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# SPIRE

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**PREPARED BY:** K.J. King; B.M. Swinyard; M.J. Griffin

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**CHECKED BY:** ..... **Date:** .....

**APPROVED BY:** **Date:**

M.J. Griffin

L. Vigroux

<b>Agreed By</b>		<b>Date</b>
DESPA	E. Lellouch	
GSFC	H. Moseley	
IAC	I. Perez-Fournon	
IAS	P. Cox	
ICSTM	M. Rowan-Robinson	
IFSI	P. Saraceno	
JPL	J. Bock	
LAS	J-P Baluteau	
MSSL	A. Smith (TBC)	
Padova	A. Franceschini	
QMW	P.A.R. Ade	
RAL	R.J. Emery	
ROE	G. Wright	
SAP	P. André	
Saskatchewan	G. Davis	
Stockholm	G. Olofsson	

## Distribution

### **Project Team**

M. J. Griffin	QMW
L. Vigroux	SAP
K.J. King	RAL
W.K.P.Gear	Cardiff
J-P Baluteau	LAS
L. Rodriguez	SAP
C.R. Cunningham	ATC
J-L Augueres	SAP
B.M. Swinyard	RAL
E. Sawyer	RAL

### **Co-Is**

G. Wright	ATC
E. Lellouch	DESPA
H. Moseley	GSFC
I. Perez-Fournon	IAC
P. Cox	IAS
M. Rowan-Robinson	ICSTM
P. Saraceno	IFSI
J. Bock	JPL
<i>J-P Baluteau</i>	LAS
<i>W.K.P. Gear</i>	Cardiff
A. Franceschini	Padova
P.A.R. Ade	QMW
R.J. Emery	RAL
P. André	SAP
G. Olofsson	Stockholm
G. Davis	USK

### **Project Managers**

I. Pain	ATC
G. Michel	DESPA
L. Duband	Grenoble
J. Roman	GSFC
J.M. Herreros	IAC
F. Pajot	IAS
T. Sumner	ICSTM
R. Cerulli	IFSI
G. Lillienthal	JPL
D. Pouliquen	LAS
B. Winter	MSSL
P. Andreani	Padova
P. Hargrave	QMW
<i>K.J. King</i>	RAL

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J-L. Augueres  
H.G Floren  
J. Taylor

SAP  
Stockholm  
USK

## Change Record

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**TABLE OF CONTENTS**

<b>1. INTRODUCTION</b> .....	<b>8</b>
<b>2. DOCUMENTS</b> .....	<b>8</b>
2.1 APPLICABLE DOCUMENTS .....	8
2.2 REFERENCE DOCUMENTS .....	8
<b>3. DELIVERABLE ITEMS</b> .....	<b>9</b>
3.1 TOP-LEVEL BREAKDOWN .....	9
3.2 INSTRUMENT SUBSYSTEMS.....	9
3.2.1 <i>Cold FPU</i> .....	10
3.2.2 <i>Instrument Thermistors</i> .....	17
3.3 SUPPORT ITEMS.....	18
3.4 MATHEMATICAL MODELS .....	21
3.5 GROUND SEGMENT DELIVERABLES .....	22
3.6 ICC DELIVERABLES .....	23

**FIGURES****TABLES**

Table 3.2-1 Instrument hardware and software items deliverable between SPIRE institutes for the four instrument models deliverable to ESA. ....	16
Table 3.2-3 Summary of types and locations of instrument thermistors (sub-system 1.1.1).....	18
Table 3.4-1Mathematical Models .....	21
Table 3.5-1Deliverables to the FIRST Ground Segment.....	22
Table 3.6-1 ICC Deliverables .....	23

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## **Glossary**

DAPSAS	Data Analysis and Science Analysis Software
ESA	European Space Agency
FIRST	Far Infra-Red Space Telescope
FSC	FIRST Science Centre
Herschel	Herschel Space Observatory (formerly FIRST)
ICC	Instrument Control Centre
MOC	Mission Operations Centre
PI	Principle Investigator
SPIRE	Spectral and Photometric Imaging REceiver

## 1. INTRODUCTION

This document details all hardware and software items to be produced by the SPIRE consortium during development and test of the instrument deliverable models and the SPIRE ICC. The intention is to identify ALL items that shall be delivered from one institute in the SPIRE consortium to another, or to ESA, and to identify the institute responsible for the production and delivery of that item.

The document forms part of the response of the SPIRE consortium to the FIRST Instrument Interface Document Part A (AD1) along with the SPIRE Management Plan (RD1).

Chapter 3 describes the deliverables required for

- a. development, manufacture and integration of deliverable instrument models (i.e. AVM, CQM, PFM and FS)
- b. development and manufacture of support equipment required for instrument AIV
- c. provision of instrument mathematical models
- d. development, manufacture and test of FIRST Ground Segment deliverables
- e. development and implementation of the SPIRE ICC.

