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Gravity Probe B Relativity Mission
Gyroscope Suspension System Verification Requirement Compliance Matrix (VRCM)
S0452 Rev. A

Part Number: FSU 26225-101
ASU 26226-101
Serial Numbers: SN001, SN002, SN003, SN004, SN005

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Rev.	Date	Section (s)	Requirement (s)	Change Description
—	11/27/2002	All	All	Original Release
A	12/23/2003	4.1 & 4.4	#3.4.10.6.1	Updated the requirement to comply with PCB 624. Moved Req #3.10.6.1 from Table 4.1 Box Level Verification to Table 4.4 System Level Verification.
A	12/23/2003	4.2 & 4.4	None	Renamed Table 4.2 to Box Level Requirements with System Level Verification and Table 4.4 to System Level Verification
A	12/23/2003	4.2	#3.4.4.1	Updated the requirement to comply with PCB 624.
A	12/23/2003	4.3	3.2.6, 3.2.7, 3.2.8.10, 3.2.8.9, 3.4.6.1, 3.4.6.2, 3.4.7.3.1, 3.4.9.2, 3.4.9.3, 3.4.10.1, 3.4.10.2, 3.4.10.3.4, 3.4.10.3.5, 3.4.10.3.6, 3.4.10.4.4, 3.4.10.4.5, 3.4.10.4.6, 3.4.10.5.4, 3.4.10.6.1, 3.4.15.3, 3.4.17.1, and 3.4.17.3	Updated with System Level Verifications.

1.0 Introduction:

This document summarizes in tables the methods of verification for the requirements of the Gyroscope Suspension System (GSS) and cross-references the procedures and analysis documents where the verifications are accomplished. The four flight GSS units, serial numbers 1-4, have been shipped to Lockheed Martin and mounted on the Space Vehicle. This document focuses on the verification of the units on the Space Vehicle. The spare flight unit, SN005, is used in the verification process to verify design principles and to support analysis of the design with test data.

1.1 Gyroscope Suspension System Description

The GSS is a collection of assemblies that control the position of the rotor within the rotor housing and align the gyroscope spin axis with the Guide Star. In addition, the GSS can electrostatically cage the gyroscope. The GSS is composed of the Forward Suspension Unit (FSU) and the Aft Suspension Unit (ASU). The FSU contains the analog components of the system and directly interface with the electrodes in the rotor housing to control the position rotor by sensing its location along 3 axes and generating compensating electrostatic forces applied via voltages to six electrodes located on the gyroscope housing wall. The FSU provides the low and high voltage (low and high control authority) drive for science and spinup modes respectively. Both science and spinup can go into a backup mode, which is determined by the autonomous *Control System Arbiter* on the FSU. The FSU unit communicates with the digitally controlled ASU through the forward/aft digital bus (GFAB). The ASU has two components: the Aft Control Unit (ACU) and the Aft Power Unit (APU). The ACU houses the GSS flight computer and runs the digital control algorithm that regulates the gyroscope position through the FSU during the science mission, and interfaces directly with the CCCA through the 1553 Bus. The ACU also synchronizes the GSS clocks to the SRE standard and provides the data processing for the science mission. The APU supplies power independently to both the ACU and the FSU.

1.1.1 ACU Function Cards:

Aft Comm Link (ACL)
Aft MUX/Timing (AMT)
Aft Clock Support (ACS)
Aft Test Card (ATC)
RAD6000 Processor

1.1.2 FSU Function Cards:

Forward Comm Link (FCL)
Forward Mode Register (FMR)
A/D and D/A Converter (ADDA)
Control System Arbiter (ARB)
Analog Backup (ABU)
Low Voltage Amplifier (LVA)
High Voltage Amplifier & Bridge (HVA)

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Approved By	**Reviewed By**	**Approved By**
Bill Bencze date Payload Technical Manager	Mac Keiser date Chief Scientist	Gaylord Green date Program Manager

ITAR Assessment Performed _____ **ITAR Control Required?** ☐ **Yes** ☐ **No**
Tom Langenstein

MUX/Oscillator (MUX)

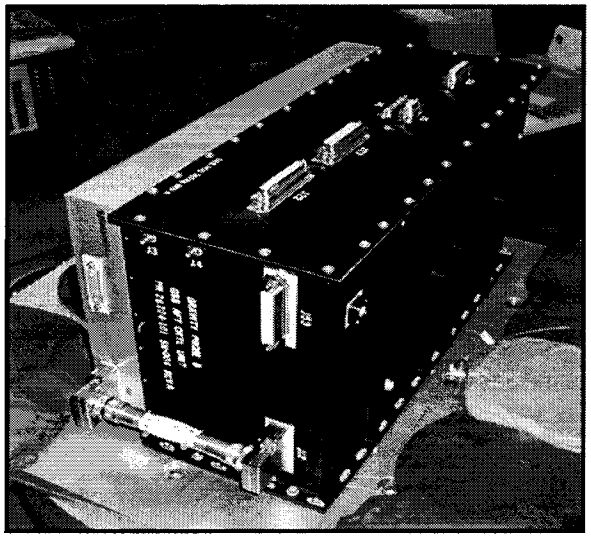

Figure 1 - Aft GSS Flight Unit; during vibration testing (1 of 5)

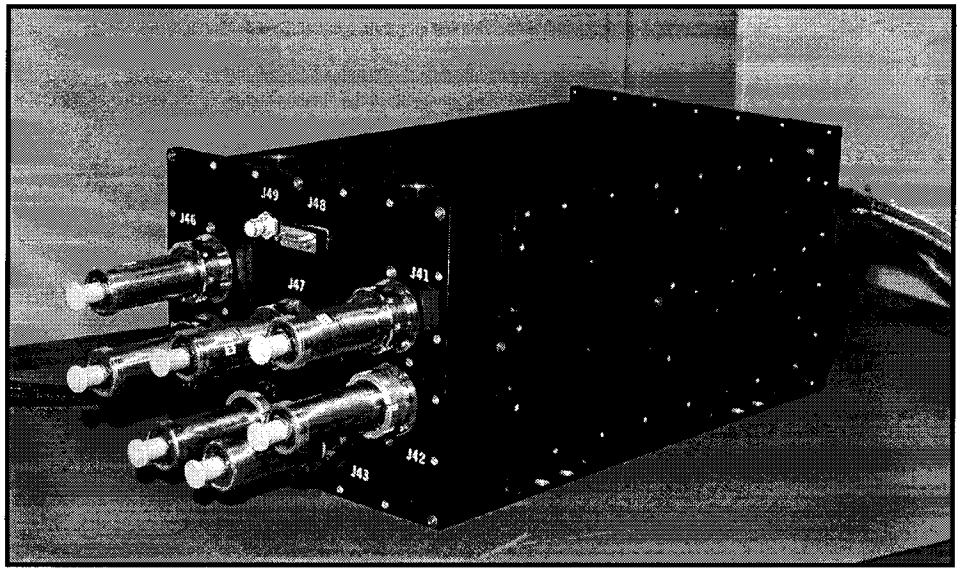

Figure 2 - Forward GSS Flight Unit; (1 of 5)

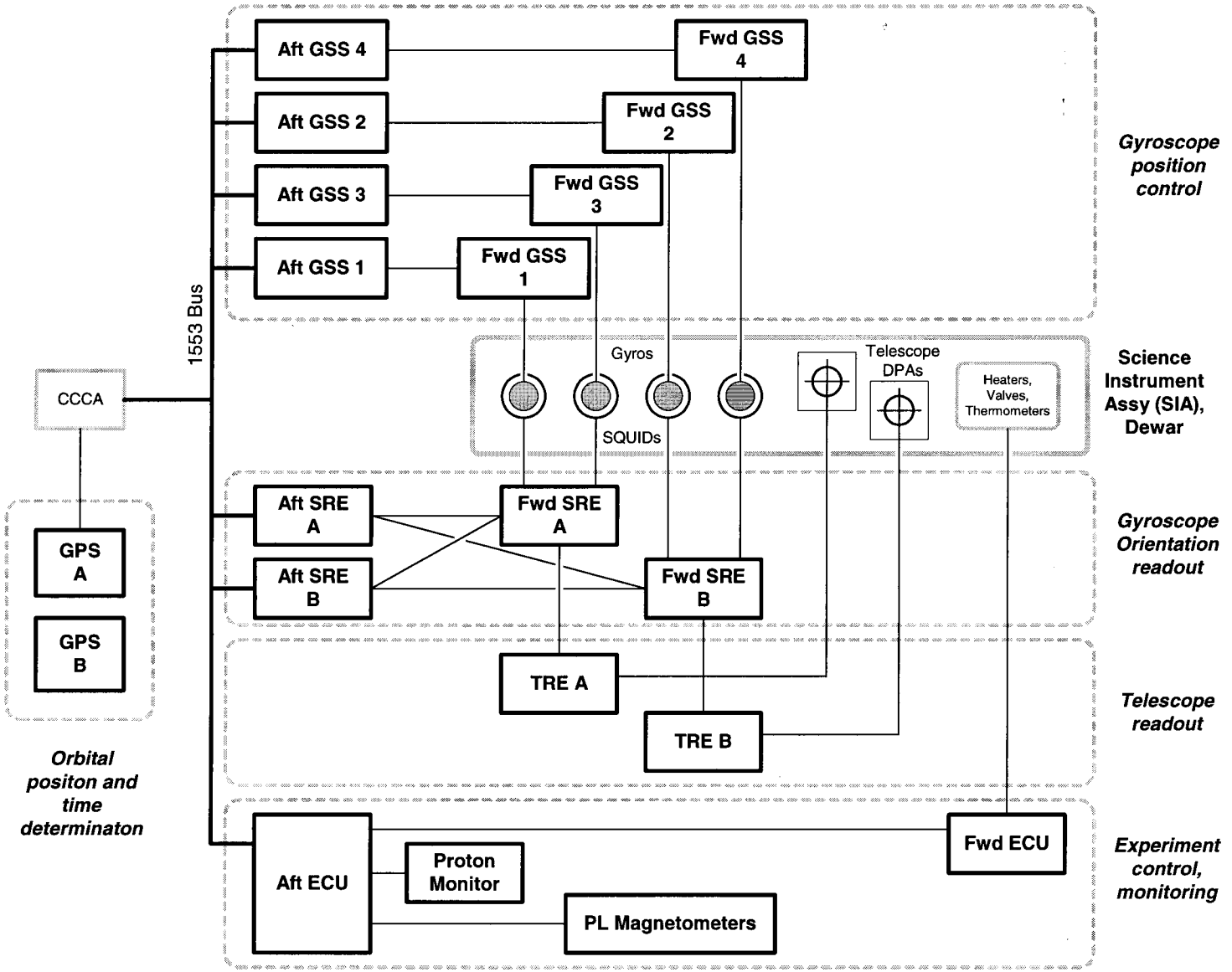

Figure 3 – Diagram of GP-B Payload Electronics suite showing the connections of the GSS units with the remainder of the Science Payload

2.0 Reference Documents

2.1	PLSE 13-1 Rev. B	GSS Specification
2.2	S0444 Rev. A	Gyroscope Suspension System (GSS) Acceptance Test Plan

3.0 Verification Methods

Verification of compliance with the requirements of Section 4.0 will be performed as specified in the verification column in the requirements table in Section 4.0 verification methods defined below establish how each requirement will be met:

Analysis (A): A process used in lieu of or in addition to testing to verify compliance with specifications. The techniques typically include an interpretation or interpolation/extrapolation of analytical or empirical data under defined conditions or reasoning to show theoretical compliance with stated requirements.

Inspection (I): A visual examination of the item against the applicable documentation to confirm compliance with requirements.

Test (T): An action by which the operability, performance capability or other specified qualities of an item are verified when subjected to controlled conditions that are real or simulated. These verifications may require the use of special test equipment and instrumentation to obtain quantitative data for analysis as well as qualitative data derived from displays and indicators inherent in the items for monitor and control.

Similarity (S): Similarity is the process of comparing a current item with a previous item, taking into consideration configuration, test data, application and environment. The evaluation must be documented and will include (1) the test procedures/reports of the item to which similarity is claimed; (2) a description of the differences between the items; (3) and the rationale for verification by similarity; (4) and pedigree of the previous item. All in-orbit experience must be documented and available for review.

Not Applicable (NA): Use of the term "Not Applicable" will be limited to those paragraphs/paragraph headings for which there are no requirements.

System Level (SL) SL test or analysis requirements are verified via specified method at the system level, and cannot be definitively verified at the box level, though supporting analysis and tests can be made.

Section 4.0 Verification Requirements Compliance Matrix

This section contains a series of tables that show the compliance for the complete set GSS requirements as stated in the GSS specification PLSE-13, Part 1, Rev. B. The focus of the compliance for this document is box level with pointers for the final verification of system level requirements.

Contents

Table 1 PLSE-13 Part 1 Box Level Requirements

4.1 Requirements Verified

"√" = System Engineering review of relevant compliance data verified that the requirement is met.

