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Gravity Probe B Relativity Mission

Science Mission Configuration Management Plan
P0098 Rev B
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			4	8.4	Add.
			7	3.0	Add SOW.
			8	4.3, 4.5	Clarifications.
			9	4.6, 4.8	Clarifications.
			10	5.1.1	Clarification.
			11, 12	5.1.3	Additions and clarifications.
			14	5.3.1	Addition of paragraph 5.3.1.
			21	5.3.3.3	Clarifications.
			22	5.3.3.5	Clarifications.
			23	8.1, 8.4	Clarifications and additions.

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1. Scope and summary

The Configuration Management Plan covers Configuration Management of Program Requirements, Design Requirements, and Product Configuration for the GP-B experiment defined in T001. The top level Program Requirements are described in T002, "12 Science Requirements" and T003, "System Design and Performance Requirements". The Program's Requirements Tree is maintained in the GP-B Configuration & Test Database. The Design Requirements include all the drawings, procedures and specifications related to the Science Mission. The drawings are detailed in the program's Drawing Trees. See **Appendix B** for a sample of a GP-B Drawing Tree. The Product Configuration includes the As-Built Configuration of the hardware and software for the program.

The purpose of this plan is to describe the procedures for the control of the items mentioned above through the development and build of the Relativity Mission. The plan includes a description of authorities/responsibilities, establishing of baselines, use of redlines, the processes for implementation of changes, identification of hardware and software, and the process for As-Built Configuration Control.

2. Applicable Documents

2.1 T001, “Science Mission Objectives”
2.2 T002, “12 Fundamental Science Requirements”
2.3 T003, “System Design Performance Requirements”
2.3 DOD-D-1000, Drawings, Engineering and Associated Lists
2.4 DOD-STD-100,
2.5 SE 08 Volume 1, LMMS “Software Management Plan”
2.6 SU P0630, “Software Quality Assurance Plan”
2.7 GP-B Configuration and Test Database, Design Specification, 8/31/94. (located on the GP-B server)

3. Acronyms

CCB - Configuration Control Board
CDR - Critical Design Review
CM - Configuration Management
CSE - Chief Systems Engineer
ECB - Engineering Change Board
ECO - Engineering Change Order
ICD - Interface Control Document
ID - Identification Number
LSEE - Lockheed Software Engineering Environment
LMMS – Lockheed Martin Missiles and Space
MSFC - Marshall Space Flight Center
MRB - Material Review Board
PCB - Program Control Board
PDR - Preliminary Design Review

RE - Responsible Engineer
SM - Science Mission
SOW – Statement of Work
SRR - System Requirement Review
SU - Stanford University

4. Organization

The GP-B Organization Chart is shown in **Appendix A**.

The responsibility and role of each member is described hereafter:

- The prime responsibility for SM Configuration Management is vested in the SM Program Manager.
- The SM Program Manager is assisted by the System Effectiveness Manager, who also serves as the Configuration Manager, and other persons assist as described herein.

4.1 Program Manager

The Configuration Management (CM) functions of the Program Manager include:

- Chairman of SU's PCB.
- Chairman of SU's Class 1 Major ECB for Science Instrumentation.
- To forward Major PCBs to MSFC for approval.
- To ensure throughout the life of the program that there shall be sufficient personnel and resources to support and meet the program objectives.

4.2 SU Spacecraft Manager

The Configuration Management functions of the Spacecraft Manager are:

- Member of SU's PCB.
- Chairman of SU's Class 2 Major ECB for Spacecraft and Software.
- Responsible for implementation of the Configuration Management Procedures for the SU Software Modules. This includes change control of Integration and Tests Procedures and As-Built Configuration requirements for Spacecraft and Software.

4.3 SU Program Technical Manager

The Configuration Management functions of the Program Technical Manager are:

- Member of SU's PCB.
- Chairman of SU's Class 2 Major ECB for Non-Electronics portions of the Science Instrumentation.
- Member of MRB.
- Responsible for implementation of the Configuration Management Procedures for the

SU Program Specification Documents. This includes change control of ~~Specification~~ Science Documents (SDOCs) as they apply to the program.

4.4 SU Payload Electronics Manager

The Payload Electronics Manager is responsible for the Gyro Suspension Units, SQUID Readout Electronics, Telescope Readout Electronics, the Experimental Control Unit, the Global Positioning System, Proton Monitor, Payload Magnetometer, Payload Wire Harness, Grounding, Shielding and EMI Control. The CM responsibilities and roles of the Payload Electronics Manager are:

- Member of SU's PCB.
- Chairman of SU's Class 2 Major ECB for Electronics.
- Chairman of SU's Drawing Release Board for the electronics listed above. Responsible for approval of Engineering Change Orders for Class 2 Minor Changes to Electronics.
- To ensure that the Electronics Engineering Group complies with the Document Release (Drawings and Procedures) and Engineering Change procedures.
- To present the Electronics Engineering position concerning Major Changes, and identify the critical manufacturing processes that need configuration control.
- Responsible for implementation of the Configuration Management Procedures by the Electronics Engineering group. This includes change control of Integration and Tests Procedures, Parts Identification and As-Built Configuration requirements for Payload Electronics Systems.

4.5 SU Payload Technical Manager

The Payload Technical Manager is responsible for all Non-Electronics Payload Sub-Systems. The CM responsibilities and roles of the Payload Technical Manager are:

~~Member of SU's PCB.~~

- Chairman of SU's Drawing Release Board for Non-Electronics.
- Responsible for approval of Engineering Change Orders for Class 2 Minor Changes to Non-Electronics.
- To ensure that the Engineering Group complies with the Document Release (Drawings and Procedures) and Engineering Change procedures for non-electronics.
- To present the engineering position concerning Major Changes, and identify the critical manufacturing processes that need configuration control.
- Responsible for implementation of the Configuration Management Procedures by the Engineering group. This includes change control of Integration and Tests Procedures, Parts Identification and As-Built Configuration requirements for Non-Payload Electronics Systems.

4.6 SU Deputy Program Manager

The CM responsibility of the Deputy Program Manager is to ensure that Sub-Contractors utilize a documented CM system for all contracts, procurement, engineering, design services and/or the delivery of hardware and software for the SM Program. ~~He/she is also responsible for the archiving of all controlled documents at SU.~~

- Member of the PCB.

4.7 SU Chief Systems Engineer

The Chief Systems Engineer or his/her designee is:

- Member of the PCB.
- Responsible for the follow up of the PCB Requests.
- Responsible for the management of the Requirements, Specifications/Requirements Verification and Action Items from Reviews (Monthly, Independent Reviews, SRR, PDR, CDR,… etc.).

4.8 SU System Effectiveness Manager

The System Effectiveness Manager is responsible for all Quality activities, including the archiving of all controlled documents at SU and the following:

- Member SU's PCB.
- Member of Drawing Release Board.
- Responsible for Quality approval of Engineering Change Orders.
- Write/review the Configuration Management Plan and configuration related procedures.
- Monitors the implementation of these procedures at SU and subcontractors.

