
2 2.1	Enable time synchronisation Send synchronise user command		 S/C procedure		
3 3.1	Check Housekeeping Check that time synchronisation is enabled and the RBI configuration register shows sync enabled	 90000	 pref H5330 = 'enabled' pref H5345 = 0x0011		
4 4.1 4.2	Send BCP3 bcp3 Check that time synchronisation is enabled and the RBI configuration register shows sync disabled	 90000	 S/C procedure pref H5330 = 'enabled' pref H5345 = 0x0001		
5 5.1 5.2 5.3	Add time code Send time code Check time synchronisation is disabled, RBI configuration register shows sync disabled and time is valid Check coarse time of ICU and DPU heartbeat timestamp	 90000 92220	 S/C procedure pref H5330 = 'disabled' pref H5345 = 0x0001 pref H5335 = 'valid' pref H7680		
6	Exit				

5.4 Operational Mode Test

Description
The function of the OM is tested in the operational mode test.
Switch on secondary rail of OM-1 and test operation.
Test operation of DPU.

Initial state
The OM (prime or redundant) is switched on and in basic mode.

Final state
The OM (prime or redundant) is switched on and in operational mode.

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and in basic mode KAL power line is on				
1 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9	Switch to operational mode Load main operational code *(< load_icu)* Check HK packet counter has increased by 507. Start Operational mode Wait 20 s. Verify operational mode started Send test packet Check TM received (verify in operational mode) Send invalid type (15,3) Check TM received Send invalid sub-type Check TM received Send wrong checksum Check TM received	 91100 90000 H9001 90000 H1 91100 TC (15,3) TM91202 TC(5,15) TM91203 TM91201	 File : ‘load ICU’ Pref H5385 = ++1FC (hex) Pref H5390 = 1(hex) Pref H550 = 0,H650 = 0 Pref H5395 = ‘Safe’ H6015=15,H6020=3 H6015=5,H6020=15		
2 2.1 2.2	Verify OM-1 secondary rails on Measure OM +28V voltage and current Compare with table 5.3-3		 S/C procedure report: voltage and current		
3 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.8	Check Housekeeping +25V secondary rail current +15V secondary rail current +11V secondary rail current +5.3V secondary rail current -5.3V secondary rail current -15V secondary rail current RBI status Perform Time Synchronisation test	90000	 Compare values with table 5.4-1 for prime or table 5.4- 2 for redundant Pref H5340 = 1014 (hex)		
4	Test DPU (start-up sequence)				

4.1	Send DPU reset *(tc_reset_dsp)*	H7201			
4.2	Check TC received	91100	'Packet accepted'		
		92201	DA_DPU_BOOT_READY		
4.3	Examine HK heart beat count	90000	Pref H5410 (incrementing every 10 seconds)		
	Only for full functional test ….				
4.4	Load DPU code procedure *(< load_dpu 928 packets)*		Ref: DPU Load Script		
4.5	Send Load DPUOS	H7202			
4.6	Check TC Received	91100	'Packet received'		
		92202	'DPU OS ready'		

1 Step 4.4, 4.5 and 4.6 should only be followed when performing a full functional test.

RAIL	PREF	VALUE
+25V secondary	H5280	16mA < n < 23mA
+15V secondary	H5285	39 mA < n < 54mA
+11V secondary	H5290	87mA < n < 96mA
+5.3V secondary	H5295	393mA < n < 541mA
-5.3V secondary	H5300	368mA < n < 506mA
-15V secondary	H5305	43mA < n < 60mA

Table 5.4-1 Prime Secondary Currents

RAIL	PREF	VALUE
+25V secondary	H5280	15mA < n < 22mA
+15V secondary	H5285	36Ma < n < 50mA
+11V secondary	H5290	77mA < n < 107mA
+5.3V secondary	H5295	391mA < n < 539mA
-5.3V secondary	H5300	360mA < n < 495mA
-15V secondary	H5305	41mA < n < 58mA

Table 5.4-2 Redundant Secondary Currents

Power Rail	**Voltage**	**Current**
+28V line	+28V +/- 2V	1440(onoffoffoff) - 2350 (ononoffoff)
Keep Alive Line	+8V +/- 1V	8mA +/- 5mA

Table 5.4-3 OM power consumption (with OM-1 secondaries on)

5.5 Filter Wheel Control Test

WARNING
The Filter wheel is a limited life time device. Each rotation of the filter wheel must be recorded in the instrument log book for the flight model.

Description
The function of the OM filter wheel operation is tested in operational mode.
Command search for coarse sensor. Command search for datum position.

Initial state
The OM (prime or redundant) is switched on and in an operational mode.

Final state
The OM (prime or redundant) is switched on and in an operational mode with filter wheel in datum position.