## 2. DOCUMENTS

### 2.1 Applicable Documents

AD1      FIRST/PLANCK Instrument Interface Document, Part A (PT-IID-A-04624)

### 2.2 Reference Documents

RD1      SPIRE Management Plan (FIRST-SPIRE-PRJ-000011)

RD2      SPIRE Instrument AIV Plan



### 3. DELIVERABLE ITEMS

#### 3.1 Top-level Breakdown

The instrument deliverables can be broken down into the following Products

ID	Product Item
<b>SPIRE</b>	
HSFPU	<b>Cold Focal Plane Unit</b>
HSJFP	<b>JFET Box (Photometer)</b>
HSJFS	<b>JFET Box (Spectrometer)</b>
HSDRC	<b>Detector Readout and Control Unit</b>
HSWIH	<b>Warm Interconnect Harness</b>
HSDPU	<b>Digital Processing Unit</b>
HSSIM	<b>Simulators</b>
HSGSE	<b>Ground Support Equipment</b>
HSMOD	<b>Mathematical Models</b>
HSICC	<b>Instrument Control Centre</b>

#### 3.2 Instrument Subsystems

In this section the instrument sub-systems are broken down into their constituent components for the purposes of identifying deliverable items between institutes. Sometimes the components for a given sub-system are all provided at a single institute in this case the table serves to clarify what is expected to be delivered from an instrument perspective.

The table has 8 columns:

- **ID:** The identifying code used in the Interface Control Document and database for this sub-system
- **Product Item:** A brief description of the item
- **Descriptor:** Configurable Item Code used for this item for requirements; specifications; labelling etc.
- **Instrument Model:** Four columns – an x in a column indicates that the product item is required for the deliverable instrument model.
- **Resp.:** Initials of the Responsible Organisation (RO) for delivery of the product item.

The major subsystems are highlighted in **bold text**. The institute denoted as responsible for the major sub-systems is also responsible for the management of that sub-system; that is the design; development and production of all components within the sub-system description are the ultimate responsibility of the sub-system institute. Table 3.1-2 summarises the number and types of thermistors required for each sub-system. Note that it is implicitly assumed that the sub-systems responsible institutes are also responsible for the thermistors for their sub-system. The thermistors may be procured and calibrated centrally if this proves more cost effective.

### 3.2.1 Cold FPU

ID	Product Item	Descriptor	Instrument Model				Resp.
			AVM	CQM	PFM	FS	
<b>1.</b>	<b>Cold FPU</b>	<b>HSFPU</b>		<b>x</b>	<b>x</b>	<b>x</b>	<b>RAL</b>
<b>1.1</b>	<b>Structure</b>	<b>STRC</b>		<b>x</b>	<b>x</b>	<b>x</b>	<b>MSSL</b>
1.1.1	Cover (including any interface structure to the JFET/Filter box and the FIRST optical bench)	COV		x	x	x	MSSL
1.1.2	Common 4-K Structure (including supports and any interface structure to the FIRST optical bench)	C4K		x	x	x	MSSL
1.1.3	Photometer 2-K Structure (including supports)	P2K		x	x	x	MSSL
1.1.4	Spectrometer 2-K Structure (including supports)	S2K		x	x	x	MSSL
1.1.5	Internal thermal straps for 4-K and 2-K stages			x	x	x	MSSL
1.1.6	Thermal interface structure to cryostat 4-K stage			x	x	x	MSSL
1.1.7	Thermal interface structure to cryostat 2-K stage			x	x	x	MSSL
1.1.8	Thermal strap from evaporator to detectors			x	x	x	MSSL
1.1.9	Alignment reference mirrors			x	x	x	MSSL
1.1.10	<b>Structure thermistors (see separate table)</b>	T_P2K_1 T_P2K_2 T_S2K_1 T_S2K_2 T_C4K_1 T_C4K_2 T_COV_1 T_COV_2		x x x x x x x x	x x x x x x x x	x x x x x x x x	MSSL
1.1.11	Structure thermistors harness and connector(s)			x	x	x	MSSL
1.1.12	FSFPU Transport containers			x	x	x	MSSL
<b>1.2</b>	<b>Mirrors</b>	<b>OPT</b>		<b>x</b>	<b>x</b>	<b>x</b>	<b>LAS</b>
<b>1.2.1</b>	<b>Photometer optical chain and fore optics</b>	<b>OPTP</b>					
	Common instrument input mirror	CPM3		x	x	x	LAS
	Common mirror at pupil (BSM)	CPM4		x	x	x	LAS
	Common reimaging mirror	CPM5		x	x	x	LAS
	Field mirror	PM6		x	x	x	LAS
	Optical relay input mirror	PM7		x	x	x	LAS
	Optical relay second mirror	PM8		x	x	x	LAS
	Optical relay output mirror	PM9		x	x	x	LAS
	Plane fold mirror for LW array	PM10		x	x	x	LAS
	Plane fold mirror for SW array	PM11		x	x	x	LAS
	Photometer Mirror mounts			x	x	x	MSSL
<b>1.2.2</b>	<b>Spectrometer optical train</b>	<b>OPTS</b>					
	Field Pick-Off Mirror	SPOM		x	x	x	LAS
	Input Fold Mirror	SIFM		x	x	x	LAS

