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THE JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY
JOHNS HOPKINS ROAD LAUREL, MD. 20723

GUVI Instrument Specific Instrument Interface Specification

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REVISION LOG

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GUVI SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

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GUVI SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Section 1.0
General Information

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1.0 GENERAL

This specification details the electrical, mechanical, thermal, and environmental interfaces between the Global Ultraviolet Imager (GUVI) instrument and the TIMED spacecraft where the interface is not already defined by the TIMED General Instrument Interface Specification (GIIS). The structure and section numbering of the GIIS and this document are correlated. Because the SIIS is a supplement to the GIIS, the SIIS's section numbers are not consecutively numbered. The GIIS requirements apply, unless amended in the corresponding sections of this document. All instrument-specific interfaces shall be documented in this specification. Note that this *GUVI SIIS* taken together with the *TIMED GIIS*, the *TIMED Component Environmental Specification*, and the *TIMED EMC Control Plan and EMI Performance Requirements Specification* form the GUVI Interface Control Document (ICD).

1.1 PURPOSE OF DOCUMENT

This document specifies the interface of the TIMED spacecraft and the GUVI Instrument. This specification assumes interface conformance with the GIIS and shall document unique or specific information and exceptions to the GIIS.

1.6 DOCUMENT CONFIGURATION

1.6.1 Update and Change Control

This document represents the current definition of the interface characteristics between GUVI and the TIMED spacecraft. After formal release, this document shall be revised only through the formal change control procedures.

1.7 DELIVERABLES

In the context of this SIIS, the term "deliverable" means an item to be provided by the IDT to support testing and performance verification of the instrument after its arrival at APL. Most of the testing will be carried out by the IDT.

The GUVI Instrument Design Team (IDT) shall deliver items for, or in support of, spacecraft integration. Ground support equipment (GSE), consisting of hardware, software and procedures, shall be shipped with or prior to the delivery of flight hardware. Safety rules, handling constraints and procedures, analytical models, analyses, drawings, test plans and procedures, test results, etc., shall be required prior to instrument delivery or as specified in the SIIS.

The GUVI IDT shall provide the items listed in Table 1.7-1.

TABLE 1.7-1

GUVI INSTRUMENT DELIVERABLES

1. GUVI instrument with flight software;

2. Shipping container / sealed instrument case;

3. Red-tag items;

4. Electrical GSE for
    a. Stand-alone testing of the GUVI instrument prior to integration with the spacecraft;
    b. Flight POC / Test POC;
    c. Instrument GSE;

5. Interface control drawings;

6. Written Procedures, which shall address:
    a. Instrument transport, handling, and storage procedure;
    b. Special mounting concerns;
    c. Bench test procedure;
    d. Pre-launch close-out procedure; and
    e. Spacecraft integration and alignment procedures;
    f. Functional Test Procedures;

7. Acceptance test data, consisting of:
    a. Electrical test and inrush current data; and
    b. Environmental test data.

GUVI SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Section 2.0
Electrical Interface

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2.0 ELECTRICAL INTERFACE REQUIREMENTS

2.3 MAIN AND SURVIVAL POWER

2.3.4 Fusing

The minimum fuse size for the main power and operational heater power bus for the GUVI instrument is 7.0 Amperes. The minimum fuse size for the survival heater power bus is 2.0 Amperes.

2.3.7 Main Bus Component Power Dissipation

The GUVI instrument average power dissipation by assembly for each instrument operating mode is given in Appendix E, Table E-1. The GUVI instrument peak power dissipation by assembly for each instrument operating mode is given in Appendix E, Table E-2. The GUVI orbit average power by orbit mode is given in Appendix E, Table E-3. An orbit mode is defined as a combination of instrument modes operating over an orbital period. Orbit modes are defined in an attempt to obtain a quantitative calculation of orbit average power, daily data rates, etc. Several orbit modes may be defined. For example, an instrument may enter the "calibration instrument mode" for ten minutes every few days. A "calibration orbit mode" can then be defined which includes ten minutes of the "calibration instrument mode" and ninety minutes of the "science instrument mode." In this manner, an orbit-averaged power can be calculated, and the spacecraft design team will determine the range and frequency of orbit average and peak powers that must be designed for.

2.3.8 Survival Bus Power Dissipation

The survival heater bus peak (+35 V) and average (cold case) power dissipation are given in Appendix E, Table E-4.

2.5 CONNECTORS

2.5.2 Interface Connectors

The nomenclature for each spacecraft-instrument interface connector, the connector type, keying (if applicable) and the drawing number that details the pinout / harness design are given in Table 2.5.2-1.

Non D-type connectors will be used for instrument heater power.