4.9 Responsible Design Engineers

The Responsible Design Engineers are:

- Members of SU’s ECB for Type II Changes that are relevant to the system they are responsible for.
- Responsible for evaluating the effect of a proposed change on system's function, cost and schedule to be presented in the ECO.
- Responsible to ensure that all drawings drafted by their group meet the engineering drafting standards.
- Member of Drawing Release Board for relevant drawings.

5. Configuration Management Practice for Documents

5.1 Establishing the baseline

5.1.1 Establishing the baseline for Specifications/Requirements

The relevant Requirements and their hierarchy are described in the Program's Requirements Tree stored in the GP-B Configuration & Test Database located on the SU GP-B server.

NASA Headquarters will approve the baseline of the Program's Objectives, document T001.
MSFC will approve the baseline of the Program's Science Requirements, documents T002.
T001 and T002 Requirements are shown in the Database under "Documents" and then subcategory "Specifications". (Reference GP-B "Contractor's Documents Requirements List"; PM, PA, SE, IT, MO and SA)

All Lower Requirements (T003) and Specifications will be released through the Drawing Release Process described in paragraph ~~5.1.3.1~~ 5.2.1. The list of the Released Specification will establish the Baseline for Lower Specification. This list is stored in the GP-B Configuration & Test Database located on the SU GP-B server under "Documents" and then subcategory "Specifications".

The release process is as follows:

1. Specification shall have a cover sheet (similar to a Operations and Integration Procedure, see **Appendix C),** signed and dated by the minimum of the persons listed below, the author of the document, the System Effectiveness Manager, and the Program Technical Manager.

NOTE: This requirement becomes effective once this procedure is approved. All changes to the existing database documents will reflect an SDOC number in addition to the original specification number.

5.1.2 Establishing the Baseline for Procedures

SU's Procedures describe special processes used in the program such as; Cleaning, Magnetic Screening, Lapping, Assembly, Integration, Testing and so on and are referenced in parts drawings, assembly drawings, travel sheets and test plans. The list of the Released Procedures will establish the Baseline for Procedures. This list of Procedures is stored in the GP-B Configuration & Test Database shown under "Documents" and then subcategory "Procedures", along with their electronic copies (when available). Procedure numbers are in sequential order and are provided by and maintained by the Document Control Center.

The release process is as follows:

1. Operation and Integration Procedures shall have a cover sheet signed and dated by the minimum of the persons listed below, see **Appendix C**
    - The author of the procedure, the Responsible Engineer (RE), the System Effectiveness Manager, the appropriate Payload Manager and when required by the Safety Engineer.

2. Test Procedures shall have a cover sheet signed and dated by the minimum of the persons listed below, see **Appendix D.**

- The author of the procedure, the Responsible Engineer (RE), the Chief System Engineer, the System Effectiveness Manager, the appropriate Payload Manager and when required the Safety Engineer.

3. All Procedures that are contract required must be approved by MSFC, i.e. the Quality Plan, Configuration Plan, etc.
   - MSFC approval will be added to the cover sheet.

4. Some procedures may be approved by 'no-response' with a specified time, the GP-B Configuration & Test Database will have in the Procedure Table the following fields: MSFC approval required (Yes/No), Date submitted to MSFC, MSFC approval (either date of approval or note "approved since no response within ~~X days~~ the number of days as defined by contract").

5.1.3 Establishing the Baseline for Science Documents

"Science Documents" describe software content, configuration control, methodology, test readiness, analysis, and requirements specifications. There are two types of SDOCs; those that define specification requirements and those that do not. The initial release process is the same for both types of SDOCs. The definition of types, maintenance, control and revision of these documents are as follows:

1. All SDOCs that define "specifications" (for example S0457/MO-02, Mission Operations Specifications) will be maintained in the GP-B Configuration & Test Database located on the SU GP-B server under "Documents" and then subcategory "Specifications". All specification type SDOCs are numbered in sequential order (such as MO-01, MO-02, etc.) when stored in this database. A link to the SDOC number will be shown in database for each specification type document. The signed off hard copy will maintained by the Document Control Center. The electronic copy will be stored in the GP-B Configuration & Test Database located on the SU GP-B server under "Documents" and then subcategory "Science Documents".

NOTE: This requirement becomes effective once this procedure is approved. All changes to the existing database documents will reflect an SDOC number in addition to the original specification number.

2. All other SDOCs will be reviewed and approved by the individuals listed on the cover page. The signed off hard copy will be maintained by the Document Control Center. The electronic copy will be stored in the GP-B Configuration & Test Database located on the SU GP-B server under "Documents" and then subcategory "Science Documents".

The release process is as follows:

1. Science Document shall have a cover sheet signed and dated by the minimum of the persons listed below, see **Appendix C**
   - The author of the procedure, the Responsible Engineer (RE), the Chief System Engineer

or designee, the System Effectiveness Manager, the appropriate Payload Manager and any other individual as deemed necessary by the author.

2. All SDOCs that are written as specifications must be approved by MSFC, i.e. the GPS Specification, etc.
   - SU shall submit to MSFC for approval.

3. Some procedures may be approved by 'no-response' with a specified time, the GP-B Configuration & Test Database will have in the Procedure Table the following fields: MSFC approval required (Yes/No), Date submitted to MSFC, MSFC approval (either date of approval or note "approved since no response within the number of days as defined by contract").

5.1.4 Establishing the Baseline for Drawings

Drawing Baseline includes Drawing Release Process, Drawing List and Drawing Tree. Drawing practices will be per DOD-D-1000 Level 2 and DOD-STD-100. Drawing numbers are in sequential order and are provided by and maintained by the Document Control Center.

5.1.5 Establishing the baseline for Software

All the software developed and released by LMMS will be controlled using LMMS document SCSE 08, Volume I, Software Management Plan. The information controlled through this system for each module of software includes, but is not limited to, the module's Title, Release Status, and Revision. The list of Released Software Modules establishes the baseline for Software.

All software developed and released by SU; the SU Software Quality Plan, P0630, will control i.e., Ground Operations, Science Data Analysis and GPS modules.

5.1.6 Establishing the Baseline for Interface Control Documents (ICD)

Interface Control Documents will be developed which define and control the interfaces between elements. ICDs will be generated by LMMS defining interfaces between SU hardware/software and LMMS hardware/software.

5.2 Release Process

The release process is described for Drawings, Procedures and Lower Level Specifications. At the completion of the each document, and prior to procurement or manufacture of flight items, drawings will be presented for review and approval.

