Title: **Harness Requirements, Documents and Verification Approach**

CI-No: 121 430

Prepared by:	for A. Knoblauch	J. Kroeker	Date: 5.08.2005
Checked by:	J. Kroeker	J. Kroeker	5.8.2005
Product Assurance:	for R. Stritter	B. Dalage	5.8.2005
Configuration Control:	W. Wietbrock	W. Wietbrock	5.8.2005
Project Management:	Dr. W. Fricke	Fricke	05/08/2005

Distribution: See Distribution List (last page)

Issue	Date	Sheet	Description of Change	Release
1	28.01.05	All		
2	28.06.05		Consideration of ASP comments where relevant (e-mail G.B. 18.02.05).	

Table of Contents

1 Scope

This technical note provides the harness verification method as derived from the Verification Control Documents for the overall harness requirements. The typical Instrument specific harness requirements are provided as defined in the IIDBs. This document summarizes the harness relevant documents as provided by ASED, CASA and ASSE. It shows which requirement is covered in which document. Finally is describes the harness verification approach.

2 Documents

2.1 Applicable Documents

[AD1] H-EPLM Requirements Specification, Doc. No.: HP-2-ASPI-SP-250, Issue 3.3; date 20.10.2004

[AD2] General Design & Interface Requirements Specification (GDIR); H-P-1-ASPI-SP-0027;Issue: 5.0 Rev. 0; date 07.10.2004

[AD3] HPLM Interface Specification; H-P-2-ASPI-IS-0039; Issue: 06 Rev. 0, date 07.10.2004

[AD4] HERSCHEL IID – Parts B HIFI; SCI-PT-IIDB-HIFI-02125; Issue 03 Rev. 02

[AD5] HERSCHEL IID – Parts B PACS; SCI-PT-IIDB-PACS-02126; Issue 3.3

[AD6] PACS-MA-SP-001;issue 3.4

[AD7] ;HERSCHEL IID – Parts B SPIRE; SCI-PT-IIDB-SPIRE-02124; Issue 03 Rev. 03

[AD8] Herschel Telescope EICD; HER-NT-0187-T-ASTR; 4.0, date 19.11.2004

2.2 Reference Documents

[RD1] H-EPLM Electrical ICD / PFM; HP-2-ASED-IC-0001;

[RD2] CCH EICD; HP-2-ASED-IC-0013;

[RD3] HIFI EICD; HP-2-ASED-IC-0014;

[RD4] PACS EICD; HP-2-ASED-IC-0015;

[RD5] SPIRE EICD; HP-2-ASED-IC-0016

[RD6] CRYO-HARNESS INPUT TO THERMAL ANALYSIS; HP-2-ASED-TN-0010;

[RD7] Electrical Interfaces of Herschel Cryogenic Components to Harness; HP-2-ASED-TN-0063;

[RD8] Cryo Harness Branch Characteristics; HP-2-ASED-TN-0085;

[RD9] CVV External Cryo Harness Definition Document; HP-2-ASED-TN-0007

[RD10] Cryo Harness Description; HP-2-ASED-TN-0103; 1

[RD11] CVV Internal Harness Definition Document; HP-2-CASA-TN-0002;

[RD12] ASED Cryo Harness CIDL PFM; HP-2-ASED-CD-0004; issue 2

[RD13] ASED Cryo Harness CIDL EQM; HP-2-ASED-CD-0005; issue 2; date 12111.2004

[RD14] CVV Internal Harness Definition Document ;HP-2-CASA-TN-0001

[RD15] PACS Cryo Harness Interconnection Diagram; HP-2-ASED-ID-0089-01-0B

[RD16] CVV External Cryo Harness Definition Document HP-2 ASSE-TN 0007;

[RD17] Cable Capacitance & Inductance Measurement Results; HP-2-CASA-RP-0016

3 Requirements and Verification

3.1 HERS Requirements and Verification (Excerpt of HP-2-ASED-VC-0004)

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
0470	The H-EPLM shall provide the harness to allow decontamination heating of the Telescope. The Telescope electrical hardware (harness and connectors) can be classified in 2 categories: Telescope heating harness Telescope thermal sensors harness See AD-4 for telescope harness interface detailed requirements	E	EQ		Contamination Control Plan	HP-2-ASED-RP-0003		Covered by Herschel EPLM Interface Specification H-P-2-ASPI-IS-0039	See I/F part
2600	The harness shall connect: the cold/warm units of the instruments as defined in IIDB (AD6 AD7 &AD8) sensors and actuators to CCU according to Interface Specifications AD23.	E	EQ					Covered inAD6– Part B SCI-PT-IIDB/HIFI-02125 AD7–Part B SCI-PT-IIDB/PACS-02126 AD8-Part B SCI-PT-IIDB/SPIRE-02124	See IIDB part

