Relativity Mission
Gravity Probe B

SQUID Readout Electronics (SRE) Usage in Payload Test II P0833 Rev C

3 July 2001

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Forward SRE 1/3 Serial Number: __________________

Forward SRE 2/4 Serial Number: __________________

Aft SRE Serial Number: __________________

Note: Section numbering in this Pdoc is mirrored in the existing Lockheed Martin software script used to operate the SRE. Removal of deleted sections from this Pdoc would require extensive modification to software script labeling. Such a modification would not add technical value to the test, but would add significant cost and delay to the GP-B program. Therefore, the deleted sections remain in this Pdoc and the script shows these sections as deleted.

SUMMARY OF CONTENTS

1.0 General Description

This document defines the use of the SRE in Payload Test II.

This procedure allows for the use of either 1 or 2 Forward SRE units and it requires one SRE Aft Electronics Unit.

The success criteria for this procedure are given in the appendix.

This procedure makes extensive use of software commands to control the state of the SRE subsystems. These commands cannot damage the flight electronics either through misuse or computer /software malfunction.

2.0 Reference Documents

SRE Specification, LMMS/P480136
LMMS LAC SPEC 3250
SRE/TRE Commands 2/20/98
Forward SRE Assembly Drawing, 8A00848
Schematic Diagram SRE FLL Board, 8A01056
CSTOL Executive Procedure, sre062_exec
CSTOL Procedures PLV2I, PLV2ii, PLV2iii, PLV2iv
P0848 – GSS EMC and Bridge Monitoring Configuration
P0843 – SRE GSE Certification Procedure.

3.0 Test Facilities

Stanford University FIST Lab

4.0 General Requirements

4.1 Notify the SU QA representative 24 hours before starting this test procedure.

Person Contacted:______________________ Date:_____________

Notify Government representative 24 hours before starting this test procedure.

Person Contacted:______________________ Date:_____________

4.2 Test will be performed under the ambient environmental conditions at Stanford.

4.3 Deleted.

4.4 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 REE or his representative.

4.5 Deleted.

4.6 Deleted.

4.8 Serial numbers of test equipment used during this test shall be recorded in the “List of Equipment” log sheet.

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

4.10 Throughout this procedure, limits are given with their units, since the SUN Workstation displays unit-less numbers, it is not necessary to include units for values read from the Workstation.

5.0 Personnel and Safety Requirement

PERSONNEL REQUIREMENTS

This test is to be conducted only by authorized personnel. Among those are Terry McGinnis, Kim Lo, Werner Growitz, Barry Muhlfelder, Jim Lockhart and Bruce Clarke. Any of these individuals or their designates may serve as the test director.

QUALITY ASSURANCE

Testing shall be conducted on a formal basis to approved and released procedures. The QA program office shall be notified 24 hours prior to the start of this procedure. A Quality Assurance Representative, designated by D. Ross shall be present during the procedure and shall review any discrepancies noted and approve their disposition. Upon completion of this procedure, the QA Manager, D. Ross or her designate, will certify concurrence that the effort was performed and accomplished in accordance with the prescribed instructions by signing and dating in the designated place(s) in this document. Discrepancies will be recorded in a D-log or as a DR per Quality Plan P0108.

RED-LINE AUTHORITY

Authority to red-line (make minor changes during execution) this procedure is given solely to the Test Director or his designate and shall be approved by the QA Representative. Additionally, approval by the Payload Technical Manager shall be required if, in the judgment of the Test Director or QA Representative, experiment functionality may be affected.

SAFETY REQUIREMENTS

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

Connector savers are to be used on the top hat connectors.

> **Note: The mating and demating of all flight connectors must be recorded in the mate/demate log. This procedure does not require removal or replacement of connector savers onto the flight connectors—they should already be in place.**

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

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

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

6.0 Support Hardware and Test Equipment

6.1 The following support hardware and test equipment, or their equivalent will be used and the applicable information for the instruments shall be recorded in the List of Equipment.

Name/ Description	Manufacturer/Model or Part No.	Qty Req'd
Strawberry Tree Data Acquisition System		1
Oscilloscope		1
Spectrum Analyzer		1
Digital Multi-meter		1
Dynamic Signal Analyzer	HP 35660A	1
Function Generator		1
Payload	Stanford / LMMS	1
+/- 15 V Lab Power Supply		1
Four Channel SRE Testbox	8A01729GSE-501	1
Aft SRE A, Fwd SRE A Power Cable	LMMS 8A00557	1
Aft SRE A, Fwd SRE A Digital Cable	LMMS 8A00558	1
SRE A HLD's Cable Assembly	LMMS 8A00561	1
Aft SRE A, Fwd SRE B Digital Cable	LMMS 8A00562	1
Aft SRE A, Fwd SRE B Power Cable	LMMS 8A00563	1
SRE Test Connector Breakout Panel	LMMS 8A01729GSE	1
SRE Test Port Cables	Stanford	4
SRE B HLD's Cable Assembly	LMMS 8A00566	1
SRE A Htr Pwr Cable Assembly	LMMS 8A00567	1
SRE B Htr Pwr Cable Assembly	LMMS 8A00568	1
Aft SRE 1553A Cable		4
Aft SRE RS232 Cable		1
SRE Power Cable		1
10 Hz / HLD Cable		1
Payload Cable Assembly	per LMMS 8A02105	1
SRE to Top Hat Cabling	per LMMS 8A02105	Set
Standard Test Cables	See Appendix 15.5	Lot

7.0 Hardware Under Test

7.1 Record the serial numbers of the equipment listed in Table 7.1.1 below and on the cover page of this procedure:

Table 7.1.1 Equipment Under Test Listing		
Assembly Name	Assembly P/N	Serial No.
Forward SRE A	8A0848-101	001
Forward SRE B	8A0848-102	001
Aft SRE A	8A0920-101	0001

8.0 Pre-test Operations

8.1 Verify that the Special Test Equipment listed in Table 8.1 below is available and has a valid certification seal indicating that is approved for use with flight hardware. For each item, write Yes in the "Certification Valid?" column if this is the case. SRE GSE is certified via P0843.

Table 8.1 Special Test Equipment		
Subassembly	Drawing No.	Certification Valid?
SRE HLD/Power GSE	26245	

8.2 deleted

9.0 SRE Preliminary Test Set-Up

9.1 Connect the SRE assemblies as shown in Figure 1 and Table 9.1.1. Use connector savers on all flight connectors. When indicated in this procedure, connect all test equipment to SRE from the Test Set Console and SRE Spacecraft Emulator GSE. Refer to drawings 8A01725GSE and 8A02105 for guidance. (NOTE: Cable 8A01743GSE is not used for this test)

Table 9.1.1 – Preliminary Set Up Cable Connections

Source Module	Cable	Destination Module
SRE Aft A: J3 (Power A)	8A00557	SRE Fwd A: J8
SRE Aft A: J5 (Digital A)	8A00558	SRE Fwd A: J5
SRE Aft A: J7 (HLDs)	8A00561	SRE Fwd A: J10
SRE Aft A: J6 (Digital B)	8A00562	SRE Fwd B: J5
SRE Aft A: J4 (Power B)	8A00563	SRE Fwd B: J8
SRE Four Channel Test Box J14A	per 8A01725	SRE Fwd A: J14
SRE Four Channel Test Box J15A	per 8A01725	SRE Fwd A: J15
SRE Four Channel Test Box J14B	per 8A01725	SRE Fwd B: J14
SRE Four Channel Test Box J15B	per 8A01725	SRE Fwd B: J15
SRE GSE P/S J1		SRE Aft A: J1
SRE GSE HLD Generator J2		SRE Aft A: J2
Testset 1553 cable		SRE Aft A: J4
GSE SRE/ECU timing cable	26246	SRE Aft A: J9
SRE Aft A: PP-J5 (RS232)		RS232 SUN Workstation
GSS Timing input, ACU J6	per 8A02105	Aft A: J8
Top Hat Connections	per 8A02105	SRE Fwd A: J1, J2, J3, J4 SRE Fwd B: J1, J2, J3, J4
SRE Fwd A: J7 (TRE A)	per 8A02105	TRE A: J5
SRE Fwd B: J7 (TRE B)	per 8A02105	TRE B: J5
SRE Fwd A: J11 (TRE A Power)	per 8A02105	TRE A :J4
SRE Fwd B: J11 (TRE B Power)	per 8A02105	TRE B :J4
SRE Fwd A: J12, J13	per 8A02105	TRE A :J2, J3
SRE Fwd B: J12, J13	per 8A02105	TRE B :J2, J3

10.0 Preliminary SRE Checkout

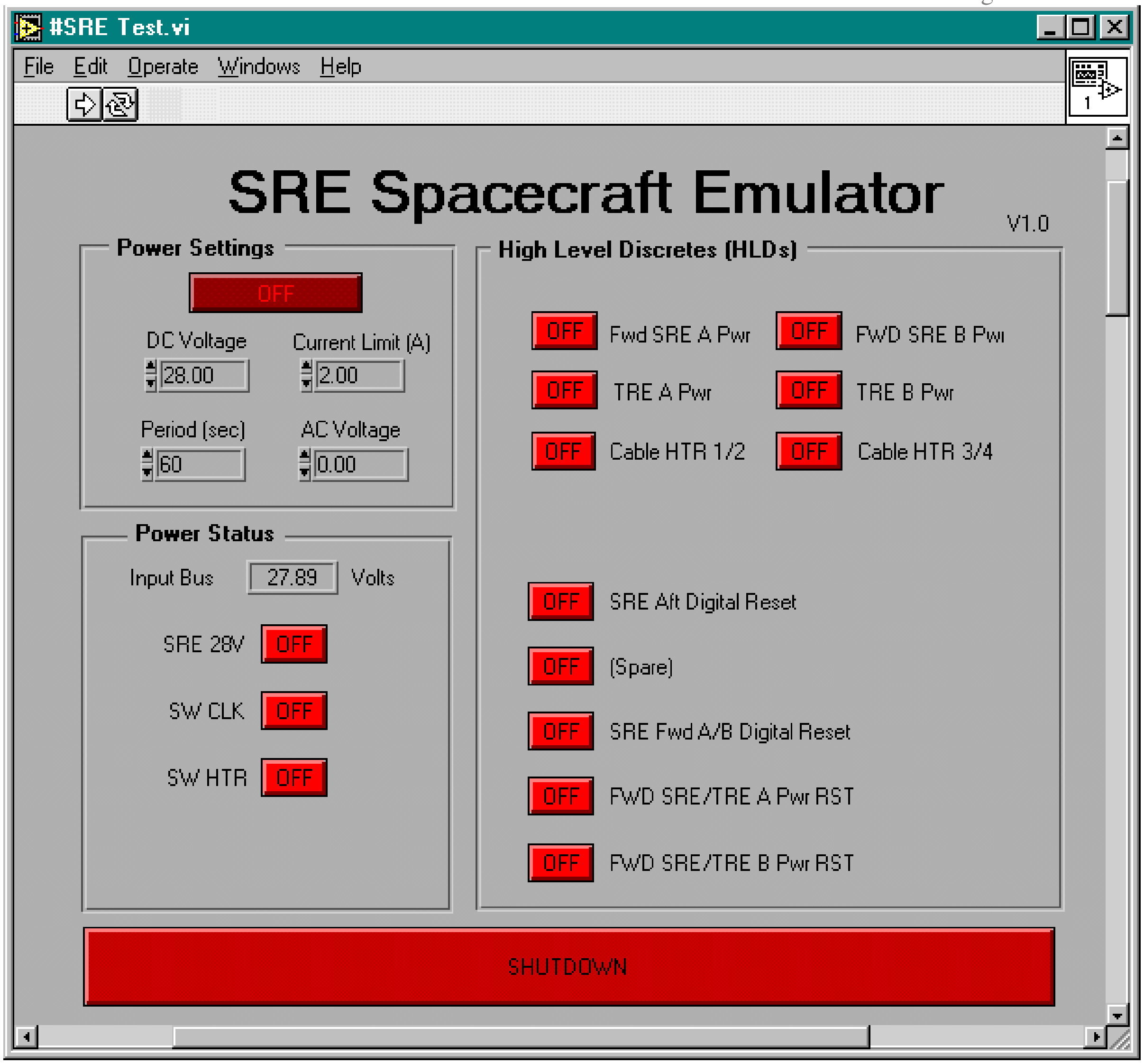
WARNING: To avoid possible damage to the DC-DC Converters in the Aft SRE, the proper power sequencing shall be followed. This sequence is to power ON by first turning on the OSC power, then after a wait, turn on the SW power. The power OFF sequence is to first turn off the OSC power, then the SW power (no wait required). Failure to follow these sequences may cause immediate damage to the Converters, resulting in failure of these parts.

10.1 **Deleted**
10.2 **Deleted**
10.3 **Deleted**
10.4 **Deleted**

10.5 System Power Supply Current Using the Aft SRE

10.5.1 Bring up SRE GSE console (boot PC and start LabView control panel) console per GSE operator's manual. Verify Power Supply and silver GSE box is powered on. (see figure below)

NOTE: In an emergency, the power to the SRE can be removed quickly by clicking the large "SHUTDOWN" button at the base of the LabView panel (see figure)



10.5.2 Set Current limit to **8.0 A** in LabView Panel. Verify bus voltage is set to 28 V.

10.5.3 Using the mouse, click the Power Settings button to **“ON”**

10.5.4 Press the “Undervoltage Reset” button on the front panel of the silver GSE box; insure the yellow undervoltage protect LED is not lit. Record the tare bus current off the front panel of the HP power supply in Table 10.5.1 below for use in subsequent steps.

10.5.5 Turn ON (click) the **SW CLK** Power for the SRE and read the change in bus current from the tare value off the front panel of the HP power supply. Record this initial change to the SRE CLK Current in Table 10.5.1 below. Compare this current with the values listed in Table 10.5.1 below. If it is outside these limits but less than 0.65 A, it may be that the oscillator oven is still using full power to warm up. Wait up to 10 minutes for the current to decrease. If it is greater than 0.6 A, turn OFF the SRE power immediately and find the cause before proceeding with any of the following tests.

10.5.6 Now turn ON (click) the **SRE 28V** Power for the SRE and read the read the change in bus current from the tare value on the HP power supply. Compare this current with the values listed in Table 10.5.1 below. If it is outside these limits, turn OFF the SRE power immediately and find the cause before proceeding with any of the following tests. Otherwise, check Pass and proceed.

10.5.7 Write down the date and time in Table 10.5.1 below for later entry in the SRE power log.

Table 10.5.1 – Basic Power Supply Currents for SRE

Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Pwr Supply Tare Bus Current	0 A	0.25 A		
Initial SRE CLK Current	0.16 A	0.65 A		
SRE CLK Current	0.16 A	0.25 A		
And SRE 28V Current	0.69 A	0.94 A		
Date	NA	NA		NA
Time	NA	NA		NA

10.5.1 Follow the appropriate procedures to initialize the Payload Processor and load the operating software. This will take about 15 minutes and should not have to be repeated unless the **SRE 28V**power is turned OFF. Do not turn this power OFF unless necessary.

10.5.2 Select and start CSTOL procedure “P0833_exec”. This will automate all of the CSTOL commands and prompt the user to perform all of the remaining test procedure steps.

10.5.3 Record CSTOL Executive Procedure revision level here:

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10.5.4 Send the HLD’s listed in Table 10.5.2 below. Send the HLDs listed in the table below by using the mouse to click the respective buttons on the LabView control panel. After each HLD, record the change in bus current from the tare value listed in Table 10.5.1 in the Table 10.5.2. If the current is outside the limits, click the associated HLD to “OFF” and determine the cause of the problem before proceeding. Also record the Date and Time the last HLD is sent.

Table 10.5.2 – SRE Power Up Changes from HLD’s				
A-SIDE HLD	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Fwd SRE A Pwr “ON”	0.69 A	1.94 A		
TRE A Pwr “ON”	0.94 A	2.19 A		
Fwd SRE B Pwr “ON”	1.54 A	3.19 A		
TRE B Pwr “ON”	1.79 A	3.41 A		
Date	NA	NA		NA
Time	NA	NA		NA

10.5.1 Command the Sun Workstation to switch to the A bus for the 1553 port for the Aft SRE.

10.5.2 Command the Sun Workstation to use SRE I/O for the Aft SRE.

10.5.3 Reset all Up and Down reset counters to 0000h.

10.6 Aft A Telemetry Data

10.6.1 Copy the specified telemetry data into Table 10.6.1 below. If available, use the CSTOL executive procedure to print out the telemetry data. Use the Write feature to get any data that is not on the screen. Write Pass in each row that is within limits. If any of the data is out of limits, write Fail in that row, but proceed with this and the following tests.

Table 10.6.1 Aft A Telemetry Data				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
SQ_AftSRE_Temp	NA	N/A		N/A
SQ_AftSRE_ClkTmp	-40° C	100° C		
SQ_SREDCvtrTmpA	-40° C	100° C		
SQ_TREDCvtrTmpA	-40° C	100° C		
SQ_SREDCvtrTmpB	-40° C	100° C		
SQ_TREDCvtrTmpB	-40° C	100° C		
SQ_AftDigPwrTmp	-40° C	100° C		
SQ_AftClkPwrTmp	-40° C	100° C		
SQ_FwdSCBdA15VC	+0.50 ADC	+1.00 ADC		
SQ_FwdTCBdA15VC	+0.15 ADC	+0.36 ADC		
SQ_FwdCvtBdA5VC	+0.01 ADC	+0.07 ADC		
SQ_FwdSCBdB15VC	+0.50 ADC	+1.00 ADC		
SQ_FwdTCBdB15VC	+0.15 ADC	+0.34 ADC		
SQ_FwdCvtBdB5VC	+0.01 ADC	+0.07 ADC		
SQ_AftCBdClkCur	+0.06 ADC	+0.22 ADC		
SQ_AftCBdDigCur	+0.35 ADC	+0.61 ADC		

10.6.2 Set up the computer to make a bridge file using the Aft Telemetry Channels listed in Table 10.6.1 above. Use the default sample rates.

10.6.3 Start the bridge file data acquisition process for the bridge file. Allow the recording process to run for 5 minutes.

