Geostationary Operational Environmental Satellite (GOES)

GOES-R Series

Solar Imaging Suite (SIS)

Unique Instrument Interface Document (UIID)

Baseline Version

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National Aeronautics and Space Administration

Goddard Space Flight Center
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To verify the correct version of this document, please contact the GOES R Series Requirements Management Office on 301-286-7898

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1 Scope

The purpose of this Unique Instrument Interface Document (UIID) is two-fold. The first is to allocate GOES-R series spacecraft resources to the Solar Imaging Suite (SIS). The second is to serve as a core building block on which the SIS-spacecraft interface can be designed. The spacecraft integrating contractor and the SIS contractor **shall** meet each of their respective interface requirements as defined in this document.

The Government **will** be the system integrator until a system performance contractor or spacecraft contractor with that responsibility is selected. Until that time, the Government **will** be responsible for accommodation trades, resource allocation (weight, power, space, bandwidth, etc.), and resolving interface issues. This UIID **will** govern the development of an Interface Control Document (ICD). The ICD development **will** be a joint activity of the SIS and spacecraft contractors.

The SIS ICD establishes the details of the electrical, communications, mechanical, thermal, integration and test, and command and data handling (C&DH) interfaces between the SIS instrument and the GOES-R spacecraft. After the ICD is signed and approved by all parties, the spacecraft contractor **shall** maintain the ICD.

The SIS consists of the Solar X-ray imager (SXI), the solar X-ray sensor (XRS), and an extreme ultraviolet sensor (EUVS). This instrument suite requires primary power and command input data from the spacecraft. Instrument output data to the spacecraft contains instrument information, instrument telemetry and ancillary data.

1.1 Document Overview

Together, the General Interface Requirements Document (GIRD) and the SIS UIID establish the SIS spacecraft interface requirements. The GIRD applies to all GOES-R instruments while the SIS UIID is specific to the SIS. Section 1 explains the use of this document. Section 2 lists reference documents. Section 3 allocates spacecraft resources, such as mass, power, and data rate, to the SIS instrument Suite. Section 4 contains government-accepted operation constraints. Section 5 contains government-accepted deviations from the GIRD. Section 6 contains a list of acronyms used within this document.

1.2 Mission Requirements

The term "(TBD)", which means "to be determined", applied to a missing requirement means that the instrument contractor determines the missing requirement in coordination with the spacecraft contractor.

The term "(TBR)", which means "to be refined/reviewed", means that the requirement is subject to review for appropriateness by both contractors , and subject to revision. Both the spacecraft and instrument contractors are liable for compliance with the requirement as if the "TBR" notation did not exist. The "TBR" merely provides an indication that the value is more likely to change in a future modification than requirements not accompanied by a "TBR".

1.3 Order of Precedence

The order of precedence of interface requirements documents is the UIID at the highest level,

followed in order by the GIRD, ICD, and IDD.

2 Reserved

3 Allocations

The GOES-R spacecraft **shall** provide communications, power and a Sun-Pointing Platform (SPP) for the SIS instruments throughout the entire mission. The following paragraphs allocate these resources to SIS.

3.1 Command and Data Handling

3.1.1 Instrument-to-Spacecraft Science Volume

The instrument science and engineering data rate, including all overhead associated with Consultative Committee for Space Data Systems (CCSDS) packetization by the instrument at the spacecraft interface, **shall** not exceed 2.8 million (10^6) bits per second when averaged over any 5 second period.

3.1.2 Telemetry Data Rate

Housekeeping telemetry data rate, including all overhead associated with Consultative Committee for Space Data Systems (CCSDS) packetization by the instrument at the spacecraft interface, **shall** not exceed 1024 bits per second, when averaged over any 5 second period.

3.1.3 Application Process Identifiers

The SIS **shall** use no more than 63 consecutive APIDs for science, telemetry, and command packets.

3.1.4 Advance Notice of Change In Sun-Pointing Platform (SPP) Position

The spacecraft **shall** provide the SIS an advance notice, in the ancillary data packet, of a change in the SPP position.
The spacecraft **shall** send the notice at least 100 milliseconds prior to the initiation of the change. (TBR)

3.1.5 Spacecraft Telemetry Required for SIS Data Processing

Spacecraft telemetry required to analyze SIS data **shall** be provided to the SIS ground system whenever SIS data are available. The spacecraft data that are required to analyze the SIS data includes the ephemeris, spacecraft attitude, flags to indicate the occurrence of any East-West or North-South maneuver for the SPP, and the SPP pointing data (TBR).

3.1.6 SIS Sun-Pointing Data to Spacecraft

The SIS **shall** send SIS Sun-pointing data to the spacecraft in a CCSDS source packet per the Command and Data Handling section of the GIRD.

