W. W. Hansen Experimental Physics Laboratory
STANFORD UNIVERSITY
STANFORD, CALIFORNIA 94305-4085

Gravity Probe B Relativity Mission

LOW PRESSURE VOLTAGE BREAKDOWN TEST PROCEDURE FOR GSS FSU FLIGHT SPARE HVA BOARD

October 28, 2002

P0938 Rev –

PN: 8A01879-101 REV:_____

Flight Spare HVA Board S/N: _____

Date Performed:_____

Prepared by: Paul Shestople	Date
Approved by: William Bencze Payload Electronics Manager	Date
Approved by: Dorrene Ross GP-B Quality Assurance	Date
Approved by: Richard Whelan GP-B Systems Engineering	Date

ITAR Assessment Performed _____ ITAR Control Req'd? ☐ Yes ☐ No
Tom Langenstein

Table of Contents:

1.0 Revision History

Rev Level	Comments/notes	Date	Revised By
-	First release of this test procedure	28 Oct. 2002	P Shestople

2.0 Scope

This procedure details operations required to test the low pressure breakdown voltage of a GSS FSU flight spare unit, PN 26225-101.

This procedure ☐ Does ☒ Does not provide formal verification of GP-B requirements.
This procedure ☐ Does ☒ Does not include constraints and restrictions for the Payload.

3.0 Formal Requirements Verification

This procedure addresses, but does not formally verify, the following GSS box-level requirement:
PLSE 13-1 Rev A, Paragraph 3.3.9.3, Forward Unit Corona Breakdown

4.0 Reference Documents

4.1.	PLSE 13-1 Rev A	GSS Specification
4.2.	P0663	GSS Gold System Hardware and Software Configuration Standard
4.3.	P0758	GSS GSE Electrical Test Procedure
4.4.	SU 26225-101	Assembly Drawing for the Forward Suspension Unit (FSU)
4.5.	MIL-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment
4.6.	MIL-STD-1540C	Test Requirements for Launch, Upper-stage, and Space Vehicles, Section 6.4.2.

5.0 Test Facilities

Primary facility: Stanford University Thermal Vacuum Facility, HEPL END Station III, Rm 175

Other facility: _____

6.0 QA Provisions

6.1. This procedure shall be conducted on a formal basis to its latest approved and released version. The QA Program Engineer (D. Ross) and the ONR representative (E. Ingraham) shall be notified 24 hours prior to the 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)	ONR (E. Ingraham)

6.2. 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.

7.0 Test Personnel

This test procedure is to be conducted only by the following personnel, or others designated by the GSS RE at the time of test (redline names in below as required)

7.1. William Bencze

7.2. Paul Shestople

7.3. Scott Smader

8.0 General Instructions

8.1. Redlines can be initiated by the test personnel listed in Section 7.0 and must be approved by QA.

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

8.3. 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.

8.4. Only the following persons have the authority to exit/terminate this test or perform a retest: test operators listed in Section 7.0 and GP-B QA.

9.0 Hardware Safety Requirements:

9.1. 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

9.2. Ensure that power is removed from cable assemblies before connecting or disconnecting cable connectors, and during evacuation and venting of TVAC chamber.

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

9.4. 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.

10.0 Special Test Notes

10.1 This test is not deliberately meant to be a spark test. However, as there is a chance that the test could cause permanent damage to the high voltage cards, it is strongly advised that this test be conducted only on the GSS FSU Flight SPARE, and only after all other testing has been complete.

10.2 THE FSU USES HIGH VOLTAGE (750 V). IF THE UNIT IS POWERED ON DURING THE EVACUATION OF THE CHAMBER, THE FSU WILL ALM0ST CERTAINLY SHORT, POSSIBLY DAMAGING THE FSU. THEREFORE:

10.2.1 THE EXTERNAL POWER CABLES MUST BE DISCONNECTED DURING THE EVACUATION AND VENTING OF THE TVAC CHAMBER.

10.2.2 HIGH VOLTAGE MUST BE TURNED OFF BETWEEN SUCCESSIVE PRESSURE STEPS.

11.0 External Test Equipment

The following support hardware 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.