Note: Specification Section Titles Included For Clarity (Method: N/A)

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.1.1	Functional Requirement Summary		N/A		N/A	N/A
3.1.1.1	Gyro suspension	The Suspension Electronics shall suspend the science gyroscopes (except the gyroscope being used as a drag-free sensor) to keep them from contacting the internal surface of the gyro cavities.	The Suspension Electronics consist of both an analog backup controller and a digital controller. Analog Backup Controller: P0769 Rev.- "Extended Functional Test Procedure for the Gyroscope Suspension System (GSS) Forward Suspension Unit" verified the suspension electronics ability to suspend and keep the gyroscopes from contacting the internal surfaces. Digital Controller: P0918, run on October 8-10, 2002 tested the suspension electronics ability to suspend and keep the gyroscopes from contacting the internal surfaces for a typical mission day. S0731 "GSS Requirements Verification Analysis Report 9" summarizes the verifications of the suspension electronics.	S0731 P0769 P0918	A	√
3.1.1.2	Charge Measurement	The Suspension Electronics shall measure the charge of the science gyros.	S0705 "GSS Charge Measurement and Rotor Potential Determination Verification Analysis" verifies this requirement by verifying that the GSS measures the SG charge for all mission cases: Science Mission section GSS #3.4.10.3 Drag Free Science Mission section GSS #3.4.10.4 Pre/Post Science Mission section GSS #3.4.10.5	S0705	A	√
3.2	Interfaces		N/A		N/A	N/A
3.2.1	Mechanical Interfaces	Mechanical interfaces shall be as defined in "Gyro Suspension System Interface Control Document S0447."	S0712 "Inspection Verifications of GSS Requirements" describes the inspection of the mechanical interfaces and their compliance the GSS ICD S0447. Installation of the ASU and FSU (Op Orders INT-117 & INT-082) on the SV validate the verification.	S0712	I	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.2.2	Electrical Interfaces	Electrical interfaces shall be as defined in "Gyro Suspension System Interface Control Document S0447."	S0447 "Gyro Suspension System Interface Control Document S0447" electrical interfaces: (1) J31 APU Power (2) J32 GFAB (3) J33 GFAB (4) J41 Z+ (Z1) DRIVE (5) J42 Z- (Z2) DRIVE (6) J43 Y+ (Y1) DRIVE (7) J44 Y- (Y2) DRIVE (8) J45 X+ (X1) DRIVE (9) J46 X- (X2) DRIVE (10) J47 - Gyro Ground (11) J48 UV Bias (12) J49 FSU Ground P0769 Rev.- "Extended Functional Test Procedure for the Gyroscope Suspension System (GSS) Forward Suspension Unit" Test setup diagram Figure 1 verifies the electrical interfaces and their functionality for #1-11 P0802 Rev.- "Manufacturing Instructions GSS Forward Suspension Unit" verifies the #12 J49 FSU Ground in Section 11.3 Forward Cover Pre-assembly step C5 and Figure C-2 - Forward Cover Labeling Schematic.	P0695 , P0698	T	√
3.2.3	Communications Interfaces	Each Aft GSS shall have dual MIL-STD-1553 serial ports and addressed as follows: Aft GSS 1: 12; Aft GSS 2: 13; Aft GSS 3: 14; Aft GSS 4: 15.	Test script to load aft GSS EEPROM with software: SCFGSSEEA Most recent successful run on 5 June 2002. Reference "as run" log in Pod C. Test states that addresses are defined per SCSE 16, Section 9.2.7 Table 9.2.7.5-1 in SCSE 16 lists remote terminal addresses as stated in requirement. Aft GSS1: 12 = SN003 Aft GSS2: 13 = SN001 Aft GSS3: 14 = SN002 Aft GSS4: 15 = SN004	P0768	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.2.4	Software command interfaces	All software functions shall be controlled via either of the two 1553 ports.	P0768 "Full Functional Test Procedure for the Gyroscope Suspension (GSS) Aft Suspension Unit (ASU) Subsystem" Figure 1: Connection Diagram for ASU Tests (pg. 9) shows J3 & J4 connected (1553 A & B) to the Test Workstation. Section 15.0 Software Tests (Operation of 1553 Bus) steps 15.7-15.13 test both A & B 1553 Buses completed in P0772. P0772 "Full Functional Test Procedure for the Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem Using the GSS Test Environment", all units passed functional testing.	P0768	T	√
3.2.5	HLD interfaces	The High Level Discrete command interface to the spacecraft shall be in accordance with SCSE-17 Spacecraft to Payload ICD.	P0768A "Full Functional Test Procedure for the Gyroscope Suspension (GSS) Aft Suspension Unit (ASU) Subsystem" Section 16.0 contains the HLD test for SN001, SN002, SN003, & SN004. SN001 - Dlog #7 - TVAC voltage dividers used in test configuration affected results (CLOSED). SN002 - Dlog #8 - TVAC voltage dividers used in test configuration affected results (CLOSED). SN001 & SN002 full functional was performed with the units in the thermal vacuum chamber, and a voltage divider was added to the HLD J21 A1 and A2 inputs to reduce the voltage to levels compatible with the chamber. The resulting voltage reduction was consistent with predicted values presented in the D-Log details.	P0768	T	√
3.2.8	Timing Interfaces		N/A		N/A	N/A
3.2.8.1	SRE Interface	The GSS shall accept the 16fo and ATC-Strobe (10Hz) to the generated by the aft SRE systems (A and B)	P0768A "Full Functional Test Procedure for the Gyroscope Suspension (GSS) Aft Suspension Unit (ASU) Subsystem" Section 15.0 Software Tests complete in P0772 P0772B "Full Functional Test Procedure for the Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem Using the GSS Test Environment" Section 12.5 SRE Clock Switching Test - A+B side 16 fo and 10 Hz Clock Simulator Test, all units passed.	P0768	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.2.8.2	Operation during clock switching	The operation of the GSS shall not be dependent on the availability of the SRE clocks.	P0768A "Full Functional Test Procedure for the Gyroscope Suspension (GSS) Aft Suspension Unit (ASU) Subsystem" Section 15.0 Software Tests complete in P0772. P0772B "Full Functional Test Procedure for the Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem Using the GSS Test Environment" Section 12.5 SRE Clock Switching Test - All units passed P0769 Sec 17.15 verifies the GSS continues to suspend the Gyros even with the loss of the ASU and the timing/control signals it supplies to the FSU. S0715 provides the analysis that summarizes the results from testing.	P0768 P0769 S0715	T	√
3.2.8.3	Knowledge of clock switching	The Payload Electronics shall telemeter sufficient information that the occurrence of clock switching in the timing hardware can be observed during Ground Data Processing.	P0768A "Full Functional Test Procedure for the Gyroscope Suspension (GSS) Aft Suspension Unit (ASU) Subsystem" Section 15.0 Software Tests complete in P0772. P0772B "Full Functional Test Procedure for the Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem Using the GSS Test Environment" Section 12.5 SRE Clock Switching Test - All units passed S0715 provides the analysis that shows that the occurrence of clock switching can be observed through processing the GSS telemetry.	P0772 S0715	A,T	√
3.2.8.4	Recovery from transient errors		N/A		N/A	N/A
3.2.8.4.1	Recovery from missed timing pulses	The GSS shall automatically recover from missed timing pulses within 1 s.	P0768A "Full Functional Test Procedure for the Gyroscope Suspension (GSS) Aft Suspension Unit (ASU) Subsystem" Section 15.0 Software Tests complete in P0772. P0772B "Full Functional Test Procedure for the Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem Using the GSS Test Environment" Section 12.5 SRE Clock Switching Test - All units passed "10 Hz Delay" step 12.5.14 and recovered immediately after the error was generated.	P0768	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.2.8.4.2	Recovery from extra timing pulses	The GSS shall automatically recover from extra timing pulses within 1 s.	P0768A "Full Functional Test Procedure for the Gyroscope Suspension (GSS) Aft Suspension Unit (ASU) Subsystem" Section 15.0 Software Tests complete in P0772. P0772B "Full Functional Test Procedure for the Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem Using the GSS Test Environment" Section 12.5 SRE Clock Switching Test - all units passed "10 Hz Advance" step 12.5.12 and recovered immediately after the error was generated.	P0768	T	√
3.2.8.6	Synchronization of timing chain to SRE signals		N/A		N/A	N/A
3.2.8.6.1	16fo clock synchronization	The GSS shall derive all of its timing signals by counting down the SRE 16fo signal, when available, from the aft SRE.	S0451 verifies the timing signals are counted down from SRE 16fo signal	S0451	A	√
3.2.8.6.2	Timing chain synchronization	All 16fo derived clock countdown chains shall be synchronized to the aft SRE by resetting each countdown chain with the ATC (10 Hz) strobe, when available, from the aft SRE.	S0693 verifies the timing signals are synchronized to the aft SRE with ATC (10 Hz) strobe.	S0693	A	√
3.2.8.6.3	GSS Backup Primary Payload Clock Frequency	The frequency of the GSS internal backup 16fo clock shall be 16.368000 MHz, +/- 1,500 Hz (+/- 90 ppm)	P0959 Rev- "GP-B GSS ACU Clock Frequency Test" Lock range- Low: 1,091,133*15 = 16.366995 MHz (16fo -1005 Hz) High: 1,091,279*15 = 16.369185 MHz (16fo +1185Hz) Nominal (unlocked) = 1,091,188.8*15 = 16.367832 MHz (-168 Hz off 16f0) GSS Backup Primary Payload Clock Frequency is a design verification. The only variable between flight units is the manufacturing of the ACS (Aft Clock Support) PWA on which the clock is installed. P0666B is the tuning procedure for the ACS card. In this procedure, a select-and-test capacitor is chosen to set the center of the lock range of the phase lock loop to 16fo +/- 100 Hz. The tuning procedure was run on each of the 5 flight boards, and in each case, the selected capacitor was of identical value. This demonstrates that the strays in the PWA are nearly identical and that the test on aft box SN005 is representative of each of the 5 ACS boards installed in the 4 flight boxes.	P0959	A	√
3.2.8.7	GSS secondary	GSS internal timing sources shall be	S0451 verifies the timing signals are counted down from	S0451	A	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
	payload clocks	counted from the 16fo clock except the GSS C side (aft) power supply.	SRE 16fo signal			
3.3	Environments		N/A		N/A	N/A
3.3.1	Natural and Man-Made External Electromagnetic (EM) Environment	The unit shall meet the EMI requirements in P0149 Section 3.	A series of EMI test were performed in P0701 "Electromagnetic Interference (EMI) Test Procedure For The Gyroscope Suspension System (GSS)" on SN 005 to comply with the box level GSS EMI requirements in PLSE-13, Part 1, paragraphs 3.5.4 to 3.5.4.7. SN 005 was exposed to radiated emissions, RE02 Narrow and Broadband, at adequate box level frequencies and power levels. The System level requirements in P0149 are verified by analysis at the Space Vehicle level where the system EMI interactions can be verified in the flight configuration. Box level EMI compliance has therefore been meet by the verifications of 3.5.4 to 3.5.4.7 and compliance with the system level aspects of this requirement will be shown at the Space Vehicle level with the completion of the Space Vehicle EMI analysis to be written by Dave Moss.	P0701	A,T	√
3.3.2	Conducted Emissions into Probe	No spurious signal in the frequency range of 1MHz to 1 GHz on any conductor which connects to the probe shall be larger than 50 uV rms measured prior to tophat filtering.	P0769A "Extended Functional Test Procedure for the Gyroscope Suspension System (GSS) Forward Suspension Unit" Section 17.6 Charged Bias Conductor - Bias A and B, 17.7 Part C – LVA, 17.8 Part C - HVA. SN 001 Bias A & B, LVA & HVA suspension lines X1, X2, Y1, Y2, Z1, & Z2 less than 50 uV. See D-Log #12, 13 for values. SN 002 Bias A & B, LVA & HVA suspension lines X1, X2, Y1, Y2, Z1, & Z2 less than 50 uV. See D-Log #15 for values. SN 003 Bias A & B, LVA & HVA suspension lines X1, X2, Y1, Y2, Z1, & Z2 less than 50 uV. See D-Log #11, 12, 13 for values. SN 004 Bias A & B, LVA & HVA suspension lines X1, X2, Y1, Y2, Z1, & Z2 less than 50 uV. See D-Log #11, 12 for values.	P0769	T	√
3.3.3	Corpuscular Radiation Environment		N/A		N/A	N/A
3.3.3.1	Ambient	The GSS shall operate within	S0684 "GSS Requirements Verification Analysis Report	S0684	A	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
	Corpuscular Radiation Environment	specification in the ambient radiation environment of all parts of the GP-B orbit except the South Atlantic Anomaly (SAA).	2" shows compliance to the radiation environment.			
3.3.3.2	SAA Corpuscular Radiation Environment	The GSS shall maintain gyro suspension during an SAA passage.	S0684 "GSS Requirements Verification Analysis Report 2" shows compliance to the radiation environment.	S0684	A	√
3.3.3.3	SAA Passage Recovery	The GSS shall operate within specification within 10 minutes after an SAA passage.	S0684 "GSS Requirements Verification Analysis Report 2" shows compliance to the radiation environment.	S0684	A	√
3.3.3.4	Proton and Electron Instantaneous Flux Disturbances	The design shall be sufficient to tolerate disturbance due to Proton and Electron Instantaneous Fluxes shown in P0149 to the level specified in roll and annual stability specs in its mounted configuration on the payload.	S0684 "GSS Requirements Verification Analysis Report 2" shows compliance to the radiation environment.	S0684	A	√
3.3.3.5	Galactic Cosmic Ray Flux Disturbances	The design shall be sufficient to reject disturbance due to Galactic Cosmic Ray Fluxes shown in P0149 to the level specified in roll and annual stability specs in its mounted configuration on the payload.	S0684 "GSS Requirements Verification Analysis Report 2" shows compliance to the radiation environment.	S0684	A	√
3.3.3.6	Mission Integrated Proton Fluence Disturbances	The design shall meet performance requirements after exposure to Mission Integrated Proton Fluence shown in P0149 attenuated by shielding due to its mounted configuration and shall meet annual stability specs.	S0684 "GSS Requirements Verification Analysis Report 2" shows compliance to the radiation environment.	S0684	A	√
3.3.4	Solar Flare X-Ray Instantaneous Flux	The GSS shall meet performance requirements when Solar Flare X-Ray Instantaneous Flux is less than 0.001 W/m^2.	S0684 "GSS Requirements Verification Analysis Report 2" shows compliance to the radiation environment.	S0684	A	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.3.5	Meteoroid strike resistance	The unit shall meet the meteoroid strike resistance requirements in P0149 Section 1.	EM SYS 316 "The Effects of Meteoroid Debris and Atomic Oxygen on the Gravity Probe B Spacecraft" P0769 "Extended Functional Test Procedure for the Gyroscope Suspension System (GSS) Forward Suspension Unit" S0694 "Reconsideration of Risk Posed by Micrometeoroid and Orbital Debris to the GP-B Relativity Mission" EM SYS 316 states that the (electronic) boxes have Adequate Thickness and Protective Outer Layer. The GSS boxes are aluminum 2.54 mm (100 mils) thick. This is typical shielding for spacecraft electronics going into a low earth orbit. The Protective Outer Layer for the FSU is the FEE, which is partially covered with MLI and 1.27 mm (50 mils) thick, and for the ASU is a honeycomb pallet approximately 0.5 cm thick with 0.0635 cm (0.025 inch) thick facesheets. P0769 is an "as run" test of backup controller in State 9 (science mode). Successful operation of the controllers is shown for a 1 kg-m/sec impulse due to a micrometeorite impact, with the limit for no loss of functionality at 0.0025 kg-m/sec impulse.	P0769 S0694 EM SYS 316	A,T	√
3.3.6	Vibration Testing Levels		N/A		N/A	N/A
3.3.6.1	Forward Unit Random Vibration Testing Levels	The forward unit shall be capable of performance as specified herein after exposure to the random vibration environments as specified in Figure 3-2 The unit shall be subjected to the environment in each of 3 axes, 1 minute /axis. Test tolerance shall be as listed in Table 3-1.	P0748 "GSS Forward Suspension Unit Vibration Test" SN 01 X 7.83 Grms, Y 7.79 Grms, Z 7.83 Grms SN 02 X 11.03 Grms, Y 11.11 Grms, Z 11.11 Grms (Run 1/29/2002) SN 03 X 7.86 Grms, Y 7.81 Grms, Z 7.79 Grms SN 04 X 7.79 Grms, Y 7.83 Grms, Z 7.79 Grms P0702A "Full Functional Test Procedure For The Gyroscope Suspension System (GSS) Forward Suspension Unit (FSU) Subsystem" All FSU units Passed Post X-axis, Post Y-axis, and Post Z-axis SN 04 - Dlog #6 Tolerances overly tight (Closed)	P0698	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.3.6.2	Aft Unit Random Vibration Testing Levels	The aft unit shall be capable of performance as specified herein after exposure to the random vibration environments as specified in Figure 3-3. The unit shall be subjected to the environment in each of 3 axes, 1 minute /axis. Test tolerance shall be as listed in Table 3-2.	P0700A "GSS Aft Suspension Unit Vibration Test" SN 01 X 8.63 Grms, Y 8.61 Grms, Z 8.64 Grms SN 02 X 8.61 Grms, Y 8.56 Grms, Z 8.57 Grms SN 02 - Dlog #3 – Loose Screws on Y-axis Vibe (Re-torque screws to 25 in-lb, Closed) SN 03 X 8.57 Grms, Y 8.57 Grms, Z 8.53 Grms SN 04 X 8.59 Grms, Y 8.59 Grms, Z 8.51 Grms SN 04 - P0700B Penalty X-axis (3/13/2001) Dlog#4 Voltages out of Spec in P0768A Functional Test Post X-axis (3/13/2001 – transferred to DR 369) DR 369 - GSS APU HV Low After Vibration (Unit Repaired – Closed) P0700B Penalty X-axis (4/24/2001) SN 04 X 8.59 Grms P0768A Full Functional ASU Test completed in P0772, SN 01, SN 02, and SN 03 units passed Post X-axis Vibe, Post Y-axis Vibe, and Post Z-axis Vibe. SN 04 completed P0768A in P0772 Post X-axis penalty Vibe (4/24/2001).	P0700	T	√
3.3.7	Pyroshock Testing Levels		N/A		N/A	N/A
3.3.7.1	Forward Unit Pyroshock Testing Levels	The forward unit shall be capable of performance as specified herein after exposure to the protoqual pyroshock environment shown in Figure 3-4. For protoqualification testing, the environment applies to a test in the normal to mounting plane axis only. The analytical Shock Response Spectrum (SRS) applies the measured normal to mounting plane acceleration in the positive and negative directions (+/-). The test tolerance is +/- 6 dB. With natural frequencies spaced at 1/6-octave intervals, at least 50 percent of the test spectrum values are greater than the nominal test specification. The off-axis (axes in mounting plane) test level (SRS) will be plotted with an overlay of the specified environment shown in Figure 3-4.	P0703 "GSS Forward Suspension Unit Pyroshock Test" SN 02 – only Baseline run set at less than 50% of the shock response to avoid exceeding the maximum shock tolerances and over testing the unit. The flight unit Pyroshock test matched the baseline-shaping run of the mass simulator. Ten of thirty-three shock responses over nominal test specification. This is acceptable given the steep response curve of the flight unit, and the +/- 6-dB constraint. Dlog #13 step 290 shaping run less than 50% above nominal (Closed) DR 437 disposition "Use As Is" (Closed)	P0703	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.3.7.2	Aft Unit Pyroshock Testing Levels	The aft unit shall be capable of performance as specified herein after exposure to the protoqual pyroshock environment shown in Figure 3-5. For protoqualification testing, the environment applies to a test in the normal to mounting plane axis only. The analytical Shock Response Spectrum (SRS) applies the measured normal to mounting plane acceleration in the positive and negative directions (+/-). The test tolerance is +/- 6 dB. With natural frequencies spaced at 1/6-octave intervals, at least 50 percent of the test spectrum values are greater than the nominal test specification. The off-axis (axes in mounting plane) test level (SRS) will be plotted with an overlay of the specified environment shown in Figure 3-5.	P0704"GSS Aft Suspension Unit Pyroshock Test" Thirty octave points from 359 Hz to 10,000 Hz measured and 21/30 above spec with 16/30 required.	P0704	T	√
3.3.8	Thermal Environment		N/A		N/A	N/A
3.3.8.1	Forward Unit Operational Temperature Range	The forward unit shall meet performance requirements over a temperature range from 253 K to 320 K (-20 C to +47 C). See Figure 3-1.	P0747 Rev- "Thermal/Vacuum Test Procedure for the Gyroscope Suspension System (GSS) Forward Suspension Unit (FSU)" Section 14.0 - 8th Operational High (+/- 3 °C) SN01 Baseplate TC6 = 117.1 °F (47.3 °C) SN02 Unit Side TC2 = 116.5 °F (46.9 °C) SN03 Baseplate TC6 = 116.7 °F (47.1 °C) Run 2/21/02 SN04 Baseplate TC6 = 117.1 °F (47.3 °C) Section 14.0 - 8th Operational/Survival Cold (+/- 3 °C) SN01 Baseplate TC6 = -4.0 °F (-20.0 °C) SN02 Baseplate TC6 = -4.5 °F (20.3 °C) SN03 Baseplate TC6 = -7.8 °F (22.1 °C) SN04 Baseplate TC6 = -4.0 °F (20.0 °C) P0702 TVAC, Hi-Temp #2 and TVAC, Low-Temp #2 SN 01/SN 04 – Dlog #3 Bad Connector Saver (Closed) SN 02 - Dlog #3/4 sec 16.7.2.1 of P0702A Dlog #3 Added ground to Dummy Load GSE (Closed) Dlog #4 Tolerances too tight, redlined Pdoc (Closed) Dlog #12 Software set point low, redline Pdoc (Closed)	P0747	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.3.8.2	Forward Unit Survival Temperature Range	The forward unit shall meet performance requirements after exposure to a survival test temperature range from 253 K to 335 K (-20 C to +62 C). See Figure 3-1.	P0747 Rev- "Thermal/Vacuum Test Procedure for the Gyroscope Suspension System (GSS) Forward Suspension Unit (FSU)" Section 14.0 - 8th Survival High (+/- 3 °C) SN 01 Baseplate TC6 = 154.6 °F (68.1 °C) SN 02 Baseplate TC6 = 142.9 °F (61.6 °C) SN 03 Baseplate TC6 = 147.3 °F (64.1 °C) SN 04 Baseplate TC6 = 154.6 °F (68.1 °C) Section 14.0 - 8th Operational/Survival Cold (+/- 3 °C) SN 01 Baseplate TC6 = -4.0 °F (-20.0 °C) SN 02 Baseplate TC6 = -4.5 °F (-20.3 °C) SN 03 Baseplate TC6 = -7.8 °F (-22.1 °C) SN 04 Baseplate TC6 = -4.0 °F (-20.0 °C) P0702 Rev B "Full Functional Test Procedure For The Gyroscope Suspension System (GSS) Forward Suspension Unit (FSU) Subsystem" All FSUs passed TVAC, Final	P0747	T	√
3.3.8.3	Nominal operating temperature ranges		N/A		N/A	N/A
3.3.8.3.1	Forward Unit Roll Temperature Variation	The temperature variation at the roll frequency will be less than 100 mK (peak-to-peak).	N/A		N/A	N/A
3.3.8.3.2	Forward Unit Orbital Temperature Variation	The orbital temperature variation will be less than 2 K (peak-to-peak).	N/A		N/A	N/A
3.3.8.3.3	Forward Unit Annual Temperature Variation	The annual temperature variation will be less than 20K (peak-to-peak).	N/A		N/A	N/A