3.2 Power

3.2.1 Average Power

The SIS **shall** draw no more than 130 Watts (TBR) averaged over five (5) minutes (TBR).

3.2.2 Peak Power

The SIS total peak power input including heaters **shall** be no more than 135Watts (TBR) over 30 seconds (TBR).

3.2.3 Survival Power

When the instrument is OFF, the instrument survival heaters shall consume no more than 45W (TBR) averaged over every 72 (TBR) minute period.

3.3 Mechanical

The requirements in this section apply to the structural and mechanical components of the instrument flight units.

3.3.1 Mass Properties

The SIS, including all units, mounting hardware, thermal blankets and cabling between units, **shall** have mass less than 60 kilograms (kg) (TBR).

3.3.2 Volume

The SIS, including all units, mounts, thermal blankets and connectors for both stowed and operational configurations, **shall** have dimensions that do not exceed the limits listed in the Instrument Unit Envelopes table. The envelope for the sensor unit articulates with the Sun Pointing Platform (SPP). For the sensor unit, height is in the Y direction of the SPP Coordinate Frame (SCF) defined in the GIRD. Width is measured in the Z direction of the SCF, and depth is in the X direction of the SCF. For the electronic units, height is in the direction normal to the mechanical interface plane.

Instrument Unit Envelopes (TBR)

Unit	Height (cm)	Width (cm)	Depth (cm)
Sensor	48	31	86
Electronics one	10	30	30
Electronics two	10	30	30

3.3.3 Fields of View

The SIS instruments **shall** have the following unobstructed fields of view, free of glint from the spacecraft:

3.3.3.1 SIS Instruments View of the Sun

The SIS instruments **shall** have the following continual unobstructed Fields of View.

3.3.3.1.1 Solar X-Ray Imager View of Sun

The Solar X-Ray Imager **shall** have continual unobstructed 56.5 (TBR) arcmin full-width East-West view and 56.5 (TBR) full-width arcmin North-South view of the Sun, and centered at the Sun, during normal operational periods.

3.3.3.1.2 X-Ray Sensor View of Sun

The X-Ray Sensor **shall** have continual unobstructed 40 (TBR) arcmin full-width East-West view and 40 (TBR) full-width arcmin North-South view of the Sun, and centered at the Sun, during normal operational periods.

3.3.3.1.3 Extreme Ultraviolet Sensor View of the Sun

The Extreme Ultraviolet Sensor **shall** have continual unobstructed 40 (TBR) arcmin full-width East-West view and 40 (TBR) full-width arcmin North-South view of the Sun, and centered at the Sun, during normal operational periods.

3.3.3.2 SIS Instruments Off-Sun Field of View

The SIS instruments **shall** be the following unobstructed off-Sun Fields of View for calibration:

3.3.3.2.1 Solar X-Ray Imager Off-Sun Field of View

The Solar X-Ray Imager **shall** have an unobstructed 56.5 arcmin radius full circle field of view centered at least 90 arcmin from the center of the Sun to support off-Sun-pointing for calibration.

3.3.3.2.2 X-Ray Sensor Off-Sun Field of View

The X-Ray Sensor **shall** have an unobstructed 40 arcmin radius full circle field of view centered at least 15 degrees (TBR) from the center of the Sun to support off-Sun-pointing for calibration.

3.3.3.2.3 Extreme Ultraviolet Sensor Off-Sun Field of View

The Extreme Ultraviolet sensor **shall** have an unobstructed 40 arcmin radius full circle field of view centered at least 15 degrees (TBR) from the center of the Sun to support off-Sun-pointing for calibration.

3.3.4 Sun Pointing Platform (SPP)

The spacecraft **shall** provide a Sun-Pointing Platform (SPP) for mounting the SIS on the spacecraft.

3.3.4.1 Sun Pointing Platform (SPP) Slew

The spacecraft design **shall** allow for the slewing of the SPP in each of N-S and E-W directions from the Sun center with a 1.5 degree amplitude, to support SXI flat-field measurements. Slewing in the North-South direction will not be required during the 45 days centered on one of the solstices.
The spacecraft **shall** initiate, upon command, a sequence of five 3-degree slews about the N-S (E-W) axis followed by five 3-degree slews about the E-W (N-S) axis, with both slews centered on the Sun.

The slew sequence transverses between +1.5 degrees and -1.5 degrees in each of the N-S and E-W axes five times at a constant rate, returning to Sun center after the completion of the sequence.
The nominal slew rate **shall** be at least 0.1 degree per second.
The variation in the slew rate **shall** be limited to +/-20% of the nominal slew rate.