TABLE 2.5.2-1

GUVI INSTRUMENT CONNECTOR DESCRIPTIONS

Connector No.	Connector Part No.	Description	Connector Keying	Harness Drawing Number
A625 J15	15-pin D Subminiature Male	Main Power	Pin 12	7363-8110
A625 J12	DEMM 9SD-NMB-K52	1553 Bus "A"	None	7363-8110
A625 J13	DEMM 9SD-NMB-K52	1553 Bus "B"	None	7363-8110
A600 J01	9-pin D Male	Pyro Connector	Pin 7	7363-8110
A600 J02	JF2P-2S-AB	Survive Heater Power	None	7363-8110
A600 J03	JF2S-2P-AB	Temperature Sensor 1	None	7363-8110
A600 J04	JF2S-2P-AB	Temperature Sensor 2	None	7363-8110
A600 J05	JF2P-2S-AB	Operational Heater Power	None	7363-8110
A600 Jx	A-401-1-2	Purge Intake		7363-8110

GUVI SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Section 3.0
Command and Data Handling Interface

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3.0 COMMAND AND DATA HANDLING INTERFACE REQUIREMENTS

3.2 TIMED C&DH SUBSYSTEM SERVICES

3.2.3 MIL-STD-1553 Bus Network Services to Instruments

3.2.3.4 Subaddress Assignment Definitions (R = Receive, T = Transmit)

3.2.3.4.1 Receive Subaddress Assignments R0 through R31

R19

GUVI will sychronize to spacecraft time using the time code message written to R19. The start of the next 1-second interval will be marked by the C&DH bus controller reading from T19.

3.2.3.4.2 Transmit Subaddress Assignments T0 through T31

The GUVI instrument will transmit a 64-bit status word at subaddress assignment T12.

T11

The C & DH will collect up to five TLM packets per second from GUVI, although the average rate is slightly less than four. The C & DH polls the TLM buffer ready to read bits at subaddress T11 four times per second at the start of bus minor frames 0, 2, 4, and 6, and reads the TLM packets during minor frames 1, 3, 5 and 7. GUVI software will clear these ready to read bits no more than a few milliseconds after the C & DH has read the packet. Thus, the C & DH does not need to see a 0 to 1 transition of the TLM ready to read bits, but will take action if a bit is 1. If both bits are set in minor frame 0, the C & DH will read two telemetry packets in minor frame 1. Otherwise, the C & DH will read only 1 packet in minor frames 3, 5, and 7. If both bits are set other than in minor frame 0, the C & DH will read from the buffer it least recently read from.

T12

The structure for GUVI Instrument's subaddress assignment T12 is given below in Table 3.2.3.4.2-1.

TABLE 3.2.3.4.2-1

GUVI INSTRUMENT'S REAL-TIME ALIVENESS/MODE WORD STRUCTURE (T12)

Word Bit Position	Number of Bits	Definition
63	1	GUVI Alive Indicator (Counts on two second boundary)
62	1	Autonomy Bit (not used)
61	3	Command Receipt Counter
58	3	Command Reject Counter
55	2	Operating Mode
53	1	Primary Detector Power
52	1	Secondary Detector Power
51	1	Narrow Slit Position
50	1	Medium Slit Position
49	1	Pop-up Mirror Position
48	1	Scan Motor Drive
47	1	Cover Closed Indicator
46	1	Cover Full Open Indicator
45	1	Sun Sensor Trip
44	1	Yaw Maneuver Indicator
43	12	Mirror Position
31	8	Last Command Sequence No. (bottom 8)
23	8	Fault Status Word
15	8	Detector High Voltage Monitor
7	8	SIS Temperature Monitor

T19

GUVI will sychronize to spacecraft time using the time code message written to R19. The start of the next 1-second interval will be marked by the C&DH bus controller reading from T19.

3.2.5 Autonomy Services

GUVI will not use the autonomy services of the C&DH processor. The optional autonomy bit in the real-time status message (T12) will not be implemented.

3.2.8 Hardware Reset Function

GUVI will not implement the hardware reset function discussed in GIIS 3.2.8.

3.3 PACKETIZED TELEMETRY FORMAT

The application process identifier source IDs used by GUVI are given in Table 3.3-1.