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
2610	For ground operations, a connector bracket for EGSE interface shall be implemented.	E	MO		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100			closed
2620	The harness shall provide adequate distribution and separation of all power supply lines, analogue and digital data lines, command and actuation pulse and stimuli lines between all units of the SVM subsystems and those lines to the H-EPLM and Telescope interfaces, the test connectors, the safe/arm brackets and connectors and the umbilical connectors.	E	MO		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100			closed
2630	The harness shall transmit all electrical currents in a manner compatible with the requirements of the source and destination unit/interface.	A	MO		E-ICD	HP-2-ASED-IC-0001		See also HP-2-ASED-IC-0013; HP-2-ASED-IC-0014; HP-2-ASED-IC-0015; HP-2-ASED-IC-0016	closed
2630	The harness shall transmit all electrical currents in a manner compatible with the requirements of the source and destination unit/interface.	A	EQ		E-ICD	HP-2-ASED-IC-0001		See also HP-2-ASED-IC-0013; HP-2-ASED-IC-0014; HP-2-ASED-IC-0015; HP-2-ASED-IC-0016	closed

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
2640	The isolation requirements between leads, which are not connected together and between shield and centre conductor and shield to shield shall be at least 10 Mohm under 500 V DC at both polarities.	T	EQ		Test report As-built CCH Tests	HP-2-CASA-DP-0005 / DP-0010/ DP-0011			open
2640	The isolation requirements between leads, which are not connected together and between shield and centre conductor and shield to shield shall be at least 10 Mohm under 500 V DC at both polarities.	T	MO	HEPLM PFM				Isolation testing on module level will be done with IDAS at 100V	open
2650	The loop resistance shall be optimised to insure the best compromise between the dissipation and thermal conductivity and the harness mass.	A	MO		CRYO-HARNESS INPUT TO THERMAL ANALYSIS	HP-2-ASED-TN-0010			closed
2660	The mechanical construction of the harness shall assure the reliable operation of the H-EPLM	E	MO		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100		See also Harness Drawings	closed
2670	No piece of harness shall be used as a mechanical support.	E	MO		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100		Inspection at HEPLM PFM level; see also harness drawings	closed

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
2750	The harness shall comply with the EMC Requirements mentioned in section 5.6.4.	T	MO		H-EPLM EMC Testreport	HP-2-ASED-TR-XXXX		See section 4.4.6 ? HERS1040, HERS1050, HERS 1100, HERS 1110	open
2770	Twisted power lines shall be pre-manufactured by the supplier to achieve the best magnetic compensation.	E	MO		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100		See also EICD; HP-2-ASED-IC-0001;	closed
2780	Other lines shall be twisted as far as practicable with their corresponding return path, or shall run adjacent to the reference grounds to minimise magnetic loops.	E	MO		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100		See also EICD; HP-2-ASED-IC-0001;	closed
2790	Harness shielding shall preferably be made by means of overall shielding. No overshielding inside the cryostat is required	E	MO		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100		See also EICD; HP-2-ASED-IC-0001;	closed
2900	The power transmission elements such as connectors and harness shall be redundant.	E	MO		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100		See also EICD; HP-2-ASED-IC-0001;	closed

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
3200	Harness shall be divided -power harness -instrumentation harness -grounding harness The power and grounding harness shall be redundant The power and grounding harness shall use common nominal and redundant SVM interface connectors.	E	MO		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100		See also EICD; HP-2-ASED-IC-0001; Telescope HTR is not redundant	closed
3210	Power harness shall be twisted but not shielded.	E	MO		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100		See also EICD; HP-2-ASED-IC-0001;	closed

