1.7_V2.0 OPEN BIG VENT VALVE

Last Revised: June 23,1999
Filename: open_bvv

BRIEF FUNCTIONAL DESCRIPTION:
The "big" (previously referred to as "large") vent valve is planned to be opened once on orbit. The big vent valve must be opened after the small vent valve has been opened and before the ACIS door is opened. This valve provides efficient venting of the ACIS camera housing and the internal pressure will quickly reach the ambient pressure after the valve is open. The pressure monitors are not sensitive below 1 torr so it is not possible to verify from the pressure that the valve is open; however there is a telemetry verifier that the valve has opened. There is one valve with redundant paraffin actuators. Extreme caution must be exercised with these actuators, from the ACIS Long Form Functional Test Procedure document:

> *Because the Optical Blocking Filters are fragile and cannot withstand much differential pressure, mechanism motions may only be initiated when the differential pressure is less than 1 torr. Be safe; check both transducers. The mechanisms are driven by Starsys hot wax actuators. Power is applied directly from the space craft bus to heat the wax and, therefore, the time for a given motion to complete is dependent upon the bus voltage. To avoid failure of an actuator due to overheating–which would occur if the completion-of-motion switches failed, for instance–we monitor the actuator temperature. If the actuator temperature exceeds 135C, a command to abort the motion should be sent. Recovery from such a condition is never routine; no further motions should be attempted without thorough analysis of the procedural failure. It is also imperative that the commanded actuator be allowed to cool below 50C before the opposing actuator is commanded, lest the afore-mentioned egregious situation occur. It is not an error to command a valve open which is already open, etc., since the PSMC logic will know from the motion switches that the mechanism is already in the commanded state and not (falsely) apply power to the actuator.*

The side A actuator has an extra bit to monitor the status of the actuator. However, the logic which determines the value of this bit is sufficiently obtuse, that it is typically easier to use side B. The valve typically takes 3.5 minutes to open with a 28VDC bus voltage; it will go faster with 32VDC on the bus. The peak temperature should be 120 C; damage can occur if the temperature exceeds 135 C. An on-board regulator disconnects the voltage if the temperature reaches 130 C. Therefore, ground intervention to abort the actuator motion should not be necessary or even possible, but is maintained as a backup to this automatic cutoff. As the actuator warms above 70 C, it begins to move and the valve closed bit should indicate the valve is no longer closed. Once the motion is complete and the actuator starts to cool, the valve open bit should indicate the valve is fully open. While in transition, both bits should indicate that the valve is neither open nor closed.

The current timeline indicates that the small vent valve will be opened while *AXAF* is still in the shuttle bay and the big vent valve will be opened days later after some of the rocket burns are complete and *AXAF* is still in its transfer orbit. There is no stringent requirement as to the time at which the big vent valve must be opened. It is desired that the big vent valve be opened at a time in which ACIS activities will be the highest priority and will not conflict with other SC activities. We heat the focal plane to -50 C and maintain that temperature for 3 hours in order to allow any water which has frozen on the CCDs to evaporate and escape the detector housing. It is desired to keep the FP temperature at -50 C after this activity and going into the next activity which should be the "CCD Diagnostic Mode" which is the major part of the ACIS Short Form Functional test. **SO, THIS PROCEDURE ENDS WITH THE FOCAL PLANE BAKEOUT ENABLED, THE FOCAL PLANE TEMPERATURE AT -50 C and THE WARM BOOT FLAG OFF**.

The sequence of actions will be:

1. turn on the pressure transducers A & B, check the pressure, validate expectations
2. start DEA housekeeping to measure FP temperature
3. Dump configuration information
4. enable FP bakeout and heat FP to -50 C
5. enable the valve mechanism B and verify actuator temperatures
6. Open valve mechanism B
7. monitor the temperature and motion of the actuator
8. Turn off valve mechanism B when the motion is complete
9. verify the actuator temperature drops after the motion is complete
10. disable the vent valve mechanism B
11. **On- orbit, WAIT FOR 3 HOURS**, Maintain elevated FP temperature

ASSUMED INSTRUMENT STATE:
Assumes that the PSMC has power from the spacecraft.
Assumes that instrument is in the canonical thermal standy state (the video boards and FEPs must be off for this procedure !!!!).
Assumes the small vent valve is open.