Table 3.3-1 GUVI Packetized Telemetry Format

ITEM	BIT FIELD	LENGTH (bits)	VALUE (binary)	DESCRIPTION
Primary Header	Version Number	3	000	Designates a source packet
	Type Indicator	1	0	Designates a telemetry packet
	Secondary header flag	1	1	Secondary header flag present
	Application process identifier (source ID)	11	100 1000 0000	GUVI Housekeeping Data
			100 1000 0001	GUVI Imaging Mode Data
			100 1000 0010	GUVI Spectrograph Mode Data
			100 1000 0011	GUVI Test Mode Data
			100 1000 0100	GUVI Maintenance Mode Data
	Grouping flags	2	01	First packet in group
			00	Intermediate packet
			10	Last packet in group
			11	Not part of group
	Source	14		Continuous sequence count (modulo 16384) of source for specific application ID
	Packet Length	16	0000 0000	Number of octets in [packet secondary header + packet data field] - 1
			1111 1111	
Secondary Header	Spacecraft Time	32		Packet source's value of mission at time of data sample
	Time Vernier (optional)	16		Time interpolation bits defined by instrument
Data		2000		With secondary header

3.5 SUMMARY OF THE GUVI INSTRUMENT'S DATA REQUIREMENTS

APL agrees to allocate sufficient data handling resources to accommodate data generated by the GUVI instrument at the rates given in Table 3.5-1. The number of relays allocated to the GUVI instrument is also given in Table 3.5-1.

TABLE 3.5-1

SUMMARY OF THE GUVI INSTRUMENT'S COMMAND AND DATA HANDLING RESOURCE REQUIREMENTS

Command requirements	1 Command Packet/week (400 bytes/week); 80 Kbytes software upload
Daily Average Data Rate	8.105 kbps
Peak Recording Data Rate	8.105 kbps
Peak Real-time Data Rate	8.105 kbps
Solid State Recorder Limit in 24.25 hours	337560 packets (262 bytes/packet)
Number of relays allocated to GUVI	2 (Power) - 2 (Pyro)

GUVI SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Section 4.0
Thermal Interface

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4.0 INSTRUMENT THERMAL INTERFACE REQUIREMENTS

This section contains the thermal interface requirements for the GUVI instrument and TIMED spacecraft. The thermal control responsibilities, concepts, and high level thermal interfaces (e.g. panel control temperatures and gradients, baseplate average power density limits, thermal gasket interface, heater bus information, etc.) are given in the TIMED GIIS. Much of the detailed thermal interface information (e.g. heater, thermostat, temperature sensor, thermal blanket, thermal control coatings, connector locations, etc.) is given in the Thermal Interface Control Drawings (Appendix C).

4.2 THERMAL CONTROL CONCEPT

The thermal part of the environmental specification includes ranges for the mounting surface temperature and the external (thermal) radiation environment. All temperatures specified refer to the interface unless otherwise specified. The final component temperature will depend on the connection to the interface, its internal dissipation, and heat leaks through the thermal blankets each of which are the responsibility of the instrument developer.

The GUVI instrument consists of 6 different components, each of which is listed below. All GUVI instrument components except for the Electronics Control Unit (ECU) are mounted to the +Z spacecraft deck inside of the Payload Adapter Fitting (PAF). The ECU is mounted to the spacecraft +X panel.

The sensor portion of the GUVI instrument is the Scanning Imaging Spectrograph (SIS). The SIS has two main boxes, the SIS optics housing and the SIS electronics box. The SIS optics housing is thermally isolated from the +Z deck through the titanium legs. The SIS electronics box is conductively mounted to the +Z deck.

The High Voltage Power Supplies (HVPS) provide the conditioned power to the sensor. There are two HVPS housings, stacked one atop the other. The HVPS stack is conductively mounted to the +Z deck.

There are two Focal Plane Electronics (FPE) boxes, each mounted separately to the +Z deck. Both FPE boxes are conductively mounted to the +Z deck.

The Electronics Control Unit (ECU) is conductively mounted on the +X panel.

All GUVI instrument components are covered with MLI blankets. The SIS optics housing's aperture will not be covered with MLI blankets. The SIS optics housing will have an uncovered silver teflon thermal radiatior as shown in Appendix C. Furthermore, the entire exposed area of the +Z deck shall be covered with MLI blankets.

4.3 MOUNTING INTERFACE

Five of the six GUVI instrument components are mounted to the outside surface of the +Z spacecraft deck. The ECU is mounted to the inside surface of the +X panel. The dimensions and mounting location of each GUVI component is given in the Mechanical Interface Control Drawings (Appendix A).

4.3.1 Interface Surface

The GUVI instrument components shall be mounted in accordance with the specifications for conductively mounted components given in section 4.3.1 of the TIMED GIIS.

4.3.2 Mounting Interface Temperature Limits

The temperatures to which APL will control the +X panel and the +Z deck at the component mounting interfaces are defined in Table 4.3.2-1. The GUVI IDT should use these temperatures as boundary conditions for their thermal analysis and testing limits.

TABLE 4.3.2-1

MOUNTING INTERFACE TEMPERATURE ANALYSIS AND TEST LIMITS

Mounting Interface	In-spec operating	Survive / Non-op
+X panel	-24 to +55 °C	-29 to +60 °C
+Z deck	-23 to +55 °C	-29 to +60 °C

4.3.3 Mounting Interface Temperature Rate of Change Limits

There is no requirement to limit the GUVI instrument's mounting interface temperature rate of change.

