SPIRE & PACS Sorption Coolers
INTERFACE CONTROL DOCUMENT

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Document Status

Issue	Revision	Date	Nb of pages	Modifications
0	0	10/04/2001	15	First draft

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List of Acronyms

AD	Applicable Document		
CEA	Commissariat à l' Energie Atomique		
CDR	Critical Design Review	Revue de conception détaillée	RCD
CQM	Cryogenic Qualification Model		
EV	Evaporator		
FIRST	Far Infrared and SubmillimetreTelescope		
FS	Flight spare		
HSE	Heat Switch (on evaporator)		
HSP	Heat Switch (on sorption pump)		
N/A	Not Applicable		
PACS	Photoconductor. Array Camera and Spectrometer		
PFM	ProtoFlight Model		
RD	Reference Document		
SAp	Service d'Astrophysique		
SBT	Service des Basses Températures		
SCO	Sorption Cooler (full unit)		
SP	Sorption pump		
SPIRE	Spectral & Photometric Imaging Receiver		
SST	Support Structure		
TS	Thermal Shunt		
TSES	Thermal Strap to Evaporator Switch		
TSPS	Thermal Strap to Pump Switch		

1 Scope of the document

This document defines the various interfaces between the ^{3}He sorption cooler and the SPIRE and PACS instruments. It comprises the mechanical, thermal and electrical interfaces. Both intruments share the same cooler design and consequently all interfaces are designed to be compatible.

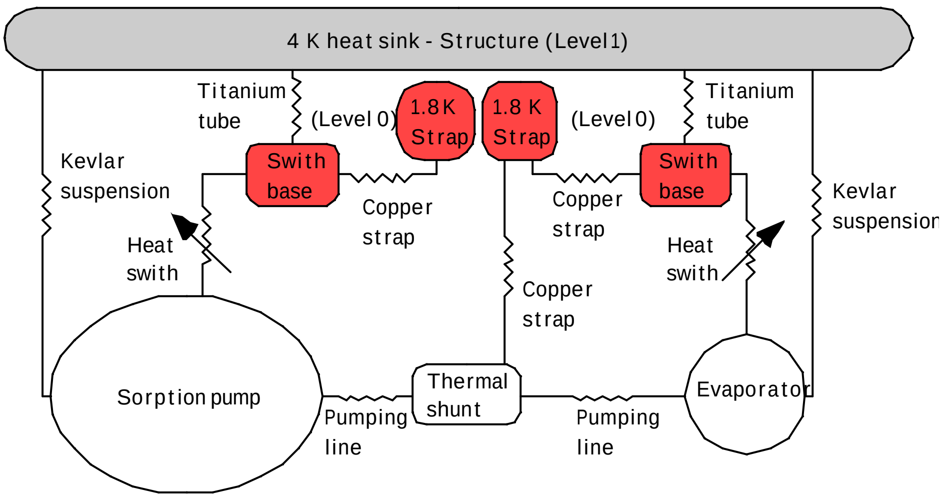
2 Documents

2.1 Applicable documents

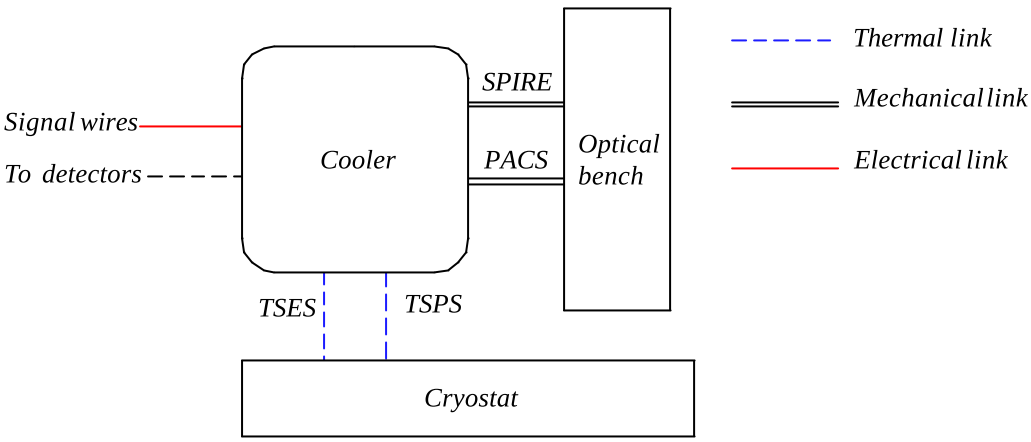
All Applicable Documents are listed in the AD chapter of the CIDL (HSO-SBT-LI-010).