10.6.4 Record the date and time of this measurement and the file name in table 10.6.2 below.

Table 10.6.2 Aft A Telemetry Bridge File	
Date	
Time	
Aft A Telemetry File Name	

10.7 **System Power Supply Current – Specified Conditions**

10.7.2 Send the commands listed in Tables 10.7.1 through 10.7.8 below to put the SRE in a specified state. Verify that each of the commands has been received by checking the Readback Value for the specified Readback Label on the computer screen. Write Yes in the Verify column of the tables if the command Readback Value is correct. (Most of the required telemetry should be on the computer screen. If a telemetry word is not there, it can brought up by typing "Write" followed by the TM mnemonic. The first readback, for example, can be seen by typing "Write SRE SQ_TmpLvlsCmd_1".)

Table 10.7.1 SQUID 1 Command Set Up for Power Measurement

Command	Parameter	Readback Label	Value	Verify
SQ1_LEVELS	9310hex	SQ_TmpLvlsCmd_1	9310hex	
SQ1_BIAS	0000hex	SQ_TmpBiasCmd_1	0000hex	
SQ1_OFFSET	8000hex	SQ_TmpOfstCmd_1	8000hex	
SQ1_CONTROL	0000hex	SQ_TmpCtrlCmd_1	0000hex	
SQ1_FLL_Etemp	0000hex	none	none	N/A
SQ1_DAC_Etemp	0000hex	none	none	N/A

Table 10.7.2 SQUID 2 Command Set Up for Power Measurement

Command	Parameter	Readback Label	Value	Verify
SQ2_LEVELS	9310hex	SQ_TmpLvlsCmd_2	9310hex	
SQ2_BIAS	0000hex	SQ_TmpBiasCmd_2	0000hex	
SQ2_OFFSET	8000hex	SQ_TmpOfstCmd_2	8000hex	
SQ2_CONTROL	0000hex	SQ_TmpCtrlCmd_2	0000hex	
SQ2_FLL_Etemp	0000hex	none	none	N/A
SQ2_DAC_Etemp	0000hex	none	none	N/A

Table 10.7.3 SQUID 3 Command Set Up for Power Measurement

Command	Parameter	Readback Label	Value	Verify
SQ3_LEVELS	9310hex	SQ_TmpLvlsCmd_3	9310hex	
SQ3_BIAS	0000hex	SQ_TmpBiasCmd_3	0000hex	
SQ3_OFFSET	8000hex	SQ_TmpOfstCmd_3	8000hex	
SQ3_CONTROL	0000hex	SQ_TmpCtrlCmd_3	0000hex	
SQ3_FLL_Etemp	0000hex	none	none	N/A
SQ3_DAC_Etemp	0000hex	none	none	N/A

Table 10.7.4 SQUID 4 Command Set Up for Power Measurement				
Command	Parameter	Readback Label	Value	Verify
SQ4_LEVELS	9310hex	SQ_TmpLvlsCmd_4	9310hex	
SQ4_BIAS	0000hex	SQ_TmpBiasCmd_4	0000hex	
SQ4_OFFSET	8000hex	SQ_TmpOfstCmd_4	8000hex	
SQ4_CONTROL	0000hex	SQ_TmpCtrlCmd_4	0000hex	
SQ4_FLL_Etemp	0000hex	none	none	N/A
SQ4_DAC_Etemp	0000hex	none	none	N/A

Table 10.7.5 DAS 1/3 Command Set Up for Power Measurement				
Command	Parameter	Readback Label	Value	Verify
DAS_4_CONTROL	F800hex	SQ_DASCtrlCmd_A	F800hex	
DAS_4_Pri_Etemp	0000hex	none	none	N/A
DAS_4_Sec_Etemp	0000hex	none	none	N/A
SQUIDCAL A	0000hex	SQ_SQUIDCalCd_A	0000hex	

Table 10.7.6 DAS 2/4 Command Set Up for Power Measurement				
Command	Parameter	Readback Label	Value	Verify
DAS_5_CONTROL	F800hex	SQ_DASCtrlCmd_B	F800hex	
DAS_5_Pri_Etemp	0000hex	none	none	N/A
DAS_5_Sec_Etemp	0000hex	none	none	N/A
SQUIDCAL B	0000hex	SQ_SQUIDCalCd_B	0000hex	

Table 10.7.7 Bracket 1/3 Command Set Up for Power Measurement				
Command	Parameter	Readback Label	Value	Verify
SB6_Sensor1_SetPoint	8000hex	SQ_Bkt1Sr1SPCdA	8000hex	
SB6_Heater1_Cmd	0000hex	SQ_Bkt1Htr1CmdA	0000hex	
SB6_Etemp_SetPoint	0000hex	none	none	N/A
SB6_Control	0002hex	SQ_BktCtrlCmd_A	0002hex	
SB6_Sensor2_SetPoint	8000hex	SQ_Bkt2Sr2SPCdA	8000hex	
SB6_Heater2_Cmd	0000hex	SQ_Bkt2Htr2CmdA	0000hex	

Table 10.7.8 Bracket 2/4 Command Set Up for Power Measurement				
Command	Parameter	Readback Label	Value	Verify
SB7_Sensor1_SetPoint	8000hex	SQ_Bkt2Sr1SPCdB	8000hex	
SB7_Heater1_Cmd	0000hex	SQ_Bkt2Htr1CmdB	0000hex	
SB7_Etemp_SetPoint	0000hex	none	none	N/A
SB7_Control	0002hex	SQ_BktCtrlCmd_B	0002hex	
SB7_Sensor2_SetPoint	8000hex	SQ_Bkt1Sr2SPCdB	8000hex	
SB7_Heater2_Cmd	0000hex	SQ_Bkt1Htr2CmdB	0000hex	

Note: 8000hex on ???_Sensor#_SetPoint = 5490 Ohms at GRT.

10.7.2 Deleted.

10.7.3 Read the 28 V current on the HP power supply in the GSE stack. After subtracting out the Tare Current from Table 10.5.1, compare this current with the values listed in Table 10.7.9 below. If it is outside these limits, turn OFF the SRE power and find the cause before proceeding with any of the following tests.

10.7.4 If it is within the limits listed, record the actual value in Table 10.7.9 below and write Pass in the Pass/Fail box.

Table 10.7.9 Power Supply Current – Specified Conditions				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
+28 Volt Current	1.79 A	3.66 A		

10.8 Basic Telemetry Data

10.8.1 With the SRE in the state commanded in section 10.7 above, copy the specified telemetry data into Table 10.8.1 below. If available, use the CSTOL executive procedure to print out the basic telemetry data. Use the Report feature to get any data that is not on the screen. Write Pass in each row that is within limits. If any of the data is out of limits, write Fail in that row, but proceed with this and the following tests.

Table 10.8.1 Basic Telemetry Data – SQUID 1				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
SQ_ResetDnCnt_1	0000hex	0000hex		
SQ_ResetUpCnt_1	0000hex	0000hex		
SQ_ElecHeat_1	-0.8 VDC	+0.1 VDC		
SQ_Bias_1	-0.5 µADC	+0.5 µADC		
SQ_Offset_1	-0.1 VDC	+0.1 VDC		
SQ_FLL_Etmp_1	20° C	55° C		
SQ_Cal_1	-1.2 VDC	-1.0 VDC		
SQ_DAC_Etmp_1	20° C	55° C		
SQ_Demod_1	-0.5 VDC	+0.5 VDC		
SQ_PASupply_1	+9.0 VDC	+11.0 VDC		
SQ_PlusVAnlg_1	+10.9 VDC	+13.1 VDC		
SQ_MinusVAnlg_1	-13.1 VDC	-10.9 VDC		

10.8.2 Continue to record the basic telemetry data specified in Table 10.8.2.

Table 10.8.2 Basic Telemetry Data – SQUID 2				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
SQ_ResetDnCnt_2	0000hex	0000hex		
SQ_ResetUpCnt_2	0000hex	0000hex		
SQ_ElecHeat_2	-0.8 VDC	+0.1 VDC		
SQ_Bias_2	-0.5 µADC	+0.5 µADC		
SQ_Offset_2	-0.1 VDC	+0.1 VDC		
SQ_FLL_Etmp_2	20° C	55° C		
SQ_Cal_2	-1.2 VDC	-1.0 VDC		
SQ_DAC_Etmp_2	20° C	55° C		
SQ_Demod_2	-0.5 VDC	+0.5 VDC		
SQ_PASupply_2	+9.0 VDC	+11.0 VDC		
SQ_PlusVAnlg_2	+10.9 VDC	+13.1 VDC		
SQ_MinusVAnlg_2	-13.1 VDC	-10.9 VDC		

10.8.3 Continue to record the basic telemetry data specified in Table 10.8.3.

Table 10.8.3 Basic Telemetry Data – SQUID 3				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
SQ_ResetDnCnt_3	0000hex	0000hex		
SQ_ResetUpCnt_3	0000hex	0000hex		
SQ_ElecHeat_3	-0.8 VDC	+0.1 VDC		
SQ_Bias_3	-0.5 µADC	+0.5 µADC		
SQ_Offset_3	-0.1 VDC	+0.1 VDC		
SQ_FLL_Etmp_3	20° C	55° C		
SQ_Cal_3	-1.2 VDC	-1.0 VDC		
SQ_DAC_Etmp_3	20° C	55° C		
SQ_Demod_3	-0.5 VDC	+0.5 VDC		
SQ_PASupply_3	+9.0VDC	+11.0VDC		
SQ_PlusVAnlg_3	+10.9 VDC	+13.1 VDC		
SQ_MinusVAnlg_3	-13.1 VDC	-10.9 VDC		

10.8.4 Continue to record the basic telemetry data specified in Table 10.8.4.

Table 10.8.4 Basic Telemetry Data - SQUID 4				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
SQ_ResetDnCnt_4	0000hex	0000hex		
SQ_ResetUpCnt_4	0000hex	0000hex		
SQ_ElecHeat_4	-0.8 VDC	+0.1 VDC		
SQ_Bias_4	-0.5 µADC	+0.5 µADC		
SQ_Offset_4	-0.1 VDC	+0.1 VDC		
SQ_FLL_Etmp_4	20° C	55° C		
SQ_Cal_4	-1.2 VDC	-1.0 VDC		
SQ_DAC_Etmp_4	20° C	55° C		
SQ_Demod_4	-0.5 VDC	+0.5 VDC		
SQ_PASupply_4	+9.0 VDC	+10.0 VDC		
SQ_PlusVAnlg_4	+10.9 VDC	+13.1 VDC		
SQ_MinusVAnlg_4	-13.1 VDC	-10.9 VDC		

10.8.5 Continue to record the basic telemetry data specified in Table 10.8.5.

Table 10.8.5 Basic Telemetry Data – DAS & BTC				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
SQ_BktETmpSP_A	0° C	1° C		
SQ_DAS_EtmpSP_A	-0.3VDC	+0.3VDC		
SQ_DAS_Etmp_A	20° C	55° C		
SQ_DASETmpHtr_A	-1.1 VDC	+0.1 VDC		
SQ_DASETmpDltaA	NA	NA		NA
SQ_Bkt1Sensor1A	-0.6 VDC	+0.6 VDC		
SQ_Bkt1Heater1A	-0.1 VDC	+0.1 VDC		
SQ_Bkt_Etmp_A	20° C	55° C		
SQ_BktETmpHtr_A	-0.7 VDC	+0.7 VDC		
SQ_Bkt2Sensor2A	-0.6 VDC	+0.6 VDC		
SQ_Bkt2Heater2A	-0.1 VDC	+0.1 VDC		
SQ_DAS_EtmpSP_B	-0.3VDC	+0.3VDC		
SQ_DAS_Etmp_B	20° C	55° C		
SQ_DASETmpHtr_B	-1.1VDC	+0.1 VDC		
SQ_DASETmpDltaB	NA	NA		NA
SQ_BktETmpSP_B	0° C	1° C		
SQ_Bkt2Sensor1B	-0.6 VDC	+0.6 VDC		
SQ_Bkt2Heater1B	-0.1 VDC	+0.1 VDC		
SQ_Bkt_Etmp_B	20° C	55° C		
SQ_BktETmpHtr_B	-0.7 VDC	+0.7 VDC		
SQ_Bkt1Sensor2B	-0.6 VDC	+0.6 VDC		
SQ_Bkt1Heater2B	-0.1 VDC	+0.1 VDC		

Table 10.8.6 Basic Telemetry Data – DAS & BTC				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
RQ_DASP5Anlg1_A	+4.9 VDC	+5.1 VDC		
RQ_DAS2P5Ref1_A	+2.45 VDC	+2.55 VDC		
RQ_DASP5Anlg2_A	+4.9 VDC	+5.1 VDC		
RQ_DAS2P5Ref2_A	+2.45 VDC	+2.55 VDC		
RQ_DASP5Anlg3_A	+4.9 VDC	+5.1 VDC		
RQ_DAS2P5Ref3_A	+2.45 VDC	+2.55 VDC		
SQ_PwrBrdTmp_A	20° C	55° C		
RQ_DASP5Anlg1_B	+4.9 VDC	+5.1 VDC		
RQ_DAS2P5Ref1_B	+2.45 VDC	+2.55 VDC		
RQ_DASP5Anlg2_B	+4.9 VDC	+5.1 VDC		
RQ_DAS2P5Ref2_B	+2.45 VDC	+2.55 VDC		
RQ_DASP5Anlg3_B	+4.9 VDC	+5.1 VDC		
RQ_DAS2P5Ref3_B	+2.45 VDC	+2.55 VDC		
SQ_PwrBrdTmp_B	20° C	55° C		
SQ_SysPlus_V_A	+13.5 VDC	+16.5 VDC		
SQ_SysMnus_V_A	-16.5 VDC	-13.5 VDC		
SQ_BktPlus_V_A	+10.8 VDC	+13.2 VDC		
SQ_BktMnus_V_A	-13.2 VDC	-10.8 VDC		
SQ_DASPlus_V_A	+10.8 VDC	+13.2 VDC		
SQ_DASMnus_V_A	-13.2 VDC	-10.8 VDC		
SQ_ST_Ref_A	NA	NA	NA	NA
SQ_DASAnlgRtn_A	-0.1 VDC	+0.1 VDC		
SQ_BktVoltRef_A	NA	NA	NA	NA
SQ_DAS_PVExt_A	+4.7 VDC	+5.3 VDC		

10.8.6 Continue to record the basic telemetry data specified in Table 10.8.7.

Table 10.8.7 Basic Telemetry Data – DAS & BTC				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
SQ_SysPlus_V_B	+13.5 VDC	+16.5 VDC		
SQ_SysMnus_V_B	-16.5 VDC	-13.5 VDC		
SQ_BktPlus_V_B	+10.8 VDC	+13.2 VDC		
SQ_BktMnus_V_B	-13.2 VDC	-10.8 VDC		
SQ_DASPlus_V_B	+10.8 VDC	+13.2 VDC		
SQ_DASMnus_V_B	-13.2 VDC	-10.8 VDC		
SQ_ST_Ref_B	NA	NA	NA	NA
SQ_DASAnlgRtn_B	-0.1 VDC	+0.1 VDC		
SQ_BktVoltRef_B	NA	NA	NA	NA
SQ_DAS_PVExt_B	+4.7 VDC	+5.3 VDC		

10.9 **Deleted**
10.10 **Deleted**
10.11 **Deleted**

10.12 Bracket Temperature Control Sensor Electronics Performance

10.12.1 Skip.

10.12.2 Enable Side A Normal Frequency by sending command "SB6_STD_Freqs".

10.12.3 Enable Low Gain for Sensor 1 by sending command "SB6_LoGain_1".

10.12.4 Enable Side A Sensor Drive by sending command "SB6_Drive_Enable".

10.12.5 Use the "SB6Sensor1_SetPoint" command to minimize SQ_Bkt1Sensor1A telemetry readout. Start with a command parameter of 8000hex and vary above and below this value to null the telemetry signal. Read the Lo Gain Null Voltage from SQ_Bkt1Sensor1A and record in Table 10.12.1 below.

10.12.6 Skip.

10.12.7 Skip.

10.12.8 Enable High Gain by sending command "SB6_HiGain_1". Now use the "SB6Sensor1_SetPoint" command to make SQ_Bkt1Sensor1A telemetry as close to zero as possible. Read the resulting High Gain Null Voltage from SQ_Bkt1Sensor1A and Null Setpoint from SQ_Bkt1Sr1SPCdA command readback and enter them in Table 10.12.1 below.

10.12.9 Deleted.

10.12.10 Adjust the Sensor Demod Phase to maximize the signal on SQ_Bkt1Sensor1A. Use the "SB6_Demod_Phase" command with parameters between 00 and Ffhex. Enter the value of this parameter that gives the largest signal in Table 10.12.1 below.

Table 10.12.1 BTC SRE-A Sensor 1 Data

Measurement	Step No.	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Low Gain Null	5	-0.006 Vdc	+0.006 Vdc		
High Gain Null	8	-0.05 Vdc	+0.05 Vdc		
Null Set Point	8	7000hex	9000hex		
Sensor Demod Phase	10	00hex	Ffhex		NA

10.12.11 Enable Low Gain for Sensor 2 by sending command "SB6_LoGain_2".

10.12.12 Use the "SB6Sensor2_SetPoint" command to minimize SQ_Bkt2Sensor2A telemetry readout. Start with a command parameter of 8000hex and vary above and below this value to null the telemetry signal. Read the Lo Gain Null Voltage from SQ_Bkt2Sensor2A and record in Table 10.12.2 below.

10.12.13 Skip.

10.12.14 Skip.

10.12.15 Enable High Gain by sending command "SB6_HiGain_2". Now use the "SB6Sensor2_SetPoint" command to make SQ_Bkt2Sensor2A telemetry as close to zero as possible. Read the resulting High Gain Null Voltage from SQ_Bkt2Sensor2A and Null Setpoint from SQ_Bkt2Sr2SPCdA command readback and enter them in Table 10.12.2 below.

10.12.16 Deleted.

10.12.17 Adjust the Sensor Demod Phase to maximize the signal on SQ_Bkt2Sensor2A. Use the "SB6_Demod_Phase" command with parameters between 00 and Ffhex. Enter the value of this parameter that gives the largest signal in Table 10.12.2 below.

Table 10.12.2 BTC SRE-A Sensor 2 Data					
Measurement	Step No.	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Low Gain Null	12	-0.006 Vdc	+0.006 Vdc		
High Gain Null	15	-0.05 Vdc	+0.05 Vdc		
Null Set Point	15	7000hex	9000hex		
Sensor Demod Phase	17	00hex	Ffhex		NA

10.12.18 Enable Side B Normal Frequency by sending command "SB7_STD_Freqs".

10.12.19 Enable Low Gain for Sensor 1 by sending command "SB7_LoGain_1".

10.12.20 Enable Side B Sensor Drive by sending command "SB7_Drive_Enable".

10.12.21 Use the "SB7Sensor1_SetPoint" command to minimize SQ_ Bkt2Sensor1B telemetry readout. Start with a command parameter of 8000hex and vary above and below this value to null the telemetry signal. Read the Lo Gain Null Voltage from SQ_ Bkt2Sensor1B and record in Table 10.12.3 below.

