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Herschel-SPIRE
Interface Control Document

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1.0	**TBD**	**M. Herman**	**Initial Release**

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1 Scope

The purpose of this document is to provide information about SPIRE instrument interfaces not included in the Interface Control Drawings listed as Applicable ICDs (Section 3). These Interface Control Drawings shall take precedence if they conflict with this document. All interface information is transferred under ITAR agreement between JPL and PPARC and between ESA and NASA according to the following restrictions:

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2 Applicable Documents

Item	Doc. Number	Document Name
AD1	SPIRE-RAL-PRJ-000608	Harness Definition Document
AD2	SPIRE-RAL-DWG-000646	SPIRE Instrument Block Diagram
AD3	SPIRE-JPL-PRJ-000456	Detector Subsystem Specification Document
AD4	SPIRE-UCF-PRJ-000822	Herschel-SPIRE Business Agreement
AD5	SPIRE-RAL-DOC-001369	JFET to BDA Wiring Harness
AD6	TBD[1]	Installation Procedure for BDAs
AD7	TBD[1]	Installation Procedure for JFET Modules
AD8	TBD[1]	Installation Procedure for RF Filters
AD9	D-25725 (JPL)	Material Utilization ID List

[1] Documents are in the process of being written by U.K. personnel with JPL input and reviewed by JPL prior to signoff.

3 Applicable ICDs

Item	Doc. Number	Document Name
ICD1	10209721	BDA, Interface Control Drawing
ICD2	10209722	JFET Module, Interface Control Drawing
ICD3	10209723	FPU RF Filter, Interface Control Drawing
ICD4	10209725	Wiring Diagram, Interface Control Drawing
ICD5	10209787	Wiring Harness, Bolometer Detector Array to JFET, SPIRE
ICD6	10209784	Harness, Spectrometer JFETs, SPIRE
ICD7	1029785	Harness, Photometer Short Wave JFET, SPIRE
ICD8	1029786	Harness, Photometer Long & Medium Wave JFETS, SPIRE
ICD9	0-KE-0104-350	6 JFET Rack Interface Drawing
ICD10	0-KE-0104-360	2 JFET Rack Interface Drawing

4 Reference Document

Item	Doc. Number	Document Name
REF1	Proc. ESA SP-460, p. 37	The SPIRE Instrument for Herschel

5 List of Acronyms

Acronym	Definition
AD	Applicable Document
BDA	Bolometer Detector Assembly
Co-I	Co-Investigator
CQM	Cryogenic Qualification Model
ESA	European Space Agency
FEA	Finite Element Analysis
Herschel	Name for Far Infrared and Submillimeter Telescope
HSJFP	Herschel SPIRE J-FET Unit (Photometer)
HSJFS	Herschel SPIRE J-FET Unit (Spectrometer)
HSDCU	Herschel SPIRE Detector Control Unit
HSFCU	Herschel SPIRE FPU Control Unit
FPU	Focal Plane Unit
FS	Flight Spare
FTS	Fourier Transform Spectrometer
GSE	Ground Support Equipment
ICD	Interface Control Document
IID-A	Instrument Interface Document (Part A)
IID-B	Instrument Interface Document (Part B)
JFET	Junction Field Effect Transistor
JPL	JET Propulsion Laboratory
MOU	Memorandum of Understanding
MUIL	Material Utilization ID List
NASA	National Aeronautics and Space Agency
PA	Product Assurance
PCB	Printed Circuit Board
PDR	Preliminary Design Review
PFM	Proto-Flight Model
PI	Principal Investigator
PPARC	Particle Physics and Astronomy Research Council
QMW	Queen Mary and Westfield College
RAL	Rutherford Appleton Laboratory
RD	Reference Document
SPIRE	Spectral and Photometric Imaging Receiver
SVM	Service Module
TBC	To Be Confirmed
TBD	To Be Decided

6 Functional Interface

6.1 Functional Description

SPIRE, the Spectral and Photometric Imaging Receiver, is a bolometer camera and spectrometer for ESA's Herschel satellite. Herschel will give the scientific community access to a large space-borne far-infrared and submillimeter telescope equipped with a suite of instruments for imaging photometry and spectroscopy. As Herschel is an observatory mission, the design and scientific performance of its payload is a matter for oversight by ESA on behalf of the scientific community. ESA has established the Herschel Science Team to oversee and monitor the development and scientific optimisation of Herschel. Matters affecting significantly the scientific performance of SPIRE must be referred to the Herschel Science Team.

The Detector Subsystem Specification Document [AD3] details the specifications for the JPL supplied equipment described herein. For more detailed information regarding the functional design, see the Herschel-SPIRE Business Agreement [AD4].