3 Functional description and block diagram

The cooling of the SPIRE and PACS detectors down to 300 mK will be effected by helium three sorption coolers. Both instruments share the same cooler design and thermal architecture. For each the cooler is mounted off a 4 K structure with two thermal straps connected to the superfluid helium cryostat. The temperature of the structure and the cryostat are referred as respectively Level 0 and Level 1. This thermal architecture is represented on the figure below.



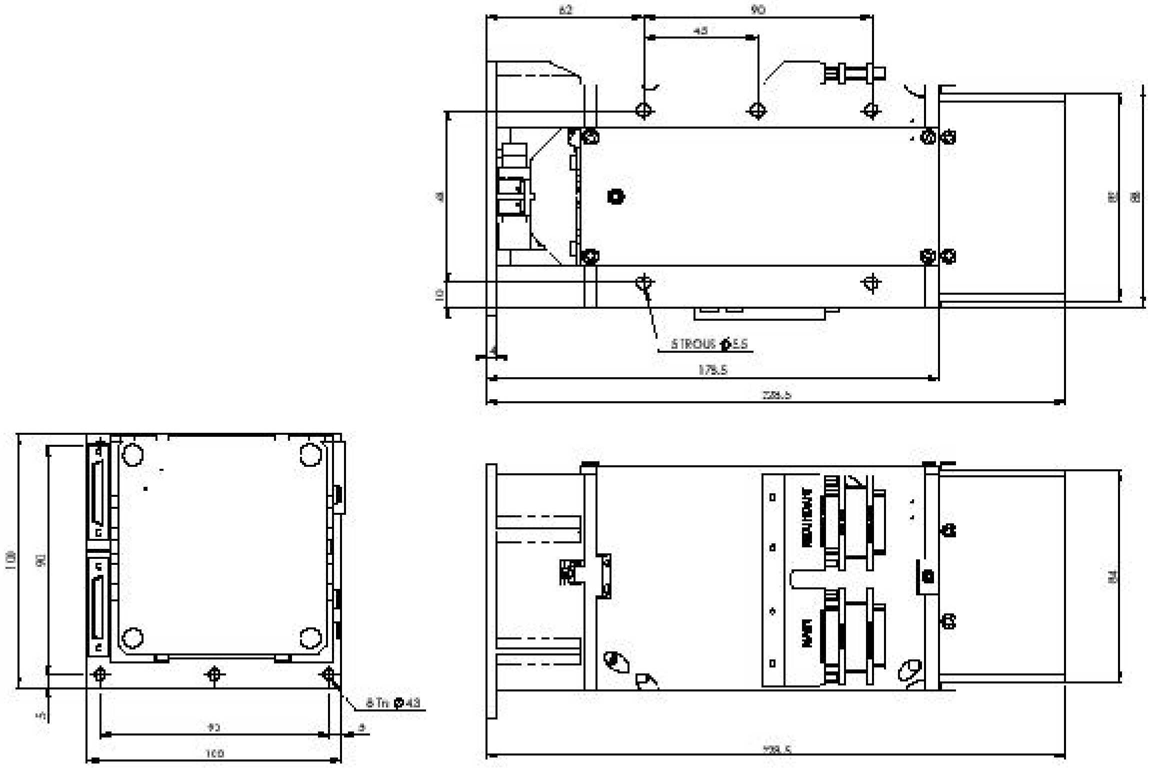
Thermal architecture



Block diagram

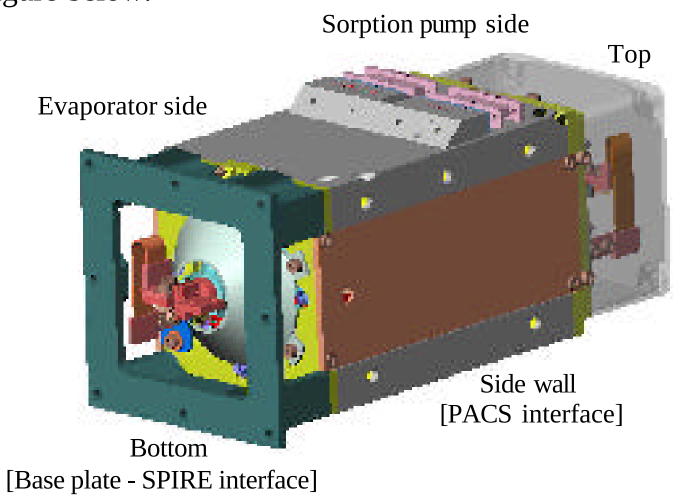
4 Mechanical interface