3.3.4.2 Spacecraft Off-Sun-Pointing of Sun Pointing Platform (SSP)

The spacecraft **shall** have the capability of pointing the SPP a minimum of 10 degrees (TBR) for off-sun calibration of the SIS instruments.

3.3.4.3 Sun-Pointing Platform (SPP) Pointing Control

The spacecraft **shall** provide N-S maneuver of the SPP in increments of no greater than is 15 arcsec.

3.3.5 SIS Mounting Panel

The SIS Mounting Panel **shall** be provided by the SIS contractor as the "instrument side" of the SIS/spacecraft interface.
The XRS, EUVS and SXI **shall** be mounted and co-aligned on the SIS mounting panel.

3.3.6 Thermal Interface

3.3.6.1 Conduction

The SIS Mounting panel / SPP interface **shall** be thermally isolated with mounting hardware/materials provided by the Spacecraft contractor. The spacecraft mechanical attachment shall have the following temperature range: -20 °C to 50 °C (TBR) and as cold as -90C at the end of eclipse. Wire bundles leading away from the SIS mounting panel shall be subjected to this temperature range.

3.3.6.2 Radiation Interface/Environment

The following table defines the thermal fluxes for four sides of the instrument:

	IR Energy		Solar Energy (Direct and Reflected)	
	Cold/Minimum watts/m^2	Hot/Maximum watts/m^2	Cold/Minimum watts/m^2	Hot/Maximum watts/m^2
Telescope facing the Solar Array ($+Y_{SIS}$)	60	70	10	15
Telescope facing Spacecraft ($-Y_{SIS}$)	40	200	10	100
Sun Side ($+X_{SIS}$)	0	60	1270	1440
Anti-sun Side ($-X_{SIS}$)	0	80	0	70

Notes:
For initial analysis and trade studies, the periphery of the instrument telescope facing between the two extremes (facing toward and facing away from the spacecraft) can be interpolated between the listed values.
The “solar” energy includes direct plus any solar energy reflected from the spacecraft. Solar flux

table inputs ignores eclipses. The "IR" energy is thermal energy radiated from spacecraft surfaces. Assume Earth "IR" is zero for non-cryogenic radiators .

3.3.6.3 Thermal Interface - Thruster Plume Heat Flux

The maximum plume heat flux onto any SIS surface **shall** not exceed 386 w/m^2 (TBR).

3.3.7 Cabling Between Units

The maximum length of the harness cables between units **shall** not exceed 1 meter.
Cables running to the sensor unit **shall** withstand its articulation for deployment and north-south solar tracking.

4 Constraints

In order to ensure proper instrument performance or to prevent possible instrument damage, the following Government-approved constraints are imposed by the instrument developer on spacecraft integration and test activities, including launch, activation and operations. No constraints have been identified at this time.

5 GIRD Deviations

This section identifies General Instrument Requirements Document (GIRD) requirements that the government has deviated from for this instrument. Where appropriate, corresponding GIRD paragraph titles and numbers are identified in parentheses.

5.1 Molecular Contamination

(3.5.2.2.2 Molecular Contamination GIRD834)
The spacecraft shall contribute no more than 9 $\mu g/cm^2$ nonvolatile residue to instrument thermal control surface apertures, and the instrument optical aperture over the life of the spacecraft.

5.2 SpaceWire Data Rate

(3.2.5.5 SpaceWire Data Rate GIRD441)
Data transferred over the SpaceWire data bus shall be clocked at 12.5 MHz. (TBR)

6 Acronyms and Abbreviations

APID	Application Process Identifiers
C&DH	Command and Data Handling
CCSDS	Consultative Commitee for Space Data Systems
CCN	Contract Change Notice
cucm	Cubic Centimeters
dB	deci-Bell(s)
EUVS	Extreme Ultraviolet Sensor
GIRD	General Interface Requirements Document
GOES	Geostationary Operational Environmental Satellite
GSFC	Goddard Space Flight Center
Hz	Hertz
ICD	Interface Control Document

IDD	Instrument Description Documents
INR	Image Navigation and Registration
kg	kilogram(s)
m	meter(s)
m-g	milli-g's (Earth's gravitational acceleration)
MHz	Megahertz
N	Newtons (unit of force)
NASA	National Aeronautics and Space Administration
PORD	Performance and Operations Requirements Document
sec	second(s)
SIS	Solar Imaging Suite
SPP	Sun-pointing Platform
TBD	To Be Determined
TBR	To Be Reviewed
TBS	To Be Specified
µg	microgram
UIID	Unique Instrument Interface Document
W	Watts
XRS	X-Ray Sensor