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Gravity Probe B Relativity Mission

BOARD-LEVEL TEST PROCEDURE
GYROSCOPE SUSPENSION SYSTEM (GSS)
HV AMPLIFIER AND BRIDGE (HVA) ASSEMBLY

PWA 8A01879 Rev F S/N:

GP-B Procedure
P0829 Rev A

Prepared by: Jay Dusenbury PWA Responsible Engineer	Date
Approved by: William Bencze RE, Gyroscope Suspension System (GSS) Group	Date
Approved by: Dorrene Ross GP-B Quality Assurance	Date

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1.0 REVISION HISTORY

Rev Level	Comments/notes	Date	Revised By
-	First release of this test procedure	30-Mar-01	J. Dusenbury
A	Added HVA and bridge response tests, multipoint bridge cal	26-Sep-01	J. Dusenbury

2.0 SCOPE

This procedure details the board-level functional tests for the GSS HV amplifier/Bridge (HVA) card. No mechanical or thermal stress testing shall be performed at this time.

All data recorded during this test is recorded in this document; each test of a board will use its own copy of this procedure, and will be identified by serial number on the cover sheet. Multiple measurments of the same section can be recorded on the document for each board.

3.0 REFERENCE DOCUMENTS

3.1. PWA Drawing, GSS HVA board, 8A01879

3.2. PWB Drawing, GSS HVA board, 8A01881

3.3. Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts,

3.4. P0609 Rev A Board Level Tuning And Test Procedure For GSS HV amplifier/Bridge Board

4.0 TEST FACILITIES

4.1. GPB Lab, HEPL Room 127, Stanford University

5.0 QA PROVISIONS

5.1. This procedure shall be conducted on a formal basis to its latest approved and released version. The QA Program Engineer (D. Ross) and the government representative (E. Ingraham) shall be notified 24 hours prior to he start of this procedure. QA may monitor the execution of all or part of this procedure should they elect to do so.

Date/time:______________________	Date/time:______________________
GP-B QA (D. Ross)	Government Rep. (E. Ingraham)

5.2. 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. Jay Dusenbury

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

8.3. 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.

8.4. Connector savers shall be used on all flight interfaces unless otherwise specified.

9.0 EQUIPMENT LIST

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.

Equipment Description	Make	Model	SN	Cal Due
9.1. Multimeter (1)				
9.2. Digital Voltmeter				
9.3. Digital Voltmeter				
9.4. HV power supply (+)	SRS	PS325		
9.5. HV power supply (-)	SRS	PS325		
9.6. Signal Generator	SRS	DS335		
9.7. Oscilloscope	Tek	460A		
9.8. Capacitance meter				
9.9. Network Analyzer				
9.10. Gyroscope simulator	SU	NA	01	NA
9.11. Gyro sim control head	SU	NA	01	NA
9.12. Multipoint Dummy Load				
9.13.				
9.14.				

10.0 DEVICE UNDER TEST (DUT)

Record the serial number of the Device Under Test, or DUT, and Identification and Axis of the Foreward Suspension Unit Enclosure used:

PWA 8A01879 GSS HVA Card	SN:	

Test Operator:	Name:	

FSU Identification	Axis	

Start of test:	Date: Time:	

11.0 TEST SETUP

11.1. Verify with a calibrated capacitance meter that the Gyro Simulator capacitances are within 2pf of nominal. Record data below

Zero (C1, C2, C3, C4 all DOWN)

E1 (nominal 139.13 pF) =___________ pF
E2 (nominal 139.13 pF) =___________ pF

+ Cal (C1, C3 DOWN – C2, C4 UP)

E1 (nominal 171.51 pF) =___________ pF
E2 (nominal 122.18 pF) =___________ pF

- Cal (C1, C3 UP – C2, C4 DOWN)

E1 (nominal 122.18 pF) =___________ pF
E2 (nominal 171.51 pF) =___________ pF

11.2. Connect DUT Airborn connector P1 to the Gyro Controller cable

11.3. Install DUT in Foreward Suspension Unit enclosure. Insure that all frame screws are installed.

11.4. Connect DUT Reynolds connectors CN20 and CN21 to the Gyro Simulator using Reynolds connector saver/MHV adapters and MHV cables.