10.12.22 Skip.

10.12.23 Skip.

10.12.24 Enable High Gain by sending command "SB7_HiGain_1". Now use the "SB7Sensor1_SetPoint" command to make SQ_Bkt2Sensor1B telemetry as close to zero as possible. Read the resulting High Gain Null Voltage from SQ_Bkt2Sensor1B and Null Setpoint from SQ_Bkt2Sr1SPCdB command readback and enter them in Table 10.12.3 below.

10.12.25 Deleted.

10.12.26 Adjust the Sensor Demod Phase to maximize the signal on SQ_Bkt2Sensor1B. Use the "SB7_Demod_Phase" command with parameters between 00 and Ffhex. Enter the value of this parameter that gives the largest signal in Table 10.12.3 below.

Table 10.12.3 BTC SRE-B Sensor 1 Data					
Measurement	Step No.	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Low Gain Null	21	-0.006 Vdc	+0.006 Vdc		
High Gain Null	24	-0.05 Vdc	+0.05 Vdc		
Null Set Point	24	7000hex	9000hex		
Sensor Demod Phase	26	00hex	Ffhex		NA

10.12.27 Enable Low Gain for Sensor 2 by sending command "SB7_LoGain_2".

10.12.28 Use the "SB7Sensor2_SetPoint" command to minimize SQ_Bkt1Sensor2B telemetry readout. Start with a command parameter of 8000hex and vary above and below this value to null the telemetry signal. Read the Lo Gain Null Voltage from SQ_Bkt1Sensor2B and record in Table 10.12.4 below.

10.12.29 Skip.

10.12.30 Skip.

10.12.31 Enable High Gain by sending command "SB7_HiGain_2. Now use the "SB7Sensor2_SetPoint" command to make SQ_Bkt1Sensor2B telemetry as close to zero as possible. Read the resulting High Gain Null Voltage from SQ_Bkt1Sensor2B and Null Setpoint from SQ_Bkt1Sr2SPCdB command readback and enter them in Table 10.12.4 below.

10.12.32 Deleted.

10.12.33 Adjust the Sensor Demod Phase to maximize the signal on SQ_Bkt1Sensor2B. Use the "SB7_Demod_Phase" command with parameters between 00 and Ffhex. Enter the value of this parameter that gives the largest signal in Table 10.12.4 below

Table 10.12.4 BTC SRE-B Sensor 2 Data					
Measurement	Step No.	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Low Gain Null	29	-0.006 Vdc	+0.006 Vdc		
High Gain Null	31	-0.05 Vdc	+0.05 Vdc		
Null Set Point	31	7000hex	9000hex		
Sensor Demod Phase	33	00hex	Ffhex		NA

10.12.34 Make disk files of the SQ_Bkt1Sensor1A, SQ_Bkt2Sensor2A, SQ_Bkt2Sensor1B, and SQ_Bkt1Sensor2B telemetry signals for 35 minutes.

10.12.35 Analyze this data using the MATLAB BTCSensor program. Write the Sensors' Noise results from this program in Table 10.12.5 below.

Table 10.12.5 BTC Sensors' Noise

Sensor	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Bkt1Sensor1A	0 Vrms/√Hz	0.2 Vrms/√Hz		
Bkt2Sensor2A	0 Vrms/√Hz	0.2 Vrms/√Hz		
Bkt2Sensor1B	0 Vrms/√Hz	0.2 Vrms/√Hz		
Bkt1Sensor2B	0 Vrms/√Hz	0.2 Vrms/√Hz		

10.13 **DELETED**

11.0 FLL Set-Up for Tests with an Active SQUID

This section will test the FLL Subsystems in both Fwd SRE's. It will test each FLL channel in turn, using the payload, which is connected to each channel as required. Though not specifically required for this test, prior to connecting or disconnecting a SQUID, the BIAS current must be set to zero and the loop opened (BIAS = 0000hex, SQ_CONTROL = 0000hex) and the Fwd SRE powered down. Only 1 aft SRE will be used for this test. Four SQUIDs were attached to the two forward electronics in Section 9, the TRE will be connected to the SRE and payload. Refer to drawing LMMS 8A02105 for further information.

12.0 SRE Box Tests for SQUID Channel 1

12.1 Initial Set-Up and Demod Output

12.1.1 Send command DAS_4_CONTROL with parameter F800hex to enable the SRE 1/3 DAS multiplexers and disable the DAS electronics temperature control.

12.1.2 Send command DAS_5_CONTROL with parameter F800hex to enable the SRE 2/4 DAS multiplexers and disable the DAS electronics temperature control.

12.1.3 Ensure all Electronics Temperature Control Temperature Commands are zero by sending commands “SQ1_FLL_Etemp”, “SQ2_FLL_Etemp”, “SQ3_FLL_Etemp”, “SQ4_FLL_Etemp”, “DAS_4_Pri_Etemp”, “DAS_4_Sec_Etemp”, “DAS_5_Pri_Etemp”, “DAS_5_Sec_Etemp”, “SB6_Etemp_Setpoint”, “SB7_Etemp_Setpoint” with parameter 0000hex.

12.1.4 Set the FLL Range to 1, the SQUID Offset Mode to low, the DAS London Moment Post Gain to 1, preset the Reset Level to 10V, but disable the automatic reset, select the FLL for ETEMP Heat Monitoring, set the Preamp Gain to 1 and disable the Electronics Temperature control by sending command “SQ1_LEVELS” with a parameter of 9710hex.

12.1.5 Set the Bias to 0 by sending command “SQ1_BIAS” with a parameter of 0000hex.

12.1.6 Set the Offset to 0 by sending command “SQ1_OFFSET” with a parameter of 8000hex.

12.1.7 Unlock the FLL and clear the Reset Counters by sending command SQ1_CONTROL with a parameter of 0004hex (this will automatically clear to 0000hex, so the display will likely only display this final condition).

12.1.8 Connect the oscilloscope and the Digital Multimeter to the SQUID 1 DEMOD MON on the Dual SRE Test Box. Set both to read a 0±10 volt signal. Set the SQUID 1 test switch to TEST OFF.

12.1.9 Using the "SQ1_BIAS" command, increase the Bias to produce a positive DC level on the scope. The parameter range of this command is 0000hex to FFFFhex. Using the scope and the DC voltmeter, adjust the Bias to maximize the DC value.

12.1.10 Using the "SQ1_OFFSET" command, increase or decrease the Offset from 8000hex to maximize the positive DC voltage on the first peak away from 8000hex. The parameter range of this command is 0000hex to FFFFhex.

12.1.11 Readjust the Bias with the "SQ1_BIAS" command to further maximize the positive DC voltage. Record the Bias command readback from telemetry SQ_TmpBiasCmd_1 in Table 12.1.1 below.

12.1.12 Readjust the Offset with "SQ1_OFFSET" command to further maximize the positive DC voltage. Record the Offset command readback from telemetry SQ_TmpOfstCmd_1 and Demod DC voltage from the Multimeter in Table 12.1.1 below.

12.1.13 Record the Bias, Offset, and Demod telemetry voltages called out in Table 12.1.1 below.

12.1.14 Move the multimeter to FLL OUT for SQUID 1.

12.1.15 Lock SQUID 1 by sending the command "enable SQUID Lock_FLL with SQUID_Unit SQUID_1". Record the FLL OUT voltage below.

FLL OUT SQUID 1 ________________________ V

12.1.16 Unlock SQUID 1 by sending the command "enable SQUID Lock_FLL with SQUID_Unit SQUID_1".

Table 12.1.1 Flux Lock Loop 1 Set Up				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
SQ_TmpBiasCmd_1	0000hex	FFFFhex		NA
SQ_TmpOfstCmd_1	0000hex	FFFFhex		NA
Demod Voltage	+/-4.8 VDC	+/-10 VDC		
SQ_Bias_1	-10µADC	-70µADC		
SQ_Offset_1	-5.0 VDC	+5.0 VDC		
SQ_Demod_1	+/-4.8 VDC	+/-10 VDC		

12.2 **Removed**

12.3 **Range 1 Scale Factor**

12.3.1 Verify that the Digital Multimeter is connected to the SQUID 1 FLL OUT on the Dual SRE Test Box.

12.3.2 Set the Offset to 0 by sending command “SQ1_OFFSET” with a parameter of 8000hex.

12.3.3 Close the Flux Lock Loop (FLL) by sending command “SQ1_Lock_Enable”.

12.3.4 This step must be completed along with steps 5 or 6 before typing “go” on the Sun Workstation. Increase or decrease the Offset from 8000hex as required to make the DC voltage at the FLL Output = 0±10 mV. This can be achieved by either increasing or decreasing the Offset. Record this value in Table 12.3.1 below as A1.

12.3.5 If increasing the Offset zeroed the FLL Output, set the Offset to A1-4000hex by decreasing the most significant nibble by 4.

12.3.6 If decreasing the Offset zeroed the FLL Output, set the Offset to A1+4000hex by increasing the most significant nibble by 4.

12.3.7 Open the Flux Lock Loop by sending command “SQ1_Lock_Disable”.

12.3.8 Close the Flux Lock Loop (FLL) by sending command “SQ1_Lock_Enable”.

12.3.9 Set the Offset back to value A1 using the "SQ1_OFFSET" command.

12.3.10 Measure the DC voltage at the SQUID 1 FLL Output using the Digital Multimeter. This is the Range 1 Scale Factor in volt/flux quanta. Record this value in Table 12.3.1 below.

Table 12.3.1		
Measurement	Measured Value	Pass/Fail
Offset A1 from step 4		NA
Range 1 Scale Factor		NA

12.4 **FLL Output Noise above 5 Hz**

12.4.1 Connect the SQUID 1 FLL OUT on the SRE Test Set Console the Digital Multimeter and Channel 1 of the HP-35660A Signal Analyzer.

12.4.2 Verify that the Bias is set to the value in Table 12.1.1. Use the SQ_TmpBiasCmd_1 telemetry to read the Bias and the "SQ1_BIAS" command to change it if necessary. Use the SQ_TmpLvlsCmd_1 telemetry to verify that the LEVELS register is set to 9710hex. This can be changed with the "SQ1_LEVELS" command.

12.4.3 Close the Flux Lock Loop (FLL) by sending command "SQ1_Lock_Enable".

12.4.4 Verify the Offset is set to the A1 value from Table 12.3.1 using the "SQ1_OFFSET" command and then adjust as required to reduce the FLL Output to 0±0.01 volts as read on the Digital Multimeter.

12.4.5 Set up the HP-35660A Signal Analyzer to measure the noise bandwidth with the following settings:

Inst Mode – FFT ANALYSIS
Meas Data – PWR SPEC CHANNEL 1
Input – CH 1 AC Coupled
Input – CH 1 AUTO RANGE
Span =1600 Hz
Avg – On, then NUMBER AVERAGES = 100, ENTER
Scale – AUTOSCALE ON
Trace Coord Yunits – Vrms/rtHz

12.4.6 Start the measurement by pressing the Start button on the Signal Analyzer.

12.4.7 After the measurement stops, use the cursor to locate the flat midband section of the noise spectrum on the HP-35660A screen. Move the cursor slowly to position it vertically in the middle of the data.

12.4.8 Read the voltage from the top of the screen and record it in Table 12.4.1 below. This is the noise voltage in µVrms/√Hz.

12.4.9 Enter the Range 1 Scale Factor from Table 12.3.1 in Table 12.4.1 below.

12.4.10 Divide the voltage from step 8 by the Range 1 Scale Factor to calculate the noise in µphi0/√Hz. Record this result in Table 12.4.1. It should be < 7 $\mu\Phi_0$ /√Hz.

Table 12.4.1 SQUID 1 High Frequency Noise

Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Noise Voltage	NA	NA		NA
Range 1 Scale Factor	NA	NA		NA
Calibrated Noise	None	7 $\mu\Phi_0$/√Hz		

12.4.11 Open the Flux Lock Loop by sending command "SQ1_Lock_Disable".

12.5 **Deleted.**

12.6 Closed Loop Linearity

12.6.1 Open the Flux Lock Loop by sending command "SQ1_Lock_Disable".

12.6.2 Set the Preamp gain to 1 by sending command "SQ1_Loop_Gain" with a parameter of 1.

12.6.3 Set the Range to 1 by sending command "SQ1_Range" with a parameter of 0.

12.6.4 Set the Offset to 0 by sending command "SQ1_OFFSET" with a parameter of 8000hex.

12.6.5 Set up the Stanford Research Systems DS360 Ultra-Low Distortion Function Generator to produce a dual tone 100/0.10 Hz sine wave. Set the 100 Hz output amplitude to 1.54Vpp and the 0.1 Hz output amplitude to 0.054Vpp (this should produce a SQUID signal of 18Vpp at 100 Hz and 0.6Vpp at 0.1 Hz) (this set-up may be stored as #9 in the DS360). Connect the Function Generator output to the SQUID 1 TEST INPUT on the SRE Test Set Console and to the HP-35660A Signal Analyzer Channel 2 Input. Set the SQUID 1 test switch to TEST OFF.

12.6.6 Connect the SQUID 1 FLL OUT connector on the Test Connector Breakout Panel to the HP-35660A Signal Analyzer Channel 1.

12.6.7 Connect the oscilloscope to the SQUID 1 FLL OUT connector on the Test Connector Breakout using a BNC Tee if necessary.

12.6.8 Close the Flux Lock Loop (FLL) by sending command "SQ1_Lock_Enable".

12.6.9 Using the "SQ1_OFFSET" command as required to reduce the HF OUT signal to 0±0.01 volts on the oscilloscope.

12.6.10 Set the SQUID 1 test switch to TEST ON. It may be necessary to repeatedly Lock and Unlock (or turn the TEST switch OFF and ON) to get the signal centered on 0.0 V. Verify an 18.0±0.2 Vpp 100 Hz sine wave at the HF OUT as seen on the oscilloscope (the 0.1 Hz signal will cause the 100 Hz signal to move up and down on the oscilloscope screen if DC coupling is used).

12.6.11 Record the maximum values of the London Moment science signal from the oscilloscope and from the SQ_20HzSignal_1 display on the workstation as well as the gain setting in Table 12.6.1.

Table 12.6.1 – Low Frequency Post Gain

Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Max LF output (oscilloscope)	10 Vpp	20 Vpp		
Max London Moment Science Signal	16384	32768		
Gain setting	3	5		

12.6.12 Using the FFT mode of the SSW, make a bridge file of twenty FFT's at 100 Hz, also take a continuous bridge file of the SQUID 1 signal for 10 minutes. Then change the DAS mode control bits so DAS2 gets SRE data and again using the FFT mode of the SSW, make another bridge file of twenty FFT's at 100 Hz, also take another continuous bridge file of the SQUID 1 signal for 10 minutes. Record the Sun System time when the bridge files is started.

____

NOTE: Steps 13 to 18 may be performed while the workstation is executing step 12. Do not proceed to step 19 till all four bridge files in step 12 are completed.

12.6.13 While the FFT's and Bridge file are being acquired, set up the HP-35660A Signal Analyzer to measure the 100 mHz signal with the following settings:

Meas Mode – 2 Channel
Inst Mode – FFT ANALYSIS
Trace A Meas Data – PWR SPEC CHANNEL 1
Trace B Meas Data – PWR SPEC CHANNEL 2
Freq – FULL SPAN, then STOP = 1.5 Hz
Avg – On, then NUMBER AVERAGES = 7, ENTER
Avg – OVLD Reject
Input – CH 1 RANGE = 10.012 Vpk, DC Coupled
Input – CH 2 AUTO RANGE, DC Coupled (AUTO RANGE button must be pressed)
Scale – AUTOSCALE ON
Trace Coord – Mag dB
Y Units – Amplitude – Vrms
Y Units – Volts

12.6.14 Start the measurement by pressing the Start button on the Signal Analyzer.

12.6.15 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 0.1 Hz of both the SQUID and the Function Generator signals and record it in Table 12.6.2 below.

Table 12.6.2					
Signal	0.1 Hz	0.2 Hz	0.3 Hz	0.4 Hz	0.5 Hz
SQUID					
Func Gen					

12.6.16 Connect channel 1 on the HP-35660A analyzer to the SQUID 1 FLL OUT signal from the Test Connector Breakout Panel. Change the following settings on the HP-35660A analyzer to measure the 100 Hz signal (these settings assume the previous settings from step 13 above).

Input – CH 1 AUTO RANGE, AC Coupled (AUTO RANGE button must be pressed)
Input – CH 2 AUTO RANGE, AC Coupled (AUTO RANGE button must be pressed)
Freq – SPAN = 800 Hz, Resolution = 800
Avg – NUMBER AVERAGES = 100, ENTER

12.6.17 Start the measurement by pressing the Start button on the Signal Analyzer.

12.6.18 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 100 Hz of both the SQUID and the Function Generator signals and record it in Table 12.6.3 below.

Table 12.6.3					
Signal	100 Hz	200 Hz	300 Hz	400 Hz	500 Hz
SQUID					
Func. Gen.					

12.6.19 Set the SQUID 1 test switch to TEST OFF. Disconnect the Function Generator. If the signal at the SQUID 1 HF OUT connector on the SSCP is not at 0 ± 0.01 volts on the oscilloscope, use the "SQ1_OFFSET" command to adjust the Offset as required to achieve this indication.

12.6.20 Using the FFT mode of the SSW, make a bridge file of twenty FFT's at 100 Hz, also take a continuous bridge file of the SQUID 1 signal for 10 minutes. Then change the DAS mode control bits so DAS1 gets SRE data and again using the FFT mode of the SSW, make another bridge file of twenty FFT's at 100 Hz, also take another continuous bridge file of the SQ_20HzSignal_1 for 10 minutes. Record the Sun System time when the bridge files is started.

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NOTE: Steps 21 and 22 may be performed while the workstation is executing step 20. Do not proceed to step 23 till all four bridge files in step 20 are completed.

12.6.21 Start a new measurement by pressing the Start button on the Signal Analyzer.

12.6.22 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 100 Hz of the SQUID and record the new data in Table 12.6.4 below.