ID	Product Item	Descriptor	Instrument Model				Resp.
			AVM	CQM	PFM	FS	
	Input Relay Mirror	SIRM		x	x		LAS
	Calibration Source Input Relay Mirror	SCIM		x	x	x	LAS
	Collimator Mirror for arm A or B	SCOM-A SCOM-B		x x	x x	x x	LAS
	Roof-Top Mirror in arm A or B	SRTM-A SRTM-B		x x	x x	x x	LAS
	De-Collimator Mirror in arm A or B	SDCM-A SDCM-B		x x	x x	x x	LAS
	Camera mirror in arm A or B	SCAM-A SCAM-B		x x	x x	x x	LAS
	Output Fold mirror in arm A or B	SOFM-A SOFM-B		x x	x x	x x	LAS
	Spectrometer mirror mounts			x	x	x	MSSL
1.2.3	<b>Filters; dichroics and beam splitters</b>	<b>FILT</b>		<b>x</b>	<b>x</b>	<b>x</b>	<b>QMW</b>
1.2.3.1	<b>Photometer dichroics</b>						
	First dichroic (reflects $\lambda > \text{TBD } \mu\text{m}$ )	PDIC-1		x	x	x	QMW
	Second dichroic (reflects $\lambda > \text{TBD } \mu\text{m}$ )	PDIC-2		x	x	x	QMW
1.2.3.2	<b>Photometer filters</b>						
	Input filter on cover	CFIL-1		x	x	x	QMW
	Edge filter over entrance to 4-K box	CFIL-2		x	x	x	QMW
	Edge filter at 2-K box entrance (pupil)	PFIL-3		x	x	x	QMW
	Bandpass filters over SW, MW and LW arrays	PFIL-4S PFIL-4M PFIL-4L		x x x	x x x	x x x	QMW
	Blocker filters over SW, MW and LW arrays	PFIL-5S PFIL-5M PFIL-5L		x x x	x x x	x x x	QMW
1.2.3.3	<b>Photometer filter and dichroic mountings</b>						
	Mounting rings			x	x	x	QMW
	Mounting structure			x	x	x	MSSL
1.2.3.4	<b>Spectrometer beam dividers</b>						
	Beam Divider 1 (common to both arms)	SBDI-1		x	x	x	QMW
	Beam Divider 2 (common to both arms)	SBDI-2		x	x	x	QMW
	Beam divider mounting rings			x	x	x	QMW
	Beam divider mounting structure			x	x	x	MSSL
1.2.3.5	<b>Spectrometer Filters</b>						
	2-K filters at entrance to 2-K box (pupil)	SFIL-3S SFIL-3L		x x	x x	x x	QMW
	Bandpass filters over arrays	SFIL-4S SFIL-4L		x x	x x	x x	QMW
	Blocking filters over arrays	SFIL-5S		x	x	x	QMW

ID	Product Item	Descriptor	Instrument Model				Resp.
			AVM	CQM	PFM	FS	
		SFIL-5L		x	x	x	
1.2.3.6	<b>Spectrometer filter and beamsplitter mountings</b>						
	Mounting Rings			x	x	x	QMW
	Mounting structure			x	x	x	MSSL
1.2.4	<b>Baffles</b>	<b>BAFF</b>					Note 1
1.2.4.1	Photometer and fore-optics optical baffling						
	Baffles (TBD)			x	x	x	Note 1
	Baffle mounts			x	x	x	Note 1
1.2.4.2	Spectrometer baffling						
	Baffles (TBD)			x	x	x	Note 1
	Baffle mounts			x	x	x	Note 1
<b>1.3</b>	<b>Cooler</b>	<b>COOL</b>					<b>CEA</b>
1.3.1	<sup>3</sup> He Cooler Unit including: pump; evaporator; connection tube; pump and evaporator heat switches and support structure.	COOL		x	x	x	CEA
1.3.2	Cooler thermistors (see separate table)						CEA
		T_CPMP_1 T_CPMP_2 T_CEV_1 T_CEV_1 T_CPHS_1 T_CPHS_2 T_CEHS_1 T_CEHS_2		x x x x x x x x	x x x x x x x x	x x x x x x x x	
1.3.3	Cooler harness and connector(s)			x	x	x	CEA
	Cooler mechanical interface structure			x	x	x	MSSL
<b>1.4</b>	<b>Bolometer Arrays</b>	<b>DET</b>					
1.4.1	<b>Photometer Bolometer Arrays</b>	<b>DETP</b>					<b>Note 2</b>
1.4.1.1	<b>Photometer short wavelength array module</b>	PSW					Note 2
	PSW array; cold readout electronics and support structure			x	x	x	Note 2
	PSW harness and connector(s)			x	x	x	Note 2
	PSW thermal interface structure			x	x	x	Note 2
	PSW mechanical interface structure			x	x	x	MSSL
1.4.1.2	<b>Photometer medium wavelength array module</b>	PMW					Note 2
	PMW array; cold readout electronics and support structure			x	x	x	Note 2
	PMW harness and connector(s)			x	x	x	Note 2
	PMW thermal interface structure			x	x	x	Note 2
	PMW mechanical interface structure			x	x	x	MSSL