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and in operational mode KAL power line is on				
1	Test of filter wheel coarse command				
1.1	Command F/W to datum				
	(tc_fw_to_datum)	H7608			
	(tc_fw_move)	H5600			
	Wait for event	92600	Pref H7010 = ‘fw @ req pos’		
1.2	Examine HK	90000	Pref H5150 = ‘seen’ Pref H5265 = 0		
1.3	Command F/W off coarse sensor				
	(tc_fw_rel_steps 1000)	H7606	Pref H290 = 1000 (dec)		
	(tc_fw_move)	H5600			
	Wait for event	92600	Pref H7010 = ‘fw @ req pos’		
1.4	Examine HK	90000	Pref H5250 = ‘not seen’ Pref H5150 = ‘seen’		
1.5	Command F/W to coarse sensor				
	(tc_fw_to_coarse)	H7609			
	(tc_fw_move)	H5600			
	Wait for event	92600	Pref H7010 = ‘fw @ req pos’		
1.6	Examine HK	90000	Pref H5250 = ‘seen’		
2	Test of filter wheel datum command				
2.1	Command F/W to datum				
	(tc_fw_to_datum)	H7608			
	(tc_fw_move)	H5600			
	Wait for event	92600	Pref H7010 = ‘fw @ req pos’		
2.2	Examine HK	90000	Pref H5150 = ‘seen’ Pref H5265 = 0		
3	Exit				

5.6 Dichroic Control Test (beam deflector)

Note
This test procedure should be reviewed by OM personnel before first execution.

The Dichroic is a limited life time device. Each movement of the dichroic wheel must be recorded in the instrument log book for the flight model instrument. A suggested movement log is given in the appendix.

Description
The function of the OM dichroic (beam deflector) is tested in engineering mode.
Command dichroic to rotate to redundant.
Command dichroic to rotate to prime.

Initial state
The OM (prime or redundant) is switched on and in an operational mode (safe, idle, science or engineering) .

Final state
The OM (prime or redundant) is switched on and in idle mode. The dichroic is at 'prime' interface position.

Step	Action	TC/TM	Remarks	Pass	Notes
0 0.1	Initial state: OM switched on and in an operational mode KAL power line is on OM-1 secondary rails are on Ensure mode is engineering 1) Go to idle mode 2) Go to engineering mode	 H9002 H9004	 H550=0,H650 = 0 H550=0,H650 = 0		
1 1.1 1.2 1.3 1.4	Test of dichroic command rotate to redundant Set-up dichroic to redundant *(tc_dm_direction 1,0)* Command dichroic to move *(tc_dm_move)* Examine TM Examine HK for steps in last movement	 H7650 H5650 92600 90000	 Pref H370 = 1 Pref H375 = 'max by sign' Pref H7010 = 'Dichroic pos' Pref H5275 = 32 (dec)		
2 2.1 2.2	Test of dichroic command rotate to prime Set-up dichroic to prime *(tc_dm_direction -1,0)* Command dichroic to move *(tc_dm_move)*	 H7650 H5650	 Pref H370 = -1 Pref H375 = 'max by sign'		

2.3 2.4 2.5	Wait up to 20 seconds Examine TM (test for event) Examine HK	 92600 90000	 Pref H7010 = ‘Dichroic pos’ Pref H5275 = -31 (dec)		
3	Ensure OM is in Idle Mode	H9002	H650 = 0		
4	Exit				

The Dichroic is a limited life time device. Each movement of the dichroic wheel must be recorded in the instrument log book for the flight model instrument.

5.7 Heater Control Test

Description
The function of the heaters is tested in an operational mode.
Each of the four main heaters are cycled on/off in turn.

Initial state
The OM (prime or redundant) is switched on and in an operational mode.

Final state
The OM (prime or redundant) is switched on and in an operational mode.

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and in operational mode KAL power line is on				
1	Prepare for heater switching				
1.1	Disable standard control algorithm *(tc_heater_stop)* Examine TM Examine HK	 H6670 91100 90000	 Pref H5240 = ‘offoffoffoff’		
1.2	Measure S/C +28V voltage and current		report: voltage and current		
1.3	Start heater contingency task	H5660			
2	Switch-on heater 1 (Main I/F) *(tc_heater_config 8)*	 H7660	 Pref H380 = ‘onoffoffoff’		
2.1	Examine HK	90000	Pref H5240 = ‘onoffoffoff’		
2.2	Measure S/C +28V voltage and current		S/C procedure report: voltage and current		
2.3	Compare with table 5.7-1				
2.4	Switch-off heater 1 *(tc_heater_config 0)*	 H7660	 Pref H380 = ‘offoffoffoff’		
2.5	Examine HK	90000	Pref H5240 = ‘offoffoffoff’		
3	Switch on heater 2 (forward tube)				
3.1	Switch-on heater 2 *(tc_heater_config 4)*	 H7660	 Pref H380 = ‘offonoffoff’		
3.2	Examine HK	90000	Pref H5240 = ‘offonoffoff’		
3.3	Measure S/C +28V voltage and current		S/C procedure report: voltage and current		
3.4	Compare with table 5.7-1				
3.5	Switch-off heater 2 *(tc_heater_config 0)*	 H7660	 Pref H380 = ‘offoffoffoff’		
3.6	Examine HK	90000	Pref H5240 = ‘offoffoffoff’		
4.	Switch on heater 3 (metering rods)				
4.1	Switch-on heater 3 *(tc_heater_config 2)*	 H7660	 Pref H380 = ‘offoffonoff’		
4.2	Examine HK	90000	Pref H5240 = ‘offoffonoff’		
4.3	Measure S/C +28V voltage and current		S/C procedure report: voltage and current		
4.4	Compare with table 5.7-1				
4.5	Switch-off heater 3				