Table 12.6.4					
Signal	100 Hz	200 Hz	300 Hz	400 Hz	500 Hz
SQUID					

12.6.23 Turn on the Trapped Flux and London Moment CAL Signals at maximum amplitude for SQUID 1 with the London Moment frequency set to 0.016 Hz and the Trapped Flux frequency set to 220 Hz (SQUIDCAL set to 007Fhex).

12.6.24 Connect channel 1 on the HP-35660A analyzer to the SQUID 1 LF OUT signal. Connect channel 2 of the HP35660A to the SQUID 1 CAL MON signal on the SQUID Test Console.

12.6.25 Using the FFT mode of the SSW, make a bridge file of twenty FFT's at 220 Hz, also take a continuous bridge file of the SQ_20HzSignal_1 for 10 minutes. Then change the DAS mode control bits so DAS2 gets SRE data and again using the FFT mode of the SSW, make another bridge file of twenty FFT's at 220 Hz, also take another continuous bridge file of the SQ_20HzSignal_1 for 10 minutes. Record the Sun System time when the bridge files is started.

NOTE: Steps 26 to 28 may be performed while the workstation is executing step 25. Do not proceed to step 29 till all four bridge files in step 25 are completed.

12.6.26 While the FFT's and Bridge file are being acquired, change the following settings on the HP-35660A analyzer to measure the 220 Hz SQUID signal (these settings assume the same settings as in step 16 above).

Freq – SPAN = 1.6 KHz
Avg – On, then NUMBER AVERAGES = 100, ENTER
Input – CH 1 AUTO RANGE (AUTO RANGE button must be pressed)
Input – CH 2 AUTO RANGE (AUTO RANGE button must be pressed)

12.6.27 Start a new measurement by pressing the Start button on the Signal Analyzer.

12.6.28 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 220 Hz of the SQUID and CAL signals and record the new data in Table 12.6.5 below.

Table 12.6.5					
Signal	220 Hz	440 Hz	660 Hz	880 Hz	1100 Hz
SQUID					
CAL					

12.6.29 Turn off the Trapped Flux and London Moment Cal Signals (SQUIDCAL set to 0000hex).

12.6.30 Change the DAS mode control bits so DAS1 gets SRE data.

12.7 **Deleted**
12.8 **Deleted**
12.9 **Deleted**
12.10 **Deleted**
12.11 **Removed**
12.12 **Removed**
12.13 **Removed**

12.14 **Deleted**

13.0 SRE Box Tests for SQUID Channel 3

13.1 Initial Set-Up and Demod Output

13.1.1 Send command DAS_4_CONTROL with parameter F800hex to enable the SRE 1/3 DAS multiplexers and disable the DAS electronics temperature control.

13.1.2 Send command DAS_5_CONTROL with parameter F800hex to enable the SRE 2/4 DAS multiplexers and disable the DAS electronics temperature control.

13.1.3 Ensure all Electronics Temperature Control Temperature Commands are zero by sending commands “SQ1_FLL_Etemp”, “SQ2_FLL_Etemp”, “SQ3_FLL_Etemp”, “SQ4_FLL_Etemp”, “DAS_4_Pri_Etemp”, “DAS_4_Sec_Etemp”, “DAS_5_Pri_Etemp”, “DAS_5_Sec_Etemp”, “SB6_Etemp_Setpoint”, “SB7_Etemp_Setpoint” with parameter 0000hex.

13.1.4 Set the FLL Range to 1, the SQUID Offset Mode to low, the DAS London Moment Post Gain to 1, preset the Reset Level to 10V, but disable the automatic reset, select the FLL for ETEMP Heat Monitoring, set the Preamp Gain to 1 and disable the Electronics Temperature control by sending command “SQ3_LEVELS” with a parameter of 9710hex.

13.1.5 Set the Bias to 0 by sending command “SQ3_BIAS” with a parameter of 0000hex.

13.1.6 Set the Offset to 0 by sending command “SQ3_OFFSET” with a parameter of 8000hex.

13.1.7 Unlock the FLL and clear the Reset Counters by sending command SQ3_CONTROL with a parameter of 0004hex (this will automatically clear to 0000hex, so the display will likely only display this final condition).

13.1.8 Connect the oscilloscope and the Digital Multimeter to the SQUID 3 DEMOD MON on the Dual SRE Test Box. Set both to read a 0±10 volt signal. Set the SQUID 3 test switch to TEST OFF.

13.1.9 Using the "SQ3_BIAS" command, increase the Bias to produce a positive DC level on the scope. The parameter range of this command is 0000hex to FFFFhex. Using the scope and the DC voltmeter, adjust the Bias to maximize the DC value.

13.1.10 Using the "SQ3_OFFSET" command, increase or decrease the Offset from 8000hex to maximize the positive DC voltage on the first peak away from 8000hex. The parameter range of this command is 0000hex to FFFFhex.

13.1.11 Readjust the Bias with the "SQ3_BIAS" command to further maximize the positive DC voltage. Record the Bias command readback from telemetry SQ_TmpBiasCmd_3 in Table 13.1.1 below.

13.1.12 Readjust the Offset with "SQ3_OFFSET" command to further maximize the positive DC voltage. Record the Offset command readback from telemetry SQ_TmpOfstCmd_3 and Demod DC voltage from the multimeter in Table 13.1.1 below.

13.1.13 Record the Bias, Offset, and Demod telemetry voltages called out in Table 13.1.1 below.

13.1.14 Move the multimeter to FLL OUT for SQUID 3.

13.1.15 Lock SQUID 3 by sending the command "enable SQUID Lock_FLL with SQUID_Unit SQUID_3". Record the FLL OUT voltage below.

FLL OUT SQUID 3 ________________________ V

13.1.16 Unlock SQUID 3 by sending the command "enable SQUID Lock_FLL with SQUID_Unit SQUID_3".

Table 13.1.1 Flux Lock Loop 3 Set Up				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
SQ_TmpBiasCmd_3	0000hex	FFFFhex		NA
SQ_OfstCmd_3	0000hex	FFFFhex		NA
Demod Voltage	+/-4.8 VDC	+/-10 VDC		
SQ_Bias_3	-10µADC	-70µADC		
SQ_Offset_3	-5.0 VDC	+5.0 VDC		
SQ_Demod_3	+/-4.8 VDC	+/-10 VDC		

13.2 **Removed from this procedure.**

13.3 **Range 1 Scale Factor**

13.3.1 Verify that the Digital Multimeter in the SRE Test Set Console is connected to the SQUID 3 FLL OUT on the SRE Test Set Console.

13.3.2 Set the Offset to 0 by sending command "SQ3_OFFSET" with a parameter of 8000hex.

13.3.3 Close the Flux Lock Loop (FLL) by sending command "SQ3_Lock_Enable".

13.3.4 This step must be completed along with steps 5 or 6 before typing "go" on the Sun Workstation. Increase or decrease the Offset from 8000hex as required to make the DC voltage at the FLL Output = 0±10 mV. This can be achieved by either increasing or decreasing the Offset. Record this value in Table 13.3.1 below as A1.

13.3.5 If increasing the Offset zeroed the FLL Output, set the Offset to A1-4000hex by decreasing the most significant nibble by 4.

13.3.6 If decreasing the Offset zeroed the FLL Output, set the Offset to A1+4000hex by increasing the most significant nibble by 4.

13.3.7 Open the Flux Lock Loop by sending command "SQ3_Lock_Disable".

13.3.8 Close the Flux Lock Loop (FLL) by sending command "SQ3_Lock_Enable".

13.3.9 Set the Offset back to value A1 using the "SQ3_OFFSET" command.

13.3.10 Measure the DC voltage at the SQUID 3 FLL Output using the Digital Multimeter. This is the Range 1 Scale Factor in volts/flux quanta. Record this value in Table 13.3.1 below.

Table 13.3.1		
Measurement	Measured Value	Pass/Fail
Offset A1 from step 4		NA
Range 1 Scale Factor		NA

13.4 FLL Output Noise above 5 Hz

13.4.1 Connect the SQUID 3 FLL OUT on the SRE Test Set Console to the Digital Multimeter and Channel 1 of the HP-35660A Signal analyzer.

13.4.2 Verify that the Bias is set to the value in Table 13.1.1. Use the SQ_TmpBiasCmd_3 telemetry to read the Bias and the "SQ3_BIAS" command to change it if necessary. Use the SQ_TmpLvlsCmd_3 telemetry to verify that the LEVELS register is set to 9710hex. This can be changed with the "SQ3_LEVELS" command.

13.4.3 Close the Flux Lock Loop (FLL) by sending command "SQ3_Lock_Enable".

13.4.4 Verify the Offset is set to the A1 value from Table 13.3.1 using the "SQ3_OFFSET" command and then adjust as required to reduce the FLL Output to 0±0.01 volts as read on the Digital Multimeter.

13.4.5 Set up the HP-35660A Signal Analyzer to measure the noise bandwidth with the following settings:

Inst Mode – FFT ANALYSIS
Meas Data – PWR SPEC CHANNEL 1
Input – CH 1 AC Coupled
Input – CH 1 AUTO RANGE
Span =1600Hz
Freq Resolution – 800
Avg – On, then NUMBER AVERAGES = 100ENTER
Scale – AUTOSCALE ON
Trace Coord Yunits – Vrms/rtHz

13.4.6 Start the measurement by pressing the Start button on the Signal Analyzer.

13.4.7 After the measurement stops, use the cursor to locate the flat midband section of the noise spectrum on the HP-35660A screen. Move the cursor slowly to position it vertically in the middle of the data.

13.4.8 Read the voltage from the top of the screen and record it in Table 13.4.1 below. This is the noise voltage in µVrms/√Hz.

13.4.9 Enter the Range 1 Scale Factor from Table 13.3.1 in Table 13.4.1 below.

13.4.10 Divide the voltage from step 8 by the Range 1 Scale Factor to calculate the noise in µphi0/√Hz. Record this result in Table 13.4.1. It should be < 7 $\mu\Phi_0$ /√Hz.

Table 13.4.1 SQUID 3 High Frequency Noise

Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Noise Voltage	NA	NA		NA
Range 1 Scale Factor	NA	NA		NA
Calibrated Noise	None	7 $\mu\Phi_0$/√Hz		

13.4.11 Open the Flux Lock Loop by sending command “SQ3_Lock_Disable”.

13.5 Deleted

13.6 Closed Loop Linearity

13.6.1 Open the Flux Lock Loop by sending command "SQ3_Lock_Disable".

13.6.2 Set the Preamp gain to 1 by sending command "SQ3_Loop_Gain" with a parameter of 1.

13.6.3 Set the Range to 1 by sending command "SQ3_Range" with a parameter of 0.

13.6.4 Set the Offset to 0 by sending command "SQ3_OFFSET" with a parameter of 8000hex.

13.6.5 Set up the Stanford Research Systems DS360 Ultra-Low Distortion Function Generator to produce a dual tone 100/0.10 Hz sine wave. Set the 100 Hz output amplitude to 1.54Vpp and the 0.1 Hz output amplitude to 0.054Vpp (this should produce a SQUID signal of 18Vp-p at 100 Hz and 0.6Vp-p at 0.1 Hz) (this set-up may be stored as #9 in the DS360). Connect the Function Generator output to the SQUID 3 TEST INPUT on the SRE Test Set Console and to the HP-35660A Signal Analyzer Channel 2 Input. Set the SQUID 3 test switch to TEST OFF.

13.6.6 Connect the SQUID 3 FLL OUT connector on the Test Connector Breakout Panel to the HP-35660A Signal Analyzer Channel 1.

13.6.7 Connect the oscilloscope to the SQUID 3 Fll OUT connector on the Test Connector Breakout panel using a BNC Tee if necessary.

13.6.8 Close the Flux Lock Loop (FLL) by sending command "SQ3_Lock_Enable".

13.6.9 Using the "SQ3_OFFSET" command as required to reduce the FLL signal to 0±0.01 volts on the oscilloscope.

13.6.10 Set the SQUID 3 test switch to TEST ON. It may be necessary to repeatedly Lock and Unlock (or turn the TEST switch OFF and ON) to get the signal centered on 0.0 V. Verify an 18.0±0.2 Vpp

100 Hz sine wave at the HF OUT as seen on the oscilloscope (the 0.1 Hz signal will cause the 100 Hz signal to move up and down on the oscilloscope screen if DC coupling is used).

13.6.11 Record the maximum values of the London Moment science signal from the oscilloscope and from the SQ_20HzSignal_3 display on the workstation as well as the gain setting in Table 13.6.1.

Table 13.6.1 – Low Frequency Post Gain				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Max LF output (oscilloscope)	10 Vpp	20 Vpp		
Max London Moment Science Signal	16384	32768		
Gain setting	3	5		

13.6.12 Using the FFT mode of the SSW, make a bridge file of twenty FFT's at 100 Hz, also take a continuous bridge file of the SQUID 3 signal for 10 minutes. Then change the DAS mode control bits so DAS2 gets SRE data and again using the FFT mode of the SSW, make another bridge file of twenty FFT's at 100 Hz, also take another continuous bridge file of the SQUID 3 signal for 10 minutes. Record the Sun System time when the bridge files are started.

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NOTE: Steps 13 to 18 may be performed while the workstation is executing step 12. Do not proceed to step 19 till all four bridge files in step 12 are completed.

13.6.13 While the FFT's and Bridge file is being acquired, set up the HP-35660A Signal Analyzer to measure the 100 mHz signal with the following settings:

Meas Mode – 2 Channel
Inst Mode – FFT ANALYSIS
Trace A Meas Data – PWR SPEC CHANNEL 1
Trace B Meas Data – PWR SPEC CHANNEL 2
Freq – FULL SPAN, then STOP = 1.5 Hz
Avg – On, then NUMBER AVERAGES = 7, ENTER
Avg – OVLD Reject
Input – CH 1 RANGE = 10.012 Vpk, DC Coupled
Input – CH 2 AUTO RANGE, DC Coupled (AUTO RANGE button must be pressed)
Scale – AUTOSCALE ON
Trace Coord – Mag dB
Y Units – Amplitude – Vrms
Y Units – Volts

13.6.14 Start the measurement by pressing the Start button on the Signal Analyzer.

13.6.15 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 0.1 Hz of both the SQUID and the Function Generator signals and record it in Table 13.6.2 below.

Table 13.6.2					
Signal	0.1 Hz	0.2 Hz	0.3 Hz	0.4 Hz	0.5 Hz
SQUID					
Func Gen					

13.6.16 Connect channel 1 on the HP-35660A analyzer to the SQUID 3 FLL OUT signal from the Test Connector Breakout Panel. Change the following settings on the HP-35660A analyzer to measure the 100 Hz signal (these settings assume the previous settings from step 13 above).

Input – CH 1 AUTO RANGE, AC Coupled (AUTO RANGE button must be pressed)
Input – CH 2 AUTO RANGE, AC Coupled (AUTO RANGE button must be pressed)
Freq – SPAN = 800 Hz, Resolution = 800
Avg – NUMBER AVERAGES = 100, ENTER

13.6.17 Start the measurement by pressing the Start button on the Signal Analyzer.

13.6.18 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 100 Hz of both the SQUID and the Function Generator signals and record it in Table 13.6.3 below.

Table 13.6.3					
Signal	100 Hz	200 Hz	300 Hz	400 Hz	500 Hz
SQUID					
Func Gen					

13.6.19 Set the SQUID 3 test switch to TEST OFF. Disconnect the Function Generator. If the signal at the SQUID 3 HF OUT connector on the SSCP is not at 0 ± 0.01 volts on the oscilloscope, use the "SQ3_OFFSET" command to adjust the Offset as required to achieve this indication.

13.6.20 Using the FFT mode of the SSW, make a bridge file of twenty FFT's at 100 Hz, also take a continuous bridge file of the SQUID 3 signal for 10 minutes. Then change the DAS mode control bits so DAS1 gets SRE data and again using the FFT mode of the SSW, make another bridge file of twenty FFT's at 100 Hz, also take another continuous bridge file of the SQ_20HzSignal_3 for 10 minutes. Record the Sun System time when the bridge file is started.

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NOTE: Steps 21 and 22 may be performed while the workstation is executing step 20. Do not proceed to step 23 till all four bridge files in step 20 are completed.

13.6.21 Start a new measurement by pressing the Start button on the Signal Analyzer.

13.6.22 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 100 Hz of the SQUID and record the new data in Table 13.6.4 below.

Table 13.6.4					
Signal	100 Hz	200 Hz	300 Hz	400 Hz	500 Hz
SQUID					

13.6.23 Turn on the Trapped Flux and London Moment CAL Signals at maximum amplitude for SQUID 3 with the London Moment frequency set to 0.016 Hz and the Trapped Flux frequency set to 220 Hz (SQUIDCAL set to 7708hex).

13.6.24 Connect channel 1 on the HP-35660A analyzer to the SQUID 3 LF OUT signal. Connect channel 2 of the HP35660A to the SQUID 3 CAL MON signal on the SQUID Test Console.

13.6.25 Using the FFT mode of the SSW, make a bridge file of twenty FFT's at 220 Hz, also take a continuous bridge file of the SQ_20HzSignal_3 for 10 minutes. Then change the DAS mode control bits so DAS2 gets SRE data and again using the FFT mode of the SSW, make another bridge file of twenty FFT's at 220 Hz, also take another continuous bridge file of the SQ_20HzSignal_3 for 10 minutes. Record the Sun System time when the bridge file is started.

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NOTE: Steps 26 to 28 may be performed while the workstation is executing step 25. Do not proceed to step 29 till all four bridge files in step 25 are completed.

13.6.26 While the FFT's and Bridge file are being acquired, change the following settings on the HP-35660A analyzer to measure the 220 Hz SQUID signal (these settings assume the same settings as in step 16 above).

Freq – SPAN = 1.6 KHz
Avg – On, then NUMBER AVERAGES = 100, ENTER
Input – CH 1 AUTO RANGE (AUTO RANGE button must be pressed)
Input – CH 2 AUTO RANGE (AUTO RANGE button must be pressed)

13.6.27 Start a new measurement by pressing the Start button on the Signal Analyzer.

13.6.28 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 220 Hz of the SQUID and CAL signals and record the new data in Table 13.6.5 below.

13.6.29 Turn off the Trapped Flux and London Moment Cal Signals (SQUIDCAL set to 0000hex).

Table 13.6.5					
Signal	220 Hz	440 Hz	660 Hz	880 Hz	1100 Hz
SQUID					
CAL					

13.6.30 Change the DAS mode control bits so DAS1 gets SRE data.

13.7 **Deleted**
13.8 **Deleted**
13.9 **Deleted**
13.10 **Deleted**
13.11 **Removed**
13.12 **Removed**
13.13 **Removed**
13.14 **Deleted**

14.0 SRE Box Tests for SQUID Channel 2

14.1 Initial Set-Up and Demod Output

14.1.1 Send command DAS_4_CONTROL with parameter F800hex to enable the SRE 1/3 DAS multiplexers and disable the DAS electronics temperature control.

