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Gravity Probe B Relativity Mission

BOARD-LEVEL TEST PROCEDURE FOR THE GYROSCOPE SUSPENSION SYSTEM (GSS) ANALOG BACKUP CONTROLLER (ABU) BOARD

PWA 8A01884 Rev C S/N:

GP-B Procedure
P0858 Rev -

Prepared by: Mike Irwin Date
RE, ABU

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

Approved by: Dorrene Ross Date
GP-B Quality Assurance

TABLE OF CONTENTS

1 REVISION HISTORY

Rev Level	Comments/notes	Date	Revised By
-	First release of this test procedure	03-Jul-01	M. Irwin

2 SCOPE

This procedure – a board-level electrical function test for the GSS Analog Backup Controller (ABU) card – is a subset (and some minor modifications) of the procedure P0736. This procedure verifies the functionality of the revision level C PWA, after rework has been performed on it. Places are clearly identified, where instructions or sections of the test have been deleted. Places where measurements to be recorded have been deleted, will be indicated by their boxes being gray shaded.

This test requires a Forward Backplane card which is electrically and interface equivalent of the GSS flight units.

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. Upon successful completion of this procedure, this board is considered electrically functional.

3 REFERENCE DOCUMENTS

3.1 PWA Drawing, GSS Analog Backup Controller board, 8A01884C.

3.2 PWB Drawing, GSS Analog Backup Controller board, 8A01888A.

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

4 TEST FACILITIES

HEPL Room 127, Stanford University.

5 QA PROVISIONS

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 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) ONR (E. Ingraham)

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 TEST PERSONNEL

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

- Mike Irwin
- Lo Van Ho

7 GENERAL INSTRUCTIONS

7.1 Redlines can be initiated by the test personnel listed in section 6 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 will be documented in a Discrepancy Log, which will be attached to this report. Any significant problems will be listed in a Discrepancy Report. Refer to the Quality Plan, P0108. 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 and GP-B QA.

8 HARDWARE SAFETY INSTRUCTIONS

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 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 EQUIPMENT SAFETY REQUIREMENTS

Record the serial number of the Forward Backplane to be used during this test.

GSS FSU Forward Backplane	SN:	

10 ADDITIONAL TEST EQUIPMENT

The following support hardware, and test equipment 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	Qty	Make	Model	SN	Cal Due
Multimeter	1	Fluke			
Multimeter	1 (opt)	Fluke			
Multimeter	1 (opt)	Fluke			
Dynamic Signal Analyzer	1	HP	3562A	3005A05537	
Signal Generator	1	SRS	345		
Oscilloscope	1	Tek			
ABU Test Cable Harness	1	GSS	NA	NA	NA
De-bounced Switch Box	1	GSS	NA	NA	NA

11 DEVICE UNDER TEST (DUT)

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

PWA 8A01884 GSS ABU Card	SN:	

Test Operator:	Name:	

Start of test:	Date:	

12 PRE-TEST VISUAL INSPECTION

Note: All handling of this PWA shall be performed using ESD control methods, as outlined in MIL-STD-1686. Do not remove PWA from storage container until unit is within the confines of an ESD certified station, test operators are wearing wrist straps and/or heel grounding straps, and any other necessary ESD precautions have been taken.

Test/Activity	✓	Notes
Verify that all PWB component footprints contain a part, except positions: R6, R14, R30, R49, R50 and U15.		
Verify that the all diodes (D1 – D18) are installed in the proper orientation.		
Verify that the following capacitors have the proper orientation: C32, C33, C73, C74, C75.		
Verify that JP1 jumper block is not installed on JP1 jumper posts.		
Verify the proper orientation of pin 1 of all DIP packages, 42 Places.		
Verify that capacitor spacers have been installed as specified in the assembly drawing.		
Verify that heatsinks have been installed under IC's: U19, U20, U21 and U25.		
Verify that both the stiffener and wedgelocks have been installed.		

13 PRE-INSERTION STATIC ELECTRICAL TESTS

Verify that no short circuit exists between any pair combination of power or ground conductors: +12V, -12V, +5VA, AGND, AGND REF. Perform measurements prescribed in table, following this procedure:

- Set multimeter to “ohms” function.
- Use gold-tipped Pomona test probes for all measurements.
- Note orientation of (+) and (-) leads on meter.
- Measure resistance between indicated circuit nodes (PWA test point, or connector reference designators).
- After leads are in contact with the PWA, wait until meter reading at least exceeds stated requirement.