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.3.8.4	Aft Unit Baseplate Operating Temperature Range	The aft unit shall meet performance requirements at the operating temperature range from 249 K to 334 K (-24 C to +61 C). See Figure 3-1.	P0696 "Thermal/Vacuum Test Procedure For The Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem" Step 25.5 – Thermal Cycle 8 (+/- 3 °C) SN 01 Baseplate TC = 62.0 °C SN 02 Baseplate TC = 59.9 °C SN 03 Baseplate TC = 65.4 °C SN 04 Baseplate TC = 62.1 °C Step 25.7 - P0772B "Full Functional Test Procedure for the Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem Using the GSS Test Environment", all units passed Full Functional Test. SN 03 - Dlog #4 - Temperature slight higher than software set point, procedure redlined (Closed) SN 04 - Dlog #8 - Temperature slight higher than software set point, procedure redlined (Closed) Step 25.12 Thermal Cycle 8 (+/- 3 °C) SN 01 Baseplate TC = -22.4 °C SN 02 Baseplate TC = -21.9 °C SN 03 Baseplate TC = -18.7 °C (from -42.1 °C) SN 04 Baseplate TC = -19.6 °C Step 25.15 P0772B "Full Functional Test Procedure for the Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem Using the GSS Test Environment", all units passed Full	P0696	T	√
3.3.8.5	Aft Unit Survival Test Temperature Range	The aft unit shall meet performance requirements after exposure to a survival test temperature range from 224 K to 339 K. (-49 C to +69 C) See Figure 3-1.	P0696 "Thermal/Vacuum Test Procedure For The Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem" Step 25.5 – Thermal Cycle 8 from C to D (+/- 3 °C) SN 01 Baseplate TC = 72.8 °C SN 02 Baseplate TC = 68.8 °C SN 03 Baseplate TC = 69.7 °C SN 04 Baseplate TC = 68.9 °C Step 25.12 Thermal Cycle 8 from I to J (+/- 3 °C) SN 01 Baseplate TC = -57.6 °C SN 02 Baseplate TC = -56.8 °C SN 03 Baseplate TC = -50.3 °C SN 04 Baseplate TC = -43.8 °C (Thermal Cycle 4, T= -64.2 +/- 3 °C) Step 25.15 P0772B all units passed Full Functional.	P0696	T	√
3.3.9	Vacuum		N/A		N/A	N/A

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
	Environment					
3.3.9.1	Forward Unit vacuum environment operational range, high pressure	The Forward unit shall meet performance specifications over ambient atmospheric pressures greater than or equal to 650 torr. The unit's high voltage subsystem will not be operated at pressures in the range (1e-5 torr < pressure < 650 torr).	P0747 Rev- "Thermal/Vacuum Test Procedure for the Gyroscope Suspension System (GSS) Forward Suspension Unit (FSU)" Section 14.0 – Post Vacuum SN 01 Pressure = 868 torr SN 02 Pressure = Atmospheric, 760-860 torr SN 03 Pressure = Atmospheric, 760-860 torr SN 04 Pressure = 868 torr P0702 Rev B "Full Functional Test Procedure For The Gyroscope Suspension System (GSS) Forward Suspension Unit (FSU) Subsystem" All FSUs passed TVAC, Final	P0747	T	√
3.3.9.2	Forward Unit vacuum environment operational range, low pressure	The Forward unit shall meet performance specifications over ambient atmospheric pressures less than or equal to 1e-5 torr. The unit's high voltage subsystem will not be operated at pressures in the range (1e-5 torr < pressure < 650 torr).	P0747 Rev- "Thermal/Vacuum Test Procedure for the Gyroscope Suspension System (GSS) Forward Suspension Unit (FSU)" Section 14.0 - 8th Operational High SN 01 Pressure = 2.37e-7 torr SN 02 Pressure = 2.80e-7 torr SN 03 Pressure = 9.75e-8 torr SN 04 Pressure = 2.37e-7 torr P0702 Rev B "Full Functional Test Procedure For The Gyroscope Suspension System (GSS) Forward Suspension Unit (FSU) Subsystem" All FSUs passed TVAC, Hi-Temp #2 SN 01 Dlog #3 Bad Connector Saver (Closed) SN 02 Dlog #12 Temperature slight higher than software set point, procedure redlined (Closed)	P0747	T	√
3.3.9.3	Forward Unit Corona Breakdown	The Forward unit shall not suffer corona breakdown when flight-level high voltage power supplies are activated in the vacuum environment operational ranges for this unit (per 3.3.9.1 and 3.3.9.2). This requirement explicitly excludes ground test high voltage levels.	P0747 Rev- "Thermal/Vacuum Test Procedure for the Gyroscope Suspension System (GSS) Forward Suspension Unit (FSU)", Section 14.0 - shows compliance with PLSE-13 #3.3.9.1 and #3.3.9.2 P0702 Rev B "Full Functional Test Procedure For The Gyroscope Suspension System (GSS) Forward Suspension Unit (FSU) Subsystem", all FSUs passed TVAC, Final Section 16.8 HVA (High Voltage Amplifier) Output Tests Note: The GSS is not powered on during ascent	P0747	T	√
3.3.9.4	Aft Unit vacuum	The Aft unit shall meet performance	P0696 "Thermal/Vacuum Test Procedure For The	P0696	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
	environment operational range, high pressure	specifications over ambient atmospheric pressures greater than or equal to 650 torr. The unit's high voltage subsystem will not be operated at pressures in the range (1e-5 torr < pressure < 650 torr).	Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem" Step 16.9 – Thermal Vacuum Pump Down SN 01 Pressure = 700 torr SN 02 Pressure = 700 torr SN 03 Pressure = Atmospheric, 760-860 torr SN 04 Pressure = 760 torr P0768A "Full Functional Test Procedure for the Gyroscope Suspension (GSS) Aft Suspension Unit (ASU) Subsystem" completed in P0772, all ASUs passed pre-thermal vacuum functional.			
3.3.9.5	Aft Unit vacuum environment operational range, low pressure	The Aft unit shall meet performance specifications over ambient atmospheric pressures less than or equal to 1e-5 torr. The unit's high voltage subsystem will not be operated at pressures in the range (1e-5 torr < pressure < 650 torr).	P0696 "Thermal/Vacuum Test Procedure For The Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem" Step 18.6 – Thermal Cycle 1 SN 01 Pressure = 3.5e-5 torr SN 02 Pressure = 1.9e-6 torr SN 03 Pressure = 2.1e-6 torr SN 04 Pressure = 9.4e-7 torr P0768A "Full Functional Test Procedure for the Gyroscope Suspension (GSS) Aft Suspension Unit (ASU) Subsystem" completed in P0772, all ASUs passed post thermal vacuum functional.	P0696	T	√
3.3.9.6	Aft Unit Corona Breakdown	The Aft unit shall not suffer corona breakdown when flight-level high voltage power supplies are activated in the vacuum environment operational ranges for this unit (per 3.3.9.4 and 3.3.9.5). This requirement explicitly excludes ground test high voltage levels.	P0696 "Thermal/Vacuum Test Procedure For The Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem" Section 16.9 & 18.6 – shows compliance with PLSE-13 #3.3.9.4 and #3.3.9.5 P0772B "Full Functional Test Procedure for the Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem Using the GSS Test Environment", Post TVAC run of P0705 "Burn-In functional Test" shows the unit functional after exposure to corona pressure levels. Note: ASU GSS is not powered on ascent	P0696	T	√
3.4	Performance Characteristics		N/A		N/A	N/A