11.5. Connect DUT to the High Voltage Supplies using test clips to the High Voltage connections CN30 and CN31

11.6. Set Controller Switches S6 through S12 OFFTurn Controller S1 POWER ON Switch to ON. Momentarily depress S3 HVA SELECT.

11.7. Connect a 34.1 kHz function generator to BNC1 EXCITATION IN. Set function generator amplitude to 1.0 V Peak-to-peak (0.3535 vrms) and record value below:

Excitation Voltage = _______________ V _______

12.0 BRIDGE EXCITATION AND DRIVEN SHIELD.

12.1. Connect an oscilloscope and 8pF 10X probes to Gyro Simulator Electrode Monitor BNC E1 and Driven Shield Monitor BNC S1.

12.2. **High Level Excitation Measurements** : With the Controller S5 GAIN SET Switch set to HIGH, measure the amplitude and phase of the following signals on the test BNCs on the Gyro Simulator using the excitation input to the Controller as a phase reference.

Measurement	Location	Voltage p-p	Phase wrt E1
Electrode 1	Simulator E1	_________ V p-p	@ _________ deg
Electrode 2	Simulator E2	_________ V p-p	@ _________ deg
Shield 1	Simulator S1	_________ V p-p	@ _________ deg
Shield 2	Simulator S1	_________ V p-p	@ _________ deg

12.3. **Low Level Excitation Measurements.** Set Controller S5 GAIN SET Switch to LOW. Measure the Amplitude and phase of the voltage at E1, E2, And S1 as in 12.2.

Measurement	Location	Voltage p-p	Phase wrt A6
Electrode 1	Simulator E1	_________ V p-p	@ _________ deg
Electrode 2	Simulator E2	_________ V p-p	@ _________ deg
Shield 1	Simulator S1	_________ V p-p	@ _________ deg

13.0 BRIDGE GAIN AND OFFSET

13.1. **High Level Zero.** Set Controller S5 GAIN SELECT to HIGH. Set the Gyro Simulator in the Balanced configuration (Cal Switches C1 through C4 DOWN). Record the Position Voltage with gyro cables in nominal position, and with cables reversed at the MHV connector on the Reynolds Connector saver/MHV adapter. Calculate and record the mean zero (mean of fwd and reversed voltages).

Position Out at Controller BNC 4, normal ___________ V DC

Position Out at Controller BNC 4, reversed ___________ V DC

Mean Position Out (norm + rev) / 2 ___________ V DC

13.2. **High Level Positive Cal.** With gyro cables in normal configurationn set the Gyro Simulator in the +Cal configuration (Cal Switches C1 and C3 DOWN, C2 and C4 UP). Assure that the Cal Position Voltage minus the Zero voltage measured in 13.1 equals 3.90 +/- .5 Vdc

Position Out at Controller BNC __________ Vdc

Cal Value (+ Cal – normal Zero) __________ Vdc

13.3. **High Level Negative Cal.** Set the Gyro Simulator in the -Cal configuration (Cal Switches C1 and C3 UP, C2 and C4 DOWN). Measure and record the specified voltage levels.

Position Out at Controller BNC 4 _________ V DC

13.4. **Low Level Zero.** Set Controller S5 GAIN SELECT to LOW. Set the Gyro Simulator in the Balanced configuration (Cal Switches C1 through C4 DOWN).

Position Out at Controller BNC 4 _________ V DC

13.5. **Low Level Positive Cal.** Set the Gyro Simulator in the +Cal configuration (Cal Switches C1 and C3 DOWN, C2 and C4 UP).

Measured Position Out at Controller BNC 4 _________ V DC

13.6. **Multipoint Cal**. Measure the capacitances of the Multipoint Dummy Load and record below.

Point	X1 C	X2 C
1	________ pf	________ pf
2	________ pf	________ pf
3	________ pf	________ pf
4	________ pf	________ pf
5	________ pf	________ pf

13.7. Install the Multipoint Dummy Load in place of the Gyro Simulator. Set Controller S5 GAIN SELECT to HIGH and record the Position Output at Controller BNC 4 observed at each pair of Dummy Load points. .The “rev” points are taken with the gyro cables to module C20 and C21 reversed at the Dummy Load.