3.2 Verification of GDIR

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
GDEL-175	All unmated connectors shall be completely capped with conductive covers prior to launch.	E	MO		EICD;	HP-2-ASED-IC-0001;			closed
GDEL-195	Braided overshields with greater than 85 % coverage shall be required on all cabling outside of the spacecraft.	E	MO	H-EPLM	Bonding Diagram				
GDEL-200	Diameter of braid strands shall be 0.1 mm or larger.							Diameter =.05 mm will used by ASED due to thermal reasons, ASED will raise RfD	
GDEL-205	Each overshield shall be grounded to structure prior to entering the spacecraft or any external, closed Faraday chamber.	E	MO	H-EPLM	Bonding Diagram			See also EICD; HP-2-ASED-IC-0001;;	closed
GDEL-282	The exposed harness di-electric charging shall be taken into account and appropriate design provisions shall be taken.	E	S/C		Grounding Diagramm			Over-shielding of all space exposed harness and proper grounding concept has been applied.	C
GDEL-300	Physical separation along common runs of the categories listed below …… shall be retained between these categories…..							RfD is raised	
GDEL-305	All equipment shall use a separate connector dedicated to its functional interface,							RfD is raised	

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
GDEL-310	Wiring of redundant systems, subsystems or units of subsystems shall be routed through separate connectors and wire bundles.							RfD is raised	
GDEL-315	Redundant wire bundles shall be routed differently wherever possible.							"Wherever possible" covers cases when separate routing of nominal and redundant bundles is not possible due to physical constraints.	
GDEL-320	Cross strapping of redundant paths and circuits shall not be carried out in the harness.				EICD	HP-2-ASED-IC-0001			
GDEL-325	The pyrotechnic harness shall satisfy the applicable safety requirements.							Not applicable since no pyrotechnics are used in the H-EPLM.	
GDEL-330	Connections to the initiators shall be capable of being mechanically broken during ground handling by safe/arm connectors accessible from the outside of the spacecraft.				EICD	HP-2-ASED-IC-0001			C

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
GDEL-335	The shields of cables shall not be used as return lines							IID-A section 5.14.2.9 explicitely agrees that the requirement that shields shall not be used for return lines do not apply to PACS triax. No RFD needed	
GDEL-337	All hot/return lines shall be twisted together				EICD	HP-2-ASED-IC-0001			
GDEL-350	The design shall ensure that 20% of the pins remain available at PDR for all foreseeable subsystem and experiment functions, and 10% at CDR							ASED has raised a RfD HP-2-ASED-RD-0018	
GDEL-355	All individual wire-to-pin interfaces shall be covered with transparent heat shrink sleeves	E	MO						
GDEL-360	The possibility of incorrect mating of connectors shall be excluded by design.							ASED will raise RfD HP-2-ASED-RD-0018	
GDEL-365	The harness connectors shall be easily accessible, attachable, and removable from the corresponding unit connectors	E	MO					Not applicable Unit requirement	c
GDEL-370	The harness shall be fixed onto the structure in order to avoid any damage during launch phase.	E	MO						

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
GDEL-375	Fixation of sensitive signal lines shall be such as to avoid micro-phonic noise.	E	MO						
GDEL-380	The harness restraining systems on the structure shall not bring about any stress at connector level.	E	MO					stresses are allowed, however the function of the harness has to be maintained at environmental conditions	
GDEL-385	The harness linking equipment mounted in or on the payload module, with the service module shall be such that the heat transferred by conduction is optimised for electrical and thermal performances	E	MO		CRYO-HARNESS INPUT TO THERMAL ANALYSIS	HP-2-ASED-TN-0010			
GDEL-390	Permanent connections installed for the purposes of test at integrated satellite level shall be routed to skin connectors of the modules concerned	E			EICD	HP-2-ASED-IC-0001		See HP-2-ASED-ID-0081	
GDEL-395	Skin connectors shall also be provided to make-or-break power circuits.				CVV external SIH and CCH Drawings	HP-2-ASED-ID-0081			
GDEL-400	All these skin connectors shall be closed by caps, bridging connectors, and thermal insulation for flight.	E	MO						
GDEL-420	Connectors shall be selected from the EEE part list and contain only gold plated contacts.	E	MO					except for connectors where non gold contacts are approved by FPCB	

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
GDEL-430	Connectors at interfaces shall be clearly identified.	E	MO	CVV external SIH and CCH Drawings	HP-2-ASED-ID-0081				
GDEL-435	That applies to equipment connectors as well to interface brackets connectors	E	MO	CVV external SIH and CCH Drawings	HP-2-ASED-ID-0081			Potted Contacts agreed as long as connectors without removable contacts are approved by FPCB	
GDEL-445	The harness connector identification shall comply with requirements below :	E	MO						
GDEL-450	Mechanical methods in conjunction with identification markings shall be employed to prevent incorrect mating of connectors.	E	MO						
GDEL-455	To establish the electrical configuration at interfaces, the Interface Data Sheets shall include the following				EICD	HP-2-ASED-IC-0001		See Bonding Diagram	
GDEL-465	In addition, a description diagram of optional detail shall indicate the layout of connectors and their position relative to the structure.	E	MO	CVV external SIH and CCH Drawings	HP-2-ASED-ID-0081				