The cooler required volume is a rectangle parallelepiped of dimensions 228.5 mm x 100 mm x 100 mm. Reference drawing : 2000-14 B 000. ***Throughout this documents, unless otherwise specified, all dimensions are in millimeters***.



Cooler overall dimensions

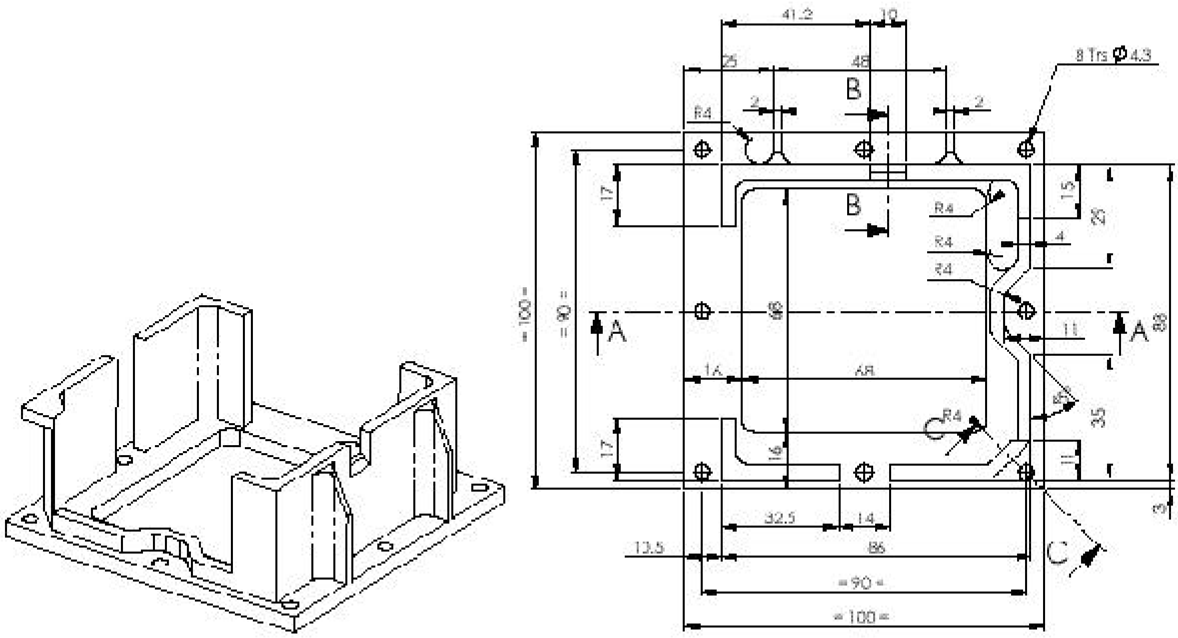
For the purpose of this discussion the top, bottom and sides of the cooler are defined as represented on the figure below.



The total overal mass of the cooler is about 1680 grams.

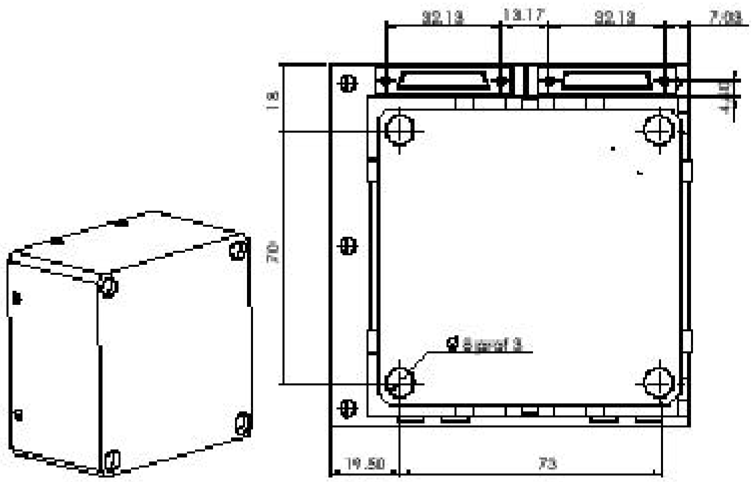
4.1 Cooler structure – SPIRE

Within the SPIRE instrument the cooler is mounted "vertically". The cooler interfaces with the structure with 8 through holes 4.3 mm in diameter located on the 100 mm x 100 mm bottom base plate, as defined on the following drawing.