14.1.2 Send command DAS_5_CONTROL with parameter F800hex to enable the SRE 2/4 DAS multiplexers and disable the DAS electronics temperature control.

14.1.3 Ensure all Electronics Temperature Control Temperature Commands are zero by sending commands “SQ1_FLL_Etemp”, “SQ2_FLL_Etemp”, “SQ3_FLL_Etemp”, “SQ4_FLL_Etemp”, “DAS_4_Pri_Etemp”, “DAS_4_Sec_Etemp”, “DAS_5_Pri_Etemp”, “DAS_5_Sec_Etemp”, “SB6_Etemp_Setpoint”, “SB7_Etemp_Setpoint” with parameter 0000hex.

14.1.4 Set the FLL Range to 1, the SQUID Offset Mode to low, the DAS London Moment Post Gain to 1, preset the Reset Level to 10V, but disable the automatic reset, select the FLL for ETEMP Heat Monitoring, set the Preamp Gain to 1 and disable the Electronics Temperature control by sending command “SQ2_LEVELS” with a parameter of 9710hex.

14.1.5 Set the Bias to 0 by sending command “SQ2_BIAS” with a parameter of 0000hex.

14.1.6 Set the Offset to 0 by sending command “SQ2_OFFSET” with a parameter of 8000hex.

14.1.7 Unlock the FLL and clear the Reset Counters by sending command SQ2_CONTROL with a parameter of 0004hex (this will automatically clear to 0000hex, so the display will likely only display this final condition).

14.1.8 Connect the oscilloscope and the Digital Multimeter to the SQUID 2 DEMOD MON on the Dual SRE Test Box. Set both to read a 0±10 volt signal. Set the SQUID 2 test switch to TEST OFF.

14.1.9 Using the "SQ2_BIAS" command, increase the Bias to produce a positive DC level on the scope. The parameter range of this command is 0000hex to FFFFhex. Using the scope and the DC voltmeter, adjust the Bias to maximize the DC value.

14.1.10 Using the "SQ2_OFFSET" command, increase or decrease the Offset from 8000hex to maximize the positive DC voltage on the first peak away from 8000hex. The parameter range of this command is 0000hex to FFFFhex.

14.1.11 Readjust the Bias with the "SQ2_BIAS" command to further maximize the positive DC voltage. Record the Bias command readback from telemetry SQ_TmpBiasCmd_2 in Table 14.1.1 below.

14.1.12 Readjust the Offset with "SQ2_OFFSET" command to further maximize the positive DC voltage. Record the Offset command readback from telemetry SQ_TmpOfstCmd_2 and Demod DC voltage from the multimeter in Table 14.1.1 below.

14.1.13 Record the Bias, Offset, and Demod telemetry voltages called out in Table 14.1.1 below.

14.1.14 Move the multimeter to FLL OUT for SQUID 2.

14.1.15 Lock SQUID 2 by sending the command "enable SQUID Lock_FLL with SQUID_Unit SQUID_2". Record the FLL OUT voltage below.

FLL OUT SQUID 2 _______________________ V

14.1.16 Unlock SQUID 2 by sending the command "disable SQUID Lock_FLL with SQUID_Unit SQUID_2".

Table 14.1.1 Flux Lock Loop 2 Set Up				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
SQ_TmpBiasCmd_2	0000hex	FFFFhex		
SQ_TmpOfstCmd_2	0000hex	FFFFhex		
Demod Voltage	+/-4.8 VDC	+/-10 VDC		
SQ_Bias_2	-10 µADC	-70 µADC		
SQ_Offset_2	-5.0 VDC	+5.0 VDC		
SQ_Demod_2	+/-4.8 VDC	+/-10 VDC		

14.2 **Removed from this procedure.**

14.3 **Range 1 Scale Factor**

14.3.1 Verify that the Digital Multimeter in the SRE Test Set Console is connected to the SQUID 2 FLL OUT on the SRE Test Set Console.

14.3.2 Set the Offset to 0 by sending command “SQ2_OFFSET” with a parameter of 8000hex.

14.3.3 Close the Flux Lock Loop (FLL) by sending command “SQ2_Lock_Enable”.

14.3.4 This step must be completed along with steps 5 or 6 before typing “go” on the Sun Workstation. Increase or decrease the Offset from 8000hex as required to make the DC voltage at the FLL Output = 0±10 mV. This can be achieved by either increasing or decreasing the Offset. Record this value in Table 14.3.1 below as A1.

14.3.5 If increasing the Offset zeroed the FLL Output, set the Offset to A1-4000hex by decreasing the most significant nibble by 4.

14.3.6 If decreasing the Offset zeroed the FLL Output, set the Offset to A1+4000hex by increasing the most significant nibble by 4.

14.3.7 Open the Flux Lock Loop by sending command “SQ2_Lock_Disable”.

14.3.8 Close the Flux Lock Loop (FLL) by sending command "SQ2_Lock_Enable".

14.3.9 Set the Offset back to value A1 using the "SQ2_OFFSET" command.

14.3.10 Measure the DC voltage at the SQUID 2 FLL Output using the Digital Multimeter. This is the Range 1 Scale Factor in volt/flux quanta. Record this value in Table 14.3.1 below.

Table 14.3.1		
Measurement	Measured Value	Pass/Fail
Offset A1 from step 4		NA
Range 1 Scale Factor		NA

14.4 **FLL Output Noise above 5 Hz**

14.4.1 Connect the SQUID 2 FLL OUT on the SRE Test Set Console to the Digital Multimeter and Channel 1 of the HP-35660A Signal Analyzer.

14.4.2 Verify that the Bias is set to the value in Table 14.1.1. Use the SQ_TmpBiasCmd_2 telemetry to read the Bias and the "SQ2_BIAS" command to change it if necessary. Use the SQ_TmpLvlsCmd_2 telemetry to verify that the LEVELS Register is set to 9710hex. This can be changed with the "SQ2_LEVELS" command.

14.4.3 Close the Flux Lock Loop (FLL) by sending command "SQ2_Lock_Enable".

14.4.4 Verify the Offset is set to the A1 value from Table 14.3.1 using the "SQ2_OFFSET" command and then adjust as required to reduce the FLL Output to 0±0.01 volts as read on the Digital Multimeter.

14.4.5 Set up the HP-35660A Signal Analyzer to measure the noise bandwidth with the following settings:

Inst Mode – FFT ANALYSIS
Meas Data – PWR SPEC CHANNEL 1
Input – CH 1 AC Coupled
Input – CH 1 AUTO RANGE
Span =1600 Hz
Freq Resolution – 800
Avg – On, then NUMBER AVERAGES = 100, ENTER
Scale – AUTOSCALE ON
Trace Coord Yunits – Vrms/rtHz

14.4.6 Start the measurement by pressing the Start button on the Signal Analyzer.

14.4.7 After the measurement stops, use the cursor to locate the flat midband section of the noise spectrum on the HP-35660A screen. Move the cursor slowly to position it vertically in the middle of the data.

14.4.8 Read the voltage from the top of the screen and record it in Table 14.4.1 below. This is the noise voltage in µVrms/√Hz.

14.4.9 Enter the Range 1 Scale Factor from Table 14.3.1 in Table 14.4.1 below.

14.4.10 Divide the voltage from step 8 by the Range 1 Scale Factor to calculate the noise in $\mu\Phi_0/\sqrt{Hz}$. Record this result in Table 14.4.1. It should be < 7 $\mu\Phi_0/\sqrt{Hz}$.

Table 14.4.1 SQUID 2 High Frequency Noise

Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Noise Voltage	NA	NA		NA
Range 1 Scale Factor	NA	NA		NA
Calibrated Noise	None	7 $\mu\Phi_0/\sqrt{Hz}$		

14.4.11 Open the Flux Lock Loop by sending command "SQ2_Lock_Disable".

14.5 **Deleted**

14.6 Closed Loop Linearity

14.6.1 Open the Flux Lock Loop by sending command "SQ2_Lock_Disable".

14.6.2 Set the Preamp gain to 1 by sending command "SQ2_Loop_Gain" with a parameter of 1.

14.6.3 Set the Range to 1 by sending command "SQ2_Range" with a parameter of 0.

14.6.4 Set the Offset to 0 by sending command "SQ2_OFFSET" with a parameter of 8000hex.

14.6.5 Set up the Stanford Research Systems DS360 Ultra-Low Distortion Function Generator to produce a dual tone 100/0.10 Hz sine wave. Set the 100 Hz output amplitude to 1.54Vpp and the 0.1 Hz output amplitude to 0.054Vpp (this should produce a SQUID signal of 18Vpp at 100 Hz and 0.6Vpp at 0.1 Hz) (this set-up may be stored as #9 in the DS360). Connect the Function Generator output to the SQUID 2 TEST INPUT on the SRE Test Set Console and to the HP-35660A Signal Analyzer Channel 2 Input. Set the SQUID 2 test switch to TEST OFF.

14.6.6 Connect the SQUID 2 FLL OUT connector on the Test Connector Breakout Panel to the HP-35660A Signal Analyzer Channel 1.

14.6.7 Connect the oscilloscope to the SQUID 2 FLL OUT connector on the Test Connector Breakout Panel using a BNC Tee if necessary.

14.6.8 Close the Flux Lock Loop (FLL) by sending command "SQ2_Lock_Enable".

14.6.9 Using the "SQ2_OFFSET" as required to reduce the FLL signal to 0±0.01 volts on the oscilloscope.

14.6.10 Set the SQUID 2 test switch to TEST ON. It may be necessary to repeatedly Lock and Unlock (or turn the TEST switch OFF and ON) to get the signal centered on 0.0 V. Verify an 18.0±0.2 Vpp 100 Hz sine wave at the HF OUT as seen on the oscilloscope (the 0.1 Hz signal will cause the 100 Hz signal to move up and down on the oscilloscope screen if DC coupling is used).

14.6.11 Record the maximum values of the London Moment science signal from the oscilloscope and from the SQ_20HzSignal_2 display on the workstation as well as the gain setting in Table 14.6.1.

Table 14.6.1 – Low Frequency Post Gain

Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Max LF output (oscilloscope)	10 Vpp	20 Vpp		
Max London Moment Science Signal	16384	32768		
Gain setting	3	5		N/A

14.6.12 Using the FFT mode of the SSW, make a bridge file of twenty FFT's at 100 Hz, also take a continuous bridge file of the SQUID 2 signal for 10 minutes. Then change the DAS mode control bits so DAS2 gets SRE data and again using the FFT mode of the SSW, make another bridge file of twenty FFT's at 100 Hz, also take another continuous bridge file of the SQUID 2 signal for 10 minutes. Record the Sun System time when the bridge files is started.

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NOTE: Steps 13 to 18 may be performed while the workstation is executing step 12. Do not proceed to step 19 till all four bridge files in step 12 are completed.

14.6.13 While the FFT's and Bridge file is being acquired, set up the HP-35660A Signal Analyzer to measure the 100 mHz signal with the following settings:

Meas Mode – 2 Channel
Inst Mode – FFT ANALYSIS
Trace A Meas Data – PWR SPEC CHANNEL 1
Trace B Meas Data – PWR SPEC CHANNEL 2
Freq – FULL SPAN, then STOP = 1.5 Hz
Avg – On, then NUMBER AVERAGES = 7, ENTER
Avg – OVLD Reject
Input – CH 1 RANGE = 10.012 Vpk, DC Coupled
Input – CH 2 AUTO RANGE, DC Coupled (AUTO RANGE button must be pressed)
Scale – AUTOSCALE ON
Trace Coord – Mag dB
Y Units – Amplitude – Vrms
Y Units – Volts

14.6.14 Start the measurement by pressing the Start button on the Signal Analyzer.

14.6.15 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 0.1 Hz of both the SQUID and the Function Generator signals and record it in Table 14.6.2 below.

Table 14.6.2					
Signal	0.1 Hz	0.2 Hz	0.3 Hz	0.4 Hz	0.5 Hz
SQUID					
Func Gen					

14.6.16 Connect channel 1 on the HP-35660A analyzer to the SQUID 2 FLL OUT signal from the Test Connector Breakout Panel. Change the following settings on the HP-35660A analyzer to measure the 100 Hz signal (these settings assume the previous settings from step 13 above).

Input – CH 1 AUTO RANGE, AC Coupled (AUTO RANGE button must be pressed)
Input – CH 2 AUTO RANGE, AC Coupled (AUTO RANGE button must be pressed)
Freq – SPAN = 800 Hz, Resolution = 800
Avg – NUMBER AVERAGES = 100, ENTER

14.6.17 Start the measurement by pressing the Start button on the Signal Analyzer.

14.6.18 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 100 Hz of both the SQUID and the Function Generator signals and record it in Table 14.6.3 below.

Table 14.6.3					
Signal	100 Hz	200 Hz	300 Hz	400 Hz	500 Hz
SQUID					
Func. Gen.					

14.6.19 Set the SQUID 2 test switch to TEST OFF. Disconnect the Function Generator. If the signal at the SQUID 2 HF OUT connector on the SSCP is not at 0 ± 0.01 volts on the oscilloscope, use the “SQ2_OFFSET” command to adjust the Offset as required to achieve this indication.

14.6.20 Using the FFT mode of the SSW, make a bridge file of twenty FFT's at 100 Hz, also take a continuous bridge file of the SQUID 2 signal for 10 minutes. Then change the DAS mode control bits so DAS1 gets SRE data and again using the FFT mode of the SSW, make another bridge file of twenty FFT's at 100 Hz, also take another continuous bridge file of the SQ_20HzSignal_2 for 10 minutes. Record the Sun System time when the bridge files is started.

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NOTE: Steps 21 and 22 may be performed while the workstation is executing step 20. Do not proceed to step 23 till all four bridge files in step 20 are completed.

14.6.21 Start a new measurement by pressing the Start button on the Signal Analyzer.

14.6.22 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 100 Hz of the SQUID and record the new data in Table 14.6.4 below.

Table 14.6.4					
Signal	100 Hz	200 Hz	300 Hz	400 Hz	500 Hz
SQUID					

14.6.23 Turn on the Trapped Flux and London Moment CAL Signals at maximum amplitude for SQUID 2 with the London Moment frequency set to 0.016 Hz and the Trapped Flux frequency set to 220 Hz (SQUIDCAL set to 007Fhex).

14.6.24 Connect channel 1 on the HP-35660A analyzer to the SQUID 2 LF OUT signal. Connect channel 2 of the HP35660A to the SQUID 2 CAL MON signal on the SQUID Test Console.

14.6.25 Using the FFT mode of the SSW, make a bridge file of twenty FFT's at 220 Hz, also take a continuous bridge file of the SQ_20HzSignal_2 for 10 minutes. Then change the DAS mode control bits so DAS2 gets SRE data and again using the FFT mode of the SSW, make another bridge file of twenty FFT's at 220 Hz, also take another continuous bridge file of the SQ_20HzSignal_2 for 10 minutes. Record the Sun System time when the bridge files is started.

NOTE: Steps 26 to 28 may be performed while the workstation is executing step 25. Do not proceed to step 29 till all four bridge files in step 25 are completed.

14.6.26 While the FFT's and Bridge file are being acquired, change the following settings on the HP-35660A analyzer to measure the 220 Hz SQUID signal (these settings assume the same settings as in step 16 above).

Freq – SPAN = 1.6 KHz
Avg – On, then NUMBER AVERAGES = 100, ENTER
Input – CH 1 AUTO RANGE (AUTO RANGE button must be pressed)
Input – CH 2 AUTO RANGE (AUTO RANGE button must be pressed)

14.6.27 Start a new measurement by pressing the Start button on the Signal Analyzer.

14.6.28 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 220 Hz of the SQUID and CAL signals and record the new data in Table 14.6.5 below.

Table 14.6.5					
Signal	220 Hz	440 Hz	660 Hz	880 Hz	1100 Hz
SQUID					
CAL					

14.6.29 Turn off the Trapped Flux and London Moment Cal Signals (SQUIDCAL set to 0000hex).

14.6.30 Change the DAS mode control bits so DAS1 gets SRE data.

14.7 **Deleted**
14.8 **Deleted**
14.9 **Deleted**
14.10 **Deleted**
14.11 **Removed**
14.12 **Removed**
14.13 **Removed**
14.14 **Deleted**

15.0 SRE Box Tests for SQUID Channel 4

15.1 Initial Set-Up and Demod Output

15.1.1 Send command DAS_4_CONTROL with parameter F800hex to enable the SRE 1/3 DAS multiplexers and disable the DAS electronics temperature control.

15.1.2 Send command DAS_5_CONTROL with parameter F800hex to enable the SRE 2/4 DAS multiplexers and disable the DAS electronics temperature control.

15.1.3 Ensure all Electronics Temperature Control Temperature Commands are zero by sending commands “SQ1_FLL_Etemp”, “SQ2_FLL_Etemp”, “SQ3_FLL_Etemp”, “SQ4_FLL_Etemp”, “DAS_4_Pri_Etemp”, “DAS_4_Sec_Etemp”, “DAS_5_Pri_Etemp”, “DAS_5_Sec_Etemp”, “SB6_Etemp_Setpoint”, “SB7_Etemp_Setpoint” with parameter 0000hex.

15.1.4 Set the FLL Range to 1, the SQUID Offset Mode to low, the DAS London Moment Post Gain to 1, preset the Reset Level to 10V, but disable the automatic reset, select the FLL for ETEMP Heat Monitoring, set the Preamp Gain to 1 and disable the Electronics Temperature control by sending command “SQ4_LEVELS” with a parameter of 9710hex.

15.1.5 Set the Bias to 0 by sending command “SQ4_BIAS” with a parameter of 0000hex.

15.1.6 Set the Offset to 0 by sending command “SQ4_OFFSET” with a parameter of 8000hex.

15.1.7 Unlock the FLL and clear the Reset Counters by sending command SQ4_CONTROL with a parameter of 0004hex (this will automatically clear to 0000hex, so the display will likely only display this final condition).

15.1.8 Connect the oscilloscope and the Digital Multimeter to the SQUID 4 DEMOD MON on the Dual SRE Test Box. Set both to read a 0±10 volt signal. Set the SQUID 4-test switch to TEST OFF.

