SPIRE

SUBJECT: **INTERNAL INTERFACE CONTROL SYSTEM**

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DOCUMENT No: **SPIRE/IICS**

ISSUE: **Draft** **Date: July 6, 1999**

CHECKED BY: ……. **Date:** …….

APPROVED BY: ……. **Date:** …….

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1. Introduction

This document describes the SPIRE internal interface control system, including the interface matrix and internal interface control documents. The purpose of the system is to ensure that when the instrument subsystems are brought together from the 17 organisations responsible for them, they can be integrated with a minimum of interface incompatibilities. Even more importantly, it will enable us to ensure that the instrument complies with the ESA IID (Instrument Interface Documents), and the instrument interface to the telescope is as expected by ESA.

1.1 Applicable Documentation

FIRST Instrument Interface Document part B	PT-SPIRE-02124, 0-1CRC2
SPIRE Steering Mirror Scientific Requirements	TBD
SPIRE Scientific Requirements	TBD
SPIRE Instrument Requirements Document	SPIRE/RAL/N/0034
SPIRE Interface Documents	

2. Description of Interface System

The SPIRE instrument consists of two main modules (the Focal Plane Units and the Warm Electronics) together with three supporting modules (Simulators, Test Facilities and Ground Segment Equipment). Each module is divided into a number of sub-systems. These are shown in the table below. For each sub-system, a member institution of the SPIRE consortium is designated as having overall responsibility for the design and construction of that sub-system.

Module	Sub-system	Number	Institution
Focal Plane Unit	Structure	1.1	MSSL
	Thermometry	1.1.1	MSSL
	Optics	1.2	LAS
	Filters	1.2.1	QMW
	Baffles	1.2.2	???
	Cooler	1.3	CEA-Grenoble
	Photometer Arrays	1.4.1	???
	Spectrometer Arrays	1.4.2	???
	Beam Steering Mechanism	1.5.1	ATC
	FTS Mechanism	1.5.2	LAS
	Shutter Mechanism	1.5.3	UoS
	Photometer Calibration Source	1.6.1	GSFC
	Spectrometer Calibration Source	1.6.2	GSFC
	JFET Module	1.7	Caltech/JPL
Warm Electronics	Buffer Amplifier Unit	2.1	CEA
	Detector Readout & Control	2.2	CEA
	Signal Processing Unit	2.3	IAC
	Digital Processing Unit	2.4	IFSI
	Warm Interconnect Harness	2.5	CEA
	On-board Software	2.6	CEA/IFSI
Simulators	Analogue Instrument Simulator	3.1	Stockholm
	Digital Instrument Simulator	3.2	IFSI
	Instrument Simulator	3.3	Stockholm
Test Facilities	EMC Test Facility	4.1	CEA
	AIV Test Facility	4.2	RAL
	Calibration Facility	4.3	RAL
	Thermal Vacuum Facility	4.4	RAL
	Cold Vibration Facility	4.5	???
	Warm Vibration Facility	4.6	RAL
	Quick Look Facility	4.7	RAL
Ground Segment Equipment	Electrical GSE	5.1	UoS
	Optical GSE	5.2	LAS
	Mechanical GSE	5.3	MSSL

Table 1 - SPIRE Sub-systems

The requirements for each sub-system are defined in a Sub-system Requirements Document. This describes the detailed requirements for that sub-system. These are derived from the top level instrument and science requirements, as shown in the document hierarchy diagram below.