ID	Product Item	Descriptor	Instrument Model				Resp.
			AVM	CQM	PFM	FS	
1.4.1.3	<b>Photometer long wavelength array module</b>	PLW					Note 2
	PLW array; cold readout electronics and support structure			x	x	x	Note 2
	PLW harness and connector(s)			x	x	x	Note 2
	PLW thermal interface structure			x	x	x	Note 2
	PLW mechanical interface structure			x	x	x	MSSL
1.4.1.4	<b>Photometer array thermistors (see separate table)</b>	T_PSW_1 T_PSW_2 T_PMW_1 T_PMW_2 T_PLW_1 T_PLW_2		x x x x x x	x x x x x x	x x x x x x	Note 2
1.4.2	<b>Spectrometer Bolometer Arrays</b>	<b>DETS</b>					<b>Note 2</b>
1.4.2.1	<b>Spectrometer short wavelength array module</b>	SSW					Note 2
	SSW array; cold readout electronics and support structure			x	x	x	Note 2
	SSW harness and connector(s)			x	x	x	Note 2
	SSW thermal interface structure			x	x	x	Note 2
	SSW mechanical interface structure			x	x	x	MSSL
1.4.2.2	<b>Spectrometer long wavelength array module</b>	SLW					Note 2
	SLW array; cold readout electronics and support structure			x	x	x	Note 2
	SLW harness and connector(s)			x	x	x	Note 2
	SLW thermal interface structure			x	x	x	Note 2
	SLW interface structure			x	x	x	MSSL
1.4.2.3	<b>Spectrometer array thermistors (see separate table)</b>	T_SSW_1 T_SSW_2 T_SLW_1 T_SLW_2		x x x x	x x x x	x x x x	Note 2
1.5	<b>Beam Steering Mechanism</b>	<b>BSM</b>					<b>ATC</b>
1.5.1	BSM motors; mirror support; position pick-offs and structure			x	x	x	ATC
1.5.2	<b>BSM thermistors (see separate table)</b>	T_BSM_1 T_BSM_2		x x	x x	x x	ATC
1.5.3	BSM harness and connector(s) (including provision for calibrator electrical connections)			x	x	x	ATC
1.5.4	BSM interface structure			x	x	x	MSSL
1.6	<b>FTS Mechanism</b>	<b>FTS</b>					<b>LAS</b>
1.6.1	FTS mechanism carriage and SRTM support			x	x	x	LAM
1.6.2	FTS mechanism motor(s)			x	x	x	LAS
1.6.3	FTS mirror position measurement system			x	x	x	LAS

ID	Product Item	Descriptor	Instrument Model				Resp.
			AVM	CQM	PFM	FS	
1.6.4	<b>FTS mechanism thermistors (see separate table)</b>	T_FTS_1 T_FTS_2		x	x	x	LAS
1.6.5	FTS mechanism harness and connector(s)			x	x	x	LAS
1.6.6	FTS mechanism interface structure			x	x	x	MSSL
<b>1.7</b>	<b>Shutter</b>	<b>SHUT</b>					<b>USK</b>
1.7.1	Shutter mechanism			x	x	x	USK
1.7.2	Shutter vane			x	x	x	USK
1.7.3	<b>Shutter vane thermistors (see separate table)</b>	T_SHUT_1 T_SHUT_2		x	x	x	USK
1.7.4	Shutter harness and connector(s)			x	x	x	USK
1.7.5	Shutter interface structure			x	x	x	MSSL
<b>1.8</b>	<b>Calibration Sources</b>	<b>CAL</b>					<b>GSFC</b>
<b>1.8.1</b>	<b>Photometer Calibration Source</b>	<b>PCAL</b>					<b>GSFC</b>
1.8.1.1	Active element(s)			x	x	x	GSFC
1.8.1.2	Integrating cavity and light pipe			x	x	x	GSFC
1.8.1.3	PCAL filters			x	x	x	QMW
1.8.1.4	<b>PCAL thermistors (see separate table)</b>	T_PCAL_1 T_PCAL_2		x	x	x	QMW
1.8.1.5	PCAL harness and connector(s) [combined with BSM harness and connector(s)]			x	x	x	ATC
1.8.1.6	PCAL interface structure			x	x	x	ATC
<b>1.8.2</b>	<b>Spectrometer Calibration Source</b>	<b>SCAL</b>					<b>QMW</b>
1.8.2.1	Active element(s)			x	x	x	QMW
1.8.2.2	Integrating cavity and optics			x	x	x	QMW
1.8.2.3	SCAL filters			x	x	x	QMW
1.8.2.4	<b>SCAL thermistors (see separate table)</b>	T_SCAL_1 T_SCAL_2		x	x	x	QMW
1.8.2.5	SCAL harness and connector(s)			x	x	x	QMW
1.8.2.6	SCAL interface structure			x	x	x	MSSL

