XMM Optical Monitor

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XMM-OM (FM) INTEGRATED FUNCTIONAL TEST PROCEDURE

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1.0 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.

2.0 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)

3.0 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, 3,3, 4,2 and 4,3 should invalidate the test.

4.0 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 20 minutes	AFT	Switch-on Boot mode test Switch-off	5.0 (ehmod_pwr_on) 5.1 (ehmod_boot_test) 5.8 (ehmod_pwr_off)
Short Functional Test Estimated test time 30 minutes		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		Switch-on Boot mode test Switch to operational Filter wheel test Dichroic test** Heater test Image Test (multiple window) Image test (full frame) Switch-off	5.0 5.1 5.2 5.3 5.4 (ehist_dic_test) 5.5 5.6 (ehist_img_multi) 5.7 (ehist_img_full) 5.8

** 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.

5.0 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 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	1850mA +/- 20mA
Keep Alive Line	+8V +/- 1V	<18mA

Table 01: 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 in basic mode.

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 is switched on and in basic mode KAL power line is on				
1 1.1 1.2 1.3 1.4	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	 TC(0,0) 91202 90000 H1 91100 90000	 TM (3,2) Pref H5390 = 1 TM (3,1) Pref H5385 = 1		
2 2.1 2.2 2.3 2.4	Dump and verify KAL is OK Dump instruction space Address 0X3800 = Start Length = 16 (10 Hex) Words Compare contents: 85D0, 4964, 8320, 0906, B122 4820, 400E, 4800, 4009, 8520, FD40, 4820, 2000, 4810, 2002, B700, 0D00, 0D02, 0D04, 85F0	 H4101 94201			
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 O.K skip ICU load IF KAL bad re-load ICU		
3	Run supplementary test and exit				

Supplementary Low Level Test (for Basic and Operational)

Step	Action	TC/TM	Remarks	Pass	Notes
1.1	Send invalid type (15,3)	TC(15,3)			
1.2	Send invalid sub-type (5,15)	TC(5,15)			
1.3	Send wrong checksum				
2.1	Watchdog off	H6510	H5345='Off'		
2.2	RBI suspend		D6203		
2.3	Use RBI write to write a few words of data to 0xfc0		D3920		
2.4	Read back memory and compare		D3921		
2.5	RBI go		D7204		
2.6	Watchdog on	H5510	H5345='On'		

5.2 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	Switch to operational mode Load main operational code *(< load_icu)* Check HK packet counter has increased by 508 (prime)507 (redundant). Start Operational mode Wait 2 s. Verify operational mode started Send test packet Check TM received (verify in operational mode)	 91100 90000 H9001 90000 H1 91100	 File : 'load ICU' [3] Pref H5385 = ++1FC (hex) Pref H5390 = 1(hex) Pref H550 = 0,H650 = 0 Pref H5395 = 'Safe'		
2 2.1 2.2	Verify OM-1 secondary rails on Measure OM +28V voltage and current Compare with table 2		 S/C procedure report: voltage and current		
4 4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10	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 Heater status RBI status	90000	 Pref H5280 = 20 mA^2 Pref H5285 = 45 mA^2 Pref H5290 = 100 mA^2 Pref H5295 = 480 mA^2 Pref H5300= 440 mA^2 Pref H5305= 55 mA^2 Pref H5240 = 'onoffoffoff' or = 'ononoffoff' Pref H5340 = 1014 (hex)		
5	Test DPU (start-up sequence)				

5.1	Send DPU reset *(tc_reset_dsp)*	H7201			
5.2	Check TC received	91100 92201	'Packet accepted' DA_DPU_BOOT_READY		
5.3	Examine HK heart beat count	90000	Pref H5410 (incrementing every 10 seconds)		
	Only for full functional test ….				
5.4	Load DPU code procedure *(< load_dpu)*		Ref: DPU Load Script		
5.5	Send Load DPUOS	H7202			
5.6	Check TC Received	91100 92202	'Packet received' 'DPU OS ready'		
6	Run supplementary test and exit				

1 Step 5.4 and 5.5 should only be followed when performing a full functional test.
2 All currents should be within the nominal range +/- 10 mA
3 There will be no telemetry command echo following this command.

