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Gravity Probe B Relativity Mission

## GB-P ITF Timing Test: Summary of Part B Testing

S0671 Rev A

July 14, 2003

A handwritten signature in black ink, appearing to read "Paul Shesopple".

Prepared by: Paul Shesopple

7/14/03

Date

A handwritten signature in black ink, appearing to read "Dorrene Ross".

Approved by: Dorrene Ross, Quality Engineering

7/14/03

Date

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Approved by: Rich Whelan, System Engineering

7/15/2003

Date

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Approved by: Mac Keiser, Chief Scientist

9/12/03

Date

ITAR Assessment Performed

A handwritten signature in black ink, appearing to read "Tom Langenstein".

Tom Langenstein

9/5/03  
ITAR Control Req'd? ☐ Yes ☒ No

**Revision History**

| Rev Level | Comments/notes                                                 | Date           | Revised By     |
|-----------|----------------------------------------------------------------|----------------|----------------|
| -         | First release of this document                                 | April 19, 2003 | Paul Shestople |
| A         | Updated to reflect completion of all Timing Test verifications | July 14, 2003  | Paul Shestople |

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**1.0 Scope**

This document details testing accomplished during the ITF timing tests. Conclusions are provided.

This document ☐ Does ☒ Does not provide formal verification of GP-B requirements.  
 This document ☐ Does ☒ Does not include constraints and restrictions for the Payload.

**2.0 Reference Documents**

| Doc ID          | Title                                                                                                    |
|-----------------|----------------------------------------------------------------------------------------------------------|
| S0530           | GP-B ITF Timing Test Part A: Overview and Verification Requirement Compliance Matrix                     |
| S0531           | GB-P ITF Timing Test Analysis: Telemetry and Data Processing                                             |
| S0532           | GP-B ITF Timing Test Analysis: Time Tagging                                                              |
| S0533           | GP-B ITF Timing Test Analysis: GPS PPS Time Tag                                                          |
| S0534           | GP-B ITF Timing Test Analysis: ATC Data Pulse Strobe Time Tag                                            |
| S0535           | GB-P ITF Timing Test Analysis: GPS PPS Ambiguity Resolution                                              |
| S0536           | GB-P ITF Timing Test Analysis: SRE Science Signals Time Tagging                                          |
| S0537           | GB-P ITF Timing Test Analysis: TRE Science Signals Time Tagging                                          |
| S0538           | GB-P ITF Timing Test Analysis: GSS Science Signals Time Tagging                                          |
| S0539           | GB-P ITF Timing Test Analysis: ECU Science Signals Time Tagging                                          |
| S0697           | GP-B ITF Timing Test Readiness Review Completion Certificate                                             |
| S0723           | Integrated Test Facility Gyroscope Suspension System Documentation                                       |
| P0939           | ITF Timing Test: Test Configuration and Version Control Documentation                                    |
| LMMS<br>P480720 | ITF Electronic Box Inventory Description (This document is ITAR controlled, but available upon request). |

### 3.0 Test Description

Timing tests, motivated by the need to understand and verify the Gravity Probe B payload timing system, were conducted over the course of several years. The testing was separated into two stages. The first, part A, is shown schematically in figure 1 and was primarily designed to test the accuracy with which the GPS subsystem interfaces with the SRE 16  $f_0$  Oven Controlled Crystal Oscillator (OCXO). Part B, which tested time latencies of individual payload units, is shown schematically in figure 2 and described in greater detail in S0697.

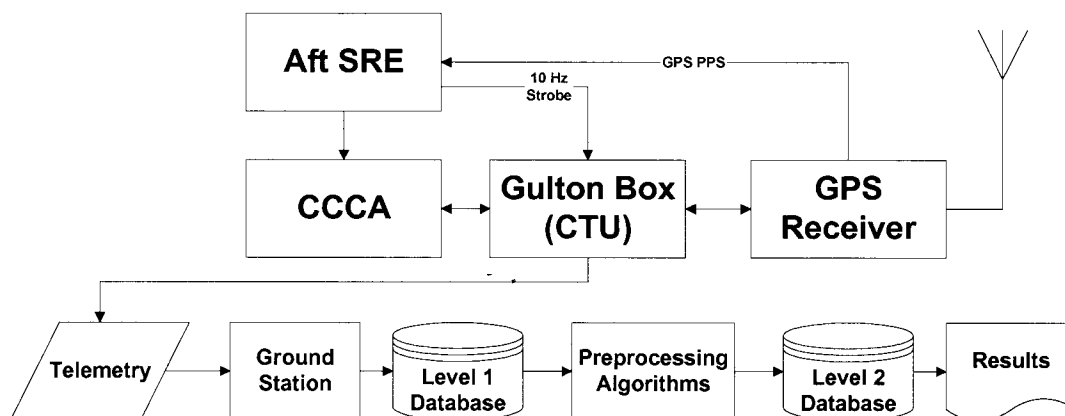


Figure 1: Part A Timing Test Schematic

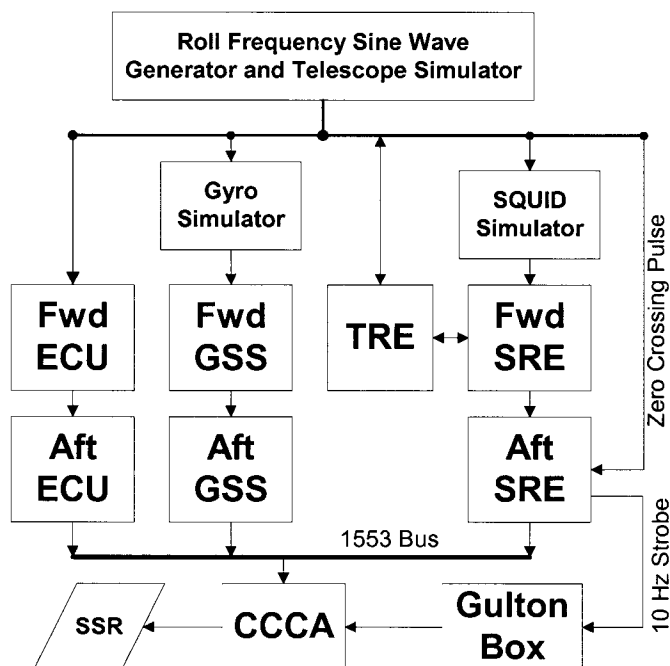


Figure 2: Part B timing test schematic.

#### 4.0 Test Summary and History

A total of 16 timing tests have been run.

##### *Timing Test, Part A*

- 06/23/01 Unsuccessful test run. **SP\_GPS\_Fract** is always zero. **SP\_RecvrMode1** is always zero. **SF\_Veh\_Time1** data is curved (suggesting serious oscillator problems). **SQ\_PPSv16F\_Time** and **SQ\_Sci10HzTime** has nonsensical jumps, as does **SP\_Time\_Trans**.
- 07/17/01 Unsuccessful test run. **SP\_GPS\_Fract** is always zero. **SQ\_PPSv16F\_Time** and **SQ\_Sci10HzTime** signals are nonsense.
- 07/23/01 Unsuccessful test run. Discovered problem with **SP\_GPS\_Fract**; value is always 0.00390625
- 08/13/01 Unsuccessful test run. **SP\_GPS\_Fract**, value is still always 0.00390625
- 10/04/01 Unsuccessful test run. **SP\_RecvrMode1** is 0 or 1. **SQ\_SciVehTimByt**, **SP\_GPSTimeWeek1** are all zeroes. **SP\_GPS\_Fract** is now always 0. Suspect bad cable connection.
- 10/10/01 Successful test run.
- 10/17/01 Successful run for the record. Data used to verify the following specifications: T003, sections 16.1.1, 16.4, 16.4.1, 16.5, 16.6, 16.6.1, and SE-23, section 3.2.1.3

##### *Timing Test, Part B*

- 01/17/02 Unsuccessful test run. Insufficient **SQ\_10HV16F\_TIME** data. ECU mnemonics (**DE\_VACG\_P9A\_SIG**, **TE\_QBS\_A\_GT10P**, **TE\_TELD\_1\_GT12Q**, **TE\_PRSLN\_AST19P**, **TE\_WIN\_3\_AST25P**) signals are saturated. **SQ\_SciVehTimByt** all zeroes **SQ\_SciLPasFiltN** all zeroes. **ST\_SciSlopexx\_x** all zeroes. **RY\_PSTNAn** signals nonsensical.
- 02/20/02 Unsuccessful test run. Insufficient **SQ\_10HV16F\_TIME** data. ECU mnemonics (**DE\_VACG\_P9A\_SIG**, **TE\_QBS\_A\_GT10P**, **TE\_TELD\_1\_GT12Q**, **TE\_PRSLN\_AST19P**, **TE\_WIN\_3\_AST25P**) signals improved, but signal still noisy. **SQ\_SciLPasFilt3** has different amplitude and much worse signal structure than **SQ\_SciLPasFilt1**, **-2**, **-4**. **SQ\_SciVehTimByt**, **SQ\_SciVehTime8**, **SQ\_PPSV16F\_Time**, and **SQ\_Sci10HzTime** are all zero (cable not connected). All **ST\_SciSlopexx\_x** signals show signs of insufficient grounding. Most non-zero signals show drift suggesting temperature rise in ITF boxes; recommend next test be longer.
- 04/03/02 Unsuccessful test run. Improved Sine Wave generator. Excellent **SQ\_10HV16F\_TIME** data used to verify T003, section 16.6.2. All **ST\_SciSlopexx\_x** signals are improved but still noisy. **SQ\_SciLPasFiltN** are noisy. ECU mnemonics (**DE\_VACG\_P9A\_SIG**, **TE\_QBS\_A\_GT10P**, **TE\_TELD\_1\_GT12Q**, **TE\_PRSLN\_AST19P**, **TE\_WIN\_3\_AST25P**) signals improved, but gain is incorrect. Most non-zero signals show drift suggesting temperature rise; suggest that next test be longer.

- 06/12/02 Unsuccessful test run. Twelve hour test resulted in approximately 2 hours of thermally stable data. Suggest using SRE oscillator to drive sine wave generator. Discovered two bad ECU GRTs, but other ECU mnemonic time tagging could be verified from this data set. GSS, SRE and TRE mnemonics require more stable data to meet specifications.
- 02/24/03 Successful test run using Bob Farley's New and Improved Dual Axis Sine Wave Generator at 184.5 seconds period. Collected good data for GSS 1 in position mode.
- 03/03/03 Successful run for the record. Collected good data for all four sine periods. Collected good data for GSS 1 in position mode.
- 03/17/03 Successful run for the record. Collected good ECU, TRE and SRE data for all four sine periods. Used other SRE DAS board in an attempt to test analog filters for bit latching. Attempted to configure GSS 1 to collect electrode voltage data and GSS 2 for position data. Neither GSS produced decent data.
- 04/07/03 Successful run for the record. Collected good ECU, TRE and SRE data for all four sine periods. Used other SRE DAS board. Configure GSS 1 to collect electrode voltage data and GSS 2 for position data. Collected good GSS 2 position data, but GSS 1 electrode voltage is too noisy.
- 5/17/03 Successful "GSS Bent Pipe Test." This special timing test exercised all subsystems, but the GSS subsystem received special attention due to previously ambiguous GSS data. Good GSS data was collected for GSS 1-4.

## 5.0 Conclusion

The ITF Timing Tests have been successful in two important ways. Testing has enabled verification of eight T003 verifications and two SE-23 verifications. Results will be used as part of a T002 verification.

Even more importantly, testing has allowed better understanding of the GPB timing system. The testing discovered programming flaws such as the value of the *SP\_GPS\_Fract* mnemonic always equal to zero. Testing showed that the SRE payload processor's precision is considerable better than previously believed. Testing revealed a 1 to 3 second ambiguity in how GSS data is time tagged. Perhaps most importantly, the testing revealed a 0.1 second discrepancy between vehicle time and SRE time, with profound implications for time tagging of all science data.

In short, ITF timing tests have directly contributed to GPB mission success.

## 6.0 Verification Matrix

| Section        | Title                                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Method | Summary/Details                                                                                                                                                                                                                                                                                                                                                                                          | ✓ |
|----------------|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| T002<br>11     | Telemetry and Data Processing              | The SG and ST signals shall be conditioned, sampled and processed so that they can be differenced on the ground with an added error due to telemetry and data processing of less than 0.1 marcsec over a range which covers aberration, dither and nominal drift. The effective sample time of all science signals shall be known relative to the GPS time, after ground processing of the science timing signals, to an accuracy and precision of 0.1 msec. A science data reduction system (DRS) shall determine the relativistic drifts from the telemetered SG, ST, roll, tracking, and time data. | A, T   | Verification of part B, <i>"The effective sample time of all science signals shall be known relative to the GPS time, after ground processing of the science timing signals, to an accuracy and precision of 0.1 msec."</i> is completed by completion of verifications for T003 paragraphs 16.6.1, 16.6.3, 16.6.4, and 16.6.6, and SE-23, 3.2.1.3 and 3.2.1.4. Those verifications have been completed. | ✓ |
| T003<br>16.5   | Payload Absolute Time Standard             | The GPS PPS signal and the associated GPS time from the corresponding GPS solution shall be the standard for absolute time for the Payload.                                                                                                                                                                                                                                                                                                                                                                                                                                                            | I      | This document summarizes testing done showing that this section is verified.                                                                                                                                                                                                                                                                                                                             | ✓ |
| T003<br>16.6   | Time Tagging                               | The $16f_0$ clock shall be continuously counted in a 31-bit register which rolls over less frequently than once every minute.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A, T   | S0532 details verification from ITF Timing Test Part A data, and confirms that the 31 bit counter rolls over every 131.20 seconds.                                                                                                                                                                                                                                                                       | ✓ |
| T003<br>16.6.1 | GPS PPS Time Tag                           | Each GPS-PPS shall be time tagged by sampling the $16f_0$ rollover counter when it occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A, T   | S0533 details verification of this specification from ITF Timing Test Part A data, and concludes that the GPS-PPS pulse is time tagged by the $16 f_0$ counter when it occurs.                                                                                                                                                                                                                           | ✓ |
| T003<br>16.6.2 | ATC Data Pulse Strobe Time Tag             | Each ATC Data Strobe Pulse shall be time tagged by sampling the $16f_0$ rollover counter when it occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A, T   | S0534 details verification from ITF Timing Test Part A data, and concludes that the ATC data strobe is accurately time tagged by the $16 f_0$ rollover counter.                                                                                                                                                                                                                                          | ✓ |
| T003<br>16.6.3 | SQUID Readout Science Signals Time Tag     | The sampling and time tagging of the SQUID Readout signals shall be done in such a way that the time at which each signal was sampled can be determined to within less than 0.1 ms relative to the $16f_0$ rollover counter.                                                                                                                                                                                                                                                                                                                                                                           | A, T   | S0536 details ITF testing results which verifies this requirement to the several milliseconds level. S0307 calculates time latency of the SRE subsystem to the level of microseconds. Covariance analysis of the SRE analog filters is detailed in S0903. The specification is verified.                                                                                                                 | ✓ |
| T003<br>16.6.4 | Telescope Readout Science Signals Time Tag | The sampling and time tagging of the Telescope Readout signals shall be done in such a way that the time at which each signal was sampled can be determined to within less than 0.1 ms relative to the $16f_0$ rollover counter.                                                                                                                                                                                                                                                                                                                                                                       | A, T   | S0537 details ITF testing results which verifies this requirement to the several milliseconds level. S0307 calculates time latency of the TRE subsystem to the level of microseconds. The specification is verified.                                                                                                                                                                                     | ✓ |

|                  |                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                              |      |                                                                                                                                                                                                                      |   |
|------------------|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| T003<br>16.6.6   | Gyroscope Suspension System Science Signals Time Tagging | The sampling and time tagging of the Gyroscope Suspension System signals, which are used for the in-flight calibration and or for in-flight verification, including the measurements of gyro rotor position and the measurements of gyro electrode voltages, shall be done in such a way that the time at which each signal was sampled can be determined on the ground to within less than 0.1 ms relative to the $16f_0$ rollover counter. | A, T | S0538 details ITF testing results which verifies this requirement to the several milliseconds level. S0867 calculates time latency of the GSS subsystem to the level of microseconds. The specification is verified. | ✓ |
| T003<br>16.6.7   | Experiment Control Unit Science Signals Time Tagging     | The sampling and time tagging of the Experiment Control Unit temperature and magnetometer signals shall be done to within less than 10 ms relative to the $16f_0$ rollover counter.                                                                                                                                                                                                                                                          | A, T | S0539 details verification of this requirement directly by data from the timing tests, and concludes that the specification has been verified.                                                                       | ✓ |
| T003<br>16.6.8   | On-board Digital Filtering                               | All on-board digital filtering and processing of science data shall be done so that the sampling of the data is known to within less than 0.1 ms relative to the $16f_0$ rollover.                                                                                                                                                                                                                                                           | A    | Verifications of 16.6.3, 16.6.4 and 16.6.6 show that this specification has been met.                                                                                                                                | ✓ |
| SE-23<br>3.2.1.3 | PPS Accuracy                                             | The PPS pulse shall be within 100 microseconds of the GPS second whenever the receiver is computing position.                                                                                                                                                                                                                                                                                                                                | A, T | S0535 details verification of this requirement from ITF Timing Test Part A data, as well as SV data, and concludes that the requirement has been met.                                                                | ✓ |
| SE-23<br>3.2.1.4 | PPS Ambiguity Resolution                                 | One of the data packets output by the GPS receiver shall provide the GPS time when the data packet is being transmitted (called time-of-transmission), and this time shall be accurate to 0.3 seconds.                                                                                                                                                                                                                                       | A, T | S0535 details verification of this requirement from ITF Timing Test Part A data, as well as SV data, and concludes that the requirement has been met.                                                                | ✓ |

## 7.0 Attachments

- 1) P0939 ITF Timing Test: Test Verification and Version Control Documentation for 3/3/03 Timing Test
- 2) LMMS GSE-016 Rev B Operations Order for 3/3/03 Timing Test
- 3) P0939 ITF Timing Test: Test Verification and Version Control Documentation for 3/17/03 Timing Test
- 4) LMMS GSE-016 Rev C Operations Order for 3/17/03 Timing Test
- 5) P0939 ITF Timing Test: Test Verification and Version Control Documentation for 4/7/03 Timing Test
- 6) LMMS GSE-016 Rev C Operations Order for 4/7/03 Timing Test
- 7) P0939 ITF Timing Test: Test Verification and Version Control Documentation for 5/19/03 Timing Test
- 8) LMMS GSE-016 Rev C Operations Order for 5/19/03 Timing Test

3/3/03



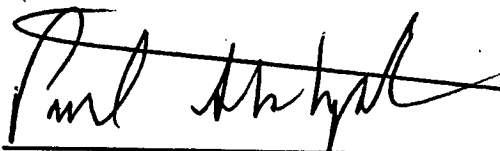
W. W. Hansen Experimental Physics Laboratory  
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STANFORD, CALIFORNIA 94305-4085

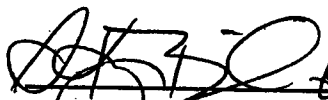
SU GP-B  
RDE 10

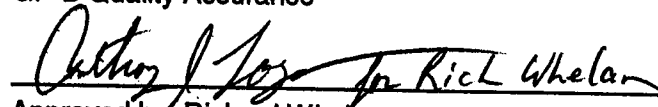
Gravity Probe B Relativity Mission

# ITF TIMING TEST: TEST CONFIGURATION AND VERSION CONTROL DOCUMENTATION

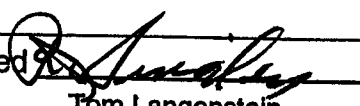
P0939 Rev -  
August 29, 2002

  
Prepared by: Paul Shestople  
Date: 8/30/02

  
Approved by: Dorrene Ross  
GP-B Quality Assurance  
Date: 8/30/02

  
Approved by: Richard Whelan  
GP-B Systems Engineering  
Date: 8/30/02

ITAR Assessment Performed

  
Tom LangensteinITAR Control Req'd? ☐ Yes ☒ No



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**1.0 Revision History**

| Rev Level | Comments/notes                       | Date        | Revised By  |
|-----------|--------------------------------------|-------------|-------------|
| -         | First release of this test procedure | 29-Aug-2002 | P Shestople |
|           |                                      |             |             |
|           |                                      |             |             |

**2.0 Scope**

This procedure documents Integrated Testing Facility (ITF) software versions and hardware configurations used during GPB Timing Tests

This procedure ☒ Does ☐ Does not provide formal verification of GP-B requirements.  
This procedure ☐ Does ☒ Does not include constraints and restrictions for the Payload.

