



Herschel/SPIRE

300-mK Strap System Requirements

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Ref.: SPIRE-RAL-PRJ-001323
Issue: Draft 0.1
Date: 4 July 2002
Page: 3 of 9

Table of Contents

1. Scope	4
2. Documents	4
2.1 Applicable documents	4
2.2 Reference documents	4
3. Glossary	4
4. Overview	5
5. Requirements	7
5.1 Thermal	7
5.2 Accommodation and Mechanical Interface	7
5.3 Optical	8
5.4 Bonding and Isolation	9



Herschel/SPIRE 300-mK Strap System Requirements

Ref.: SPIRE-RAL-PRJ-001323
Issue: Draft 0.1
Date: 4 July 2002
Page: 4 of 9

1. Scope

This document lists the requirements on the Herschel/SPIRE 300-mK Thermal Strap subsystem. It refers to the hardware that provides the thermal link between the Sorption Cooler interface and the three Photometer BDAs and the two Spectrometer BDAs. The 300-mK Strap system includes the following items of hardware:

1. The support structure that locates and supports the strap .
2. The Cooler – Photometer BDA Strap
3. The Cooler to Spectrometer BDA Strap
4. The Photometer Detector Box Stray Light Baffle
5. The Spectrometer Detector Box Stray Light Baffle
6. The electrically isolating / thermally conductive joint at the cooler interface
7. The Photometer Thermal Control Hardware

2. Documents

2.1 *Applicable documents*

	Title	Author	Reference
AD1	Instrument Requirements Document	B.M. Swinyard	SPIRE-RAL-PRJ-000034 Issue 0.30
AD2	SPIRE Thermal Configuration Control Document	S. Heys	SPIRE-RAL-PRJ-000560, Issue D9
AD3	SPIRE Structural Mechanical I/F	B. Winter	MSSL/SPIRE/SP004.12

2.2 *Reference documents*

	Title	Author	Reference
RD1	SPIRE 300-mK Strap System Development Plan	D. Griffin	SPIRE-RAL-PRJ-001317
RD2	A stray-light baffle design for thermal strap entry ports	A G Richards	SPIRE-RAL-NOT-000344

3. Glossary

AD	Applicable Document
BDA	Bolometer Detector Assembly
CDR	Critical Design Review
DDR	Detailed Design Review
FPU	Focal Plane Unit
FS	Flight Spare
MGSE	Mechanical Ground Support Equipment



Herschel/SPIRE 300-mK Strap System Requirements

Ref.: SPIRE-RAL-PRJ-001323
Issue: Draft 0.1
Date: 4 July 2002
Page: 5 of 9

MSSL	Mullard Space Science Laboratory
PFM	ProtoFlight Model
PTC	Photometer Thermal Control
RAL	Rutherford Appleton Laboratory
RD	Reference Document
SLB	Stray-Light Baffle
SLB-Phot.	Photometer Detector Box Stray Light Baffle
SLB-Spect.	Spectrometer Detector Box Stray Light Baffle
TSS	300-mK Strap Support
TSS-PLW	The 300-mK Strap Support inside the Photometer Detector Box mounted near the PLW BDA
TSS-PMW	The 300-mK Strap Support inside the Photometer Detector Box mounted near the PMW BDA
UWC	University of Wales, Cardiff
DM	Development Model

4. Overview

A schematic layout diagram of the various components in system is shown in Figure 1. As can be seen from the Figure, the system is non-redundant. Any thermal short between the components at 300-mK and the Level-0 structure would result in either severely degraded instrument performance or loss of the instrument. Consequently, the reliability and robustness of the system is of paramount importance.