Point	Position Out
1	________ Vdc
2	________ Vdc
3	________ Vdc
4	________ Vdc
5	________ Vdc
1 rev	________ Vdc
2 rev	________ Vdc
3 rev	________ Vdc
4 rev	________ Vdc
5 rev	________ Vdc

14.0 BRIDGE RESPONSE AND NOISE

14.1. **Frequency Response.** Connect Network Analyzer SOURCE output to Controller BNC2 EXTERNAL FGEN IN. Connect Network Analyzer INPUT 1 to Controller BNC4 POSITION signal.

14.2. Turn Controller HV and LV amp input switches S6 through S9 off. Momentarily press S4 LVA SELECT pushbutton. Turn S11 Y VARACTOR switch to ON. Set S5 EXCITATION LEVEL to HIGH

14.3. Adjust Network Analyzer for lowest output level that results in a clean measurment.

14.4. With the Network Analyzer record the bridge frequency response in bode plot form.

14.5. Set S5 EXCITATION LEVEL to LOW

14.6. With the Network Analyzer record the bridge frequency response in bode plot form.

14.7. **Bridge Noise.** Turn S11 Y VARACTOR switch to OFF. Set S5 EXCITATION LEVEL to HIGH

14.8. With the Network Analyzer record the bridge noise in psd form

14.9. Set S5 EXCITATION LEVEL to LOW

14.10. With the Network Analyzer record the bridge noise in psd form

14.11. Sign and date the plots recorded in 14.4 through 14.10 and attatch to the test procedure.

15.0 HV AMPLIFIER TESTING

15.1. Press Controller S3 HVA SELECT pushbutton momentarily.

15.2. Turn Controller S6 and S7 HV IN 1 and HV IN 2 switches ON. Turn Controller S8 and S9 LV IN 1 and LV IN 2 switches both OFF. Turn Controller S5 GAIN SELECT switch to HIGH. Set Controller S2 FUNCTION SELECT switch to SINE.

15.3. Set POT1 FUNCTION LEVEL pot to minimum.

15.4. Turn On Both High Voltage Supplies, set the ouptut voltage to +/- 100 V, and apply + and – 100 Vdc to the DUT. Assure that the high voltage supply currents are less than 1.5 ma.

15.5. Increase the voltage of both supplies to 1450 Vdc. Assure that the high voltage supply currents are less than 1.5 ma and that no high voltage arcing occurs. Record the high voltage supply current to the amplifiers.

High Voltage Current + Supply = ___________ ma

High Voltage Current - Supply = ___________ ma

15.6. Advance FUNCTION LEVEL Pot P1 so that the sine wave amplitude is 12 +/- 0.1 V peak-to-peak at BNC3 FUNCTION MONITOR. With an oscilloscope and high voltage probe verify that a 2400 +/- 200 V peak-to-peak clean sine wave occurs at Gyro Simulator E1 and E2 BNCs

15.7. Advance FUNCTION LEVEL Pot P1 until a sine wave clipped at approx 2900 peak-to-peak VDC is seen at E1 and E2. Assure that no arcing, amplifier instability, or other undesirable behavior occurs.

15.8. HVA1 Calibration: Set P1 FUNCTION LEVEL to minimum setting. Set S2 FUNCTION SELECT to DC Level. Set P2 DC LEVEL to maximum. Advance P1 CW until a DC Voltage of 5.0 +/- .02 VDC is measured at BNC3 FUNCTION LEVEL. Measure the DC Voltage at BNC3, the high voltage level at E1, and the DC Voltage at GR2 HVA1 MONITOR. Record values below and assure that they are within stated limits

Measurement	Location	Limits	Actual Level
HVA1 In	BNC3	5.00 +/-.02 Vdc	__________
HVA1 Out	E1	1000 +/- 50 Vdc	__________
HVA1 Monitor	GR2	5.00 +/- .25 Vdc	__________