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.1	Description	The gyroscope suspension is designed to keep the rotors centered in the housing under various conditions. It operates in a very low-g space environment during science data taking in accordance with the requirements stated below. It is designed to suspend the rotor after electrostatic caging release during the science data gathering phase of the mission. It is able to support the rotor during spin-up and all other pre-science activities on orbit.	N/A		N/A	N/A
3.4.2	Definition of Si	Definition: Si is the sum of the squares of the voltages applied to the opposite electrodes on the electrode axis designated by i. The two electrode axes which lie at 45 degrees to the satellite roll axis are designated by a and b, and the electrode axis which lies at 90 degrees to the satellite roll axis is designated as the c axis. The voltage on each electrode is defined relative to the voltage on the ground plane. The voltage applied to each electrode includes the control voltage used to keep the rotor centered, the voltage applied by the capacitive sensing bridge, and any voltage applied to measure the rotor potential.	N/A		N/A	N/A

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.2.1	Average value of Si on any Axis	Given the acceleration for the GP-B mission, the value of Si averaged over one year along any one of the three electrode axes shall be less than 0.08 V^2.	P0918, run on October 8-10, 2002 collected data and analysis was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). For the Basic Science Mission without temperature variation, the result was 0.052, 0.052, and 0.052 V^2 (P0918, section 17.2). For the Basic Science Mission with temperature variation, the result was 0.052, 0.052, and 0.052 V^2 (P0918, section 17.4). Acceleration of the GP-B mission is defined in the GP-B Error Tree, S0264, which was input to this test as defined in S0706. The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	T	√
3.4.2.2	Difference between Si on Different Axes	Given the acceleration for the GP-B mission, the value of Si along the c electrode axis (perpendicular to the roll axis) averaged over one year shall be equal to the average value of Si along the a and b axes (the two axes which lie at 45 degrees to the spacecraft roll axis) to within 0.04 V^2.	P0918, run on October 8-10, 2002 collected data and analysis was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). For the Basic Science Mission without temperature variation, the result was -0.000235 V^2 (P0918, section 17.2). For the Basic Science Mission with temperature variation, the result was -0.000270 V^2 (P0918, section 17.4). Acceleration of the GP-B mission is defined in the GP-B Error Tree, S0264, which was input to this test as defined in S0706. The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	T	√
3.4.2.3	Roll Frequency Variation in Mismatch of Si along Different Axes	Given the acceleration for the GP-B mission, the roll frequency variation in the mismatch of Si along the a and b electrode axes, averaged over one year, has the following requirements:	N/A		N/A	N/A

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.2.3.1	Roll Frequency Variation in Mismatch along Different Axes	The roll frequency variation in the mismatch of Si along the A and B electrode axes, averaged over one year, shall be less than 1.7e-6 V^2.	P0918, run on October 8-10, 2002 collected data and analysis was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). For the Basic Science Mission without temperature variation, the result was 7.18e-7 V^2 (P0918, section 17.2). For the Basic Science Mission with temperature variation, the result was 5.04e-7 V^2 (P0918, section 17.4). The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	T	√
3.4.2.3.2	Random Variation in Roll Frequency Variation in Mismatch along Different Axes	The random variation in the mismatch of Si along the a and b electrode axes at roll frequency shall have a single-sided spectral density at roll and within a bandwidth of twice roll of 0.0016 V^2/rt(Hz).	P0918, run on October 8-10, 2002 collected data and analysis was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). For the Basic Science Mission without temperature variation, the result was 0.00157 V^2/sqrt-Hz (P0918, section 17.2). For the Basic Science Mission with temperature variation, the result was 0.00129 V^2/sqrt-Hz (P0918, section 17.4). The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	T	√
3.4.2.4	Roll Frequency Variation in Si along Any Axis	Given the acceleration for the GP-B mission, the roll frequency variation in Si along any one of the three electrode axes shall be less than 1.7e-5 V^2 averaged over one year.	P0918, run on October 8-10, 2002 collected data and analysis was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). For the Basic Science Mission without temperature variation, the result was 2.70e-6, 1.99e-6, 1.61e-6 V^2 (P0918, section 17.2). For the Basic Science Mission with temperature variation, the result was 8.52e-7, 8.95e-7, and 1.55e-6 V^2 (P0918, section 17.4). Acceleration of the GP-B mission is defined in the GP-B Error Tree, S0264, which was input to this test as defined in S0706. The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.2.5	Twice Roll Frequency Variation in Si along Axis	Given the acceleration for the GP-B mission, the twice roll frequency variation in Si along any of the three electrode axes shall be less than 0.05 V^2 averaged over one year.	P0918, run on October 8-10, 2002 collected data and analysis was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). For the Basic Science Mission without temperature variation, the result was 0.000422, 0.000427, 0.000850 V^2 (P0918, section 17.2). For the Basic Science Mission with temperature variation, the result was 0.000423, 0.000427, and 0.000849 V^2 (P0918, section 17.4). Acceleration of the GP-B mission is defined in the GP-B Error Tree, S0264, which was input to this test as defined in S0706. The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	T	√
3.4.3	Rotor Centering Accuracy	The capacitive center is defined as the position at which the capacitance between the rotor and the two electrodes on the same axis are equal. Miscentering of the rotor is defined to be the displacement of the rotor from the capacitive center of the housing.	N/A		N/A	N/A
3.4.3.1	Random Rotor Miscentering	The spectral density of the random miscentering within a band of (2/year) about roll frequency shall be less than 1.0 um/rt(Hz) single-sided on each electrode axis.	P0918, run on October 8-10, 2002 collected data and was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). For the Basic Science Mission without temperature variation, the result was 0.00793, 0.00466, 0.00362 micrometers per root Hertz (P0918, section 17.2). For the Basic Science Mission with temperature variation, the result was 0.00509, 0.00305, and 0.00204 micrometers per root Hertz (P0918, section 17.4). The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	T	√
3.4.3.2	Body-Fixed Miscentering	The DC (zero frequency) body fixed rotor miscentering has the following requirements:	N/A		N/A	N/A

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.3.2.1	Miscentering on Any Axis	The miscentering parallel to each of the electrode axes, averaged over any one-month period, shall be less than 0.6 um.	P0918, run on October 8-10, 2002 collected data and analysis was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). For the Basic Science Mission without temperature variation, the result was 0.267, 0.0753, and -0.0332 micrometers (P0918, section 17.2). For the Basic Science Mission with temperature variation, the result was 0.2165, 0.0502, and -0.0817 micrometers (P0918, section 17.4). The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	T	√
3.4.3.2.2	Miscentering Parallel to the S/V Roll Axis	The miscentering parallel to the S/V Roll Axis, averaged over one year, shall be less than 0.6 um.	P0918, run on October 8-10, 2002 collected data and analysis was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). For the Basic Science Mission without temperature variation, the result was 0.2126 micrometers (P0918, section 17.2). For the Basic Science Mission with temperature variation, the result was 0.2108 micrometers (P0918, section 17.4). Acceleration of the GP-B mission is defined in the GP-B Error Tree, S0264, which was used as input to the test. The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	T	√
3.4.3.3	Sinusoidal Miscentering	Any sinusoidal rotor miscentering has the following requirements:	N/A		N/A	N/A
3.4.3.3.1	Sinusoidal Miscentering at Roll	Any sinusoidal rotor miscentering in a direction perpendicular to the S/V roll axis at roll frequency and within a band of 2/(1year) centered at roll frequency shall be less than 0.3 nm.	P0918, run on October 8-10, 2002 collected data and analysis was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). For the Basic Science Mission without temperature variation, the result was 0.00164 and 0.0682 nanometers (P0918, section 17.2). For the Basic Science Mission with temperature variation, the result was 0.00182 and 0.0733 nanometers (P0918, section 17.4). The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.3.3.2	Sinusoidal Miscentering at Roll Modulated by Annual	Any sinusoidal miscentering in a direction perpendicular to the S/V roll axis at roll frequency modulated by annual shall be less than 1 nm.	P0918, run on October 8-10, 2002 collected data and analysis was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). Although P0918 testing does not provide the desired frequency resolution (the test is set for 24 hours, but 1 years worth of data is necessary to provided the frequency resolution called for), the requirement is satisfied if the roll frequency component of the miscentering is always less than 1 nanometer. For the Basic Science Mission without temperature variation, the roll frequency component is 0.00164 and 0.0682 nanometers (P0918, section 17.2). For the Basic Science Mission with temperature variation, the roll frequency component is 0.00182 and 0.0733 nanometers (P0918, section 17.4). The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	T	√
3.4.3.3.3	Sinusoidal Miscentering at Roll Modulated by Twice Orbital	Any sinusoidal rotor miscentering at roll modulated by twice orbital has the following requirements:	N/A		N/A	N/A
3.4.3.3.3.1	Sinusoidal Miscentering at Roll Modulated by Twice Orbital Parallel to Roll Axis	Any sinusoidal rotor miscentering at roll modulated by twice orbital in a direction parallel to the S/V roll axis shall be less than 25 nm.	P0918, run on October 8-10, 2002 collected data and analysis was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). For the Basic Science Mission without temperature variation, the result was 0.0102 and 0.0144 nanometers (P0918, section 17.2). For the Basic Science Mission with temperature variation, the result was 0.0268 and 0.0210 nanometers (P0918, section 17.4). The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.3.3.3.2	Sinusoidal Miscentering at Roll Modulated by Twice Orbital Perpendicular to Roll Axis	Any sinusoidal rotor miscentering at roll modulated by twice orbital in a direction perpendicular to the S/V roll axis shall be less than 3 nm.	P0918, run on October 8-10, 2002 collected data and analysis was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). For the Basic Science Mission without temperature variation, the result was 0.9766 and 0.9891 nanometers (for roll + 2 x orbital frequency) and 0.8598 and 0.8645 nanometers (for roll - 2 x orbital frequency) per P0918, section 17.2. For the Basic Science Mission with temperature variation, the result was 0.9183 and 0.9408 (for roll + 2 x orbital frequency) and 0.8165 and 0.8294 nanometers (for roll - 2 x orbital frequency) per P0918, section 17.4. The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	T	√
3.4.4	Suspension Control System Transfer Function	The suspension control system transfer function has the following requirements:	N/A		N/A	N/A
3.4.4.2	Induced Rotor Potential	The rotor potential induced by voltages applied to the electrodes from the suspension system shall be <= 0.015 V rms.	Analysis of P0918 test data (P0918 run on October 8-10, 2002) was performed within P0918 using MATLAB scripts (defined in S0704, Software Version Description Document (VDD) for the GSS Test Environment). For the Basic Science Mission without temperature variation, the result was 2.035e-6 V (P0918, section 17.2). For the Basic Science Mission with temperature variation, the result was 1.95e-6 V (P0918, section 17.4). The additional on-orbit effect due to micrometeoroid strikes is addressed in S0721.	P0918	A	√
3.4.5	Gyro spin-up support		N/A		N/A	N/A
3.4.5.1	Spinup suspension acceleration range	The suspension system shall be able to apply a minimum acceleration of 1 m/s^2 (0.1 g) to the rotor to compensate for the force generated by the spinup gas.	S0715 "GSS Requirements Verification Analysis Report 5" shows by analysis that the maximum suspension voltage required to produce 1 m/s^2 (0.1 g) acceleration is 400 Volts, and from the verification of PLSE-13, Part 1 #3.4.8.2.1.1 the GSS is capable of applying +/- 600 Volts suspension potential.	S0715	A	√
3.4.5.2	Control bandwidth	The bandwidth of the spinup control system shall be greater than 100 Hz.	S0731 "GSS Requirements Verification Analysis Report 9" shows that the bandwidth for the individual digital control system components are greater than 100 Hz.	S0731	A	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.5.3	Stability Margin (Window)	The gain margin window for this conditionally-stable control system shall be greater than or equal to 12 dB.	S0731 "GSS Requirements Verification Analysis Report 9" shows that the stabillity margin window for the analog and digital controller are greater than 12 dB.	S0731	A	√
3.4.6	Arc Detection		N/A		N/A	N/A
3.4.7	Gyro spin axis alignment support	The gyroscope spin axis alignment is achieved by the interaction of a modulated suspension preload with the centrifugally generated rotor oblateness.	N/A		N/A	N/A
3.4.7.3	Spin axis alignment technical requirements	The spin axis alignment system will conform to the following requirements:	N/A		N/A	N/A
3.4.7.3.2	Latency of preload modulation command.	The GSS shall respond to a command to change a preload setting with a latency of less than or equal to 1 second.	S0731 "GSS Requirements Verification Analysis Report 9" shows that the latency of changes to the preload modulation takes less than 78 msec to complete from the time the CCCA command is received to its application.	S0731	A	√
3.4.7.3.3	Spin alignment actuation and monitoring.	Measurement of the spin axis orientation shall be interleaved with the actuation of the spin alignment torques. The SQUIDs are not required to function during spin axis alignment actuation.	S0716 "GSS Requirements Verification Analysis Report 7" details the GSW V&V test cases that successfully exercised the alignment algorithms: TMSSGUP4007, TMSSGUP0008, & TMSSGUP0009.	S0716	A	√
3.4.7.3.4	Measurement period for rotor orientation determination during spin axis alignment	The Spin Axis alignment algorithm shall require less than two roll periods to determine the orientation of the spin axis during the spin axis alignment process.	S0716 "GSS Requirements Verification Analysis Report 7" details the GSW V&V test cases that successfully exercised the alignment algorithms: TMSSGUP4007 & TMSSGUP0008.	S0716	A	√
3.4.8	GSS Functional Requirements		N/A		N/A	N/A
3.4.8.1	Backup suspension control system		N/A		N/A	N/A

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.8.1.1	Spinup backup	A spinup backup controller shall be provided which is capable of suspending the gyroscope while spinup gas is flowing but may not necessarily meet the suspension performance requirements outlined in this document.	P0769 "Extended Functional Test Procedure for the Gyroscope Suspension System (GSS) Forward Suspension Unit", Section 17.14 - The back controller was exercised with simulated forces applied to the X, Y, and Z-axis for a net 0.05 G force on the gyro. P0522 "Fast Spin Test" contains the force data from the flight spin up flow rates of flight Gyro #3. Results show that the average net force on the gyro applied by the spinup gas at 726 sccm (calculated by subtracting the control vector forces of 0 sccm flow from 726 sccm flow) is 0.048 G (see S0692 Spinup Gas Force on the Gyro). The gyro was positioned at center, -7.0 um, -9.0 um, and -11.0 um to simulate the possible positions of the gyro when the spin up back controller engages per a given scenario. The maximum allowed movement of the gyro is 19.5 um, with the housing at a distance of 33 um. All FSU spinup backup controllers suspended the gyro within the 19.5 um limit for the four stated positions.	P0769 S0692	T	√
3.4.8.1.2	Science mode backup	A science mode backup controller shall be provided which is capable of suspending the gyroscope in science mode and capable of rejecting disturbances specified in P0149, but may not necessarily meet the suspension performance requirements outlined in this document.	P0769 "Extended Functional Test Procedure for the Gyroscope Suspension System (GSS) Forward Suspension Unit" S0694 "Reconsideration of Risk Posed by Micrometeoroid and Orbital Debris to the GP-B Relativity Mission" P0769 is an "as run" test of backup controller in State 9 (science mode). Successful operation of the controllers is shown for a 1 kg-m/sec impulse due to a micrometeorite impact, with the limit for no loss of functionality at 0.0025 kg-m/sec impulse. P0149 states that the Payload shall continue the science mission with the loss of redundant systems in the event of an impact, where the "worst case" impact impulse is 2.5 kg-m/sec. While only one of the three science gyroscopes is needed to complete the mission, a 2.5 kg-m/sec impulse has the possibility of damaging all of the rotors and housings when the gyros are spun-up. The risk of not testing the GSS to "worst case" scenario is minimal and is addressed in S0694. This requirement is met for the expected on orbit environment evaluated in E	P0769	T	√
3.4.8.1.3	Autonomous engagement of		N/A		N/A	N/A