15.1.9 Using the "SQ4_BIAS" command, increase the Bias to produce a positive DC level on the scope. The parameter range of this command is 0000hex to FFFFhex. Using the scope and the DC voltmeter, adjust the Bias to maximize the DC value.

15.1.10 Using the "SQ4_OFFSET" command, increase or decrease the Offset from 8000hex to maximize the positive DC voltage on the first peak away from 8000hex. The parameter range of this command is 0000hex to FFFFhex.

15.1.11 Readjust the Bias with the "SQ4_BIAS" command to further maximize the positive DC voltage. Record the Bias command readback from telemetry SQ_TmpBiasCmd_4 in Table 15.1.1 below.

15.1.12 Readjust the Offset with "SQ4_OFFSET" command to further maximize the positive DC voltage. Record the Offset command readback from telemetry SQ_TmpOfstCmd_4 and Demod DC voltage from the multimeter in Table 15.1.1 below.

15.1.13 Record the Bias, Offset, and Demod telemetry voltages called out in Table 15.1.1 below.

15.1.14 Move the multimeter to FLL OUT for SQUID 4.

15.1.15 Lock SQUID 4 by sending the command "enable SQUID Lock_FLL with SQUID_Unit SQUID_4". Record the FLL OUT voltage below.

FLL OUT SQUID 4 ________________________ V

15.1.16 Unlock SQUID 4 by sending the command "disable SQUID Lock_FLL with SQUID_Unit SQUID_4".

Table 15.1.1 Flux Lock Loop 4 Set Up				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
SQ_TmpBiasCmd_4	0000hex	FFFFhex		NA
SQ_OfstCmd_4	0000hex	FFFFhex		NA
Demod Voltage	+/-4.8 VDC	+/-10 VDC		
SQ_Bias_4	-10µADC	-70µADC		
SQ_Offset_4	-5.0 VDC	+5.0 VDC		
SQ_Demod_4	+/-4.8 VDC	+/-10 VDC		

15.2 **Removed**

15.3 **Range 1 Scale Factor**

15.3.1 Verify that the Digital Multimeter in the SRE Test Set Console is connected to the SQUID 4 FLL OUT on the SRE Test Set Console.

15.3.2 Set the Offset to 0 by sending command "SQ4_OFFSET" with a parameter of 8000hex.

15.3.3 Close the Flux Lock Loop (FLL) by sending command "SQ4_Lock_Enable".

15.3.4 This step must be completed along with steps 5 or 6 before typing "go" on the Sun Workstation. Increase or decrease the Offset from 8000hex as required to make the DC voltage at the FLL Output = 0±10 mV. This can be achieved by either increasing or decreasing the Offset. Record this value in Table 15.3.1 below as A1.

15.3.5 If increasing the Offset zeroed the FLL Output, set the Offset to A1-6000hex by decreasing the most significant nibble by 4.

15.3.6 If decreasing the Offset zeroed the FLL Output, set the Offset to A1+6000hex by increasing the most significant nibble by 4.

15.3.7 Open the Flux Lock Loop by sending command "SQ4_Lock_Disable".

15.3.8 Close the Flux Lock Loop (FLL) by sending command "SQ4_Lock_Enable".

15.3.9 Set the Offset back to value A1 using the "SQ4_OFFSET" command.

15.3.10 Measure the DC voltage at the SQUID 4 FLL Output using the Digital Multimeter. This is the Range 1 Scale Factor in volts/flux quanta. Record this value in Table 15.3.1 below.

Table 15.3.1		
Measurement	Measured Value	Pass/Fail
Offset A1 from step 4		NA
Range 1 Scale Factor		NA

15.4 **FLL Output Noise above 5 Hz**

15.4.1 Connect the SQUID 4 FLL OUT on the SRE Test Set Console to the Digital Multimeter and Channel 1 of the HP-35660A Signal Analyzer.

15.4.2 Verify that the Bias is set to the value in Table 15.1.1. Use the SQ_TmpBiasCmd_4 telemetry to read the Bias and the "SQ4_BIAS" command to change it if necessary. Use the SQ_TmpLvlsCmd_4 telemetry to verify that the LEVELS register is set to 9710hex. This can be changed with the "SQ4_LEVELS" command.

15.4.3 Close the Flux Lock Loop (FLL) by sending command "SQ4_Lock_Enable".

15.4.4 Verify the Offset is set to the A1 value from Table 15.3.1 using the "SQ4_OFFSET" command and then adjust as required to reduce the FLL Output to 0±0.01 volts as read on the Digital Multimeter.

15.4.5 Set up the HP-35660A Signal Analyzer to measure the noise bandwidth with the following settings:

Inst Mode – FFT ANALYSIS
Meas Data – PWR SPEC CHANNEL 1
Input – CH 1 AC Coupled
Input – CH 1 AUTO RANGE
Freq – FULL SPAN, then STOP=1600Hz
Freq Resolution – 800
Avg – On, then NUMBER AVERAGES = 100ENTER
Scale – AUTOSCALE ON
Trace Coord Yunits – Vrms/rtHz

15.4.6 Start the measurement by pressing the Start button on the Signal Analyzer.

15.4.7 After the measurement stops, use the cursor to locate the flat midband section of the noise spectrum on the HP-35660A screen. Move the cursor slowly to position it vertically in the middle of the data.

15.4.8 Read the voltage from the top of the screen and record it in Table 15.4.1 below. This is the noise voltage in µVrms/√Hz.

15.4.9 Enter the Range 1 Scale Factor from Table 15.3.1 in Table 15.4.1 below.

15.4.10 Divide the voltage from step 8 by the Range 1 Scale Factor to calculate the noise in µphi0/√Hz. Record this result in Table 15.4.1. It should be < 7 $\mu\Phi_0$ /√Hz.

Table 15.4.1 SQUID 4 High Frequency Noise				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Noise Voltage	NA	NA		NA
Range 1 Scale Factor	NA	NA		NA
Calibrated Noise	None	7 $\mu\Phi_0$/√Hz		

15.4.11 Open the Flux Lock Loop by sending command "SQ4_Lock_Disable".

15.5 Deleted

15.6 Closed Loop Linearity

15.6.1 Open the Flux Lock Loop by sending command "SQ4_Lock_Disable".

15.6.2 Set the Preamp gain to 1 by sending command "SQ4_Loop_Gain" with a parameter of 1.

15.6.3 Set the Range to 1 by sending command “SQ4_Range” with a parameter of 0.

15.6.4 Set the Offset to 0 by sending command “SQ4_OFFSET” with a parameter of 8000hex.

15.6.5 Set up the Stanford Research Systems DS360 Ultra-Low Distortion Function Generator to produce a dual tone 100/0.10 Hz sine wave. Set the 100 Hz output amplitude to 1.54Vpp and the 0.1 Hz output amplitude to 0.054Vpp (this should produce a SQUID signal of 18Vp-p at 100 Hz and 0.6Vp-p at 0.1 Hz) (this set-up may be stored as #9 in the DS360). Connect the Function Generator output to the SQUID 4 TEST INPUT on the SRE Test Set Console and to the HP-35660A Signal Analyzer Channel 2 Input. Set the SQUID 4 test switch to TEST OFF.

15.6.6 Connect the SQUID 4 FLL OUT connector on the Test Connector Breakout Panel to the HP-35660A Signal Analyzer Channel 1 Input.

15.6.7 7. Connect the oscilloscope to the SQUID 4 FLL OUT connector on the Test Connector Breakout Panel using a BNC Tee if necessary.

15.6.8 Close the Flux Lock Loop (FLL) by sending command “SQ4_Lock_Enable”.

15.6.9 Using the “SQ4_OFFSET” command as required to reduce the FLL signal to 0±0.01 volts on the oscilloscope.

15.6.10 Set the SQUID 4 test switch to TEST ON. It may be necessary to repeatedly Lock and Unlock (or turn the TEST switch OFF and ON) to get the signal centered on 0.0 V. Verify an 18.0±0.2 Vpp 100 Hz sine wave at the HF OUT as seen on the oscilloscope (the 0.1 Hz signal will cause the 100 Hz signal to move up and down on the oscilloscope screen if DC coupling is used).

15.6.11 Record the maximum values of the London Moment science signal from the oscilloscope and from the SQ_20HzSignal_4 display on the workstation as well as the gain setting in Table 15.6.1.

Table 15.6.1 – Low Frequency Post Gain				
Measurement	Lower Limit	Upper Limit	Measured Value	Pass/ Fail
Max LF output (oscilloscope)	10 Vpp	20 Vpp		
Max London Moment Science Signal	16384	32768		
Gain setting	3	5		

15.6.12 Using the FFT mode of the SSW, make a bridge file of twenty FFT's at 100 Hz, also take a continuous bridge file of the SQUID 4 signal for 10 minutes. Then change the DAS mode control bits so DAS2 gets SRE data and again using the FFT mode of the SSW, make another bridge file of twenty FFT's at 100 Hz, also take another continuous bridge file of the SQUID 4 signal for 10 minutes. Record the Sun System time when the bridge files are started.

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NOTE: Steps 13 to 18 may be performed while the workstation is executing step 12. Do not proceed to step 19 till all four bridge files in step 12 are completed.

15.6.13 While the FFT's and Bridge file is being acquired, set up the HP-35660A Signal Analyzer to measure the 100 mHz signal with the following settings:

Meas Mode – 2 Channel
Inst Mode – FFT ANALYSIS
Trace A Meas Data – PWR SPEC CHANNEL 1
Trace B Meas Data – PWR SPEC CHANNEL 2
Freq – FULL SPAN, then STOP = 1.5 Hz
Avg – On, then NUMBER AVERAGES = 7, ENTER
Avg – OVLD Reject
Input – CH 1 RANGE = 10.012 Vpk, DC Coupled
Input – CH 2 AUTO RANGE, DC Coupled (AUTO RANGE button must be pressed)
Scale – AUTOSCALE ON
Trace Coord – Mag dB
Y Units – Amplitude – Vrms
Y Units – Volts

15.6.14 Start the measurement by pressing the Start button on the Signal Analyzer.

15.6.15 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 0.1 Hz of both the SQUID and the Function Generator signals and record it in Table 15.6.2 below.

Table 15.6.2					
Signal	0.1 Hz	0.2 Hz	0.3 Hz	0.4 Hz	0.5 Hz
SQUID					
Func Gen					

15.6.16 Connect channel 1 on the HP-35660A analyzer to the SQUID 4 FLL OUT signal from the Test Connector Breakout Panel. Change the following settings on the HP-35660A analyzer to measure the 100 Hz signal (these settings assume the previous settings from step 13 above).

Input – CH 1 AUTO RANGE, AC Coupled (AUTO RANGE button must be pressed)
Input – CH 2 AUTO RANGE, AC Coupled (AUTO RANGE button must be pressed)
Freq – SPAN = 800 Hz, Resolution = 800
Avg – NUMBER AVERAGES = 100, ENTER

15.6.17 Start the measurement by pressing the Start button on the Signal Analyzer.

15.6.18 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 100 Hz of both the SQUID and the Function Generator signals and record it in Table 15.6.3 below.

Table 15.6.3					
Signal	100 Hz	200 Hz	300 Hz	400 Hz	500 Hz
SQUID					
Func Gen					

15.6.19 Set the SQUID 4 test switch to TEST OFF. Disconnect the Function Generator. If the signal at the SQUID 4 HF OUT connector on the SSCP is not at 0 ± 0.01 volts on the oscilloscope, use the "SQ4_OFFSET" command to adjust the Offset as required to achieve this indication.

15.6.20 Using the FFT mode of the SSW, make a bridge file of twenty FFT's at 100 Hz, also take a continuous bridge file of the SQUID 4 signal for 10 minutes. Then change the DAS mode control bits so DAS1 gets SRE data and again using the FFT mode of the SSW, make another bridge file of twenty FFT's at 100 Hz, also take another continuous bridge file of the SQ_20HzSignal_4 for 10 minutes. Record the Sun System time when the bridge file is started.

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NOTE: Steps 21 and 22 may be performed while the workstation is executing step 20. Do not proceed to step 23 till all four bridge files in step 20 are completed.

15.6.21 Start a new measurement by pressing the Start button on the Signal Analyzer.

15.6.22 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 100 Hz of the SQUID and record the new data in Table 15.6.4 below.

Table 15.6.4					
Signal	100 Hz	200 Hz	300 Hz	400 Hz	500 Hz
SQUID					

15.6.23 Turn on the Trapped Flux and London Moment CAL Signals at maximum amplitude for SQUID 4 with the London Moment frequency set to 0.016 Hz and the Trapped Flux frequency set to 220 Hz (SQUIDCAL set to 7708hex).

15.6.24 Connect channel 1 on the HP-35660A analyzer to the SQUID 4 LF OUT signal. Connect channel 2 of the HP35660A to the SQUID 4 CAL MON signal on the SQUID Test Console.

15.6.25 Using the FFT mode of the SSW, make a bridge file of twenty FFT's at 220 Hz, also take a continuous bridge file of the SQ_20HzSignal_4 for 10 minutes. Then change the DAS mode control bits so DAS2 gets SRE data and again using the FFT mode of the SSW, make another bridge file of twenty FFT's at 220 Hz, also take another continuous bridge file of the SQ_20HzSignal_4 for 10 minutes. Record the Sun System time when the bridge file is started.

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NOTE: Steps 26 to 28 may be performed while the workstation is executing step 25. Do not proceed to step 29 till all four bridge files in step 25 are completed.

15.6.26 While the FFT's and Bridge file are being acquired, change the following settings on the HP-35660A analyzer to measure the 220 Hz SQUID signal (these settings assume the same settings as in step 16 above).

Freq – SPAN = 1.6 KHz
Avg – On, then NUMBER AVERAGES = 100, ENTER
Input – CH 1 AUTO RANGE (AUTO RANGE button must be pressed)
Input – CH 2 AUTO RANGE (AUTO RANGE button must be pressed)

15.6.27 Start a new measurement by pressing the Start button on the Signal Analyzer.

15.6.28 When the measurement is finished, use the analyzer to take the amplitudes of the 5 harmonics of 220 Hz of the SQUID and CAL signals and record the new data in Table 15.6.5 below.

Table 15.6.5					
Signal	220 Hz	440 Hz	660 Hz	880 Hz	1100 Hz
SQUID					
CAL					

15.6.29 Turn off the Trapped Flux and London Moment Cal Signals (SQUIDCAL set to 0000hex).

15.6.30 Change the DAS mode control bits so DAS1 gets SRE data.

15.7 **Deleted**
15.8 **Deleted**
15.9 **Deleted**
15.10 **Deleted**
15.11 **Removed from this procedure.**
15.12 **Removed from this procedure.**
15.13 **Removed from this procedure.**
15.14 **Deleted**

16.0 SQUID BRACKET ID AND BIAS TEMP-CO

16.1.1 Verify that the BTC's are in Coarse Mode with sensor excitation on at the normal frequency and that the Bracket Demod Phase is correct per section 10.12 (Bkt Control Register = xx03hex, where xx=demod phase). Then, using the SQUID bracket sensor setpoint command, adjust the sensor setpoints so that all four sensor signals read 7.5 +/- 0.2 V. Record the final setpoint values and the final sensor signal values in Table 16.0 below. Note the default temperature setpoints for 2.7 K with sensor signals of 7.5 V are about 7E39 hex.

16.1.2 Activate the BTC algorithm in coarse mode with control off.

16.1.3 The base temperature of the SQUID brackets should be 2.7 +/- 1.0 K. Call up the SQUID Bracket Thermal Display and verify that the temperatures are within the acceptable range. If they are not, have the ECU test set operator control the SIA temperature to 2.7 +/- 1.0 K. Then perform steps 16.1.1 and 16.1.2 again

16.1.4 Complete Table 16.0 below once the temperatures are in range.

Table 16.0

Mnemonic	location	value	range	in range (4)
SQ_Bkt1Sensor1A (V)	bracket 1 sensor 1		7.3 – 7.7	
SQ_CmpBTC1_Sr1A (K)			2.6 – 2.8	
SQ_Bkt1Sr1SPCdA (counts)			N/A	N/A
SQ_Bkt1Sensor2B (V)	bracket 1 sensor 2		7.3 – 7.7	
SQ_CmpBTC1_Sr2B (K)			2.6 – 2.8	
SQ_Bkt1Sr2SPCdB (counts)			N/A	N/A
SQ_Bkt2Sensor1B (V)	bracket 2 sensor 1		7.3 – 7.7	
SQ_CmpBTC2_Sr1B (K)			2.6 – 2.8	
SQ_Bkt2Sr1SPCdB (counts)			N/A	N/A
SQ_Bkt2Sensor2A (V)	bracket 2 sensor 2		7.3 – 7.7	
SQ_CmpBTC2_Sr2A (K)			2.6 – 2.8	
SQ_Bkt2Sr2SPCdA (counts)			N/A	N/A

16.1.5 All four SQUIDS should be on and flux locked. If they are not, the appropriate portions of sections 12, 13, 14 and 15 of this procedure should be repeated.

16.1.6 Using the Strawberry Tree Data Acquisition System, have a qualified Analog Data Acquisition System Operator begin analog data acquisition of all four SQUID outputs and record the parameters in table 16.1 below. This analog data acquisition may be started and stopped at the discretion of the test director throughout the running of section 16.0. Table 16.1 should be used as a log of the analog data acquisition activities. The qualified operators of the Analog Data Acquisition System are Bruce Clarke, Barry Muhlfelder and Jim Lockhart or their designates.

Table 16.1

filename	sampling rate (Hz)	post gain / range (SRE)	GSE LP filter cutoff (Hz)	GSE LP filter gain (dB)	Comments (start date/time, stop date/time, etc.)

16.2 STEP A – Measure Ambient Temperature with SRE

16.2.1 If it is not already active, call up SQUID bracket thermal display page.

16.2.2 In table 16.3, record 5 readings ~1 minute apart of each of the 4 SQUID bracket temperature sensors. Record the sensor setpoint (from Table 16.0) and both the raw data (V) and the calculated temperature (K) with the error on the calculated temperature (K).