### 3.0 Formal Requirements Verification

This procedure documents hardware configuration and software versions used to verify requirements shown in Table 1.

|      | Section        | Title                                                    | Part A | Part B |
|------|----------------|----------------------------------------------------------|--------|--------|
| 3.1  | T002, 11       | Telemetry and Data Processing                            |        | ✓      |
| 3.2  | T003, 3.6.6    | Timing and Signal Processing                             |        | ✓      |
| 3.3  | T003, 7.6.5    | Pointing and Light Intensity Signals                     |        | ✓      |
| 3.4  | T003, 16.1.1   | Primary Payload Clock Frequency                          | ✓      |        |
| 3.5  | T003, 16.4     | Payload-to-Spacecraft Synchronization                    | ✓      |        |
| 3.6  | T003, 16.4.1   | ATC Data Strobe Pulse Frequency                          |        | ✓      |
| 3.7  | T003, 16.5     | Payload Absolute Time Standard                           | ✓      |        |
| 3.8  | T003, 16.6     | Time Tagging                                             | ✓      |        |
| 3.9  | T003, 16.6.1   | GPS PPS Time Tag                                         | ✓      |        |
| 3.10 | T003, 16.6.2   | ATC Data Pulse Strobe Time Tag                           | ✓      |        |
| 3.11 | T003, 16.6.3   | SQUID Readout Science Signals Time Tag                   |        | ✓      |
| 3.12 | T003, 16.6.4   | Telescope Readout Science Signals Time Tag               |        | ✓      |
| 3.13 | T003, 16.6.6   | Gyroscope Suspension System Science Signals Time Tagging |        | ✓      |
| 3.14 | T003, 16.6.7   | Experiment Control Unit Science Signals Time Tagging     |        | ✓      |
| 3.15 | SE-23, 3.2.1.3 | PPS Accuracy                                             | ✓      |        |
| 3.16 | SE-23, 3.2.1.4 | PPS Ambiguity Resolution                                 | ✓      |        |

Table 1: GPB Timing Requirements

### 4.0 Reference Documents

- 4.1. MIL-STD-1686 Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment
- 4.2. P0875 GP-B Maintenance and Testing at all Facilities
- 4.3. MIL-STD-1540C Test Requirements for Launch, Upper-stage, and Space Vehicles, Section 6.4.2.

### 5.0 Test Facility

Primary facility: Lockheed Palo Alto Integrated Testing Facility, Bldg. 205.

## 6.0 QA Provisions

- 6.1. This procedure shall be conducted on a formal basis to its latest approved and released version. The QA Program Engineer (D. Ross) and the ONR representative (E. Ingraham) shall be notified 24 hours prior to the start of this procedure. QA may monitor the execution of all or part of this procedure should they elect to do so.

Date/time: 3/1/03 16:00  
GP-B QA (D. Ross)

Date/time: 3/1/03 16:00  
ONR (E. Ingraham)

- 6.2. Upon completion of this procedure, the Timing Test REE and the GP-B QA manager shall certify her/his concurrence that the procedure was performed and accomplished in accordance with the prescribed instructions by signing and dating his approval at the end of this procedure.

## 7.0 Test Personnel

This document shall be completed only by persons familiar with hardware configuration and software version control, or be those designated by the Timing Test REE at the time of test (redline names in below as required).

- 7.1. Kelly Burlingham
- 7.2. Bill Given
- 7.3. Paul Shestople

## 8.0 General Instructions

- 8.1. Redlines can be initiated by the test personnel listed in Section 7.0 and must be approved by QA.
- 8.2. Test operators shall read this procedure in its entirety and resolve any apparent ambiguities prior to beginning this test.
- 8.3. Any nonconformance or test anomaly should be reported by a Discrepancy Report. Refer to the Quality Plan, P0108, for guidance. Do not alter or break test configuration if a test failure occurs; notify quality assurance.
- 8.4. Only the following persons have the authority to exit/terminate this test or perform a retest: test operators listed in Section 7.0 and GP-B QA.

## 9.0 Hardware Safety Requirements:

- 9.1. Hardware used in this test is ESD sensitive; special care shall be exercised per the "Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment", MIL-STD-1686.
- 9.2. Lockheed facilities are under Lockheed configuration control. Only Rich Campbell, or his representative, may change ITF hardware configuration, and all such changes must be documented.
- 9.3. Software version control must be strictly adhered to. Only Bill Given, or his representative, may change software versions, and all such changes must be documented.

## 10.0 Hardware Configuration

Timing Test Hardware Configuration is shown schematically in Figure 1. Document Configuration by completing table on next page.

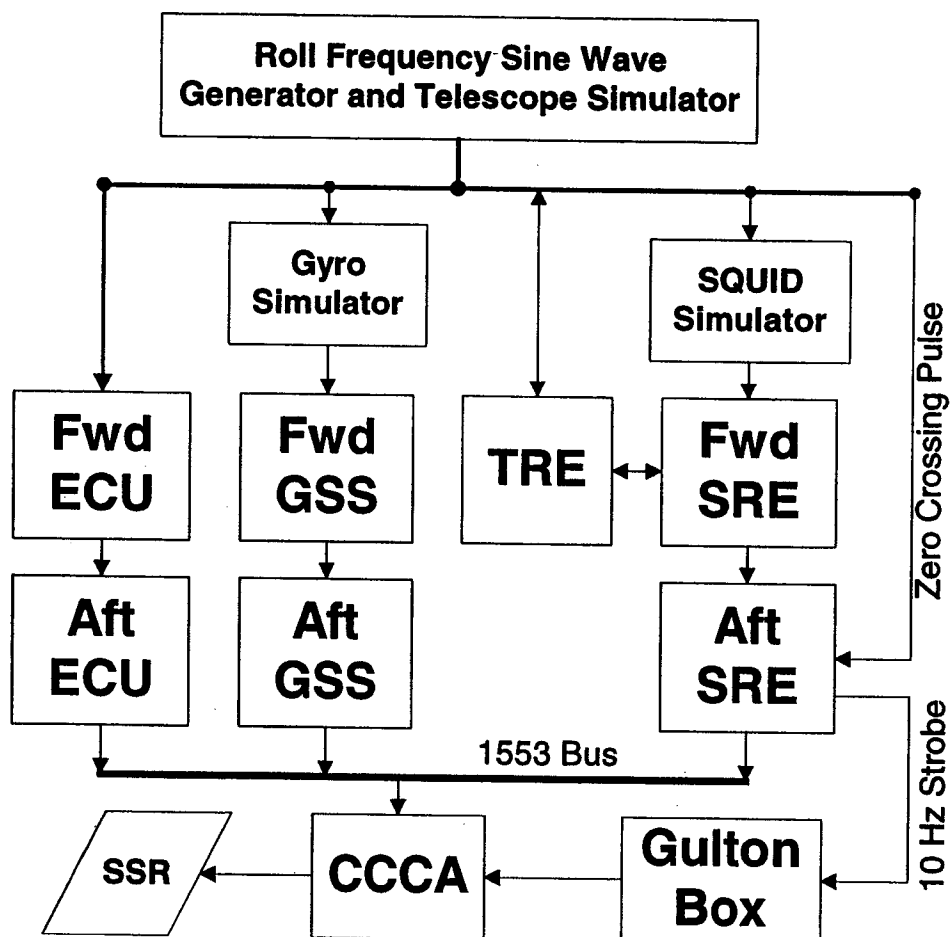


Figure 1: Hardware Configuration

| Item | Equipment Description                                      | Qty | Make | PN                  | SN                   | Pedigree |
|------|------------------------------------------------------------|-----|------|---------------------|----------------------|----------|
| 1.   | Roll Frequency Sine Wave Generator and Telescope Simulator | 1   | LMMS | T2ADM               | 001                  | GSE      |
| 2.   | Gyro Simulator                                             | 1   | SU   | GSS GYRO Simulator  | 001                  | GSE      |
| 3.   | SQUID Simulator                                            | 1   | LMMS | SRE SQUID Simulator | 001                  | GSE      |
| 4.   | Forward ECU                                                | 1   | LMMS | 8A01313             | 001                  | FEU      |
| 5.   | Aft ECU                                                    | 1   | LMMS | 8A00922             | 001                  | FEU      |
| 6.   | Forward GSS - 1                                            | 1   | SU   | 26225-101           | ITF 001<br>See S0723 | EU       |
| 7.   | Aft GSS - 1                                                | 1   | SU   | 26224-101           | ITF 001<br>See S0723 | EU       |
| 8.   | TRE                                                        | 1   | LMMS | TRE                 | 004                  | EU       |
| 9.   | Forward SRE - A                                            | 1   | LMMS | 8A00848GSE-101      | 001                  | FEU      |
| 10.  | Aft SRE - A                                                | 1   | LMMS | 8A00920-101         | 001                  | FEU      |
| 11.  | Gulton Box                                                 | 1   | LMMS | EAN60411-001-01     | 101                  | FEU      |
| 12.  | CCCA                                                       | 1   | LMMS | 7578100-01          | 001                  | FEU      |
| 13.  | SSR                                                        | 1   | LMMS | 161100              | 001                  | EU       |
| 14.  | Forward SRE - B                                            | 1   | LMMS | 8A00848GSE-101      | 002                  | FEU      |
| 15.  | Aft SRE - B                                                | 1   | LMMS | 8A00920-102         | 001                  | FEU      |
| 16.  | Forward GSS - 2                                            | 1   | SU   | 26225-101           | ITF 002<br>See S0723 | EU       |
| 17.  | Aft GSS -2                                                 | 1   | SU   | 26224-101           | ITF 002<br>See S0723 | EU       |
| 18.  | Aft GSS - 3                                                | 1   | SU   | 26224-101           | ITF 003<br>See S0723 | FU       |
| 19.  | Aft GSS - 4                                                | 1   | SU   | 26224-101           | ITF 004<br>See S0723 | EU       |
| 20.  | Timing Distribution Box                                    | 1   | LMMS | 8A03008GSE-502      | 001                  | GSE      |
| 21.  |                                                            |     |      |                     |                      |          |
| 22.  |                                                            |     |      |                     |                      |          |
| 23.  |                                                            |     |      |                     |                      |          |
| 24.  |                                                            |     |      |                     |                      |          |
| 25.  |                                                            |     |      |                     |                      |          |
| 26.  |                                                            |     |      |                     |                      |          |

**11.0 Software Control**

Software version is documented by completing the following table.

|                   | Software                                      | Version                         |
|-------------------|-----------------------------------------------|---------------------------------|
| 11.1              | Oasis CSTOL                                   |                                 |
| 11.1.1            | timing_test2.prc                              | 1.6                             |
| 11.1.2            | scfpodon.prc                                  | 1.42                            |
| 11.1.3            | <del>ftt_ophem.prc</del>                      |                                 |
| 11.2              | Command Load, modified for timing test        |                                 |
| 11.2.1            | pong11921736.load                             | see attached pong11921736.tline |
| <del>11.2.2</del> | <del>pong11921736.tline (Informational)</del> |                                 |
| 11.2.3            | atc at_init.load - TBD Don K                  | 1.19                            |
| 11.3              | Relevant software versions in ITF             |                                 |
| 11.3.1            | Onboard SPCs in EEPROM                        | 1.115 1-135                     |
| 11.3.2            | MSS                                           | 3.4.0                           |
| 11.3.3            | GSW                                           | 2.1.3.0                         |
| 11.3.4            | GndRT                                         | 5.1.0                           |
| 11.4              | Other                                         |                                 |
|                   | <del>ecclae SVS</del>                         | 2.1.2                           |
|                   | <del>ecclae SPC</del>                         | 1-135                           |
|                   | <del>ecclae FMT</del>                         | 3.4.0.0                         |
|                   | VES                                           | 1.07                            |
|                   | <del>RS232</del>                              | <del>3332</del>                 |
|                   | SSW                                           | 3.3.3.0                         |

**CYCLE SWITCHING**

| <u>TIME</u> | <u>MINUTES/CYCLE</u> |
|-------------|----------------------|
| 16:55       | 0.25                 |
| 18:15       | 0.51                 |
| 18:45       | 1.54                 |
| 19:45       | 3.08                 |

**12.0 Start and End of Test**

Record start and end of test time

|                |       |            |
|----------------|-------|------------|
| Test Operator: | Name: | Bill Given |
| Start of test: | Date: | 3/3/03     |
|                | Time: | 15:00      |
| End of test:   | Date: | 3/4/03     |
|                | Time: | 08:00      |

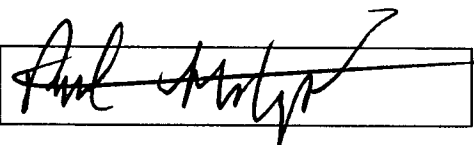
**13.0 Data File**

Record file name

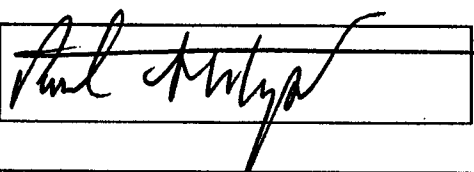
|            |               |
|------------|---------------|
| File Name: | CYCLE: - 5003 |
|------------|---------------|

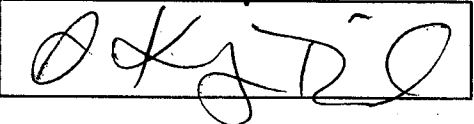
**14.0 Certification**

The undersigned certify that this procedure was performed in whole and that the data recorded above is complete and accurate.

Test Engineer  Date 3/3/03

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

Timing Test REE  Date 3/4/03

Quality Assurance  Date 4/21/03

3/3/03

OPERATIONS ORDER  
**RELATIVITY MISSION**SU GP-B  
RDE 10

SPACECRAFT

TITLE: ITF Timing Test

DRAWING: \_\_\_\_\_

DWG REV. \_\_\_\_\_

S/N: S/N \_\_\_\_\_, Unit \_\_\_\_\_LOG NO: ITF - 38ORIGINATOR: Rich Campbell *Rich Campbell* <sup>2/24/03</sup> EXT: 42141APPROVAL: *JP Farley* <sup>2/24/03</sup>CHARGE NO: F1-WMEE-GAAAQ.A. *[Signature]*QE-1  
J03038

DATE

2/24/03

## NOTE:

- All redlines must be stamped by Q.A.
- All steps shall be performed in sequence unless otherwise noted as to why on back of page and approved by originator and Q.A prior to being performed.

**LOCKHEED MARTIN**

Lockheed Martin Missiles &amp; Space, Co.



## REVISION HISTORY

| REV | DATE          | NAME        | DESCRIPTION                                                                                    |
|-----|---------------|-------------|------------------------------------------------------------------------------------------------|
| NC  | Dec. 20, 2001 | R. Campbell | Initial release                                                                                |
| A   | Feb. 14, 2002 | R. Campbell | Added the disconnect of probe simulator.                                                       |
| B   | Feb. 24, 2003 | R. Campbell | Updated figure 1, added figure 2, and changed steps for timing test hardware changes per ICCB. |
|     |               |             |                                                                                                |

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## INTRODUCTION

This operations order connects a timing distribution box to the SRE, ECU, GSS Gyro Simulator Interface, and SQUID simulator in the ITF for timing measurements. GSS that will be used is specified and roll rate to be simulated.

## DEFINITIONS

ITF = Integrated Test Facility  
SRE = SQUID Readout Electronics  
TDB = Timing Distribution Box  
ECU = Experiment Control Unit  
TRE = Telescope Readout Electronics  
T2ADM = TRE 2 Axis Differential Modulator

Assure = To perform whatever necessary steps are required to meet the condition.  
Verify = To witness the condition. There shall be no steps taken to change the condition.

## TOOLS and EQUIPMENT

### Tools and Equipment Needed:

- One (1) Timing Distribution Box, 8A03008GSE-001
- One (1) Timing Distribution Box power transformer
- One (1) Timing Distribution Box ECU cable, 8A03008GSE-501
- One (1) Timing Distribution Box cable with rate select box, 8A03008GSE-502
- Five (5) BNC cable
- Three(3) BNC "T" adapter

| Operation Number | Procedure                                                                                                                                                                                                                                                                                                   | Data | Date   | Stamp                      |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|----------------------------|
|                  | <b>SETUP</b>                                                                                                                                                                                                                                                                                                |      |        | N/A                        |
| Step 1           | Obtain ok to proceed from responsible engineer<br><br>Ok to proceed: <u><i>KAB</i></u> <sup>OK per</sup> <u>Bill Jacobsen</u><br>signature                                                                                                                                                                  |      | 3/3/03 | P<br><i>4RTE</i><br>J16535 |
| Step 2           | REE initial GSS and Roll Rate to be used for Timing Test.<br><br>GSS TO BE CONFIGURED (initial one)<br><br><u>KAC</u><br>GSS#1      GSS#2      GSS#3      GSS#4<br><br>ROLL RATE, Min/Cycle (Initial one)<br><br>0.0256      0.513      1.540 <u>KAC</u><br>3.075<br><i>per Bill Givens 3/3/03 Jacobsen</i> |      | 3/3/03 | P<br><i>4RTE</i><br>J16535 |
|                  |                                                                                                                                                                                                                                                                                                             |      |        |                            |
| Step 3           | POWER OFF<br><br>Verify ITF power is off.                                                                                                                                                                                                                                                                   |      | 3/3/03 | P<br><i>4RTE</i><br>J16535 |
| Step 4           | Disconnect cable 8A02698GSE-501 connector 2A33P3 from GPS receiver B 2A33 J3.<br><br>Note that this cable shall remain disconnected during timing test.                                                                                                                                                     |      | 3/3/03 | P<br><i>4RTE</i><br>J16535 |
|                  | NOTE: The following steps refer to Figure 1.                                                                                                                                                                                                                                                                |      |        | N/A                        |
| Step 5           | Disconnect cable 8A02698GSE-501 connector 2A22P3 from GPS receiver A 2A22 J3.                                                                                                                                                                                                                               |      | 3/3/03 | P<br><i>4RTE</i><br>J16535 |

| Operation Number | Procedure                                                                                                                                                                                                                       | Data | Date   | Stamp              |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|--------------------|
| Step 6           | Connect cable 8A02698GSE-501 connector 2A22P3 to TDB J6.<br><br>(Connects TDB 1PPS signal to SRE)                                                                                                                               |      | 3/3/03 | P<br>ATE<br>J16535 |
| Step 7           | Disconnect existing BNC cable from GSS Gyro Simulator Interface BNC specified in Step 2.<br>BNC located in lower corner of GSS Gyro Simulator Interface<br><br>(Note: Existing BNC cable originates from specified FWD GSS PHV) |      | 3/3/03 | P<br>ATE<br>J16535 |
| Step 8           | Connect a new BNC cable from TDB J3 to the GSS Gyro Simulator Interface BNC specified in Step 2.<br><br>(located in lower corner of GSS Gyro Simulator Interface)                                                               |      | 3/3/03 | P<br>ATE<br>J16535 |
| Step 9           | Connect a new BNC cable from the TDB J4 to the TEST input of all four Squid Simulators using BNC Tees as necessary.                                                                                                             |      | 3/3/03 | P<br>ATE<br>J16535 |
| Step 10          | Connect the TDB ECU cable, 8A03008GSE-503, to TDB J5.                                                                                                                                                                           |      | 3/3/03 | P<br>ATE<br>J16535 |
| Step 11          | Connect the TDB ECU cable, 8A03008GSE-503, P3E to Aft ECU J3                                                                                                                                                                    |      | 3/3/03 | P<br>ATE<br>J16535 |
| Step 12          | Disconnect the following from FWD ECU<br><br>Probe Simulator cable 8A02849GSE-101 1A06P5 from FWD ECU J5<br><br>Probe Simulator cable 8A02711GSE-501 1A06P7 from FWD ECU J7                                                     |      | 3/3/03 | P<br>ATE<br>J16535 |
| Step 13          | Connect the TDB ECU cable, 8A03008GSE-503, to the following<br><br>cable P5E to Fwd ECU J5<br>cable P7E to Fwd ECU J7                                                                                                           |      | 3/3/03 | P<br>ATE<br>J16535 |