3D view and interface drawing for cooler mounting

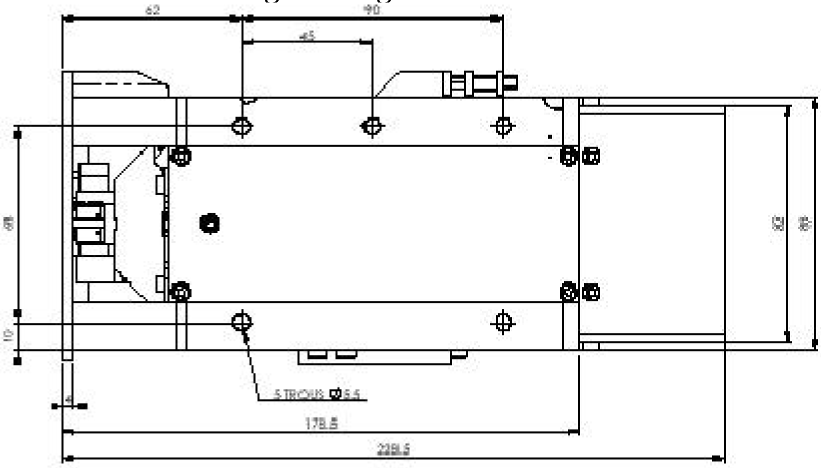
In addition the top cover features four holes as shown on the figure below. Part (or all) of these holes will be used as snubber(s): within SPIRE some extension(s) is (are) foreseen which insert in this (these) holes after the cooler is mounted, to prevent any excessive lateral motion.



3D view and interface drawing for top cover (sorption pump)

4.2 Cooler structure - PACS

Within the PACS instrument the cooler is mounted along one of its side. The cooler interfaces with the structure with 5 through holes 5.5 mm in diameter located on one of the side wall as defined on the following drawing.

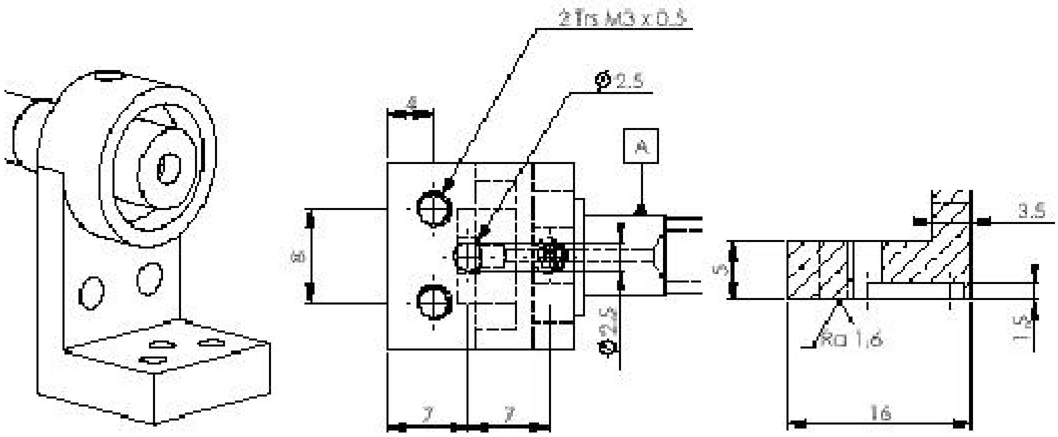


3D view and interface drawing for cooler mounting

4.3 Heat switches

The cooler comprises two gas gap heat switches. Each heat switch interfaces with a thermal strap (connected to the superfluid cryostat). The mechanical interface for both switches is similar and is a copper plate gold plated 16 mm x 16 mm featuring two M3 holes. This interface also features a tool designed to prevent any excessive torque on the gas gap heat switch when mounting the thermal strap. ***This tool is intended to be used only while screwing the strap and must be removed before cooler operation***. The recommended torque for the screws is TBD Nm.