5.2.1 Drawing Release Process

Each drawing shall be reviewed and approved by a minimum of responsible parties which include but are not limited to the appropriate Payload Manager, who serves as the chairman, the Responsible Design Engineer for the system, whether mechanical or electronic, and the System Effectiveness Manager. It is the responsibility of each Payload Manager to add to the release approval of each drawing the relevant experts to cover aspects such as magnetics, cleanliness, vacuum, integration,

stress & dynamics, manufacturing, etc.

Release of drawings will be by signing the Drawing Approval form (**Appendix E**) and by the appropriate Payload Manager signing the "Master" hard copy drawing. The signed master copy of the released drawing will be kept in the Documentation Center which is a secured, limited access storage location, accessible to assigned personnel only.

All "Work copies" of the master drawing will be will be issued by the Documentation Control Center and will be identified by a red "RELEASED" stamp. When a drawing is issued from the Document Control Center the clerk will date the day the drawing was issued to the requestor.

5.2.2 The Drawings List /Procedures List and the Specifications List

1. The Drawing List includes all the Released drawings and establishes the baseline for drawings. This list is stored in the 'Design Table' in the GP-B Configuration & Test Database located on the GP-B server.
2. The Procedures List includes all the Released Procedures and establishes the baseline for Procedures. This list is stored in the 'Documents Table' in the GP-B Configuration & Test Database located on the GP-B server.
3. The Lower Level Specifications List includes all the Released Lower Level Specifications and establishes the baseline for Lower Level Specifications. This list is stored in the 'Documents Table' in the GP-B Configuration & Test Database located on the GP-B server. Specification numbers are in sequential order and are provided by and maintained by the Document Control Center.

Both the Payload Technical Manager and Payload Electronics Manager are responsible for establishing and updating the Drawing List, the Procedures List and the Lower Level Specification in their individual groups.

Note: Both Payload Managers will be required to approve and sign-off on procedures that incorporate the technical and electronics groups.

5.2.3 Drawing Tree

As the design progresses, a Drawing Tree will be prepared. The Drawing Tree will include Part Number, Dwg #, Title, Type (Assembly/ Kit/ Part) and Quantity. See **Appendix F** for example of a Drawing Tree. When the design of an assembly is completed, the Drawing Tree will be released through a Drawing Release Process per paragraph 5.2.1 and will be controlled as any other released document.

5.3 Change Process

All changes to the Specifications, Drawings and Procedures, introduced after release, will be subjected to the following Change Control measures defined in this document. It must be noted that Stanford University will use two methods of 'REDLINES'.

- Redlines to drawings as a way of expediting the manufacture or procurement of flight items. These redlines will be reviewed and approved by both the Responsible Engineer and Quality Engineer. SU will retain the 'Master Copy Redline' which will carry the dated stamps of both the RE and QE. These redlines must be incorporated via the ECO process into the next revision release of the drawing. Quality's final Acceptance will be to released drawings only.
- Redlines to a procedure as a method of showing changes to an 'As-Built'. All redlines shall be agreed upon by the RE and QE, stamped and dated. If the procedure is to be used again, all redlines if intended for a permanent change to the procedure must be incorporated into the next revision release before use. ECO number for changes incorporating changes to a procedure shall be noted by the QE on the Procedure Cover Sheet.

5.3.1 Change to Science Documents

A PCB will be use when making revision changes to all SDOCs that define specifications.

All non-specification type SDOCs will be revised in the following manner. The original approvers, their designees, or their replacements will approve revisions of all these SDOCs. The revision block will reflect all changes made to the original document.

5.3.2 Changes Classification and Definition

Figure 1 shows the summary of change classifications and approval

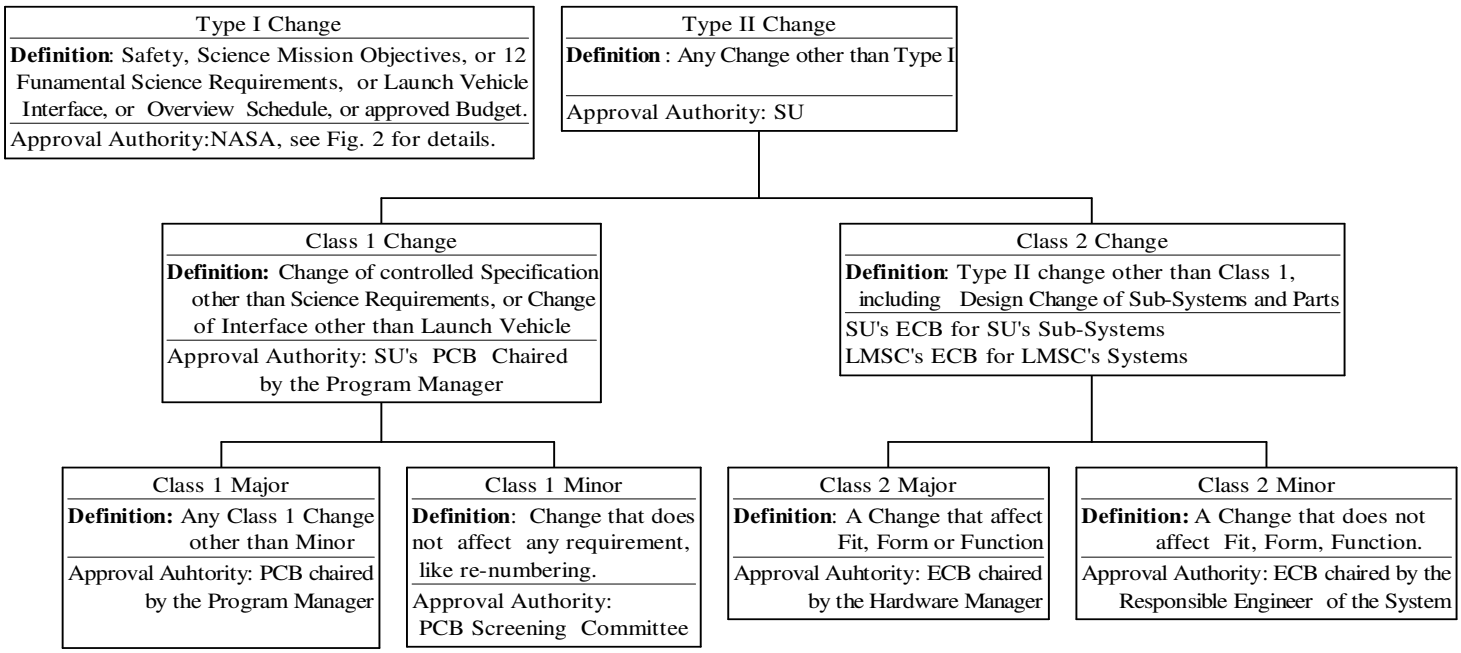


Figure 1

5.3.2.1 Type I Change

Any change to the baseline configuration that affects one or more of the following: Safety, Science Mission Objectives (T001), 12 Fundamental Science Requirements (T002), Launch Vehicle Interface, Overview Schedule and Approval Budget.