| Operation Number | Procedure                                                                                                                                                                                                                                                                                                                                       | Data | Date   | Stamp                                     |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|-------------------------------------------|
| Step 14          | <p>Assure the TRE simulator is connected to a Fwd SRE as follows and record which Fwd SRE it is connected to, A or B.</p> <p>TRE J2 to Fwd SRE J12 (cable 8A01410-101)</p> <p>TRE J4 to Fwd SRE J11 (cable 8A01412-101)</p> <p>TRE J5 to Fwd SRE J7 (cable 8A01413-101)</p> <p>TRE connected to Fwd SRE <u>A</u><br/>(A, 2A110 or B, 2A111)</p> |      | 3/3/03 | <p>P</p> <p><del>ATE</del><br/>J16535</p> |
| Step 15          | Connect the TDB cable 8A03008GSE-502 to TDB J2.                                                                                                                                                                                                                                                                                                 |      | 3/3/03 | <p>P</p> <p><del>ATE</del><br/>J16535</p> |
| Step 16          | Connect the TDB cable 8A03008GSE-502 to T2ADM P3.                                                                                                                                                                                                                                                                                               |      | 3/3/03 | <p>P</p> <p><del>ATE</del><br/>J16535</p> |
| Step 17          | Connect the TDB cable 8A03008GSE-502 PA7 to FWD SRE not specified in Step 14 J7                                                                                                                                                                                                                                                                 |      | 3/3/03 | <p>P</p> <p><del>ATE</del><br/>J16535</p> |
| Step 18          | Disconnect cable 8A02698GSE-501 connector 2A111P10 from AFT SRE B (2A111) J10.                                                                                                                                                                                                                                                                  |      | 3/3/03 | <p>P</p> <p><del>ATE</del><br/>J16535</p> |
| Step 19          | Set cable Clock Rate Selector switches, 8A03008GSE-502 SA1 and SA2, to rate specified in Step 2 by using Figure 2.                                                                                                                                                                                                                              |      | 3/3/03 | <p>P</p> <p><del>ATE</del><br/>J16535</p> |
| Step 20          | Assure the T2ADM J7 is connected to a TRE simulator J1 directly without going through the TDB.                                                                                                                                                                                                                                                  |      | 3/3/03 | <p>P</p> <p><del>ATE</del><br/>J16535</p> |

| Operation Number                                  | Procedure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Data | Date    | Stamp       |
|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|-------------|
| Step 21                                           | <p><b>CURRENT SWITCH POSITION</b></p> <p>Record the following switch and knob positions on the T2ADM by circling current switch positions and recording Rate knob setting.</p> <div style="display: flex; justify-content: space-around;"><div style="text-align: center;"><p>X - Axis</p><div style="border: 1px solid black; padding: 5px; width: 60px; margin: 0 auto;">Sine<br/>Off<br/>Cosine</div></div><div style="text-align: center;"><p>Y - Axis</p><div style="border: 1px solid black; padding: 5px; width: 60px; margin: 0 auto;">Sine<br/>Off<br/>Cosine</div></div></div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"><div style="text-align: center;"><div style="border: 1px solid black; padding: 5px; width: 60px; margin: 0 auto;">Internal<br/>External</div></div><div style="text-align: center;"><div style="border: 1px solid black; padding: 5px; width: 60px; margin: 0 auto;">Internal<br/>External</div></div></div> <p>Rate Dial Setting = <u>1.07</u></p> |      | 03/3/03 | P<br>J16535 |
| Step 22                                           | Set the AXIS Signal Selection switches for both X and Y axes on the T2ADM to SINE and INTERNAL.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      | 3/3/03  | P<br>J16535 |
| Step 23                                           | Connect TDB power supply from TDB J1 to facility power.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      | 3/3/03  | P<br>J16535 |
| <b>SYSTEM IS NOW CONFIGURED FOR A TIMING TEST</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |         |             |

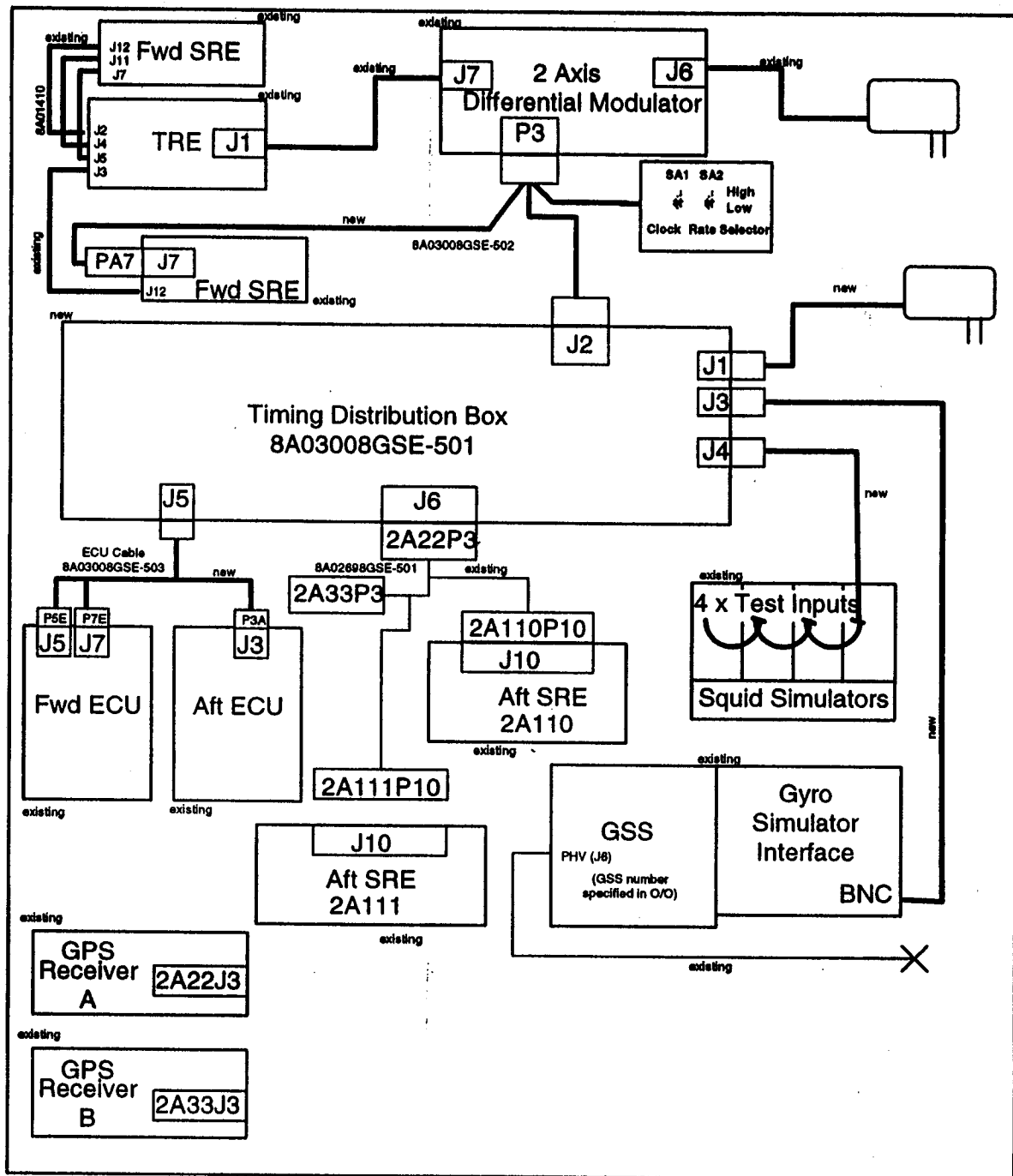


Figure 1, Timing Test Interconnect

| Clock Rate Selector     |                |                |
|-------------------------|----------------|----------------|
| Sine Period,<br>Minutes | SA1<br>(MUX B) | SA2<br>(MUX A) |
| 0.256                   | Low            | Low            |
| 0.513                   | Low            | High           |
| 1.54                    | High           | Low            |
| 3.075                   | High           | High           |

Figure 2, Clock Rate Selector

| Operation Number | Procedure                                                                                                 | Data | Date   | Stamp                |
|------------------|-----------------------------------------------------------------------------------------------------------|------|--------|----------------------|
|                  |                                                                                                           |      |        |                      |
|                  | <b>DISCONNECT</b>                                                                                         |      |        | N/A                  |
| Step 24          | Obtain ok to proceed from responsible engineer<br><br>Ok to proceed: <u><i>Sam J. JH</i></u><br>signature |      | 3-4-03 | P<br>J1837<br>ST     |
|                  |                                                                                                           |      |        |                      |
|                  | POWER OFF<br><br>Verify ITF power is off.                                                                 |      | 3/4/03 | P<br>- RTE<br>J16535 |
| Step 25          | Connect cable 8A02698GSE-501 connector 2A33P3 to GPS receiver B 2A33 J3.                                  |      | 3/4/03 | P<br>- RTE<br>J16535 |
| Step 26          | Disconnect cable 8A02698GSE-501 connector 2A22P3 from TDB J6.                                             |      | 3/4/03 | P<br>- RTE<br>J16535 |
| Step 27          | Connect cable 8A02698GSE-501 connector 2A22P3 to GPS receiver A 2A22 J3.                                  |      | 3/4/03 | P<br>- RTE<br>J16535 |



| Operation Number | Procedure                                                                                                                                                                 | Data | Date   | Stamp               |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|---------------------|
| Step 28          | Reconnect cable 8A02698GSE-501 connector 2A111P10 to AFT SRE B J10.                                                                                                       |      | 3/4/03 | P<br>-AFT<br>J16535 |
| Step 29          | Disconnect BNC cable from TDB J3 and from GSS Gyro Simulator Interface BNC specified in Step 2.                                                                           |      | 3/4/03 | P<br>-AFT<br>J16535 |
| Step 30          | Reconnected BNC cable from GSS specified in Step 2 to specified GSS Gyro Simulator Interface BNC.<br><br>(Note: Existing BNC cable originates from specified FWD GSS PHV) |      | 3/4/03 | P<br>-AFT<br>J16535 |
| Step 31          | Disconnect BNC cables and "T"s from TDB J4 and from TEST input of all four Squid Simulators.                                                                              |      | 3/4/03 | P<br>-AFT<br>J16535 |
| Step 32          | Disconnect the TDB ECU cable from TDB J5 and from the following<br><br>P3E from Aft ECU J3<br>P5E from Fwd ECU J5<br>P7E from Fwd ECU J7                                  |      | 3/4/03 | P<br>-AFT<br>J16535 |
| Step 33          | Reconnect the following to FWD ECU<br><br>Probe Simulator cable 8A02849GSE-101 1A06P5 to FWD ECU J5<br><br>Probe Simulator cable 8A02711GSE-501 1A06P7 to FWD ECU J7      |      | 3/4/03 | P<br>-AFT<br>J16535 |
| Step 34          | Disconnect TDB cable 8A03008GSE-502 from the following<br><br>Cable from TDB J2<br>Cable from T2ADM P3<br>Cable from SRE J7                                               |      | 3/4/03 | P<br>-AFT<br>J16535 |
|                  |                                                                                                                                                                           |      |        |                     |

| Operation Number | Procedure                                                                               | Data | Date   | Stamp              |
|------------------|-----------------------------------------------------------------------------------------|------|--------|--------------------|
| Step 35          | Set T2ADM AXIS Signal Selection switches to their original settings, reference Step 21. |      | 3/4/03 | P<br>RTE<br>J16535 |
| Step 36          | Set T2ADM Rate knob to its original position, reference Step 21.                        |      | 3/4/03 | P<br>RTE<br>J16535 |
| Step 37          | Disconnect TDB power supply from TDB J1 and from facility power.                        |      | 3/4/03 | P<br>RTE<br>J16535 |
| Step 38          | Return TDB, cables, and power supply to ITF stores.                                     |      | 3/4/03 | P<br>RTE<br>J16535 |
|                  |                                                                                         |      |        |                    |
| Step 999         | Q.A. stamp, operations order complete.                                                  | N/A  |        | I                  |

## Timing Test Rate Change History

### Supplemental data

Timing Test Date 3/3/03

During the execution of the timing test, it is desired to collect data with more than one switch selectable rates. The rates are selected by switches on a cable box as part of Assembly 502 of 8A03008GSE.

Record in the table the start time and the indicated rate setting each time the rates are changed. The rate and switch settings are listed on the side of the switch control box.

| Indicated Rate,<br>Minutes/Cycle | Time Set              | Operator               |
|----------------------------------|-----------------------|------------------------|
| 0.25                             | <del>4:55</del> 16:55 | Bob Farley             |
| 0.51                             | 18:15                 | Paul Holyst            |
| 1.54                             | 18:45                 | <del>Paul Holyst</del> |
| 3.08                             | 19:47                 | Paul Holyst            |
|                                  |                       |                        |

3/17/03



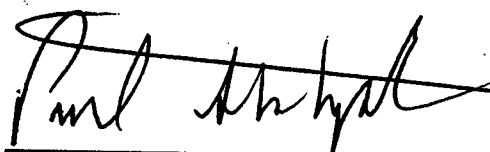
W. W. Hansen Experimental Physics Laboratory  
STANFORD UNIVERSITY  
STANFORD, CALIFORNIA 94305-4085

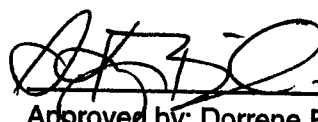
SU GP-B  
RDE 10

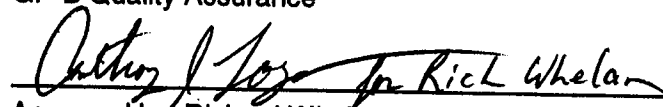
Gravity Probe B Relativity Mission

**ITF TIMING TEST:  
TEST CONFIGURATION  
AND VERSION CONTROL  
DOCUMENTATION**

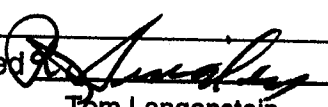
P0939 Rev -  
August 29, 2002

 8/30/02  
Prepared by: Paul Shestopole Date

 for Dorrene Ross 8/30/02  
Approved by: Dorrene Ross Date  
GP-B Quality Assurance

 for Rick Whelan 8/30/02  
Approved by: Richard Whelan Date  
GP-B Systems Engineering

ITAR Assessment Performed

  
Tom LangensteinITAR Control Req'd? ☐ Yes ☒ No

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**1.0 Revision History**

| Rev Level | Comments/notes                       | Date        | Revised By  |
|-----------|--------------------------------------|-------------|-------------|
| -         | First release of this test procedure | 29-Aug-2002 | P Shestople |
|           |                                      |             |             |
|           |                                      |             |             |

**2.0 Scope**

This procedure documents Integrated Testing Facility (ITF) software versions and hardware configurations used during GPB Timing Tests

This procedure ☒ Does ☐ Does not provide formal verification of GP-B requirements.  
 This procedure ☐ Does ☒ Does not include constraints and restrictions for the Payload.

### 3.0 Formal Requirements Verification

This procedure documents hardware configuration and software versions used to verify requirements shown in Table 1.

|      | Section        | Title                                                    | Part A | Part B |
|------|----------------|----------------------------------------------------------|--------|--------|
| 3.1  | T002, 11       | Telemetry and Data Processing                            |        | ✓      |
| 3.2  | T003, 3.6.6    | Timing and Signal Processing                             |        | ✓      |
| 3.3  | T003, 7.6.5    | Pointing and Light Intensity Signals                     |        | ✓      |
| 3.4  | T003, 16.1.1   | Primary Payload Clock Frequency                          | ✓      |        |
| 3.5  | T003, 16.4     | Payload-to-Spacecraft Synchronization                    | ✓      |        |
| 3.6  | T003, 16.4.1   | ATC Data Strobe Pulse Frequency                          |        | ✓      |
| 3.7  | T003, 16.5     | Payload Absolute Time Standard                           | ✓      |        |
| 3.8  | T003, 16.6     | Time Tagging                                             | ✓      |        |
| 3.9  | T003, 16.6.1   | GPS PPS Time Tag                                         | ✓      |        |
| 3.10 | T003, 16.6.2   | ATC Data Pulse Strobe Time Tag                           | ✓      |        |
| 3.11 | T003, 16.6.3   | SQUID Readout Science Signals Time Tag                   |        | ✓      |
| 3.12 | T003, 16.6.4   | Telescope Readout Science Signals Time Tag               |        | ✓      |
| 3.13 | T003, 16.6.6   | Gyroscope Suspension System Science Signals Time Tagging |        | ✓      |
| 3.14 | T003, 16.6.7   | Experiment Control Unit Science Signals Time Tagging     |        | ✓      |
| 3.15 | SE-23, 3.2.1.3 | PPS Accuracy                                             | ✓      |        |
| 3.16 | SE-23, 3.2.1.4 | PPS Ambiguity Resolution                                 | ✓      |        |

Table 1: GPB Timing Requirements

### 4.0 Reference Documents

- 4.1. MIL-STD-1686 Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment
- 4.2. P0875 GP-B Maintenance and Testing at all Facilities
- 4.3. MIL-STD-1540C Test Requirements for Launch, Upper-stage, and Space Vehicles, Section 6.4.2.

### 5.0 Test Facility

Primary facility: Lockheed Palo Alto Integrated Testing Facility, Bldg. 205.

## 6.0 QA Provisions

- 6.1. This procedure shall be conducted on a formal basis to its latest approved and released version. The QA Program Engineer (D. Ross) and the ONR representative (E. Ingraham) shall be notified 24 hours prior to the start of this procedure. QA may monitor the execution of all or part of this procedure should they elect to do so.

Date/time: 3/10/03 16:00 Date/time: 3/10/03 16:00  
GP-B QA (D. Ross) K. BURLINGHAM ONR (E. Ingraham)

- 6.2. Upon completion of this procedure, the Timing Test REE and the GP-B QA manager shall certify her/his concurrence that the procedure was performed and accomplished in accordance with the prescribed instructions by signing and dating his approval at the end of this procedure.

## 7.0 Test Personnel

This document shall be completed only by persons familiar with hardware configuration and software version control, or be those designated by the Timing Test REE at the time of test (redline names in below as required).