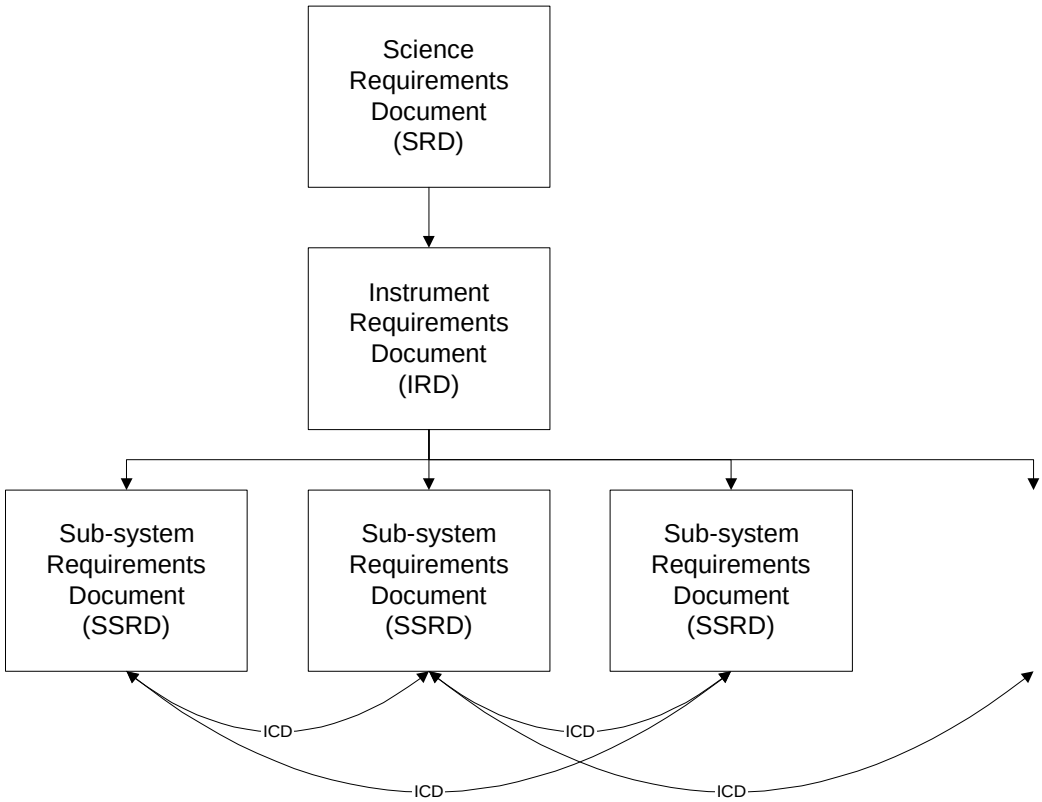

Figure 1 - SPIRE Document Hierarchy

3. Control of Interfaces

3.1 The Interface Matrix

The interfaces between the various sub-systems are controlled by means of the Interface Matrix. (ref _____).The full version of the matrix is available at _____. A section of the Interface Matrix is shown below, together with the key to the matrix.