The design and scientific capabilities of SPIRE are described in more detail in *The SPIRE Instrument for Herschel* [REF1]. The main elements of the SPIRE instrument are shown schematically in Figure 1.

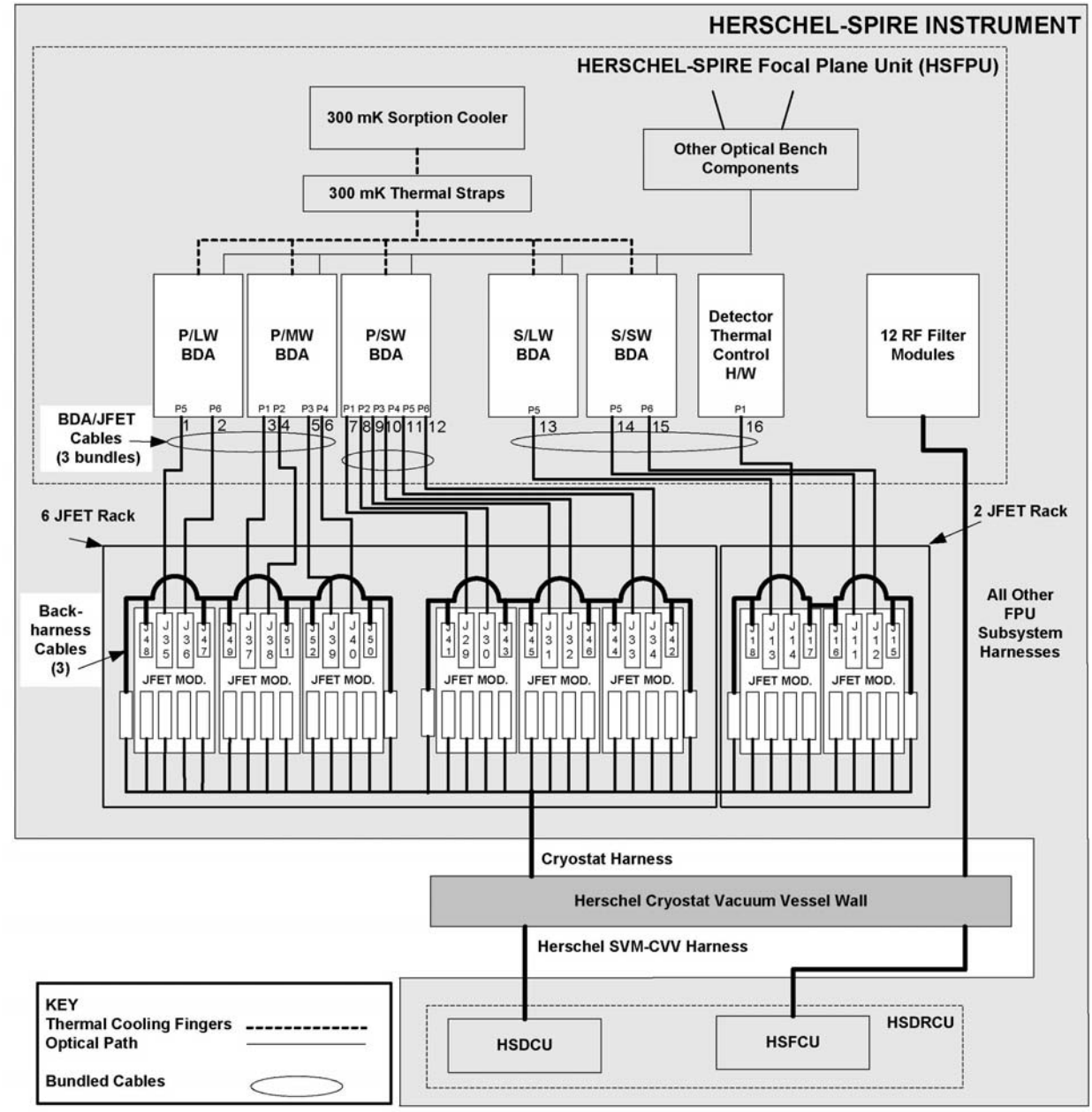

Figure 1: Functional block diagram of SPIRE

For a more detailed block diagram please see [AD2].

6.2 Mechanical Interfaces

The mechanical mounting and interface features for each assembly are shown in their individual Interface Drawings, [ICD1-3].

6.3 Fastener Data

The fasteners and washers required for installation of the JFET Modules are called out in [ICD9] and [ICD10]. Table 1 summarizes the fasteners used in mounting the hardware.