4.3.4 Temperature Gradient Requirements

APL will limit the temperature gradient across the +Z deck to less than 15° C across any diagonal of the GUVI SIS's mounting points. However, since the GUVI Instrument is conductively tied to the +Z panel, the thermal design of the +Z panel and the GUVI Instrument are coupled.

4.3.5 Power Density Limits

The GUVI instrument components shall have an average power density, over each component's entire mounting surface, of less than 0.14 Watts per square inch.

4.4 THERMAL CONTROL HARDWARE

All thermal control hardware for the GUVI instrument is documented in the Thermal Interface Control Drawings (Appendix C). The drawings show:

- radiator locations and sizes,
- MLI locations and attach points,
- MLI grounding strap locations,
- heater and spacecraft monitored temperature sensor connector locations,
- operational and survival heater/thermostat locations,
- heater part number and resistance values,
- thermostat part number and set points,
- spacecraft and instrument monitored temperature sensor locations and types,
- thermal control coatings,
- thermal isolation hardware,
- operate, survive, and test temperature specifications for individual box, major subassembly, and critical components.

4.4.1 Heaters/Thermostats

4.4.1.1 Operational Heaters

Power for the operational heaters is supplied by the operational bus. The location, size, and designation of the operational heaters and location and designation of the operational thermostats on the GUVI instrument are shown in the Thermal Interface Control Drawings (Appendix C). The schematic which details the electrical hookup of the operational heaters and thermostats, including the heater part number and resistance and thermostat part number, open and close temperatures, etc. for the GUVI instrument are shown in the Spacecraft Harness Drawing (Appendix B). The GUVI IDT is responsible for providing all hardware up to and including the interface connector.

4.4.1.2 Survival Heaters

Power for the survival heaters is supplied by the survival bus. The location, size, and designation of the survival heaters and location and designation of the survival thermostats for the GUVI is given in the Thermal Interface Control Drawings (Appendix C). The schematic which details the electrical hookup of the survival heaters and thermostats, including the heater part number and resistance and the thermostat part number, open and close temperatures, etc. for the GUVI instrument is given in the Spacecraft Harness Drawing (Appendix B). The GUVI IDT is responsible for providing and mounting this hardware up to and including the interface connector.

4.4.2 Temperature Sensors

4.4.2.1 Spacecraft-Monitored Temperature Sensors

The GUVI instrument will have two primary and two redundant spacecraft-monitored temperature sensors. One primary/redundant sensor pair will cover the temperature range from -100°C to +100°C. The other primary/redundant sensor pair will cover the temperature range from -35°C to +65°C. The nomenclature, type, and location of the spacecraft-monitored temperature sensors located on the GUVI instrument is given in the Thermal Interface Control Drawings (Appendix C). The schematic which details the electrical hookup of the spacecraft- monitored operational temperature sensors located on the GUVI instrument, including the electrical part number, wiring information, etc. is given in the Spacecraft Harness Drawing (Appendix B).

4.4.2.2 Instrument-Monitored Temperature Sensors

The GUVI IDT is responsible for providing, mounting, and monitoring any additional temperature sensors required over and above the spacecraft-monitored temperature sensors. The nomenclature, type, and location of the instrument-monitored temperature sensors is given in the Thermal Interface Control Drawings (Appendix C).

4.4.3 Radiators

The GUVI instrument has a silver teflon thermal radiator on the spectrograph housing. This radiator is shown in the Thermal Interface Control Drawings (Appendix C).

4.4.4 Thermal Control Coatings

The thermal control coatings are the responsibility of the GUVI IDT. Details regarding the thermal control coating type, thickness, and locations are given on the Thermal Interface Control Drawings (Appendix C). Details of the thermal control coatings will be agreed to by the spacecraft thermal engineer.

4.4.5 Thermal Blankets

The GUVI IDT is responsible for the design and manufacture of all GUVI thermal blankets. Details regarding the thermal blanket sizes and locations, and grounding strap locations are given in the Thermal Interface Control Drawings (Appendix C) and will be agreed to by the spacecraft thermal engineer.

APL is responsible for covering the unoccupied portion of the +Z deck with thermal blankets.

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GUVI SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Section 5.0
Mechanical Interface

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5.0 MECHANICAL INTERFACE REQUIREMENTS

5.1 STRUCTURAL / MECHANICAL

This section contains the mechanical interface requirements for the GUVI instrument and the TIMED spacecraft. Much of the detailed mechanical interface information (e.g. instrument envelope, location of major components, spacecraft interface bolt hole locations and dimensions, spacecraft interface mounting hardware type, locations of spacecraft interface connectors, purge ports, optical cubes, and thermal gaskets, fields of view, GSE access, etc.) are defined in the Mechanical Interface Control Drawings (Appendix A).