Node Pair	Measurement	Requirement	✓
TP1 / TP2		> 500kohms	
TP1 / TP3		> 500kohms	
TP1 / TP4		> 500kohms	
TP2 / TP3		> 500kohms	
TP2 / TP4		> 500kohms	
TP3 / TP4		> 500kohms	
CN1 pin 19 / TP1		> 500kohms	
CN1 pin 19 / TP2		> 500kohms	
CN1 pin 19 / TP3		> 500kohms	
CN1 pin 19 / TP4		> 500kohms	

14 IN-SYSTEM TESTING – FLIGHT CONFIGURATION

Note: Tests run in this section are run with the hardware in “flight” configuration: no external test equipment or cables. The tests here use only the onboard diagnostic facilities of the GSS hardware. These will be the equivalent of the on-orbit tests of this system.

This section not applicable

15 IN-SYSTEM TESTING – GROUND TEST CONFIGURATION

Note: Tests run in this section require the addition of test cables and external test hardware. They are used to verify functioning of the board in fine detail, and are only used at the time of board-level test and acceptance. These may be considered “Engineering Confidence Tests”.

15.1 Test Bench Preparation

This board-level test does not require the aft GSS unit. It only requires a forward backplane, and preferably an FSU enclosure.

- Inspect test bench. Ensure that rack power supplies are properly cabled, and voltage levels are correct.
- Referring to Table 15.2.3, connect test harness cables to DUT circuit nodes.
- Install DUT into its proper slot in the forward enclosure. *(no FSU covers required for this test)*
- Apply power to the FSU enclosure.

15.2 PWA Function Configuration Reference

Throughout this procedure, the ABU configuration must be set via two Mode Register bit settings: Controller Select (CNTL), and SU Position Goal Select (SU_GOAL). Refer to the following two tables to determine PC610 jumper settings necessary to obtain the required state. For each jumper block, there are two setting options: jumper pins 1 and 2, or jumper pins 2 and 3.

15.2.1 Controller Select Jumper Settings

Controller Select (CNTL)	PC610 JP18 (HBU/LBU)	PC610 JP34 (MODE1)
SMLB	2-3	2-3
SMHB	1-2	2-3
SU	x	1-2

15.2.2 SU Position Goal Select Jumper Settings

SU Posn Goal Select (SU_GOAL)	PC610 JP33 (SU_CMD_1)	PC610 JP30 (SU_CMD_2)	PC610 JP27 (SU_CMD_3)
Center (CTR)	2-3	2-3	2-3
Offset posn 1 (OFF1)	2-3	2-3	1-2
Offset posn 2 (OFF2)	2-3	1-2	1-2
Offset posn 3 (OFF3)	1-2	1-2	1-2

Refer to the following table to determine which PWA test point (ref des) corresponds to a given node name.

15.2.3 PWA Signal Node Test Points

ABU Node (Signal) Name	Testpoint (axis indep)	*	Testpoint (n = X)	*	Testpoint (n = Y)	*	Testpoint (n = Z)	*
AGND	TP4, 9, 23							
AMP_n1_CMD			TP26		TP28		TP30	
AMP_n2_CMD			TP25		TP27		TP29	
CNTL_n_LIM			TP10		TP11		TP12	
M12A	TP2							
n*Un			TP13		TP14		TP15	
P5A	TP3							
P12A	TP1							
POS_n			TP21		TP22		TP24	
POS_n_N			TP16		TP18		TP20	
PRE_XY	TP19							
PRE_Z	TP17							
SU_CMD	TP5							

* Test personnel can (optionally) fill in these table entries to document which test cable harness pin, if any, has been assigned to each ABU signal node.