 4.6	*(tc_heater_config 0)* Examine HK	H7660 90000	Pref H380 = 'offoffoffoff' Pref H5240 = 'offoffoffoff'		
5 5.1 5.2 5.3 5.4 5.5 5.6	Switch on heater 4 (secondary mirror) Switch-on heater 4 *(tc_heater_config 1)* Examine HK Measure S/C +28V voltage and current Compare with table 5.7-1 Switch-off heater 4 *(tc_heater_config 0)* Examine HK	 H7660 90000 H7660 90000	 Pref H380 = 'offoffoffon' Pref H5240 = 'offoffoffon' S/C procedure report: voltage and current Pref H380 = 'offoffoffoff' Pref H5240 = 'offoffoffoff'		
6 6.1	Disable heater switching Stop heater contingency task Enable standard control algorithm *(tc_heater_start)*	 H6660 H5670			
7	Exit				

Heater	+28V Current
1 (Main Interface)	1440mA +/- 100mA
2 (Forward tube)	1740mA +/- 100mA
3 (Metering Rods)	1060mA +/- 100mA
4 (Secondary Mirror)	950mA +/- 100mA
Disable Heater Algorithm	810mA +/- 100mA

Table 5.7-1 Heater switching power profile

5.8 Image Acquisition Test - Multiple Window

WARNING

Operation of the high voltage unit must only be performed when OM personnel are present and only in a controlled environment - irreparable damage of the detector can occur.

The Filter wheel is a limited life time device. All movements of the filter wheel (such as occur in this test) must be recorded in the instrument log book for the flight model.

Under no circumstances should the instrument main power be switched off without first switching off the HVU using the script.

Description

The function of the OM Image acquisition is tested in operational mode.
A full image will be acquired and dumped to the instrument workstation. Only those areas enabled in the window table should contain events.

Initial state

The OM (prime or redundant) is switched on and in an operational mode.
OM-1 secondary rails are switched on.

Final state

The OM (prime or redundant) is switched on and in idle mode.

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and in engineering mode KAL power line is on OM-1 secondary rails are on				
1	Complete DPU reset				
1.1	Send DPU reset	H7201			
1.2	Check TM received	91100 92201	Packet accepted DA_DPU_BOOT_READY		
1.3	Enable DPUOS code	H7202			
1.4	Check TM received	91100 92202	Packet accepted DPU OS Ready		
1.5	Enable blue 1 dsp	H7207	Pref H522 = ‘Blue1’ Pref H16 = ‘Enabled’		
1.6	Enable blue 2 dsp	H7207	Pref H522 = ‘Blue2’ Pref H16 = ‘Enabled’		
1.7	Enable red dsp	H7207	Pref H522 = ‘Red’ Pref H16 = ‘Enabled’		
1.8	Init DPU	H7248			
1.9	Check for event	92210	DA_EOT_INIT_DPU		

2 2.1 2.2	Prepare DPU for image acquisition Ensure OM is in idle mode (tc_mode 2) Set exposure number	 H9002 H7238	 Pref H650=0 Pref H530 = 1		
3 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.8	Prepare BPE for image acquisition Set acquisition mode (High Res, Windowed) Examine HK Set event threshold Specify centroid channel boundaries Load channel boundaries Wait for event (2.5 minutes) Specify window params Load window look-up table wait for event (1 minute) Ensure Frame Tags disabled	 H7130 90000 H7131 H7100 H5100 92100 H7110 H5110 92100 H7135	 Pref H110 = ‘Hi Res Win’ Pref H5215 = ‘Hi Res Win’ Pref H120 = 2 Table 5.8-1 H7000 = ‘cen tab load’ Table 5.8-2 H7000 = ‘win tab load’ H16 = ‘Disabled’		
4 4.1 4.2 4.3 4.4 4.5 4.6	Place Filter Wheel in Blocked Position. Ensure coarse and fine sensors have correct values (tc_fw_coarse_sensor_current 4 tc_fw_fine_sensor_current 9) Specify filter wheel to datum Move it there. Await Event Specify move to blocked (Filt. = 0) Move it there Await Event	 H7600 H7601 H7608 H5600 92600 H7604 H5600 92600	 H300 = 4 (56 mA) H310 = 9 (25 mA) H7010 = ‘fw @ req pos’ H280 = ‘Blocked’ H7010 = ‘fw @ req pos’		
5 5.1 5.2 5.3 5.4 5.5 5.6 5.7	Acquire image. Ensure we are in engineering mode (tc_mode 4). Turn on Flood LED (level =3). Set DPU frame time to 5 mins. (ic_set_frame_time) Start sending events to DPU. Start full image eng integration (tc_enbl_eng 1,4). Wait 5 minutes to acquire data Await Event (DA_ENDOF_EXP). Stop sending events to DPU (failsafe command). Disable Flood LED (level=0)	 H9004 H7134 H7236 H5130 H7254 92205 H6130 H7134	 H550=0,H650 = 0 H1040 = 3 (4 uA) H710 = 300000 H880 = ‘Full hi res’ H1040 = 0 (0 mA)		
6	Await Dumping of Engineering Image (2.5 hours) Await Event DA_SENT_CMPRSSQ for operator intervention to exit or continue Await Event DA_COMPLETE_EXP	 92217 92209			
7	Exit				

