Gravity Probe B

Procedure for

GTU-2 EMC Tests

P0329 Rev. -

04, September 1997

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_____/ _____ / _____

Approvals:

Program Responsibility	Signature	Date
Rodger Cliff Test Leader		
P. Ehrensberger TRE IPT Lead		
Jim Lockhart SRE IPT Lead		
John Thatcher ECU REE and IPT Lead		
G. Gutt REE		
M. Taber GTU Test Director		
J. Kasdin GP-B System Engineering		
B. Taller GP-B Quality Assurance		
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Table of Contents

1. Introduction

The EMC test is one of the series of tests to be performed on Ground Test Unit 2 (GTU-2) in accordance with the Stanford test plan documented in GP-B GTU-2 Test List Table 7-1. Test reference No. 2.8

These tests will be performed in Hansen Experimental Physics Laboratory (HEPL) building of the Stanford University. The Equipment Under Test (EUT) will be GTU-2 hardware configuration as described in the GTU-2 test plan.

2. Purpose

The main purpose of this test is to verify the compatibility of the Fwd Payload Electronics specially the compatibility of DSS, with SQUID and SRE in ambient electromagnetic environment.

3.0 Reference Documents

TRE Specification.
SRE Specification
ECU Specification
GSS Specification
GTU-2 Test Plan
GPB Mission Event Timeline Database
GPB Payload Electronics Units Testing Philosophy EM No. 449
Electrostatic Discharge procedure as posted in the working area
GP-B Safety, Maint. , & PA Plan F428533 Rev.E

4.0 Test Facilities

Hansen Experimental Physics Laboratory (HEPL) building of the Stanford University.

5.0 General Requirements

5.1 Test will be performed under the environmental conditions existing, at Hansen Experimental Physics Laboratory (HEPL) building of the Stanford University.

5.2 Calibration status of all the support equipment must be recorded.

5.3 Red lines to the procedure shall require the approval and initial of any one of the following key contacts or their representatives.

Stanford	M. Taber
Stanford	Jim Lockhart
Stanford	Paul Ehrensberger
Stanford	B. Muhlfelder
Stanford	B. Taller
LMMS	Rodger Cliff
LMMS	John Thatcher
LMMS	Mirza Siddique

5.4 In order to expedite test operations, unless specifically noted, the sequence in which major sections or subsections are performed may be altered at the discretion of the following people:

Stanford	M. Taber
Stanford	Jim Lockhart
LMMS	Rodger Cliff

5.5 PA or their representative shall be present to witness and verify the test is performed as described in the test procedure, and stamp each page of the procedure as it progresses.

5.6 Test equipment used during this test, their serial numbers shall be recorded in the log book or in section 12.0 “List of Equipment” of this procedure.

5.7 All the disks/tapes used must be identified and as appropriate.

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

6.0 Safety / Security Requirement

6.1 Standard safety practices to ensure safety of personal and prevent damage to equipment shall be observed during performance of this test.

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

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

6.4 Protect all electrical connectors with plastic caps or connectors savers when the connectors are not mated.

6.5 Special care shall be exercised as posted in the operations area to prevent damage caused by Electrostatic Discharge.

7.0 Hardware Under Test

Probe B

Fwd ECU

Fwd TRE

Fwd SRE

Fwd GSS

8.0 Support Hardware / Software

8.1 Test equipment

The following test equipment, or equivalent, will be used to perform this test.

Write all the equipment and necessary information in the table " List of Equipment" of this procedure.

Oscillators, specialized cables for injection (and reception) of signals into (and out of) the suspension and instrumentation probe feed throughs.

SRE Fwd Engineering Unit

SRE aft simulator with software

GSS gyro unit (forward EU and aft simulator)

TRE (forward EU, and GSE)

ECU (forward EU and Aft. EU)

4 channel chart recorder

Computer data recorder

R F Spectrum Analyzer

Lo Frequency Spectrum Analyzer

8.2 GPB Specialized Equipment

The following test equipment, or equivalent, will be used to perform this test.

Write all the equipment and necessary information in the table " List of Equipment" of this procedure.

GSS with cable/filter
TRE (forward)
Forward SRE and aft emulator
Probe Suspension Connector Caps
Probe Instr. Connector Caps
Dewar Instr. Vonnector Caps
SRE Instr. Connector Caps
Probe EMI cover
Signal injection cable for suspension line
Signal injection cable for gyro heater line
Signal injection cable for telescope heater
SRE tophat cables
Instrumentation cables/filters
Grid dip oscillator
SRE forward caps
Caps for unused ECU ports and I1/I3 lines
Frequency counter
Chart recorder
Lo and RF spectrum analyzers
RF oscillator

9.0 EMC Functional Test

9.1 Test Preconditions

Gyros caged, SIA thermally cycled once to remove excess magnetic flux, SQUID setup complete.

