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Gravity Probe B Relativity Mission

ON-BOARD A/D AND D/A CONVERTER CALIBRATION PROCEDURE FOR GSS FORWARD SUSPENSION UNITS (FSU)

PN 26225-101 REV _____ SN: [ ]

GP-B Procedure
P0892 Rev -

The activities described herein are not intended to stand-alone; they are written to be called from a higher-level test procedure. Note the calling procedure below:

○ P0702 Rev_____ ○ P0769 Rev:_____ ○ Other:_____

Prepared by: William Bencze
RE, Gyroscope Suspension System (GSS) Group

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Approved by: William Bencze Date
RE, Gyroscope Suspension System (GSS) Group

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Approved by: Dorrene Ross Date
GP-B Quality Assurance

1.0 Revision History

Rev Level	Comments/notes	Date	Revised By
-	First release of this test procedure	26-Dec-01	WJ Bencze

2.0 Scope:

2.1. This procedure describes the procedure required to calibrate the AD and DA channels of a particular FSU box. The calibrations this procedure produces will remove the residual gain and bias errors on the MUX monitor channels (48), LVA outputs (6), HVA outputs (6) and bridge inputs (3).

2.2. It is intended that these calibrations will be used during the functional tests of the FSU box and subsequently uploaded into the box on orbit following initial power on.

3.0 Reference Documents

3.1. Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment, MIL-STD-1686

4.0 Test Facilities

4.1. HEPL Room 127, Stanford University

4.2. HEPL Room 175, Stanford University

4.3. Other:_____

5.0 QA Provisions:

5.1. Upon completion of this procedure, the GSS manager and the GP-B QA manager shall certify her/his concurrence that the procedure was performed and accomplished in accordance with the prescribed instructions by signing and dating his approval at the end of this procedure.

6.0 Test Personnel

This test procedure is to be conducted only by the following personnel:

6.1. William Bencze

6.2. David Hipkins

6.3. Yoshimi Ohshima

6.4. Other: _____

7.0 General Instructions

7.1. Redlines can be initiated by the test personnel listed in Section 6.0 and must be approved by QA.

7.2. Test operators shall read this procedure in its entirety and resolve any apparent ambiguities prior to beginning this test.

7.3. Any nonconformance or test anomaly should be reported by a Discrepancy Report. Refer to the Quality Plan, P0108, for guidance. Do not alter or break test configuration if a test failure occurs; notify quality assurance.

7.4. Only the following persons have the authority to exit/terminate this test or perform a retest: test operators listed in Section 6.0 and GP-B QA.

8.0 Hardware Safety Requirements:

8.1. This assembly is ESD sensitive; special care shall be exercised per the "Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment", MIL-STD-1686

8.2. Ensure that power is removed from cable assemblies before connecting or disconnecting cable connectors.

8.3. Connector savers are to be used on all flight connector interfaces unless otherwise specified.

8.4. Examine all mating connectors before attempting to mate them. Remove any foreign particles. Look for any damaged pins or sockets. Do not force the coupling action if excessive resistance is encountered. Ensure that key-ways are aligned when mating connectors.

9.0 Test Equipment

The following support hardware, test equipment, or software will be used and the applicable information for the instruments shall be recorded below. Hand-written additions to this list may be made in the space provided.

This procedure assumes that the FSU has been connected to a power source and computer workstation via another procedure.

9.1. Hardware:

Equipment Description	Make	Model	SN	Cal Due
1. 6-digit multimeter	HP			
2. Reference Dummy Load	SU	-		
3.				
4.				
5.				

9.2. Software:

Code Description	Version Information	Build Date
1. Matlab application	Release 11.1 or later	NA (COTS)
2. FSUCAL Matlab suite	Archived in: P0892NC_matlab.zip (GSS release site)	
3. GSW RAD6000 image	Version: 2.0.8.1 File Size: Date:	
4.		
5.		

10.0 Test Configuration

Note: All handling of this DUT shall be performed using ESD control methods, as outlined in MIL-STD-1686. Unit shall be inspected at an ESD certified station. Wrist straps and/or heel grounding straps shall be used.

		P/F	Notes
10.1.	Verify that power to FSU is **OFF.**		
10.2.	Disconnect FSU from testbed, if required, at testbed interface box end.		
10.3.	Record dummy load SN at right; attach dummy load calibration sheet to this procedure.		SN:
10.4.	Connect FSU J41 to load J41 (Z1)		
10.5.	Connect FSU J42 to load J42 (Z2)		
10.6.	Connect FSU J43 to load J43 (Y1)		
10.7.	Connect FSU J44 to load J44 (Y2)		
10.8.	Connect FSU J45 to load J45 (X1)		
10.9.	Connect FSU J46 to load J46 (X2)		
10.10.	Connect FSU J47 (GSS ground) to case ground of the dummy load.		
10.11.	Set all toggle switches to “zero” position on dummy load (6 places)		

11.0 Test Setup:

Note: All handling of this DUT shall be performed using ESD control methods, as outlined in MIL-STD-1686. Unit shall be inspected at an ESD certified station. Wrist straps and/or heel grounding straps shall be used.