- 7.1. Kelly Burlingham  
7.2. Bill Given  
7.3. Paul Shestople

## 8.0 General Instructions

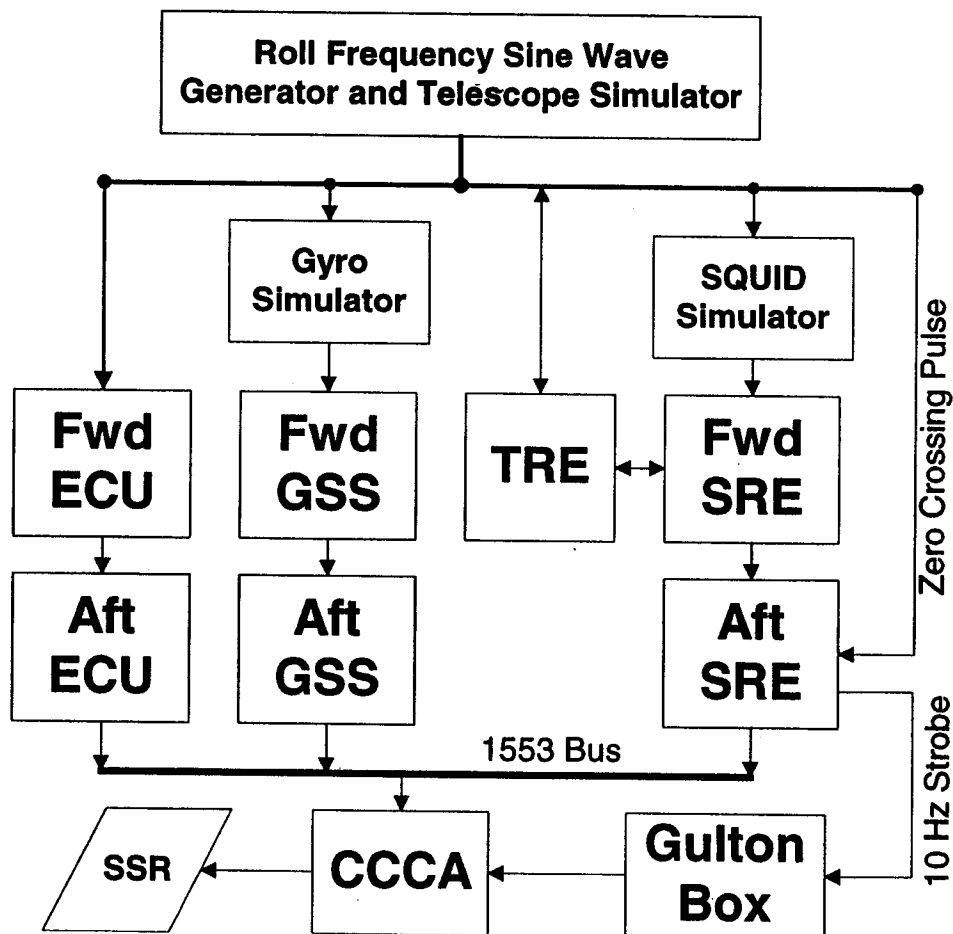
- 8.1. Redlines can be initiated by the test personnel listed in Section 7.0 and must be approved by QA.
- 8.2. Test operators shall read this procedure in its entirety and resolve any apparent ambiguities prior to beginning this test.
- 8.3. Any nonconformance or test anomaly should be reported by a Discrepancy Report. Refer to the Quality Plan, P0108, for guidance. Do not alter or break test configuration if a test failure occurs; notify quality assurance.
- 8.4. Only the following persons have the authority to exit/terminate this test or perform a retest: test operators listed in Section 7.0 and GP-B QA.

## 9.0 Hardware Safety Requirements:

- 9.1. Hardware used in this test is ESD sensitive; special care shall be exercised per the "Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment", MIL-STD-1686.
- 9.2. Lockheed facilities are under Lockheed configuration control. Only Rich Campbell, or his representative, may change ITF hardware configuration, and all such changes must be documented.
- 9.3. Software version control must be strictly adhered to. Only Bill Given, or his representative, may change software versions, and all such changes must be documented.

## 10.0 Hardware Configuration

Timing Test Hardware Configuration is shown schematically in Figure 1. Document Configuration by completing table on next page.



### Figure 1: Hardware Configuration



| Item | Equipment Description                                      | Qty | Make | PN                  | SN                   | Pedigree |
|------|------------------------------------------------------------|-----|------|---------------------|----------------------|----------|
| 1.   | Roll Frequency Sine Wave Generator and Telescope Simulator | 1   | LMMS | T2ADM               | 001                  | GSE      |
| 2.   | Gyro Simulator                                             | 1   | SU   | GSS GYRO Simulator  | 001                  | GSE      |
| 3.   | SQUID Simulator                                            | 1   | LMMS | SRE SQUID Simulator | 001                  | GSE      |
| 4.   | Forward ECU                                                | 1   | LMMS | 8A01313             | 001                  | FEU      |
| 5.   | Aft ECU                                                    | 1   | LMMS | 8A00922             | 001                  | FEU      |
| 6.   | Forward GSS - 1                                            | 1   | SU   | 26225-101           | ITF 001<br>See S0723 | EU       |
| 7.   | Aft GSS - 1                                                | 1   | SU   | 26224-101           | ITF 001<br>See S0723 | EU       |
| 8.   | TRE                                                        | 1   | LMMS | TRE                 | 004                  | EU       |
| 9.   | Forward SRE - A                                            | 1   | LMMS | 8A00848GSE-101      | 001                  | FEU      |
| 10.  | Aft SRE - A                                                | 1   | LMMS | 8A00920-101         | 001                  | FEU      |
| 11.  | Gulton Box                                                 | 1   | LMMS | EAN60411-001-01     | 101                  | FEU      |
| 12.  | CCCA                                                       | 1   | LMMS | 7578100-01          | 001                  | FEU      |
| 13.  | SSR                                                        | 1   | LMMS | 161100              | 001                  | EU       |
| 14.  | Forward SRE - B                                            | 1   | LMMS | 8A00848GSE-101      | 002                  | FEU      |
| 15.  | Aft SRE - B                                                | 1   | LMMS | 8A00920-102         | 001                  | FEU      |
| 16.  | Forward GSS - 2                                            | 1   | SU   | 26225-101           | ITF 002<br>See S0723 | EU       |
| 17.  | Aft GSS - 2                                                | 1   | SU   | 26224-101           | ITF 002<br>See S0723 | EU       |
| 18.  | Aft GSS - 3                                                | 1   | SU   | 26224-101           | ITF 003<br>See S0723 | FU       |
| 19.  | Aft GSS - 4                                                | 1   | SU   | 26224-101           | ITF 004<br>See S0723 | EU       |
| 20.  | Timing Distribution Box                                    | 1   | LMMS | 8A03008GSE-502      | 001                  | GSE      |
| 21.  |                                                            |     |      |                     |                      |          |
| 22.  |                                                            |     |      |                     |                      |          |
| 23.  |                                                            |     |      |                     |                      |          |
| 24.  |                                                            |     |      |                     |                      |          |
| 25.  |                                                            |     |      |                     |                      |          |
| 26.  |                                                            |     |      |                     |                      |          |

**12.0 Start and End of Test**

Record start and end of test time

|                |       |                |
|----------------|-------|----------------|
| Test Operator: | Name: | Paul Shestople |
| Start of test: | Date: | 3/17/03        |
|                | Time: | 16:00          |
| End of test:   | Date: | 3/18/03        |
|                | Time: | 10:00          |

**13.0 Data File**

Record file name

|            |        |
|------------|--------|
| File Name: | - 5004 |
|------------|--------|

**14.0 Certification**

The undersigned certify that this procedure was performed in whole and that the data recorded above is complete and accurate.

Test Engineer

*Paul Shestople*  
SU GP-B  
RDE 10

Date

3/18/03

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

Timing Test  
REE

*Paul Shestople*  
SU GP-B  
RDE 10

Date

3/18/03

Quality  
Assurance

*J. K. R. I.*  
SU GP-B  
INSP 20

Date

4/21/03

**11.0 Software Control**

Software version is documented by completing the following table.

|        | Software                               | Version  |
|--------|----------------------------------------|----------|
| 11.1   | Oasis CSTOL                            | 1.428    |
| 11.1.1 | timing_test2.prc                       | 1.9      |
| 11.1.2 | scfpodon.prc                           | 1.42     |
| 11.1.3 | fqt_ephem.prc                          | N/A      |
| 11.2   | Command Load, modified for timing test | See at 4 |
| 11.2.1 | pong11921736.load                      | "        |
| 11.2.2 | pong11921736.tline                     | "        |
| 11.2.3 | <del>at</del> init.load                | 1.20     |
| 11.3   | Relevant software versions in ITF      |          |
| 11.3.1 | Onboard SPCs in EEPROM                 | 1-136    |
| 11.3.2 | MSS                                    | 3.4.0.1  |
| 11.3.3 | GSW                                    | 2.2.0.0  |
| 11.3.4 | GndRT                                  | 5.1.0    |
| 11.4   | Other                                  |          |
|        | GYRO SIMULATOR                         | 1.1      |
|        |                                        |          |
|        |                                        |          |
|        |                                        |          |
|        |                                        |          |
|        |                                        |          |



3/17/03



# OPERATIONS ORDER

## RELATIVITY MISSION

### SPACECRAFT



TITLE: ITF Timing Test

DRAWING: \_\_\_\_\_

DWG REV. \_\_\_\_\_

S/N: S/N , Unit \_\_\_\_\_

LOG NO: \_\_\_\_\_

ORIGINATOR: Rich Campbell *Rich Campbell* <sup>3/17/03</sup>

EXT: 42141

APPROVAL: \_\_\_\_\_

CHARGE NO: F1-WMEE-GAAA

Q.A. *Amber* <sup>506843</sup>

DATE 3/18/03

NOTE:

- All redlines must be stamped by Q.A.
- All steps shall be performed in sequence unless otherwise noted as to why on back of page and approved by originator and Q.A prior to being performed.

**LOCKHEED MARTIN**

Lockheed Martin Missiles & Space, Co.

**REVISION HISTORY**

| <b>REV</b> | <b>DATE</b>    | <b>NAME</b> | <b>DESCRIPTION</b>                                                                                                                                                                                                                                             |
|------------|----------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NC         | Dec. 20, 2001  | R. Campbell | Initial release                                                                                                                                                                                                                                                |
| A          | Feb. 14, 2002  | R. Campbell | Added the disconnect of probe simulator.                                                                                                                                                                                                                       |
| B          | Feb. 24, 2003  | R. Campbell | Updated figure 1, added figure 2, and changed steps for timing test hardware changes per ICCB.                                                                                                                                                                 |
| C          | March 17, 2003 | R. Campbell | Updated figure 1, step 2, 7, 8, 29, and 30 to allow more than one fwd GSS to be connected.<br>Added Table 1 to record roll rates used.<br>Added step to assure all four SQUID simulators are installed.<br>Added steps to configure SRE DAS interfaces to TRE. |
|            |                |             |                                                                                                                                                                                                                                                                |

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## INTRODUCTION

This operations order connects a timing distribution box to the SRE, ECU, GSS Gyro Simulator Interface, and SQUID simulator in the ITF for timing measurements. GSSs that will be used is specified and roll rate to be simulated. During Timing Test changes in roll rates are recorded in table.

## DEFINITIONS

ITF = Integrated Test Facility  
SRE = SQUID Readout Electronics  
TDB = Timing Distribution Box  
ECU = Experiment Control Unit  
TRE = Telescope Readout Electronics  
T2ADM = TRE 2 Axis Differential Modulator

Assure = To perform whatever necessary steps are required to meet the condition.  
Verify = To witness the condition. There shall be no steps taken to change the condition.

## TOOLS and EQUIPMENT

### Tools and Equipment Needed:

- One (1) Timing Distribution Box, 8A03008GSE-001
- One (1) Timing Distribution Box power transformer
- One (1) Timing Distribution Box ECU cable, 8A03008GSE-501
- One (1) Timing Distribution Box cable with rate select box, 8A03008GSE-502
- Eight (8) BNC cable
- Six (6) BNC "T" adapter

| Operation Number | Procedure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Data | Date           | Stamp       |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------|-------------|
|                  | <b>SETUP</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |                | N/A         |
| Step 1           | Obtain ok to proceed from responsible engineer<br><br>Ok to proceed: <u><i>Rob</i> <i>3/17/03</i></u><br>signature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      | <i>3/17/03</i> | P <i>RL</i> |
| Step 2           | SRE DAS INITIAL CONFIGURATION<br><br>Record SRE to TRE interfaces below.<br><br>TRE J2 mated to SRE# <u><i>BA</i></u> , SRE connector <u><i>J12</i></u><br>(A or B) (J12 or J13)<br><br>TRE J3 mated to SRE# <u><i>B</i></u> , SRE connector <u><i>J12</i></u><br>(A or B) (J12 or J13)                                                                                                                                                                                                                                                                                                                                                                      |      | <i>3/17/03</i> | P <i>RL</i> |
| Step 3           | REE initial GSS, SRE DAS, and initial Roll Rate to be used for Timing Test.<br><br>GSS(s) TO BE CONFIGURED<br><br><u><i>RL</i></u> <u><i>RL</i></u> _____      _____<br>GSS#1      GSS#2      GSS#3      GSS#4<br><br>ROLL RATE, Min/Cycle (Initial one)<br><br><u><i>RL</i></u> _____      _____      _____<br>0.0256      0.513      1.540      3.075<br><br>TRE J2 mates to SRE# <u><i>BA</i></u> , SRE connector <u><i>J13</i></u> *<br>(A or B) (J12 or J13)<br><br>TRE J3 mates to SRE# <u><i>B</i></u> , SRE connector <u><i>J13</i></u> *<br>(A or B) (J12 or J13)<br><br>* Mark these options as "NA" if they are to remain as specified in Step 2. |      | <i>3/17/03</i> | P <i>RL</i> |
| Step 4           | POWER OFF<br><br>Verify ITF power is off.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      | <i>3/17/03</i> | P <i>RL</i> |

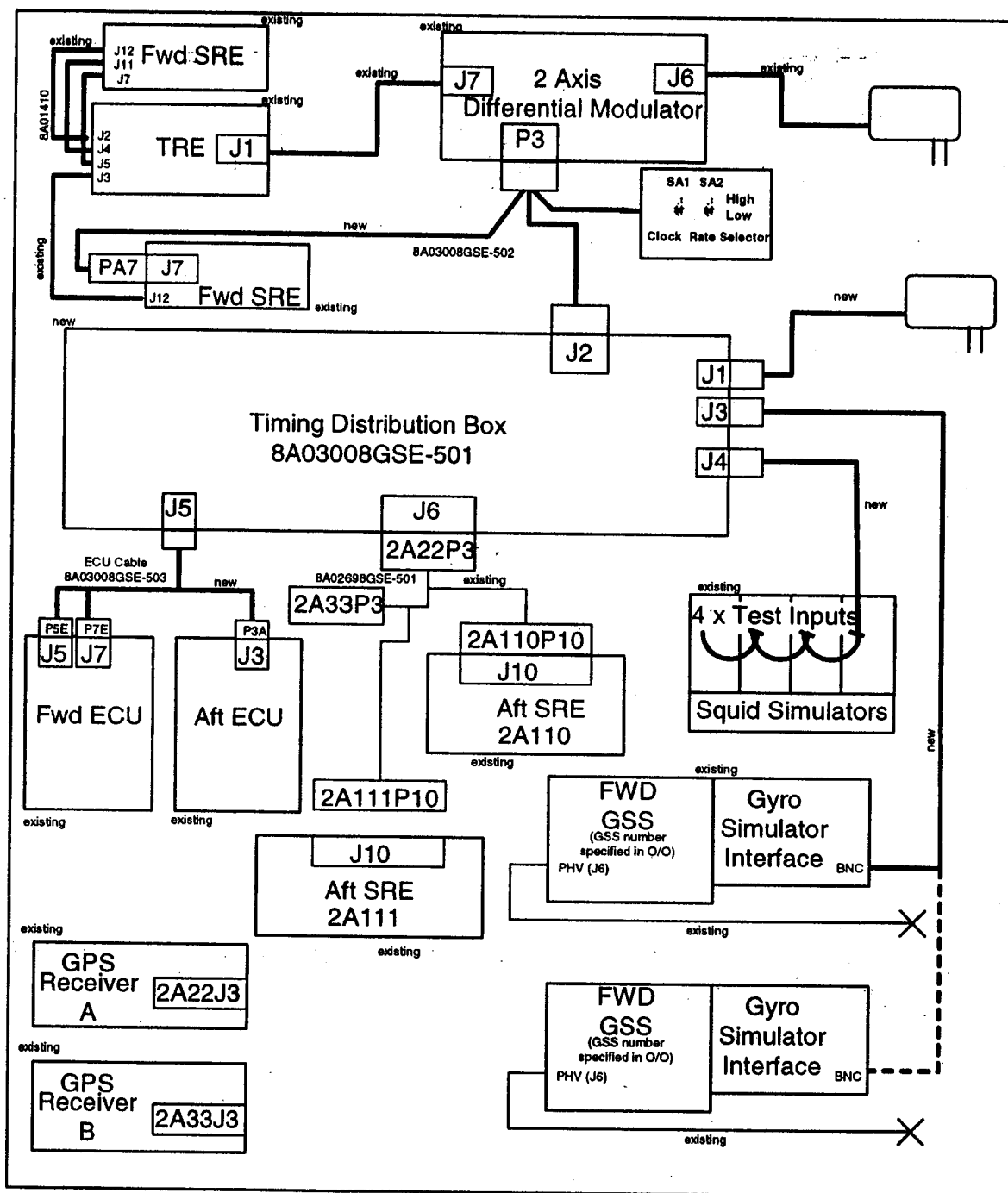
| Operation Number | Procedure                                                                                                                                                                                                                                                                             | Data | Date    | Stamp             |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|-------------------|
| Step 5           | SRE DAS RE-CONFIGURATION<br><br>Assure TRE to SRE cables are per Step 3.                                                                                                                                                                                                              |      | 3/17/03 | P<br>OK<br>247651 |
| Step 6           | Disconnect cable 8A02698GSE-501 connector 2A33P3 from GPS receiver B 2A33 J3.<br><br>Note that this cable shall remain disconnected during timing test.                                                                                                                               |      | 3/17/03 | P<br>OK           |
|                  | NOTE: The following steps refer to Figure 1.                                                                                                                                                                                                                                          |      |         | N/A               |
| Step 7           | Disconnect cable 8A02698GSE-501 connector 2A22P3 from GPS receiver A 2A22 J3.                                                                                                                                                                                                         |      | 3/17/03 | P                 |
| Step 8           | Connect cable 8A02698GSE-501 connector 2A22P3 to TDB J6.<br><br>(Connects TDB 1PPS signal to SRE)                                                                                                                                                                                     |      | 3/17/03 | P                 |
| Step 9           | Disconnect existing BNC cable(s) from GSS Gyro Simulator Interface BNC(s) specified in Step 3.<br>BNC located in lower corner of GSS Gyro Simulator Interface<br><br>(Note: Existing BNC cable originates from specified FWD GSS PHV)                                                 |      | 3/17/03 | P                 |
| Step 10          | Connect a new BNC cable from TDB J3 to the GSS Gyro Simulator Interface BNC(s) specified in Step 3. If more than one GSS is specified use BNC "T"s as required at the Gyro Simulator Interface to daisy chain units.<br><br>(located in lower corner of GSS Gyro Simulator Interface) |      | 3/17/03 | P                 |
| Step 11          | Connect a new BNC cable from the TDB J4 to the TEST input of all four Squid Simulators using BNC Tees as necessary.                                                                                                                                                                   |      | 3/17/03 | P                 |
| Step 12          | Disconnect SQUID from FWD SRE B (1A09) J1 and connect SQUID simulator as follows<br><br>SQUID Simulator Cable FEU SQ 1/2 to FWD SRE B J1                                                                                                                                              |      | 3/17/03 | P<br>OK<br>247651 |



| Operation Number | Procedure                                                                                                                                                                                                                                                                                 | Data | Date    | Stamp             |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|-------------------|
| Step 13          | Connect the TDB ECU cable, 8A03008GSE-503, to TDB J5.                                                                                                                                                                                                                                     |      | 3/17/03 | P<br>AL<br>247651 |
| Step 14          | Connect the TDB ECU cable, 8A03008GSE-503, P3E to Aft ECU J3                                                                                                                                                                                                                              |      |         | P                 |
| Step 15          | Disconnect the following from FWD ECU<br><br>Probe Simulator cable 8A02849GSE-101 1A06P5 from FWD ECU J5<br><br>Probe Simulator cable 8A02711GSE-501 1A06P7 from FWD ECU J7                                                                                                               |      |         | P                 |
| Step 16          | Connect the TDB ECU cable, 8A03008GSE-503, to the following<br><br>cable P5E to Fwd ECU J5<br>cable P7E to Fwd ECU J7                                                                                                                                                                     |      |         | P                 |
| Step 17          | Assure the TRE simulator is connected to a Fwd SRE as follows and record which Fwd SRE it is connected to, A or B.<br><br>TRE J4 to Fwd SRE J11 (cable 8A01412-101)<br>TRE J5 to Fwd SRE J7 (cable 8A01413-101)<br><br>TRE connected to Fwd SRE <u>A(2A110)</u><br>(A, 2A110 or B, 2A111) |      |         | P                 |
| Step 18          | Connect the TDB cable 8A03008GSE-502 to TDB J2.                                                                                                                                                                                                                                           |      |         | P                 |
| Step 19          | Connect the TDB cable 8A03008GSE-502 to T2ADM P3.                                                                                                                                                                                                                                         |      |         | P                 |
| Step 20          | Connect the TDB cable 8A03008GSE-502 PA7 to FWD SRE not specified in Step 17 J7                                                                                                                                                                                                           |      | 3/17/03 | P<br>AL<br>247651 |

