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REVISION LOG

This log identifies the portions of this specification revised since the formal issue date.

SEE SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

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SEE 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 Solar EUV Experiment (SEE) 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 *SEE 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 SEE Interface Control Document (ICD).

1.1 PURPOSE OF DOCUMENT

This document specifies the interface of the TIMED spacecraft and the SEE 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 SEE 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 SEE 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 SEE IDT shall provide the items listed in Table 1.7-1.

TABLE 1.7-1

SEE INSTRUMENT DELIVERABLES

1. SEE instrument with flight software;

2. Sealed instrument case;

3. Shipping container;

4. Red-tag items;

5. Green-tag items;

6. Handling fixtures;

7. Electrical GSE for
    a. Stand-alone testing of the SEE instrument prior to integration with the spacecraft; and
    b. Command and telemetry readout via the Missions Operation Center (MOC) during spacecraft integration.

8. Interface control drawings;

9. 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;

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

SEE SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Section 2.0
Electrical Interface

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2.0 ELECTRICAL INTERFACE REQUIREMENTS

2.2 INSTRUMENT GROUNDING

No provision for grounding straps between the instrument and the spacecraft deck shall be required. Two 20 AWG chassis ground wires shall be attached to the +X support leg and routed through the cable wrap to the rotating platform.

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 SEE instrument is 7.0 Amperes. The minimum fuse size for the survival heater power bus for the SEE instrument is 3.0 Amperes.

2.3.7 Main Bus Component Power Dissipation

The SEE instrument average power dissipation by assembly for each instrument operating mode is given in Appendix E, Table E-1. The SEE instrument peak power dissipation by assembly for each instrument operating mode is given in Appendix E, Table E-2. The SEE 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 "egs flat-field 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.

The power profiles for each of the orbit modes for the SEE instrument are given in Appendix E, Figures E-1 through E-4.

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 HARNESS

2.5.1 Spacecraft/Instrument Interface Harness

The SEE Main Power harness shall consist of 2 - 20 AWG twisted wire pairs. The SEE Operational Heater harness shall consist of 3 - 22 AWG twisted wire pairs. The SEE Survival Heater harness shall consist of 2 - 22 AWG twisted wire pairs.

2.6 CONNECTORS

2.6.2 <u>Interface Connectors</u>

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.

TABLE 2.5.2-1

SEE INSTRUMENT CONNECTOR DESCRIPTIONS

Connector No.	Connector Part No.	Description	Connector Keying	Harness Drawing Number
A400-J1	GSFC-S-311P409-1P-B-12	Main Power	n/a	7363-8113 (APL)
A400-J2	GSFC-S-311P409-1S-B-12	1553 Bus "A"	n/a	7363-8104 (APL)
A400-J3	GSFC-S-311P409-1S-B-12	1553 Bus "B"	n/a	7363-8104 (APL)
A400-J4	GSFC-S-311P409-2P-B-12	Heater Power	n/a	7363-8113 (APL)
A400-J5	GSFC-S-311P407-1S-B-12	Temperature Sensors	n/a	20550-D2-0101
A400-J6†	MS27508E16F-26P	GSE Ion Pump & Flt Arm Plug	n/a	20550-D2-0102 (LASP)
A400-PG1	Swagelock SS-400-61-X	Purge Intake	n/a	n/a

† Mating Green-tag arming plug to be supplied by IDT

SEE 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)

SEE shall use message indexing for command receipt and instrument telemetry.

3.2.3.4.1 Receive Subaddress Assignments R0 Through R31

R1

This is buffer 1 of the SEE command input double buffer. As described in the GIIS, the C & DH breaks up CCSDS telecommand packets into command messages of 128, 16-bit words for transmission across the 1553 bus. Because SEE is using message indexing, the C & DH will load all 1553 messages destined for command buffer 1 to R1.

SEE has stated that the length of their telecommand packets will always be 128, 16-bit words. As stated in the GIIS, the C & DH will always send the first command message of a telecommand packet to command buffer 1. Since the SEE packet size equals the size of the command message, all SEE command messages will go to command buffer 1. If SEE ever decides to increase the length of their telecommand packets, SEE command messages will then be sent to both command buffers 1 and 2.

R2 - R5 (SEE will assign these subaddresses as illegal)

R6

This is buffer 2 of the SEE command input double buffer. Because SEE uses message indexing, the C & DH will load all 1553 messages destined for command buffer 2 to R6. However, as stated in the section on R1, if SEE does not send any telecommand packets longer than 128, 16-bit words, the C & DH will never load any command messages to command buffer 2.

R7 - R10

(SEE will assign these subaddresses as illegal)

R19

SEE shall synchronize time by reading the 2-word time code message from R19. This time code shall define the start time of the next 1-second interval.

The next 1-second interval shall start by the C&DH bus controller reading from T19. The SEE microprocessor shall receive an interrupt at this event and shall clear an internal vernier timer.

R20

Spacecraft status message, updated once per second

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3.2.3.4.2 Transmit Subaddress Assignments T0 through T31

T1

This is buffer 1 of the telemetry double-buffer. All telemetry packets are 131 words in length (6 word-header, 125-word data). The maximum packet rate shall be 2 packets per second.

T2 - T5

(SEE will assign these subaddresses as illegal)

T6

This is buffer 2 of the telemetry double-buffer. All telemetry packets are 131 words in length.

T7 - T10

(SEE will assign these subaddresses as illegal)

T11

The C & DH polls T11 only once per second, during minor frame 0, and looks at bits 15 and 14, which indicate if there is a telemetry packet ready in buffers 1 and 2, respectively. The C & DH takes action based on the level of these bits, and does not require a 0 to 1 transition. The C & DH will read a single packet in each of minor frames 3 and 5, if both bits are set, or will read a single packet in minor frame 3 only, if one bit is set. If both bits are set, buffer 1 will be read first. The nature of this scheme does not require SEE to ping-pong between the two buffers.

T12

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

TABLE 3.2.3.4.2-1

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

Word Bit Position	Number of Bits	Definition
63	1	Heartbeat (1/0)†
62	1	Reserved (Autonomy bit for some instruments)
61-59	3	Count of Packets Received (0-8 nominal, counter sticks on 7)
58-56	3	Count of Packets Rejected (0-8 nominal, counter sticks on 7)
55-52	4	Count of internal errors (contributors TBD)
51	1	GCI Communication Error/No Error (1/0)
50	1	EDAC Error/No Error (1/0)
49	1	RAM_Swap_1 (1/0)
48	1	RAM_Swap_0 (1/0)
47	1	RAM Program/ROM Program running (1/0)
46-40	7	SEE MU Operational Mode
39	1	Default Science Mode Enabled/Disabled (1/0)
38	1	Valid RAM Program Loaded/Not Loaded (1/0)
37	1	EGS On/Off (1/0)
36	1	XPS On/Off (1/0)
35	1	SSPP On/Off (1/0)
34	1	Operational Heater Enabled/Disabled (1/0)
33	1	EGS Door Closed/Open (1/0)
32	1	EGS Slit Cal/Normal (1/0)
31	1	EGS Lamp On/Off (1/0)
30	1	ODC Running/Not Running (1/0)
29	1	GCI_Swap_1
28	1	GCI_Swap_0
27-16	12	EGS HVPS Level (A/D value)
15-12	4	XPS Filter Wheel Position
11-0	12	SSPP Position (1 bit = 1 degree)

† Heartbeat shall toggle once per second

T19

The start of the next 1-second interval is marked by the C&DH bus controller reading from T19.