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
	backup control					
3.4.8.1.3.1	Position error	The GSS shall autonomously (without command from the CCCA or ground) engage the backup system when the position of the gyro exceeds a 12 um radius from the center of the housing as indicated on the position bridge.	P0769, Paragraph 17.14 Part A. verifies the Autonomous switching portion of this requirement. P0769, Para. 17.12 Arbiter Test: Measured data shows that the high backup system has control of the Gyro at a distance, as measured from the center of the Gyro housing, FSU SN001, SN002, SN003, SN004 captured the Gyro at less then 12 um.	P0769	T	√
3.4.8.1.3.2	Computer fault	The GSS shall autonomously (without command from the CCCA or ground) engage the backup system when the computer reads/writes to the FSU late by a factor of 1.5 of the nominal update rate.	P0769 "Extended Functional Test Procedure for the Gyroscope Suspension System (GSS) Forward Suspension Unit", Para 17.15 verifies that the High Back Analog Controller engages when the computer is turned off (simulating a fault). The Science Mission nominal update rate is 220 Hz was stated in PLSE-13 Part 1 #3.2.8.10 and SCSE-15, section 5.1.6. "GYP610011 Gyro Processing at 220 Hz". In the release drawing for the FMR board, drawing number 8A01892 it states that in the science mode (as it is for procedure P0769 section 17.15) the "watchdog counter" triggers at 171 counts. The clock used for the counter has a frequency of 34.1 kHz corresponding to 5.01 milliseconds. Since the nominal update rate in science mode is 220 Hz, the period of a nominal update is 4.55 milliseconds. The test uses the heartbeat failure condition (also known as the watchdog timer) to trigger the transition from digital control to the backup system and thus in fact shows that the transition takes place in 1.10 times the nominal update rat	P0769	T	√
3.4.8.2	Suspension voltage amplifier requirements		N/A		N/A	N/A
3.4.8.2.1	Spinup drive parameters		N/A		N/A	N/A

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.8.2.1.1	Range	The suspension voltage amplifier spinup drive output shall be commandable over the range of at least +600 to -600 V.	P0769 Para 17.9 shows the voltage range for all four FSU. SN004 measured voltage range: +606.0, -605.9, SN003 measured voltage range: +605.9, -606.1, SN002 measured voltage range: +605.8, -605.9, SN001 measured voltage range: +605.8, -605.8,	P0769	T	√
3.4.8.2.1.2	Noise	The suspension voltage amplifier spinup drive output noise shall be less than 1 V rms.	P0769, Para 17.8, Parts A, B. SN004 measured noise: < 1 kHz = .0028 V > 100 Hz = .126 V SN003 measured noise: < 1 kHz = .0033 V > 100 Hz = .127 V SN002 measured noise: < 1 kHz = .0007 V > 100 Hz = .117 V SN001 measured noise: < 1 kHz = .0075 V > 100 Hz = .121 V	P0769	T	√
3.4.8.2.2	Science drive amplifier characteristics:		N/A		N/A	N/A
3.4.8.2.2.1	Range	The suspension voltage amplifier science drive output-shall be commandable over the range of at least +45 to -45 V.	P0769, Para 17.11 for SN004, SN003, SN002 (Para. 17.12 for SN001) SN 004 measured output range: +45.5, -46.8 SN 003 measured output range: +45.4, -46.4 SN 002 measured output range: +45.3, -46.4 SN 001 measured output range: +45.6, -46.85	P0769	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.8.2.2.2	Noise	The suspension voltage amplifier science drive output noise spectral density shall be < 4 V/rt(Hz) at 5.5 mHz; < 20 mV/rt(Hz) at 1 Hz; < 200 uV/rt(Hz) at > 100 Hz.	P0769, Para 17.7, Parts A, B Req.: < 4 V/rt.(Hz) at 5.5 mHz SN 001: Measured : 80 uV SN 002: Measured: 501.19 uV SN 003: Measured : 64.1 uV SN 004: Measured : 79.4 uV Req.: < 20 mV/rt.(Hz) at 1 Hz SN 001: Measured : 10 uV SN 002: Measured: 12.3 uV SN 003: Measured : 7.08 uV SN 004: Measured : 8.1 uV Req.: < 200 uV/rt.(Hz) at > 100 Hz SN 001: Measured inadvertently at 3 Hz: (see D-Log 11 - Closed) SN 002: Measured: 66.6 uV SN 003: Measured : 54.2 uV SN 004: Measured : 34.9 uV PCB 558 Updated this requirement to baseline specification values. Original values were based of test data and were set extremely low.	P0769	T	√
3.4.8.2.2.3	Temperature coefficient	The suspension voltage amplifier science drive output temperature coefficient shall be less than < 200 PPM/deg C.	P0747 Rev- "Thermal/Vacuum Test Procedure for the Gyroscope Suspension System (GSS) Forward Suspension Unit (FSU)" exposes the FSU to the on-orbit maximum and minimum temperature profile. P0702 "Full Functional Test Procedure For The Gyroscope Suspension System (GSS) Forward Suspension Unit (FSU) Subsystem" LVA Output, Para. 16.7 provides the voltages at the various temperatures during TVAC. S0690 provides the analysis on the P0747 and P0702 test data and shows that the units vary from about 11-14 PPM/deg C.	P0702 S0690	A,T	√
3.4.8.2.3	Ground test drive amplifier characteristics:		N/A		N/A	N/A
3.4.8.2.3.1	Range	The suspension voltage amplifier ground test drive output will be commandable over the range of +/- 1400 V.	N/A		N/A	N/A

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.8.2.3.2	Noise	The suspension voltage amplifier ground test drive output noise will be less than 1 V rms.	N/A		N/A	N/A
3.4.8.3	Persistent state storage	The GSS shall store 16 bits of mode register information in non-volatile storage so that a power off/on cycle does not erase this information. Mode register information is defined in SCSE-16, section 9.	P0769, Para 17.12.1 - 17.12.11 for SN004, SN003, SN002 P0769, Para 17.13.1 - 17.13.11 for SN001 Test results show that 16-bit mode register information is not lost during a power on/off cycle for each FSU.	P0769	T	√
3.4.8.4	Position bridge characteristics		N/A		N/A	N/A
3.4.8.4.1	Position Bridge Bandwidth	The position bridge shall have a measurement bandwidth greater than 600 Hz.	P0829 Rev A "Board-Level Test Procedure for Gyroscope Suspension System (GSS) HV Amplifier and Bridge (HVA) Assembly" tested SNs 1-15 HV Amplifier and Bridge (HVA) Assemblies. S0693 "GSS Requirements Verification Analysis Report 4" provides analysis of the test results that show the position bridge bandwidth is approximately 1,800 Hz at science excitation level and about 2,100 Hz at spin-up excitation level for SNs 1-15.	S0693 P0829	A,T	√
3.4.8.4.2	Position Bridge Error at Roll Frequency	The position bridge error in a 1/2-year band about roll frequency shall be less than 0.3 nm.	S0715 analysis shows that for the specification temperature variation at roll the bridge error is +/- 0.192 nm and complies with the 0.3 limitation.	S0715	A	√
3.4.8.4.3	Digitized Position Bridge Noise Level	The position bridge spectral density noise level, including A/D quantization noise shall be less than 1.5 nm/rt(Hz) for frequencies less than 1 kHz.	S0716 "GSS Requirements Verification Analysis Report 7" converts the 1.5 nm/rt(Hz) into a rms equivalent specification of 15.7 nm_rms over the appropriate bandwidth. The computed net noise was 0.54 nm_rms. P0829 "Board-Level Test Procedure for Gyroscope Suspension System (GSS) HV Amplifier and Bridge (HVA) Assembly" provided analysis data.	P0829 S0716	A,T	√
3.4.9	Gyro science mission calibration support		N/A		N/A	N/A
3.4.9.1	Pre-load Modes	The preload for the suspension system in science mode shall be manually commandable to a minimum floor value from 2e-7 g to 2e-4 g.	S0731 "GSS Requirements Verification Analysis Report 9" shows that the preload parameter is floating point type and can be set in the GSW to any value within the range of 2e-7 g to 2e-4 g. Application of the preload parameter as exercised in P0918 revealed that the value should be set in science mode to 2e-7 g.	S0731	A	√
3.4.9.4	Modulation of	Commanded changes in the preload	S0731 "GSS Requirements Verification Analysis Report	S0731	A	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
	Preload Voltage Timing Accuracy	shall be applied to the gyroscope with a latency of less than or equal to 0.1 sec from the receipt of the command by the GSS computer.	9" shows that command changes in the preload are applied to the gyroscope with a latency of about 65 msec.			
3.4.9.5	Electrostatic caging	The GSS shall provide the ability to electrostatically cage the gyroscope (draw gyroscope into an electrode)	S0715 "GSS Requirements Verification Analysis Report 5" verifies by analysis that the GSS has the capability to electrostatically cage the gyroscope by applying a suspension voltage of +30 V to one electrode, -30 V to one electrode, and 0 V to the remaining four electrodes.	S0715	A	√
3.4.10	Gyroscope charge measurement		N/A		N/A	N/A
3.4.10.3	Suspended gyroscope during SM phase		N/A		N/A	N/A
3.4.10.3.1	Accuracy	The gyroscope charge shall be measured to an accuracy less than or equal to 10 mV.	S0705 "GSS Charge Measurement and Rotor Potential Determination Verification Analysis" verifies that the accuracy is +/- 1 mV, and meets the 10 mV or less.	S0705	A	√
3.4.10.3.2	Precision	The precision of the measured rotor charge for measurement times not to exceed 1200 sec shall be less than or equal to 5 mV.	S0705 "GSS Charge Measurement and Rotor Potential Determination Verification Analysis" verifies that the precision is +/- 1 mV, and meets the 5 mV or less.	S0705	A	√
3.4.10.3.3	Measurement Time constant	The time required for the charge measurement to settle to within +/- 1.5 mV of the final value for a 10 mV step in rotor potential shall be less than 300 sec.	S0705 "GSS Charge Measurement and Rotor Potential Determination Verification Analysis" verifies that the time constant is 80 sec, and meets the 300-sec or less.	S0705	A	√
3.4.10.4	Drag-free sensor gyroscope during SM phase		N/A		N/A	N/A
3.4.10.4.1	Accuracy	The gyroscope charge shall be measured to an accuracy less than or equal to 3 mV.	S0705 "GSS Charge Measurement and Rotor Potential Determination Verification Analysis" verifies that the accuracy is +/- 1 mV, and meets the 3 mV or less.	S0705	A	√
3.4.10.4.2	Precision	The precision of the measured rotor charge for measurement times not to exceed 1200 sec shall be less than or equal to 1 mV.	S0705 "GSS Charge Measurement and Rotor Potential Determination Verification Analysis" verifies that the precision is +/- 0.5 mV, and meets the 1 mV or less.	S0705	A	√
3.4.10.4.3	Measurement Time constant	The time required for the charge measurement to settle to within +/- 1.5 mV of the final value for a 10 mV step in rotor potential shall be less than 1000 s.	S0705 "GSS Charge Measurement and Rotor Potential Determination Verification Analysis" verifies that the time constant is 800 sec, and meets the 1000-sec or less.	S0705	A	√
3.4.10.5	Gyroscope pre/post		N/A		N/A	N/A