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

Table 01: OM power consumption (with OM-1 secondaries on)

5.3 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 off coarse sensor *(tc_fw_rel_steps 1000)* *(tc_fw_move)*	 H7606 H5600	 Pref H290 = 1000 (dec)		
1.2	Examine HK	92600 90000	Pref H7010 = ‘fw @ req pos’ Pref H5250 = ‘not seen’		
1.3	Command F/W to coarse sensor *(tc_fw_to_coarse)* *(tc_fw_move)*	 H7609 H5600	Pref H5150 = ‘not seen’		
1.4	Examine HK	92600 90000	Pref H7010 = ‘fw @ req pos’ Pref H5250 = ‘seen’		
2	Test of filter wheel datum command				
2.1	Command F/W to datum *(tc_fw_to_datum)* *(tc_fw_move)*	 H7608 H5600			
2.2	Examine HK	92600 90000	Pref H7010 = ‘fw @ req pos’ Pref H5150 = ‘seen’ Pref H5265 = 0		
3	Exit				

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

2.2	Command dichroic to move *(tc_dm_move)*	H5650			
2.3	Wait up to 20 seconds				
2.4	Examine TM (test for event)	92600	Pref H7010 = 'Dichroic pos'		
2.5	Examine HK	90000	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.

5.5 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 rdundant) 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 1.1	Prepare for heater switching Disable standard control algorithm *(tc_heater_stop)* Examine TM Examine HK	 H6670 91100 90000	 Pref H5240 = ‘offoffoffoff’		
2 2.1 2.2 2.3 2.4 2.5	Switch-on heater 1 (Main I/F) *(tc_heater_config 8)* Examine HK Measure S/C +28V voltage and current Compare with table 5 Switch-off heater 1 *(tc_heater_config 0)* Examine HK	 H7660 90000 H7660 90000	 Pref H380 = ‘onoffoffoff’ Pref H5240 = ‘onoffoffoff’ S/C procedure report: voltage and current Pref H380 = ‘offoffoffoff’ Pref H5240 = ‘offoffoffoff’		
3 3.1 3.2 3.3 3.4 3.5 3.6	Switch on heater 2 (forward tube) Switch-on heater 2 *(tc_heater_config 4)* Examine HK Measure S/C +28V voltage and current Compare with table 5 Switch-off heater 2 *(tc_heater_config 0)* Examine HK	 H7660 90000 H7660 90000	 Pref H380 = ‘offonoffoff’ Pref H5240 = ‘offonoffoff’ S/C procedure report: voltage and current Pref H380 = ‘offoffoffoff’ Pref H5240 = ‘offoffoffoff’		
4. 4.1 4.2 4.3 4.4 4.5	Switch on heater 3 (metering rods) Switch-on heater 3 *(tc_heater_config 2)* Examine HK Measure S/C +28V voltage and current Compare with table 5 Switch-off heater 3	 H7660 90000 	 Pref H380 = ‘offoffonoff’ Pref H5240 = ‘offoffonoff’ S/C procedure report: voltage and current 		

	(tc_heater_config 0)	H7660	Pref H380 = 'offoffoffoff'		
4.6	Examine HK	90000	Pref H5240 = 'offoffoffoff'		
5	Switch on heater 4 (secondary mirror)				
5.1	Switch-on heater 4				
	(tc_heater_config 1)	H7660	Pref H380 = 'offoffoffon'		
5.2	Examine HK	90000	Pref H5240 = 'offoffoffon'		
5.3	Measure S/C +28V voltage and current		S/C procedure report: voltage and current		
5.4	Compare with table 5				
5.5	Switch-off heater 4				
	(tc_heater_config 0)	H7660	Pref H380 = 'offoffoffoff'		
5.6	Examine HK	90000	Pref H5240 = 'offoffoffoff'		
6	Disable heater switching				
6.1	Enable standard control algorithm				
	(tc_heater_start)	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 02 Heater switching power profile

5.6 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.

