High Energy Spectroscopic Imager (HESSI)
Spacecraft to Spectrometer
Interface Control Document (ICD)

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Document Revision Record

Rev.	Date	Description of Change	Approved By
A	1998-May-18	Preliminary Draft	-
B	1998-Sep-18	Incorporate SA Revisions	-
C	1998-Oct-7	Update bus-side temperatures, add I&T requirements on bus	-
D	1998-Oct-15	Minor clarifications from Spectrum Astro	DC, PH, JJ, JP
E	1998-Dec-21	Change Spectrometer heater to instrument heater service and change non-op limit. (Section 3.2.1)	
F	1999-Mar-5	Update ICD Drawing	
G	1999-Mar-12	• Update Drawing • Change Thermal interface • Add thermostat characteristics • Replace harness drawing (HSI_SYS_005) reference to harness specification reference (HSI_SYS_022)	

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1. Introduction

This document shall describe the interface between the HESSI spacecraft bus and the instrument Spectrometer (AKA Cryostat).

1.1. *Spectrometer Description.*

The Spectrometer consists of a Cryostat that houses the nine Germanium detectors that provide primary science data. These detectors are actively cooled to LN2 temperatures by the helium based Stirling cycle cryocooler. This cooler is electrically driven by the Cooler Power Controller (CPC), which in turn is controlled by the IDPU. The Spectrometer also includes the Shutter mechanism to attenuate photon rates, the Charge Sensitive Amplifiers (CSA), and the High Voltage Filters, all mounted outside the Cryostat.

1.2. *Document Conventions*

In this document, TBD (To Be Determined) means that no data currently exists. A value followed by TBR (To Be Resolved) means that this value is preliminary. In either case, the value is typically followed by UCB (University of California at Berkeley) and / or SA (Spectrum Astro) indicating who is responsible for providing the data, and a unique reference number.

1.3. *Applicable Documents*

The following documents include drawings and HESSI Project policies, and are part of the Interface Requirements. In the event of a conflict between this ICD and the following documents, this ICD takes precedence. All ICD documents and drawings can be found on the Berkeley HESSI FTP site:

ftp://apollo.ssl.berkeley.edu/pub/hessi/released/icd

Pre-released versions of these documents may be found at:

ftp://apollo.ssl.berkeley.edu/pub/hessi/icd

1. HESSI Spacecraft to Spectrometer ICD Drawing, File HSI_SYS_014F
2. HESSI Spacecraft to IDPU-ICD, File HSI_SYS_001G
3. HESSI IDPU Block Diagram, File HSI_IDPU_001D
4. HESSI Instrument Harness Specification, File HSI_SYS_022G
5. HESSI Instruments Power Spreadsheet, File HSI_SYS_006H
6. HESSI Instruments Mass Spreadsheet, File HSI_SYS_010E
7. Spectrum Astro HESSI Product Assurance Plan, Rev-, December 17 1997, Document number 1110-EP-Q09920, File epq09929, HSI_PA_002A.

2. Mechanical Interface

2.1. *Interface Drawing*

The mechanical configuration of the Spectrometer is shown in the Spectrometer ICD Drawing (reference 1).

2.2. *Mass Properties*

Reference (6) shows the instrument mass properties, including current best estimate and maximum (with margin).

2.3. *Field of View and Alignment.*

The nine detectors must be aligned to be within 1mm of concentric to the field of view of each of the nine grid pairs on the imager. This alignment is achieved when installing the Spectrometer on the spacecraft by shimming at the imager interface points.

An "all sky" field of view is also desired for the detectors. This means that reasonable effort should be made to minimize the amount of metal on this region. This center of this field of view is defined by an XY plane through the middle of the detectors, at spacecraft station Z=+7.32 inches. The field of view then extends radially outward 15° above and below this plane, starting at the spacecraft Z axis.

2.4. *Mechanisms*

2.4.1. Cryocooler.

The Cryocooler contains a free piston, linear motion, Helium gas compressor that is powered by the CPC and is actively controlled by the IDPU. The cryocooler contains a counterbalance mass that is also controlled by the IDPU. The residual operating forces will not exceed (TBR-UCB-102) newtons driven at 59 Hz.