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
	SM data acquisition phase					
3.4.10.5.1	Accuracy	The gyroscope charge shall be measured to an accuracy less than or equal to 10 V.	S0705 "GSS Charge Measurement and Rotor Potential Determination Verification Analysis" verifies that the accuracy is +/- 1 mV, and meets the 10 mV or less.	S0705	A	√
3.4.10.5.2	Precision	The precision of the measured rotor charge shall be better than or equal to 3 V.	S0705 "GSS Charge Measurement and Rotor Potential Determination Verification Analysis" verifies that the precision is +/- 1 mV, and meets the 3 mV or less.	S0705	A	√
3.4.10.5.3	Measurement Time constant	The time constant of the charge measurement shall be less than 100 s.	S0705 "GSS Charge Measurement and Rotor Potential Determination Verification Analysis" verifies that the time constant is 80 sec, and meets the 100-sec or less.	S0705	A	√
3.4.10.6	Charge measurement during spinup.		N/A		N/A	N/A
3.4.11	Charge Control Support		N/A		N/A	N/A
3.4.11.1	Electrode Bias	The electrode bias signal shall be commandable to the following values: +3 V, -3 V, 0 V with respect to the FSU ground reference.	P0769, Para 17.4 verifies that the FSU SN001, SN002, SN003, SN004 boxes were commanded to +3 V, -3 V, 0 V.	P0769	T	√
3.4.11.2	Accuracy at +/- 3 V	The accuracy of the electrode bias signal shall be +/- 0.2 V at the +/- 3 V settings with respect to the FSU ground reference.	P0769, Para 17.4 FSU measured accuracy: SN004 +3V = +.02V, -3V = +.01V SN003 +3V = +.03V, -3V = -.04V SN002 +3V = +.03V, -3V = +.01V and -.02V SN001 +3V = +.02V, -3V = -.02V	P0769	T	√
3.4.11.3	Accuracy at 0 V	The accuracy of the electrode bias signal shall be +/-5 mV at the 0 V setting with respect to the FSU ground reference.	P0769, Para 17.4 SN004 measured accuracy: +2.83 mV SN003 measured accuracy: +2.30 mV SN002 measured accuracy: +2.1 mV SN001 measured accuracy: -1.22 mV	P0769	T	√
3.4.11.4	Bias to Roll Rate Synchronization Accuracy	Commanded changes in the charge control bias shall be applied to the gyroscope with a latency of less than or equal to 0.1 s from the receipt of the command by the GSS computer.	S0731 "GSS Requirements Verification Analysis Report 9" shows that the latency of changes to the charge control bias takes less than 78 msec to complete from the time the GSS CPU sends the command till the FMR is updated.	S0731	A	√
3.4.11.5	Noise on charge control bias	The noise on the electrode bias signal shall be less than 500 uV/rt(Hz) for frequencies below 100 Hz	P0769, Para 17.5 SN004 max measured noise = 33.0 uV/rt.(Hz) SN003 max measured noise = 5.0 uV/rt.(Hz)	P0769	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
			SN002 max measured noise = 17.0 uV/rt.(Hz) SN001 max measured noise = See attachment to D-log 9 requirement not re-tested. SN001 tested first and D-log 9 was written against it when it failed. The source of the discrepancy was discovered and resolved for the remaining boxes. All of the remaining boxes passed the requirement with better than an order of magnitude margin. Because all of the remaining boxes passed with a high level of margin SN001 was delivered and installed on the SV as part of the critical path without re-testing. DR 440 addresses this test discrepancy, disposition "use as is".			
3.4.12	Telemetry Accuracy and Precision		N/A		N/A	N/A
3.4.12.1	Analog signal monitor data rate	All analog monitor channels shall individually support data collection up to the GSS Mission Mode control rate on a single channel at a time. (for reference only, sample rates are 220 Hz for Science Mode and 660 Hz for Spin-up Mode as defined in SCSE-16)	S0715 "GSS Requirements Verification Analysis Report 5" shows by analysis that the total read time of the slowest analog monitor is at least less than 200 microseconds and that the shortest GSS mission mode is greater than 1500 microseconds. Because the monitor read time is at least 7.5 times faster than the mission mode time, all analog monitor are individually capable of supporting data collection up to the GSS mission mode control rate.	S0715	A	√
3.4.12.2	Analog signal monitor precision	Each analog monitor channel shall be measured to within 0.05% of the magnitude of its expected range.	S0690 verifies the signal monitor precision is based off of the full-scale range of the 16-bit A/D converters and meets the requirement with margin.	S0690	A	√
3.4.12.3	Measurement of temperature variation	All temperatures shall be measured so that variations in temperature resolved to a precision better than 0.1 deg C.	S0690 verifies the signal monitor precision to variation in temperature is 0.00031 volts, and that the 0.1 degree = 0.001 volts measured.	S0690	A	√
3.4.12.4	Measurement of DC supply voltages	DC supply voltages, where measured, shall be reported in telemetry to an accuracy of better than 5% of their nominal values.	The AMT monitors DC supply voltages for the ASU unit and the MUX monitors DC supply voltages for the FSU. P0702 ASU functional test, section 12.1 "Summary of Test Activity" shows monitor test 14, 21:1 telemeters the AMT supply voltages. P0772 FSU functional test, section 16.2 "Baseline MUX Monitor Tests" verifies the MUX DC supply voltages are telemetered. S0731 verifies that the accuracy of the measurements is 2.02 % for the ASU and 1.57% for the FSU.	S0731 P0772 P0702	A,T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.12.5	Measurement of variation in supply voltages	Variation at roll rate of DC supply voltages, where measured, shall be reported in telemetry to a precision of better than 0.05% of their nominal DC supply values.	S0690 verifies the variation in supply voltages by GSS #3.4.12.2, which covers all DC voltages.	S0690	A	√
3.4.12.6	Measurement of variation in supply current	Variation at roll rate of DC supply currents, where measured, shall be reported in telemetry to a precision of better than 0.1% of their full-scale values.	S0690 verifies the precision in the variation in supply current measurement is better than 0.1% of their full-scale values.	S0690	A	√
3.4.13	Control system stability requirements		N/A		N/A	N/A
3.4.13.1	Control Gain Margins	Gain margins for all closed loop control system shall be greater than or equal to 3 (~10 dB).	S0731 "GSS Requirements Verification Analysis Report 9" verifies that gain margins for the analog and digital controller are greater than 10 dB.	S0731	A	√
3.4.13.2	Control Phase Margins	Phase margins for all closed loop control system shall be greater than or equal to 35 degrees.	S0731 "GSS Requirements Verification Analysis Report 9" shows that the phase margins for the analog and digital controller are all greater than 37.1 degrees.	S0731	A	√
3.4.14	Compatibility with the read-out system	Bright line peak to peak voltage will conform to the following:	N/A		N/A	N/A
3.4.14.1	Suspension line signals at or above 100 kHz	Bright line peak-to-peak voltage for frequencies at or above 100 kHz shall be less than or equal to the following equation at each frequency: 500e-3 V / frequency (kHz)	P0769, Para. 17.7, Part D. verifies: SN004 max P-P V < 250.8 V, (100 kHz - 1 MHz). SN003 max P-P V < 124.4 V, (100 kHz - 1 MHz). SN002 max P-P V < 124.4 V, (100 kHz - 1 MHz). SN001 max P-P V < 251.1 V, (100 kHz - 1 MHz).	P0769	T	√
3.4.14.2	Suspension line signals below 100 kHz	Bright line peak-to-peak voltage for frequencies below 100 kHz shall be less than or equal to the following equation at each frequency: 1e5 V / frequency ^2 (frequency in kHz).	P0769, Para. 17.7, Part D. for the FSU (measurements made on all 6 suspension lines for each box). SN004 max P-P V = 12.529 mV, (freq. <100 kHz). SN003 max P-P V = 11.63 mV, (freq. <100 kHz). SN002 max P-P V = 11.7 mV, (freq. <100 kHz). SN001 max P-P V = 13.1 mV, (freq. <100 kHz).	P0769	T	√
3.4.14.3	Electrode Currents	Electrode Currents near roll frequency spin frequency or spin frequency harmonics, and calibration frequencies must satisfy the following:	N/A		N/A	N/A
3.4.14.3.1	Suspension forcing current near roll rate	Suspension forcing current at the frequency in the band of roll frequency +/-1.5 mHz shall be less than or equal to	P0918, run on October 8-10, 2002 collected data and analysis was performed in S0724 "Electrode Current Requirements." The graph on page 8 shows compliance	P0918 S0724	A,T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
		1 pA peak-peak.	is met.			
3.4.14.3.2	Suspension forcing current at odd multiples of rotor spin rate	Suspension forcing currents in the frequency bands of N*fspin +/- 6 mHz) (for N=3,5, ...) shall be less than or equal to 200 pA peak-peak.	P0918, run on October 8-10, 2002 collected data and analysis was performed in S0724 "Electrode Current Requirements." The graph on page 8 shows compliance is met.	P0918 S0724	A,T	√
3.4.14.3.3	Suspension forcing current at even multiples of rotor spin rate	Suspension forcing currents in the frequency bands of N*fspin +/- 6 mHz) (for N=2,4, ...) shall be less than or equal to 1 pA peak-peak.	P0918, run on October 8-10, 2002 collected data and analysis was performed in S0724 "Electrode Current Requirements." The graph on page 8 shows the GSS exceeds the requirement. SN005 - DR 441 - explains that this requirement applies to an alternative spin-axis readout method that does not apply to the baseline. The values reported still comply with the current baseline for mission success.	P0918 S0724	A,T	√
3.4.14.3.4	Suspension forcing current at low frequency SRE calibration signal frequency	Suspension forcing current at the frequency in the band of 10mHz +/-1.5 mHz shall be less than or equal to 1 pA peak-peak.	P0918, run on October 8-10, 2002 collected data and analysis was performed in S0724 "Electrode Current Requirements." The graph on page 8 shows compliance is met.	P0918 S0724	A,T	√
3.4.14.3.5	Suspension forcing current at high frequency SRE calibration signal frequency	Suspension forcing current at the frequency in the band of 250 Hz +/-1.5 mHz shall be less than or equal to 10 pA peak-peak.	P0918, run on October 8-10, 2002 collected data and analysis was performed in S0724 "Electrode Current Requirements." The graph on page 8 shows compliance is met.	P0918 S0724	A,T	√
3.4.14.3.6	Suspension Forcing Currents below 2 kHz	Suspension forcing currents at frequencies at or below 2 kHz shall be less than or equal to 50 nA peak-peak.	P0918, run on October 8-10, 2002 collected data and analysis was performed in S0724 "Electrode Current Requirements." The graph on page 8 shows compliance is met.	P0918 S0724	A,T	√
3.4.14.3.7	Spurious suspension currents below 2 kHz	Spurious currents at frequencies at or below 2 kHz shall be less than or equal to 50 nA peak-peak.	P0918, run on October 8-10, 2002 collected data and analysis was performed in S0724 "Electrode Current Requirements." The graph on page 8 shows compliance is met.	P0918 S0724	A,T	√
3.4.14.3.8	Spurious suspension currents above 2 kHz	Spurious currents at frequencies above 2 kHz shall be less than or equal to following at each frequency: 100 uA peak-peak / frequency (Hz).	P0918, run on October 8-10, 2002 collected data and analysis was performed in S0724 "Electrode Current Requirements." The graph on page 8 shows compliance is met.	P0918 S0724	A,T	√
3.4.14.3.9	Bridge Excitation Variation at SV roll frequency	Variation of amplitude of bridge sense frequency in the band around SV roll frequency +/- 1.5 mHz shall be less than 0.1% in the on-orbit environment.	S0690 verifies that the percent amplitude deviation over the operation temperature range for the GSS is 0.000017% using thermal vacuum data from P0747 and functional test data from P0702 for SN001, SN002, SN003, and SN004.	P0702 S0690	A,T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.4.14.4	Low-pass Filter Near the Probe	The suspension lines from the GSS to Top-hat shall contain a first order low pass filter with a cutoff frequency at or below 500 kHz.	S0690 verifies that the low-pass filter cut off frequency is 114 kHz.	S0690	A	√
3.4.15	Rotor position offset capability		N/A		N/A	N/A
3.4.15.1	Position command offset range	The gyroscope position shall be commandable to any position within a 10.0 um sphere about the capacitive center of the housing.	P0918, run on October 8-10, 2002 section 17.5 "Cavity Exploration" shows that the simulated rotor was commandable to from +/-10 um in the X, Y, & Z axes at 2.5 um intervals. An exception occurs at +7.5 um because that position can trigger the arbiter's threshold level of 8.0 um for backup mode due to noise in the test bed.	P0918	T	√
3.4.15.2	Rotor Position Offset Accuracy	The error between the commanded and actual rotor position shall be less than 2% of the rotor/electrode gap. (for reference only, the nominal gap is 32e-6 meters)	S0693 verifies the position error is less than 2% of the bias.	S0693	A	√
3.4.15.4	Modulation of Rotor Position Timing Accuracy	Commanded changes in the gyro position shall be applied to the gyroscope with a latency of less than or equal to 0.1 s from the receipt of the command by the GSS computer.	S0731 "GSS Requirements Verification Analysis Report 9" shows that command changes in the gyroscope position are applied to the gyroscope with a latency of about 65 msec.	S0731	A	√
3.4.16	Compatibility with gyro ground testing		N/A		N/A	N/A
3.4.16.1	1 g suspension capability	GSS will levitate a ground test gyroscope through flight interfaces using an external non-flight booster computer.	N/A		N/A	N/A
3.4.17	Compatibility with the drag free sensor function	These requirements pertain to the data delivered in the ATC PIT over the 1553 bus to the CCCA. Data is made available to the CCCA at the 10 Hz strobe.	N/A		N/A	N/A
3.4.17.2	Position data nonlinearity	The nonlinearity of the position data provided to the drag-free control system shall be less than 6% over a 10 micro-meter range from the capacitive center of the housing.	VP - 10/4/02 - S0693 in review Test = P0769 Sect. 17.13, Bridge Calibration using the Gyro Simulator, FSUs.	S0693 P0769	A,T	√
3.4.17.5	Bridge Excitation Voltage	The capacitive bridge excitation voltage shall be less than 50 mV peak-peak.	P0769 Rev. A Oscillator Low Level Tests Para.17.3.11, 17.3.12 and 17.3.13 for all four GSS Forward Boxes. Measured voltages: SN001 35 mV peak-peak	P0769	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
			SN 002 42 mV peak-peak SN 003 42 mV peak-peak SN 004 38 mV peak-peak			
3.5	Design and Construction		N/A		N/A	N/A
3.5.1	Component Selection	The component selections shall be from MIL-STD-975, "NASA Standard Electrical, Electronic, and Electromechanical (EEE) Parts List," or Relativity Mission list of approved parts, PA-06. All parts not on these lists shall be qualified by an internal Non-Standard Part Approval Request (NSPAR) process.	S0726 "GSS Standard EEE and Non-Standard Parts" contains all of the components that require EEE screening used in the GSS and verifies that they have all under gone adequate parts qualification.	S0726	A	√
3.5.2	Part Derating	The selected parts shall be derated per JPL-D-8545-A or MIL-STD-975 (last revision)	S0445 "GSS EEE Parts Derating Analysis" verifies that the parts derating was done as part of the design process.	S0445	A	√
3.5.3	Single Point Failure	Design shall have no mission critical single point failure, as defined in GPB-S0278, "Gyro Suspension System (GSS) Failure Modes, Effects and Criticality Analysis (FMECA)."	S0684 verifies the GSS redundancy and contains no mission critical signal point failure.	S0684	A	√
3.5.4	Electromagnetic Compatibility	The EMI/EMC characteristics for the unit will comply with electromagnetic requirements of CE01, CE03, CS01, CS02, CS06, RE02 and RS03 of MIL-STD-461C as tailored below.	N/A		N/A	N/A
3.5.4.1	CE01, CE03 Narrowband	CE01, CE03: The unit's narrowband power-line conducted emissions shall be less than the levels indicated in Figure 3-6.	P0701 "Electromagnetic Interference (EMI) Test Report for the Gyroscope Suspension System (GSS)", CE01 Narrowband Para. 14.1.1.1 CE03 Narrowband Para. 14.1.1.2 for the Forward and Aft GSS SN005. (Non Flight Interconnect Cables) 1. CE01 (30 Hz to 15 kHz): six +28 VDC power supply and return leads were measured for conductive emissions. The conductive emissions measured were less than the levels in Figure 3-6. 2. CE03 (15kHz to 50 MHz) six +28 VDC power supply and return lines were measured for conductive emissions. The conductive emissions measured were less than the levels in Figure 3-6.	P0701	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.5.4.2	CE03 Wideband	CE03: The unit's broadband power-line conducted emissions shall be less than the levels indicated in Figure 3-7.	P0701 "Electromagnetic Interference (EMI) Test Procedure For The Gyroscope Suspension System (GSS)", CE03 Wideband Para. 14.1.1.2 for the Forward and Aft GSS SN005. (Non Flight Interconnect Cables) CE03 (20k Hz to 50 MHz) six +28 VDC power supply and return leads were measured for conductive emissions. The conductive emissions measured were less than the levels indicated in Figure 3-7. D-Log #17 for CE03 wideband +C location and -C location at 15 kHz. The test starts at 15 kHz and the specification pass/fail criteria starts at 20 kHz, so the 15 kHz anomalies are outside of the required test range. This appears to be a Start Test Transient "Failure reported is spurious, No action required."	P0701	T	√
3.5.4.3	CS01,02	CS01,02: The unit shall operate properly with the signal span identified in Figure 3-8 superimposed on the nominal +28 Vdc prime power bus.	P0701 "Electromagnetic Interference (EMI) Test Procedure For The Gyroscope Suspension System (GSS)" CS01 Para. 14.2.1.1and CS02 14.2.1.2 for the Forward and Aft GSS SN005 (Non Flight Interconnect Cables) 1. CS01 (30 Hz to 50 kHz, at 3.0 Vpeak-peak) six +28 VDC power supply and return leads were subjected to transformer-coupled low frequency sinusoids while the GSS was monitoring telemetry. There were no instances of conductive susceptibility while the GSS was monitoring telemetry and the GSS operated properly within the signal span in Figure 3-8. 2. CS02 (50 kHz to 10 MHz, at 3.0 Vpeak-peak) six +28 VDC power supply and return leads were subjected to transformer-coupled low frequency sinusoids while the GSS was monitoring telemetry. There were no instances of conductive susceptibility while the GSS was monitoring telemetry and the GSS operated properly within the signal span in Figure 3-8.	P0701	T	√
3.5.4.4	CS06	CS06: The unit shall operate properly with the broadband (spike) stimulus identified in Figure 3-9 superimposed on the nominal +35 Vdc prime power bus.	P0701 "Electromagnetic Interference (EMI) Test Procedure For The Gyroscope Suspension System (GSS)": CS06 Para. 14.2.1.3 for the Forward and Aft GSS SN005 (Non Flight Interconnect Cables). Six +28 VDC power supply and return leads were	P0701	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
			subjected to Time Domain transients (Time Domain at 35 Vpeak spikes @ 0.15 and 10uS duration and the free running rate was 10 PPS) while the GSS was monitoring telemetry. There were no instances of conductive susceptibility while the GSS was monitoring telemetry and the GSS operated properly with the broadband (spike) stimulus in Figure 3-9.			
3.5.4.5	RE02 narrowband	RE02: The unit's narrowband radiated emissions shall be less than the levels indicated in Figure 3-10 using shielded signal bundles, and unshielded power lines.	P0701 "Electromagnetic Interference (EMI) Test Report for the Gyroscope Suspension System (GSS)": RE02 Para. 14.1.2 For the Forward and Aft GSS SN005. (Non Flight Interconnect Cables) Radiated emissions were measured emanating from the GSS over the frequency range of 14 kHz to 10 GHz. The GSS narrowband radiated emissions limit in Figure 3-10 of PLSE-13, Part 1 was exceeded three times during this test using shielded signal bundles and unshielded power lines. In the vertically polarized frequency range of 25 to 50 MHz by 4.5 dB, in the horizontally polarized frequency range of 25 MHz to 50 MHz by 2.5 dB, and in the 50 MHz to 100M Hz range by 5.8 dB. SN 005 - DR#411 was disposition that the out of tolerance condition will have no effect on the SV, "use as is."	P0701	T	√
3.5.4.6	RE02 wideband	RE02: The unit's broadband radiated emissions shall be less than the levels indicated in Figure 3-11 using shielded signal bundles, and unshielded power lines.	P0701 "Electromagnetic Interference (EMI) Test Report for the Gyroscope Suspension System (GSS)": RE02 Para. 14.1.2 for the Forward and Aft GSS SN005 (Non Flight Interconnect Cables). Radiated emissions were measured emanating from the GSS over the frequency range of 14 kHz to 1 GHz. The GSS broadband radiated emissions limit in Figure 3-10 of PLSE-13 Part1 was exceeded once during the horizontally polarized frequency range of 100 MHz to 199.9 MHz by 0.1dB using shielded signal bundles and unshielded power lines. DR #438 covers the 0.1-dB discrepancy, disposition "Use As Is" - Requirement met.	P0701	T	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
3.5.4.7	RS03	RS03: The unit shall operate properly when subjected to radiated energy as defined in Table 3-3.	P0701 "Electromagnetic Interference (EMI) Test Report for the Gyroscope Suspension System (GSS)": RS03 Para. 14.2.2 for the Forward and Aft GSS SN005 (Non Flight Interconnect Cables). RS03 (14 kHz to 2 GHz at a field strength of 1 V/m and 2 GHz to 18 GHz at a field strength of 2 V/m) the ASU operated properly. There were no susceptibility indications at any frequencies while the GSS was monitoring telemetry and the GSS operated properly when subjected to radiated energy as defined in Table 3-3 of PLSE-13 Part 1 SN 005 D-Log #10 During the RS03 testing the ASU crashed due to a large resonance frequency that occurred in the test chamber causing field strengths greater than specified. The automatic controller was unable to control the field. The manual controller was used to control the resonance frequency and was successful.	P0701	T	√
3.5.5	Electrical Bonding	Electrical bonding will be in accordance with MIL-B-5087B Class R. The DC resistance across any electrically bonded joint will be less than 2.5 milliohms. Items requiring bonding only for the prevention of static charge buildup will be bonded per MIL-B-5087B Class S.	N/A		N/A	N/A
3.5.5.1	Electrical Bonding of the Enclosure	All metallic items having a maximum projected area of 1 square inch or more shall be connected to ground through a resistance of 10 megaohms or less. Surfaces to be electrically bonded shall be covered with protective, electrically conductive coatings (where possible) to prevent corrosion. Electrically bonded joints shall not depend on screw threads, hinge springs, friction-fit parts, or nonconductive adhesive joints (such as laminated shims) to furnish the conduction path. The exterior housing shall be conductive metal, assembled	S0731 "GSS Requirements Verification Analysis Report 9" verifies the following: 1) All metallic items having a maximum projected area of 1 square inch or more are connected to ground through a resistance of 10 megaohms or less. 2) Surfaces to be electrically bonded are covered with protective, electrically conductive coatings (where possible). 3) Electrically bonded joints are not dependent on screw threads, hinge springs, friction-fit parts, or nonconductive adhesive joints (such as laminated shims) to furnish the conduction path. 4) The exterior housing is conductive metal, assembled and electrically bonded to provide a continuous shield	S0731	A	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
		and electrically bonded to provide a continuous shield with a resistance of no greater than 2.5 milliohms across any bond joint.	with a resistance of no greater than 2.5 milliohms across any bond joint. P0936 supports this requirement by verifying GSS #3.5.11 Cable Shield Termination. Resistance requirement between GSS boxes and SC are covered in SCSE-18 (P086899) and are verified by GSS #3.5.9.			
3.5.5.2	Electrical Bonding of Mounting Surfaces	The exterior mounting surface(s) shall be such that the unit may be electrically bonded to the structure upon which it is to be mounted with a resistance of no greater than 2.5 milliohms across the joint.	AFT GSS Operations Order GSS-043, Drawing 8A02414, measured the resistance at two locations per box. SN 001 = 0.34/0.04 milliohms measured. SN 002 = 0.76/0.32 milliohms measured. SN 003 = 0.45/0.06 milliohms measured. SN 004 = 0.26/0.28 milliohms measured. FWD GSS Operations Order INT-082, Drawing 8A00631, measured the resistance at two locations per box. SN001 = 1.86/1.78 milliohms measured. SN 002 = 1.01/1.01 milliohms measured. SN 003 = 1.09/0.77 milliohms measured. SN 004 = 1.01/1.01 milliohms measured. The resistance between the GSS AFT and FWD Units to the mounting structure was not greater than 2.5 milliohms.	GSS-043 INT-082	T	√
3.5.6	Electrical Isolation	Unit circuits having incompatible electromagnetic interference characteristics will be isolated to the maximum extent possible to minimize interference coupling. Circuit categories requiring isolation are listed below. a. Power b. Deploy signals c. Commands, monitors, status and test points Pin assignments will be made to provide a maximum isolation between the circuit categories listed above.	N/A		N/A	N/A
3.5.6.1	Power returns	Power returns shall not be used as returns for signal circuits.	S0712 "Inspection Verifications of GSS Requirements" describes the inspection of the GSS board level and assembly level drawings that verify power returns are not used as returns for signal circuits.	S0712	I	√
3.5.6.2	Signal returns	Low-level signal circuit return paths shall	S0712 "Inspection Verifications of GSS Requirements"	S0712	I	√