ID	Product Item	Descriptor	Instrument Model				Resp.
			AVM	CQM	PFM	FS	
<b>2</b>	<b>JFET Boxes</b>						
<b>2.1</b>	<b>JFET (Photometer) Box</b>	<b>HSJFP</b>					
2.1.1	Box including interface structure to the FIRST optical bench.			X	x	x	MSSL
2.1.2	Thermal interface structure			x	x	x	MSSL
2.1.3	JFETS and heaters (NTD option only)			x	x	x	JPL
2.1.4	RF filters for all wires into/out of FPU			x	x	x	JPL
2.1.5	<b>FSFTB thermistors (see separate table)</b>	T_FTB_1 T_FTB_2		x	x	x	JPL

ID	Product Item	Descriptor	Instrument Model				Resp.
			AVM	CQM	PFM	FS	
2.1.6	Connectors			x	x	x	JPL
2.1.7	Savers			x	x	x	JPL
2.1.8	FSJFP transport container			x	x	x	MSSL
<b>2.2</b>	<b>JFET (Spectrometer) Box</b>	<b>HSJFS</b>					
2.2.1	Box including interface structure to the FIRST optical bench.			x	x	x	MSSL
2.2.2	Thermal interface structure			x	x	x	MSSL
2.2.3	JFETS and heaters (NTD option only)			x	x	x	JPL
2.2.4	RF filters for all wires into/out of FPU			x	x	x	JPL
2.2.5	<b>FSFTB thermistors (see separate table)</b>	T_FTB_1 T_FTB_2		x x	x x	x x	JPL
2.2.6	Connectors			x	x	x	JPL
2.2.7	Savers			x	x	x	JPL
2.2.8	FSJFS transport container			x	x	x	MSSL

ID	Product Item	Descriptor	Instrument Model				Resp.
			AVM	CQM	PFM	FS	
<b>3</b>	<b>Detector Readout and Control Unit</b>	<b>HHSDRC</b>					<b>CEA</b>
<b>2.1</b>	<b>Detector Control Unit</b>	<b>FSDCU</b>					<b>CEA</b>
2.1.1	Box including interconnect plane and card rack(s)			x	x		CEA
2.1.2	Detector read out electronics			x	x	x	
2.1.3	DCU Transport Container			x	x	x	
<b>2.2</b>	<b>Control Unit</b>	<b>FSFCU</b>					<b>CEA</b>
2.2.1	Instrument control electronics			x	x	x	CEA
2.2.2	Beam steering mirror drive electronics			x	x	x	LAM Note 3
2.2.3	Spectrometer mechanism drive electronics			x	x	x	LAM
2.2.4	Cooler control electronics			x	x	x	CEA
2.2.5	Calibration source control electronics			x	x	x	CEA
2.2.6	Temperature monitor electronics			x	x	x	CEA
2.2.7	Digital interface to DPU			x	x	x	CEA
2.2.8	Power supplies			x	x	x	CEA
2.2.9	<b>FSDRC thermistors (see separate table)</b>	T_DRCU_1 T_DRCU_2 T_DRCU_3		x x x	x x x	x x x	CEA
2.2.10	Connectors			x	x		CEA
2.2.11	Savers			x	x		CEA
2.2.12	FCU transport container			x	x	x	CEA

