GRAVITY PROBE B

PROCEDURE FOR

PAYLOAD VERIFICATION

SQUID FUNCTIONALITY AND PICKUP LOOP VERIFICATION

P0510 Rev. A

May 06, 2000

Rev A: ECO 1165

Prepared by: B. Muhlfelder

Approvals: *If the procedure involves operations which may affect SQUID Readout health (e.g., connecting to SQUID connectors or applying voltage to gyro electrodes), B. Muhlfelder must be included in the approval block.*

Program Responsibility	Signature	Date
B. Muhlfelder *SQUID Hardware Test Leader*		
B. Schultz GP-B System Engineering		
D. Ross GP-B Quality Assurance		
B. Muhlfelder GP-B Payload Technical Manager		

NOTES:
Level of QA required during performance of this procedure:
__X__ Stanford QA Representative
__X__ Notification of Government QA Representative

All redlines must be approved by QA. Redline authority: J. Lockhart, B. Muhlfelder

Revision Record:

Rev	Rev Date	ECO #	Summary Description
Rev A	5/06/00	1165	Incorporation of redlines from payload test I

Acronyms and Abbreviations:

Acronym / Abbreviation	Meaning

A Scope

This document is the Test procedure to verify the functionality of the 4 flight dc SQUIDs. This test also verifies the adequacy of the pickup loops on the 4 flight gyroscopes. Revision C SQUID readout electronics (non-flight) are to be used to carry out this test. These electronics have been pre-tested and accepted for use per P0498.

B Requirements Verification

B.1 Low frequency SQUID data required for verification per requirement

C Configuration Requirements

The configuration requirements are that all non-essential GSE be disconnected from the payload. This includes the DDC gyro suspension systems and the telescope electronics. If SQUID problems are encountered it may be necessary to disconnect plumbing lines and the ECU GSE electronics.

The probe and dewar shall be in the vertical orientation. The nominal temperature of the LHe is 4.2 K. Probe C exchange gas is optional. It is assumed that the gyroscope rotors will be uncaged and contain milligauss trapped flux levels. Note that if SQUID problems are encountered it may be necessary to perform a flux flushing prior to completion of this test. The test will be performed under the environmental conditions existing in the payload test area of HEPL.

D Hardware Required

D.1 Flight hardware required

Description	No. Req'd
Probe C with 4 flight SQUIDs attached to 4 gyroscope readout cables	1

D.2 Commercial test equipment

Equipment	Model	Serial Number	Calibr. Exp. Date
Laboratory Power Supplies	Tektronix PS281		
Digital Multimeters	Keithley Model 196		
Oscilloscope	Tektronix TAS 220		
Standard Test Cables	Various		

D.3 Mechanical/Electrical Special test equipment

Description	Part No.	Rev. no.	Serial No.	Certification Date
Rev C SQUID Electronics(fwd/aft)				SEE TABLE 1
And related Cables				For all information
				Related to this
				Equipment.

D.4 Tools

Description	No. Req'd
Various hand tools	A/R

D.5 Expendables

Description	Quantity
None	

E Software Required

E.1 Flight Software

Flight Software Name	Version No.
None	

E.2 CSTOL Scripts

CSTOL Script Name	Version No.
None	

E.3 SPC Scripts

SPC Script Name	Version No.
None	

E.4 Test Support Software

Test Software Name	Version No.

F Procedures Required

EOS/ESD Risk Mitigation Procedure P0476

G Equipment Pretest Requirements

Equipment	Serial No.	Test Required	Proc. No.	Test Performed Date	By
Rev C Electronics	Head: Cont:	P0498	P0498		
Rev C Electronics	Head: Cont:	P0498	P0498		
Rev C Electronics	Head: Cont:	P0498	P0498		
Rev C Electronics	Head: Cont:	P0498	P0498		

H Personnel Requirements

Test Leader: B. Muhlfelder
Test Engineers: J. Lockhart, G. Gutt, M. Luo, T. McGinnis (only for electronics troubleshooting)
QA: D. Ross, R. Lesse

I Safety Requirements

The hardware used is this test is ESD/EOS sensitive. In addition to the items listed below, the test leader must read the EOS/ESD Risk Mitigation Procedure P0476 _____ (Barry Muhlfelder).

I.1 Electrical mating and demating of flight hardware connectors

I.1.1 Connection and disconnection shall be performed only when the equipment involved is in a powered-down state.

I.1.2 Connector savers are to be used unless otherwise specified.

I.1.3 Connectors shall be inspected for contamination and for bent, damaged, or recessed pins prior to mating.

I.1.4 Grounded wrist straps are to be worn prior to removal of connector caps or covers and during mating/demating operations.

I.1.5 ESD-protective caps or covers are to be immediately installed after demating of connectors.

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.

J General Instructions

J.1 Redlines must be approved by QA.