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
GDEL-470	The connector designation of design authority and manufacturer, including keyway and insert arrangements, shall be indicated.							"designation of design authority" refers to the designation in the standard (e.g. MIL or SCC)	
GDEL-475	Critical cable lengths, for voltage drop reasons for instance, must be shown where applicable.	E	MO		CRYO-HARNESS INPUT TO THERMAL ANALYSIS	HP-2-ASED-TN-0010			
GDEL-480	For test purpose, flight connectors shall be protected against multiple mating/demating operations by connector savers.	E	MO					Integration Procedures	
GDEL-485	Such connector savers shall be a flight type connector								
GDEL-490	The twisted wires shall be routed through a connector on adjacent pins to minimize the wire loop.	E	MO		EICD	HP-2-ASED-IC-0001			
GDEL-495	Signal interface harnesses, in general shall be constructed using twisted shielded wires.	E	MO		EICD	HP-2-ASED-IC-0001			
GDEL-500	Power lines shall be twisted pairs.	E	MO		EICD	HP-2-ASED-IC-0001			

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
GDEL-505	The pyrotechnic harness shall consist of twisted pairs of wires with an overall shield being continuous and connected to the conductive connector shells	E	MO		EICD	HP-2-ASED-IC-0001			
GDEL-510	Neither the structure nor any cable shield shall be used to carry bus power return.	E	MO		EICD	HP-2-ASED-IC-0001			
GDEL-515	Shields shall always be connected to connector shells which will be grounded at any intermediate connectors.	E	MO		EICD	HP-2-ASED-IC-0001		SPIRE requests individual shielding and daisy chains	
GDEL-525	The resistive between cable shield and the adjacent grounding point shall be less than 2.5 mΩ.	E	MO					Problems are expected to measure compliant resistance values (Agreed as per HP-2-ASED-MN-413, 26.06.03)	
GDEL-530	For sensitive and critical functions, overshield shall be added that is continuous from the backshells of each of the associated unit connectors.	E	MO		EICD	HP-2-ASED-IC-0001			
GDEL-535	Every cable submitted to the external environment (i.e. external to the Spacecraft) shall be overshielded.	E	MO		EICD	HP-2-ASED-IC-0001			
GDEL-540	The wiring including pins and sockets of connectors shall be made redundant at all critical interfaces							Not relevant for H-EPLM	

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
GDEL-545	When equipment is made redundant, the associated wiring shall be redundant in the same manner	E	MO		EICD	HP-2-ASED-IC-0001			
GDEL-547	Wire type shall be selected from the ESA EEE preferred Parts List unless explicitly specified by the detailed interface requirements.	E	MO		CRYO-HARNESS INPUT TO THERMAL ANALYSIS	HP-2-ASED-TN-0010			
GDEL-550	Crimping method shall meet the requirements of AD- 38.	E	MO					ESA ECC processes are used	
GDEL-555	Everywhere crimping and soldering methods are usable, for the same type of connectors, crimping ones shall be preferred.	E	MO		EICD	HP-2-ASED-IC-0001			
GDEL-565	Soldering method shall meet the requirements of AD- 39.							Qualified processes are used	
GDEL-570	The maximum current allowed per type of gauge shall not exceed the value given in Table 6-2	E	MO		EICD	HP-2-ASED-IC-0001			
GDEL-665	Insulation quality shall be as specified for 100 VDC at both polarities	E	EQ						

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
GDEL-670	For purposes of verification, this 100 VDC (+ 5 V, - 0 V tolerance) shall be applied at a rate of not less than 50 V/s for a test period of 60 (+ 10, - 0) seconds	T	EQ						

3.3 Verification of I/F Spec

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
ME-065	The interface of the electrical connection of the solar array harness on the SVM shall be according to drawing ME.HES.A16G.S.001SA specified in AD-26. The share of responsibilities for the SVM/PLM electrical hardware (harness and connectors) is defined in chapter 5.5 of this specification.	E	EQ		Solar Array ICD				c
HEIF-ME-140	The cryo-harness routing on SVM will be defined by the PLM Contractor with respect of the allocated volume defined by the Prime. The harness fixation concept and hardware manufacturing / procurement shall be under PLM responsibility. The harness integration shall be under PLM responsibility.	E	MO		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100		see harness drawings	closed
HEIF-ME-145	The cryo-harness bracket shall be provided by the PLM Contractor.	E	MO		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100			closed