Description	Pref	Value
Enable/Disable Verification	H10	'Enable'
X Centroid Table Boundary 0	H20	-1000
X Centroid Table Boundary 1	H21	-750
X Centroid Table Boundary 2	H22	-500
X Centroid Table Boundary 3	H23	-250
X Centroid Table Boundary 4	H24	0
X Centroid Table Boundary 5	H25	250
X Centroid Table Boundary 6	H26	500
X Centroid Table Boundary 7	H27	750
X Centroid Table Boundary 8	H28	1000
Y Centroid Table Boundary 0	H30	-1000
Y Centroid Table Boundary 1	H31	-750
Y Centroid Table Boundary 2	H32	-500
Y Centroid Table Boundary 3	H33	-250
Y Centroid Table Boundary 4	H34	0
Y Centroid Table Boundary 5	H35	250
Y Centroid Table Boundary 6	H36	500
Y Centroid Table Boundary 7	H37	750
Y Centroid Table Boundary 8	H38	1000

Table 5.8-1 Centroid Table Boundaries

Description		Pref	Value
Enable/Disable Verification = 1/0		H10	'Enable'
No of Windows		H40	2
X_{low}	**Parameters for**	H50	64
Y_{low}	**Window 1**	H51	15
X_{size}	**(Units are CCD pixels)**	H52	64
Y_{size}		H53	64
X_{low}	**Parameters for**	H54	216
Y_{low}	**Window 2**	H55	77
X_{size}	**(Units are CCD pixels)**	H56	64
Y_{size}		H57	64
	All remaining parameters	H58-H109	0

Table 5.8-2 Window Parameters

5.9 Image Acquisition Test - Full Frame

WARNING
Operation of the high voltage unit must only be performed when OM personnel are present and only in a controlled environment - irreparable damage of the detector can occur.

The Filter wheel is a limited life time device. All movements of the filter wheel (such as occur in this test) must be recorded in the instrument log book for the flight model.

Description
The function of the OM Image acquisition is tested in engineering mode.
A full frame image will be acquired and dumped to the instrument work station. The filter wheel is commanded to the blocked position and the flood LED's will be used to generate events.

This script should be used in addition to tables 5.9-2 and 5.9-3 to commission the high voltage unit. Four iterations of instrument HVU being switched on and an image acquired will be needed. For each iteration, the relevant HVU operational voltages should be used (these voltages are the target voltages, the HVU must be switched on following the normal algorithm to permit these voltages to be reached). An MSSL representative will be responsible for commencing with each iteration after first having examined the data for safe background event levels.

Initial state
The OM (prime or redundant) is switched on and in an operational mode (safe, idle, science or engineering).
OM-1 secondary rails are switched on.

Final state
The OM (prime or redundant) is switched on and in engineering mode.

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and in an operational mode KAL power line is on OM-1 secondary rails are on				

1	Complete DPU reset				
1.0	Send DPU reset	H7201			
1.1	Check TM received	91100 92201	Packet accepted DA_DPU_BOOT_READY		
1.2	Enable DPUOS code	H7202			
1.3	Check TM received	91100 92202	Packet accepted DPU OS Ready		
1.4	Enable blue 1 dsp	H7207	Pref H522 = 'Blue1' Pref H16 = 'Enabled'		
1.5	Enable blue 2 dsp	H7207	Pref H522 = 'Blue2' Pref H16 = 'Enabled'		
1.6	Enable red dsp	H7207	Pref H522 = 'Red' Pref H16 = 'Enabled'		
1.7	Init DPU Check for event	H7248 92210	DA_EOT_INIT_DPU		
2	Prepare DPU for image acquisition				
2.1	Ensure OM is in idle mode (tc_mode 2)	H9002	Pref H650=0		
2.2	Set exposure number	H7238	Pref H530 = 2		
3	Prepare BPE for image acquisition				
3.1	Set acquisition mode (High Res, Full Frame)	H7130	Pref H110 = 'Hi Res Full'		
3.2	Examine HK	90000	Pref H5215 = 'Hi Res Full'		
3.3	Set event threshold	H7131	Pref H120 = 15 (2 if no HV)		
3.4	Specify centroid channel boundaries	H7100	Table 5.8-1		
3.5	Load channel boundaries Wait for event (2.5 minutes)	H5100 92100	H7000 = 'cen tab load'		
3.6	Specify window params Load window look-up table	H7110	Table 5.9-1		
3.7	Wait for event (1 minute)	H5110	H7000 = 'win tab load'		
3.8	Ensure Frame Tags disabled	H7135	H16 = 'disabled'		
4	Place Filter Wheel in Blocked Position. Ensure coarse and fine sensors have correct values				
4.1	(tc_fw_coarse_sensor_current 4	H7600	H300 = 4 (56 mA)		
4.2	tc_fw_fine_sensor_current 9)	H7601	H310 = 9 (25mA)		
4.3	Specify filter wheel to datum	H7608			
4.4	Move it there. Await Event	H5600 92600	H7010 = 'fw @ req pos'		
4.5	Specify move to blocked (Filt. = 0)	H7604	H280 = 'Blocked'		
4.6	Move it there Await Event	H5600 92600	H7010 = 'fw @ req pos'		

