Relativity Mission
Gravity Probe B
Revision C SQUID Readout Electronics (Rev. C SRE)

Engineering
Test Procedure
For

Non-Flight Unit for Payload Verification

REVISION C SQUID ELECTRONICS

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Rev. C Forward Unit Serial Number _____
Rev. C Control Unit Serial Number _____

Total Pages:
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1.0 General Description

This document is the Engineering Test procedure for REVISION C SQUID READOUT ELECTRONICS (Rev. C SRE). The purpose of this test is to verify the electronic performance of the Rev. C SRE and to assure that it is satisfactory for use in Payload Verification operations. This is a stand alone test and requires a Test Fixture consisting of a Flight-Equivalent SQUID in a test dewar..

2.0 Reference Documents

Rev. C SRE Schematics Package

3.0 Test Facilities

Readout Area, Hansen Labs GP-B

4.0 General Requirements

4.1 Test will be performed under the environmental conditions existing in HEPL Main Bay.

4.2 Any red lines to the procedure shall require the approval and initial of the Test Engineer.

4.3 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 Test Technician or Test Engineer.

4.4 QA or their representative shall be notified 24 hours before test procedure operations are initiated.

4.5 Initial and date (_____) the bottom of each page of this procedure to verify that its tasks have been accomplished.

4.6 Serial numbers of test equipment used during this test shall be recorded in the List of Equipment" log sheet.

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

5.0 Safety / Security Requirement

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

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

5.3 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.

5.4 Special care shall be exercised to prevent damage caused by Electrostatic Discharge when connections are made to the Flight Equivalent SQUID..

6.0 Support Hardware / Test Equipment

6.1 The following support hardware and test equipment will be used and the applicable information for the instruments shall be recorded in the List of Equipment (Appendix 11.1). Verify that the Multimeter, Analyzer, and Oscilloscope have valid calibration stickers.

Name/ Description	Manufacturer/Model No. Part. No.	Qty Req'd
Flight Equivalent SQUID fixture	SQUID 35C	1
Laboratory Power Supply	Tektronix PS281	1
Dynamic Signal Analyzer	HP 35660A	1
Digital Multimeter	Keithley Model 196	1
Oscilloscope	Tektronix TAS 220	1
Standard Test Cables	See 6.2 below.	lot

6.2 An assortment of standard test leads is required to complete the signal connections between test points and meters, etc. The following table lists a number of such leads that might be required.

Description	Vendor Part number	Qty
SMD Microtip* Test Probe, black	Pomona 5144-48-0	2
SMD Microtip* Test Probe, red	Pomona 5144-48-2	2
Micrograbber*/Banana Plug, black	Pomona 5053-36-0	2
Micrograbber*/Banana Plug, red	Pomona 5053-36-2	2
Patch Cord, black	Pomona B-36-0	2
Patch Cord, red	Pomona B-36-2	2
Dbl Banana/BNC cable	Pomona 2BC-BNC-36	2
BNC Cables	Pomona 2249-C-12	4
BNC Cables	Pomona 2249-C-36	4
BNC Cables	Pomona 2249-C-60	4
BNC female to Dbl Banana Adapter	Pomona 1269	4
BNC Tees (f/m/f)	Pomona 3285	2
Stackup Banana plugs	Pomona 1325-0	10

7.0 Rev. C SRE Cable Installation

7.1 Verify that the power switches on the Aft Rev. C (Control Unit) and the Tektronix Power Supply are OFF.

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

7.2 Install the following cables to the forward Rev. C SRE and the aft Rev. C SRE (Control Unit):

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 _____.

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 _____.

Red and Black Banana Cables connected between red and black banana terminals on Control Unit rear panel and red and black terminals of Tektronix DC Power Supply.

SQUID Cable (GTU2-1001-101) connected between Rec. C SRE SQUID connector and connectors on Test Fixture as follows:

Cable connector MSX-P3 to test fixture connector M ___ Verified
Cable connector SSX-P4 to test fixture connector S ___ Verified
Cable connector FBX-P2 to test fixture connector FB ___ Verified

Record serial number of SQUID cable used _____.

BNC Coaxial Cable connected between Control Unit "Preamp" connector and Channel 1 input of oscilloscope.

BNC Coaxial Cable connected between Control Unit "Low Pass" connector and Keithley 196 DVM voltage input.

BNC Coaxial Cable connected between Control Unit "Wide Pass" connector and HP Dynamic Signal Analyzer Channel 1 input.

8.0 Rev. C Electronics Setup and Test

8.1 Make the following settings on the power supply: 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.

Displayed voltage after setting: _____

8.2 Set the controls of the Control Unit as follows

Int/Ext switch (real panel) set to "Int" _____ Verified
Power switch set to "Off" _____ Verified
Meter switch set to "DM" _____ Verified
Bias switch set to "0000" _____ Verified
Range switch set to "1" _____ Verified
DC Mod switch set to "8000" _____ Verified
Gain switch set to "1" _____ Verified
Reset Level switch set to "13V" _____ Verified
Phase switch set to "300" _____ Verified

8.3 Control Unit Startup

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

Press the "Sys Reset" button once.

