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Gravity Probe B Relativity Mission

Proton Monitor Functional Test Procedure

GP-B P0636

19 November, 1999

Prepared by: Peter Rusznyak **Date**
STI

Approved by: Awele Ndili **Date**
Proton Monitor Product Team Leader

Approved by: S. Buchman **Date**
Hardware Manager

Approved by: Dorrene Ross **Date**
Quality Assurance

Notes:

1. This procedure was originally written by STI as document No.: GPB-GI-401.

2: All redlines must be approved by QA

Level of QA required during performance of this procedure:

Stanford QA Representative

Government QA Representative

1 Scope

This document provides information on the Limited Performance Testing, Comprehensive Performance Testing, Power On-Off Testing, Command List Verification, TM Frame Content Verification, Housekeeping Parameter List Verification, Stand-alone Operation Testing and Data&Timing Verification. These Procedures are all referenced under Functional Testing in the Verification Matrix.

These tests will be performed several times and at several locations. Each test in this document is performed when called from other test procedures. The calling procedure Name / Number will be recorded below along with Test Location.

The Proton Monitor under test may need to be connected to the calibrated GSE pulser via the test connector. If so, this is included in the relevant test flow. Refer to STIL Document GPB-GI-250 (Installation Procedures).

RECORD TEST LOCATION:

Testing per this procedure has been invoked by (indicate with X on proper line):

<input type="checkbox"/>	P0634	PM Vibration Test Procedure	(Ref. STI No.: GPB-GI-205)	Test Nr. T10
<input type="checkbox"/>	P0635	PM Thermal Vacuum Test Procedure	(Ref. STI No.: GPB-GI-210)	Test Nr. T12
<input type="checkbox"/>	P0636	PM Functional Test Procedure (full and abbreviated)	(Ref. STI No.: GPB-GI-401)	Test Nr. T01
<input type="checkbox"/>	P0638	PM Inrush Current Test Procedure	(Ref. STI No.: GPB-GI-430)	Test Nr. T07
<input type="checkbox"/>	P0639	PM Power Consumption Test Procedure	(Ref. STI No.: GPB-GI-425)	Test Nr. T06
<input type="checkbox"/>	P0640	PM Transient Amplitude Test Procedure	(Ref. STI No.: GPB-GI-410)	Test Nr. T03
<input type="checkbox"/>	P0641	PM Extreme Primary Voltages Test Procedure	(Ref. STI No.: GPB-GI-405)	Test Nr. T02
<input type="checkbox"/>	P0642	PM Synchronization Test Procedure	(Ref. STI No.: GPB-GI-435)	Test Nr. T05

Applicable Section (circle one):

LPT	Limited Performance Test	Section 8
CPT	Comprehensive Performance Test	Section 9
	Power On-Off Testing	Section 10
	Command List Verification	Section 11
	TM Frame Content Verification	Section 12
	HK Parameter List Verification	Section 13
	Stand-alone Operation Testing	Section 14
	Data & Timing Verification	Section 15

2 Personnel Requirements

This test to be conducted only by certified personnel: Peter Rusznyak and Awele Ndili.
 Notify ONR 24 hours prior to beginning testing.

Person Contacted: _____ Date and Time: _____

Notify QA 24 hours prior to beginning testing.

Person Contacted: _____ Date and Time: _____

3 Quality Assurance

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

4 Safety Requirements

4.1 Electrical mating and demating of flight hardware connectors

- 4.1.1 Place cable connector A only into socket A, etc.
- 4.1.2 Strain relieve all cables
- 4.1.3 Connection and disconnection shall be performed only when the equipment involved is in a powered-down state.
- 4.1.4 Connectors shall be inspected for contamination and for bent, damaged, or recessed pins prior to mating.
- 4.1.5 Connector savers are to be used on the Proton Monitor connectors.

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

4.2 Electro Static Discharge (ESD)

- 4.2.1 No special precautions for ESD are required for this device.

5 General Instructions

This section should include general instructions that apply throughout the procedure and are not covered elsewhere.

5.1 Red-line Authority

- 5.1.1 Authority to red-line (make minor changes during execution) this procedure is given solely to the PTD or his designate and shall be approved by the QA representative. Additionally, approval by the Hardware Manager shall be required, if in the judgement of the PTD or QA Representative, experiment functionality may be affected.
- 5.1.2 Any nonconformance or test anomaly should be reported by a Discrepancy Report. Refer to the Quality Plan, P0108, for guidance. Do not alter or break test configuration if a test failure occurs; notify quality assurance.
- 5.1.3 Only the following persons have the authority to exit/terminate this test or perform a retest: Peter Rusznyak and Awele Ndili

6 Cleanliness requirements

The Proton Detector FM and FS should always be kept in a Class 10,000 or better environment. The units must be handled using gloves. Cleaning of the units is possible using ethanol only. Special precaution has to be made to avoid ethanol getting under the titanium shields.