5	If using Redundant Chain, go to next section. Set up High Voltages (Prime) **(Warning, these are hazardous commands)** Operator input for iteration number				
5.1	Specify Vmcp23 Ramp.	H7140	H150='mcp23', H160=table 5.9-2, H175='off'		
5.2	Perform Ramp	H5140			
	Await Event.	92100	H7000 = 'mcp23 ok'		
5.3	If Vmcp23 is to be raised higher than 100 volts then perform second Vmcp23 ramp	H7140	H150='mcp23', H160=table 5.9-2, H175='off'		
	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'mcp23 ok'		
5.4	Specify Vmcp1 Ramp.	H7140	H150='mcp1',H160= table 5.9-2, H175='off'		
5.5	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'mcp1 ok'		
5.6	Specify Vcathode Ramp.	H7140	H150='cathode',H160= table 5.9-2, H175='off'		
5.7	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'cathode ok'		
6	If using Prime chain, go to next section Set up High Voltages (Redundant) **(Warning, these are hazardous commands)** Operator input for iteration number				
6.1	Specify Vmcp23 Ramp.	H7140	H150='mcp23',H160=table 5.9-3, H175='off'		
6.2	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'mcp23 ok'		
	If Vmcp23 is to be raised higher than 100 volts then perform second Vmcp23 ramp	H7140	H150='mcp23',H160=table 5.9-3, H175='off'		
6.3	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'mcp23 ok'		
6.4	Specify Vmcp1 Ramp.	H7140	H150='mcp1',H160= table 5.9-3, H175='off'		
6.5	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'mcp1 ok'		
6.6	Specify Vcathode Ramp.	H7140	H150='cathode',H160= table 5.9-3, H175='off'		
6.7	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'cathode ok'		

7	Acquire image.				
7.1	Ensure we are in engineering mode (tc_mode 4).	H9004	H550=0,H650 = 0		
7.2	Turn on Flood LED (level =3).	H7134	H1040 = 3 (4 uA)		
	Set DPU frame time to 5 mins.				
7.3	(ic_set_frame_time)	H7236	H720 = 300000		
7.4	Start sending events to DPU.	H5130			
7.5	Start full image eng integration (tc_enbl_eng 1,4).	H7254	H880 = 'Full hi res'		
	Wait 5 minutes to acquire data				
	Await Event (DA_ENDOF_EXP).	92205			
	Stop sending events to DPU (failsafe command).	H6130			
7.6	Disable Flood LED (level=0)	H7134	H1040 = 0 uA		
8	Ramp down HV **(Warning, these commands are hazardous)**				
8.1	Specify Vcathode Ramp.	H7140	H150='cathode',H160=0, H175='off'		
8.2	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'cathode ok'		
8.3	Specify Vmcp1 Ramp.	H7140	H150='mcp1',H160=0, H175='off'		
8.4	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'mcp1 ok'		
8.5	Specify Vmcp23 Ramp.	H7140	H150='mcp23', H160=0, H175='off'		
8.6	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'mcp23 ok'		
9	Await Dumping of Engineering Image (2.5 hours)				
	Await Event DA_SENT_CMPRSSQ for operator intervention to exit or continue	92217			
	Await Event DA_COMPLETE_EXP	92209			
10	Exit				

Description		Pref	Value	
			Prime	Redundant
Enable/Disable Verification = 1/0		H10	'Enable'	'Enable'
No of Windows		H40	1	1
X_{low}	**Parameters for Window 1 (Units are CCD pixels)**	H50	52	64
Y_{low}		H51	27	15
X_{size}		H52	256	256
Y_{size}		H53	256	256
	All remaining parameters	H54-H109	0	0

Table 5.9-1 Window Parameters

Iteration	Vmcp23	Vmcp1	Vcathode	Comment
1	**100**	**10**	**10**	**I/F Verification**
2	**100 then 1400**	**500**	**2**	**Cathode open**
3	**100 then 1400**	**500**	**396**	**Low Gain**
4	**100 then 1700**	**500**	**396**	**Normal Gain**