Table 1. Fastener Data

Item	Provided by	Type	Qty (Total)	Length	Matl.	Lube	Locking Feature	Instal. Torque	Docs.	Need Date
BDA Flange	JPL	6-32 UNC	20	TBD	TBD (A286?)	TBD	TBD	TBD	TBD[1] AD6[2]	TBD
BDA Cold Finger	JPL	M2x0.4	10	10 mm (TBC)	A286	TBD	TBD	250 N-mm (TBC)	TBD[1] AD6[2]	TBD
JFET Module	RAL	M2-5 Washer	30	N/A	304S	TBD	N/A	N/A	ICD9[1], ICD10, AD7[2]	N/A for JPL
	RAL	M2-5_X_8LG-CPHD_SKT_SS	80	8 mm	A2	TBD	TBD	TBD		N/A for JPL
RF Filter Modules	RAL	Filters mounted via a clamp and the Micro-D connector hardware as specified and supplied by RAL.								

6.3.1 BDA

Each Bolometer Detector Array (BDA) is secured in place using 4 No. 6-32 UNC screws, 4 specially machined washers provided by MSSL, and torqued as specified in [AD8]. Note that torques depend on design of MSSL side of interface. Each 300 mK thermal strap is secured to its respective BDA with 2 M2x0.4 screws, a Belleville spring stack, and is torqued to 250 N-mm (TBC). The installation procedure [AD8] must call out special inspection steps to insure that the connector integrity is maintained since no connector savers can be used at this interface.

6.3.2 JFET Module Assembly

Each JFET Module Assembly is secured in place to the appropriate rack using fasteners and washers as specified in [ICD9] and [ICD10]. Installation torques are as specified in [AD7].

6.3.3 RF Filter Assembly

The RF Filter Module Assembly is secured in place with hardware supplied by RAL and torqued as specified in [AD8]. (Gaskets and studlocks and any clamps will be supplied by RAL.)

[1] Type and quantity call-outs.
[2] Installation torque and locking procedures.

6.4 Electrical Connector Mechanical Identification

6.4.1 BDAs

Each BDA has six possible connector positions J1-J6 as shown in [ICD1]. Not all the positions are used on every BDA, and the unused ones shall either be RF tight blanked or not machined through in the first place.