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
HEIF-ME-147	Cryo-harness brackets and standoffs interface to the SVM shall be according to the drawing ME.HES.S14H.S.001SA specified in AD-26. o The Telescope electrical hardware (harness and connectors) can be classified in 2 categories : − Telescope heating harness − Telescope thermal sensors harness H-EPLM responsibility extends from SVM I/F bracket to telescope I/F bracket.	E	MO		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100			closed
HEIF-ME-230	The definition and supply of the Telescope electrical hardware shall be under PLM responsibility.	E	EQ			HP-2-ASED-ID-0081			closed
HEIF-ME-240[	Telescope electrical hardware responsibility share shall be as per cryo harness.	E	EQ			HP-2-ASED-ID-0081			closed

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
HEIF-TH-260	Definition of additional cryo-harness linking elements in the PLM to the CCU shall be under PLM responsibility and shall be included in the TMM.	A	MO	HEPLM PFM	HEPLM PFM Thermal Model and Analysis	PFM HP-2-ASED-RP-0011		The thermal analysis uses the values as provided in HP-2-ASED-TN-0010	closed
HEIF-TH-270	Each harness TMM shall take into account the over-shielding of the bundles as defined for EMC purpose.	A	MO	HEPLM PFM	HEPLM PFM Thermal Model and Analysis	PFM HP-2-ASED-RP-0011		The thermal analysis uses the values as provided in HP-2-ASED-TN-0010	closed
HEIF-TH-290	The thermal loads through the harness used to power telescope decontamination heaters and through the associated thermal sensor harness shall be taken into account in the TMM. Definition of this harness shall be under PLM responsibility.	A	MO	HEPLM PFM	HEPLM PFM Thermal Model and Analysis	PFM HP-2-ASED-RP-0011		The thermal analysis uses the values as provided in HP-2-ASED-TN-0010	closed

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
HEIF-EL-025 a	The telescope decontamination heaters shall be compatible with the 9 power lines provided by the HERSCHEL SVM. For 7 heater lines, total harness resistance (hot+return) from SVM bracket to telescope bracket shall be 0.9 Ohm +/- 10 %. For the 2 remaining heater lines, total harness resistance (hot+return) from SVM bracket to telescope bracket shall be 1.36 Ohm +/- 10 %. Maximum current line in the wire is 4 A							Obsolete requirement Up-date to be done by ASP	
HEIF-EL-090 a	The H-EPLM shall be provided by the SVM with two power lines (1N+1R) for NCA actuation.	E	EQ		Cryo-Harness Baseline Definition PFM	HP-2-ASED-TN-0100			closed

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
HEIF-EL-100a	The H-EPLM shall provide the SVM with 2 DRS lines corresponding to the N and R NCA status. DRS lines electrical characteristics shall be as defined in §6.8.2.4 of the GDIR (see AD-8). The detailed interfaces of these NCA lines are given in §6.7.13 of the GDIR (see AD-8). The Solar Array electrical interfaces are specified in the HERS (see RD-1).In addition :	E	MO	HEPLM PFM	HEPLM PFM Electrical ICD / PFM	HP-2-ASED-IC-0001		see GDIR	closed
HEIF-EL-140	The SVM / H-EPLM interface shall be as shown in block diagram Fig. 5.1-1.	E	MO	HEPLM PFM	HEPLM PFM Electrical ICD / PFM	HP-2-ASED-IC-0001			closed

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
HEIF-EL-150	The harness from the telescope to the SVM platform shall be routed as defined in the drawing ME.HES.S14H.S.001SA "I/F cryo harness on SVM" specified in AD-26. Note : The harness from the telescope to the SVM platform consists in : − the harness from the telescope decontamination heaters to the SVM ; − the harness from the telescope operation temperature sensors to the CCU.	E	MO	HEPLM PFM	HEPLM PFM Electrical ICD / PFM	HP-2-ASED-IC-0001			closed

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
HEIF-EL-160	The harness from the cryo-cover to the SVM platform shall be routed as defined in drawing ME.HES.S14H.S.001SA "I/F cryo harness on SVM" specified in AD-26. Note : The harness from the cryo-cover to the SVM platform consists in : − the harness from the NCA DRS to the SVM ; − the power harness from the NCA to the SVM.	E	MO	HEPLM PFM	HEPLM PFM Electrical ICD / PFM	HP-2-ASED-IC-0001			closed