Herschel/SPIRE 300-mK Strap System Requirements

Ref.: SPIRE-RAL-PRJ-001323
Issue: Draft 0.1
Date: 4 July 2002
Page: 6 of 9

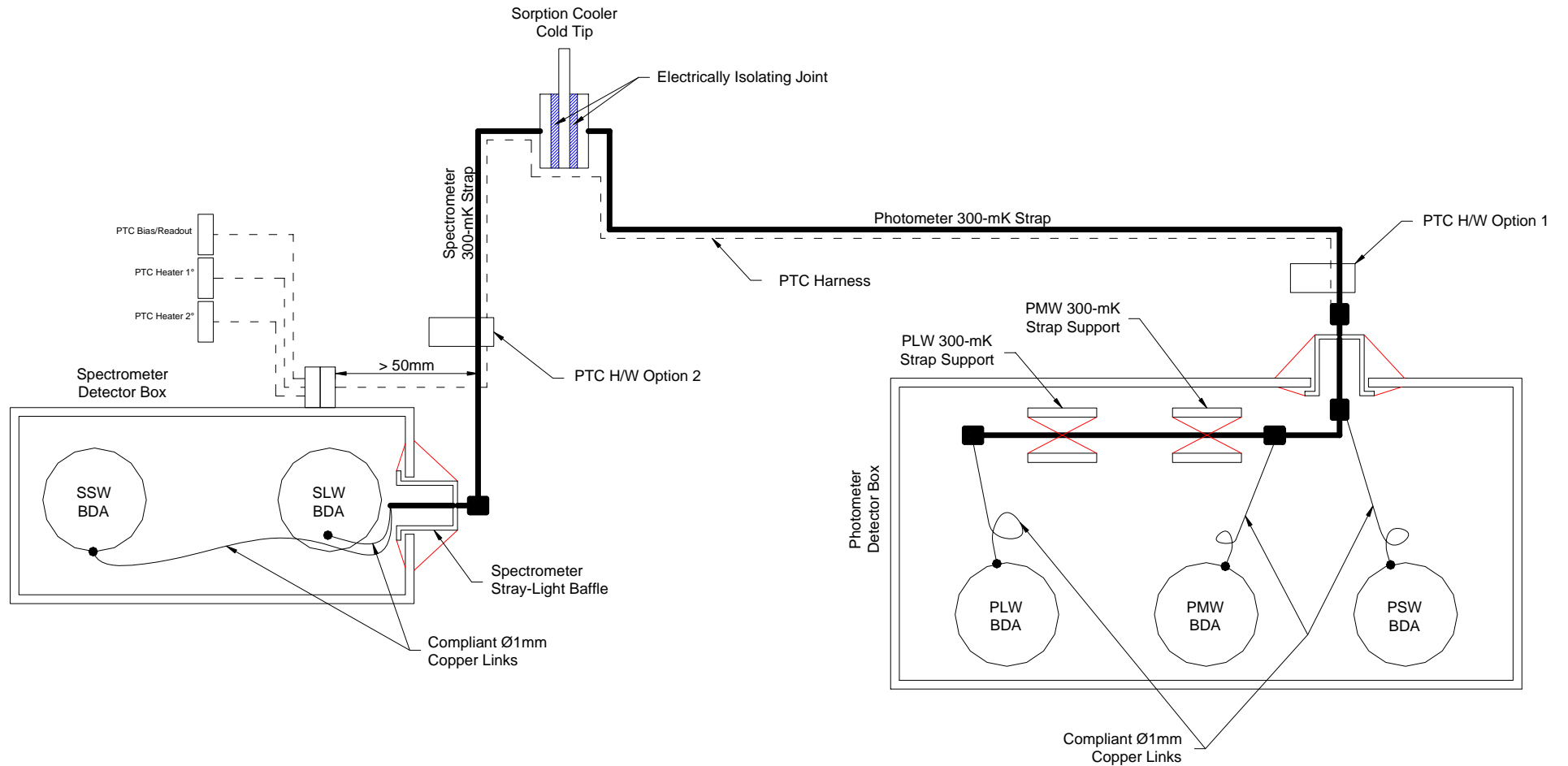


Figure 1 - Schematic diagram of 300-mK Strap System.



Herschel/SPIRE 300-mK Strap System Requirements

Ref.: SPIRE-RAL-PRJ-001323
Issue: Draft 0.1
Date: 4 July 2002
Page: 7 of 9

5. Requirements

5.1 Thermal

Requirement ID	Description	Value	Reference	Notes
STRAP-Req-01	Temperature drop across thermal link between detectors and evaporator cold tip	Maximum of 20mK	IRD-COOL-R03 IRD [AD1] TCC [AD2]	The thermal conductance between the sorption cooler interface (i.e. cold tip) and each of the spectrometer and photometer BDA interfaces (i.e. BDA temperature) shall be sufficient to provide a temperature drop of no more than 20mK at normal operating conditions as contained in the SPIRE Thermal Configuration Document. The boundaries are the cold tip side of the cooler interface and the BDA side of the BDA interface.
STRAP-Req-02	Strap Support and Stray-Light Baffles Parasitic heat load	Maximum of 2 μ W	TCC [AD2]	The parasitic heat load from the Level-0 structure to the Photometer Strap and the Spectrometer strap through the supporting structure.
STRAP-Req-03	PTC Hardware Parasitic heat load	Maximum of 0.2 μ W		This is the parasitic heat load through the Manganin wires between Level-0 and the PTC hardware mounted on the 300-mK Strap System