5.3.2.2 Type II Change

Any Change other than Type I Change. Type II Changes are divided into Class 1 and Class 2 Changes.

Type II Class 1 Change:

Any change that affects controlled Requirements other than the Science Requirements (T001 & T002), or a change that affects Interface other than the Launch Vehicle Interface, or a change that has substantial effect on cost or Target Schedule.

- **Type II, Class 1 Major Change:**
  Any Class 1 change other then a Minor.

- **Type II, Class 1 Minor Change:**
  Changes that do not affect any requirements like correction of typo or re-numbering of paragraphs inside the System Design and Performance Requirements.

Type II Class 2 Change:
Any change other than a Class 1 including design changes of Sub-Systems and Parts.

- **Type II, Class 2 Minor Change:**
  Change that does not affect Fit, Form or Function at the Box Level, including changes which will be found necessary from manufacturing considerations, during the manufacturing of the first lot of parts or "fine tuning" of electronic boards during assembly. Also changes of non-flight parts.

- **Type II, Class 2 Major Change:**
  A change that affects Fit, Form or Function at the Box Level or major sub-systems such as GMA, QBA or subcontracted work scope.

5.3.3 Change Boards

The hierarchy, authority and members of the involved Change Boards are shown in following Figure 2.

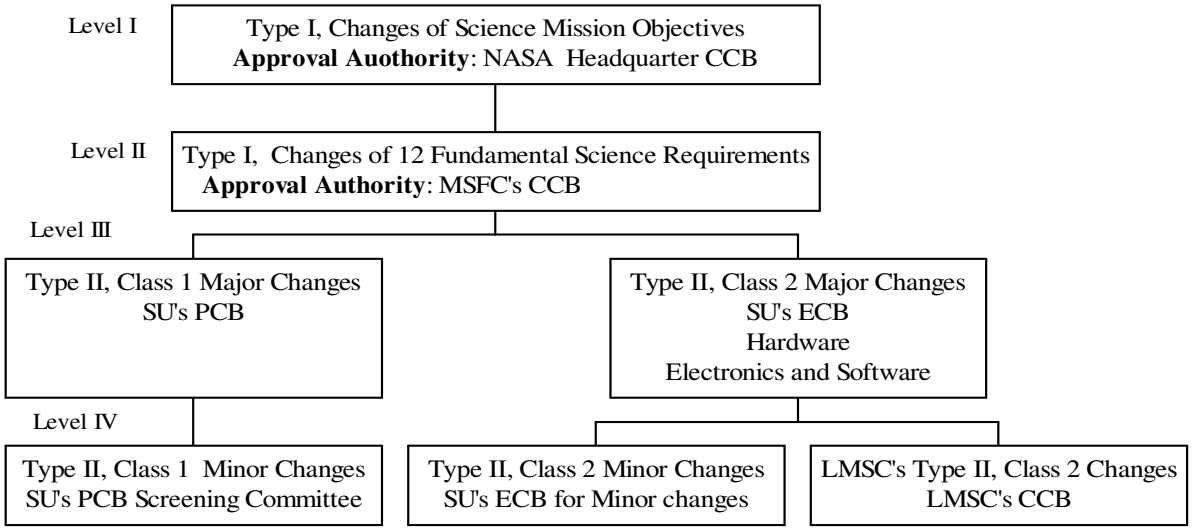


Figure 2

5.3.3.1 NASA Headquarters CCB (Level 1)

Type 1 Changes of Science Mission Objectives shall be approved by NASA Headquarters CCB prior to implementation.

5.3.3.2 MSFC CCB (Level II)

Type 2 Changes of 12 Fundamental Science Requirements shall be approved by the MSFC CCB prior to implementation.

5.3.3.3 SU Program Control Board PCB (Level III)

This PCB will review and approve Type II, Class 1 Changes. The Chairman of the Board is the SU Program Manager. Other members include the SU Program Technical Manager, SU Payload Electronics Manager, the SU Spacecraft Manager, the Chief System Engineer, LM Program Manager *, SU Business Manager, SU System Effectiveness Manager, SU Mission Operations Manager, Chief Scientist and NASA Resident Manager.

* Note that the LM Program Manager's signature may indicate acknowledgement of the baseline change and not agreement with the technical implementation. The LM Program Manager's reservations toward the technical implementation will be added to the PCB. All costs that direct LM activity will be negotiated outside the PCB process; however, all PCB's that direct LM activity must include a rough order of magnitude (ROM) to scope the magnitude of the change impact.

Experts of various disciplines and Responsible Engineers of specific systems are summoned as needed. The Deputy Program Manager is consulted when a PCB includes over $15,000 cost impact.

5.3.3.4 PCB Screening Committee

The responsibilities and authority of the PCB Screening Committee are:

- Review and verify completeness of the Change Request including the reason for change, supporting documentation, effects if not approved, effects on other requirements, schedule impact, cost, etc.

The Screening Committee has authority for the following:

- To reject a Change request
- To approve Class 1 Minor Changes
- To forward a change Request to the PCB with recommendation for approval

The process for generating a PCB is as follows:

1. The Chairman of the PCB Screening Committee will assign a PCB number.

2. The initiator shall write the PCB request in the GP-B Configuration & Test Database including the title, change details, reason for change, impacts on schedule and cost.
3. The PCB Screening Committee shall review the Change request.
4. If rejected the Change Request shall be returned to the requestor with reasons for rejection.
5. If approved the PCB members shall sign the hard copy of the Change Request. The Chairman will mark the PCB as approved in the database. The affected documents, such as specifications, shall also be updated in the database. The signed hard copy shall be archived in the Documentation Center.

5.3.3.5 SU Engineering Change Orders (Level III)

Engineering Change Orders (ECO) shall be used for requests for Type II, Class 2 Changes to hardware, electronics and software. The initiator shall write the ECO request in the GP-B Configuration & Test Database including the title, change details, reason for change, impacts on schedule and cost.

Changes to Hardware

- Minimum reviewers are the Payload Technical Manager (also the Chairman), the Responsible Engineer and the System Effectiveness Manager.
- If approved the ECO members shall sign the hard copy of the Change Request. The Chairman will mark the ECO as approved in the database. The affected documents, such as drawings, shall also be updated in the database. The signed hard copy shall be archived in the Documentation Center.

Changes to Electronics

- Minimum reviewers are the Payload Electronics Manager (also the Chairman), the Responsible Engineer and the System Effectiveness Manager.
- If approved the ECO members shall sign the hard copy of the Change Request. The Chairman will mark the ECO as approved in the database. The affected documents, such as drawings, shall also be updated in the database. The signed hard copy shall be archived in the Documentation Center.