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
HEIF-EL-170	The harness from the PLM cryostat vessel to the SVM platform shall be routed as defined in drawingME.HES.S14H.S.001SA "I/F cryo harness on SVM" specified in AD-26. Note : The harness from the cryostat vessel to the SVM platform consists in : − the harness from the cryostat vessel temperature sensors to the CCU ; − the harness from the cryostat vessel valves to the CCU ; − the harness from the cryostat vessel heaters to the CCU.	E	MO	HEPLM PFM	HEPLM PFM Electrical ICD / PFM	HP-2-ASED-IC-0001			closed
HEIF-EL-180	The cryo-harness between PLM and CCU shall be defined by the PLM contractor.	E	MO	HEPLM PFM	HEPLM PFM Electrical ICD / PFM	HP-2-ASED-IC-0001			closed
HEIF-EL-190	The cryo-harness shall be as defined in the instruments IID part B's.							See IIDB part	closed

Req. Identifier	Requirement	Verif. Method	Verif. Level	Model	Reporting Document Title	Reporting Document Reference	Reporting Document Paragraph	Remarks	Execution Status
HEIF-EL-200	The harness from the Sunshield to the SVM shall be routed as defined in drawing ME.HES.A16G.S.001SA "I/F SVM SA skin connectors" specified in AD-26. The interface connectors shall be located on the SVM upper platform as shown on the drawing ME.HES.A16G.S.001SA "I/F SVM SA skin connectors" specified in AD-26. Note : The harness from the Sunshield to the SVM consists in : − the power harness carrying the 30 sections to the SVM ; − the harness from the Solar Array temperature monitoring sensors to the SVM.	E	MO	HEPLM PFM	HEPLM PFM Electrical ICD / PFM	HP-2-ASED-IC-0001			

3.4 PACS Specific Requirements (chapter number refer to the IIDB)

The PACS specific requirements are provided in ref: [AD6]

4 Harness Diagrams

The Harness design is provided in the PACS Cryo Harness Interconnection Diagram; HP-2-ASED-0089-01-0B

5 Harness Tables

Cable ID	Description	Location	# wires SST	# wires brass	Wire size [AWG]	Number of shields	max. resist. [Ohms]	max. capacity [pF]	max. curr. [mA]	nom. curr. [mA]	max volt. [V]	Duty cycle	EMC class	cross sect SST	cross sect insul	cross sect brass	Possible cable types CVV int.,CVV ext.	Possible cable types SVM	Remarks
001	Shielded cable, CRE DC/logic supply 1	FPFPU P11	10	0	38	1	400 / 800	2000	0.1	0.03 0.01	10	0.5	3				1ST11C38SS	1ST03C28CC 1ST06C28CC	CRE supply and control signals; for VDDd lower resistance required -> 2 wires in parallel, 30µA
002	Shielded cable, CRE DC supply 1	FPFPU P10	24	0	38	1	400 / 800	2000	0.6	0.3 0.01	10	0.5	3				1ST24C38SS	1ST04C28CC 1ST06C28CC 1ST06C28CC 1ST04C28CC	CRE supply, for two signals (VSS, VDDa) lower resistance required (0.3mA, 2 parallel lines), others 10µA
	Shielded cable,	FPFPU															1ST06C38SS	1ST06C28CC	

5.1 Cryo cable list, Ge-detectors (FPU to warm electronics) typical

In Document CRYO-HARNESS INPUT TO THERMAL ANALYSIS ; HP-2-ASED-TN-0010; will be update to provide the as built performance data of the harness.

6 Summary of Harness Types (N/A)

7 Bundling, Overshields and Feed Through Pinning

Bundling, Overshields and Feed Through Pinning

In order to minimize electro magnetic interference (EMI) and crosstalk the cryo cables shall be bundled according the following table. Each bundle shall be equipped with an overshield with a maximum transfer impedance of R_{DC} = 25 mOhm/m and L_t = 3 nH/m and connected to the backshells via 360° connections. For the Bolometer the individual cable shields shall be connected to S/C GND at the beginning and end of the overall harness (means at FPU and at BOLC). The harness' intermediate shield connections (at CVV Feedthrough and SVM Connector Bracket) with pigtails shall be as short as possible with a maximum length of 40 mm. The bundle routing shall be as close as possible together and to the next S/C Structure to minimize inductive coupling areas.
Feedthrough (FTH) Pinnings of functional identical nominal and redundant bundles shall be identical. For instance all Blue and all Red Photometer FTH pinnings shall be identical. As well functional identical Spectrometer FTH Pinnings should be identical or at least comparable where the Heater for the blue CRE is added. The Pinnings of all FTHs or Connector Brackets which interrupt one physical bundle shall be identical.