SPECIAL INITIAL CONDITIONS:
Assumes that RT contact is available for an extended period.
Assumes that *AXAF* ISIM RCTU is powered on and in telemetry format 1 or 2.

OPERATIONAL CONSTRAINTS/CAUTIONS:
The instrument is left in a state in which the focal plane bakeout is enabled and the focal plane temperature is at -50 C.
The small vent valve must already be open.
The open and close mechanism must not be enabled at the same time.
CARD ACIS-002
CARD ACIS-007

REFERENCES:
ACIS Long Form Functional Test Procedure (36-01301.01)
CHANGE HISTORY:

V1.2

- changed filenames from "open_vv" to "open_bvv"

V1.3

- changed title from "large vent valve" to "big vent valve"
- deleted "CMD EGSE" and "SEQ KEY" from the LaTeX table
- changed HW TLM verifiers in steps 1.1 and 1.2 to "ENB"
- changed expected value of pressure in steps 1.3 and 1.4 to 0 ± 2 T
- changed required TLM format to 1or2 for all steps except step 2

- changed “Command echo” in the Telemetry Description column to “Check cmdResult == OK” in the Telemetry EGSE column in steps 2.1, 4.2, 4.3, and 4.4
- moved “deaHousekeepingData” in Telemetry Description column to “Telemetry EGSE” column in steps 2.2, 2.3, and 4.5
- changed expected focal plane temperature in step 2.3 to < -50 C
- moved “bepReadReply” in Telemetry Description column to Telemetry EGSE column and changed the verifier to “Check cmdResult == OK”
- put not in step 4.1 to warn that DEA A input current is noisy
- added command to set the warm boot flag off in a new step 4.2
- added a “dumpSysConfig” command in a new step 4.6
- changed expected value of HW TLM verifiers in steps 5.1, 5.2, 5.3, and 5.4 to ENB, $<$ 30 C, CLOS, and NOPE
- added expected value of HW TLM verifier in step 6.1
- changed expected values of HW TLM verifiers in steps 8.1 and 10.1 to OFF and DIS
- changed Time Req in step 9.1 to 30 minutes
- changed HW TLM verifiers in step 11.1 to 1CBAT and 1CBBT
- last step which disabled the focal plane bakeout and set the focal plane temperature back to -120 C was deleted
- edited Brief Functional Description to be consistent with edits

V1.4

- added commandEcho values for steps 3.1–3.11 and 4.5 & 4.6
- changed “Command Desription” columns for steps 5.1, 6.1, and 8.1
- added filename identification at top of procedure

V1.5

- changed HW TLM verifier in step 4.1 to 1DE28AV0 from 1DEP3AVO, and expected value to 27.0-35.0 V, and changed DEA A input current to 0.60–0.78 A

V2.0

- ACIS Team signed-off version
- changed required TLM format to 1or2 for all steps except step 3
- added step 12 to turn off the pressure XDCRs

Table 1: **Big Vent Valve Opening Procedure**

Step #	Title (Revision 1.7_V2.0)	Time Req (m)	Command Description	Command Mnemonic	Telemetry Description	Telemetry Mnemonic	Expected Value	Units
1.0	Measure Pressure							
1.1	turn on Pressure Transducer A	1	XDCR A on	1PRESAON	Pressure XDCR A	1PRDBAON	ENB	
1.2	turn on Pressure Transducer B	1	XDCR B on	1PRESBON	Pressure XDCR B	1PRDBBON	ENB	
1.3	Measure Pressure A	2			Differential Housing Pressure A	1HOPRAPR	0 ± 2	T
1.4	Measure Pressure B				Differential Housing Pressure B	1HOPRBPR	0 ± 2	T
2.0	Measure FP temperature							
2.1	Load Board 11 DEA HK	1	loadDeaBlock	WD00001024				
2.2	Start DEA Hkp run	1	startDEA	XDZ0000005				
2.3	Record FP temp	2					< -50	C
3	Dump Config Info							
3.1	dump default TE PBs	0.1	dumpParameterSlots	RT_0000001				
3.2	dump default CC PBs	0.1	dumpParameterSlots	RC_0000001				
3.3	dump default 2D PBs	0.1	dumpParameterSlots	R2_0000001				
3.4	dump default 1D PBs	0.1	dumpParameterSlots	R1_0000001				
3.5	dump default DeaHk PBs	0.1	dumpParameterSlots	RD_0000001				
3.6	dump system config.	0.1	dumpSysConfig	RS_0000001				
3.7	dump bad pixel list	0.5	dumpBadPixels	RP_0000001				
3.8	dump bad TE columns	0.1	dumpBadTeColumn	R4_0000001				
3.9	dump bad CC columns	0.1	dumpBadCcColumn	R3_0000001				