Changes to Software

- Minimum reviewers are the Spacecraft Manager (also the Chairman), the Responsible Software Module Manager, Responsible Engineer and the System Effectiveness Manager.
- If approved the ECO members shall sign the hard copy of the Change Request. The Chairman will mark the ECO as approved in the database. The affected documents,

such as drawings, shall also be updated in the database. The signed hard copy shall be archived in the Documentation Center.

Experts of various disciplines and Responsible Engineers of specific systems are summoned as needed. The Deputy Program Manager is consulted when a PCB includes over $15,000 cost impact.

5.3.3.6 LMMS ECB (Level IV)

LMMS will have two Boards:

ECB for Type II Class 1 Changes

- This Board will include the LMMS Program Manager as chairman. Other members include the Chief System Engineer. Decisions of this Board shall be forwarded to the SU PCB committee for concurrence.

ECB for Type II Class 2 Changes

- The chairman of this Board will be the Chief System Engineer and shall include the Responsible Design Engineer

5.3.4 Authorities, Responsibilities and the Processes for Changes

It is the responsibility of the chairman of each Change Board to classify the change and elevate to higher-class level when necessary.

5.3.4.1 Type I Changes

The NASA (Level I and II) CCB is the only Board that has authority to approve Type I Changes.

The process

- Initial approval by the SU PCB; using "Program Control Board Change Request" form **(Appendix F).** Each form shall have a PCB Number assigned by the Chief Systems Engineer (sequential order).
- NASA's approval
  The Chairman of the SU PCB shall add the cost and schedule impact of the proposed change and forward the PCB Request to the MSFC Contracting Officer for approval.

Follow up

The Chief Systems Engineer is responsible for the follow up of the open PCBs.

5.3.4.2 Type II, Class 1 Changes

The SU PCB has the authority to approve Type II, Class 1 Changes. The PCB has a Screening Committee for Payload/Science Instrumentation and another for Spacecraft and Electronics. The relevant Screening Committee shall review each change proposal. Changes that are approved by the Committee will be forwarded to the PCB.

The details of the proposed change, including affects disposition approval etc. will be documented in the "Program Control Board Change Request". Each form will have number assigned by the Chief System Engineer (sequential order). The Chief Systems Engineer is responsible for the follow up of the open PCBs.

Change effectivity

The effectivity point to changed documents (e.g. Date, Serial Number or Lot Number) shall be defined by the PCB. The PCB will also specify disposition regarding existing items, whether in process or in stores. The disposition shall be Use-As-Is per the old Revision, Rework to the new Revision, or Scrap.

Follow up and Review

The Chief Systems Engineer or his designee will keep an updated Log for follow up on open changes. The log will assist Systems Engineering in the verification that all the changes have been approved and closed. All Change documentation is open for MSFC review.

5.3.4.3 Type II, Class 2 Changes

Type II, Class 2 Changes for drawings and procedures are performed using by use of an ECO. For review and approval of Class 2 Changes to Non-Electronics Hardware, the Payload Technical Manager shall chair the Board. For review and approval of Class 2 Changes to Electronics, the Payload Electronics Manager shall chair the Board. For review and approval of Class 2 Changes to Software, the Spacecraft Manager shall chair the Board. The form to be used is the "Engineering Change Order" form, **(Appendix G)**. Each ECO form will have ECO No assigned by the Documentation Center (sequential order).

Change effectivity

The effectivity point to changed documents (e.g. Date, Serial Number or Lot Number) shall be defined by the Chairman. The Responsible Engineer shall specify disposition regarding existing items, whether in process or in stores. The disposition shall be Use-As-Is per the old Revision,

Rework to the new Revision or Scrap.

Distribution

It is the responsibility of the RE (or his assignee) to distribute the changed drawing to the relevant persons. This may includes functions as: Manufacturing (in house or vendors), Receiving Inspection, Bonded Stores, Assembly and/or Testing. The RE (or his assignee) will also verify eliminating of the old version.

Follow up

The Documentation Center shall keep an updated ECO Log **(Appendix H)** for follow up of open change requests. The log shall assist the System Effectiveness Manager in the verification that each ECO has been approved and reported as required.

Reports

The ~~Quality Engineer~~ System Effectiveness Manager during each Monthly Review shall report all changes. A copy of the handout of each review shall be sent to MSFC. All Change documentation is open for MSFC review.

5.3.4.4 Type II, Class 2 Minor Changes

For reviewing and approval of Class 2 Minor Changes the Responsible Payload Manager will be the SU chairperson. Other members will include the Responsible Design Engineer and the System Effectiveness Manager. The Form to be used is Engineering Change Order (ECO) and is generated in the GP-B Configuration & Test Database. A hard copy of the ECO will be attached to the original drawing.

The Document Control Center will keep an ECO Log to verify incorporation of the ECO in a timely manner. All ECOs are open for MSFC review.

5.3.4.5 Changes at Sub-Contractors

LMMS and selected other sub-contractors might be granted limited change authority. This authority will be defined in the contract. The classification/definition of changes described in paragraph ~~5.3.1~~ 5.3.2 will apply.

The process

A subcontractor that was granted Change Authority will establish a Level IV Engineering Change Board, ECB. This board will include as a minimum the Responsible Engineer and the System Effectiveness Manager.

Type II Class 1 Changes, after approval by the Subcontractor's ECB, will be forwarded to SU for approval by the Responsible Payload Manager. Changes that will be found to be SU's Class 1 Changes will be processed as described in paragraph ~~5.3.3.1~~ 5.3.4.1. Class 2 Changes will be approved by the Sub-Contractor's ECB. All Class 2 changes will be open to SU's and MSFC's review.
The internal procedures for implementation of the Configuration Control will be described in the Sub-Contractor's Configuration Plan that will be approved by SU and MSFC.

Sub-Contractors without Change Authority
Configuration Control for Sub-Contractors without Change Authority will be performed by SU as described in ~~paragraphs 5.3.3~~ the SOW.

6. Configuration Management for Product

6.1 Product Identification
Product identification is defined as hardware or software as described below.

6.1.1 Hardware Identification
Each Technical Document (Drawing, Spec etc.) will include the Identification Number of the article/material. For fabricated parts the ID No is the Drawing Number plus Lot Number which is the date of fabrication. When Serial Numbers are required, they will be assigned by the RE. For purchased parts (Off the Shelf), the vendor's ID No and Lot No will be used. The method for identification, usually Tag and Bag, will also be described in the Technical Document.

6.1.2 Software Identification
Title and Revision will identify each Software Module. This information will be logged and control through the LSEE System for LMMS developed software. SU developed Software Modules will be logged and controlled by SU per P0630, Software Quality Assurance Plan.

6.2 As-Built Configuration

6.2.1 Hardware As-Built Configuration
During the manufacturing and assembly of the hardware, the As-Built Configuration will be recorded using the Kit List forms (**Appendix I).** These forms will be filled out during each step of the assembly process. The recorded information includes Part No., Drawing No., Revision, Title, Quantity and Part Identification- Serial No. or Lot Date Code. (see paragraph 6.1.1)

The As-Built Configuration will be reported in the Acceptance Data Packages for top assemblies.