3.3 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	110 0000 0001	SEE EGS Data Packet
			110 0000 0010	SEE XPS Data Packet
			110 0000 0011	SEE Housekeeping Packet
			110 0000 0100	SEE Memory Packet
	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 1111 1111	Number of octets in packet (255 decimal)
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

3.4 TELECOMMAND FORMAT

ITEM	BIT FIELD	LENGTH (bits)	VALUE (binary)	DESCRIPTION
Primary Header	Version Number	3	000	Designates a source packet
	Type Indicator	1	1	Designates a command packet
	Secondary header flag	1	0	No Secondary Header
	Application process identifier (source ID)	11	110 0001 0000	Direct Command Packet
			110 0010 0000	ODC Command Packet
			110 0011 0000	SW Load Start Packet
			110 0100 0000	SW Load Mid Packet
			110 0101 0000	SW Load End Packet
	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 1111 1001	Number of octets in data field (249 decimal)
Data		2000		No secondary header in cmd packets

3.5 SUMMARY OF THE SEE INSTRUMENT'S DATA REQUIREMENTS

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

TABLE 3.5-1

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

Daily Command requirements	2 Kbytes per day
Infrequent Software Upload requirements	~80Kbytes
Daily Average Data Rate	0.226 kbps
Peak Recording Data Rate	4.192 kbps
Peak Real-time Data Rate	4.192 kbps
Solid State Recorder Limit in 24.25 Hours	9497 Packets (262 bytes/packet)
Number of relays allocated to SEE	2†

† S/C Survival Heater Relay shall be normally closed

SEE 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 SEE 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 exposure to the space environment for radiators and apertures, the connection to the mounting interface, its internal dissipation, and heat leaks through the thermal blankets, each of which are the responsibility of the SEE IDT.

The SEE instrument consists of several different subassemblies, all mounted to a gimballed platform. The platform will be suspended above the spacecraft (S/C) -Z deck via two support legs, allowing for rotation of the platform, with the support legs mounted directly to spacecraft -Z deck. The sensor assemblies, power supplies and main electronics will populate both sides of the platform. Heat pipes shall conductively carry heat from the platform to a radiator over the top of the platform. The entire instrument will be covered with multi-layer insulation (MLI) blankets, except for the apertures,; the latter shall have thermal control coatings applied as will the areas adjacent to the apertures. The spacecraft will provide the external environment to the SEE IDT.

The EUV Grating Spectrograph (EGS) is conductively mounted to the underside of the platform. The EGS contains an optical system and a detector to provide solar spectral information in the 25 to 200 nm range. The platform will be designed by the SEE IDT to control the temperature and gradients within the EGS. The majority of EGS will reside under MLI blanketing, with a thermal control coating applied to the area around the vacuum door aperture.

The XUV Photometer (XPS) is conductively mounted to the top of the platform. The XPS uses photodiodes to provide solar spectral information in the 0.1 to 35 nm range. The platform will be designed by the SEE IDT to control the temperature and gradients within the XPS. The majority of XPS will reside under MLI blanketing, with a thermal control coating applied to the aperture plate.

Power supplies and electronics boards will be mounted in housings which will be conductively tied to the platform. The electronics housing will be under MLI blanketing, with the radiator used to reject heat.

4.3 MOUNTING INTERFACE

The SEE instrument will be mounted to the S/C -Z deck. The gimballing platform will achieve partial thermal isolation from the deck via the drive actuator and support bearings. The supports legs will be in thermal contact with the S/C -Z deck. The dimensions of the SEE instrument and details of its mechanical interface are given in the Mechanical Interface Control Drawings (Appendix A).

4.3.1 Interface Surface

The SEE Solar Pointing Platform (SSPP) support legs shall be mounted directly to the spacecraft -Z deck without thermal isolation or coupling material placed between the deck and the instrument. The total thermal resistance between the instrument gimballing platform and the -Z deck shall be > 8°C/W.

4.3.2 Mounting Interface Temperature Limits

The temperatures to which APL will control the -Z deck at the mounting interface are defined in Table 4.3.2-1. The SEE instrument developers 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
-Z Deck	-20 to +55 °C	-34 to +60 °C

4.3.3 Mounting Interface Temperature Rate of Change Limits

There is no requirement to limit the SEE 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 or equal to 16°C across any diagonal of the SEE instrument mounting points.

4.4 THERMAL CONTROL HARDWARE

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

- radiator locations and sizes
- heat pipe 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 temperature sensor locations and types
- thermal control coatings
- operate, survive, and test temperature specifications for individual box, major subassembly, and critical components

4.4.1 <u>Heaters/Thermostats</u>

4.4.1.1 Operational Heaters

Power for the operational heaters is supplied by the main bus. The location, size, and designation of the operational heaters and location and designation of the operational thermostats on the SEE 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 SEE instrument are shown in the Spacecraft Harness Drawing (Appendix B). The SEE 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 SEE 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 SEE instrument is given in the Spacecraft Harness Drawing (Appendix B). The SEE instrument developer 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 SEE instrument will have two primary and two redundant spacecraft-monitored temperature sensors. These temperature sensors will be 1000 ohm platinum resistors (Part # S100480PFY72B). 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 SEE instrument is given in the Thermal Interface Control Drawings (Appendix C). The schematic which details the electrical hookup of the spacecraft-monitored survival temperature sensors located on the SEE 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 SEE IDT is responsible for providing, mounting, and monitoring any additional temperature sensors required over and above the "spacecraft-monitored" temperature sensors.

4.4.3 Radiators

The SEE thermal radiator is located on the SEE instrument. The SEE thermal radiator will be provided as part of the instrument, and is the responsibility of the SEE IDT. The radiator size, location, thermal control coatings, etc. are detailed on the Thermal Interface Control Drawings (Appendix C). The clear field of view is given in SEE Field of View Drawing (Appendix A).

4.4.4 Thermal Control Coatings

The thermal control coatings are the responsibility of the SEE 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 SEE IDT is responsible for the design and manufacture of all SEE 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.

SEE 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 SEE 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 SEE instrument platform mounts to the S/C -Z deck via two support legs. Each of the two legs is directly bolted to the deck using 4 bolts for a total of 8 bolts. Two removable spacer bars shall maintain the optimum distance between the uprights before and during integration to the S/C deck; once the mounting bolts are installed, the spacer bars shall be removed.

To allow for fabrication tolerance in the deck, only the clearance hole at the M(X=0,Y=0) position (see 5.1.3.2) shall be a close clearance fit. To maintain rotation of the instrument about the Z direction at installation, one hole in the opposing leg shall be slotted for close clearance fit in the Y-dimension and free clearance fit in the X-dimension; the remainder of the clearance holes in both legs shall be free clearance fit.

Once mounted, thermally induced dimensional differencing between the platform and the deck shall be compensated through an axially compliant flexure and a spherical bearing interface between the support legs and the platform. The SEE instrument's mounting concept is shown in the Mechanical Interface Control Drawings (Appendix A) entitled SEE Mounting Assembly TIMED SEE SSPP (20550-1-0119-1).

5.1.3 Reference Coordinate Systems

5.1.3.2 Instrument Component Reference Coordinate Systems

Two coordinate systems are defined for the SEE instrument, one, M, for the instrument as a stationary body mounted atop the spacecraft and the other, P, fixed to the rotating platform. The M coordinate system is the spacecraft reference coordinate system translated to the center of the extreme S/C(-X/-Y) corner mounting hole of the instrument. The M(Z=0) origin is set at the bottom of the mount structure. NOTE: the M coordinate is designated as SEE_CSYS in the Appendix drawings.