15.3 Supply and Reference DC Voltages

** Section 15 calls for DC voltage measurements and recording of the results in tables, to within a prescribed resolution. Note the following details and procedure for these measurements:

- Use multimeter for Vdc measurements, set to "V" function, and "auto" mode.
- Use gold-tipped Pomona test probes for all measurements. Remove probes from DUT when finished.
- All table values are in volts, and all measurements refer to the voltage potential between the specified node and the AGND node (always attack black multimeter probe to AGND).
- Record measurement with two or three decimal places, using the listed +/- Lim values to determine if two or three significant figures are called for (round measurement to the nearest mV, as required).
- There is an upper/lower limit adjacent to every prescribed measurement, in any row of any table. If all measurements in a row are within their respective allowed range, check the box at the right of the row (indicating acceptance of ALL measurements in that table row). If any one measurement is beyond it's limit, do not check the box (indicating one or more out-of-bounds measurements in the row).

15.3.1 Measure power supply voltages, and "preload" reference voltages **.

P12A			M12A			P5A			✓
- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	
11.90		12.10	-12.10		-11.90	4.90		5.10	

PRE_XY			PRE_Z			✓
- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	
-5.01		-4.99	4.99		5.01	

15.3.2 Measure SU_GOAL reference voltages **.

- Set: CNTL = SU; SU_GOAL = CTR.

SU_CMD			✓
- Lim	Meas Val	+ Lim	
-0.002		0.038	

- Set: SU_GOAL = OFF1 (CNTL = SU).

SU_CMD			✓
- Lim	Meas Val	+ Lim	
-1.736		-1.696	

- Set: SU_GOAL = OFF2 (CNTL = SU).

SU_CMD			✓
- Lim	Meas Val	+ Lim	
-2.190		-2.150	

- Set: SU_GOAL = OFF3 (CNTL = SU).

SU_CMD			✓
- Lim	Meas Val	+ Lim	
-2.644		-2.604	

15.4 SU_GOAL Reference Voltage Transitions

During switching, the voltage (over time) transition between each adjacent pairs of SU_GOAL reference voltages must adhere to certain requirements. Observe and check this switched signal in the time domain.

- Set: SU_GOAL = CTR (CNTL = SU).
- On PC610 test card, remove jumper from jumper block JP27.
- Connect BNC side of a BNC-clip coax cable to any channel of the debounced switch box. Connect the red clip (on the cable's other side) to the center pin (pin 2) of jumper block JP27 (PC610 test card). There is no need to connect the black clip.
- Connect one oscilloscope probe to DUT circuit node: SU_CMD.
- Set the oscilloscope channels to display: 500mV/div; 1mS/div.
- Set oscilloscope for single event trigger, at approx. –0.2V trigger level.

Test/Activity	✓	Notes
Toggle the switch on the switch box. Verify qualitatively that the SU_CMD signal smoothly transitions (curve shape, not step) from initial value to final value, and back again. Verify that the transition time is >/= 2mS.		

- On PC610 test card, remove red clip, and replace jumper on pins 1 and 2 of jumper block JP27.
- On PC610 test card, remove jumper from jumper block JP30.
- Reconnect the red clip to the center pin (pin 2) of jumper block JP30.
- Set oscilloscope for single event trigger, at approx. –1.8V trigger level.

Test/Activity	✓	Notes
Toggle the switch on the switch box. Verify qualitatively that the SU_CMD signal smoothly transitions (curve shape, not step) from initial value to final value, and back again. Verify that the transition time is >/= 2mS.		

- On PC610 test card, remove red clip, and replace jumper on pins 1 and 2 of jumper block JP30.
- On PC610 test card, remove jumper from jumper block JP33.
- Reconnect the red clip to the center pin (pin 2) of jumper block JP33.
- Set oscilloscope for single event trigger, at approx. –2.4V trigger level.

Test/Activity	✓	Notes
Toggle the switch on the switch box. Verify qualitatively that the SU_CMD signal smoothly transitions (curve shape, not step) from initial value to final value, and back again. Verify that the transition time is >/= 2mS.		

- Disconnect the oscilloscope probe from DUT PWA, and disconnect the red clip from PC610.

15.5 POS – POSN Transfer Function

This section has been removed. It is not required for abbreviated test.

15.6 POS – CNTL_LIM Transfer Function

The ABU has three controller blocks, each applying three axis control. Qualitatively observe and check these transfer functions in the time domain.