| Operation Number                           | Procedure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Data | Date    | Stamp                 |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|-----------------------|
| Step 21                                    | Disconnect cable 8A02698GSE-501 connector 2A111P10 from AFT SRE B (2A111) J10.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      | 3/17/03 | P <i>AL</i><br>247057 |
| Step 22                                    | Set cable Clock Rate Selector switches, 8A03008GSE-502 SA1 and SA2, to rate specified in Step 3 by using Figure 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      | 3/17/03 | P <i>AL</i>           |
| Step 23                                    | Assure the T2ADM J7 is connected to a TRE simulator J1 directly without going through the TDB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      | 3/17/03 | P <i>AL</i>           |
| Step 24                                    | <p>CURRENT SWITCH POSITION</p> <p>Record the following switch and knob positions on the T2ADM by circling current switch positions and recording Rate knob setting.</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>X - Axis</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Sine</div> <p>Off</p> <div style="border: 1px solid black; padding: 5px;">Cosine</div> </div> <div style="text-align: center;"> <p>Y - Axis</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Sine</div> <p>Off</p> <div style="border: 1px solid black; padding: 5px;">Cosine</div> </div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Internal</div> <p>External</p> </div> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Internal</div> <p>External</p> </div> </div> <p>Rate Dial Setting = <u>2.07</u></p> |      | 3/17/03 | P <i>AL</i>           |
| Step 25                                    | Set the AXIS Signal Selection switches for both X and Y axes on the T2ADM to SINE and INTERNAL.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      | 3/17/03 | P <i>AL</i>           |
| Step 26                                    | Connect TDB power supply from TDB J1 to facility power.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      | 3/17/03 | P <i>AL</i>           |
| SYSTEM IS NOW CONFIGURED FOR A TIMING TEST |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |         |                       |

| Operation Number | Procedure                                                                                                                                                                                                                                                                                   | Data | Date    | Stamp               |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|---------------------|
|                  | It is understood that the user selectable roll rate may change during the Timing Test and changes shall be recorded in Table 1.                                                                                                                                                             |      |         |                     |
|                  | It is understood that the TRE to SRE DAS interface(s) may change upon Test Directors direction per Step 27                                                                                                                                                                                  |      |         |                     |
| Step 27          | <p>REE specify SRE DAS reconfiguration below.</p> <p>TRE J2 mates to SRE#_____, SRE connector_____</p> <p>(A or B) (J12 or J13)</p> <p>TRE J3 mates to SRE#_____, SRE connector_____</p> <p>(A or B) (J12 or J13)</p> <p>Mark this step as "NA" if DAS reconfiguration is not required.</p> |      | N/A     | P                   |
| Step 28          | <p>Assure SRE A and SRE B power is off prior to performing this step.</p> <p>Assure TRE to SRE cables are configured per Step 27.</p>                                                                                                                                                       |      | 3/18/03 | P<br>*RTE<br>J16535 |



### Figure 1, Timing Test Interconnect

| Clock Rate Selector     |                |                |
|-------------------------|----------------|----------------|
| Sine Period,<br>Minutes | SA1<br>(MUX B) | SA2<br>(MUX A) |
| 0.256                   | Low            | Low            |
| 0.513                   | Low            | High           |
| 1.54                    | High           | Low            |
| 3.075                   | High           | High           |

Figure 2, Clock Rate Selector

NOTE VT-48157678 ↔ 9:57 PST

Record in the table the start time and the indicated rate setting each time the rates are changed once the initial rate is changed.

| Indicated Rate,<br>Minutes/Cycle | Time Set | Operator                           |
|----------------------------------|----------|------------------------------------|
| 0.513                            | 9:00     | TS                                 |
| 1.54                             | 9:30     | TS                                 |
| 3.054                            | 10:00    | OK per Telecom w/ Paul S. J. 10:00 |
|                                  |          |                                    |
|                                  |          |                                    |

Table 1, Rate Settings

| Operation<br>Number | Procedure                                                                                             | Data | Date    | Stamp    |
|---------------------|-------------------------------------------------------------------------------------------------------|------|---------|----------|
|                     |                                                                                                       |      |         |          |
|                     | <b>DISCONNECT</b>                                                                                     |      |         | N/A      |
| Step 29             | Obtain ok to proceed from responsible engineer<br><br>Ok to proceed: <u>Walter C. Li</u><br>signature |      | 3/18/03 | P<br>wes |
|                     |                                                                                                       |      |         |          |
| Step 30             | POWER OFF<br><br>Verify ITF power is off.                                                             |      | 3/18/03 | P        |

| Operation Number | Procedure                                                                                                                                                                       | Data | Date    | Stamp        |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|--------------|
| Step 31          | Disconnect cable 8A02698GSE-501 connector 2A22P3 from TDB J6.                                                                                                                   |      | 3/18/03 | P<br>[Stamp] |
| Step 32          | Connect cable 8A02698GSE-501 connector 2A33P3 to GPS receiver B 2A33 J3.                                                                                                        |      | 3/18/03 | P<br>[Stamp] |
| Step 33          | Connect cable 8A02698GSE-501 connector 2A22P3 to GPS receiver A 2A22 J3.                                                                                                        |      | 3/18/03 | P<br>[Stamp] |
| Step 34          | Reconnect cable 8A02698GSE-501 connector 2A111P10 to AFT SRE B J10.                                                                                                             |      | 3/18/03 | P<br>[Stamp] |
| Step 35          | Disconnect BNC cable from TDB J3 and from GSS Gyro Simulator Interface BNC(s), including any BND "T"s, specified in Step 3.                                                     |      | 3/18/03 | P<br>[Stamp] |
| Step 36          | Reconnected BNC cable from GSS(s) specified in Step 3 to specified GSS Gyro Simulator Interface BNC(s).<br><br>(Note: Existing BNC cable originates from specified FWD GSS PHV) |      | 3/18/03 | P<br>[Stamp] |
| Step 37          | Disconnect BNC cables and "T"s from TDB J4 and from TEST input of all four Squid Simulators.                                                                                    |      | 3/18/03 | P<br>[Stamp] |
| Step 38          | Disconnect SQUID Simulator from FWD SRE B (1A09) J1 and connect SQUID as follows,<br><br>SQUID Cable to FWD SRE B J1                                                            |      | 3/18/03 | P<br>[Stamp] |
| Step 39          | Disconnect the TDB ECU cable from TDB J5 and from the following<br><br>P3E from Aft ECU J3<br>P5E from Fwd ECU J5<br>P7E from Fwd ECU J7                                        |      | 3/18/03 | P<br>[Stamp] |

| Operation Number | Procedure                                                                                                                                                            | Data | Date    | Stamp         |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|---------------|
| Step 40          | Reconnect the following to FWD ECU<br><br>Probe Simulator cable 8A02849GSE-101 1A06P5 to FWD ECU J5<br><br>Probe Simulator cable 8A02711GSE-501 1A06P7 to FWD ECU J7 |      | 3/18/03 | P<br>7/15/03  |
| Step 41          | Disconnect TDB cable 8A03008GSE-502 from the following<br><br>Cable from TDB J2<br>Cable from T2ADM P3<br>Cable from SRE J7                                          |      | 3/18/03 | P<br>7/15/03  |
| Step 42          | Set T2ADM AXIS Signal Selection switches to their original settings, reference Step 24.                                                                              |      | 3/18/03 | P<br>7/15/03  |
| Step 43          | Set T2ADM Rate knob to its original position, reference Step 24.                                                                                                     |      | 3/18/03 | P<br>7/15/03  |
| Step 44          | Disconnect TDB power supply from TDB J1 and from facility power.                                                                                                     |      | 3/18/03 | P<br>7/15/03  |
| Step 45          | Assure TRE to SRE cables are configured per Step 2.                                                                                                                  |      | 3/18/03 | P<br>7/15/03  |
| Step 46          | Return TDB, cables, and power supply to ITF stores.                                                                                                                  |      | 3/18/03 | P<br>7/15/03  |
|                  |                                                                                                                                                                      |      |         |               |
| Step 999         | Q.A. stamp, operations order complete.                                                                                                                               | N/A  | 3/18/03 | P<br>QE 60684 |

417103



W. W. Hansen Experimental Physics Laboratory  
STANFORD UNIVERSITY  
STANFORD, CALIFORNIA 94305-4085

SU GP-B  
RDE 10

Gravity Probe B Relativity Mission

# ITF TIMING TEST: TEST CONFIGURATION AND VERSION CONTROL DOCUMENTATION

P0939 Rev -  
August 29, 2002

8/30/02

Prepared by: Paul Shestople

Date

8/30/02

Approved by: Dorrene Ross

Date

GP-B Quality Assurance

8/30/02

Approved by: Richard Whelan

Date

GP-B Systems Engineering

ITAR Assessment Performed

  
Tom LangensteinITAR Control Req'd? ☐ Yes ☒ No



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**1.0 Revision History**

| Rev Level | Comments/notes                       | Date        | Revised By  |
|-----------|--------------------------------------|-------------|-------------|
| -         | First release of this test procedure | 29-Aug-2002 | P Shestople |
|           |                                      |             |             |
|           |                                      |             |             |

**2.0 Scope**

This procedure documents Integrated Testing Facility (ITF) software versions and hardware configurations used during GPB Timing Tests

This procedure ☒ Does ☐ Does not provide formal verification of GP-B requirements.  
 This procedure ☐ Does ☒ Does not include constraints and restrictions for the Payload.

**3.0 Formal Requirements Verification**

This procedure documents hardware configuration and software versions used to verify requirements shown in Table 1.

|      | Section        | Title                                                    | Part A | Part B |
|------|----------------|----------------------------------------------------------|--------|--------|
| 3.1  | T002, 11       | Telemetry and Data Processing                            |        | ✓      |
| 3.2  | T003, 3.6.6    | Timing and Signal Processing                             |        | ✓      |
| 3.3  | T003, 7.6.5    | Pointing and Light Intensity Signals                     |        | ✓      |
| 3.4  | T003, 16.1.1   | Primary Payload Clock Frequency                          | ✓      |        |
| 3.5  | T003, 16.4     | Payload-to-Spacecraft Synchronization                    | ✓      |        |
| 3.6  | T003, 16.4.1   | ATC Data Strobe Pulse Frequency                          |        | ✓      |
| 3.7  | T003, 16.5     | Payload Absolute Time Standard                           | ✓      |        |
| 3.8  | T003, 16.6     | Time Tagging                                             | ✓      |        |
| 3.9  | T003, 16.6.1   | GPS PPS Time Tag                                         | ✓      |        |
| 3.10 | T003, 16.6.2   | ATC Data Pulse Strobe Time Tag                           | ✓      |        |
| 3.11 | T003, 16.6.3   | SQUID Readout Science Signals Time Tag                   |        | ✓      |
| 3.12 | T003, 16.6.4   | Telescope Readout Science Signals Time Tag               |        | ✓      |
| 3.13 | T003, 16.6.6   | Gyroscope Suspension System Science Signals Time Tagging |        | ✓      |
| 3.14 | T003, 16.6.7   | Experiment Control Unit Science Signals Time Tagging     |        | ✓      |
| 3.15 | SE-23, 3.2.1.3 | PPS Accuracy                                             | ✓      |        |
| 3.16 | SE-23, 3.2.1.4 | PPS Ambiguity Resolution                                 | ✓      |        |

Table 1: GPB Timing Requirements

**4.0 Reference Documents**

- 4.1. MIL-STD-1686 Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment
- 4.2. P0875 GP-B Maintenance and Testing at all Facilities
- 4.3. MIL-STD-1540C Test Requirements for Launch, Upper-stage, and Space Vehicles, Section 6.4.2.

**5.0 Test Facility**

Primary facility: Lockheed Palo Alto Integrated Testing Facility, Bldg 205.

## 6.0 QA Provisions

- 6.1. This procedure shall be conducted on a formal basis to its latest approved and released version. The QA Program Engineer (D. Ross) and the ONR representative (E. Ingraham) shall be notified 24 hours prior to the start of this procedure. QA may monitor the execution of all or part of this procedure should they elect to do so.

Date/time: 4/1/03 Date/time: 4/1/03  
GP-B QA (D. Ross) K. BURLINGHAM ONR (E. Ingraham)

- 6.2. Upon completion of this procedure, the Timing Test REE and the GP-B QA manager shall certify her/his concurrence that the procedure was performed and accomplished in accordance with the prescribed instructions by signing and dating his approval at the end of this procedure.

## 7.0 Test Personnel

This document shall be completed only by persons familiar with hardware configuration and software version control, or be those designated by the Timing Test REE at the time of test (redline names in below as required).

- 7.1. Kelly Burlingham  
7.2. Bill Given  
7.3. Paul Shestople

## 8.0 General Instructions

- 8.1. Redlines can be initiated by the test personnel listed in Section 7.0 and must be approved by QA.
- 8.2. Test operators shall read this procedure in its entirety and resolve any apparent ambiguities prior to beginning this test.
- 8.3. Any nonconformance or test anomaly should be reported by a Discrepancy Report. Refer to the Quality Plan, P0108, for guidance. Do not alter or break test configuration if a test failure occurs; notify quality assurance.
- 8.4. Only the following persons have the authority to exit/terminate this test or perform a retest: test operators listed in Section 7.0 and GP-B QA.

**9.0 Hardware Safety Requirements:**

- 9.1. Hardware used in this test is ESD sensitive; special care shall be exercised per the "Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment", MIL-STD-1686.
- 9.2. Lockheed facilities are under Lockheed configuration control. Only Rich Campbell, or his representative, may change ITF hardware configuration, and all such changes must be documented.
- 9.3. Software version control must be strictly adhered to. Only Bill Given, or his representative, may change software versions, and all such changes must be documented.

**10.0 Hardware Configuration**

Timing Test Hardware Configuration is shown schematically in Figure 1. Document Configuration by completing table on next page.

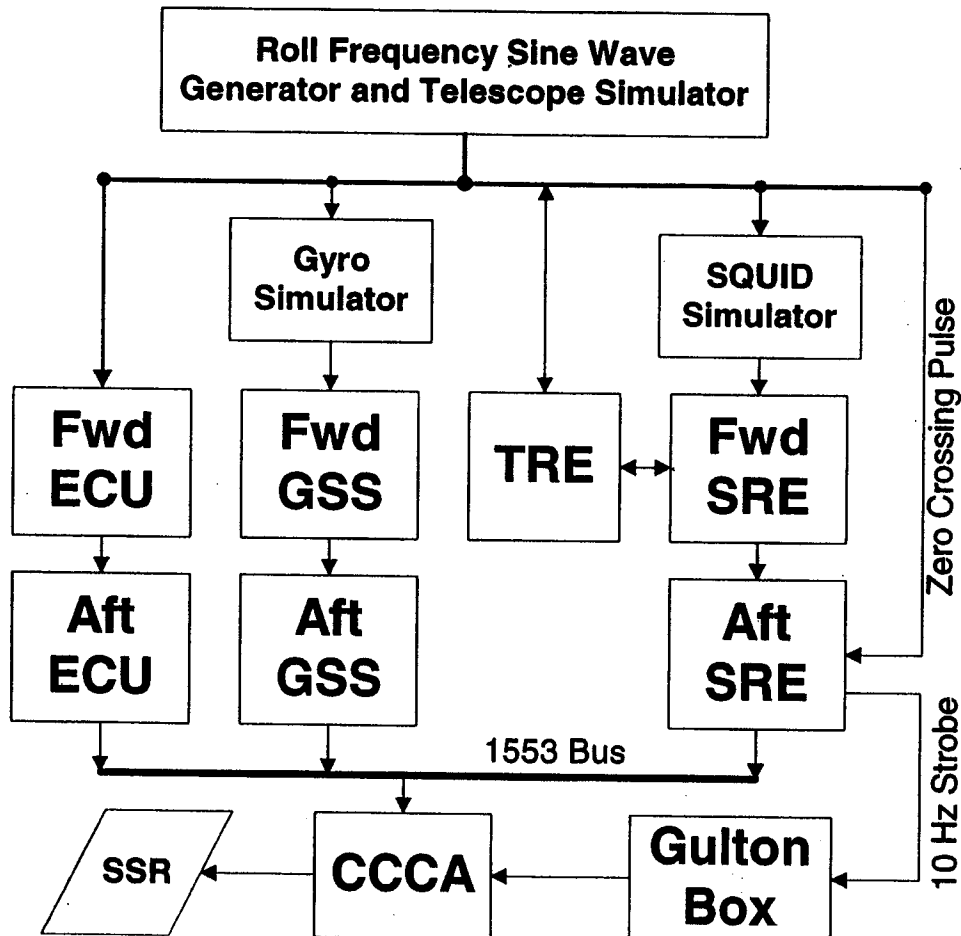


Figure 1: Hardware Configuration

| Item | Equipment Description                                      | Qty | Make | PN                  | SN                   | Pedigree |
|------|------------------------------------------------------------|-----|------|---------------------|----------------------|----------|
| 1.   | Roll Frequency Sine Wave Generator and Telescope Simulator | 1   | LMMS | T2ADM               | 001                  | GSE      |
| 2.   | Gyro Simulator                                             | 1   | SU   | GSS GYRO Simulator  | 001                  | GSE      |
| 3.   | SQUID Simulator                                            | 1   | LMMS | SRE SQUID Simulator | 001                  | GSE      |
| 4.   | Forward ECU                                                | 1   | LMMS | 8A01313             | 001                  | FEU      |
| 5.   | Aft ECU                                                    | 1   | LMMS | 8A00922             | 001                  | FEU      |
| 6.   | Forward GSS - 1                                            | 1   | SU   | 26225-101           | ITF 001<br>See S0723 | EU       |
| 7.   | Aft GSS - 1                                                | 1   | SU   | 26224-101           | ITF 001<br>See S0723 | EU       |
| 8.   | TRE                                                        | 1   | LMMS | TRE                 | 004                  | EU       |
| 9.   | Forward SRE - A                                            | 1   | LMMS | 8A00848GSE-101      | 001                  | FEU      |
| 10.  | Aft SRE - A                                                | 1   | LMMS | 8A00920-101         | 001                  | FEU      |
| 11.  | Gulton Box                                                 | 1   | LMMS | EAN60411-001-01     | 101                  | FEU      |
| 12.  | CCCA                                                       | 1   | LMMS | 7578100-01          | 001                  | FEU      |
| 13.  | SSR                                                        | 1   | LMMS | 161100              | 001                  | EU       |
| 14.  | Forward SRE - B                                            | 1   | LMMS | 8A00848GSE-101      | 002                  | FEU      |
| 15.  | Aft SRE - B                                                | 1   | LMMS | 8A00920-102         | 001                  | FEU      |
| 16.  | Forward GSS - 2                                            | 1   | SU   | 26225-101           | ITF 002<br>See S0723 | EU       |
| 17.  | Aft GSS - 2                                                | 1   | SU   | 26224-101           | ITF 002<br>See S0723 | EU       |
| 18.  | Aft GSS - 3                                                | 1   | SU   | 26224-101           | ITF 003<br>See S0723 | FU       |
| 19.  | Aft GSS - 4                                                | 1   | SU   | 26224-101           | ITF 004<br>See S0723 | EU       |
| 20.  | Timing Distribution Box                                    | 1   | LMMS | 8A03008GSE-502      | 001                  | GSE      |
| 21.  |                                                            |     |      |                     |                      |          |
| 22.  |                                                            |     |      |                     |                      |          |
| 23.  |                                                            |     |      |                     |                      |          |
| 24.  |                                                            |     |      |                     |                      |          |
| 25.  |                                                            |     |      |                     |                      |          |
| 26.  |                                                            |     |      |                     |                      |          |

**11.0 Software Control**

Software version is documented by completing the following table.

|        | Software                               | Version      |
|--------|----------------------------------------|--------------|
| 11.1   | Oasis CSTOL                            |              |
| 11.1.1 | timing_test2.prc                       | 1.10         |
| 11.1.2 | scfpodon.prc                           | 1.42         |
| 11.1.3 | fqt_ephem.prc                          |              |
| 11.2   | Command Load, modified for timing test |              |
| 11.2.1 | pong11921736.load                      | See attached |
| 11.2.2 | pong11921736.tlfile                    |              |
| 11.2.3 | at_init.load                           |              |
| 11.3   | Relevant software versions in ITF      |              |
| 11.3.1 | Onboard SPCs in EEPROM                 |              |
| 11.3.2 | MSS                                    | 3.4.0.1      |
| 11.3.3 | GSW                                    | 2.2.0.0      |
| 11.3.4 | GndRT                                  | 5.1.0.3      |
| 11.4   | Other                                  |              |
|        | GYRO Sim SOFTWARE                      | 1.1          |
|        |                                        |              |
|        |                                        |              |
|        |                                        |              |
|        |                                        |              |
|        |                                        |              |

SU GP-B  
INSP 23SU GP-B  
INSP 23

**12.0 Start and End of Test**

Record start and end of test time

|                |       |             |
|----------------|-------|-------------|
| Test Operator: | Name: | Paul Hestep |
| Start of test: | Date: | 4/7/03      |
|                | Time: | 16:00       |
| End of test:   | Date: | 4/8/03      |
|                | Time: | 10:00       |

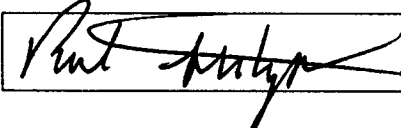
**13.0 Data File**

Record file name

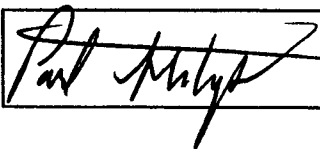
|            |        |
|------------|--------|
| File Name: | - 5005 |
|------------|--------|

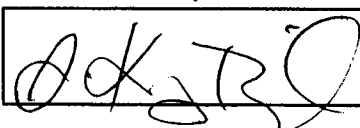
**14.0 Certification**

The undersigned certify that this procedure was performed in whole and that the data recorded above is complete and accurate.