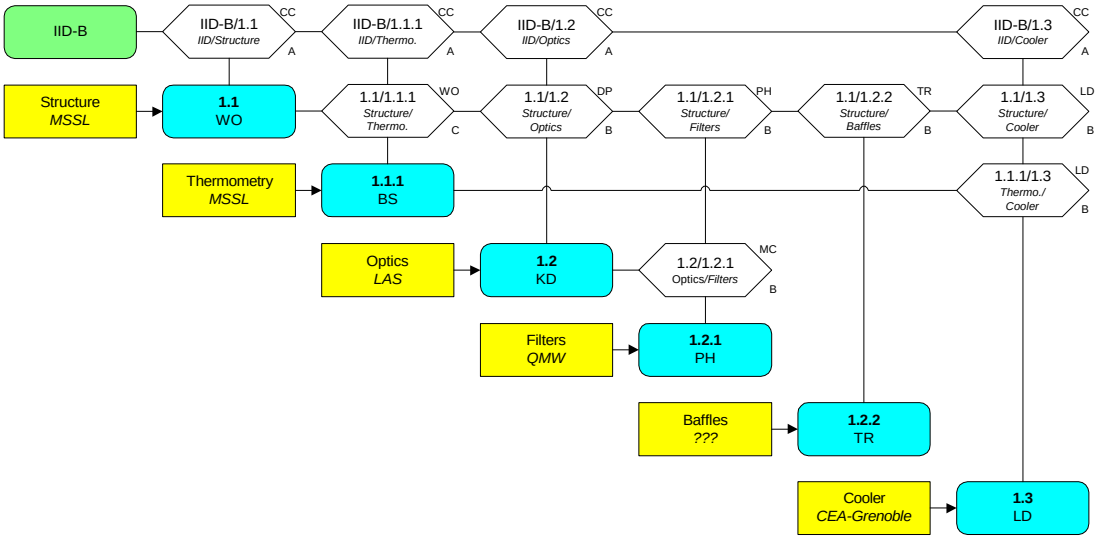

Figure 2- Section of Interface Matrix

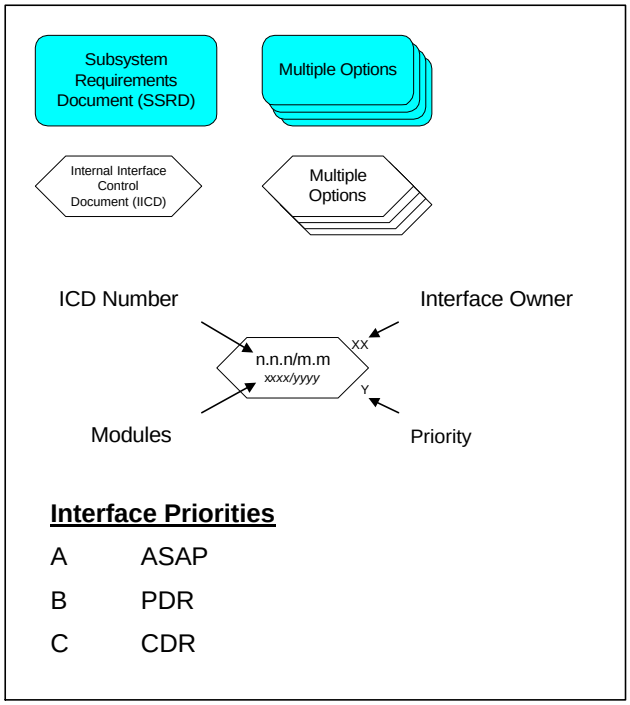

Figure 3 - Interface Matrix Key

The matrix shows each sub-system of the instrument. Each Sub-system is connected to the other sub-systems by a grid. Where there is an interface between two sub-systems, this is indicated by an entry into the matrix at the grid intersection between those two sub-systems.

Each entry on the Interface matrix has a corresponding Interface Control Documents (ICD's). These are uniquely designated according to the Sub-System numbers. For instance, in the diagram above, the ICD for the interface between the **structure (sub-system 1.1)** and the **filters (sub-system 1.2.1)** is designated as **ICD 1.1/1.2.1**.

Appendix A contains an example of an ICD.

3.2 Interface Approval

The procedure for production and approval of an ICD is as follows.

- One person is nominated as the editor for each ICD. This will normally be someone from one of the member institutions responsible for one or other of the subsystems. He or she is responsible for
  a) collecting all the relevant information regarding the interface, and
  b) preparing the ICD. All ICD's are to be prepared in electronic format (PDF?)
- The ICD is then submitted to the institution responsible for the second sub-system for approval.
- The ICD is then submitted for formal approval to the ICD approval board. This consists of the following people:

  Colin Cunningham

  Louis Rodriguez

  Bruce Swinyard

  Ken King

  The approval board takes advice as necessary from the relevant technical experts in approving a particular ICD. The approval board also seek approval from ESA for the interfaces which directly affect the interface between the SPIRE instrument and the FIRST satellite.
- Once approved by the board, ICD's are submitted to Judy Long, who issues the ICD via the DMS database.

3.3 Interface Change Control

A similar procedure is used for requests for changes to an ICD, as follows.

- The updated ICD is prepared by the editor.
- This is then submitted for approval by the institutes responsible for the sub-systems on either side of the interface.
- The editor then submits the change request to the ICD to the ICD approval board.
- Once approved by the board, the updated ICD's are submitted to Judy Long, who issues the ICD via the DMS database.

Appendix A
Example of Interface Control Document

SPIRE

SUBJECT:	**SUBSYSTEM INTERFACE CONTROL DOCUMENT** **Interface between *Subsystem aaa and Subsystem bbb***		
PREPARED BY:	**David Henry**		
DOCUMENT No:	**SPIRE/ICD/n.n.n/m.m.m**		
ISSUE:	**Draft**	**Date:**	**July 6, 1999**
CHECKED BY:	**…….**	**Date:**	**…….**
AGREED BY:	**…….**	**Date:**	**…….**
APPROVED BY:	**…….**	**Date:**	**…….**
APPROVED BY:	**…….**	**Date:**	**…….**
APPROVED BY:	**…….**	**Date:**	**…….**
APPROVED BY:	**…….**	**Date:**	**…….**

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1. Scope

This document defines the mechanical, thermal, optical, electrical and data flow interfaces between *subsystem aaa* and *subsystem bbb* of the SPIRE instrument.

1.1 Abbreviations

The following are abbreviations used within this specification.

1.2 Applicable Documents and Drawings

The following documents and drawings form part of this document to the extent specified herein.