The As-Built Configuration will be attached to the back of the Travel Sheet and will be archived.

6.2.2 Software As-Built Configuration

Version Description Document will be generated by the LSEE and will include the Title, and Revision of all the Software Modules that will be used in the Flight SM Units. Su will generate the same documentation for all SU developed software.

7. Audits

The program System Effectiveness Manager or his/her designee will perform ongoing audits to verify the performance of this plan.

8. Configuration and Test Database

The GP-B Configuration & Test Database, residing on the GP-B server, will include documents and/or information regarding configuration of all the controlled documents. It will be used for reviewing, updating, managing and reporting. The system will include security levels for reading/updating authorities. Users will include SU, LMMS and MSFC.

Items included in the database include the following:

8.1 Specifications ~~(SDOC)~~

Hierarchical list of Specifications and electronic master copy of each specification.

8.2 Program Control Board

Records of all PCBs including the PCB number, originator, title, date, description, reason for change, cost and schedule effect, other documents affected, PCB type, PCB status, and sign-off list.

8.3 Procedures (Pdoc)

Procedure number, title, release/revision date, procedure type, procedure status, sign-off list and electronic master copy of the procedure when possible.

8.4 Science Documents (SDOC)

Science Document number, title, origin date, revision date, sub-system, and author. When applicable this document will show a link to the "Specification Requirements" document as defined in paragraph 5.1.1.

8.5 Drawing

Drawing number, drawing title, release date, revision, revision date, drawing type (part or process), Responsible Engineer, status (released or in-review), sub-system, applicability (GTU-2, Science Mission or both), notes, number of sheets and check box if drawing is expected a

revision.

8.6 Component

This table includes data of each component described in each drawing. It includes, but is not limited to, details such as material, material specification, magnetic zone. The data relevant to configuration is the revision and revision date which is identical to that shown in the drawing table.

8.7 Drawing Tree

This table includes the links between parts and sub-assemblies. Each part has a Location Number that has a logic link to the parent and its children. The data includes part number, part title, location number, quantity per assembly, total quantity, type-part, assembly or Kit.

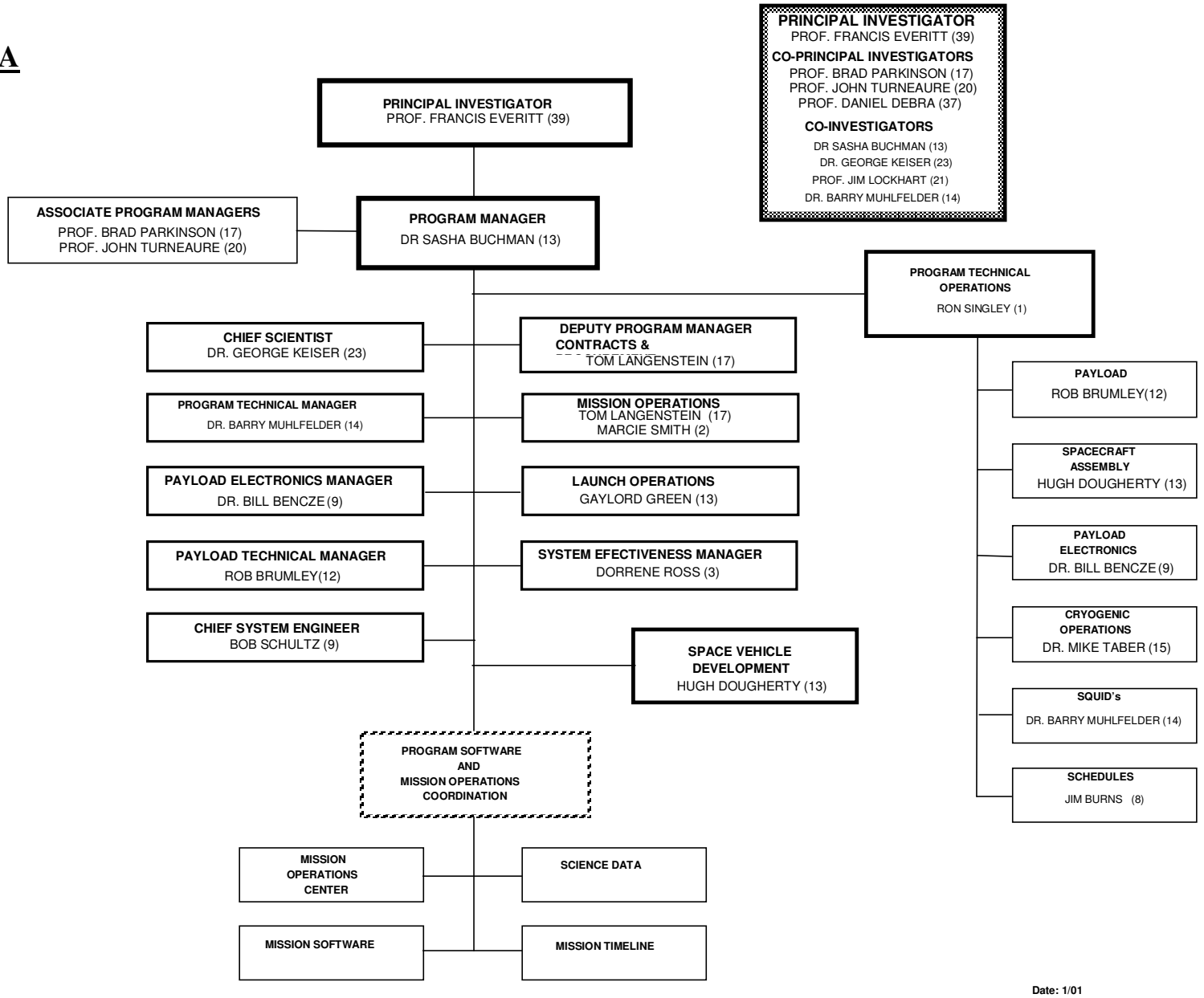
8.8 Engineering Change Order (ECO)

This table includes records of all ECOs. It includes the ECO number, drawing or procedure number, drawing or procedure title, revision, revision date, Responsible Engineer, change type, subsystem, description of the change, reason for change, impact if not approved, schedule impact, cost impact, was/is description, existing hardware disposition, sign-off list and status.