5.1.2 Instrument Mounting Concept

The GUVI instrument's mounting concept is shown in the Mechanical Interface Control Drawings (Appendix A).

5.1.3 Reference Coordinate Systems

5.1.3.2 Instrument Component Reference Coordinate Systems

The GUVI instrument's reference coordinate system is defined in the Mechanical Interface Control Drawings (Appendix A). The TIMED spacecraft reference coordinate system is defined in section 5.1.3.1 of the TIMED GIIS.

5.1.4 Instrument/Component Mounting

5.1.4.1 Mounting Interface Description

5.1.4.1.1 Instrument Mounting Locations

The mounting locations on the spacecraft of the GUVI instrument components are shown in the Mechanical Interface Control Drawings (Appendix A).

5.1.4.1.1.1 Instrument Mounting Hardware

Payload instrument enclosures will be mounted with fasteners as shown in the Mechanical Interface Control Drawings (Appendix A).

5.1.4.1.2 Instrument Bolt Hole Locations

The dimensions, sizes and tolerances of the bolt holes on the payload instrument mounting plates are given in the Mechanical Interface Control Drawings (Appendix A).

5.1.4.1.3 Thermal Gaskets and Washers

APL is responsible for providing the thermal gaskets to be placed between the GUVI instrument components (excluding the SIS) and the +Z deck/+X panel of the spacecraft. These gaskets are shown in the Thermal Interface Control Drawing (Appendix C) and the Mechanical Interface Drawings (Appendix A).

The GUVI IDT will supply the mounting feet to be used to thermally isolate the GUVI SIS. These feet are shown in the Thermal Interface Control Drawing (Appendix C) and the Mechanical Interface Drawings (Appendix A).

5.1.4.1.4 Grounding Strap

The instrument locations to which ground straps will be tied are shown in the Mechanical Interface Drawings (Appendix A).

5.1.5 Mass Properties

5.1.5.1 Mass

The GUVI instrument's mass, itemized by component, is shown in Appendix D, Table D-1.

5.1.5.2 Center-of-Mass Location

The GUVI instrument components' centers-of-mass, both in the launch configuration and after cover opening, with respect to the instrument's coordinate system shall be determined and specified in Appendix D, Table D-2.

5.1.5.3 Moments of Inertia

The GUVI IDT shall provide the flight- and launch-configuration moments of inertia for their instrument in accordance with the guidelines specified in the TIMED GIIS. These are tabulated in Appendix D, Table D-2.

5.1.6 Envelopes and Fields-of-view

5.1.6.1 Static Envelope

The GUVI Instrument's Mechanical Interface Drawing (Appendix A) shows the GUVI Instrument's static envelope.

5.1.6.2 Dynamic Envelope

The GUVI Instrument's Mechanical Interface Drawing (Appendix A) shows the GUVI Instrument's dynamic envelope.

5.1.6.3 Integration and Test Access Requirements

The GUVI Instrument Access Drawing (Appendix A) contains a separate sheet for each of the different test configurations required during spacecraft integration and test.

5.1.6.4 Payload Instrument Fields-of-view

The primary active field-of-view requirements of the GUVI instruments SIS is contained in the GUVI Instrument Field-of-View Drawing (Appendix A). The drawing includes location and size of the SIS's aperture, boresight direction, and field-of-view extent. The glint-free or clear field-of-view is also provided as required.

5.1.7 Payload Instrument Alignment Provisions

5.1.7.1 Alignment Position Requirement

APL shall mount the GUVI Instrument Scanning Imaging Spectrograph (SIS) such that the SIS is aligned to the star camera's optical cube to within ± 1° along each of the spacecraft's X, Y and Z axes.

5.1.7.2 Alignment Knowledge Requirement

APL shall measure the alignment of the GUVI SIS with respect to the spacecraft's optical cube to within ± 0.05 degrees along each of the spacecraft's X, Y and Z axes.

5.1.7.4 Optical Alignment Cube Location

The location of the GUVI SIS's optical alignment cube is documented within the GUVI Instrument's Mechanical Interface Drawing (Appendix A).

5.1.8 Mechanisms, Moving Parts, and Dynamics

The GUVI instrument has the following moving parts: a scan mirror, a pop-up mirror, a slit shutter, and the SIS cover.

5.1.8.1 Operation

Dynamic forces and torques induced at the component mount by the GUVI components shall be described and recorded within this section by the GUVI IDT and shall comply with the limits specified within the GIIS.

5.1.8.1.1 Non-recurring Transient Events

The forces, torques, and/or total momentum imparted to the spacecraft by each non-recurring transient event on the GUVI instrument shall be defined within Table 5.1.8.1.1-1.