J.2 Any nonconformance or test anomaly should be reported by a Discrepancy Report. Refer to the Quality Plan, P0108, for guidance. Do not alter or break test configuration if a test failure occurs; notify quality assurance.

K DELETED

L Operations

L.1 *Notify via email the ONR government representative 24 hours prior to starting*

test_____ (bm)

Notify via email QA 24 hours prior to starting test_____(bm).

L.2 Verify that the power switches on the 4 Aft Rev. C (Control Unit) and the Tektronix Power Supplies are OFF.

Rev. C Control Unit Power Switches OFF ___ Verified
Tektronix DC Power Supply Power Switches Off ____ Verified

Install the following cables to each of the forward Rev. C SREs and the each of the aft Rev. C units (Control Units):

Digital Control Cable connected between Control Unit Digital Connector (labeled "FLL Digital I/O") on rear panel and Forward Rev. C SRE Digital Connector. Record Serial Number of Digital Control Cable in Table 1.

Analog Control Cable connected between Control Unit Analog Connector (labeled "FLL Analog I/O") on rear panel and Forward Rev. C SRE Analog Connector. Record Serial Number of Analog Control Cable in Table 1.

Install the Tophat to forward Rev C cables. Record serial numbers of these cables in Table 1.

Record in Table 1 below which SQUID # (corresponds to gyro #) is to be connected to which SQUID Electronics and the associated cables.

Table 1

SQUID Number	Fwd Elec. S/N	Aft Elec. S/N	Top Hat Cable S/N	Analog Control Cable S/N	Digital Control Cable S/N
1					
2					
3					
4					

Hook up the cables that connect the Tophat to squid electronics as given in Table 2 below.

Table 2

TOPHAT CABLES	PROBE C CONNECTOR
Tophat cable __, sub-cable: signal(SSX-P4)	SS1
Tophat cable __, sub-cable:	FB1

FB/bias(FBX-P2)	
Tophat cable __, sub-cable: mod(MSX-P3)	MS1
Tophat cable __, sub-cable: signal(SSX-P4)	SS2
Tophat cable __, sub-cable: FB/bias(FBX-P2)	FB2
Tophat cable __, sub-cable: mod(MSX-P3)	MS2
Tophat cable __, sub-cable: signal(SSX-P4)	SS3
Tophat cable __, sub-cable: FB/bias(FBX-P2)	FB3
Tophat cable __, sub-cable: mod(MSX-P3)	MSS3
Tophat cable __, sub-cable: signal(SSX-P4)	SS4
Tophat cable __, sub-cable: FB/bias(FBX-P2)	FB4
Tophat cable __, sub-cable: mod(MSX-P3)	MS4

L3: Rev. C Electronics Setup and Test

Connect red and black Banana Cables to the red and black banana terminals on Control Unit rear panel and to the red and black terminals of Tektronix DC Power Supply.

Make the following settings on the power supplies: Current Coarse adjustment to 70 - 80 % of full scale; Volts/Amps switch to Volts; Amps Hi/Lo to Hi. Turn on the supply and set the displayed voltage to 28.0 V +/- 0.2 V using the Coarse and Fine voltage controls.

<u>THE BALANCE OF THIS SECTION OF THE PROCEDURE IS TO BE DONE TO COMPLETION FOR EACH SQUID BEFORE MOVING ON TO THE NEXT SQUID.</u>

Set/verify Control Unit settings:	SQUID 1	SQUID 2	SQUID 3	SQUID 4
Int/Ext switch (real panel) to “Int”	_____	_____	_____	_____
Power switch set to “Off”	_____	_____	_____	_____
Meter switch set to “DM”	_____	_____	_____	_____
Bias switch set to “0000”	_____	_____	_____	_____
Range switch set to “1”	_____	_____	_____	_____
DC Mod switch set to “8000”	_____	_____	_____	_____

Gain switch set to "1"	_____	_____	_____	_____
Reset Level switch set to "13V"	_____	_____	_____	_____
Phase switch set to "300"	_____	_____	_____	_____

Control Unit Startup

Turn the Control Unit power switch to "On" and verify that the green power LED is illuminated.

SQUID 1 _____ Verified.
SQUID 2 _____ Verified.
SQUID 3 _____ Verified
SQUID 4 _____ Verified

Press the "Sys Reset" button once.

If the red LED near the "Bias" control is lit, press the corresponding "Enter" button. If the red LED near the DC Mod switch is lit, press the corresponding "Enter" button.

Verify that the only LED's illuminated are the green "Power" LED and the red "Int. Reset" LED.

SQUID 1 _____ Verified
SQUID 2 _____ Verified
SQUID 3 _____ Verified
SQUID 4 _____ Verified

Set the oscilloscope controls as follows:

Channel 1: ac coupled, 0.5 V/div
Timebase 1 microsecond per division
Triggering Source Channel 1, Mode Auto

Turn on the oscilloscope and the Keithley 196 meter. The Keithley meter should be in DC Volts, Autorange mode.