Table 5.9-2 HVU Table (PRIME)

Iteration	Vmcp23	Vmcp1	Vcathode	Comment
1	**100**	**10**	**10**	**I/F Verification**
2	**100 then 1500**	**500**	**2**	**Cathode open**
3	**100 then 1400**	**500**	**390**	**Low Gain**
4	**100 then 1800**	**550**	**390**	**Normal Gain**

Table 5.9-3 HVU Table (Redundant)

5.10 Image Acquisition Test - Thermal Vacuum - Full Frame

WARNING
Operation of the high voltage unit must only be performed when OM personnel are present and only in a controlled environment - irreparable damage of the detector can occur.

The Filter wheel is a limited life time device. All movements of the filter wheel (such as occur in this test) must be recorded in the instrument log book for the flight model.

Under no circumstances should the instrument main power be switched off without first switching off the HVU using the script.

Description
This version of section 5.8 is intended to be used to support the thermal vacuum testing of the XMM spacecraft.
A full frame image will be acquired and dumped to the instrument work station. The filter wheel is commanded to the blocked position and the flood LED's will be used to generate events. Operator intervention is required to dump a 5 minute exposure to the instrument workstation. Failing this, the instrument will continue to acquire 5 minute exposures indefinitely. The high voltage unit will remain on until user intervention is used to break out of the loop.

Initial state
The OM (prime or redundant) is switched on and in an operational mode (safe, idle, science or engineering).
OM-1 secondary rails are switched on.

Final state
The OM (prime or redundant) is switched on and in engineering mode.

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and in an operational mode KAL power line is on OM-1 secondary rails are on				

1	Complete DPU reset				
1.0	Send DPU reset	H7201			
1.1	Check TM received	91100 92201	Packet accepted DA_DPU_BOOT_READY		
1.2	Enable DPUOS code	H7202			
1.3	Check TM received	91100 92202	Packet accepted DPU OS Ready		
1.4	Enable blue 1 dsp	H7207	Pref H522 = ‘Blue1’ Pref H16 = ‘Enabled’		
1.5	Enable blue 2 dsp	H7207	Pref H522 = ‘Blue2’ Pref H16 = ‘Enabled’		
1.6	Enable red dsp	H7207	Pref H522 = ‘Red’ Pref H16 = ‘Enabled’		
1.7	Init DPU Check for event	H7248 92210	 DA_EOT_INIT_DPU		
2	Prepare DPU for image acquisition				
2.1	Ensure OM is in idle mode (tc_mode 2)	H9002	Pref H550=0,H650=0		
2.2	Set exposure number	H7238	Pref H530 = 2		
3	Prepare BPE for image acquisition				
3.1	Set acquisition mode (High Res, Full Frame)	H7130	Pref H110 = ‘Hi Res Full’		
3.2	Examine HK	90000	Pref H5215 = ‘Hi Res Full’		
3.3	Set event threshold	H7131	Pref H120 = 15 (2 if no HV)		
3.4	Specify centroid channel boundaries	H7100	Table 5.8-1		
3.5	Load channel boundaries Wait for event (2.5 minutes)	H5100 92100	 H7000 = ‘cen tab load’		
3.6	Specify window params Load window look-up table	 H7110	 Table 5.10-1		
3.7	wait for event (1 minute)	H5110	H7000 = ‘win tab load’		
3.8	Ensure Frame Tags disabled	H7135	H16 = ‘disabled’		
4	Place Filter Wheel in Blocked Position. Ensure coarse and fine sensors have correct values				
4.1	(tc_fw_coarse_sensor_current 4	H7600	H300 = 4 (56 mA)		
4.2	tc_fw_fine_sensor_current 9)	H7601	H310 = 9 (25mA)		
4.3	Specify filter wheel to datum	H7608			
4.4	Move it there. Await Event	H5600 92600	 H7010 = ‘fw @ req pos’		
4.5	Specify move to blocked (Filt. = 0)	H7604	H280 = ‘Blocked’		
4.6	Move it there Await Event	H5600 92600	 H7010 = ‘fw @ req pos’		

5	If using Redundant Chain, go to next section. Set up High Voltages (Prime) **(Warning, these are hazardous commands)**				
5.1	Specify Vmcp23 Ramp.	H7140	H150='mcp23',H160=100, H175='off'		
5.2	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp23 ok'		
5.3	Specify Vmcp23 Ramp.	H7140	H150='mcp23',H160=1400, H175='off'		
5.4	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp23 ok'		
5.5	Specify Vmcp1 Ramp.	H7140	H150='mcp1',H160=550, H175='off'		
5.6	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp1 ok'		
5.7	Specify Vcathode Ramp	H7140	H150='cathode',H160=396, H175='off'		
5.8	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'cathode pk'		
5.9	Specify Vmcp1 Ramp.	H7140	H150='mcp1',H160=520, H175='off'		
5.10	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp1 ok'		
5.11	Specify Vmcp23 Ramp.	H7140	H150='mcp23',H160=1700, H175='off'		
 5.12	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp23 ok'		