Switch the power supply Volts/Amps switch to “Amps” and record the displated current: _____ Amps. Then switch back to the “Volts” setting.

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. _____ 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, the Keithley 196 meter, and the Dynamic signal analyzer. 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.

Likewise, change the “Bias” control by steps of “0100” or “0010” until the control unit meter reading is maximized. Record the resulting bias value below:

Bias setting for Maximum Demod reading _____

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 _____.

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: _____
Make changes by <u>increasing</u> the “DC Mod” control by steps of 0100 or 0010 to obtain and record the following:

	DC Mod Setting
a. Prior to Changes	_____
b. Next Minimum Control Unit meter reading	_____
c. Next Maximum Control Unit Meter reading	_____
d. Next Minimum Control Unit Meter reading	_____
e. Next Maximum Control Unit Meter reading	_____

Now return to the "DC Mod" setting of line "a" above (using steps no larger than 0100) and make further changes by <u>decreasing</u> the "DC Mod" control by steps of 0100 or 0010 to obtain and record the following

f. Prior to Changes (same value as "a")	_____
g. Next Minimum Control Unit Meter reading	_____
h. Next Maximum Control Unit Meter reading	_____
i. Next Minimum Control Unit Meter reading	_____
j. Next Maximum Control Unit Meter 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 : _____ Verified

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

Condition	Voltage Reading (in Volts)
a.	_____
b.	_____
c.	_____
d.	_____
e.	_____
f.	_____
g.	_____
h.	_____
i.	_____
j.	_____

k. Calculate and record the difference between the voltage readings of "a" and "e" above (ignore the sign of the difference): _____

l. Calculate and record the difference between the voltage readings of "f" and "j" above (ignore the sign of the difference): _____

Record the average of "k" and "l" above :
This is the Volts per Flux Quantum calibration for this system

Set “DC Mod” so as to obtain a reading as close as possible to 0 on the Keithley 196 meter. Record: DC Mod setting _____
Keithley 196 Reading _____

Press the “Recall” button on the HP dynamic signal analyzer.Then press the “Recall State” softkey, followed by the “Rcl from ‘State 7’” softkey.

Press the “start” button on the HP dynamic signal analyzer.

When the “average complete” notation appears on the screen, check to see if the overload message “Ovl 1” appears at the top of the screen, or the message “OVLD” appears at the bottom of the screen. If either of these messages appears, the dynamic signal analyzer test must be rerun using the “Start” button until a complete average with no overload message is obtained.

Then, place the cursor at about 10 kHz, load paper and pen onto the plotter and plot the analyzer screen using the “Plot/Print” button followed by the “Plot Screen” button. Annotate the plot with the date and the serial numbers of the forward Rev. C unit and the Rev. C Control Unit and with the Volts per Flux Quantum calibration for this system.

Again press the “Recall” button on the HP dynamic signal analyzer. Then, press the “Recall State” softkey, followed by the “Rcl from ‘State 8’” softkey.

Press the “start” button on the HP dynamic signal analyzer.

When the “average complete” notation appears on the screen (note that this will take a time period of about 35 min.), check to see if the overload message “Ovl 1” appears at the top of the screen, or the message “OVLD” appears at the bottom of the screen. If either of these messages appears, the dynamic signal analyzer test must be rerun using the “Start” button until a complete average with no overload message is obtained.

Then, place the cursor at about 0.005 Hz, load paper and pen onto the plotter and plot the analyzer screen using the “Plot/Print” button followed by the “Plot Screen” button. Annotate the plot with the date and the serial numbers of the forward Rev. C unit and the Rev. C Control Unit and with the Volts per Flux Quantum calibration for this system.

9.0 Electronics Shutdown and Documentation

Press the “Lock On” button. Return the DC Mod control to 8000 using steps no larger than 0100. Return the Bias control to 0000 using steps of no more than 0100. Leave other control as they are. Turn the Control Unit Power switch to “Off”. Turn the Tektronix Power Supply power switch to off.

Attach the analyzer plots to this procedure. Fill in the list of equipment in Section 11.1 if not already done.

10.0 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_____

11.0 Appendix

11.1 List of Equipment

Fill in the "List of Equipment" Table as required below.

Name/ Description	Manufacturer/Model No.	Serial #	Cal. Due
Flight Equivalent SQUID fixture	SQUID 35C		N/A
Laboratory Power Supply	Tektronix PS281		N/A
Dynamic Signal Analyzer	HP 35660A		
Digital Multimeter	Keithley Model 196		
Oscilloscope	Tektronix TAS 220		

If Cal. Due date not specified on Cal. Sticker, add one year to the date of most recent calibration and enter the implied due date in parentheses [example: (9/21/99)] in the Cal. Due column.

Product Assurance Initials or Stamp (_____)

Test Technician Initials or Stamp (_____)

Test Engineer Initials or Stamp (_____)