Test Engineer   Date 4/8/03

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

Timing Test REE   Date 4/8/03

Quality Assurance   Date 4/21/03

March 17, 2003  
Page 1 of 12

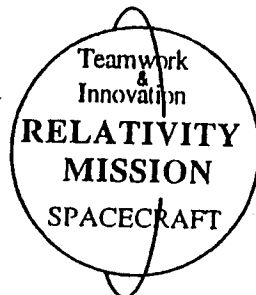
4/7/03

# OPERATIONS ORDER

## RELATIVITY MISSION

SPACECRAFT

SU GP-B  
RDE 10



TITLE: ITF Timing Test

DRAWING: \_\_\_\_\_

DWG REV. \_\_\_\_\_

S/N: S/N, Unit \_\_\_\_\_

LOG NO: ITF 48

ORIGINATOR: Rich Campbell *Rich Campbell* <sup>3/17/03</sup>

EXT: 42141

APPROVAL: \_\_\_\_\_

CHARGE NO: F1-WMEE-GAAA

Q.A. *Amber*

DATE 3/18/03

NOTE:

- All redlines must be stamped by Q.A.
- All steps shall be performed in sequence unless otherwise noted as to why on back of page and approved by originator and Q.A prior to being performed.

**LOCKHEED MARTIN**

Lockheed Martin Missiles & Space, Co.



## REVISION HISTORY

| REV | DATE           | NAME        | DESCRIPTION                                                                                                                                                                                                                                                    |
|-----|----------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NC  | Dec. 20, 2001  | R. Campbell | Initial release                                                                                                                                                                                                                                                |
| A   | Feb. 14, 2002  | R. Campbell | Added the disconnect of probe simulator.                                                                                                                                                                                                                       |
| B   | Feb. 24, 2003  | R. Campbell | Updated figure 1, added figure 2, and changed steps for timing test hardware changes per ICCB.                                                                                                                                                                 |
| C   | March 17, 2003 | R. Campbell | Updated figure 1, step 2, 7, 8, 29, and 30 to allow more than one fwd GSS to be connected.<br>Added Table 1 to record roll rates used.<br>Added step to assure all four SQUID simulators are installed.<br>Added steps to configure SRE DAS interfaces to TRE. |
|     |                |             |                                                                                                                                                                                                                                                                |

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## INTRODUCTION

This operations order connects a timing distribution box to the SRE, ECU, GSS Gyro Simulator Interface, and SQUID simulator in the ITF for timing measurements. GSSs that will be used are specified and roll rate to be simulated. During Timing Test changes in roll rates are recorded in table.

## DEFINITIONS

ITF = Integrated Test Facility  
SRE = SQUID Readout Electronics  
TDB = Timing Distribution Box  
ECU = Experiment Control Unit  
TRE = Telescope Readout Electronics  
T2ADM = TRE 2 Axis Differential Modulator  
TRE = Telescope Readout Electronics

Assure = To perform whatever necessary steps are required to meet the condition.

Verify = To witness the condition. There shall be no steps taken to change the condition.

## TOOLS and EQUIPMENT

### Tools and Equipment Needed:

- One (1) Timing Distribution Box, 8A03008GSE-001
- One (1) Timing Distribution Box power transformer
- One (1) Timing Distribution Box ECU cable, 8A03008GSE-501
- One (1) Timing Distribution Box cable with rate select box, 8A03008GSE-502
- Eight (8) BNC cable
- Six (6) BNC "T" adapter

| Operation Number | Procedure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Data | Date   | Stamp                |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|----------------------|
|                  | <b>SETUP</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |        | N/A                  |
| Step 1           | Obtain ok to proceed from responsible engineer<br><br>Ok to proceed: <u><i>[Signature]</i></u><br>signature                                                                                                                                                                                                                                                                                                                                                                                                                                                     |      | 4/7/03 | P<br>* RTE<br>J16535 |
| Step 2           | SRE DAS INITIAL CONFIGURATION<br><br>Record SRE to TRE interfaces below.<br><br>TRE J2 mated to SRE# <u>A</u> , SRE connector <u>J12</u><br>(A or B) (J12 or J13)<br><br>TRE J3 mated to SRE# <u>B</u> , SRE connector <u>J12</u><br>(A or B) (J12 or J13)                                                                                                                                                                                                                                                                                                      |      | 4/7/03 | P<br>* RTE<br>J16535 |
| Step 3           | REE initial GSS, SRE DAS, and initial Roll Rate to be used for Timing Test.<br><br>GSS(s) TO BE CONFIGURED<br><br><u>✓</u> <u>✓</u><br>GSS#1 GSS#2 GSS#3 GSS#4<br><br>ROLL RATE, Min/Cycle (Initial one)<br><br><u>0.256</u> <u>0.513</u> <u>1.540</u> <u>3.075</u><br><br>TRE J2 mates to SRE# <u>A</u> , SRE connector <u>J13</u> *<br>(A=1A08 or B=1A09) (J12 or J13)<br><br>TRE J3 mates to SRE# <u>B</u> , SRE connector <u>J13</u> *<br>(A=1A08 or B=1A09) (J12 or J13)<br><br>* Mark these options as "NA" if they are to remain as specified in Step 2. |      | 4/7/03 | P<br>* RTE<br>J16535 |
| Step 4           | POWER OFF<br><br>Verify ITF power is off.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      | 4/7/03 | P<br>* RTE<br>J16535 |

| Operation Number | Procedure                                                                                                                                                                                                                                                                             | Data | Date   | Stamp               |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|---------------------|
| Step 5           | SRE DAS RE-CONFIGURATION<br><br>Assure TRE to SRE cables are per Step 3.                                                                                                                                                                                                              |      | 4/7/03 | P<br>*RTE<br>J16535 |
| Step 6           | Disconnect cable 8A02698GSE-501 connector 2A33P3 from GPS receiver B 2A33 J3.<br><br>Note that this cable shall remain disconnected during timing test.                                                                                                                               |      | 4/7/03 | P<br>*RTE<br>J16535 |
|                  | NOTE: The following steps refer to Figure 1.                                                                                                                                                                                                                                          |      |        | N/A                 |
| Step 7           | Disconnect cable 8A02698GSE-501 connector 2A22P3 from GPS receiver A 2A22 J3.                                                                                                                                                                                                         |      | 4/7/03 | P<br>*RTE<br>J16535 |
| Step 8           | Connect cable 8A02698GSE-501 connector 2A22P3 to TDB J6.<br><br>(Connects TDB 1PPS signal to SRE)                                                                                                                                                                                     |      | 4/7/03 | P<br>*RTE<br>J16535 |
| Step 9           | Disconnect existing BNC cable(s) from GSS Gyro Simulator Interface BNC(s) specified in Step 3.<br>BNC located in lower corner of GSS Gyro Simulator Interface<br><br>(Note: Existing BNC cable originates from specified FWD GSS PHV)                                                 |      | 4/7/03 | P<br>*RTE<br>J16535 |
| Step 10          | Connect a new BNC cable from TDB J3 to the GSS Gyro Simulator Interface BNC(s) specified in Step 3. If more than one GSS is specified use BNC "T"s as required at the Gyro Simulator Interface to daisy chain units.<br><br>(located in lower corner of GSS Gyro Simulator Interface) |      | 4/7/03 | P<br>*RTE<br>J16535 |
| Step 11          | Connect a new BNC cable from the TDB J4 to the TEST input of all four Squid Simulators using BNC Tees as necessary.                                                                                                                                                                   |      | 4/7/03 | P<br>*RTE<br>J16535 |
| Step 12          | Disconnect SQUID from FWD SRE B (1A09) J1 and connect SQUID simulator as follows<br><br>SQUID Simulator Cable FEU SQ 1/2 to FWD SRE B J1                                                                                                                                              |      | 4/7/03 | P<br>*RTE<br>J16535 |

| Operation Number | Procedure                                                                                                                                                                                                                                                                          | Data | Date   | Stamp              |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|--------------------|
| Step 13          | Connect the TDB ECU cable, 8A03008GSE-503, to TDB J5.                                                                                                                                                                                                                              |      | 4/7/03 | P<br>*RT<br>J16535 |
| Step 14          | Connect the TDB ECU cable, 8A03008GSE-503, P3A to Aft ECU J3                                                                                                                                                                                                                       |      | 4/7/03 | P<br>*RT<br>J16535 |
| Step 15          | Disconnect the following from FWD ECU<br><br>Probe Simulator cable 8A02849GSE-101 1A06P5 from FWD ECU J5<br><br>Probe Simulator cable 8A02711GSE-501 1A06P7 from FWD ECU J7                                                                                                        |      | 4/7/03 | P<br>*RT<br>J16535 |
| Step 16          | Connect the TDB ECU cable, 8A03008GSE-503, to the following<br><br>cable P5E to Fwd ECU J5<br>cable P7E to Fwd ECU J7                                                                                                                                                              |      | 4/7/03 | P<br>*RT<br>J16535 |
| Step 17          | Assure the TRE simulator is connected to a Fwd SRE as follows and record which Fwd SRE it is connected to, A or B.<br><br>TRE J4 to Fwd SRE J11 (cable 8A01412-101)<br><br>TRE J5 to Fwd SRE J7 (cable 8A01413-101)<br><br>TRE connected to Fwd SRE <u>A</u><br>(A=1A08 or B=1A09) |      | 4/7/03 | P<br>*RT<br>J16535 |
| Step 18          | Connect the TDB cable 8A03008GSE-502 to TDB J2.                                                                                                                                                                                                                                    |      | 4/7/03 | P<br>*RT<br>J16535 |
| Step 19          | Connect the TDB cable 8A03008GSE-502 to T2ADM P3.                                                                                                                                                                                                                                  |      | 4/7/03 | P<br>*RT<br>J16535 |
| Step 20          | Connect the TDB cable 8A03008GSE-502 PA7 to FWD SRE not specified in Step 17 J7                                                                                                                                                                                                    |      | 4/7/03 | P<br>*RT<br>J16535 |

| Operation Number                           | Procedure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Data | Date   | Stamp               |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|---------------------|
| Step 21                                    | Disconnect cable 8A02698GSE-501 connector 2A111P10 from AFT SRE B (2A111) J10.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      | 4/7/03 | P<br>*RTE<br>J16535 |
| Step 22                                    | Set cable Clock Rate Selector switches, 8A03008GSE-502 SA1 and SA2, to rate specified in Step 3 by using Figure 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      | 4/7/03 | P<br>*RTE<br>J16535 |
| Step 23                                    | Assure the T2ADM J7 is connected to a TRE simulator J1 directly without going through the TDB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      | 4/7/03 | P<br>*RTE<br>J16535 |
| Step 24                                    | <p><b>CURRENT SWITCH POSITION</b></p> <p>Record the following switch and knob positions on the T2ADM by circling current switch positions and recording Rate knob setting.</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>X - Axis</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Sine</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Off</div> <div style="border: 1px solid black; padding: 5px;">Cosine</div> </div> <div style="text-align: center;"> <p>Y - Axis</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Sine</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Off</div> <div style="border: 1px solid black; padding: 5px;">Cosine</div> </div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Internal</div> <div style="border: 1px solid black; padding: 5px;">External</div> </div> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Internal</div> <div style="border: 1px solid black; padding: 5px;">External</div> </div> </div> <p>Rate Dial Setting = <u>2.07</u></p> |      | 4/7/03 | P<br>*RTE<br>J16535 |
| Step 25                                    | Set the AXIS Signal Selection switches for both X and Y axes on the T2ADM to SINE and INTERNAL.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      | 4/7/03 | P<br>*RTE<br>J16535 |
| Step 26                                    | Connect TDB power supply from TDB J1 to facility power.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      | 4/7/03 | P<br>*RTE<br>J16535 |
| SYSTEM IS NOW CONFIGURED FOR A TIMING TEST |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |        |                     |

| Operation Number | Procedure                                                                                                                                                                                                                                                                                                                                           | Data | Date   | Stamp              |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|--------------------|
|                  | It is understood that the user selectable roll rate may change during the Timing Test and changes shall be recorded in Table 1.                                                                                                                                                                                                                     |      |        |                    |
|                  | It is understood that the TRE to SRE DAS interface(s) may change upon Test Directors direction per Step 27                                                                                                                                                                                                                                          |      |        |                    |
| Step 27          | <p>REE specify SRE DAS reconfiguration below.</p> <p>TRE J2 mates to SRE#_____, SRE connector_____</p> <p style="text-align: center;">(A or B) (J12 or J13)</p> <p>TRE J3 mates to SRE#_____, SRE connector_____</p> <p style="text-align: center;">(A or B) (J12 or J13)</p> <p>Mark this step as "NA" if DAS reconfiguration is not required.</p> | N/A  | 4/7/03 | P<br>WCS           |
| Step 28          | <p>Assure SRE A and SRE B power is off prior to performing this step.</p> <p>Assure TRE to SRE cables are configured per Step 27.</p>                                                                                                                                                                                                               |      | 4/8/03 | P<br>RTE<br>J16535 |

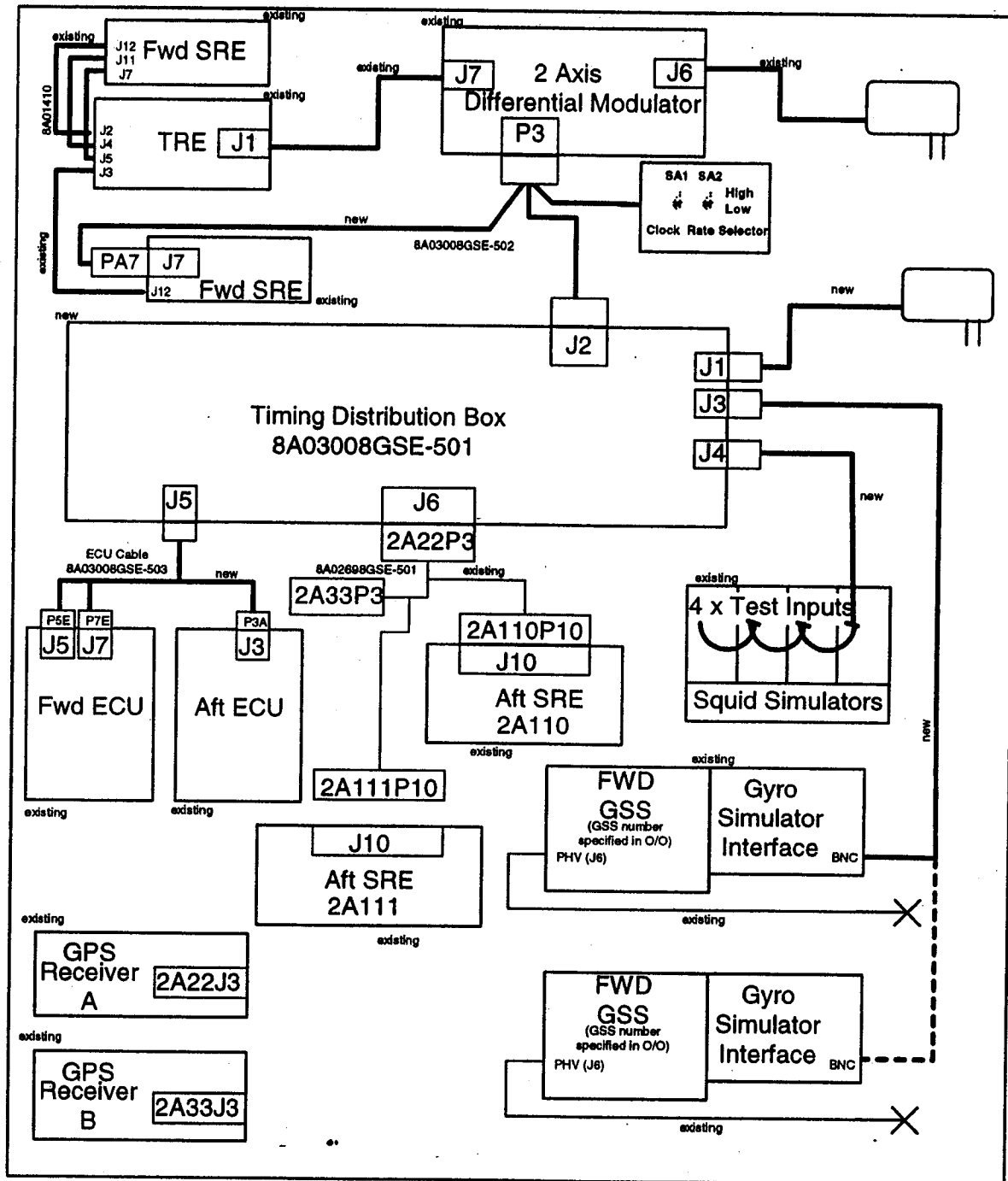


Figure 1, Timing Test Interconnect



| Clock Rate Selector     |                |                |       |
|-------------------------|----------------|----------------|-------|
| Sine Period,<br>Minutes | SA1<br>(MUX B) | SA2<br>(MUX A) | Box h |
| 0.256                   | Low            | Low            |       |
| 0.513                   | Low            | High           | 0.064 |
| 1.54                    | High           | Low            |       |
| 3.075                   | High           | High           |       |

Figure 2, Clock Rate Selector

48151981.1  $\approx$  7:32 pm

Record in the table the start time and the indicated rate setting each time the rates are changed once the initial rate is changed.