Item	Equipment Description	Qty	Make	PN	SN	Cal Due
1.	Thermal Vacuum test chamber	1	SU	001	001	N/A
2.	Feedthrough	1	Douglas Engineering	24056		NA
3.	TVAC FSU mounting plate	1	SU	N/A	N/A	N/A
4.	Frequency Generator	1	SRS	DS345	20311	N/A
5.	High Voltage Power Supply	1	SRS	PS325	02262	N/A
6.	High Voltage Power Supply	1	SRS	PS325	02269	N/A
7.	O-Scope	1	Hitachi	V-212	9062446	
8.	Multimeter	1	Fluke			
9.	FSU Diagnostic Box	1	SU	N/A	N/A	N/A
10.						
11.						
12.						
13.						
14.						

12.0 Device Under Test (DUT):

Record the serial number of the Device Undergoing Test, or DUT.

8A01424-101 **GSS FSU FLIGHT SPARE CHASSIS**	SN:	

8A01879-101 **GSS FSU FLIGHT SPARE HVA BOARD**	SN:	

Test Operator:	Name:	

Start of test:	Date: Time:	

13.0 Installation of DUT in Chamber

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

13.1 Remove DUT from its storage container. Visually inspect all connectors for damage. Istall the dummy loads using the Pasternack coax cables.

13.2 Install DUT into the TVAC Chamber.

13.2.1 Place FSU DUT on cold plate adapter plate. Bolt the FSU DUT to the cold plate adapter plate with four ¼ x 20 bolts, with washers, torqued to 30 in-lbs ± 5 in-lbs.

13.2.2 Place the FSU DUT and cold plate adapter plate into the TVAC Chamber.

13.2.3 Secure the cold plate adapter to the cold plate using with four ¼ x 20 bolts, with washers, torqued to 30 in-lbs ± 5 in-lbs.

13.3 Install test cables, as shown in Figure 2 and described below

13.3.1 Remove the end covers (PN 8A02425-101 and 8A02426-101) from the chassis.

13.3.1.1 The red clip is connected to the positive nub on the rear of the HVA card.

13.3.1.2 The black clip is connected to the negative nub on the rear of the HVA card.

13.3.1.3 The 20 pin connector is connected to the 20 pin connector on the front face of the HVA card.

13.3.2 Replace the chassis covers, being careful not to crush the wires; use spacers if needed.

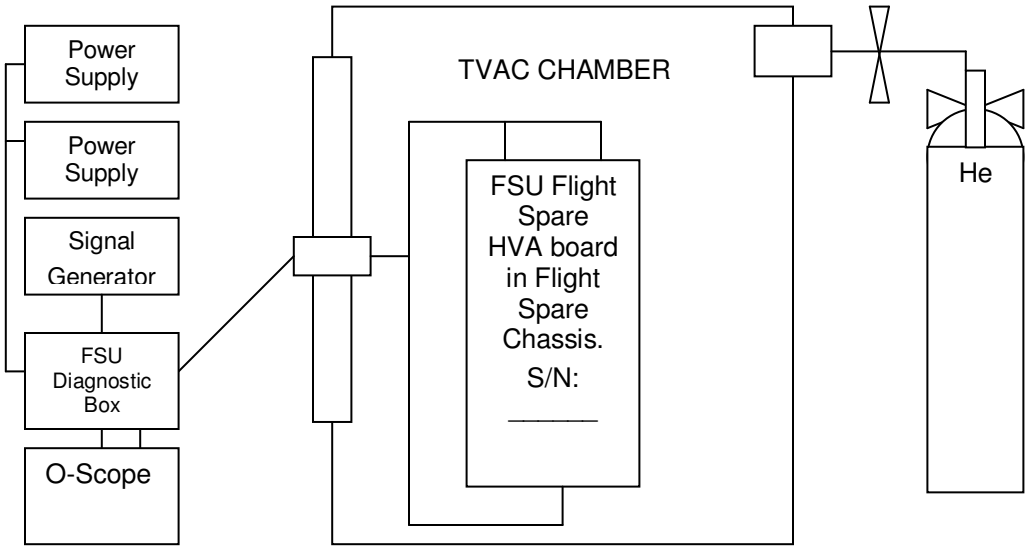

Figure 2 – TVAC Setup

Installation Complete:

Test Engineer _____ Date _____

14.0 Test Procedure

14.1 *Adjusting the Helium pressure between successive low pressure high voltage tests.* A set of two needle valves is mounted on the left hand side of the chamber. The needle values, along with the Helium cylinder regulator and two in-line values, can be used to finely adjust the pressure inside the chamber.