15.6.1 Observe SMLB POS – CNTL_LIM transfer function

- Verify: CNTL = SMLB; SU_GOAL = CTR.
- Set function generator to provide: Triangle waveform; 0.5Hz; 0.2Vpp; 0V offset.
- Connect oscilloscope probe to DUT circuit node: CNTL_X_LIM.
- Set oscilloscope channel display: 2V/div; 100mS/div. Observe that CNTL_X_LIM waveform is a triangle wave, clipped near the positive and negative peaks.

Test/Activity	✓	Notes
Verify qualitatively that CNTL_X_LIM waveform is linear in the unclipped portions of the waveform.		
Verify qualitatively that CNTL_X_LIM has a “sharp knee” at all places where clipping begins.		
Verify that both positive and negative clipping of CNTL_X_LIM occurs at a magnitude of: 5.1V +/- 0.2V.		
(This instruction has been removed. It is not required for abbreviated test.)		
(This instruction has been removed. It is not required for abbreviated test.)		

- Connect oscilloscope probe to DUT circuit node: CNTL_Y_LIM.

Test/Activity	✓	Notes
Verify qualitatively that CNTL_Y_LIM waveform is linear in the unclipped portions of the waveform.		
Verify qualitatively that CNTL_Y_LIM has a “sharp knee” at all places where clipping begins.		
Verify that both positive and negative clipping of CNTL_Y_LIM occurs at a magnitude of: 5.1V +/- 0.2V.		
(This instruction has been removed. It is not required for abbreviated test.)		
(This instruction has been removed. It is not required for abbreviated test.)		

- Connect oscilloscope probe to DUT circuit node: CNTL_Z_LIM.

Test/Activity	✓	Notes
Verify qualitatively that CNTL_Z_LIM waveform is linear in the unclipped portions of the waveform.		
Verify qualitatively that CNTL_Z_LIM has a “sharp knee” at all places where clipping begins.		
Verify that both positive and negative clipping of CNTL_Z_LIM occurs at a magnitude of: 5.1V +/- 0.2V.		
(This instruction has been removed. It is not required for abbreviated test.)		
(This instruction has been removed. It is not required for abbreviated test.)		

- Disconnect oscilloscope probe from DUT.

15.6.2 Observe SMHB POS – CNTL_LIM transfer function

This section has been removed. It is not required for abbreviated test.

15.6.3 Observe SU POS – CNTL_LIM transfer function

This section has been removed. It is not required for abbreviated test.

15.7 Output DC Voltages as a Function of Input Voltages

Fundamentally, the ABU consists of three Bridge inputs, which through several circuit paths produce six outputs (actuator inputs). The circuit paths contain a number of gain stages that need to be checked. In the six tables that follow below, DC voltages will be applied to DUT inputs, and DC voltage responses will be measured at output circuit nodes.

Each table consists of from one to seven input voltage tests (listed in the “Input” column). For each test, the listed input voltage is applied simultaneously to the POS_X, POS_Y, and POS_Z inputs. The six output responses are then measured. Depending on the result of these six measurements, additional intermediate circuit node responses may also require measurement. This process is then repeated for each input voltage value.

Measurement Setup

- The function generator setup should be maintained from the last section. As such, the function generator voltage output will be applied simultaneously to all three inputs: POS_X, POS_Y, and POS_Z.
- Set function generator to provide: Sine wave; 0Hz; 0Vpp; 0V offset.
- Connect one multimeter to DUT node POS_X **.
- During this series of measurements, optionally use a second and third multimeter, as deemed most efficient.

Measurement Procedure

1. Set function generator V offset to the nominal value listed in “Input” column of the table**. Skip input values where the entry boxes, in that row, have been greyed-out (these measurement steps have been deleted in the abbreviated test)**.
2. Toggle the +/-0.01V buttons until the POS_X multimeter indicates a value that is within the allowed range (listed in the table). Record the actual input value in the “POS” column **.
3. Measure the resultant output DC voltages on DUT nodes AMP_X1_CMD and AMP_X2_CMD, and record the values in the “AMP_1_CMD and “AMP_2_CMD” columns, respectively **.
4. If both measured output values (step 3) are within their allowed ranges, check the box at the right of their row (in the table). If either value is out of bounds, DO NOT check the box.
5. Repeat steps 3 and 4 for Y1 and Y2 DUT nodes; and then repeat steps 3 and 4 again, for Z1 and Z2 DUT nodes. Note that for any given input, the X1 and Y1 measured values are expected to be nominally identical, and therefore have the same tolerance range. This is also the case for the X2 and Y2 values.
6. If during step 3 through 5 an out-of-bounds measurement occurred, make additional measurements. For any axis (table row) that contain a “failed” measurement, measure the three additional DUT nodes: POSn_N, CNTL_n_LIM, and n*Un. Record the results in the last three columns of the table.