Bundle	CableIDs	Description	Connectors		Remarks
1	002, 003	Group 1 DC supplies Ge:Ga detectors	FPFPU P10	P151 (DEC LWL)	
	001	Group 1 logic signals	FPFPU P11	P153 (DEC LWL)	
	013a, 017 to 023	Group 1 Out signals	FPFPU P12	P155 (DEC LWL)	
	013b, 024 to 031	Group 1 Clock, Synch, Out signals	FPFPU P13	P157 (DEC LWL)	
	075	Group ½ Temp. sensors	FPFPU P14	P178 (DEC LWL)	

Typical bundling w.r.t. unit connectors mounted on PACS FPU, Ge:Ga detectors

Verification of bundling, over shields and feed-through connector pinning

The bundling design of all 15 PACS cyro harness bundles is provided in the PACS Cryo Harness Interconnection Diagram; HP-2-ASED-0089-01-0B

Over shielding (applicable to CVV ext. harness parts only) will be verified by inspection.

The measurement of the over shielding characteristic resistance and inductance will be performed during the acceptance testing of the respective bundle.

Pinning of the feed-through connector and SVM I/F connectors is provided in the PACS EICD HP-2-ASED-IC-0015

8 Connector List

The reference to the connector list can be found in PACS EICD HP-2-ASED-IC-0015

9 ESD Sensitive interfaces

The PACS Focal Plane Unit (FPU) contains very sensitive readout electronics, based on MOS technology. Such devices may be destroyed or degraded in their performance by unintended Electro Static Discharges (ESD). Therefore extreme care has to be taken during work on these interfaces or when making connections to the FPU.
Detector interfaces must not be touched without the adequate ESD protection, continuity checks shall be done by members of the instrument team only.
All ESD sensitive interfaces have to be equipped with short circuit plugs. Before making connections, the common ground connection has to be verified and the harness has to be discharged. ESD sensitive interfaces are: FP_FPU_J10 …. J18

FP_FPU_J20 …. J28
FP_FPU_J50 …. J65

The requirement has no influence on the harness design. The implementation of the requirement is presently discussed between ASED and PACS.

10 Connector pin allocation diagrams

The reference to the pin allocation can be found in PACS EICD HP-2-ASED-IC-0015

Compliance Matrix PACS

Pacs requirements		Reporting Document Title	Reporting Document Reference	Compliance	Comment
Chapter 4 Harness Diagrams		PACS Cryo Harness Interconnection Diagram	HP-2-ASED-0089-01-0B	c	
Chapter 5 Harness Tables		Harness Input to Thermal analysis	HP-2-ASED-TN-0010		
	# wires SST			c	
	# wires brass			c	
	Wire size [AWG]			c	
	Number of shields			c	
	max. resist. [Ohms			c	
	max.			Nonconformance	Related NCR and RFD will

Pacs requirements		Reporting Document Title	Reporting Document Reference	Compliance	Comment
	capacity [pF]			w.r.t. Triax cable connections capacity req. has been identified.	be raised.
	max. curr. [mA]			c	
	nom. curr. [mA]			c	
	max volt. [V]			c	
	Duty cycle			c	
	EMC class			c	
Chapter 3.4.7Bundling, Overshields and Feed Through Pinning				c	The bundling design of all 15 PACS cyro harness bundles is provided in the PACS Cryo Harness Interconnection Diagram; HP-2-ASED-0089-01-0B

Pacs requirements	Reporting Document Title	Reporting Document Reference	Compliance	Comment
Chapter 3.4.7 Each bundle shall be equipped with an overshield with a maximum transfer impedance of R_{DC} = 25 mOhm/m and L_t = 3 nH/m and connected to the backshells via 360° connections			open	For each bundle the over shield transfer resistance of R_{DC} = 25 mOhm/m will be measured by ASSE for the CVV external part and by CASA for the SVM part.
Chapter 3.4.7 with pigtails shall be as short as possible with a maximum length of 40 mm The harness' intermediate shield connections			Non compliant	The length of the pig tails are minimized, however the maximum pigtail length is~ 65 mm. Corresponding NCR HP-121432-ASED-NC-0682 has been raised. A related RfD will be raised
Chapter 3.4.7 Pinnings of functional identical nominal and redundant bundles shall be identical	PACS EICD	HP-2-ASED-IC-0015	c	
Chapter 3.4.7Bundling, Overshields and Feed Through Pinning Connectors mounted on PACS FPU, Ge:Ga detectors typical	PACS EICD	HP-2-ASED-IC-0015	c	