TABLE 5.1.8.1.1-1

TABLE OF FORCES, TORQUES AND ANGULAR MOMENTUM IMPARTED TO THE TIMED SPACECRAFT FROM THE GUVI INSTRUMENT'S NON-RECURRING TRANSIENT EVENTS

Event	Force* (N)	Torque* (N-m)	Angular Momentum * (kg m^2/s)
Cover Opening	TBD	TBD	TBD
Pop-up Mirror	TBD	TBD	TBD
Slit Mechanism	TBD	TBD	TBD

* Vectors are specified along the axes of the spacecraft coordinate system defined within section 5.1.3.1 of the TIMED GIIS.

5.1.8.1.2 Recurring Forces and Torques (spectra)

Disturbance torques at the component mount generated by the GUVI instrument are specified within Table 5.1.8.1.2-1.

TABLE 5.1.8.1.2-1

TABLE OF RECURRING FORCES AND TORQUES GENERATED BY THE GUVI INSTRUMENT

Maneuver	Force* (N)	Torque* (N-m)
Scan Mirror	TBD	TBD

* Vectors are specified along the axes of the spacecraft coordinate system defined within section 5.1.3.1 of the TIMED GIIS.

5.1.8.2 Caging

The SIS scan mirror shall be caged during launch. The caging will be accomplished by the deployable cover on the SIS housing. The GUVI IDT is responsible for the design, development and operation of this caging mechanism. For mechanisms which do not require caging, the GUVI IDT shall provide an analysis justifying that decision.

Verification of the GUVI spectrograph cover position prior to launch shall be based on the last known position.

5.1.10 Protective Covers (Flight, Red Tag, etc.)

GUVI shall include a non-flight test cover that mounts to the SIS housing during ground testing. This cover shall have a red tag and shall be removed for flight.

5.2 PAYLOAD INSTRUMENT IDENTIFICATION AND MARKING

The GUVI instrument components shall be marked as follows: GUVI SIS optics housing, A600; SIS electronics box, A605; FPE 1, A610; FPE 2, A612; HVPS 1, A620; HVPS 2, A622; ECU, A625. Interface connectors, test points and adjustments shall be clearly labeled. (A6XX-JXX).

GUVI SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Section 6.0
Navigation and Attitude Control Interface Section
Signature Page

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6.0 NAVIGATION AND ATTITUDE CONTROL

6.3 POINTING ACCURACY

6.3.1 Pointing Knowledge

The GUVI boresight pointing knowledge requirement is 0.3 degrees. This requirement is driven by the limb pixels. The pointing knowledge error budget below lists the maximum error allocated for the various sources of pointing error. The resultant pointing error is the root sum square of the various error sources.

Alignment Operation	Alignment Knowledge Error Budget (3 sigma, each axis)
Spacecraft Pointing Error	0.25°
GUVI Mechanical Alignment (boresight)	0.05°
GUVI Launch Vibration	0.08°
GUVI Thermal Gradient	0.08°
GUVI Scan Mirror	0.1°

GUVI SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Section 7.0
Integration, Qualification, and Field Test Requirements
Signature Page

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7.0 INTEGRATION AND FIELD TEST REQUIREMENTS

7.2 INSTRUMENT GROUND SUPPORT EQUIPMENT (GSE)

7.2.1.1 Stand Alone Instrument GSE

7.2.1.2 Instrument Specific Ground Support Equipment (GSE)

GUVI's Instrument Specific GSE will consist of a power supply used for test lamps. This supply has an ethernet interface and will be controlled from the Test POC or Flight POC.

7.2.1.2.6 Instrument GSE Test Cables

The GSE power supply for the GUVI test lamps will provide 12 VDC power to the SIS test cover during spacecraft testing. The test cable shall be fabricated to meet the requirements in 7.2.1.2.6 of the GIIS.

7.2.2 Mechanical GSE

GUVI shall not have any mechanical GSE for lifting the instrument. GUVI is comprised of several independent boxes, each weighing less than the lifting limit.

7.5 PURGE REQUIREMENTS

GUVI shall require a continuous Nitrogen purge during spacecraft integration and test.

7.5.5 Instrument Purge Flow Rate

GUVI requires a flow rate of 0.2 - 0.5 liters/minute. The maximum allowable time without purge is 72 hours.

7.5.6 Purge Connectors

The purge connector at the GUVI (SIS) housing will be a 1/4 inch fitting.

7.7 SAFETY

7.7.2.1 Instrument Related Hazards

The following items are identified as potential hazards

- 4000 - 5000 VDC high voltage power supplies
- 1000 VDC high voltage power supply for test lamp (removed for flight)
- Hg pen-ray test lamp (removed for flight)
- 2 pyrotechnic devices for opening covers

7.8 CONTAMINATION CONTROL

7.8.1 Instrument Cleanliness

Isopropyl alcohol will be used to clean housing surfaces on GUVI throughout integration and testing of the TIMED spacecraft.