15.9. **HVA2 Calibration:** Set P1 FUNCTION LEVEL to minimum setting. Set S2 FUNCTION SELECT to DC Level. Set P2 DC LEVEL to maximum. Advance P1 CW until a DC Voltage of 5.0 +/- .02 VDC is measured at BNC3 FUNCTION LEVEL. Measure the DC Voltage at BNC3, the high voltage level at E2, and the DC Voltage at GR2 HVA2 MONITOR. Record values below and assure that they are within acceptable limits

Measurement	Location	Limits	Actual Level
HVA2 In	BNC3	5.00 +/- .02 Vdc	__________
HVA2 Out	E2	1000 +/- 50 Vdc	__________
HVA2 Monitor	GR3	5.00 +/- .25 Vdc	__________

16.0 HVA FREQUENCY RESPONSE

16.1. Connect the network analyzer SOURCE output to the Controller BNC2 EXTERNAL FUNCTION GENERATOR input.

16.2. Set Controller S2 FUNCTION SELECT switch to EXTERNAL. Momentarily depress HVA SELECT S3. Set S5 EXCITATION LEVEL to high. Set S6 and S7 HVA input switches ON. Set S8 and S9 LVA input switches OFF

16.3. Connect the network analyzer INPUT 1 to the Gyro Simulator E1 electrode monitor BNC through apropriate voltage probe. Set the analyzer output and Controller P1 FUNCTION LEVEL pot to get a +/- 200 VDC peak to peak output at the E1 BNC.

16.4. Record the HVA1 frequency response in bode plot format

16.5. Connect the network analyzer INPUT 1 to the Gyro Simulator E2 electrode monitor BNC through apropriate voltage probe. Set the analyzer output and Controller P1 FUNCTION LEVEL pot to get a +/- 200 VDC peak to peak output at the E2 BNC.

16.6. Record the HVA2 frequency response in bode plot format

16.7. Sign and date the plots obtained in 16.5 and 16.8 and attach to the test procedure document

17.0 TRANSIENT THUMP TEST

17.1. Set Controller S5 EXCITATION LEVEL to High. Set S2 FUNCTION SELECT to Square Wave. Set the P1 FUNCTION LEVEL minimum.

17.2. Turn that both high voltage supplies OFF. Connect oscilloscope and probe to E1. Turn S6 HV IN 1 switch ON and S7 HV IN 2 switch S9 OFF.

17.3. Turn both high voltage supplies ON and advance P1 untill a 200 +/- 10 volt peak-to-peak square wave at E1. Disconnect the scope probe from E1.

17.4. With an oscilloscope measure the maximum amplitude of the transient on the bridge position signal at Controller POSITION BNC15 at the input square wave transition points

Transient = __________ V zero-to-peak

17.5. Turn both high voltage supplies OFF. Set P1 to mimimum. Connect oscilloscope and probe to E2. Turn S6 HV IN 1 switch OFF and S7 HV IN 2 switch ON.

17.6. Turn both high voltage supplies ON and advance P1 untill a 200 +/- 10 volt peak-to-peak square wave at E2. Disconnect the scope probe from E2.

17.7. With an oscilloscope measure the maximum amplitude of the transient on the bridge position signal at Controller POSITION BNC15 at the input square wave transition points

Transient = __________ V zero-to-peak

18.0 LVA INPUT VERIFICATION

18.1. Turn the high voltage supplies OFF. Turn S6 HV IN 1 and S7 HV IN 2 both OFF. Set S2 to Sine Wave. Set P1 FUNCTION LEVEL a 10 v +/- .5 p-p sine wave is seen on the oscilloscope connected to the FUNCTION MONITOR BNC3.

18.2. Turn S8 LV IN 1 and S9 LV IN 2 both ON. Press S4 LV AMP SELECT on momentarily to cycle the relays K1 and K2 to the LV position. With an oscilloscope observe a 10 V +/- 1 V sine wave is seen at the Gyro Simulator BNCs E1 and E2 (the 400 mV 34.1 kHz excitation may be noticeable superimposed on this signal)

19.0 Completion of Procedure:

		P/F	Notes
19.1.	Remove power from the DUT enclosure; disconnect cables		
19.2.	Return DUT to ESD packaging.		

20.0 Certification:

The results obtained in the performance of this test procedure are acceptable.

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	