The P coordinate system is defined by the M coordinate system translated to the platform axis of rotation when the instrument fields-of-view are rotated toward the spacecraft -Z deck. P is fixed to the platform and hence rotates with the platform, with the P(X=0) origin defined to be in the same plane as M(X=0). The platform rotation angle, θ, is the rotation about the P(X) axis and follows the right hand rule. $\theta = 0°$ is defined to be when the boresight of the components are pointed in the direction of S/C(+Z).

The SEE instrument's M (SEE_CSYS) reference coordinate system is shown 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

The mounting location on the spacecraft of the SEE instrument is shown in the Mechanical Interface Control Drawings (Appendix A).

5.1.4.1.1 Instrument Mounting Locations

The mounting location on the spacecraft of the SEE instrument is shown in the Mechanical Interface Control Drawings (Appendix A).

5.1.4.1.1.1 Instrument Mounting Hardware

The SEE instrument 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) in the drawing entitled SSPP Mounting Assembly TIMED SEE, SSPP (20550-1-0119-1).

5.1.4.1.3 Thermal Gaskets and Washers

No thermal gaskets or washers shall be placed between the spacecraft -Z deck and SEE instrument.

5.1.4.1.4 Grounding Strap

No provision for grounding straps between the instrument and the spacecraft deck shall be required. Two 20 AWG chassis ground wires shall be attached to the +X support leg and routed through the cable wrap to the rotating platform.

5.1.5 Mass Properties

5.1.5.1 Mass

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

5.1.5.2 Center-of-Mass Location

The SEE instrument's center-of-mass, both in the launch and flight configurations, with respect to the instrument's coordinate system shall are specified in Appendix D, Table D-2.

5.1.5.3 Moments of Inertia

The SEE flight- and launch-configuration moments of inertia are tabulated in Appendix D, Table D-2.

5.1.6 <u>Envelopes and Fields-of-view</u>

5.1.6.1 Static Envelope

The SEE Instrument's Mechanical Interface Drawing (Appendix A) entitled SEE Static Envelope (20550-1-0119-3) shows the SEE Instrument's static envelope.

5.1.6.2 Dynamic Envelope

The SEE Instrument's Mechanical Interface Drawing (Appendix A) entitled SEE Dynamic Envelope (20550-1-0119-2) shows the SEE Instrument's dynamic envelope.

5.1.6.3 Integration and Test Access Requirements

The SEE Instrument Access Drawing (Appendix A) contains a separate sheet for each of the different test configurations required during spacecraft integration and test. There are three: Instrument Installation (Removal), EGS Evacuation/Backfill and Pre-flight Cover Removal, and Optical Alignment

5.1.6.4 Payload Instrument Fields-of-view

The primary active fields-of-view requirements of the SEE instruments are contained in the SEE Instrument Field-of-View Drawing (Appendix A) in the drawings entitled EGS, XPS, & Radiator Fields of View (20550-1-0119-5) and SAS Fields of View (20550-1-0119-6). The instantaneous active and glint-free fields-of-view are listed in Table 5.1.6.4-1. The drawing includes location and size of apertures, boresight directions, and glint-free and clear fields-of-view extents.

Component	Instantaneous Active Full FOV	Instantaneous Glint-Free FOV
EGS	5.03° x 12.6°	25° x 35°
XPS	21.4° (dia.)	60° (dia.)
SAS	15° x 15°	70° x 70°

Table 5.1.6.4-1

5.1.6.5 Thermal Radiator Field-of-View

The SEE instrument's thermal radiator's field-of-view is contained in the instrument's Field-of-View Drawing (Appendix A) in the drawing entitled EGS, XPS, & Radiator Fields of View (20550-1-0119-5).

5.1.7 Payload Instrument Alignment Provisions

5.1.7.1 Alignment Position Requirement

APL shall mount the SEE instrument on the -Z deck such that the SEE instrument axes are parallel to the spacecraft X, Y and Z axes to within ± 1.0° (3σ).

5.1.7.2 Alignment Knowledge Requirement

APL shall measure the alignment of the SEE optical cube on the foot of the SEE instrument with respect to the spacecraft's optical cube to within ± 0.05° each axis (3σ).

5.1.7.4 Optical Alignment Cube Location

The location of the SEE instrument's optical alignment cube is documented within the SEE Instrument's Mechanical Interface Drawing (Appendix A) in the drawing entitled Component Placement Assembly (20550-1-0119-10).

5.1.8 Mechanisms, Moving Parts, and Dynamics

The SEE instrument has the following moving parts: a rotating platform, a slit selector, a filter wheel and a recloseable vacuum door.

5.1.8.1 Operation

Dynamic forces and torques induced at the component mount by the SEE instrument are described and recorded within this section by the SEE IDT and shall comply with the limits specified within the GIIS.

5.1.8.1.1 Non-recurring Transient Events

The torques imparted to the spacecraft by each non-recurring transient event on the SEE instrument shall be defined within Table 5.1.8.1.1-1. The torque vs. time curve appears in Appendix D, Figure D-4.

TABLE 5.1.8.1.1-1

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

Event	Torque* (N-m)
EGS Vacuum Door Open	$0\hat{\mathbf{x}} + \text{<TBD>}\hat{\mathbf{y}} + 0\hat{\mathbf{z}}$

* Vectors are specified along the axes of the spacecraft coordinate system defined within section 5.1.3.1 of the TIMED GIIS with the platform rotated to the θ = 180°

5.1.8.1.2 Recurring Forces and Torques (spectra)

Maximum disturbance torques generated by the SEE instrument are specified within Table 5.1.8.1.2-1. The torque vs. time curves are shown in Appendix D, figures D-1 through D-3 and are given about the location of the rotation axes for each mechanism; the axes locations are shown in the mechanical ICD drawings in Appendix A (20550-1-0119-2). For the XPS filter wheel and EGS slit selector torques, the SSPP rotational position is defined such that the instrument boresights are pointed horizontally ie θ = 90° as in the FOV drawings.

TABLE 5.1.8.1.2-1

TABLE OF RECURRING FORCES AND TORQUES GENERATED BY THE SEE INSTRUMENT

Maneuver	Torque* (N-m)
SSPP Step	$0.582\hat{\mathbf{x}} + 0\hat{\mathbf{y}} + 0\hat{\mathbf{z}}$
XPS Filter Wheel Step	$0\hat{\mathbf{x}} + 0.022\hat{\mathbf{y}} + 0\hat{\mathbf{z}}$
EGS Slit Selector	$2.19\text{E-}5\hat{\mathbf{x}} + 0\hat{\mathbf{y}} + 0\hat{\mathbf{z}}$

* Vectors are specified along the axes of the spacecraft coordinate system defined within section 5.1.3.1 of the TIMED GIIS with the platform rotated to the θ = 90°

5.1.8.2 Caging

No SEE mechanisms require caging for launch. The SEE Solar-Pointing Platform (SSPP) shall rely on the unpowered holding torque of the actuator and the positioning of the platform center of gravity near the rotation axis to maintain rotational position during launch.

The XPS filter wheel incorporates a geneva wheel and cam coupled to a high reduction gear motor. The geneva drive is inherently self caging.