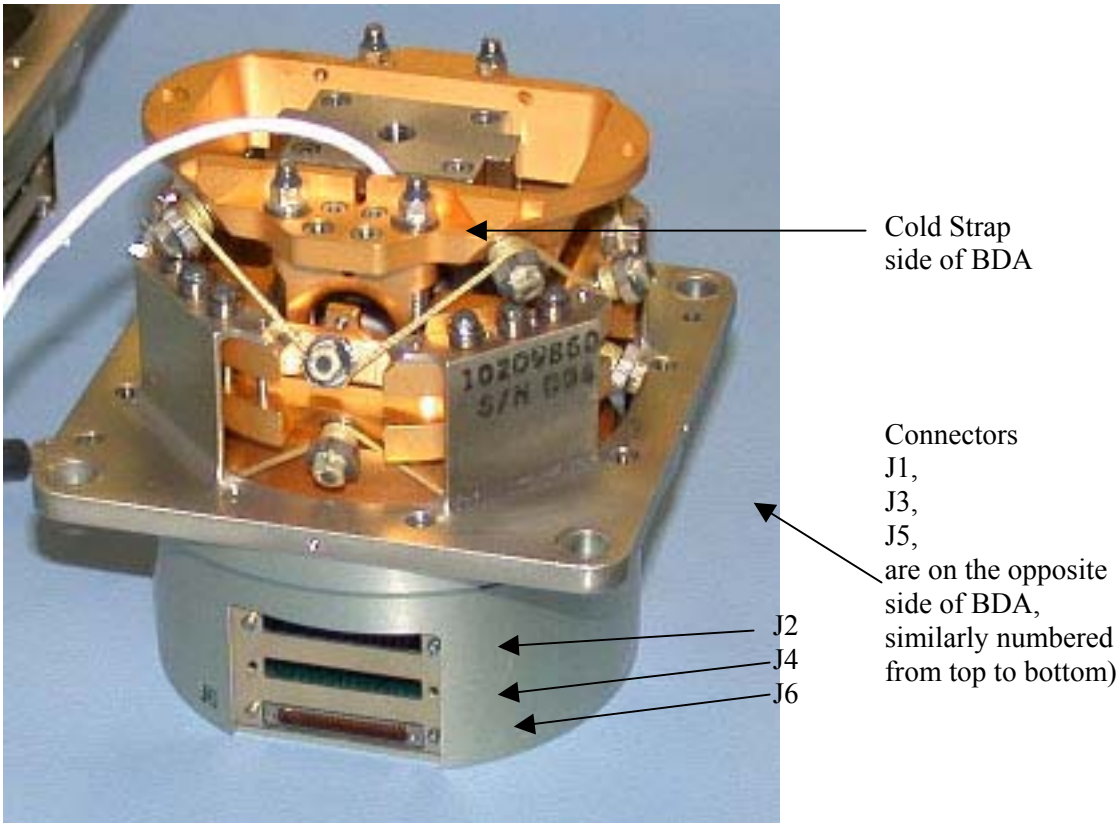

Figure 2: Typical BDA connector locations (see [ICD1] for complete detail).

For each of the 5 BDA types, sheets 5-7 of [ICD1] contains a data table identifying the BDA type number for each wavelength and photometer/spectrometer, and defines which out of J1 to J6 are used. Locations J1-J6 are labelled with epoxy ink [AD9]. Pin one locations will be noted on the ICD drawing.

All BDA connectors are Nanonics type STM 051 M6SN.

6.4.2 JFET Module Assembly

JFET modules are assembled into two RAL provided racks, two modules making the HSJFS for the spectrometer and six making the HSJFP for the photometer. Electrically all JFET Modules are nominally identical, each containing two JFET membrane PCBs. Not all the JFETs on every membrane are used. The best devices are selected during the assembly and testing of the units at JPL. Connector reference designators will be enumerated on the rack by RAL. Serial numbers for the JFETs will be labelled with epoxy ink, see [AD9].

6.4.3 RF Filter Assembly

JPL's RF Filter Modules are assembled into one RAL provided rack. This rack will hold all 12 modules. Electrically all RF modules are nominally identical servicing a single 37 way MDM connector pair. Connectors will be shown on the assembled rack. RAL will provide for the labelling of the modules in the housing. JPL will mark the modules with serial numbers using epoxy ink [AD9]. Wiring within the RF Filter is one-to-one, pin-to-pin.

7 Electrical Interface

This information is in addition to that given in JPL's [ICD3] and [ICD4].

The overall configuration of BDAs, JFETs and harnesses is given in [AD1].

7.1 BDA

Each BDA electrical bolometer signal is a differential signal taken directly from the ends of the bolometer element. A quiet symmetric AC voltage bias, accurately symmetrical about ground, is supplied to each detector array. The bolometer elements are each current biased from this AC bias by two 300mK 10MΩ resistors from a resistor array integral within the BDA. The A-side of each signal is connected to the positive AC bias polarity, and the B-side is connected to the negative polarity.

7.2 BDA to JFET Module Cables

Fifteen cables carry bolometer signals, detector bias and ground between the BDAs and the JFET modules as defined in [AD5] and [ICD5]. The sixteenth cable defined in this ICD provides signals for the thermal control hardware. Each of the fifteen cables connects the JFET module to the BDA as shown in Figure 1. The cables are RF shielded from the JFET module to the BDA to maintain the electrical continuity of the Faraday cage.

7.3 JFET Modules

The JFET module provides differential power amplification at a little less than unity voltage gain for the bolometer signals. The electrical interface consists of input signals from the bolometers, and output signals to the ESA-supplied cryoharness. The JFET modules require power (V_{dd}, V_{ss}) and heater supply for operation. The module also passes detector bias and ground along to the bolometers. The JFET module is electrically integral to the cryogenic Faraday cage, and thus provides RF filtering of all electrical connection passing through the Faraday cage.

7.4 RF Filters

JPL is providing RF filter modules for filtering cables at the cryogenic Faraday cage required by other subsystems. The electrical interface for the RF filter modules is shown in drawing [ICD3].

7.5 Backharnesses

JPL is also providing cables connecting the 15-way MDM inputs from the JFET modules to the ESA cryoharness. The wiring of these cables is defined in [ICD6-8].

The electrical interface shown in drawing [ICD4] describes the wiring of detector channels through the BDA nano connector interface, BDA-to-JFET cables, through JFET amplifiers, out to the 25-way MDM

output connectors on the JFET module. All shielding and ground connections are specified in this drawing

The JFET 15way filtered connectors HSJFP 41-46, HSJFP 47-52, HSJFS 15-18 couple to HSJFP 25&26, HSJFP 27&28 and HSJFS 9&10 respectively using three JPL supplied back harnesses [ICD6-8] that may be left connected to the racks. These route the JFET power, bias and heater wiring.