7 Hardware Required:

Flight Proton Monitor, PN _____

Ground Support Equipment: _____

8 Applicable Documents

PR 9071 Stanford contract to design, fabricate and deliver the High Energy Proton Monitor
GPB-GI-250 STIL Proton Detector Installation Procedures
GPB-GI-702 STIL Proton Detector Command List
GPB-GI-750 STIL Command Execution

9 Limited Performance Test - LPT

The purpose of the LPT is to test selected functions of the Proton Detector in order to allow the operator to commission the instrument. It is an abbreviated functional test and does not guarantee full compliance with all specifications neither does it verify full functionality of the unit. Instead, it is designed to provide the operator with a means for basic performance verification in a short time. A successfully completed LPT will leave very little room for any malfunction to pass unnoticed. When performed at instrument level it does not require any other equipment but the GSE (ECU simulator) and the GSE Computer running the GSE SW.

Test Entry: Test Operator Initial: _____, Date: _____, Time: _____

<u>Action</u>		<u>Expected reaction</u>	√ complete
Step 1	Switch On	First Science frame (SC) has to be received within 1 minute with Default Channel Configuration (DCC) & Default Time Resolution (DTR)	
Step 2	Wait 2 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR)	
Step 3	Self Calibration request	32 SC frames will be received with calibration data (CAL flag on)	
Step 4	Wait 8 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR). Self calibration will terminate automatically (CAL flag off).	
Step 5	Housekeeping request	One HK frame will be received	
Step 6	Wait 2 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR)	
Step 7	Switch Off	End of testing	

The expected duration of the LPT is approximately 20 minutes.

Test Complete with acceptable results.

Performed by: _____ Date: _____

QA Witness: _____ Date: _____

10 Comprehensive Performance Test - CPT

The purpose of the CPT is to test all the functions of the Proton Detector in full and therefore require the sending of all commands at least once. It will also allow the verification of the performance of the analog section (noise, resolution, linearity) through the use of the calibrated programmable precision pulser that is part of the GSE. The estimated time required for the CPT is 4 hours, and therefore only a limited number of executed CPTs is foreseen during the ground testing of the Proton Detector.

Test Entry: Test Operator Initial: _____, Date: _____, Time: _____

<u>Action</u>		<u>Expected reaction</u>	√ complete
Step 1	Switch On	First Science frame (SC) has to be received within 1 minute with Default Channel Configuration (DCC) & Default Time Resolution (DTR)	
Step 2	Wait 2 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR)	
Step 3	Self Calibration request	32 SC frames will be received with calibration data (CAL flag on)	
Step 4	Wait 8 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR). Self calibration will terminate automatically (CAL flag off).	
Step 5	Housekeeping request	One HK frame will be received	
Step 6	Wait 2 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR)	
Step 7	Channel Config. request	Channel Configuration will be changed to requested CC	
Step 8	Self Calibration request	32 SC frames will be received with calibration data (CAL flag on), with Current Channel Configuration (CCC)	
Step 9	Wait 8 minutes	SC frames will be arriving in every 12.8 second intervals (CCC & DTR). Self calibration will terminate automatically (CAL flag off).	
Step 10	Repeat Step 7-9	Checking all Channel Configuration codes	
Step 11	Time Resolution request	Time resolution will be changed to 25.6 seconds	
Step 12	Self Calibration request	32 SC frames will be received with calibration data (CAL flag on), data shall reflect to Current Time Resolution	
Step 13	Wait 16 minutes	SC frames will be arriving in every 25.6 minute intervals	
Step 14	Reload SW with	All flags shall be cleared to default modes	

<u>Action</u>		<u>Expected reaction</u>	√ complete
	Defaults		
Step 15	Connect GSE pulser	SC frames with pre-defined data patterns shall be received to verify analog electronics & detector performance parameters (thresholds, gains, offsets etc.)	
Step 16	Disable electron suppression	On board electron suppression logic is disabled (ES flag set), data shall reflect to this	
Step 17	Disable maximum mode	On board mode logic is disabled (Criterion flag set), data shall reflect the mode change	
Step 18	Reload SW with Defaults	All flags shall be cleared to default modes	
Step 19	Wait 2 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR)	
Step 20	Self Calibration request	32 SC frames will be received with calibration data (CAL flag on)	
Step 21	Wait 8 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR). Self calibration will terminate automatically (CAL flag off).	
Step 22	Housekeeping request	One HK frame will be received	
Step 23	Wait 2 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR)	
Step 24	Switch Off	End of testing	

The expected duration of the CPT is approximately 4 hours. Steps 14 – 16 may not be executable when the PD is mounted on the spacecraft. The duration of the CPT in this case shall be approximately 1 hour shorter.