| Indicated Rate,<br>Minutes/Cycle | Time Set                       | M/L | Operator |
|----------------------------------|--------------------------------|-----|----------|
| 0.51 / 0.064                     | 5:46                           | h   | PS       |
| 3.075                            | 6:57                           | L   | PS       |
| 0.064                            | 7:09                           | H   | PS       |
| 2.56                             | 7:30                           | L   | PS       |
| 0.513                            | 9:05                           | L   | PS       |
| 1.54                             | Table 1, Rate Settings<br>9:32 | L   | PS       |
| 3.075                            | 10:10                          | L   | PS       |

| Operation Number | Procedure                                                                                            | Data | Date                    | Stamp       |
|------------------|------------------------------------------------------------------------------------------------------|------|-------------------------|-------------|
|                  |                                                                                                      |      |                         |             |
|                  | <b>DISCONNECT</b>                                                                                    |      |                         | N/A         |
| Step 29          | Obtain ok to proceed from responsible engineer<br><br>Ok to proceed: <u>With: C. N.</u><br>signature |      | 4/8/03<br>3/8/03<br>wcy | P<br>wcy    |
|                  |                                                                                                      |      |                         |             |
| Step 30          | POWER OFF<br><br>Verify ITF power is off.                                                            |      | 4/8/03                  | P<br>116535 |

| Operation Number | Procedure                                                                                                                                                                       | Data | Date   | Stamp               |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|---------------------|
| Step 31          | Disconnect cable 8A02698GSE-501 connector 2A22P3 from TDB J6.                                                                                                                   |      | 4/8/03 | P<br>ARTE<br>J16535 |
| Step 32          | Connect cable 8A02698GSE-501 connector 2A33P3 to GPS receiver B 2A33 J3.                                                                                                        |      | 4/8/03 | P<br>ARTE<br>J16535 |
| Step 33          | Connect cable 8A02698GSE-501 connector 2A22P3 to GPS receiver A 2A22 J3.                                                                                                        |      | 4/8/03 | P<br>ARTE<br>J16535 |
| Step 34          | Reconnect cable 8A02698GSE-501 connector 2A111P10 to AFT SRE B J10.                                                                                                             |      | 4/8/03 | P<br>ARTE<br>J16535 |
| Step 35          | Disconnect BNC cable from TDB J3 and from GSS Gyro Simulator Interface BNC(s), including any BND "T"s, specified in Step 3.                                                     |      | 4/8/03 | P<br>ARTE<br>J16535 |
| Step 36          | Reconnected BNC cable from GSS(s) specified in Step 3 to specified GSS Gyro Simulator Interface BNC(s).<br><br>(Note: Existing BNC cable originates from specified FWD GSS PHV) |      | 4/8/03 | P<br>ARTE<br>J16535 |
| Step 37          | Disconnect BNC cables and "T"s from TDB J4 and from TEST input of all four Squid Simulators.                                                                                    |      | 4/8/03 | P<br>ARTE<br>J16535 |
| Step 38          | Disconnect SQUID Simulator from FWD SRE B (1A09) J1 and connect SQUID as follows,<br><br>SQUID Cable to FWD SRE B J1                                                            |      | 4/8/03 | P<br>ARTE<br>J16535 |
| Step 39          | Disconnect the TDB ECU cable from TDB J5 and from the following<br><br>P3E from Aft ECU J3<br>P5E from Fwd ECU J5<br>P7E from Fwd ECU J7                                        |      | 4/8/03 | P<br>ARTE<br>J16535 |

| Operation Number | Procedure                                                                                                                                                            | Data | Date    | Stamp                |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|----------------------|
| Step 40          | Reconnect the following to FWD ECU<br><br>Probe Simulator cable 8A02849GSE-101 1A06P5 to FWD ECU J5<br><br>Probe Simulator cable 8A02711GSE-501 1A06P7 to FWD ECU J7 |      | 4/8/03  | P<br>★ RTE<br>J16535 |
| Step 41          | Disconnect TDB cable 8A03008GSE-502 from the following<br><br>Cable from TDB J2<br>Cable from T2ADM P3<br>Cable from SRE J7                                          |      | 4/8/03  | P<br>★ RTE<br>J16535 |
| Step 42          | Set T2ADM AXIS Signal Selection switches to their original settings, reference Step 24.                                                                              |      | 4/8/03  | P<br>★ RTE<br>J16535 |
| Step 43          | Set T2ADM Rate knob to its original position, reference Step 24.                                                                                                     |      | 4/8/03  | P<br>★ RTE<br>J16535 |
| Step 44          | Disconnect TDB power supply from TDB J1 and from facility power.                                                                                                     |      | 4/8/03  | P<br>★ RTE<br>J16535 |
| Step 45          | Assure TRE to SRE cables are configured per Step 2.                                                                                                                  |      | 4/8/03  | P<br>★ RTE<br>J16535 |
| Step 46          | Return TDB, cables, and power supply to ITF stores.                                                                                                                  |      | 4/8/03  | P<br>★ RTE<br>J16535 |
|                  |                                                                                                                                                                      |      |         |                      |
| Step 999         | Q.A. stamp, operations order complete.                                                                                                                               | N/A  | 4/10/03 | IQE<br>606843        |



5/19/03

W. W. Hansen Experimental Physics Laboratory  
STANFORD UNIVERSITY  
STANFORD, CALIFORNIA 94305-4085

Gravity Probe B Relativity Mission

**ITF TIMING TEST:  
TEST CONFIGURATION  
AND VERSION CONTROL  
DOCUMENTATION**

P0939 Rev -  
August 29, 2002

Prepared by: Paul Shestople

8/30/02

Date

Approved by: Dorrene Ross  
GP-B Quality Assurance

8/30/02

Date

Approved by: Richard Whelan  
GP-B Systems Engineering

8/30/02

Date

ITAR Assessment Performed

  
Tom LangensteinITAR Control Req'd? ☐ Yes ☒ No

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**1.0 Revision History**

| Rev Level | Comments/notes                       | Date        | Revised By  |
|-----------|--------------------------------------|-------------|-------------|
| -         | First release of this test procedure | 29-Aug-2002 | P Shestople |
|           |                                      |             |             |
|           |                                      |             |             |

**2.0 Scope**

This procedure documents Integrated Testing Facility (ITF) software versions and hardware configurations used during GPB Timing Tests

This procedure ☒ Does ☐ Does not provide formal verification of GP-B requirements.  
 This procedure ☐ Does ☒ Does not include constraints and restrictions for the Payload.

### 3.0 Formal Requirements Verification

This procedure documents hardware configuration and software versions used to verify requirements shown in Table 1.

|      | Section        | Title                                                    | Part A | Part B |
|------|----------------|----------------------------------------------------------|--------|--------|
| 3.1  | T002, 11       | Telemetry and Data Processing                            |        | ✓      |
| 3.2  | T003, 3.6.6    | Timing and Signal Processing                             |        | ✓      |
| 3.3  | T003, 7.6.5    | Pointing and Light Intensity Signals                     |        | ✓      |
| 3.4  | T003, 16.1.1   | Primary Payload Clock Frequency                          | ✓      |        |
| 3.5  | T003, 16.4     | Payload-to-Spacecraft Synchronization                    | ✓      |        |
| 3.6  | T003, 16.4.1   | ATC Data Strobe Pulse Frequency                          |        | ✓      |
| 3.7  | T003, 16.5     | Payload Absolute Time Standard                           | ✓      |        |
| 3.8  | T003, 16.6     | Time Tagging                                             | ✓      |        |
| 3.9  | T003, 16.6.1   | GPS PPS Time Tag                                         | ✓      |        |
| 3.10 | T003, 16.6.2   | ATC Data Pulse Strobe Time Tag                           | ✓      |        |
| 3.11 | T003, 16.6.3   | SQUID Readout Science Signals Time Tag                   |        | ✓      |
| 3.12 | T003, 16.6.4   | Telescope Readout Science Signals Time Tag               |        | ✓      |
| 3.13 | T003, 16.6.6   | Gyroscope Suspension System Science Signals Time Tagging |        | ✓      |
| 3.14 | T003, 16.6.7   | Experiment Control Unit Science Signals Time Tagging     |        | ✓      |
| 3.15 | SE-23, 3.2.1.3 | PPS Accuracy                                             | ✓      |        |
| 3.16 | SE-23, 3.2.1.4 | PPS Ambiguity Resolution                                 | ✓      |        |

Table 1: GPB Timing Requirements

### 4.0 Reference Documents

- 4.1. MIL-STD-1686 Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment
- 4.2. P0875 GP-B Maintenance and Testing at all Facilities
- 4.3. MIL-STD-1540C Test Requirements for Launch, Upper-stage, and Space Vehicles, Section 6.4.2.

### 5.0 Test Facility

Primary facility: Lockheed Palo Alto Integrated Testing Facility, Bldg. 205.

## 6.0 QA Provisions

- 6.1. This procedure shall be conducted on a formal basis to its latest approved and released version. The QA Program Engineer (D. Ross) and the ONR representative (E. Ingraham) shall be notified 24 hours prior to the start of this procedure. QA may monitor the execution of all or part of this procedure should they elect to do so.

Date/time: 5/12/03 3<sup>pm</sup> Date/time: \_\_\_\_\_  
GP-B QA (D. Ross) K. BURLINGHAM ONR (E. Ingraham)

- 6.2. Upon completion of this procedure, the Timing Test REE and the GP-B QA manager shall certify her/his concurrence that the procedure was performed and accomplished in accordance with the prescribed instructions by signing and dating his approval at the end of this procedure.

## 7.0 Test Personnel

This document shall be completed only by persons familiar with hardware configuration and software version control, or be those designated by the Timing Test REE at the time of test (redline names in below as required).

- 7.1. Kelly Burlingham  
7.2. Bill Given  
7.3. Paul Shestople

## 8.0 General Instructions

- 8.1. Redlines can be initiated by the test personnel listed in Section 7.0 and must be approved by QA.
- 8.2. Test operators shall read this procedure in its entirety and resolve any apparent ambiguities prior to beginning this test.
- 8.3. Any nonconformance or test anomaly should be reported by a Discrepancy Report. Refer to the Quality Plan, P0108, for guidance. Do not alter or break test configuration if a test failure occurs; notify quality assurance.
- 8.4. Only the following persons have the authority to exit/terminate this test or perform a retest: test operators listed in Section 7.0 and GP-B QA.

## 9.0 Hardware Safety Requirements:

- 9.1. Hardware used in this test is ESD sensitive; special care shall be exercised per the "Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment", MIL-STD-1686.
- 9.2. Lockheed facilities are under Lockheed configuration control. Only Rich Campbell, or his representative, may change ITF hardware configuration, and all such changes must be documented.
- 9.3. Software version control must be strictly adhered to. Only Bill Given, or his representative, may change software versions, and all such changes must be documented.

## 10.0 Hardware Configuration

Timing Test Hardware Configuration is shown schematically in Figure 1. Document Configuration by completing table on next page.

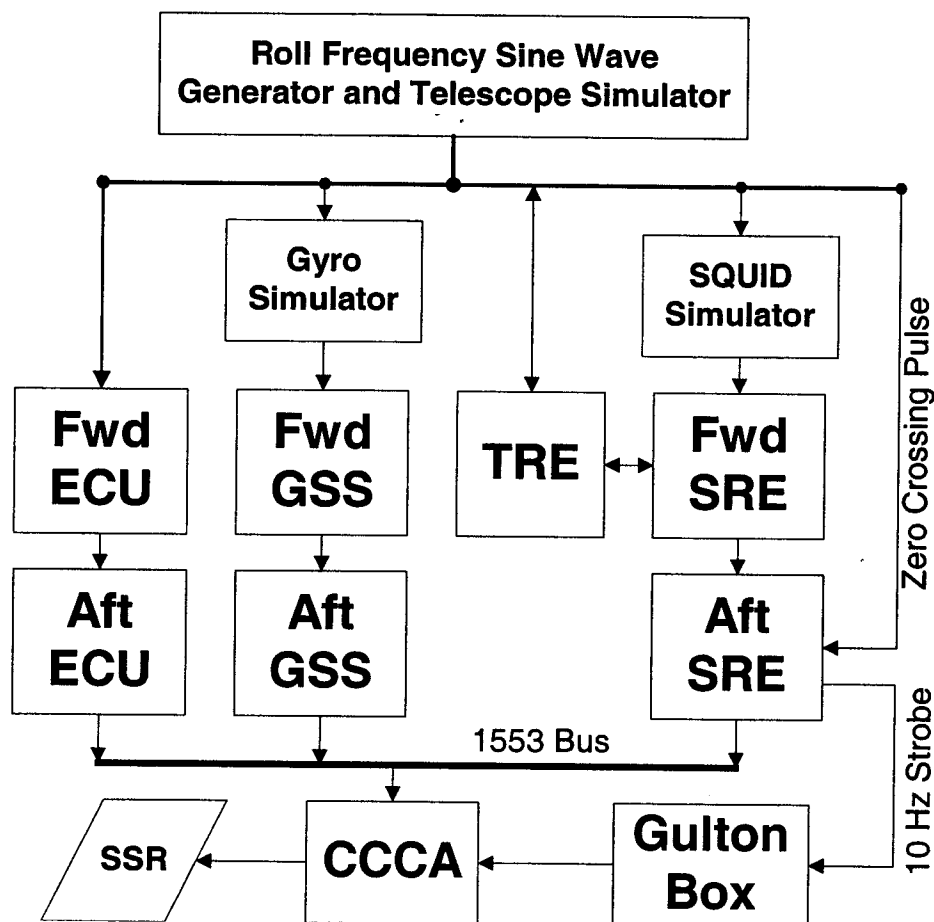


Figure 1: Hardware Configuration



| Item | Equipment Description                                      | Qty | Make | PN                  | SN                   | Pedigree |
|------|------------------------------------------------------------|-----|------|---------------------|----------------------|----------|
| 1.   | Roll Frequency Sine Wave Generator and Telescope Simulator | 1   | LMMS | T2ADM               | 001                  | GSE      |
| 2.   | Gyro Simulator                                             | 1   | SU   | GSS GYRO Simulator  | 001                  | GSE      |
| 3.   | SQUID Simulator                                            | 1   | LMMS | SRE SQUID Simulator | 001                  | GSE      |
| 4.   | Forward ECU                                                | 1   | LMMS | 8A01313             | 001                  | FEU      |
| 5.   | Aft ECU                                                    | 1   | LMMS | 8A00922             | 001                  | FEU      |
| 6.   | Forward GSS - 1                                            | 1   | SU   | 26225-101           | ITF 001<br>See S0723 | EU       |
| 7.   | Aft GSS - 1                                                | 1   | SU   | 26224-101           | ITF 001<br>See S0723 | EU       |
| 8.   | TRE                                                        | 1   | LMMS | TRE                 | 004                  | EU       |
| 9.   | Forward SRE – A                                            | 1   | LMMS | 8A00848GSE-101      | 001                  | FEU      |
| 10.  | Aft SRE - A                                                | 1   | LMMS | 8A00920-101         | 001                  | FEU      |
| 11.  | Gulton Box                                                 | 1   | LMMS | EAN60411-001-01     | 101                  | FEU      |
| 12.  | CCCA                                                       | 1   | LMMS | 7578100-01          | 001                  | FEU      |
| 13.  | SSR                                                        | 1   | LMMS | 161100              | 001                  | EU       |
| 14.  | Forward SRE – B                                            | 1   | LMMS | 8A00848GSE-101      | 002                  | FEU      |
| 15.  | Aft SRE – B                                                | 1   | LMMS | 8A00920-102         | 001                  | FEU      |
| 16.  | Forward GSS – 2                                            | 1   | SU   | 26225-101           | ITF 002<br>See S0723 | EU       |
| 17.  | Aft GSS -2                                                 | 1   | SU   | 26224-101           | ITF 002<br>See S0723 | EU       |
| 18.  | Aft GSS - 3                                                | 1   | SU   | 26224-101           | ITF 003<br>See S0723 | FU       |
| 19.  | Aft GSS - 4                                                | 1   | SU   | 26224-101           | ITF 004<br>See S0723 | EU       |
| 20.  | Timing Distribution Box                                    | 1   | LMMS | 8A03008GSE-502      | 001                  | GSE      |
| 21.  |                                                            |     |      |                     |                      |          |
| 22.  |                                                            |     |      |                     |                      |          |
| 23.  |                                                            |     |      |                     |                      |          |
| 24.  |                                                            |     |      |                     |                      |          |
| 25.  |                                                            |     |      |                     |                      |          |
| 26.  |                                                            |     |      |                     |                      |          |

**11.0 Software Control**

Software version is documented by completing the following table.

|        | Software                               | Version          |
|--------|----------------------------------------|------------------|
| 11.1   | Oasis CSTOL                            |                  |
| 11.1.1 | timing_test2.prc                       | N/A              |
| 11.1.2 | scfpodon.prc                           | 1.42             |
| 11.1.3 | fqt_ephem.prc                          | N/A              |
| 11.2   | Command Load, modified for timing test | N/A              |
| 11.2.1 | pong11921736.load                      | 11921600         |
| 11.2.2 | pong11921736.tline                     | N/A              |
| 11.2.3 | at_init.load      ATC ~INIT.LOAD       | 3/19/03 16:48:30 |
| 11.3   | Relevant software versions in ITF      |                  |
| 11.3.1 | Onboard SPCs in EEPROM                 | 1-136            |
| 11.3.2 | MSS                                    | 34.0.1           |
| 11.3.3 | GSW                                    | 2.2.02.          |
| 11.3.4 | GndRT                                  | 5.1.0.4          |
| 11.4   | Other                                  | •                |
|        | Timing - GSS. PRG                      | 1.0              |
|        |                                        |                  |
|        |                                        |                  |
|        |                                        |                  |
|        |                                        |                  |
|        |                                        |                  |

**12.0 Start and End of Test**

Record start and end of test time

|                |       |               |
|----------------|-------|---------------|
| Test Operator: | Name: | Paul McIntyre |
| Start of test: | Date: | 5/29/03       |
|                | Time: | 16:00         |
| End of test:   | Date: | 5/20/03       |
|                | Time: | 10:00         |

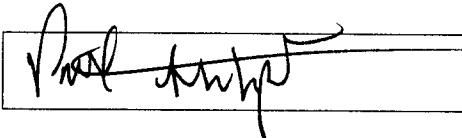
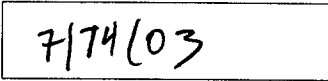
**13.0 Data File**

Record file name

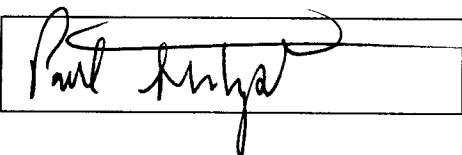
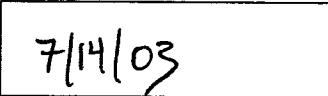
|            |                          |
|------------|--------------------------|
| File Name: | LI database cycle - 5005 |
|------------|--------------------------|

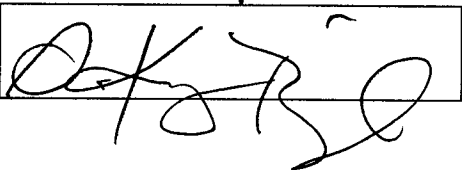
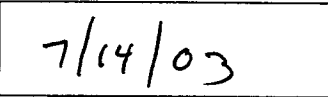
**14.0 Certification**

The undersigned certify that this procedure was performed in whole and that the data recorded above is complete and accurate.

Test Engineer  Date 

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

Timing Test  
REE  Date 

Quality  
Assurance  Date 

# OPERATIONS ORDER

## RELATIVITY MISSION

### SPACECRAFT



TITLE: ITF Timing Test

DRAWING: \_\_\_\_\_

DWG REV. \_\_\_\_\_

S/N: S/N \_\_\_\_\_, Unit \_\_\_\_\_

LOG NO: ITF 48 60

ORIGINATOR: Rich Campbell *Rich Campbell* <sup>3/17/03</sup>

EXT: 42141

APPROVAL: \_\_\_\_\_

CHARGE NO: F1-WMEE-GAAA

Q.A. *Avl-65*

JE ~~506843~~  
3/18/03  
DATE

NOTE:

- All redlines must be stamped by Q.A.
- All steps shall be performed in sequence unless otherwise noted as to why on back of page and approved by originator and Q.A prior to being performed.