The EGS slit selector utilizes a high reduction gear motor coupled to a cam that engages a pushrod attached to a rotating member. The cam's low mechanical advantage coupled with the high reduction of the motor effectively cage the selector.

The EGS vacuum door actuates through a crank-slider mechanism connected to a high reduction gear motor. The vacuum door itself is connected to the linear shaft through a compliant member and rotates on a pivot into the closed position. The oring seal is then compressed by bearings attached to the linear shaft which engage a ramp on the door. The bearings fully engage the door ramp at the maximum extent of linear shaft travel. At this position, the slider-crank mechanism attached to the motor is positioned such that the crank coupling is perpendicular to the crank wheel and results in the minimum rotational backdrive torque applied to the motor. This, coupled with the high reduction of the motor's gear train, assures the door will remain in the closed position during launch.

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During launch, the SEE instrument's aperture shall be positioned facing downward (i.e., in the +Z direction) to minimize possible contamination.

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

No flight covers shall be used on SEE. A single, non-flight aperture cover shall be installed as a red-tag item over the XPS aperture plate throughout most I&T activities. The cover shall provide enviromental containment for the purge, with a removable section of the purge line directly attached. Additionally the cover shall incorporate windows for visible light stimulation of sensors. Provision for access to cover and removable purge line section shall be required during pre-flight preparation.

5.2 PAYLOAD INSTRUMENT IDENTIFICATION AND MARKING

The SEE instrument, which will consist of a single module, shall be marked with the identification mark A-400. Interface connectors, test points and adjustments shall be clearly labeled. (A400-JXX).

SEE SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Section 6.0
Navigation and Attitude Control Interface Section
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6.0 NAVIGATION AND ATTITUDE CONTROL

The SEE Solar Pointing Platform (SSPP) provides one-axis pointing for the SEE instrument during its solar observations. The SSPP is positioned prior to each solar observation so that the sun will drift through its field of view (FOV). During the solar observation, the SSPP will be used to maintain the component FOVs to the solar position within 2 arc-minutes about the S/C X axis using the one of the two SEE Solar Aspect Sensors (SAS). A single SSPP step is 0.56 arc-minutes. The SSPP is expected to take about 1 step every 3 seconds, but is dependent on the S/C drift about the S/C X and Z axes and the misalignment between the ram direction and the SAS "control-to" axis.

The SEE Solar Aspect Sensor (SAS) will provide the solar position during a solar observation. The SAS field of view (FOV) is square 15 x 15 degrees. The SAS resolution is 0.3 arc-minute.

6.3 POINTING ACCURACY

6.3.1 Pointing Knowledge

In order to meet the science requirement for the EGS, SEE will allow only 4.2% variation in EGS sensitivity. Calibration measurements on the EGS grating yield a variation of 3.5% / arcminute. This results in an overall pointing knowledge accuracy of 1.2 arcminutes for the SEE instrument.

In normal circumstances, the EGS Solar Aspect Sensor (SAS) will provide pointing knowledge for SEE. The error between the SAS and EGS boresight shall be less than 0.5 arcminutes (accounts for thermal distortion, launch shifts, 1G effects).

In the case of a failure of both SAS, SEE will not be able to meet the science requirements for the EGS instrument, but will have sensitivity variation limited to 33% by mounting and alignment of the instrument. Table 6.3.1 summarizes the alignment error budget required to meet the maximum sensitivity variation of 33%.

Alignment Operation	Alignment Knowledge Error Budget (3 sigma, each axis, arcmin)
EGS Boresight-EGS Cube (2 axes)	2.0
Platform Fiducial Determination (1 axis)	0.6
On-orbit Fiducial Determination (1 axis)	3.6
Periodic Rotational Error (1 axis)	2.4
EGS Cube - SEE Base (2 axis)	3.0
SEE Base - Star Tracker (2 axis)	3.0
1553 Solar Vector Accuracy	3.6

Total 1553 Solar Vector - EGS Boresight Error	9.4

SEE SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Section 7.0
Integration, Qualification, and Field Test Requirements
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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

The Stand Alone Instrument GSE for SEE will consist of a ‘suitcase’-style GSE (IGSE) principally for providing +28V power to SEE, an APL-provided S/C emulator, and a workstation running OASIS-CC s/w for monitoring and recording SEE TM and generating commands. Additionally the EGS Vacuum Maintenance System will be used to maintain the vacuum integrity of the EGS component during these tests (Section 7.2.1.2).

The IGSE shall provide switchable power to the instrument, and to operational and survive heater circuits. Selectable panel-mount current and voltage monitors will give visibility. Test points/monitors shall be available for S/C-monitored temperature sensors. Connections from the IGSE to the instrument shall be made through A400-J1, J4 and J5. This unit will be portable and will require little space for storage.

The S/C emulator provides the 1553 command and telemetry interface between the instrument and the TCP/IP connection to the workstation operating OASIS-CC TM-monitoring and command-generation software. The S/C simulator requires 120VAC power and an ethernet connection.

As stated, a workstation running OASIS-CC shall provide monitoring and command generation capabilties for the SEE instrument and communicates to the S/C simulator via TCP/IP (ethernet) connection, requiring an ethernet connection and 120VAC power. This computer shall also be used for subsequent on-site testing through the MOC once the instrument is integrated with the S/C.

Should it be necessary, a system for testing individual channels separate from the fully integrated instrument shall be available on-site; this consists of a suitcase-style GSE (CGSE) and a Macintosh computer. The CGSE provides switchable +28VDC power to the channel and provides data and command pass-through interconnectivity between the personal computer and the channel. The CGSE will be portable and will require little space for storage. Both the CGSE and personal computer require 120VAC.

7.2.1.2 Instrument Specific Ground Support Equipment (GSE)

SEE’s Instrument Specific GSE will consist of a EGS vacuum maintenance and an evacuation and backfill system.

The Vacuum Maintenance and Backfill System (VMBS) incorporates all GSE required to evacuate, maintain the vacuum and backfill the EGS and consists of the following items:

A) Ion Pump GSE (IOP): mounts to the EGS vacuum door and maintains the EGS internal environment for safe detector operation, nominally a pressure < $1x10^{-5}$T. The IOP contains an ion pump, an ion pump high-voltage (3.5kV) power supply and a small valve for EGS evacuation and backfilling operations. The IOP is a red-tag item and shall be removed prior to flight.

B) Ion pump, Vacuum Door and HV Arm GSE (IPA): throughout most of I&T, a suitcase-style GSE will be connected to the SEE instrument through a cable to instrument connector A400-J6. The IPA supplies +28VDC power through the instrument harness to the IOP physically attached to the vacuum door of the EGS component.

The IPA also provides a connection to the IPAC (see below) for the IOP and vacuum door state monitors and for the EGS vacuum door and detector HV safing switch status monitors. NOTE: Safing switches can only be configured via the IPA front panel.

For power outage protection the IPA shall require 120VAC from an uninterruptable power source which shall have the ability to operate the IPA and the IOP for 16hr duration. Additionally, to protect the IOP during extended or unintentional 120VAC power outages a reset switch shall be incorporated in the IPA to prevent 28VDC from being applied to the IOP HV supply on power restoration. For transport when feasible, the IPA shall also have an electrical connection and mount suitable for a +28V, 2.5AHr NiCad battery pack.