Test Complete with acceptable results. Performed by: _____ Date: _____ QA Witness: _____ Date: _____
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11 Power On-Off Testing

Test Entry: Test Operator Initial: _____, Date: _____, Time: _____

<u>Action</u>		<u>Expected reaction</u>	√ complete
Step 1	Switch On	First Science frame (SC) has to be received within 1 minute with Default Channel Configuration (DCC) & Default Time Resolution (DTR)	
Step 2	Wait 2 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR)	
Step 3	Switch Off	End of testing	

Test Complete with acceptable results. Performed by: _____ Date: _____ QA Witness: _____ Date: _____
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12 Command List Verification

Test Entry: Test Operator Initial: _____, Date: _____, Time: _____

<u>Action</u>		<u>Expected reaction</u>	√ complete
Step 1	Switch On	First Science frame (SC) has to be received within 1 minute with Default Channel Configuration (DCC) & Default Time Resolution (DTR)	
Step 2	Wait 2 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR)	
Step 3	Send commands	Send all commands listed in STIL Document GPB-GI-702 (Command List) and verify their acknowledgement	
Step 4	Execution	Verify Command Execution based on STIL Document GPB-GI-750 (Command Execution)	
Step 5	Switch off	End of testing	

Test Complete with acceptable results. Performed by: _____ Date: _____ QA Witness: _____ Date: _____
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13 TM Frame Content Verification

Test Entry: Test Operator Initial: _____, Date: _____, Time: _____

<u>Action</u>		<u>Expected reaction</u>	√ complete
Step 1	Switch On	First Science frame (SC) has to be received within 1 minute with Default Channel Configuration (DCC) & Default Time Resolution (DTR)	
Step 2	Wait 2 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR)	
Step 3	Self Calibration request	32 SC frames will be received with calibration data (CAL flag on)	
Step 4	Wait 8 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR). Self calibration will terminate automatically (CAL flag off).	
Step 5	Switch off	End of testing	

Each parameter that appears on the GSE screen has to be verified (status and mode flags, frame counter, command acknowledge, integral channels and PHA spectra for both the vertical and the horizontal telescopes) during the testing.

Test Complete with acceptable results.

Performed by: _____ Date: _____

QA Witness: _____ Date: _____

14 HK Parameter List Verification

<u>Action</u>		<u>Expected reaction</u>	√ complete
Step 1	Switch On	First Science frame (SC) has to be received within 1 minute with Default Channel Configuration (DCC) & Default Time Resolution (DTR)	
Step 2	Wait 2 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR)	
Step 3	Housekeeping request	One HK frame will be received	
Step 4	Verification	The operator has to switch the GSE screen to displaying the Housekeeping Frame and verify the correct contents.	
Step 5	Switch off	End of testing	

Test Complete with acceptable results.

Performed by: _____ Date: _____

QA Witness: _____ Date: _____

15 Stand-alone Operation Testing

Test Entry: Test Operator Initial: _____, Date: _____, Time: _____

<u>Action</u>		<u>Expected reaction</u>	√ complete
Step 1	Connect GSE pulser	External stimuli must be provided for this testing	
Step 2	Switch On	First Science frame (SC) has to be received within 1 minute with Default Channel Configuration (DCC) & Default Time Resolution (DTR)	
Step 3	Wait 60 minutes	SC frames will be arriving in every 12.8 second intervals (DCC & DTR). Monitor the Science Frame contents (status and mode flags, frame counter, command acknowledge, integral channels and PHA spectra for both telescopes) during the testing	
Step 4	Switch Off	End of testing	

Test Complete with acceptable results.	
Performed by: _____	Date: _____
QA Witness: _____	Date: _____

16 Data & Timing Verification

This test is equivalent with the TM Frame Content Verification procedure – once the content of the Science Frame has been verified and accepted, the Interface Data and Timing is also deemed to be correct.

Test Entry (perform TM Frame Content Verification procedure)

Test Operator Initial: _____, Date: _____, Time: _____

Verify content of the Science Frame. Contents acceptable (circle one): Y N

Test Complete with acceptable results.	
Performed by: _____	Date: _____
QA Witness: _____	Date: _____

17 Procedure Completed

Discrepancies if any:

Approval. The information obtained under this assembly and test procedure is as represented and the documentation is complete and correct:	
Test Director/ PTD: _____	Date: _____
QA Manager: _____	Date: _____