ID	Product Item	Descriptor	AVM	CQM	PFM	FS	Resp.
<b>3</b>	<b>Digital Processing Unit</b>						
<b>3.1</b>	<b>Digital Processing Unit</b>	<b>HSDPU</b>					<b>IFSI</b>
3.1.1	Box including interconnect plane and card rack(s)		x	x	x		IFSI
3.1.2	CPU		x	x	x	x	IFSI
3.1.3	Mass memory		x	x	x	x	IFSI
3.1.4	Digital interface to S/C OBDH		x	x	x	x	IFSI
3.1.5	Digital interface to S/C DRCU		x	x	x	x	IFSI
3.1.6	Analogue interface to S/C DRCU		x	x	x	x	IFSI
3.1.7	Power supplies		x	x	x	x	IFSI
3.1.8	<b>DPU thermistors (see separate table)</b>	T_DPU_1 T_DPU_2	x x	x	x x	x x	IFSI
3.1.9	Connectors		x	x	x		IFSI
3.1.10	Savers		x	x	x		IFSI
3.1.11	DPU transport container		x	x	x	x	IFSI
<b>3.2</b>	<b>On Board Software</b>						
3.2.1	DPU software		x	x	x	x	IFSI

		Instrument Model					
ID	Product Item	Descriptor	AVM	CQM	PFM	FS	Resp.
<b>4</b>	<b>Warm Interconnect Harness</b>						
<b>4.1</b>	<b>Warm Interconnect Harnesses</b>	<b>HSWIH</b>					<b>CEA</b>
4.1.1	DPU to DRCU harness			x	x	x	<b>CEA</b>
4.1.2	DPU to DRCU simulator harness		x				Stock-holm

		Instrument Model					
ID	Product Item	Descriptor	AVM	CQM	PFM	FS	Resp.
<b>5</b>	<b>Simulators</b>						
5.1	DRCU Simulator		x	x			Stock-holm

**Table 3.2-1 Instrument hardware and software items deliverable between SPIRE institutes for the four instrument models deliverable to ESA.**

Notes:

- No single institute has been identified as being responsible for the optical baffles. This being so the following compromise is suggested. RAL will design them optically and specify the requirements on them. The baseline will then be that they are implemented as part of the structure by MSSSL. They may possibly need special edge and surface treatments, again these to be specified by RAL or QMW and support will be provided in their application. If the baffling is to be more specialised than walls within the structure, then RAL will do the mechanical design and MSSSL will implement them.



2. The requirements for the CQM arrays are under discussion
3. The ATC will provide the BSM drive electronics design and possibly breadboard electronics during development. LAM will implement the final design for the DRCU.

### 3.2.2 Instrument Thermistors

Unit	Power		Location	Acronym	Type	Temp. Range
	S/C	Instr.				
FSFPU		X	200 $\mu$ m array	T_PSW_1	TBD	0.2 K>5 K
FSFPU		X	200 $\mu$ m array	T_PSW_2	TBD	0.2 K>5 K
FSFPU		X	350 $\mu$ m array	T_PMW_1	TBD	0.2 K>5 K
FSFPU		X	350 $\mu$ m array	T_PMW_2	TBD	0.2 K>5 K
FSFPU		X	500 $\mu$ m array	T_PLW_1	TBD	0.2 K>5 K
FSFPU		X	500 $\mu$ m array	T_PLW_2	TBD	0.2 K>5 K
FSFPU		X	FTS array 1	T_SSW_1	TBD	0.2 K>5 K
FSFPU		X	FTS array 1	T_SSW_2	TBD	0.2 K>5 K
FSFPU		X	FTS array 2	T_SLW_1	TBD	0.2 K>5 K
FSFPU		X	FTS array 2	T_SLW_2	TBD	0.2 K>5 K
FSFPU	X		PHOT 2-K box	T_P2K_1	TBD	1 K>300 K
FSFPU		X	PHOT 2-K box	T_P2K_2	TBD	1 K>300 K
FSFPU	X		FTS 2-K box	T_S2K_1	TBD	1 K>300 K
FSFPU		X	FTS 2-K box	T_S2K_2	TBD	1 K>300 K
FSFPU	X		4-K structure	T_C4K_1	TBD	3 K>300 K
FSFPU		X	4-K structure	T_C4K_2	TBD	3 K>300 K
FSFPU	X		Instrument cover	T_COV_1	TBD	3 K>300 K
FSFPU		X	Instrument cover	T_COV_2	TBD	3 K>300 K
FSFPU		X	Phot Calibrator	T_PCAL_1	TBD	3 K>300 K
FSFPU		X	Phot Calibrator	T_PCAL_2	TBD	3 K>300 K
FSFPU		X	FTS Mechanism	T_FTS_1	TBD	3 K>300 K
FSFPU		X	FTS Mechanism	T_FTS_2	TBD	3 K>300 K
FSFPU		X	FTS Calibrator	T_SCAL_1	TBD	3 K>300 K
FSFPU		X	FTS Calibrator	T_SCAL_2	TBD	3 K>300 K
FSFPU		X	Cooler Pump	T_CPMP_1	TBD	3 K>300 K
FSFPU		X	Cooler Pump	T_CPMP_2	TBD	3 K>300 K
FSFPU		X	Cooler Evaporator	T_CEV_1	TBD	0.2 K>5 K
FSFPU		X	Cooler Evaporator	T_CEV_1	TBD	0.2 K>5 K
FSFPU		X	Cooler Pump heat switch	T_CPHS_1	TBD	1 K>50 K
FSFPU		X	Cooler Pump heat switch	T_CPHS_2	TBD	1 K>50 K
FSFPU		X	Cooler Evap. Heat switch	T_CEHS_1	TBD	1 K>50 K
FSFPU		X	Cooler Evap. Heat switch	T_CEHS_2	TBD	1 K>50 K
FSFPU		X	Shutter Vane	T_SHUT_1	TBD	3 K > 30 K
FSFPU		X	Shutter Vane	T_SHUT_2	TBD	3 K > 30 K
FSFPU		X	BSM (TBC)	T_BSM_1	TBD	3 K>300 K
FSFPU		X	BSM (TBC)	T_BSM_2	TBD	3 K>300 K
FSFTB	X		JFET/Filter box	T_FTB_1	TBD	3 K>300 K