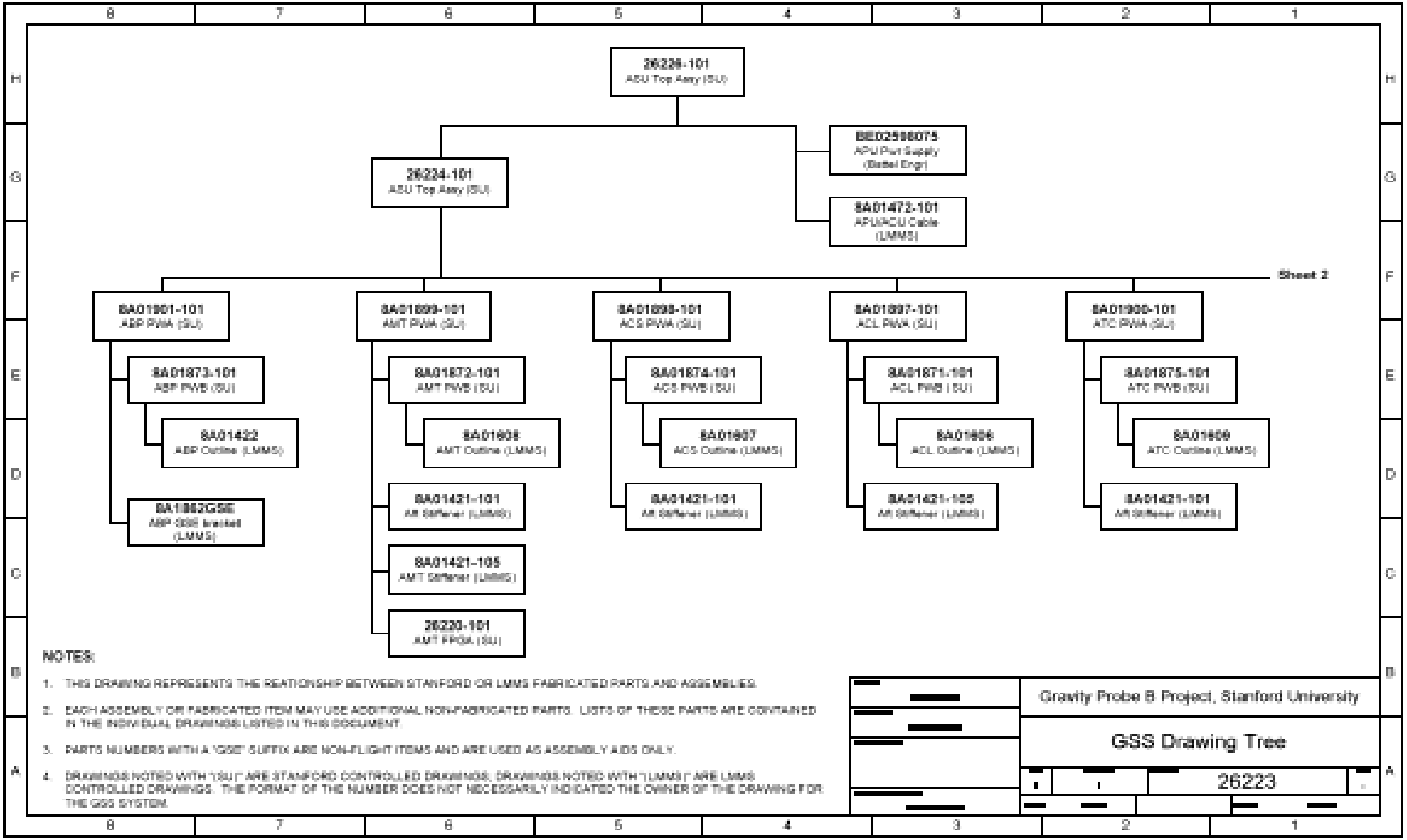
8.9 As-Built Configuration

This table includes for each assembly the data of the actual hardware that was used: Assembly number, title and serial number, and for each component the part number, part title, location number (in the drawing tree), revision and serial number or lot date code and quantity.

Appendix A


PRINCIPAL INVESTIGATOR
PROF. FRANCIS EVERITT (39)
CO-PRINCIPAL INVESTIGATORS
PROF. BRAD PARKINSON (17)
PROF. JOHN TURNEAURE (20)
PROF. DANIEL DEBRA (37)
CO-INVESTIGATORS
DR SASHA BUCHMAN (13)
DR. GEORGE KEISER (23)
PROF. JIM LOCKHART (21)
DR. BARRY MUHLFELDER (14)
PRINCIPAL INVESTIGATOR
PROF. FRANCIS EVERITT (39)
ASSOCIATE PROGRAM MANAGERS
PROF. BRAD PARKINSON (17)
PROF. JOHN TURNEAURE (20)
PROGRAM MANAGER
DR SASHA BUCHMAN (13)
PROGRAM TECHNICAL OPERATIONS
RON SINGLEY (1)
CHIEF SCIENTIST
DR. GEORGE KEISER (23)
DEPUTY PROGRAM MANAGER
CONTRACTS &
TOM LANGENSTEIN (17)
PROGRAM TECHNICAL MANAGER
DR. BARRY MUHLFELDER (14)
MISSION OPERATIONS
TOM LANGENSTEIN (17)
MARCIE SMITH (2)
PAYLOAD ELECTRONICS MANAGER
DR. BILL BENCZE (9)
LAUNCH OPERATIONS
GAYLORD GREEN (13)
PAYLOAD TECHNICAL MANAGER
ROB BRUMLEY(12)
SYSTEM EFECTIVENESS MANAGER
DORRENE ROSS (3)
CHIEF SYSTEM ENGINEER
BOB SCHULTZ (9)
SPACE VEHICLE DEVELOPMENT
HUGH DOUGHERTY (13)
PROGRAM SOFTWARE AND MISSION OPERATIONS COORDINATION
MISSION OPERATIONS CENTER
SCIENCE DATA
MISSION SOFTWARE
MISSION TIMELINE
PAYLOAD
ROB BRUMLEY(12)
SPACECRAFT ASSEMBLY
HUGH DOUGHERTY (13)
PAYLOAD ELECTRONICS
DR. BILL BENCZE (9)
CRYOGENIC OPERATIONS
DR. MIKE TABER (15)
SQUID's
DR. BARRY MUHLFELDER (14)
SCHEDULES
JIM BURNS (8)
Date: 1/01

Appendix B Sample Only



Appendix C

GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

Title

P0xxx Rev. x
Date

Prepared by:

_____Date_____
Jim Maddocks
Cryogenic Test

Checked by:

_____Date_____
Tom Welsh
Cryogenic Test

Approvals:

_____Date_____
Dorrene Ross
Quality Assurance

_____Date_____
Rob Brumley
Payload Technical Manager

_____Date_____
Mike Taber
Test Director

SAMPLE ONLY – names may not apply
Please note Header w/reference to Pdoc and date require on originals
Please insert page numbers on bottom, center on originals

Appendix D

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

Gravity Probe B Relativity Mission

Title

GP-B Procedure

Pxxxx Rev -

DUT PN: xxxxxxx REV _____
SN: _____

Date Performed:_____

Prepared by: Scott Smader Date
RE, Aft Backplane, Aft Comm Link

Approved by: William Bencze Date
Payload Electronics Manager.