C) Ion Pump Vacuum Door And HV Arm GSE Computer (IPAC): During I&T, the IPAC ground computer will monitor and record the IOP current and voltage, the vacuum door status, and status of the safety switches. The IPAC shall provide access to the log from an off-site computer via internet and hence will require an internet connection. The IPAC shall require 120VAC power. SEE test engineers shall be responsible for checking the vacuum integrity of the EGS either through remote connection to the IPAC or via the IPA panel directly prior to any electrical tests requiring turn-on of the SEE instrument.

D) EGS Pump and Backfill Station (EPUB): Certain operations and test configurations will require backfilling the EGS with nitrogen gas and removing the IOP. These conditions will occur under the following circumstances:

1. Vibration testing of the spacecraft
2. Packing / Moving of the spacecraft to new facility
3. Any operation where the Ion Pump will not be powered for a period greater than maximum duration without ion pumping

Other circumstances, such as an unforeseen power outage of duration exceeding the maximum duration without ion pumping, will require a re-evacuation via the EPUB prior to reactivating the IOP. SEE test engineers will be responsible for EPUB backfill/evacuation of the EGS. The maximum duration without ion pumping is 90 minutes.

The EPUB is a cart incorporating a ‘dry’ turbomolecular pump backed by an oil-free diaphram pump for evacuation, and an ‘F’ style tube of high purity gaseous nitrogen with a 2-stage regulator for backfilling. These are plumbed together with stainless steel fittings and valved to allow for operations as required. The EPUB connects to the IOP via Cryolab valve, with the valve on the IOP and the valve actuator on the EPUB (see Appendix A).

7.2.1.2.6 Instrument GSE Test Cables

The GSE cable connecting the IPA and the IOP shall be fabricated to meet the requirements in 7.2.1.2.6 of the GIIS.

7.2.2 Mechanical GSE

7.5 PURGE REQUIREMENTS

SEE shall require a continuous nitrogen purge during spacecraft integration and test. The maximum allowable time without purge is 24 hours.

7.5.5 Instrument Purge Flow Rate

SEE requires two different flow rates; a low rate of 0.45 liters per minute to be used throughout instrument testing and spacecraft integration and test, and a high rate of 9 liters per minute to be used following close-out of the instrument and DPAF installation. The S/C purge system will employ a high rate restrictor and low rate restrictor to control purge flow into the instrument. The low rate restrictor wll be removed at instrument close-out (removal of XPS cover) to provide the high rate purge. For the low rate restrictor removal, the low rate restrictor will be located near the instrument purge interface on the spacecraft deck and shall be accessible through the spacecraft thermal blankets.

7.5.6 Purge Connectors

A single Swagelock SS-400-61-X purge connector will be located on the SEE S/C connector interface plate.

7.7 SAFETY

7.7.2.1 Instrument Related Hazards

The following items are identified as potential hazards

— -2600 VDC high voltage power supply (EGS)
— 800 ADC high voltage power supply for calibration lamp (starting voltage, encapsulated)
— Ultraviolet-producing Hg pen-ray calibration lamp (fully enclosed)
— +3500 VDC high voltage power supply contained within the IOP (red-tag, encapsulated)

7.8 CONTAMINATION CONTROL

7.8.1 Instrument Cleanliness

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

SEE SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Appendix A
SEE Instrument Mechanical Interface Control Drawings
SEE MICD
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Appendix A
SEE Instrument Mechanical Interface Control Drawings
SSPP Mounting Assembly
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Appendix A
SEE Instrument Mechanical Interface Control Drawings
SEE Static Envelope
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SEE SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Appendix A
SEE Instrument Mechanical Interface Control Drawings
SEE XPS, EGS, Radiator FOV
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Appendix A
SEE Instrument Mechanical Interface Control Drawings
SEE SAS Field-of-View
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SEE SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

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SEE Instrument Electrical Harness Drawings
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TECHNICAL CONTENT APPROVAL

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SEE SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Appendix B
SEE Instrument Electrical Harness Drawings
Harness Schematic Instrument Sub-System Power
APL 7363-8113
Signature Page

TECHNICAL CONTENT APPROVAL

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SEE SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Appendix B
SEE Instrument Electrical Harness Drawings
Harness Schematic RIU to Temperature Sensors
APL 7363-8133 sheet 5 of 6
Signature Page

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SEE SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Appendix B
SEE Instrument Electrical Harness Drawings
Harness Schematic RIU to Temperature Sensors
APL 7363-8133 sheet 6 of 6
Signature Page

TECHNICAL CONTENT APPROVAL

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APPENDIX C

SEE INSTRUMENT THERMAL INTERFACE CONTROL DRAWINGS

TABLE C-1

SEE COMPONENT TEMPERATURE RANGES

Component	Operational (C)	Operational Test (C)	Survival (C)	Survival Test (C)
EGS	+10 / +34	0 / +51	-30 / +43	-40 / +60
EGS GCI	+10 / +34	0 / +51	-30 / +43	-40 / +60
XPS	-10 / +38	-20 / +55	-30 / +43	-40 / +60
XPS GCI	-10 / +38	-20 / +55	-30 / +43	-40 / +60
SSPP (SMI-provided)	-29 / +40	-34 / +50	-30 / +43	-40 / +60
SSPP GCI	-29 / +40	-34 / +50	-30 / +43	-40 / +60
Microprocessor	-30 / +38	-40 / +55	-30 / +43	-40 / +60
SAS (2)	-10 / +38	-20 / +55	-30 / +43	-40 / +60

SEE SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Appendix D
SEE Instrument Mechanical Properties Summary
Signature Page

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TABLE D-1

SEE INSTRUMENT'S MASS ITEMIZED BY COMPONENT

SEE Component	Mass (kg)
EGS	5.13
XPS	2.91
SSPP	11.63
Microprocessor Unit (MU)	2.11
Harness + Thermal	5.32
TOTAL	27.1

TABLE D-2

SEE INSTRUMENT
TABLE OF MASS PROPERTIES

PROPERTY	CONFIG	GIMBAL ANGLE	VALUE
Center-of-mass Location [1]	Launch	$\theta = 0°$	$0.356\hat{\mathbf{x}} + 0.162\hat{\mathbf{y}} - 0.246\hat{\mathbf{z}}$
	Flight	$65° \leq \theta \leq 190°$	$0.356\hat{\mathbf{x}} + 0.169\hat{\mathbf{y}} - 0.243\hat{\mathbf{z}}$
Moments of Inertia [2]	Launch	$\theta = 0°$	$3.324\hat{\mathbf{x}} + 7.116\hat{\mathbf{y}} + 5.737\hat{\mathbf{z}}$
	Flight	$\theta = 90°$	$3.341\hat{\mathbf{x}} + 6.922\hat{\mathbf{y}} + 5.951\hat{\mathbf{z}}$
		$\theta = 180°$	$3.180\hat{\mathbf{x}} + 6.931\hat{\mathbf{y}} + 5.781\hat{\mathbf{z}}$

[1] Center of gravity in meters referenced from M(0, 0, 0). CG of platform designed to be coincident with rotational axis of platform in y-z plane.
[2] Moment of Inertia in $kg*m^2$ referenced from M(0, 0, 0).
NOTE: These are based on 20550-1-0119-0 rev A