Table 16.2

Mnemonic	location	setpoint	1min	2 min	3 min	4 min	5 min
SQ_Bkt1Sensor1A (V)	bracket 1						
SQ_CmpBTC1_Sr1A (K)	sensor 1						
SQ_CmpBTC1S1ErA (K)							
SQ_Bkt1Sensor2B (V)	bracket 1						
SQ_CmpBTC1_Sr2B (K)	sensor 2						
SQ_CmpBTC1S2ErB (K)							
SQ_Bkt2Sensor1B (V)	bracket 2						
SQ_CmpBTC2_Sr1B (K)	sensor 1						
SQ_CmpBTC2S1ErB (K)							
SQ_Bkt2Sensor2A (V)	bracket 2						
SQ_CmpBTC2_Sr2A (K)	sensor 2						
SQ_CmpBTC2S2ErA (K)							

16.3 STEP B – Inject Step Function to Auxiliary Heaters and Collect Bridge Files

16.3.1 Start a bridge file of the SQUID bracket raw sensor monitors, sensor setpoints, bracket temperature monitors, heater monitors and calculated heater power. Set the sampling rate to 1 Hz. Record the bridge file name and the time started.

Bracket 1, heater 1

Bridge file: ________________________________

Date/Time: ________________________________

16.3.2 Update Table 16.3 below. Wait 10 minutes.

16.3.3 Update Table 16.3 below. Command 200 uA on bracket 1, heater 1 by sending SQ_Bkt1Htr1CmdA with argument 0300hex. Update Table 16.3 below.

16.3.4 Wait 20 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.5 Update Table 16.3 below. Command 400 uA on bracket 1, heater 1 by sending SQ_Bkt1Htr1CmdA with argument 0600hex. Update Table 16.3 below.

16.3.6 Wait 20 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.7 Update Table 16.3 below. Command 200 uA on bracket 1, heater 1 by sending SQ_Bkt1Htr1CmdA with argument 0300hex. Update Table 16.3 below.

16.3.8 Wait 20 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.9 Update Table 16.3 below. Command zero uA on bracket 1, heater 1 by sending SQ_Bkt1Htr1CmdA with argument 0000hex. Update Table 16.3 below.

16.3.10 Wait 30 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.11 Update Table 16.3 below. Stop the bridge files.

TABLE 16.3										
time										
RAW SENSOR DATA										
SQ_Bkt1Sensor1A										
SQ_Bkt1Sensor2B										
SQ_Bkt2Sensor1B										
SQ_Bkt2Sensor2A										
TEMP IN KELVIN										
SQ_CmpBTC1_Sr1A										
SQ_CmpBTC1_Sr2B										

SQ_CmpBTC2_Sr1B										
SQ_CmpBTC2_Sr2A										
HEATER COMMAND										
SQ_Bkt1Htr1CmdA										

16.3.12 Start a bridge file for the SQUID bracket raw sensor monitors, bracket temperature monitors, heater monitors and calculated heater power. Set the sampling rate to 1 Hz. Record the bridge file name and the time started.

Bracket 1, heater 2

Bridge file: ________________________________

Date/Time: ________________________________

16.3.13 Update Table 16.4 below. Wait 10 minutes.

16.3.14 Update Table 16.4 below. Command 200 uA on bracket 1, heater 2 by sending SQ_Bkt1Htr2CmdB with argument 0300hex. Update Table 16.4 below.

16.3.15 Wait 20 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.16 Update Table 16.4 below. Command 400 uA on bracket 1, heater 2 by sending SQ_Bkt1Htr2CmdB with argument 0600hex. Update Table 16.4 below.

16.3.17 Wait 20 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.18 Update Table 16.4 below. Command 200 uA on bracket 1, heater 2 by sending SQ_Bkt1Htr2CmdB with argument 0300hex. Update Table 16.4 below.

16.3.19 Wait 20 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.20 Update Table 16.4 below. Command zero uA on bracket 1, heater 2 by sending SQ_Bkt1Htr2CmdB with argument 0000hex. Update Table 16.4 below.

16.3.21 Wait 30 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.22 Update Table 16.4 below. Stop the bridge files.

TABLE 16.4										
time										
RAW SENSOR DATA										
SQ_Bkt1Sensor1A										
SQ_Bkt1Sensor2B										
SQ_Bkt2Sensor1B										
SQ_Bkt2Sensor2A										
TEMP IN KELVIN										
SQ_CmpBTC1_Sr1A										
SQ_CmpBTC1_Sr2B										
SQ_CmpBTC2_Sr1B										
SQ_CmpBTC2_Sr2A										
HEATER COMMAND										
SQ_Bkt1Htr2CmdB										

16.3.23 Start a bridge file for the SQUID bracket raw sensor monitors, bracket temperature monitors, heater monitors and calculated heater power. Set the sampling rate to 1 Hz. Record the bridge file name and the time started.

Bracket 2, heater 1

Bridge file: ______________________________

Date/Time: ______________________________

16.3.24 Update Table 16.5 below. Wait 10 minutes.

16.3.25 Update Table 16.5 below. Command 200 uA on bracket 2, heater 1 by sending SQ_Bkt2Htr1CmdB with argument 0300hex. Update Table 16.5 below.

16.3.26 Wait 20 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.27 Update Table 16.5 below. Command 400 uA on bracket 2, heater 1 by sending SQ_Bkt2Htr1CmdB with argument 0600hex. Update Table 16.5 below.

16.3.28 Wait 20 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.29 Update Table 16.5 below. Command 200 uA on bracket 2, heater 1 by sending SQ_Bkt2Htr1CmdB with argument 0300hex. Update Table 16.5 below.

16.3.30 Wait 20 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.31 Update Table 16.5 below. Command zero uA on bracket 2, heater 1 by sending SQ_Bkt2Htr1CmdB with argument 0000hex. Update Table 16.5 below.

16.3.32 Wait 30 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to

<10 mK over 2 minutes is desired.

16.3.33 Update Table 16.5 below. Stop the bridge files.

TABLE 16.5										
time										
RAW SENSOR DATA										
SQ_Bkt1Sensor1A										
SQ_Bkt1Sensor2B										
SQ_Bkt2Sensor1B										
SQ_Bkt2Sensor2A										
TEMP IN KELVIN										
SQ_CmpBTC1_Sr1A										
SQ_CmpBTC1_Sr2B										
SQ_CmpBTC2_Sr1B										
SQ_CmpBTC2_Sr2A										
HEATER COMMAND										
SQ_Bkt2Htr1CmdB										

16.3.34 Start a bridge file for the SQUID bracket raw sensor monitors, bracket temperature monitors, heater monitors and calculated heater power. Set the sampling rate to 1 Hz. Record the bridge file name and the time started.

Bracket 2, heater 2

Bridge file: ________________________________

Date/Time: ________________________________

16.3.35 Update Table 16.6 below. Wait 10 minutes.

16.3.36 Update Table 16.6 below. Command 200 uA on bracket 2, heater 2 by sending SQ_Bkt2Htr2CmdA with argument 0300hex. Update Table 16.6 below.

16.3.37 Wait 20 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.38 Update Table 16.6 below. Command 400 uA on bracket 2, heater 2 by sending SQ_Bkt2Htr2CmdA with argument 0600hex. Update Table 16.6 below.

16.3.39 Wait 20 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.40 Update Table 16.6 below. Command 200 uA on bracket 2, heater 2 by sending SQ_Bkt2Htr2CmdA with argument 0300hex. Update Table 16.6 below.

16.3.41 Wait 20 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.42 Update Table 16.6 below. Command zero uA on bracket 2, heater 2 by sending SQ_Bkt2Htr2CmdA with argument 0000hex. Update Table 16.6 below.

16.3.43 Wait 30 minutes or until the Test Director has determined the bracket temperatures are stable enough to move on. A stability to <10 mK over 2 minutes is desired.

16.3.44 Update Table 16.6 below. Stop the bridge files.

TABLE 16.6										
time										
RAW SENSOR DATA										
SQ_Bkt1Sensor1A										
SQ_Bkt1Sensor2B										
SQ_Bkt2Sensor1B										
SQ_Bkt2Sensor2A										
TEMP IN KELVIN										
SQ_CmpBTC1_Sr1A										
SQ_CmpBTC1_Sr2B										
SQ_CmpBTC2_Sr1B										
SQ_CmpBTC2_Sr2A										
HEATER COMMAND										
SQ_Bkt2Htr2CmdA										

16.4 STEP C – SQUID Bracket Temperature Control Performance

16.4.1 Confirm that the quartz block fingers are being controlled to 2.65 +/- 0.25 K. Temperature data on the quartz block must be collected by the Probe Data Acquisition System (DAS) at least every 5 minutes.

16.4.2 Record the Probe DAS filename: ________________________

16.4.3 Start CSTOL "plv_bkt.prc".

16.4.4 In order to facilitate an emergency shutdown of the temperature controller and the bracket heaters in the event of overheating, prepare the command "goto off" in the CSTOL window but do not issue it. The operator may issue this command at any time during the performance of section 16.4 if a hazardous condition is thought to exist. This command effectively skips directly to step 16.4.78 in this procedure.

16.4.5 Initialize BTC algorithm for Fwd SRE A by sending the following command:

```
Set SQUID BktControl &
   with SRE_Unit Fwd_SRE_A &
   , Bkt_Snr_Drv_Ctrl Enable &
   , BktEtempCtrl_Dsb Yes_Dsbl_1 &
   , BktSr1LoGainCtrl Hi_Gain_Mode &
   , BktSr2LoGainCtrl Hi_Gain_Mode &
   , BktSrHtrDrvAltFq Hz_30_120 &
   , Bkt_QuadDetMCtrl Normal_Mode &
   , Bkt_Demod_Phase x#00
```

16.4.5 Initialize BTC algorithm for Fwd SRE B by sending the following command:

```
Set SQUID BktControl &
   with SRE_Unit Fwd_SRE_B &
   , Bkt_Snr_Drv_Ctrl Enable &
   , BktEtempCtrl_Dsb Yes_Dsbl_1 &
   , BktSr1LoGainCtrl Hi_Gain_Mode &
   , BktSr2LoGainCtrl Hi_Gain_Mode &
   , BktSrHtrDrvAltFq Hz_30_120 &
   , Bkt_QuadDetMCtrl Normal_Mode &
```

, Bkt_Demod_Phase x#00

16.4.6 Enter the sensor setpoints for 2.7 K as follows:

sensor1/bracket1 setpoint count = 32004 (7D04 hex)
sensor2/bracket1 setpoint count = 34804 (87F4 hex)
sensor1/bracket2 setpoint count = 32373 (7E75 hex)
sensor2/bracket2 setpoint count = 32460 (7ECC hex)

16.4.7 Upload database values for CASE 1 (B1, H1, S1 / B2, H1, S1 where B# = Bracket #, H# = Heater #, S# = Sensor #).

16.4.8 Start a bridge file on the following monitors:
sq_low_freq_br
btc_cmp_snsr_br
btc_snsr_br
btc_htr_br

Bridge filename: ________________________________

16.4.9 Turn on Bracket Temperature Controller in mode 1.

16.4.10 Switch Bracket Temperature Controller mode to 'monitor'. Record sensor temperatures as displayed on the CSTOL display window.

bracket1/sensor 1 ____________________ K

bracket 2/sensor 2 ____________________ K

bracket 2/sensor 1 ____________________K

bracket 1/sensor 2 ____________________ K

16.4.11 Switch Bracket Temperature Controller off.

16.4.12 Upload database values for closed loop heating in CASE 1.

16.4.13 Turn on mode 2.

16.4.14 Switch Bracket Temperature Controller on.

16.4.15 Monitor bracket temperatures for 20 minutes.

16.4.16 Record sensor temperatures as displayed on the CSTOL display window.

bracket1/sensor 1 ___________________ K

bracket 2/sensor 2 ___________________ K

bracket 2/sensor 1 ___________________K

bracket 1/sensor 2 ___________________ K

16.4.17 Switch Bracket Temperature Controller off.

16.4.18 Upload database values for cooling in mode 1.

16.4.19 Turn on mode 1 and switch Bracket Temperature Controller to ‘monitor’.

16.4.20 Monitor bracket temperatures for 30 minutes or until all bracket temperatures are stable to 0.020 K over 10 minutes.

16.4.21 Record sensor temperatures as displayed on the CSTOL display window.

bracket1/sensor 1 ___________________ K

bracket 2/sensor 2 ___________________ K

bracket 2/sensor 1 ___________________K

bracket 1/sensor 2 ___________________ K

16.4.22 Stop bridge file.

16.4.23 Upload database values for closed loop heating in CASE 2 (B1, H2, S2 / B2, H2, S2).

16.4.24 Start a bridge file on the following monitors:
sq_low_freq_br
btc_cmp_snsr_br

btc_snsr_br
btc_htr_br

Bridge filename: ______________________________

16.4.25 Switch Bracket Temperature Controller off.

16.4.26 Turn on mode 2.

16.4.27 Switch Bracket Temperature Controller on.

16.4.28 Monitor bracket temperatures for 40 minutes.

16.4.29 Record sensor temperatures as displayed on the CSTOL display window.

bracket1/sensor 1 ___________________ K

bracket 2/sensor 2 ___________________ K

bracket 2/sensor 1 ___________________K

bracket 1/sensor 2 ___________________ K

16.4.30 Switch Bracket Temperature Controller off.

16.4.31 Upload database values for cooling in mode 1.

16.4.32 Turn on mode 1 and switch Bracket Temperature Controller to ‘monitor’.

16.4.33 Monitor bracket temperatures for 30 minutes or until all bracket temperatures are stable to 0.020 K over 10 minutes.

16.4.34 Record sensor temperatures as displayed on the CSTOL display window.

bracket1/sensor 1 ___________________ K

bracket 2/sensor 2 ___________________ K bracket 2/sensor 1 ____________________K

bracket 1/sensor 2 ____________________ K

16.4.35 Stop bridge file.

16.4.36 Upload database values for closed loop heating in CASE 3 (B1, H1, S1 / B2, H2, S2 with no anti-aliasing filtering).

16.4.37 Start a bridge file on the following monitors:
sq_low_freq_br
btc_cmp_snsr_br
btc_snsr_br
btc_htr_br

Bridge filename: ________________________________

16.4.38 Switch Bracket Temperature Controller off.

16.4.39 Turn on mode 2.

16.4.40 Switch Bracket Temperature Controller on.

16.4.41 Monitor bracket temperatures for 40 minutes.

16.4.42 Record sensor temperatures as displayed on the CSTOL display window.

bracket1/sensor 1 ____________________ K

bracket 2/sensor 2 ____________________ K

bracket 2/sensor 1 ____________________K

bracket 1/sensor 2 ____________________ K

16.4.43 Switch Bracket Temperature Controller off.

16.4.44 Upload database values for cooling in mode 1.

16.4.45 Turn on mode 1 and switch Bracket Temperature Controller to 'monitor'.

16.4.46 Monitor bracket temperatures for 30 minutes or until all bracket temperatures are stable to 0.020 K over 10 minutes.

16.4.47 Record sensor temperatures as displayed on the CSTOL display window.

bracket1/sensor 1 ___________________ K

bracket 2/sensor 2 ___________________ K

bracket 2/sensor 1 ___________________K

bracket 1/sensor 2 ___________________ K

16.4.48 Stop bridge file.

16.4.49 Upload database values for closed loop heating in CASE 4 (B1, H2, S2 / B2, H1, S1 with IIR anti-aliasing filtering).

16.4.50 Start a bridge file on the following monitors:
sq_low_freq_br
btc_cmp_snsr_br
btc_snsr_br
btc_htr_br

Bridge filename: ______________________________

16.4.51 Switch Bracket Temperature Controller off.

16.4.52 Turn on mode 2.

16.4.53 Switch Bracket Temperature Controller on.

16.4.54 Monitor bracket temperatures for 40 minutes.

16.4.55 Record sensor temperatures as displayed on the CSTOL display window.

bracket1/sensor 1 ___________________ K

bracket 2/sensor 2 ___________________ K

bracket 2/sensor 1 ___________________K

bracket 1/sensor 2 ___________________ K

16.4.56 Switch Bracket Temperature Controller off.

16.4.57 Upload database values for cooling in mode 1.

16.4.58 Turn on mode 1 and switch Bracket Temperature Controller to ‘monitor’.

16.4.59 Monitor bracket temperatures for 30 minutes or until all bracket temperatures are stable to 0.020 K over 10 minutes.

16.4.60 Record sensor temperatures as displayed on the CSTOL display window.

bracket1/sensor 1 ___________________ K

bracket 2/sensor 2 ___________________ K

bracket 2/sensor 1 ___________________K

bracket 1/sensor 2 ___________________ K

16.4.61 Stop bridge file.

16.4.62 Upload database values for closed loop heating in CASE 5 (B1, H2, S1 / B2, H1, S2).

16.4.63 Start a bridge file on the following monitors:
sq_low_freq_br
btc_cmp_snsr_br
btc_snsr_br
btc_htr_br

Bridge filename: ______________________________

16.4.64 Switch Bracket Temperature Controller off.

16.4.65 Turn on mode 2.

16.4.66 Switch Bracket Temperature Controller on.

16.4.67 Monitor bracket temperatures for 40 minutes.

16.4.68 Record sensor temperatures as displayed on the CSTOL display window.

bracket1/sensor 1 ____________________ K

bracket 2/sensor 2 ____________________ K

bracket 2/sensor 1 ____________________K

bracket 1/sensor 2 ____________________ K

16.4.69 Switch Bracket Temperature Controller off.

16.4.70 Upload database values for cooling in mode 1.

16.4.71 Turn on mode 1 and switch Bracket Temperature Controller to ‘monitor’.

16.4.72 Monitor bracket temperatures for 30 minutes or until all bracket temperatures are stable to 0.020 K over 10 minutes.

16.4.73 Record sensor temperatures as displayed on the CSTOL display window.

bracket1/sensor 1 ____________________ K

bracket 2/sensor 2 ____________________ K

bracket 2/sensor 1 ____________________K

bracket 1/sensor 2 ____________________ K

16.4.74 Stop bridge file.

16.4.75 Upload database values for closed loop heating in CASE 6 (B1, H1, S2 / B2, H2, S1).

16.4.76 Start a bridge file on the following monitors:
sq_low_freq_br
btc_cmp_snsr_br
btc_snsr_br
btc_htr_br

Bridge filename: ______________________________

16.4.77 Switch Bracket Temperature Controller off.

16.4.78 Turn on mode 2.

16.4.79 Switch Bracket Temperature Controller on.

16.4.80 Monitor bracket temperatures for 40 minutes.

16.4.81 Record sensor temperatures as displayed on the CSTOL display window.

bracket1/sensor 1 ___________________ K

bracket 2/sensor 2 ___________________ K

bracket 2/sensor 1 ___________________K

bracket 1/sensor 2 ___________________ K

16.4.82 Switch Bracket Temperature Controller off.

16.4.83 Stop bridge file.

16.4.84 Switch Bracket Temperature Controller off. Turn off all SQUID bracket heaters by sending the bracket heater command with an argument of 0000hex at the CSTOL prompt. Wildcards here are ? == A and B, and # == 1 and 2.