6	If using Prime chain, go to next section Set up High Voltages (Redundant) **(Warning, these are hazardous commands)**				
6.1	Specify Vmcp23 Ramp.	H7140	H150='mcp23',H160=100, H175='off'		
6.2	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp23 ok'		
6.3	Specify Vmcp23 Ramp.	H7140	H150='mcp23',H160=1500, H175='off'		
6.4	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp23 ok'		
6.5	Specify Vmcp1 Ramp.	H7140	H150='mcp1',H160=500, H175='off'		
6.6	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp1 ok'		
6.7	Specify Vcathode Ramp .	H7140	H150='cathode',H160=390, H175='off'		
6.8	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'cathode ok'		
6.9	Specify Vmcp1 Ramp.	H7140	H150='mcp1',H160=550, H175='off'		
6.10	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp1 ok'		
6.11	Specify Vmcp23 Ramp.	H7140	H150='mcp23',H160=1850, H175='off'		
6.12	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp23 ok'		

7 7.1 7.2 7.3 7.4 7.5 7.6	Acquire image. Ensure we are in engineering mode (tc_mode 4). Turn on Flood LED (level =3). Set DPU frame time to 5 mins. (ic_set_frame_time) Start sending events to DPU. Start full image eng integration (tc_enbl_eng 1,4). Wait 5 minutes to acquire data Await Event (DA_ENDOF_EXP). Stop sending events to DPU (failsafe command). Disable Flood LED (level=0)	 H9004 H7134 H7236 H5130 H7254 92205 H6130 H7134	 H550=0,H650 = 0 H1040 = 3 (4 uA) H720 = 300000 H880 = 'Full hi res' H1040 = 0 uA		
	Unless operator intervention go back to step 1 and repeat, skipping points 5 and 6. Await Event DA_SENT_CMPRSSQ	 92217			
8 8.1 8.2 8.3 8.4 8.5 8.6	Ramp down HV **(Warning, these commands are hazardous)** Specify Vcathode Ramp. Perform Ramp. Await Event. Specify Vmcp1 Ramp. Perform Ramp. Await Event. Specify Vmcp23 Ramp. Perform Ramp. Await Event.	 H7140 H5140 92100 H7140 H5140 92100 H7140 H5140 92100	 H150='cathode',H160=0, H175='off' H7000 = 'cathode ok' H150='mcp1',H160=0, H175='off' H7000 = 'mcp1 ok' H150='mcp23', H160=0, H175='off' H7000 = 'mcp23 ok'		
9	Await Dumping of Engineering Image (2.5 hours) Await Event DA_COMPLETE_EXP	 92209			
10	Exit				

Description		Pref	Value	
			Prime	Redundant
Enable/Disable Verification = 1/0		H10	'Enable'	'Enable'
No of Windows		H40	1	1
X_{low}	**Parameters for Window 1 (Units are CCD pixels)**	H50	52	64
Y_{low}		H51	27	15
X_{size}		H52	256	256
Y_{size}		H53	256	256
	All remaining parameters	H54-H109	0	0

Table 5.10-1 Window Parameters

5.11 Image Acquisition Test - EMC Full Frame

Note
This test is not part of the normal functional test procedure, but is intended for use during the EMC tests.

WARNING
The Filter wheel is a limited life time device. All movements of the filter wheel (such as occur in this test) must be recorded in the instrument log book for the flight model.

Description
This script has been designed for sole use during EMC testing of the instrument.
The High voltage will not be used during this test. Data will be obtained by artificially lowering the detector threshold to 6. System noise will provide the data.

Initial state
The OM (prime or redundant) is switched on and in an operational mode (safe, idle, science or engineering).
OM-1 secondary rails are switched on.
It is assumed for the purposes of this test that the DPU has had its operating system code already loaded (this should be the case if the KAL has been left on)

Final state
The OM (prime or redundant) is switched on and in engineering mode.

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and in an operational mode KAL power line is on OM-1 secondary rails are on				
1	Complete DPU reset				
1.0	Send DPU reset	H7201			
1.1	Check TM received	91100 92201	Packet accepted DA_DPU_BOOT_READY		
1.2	Enable DPUOS code	H7202			
1.3	Check TM received	91100 92202	Packet accepted DPU OS Ready		
1.4	Enable blue 1 dsp	H7207	Pref H522 = ‘Blue1’ Pref H16 = ‘Enabled’		
1.5	Enable blue 2 dsp	H7207	Pref H522 = ‘Blue2’ Pref H16 = ‘Enabled’		
1.6	Enable red dsp	H7207	Pref H522 = ‘Red’ Pref H16 = ‘Enabled’		
1.7	Init DPU Check for event	H7248 92210	 DA_EOT_INIT_DPU		