14.1.1 Double check to make sure the DUT power supplies are off.

14.1.2 Double check to make sure that all valves are closed.

14.1.3 Adjust the Helium Cylinder regulator to 5 PSI. Open the Helium cylinder valve.

14.1.4 Open the values between the regulator and the needle values. A half turn is sufficient.

14.1.5 While monitoring the chamber pressure, slowly open the needle values until the proper chamber pressure is achieved.

14.1.6 Do not begin the test until after the pressure has stabilized for 1 minute, to ensure that no pressure spikes occur.

14.2 *Low Pressure High Voltage Test.* The following steps are performed at each pressure listed in section 15.

14.2.1 Verify that the Function Level potentiometer on the FSU Diagnostic box is turned fully counter clockwise.

14.2.2 Turn on the power to each GSE box. Set the high side power voltage to + 725 volts and the low side power supply to -725 volts. Set the current limiting to 2 amps.

14.2.3 Turn on the power out rocker switch on both power supplies. Verify that the current draw on each power supply has roughly the same value. To start, the currents will be around 0.9 A.

14.2.4 Slowly turn the Function Level potentiometer on the FSU Diagnostic box clockwise. This increases the voltage to the high voltage amplifier in the FSU. While turning the potentiometer, monitor both the o-scope and the power supplies.

14.2.4.1 The currents displayed on the power supplies will steadily increase. If the currents suddenly decrease, the high voltage amplifier has "sparked" and the test is over. Annotate the last current seen before the breakdown.

14.2.4.2 The wave form on the o-scope will go from a straight line to a triangle wave. If the waveform on the oscilloscope becomes a straight line before the end of the test, the board has shorted and the test is over.

14.2.5 Continue to monitor the currents and the oscilloscope. Above 1.9 A, the amplifier becomes saturated and the wave form become truncated. If the wave form has not flat-lined and the power supplies have not tripped, the test was successful.

14.2.6 Annotate Pass or Fail on the test log in section 16. Shut the power supplies off.

15.0 Test Log

Step	Description	Nominal Pressure (Torr)	Time Pressure	P/F
15.1	Pre-Vacuum, Ambient Functional Test	760		
15.2	Evacuate chamber pressure to 0.00001 Torr. Allow chamber to pump for at least five hours before performing the test listed in Section 14.2.	0.00001		
15.3	Increase chamber pressure to 0.00005 Torr, as described in section 14.1. Perform the test described in section 14.2.	0.00005		
15.4	Increase chamber pressure to 0.0001 Torr, as described in section 14.1. Perform the test described in section 14.2.	0.0001		
15.5	Increase chamber pressure to 0.0005 Torr, as described in section 14.1. Perform the test described in section 14.2.	0.0005		
15.6	Increase chamber pressure to 0.001 Torr, as described in section 14.1. Perform the test described in section 14.2.	0.001		
15.7	Increase chamber pressure to 0.005 Torr, as described in section 14.1. Perform the test described in section 14.2.	0.005		
15.8	Increase chamber pressure to 0.010 Torr, as described in section 14.1. Perform the test described in section 14.2.	0.010		
15.9	Increase chamber pressure to as high as possible before the cold cathode gauge cuts off. This should be around 0.050 Torr. Perform the test described in section 14.2.	≈ 0.050		
15.10	Increase chamber pressure to 760, as described in section 14.1. Perform the test described in section 14.2.	760		

16.0 Completion of Procedure

	P/F	Notes
Remove DUT from TVAC Chamber.		
Return DUT to storage container.		

17.0 Certification

The undersigned 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	