PLSE-13 #	Title	4.1 Box Level Requirement (Verified)	Compliance Data	Verified In	Method	Verified
		be arranged so that interference will not occur as a result of common paths with other circuits or with the enclosure or structure ground paths.	describes the inspection of the GSS board level and assembly level drawings that verify low-level circuit return paths are grounded and isolated in accordance with this requirement to avoid interference from other circuits.			
3.5.7	Primary Power Isolation	The unit primary power input and return leads shall be electrically isolated by a minimum of 1 megaohm from the metallic case and from all signal, telemetry, command, and secondary power returns within the unit.	P0936 "Isolation and Grounding Test Procedure for the Gyroscope Suspension System Power Subsystem", ran 10/23/02 section 13 "Primary Power Isolation Tests" shows the APU node pair resistances. SN005 – APU node pair resistances: Required >= 1 megaohm Tested: 14.5 to 40 megaohms Note: P0936 is an EMI test, only SN005 required for design verification.	P0936	T	√
3.5.8	Grounding		N/A		N/A	N/A
3.5.10	Secondary Power Grounding Redundancy	The unit secondary power shall be grounded to the unit chassis.	P0936 "Isolation and Grounding Test Procedure for the Gyroscope Suspension System Power Subsystem", ran 10/23/02 section 14 "Secondary Power Grounding Redundancy Tests" shows the node pair resistances. SN005 – ACU node pair resistances: Required < 10 ohms Tested: 0.2 to 0.4 ohms SN005 – FSU node pair resistances: Required < 10 ohms Tested: 0.5 ohms Note: P0936 is an EMI test, only SN005 required for design verification.	P0936	T	√
3.5.11	Cable Shield Termination	The shells of connectors mounted on the enclosure shall be electrically bonded to the enclosure.	P0936 "Isolation and Grounding Test Procedure for the Gyroscope Suspension System Power Subsystem", ran 10/23/02 section 15 "Cable Shield Termination Tests" shows the ACU and APU node pair resistances. SN005 – ACU/APU node pair resistances to chassis: Required < 2.5 milliohms Tested: 0.02 to 1.67 milliohms Note: P0936 is an EMI test, only SN005 required for design verification.	P0936	T	√
3.5.12	Single Event upset	Design shall incorporate features such that the GSS system recovers from single event upsets and single event latch-up without damage.	S0690 shows that the GSS recovers from SELs using supporting analysis in S0684 for Ionizing Radiation Environment.	S0690	A	√

4.2 PLSE-13 Part 1 Box Level Requirements Verified at the System Level

The requirements in this section have only box level verification attributed to them and are verified at the system level only.

PLSE-13 #	Title	4.2 Box Level Requirements Verified at the System Level	Verification Plan/Compliance Data	Verified In	Method	Verified
3.4.4.1	Measurement-to-Force Transfer Function	The measurement-to-force transfer function, at the nth harmonic of the rotor spin speed, H(wn), normalized by the mass of the rotor, m, multiplied by n, and multiplied by the phase shift, d, (in radians) at that frequency shall be less than 81.7/s^2: (H(wn)/m)*n*d<81.7/s^2.	This requirement is a direct flow-down from T003 #2.8.1 "Measurement-to-Force Transfer Function" SL Analysis: The analysis of S0860 provides the results from the GSS simulation which shows that the magnitude of the measurement-to-force transfer function is 0.1 / sec^2, which is approximately 800 times smaller than the maximum value allowed in the requirement. Furthermore, this result was arrived at using very conservative assumptions of a gyro spin frequency of 80 Hz (worst-case based on requirements), and a controller bandwidth of 1 radian/sec (approximately 10 times larger than the controller is expected to achieve on orbit). Verification data for the System Level Analysis came from P0918.	T003 #2.8.1 S0860 P0918	A	√

Table 2: System Level PLSE-13 Part 1 Requirements

4.3 Requirements Verified at the Box Level

"√" = System Engineering review of relevant compliance data verified that the requirement is met.

Note: Specification Section Titles Included For Clarity (Method: N/A)

PLSE-13 #	Title	4.3 System Level Requirement (Verified at Box Level)	Compliance Data	Verified in	Method	Verified
3.2	Interfaces		N/A		N/A	N/A
3.2.6	Telemetry Interfaces	The GSS shall generate valid data, including digital signal processing, in response to Spacecraft commands. The unit shall provide telemetry in accordance with SCSE-17 Spacecraft to Payload ICD.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" verifies by analysis that the hardware and software support the telemetry interfaces to generate valid data in compliance to the SCSE-17. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirements: GHW710010, GSB710010, GSP210060, GTP210010, GTP310010, GUP110050, GUP310020, GUP710040 Verified by Test Case IDs: TGSWCDS0001, TGSWGCP0001, TGSWGHW0001, TGSWGSP0001, TGSWGTP0001, TMSS0004 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √
3.2.7	Command and Data Interface	The forward and aft units shall provide the data and conform to the command and data interfaces specified in section 9 of SCSE-16, "Flight Software Design Specification."	S0713 "Verification of GSS Software Requirements Carried at the Box Level" verifies by analysis that the hardware and software support the telemetry interfaces to generate valid data in compliance to the SCSE-16. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirements: GHW710010, GSB710010, GSP210060, GTP210010, GTP310010, GUP110050, GUP310020, GUP710040 Verified by Test Case IDs: TGSWCDS0001, TGSWGCP0001, TGSWGHW0001, TGSWGSP0001, TGSWGTP0001, TMSS0004 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √
3.2.8.4	Recovery from transient errors		N/A		N/A	N/A

PLSE-13 #	Title	4.3 System Level Requirement (Verified at Box Level)	Compliance Data	Verified in	Method	Verified
3.2.8.5	Knowledge of transient errors	The GSS shall telemeter sufficient information that the occurrence of transient errors in the timing hardware can be observed during Ground Data Processing.	P0768A "Full Functional Test Procedure for the Gyroscope Suspension (GSS) Aft Suspension Unit (ASU) Subsystem" Section 15.0 Software Tests complete in P0772. P0772B "Full Functional Test Procedure for the Gyroscope Suspension System (GSS) Aft Suspension Unit (ASU) Subsystem Using the GSS Test Environment" Section 12.5 SRE Clock Switching Test - generated errors in the timing hardware. S0715, under the PLSE-13 Part 1 requirement #3.2.8.3, provides the analysis that shows the occurrence of transient errors (generated in clock switching) can be observed through processing the GSS telemetry. S0731 provides the analysis that shows that the flight software supports the GSS timing error telemetry.	P0772 S0715 S0731	T, SL-T	Box Level: √ System Level: √
3.2.8.9	Spinup suspension update rate	While under computer controlled suspension during spinup, the control system shall operate at a 660 Hz update rate, synchronized to 16fo and 10 Hz.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" verifies by analysis that the hardware and software support the 660 Hz update rate while synchronized to the 16fo and 10 Hz timing signals. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirement: GYP610012 Verified by Test Case ID: TGSWGYP0002 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the test.	S0713 P086724	A, SL-T	Box Level: √ System Level: √
3.2.8.10	Science Mission suspension update rate	While under computer controlled suspension during science mission suspension, the control system shall operate at a 220 Hz update rate, synchronized to 16fo and 10 Hz.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" verifies by analysis that the hardware and software support the 220 Hz update rate while synchronized to the 16fo and 10 Hz timing signals. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirement: GYP610011 Verified by Test Case ID: TGSWGYP0002 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the test.	S0713 P086724	A, SL-T	Box Level: √ System Level: √