SEE INSTRUMENT INSTANTANEOUS DISTURBANCE TORQUE CURVES

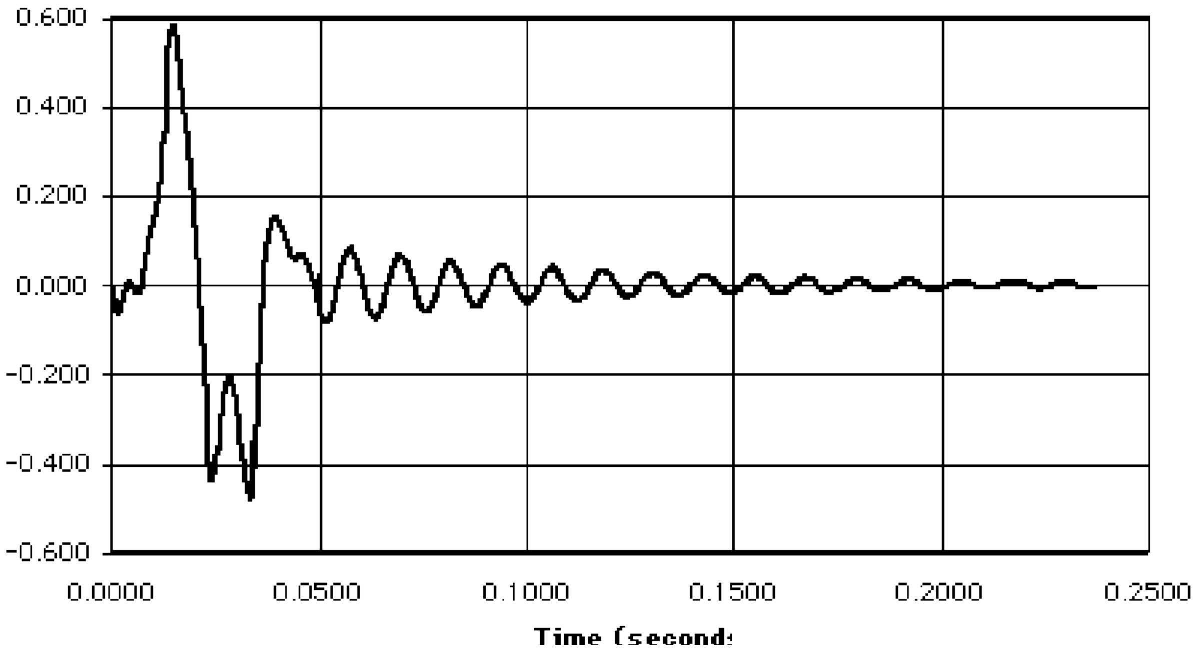

Figure D-1 Instantaneous Torque for Single Step of SSPP

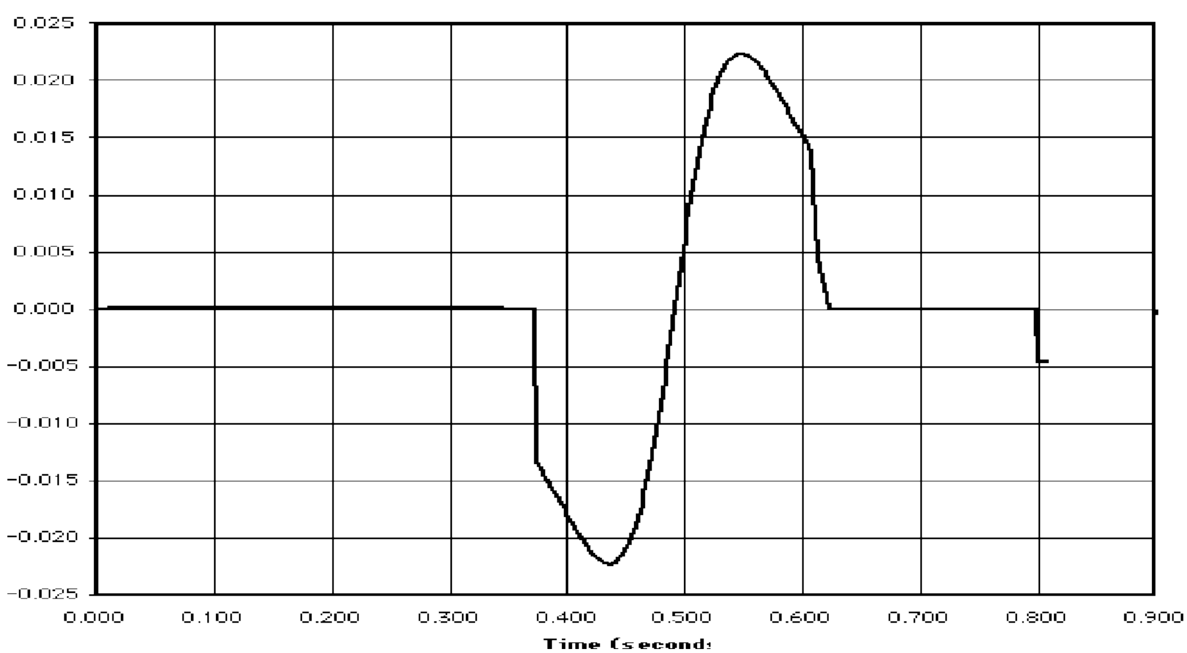

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Figure D-2 Instantaneous Torque for Single Step of XPS Filter Wheel

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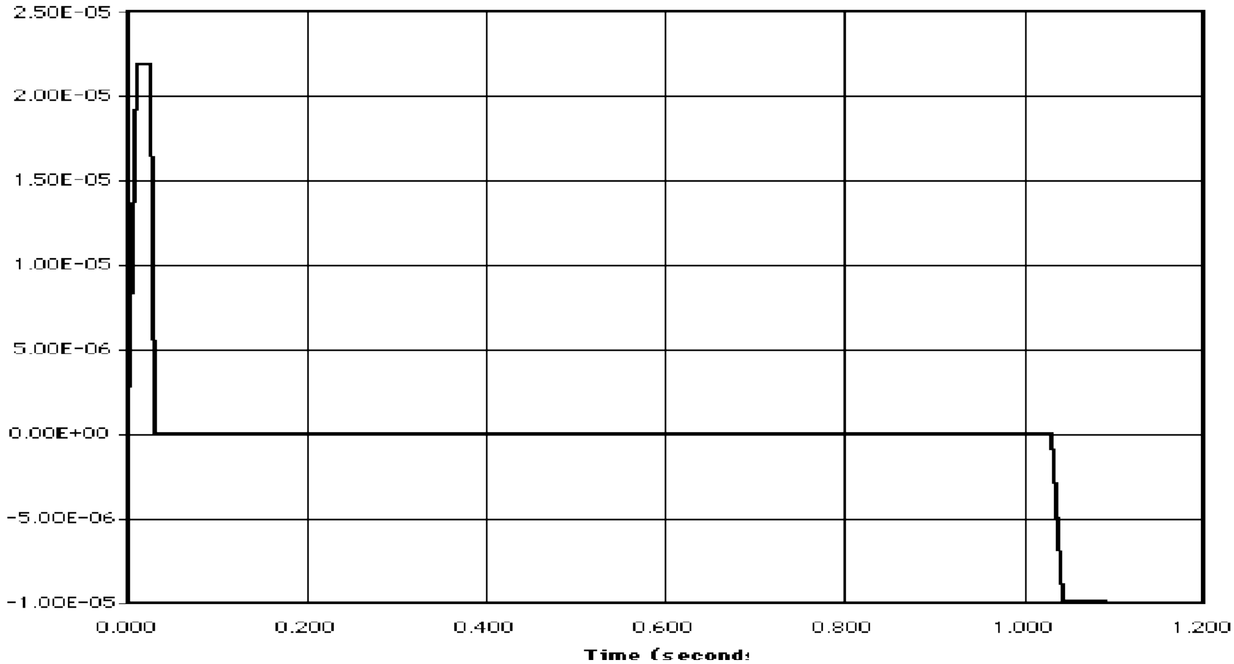