2.4.2. Hi-Z Shutters

The Spectrometer includes two Hi-Z shutters. They are used to reduce the science data rate by blocking out low energy radiation during periods of high flux. The shutters are mounted on the top of the Spectrometer, with a center of mass at spacecraft station Z=11.3 inches, and near 0 in X and Y. The moving mass is 300g Current Best Estimate (CBE) for the thick attenuator and 230g CBE for the thin attenuator. The thick attenuator is caged in the OUT position at launch, and activation of the shutter causes a motion of 60mm in the –Y direction In about 0.5 seconds. The thin shutter is caged in the IN position at launch, and activation causes a motion of 60mm in the +Y direction. The shutters are controlled to move in and out by the IDPU.

2.4.3. Cryostat Vacuum Valve

The cryostat includes a one shot vacuum valve to vent the cryostat to space after launch. This valve will be opened no sooner than several days after launch (nominally much later), and is controlled by the IDPU. A SMA device opens the valve.

2.4.4. Liquid Nitrogen Service

The cryostat includes an open liquid nitrogen cooling loop that is used for ground testing of the detectors. Nitrogen will provided by a remote GSE supply dewar that is piped to the LN2 port shown on the Cryostat Interface Drawing. The LN2 port must be accessible when the Cryostat is installed in the spacecraft bus. This system will be open and empty of LN2 at Launch and on orbit.

3. Thermal Interface

3.1. *Thermal Design*

The thermal design shall address radiative and conductive heat transfer between the Cryostat, spacecraft, and space. The design shall meet the thermal constraints listed in section 3.3. Thermal dissipation shall be primarily radiative, via the large bottom radiator surface. The Cryostat is conductively coupled to the spacecraft by aluminum mounting flanges as shown in the Cryostat ICD drawing. Thermal properties of the exposed surfaces of the Cryostat (both MLI and radiator surfaces) are also shown in the Cryostat ICD Drawing (Reference 1).

3.1.1. Thermal Design Responsibilities

The Spectrometer thermal design is the responsibility of UCB. The design of the Spectrometer shall allow for conduction between the Spectrometer and the spacecraft bus. UCB shall provide sufficient information to Spectrum Astro to allow Spectrum Astro to accurately model the Spectrometer thermal properties as input to the spacecraft bus thermal model. Spectrum Astro shall verify that the spacecraft bus meets its thermal control system requirements using this information. Spectrum Astro shall deliver the spacecraft bus thermal model to UCB as input to the spacecraft thermal model which is integrated and verified by UCB.

3.1.2. Spectrometer Thermal Conduction to Spacecraft

The contact resistance at the Spectrometer to Spacecraft interface shall not exceed 0.2°C/W

3.2. *Spectrometer Power Dissipation*

The cooler provides up to 4 thermal watts of cooling using up to 100 watts of input electrical power. All of this power is ultimately radiated from the large bottom surface of the Cryostat. Cooler operation is controlled by the IDPU with feedback from temperature sensors in the Cryostat. Nominal and Maximum power dissipation in the Spectrometer is shown in Reference 5.

3.2.1. Spectrometer Heaters

The Spectrometer includes two heater circuits. The radiator heater (aka Spectrometer heater or Cryocooler heater) is used to avoid going below the Cryocooler non-op limit prior to powering on the cryocooler. The spectrometer heater is run off the Instrument heater bus (via the IDPU) and is thermostatically controlled, as described in reference 2 and Table 3.2.1-1.

Table 3.2.1-1 Spectrometer Thermostat Characteristics

Characteristic	Setting
Power	30W (TBR-UCB-110)
Turn-on Temperature	-30C
Turn-off Temperature	-20C

A Coldplate heater is also provided to control the cool-down and warm-up temperature distribution within the cryostat, and to allow on orbit annealing of the detectors. This heater is controlled by the IDPU off the Switched loads power bus. Power levels are programmable, up to 15W maximum.

3.3. *Spectrometer Temperature Requirements*

The Non-Op temperature limits apply when the instrument power is off. The Spectrometer should not be turned on unless it is in the Start-up temperature limits.

Table 3.3-1 Thermal Limits

Range	Bus Side Interface Temperature, °C	Spectrometer Temperature, °C
Non-Op Limits	-60 – +61	-30 - +70
Start-up Limits	-60 – +61	-30 - +40
Operational Limits	-60 – +61	-30 - +50

4. Electrical Interface

The IDPU will be the single-point electrical interface between the spacecraft and the instruments. Details of the operation, power consumption, harnessing are all contained in the IDPU ICD, reference 2.

5. Spectrometer Integration and Test Requirements on Bus

The Spectrometer is installed into the bus from the -Z direction. The aft antennas will be in the way for this operation, and need to be temporarily moved out of the way.