5.2 Accommodation and Mechanical Interface

Requirement ID	Description	Value	Reference	Notes
STRAP-Req-04	Accommodation	The 300-mK Strap system is to be supported entirely from the Level-0 Photometer and Spectrometer Detector Boxes.		
STRAP-Req-05	Mass	285g	AD 3 - §2.12.6	This includes the mass of the Photometer and Spectrometer Straps and Stray Light Baffles
STRAP-Req-06	First mode of vibration	>300Hz, goal > 400Hz		



Herschel/SPIRE 300-mK Strap System Requirements

Ref.: SPIRE-RAL-PRJ-001323
Issue: Draft 0.1
Date: 4 July 2002
Page: 8 of 9

Requirement ID	Description	Value	Reference	Notes
STRAP-Req-07	Qualification level random vibration loads.	0.5g ² /Hz between 100Hz and 400Hz. 6dB/octave roll-off below and above this.		This specification applies to all three axes
STRAP-Req-08	Qualification level Sine vibration loads	40g between 5Hz and 110Hz		This specification applies to all three axes
STRAP-Req-09	Interface surface finish	Gold plated to TBD thickness with TBD surface roughness.		
STRAP-Req-10	BDA Interface vibration loads	The strap is to transmit no more than TBD N to each of the BDAs via the Ø1mm high purity annealed copper wire while undergoing qualification level random vibration testing.		
STRAP-Req-11	Cooler Interface vibration loads	The straps are to transmit no more than TBD N to the cooler cold tip via the Photometer and Spectrometer cold straps while undergoing qualification level random vibration testing.		
STRAP-Req-12	BDA Interface static loads	In-orbit, the strap is to transmit no more than TBD N to each of the BDAs via the Ø1mm high purity annealed copper wire under conditions		
STRAP-Req-13	Cooler Interface static loads	In-orbit, the strap are to transmit no more than TBD N to the cooler cold tip via the Photometer and Spectrometer cold straps.		
STRAP-Req-14	PTC Accommodation	Provision is to be made for the mounting of the PTC hardware on either the Photometer Strap or on the Spectrometer Strap.		The PTC Hardware ICD is TBW
STRAP-Req-15	PTC Envelope	The PTC hardware is to mount onto a Ø3mm copper strap. The volume envelope for this is to be TBDmm x TBDmm x TBDmm.		The PTC Hardware ICD is TBW
STRAP-Req-16	PTC Mass	The mass of the PTC hardware is to be less than TBDg.		The PTC Hardware ICD is TBW

5.3 Optical

Requirement ID	Description	Value	Reference	Notes
STRAP-Req-17	Stray-light baffling effectiveness	The Photometer and Spectrometer Stray-Light Baffles are to provide at least four reflections for the shortest optical path between the Level-1 environment outside the detector box and the Level-0 environment inside the detector boxes.	IRD-STRP-R06 IRD-STRS-R06. [AD1]	These requirements on the stray-light shielding in terms of attenuation have in terms of been changed into geometric requirements. See RD02
STRAP-Req-18	Stray-Light Baffle Opacity	The Photometer and Spectrometer Stray-Light Baffles are to be opaque (>99.9%) in the wavelengths 0.5µm to 670µm	IRD-STRP-R06 IRD-STRS-R06. [AD1]	Since the attenuation requirement in the IRD has been translated into a geometric requirement, the opacity of the stray light baffle needs to be specified as well.



Herschel/SPIRE 300-mK Strap System Requirements

Ref.: SPIRE-RAL-PRJ-001323
Issue: Draft 0.1
Date: 4 July 2002
Page: 9 of 9

5.4 Bonding and Isolation

Requirement ID	Description	Value	Reference
STRAP-Req-19	Isolation of the Photometer strap from the Sorption Cooler cold tip and the spectrometer strap.	$> 1M\Omega$	Detector grounding "Tiger Team" verbal communication.
STRAP-Req-20	Isolation of the Spectrometer strap from the Sorption Cooler cold tip and the spectrometer strap.	$> 1M\Omega$	Detector grounding "Tiger Team" verbal communication.
STRAP-Req-21	Stray capacitance between the spectrometer strap and Sorption Cooler cold tip	$< 20pF$	Detector grounding "Tiger Team" verbal communication.
STRAP-Req-22	Stray capacitance between the photometer strap and Sorption Cooler cold tip	$< 20pF$	Detector grounding "Tiger Team" verbal communication.

End of Document.