Approved by: Dorrene Ross Date
GP-B Quality Assurance

SAMPLE ONLY – names may not apply
Please note Header w/reference to Pdoc and date require on originals
Please note Part Number is required, may be shown in the title
Please insert page numbers on bottom, center on originals

Appendix E

STANFORD

GRAVITY PROBE - B

DRAWING APPROVAL

DRAWING TITLE:

DRAWING NUMBER:

DRAWING REVISION: -

REVISION DATE:

NUMBER OF SHEETS:

DRAWING FILE NAME:

APPROVAL ORIGINATION DATE:

X _____

Originator Date

X _____

D. M Ross - Safety, Reliability, and Quality Assurance Date

X _____

B. Bencze – Payload Electronics Manager

SAMPLE ONLY – names and titles may not apply

Appendix F Sample Only

PCB number 376
Revision Date / /
Type I /II to NASA 2
Submittal Date / /

Program Control Board Change Request

PCB Name: **Timing Requirement Update**

Pg. 1

Screening Committee Disposition:	**Disposition:** Rejected ( ) Approved ( )	**Concurrence:**
Submit to full PCB for decision [ ]	Date of approval _____	SU Payload Electronics Manager _____
Date of screening _____	PCB Chairman (Program Mgr) _____	SU Payload Technical Manager _____
Screening Chairman (CSE)_____		SU Spacecraft Manager _____
	Primary Reason for PCB:	Chief Systems Engineer _____
	Spec [x]	Mission Operations Manager _____
	Cost [ ]	LM Program Manager _____
	Schedule [ ]	SU Business Manager _____
		Chief Scientist _____
		SU Quality Manager _____
		NASA Resident Manager _____
		PI (only for Science Data Changes) _____
		NASA Project Manager (Class 1 Only) _____

Additional Signoffs:

Description of Proposed Change:

Udpate the T003 timing requirements and verification methods. See attachment showing T003 strikethough removals and underlined additions. These updates were agreed upon after review of all the T003 timing requirement at Mac Kaiser's timing meeting held on 6/17/99. Meeting attendees included: Mac Keiser, Hugh Dougherty, Jim Lockhart, Bill Bencze, Terry McGinnis, Lim Mar, Jon Kirschenbaum and Bob Schultz.

Reason for the Proposed Change:

Update T003 timing requirements that are not corrrect.

Technical Impact of Proposed Change:

None. This PCB corrects the T003 timeiing requirements and verification methods.

Impact if not approved:

T003 will have incorrect timing requirements and verification methods.

pcb_form.frx

Appendix G

ECO NO.	ORIGIN. DATE	ORIGINATOR	MAIN DOCUMENT	SECONDARY DOCUMENT	APPROVAL LEVEL Minor, Major, PCB, NASA	APPROVAL DATE
001	01/15/93	R. Atzmon	P0095	Change of Revision A	Minor, Major,	02/02/93
002	None	P.Ehrensberger	GP-B235SF, 223SF, 234SF and 422SF	GP-B 230SF, GP-B242SF, GSU Spec., GP-B 252SF,347SF, Telemetry Spec.	Minor, Major, PCB	02/17/93
003	02/22/93	D. Richardson	Dwg. 13179 Revision A	Dwg.13171	Minor	02/24/93
004	02/24/93	M. Sullivan	Dwg. 412521 Revision C	Dwg. 512785	Minor	02/24/93
005	02/23/93	M. Sullivan	Dwg. 412523 Revision C	Dwg. 512785	Minor	02/24/93
006	02/26/93	T. Quinn	Dwgs. 13203, 13185, 13171, 13170, 13192, GP-B423SF-10X, 65113-5833201, 13200		Minor, Major, PCB	02/26/93
007	03/19/93	R. Sharbaugh	GP-B 225 SF.FLT	N/A	Minor, Major	03/19/93
008	03/25/93	R. Sharbaugh	GP-B 393SF,(Schematic)	ECU Thermistor Card	Minor	03/25/93
009	04/2/93	R. Sharbaugh	GP-B 370SF-FLT, (ECU)	-	Minor	04/02/93
010	04/5/93	M. Sullivan	Drawing 13234	Drawing 13171, 13170	Minor	04/23/93

ECO NO.	ORIGIN. DATE	ORIGINATOR	MAIN DOCUMENT	SECONDARY DOCUMENT	APPROVAL LEVEL Minor, Major, PCB, NASA	APPROVAL DATE

W. W. Hansen Experimental Physics Laboratory
Stanford University

Gravity Probe B Relativity Mission

Engineering Change Order ECO#: *1100*

Drawing or Document Number: *25741 A : GPS MECHANICAL UPGRADES - GPS HOUSING*

Other Drawing(s) or Document(s) Affected: *None Listed*

Subsystem affected by this change: *GPS*

Drawing Rev Date: *03/02/00*

Effective Date: *03/13/00* Serial Number or Lot/Date Code:

Existing Hardware Disposition: *Use* Class of Change: *Type II Minor*

Description of Change:
Rev A to Rev B; Add ident markings

Estimated Cost: $ *0.00* Estimated Schedule Impact: *None*

Reason for Change:
Better part tracking and management

Impact if Not Approved:
Parts could be misplaced

Check the appropriate box below to indicate Class of proposed change. Signatures within that box are sufficient to approve the change for immediate implementation. The Hardware Manager for the affected system must sign in the first box.
Note: It is the responsibility of the ECO signatories to concur with the classification of the change and elevate it to the next level when necessary.

X Class II, Minor - Parts or Subassembly Level Change.

Designer: D Simpson	_____	_____
Checker: P Shestople	_____	_____
Safety & Quality: D. Ross		_____
Other Approval: (None Required)	_____	_____
Responsible Engineer: P Shestople	_____	_____
Payload Electronics Manager:	_____	_____
Payload Technical Manager:	_____	_____
	Signature	Date

Class II, Major - Assembly Level or Flight Software Interface Change.

Payload Electronics Manager:	_____	_____
Payload Technical Manager:	_____	_____
	Signature	Date

Class I, Program Configuration Level Change

Program Manager: S. Buchman	_____	_____
	Signature	Date

Appendix H Sample Only

Appendix I Sample Only

									RE SIGNATURE_____ ____
									(VERIFY KITS CONTENTS)
KIT LIST									
SUB-ASSEMBLY									
DWG #									DATE _____
REV:									
ECN# / S/N								(Gray Areas for QA use Only)	
NEXT ASSY: #									
PART NO.	**REV**	**S/N or LDC**	**PART NAME**	**PO#**	**QTY REQ'D**	**QTY ISSUED & INITIALS**	**QTY REPLACED**	**OPEN DR's**	**REMARKS**
RE Approval Signature			Ship Short List						
_____									