Step		P/F	Notes
11.1.	Apply low voltage power to FSU.		
11.2.	Reset RAD6000 Processor (via power cycle or reset button on APU emulator)		
11.3.	Verify no software that uses the 1553 bus is running on the testset (shared memory server)		
11.4.	Load FSU calibration binary to RAD6000 (via GSSLOADER) in directory ~/gsw/builds/build_2_0_8_1/bsp/pp		
11.5.	Start PITVIEW software from ~gpbvx/hwQual/ron directory (via STARTALL)		
11.6.	Start MATLAB; change working directory to location of FSUCAL files		
11.7.	(~gpbvx/hwQual/ron/fsucal)		
11.8.	In MATLAB window, run FSUCAL function. (fsucal.m)		

12.0 Execution of Test:

12.1. Step through each of the calibration options in the MATLAB routine in numerical order.

12.2. Use the calibration record sheet on the following pages to record measured data. Each data recording step has a unique step number associated with it; this number is duplicated in the text surrounding the data entry and PITVIEW script execution points in the MATLAB .m file.

12.3. Enter raw measurements from either a volt meter or screen readings in the “Raw Value” column.

12.4. Most rows have a “Post-cal Value” column in which to record the results of the calibration. Associated with each is a “Post-cal Step” that must be executed prior to making the measurement. The unique step numbers are provided for reference.

12.5. If a value is mis-entered, continue through the remainder of the data entry steps. Re-enter the calibration sub task and enter the data as recorded on the calibration sheet. When the sub-task completes, the erroneous data will be replaced by the proper value.

FSU Calibration Record – Sheet 1 of 3					FSU SN:	
Step	**Signal**	**Raw Value**	**Post-cal Step**	**Post-cal Value**	**Post-cal Acceptable Range**	**P/F**
1.02	SIG_AGND		1.04		0.000 ± 0.005	
1.03	P5A_REF		1.04		5.000 ± 0.005	
2.02	Measured X1 – LVA (J45)		2.08		0.000 ± 0.005	
2.03	Measured X2 – LVA (J46)		2.08			
2.04	Measured Y1 – LVA (J43)		2.08			
2.05	Measured Y2 – LVA (J44)		2.08			
2.06	Measured Z1 – LVA (J41)		2.08			
2.07	Measured Z2 – LVA (J42)		2.08			
2.10	Measured X1 – LVA (J45)		2.16		5.000 ± 0.005	
2.11	Measured X2 – LVA (J46)		2.16			
2.12	Measured Y1 – LVA (J43)		2.16			
2.13	Measured Y2 – LVA (J44)		2.16			
2.14	Measured Z1 – LVA (J41)		2.16			
2.15	Measured Z2 – LVA (J42)		2.16			
3.02	Mux Monitor X1 – LVA (FLT1)		3.08		0 ± 10	
3.03	Mux Monitor X2 – LVA (FLT2)		3.08			
3.04	Mux Monitor Y1 – LVA (FLT3)		3.08			
3.05	Mux Monitor Y2 – LVA (FLT4)		3.08			
3.06	Mux Monitor Z1 – LVA (FLT5)		3.08			
3.07	Mux Monitor Z2 – LVA (FLT6)		3.08			
3.10	Mux Monitor X1 – LVA (FLT1)		3.16		5.000 ± 0.005	
3.11	Mux Monitor X2 – LVA (FLT2)		3.16			
3.12	Mux Monitor Y1 – LVA (FLT3)		3.16			
3.13	Mux Monitor Y2 – LVA (FLT4)		3.16			
3.14	Mux Monitor Z1 – LVA (FLT5)		3.16			
3.15	Mux Monitor Z2 – LVA (FLT6)		3.16			
XXX	Mux Monitor X1 – LVA (FLT1)	XXXXXX	3.17		0.000 ± 0.005	
XXX	Mux Monitor X2 – LVA (FLT2)	XXXXXX	3.17			
XXX	Mux Monitor Y1 – LVA (FLT3)	XXXXXX	3.17			
XXX	Mux Monitor Y2 – LVA (FLT4)	XXXXXX	3.17			
XXX	Mux Monitor Z1 – LVA (FLT5)	XXXXXX	3.17			
XXX	Mux Monitor Z2 – LVA (FLT6)	XXXXXX	3.17			