D-3 Instantaneous Torque for EGS Slit Selector Change

<TBD>

D-4 Instantaneous Torque for EGS Vacuum Door Open

SEE SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Appendix E
SEE Instrument Power Consumption
Signature Page

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Model Version: Power Dissipation Tables based on SEE Power Model version 4.32b

TABLE E-1

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

Element	Average Power Dissipation Per Instrument Mode (W)					
	OFF	STANDBY	NORMAL	CALIBRA-TION	OCCULTA-TION	EGS FLAT FIELDING
EGS	0.0	5.65	5.65	5.72	5.65	5.9
XPS	0.0	0.00	6.78	6.78	0.00	0.00
MU	0.0	8.43	8.43	8.43	8.43	8.43
SSPP	0.0	0.00	6.21	6.74	6.9	0.00
SUBTOTAL	0.0	14.1	27.1	27.7	21	14.3
Operational Heaters (Cold case)	0.0	14.43	2.2	1.63	7.65	13.93
TOTAL	0.0	27.0	27.0	27.0	27.0	27.0

TABLE E-2

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

Element	Orbit-Peak Power Dissipation Per Instrument Mode (W)					
	OFF	STANDBY	NORMAL	CALIBRA-TION	OCCULTA-TION	EGS FLAT FIELDING
EGS	0.0	5.03	5.03	5.03	5.03	5.53
XPS	0.0	0.0	11.38	11.38	0.00	0.0
MU	0.0	10.62	10.62	10.62	10.62	10.62
SSPP	0.0	0.00	14.45	14.45	14.45	0.0
SUBTOTAL	0	15.65	41.48	41.48	30.10	16.15
Operational Heaters (at 35 V)	0	38	38	38	38	38
TOTAL	0	53.65	79.48	79.48	68.10	54.15

TABLE E-3

SEE 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)
OFF	Off	1.000	0.00	0.00
STANDBY	Standby	1.000	14.1	14.1
NORMAL	Normal Standby	0.057 0.943	27.1 14.1	14.8
CALIBRATION	Calibration EGS Flat-Field Standby	0.057 0.824 0.119	27.7 14.3 14.1	15.1
OCCULTATION	Normal Standby Occultation	0.057 0.558 0.385	27.1 21 14.1	17.5