GUVI SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Section 8.0
Ground System and the Payload Operations Centers (POC's) Interface
Signature Page

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8.0 GROUND SYSTEM AND THE PAYLOAD OPERATIONS CENTERS (POC's) INTERFACE

8.2 Interfaces

8.2.3 POC to MOC Interfaces

8.2.4 MOC to POC Interfaces

8.2.5 MDC to POC Interfaces

8.2.6 POC to MDC Interfaces

APPENDIX A

GUVI INSTRUMENT MECHANICAL INTERFACE CONTROL DRAWINGS

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APPENDIX B

TIMED SPACECRAFT HARNESS DRAWINGS

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APPENDIX C

GUVI INSTRUMENT THERMAL INTERFACE CONTROL DRAWINGS

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GUVI SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Appendix D
GUVI Instrument Mechanical Properties Summary
Signature Page

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TABLE D-1

GUVI INSTRUMENT'S MASS ITEMIZED BY COMPONENT

GUVI Component	Mass (kg)
SIS Optics Housing	6.61
SIS Electronics Box	1.03
HVPS 1	0.455
HVPS 2	0.455
FPE 1	0.75
FPE 2	0.75
ECU	6.41
Intra-instrument Harness	1.73
Blankets	1.06
TOTAL	19.25

TABLE D-2

GUVI INSTRUMENT
TABLE OF MASS PROPERTIES

PROPERTY	COMPONENT	VALUE	
		Launch	Flight
Center-of-mass Location	SIS Optics Housing	TBD	TBD
	SIS Electronics Box	TBD	TBD
	HVPS 1	TBD	TBD
	HVPS 2	TBD	TBD
	FPE 1	TBD	TBD
	FPE 2	TBD	TBD
	ECU	TBD	TBD
Moments of Inertia	SIS Optics Housing	TBD	TBD
	SIS Electronics Box	TBD	TBD
	HVPS 1	TBD	TBD
	HVPS 2	TBD	TBD
	FPE 1	TBD	TBD
	FPE 2	TBD	TBD
	ECU	TBD	TBD

GUVI SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Appendix E
GUVI Instrument Power Consumption
Signature Page

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TABLE E-1

GUVI INSTRUMENT: AVERAGE POWER DISSIPATION , ITEMIZED BY ASSEMBLY AND INSTRUMENT MODE

ID	Element	Average Power Dissipation Per Instrument Mode (W)						
		OFF	STANDBY	Maintenance	Safe	Test	Imaging	Spectrograph
A600	SIS Optics	0		0	0	5	5	5
A605	SIS E- Box	0		0.3	0.3	0.3	0.3	0.3
A610	FPE-1	0		2.2	2.2	2.2	2.2	2.2
A612	FPE-2	0		0	0	0	0	0
A620	HVPS	0		1	1	1	1	1
A625	ECU	0		14.5	14.5	15.5	15.5	15.5
SUBTOTAL		0		18	18	24	24	24
Operational Heaters (Cold case)				7	7	7	7	7
TOTAL		0		25	25	31	31	31

TABLE E-2

GUVI INSTRUMENT: ORBIT-PEAK ELECTRICAL POWER DISSIPATION, ITEMIZED BY ASSEMBLY AND INSTRUMENT MODE

ID	Element	Orbit-Peak Power Dissipation Per Instrument Mode (W)						
		OFF	STANDBY	Maintenance	Safe	Test	Imaging	Spectrograph
A600	SIS Optics	0		0	5	9	9	9
A605	SIS E- Box	0		0.3	0.3	0.3	0.3	0.3
A610	FPE-1	0		2.2	2.2	2.2	2.2	2.2
A612	FPE-2	0		0	0	0	0	0
A620	HVPS	0		1	1	1	1	1
A625	ECU	0		14.5	16.5	16.5	16.5	16.5
SUBTOTAL		0		18	24	29	29	29
Operational Heaters (Cold case)				17	17	17	17	17
TOTAL		0		35	41	46	46	46

TABLE E-3

GUVI INSTRUMENT: ORBIT-AVERAGED ELECTRICAL POWER DISSIPATION, ITEMIZED BY ASSEMBLY AND OPERATING MODE

Orbit Mode	Instrument Mode	Period of Instrument Mode	Average Power of Instrument Mode	Orbit-Averaged Power of Orbit Mode (W)
Imaging	Imaging	1	31	31
Spectrograph	Spectrograph	1	31	31
Calibration	Imaging Spectrograph	0.95 0.05	31 31	31
Safe	Safe	1	25	25