Measurement Interpretation

If an out-of-bounds output measurement occurs, this does not necessarily indicate a flaw in the PWA functionality. The mathematical tolerances used to create the “acceptance” ranges in these tables are conservative. They are designed to expose systematic flaws in a given DUT (i.e. an incorrect gain in some node). If there are a small number of scattered “failures” throughout these tables, the DUT is likely still functional. Any table row which contains a failure will be “hand checked” mathematically (using the output values, and the additional intermediate node measurements) to ensure that the DUT performance is indeed acceptable. Additional documentation will be attached to this test report for all such cases, showing that the values have been checked and approved.

15.7.1 Measure SMLB Controller DC Voltage Response

- Set: CNTL = SMLB (SU_GOAL = CTR).

Input	POS			AMP_1_CMD			AMP_2_CMD			✓	POS_N	CNTL_LIM	U*POS
0.00	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	-0.010		0.010	0.016		0.026	0.016		0.026				
Y Axis													
Z Axis				-0.046		-0.036	-0.046		-0.036				
1.77	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	1.760		1.780	-0.234		-0.212	0.326		0.360				
Y Axis													
Z Axis				0.080		0.090	-0.217		-0.196				
0.05	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	0.040		0.060	-0.246		-0.223	0.264		0.292				
Y Axis													
Z Axis				0.081		0.091	-0.178		-0.161				
0.02	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	0.010		0.030	-0.087		-0.077	0.117		0.129				
Y Axis													
Z Axis				0.005		0.015	-0.098		-0.088				
-0.03	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	-0.040		-0.020	0.166		0.183	-0.139		-0.126				
Y Axis													
Z Axis				-0.124		-0.112	0.030		0.040				
-0.05	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	-0.060		-0.040	0.264		0.292	-0.246		-0.223				
Y Axis													
Z Axis				-0.178		-0.161	0.081		0.091				
-1.77	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	-1.780		-1.760	0.326		0.360	-0.234		-0.212				
Y Axis													
Z Axis				-0.217		-0.196	0.080		0.090				

15.7.2 Measure SMHB Controller DC Voltage Response

- Set: CNTL = SMHB (SU_GOAL = CTR).

Input	POS			AMP1_CMD			AMP2_CMD			✓	POS_N	CNTL_LIM	U*POS
0.00	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	-0.010		0.010	1.983		2.236	1.983		2.236				
Y Axis													
Z Axis				-4.38		-3.884	-4.38		-3.884				
5.32	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	5.31		5.33	-1.282		-1.137	8.44		9.52				
Y Axis													
Z Axis				-1.222		-1.084	-9.42		-8.35				
3.74	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	3.730		3.750	-1.495		-1.325	7.59		8.56				
Y Axis													
Z Axis				-1.534		-1.360	-8.52		-7.55				
1.00	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	0.990		1.010	0.874		0.985	3.257		3.673				
Y Axis													
Z Axis				-3.492		-3.097	-5.36		-4.75				
-3.00	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	-3.010		-2.990	6.30		7.10	-0.962		-0.853				
Y Axis													
Z Axis				-7.60		-6.74	-1.994		-1.769				
-3.74	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	-3.750		-3.730	7.59		8.56	-1.495		-1.325				
Y Axis													
Z Axis				-8.52		-7.55	-1.534		-1.360				
-5.32	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	-5.33		-5.31	8.44		9.52	-1.282		-1.137				
Y Axis													
Z Axis				-9.42		-8.35	-1.222		-1.084				

15.7.3 Measure SU Controller DC Voltage Response, SU_GOAL = CTR

- Set: CNTL = SU (SU_GOAL = CTR).