9.2 Test Description

Baseline SQUID noise performance will first be obtained by operating the SQUID system in isolation of the other subsystems. The ambient electromagnetic environment at a gyroscope will be measured using a suspension cable as a receiving antenna. Interactions between the GSS, the ECU, the TRE and the SQUID will then be studied. Measurements of SQUID noise, SQUID bias offsets and the electromagnetic environment at the gyroscope will be evaluated. Induced SQUID bias offsets will be measured as the GSS bridge amplitude is varied. Signals in the frequency range from 1 MHz to 1.5 GHz (with a 1 KHz squarewave, 100% modulation depth) will be injected into the gyroscope suspension cables, the gyroscope heater cables and the telescope heater cables. Bias shifts and noise performance will be monitored for the GSS, the SRE, the ECU and the TRE.

9.3 Test Sequence

9.3.1 Perform P0323 for SQUIDs #5 and #8. Leave the SRE powered and the SQUIDs flux locked.

9.3.2. Measure the FLL power spectral density at 5 mHz using an HP spectrum analyzer. Install window #4 EMI cover, cable covers and mock FEE as required.

9.3.3 Connect a suspension cable (acting as a receiving antenna) to an rf spectrum analyzer, measure the electromagnetic environment near gyroscopes #3 and #4.
Gyro #3 cable_____
Gyro #4 cable_____

9.3.4 With the rf spectrum analyzer connected to the suspension cable, measure SQUID's #5 and #8 FLL power spectral density at 5 mHz using an HP spectrum ananalyzer.

9.3.5 Inject rf signals into a suspension cable of gyro #3. Gyro cable #_____. Vary the frequency from 1 MHz to 2.2 GHz. Vary the rf power from -70 dBm to -20 dBm. Remeasure SQUID noise, bias shifts and electromagnetic environment near the gyroscope. Repeat for gyro #4. Gyro cable #_____.

9.3.6 Connect the GSS system to gyro #3. Turn on the GSS bridge signal. Bridge amplitude_____ volts (p-p). Measure bridge signal as indicated by SQUID #5. _____ Fo (p-p). Remeasure the noise of SQUIDs #5 and #8 and the electromagnetic environment near gyro #3. Change the bridge amplitude to _____ volts (p-p). Measure the change in the dc output of SQUID #5 FLL (_____Fo) and the amplitude of the bridge signal as indicated by SQUID #5 (_____Fo). Remeasure the SQUID noise and elecromagnetic envoronment near gyroscope #3.

9.3.7 Repeat step #6 using gyro #4 and SQUID #8.

9.3.8 Turn off GSS and disconnect it from the probe.

9.3.9 Connect the probe's telescope cables to the TRE. Turn on the TRE and operate the system to simulate science mission operating conditions. Measure the noise performance of SQUIDs #5 and #8 at 5 mHz. Measure the electromagnetic environment at gyroscopes #3 and #4. Disconnect the TRE from the probe.

9.3.10 Connect the probe's insturmentation cables to the ECU. Activate the ECU. Measure the noise performance of SQUIDs #5 and #8. Measure the electromagnetic environment at gyroscopes #3 and #4. Disconnect from the ECU those probe instrumentation cables which connect to the heaters and thermometers of gyros #3 and #4. Remeasure the SQUID noise performance and the electromagnetic environment at gyroscopes #3 and #4. Reconnect all probe instrumentation cables.

9.3.11 Connect the GSS to gyro #3. Connect the probe's telescope cables to the TRE. Turn on the TRE and GSS bridge signal. Bridge amplitude _____volts (p-p). Remeasure the noise of SQUIDs #5 and #8 and the elecromagnetic environment near gyro #3. Repeat for gyro #4.

10.0 Completion of Procedure

Test Leader_____ Date_____
Roger Cliff

Test Director_____ Date_____
M. Taber

TRE IPT Leader_____ Date_____
P. Ehrensberger

SRE IPT Leader_____ Date_____
Jim Lockhart

ECU IPT Leader_____ Date_____
John Thatcher

GSS IPT Leader_____ Date_____
S. Buchman

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

Product Assurance_____ Date_____

11.0 Re-Run Documentation

Make copies of the " Re-Run Documentation " Table as required

RE- Run Documentation

No	DR. No.	TP Page No.	TP Para No.	Retest Title	Comments

12.0 List of Equipment

Make copies of the " List of Equipment " Table as required

List of Equipment

No.	Name Description	Manufacturer	Model	Prop./Serial No.	Cal. Due Date

13.0 Data Sheets

Strip Chart Recorders, and Electronics Media is used to record the Test Results, log books are maintained during the tests, Test Data Sheets may be prepared as required, during and after the tests.