Set SQUID Bktheater with SRE_Unit FWD_SRE_? , Heater_Unit Heater_# , Value x#0000

17.0 Flux Slip Calibration

For each of the four SQUIDs in turn perform sections 17.1 and 17.2 below.

17.1 Setting Initial Conditions

17.1.1 Turn off SQUID Calibration signals (both London Moment and Trapped Flux).

17.1.2 Unlock FLL.

17.1.3 Set DAS London Moment Post Gain to 64 (Post_Gain_5).

17.1.4 Set OFFSET to 8000hex.

17.1.5 Set OFFSET to High Offset mode.

17.1.6 Lock FLL.

17.1.7 Null FLL output to 0+/-0.1 Volts using OFFSET commands.

17.1.8 Record the final OFFSET Command as A1 and the final FLL signal to as many decimal places as possible in the Table 17-1 below.

Table 17-1

SQUID Number	OFFSET Command (A1)	ANALOG FLL Signal	Flux Slip OFFSET Command	Flux Slip OFFSET Command (A2)	Flux Slip FLL Signal
1			D7A1		
2			D775		
3			D7CD		
4			E47D		

17.1.9 Unlock FLL.

17.1.10 Enter the value for the Flux Slip OFFSET Command from Table 17-1, above.

17.1.11 Lock FLL.

17.1.12 Null FLL output to 0+/-0.1 Volts using OFFSET commands.

17.1.13 Record the final Flux Slip OFFSET Command as A2 and the final Flux Slip FLL signal to as many decimal places as possible in the Table 17-1 above.

17.2 **Flux Slip**

17.2.1 Unlock FLL.

17.2.2 Set OFFSET to A1 value from Table 17-1.

17.2.3 Lock FLL.

17.2.4 Record data in Tables 17-2 through 17-5 depending on which SQUID is being tested. Use as many decimal places as the instrument allows. MON indicates analog voltage from the Test Connector Breakout Box, TLM indicates values read from the Test Set Displays. If required by Test Director wait before proceeding to next step.

17.2.5 Unlock FLL.

17.2.6 Set OFFSET to A2 value from Table 17-1.

17.2.7 Lock FLL.

17.2.8 Record data in Tables 17-2 through 17-5 depending on which SQUID is being tested. Use as many decimal places as the instrument allows. MON indicates analog voltage from the Test Connector Breakout Box, TLM indicates values read from the Test Set Displays. If required by Test Director wait before proceeding to next step.

17.2.9 Repeat Steps 17.2.1 through 17.2.8 five times or more or until Test Director determines enough data has been gathered.

Table 17-2 SQUID 1 Flux Slip Calibration Data

Step No. / OFFSET Command	Loop Number through Steps 2.1 to 2.8	ANALOG FLL MON Signal	20Hz SQUID TLM Signal	OFFSET TLM
2.4 / A1	1			
2.8 / A2	1			
2.4 / A1	2			
2.8 / A2	2			
2.4 / A1	3			
2.8 / A2	3			
2.4 / A1	4			
2.8 / A2	4			
2.4 / A1	5			
2.8 / A2	5			
2.4 / A1	6			
2.8 / A2	6			
2.4 / A1	7			
2.8 / A2	7			

Table 17-3 SQUID 2 Flux Slip Calibration Data

Step No. / OFFSET Command	Loop Number through Steps 2.1 to 2.8	ANALOG FLL MON Signal	20Hz SQUID TLM Signal	OFFSET TLM
2.4 / A1	1			
2.8 / A2	1			
2.4 / A1	2			
2.8 / A2	2			
2.4 / A1	3			
2.8 / A2	3			
2.4 / A1	4			
2.8 / A2	4			
2.4 / A1	5			
2.8 / A2	5			
2.4 / A1	6			
2.8 / A2	6			
2.4 / A1	7			
2.8 / A2	7			

Table 17-4 SQUID 3 Flux Slip Calibration Data

Step No. / OFFSET Command	Loop Number through Steps 2.1 to 2.8	ANALOG FLL MON Signal	20Hz SQUID TLM Signal	OFFSET TLM
2.4 / A1	1			
2.8 / A2	1			
2.4 / A1	2			
2.8 / A2	2			
2.4 / A1	3			
2.8 / A2	3			
2.4 / A1	4			
2.8 / A2	4			
2.4 / A1	5			
2.8 / A2	5			
2.4 / A1	6			
2.8 / A2	6			
2.4 / A1	7			
2.8 / A2	7			

Table 17-5 SQUID 4 Flux Slip Calibration Data

Step No. / OFFSET Command	Loop Number through Steps 2.1 to 2.8	ANALOG FLL MON Signal	20Hz SQUID TLM Signal	OFFSET TLM
2.4 / A1	1			
2.8 / A2	1			
2.4 / A1	2			
2.8 / A2	2			
2.4 / A1	3			
2.8 / A2	3			
2.4 / A1	4			
2.8 / A2	4			
2.4 / A1	5			
2.8 / A2	5			
2.4 / A1	6			
2.8 / A2	6			
2.4 / A1	7			
2.8 / A2	7			

17.2.10 Unlock FLL.

17.2.11 Set the OFFSET mode to Normal and the OFFSET command to 8000hex.

17.2.12 Lock FLL.

17.2.13 Set FLL output to 0.025 +/-0.001 Volts using OFFSET commands.

17.2.14 Record the OFFSET Command as A3 and the FLL signal to as many decimal places as possible in the Table 17-6 below.

17.2.15 Set FLL output to –0.025 +/-0.001 Volts using OFFSET commands.

17.2.16 Record the OFFSET Command as A4 and the FLL signal to as many decimal places as possible in the Table 17-6 below.

17.2.17 Determine if the DAS Post Gain should be set to a different value.

Table 17-6

SQUID Number	OFFSET Command (A3)	ANALOG FLL Signal	OFFSET Command (A4)	Flux Slip FLL Signal
1				
2				
3				
4				

17.2.18 Set OFFSET to A3 value from Table 17-6.

17.2.19 Record data in Tables 17-7 through 17-10 depending on which SQUID is being tested. Use as many decimal places as the instrument allows. MON indicates analog voltage from the Test Connector Breakout Box, TLM indicates values read from the Test Set Displays. If required by Test Director wait before proceeding to next step.

17.2.20 Set OFFSET to A4 value from Table 17-6.

17.2.21 Record data in Tables 17-7 through 17-10 depending on which SQUID is being tested. Use as many decimal places as the instrument allows. MON indicates analog voltage from the Test Connector Breakout Box, TLM indicates values read from the Test Set Displays. If required by Test Director wait before proceeding to next step.

17.2.22 Repeat Steps 17.2.18 through 17.2.21 five times or more or until Test Director determines enough data has been gathered.

Table 17-7 SQUID 1 Flux Dither Calibration Data

Step No. / OFFSET Command	Loop Number through Steps 2.17 to 2.20	ANALOG FLL MON Signal	20Hz SQUID TLM Signal	OFFSET TLM
2.18 / A3	1			
2.20 / A4	1			
2.18 / A3	2			
2.20 / A4	2			
2.18 / A3	3			
2.20 / A4	3			
2.18 / A3	4			
2.20 / A4	4			
2.18 / A3	5			
2.20 / A4	5			
2.18 / A3	6			
2.20 / A4	6			
2.18 / A3	7			
2.20 / A4	7			

Table 17-8 SQUID 2 Flux Dither Calibration Data

Step No. / OFFSET Command	Loop Number through Steps 2.17 to 2.20	ANALOG FLL MON Signal	20Hz SQUID TLM Signal	OFFSET TLM
2.18 / A3	1			
2.20 / A4	1			
2.18 / A3	2			
2.20 / A4	2			
2.18 / A3	3			
2.20 / A4	3			
2.18 / A3	4			
2.20 / A4	4			
2.18 / A3	5			
2.20 / A4	5			
2.18 / A3	6			
2.20 / A4	6			
2.18 / A3	7			
2.20 / A4	7			

Table 17-9 SQUID 3 Flux Dither Calibration Data

Step No. / OFFSET Command	Loop Number through Steps 2.17 to 2.20	ANALOG FLL MON Signal	20Hz SQUID TLM Signal	OFFSET TLM
2.18 / A3	1			
2.20 / A4	1			
2.18 / A3	2			
2.20 / A4	2			
2.18 / A3	3			
2.20 / A4	3			
2.18 / A3	4			
2.20 / A4	4			
2.18 / A3	5			
2.20 / A4	5			
2.18 / A3	6			
2.20 / A4	6			
2.18 / A3	7			
2.20 / A4	7			

Table 17-10 SQUID 4 Flux Dither Calibration Data

Step No. / OFFSET Command	Loop Number through Steps 2.17 to 2.20	ANALOG FLL MON Signal	20Hz SQUID TLM Signal	OFFSET TLM
2.18 / A3	1			
2.20 / A4	1			
2.18 / A3	2			
2.20 / A4	2			
2.18 / A3	3			
2.20 / A4	3			
2.18 / A3	4			
2.20 / A4	4			
2.18 / A3	5			
2.20 / A4	5			
2.18 / A3	6			
2.20 / A4	6			
2.18 / A3	7			
2.20 / A4	7			

18.0 SQUID Noise Measurement

18.1 Collect SQUID noise data for 12 hours per CSTOL plv2ii.prc.

19.0 EMC Measurement

19.1 Power on the GSS per approved procedure.

19.2 Configure GSS for simulated science mission signal generation (aka“wiggle” test) per P0848. Record GSS test configuration below:

19.3 Continue collecting SQUID noise data for 12 hours.

20.0 Completion of Procedure

Prior to completion of this procedure verify all outstanding discrepancies have been addressed.

I verify that this Test Procedure (TP) has been successfully.

Test Director ______________________ Date________________

REE_____________________________ Date________________
Bruce Clarke

SU Quality Assurance Date________________
Manager_____________________

21.0 List of Equipment

Make copies of the “List of Equipment” Table on next page as required

Item No.	Name / Description	Manufacturer	Model No.	Prop.Tag/ Serial No.	Calibration Due Date
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

22.0 Appendix

22.1 Commercial test cables

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
Double 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 Double Banana Adapter	Pomona 1269	4
BNC Tees (f/m/f)	Pomona 3285	2
Stackup Banana plugs	Pomona 1325-0	10

23.0 Requirements Verification

Seq. # (ref.)	Req't Source	Req't #	Requirement (Title and Description)	Ver. Method	Verified in Step
178	3. PLSE-12	3.7.2.5.7	**Heat Power into QBS –** The maximum heat power into the QBS shall not exceed the values given in the following table for each item, while Science Data is being collected. Item # of items Power(mW)/item Power (mw) SQUID Bracket Assy 2 0.250 0.500 QB GRTs (lot) 1 0.001 0.001 SDs (lot) not used 1 0.000 0.000 Thermal radiation on QB 1 0.250 0.250 Gyroscope Assemblies 4 0.001 0.004 Telescope DPA (2 ea DMAs) 2 3.000 6.000 QBS heater 1 2.000 2.000 TOTAL 8.755	A,T	16.0 (partial)
180	3. PLSE-12	3.7.1.7.2.1.2	**Noise at 130 Hertz** – The SQUID sensor noise shall have a magnitude less than 60 marcsec/Hz^0.5 at 130 Hz, where the flux to angle scale factor assumes a rotating trapped dipole flux level equal to the London dipole moment at 130 Hz (this trapped flux level is an assumption only, and does not occur in fact). (Engineering test only)	T	12.4 13.4 14.4 15.4
181	1. T002	5.0	**Science Gyroscope Readout** – The SG readout system shall have a linearity consistent with an error of less than 0.3 marcsec/year. The gyroscope readout system single-sided noise spectral density shall be less than 190 marcsec/sqrt(Hz) x sqrt(roll period/180 sec) x (130 Hz/spin speed).	A, T (PCB pending to change to A only)	17.0
197	2. T003	2.7	**Suspension Electrical Interference** – The suspension system electromagnetic interference coupled to the SQUID readout system under science data acquisition conditions shall not cause violation of the readout resolution and noise requirements of section 3 and document T002, #2 and #5. This will be verified in ground test by operating the suspension bridge and control effort at science mission levels.	Eng. Test only	18.0
198	3. PLSE-12	3.3.2	**Electromagnetic Compatibility (EMC) –** The payload shall comply with the EMC requirements specified in T003, Section 15.	Eng. Test only	18.0
199	1. T002	10.0	**Bias Rejection**- The joint effects of all bias drifts, including electronic, magnetic, optical, thermal, and mechanical, on the SG and ST readouts and on the science-data instrumentation and data reduction systems shall be reduced to less than 0.15 marcsec/year when referenced to inertial space.	A, T	16.0 (partial)
207	3. PLSE-12	3.7.2.5.7.1	**Heat Power to QBS in SQUID Bracket Assembly** – The maximum heat power into the QBS shall not exceed the values given in the following while Science Data is being collected. Item: #of Items Power(mW)/item Power(mW) SQUID Bracket Assy 2 0.250 0.500	T	16.0 (partial)
209	2. T003	3.2.1.1	**High Frequency** – In the frequency range 100-1000 Hz the harmonic distortion of each of harmonics 2-5 of sinusoids with amplitude corresponding to the trapped flux levels of section 1.5 shall be less than 1e-4.	A, T	12.6 13.6 14.6 15.6
210	2. T003	3.2.2	**Noise** – The gyroscope readout system single-sided noise spectral density at the roll frequency shall be less than 190 marcsec/sqrt-Hz (corresponding to a 10 hour integration time to resolve a 1 marcsec angle) for roll period of 3 minutes or less and gyroscope spin speed >=130Hz.	A, T	17.0
211	3. PLSE-12	3.7.1.7.2.1.4.2	The SQUID shall have a bias temperature coefficient of less than 0.01 flux quanta/K over the temperature range 2.7 K – 3K	T	16.0
212	3. PLSE-12	3.7.2.5.7.1	**Heat Power to QBS in SQUID Bracket Assembly** – The maximum heat power into the QBS shall not exceed the values given in the following while Science Data is being collected. Item: #of Items Power(mW)/item Power(mW) SQUID Bracket Assy 2 0.250 0.500	T	16.0 (partial)
214	2. T003	3.7	**Flux Quantum Calibration** – The Readout System shall have the capability of measuring changes in the scale factor to an accuracy of better than 1e-5 using the flux quantum in the SQUID.	A,T	16.1

Seq. # (ref.)	Req't Source	Req't #	Requirement (Title and Description)	Ver. Method	Verified in Step
215	3. PLSE-12	3.7.1.7.2.1.17	**Flux Slipping –** It shall be possible to slip a flux quantum in the SQUID loop with a measurement error of less than 1 part in 10^5.	T	16.1
216	3. PLSE-12	3.7.1.7.2.1.3.1	**Harmonic Distortion –** The harmonic distortion of the SQUID operating with flux-locked-loop electronics having a disturbance rejection of 100-200 for a 1 kHz signal with an amplitude of 2 flux quanta shall be less than 10^-4.	T	12.6 13.6 14.6 15.6

24.0 Revision History

Revision	Date	ECO #	Outline of Changes
-	25 May 2001	N/A	Original Rev.
A	15 June 2001	1277	1. Add procedure instructions to Section 16.0, SQUID Bracket ID and Bias Temp-Co., Steps A and B 2. Update equipment to reflect redline changes from procedure run 6/12/01. 3. Changes from T. McGinnis detailed below in section date 6/15/2001
B	27 June 2001	1279	1. Add section to perform flux slipping measurement. (Section 17.0, other section numbers adjusted accordingly. See Summary of Contents for details). 2. Add redline changes to Section 16.0 from runs of 6/24-6/26/01. Run heaters and temperature sensors in coarse mode. Heater commands are now 0300hex (for 200 uA) and 0600hex (for 400 uA). 3. Update Requirements Verification Matrix to show which steps of this procedure gather data to verify which requirements. 4. Reformatted section numbering on entire document.
C	3 July 2001		1. Add text to section 16.4, Bracket Temperature Control Performance. 2. Delete sections 16.5, 16.6, 16.7. These were placeholders for subsections of the Bracket Temperature Controller Performance procedure. 3. Change steps 12.1.9-12.1.12, 13.1.9-13.1.12, 14.1.9-14.1.12 and 15.1.9-15.1.12 to require peaking the positive demod DC voltage when tuning the SQUID. 4. Add steps 12.1.14-12.1.16, 13.1.14-13.1.16, 14.1.14-14.1.16, 15.1.14-15.1.16 to enable the flux locked loop, measure the FLL output voltage and then disable the flux locked loop.

6/15/2001

- Made the signature lines the same for Doreen as for all the others.
- Cleaned up some formatting in sections 4 and 5
- Changed Digital Oscilloscope to Oscilloscope in the List of Equipment
- Added "or their equivalent" to para. 6.1
- Added part number for the four channel test box
- Table 9.1.1: Corrected entry for Dual Test Box to four separate entries for the Four Channel Box, altered table to fit in one page, added (RS232) for PP J5 consistent with previous Aft SRE A J5 entry and added SQUID connections (J1, J2) to Tophat Connections.
- Added warning at beginning of Section 10
- 10.5.5: Added Tare Bus Current Recording
- 10.5.6 and 10.5.7: Changed to take into account the Tare Bus Current

- Table 10.5.1: Removed Secondary from title, added two entries (tare and initial)
- 10.5.12: Changed to take into account the Tare Bus Current and added Date and Time entries
- 10.5.15: Separated from 10.5.14
- Table 10.12.1: Added Step # column consistent with subsequent tables, removed Low Gain High Temp entry
- Tables 10.12.2 and 10.12.3: Removed Low Gain High Temp entry
- Table 10.12.4: Corrected Step # 31 and 33 indication (was 32 and 34), removed Low Gain High Temp entry
- 11.1: Removed sentence allowing connect/disconnect of BTC cables, made requirement to power down SRE prior to connect/disconnect of SQUID's, removed Offset zero requirement, indicated all SQUID's are already connected as well as the TRE.
- 12.1.8, 13.1.8, 14.1.8 and 15.1.8: removed LeCroy from the oscilloscope
- 16.0.1: Changed Sensor Setpoint (SSP) to the default value for a 7.5V reading from the sensor
- Section 16 tables: Re-formatted for more writing space
- Section 16: Added heater values
- Got rid of the mystery 18 and 19 between sections 16 and 17