Input	POS			AMP1_CMD			AMP2_CMD			✓	POS_N	CNTL_LIM	U*POS
0.02	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	0.010		0.030	0.356		0.482	0.363		0.491				
Y Axis													
Z Axis				-0.972		-0.718	-0.979		-0.724				
0.50	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	0.490		0.510										
Y Axis													
Z Axis													
0.10	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	0.090		0.110	0.237		0.320	0.484		0.656				
Y Axis													
Z Axis				-0.886		-0.655	-1.066		-0.788				
-0.30	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	-0.310		-0.290	0.849		1.149	-0.166		-0.086				
Y Axis													
Z Axis				-1.324		-0.978	-0.643		-0.475				
-0.49	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	-0.500		-0.480										
Y Axis													
Z Axis													

15.7.4 Measure SU Controller DC Voltage Response, SU_GOAL = OFF1

- Set: SU_GOAL = OFF1 (CNTL = SU).

Input	POS			AMP1_CMD			AMP2_CMD			✓	POS_N	CNTL_LIM	U*POS
	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis													
Y Axis													
Z Axis													

15.7.5 Measure SU Controller DC Voltage Response, SU_GOAL = OFF2

- Set: SU_GOAL = OFF2 (CNTL = SU).

Input	POS			AMP1_CMD			AMP2_CMD			✓	POS_N	CNTL_LIM	U*POS
	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis													
Y Axis													
Z Axis													

15.7.6 Measure SU Controller DC Voltage Response, SU_GOAL = OFF3

- Set: SU_GOAL = OFF3 (CNTL = SU).

Input	POS			AMP1_CMD			AMP2_CMD			✓	POS_N	CNTL_LIM	U*POS
	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis													
Y Axis													
Z Axis													
-2.54	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	-2.550		-2.530	0.284		0.384	0.385		0.520				
Y Axis													
Z Axis				-1.073		-0.793	-0.843		-0.623				
-2.62	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	-2.630		-2.610	0.428		0.580	0.289		0.390				
Y Axis													
Z Axis				-1.176		-0.869	-0.773		-0.572				
-2.94	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis	-2.950		-2.930	1.023		1.384	-0.135		-0.055				
Y Axis													
Z Axis				-1.596		-1.180	-0.505		-0.374				
	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim	- Lim	Meas Val	+ Lim		Meas Val	Meas Val	Meas Val
X Axis													
Y Axis													
Z Axis													

15.8 POS – CNTL_LIM Transfer Function, Part II

- Disconnect multimeter probe(s) from DUT; and disconnect all function generator cables from PC610 card.
- On the dynamic signal analyzer (hereafter referred to as the HP3562), connect a tee-splitter to the CHANNEL1 connector.
- Use a short coax cable, to connect one side of the above tee-splitter to the HP3562 SOURCE connector.
- Connect the BNC side of a BNC-SMA coax cable to the tee-splitter. Connect the SMA side of the cable to the POS_X SMA connector on the PC610 test card.
- Connect the BNC side of a BNC-clip coax cable to the HP3562 CHANNEL2 connector. Attach the red clip (other end of the cable) to the CNTL_X_LIM node (DUT). Attach the black clip to the AGND node (DUT).

15.8.1 Measure SMLB POS – CNTL_LIM transfer function

- Set: CNTL = SMLB; SU_GOAL = CTR.
- Perform the following measurement setup on the HP3562:

Test/Activity	✓	Notes
Measurement mode: Swept sine; Log sweep		
Source: Sweep up		
Source: analog		
Source level: 10mVpk		
Frequency start: 100mHz		
Frequency span: 4.5 decades (100mHz – 3.16kHz)		
Frequency resolution: 25 points/decade min; fixed		
Averaging: fixed integration		
Ch1 and Ch2 Input coupling: DC		

- Run the HP3562 frequency response measurement.
- Create a plot using measurement frequency span for x-axis, and 20 - 60dB for y-axis. Attach to report.
- Use the cursor on the HP 3562 to verify the output response of the node at specific frequencies.