It is important to note that any excessive mechanical load on this interface must be avoided and shall in any case never exceeds 80 Nw in any directions.



3D view and interface drawing for heat switch base / thermal strap

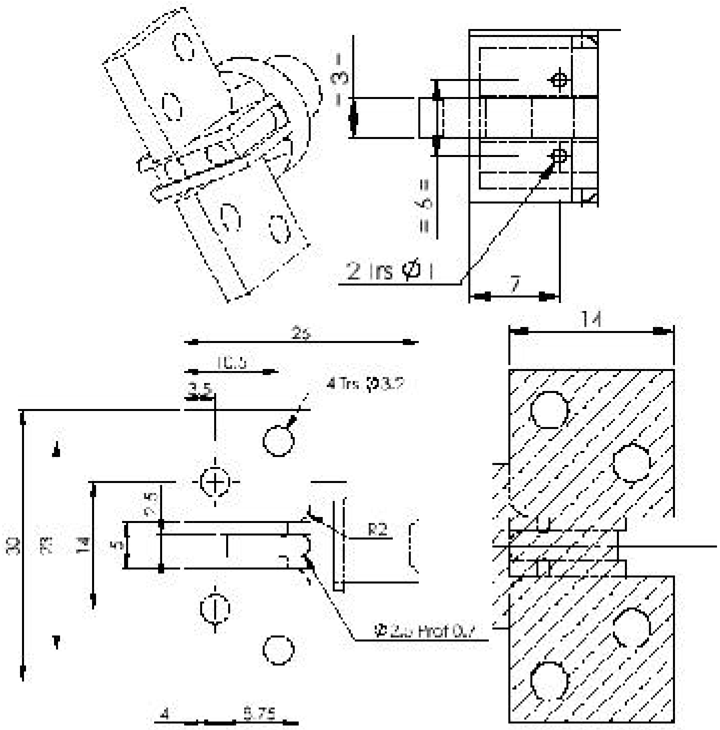
4.4 Evaporator cold end

The evaporator cold end interfaces with a 300 mK thermal strap which is then splitted and connected to the detectors. This interface is a copper piece gold plated 14 mm x 12.5 mm, 3 mm thick, featuring two through holes 3.2 mm in diameter. Each side of the copper piece is available as a contacting area.

The quality of this interface is critical to the performance of the cooler.

Any excessive troque or bending force on this interface must be avoided. Always use two wrenches (one on each side) when tightening screws on the cold head.

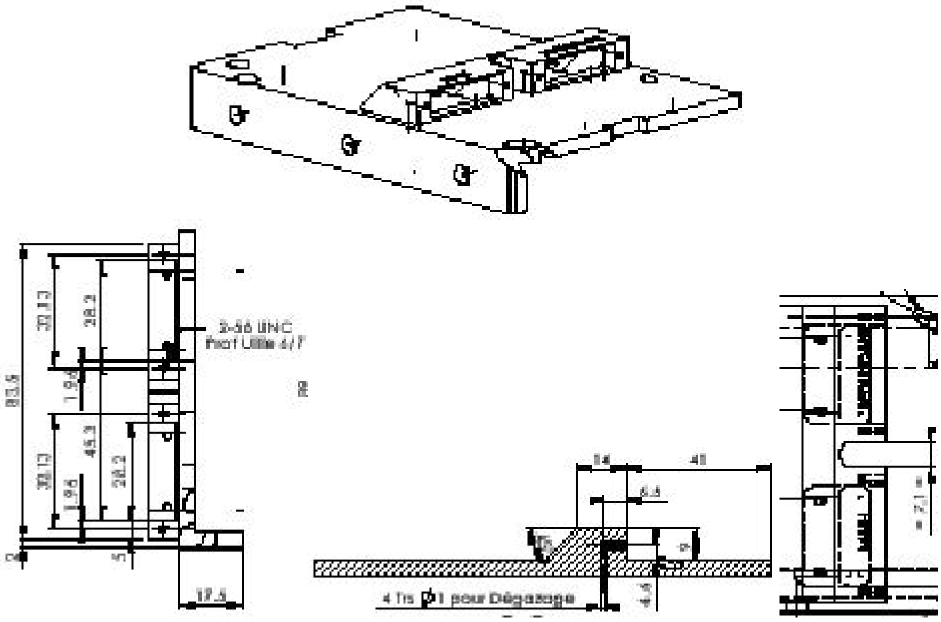
The mounting of the 300 mK thermal strap to the cold end must be performed by trained people. A specific procedure will be established.