Adjust the Control Unit "Bias" control to 5000 by making steps of 1000 and pressing the "Adjust" button after each change.

Adjust the Control Unit "DC Mod" control in steps of 0100 or 0010 (pressing the adjust button each time, as will always be done when making adjustments) until the largest possible reading is obtained on the control unit meter. Adjust 1000 step as required.

Likewise, change the "Bias" control by steps of "0100" or "0010" until the control unit meter reading is maximized. Adjust 1000 as required. Record the resulting bias value below:

Bias setting for Maximum Demod reading:

SQUID 1 _____
SQUID 2 _____
SQUID 3 _____
SQUID 4 _____

Turn the "Mod Level" screwdriver-adjust control on the Rev. C forward unit to the full Clockwise (CW) position. Then, turn the control CCW until the Control Unit meter reading reaches a maximum. The oscilloscope pattern should reach a maximum at the same time.

Adjust the "phase" control on the Rev. C Control Unit until the Rev. C meter reading reaches a maximum positive or negative value. Record the meter reading at maximum (include sign) and the final setting of the "Phase" control.

SQUID #	METER READING	PHASE
1	_____	_____
2	_____	_____
3	_____	_____
4	_____	_____

Verify that a waveform of greater than 1 V p-p is present on the oscilloscope screen and record the value observed (adjust triggering as need for stable display).
Waveform peak-peak amplitude:

SQUID #	AMPLITUDE
1	_____
2	_____
3	_____
4	_____

Make changes by increasing the "DC Mod" control by steps of 0100 or 0010 to obtain and record the following:

	Squid 1 DC Mod	Squid 2 DC Mod	Squid 3 DC Mod	Squid 4 DC Mo
Prior to Changes	_____	_____	_____	_____
Next Min. Control Unit value	_____	_____	_____	_____
Next Max. Control Unit value	_____	_____	_____	_____
Next Min. Control Unit value	_____	_____	_____	_____
Next Max. Control Unit value	_____	_____	_____	_____

Now return to the original "DC Mod" settings above (using steps no larger than 0100) and make further changes by decreasing the "DC Mod" control by steps of 0100 or 0010 to obtain and record the following:

	SQUID 1 DC Mod	Squid 2 DC Mod	Squid 3 DC Mod	Squid 4 DC Mod
Prior to Changes	_____	_____	_____	_____
Next Min. Control Unit reading	_____	_____	_____	_____
Next Max. Control Unit reading	_____	_____	_____	_____
Next Min. Control Unit reading	_____	_____	_____	_____
Next Max. Control Unit reading	_____	_____	_____	_____

Press the "Lock On" button and verify that the green "Lock On" LED is lit and the red "Int Reset" LED is no longer lit :

Squid #	Verified
1	
2	
3	
4	

Set the "DC Mod" to each of the values above (using steps no larger than 0100) and record the corresponding readings on the Keithley 196 meter

SQUID 1 volts	SQUID 2 volts	SQUID 3 volts	SQUID 4 volts
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Calculate and record the difference between each set of voltage readings above.

SQUID #	1st Set Max diff. volts	2nd Set Max diff. volts	Average volts/flux q.	Required Range volts/flux q.
1	_____	_____	_____	1.1-2.6
2	_____	_____	_____	1.1-2.6
3	_____	_____	_____	1.1-2.6
4	_____	_____	_____	1.1-2.6

Record the average of the 1st and 2nd set of data above, for each SQUID:
This is the Volts per Flux Quantum calibration for this system

Configure electronics to apply FB to mod. Apply test signal to input. Set electronics to R100 G1. Apply test signal so as to obtain a reading as close as possible to 5 V on FLL output on the Keithley 196 meter. Record mod settings and the initial Keithley voltage in the table below. Record Keithley voltage after 10 minutes have elapsed.

SQUID #	Vtest zero	Vtest setting	Mod Setting	Keithley Volts (initial)	Keithley (Volts) (10 m)
1	____	_____	_____	_____	_____
2	____	_____	_____	_____	_____
3	____	_____	_____	_____	_____
4	____	_____	_____	_____	_____

Return mod to “8000”. Return SQUID electronics range to 1.

Continue procedure, step L3 with next SQUID.

Optional: Acquire FFT data using either commercial FFT unit or computer data acquisition system. Also optional: Shut down Rev C electronics.

M Documentation

Data from this Procedure stored in laboratory notebook of B. Muhlfelder_____(bm).

Summary of key results: (as-built procedure will contain text here).

Copy of this procedure shall be placed on GP-B computer network.

N Completion of Procedure

This test procedure was completed satisfactorily.

Test Technician _____ Date_____

Test Engineer_____ Date_____

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

Product Assurance_____ Date_____