Frequency Response: SMLB CNTL_X_LIM				✓
Frequency	- Lim	Meas Val	+ Lim	
0.2Hz +/- 0.1Hz	39.1dB		40.1dB	
2Hz +/- 0.1Hz	45.8dB		47.8dB	
30Hz +/- 5Hz	51.8dB		55.8dB	
2kHz +/- 100Hz	22.9dB		26.9dB	

- Disconnect BNC-SMA cable (SMA end) from PC610 POS_X SMA; reconnect to PC610 POS_Y SMA.
- Disconnect BNC-clip cable (clip end) from DUT node CNTL_X_LIM; reconnect to node CNTL_Y_LIM.
- Run the HP3562 frequency response measurement.
- Create a plot using measurement frequency span for x-axis, and 20 - 60dB for y-axis. Attach to report.
- Use the cursor on the HP 3562 to verify the output response of the node at specific frequencies.

Frequency Response: SMLB CNTL_Y_LIM				✓
Frequency	- Lim	Meas Val	+ Lim	
0.2Hz +/- 0.1Hz	39.1dB		40.1dB	
2Hz +/- 0.1Hz	45.8dB		47.8dB	
30Hz +/- 5Hz	51.8dB		55.8dB	
2kHz +/- 100Hz	22.9dB		26.9dB	

- Disconnect BNC-SMA cable (SMA end) from PC610 POS_Y SMA; reconnect to PC610 POS_Z SMA.
- Disconnect BNC-clip cable (clip end) from DUT node CNTL_Y_LIM; reconnect to node CNTL_Z_LIM.
- Run the HP3562 frequency response measurement.
- Create a plot using measurement frequency span for x-axis, and 20 - 60dB for y-axis. Attach to report.
- Use the cursor on the HP 3562 to verify the output response of the node at specific frequencies.

Frequency Response: SMLB CNTL_Z_LIM				✓
Frequency	- Lim	Meas Val	+ Lim	
0.2Hz +/- 0.1Hz	39.1dB		40.1dB	
2Hz +/- 0.1Hz	45.8dB		47.8dB	
30Hz +/- 5Hz	51.8dB		55.8dB	
2kHz +/- 100Hz	22.9dB		26.9dB	

15.8.2 Measure SMHB POS – CNTL_LIM transfer function

- Disconnect BNC-SMA cable (SMA end) from PC610 POS_Z SMA; reconnect to PC610 POS_X SMA.
- Disconnect BNC-clip cable (clip end) from DUT node CNTL_Z_LIM; reconnect to node CNTL_X_LIM.
- Set: CNTL = SMHB (SU_GOAL = CTR).
- Perform the following measurement setup on the HP3562:

Test/Activity	✓	Notes
Measurement mode: Swept sine; Log sweep		
Source: Sweep up		
Source: analog		
Source level: 100mVpk		
Frequency start: 100mHz		
Frequency span: 4.5 decades (100mHz – 3.16kHz)		
Frequency resolution: 25 points/decade min; fixed		
Averaging: fixed integration		
Ch1 and Ch2 Input coupling: DC		

- Run the HP3562 frequency response measurement.
- Create a plot using measurement frequency span for x-axis, and 0 -20dB for y-axis. Attach to report.
- Use the cursor on the HP 3562 to verify the output response of the node at specific frequencies.

Frequency Response: SMHB CNTL_X_LIM				✓
Frequency	- Lim	Meas Val	+ Lim	
0.3Hz +/- 0.2Hz	2dB		3dB	
10Hz +/- 1Hz	9dB		11dB	
175Hz +/- 100Hz	16.7dB		18.7dB	
2kHz +/- 100Hz	7dB		9dB	

- Disconnect BNC-SMA cable (SMA end) from PC610 POS_X SMA; reconnect to PC610 POS_Y SMA.
- Disconnect BNC-clip cable (clip end) from DUT node CNTL_X_LIM; reconnect to node CNTL_Y_LIM.
- Run the HP3562 frequency response measurement.
- Create a plot using measurement frequency span for x-axis, and 0 -20dB for y-axis. Attach to report.
- Use the cursor on the HP 3562 to verify the output response of the node at specific frequencies.

Frequency Response: SMHB CNTL_Y_LIM				✓
Frequency	- Lim	Meas Val	+ Lim	
0.3Hz +/- 0.2Hz	2dB		3dB	
10Hz +/- 1Hz	9dB		11dB	
175Hz +/- 100Hz	16.7dB		18.7dB	
2kHz +/- 100Hz	7dB		9dB	

- Disconnect BNC-SMA cable (SMA end) from PC610 POS_Y SMA; reconnect to PC610 POS_Z SMA.
- Disconnect BNC-clip cable (clip end) from DUT node CNTL_Y_LIM; reconnect to node CNTL_Z_LIM.
- Run the HP3562 frequency response measurement.
- Create a plot using measurement frequency span for x-axis, and 0 - 20dB for y-axis. Attach to report.
- Use the cursor on the HP 3562 to verify the output response of the node at specific frequencies.