PLSE-13 #	Title	4.3 System Level Requirement (Verified at Box Level)	Compliance Data	Verified in	Method	Verified
3.4.6	Arc Detection		N/A		N/A	N/A
3.4.6.1	Arc detection function	The suspension system shall have an arc-detection function, which will use measured voltage and position data to identify arcing events between the rotor and the electrodes. A flag bit shall be made available in the software interface to notify the spacecraft that an arcing event has taken place.	S0690 "GSS Requirements Verification Analysis Report 3" verifies that system has the ability to detect, snapshots and the flag bit in the software code. Verified at the Box Level. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirements: SSN110010, SSN210030, SSN210040, GSP710010 Verified by Test Case ID: TGSWSSN0001, TGSWSSN0002, TGSWCDS0001 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the test.	S0690 P086724	A, SL-T	Box Level: √ System Level: √
3.4.6.2	Arc detection snapshot	The suspension system shall take a control system snapshot of some critical control system data defined in SCSE 16 at its control rate in the event that an arc is detected; this snapshot format is defined in SCSE16, Section 9.	S0715 "GSS Requirements Verification Analysis Report 5" shows by analysis that the GSS control system is programmed to take a snapshot after an arc is detected. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirements: SSN110010, SSN210030, SSN210040, GSP710010 Verified by Test Case IDs: TGSWSSN0001, TGSWSSN0002, TGSWCDS0001 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the test.	S0715 P086724	A, SL-T	Box Level: √ System Level: √
3.4.7	Gyro spin axis alignment support	The gyroscope spin axis alignment is achieved by the interaction of a modulated suspension preload with the centrifugally generated rotor oblateness.	N/A		N/A	N/A
3.4.7.1	Coarse alignment accuracy	The coarse alignment of the gyroscope shall bring the spin axis within 10 arcsec of the initial apparent line of sight to the guide star.	S0256 "Gyroscope Spin Axis Alignment Algorithms For The Gravity Probe B Satellite" simulation results show the spin axis was within 10 arcsec of the initial apparent line of sight to the Guide Star. SL-A is covered in the T003 #5.2 VLOA and S0256A	S0256A	A, SL-A	Box Level: √ System Level: √
3.4.7.2	Fine alignment accuracy	The onboard procedures for aligning the spin axis of the gyroscope shall have the capability of aligning the gyroscope to within 1 arc-second of a commanded position within 30 arc-second of the line of sight to the guide star.	S0256 "Gyroscope Spin Axis Alignment Algorithms For The Gravity Probe B Satellite" simulation results show the spin axis was within 30 arcsec of the initial apparent line of sight to the Guide Star with an accuracy of better than 1 arc second. SL-A is covered in the T003 #5.3 VLOA and S0256A.	S0256A	A, SL-A	Box Level: √ System Level: √

PLSE-13 #	Title	4.3 System Level Requirement (Verified at Box Level)	Compliance Data	Verified in	Method	Verified
3.4.7.3	Spin axis alignment technical requirements	The spin axis alignment system will conform to the following requirements:	N/A		N/A	N/A
3.4.7.3.1	Preload modulation capability	When under computer-based suspension, the preloads on the A and B electrode axes shall be independently commandable to +/- 10% of their nominal values.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" shows that the preloads on the A and B (now labeled as X and Y) electrode axes are independently commandable to greater than +/- 10% of their values. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirement: GUP310210 Verified by Test Case IDs: TMSSGUP0007, TMSSGUP0010 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √
3.4.9	Gyro science mission calibration support		N/A		N/A	N/A
3.4.9.2	Modulation of Preload Voltage	Subject to suspension constraints, the preloads on the electrode axes shall be sinusoidally modulatable at roll frequency up to 10% of their nominal values.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" shows that the preloads on the electrode axes are sinusoidally commandable through the range of +/- 10% of their values. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirements: GUP210220, GUP310210, GUP410210 Verified by Test Case IDs: TMSSGUP0007, TMSSGUP0010, TMSSGUP4007 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √

PLSE-13 #	Title	4.3 System Level Requirement (Verified at Box Level)	Compliance Data	Verified in	Method	Verified
3.4.9.3	Modulation of Preload Voltage Amplitude Accuracy	The accuracy of the amplitude of the modulated preloads shall be +/- 0.1% of the maximum amplitude of modulation.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" shows that the software sets the amplitude of the modulated preloads, and the accuracy is dependent upon the parameter type. The amplitude parameter is floating point and is commandable to an accuracy greater than +/- 0.01% (0.0001). Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirements: GUP210220, GUP310210, GUP410210, GYP410010 Verified by Test Case IDs: TGSWGYP0001, TGSWGYP0002, TMSSGUP0007, TMSSGUP0010, TMSSGUP4007 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √
3.4.10	Gyroscope charge measurement		N/A		N/A	N/A
3.4.10.1	Rotor Potential Determination	The suspension system shall have the capability for determining the SG rotor potential with accuracy sufficient for meeting the rotor potential requirement in Section T003 section 2.5.	T003 section #2.5 requires an accuracy of 15 mV. S0705 "GSS Charge Measurement and Rotor Potential Determination Verification Analysis" verifies that the accuracy is +/- 1 mV for the equivalent science mission requirement PLSE-13-1 #3.4.10.3.1, and meets the 15 mV or less T003 requirement. System Level verification provided in VLOAs T003 #2.5.1 & #2.5.2. The VLOA reference documents are S0852, S0721, S0704, & P0918.	S0705 VLOA T003 #2.5.1 #2.5.2	A, SL-A	Box Level: √ System Level: √
3.4.10.2	Update rate	The measured gyroscope charge shall be sent to the S/V at a 1 Hz rate.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" shows that all GSS PITs are sent to the space vehicle at 1 Hz by design, and that identical SCSE-15 requirements verify the software functionality of the 1 Hz update rate. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirements: GCM210010, GCM210020, GCM310010, GCM710010 Verified by Test Case IDs: TGSWGCM0001, TGSWGCM0002 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √

PLSE-13 #	Title	4.3 System Level Requirement (Verified at Box Level)	Compliance Data	Verified in	Method	Verified
3.4.10.3	Suspended gyroscope during SM phase		N/A	S0690	N/A	N/A
3.4.10.3.4	Minimum Frequency of Charge Measurement Excitation	The minimum charge measurement excitation frequency shall be 0.001 Hz.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" shows that the minimum charge measurement excitation frequency is variable and set by the GSW to 0.001 Hz. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirement: GCM410010 Verified by Test Case IDs: TGSWGCM0001, TGSWGCM0002 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √
3.4.10.3.5	Maximum Frequency of Charge Measurement Excitation	The maximum charge measurement excitation frequency shall be 1 Hz.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" shows that the minimum charge measurement excitation frequency is variable and set by the GSW to 1 Hz. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirement: GCM410010 Verified by Test Case IDs: TGSWGCM0001, TGSWGCM0002 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √
3.4.10.3.6	Charge Measurement Voltage	The amplitude of the charge measurement excitation voltage shall be less than or equal to 20 mV peak-peak.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" shows that the charge measurement excitation voltage is variable and set by the GSW to 20 mV peak-peak. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirement: GCM410010 Verified by Test Case IDs: TGSWGCM0001, TGSWGCM0002 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √

PLSE-13 #	Title	4.3 System Level Requirement (Verified at Box Level)	Compliance Data	Verified in	Method	Verified
3.4.10.4	Drag-free sensor gyroscope during SM phase		N/A		N/A	N/A
3.4.10.4.4	Minimum Freq. of Charge Meas. Excitation	The minimum charge measurement excitation frequency shall be 0.001 Hz.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" shows that the minimum charge measurement excitation frequency is variable and set by the GSW to 0.001 Hz. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirement: GCM410010 Verified by Test Case IDs: TGSWGCM0001, TGSWGCM0002 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √
3.4.10.4.5	Maximum Frequency of Charge Measurement Excitation	The maximum charge measurement excitation frequency shall be 10 Hz.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" shows that the minimum charge measurement excitation frequency is variable and set by the GSW to 10 Hz. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirement: GCM410010 Verified by Test Case IDs: TGSWGCM0001, TGSWGCM0002 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √
3.4.10.4.6	Charge Measurement Voltage	The amplitude of the charge measurement excitation voltage shall be less than or equal to 20 mV peak-peak.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" shows that the charge measurement excitation voltage is variable and set by the GSW to 20 mV peak-peak. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirement: GCM410010 Verified by Test Case IDs: TGSWGCM0001, TGSWGCM0002 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √

PLSE-13 #	Title	4.3 System Level Requirement (Verified at Box Level)	Compliance Data	Verified in	Method	Verified
3.4.10.5	Gyroscope pre/post SM data acquisition phase		N/A		N/A	N/A
3.4.10.5.4	Maximum Excitation Voltage	The maximum excitation voltage shall 100 mV rms.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" shows that the charge measurement excitation voltage is variable from 0 to 100 mV and set by the GSW to 100-mV rms for spinup and calibration. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirement: GCM410010 Verified by Test Case IDs: TGSWGCM0001, TGSWGCM0002 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √
3.4.15	Rotor position offset capability		N/A		N/A	N/A
3.4.15.3	Modulation of Rotor Position	The suspension system shall support sinusoidal modulation of rotor position in any direction at roll frequency.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" shows that the preloads on the electrode axes are sinusoidally commandable through the range of +/- 10% of their values. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirements: GUP310210, GUP210220, GUP410210, GYP410010 Verified by Test Case IDs: TGSWGYP0001, TGSWGYP0002, TMSSGUP0007, TMSSGUP0010, TMSSGUP4007 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √

PLSE-13 #	Title	4.3 System Level Requirement (Verified at Box Level)	Compliance Data	Verified in	Method	Verified
3.4.17	Compatibility with the drag free sensor function	These requirements pertain to the data delivered in the ATC PIT over the 1553 bus to the CCCA. Data is made available to the CCCA at the 10 Hz strobe.	N/A		N/A	N/A
3.4.17.1	Position data filtering	GSS position data shall be digitally filtered 5 Hz with a 2-pole filter and damping of 0.5.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" verifies that the position data is digitally filter at 5 Hz with a 2-pole filter (given by the eigenvalue) and has a damping of about 0.5 (4.99). Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirements: GPA210010, GPA410010 Verified by Test Case ID: TGSWGPA0001 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the test.	S0713 P086724	A, SL-T	Box Level: √ System Level: √
3.4.17.3	Position data quantization	The quantization of the position data sent to the drag free control system shall be 1.0 nm.	S0713 "Verification of GSS Software Requirements Carried at the Box Level" verifies that the position data is digitally quantized to 1.0 nm/bit by the suspension electronics. This telemetry of the position data is sent by the GSW, and is verified by software test cases. Software V&V on the Integrated Test Facility (ITF) complete the System Level test. SL GSW requirement: GTP310010 Verified by Test Case IDs: TGSWCDS0001, TGSWGSP0001, TGSWGTP0001 P086724 "Flight Software Verification and Validation Test Reports and Procedures" documents the tests.	S0713 P086724	A, SL-T	Box Level: √ System Level: √
3.4.17.4	Bias Force Input Range	The GSS system shall accept and apply a force bias to the rotor on command from the CCCA. This force bias shall be internally limited so that it shall not exceed 3.2e-8 N (5e-7 g).	S0716 "GSS Requirements Verification Analysis Report 7" details the bias force limit embedded in GSW and the system level V&V test cases that will successfully exercised the bias force input algorithms: TGSWGYP0001.	S0716	A, SL-T	Box Level: √ System Level: √

PLSE-13 #	Title	4.3 System Level Requirement (Verified at Box Level)	Compliance Data	Verified in	Method	Verified
3.5.9	Primary Power Grounding	The unit shall perform as specified with an external single-point ground on the spacecraft primary power system, which is at the same electrical potential as the unit chassis.	This requirement is verified by the GSS being internal electrically grounded and the GSS being grounding to the Space Vehicle (spacecraft) and functioning at expected parameters. P0936 "Isolation and Grounding Test Procedure for the Gyroscope Suspension System Power Subsystem", ran 10/23/02 shows the GSS is electrically grounded. Op Order INT-082, Drawing 8A00631, FSU and mounting surface resistance less than 2.5 milliohms. Op Order GSS-043, Drawing 8A02414, ASU and mounting surface resistance less than 2.5 milliohms. E10 Space Vehicle Functional Test verifies the functionality of the GSS units after installation. The given compliance data provides the required analysis for verification	GSS-043 INT-082 P0936	A, SL-T	Box Level: √ System Level: √

Table 2: System Level PLSE-13 Part 1 Requirements

4.4 GSS Requirements System Level Verification

The requirements in this section are primarily verified at the system level. Supporting box level verifications are simply a pointer to the system level verification and the requirement is met at the system level only.

PLSE-13 #	Title	4.4 System Level Requirement	Verification Plan/Compliance Data	Verified In	Method	Verified
3.2.8.8	Gyroscope Suspension System Science Signals Time Tagging	The sampling and time tagging of the Gyroscope Suspension System signals, which are used for the in-flight calibration and/ or for in-flight verification, including the measurements of gyro rotor position and the measurements of gyro electrode voltages, shall be done in such a way that the time at which each signal was sampled can be determined on the ground to within less than 0.1 ms relative to the 16fo rollover counter.	This requirement is a direct flow down from T003 #16.6.6 "Gyroscope Suspension System Science Signals Time Tagging" Analysis: S0876 details analysis of GSS time tagging and concludes that each GSS signal can be determined to 0.1 milliseconds relative to the 16 fo rollover counter. SL Test: S0538 "GP-B ITF Timing Test Analysis: GSS Signals Time Tagging" details the results from Timing Test Part B and shows that GSS data time tagging is directly verified on the order of several milliseconds. The results are consistent, to measurement uncertainty, with estimated time latency as detailed in S0876.	T003 #16.6.6 S0876 S0538	A, SL-T	√
3.4.10.6.1	Spinup charge measurement accuracy	During spinup, the charge on the rotor shall be measured to a resolution of 10 Volts via ground processing. [PCB624]	S0705A presents data from an end-to-end test of the spinup mode charge measurement scheme, from voltages applied to the gyro simulator in the ITF to the output of the RTWorks charge measurement algorithm that generates the plots during gyroscope spinup. Accuracy is better than ± 2V in this test.	S0705A	SL-A	√