Document	Reference:

2. Functional Interface

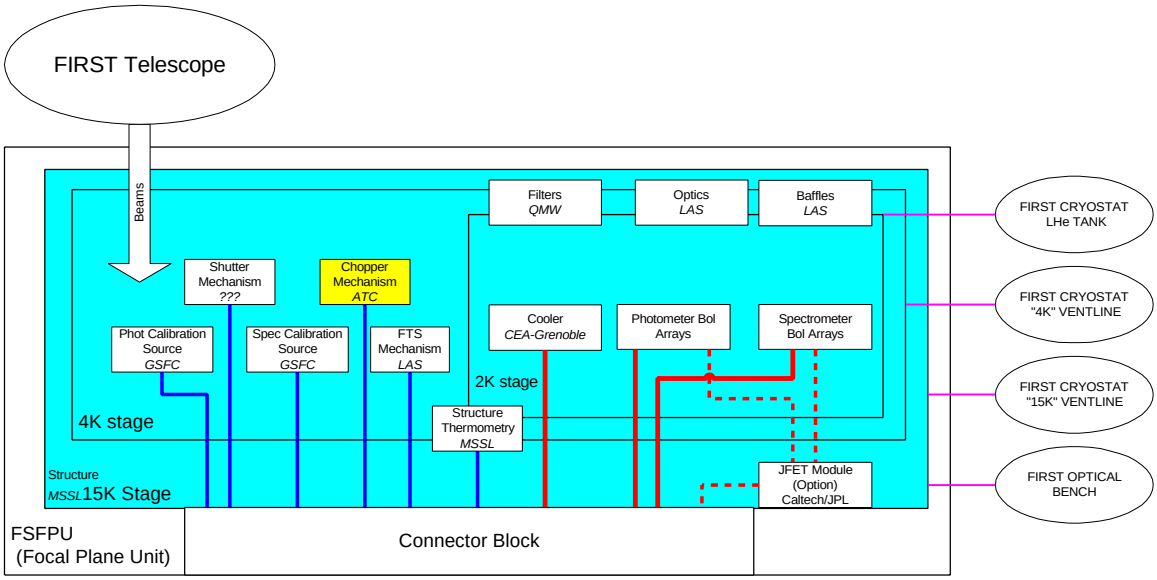
2.1 Functional Description of Interface

The interface between the steering mirror and the structure consists of the following distinct parts:

- **Mechanical Interface -** The mechanical interface consists of the datum alignment features and the fixings.
- **Thermal Interface -** The thermal interface consists of the conductive heat path through the mechanical interface, *and the thermal radiation flowing to and from the structure and the chopper.*
- **Electrical Interface** - *Are there any electrical interfaces? Does the structure contain any wiring?*
- **Optical Interface** - *??? There is no optical interface between the steering mirror and the structure. ???*

  (there is an optical interface between the chopper and the optics. Is the chopper mirror part of the chopper or part of the optics?).
- **Data Flow Interface** - *Are there any data flow interfaces? Does the structure contain any data processing?*

2.2 System Block Diagram



3. Mechanical Interface

3.1 Mechanical Interface Control Drawing

The mechanical interface between *subsystem aaa* and *subsystem bbb* is described in drawing number ROE/nnn.mmm.

3.2 Summary of Mechanical Interface Characteristics

The table below shows a summary of the relevant mechanical characteristics of the subsystems.

	Subsystem aaa	***Subsystem bbb***
Mass		
Centre of gravity		
X		
Y		
Z		
Moment of Inertia		
I_{xx}		
I_{yy}		
I_{zz}		
1^{st} Eigen frequency		

NB. All dimensional locations are specified with reference to the coordinate system as defined in TBD.

3.3 Special Mechanical Characteristics

(eg. Required electrical resistance of mounting, vibration limit etc.)

4. Thermal interface

4.1 Conductive Properties

e.g. thermal resistance, etc…

4.1.1 Heat Flow

The heat flow across the interface is as shown in the table below.

Mode	Average	Minimum	Maximum
OFF STAND-BY OPERATING			

NB. Heat flow **from** subsystem aaa **to** subsystem bbb has a **positive** value, and vice versa.

4.2 Radiative Properties

Eg. Emissivity, thermal insulation, etc.

(How do we isolate thermal radiation between two distinct subsystems? How do you differentiate between radiation from the chopper which goes to the structure, and which goes to the optics?)

Would radiative properties be better described in the subsystem requirements (eg. Subsystem aa shall have an effective emissivity of less than TBD%, and shall radiate less than TBD W.)

4.3 Special Thermal Characteristics

5. Electrical Interface

5.1 Electrical Connectors

The table below describes the electrical connectors between *subsystem aaa* and *subsystem bbb*. Matching connectors are shown on the same row.