TABLE E-4

SEE INSTRUMENT SURVIVAL HEATER BUS POWER ALLOCATIONS

Peak Power (+35 V)	Average Power (Cold Case)
<TBD>	<TBD>

SEE INSTRUMENT POWER PROFILES BY ORBIT MODE

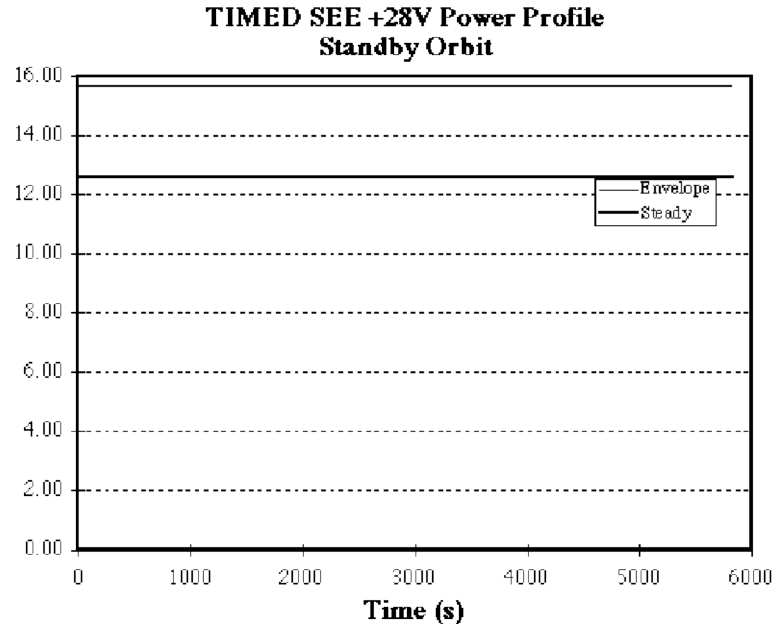

Figure E-1

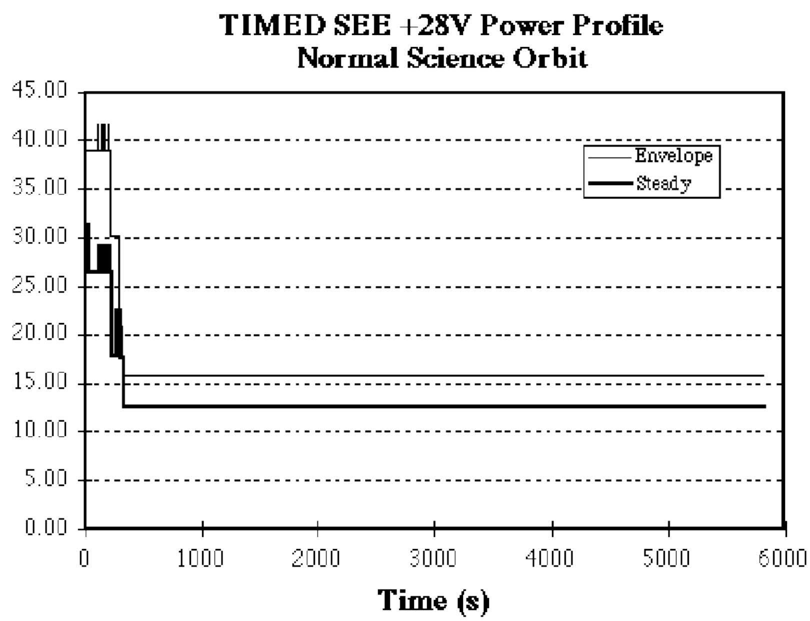

Figure E-2

TIMED SEE +28V Power Profile
Calibration Orbit

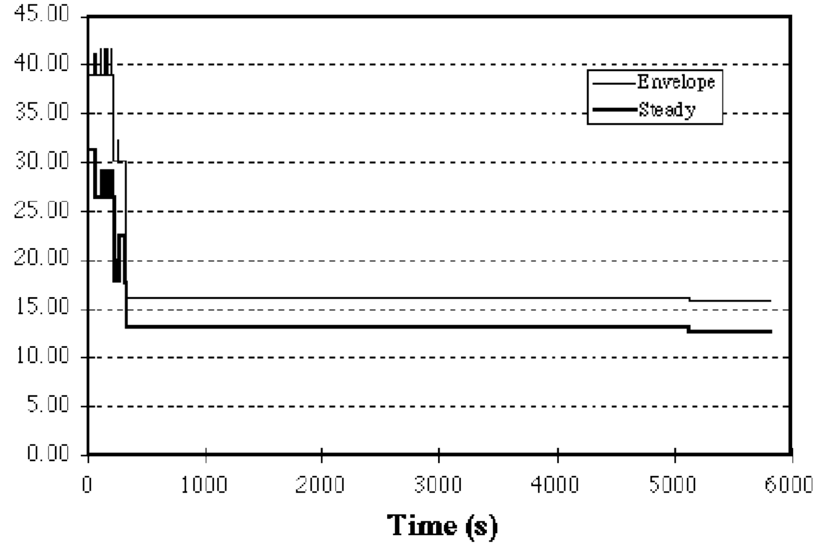

Figure E-3

TIMED SEE +28V Power Profile
Occultation Orbit

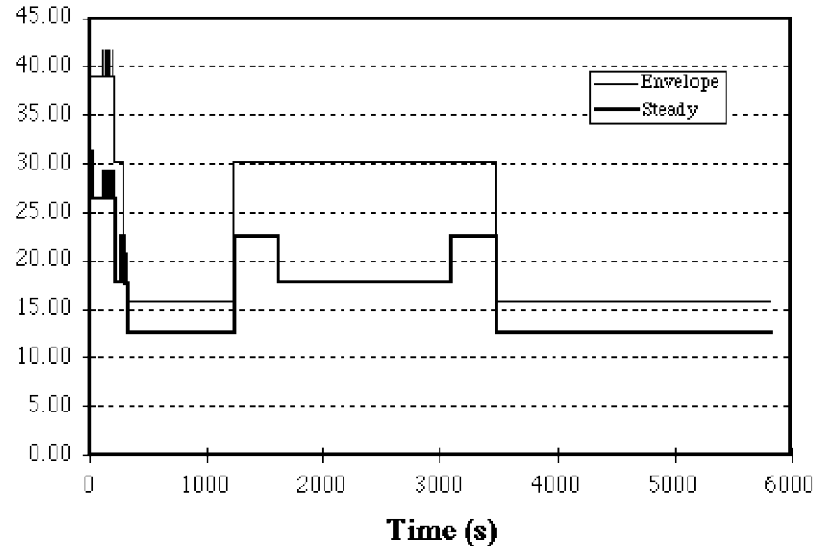

Figure E-4

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SEE SPECIFIC INSTRUMENT INTERFACE SPECIFICATION

Appendix F
SEE Instrument Resource Requirements Summary
Signature Page

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SEE (SOLAR EUV Experiment)
(EGS, XPS, MU, SSPP)

Mechanical Requirements:

Dimensions	(in)	26.995 (X) x 16.406 (Y) x 19.898 (Z)
Mounting Configuration (footprint, etc.)	(in)	26.995 (X) x 15.172 (Y)
Weight	(kg)	27.1
Center of Gravity		TBD
Pointing Direction(s)		190° movement range; Y-Z plane; from 25° below -Y axis (toward +Z for launch) to 10° beyond -Z axis (toward +Y)
Initial mechanical alignment placement error (S/C master cube to optical cube on SEE foot)	(deg)	± 1.0
Initial mechanical alignment knowledge error (S/C master cube to optical cube on SEE foot)	(deg)	0.05
Clear Field(s) of View	(deg)	185 x 38 (XPS); 185 x 31.3 (EGS); see CFOV drwg for details and origins of
Pinning req'd		No
Jitter		±0.03°/sec; each axis; 3s

Thermal Requirements (for each piece):

Mounting I/F temp range	(deg C)	-20 to +55°C (operate); -34 to +60°C (survive); -Z deck; hard mounted
Mounting I/F temperature stability	(deg C/min)	No req't
Mounting I/F thermal gradient	(deg C)	16°C across diagonal
# / range of S/C monitored temp sensors		2; -100°C to +100°C;-35°C to +65°C
S/C provided radiators		None
Instrument provided radiator CFOV:		
Platform radiator	(deg)	Cannot provide CLEAR FOV over entire scan range; thermal analysis indicates that layout is adequate

Attitude and Navigation Requirements:

Attitude control error (defined at SEE mounting location)	(deg)	1.0°, each axis, 3 s
Attitude determination knowledge error (defined at optical bench optical cube)	(deg)	0.03°, each axis, 3s
Stability	(deg/sec)	2°/60sec, each axis, 3 s
Pointing knowledge error (star camera boresight to SEE base optical cube; includes thermal and mechanical sources)	(deg)	0.05° each axis, 3s
Position Knowledge	(km)	2 (radial); 10 along and cross track, 3s
Velocity Knowledge	(m/s)	none
Keep out zones (such as sun, moon, earth)		none
Perturbing Mechanisms		rotating platform, egs slit shutter,
		filter wheel, reclosable door

Command and Data Handling Requirements

Number and type of commands		2 KBytes/day (μproc upload), infrequent ~80KByte ram loads
Instrument modes		6 -off,stndby,normal science, solar cal, occultation, EGS flat fielding
Orbit modes		5 - off, standby, normal science, calibration, occultation
Daily avg data rate	(kbps)	0.228
Peak record data rate	(kbps)	4.192
Peak real time downlink data rate	(kbps)	4.192
Duty cycle		5% Datataking (5 min/orbit), 95% Standby
Time knowledge	(ms)	1000
Special data needs (terminator crossings, etc.)		UT time, S/C pos, S/C velocity, S/C attitude, orbit ephemeris, Sun-S/C angles, solar panel maneuver, yaw maneuver, anomolous cond flag, SAA flag?
Preferred S/C data interface concept		MIL-STD-1553

Power Requirements:

Avg pwr / instrument mode (does not include htr pwr)	(watt)	0,12.6,24.8,25.4,24.7,13
Peak power / instrument mode (does not include htr pwr)	(watt)	0, 15.6, 46.2, 46.2, 46.2, 16.1
Peak Power duration (does not include htr pwr)	(msec)	1000-2000
Orbit avg power / orbit mode (does not include htr pwr)	(watt)	0, 12.6, 13.3, 13.7, 15.9
Operational heater power [OAP (cold case); peak (35v)]	(watt)	17; 38
Survive heater power[OAP (cold case); peak (35v)]	(watt)	11.5, 26
Voltage Range	(volts)	22 to 35
# of relays		2

Cleanliness Requirements:

Acceptable Cleanliness Levels for S/C Intgr		class 100,000; -Z panel precision clean/bakeout; Mil-Spec 1246 - 700A
S/C Surface Cleanliness		No S/C Cleanliness req't; -Z deck to be precision cleaned, -Z deck and MLI to be baked out
Hydrocarbon levels	ppm	15
Purge Requirements (type, purity, flow rate, max time w/o, pad req't)		$GN_{2;}$ std grade, 99.999%, hydrocarbon < 1 ppm; 0.1 L/min with red tag XPS cover; fill EGS with 1.2 atm nitrogen as late as possible in process flow
Bakeout req'ts on S/C		All mechanical hdwr, harnesses, thermal blankets. Highly desirable to bakeout elec boxes as well.

Special Requirements For:

Integration and Test		access to spectrometer; VIP on front of EGS; Ion pump test conn (I&T and TV), uP test conn (I&T only); EGS nitrogen backfill and XPS Cover removal late in process; remove EGS for cal (post S/C TV)
A#s		A400
Arming plug on S/C side		No
Mission Operations (such as deployments)		Move SSPP away from -Z deck ASAP after launch; power XPS and move filter wheel once / week in early ops.
Safety (such as a radiation source)		UV lamp, purge, pressure system (nitrogen cylinder, GSE), cryo (roughing pumps (GSE), battery (ion pump supply, GSE), handling fixture, high voltage
EMC		Mercury pen-ray lamp (<700 v striking voltage; 100 - 200v operating voltage; 100 Hz; ~10 mA)
Calibration		post TV calibration of EGS desired