FSU Calibration Record – Sheet 2 of 3					FSU SN:	
Step	**Signal**	**Raw Value**	**Post-cal Step**	**Post-cal Value**	**Post-cal Acceptable Range**	**P/F**
4.02	Measured X1 – HVA (J45)		4.08		0.0 ± 1.0	
4.03	Measured X2 – HVA (J46)		4.08			
4.04	Measured Y1 – HVA (J43)		4.08			
4.05	Measured Y2 – HVA (J44)		4.08			
4.06	Measured Z1 – HVA (J41)		4.08			
4.07	Measured Z2 – HVA (J42)		4.08			
4.10	Measured X1 – HVA (J45)		4.16		200.0 ± 2.0	
4.11	Measured X2 – HVA (J46)		4.16			
4.12	Measured Y1 – HVA (J43)		4.16			
4.13	Measured Y2 – HVA (J44)		4.16			
4.14	Measured Z1 – HVA (J41)		4.16			
4.15	Measured Z2 – HVA (J42)		4.16			
5.02	Mux Monitor X1 – HVA (FLT1)		5.08		0 ± 10	
5.03	Mux Monitor X2 – HVA (FLT2)		5.08			
5.04	Mux Monitor Y1 – HVA (FLT3)		5.08			
5.05	Mux Monitor Y2 – HVA (FLT4)		5.08			
5.06	Mux Monitor Z1 – HVA (FLT5)		5.08			
5.07	Mux Monitor Z2 – HVA (FLT6)		5.08			
5.10	Mux Monitor X1 – HVA (FLT1)		5.16		200.0 ± 2.0	
5.11	Mux Monitor X2 – HVA (FLT2)		5.16			
5.12	Mux Monitor Y1 – HVA (FLT3)		5.16			
5.13	Mux Monitor Y2 – HVA (FLT4)		5.16			
5.14	Mux Monitor Z1 – HVA (FLT5)		5.16			
5.15	Mux Monitor Z2 – HVA (FLT6)		5.16			
XXX	Mux Monitor X1 – HVA (FLT1)	XXXXXX	5.17		0.0 ± 1.0	
XXX	Mux Monitor X2 – HVA (FLT2)	XXXXXX	5.17			
XXX	Mux Monitor Y1 – HVA (FLT3)	XXXXXX	5.17			
XXX	Mux Monitor Y2 – HVA (FLT4)	XXXXXX	5.17			
XXX	Mux Monitor Z1 – HVA (FLT5)	XXXXXX	5.17			
XXX	Mux Monitor Z2 – HVA (FLT6)	XXXXXX	5.17			

FSU Calibration Record – Sheet 3 of 3 **FSU SN:**

Remove all volt meters/cables from the dummy load test points

Step	Signal	Raw Value	Post-cal Step	Post-cal Value	Post-cal Acceptable Range	P/F
6.03	PIT 2/3 - X Position		6.06		0 ± 10	
6.04	PIT 2/3 - Y Position		6.06		0 ± 10	
6.04	PIT 2/3 - Z Position		6.06		0 ± 10	
6.09	PIT 2/3 - X Position		6.15		(Step 6.12) ± 0.01	
6.10	PIT 2/3 - Y Position		6.15		(Step 6.13) ± 0.01	
6.11	PIT 2/3 - Z Position		6.15		(Step 6.14) ± 0.01	
6.12	X axis calibrated offset		6.15	XXXXX		XXXXX
6.13	Y axis calibrated offset		6.15	XXXXX		XXXXX
6.14	Z axis calibrated offset		6.15	XXXXX		XXXXX
XXX	PIT 2/3 - X Position	XXXXX	6.16		0.000 ± 0.005	
XXX	PIT 2/3 - Y Position	XXXXX	6.16		0.000 ± 0.005	
XXX	PIT 2/3 - Z Position	XXXXX	6.16		0.000 ± 0.005	
XXX	PIT 2/3 - X Position (hi osc)	XXXXX	6.17		(record only)	XXXXX
XXX	PIT 2/3 - Y Position (hi osc)	XXXXX	6.17		(record only)	XXXXX
XXX	PIT 2/3 - Z Position (hi osc)	XXXXX	6.17		(record only)	XXXXX

13.0 Completion of procedure:

		P/F	Notes
13.1.	Disconnect dummy load from FSU		
13.2.	Attach a copy of the final calibration files script to this procedure as an official record of the calibration run.		
13.3.	Archive calibration file for this FSU on the GSS release site (.mat file)		

I certify that this procedure was performed in whole and that the data recorded above is complete and accurate.

Test Engineer		Date	

This is to certify that the information obtained under this test procedure is as represented and the documentation is completed and correct.

GSS Representative		Date	
Quality Assurance		Date	