TABLE E-4

GUVI INSTRUMENT SURVIVAL HEATER BUS POWER ALLOCATIONS

Peak Power (+35 V)	Average Power (Cold Case)
26.6	11

GUVI SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Appendix F
GUVI Instrument Resource Requirements Summary
Signature Page

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Mechanical Requirements:

Dimensions	(in)	11(H) x 27(W) x 16(D) (SIS; FPE #1,#2; HVPS #1,#2; SIS Elec) 5.0(H) x 14.28(W) x 9.0(D) (ECU)
Mounting Configuration (footprint, etc.)	(in)	27(W) x 16(D) (SIS; FPE #1, #2; HVPS #1,#2; SIS Elec) 14.28(W) x 9.0(D) (ECU)
Weight	(kg)	19.3
Center of Gravity		available
Pointing Direction(s)		Cross trk; +80 (anti-sun) to -60° wrt Nadir
Initial SIS mechanical alignment placement error (S/C master cube to GUVI ref cube)	(deg)	±1.0
Intial SIS mechanical alignment knowledge error (S/C master cube to GUVI ref cube)	(deg)	±0.05 each axis
Clear Field(s) of View		+85° to -62° (cross track) x ±10° along track
Pinning req't		yes
Jitter		0.04° / 0.068 sec P,R; 3s

Thermal Requirements (for each piece):

I/F temperature range	(deg C)	All pkgs -24°C to +55°C (operate); -29°C to +60°C (survive)
I/F temperature stability	(deg C/min)	2.0 (SIS); no req't (all others)
I/F thermal gradients	(deg C)	15°C (SIS, Y axis); 4°C (SIS, X axis) no req't (all others)
# / range of S/C monitored temp sensors		2; -70 to +100°C
S/C provided radiators		None
Instrument provided radiator clear field of view: SIS radiator	(deg)	±60° both axis

Attitude and Navigation Requirements:

Attitude control error (defined at SIS mounting location)	(deg)	1°, each axis, 3s
Attitude determination knowledge error (defined at optical bench optical cube)	(deg)	< 0.03°, each axis, 3s
Stability	(deg/sec)	0.1° / 15 sec, each axis, 3s
Pointing knowledge error (star camera boresight to GUVI mounting location; includes attitude, thermal and mechanical sources)	(deg)	0.25°, each axis, 3s
Position Knowledge	(km)	1, each axis ,3s
Velocity Knowledge	(m/s)	250, each axis, 3s
Keep out zones (such as sun, moon, earth)		prolonged ram or sun
Perturbing Mechanisms		scan mirror, pop-up mirror, slit shutter

Command and Data Handling Requirements

Number and type of commands		3.2 kb/wk; 640 kb S/W upload
Instrument modes of operation		6 - off, 5 oper
Orbit modes		2 - Imaging, spectrograph
Daily avg data rate	(kbps)	8.105
Peak record data rate	(kbps)	8.105
Peak real time downlink data rate	(kbps)	8.105
Duty cycle		100%
Time knowledge	(ms)	100
Special data needs (terminator crossings, etc.)		UT time; term xing; yaw mnvr; sun vector; solar panel move; safe flag; S/C attitude (1 Hz), SAA
Preferred S/C data interface concept		MIL-STD-1553

Power Requirements:

Avg pwr / instrument mode (does not include htr pwr)	(watt)	0, 18 to 24
Peak power / instrument mode (does not include htr pwr)	(watt)	0, 18 to 29
Peak Power duration (does not include htr pwr)	(msec)	1000 - every 50 min
Orbit avg power / orbit mode (does not include htr pwr)	(watt)	24, 24
Operational heater power [OAP (cold case); peak (35v)]	(watt)	7, 17
Survive heater power[OAP (cold case); peak (35v)]	(watt)	11, 26.6
Voltage Range	(volts)	22 to 35
# of relays		2 (power) + 2 (pyros)

Cleanliness Requirements:

Acceptable Cleanliness Levels for S/C Intgr		class 100,000
S/C Surface Cleanliness		1,000
Hydrocarbon levels		15 ppm
Purge Requirements (type, purity, flow rate, max time w/o, pad req't)		N2 purge, grade C, 0.2 to 0.5 l/min, 8 hrs, N2 purge
Bakeout req'ts on S/C		All mechanical hdwr, harnesses, thermal blankets, and electronics boxes

Special Requirements For:

Integration and Test		none
A#s		A600 (SIS); A605 (SIS Electronics); A610 (FPE#1); A612 (FPE#2); A620 (HVPS#1); A622 (HVPS#2); A625 (ECU)
Arming plug on S/C side		Yes (part of S/C arming plug)
Mission Operations (such as deployments)		pyro release cover, yaw maneuver
Safety (such as a radiation source)		HVPS, GSE lamp, purge
EMC		FPE wideband amp susceptibility
Calibration		none