Unit	Power S/C	Instr.	Location	Acronym	Type	Temp. Range
FSFTB		X	JFET/Filter box	T_FTB_2	TBD	3 K>300 K
FSBAU	X		Buffer Amp Unit	T_BAU_1	TBD	70 K > 300 K
FSBAU		X	Buffer Amp Unit	T_BAU_2	TBD	70 K > 300 K
FSDRC	X		DRCU	T_DRCU_1	TBD	-40 °C >80 °C
FSDRC		X	DRCU	T_DRCU_2	TBD	-40 °C >80 °C
FSDRC		X	DRCU	T_DRCU_3	TBD	-40 °C >80 °C
FSDPU	X		DPU	T_DPU_1	TBD	-40 °C >80 °C
FSDPU		X	DPU	T_DPU_2	TBD	-40 °C >80 °C

**Table 3.2-2 Summary of types and locations of instrument thermistors (sub-system 1.1.1).**

### 3.3 Support Items

In this section the equipment required for the instrument and satellite level AIV is described and broken down into its constituent components as appropriate for the purposes of identifying deliverable items between institutes.

The table has 8 columns:

ID: The identifying code used in the Interface Control Document and database for this sub-system

Product Item: A brief description of the item

Descriptor: A letter code used for this item for requirements; specifications; labelling etc.

Instrument Model: Four columns – an x in a column indicates that the product item is required for the deliverable instrument model.

Resp.: Initials of the institute responsible for delivery of the product item.

The major subsystems are highlighted in **bold text**. The institute denoted as responsible for the major sub-systems is also responsible for the management of that sub-system; that is the design; development and production of all components within the sub-system description are the ultimate responsibility of the sub-system institute.

ID	Product Item	Descriptor	Number /location	Function/description	Resp.
<b>5.1</b>	<b>OGSE</b>	<b>OGSE</b>			<b>LAM</b>
	OGSE as specified in alignment plan		2 sets LAS RAL	Detector focal plane jig; Telescope focal plane jig; Cold stop jig; Sources; Detectors	LAM
	Replacement jig for beam steering mirror		2 sets MSSL LAM/RAL	Note 3	ATC
	Replacement jig for FTS mechanism		2 sets MSSL LAM/RAL	Note 3	LAS

ID	Product Item	Descriptor	Number /location	Function/description	Resp.
<b>5.2</b>	<b>EGSE</b>	<b>EGSE</b>			<b>Note 2</b>
	FPU simulator		2 sets CEA RAL	Simulates SPIRE FPU and BAU for testing operation of SPIRE warm electronics; includes: Hardware and (TBC)Software;	CEA Note 1
	Spacecraft interface & commanding GSE		4 sets IFSI CEA RAL (2)	Simulates S/C interface to allow testing of DPU; includes: S/C Interface Hardware; EGSE Software;	Note 2
<b>5.3</b>	<b>MGSE</b>	<b>MGSE</b>			<b>MSSL</b>
	FSFPU assembly jig		2 sets MSSL RAL		MSSL
	FSFPU handling equipment		3 sets One goes with each model		MSSL
	<b>AIV/Ground Test Facilities</b>				
4.1	EMC test facility		1 set CEA	Facility for the radiative and conductive emission/susceptibility testing at unit level.	CEA
4.2	AIV facility		1 set RAL	Instrument Cryostat; Facility Electronics; Clean Room; Infrastructure;	RAL
4.3	Calibration facility		1 set RAL	Telescope simulator; Calibration Sources; Facility Electronics	RAL
4.4	Thermal vac. facility		2 sets CEA RAL	Facility for operating warm electronics over a range of emperatures	RAL /CEA
4.5	Cold vibration facility		2 sets RAL Note 4	Small facility for vibrating at <10 K at sub-system level available at RAL Large facility capable of vibrating the whole instrument at <10 K will be rented	Note 4
4.6	Warm vibration facility		1 set	Facility for vibration of	RAL