	Subsystem aaa		***Subsystem bbb***	
Description	**ID**	**Type**	**ID**	**Type**
	JE 08	37 P	JD01	37 S
	JE 09	15 P	JD02	15 S

5.2 Connector Details

The details of each connector pair listed in the table above are described in separate tables on the following pages.

5.2.1 Connector JE 08 to Connector JD 01

JE 08	
Pin No.	**Assignment**
1	
2	
3	
4	

JD 01	
Pin No.	**Assignment**
27	
26	
25	

Description	Max/Min Voltage	Max bandwidth	Max Current

5.2.2 Connector JE 09 to Connector JD 02

JE 09	
Pin No.	**Assignment**
1	
2	
3	
4	

JD 02	
Pin No.	**Assignment**
27	
26	
25	

Description	Max/Min Voltage	Max bandwidth	Max Current

5.3 Electrical Power Demand

The table below shows the maximum power demand.

Phase	Mode	Peak Type	Peak Demand	Duration	Repetition Rate (P/S)	Occurrence

6. Optical interface

The diagram below shows the optical interface between *subsystem aaa* and *subsystem bbb*.

0r

There is no optical interface between *subsystem aaa* and *subsystem bbb*.

(*Strictly speaking, there is no optical interface between the chopper and the structure, only between the chopper and the optics*).

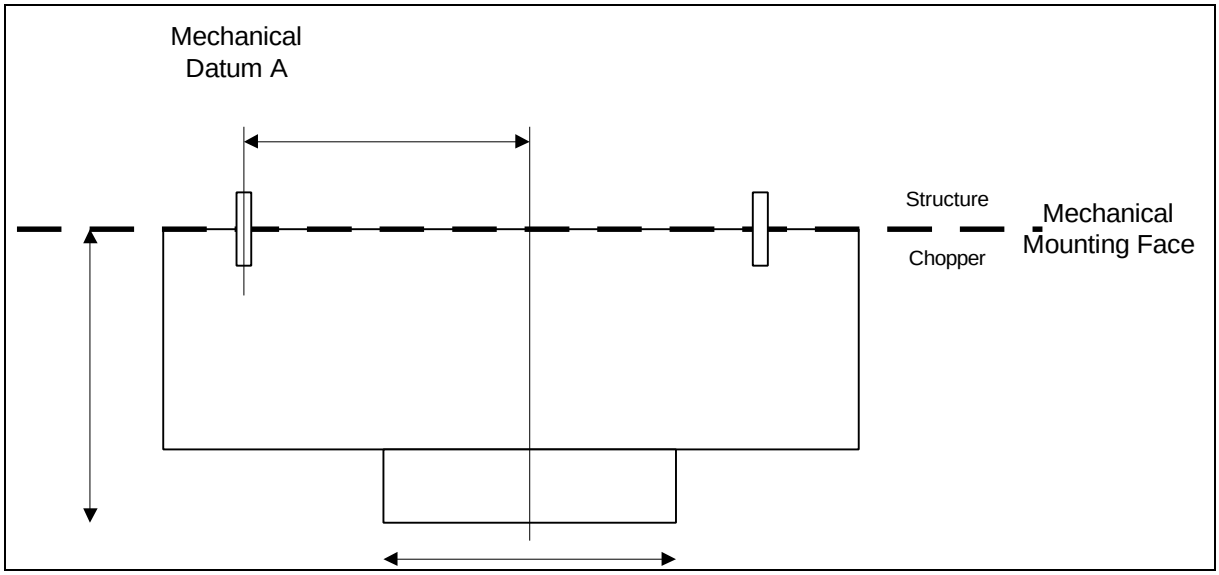


Diagram showing optical interface - physical apertures, pupil planes, image planes, etc. relative to mechanical data for subsystems.

May require one for each waveband.

7. Data Flow Interface

7.1 Data Signals Summary

The table below describes the data signals which flow between *subsystem aaa* and *subsystem bbb*.

Signal Name	Signal Description	Connector ID	Connector Pins
MIR_POS_DEMAND	Mirror position demand	JK 21	1-5
MIR_POS_READ	Mirror position feedback	JK 21	6-10

7.2 Data Signals Description

The following sections describe the data signals shown in the table above.

7.2.1 MIR_POS_DEMAND

(Timing diagram, etc)

7.2.2 MIR_POS_READ

(Timing diagram, etc)