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			
1.3	Enable DPUOS code	H7202			
1.4	Check TM received	91100 92202			
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 Check for event	H7248 92210			
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 = 1		
3	Prepare BPE for image acquisition				
3.1	Set acquisition mode (High Res, Windowed)	H7130	Pref H110 = 'Hi Res Win'		
3.2	Examine HK	90000	Pref H5215 = 'Hi Res Win'		
3.3	Set event threshold	H7131	Pref H120 = 15		
3.4	Specify centroid channel boundaries	H7100	Table 5.6-1		
3.5	Load channel boundaries Wait for event (2 minutes)	H5100 92100	H7000 = 'cen tab load'		
3.6	Specify window params	H7110	Table 5.6-2		
3.7	Load window look-up table wait for event (1 minute) Ensure Frame Tags disabled	H5110 92100 H7135	H7000 = 'win tab load' 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 (25 mA)		
4.3	Specify filter wheel to datum	H7608			
4.4	Move it there.	H5600			
	Await Event	92600	H7010 = 'fw @ req pos'		
4.5	Specify move to blocked (Filt. = 0)	H7604	H280 = 'Blocked'		
4.6	Move it there	H5600			
	Await Event	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=1400, H175='off'		
5.2	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'mcp23 ok'		
5.3	Specify Vmcp1 Ramp.	H7140	H150='mcp1',H160=550, H175='off'		
5.4	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'mcp1 ok'		
5.5	Specify Vcathode Ramp.	H7140	H150='cathode',H160=2, H175='off'		
5.6	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'cathode ok'		
5.7	Specify Vcathode Ramp .	H7140	H150='cathode',H160=396, H175='off'		
5.8	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'cathode ok'		
5.9	Specify Vmcp1 Ramp.	H7140	H150='mcp1',H160=520, H175='off'		
5.10	Perform Ramp.	H5140			
	Await Event.	92100	H7000 = 'mcp1 ok'		
5.11	Specify Vmcp23 Ramp.	H7140	H150='mcp23',H160=1700, H175='off'		
5.12	Perform Ramp.	H5140			
	Await Event.	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=1500, H175='off'		
6.2	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp23 ok'		
6.3	Specify Vmcp1 Ramp.	H7140	H150='mcp1',H160=500, H175='off'		
6.4	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp1 ok'		
6.5	Specify Vcathode Ramp.	H7140	H150='cathode',H160=2, H175='off'		
6.6	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'cathode 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	Acquire image.				
7.1	Ensure we are in engineering mode (tc_mode 4).	H9004	H650 = 0		
7.2	Turn on Flood LED (level =2).	H7134	H1040 = 2 (4 uA)		
7.3	Set DPU frame time to 5 mins. (ic_set_frame_time)	H7236	H710 = 300000		
7.4	Start sending events to DPU.	H5130			
7.5	Start full image eng integration (tc_enbl_eng 1,4). Wait 5 minutes to acquire data Await Event (DA_COMPLETE_EXP).	H7254 92209	H880 = 'Full hi res'		
7.6	Stop sending events to DPU (failsafe command).	H6130			
7.7	Disable Flood LED (level=0)	H7134	H1040 = 0 (0 mA)		

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. Await Event.	H5140 92100	 H7000 = 'cathode ok'		
8.3	Specify Vmcp1 Ramp.	H7140	H150='mcp1', H160=0, H175='off'		
8.4	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp1 ok'		
8.5	Specify Vmcp23 Ramp.	H7140	H150='mcp23',H160=0, H175='off'		
8.6	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp23 ok'		
9	Await Dumping of Engineering Image (2.5 hours)				
10	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 5.6-1 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 5.6-2 Window Parameters

5.7 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.