Table 2: (CONT) **Big Vent Valve Opening Procedure**

Step #	Telemetry EGSE	Other Verifier	Crit	Description	Notes	RT Con	Tlm Fmt	Min Alt	SIM Pos
1.0									
1.1			2			Y	1or2		
1.2			2			Y	1or2		
1.3			2			Y	1or2		
1.4			2			Y	1or2		
2.0									
2.1	Check cmdResult == OK commandEcho 225		B	Load Fullhouse DEA housekeeping parameter block into slot 4			1or2		
2.2	Check cmdResult == OK commandEcho 18		B	get FP temp from deaHousekeepingData			1or2		
2.3	deaHousekeepingData		B			Y	1or2		
3									
3.1	Check cmdResult == OK commandEcho 78		B		*psci* should not indicate any errors regarding “truncated blocks” for any of these dumps.	Y	2	60k	
3.2	Check cmdResult == OK commandEcho 75		B			Y	2	60k	
3.3	Check cmdResult == OK commandEcho 72		B			Y	2	60k	
3.4	Check cmdResult == OK commandEcho 71		B			Y	2	60k	
3.5	Check cmdResult == OK commandEcho 63		B			Y	2		
3.6	Check cmdResult == OK commandEcho 66		B	verify video boards & FEPs off		Y	2		
3.7	Check cmdResult == OK commandEcho 83		B			Y	2		
3.8	Check cmdResult == OK commandEcho 80		B			Y	2		
3.9	Check cmdResult == OK commandEcho 77		B			Y	2		

Table 1: **Big Vent Valve Opening Procedure(Page 2)**

Step #	Title (Revision 1.7_V2.0)	Time Req (m)	Command Description	Command Mnemonic	Telemetry Description	Telemetry Mnemonic	Expected Value	Units
3.10	dump Huffman tables	0.5	dumpHuffman	RH_0000001				
3.11	dump patches	2	dumpPatchlist	RU_0000001				
4.0	Heat FP to -50 C							
4.1	verify power consumption	10			DEA Input I	1DEICACU	0.60–0.78	A
					DEA Input V	1DE28AVO	27.0-35.0	V
4.2	Set warm boot flag off	1	DPA Cold Boot	1WRMBTSB(0)				
4.3	Upload bakeout patch	1	writeBep	WBBOEN_ENB				
4.4	Enable the FP BO htr	1	changeConfigSetting	WSBAKENABL				
4.5	Set FP temp to -50 C	1	changeConfigSetting	WSFTNEG_50				
4.6	dump system config.	0.1	dumpSysConfig	RS_0000001				
4.7	monitor FP temp	40					-50	C
5.0	Enable Large Valve							
5.1	Enable vent valve B	1	V V Enable B	1VVCBEN	VV Open Drive B	1VVDBBON	ENB	
5.2	Verify Actuator temps	2			VV Open Act. B T	1VAHOBT	< +30	C
					VV Close Act. B T	1VAHCBT	< +30	C
5.3	Verify close bit	2				1VVCLBCL	CLOS	
5.4	Verify open bit	2				1VVOPBOP	NOPE	
6.0	Open Large Valve							
6.1	Open valve B	1	V V Open On B	1VVCOBON	Vent Valve Open B	1VVODBOP	ON	
7.0	Monitor Actuator Motion							
7.1	Monitor actuator temp	20				1VAHOBT	120	C
7.2	Verify close bit					1VVCLBCL	NCLO	
7.3	Verify open bit					1VVOPBOP	OPEN	