Frequency Response: SMHB CNTL_Z_LIM				✓
Frequency	- Lim	Meas Val	+ Lim	
0.3Hz +/- 0.2Hz	2dB		3dB	
10Hz +/- 1Hz	9dB		11dB	
175Hz +/- 100Hz	16.7dB		18.7dB	
2kHz +/- 100Hz	7dB		9dB	

15.8.3 Measure SU POS – CNTL_LIM transfer function

- Disconnect BNC-SMA cable (SMA end) from PC610 POS_Z SMA; reconnect to PC610 POS_X SMA.
- Disconnect BNC-clip cable (clip end) from DUT node CNTL_Z_LIM; reconnect to node CNTL_X_LIM.
- Set: CNTL = SU (SU_GOAL = CTR).
- Perform the following measurement setup on the HP3562:

Test/Activity	✓	Notes
Measurement mode: Swept sine; Log sweep		
Source: Sweep up		
Source: analog		
Source level: 100mVpk		
Frequency start: 1Hz		
Frequency span: 4 decades		
Frequency resolution: 25 points/decade min; fixed		
Averaging: fixed integration		
Ch1 and Ch2 Input coupling: DC		

- Run the HP3562 frequency response measurement.
- Create a plot using measurement frequency span for x-axis, and 12 - 36dB for y-axis. Attach to report.
- Use the cursor on the HP 3562 to verify the output response of the node at specific frequencies.

Frequency Response: SU CNTL_X_LIM				✓
Frequency	- Lim	Meas Val	+ Lim	
3Hz +/- 2Hz	19.9dB		20.9dB	
200Hz +/- 10Hz	26.4dB		28.4dB	
800Hz +/- 100Hz	33dB		35dB	
4kHz +/- 100Hz	20dB		22dB	

- Disconnect BNC-SMA cable (SMA end) from PC610 POS_X SMA; reconnect to PC610 POS_Y SMA.
- Disconnect BNC-clip cable (clip end) from DUT node CNTL_X_LIM; reconnect to node CNTL_Y_LIM.
- Run the HP3562 frequency response measurement.
- Create a plot using measurement frequency span for x-axis, and 12 - 36dB for y-axis. Attach to report.
- Use the cursor on the HP 3562 to verify the output response of the node at specific frequencies.

Frequency Response: SU CNTL_Y_LIM				✓
Frequency	- Lim	Meas Val	+ Lim	
3Hz +/- 2Hz	19.9dB		20.9dB	
200Hz +/- 10Hz	26.4dB		28.4dB	
800Hz +/- 100Hz	33dB		35dB	
4kHz +/- 100Hz	20dB		22dB	

- Disconnect BNC-SMA cable (SMA end) from PC610 POS_Y SMA; reconnect to PC610 POS_Z SMA.
- Disconnect BNC-clip cable (clip end) from DUT node CNTL_Y_LIM; reconnect to node CNTL_Z_LIM.
- Run the HP3562 frequency response measurement.
- Create a plot using measurement frequency span for x-axis, and 12 - 36dB for y-axis. Attach to report.
- Use the cursor on the HP 3562 to verify the output response of the node at specific frequencies.

Frequency Response: SU CNTL_Z_LIM				✓
Frequency	- Lim	Meas Val	+ Lim	
3Hz +/- 2Hz	19.9dB		20.9dB	
200Hz +/- 10Hz	26.4dB		28.4dB	
800Hz +/- 100Hz	33dB		35dB	
4kHz +/- 100Hz	20dB		22dB	

16 COMPLETION OF PROCEDURE

- Disconnect BNC-SMA cable (SMA end) from PC610.
- Disconnect BNC-clip cable (clip end) from DUT.
- Turn off power to the FSU enclosure.
- Remove PWA from enclosure per P0663.
- Disconnect Test Harness from PWA, and return PWA to storage container.

I certify that the 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	