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			
1.2	Enable DPUOS code	H7202			
1.3	Check TM received	91100 92202			
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			

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		
3.4	Specify centroid channel boundaries	H7100	Table 5.6-1		
3.5	Load channel boundaries	H5100			
	Wait for event (2 minutes)	92100	H7000 = 'cen tab load'		
3.6	Specify window params		Table 5.7-1		
	Load window look-up table	H7110			
3.7	wait for event (1 minute)	H5110	H7000 = 'win tab load'		
	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.	H5600			
	Await Event	92600	H7010 = 'fw @ req pos'		
4.5	Specify move to blocked (Filt. = 0)	H7604	H280 = 'Blocked'		
4.6	Move it there	H5600			
	Await Event	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=1400, H175='off'		
5.2	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp23 ok'		
5.3	Specify Vmcp1 Ramp.	H7140	H150='mcp1',H160=550, H175='off'		
5.4	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp1 ok'		
5.5	Specify Vcathode Ramp.	H7140	H150='cathode',H160=2, H175='off'		
5.6	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'cathode 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=1500, H175='off'		
6.2	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp23 ok'		
6.3	Specify Vmcp1 Ramp.	H7140	H150='mcp1',H160=500, H175='off'		
6.4	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp1 ok'		
6.5	Specify Vcathode Ramp.	H7140	H150='cathode',H160=2, H175='off'		
6.6	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'cathode ok'		
6.7	Specify Vcathode Ramp .	H7140	H150='cathode',H160=390, H175='off'		
6.8	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'cathode'		
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	Acquire image.				
7.1	Ensure we are in engineering mode (tc_mode 4).	H9004	H650 = 0		
7.2	Turn on Flood LED (level =2).	H7134	H1040 = 2 (4 uA)		
7.3	Set DPU frame time to 5 mins. (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_COMPLETE_EXP).	92209			
	Stop sending events to DPU				
7.6	(failsafe command).	H6130			
7.7	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)				
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**	H50	52	64
Y_{low}	**Window 1**	H51	27	15
X_{size}	**(Units are CCD pixels)**	H52	256	256
Y_{size}		H53	256	256
	All remaining parameters	H54-H109	0	0

Table 5.7-1 Window Parameters

5.8 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 OM mode if mode = Operational = Basic		 goto step 2 goto step 3		
2.	If HV enabled: Ramp down HV **(Warning, these commands are hazardous)**	90000	H5145 = 1 = ‘Enabled’		
2.1	Specify Vcathode Ramp.	H7140	H150=’cathode’,H160=0, H175=’off’		
2.2	Perform Ramp. Await Event.	H5140 92100	 H7000 = ‘cathode ok’		
2.3	Specify Vmcp1 Ramp.	H7140	H150=’mcp1’,H160=0, H175=’off’		
2.4	Perform Ramp. Await Event.	H5140 92100	 H7000 = ‘mcp1 ok’		
2.5	Specify Vmcp23 Ramp.	H7140	H150=’mcp23’,H160=0, H175=’off’		
2.6	Perform Ramp. Await Event. Examine HK	H5140 92100 90000	 H7000 = ‘mcp23 ok’ H5145=’Disabled’		
3.1 3.2	Switch off OM-1 secondary rails Disable heater algorithm	H6690 H6670			
4	Switch-off +28V power		S/C procedure report: voltage and current		
5	Switch-off KAL		S/C procedure report: voltage and current		
6	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
H5340	RBI Status
H5345	RBI Config
H5385	Good TC
H5390	Bad TC
H5395	OM State
H5410	Heartbeat Count

Table 03: Pref look-up Table

Dichroic Rotation Log

1. □	26.□
2. □	27.□
3. □	28.□
4. □	29.□
5. □	30.□
6. □	31.□
7. □	32.□
8. □	33.□
9. □	34.□
10.□	35.□
11.□	36.□
12.□	37.□
13.□	38.□
14.□	39.□
15.□	40.□
16.□	41.□
17.□	42.□
18.□	43.□
19.□	44.□
20.□	45.□
21.□	46.□
22.□	47.□
23.□	48.□
24.□	49.□
25.□	50.□