Table 2: (CONT) **Big Vent Valve Opening Procedure(Page 2)**

Step #	Telemetry EGSE	Other Verifier	Crit	Description	Notes	RT Con	Tlm Fmt	Min Alt	SIM Pos
3.10	Check cmdResult == OK commandEcho 68		B			Y	2		
3.11	Check cmdResult == OK commandEcho 65		B			Y	2		
4.0									
4.1			2	DEA A Power should be 21 $\pm$ 3 W,		Y	1or2		
				current is noisy so an avg. is needed		Y	1or2		
4.2				disable Warm boot if BEP watchdogs		Y	1or2		
4.3	Check cmdResult == OK commandEcho 101		A	Enable the "enable"		Y	1or2		
4.4	Check cmdResult == OK commandEcho 114		A	enable the FP bakeout heater	If *psci* indicates a SWSTAT_DEAMAN_BADCNTLREG	Y	1or2		
4.5	Check cmdResult == OK commandEcho 163		A	Set desired FP temp to -50 C, FP bakeout htr comes on.	or SWSTAT_DEABOARD_ERROR, bakeout enabled failed.	Y	1or2		
4.6	Check cmdResult == OK commandEcho 66		B	get data to verify bakeout enable	run *psci -a -l* to examine SysConfig packets.	Y	1or2		
4.7	deaHousekeepingData		A		Time depends on starting T	P	1or2		
5.0									
5.1			1			Y	1or2		
5.2			2			Y	1or2		
			2			Y	1or2		
5.3			1	0 means valve is closed		Y	1or2		
5.4			1	1 means valve is not fully open		Y	1or2		
6.0									
6.1			1	1 means actuator is on		Y	1or2		
7.0									
7.1			1	declare contingency & execute abort if temp exceeds 120 C		Y	1or2		
7.2			1	0 $\Rightarrow$ 1 indicates mechanism is opening		Y	1or2		
7.3			1	1 $\Rightarrow$ 0 indicates mechanism has opened		Y	1or2		

Table 1: **Big Vent Valve Opening Procedure(Page 3)**

Step #	Title (Revision 1.7_V2.0)	Time Req (m)	Command Description	Command Mnemonic	Telemetry Description	Telemetry Mnemonic	Expected Value	Units
8.0	Turn Off Valve B							
8.1	Turn off valve B	2	V V Open Off B	1VVCOBOF	Vent Valve Open B	1VVODBOP	OFF	
9.0	Monitor Actuator cooldown							
9.1	Monitor actuator temps	30			VV Open Act. B T	1VAHOBT	+50	C
					VV Close Act. B T	1VAHCBT	$< +30$	C
10.0	Disable Valve B							
10.1	Disable valve B	2	VV Disable B	1VVCBDS	VV Open Drive B	1VVDBBON	DIS	
11.0	Maintain FP temp of -50 C							
11.1	monitor Camera body temp	2			Camera Body T A	1CBAT	-60	C
					Camera Body T B	1CBBT	-60	C
11.2	monitor FP temp	180					-50	C
12.0	Turn Off XDCRs							
12.1	turn off Pressure Transducer A	0.1	XDCR A on	1PRESAOF	Pressure XDCR A	1PRDBAON	OFF	
12.2	turn off Pressure Transducer B	0.1	XDCR B on	1PRESBOF	Pressure XDCR B	1PRDBBON	OFF	
12.3	Measure Pressure A	2.0			Differential Housing Pressure A	1HOPRAPR	-21.1	T
12.4	Measure Pressure B				Differential Housing Pressure B	1HOPRBPR	-19.1	T
	Total Time	312.1						

Table 2: (CONT) **Big Vent Valve Opening Procedure(Page 3)**

Step #	Telemetry EGSE	Other Verifier	Crit	Description	Notes	RT Con	Tlm Fmt	Min Alt	SIM Pos
8.0									
8.1			1	0 means actuator is off		Y	1or2		
9.0									
9.1			1	temp goes from +120 to +50 C	should take 30 minutes to drop	Y	1or2		
			1						
10.0									
10.1			2			Y	1or2		
11.0									
11.1			2			P	1or2		
			2						
11.2	deaHousekeepingData		A	leave FP at -50 C		P	1or2		
12.0									
12.1			2		verifiers only valid if one		1,2 or 4		
12.2			2		side of the DPA is on		1,2 or 4		
12.3			1				1or2		
12.4			1				1or2		