2 2.1 2.2	Prepare DPU for image acquisition Ensure OM is in idle mode (tc_mode 2) Set exposure number	 H9002 H7238	 Pref H650=0 Pref H530 = 2		
3 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.8	Prepare BPE for image acquisition Set acquisition mode (High Res, Full Frame) Examine HK Set event threshold Specify centroid channel boundaries Load channel boundaries Wait for event (2.5 minutes) Specify window params Load window look-up table wait for event (1 minute) Ensure Frame Tags disabled	 H7130 90000 H7131 H7100 H5100 92100 H7110 H5110 H7135	 Pref H110 = 'Hi Res Full' Pref H5215 = 'Hi Res Full' Pref H120 = 2 Table 5.8-1 H7000 = 'cen tab load' Table 5.11-1 H7000 = 'win tab load' H16 = 'disabled'		
4 4.1 4.2 4.3 4.4 4.5 4.6	Place Filter Wheel in Blocked Position. Ensure coarse and fine sensors have correct values (tc_fw_coarse_sensor_current 4 tc_fw_fine_sensor_current 9) Specify filter wheel to datum Move it there. Await Event Specify move to blocked (Filt. = 0) Move it there Await Event	 H7600 H7601 H7608 H5600 92600 H7604 H5600 92600	 H300 = 4 (56 mA) H310 = 9 (25mA) H7010 = 'fw @ req pos' H280 = 'Blocked' H7010 = 'fw @ req pos'		
5 5.1 5.3 5.4 5.5 5.6	Acquire image. Ensure we are in engineering mode (tc_mode 4). Set DPU frame time to 5 mins. (ic_set_frame_time) Start sending events to DPU. Start full image eng integration (tc_enbl_eng 1,4). Wait 5 minutes to acquire data Await Event (DA_ENDOF_EXP). Stop sending events to DPU (failsafe command).	 H9004 H7236 H5130 H7254 92205 H6130	 H550=0,H650 = 0 H720 = 300000 H880 = 'Full hi res'		
6	Unless operator intervention go back to step 1 and repeat. Await Event DA_SENT_CMPRSSQ	 92217			
7	Await Dumping of Engineering Image (2.5 hours) Await Event DA_COMPLETE_EXP	 92209			
8	Exit				

Description		Pref	Value	
			Prime	Redundant
Enable/Disable Verification = 1/0		H10	'Enable'	'Enable'
No of Windows		H40	1	1
X_{low}	**Parameters for Window 1 (Units are CCD pixels)**	H50	52	64
Y_{low}		H51	27	15
X_{size}		H52	256	256
Y_{size}		H53	256	256
	All remaining parameters	H54-H109	0	0

Table 5.11-1 Window Parameters

5.12 Switch-off

Description
Mode and state are checked and the appropriate procedure is followed to switch-off in an orderly way.

Initial state
The OM (prime or redundant) is switched on.

Final state
The OM (prime or redundant) is switched off. The KAL power lines may be left on.

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on KAL power line is on				
1	Check ICU state if mode = Operational = Basic		H5405 goto step 2 goto step 3		
2.0 2.1 2.2 2.3 2.4 2.5 2.6	If HV enabled: Ramp down HV **(Warning, these commands are hazardous)** Specify Vcathode Ramp. Perform Ramp. Await Event. Specify Vmcp1 Ramp. Perform Ramp. Await Event. Specify Vmcp23 Ramp. Perform Ramp. Await Event. Examine HK	90000 H7140 H5140 92100 H7140 H5140 92100 H7140 H5140 92100 90000	H5145 = 1 = 'Enabled' H150='cathode',H160=0, H175='off' H7000 = 'cathode ok' H150='mcp1',H160=0, H175='off' H7000 = 'mcp1 ok' H150='mcp23',H160=0, H175='off' H7000 = 'mcp23 ok' H5145='Disabled'		
3.1 3.2	Switch off OM-1 secondary rails Disable heater algorithm	H6690 H6670			
4	Send RBI suspend command	D7200			
5	Switch-off +28V power		S/C procedure report: voltage and current		
6	Switch-off KAL		S/C procedure report: voltage and current		
7	Exit				

Appendix

Parameter reference Table

Pref ID	HK Monitor
H5150	Fine Pick-Off Sensor
H5215	Acquisition Mode
H5240	Commanded Heater Status
H5250	Coarse Sensor Status
H5265	Filter Wheel Position Counter
H5275	S/w Dichroic Position Counter
H5280	Switched +25V Current
H5285	Switched +15V Current
H5290	Switched +11V Current
H5295	Switched +5.3V Current
H5300	Switched -5.3V Current
H5305	Switched -15V Current
H5320	ICB Status
H5330	Time Synchronisation Active
H5335	Time Invalid Flag
H5340	RBI Status
H5345	RBI Config
H5385	Good TC
H5390	Bad TC
H5395	OM State
H5405	ICU State
H5410	Heartbeat Count
H7680	Timestamp

Table A1 Pref look-up Table

Dichroic Rotation Log

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