ID	Product Item	Descriptor	Number /location	Function/description	Resp.
			RAL or CEA	warm electronics units.	/CEA
4.7	Quick Look Facility	QLF	4 sets RAL (2) ESA (2)	QLF Hardware; RTA/QLA S/W; Documentation	RAL
4.8	Instrument bakeout facility		1 set RAL	Facility for the bake of the whole instrument	RAL

**Table 3.2-1: The ground test equipment required for the SPIRE instrument level AIV and satellite level AIV.**

Notes:

1. The specifications for the FPU simulator shall be provided to CEA by the FPU subsystem groups.
2. This piece of EGSE is at present no-one's responsibility. A proposal has been put to the Canadian Space Agency to provide the Spacecraft interface EGSE, in the event that this is not successful this equipment will have to be specified centrally (CEA or RAL) and individual institutes requiring a set will be expected to purchase the necessary equipment.
3. This depends on the exact details of the optical alignment procedure – there may be a requirement to replace the actual mechanisms with jigs to hold or replace the mirrors. These jigs are to be provided by the institutes responsible for the mechanisms.
4. It is likely that a single cold vibration facility for instrument level testing will be provided as an ESA facility. In this event we will have to buy time on the facility for our instrument level testing – this activity is not currently funded.

### 3.4 Mathematical Models

Mathematical Models	Responsible	Deliverable
<b>Optical</b>		
Instrument Geometrical Optics Model ( <i>Synopsis</i> )	LAM	No
Straylight Model ( <i>APART; Code V</i> )	RAL	To Estec
Diffraction analysis ( <i>ASAP</i> )	RAL	No
<b>Performance</b>		
Radiometric ( <i>MathCad</i> and/or <i>IDL</i> )	QMW	No
Operations simulations ( <i>IDL</i> )	ICC	No
Time Estimator ( <i>IDL</i> )	ICC	To FSC
<b>Engineering</b>		
Structural FEA ( <i>IDEAS?</i> )	MSSL	To Estec
Thermal FEA (?) (Note 1)	MSSL	No?
Thermal balance (Note 1)	ATC	To Estec

**Table 3.4-1 Mathematical Models**

Notes:

1. Compilation and maintenance of the thermal models will be organised by the FPU Systems Engineer.

### 3.5 Ground Segment Deliverables

These items are deliverable to the FIRST Ground Segment centres, other than the SPIRE ICC.

<b>ID</b>	<b>Product Item</b>	<b>Descriptor</b>	<b>Number /location</b>	<b>Function/description</b>	<b>Resp.</b>
S12_10	Instrument Users Manual		3 versions (one with each model)		RAL
S12_20	Instrument Database		3 versions (one with each model)		RAL
S12_30	Calibration Database		3 versions (one with each model)		RAL
S22_40	Instrument Simulator:		1	<i>Instrument Simulation Software;</i> <i>Instrument Simulator Hardware;</i> <i>Documentation</i>	Stockholm
S13_10	Instrument Time Estimator		TBD		TBD
S13_20	Instrument Command Translator (TBC)		TBD		TBD

**Table 3.5-1 Deliverables to the FIRST Ground Segment**

### 3.6 ICC Deliverables

ID	Product Item	Descriptor	Number /location	Function/description	Resp.
S22_50	DPU On Board Software Maintenance System: <i>DPU Software Maintenance Software;</i> <i>DPU Software Maintenance Hardware;</i> <i>Documentation</i>		1		IFSI
S13_30	RTA/QLA Software		TBD		TBD
S13_40	Trend Analysis Software		TBD	<i>Instrument Simulation Software;</i> <i>Instrument Simulator Hardware;</i> <i>Documentation</i>	TBD
S13_50	Calibration Analysis Software		TBD		TBD
S13_60	Interactive Analysis Software		TBD		TBD
S13_70	Science Processing Software		TBD		TBD
S13_80	Science Analysis Software		TBD		TBD
S13_90	Diagnostic Tools		TBD		TBD
S22_11	ICC Operations Centre Infrastructure		TBD		RAL
S22_12	DAPSAS (UK) Centre Infrastructure		TBD		ICSTM
S22_13	DAPSAS (Fr) Centre Infrastructure		TBD		CEA
S22_21	ICC Operations Centre Computing Hardware		TBD		RAL
S22_22	DAPSAS (UK) Centre Computing Hardware		TBD		ICSTM
S22_23	DAPSAS (Fr) Centre Computing Hardware		TBD		CEA
	FINDAS		TBD		RAL

**Table 3.6-1 ICC Deliverables**