3D view and interface drawing for evaporator cold end / 300 mK thermal strap

4.5 Electrical connector

Two electrical connectors type MDM 37 pins (main and redundant) are provided for the cooler operation. These connectors are supported by a bracket included in the structural box and located on the side of the cooler as shown on the following drawing.



3D view and interface drawing for connector / connector

5 Thermal interface

Informations of the mechanics of the thermal interfaces are given in the previous paragraphs. In these paragraphs, we define only the interfaces from the thermal point of view.

The maximum storage temperature is 353 K (80 °C). There is no minimum storage temperature. The thermal interfaces are defined in functional conditions.

5.1 Cooler structure

The structure of the cooler is mounted on a 4 K structure.

5.2 Heat switches

The cooler comprises two identical gas gap heat switches. They both interface with a strap (one each) thermally connected to the 1.8 K superfluid tank. The two straps are different due to the difference in power flowing to the cryostat from one strap to the other (see hereafter). The interface with the switch to the sorption pump (TSPS) is less critical as it is possible to have this interface temperature raise to 10 K (TBD) during recycling. On the contrary the interface to the evaporator switch has a significant impact on the performance. During the recycling process this interface must be kept as close as possible to the cryostat temperature to guarantee good condensation efficiency, minimal cooldown losses, etc… for the cooler.

5.2.1 Sorption pump heat switch

(related to TSPS)

Temperature range (K)	1.8	10 (TBD)
Heat flow range (mW)	= 2 mW*	= 1 W

(* : this number is a function of the detectors dissipation)

5.2.2 Evaporator heat switch

(related to TSES)

Temperature range (K)	1.8	1.8 + ε
Heat flow range (mW)	= 1 mW	= 50 mW

5.3 Evaporator cold tip

Temperature range (K)	0.29	1.8
Heat flow range (μW)	20	-

6 Electrical interface

All thermometers used are Cernox thermometers type 1030 with SD package (supplier : LakeShore) measured in four wires mode.
All heaters used are high reliability metal film resistors 402 Ohms resistance type RLR/2H3 (TBC) (supplier : Vishay/Sfernice) driven by four wires.
Two electrical connectors type MDM 37 pins (supplier : Canon) are used, one prime and one redondant. The wiring of both connectors is identical.
All wiring is made using manganin wires.

Signal	Pin n°	Wire diam.	Max. current	Remarks
SP temperature I+	1	TBD (0.2 ?)	1 µA	
SP temperature V+	2	"	N/A	
SP temperature V-	3	"	N/A	
SP temperature I-	4	"	1 µA	
EV temperature I+	5	0.1 mm	250 nA	
EV temperature V+	6	"	N/A	
EV temperature V-	7	"	N/A	
EV temperature I-	8	"	250 nA	
HSP pump temperature I+	9	TBD (0.2 ?)	1 µA	
HSP pump temperature V+	10	"	N/A	
HSP pump temperature V-	11	"	N/A	
HSP pump temperature I-	12	"	1 µA	
HSE pump temperature I+	13	TBD (0.2 ?)	1 µA	
HSE pump temperature V+	14	"	N/A	
HSE pump temperature V-	15	"	N/A	
HSE pump temperature I-	16	"	1 µA	
Thermal shunt temperature I+	17	TBD (0.2 ?)	1 µA	
Thermal shunt temperature V+	18	"	N/A	
Thermal shunt temperature V-	19	"	N/A	
Thermal shunt temperature I-	20	"	1 µA	
SP heater I+	21	TBD (0.2 ?)	25 mA	
SP heater I+	22	"	"	
SP heater I-	23	"	"	
SP heater I-	24	"	"	
EV heater I+	25	0.1 mm	1 mA	
EV heater I+	26	"	"	
EV heater I-	27	"	"	
EV heater I-	28	"	"	
HSP heater I+	29	TBD (0.2 ?)	1.5 mA	
HSP heater I+	30	"	"	
HSP heater I-	31	"	"	
HSP heater I-	32	"	"	
HSE heater I+	33	TBD (0.2 ?)	1.5 mA	
HSE heater I+	34	"	"	
HSE heater I-	35	"	"	
HSE heater I-	36	"	"	
Not used	37			

7 Appendix – General interface drawing