**LOCKHEED MARTIN**

Lockheed Martin Missiles & Space, Co.

## REVISION HISTORY

| REV | DATE           | NAME        | DESCRIPTION                                                                                                                                                                                                                                                    |
|-----|----------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NC  | Dec. 20, 2001  | R. Campbell | Initial release                                                                                                                                                                                                                                                |
| A   | Feb. 14, 2002  | R. Campbell | Added the disconnect of probe simulator.                                                                                                                                                                                                                       |
| B   | Feb. 24, 2003  | R. Campbell | Updated figure 1, added figure 2, and changed steps for timing test hardware changes per ICCB.                                                                                                                                                                 |
| C   | March 17, 2003 | R. Campbell | Updated figure 1, step 2, 7, 8, 29, and 30 to allow more than one fwd GSS to be connected.<br>Added Table 1 to record roll rates used.<br>Added step to assure all four SQUID simulators are installed.<br>Added steps to configure SRE DAS interfaces to TRE. |
|     |                |             |                                                                                                                                                                                                                                                                |

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## INTRODUCTION

This operations order connects a timing distribution box to the SRE, ECU, GSS Gyro Simulator Interface, and SQUID simulator in the ITF for timing measurements. GSSs that will be used are specified and roll rate to be simulated. During Timing Test changes in roll rates are recorded in table.

## DEFINITIONS

ITF = Integrated Test Facility  
SRE = SQUID Readout Electronics  
TDB = Timing Distribution Box  
ECU = Experiment Control Unit  
TRE = Telescope Readout Electronics  
T2ADM = TRE 2 Axis Differential Modulator  
TRE = Telescope Readout Electronics

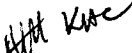
Assure = To perform whatever necessary steps are required to meet the condition.

Verify = To witness the condition. There shall be no steps taken to change the condition.

## TOOLS and EQUIPMENT

### Tools and Equipment Needed:

- One (1) Timing Distribution Box, 8A03008GSE-001
- One (1) Timing Distribution Box power transformer
- One (1) Timing Distribution Box ECU cable, 8A03008GSE-501
- One (1) Timing Distribution Box cable with rate select box, 8A03008GSE-502
- Eight (8) BNC cable
- Six (6) BNC "T" adapter

| Operation Number | Procedure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Data | Date    | Stamp                |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|----------------------|
|                  | <b>SETUP</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |         | N/A                  |
| Step 1           | Obtain ok to proceed from responsible engineer<br><br>Ok to proceed: <u></u><br>signature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 2           | SRE DAS INITIAL CONFIGURATION<br><br>Record SRE to TRE interfaces below.<br><br>TRE J2 mated to SRE# <u>A</u> , SRE connector <u>J12</u><br>(A or B) (J12 or J13)<br><br>TRE J3 mated to SRE# <u>B</u> , SRE connector <u>J12</u><br>(A or B) (J12 or J13)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 3           | REE initial GSS, SRE DAS, and initial Roll Rate to be used for Timing Test.<br><br>GSS(s) TO BE CONFIGURED<br><br><u>✓</u> <u>✓</u> <u>      </u> <u>      </u><br>GSS#1 GSS#2 GSS#3 GSS#4<br><br>ROLL RATE, Min/Cycle (Initial one)<br><br><u>      </u> <u></u> <u>      </u> <u></u><br>0.256 0.513 1.540 3.075<br><br>TRE J2 mates to SRE# <u>A</u> , SRE connector <u>J12</u> *<br>(A=1A08 or B=1A09) (J12 or J13)<br><br>TRE J3 mates to SRE# <u>B</u> , SRE connector <u>J12</u> *<br>(A=1A08 or B=1A09) (J12 or J13)<br><br>* Mark these options as "NA" if they are to remain as specified in Step 2. | N/A  | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 4           | POWER OFF<br><br>Verify ITF power is off.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      | 5/19/03 | P<br>* RTE<br>J16535 |

| Operation Number | Procedure                                                                                                                                                                                                                                                                             | Data | Date    | Stamp                |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|----------------------|
| Step 5           | SRE DAS RE-CONFIGURATION<br><br>Assure TRE to SRE cables are per Step 3.                                                                                                                                                                                                              |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 6           | Disconnect cable 8A02698GSE-501 connector 2A33P3 from GPS receiver B 2A33 J3.<br><br>Note that this cable shall remain disconnected during timing test.                                                                                                                               |      | 5/19/03 | P<br>* RTE<br>J16535 |
|                  | NOTE: The following steps refer to Figure 1.                                                                                                                                                                                                                                          |      |         | N/A                  |
| Step 7           | Disconnect cable 8A02698GSE-501 connector 2A22P3 from GPS receiver A 2A22 J3.                                                                                                                                                                                                         |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 8           | Connect cable 8A02698GSE-501 connector 2A22P3 to TDB J6.<br><br>(Connects TDB 1PPS signal to SRE)                                                                                                                                                                                     |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 9           | Disconnect existing BNC cable(s) from GSS Gyro Simulator Interface BNC(s) specified in Step 3.<br>BNC located in lower corner of GSS Gyro Simulator Interface<br><br>(Note: Existing BNC cable originates from specified FWD GSS PHV)                                                 |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 10          | Connect a new BNC cable from TDB J3 to the GSS Gyro Simulator Interface BNC(s) specified in Step 3. If more than one GSS is specified use BNC "T"s as required at the Gyro Simulator Interface to daisy chain units.<br><br>(located in lower corner of GSS Gyro Simulator Interface) |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 11          | Connect a new BNC cable from the TDB J4 to the TEST input of all four Squid Simulators using BNC Tees as necessary.                                                                                                                                                                   |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 12          | Disconnect SQUID from FWD SRE B (1A09) J1 and connect SQUID simulator as follows<br><br>SQUID Simulator Cable FEU SQ 1/2 to FWD SRE B J1                                                                                                                                              |      | 5/19/03 | P<br>* RTE<br>J16535 |



| Operation Number | Procedure                                                                                                                                                                                                                                                                      | Data | Date    | Stamp                |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|----------------------|
| Step 13          | Connect the TDB ECU cable, 8A03008GSE-503, to TDB J5.                                                                                                                                                                                                                          |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 14          | Connect the TDB ECU cable, 8A03008GSE-503, P3A to Aft ECU J3                                                                                                                                                                                                                   |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 15          | Disconnect the following from FWD ECU<br><br>Probe Simulator cable 8A02849GSE-101 1A06P5 from FWD ECU J5<br><br>Probe Simulator cable 8A02711GSE-501 1A06P7 from FWD ECU J7                                                                                                    |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 16          | Connect the TDB ECU cable, 8A03008GSE-503, to the following<br><br>cable P5E to Fwd ECU J5<br>cable P7E to Fwd ECU J7                                                                                                                                                          |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 17          | Assure the TRE simulator is connected to a Fwd SRE as follows and record which Fwd SRE it is connected to, A or B.<br><br>TRE J4 to Fwd SRE J11 (cable 8A01412-101)<br>TRE J5 to Fwd SRE J7 (cable 8A01413-101)<br><br>TRE connected to Fwd SRE <u>A</u><br>(A=1A08 or B=1A09) |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 18          | Connect the TDB cable 8A03008GSE-502 to TDB J2.                                                                                                                                                                                                                                |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 19          | Connect the TDB cable 8A03008GSE-502 to T2ADM P3.                                                                                                                                                                                                                              |      | 5/19/03 | P<br>* RTE<br>J16535 |
| Step 20          | Connect the TDB cable 8A03008GSE-502 PA7 to FWD SRE not specified in Step 17 J7                                                                                                                                                                                                |      | 5/19/03 | P<br>* RTE<br>J16535 |

| Operation Number | Procedure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Data | Date    | Stamp               |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|---------------------|
| Step 21          | Disconnect cable 8A02698GSE-501 connector 2A111P10 from AFT SRE B (2A111) J10.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      | 5/19/03 | P<br>ARTE<br>J16535 |
| Step 22          | Set cable Clock Rate Selector switches, 8A03008GSE-502 SA1 and SA2, to rate specified in Step 3 by using Figure 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      | 5/19/03 | P<br>ARTE<br>J16535 |
| Step 23          | Assure the T2ADM J7 is connected to a TRE simulator J1 directly without going through the TDB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      | 5/19/03 | P<br>ARTE<br>J16535 |
| Step 24          | <p>CURRENT SWITCH POSITION</p> <p>Record the following switch and knob positions on the T2ADM by circling current switch positions and recording Rate knob setting.</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>X - Axis</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Sine</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Off</div> <div style="border: 1px solid black; padding: 5px;">Cosine</div> </div> <div style="text-align: center;"> <p>Y - Axis</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Sine</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Off</div> <div style="border: 1px solid black; padding: 5px;">Cosine</div> </div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Internal</div> <div style="border: 1px solid black; padding: 5px;">External</div> </div> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Internal</div> <div style="border: 1px solid black; padding: 5px;">External</div> </div> </div> <p>Rate Dial Setting = <u>2.07</u></p> |      | 5/19/03 | P<br>ARTE<br>J16535 |
| Step 25          | Set the AXIS Signal Selection switches for both X and Y axes on the T2ADM to SINE and INTERNAL.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      | 5/19/03 | P<br>ARTE<br>J16535 |
| Step 26          | Connect TDB power supply from TDB J1 to facility power.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      | 5/19/03 | P<br>ARTE<br>J16535 |
|                  | SYSTEM IS NOW CONFIGURED FOR A TIMING TEST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |         |                     |

| Operation Number | Procedure                                                                                                                                                                                                                                                                                                                                                                                     | Data | Date    | Stamp                      |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|----------------------------|
|                  | It is understood that the user selectable roll rate may change during the Timing Test and changes shall be recorded in Table 1.                                                                                                                                                                                                                                                               |      |         |                            |
|                  | It is understood that the TRE to SRE DAS interface(s) may change upon Test Directors direction per Step 27                                                                                                                                                                                                                                                                                    |      |         |                            |
| Step 27          | <p>REE specify SRE DAS reconfiguration below.</p> <p>TRE J2 mates to SRE#_____, SRE connector_____</p> <p style="text-align: center;">(A or B)                      (J12 or J13)</p> <p>TRE J3 mates to SRE#_____, SRE connector_____</p> <p style="text-align: center;">(A or B)                      (J12 or J13)</p> <p>Mark this step as "NA" if DAS reconfiguration is not required.</p> |      | N/A     | <p>P</p> <p>ATE J16535</p> |
| Step 28          | <p>Assure SRE A and SRE B power is off prior to performing this step.</p> <p>Assure TRE to SRE cables are configured per Step 27.</p>                                                                                                                                                                                                                                                         |      | 5/20/03 | <p>P</p> <p>ATE J16535</p> |

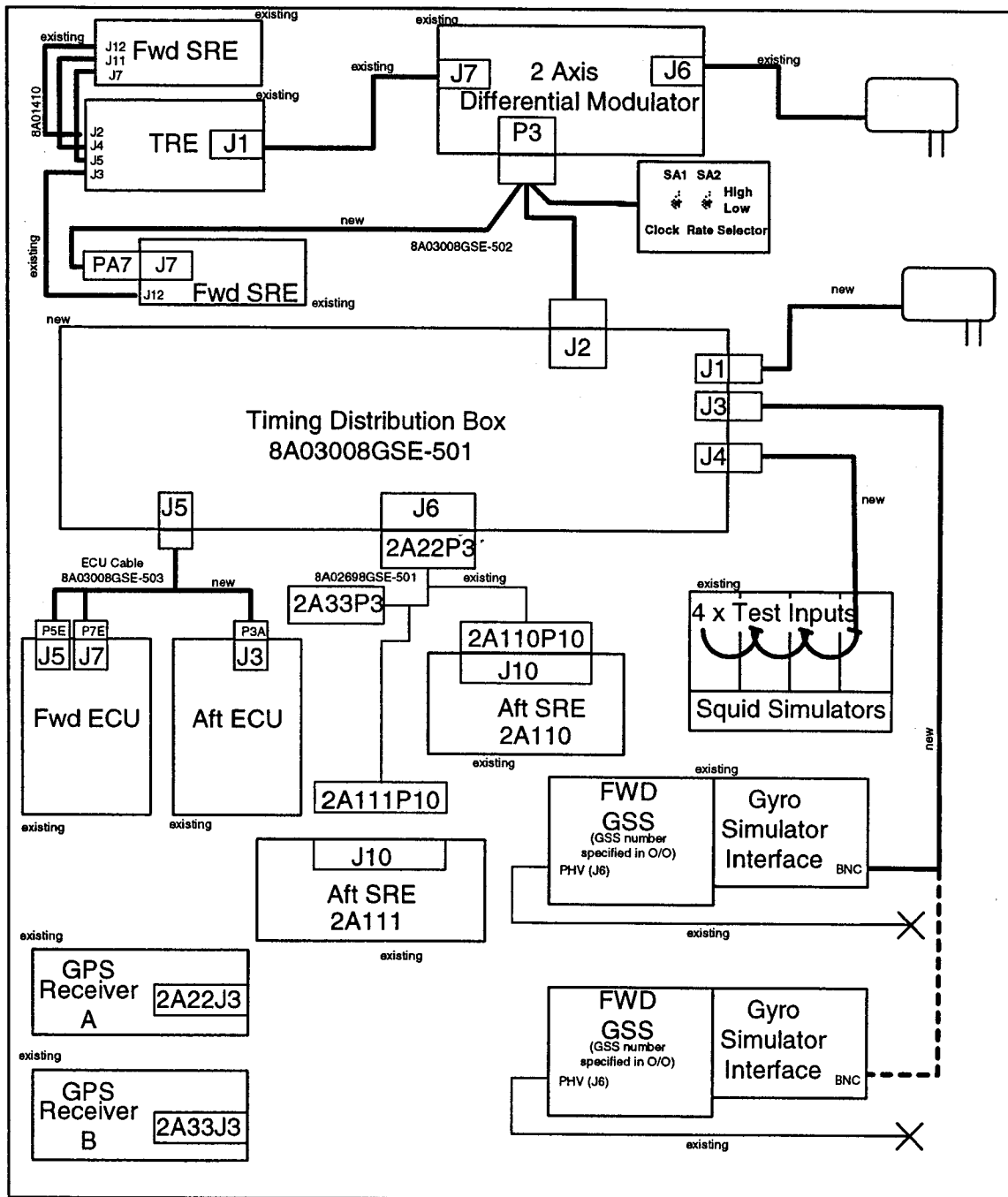


Figure 1, Timing Test Interconnect

| Clock Rate Selector     |                |                |
|-------------------------|----------------|----------------|
| Sine Period,<br>Minutes | SA1<br>(MUX B) | SA2<br>(MUX A) |
| 0.256                   | Low            | Low            |
| 0.513                   | Low            | High           |
| 1.54                    | High           | Low            |
| 3.075                   | High           | High           |

Figure 2, Clock Rate Selector

Record in the table the start time and the indicated rate setting each time the rates are changed once the initial rate is changed.

| Indicated Rate,<br>Minutes/Cycle | Time Set | Operator |
|----------------------------------|----------|----------|
| N/A                              |          |          |
|                                  |          |          |
|                                  |          |          |
|                                  |          |          |
|                                  |          |          |

Table 1, Rate Settings

| Operation<br>Number | Procedure                                                                                                  | Data                   | Date | Stamp                |
|---------------------|------------------------------------------------------------------------------------------------------------|------------------------|------|----------------------|
|                     |                                                                                                            |                        |      |                      |
|                     | <b>DISCONNECT</b>                                                                                          |                        |      | N/A                  |
| Step 29             | Obtain ok to proceed from responsible engineer<br><br>Ok to proceed: <u>W. H. [Signature]</u><br>signature | 5/20/03<br>[Signature] |      | P<br>- RTE<br>668183 |
|                     |                                                                                                            |                        |      |                      |
| Step 30             | POWER OFF<br><br>Verify ITF power is off.                                                                  | 5/20/03                |      | P<br>668183          |

| Operation Number | Procedure                                                                                                                                                                       | Data | Date    | Stamp               |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|---------------------|
| Step 31          | Disconnect cable 8A02698GSE-501 connector 2A22P3 from TDB J6.                                                                                                                   |      | 5/20/03 | P<br>ARIE<br>J16535 |
| Step 32          | Connect cable 8A02698GSE-501 connector 2A33P3 to GPS receiver B 2A33 J3.                                                                                                        |      | 5/20/03 | P<br>ARIE<br>J16535 |
| Step 33          | Connect cable 8A02698GSE-501 connector 2A22P3 to GPS receiver A 2A22 J3.                                                                                                        |      | 5/20/03 | P<br>ARIE<br>J16535 |
| Step 34          | Reconnect cable 8A02698GSE-501 connector 2A111P10 to AFT SRE B J10.                                                                                                             |      | 5/20/03 | P<br>ARIE<br>J16535 |
| Step 35          | Disconnect BNC cable from TDB J3 and from GSS Gyro Simulator Interface BNC(s), including any BND "T"s, specified in Step 3.                                                     |      | 5/20/03 | P<br>ARIE<br>J16535 |
| Step 36          | Reconnected BNC cable from GSS(s) specified in Step 3 to specified GSS Gyro Simulator Interface BNC(s).<br><br>(Note: Existing BNC cable originates from specified FWD GSS PHV) |      | 5/20/03 | P<br>ARIE<br>J16535 |
| Step 37          | Disconnect BNC cables and "T"s from TDB J4 and from TEST input of all four Squid Simulators.                                                                                    |      | 5/20/03 | P<br>ARIE<br>J16535 |
| Step 38          | Disconnect SQUID Simulator from FWD SRE B (1A09) J1 and connect SQUID as follows,<br><br>SQUID Cable to FWD SRE B J1                                                            |      | 5/20/03 | P<br>ARIE<br>J16535 |
| Step 39          | Disconnect the TDB ECU cable from TDB J5 and from the following<br><br>P3E from Aft ECU J3<br>P5E from Fwd ECU J5<br>P7E from Fwd ECU J7                                        |      | 5/20/03 | P<br>ARIE<br>J16535 |

| Operation Number | Procedure                                                                                                                                                            | Data | Date    | Stamp               |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------|---------------------|
| Step 40          | Reconnect the following to FWD ECU<br><br>Probe Simulator cable 8A02849GSE-101 1A06P5 to FWD ECU J5<br><br>Probe Simulator cable 8A02711GSE-501 1A06P7 to FWD ECU J7 |      | 5/20/03 | P<br>*RTE<br>J16535 |
| Step 41          | Disconnect TDB cable 8A03008GSE-502 from the following<br><br>Cable from TDB J2<br>Cable from T2ADM P3<br>Cable from SRE J7                                          |      | 5/20/03 | P<br>*RTE<br>J16535 |
| Step 42          | Set T2ADM AXIS Signal Selection switches to their original settings, reference Step 24.                                                                              |      | 5/20/03 | P<br>*RTE<br>J16535 |
| Step 43          | Set T2ADM Rate knob to its original position, reference Step 24.                                                                                                     |      | 5/20/03 | P<br>*RTE<br>J16535 |
| Step 44          | Disconnect TDB power supply from TDB J1 and from facility power.                                                                                                     |      | 5/20/03 | P<br>*RTE<br>J16535 |
| Step 45          | Assure TRE to SRE cables are configured per Step 2.                                                                                                                  |      | 5/20/03 | P<br>*RTE<br>J16535 |
| Step 46          | Return TDB, cables, and power supply to ITF stores.                                                                                                                  |      | 5/20/03 | P<br>*RTE<br>J16535 |
|                  |                                                                                                                                                                      |      |         |                     |
| Step 999         | Q.A. stamp, operations order complete.                                                                                                                               | N/A  | 5/21/03 | 10E<br>600843       |