Pacs requirements	Reporting Document Title	Reporting Document Reference	Compliance	Comment
Chapter 8 Connector List	PACS EICD	HP-2-ASED-IC-0015	c	
Chapter 9 ESD Sensitive interfaces				Not related to harness design; realization is under discussion between PACS and ASED
Chapter 10 Connector pin allocation diagrams	PACS EICD	HP-2-ASED-IC-0015	c	

11 HIFI Specific Requirements (Chapter number refer to the IIDB)

11.1 Cryo-Harness

There are two cryo-harnesses, connecting the FHFPU (15 K) and the FHLOU (100 – 200 K) with the 300 K units on the SVM. The FHFPU is connected to the FHFCU for power and control and 4 coax cables to connect it with the spectrometers. FHLOU is connected with FHLCU for power and control. The cryo-harnesses will be delivered through the S/C Contractor, manufactured to agreed requirements. The routing and the interfaces of the wave-guides are under study by Industry.
The routing and the provision of the wave-guides are under the responsibility of Industry.

11.2 Cryo Harness for the FHFPU

The table below gives an overview of the cryo-harness between the FHFPU on the optical bench and the connectors on the FHFPU.
Most of the harnesses, routing from one of the FHFCU connectors have to be spliced and will route to different connectors on the FHFPU.

Description	SVM	Opt. Bench	Harness definition
Mixer bias horizontal	FHFCUP11	FHFPUP11–17	table 5.10.2.3.1-2 figures 5.10.2.3.1-1, -8
Magnets and Heaters horizontal	FHFCUP12	FHFPUP25 – 29	table 5.10.2.3.1-3 figures 5.10.2.3.1-2, -9

Table: 5.10.2.3.1-1 Overview FHFPU cryo-harness typical

The detailed definition of the harness is given in the tables and figures below, with the following remarks:
- Maximum resistance is defined from each individual pin on the FHFCU side to each of the corresponding

individual pin on the FHFPU side..

- The maximum current, nominal current and duty cycle are defined for the complete set of wires in one row
- In the column Duty cycle 't' is the part of 'T' in which the signal is active. HIFI is assumed to be primary Mode 1/3 of the time, so T=1/3 for the majority of signal lines.
- Return leads are combined to a single pair per item per polarisation. This reduces the amount of cabling, at the expense of patching.
- The 'over shield' of the cabling from the FHFCU should route up to the CVV wall connectors.
- All cryo-harness cables are EMC class 3 (low level sensitive analog signals) except for the bundles FHFCUP16 and FHFCUP26, which have 10kHz signal emission. These bundles can only be combined onthe CVV feedtrough connectors with the bundles FHFCUP17 and FHFCUP27.

FHFCU	FHFPU	Description	Max. Resist. (Ohm)	Max. Current (mA)	Nom. Current (mA)	Duty cycle (t * T)	Remarks
P11-02	P11-03	MX1-V ;-H	1000	0.0001	0.0001	1/7* 1/3	

Typical table shown of
Table: 5.10.2.3.1-2 Horizontal Mixers bias cryo-harness to Table: 5.1 0.2.3.1 -1 4 IF signals cryo-harness

HIFI Compliance Matrix

HIFI requirement		Reporting Document Title	Reporting Document Reference	Compliance	Comment
5.10.2.3 Cryo-Harness		Cryo-Harness Baseline Definition PFM;	HP-2-ASED-TN-0100;	c	see also HIFI EICD
Chapter 5.10.2 Cryo Harness Tables		Harness Input to Thermal analysis	HP-2-ASED-TN-0010		see also HIFI EICD
	Max. Resist. (Ohm)	Harness Input to Thermal analysis	HP-2-ASED-TN-0010	c	
	Max. Current (mA)	Harness Input to Thermal analysis	HP-2-ASED-TN-0010	c	
	Nom. Current (mA)	Harness Input to Thermal analysis	HP-2-ASED-TN-0010	c	
	Duty cycle (t * T)	Harness Input to Thermal analysis	HP-2-ASED-TN-0010		

12 SPIRE Specific Requirements (Chapter number refer to the IIDB)

Harness and Connectors
The cryoharness interface pin-out shall be compliant with RD-19, SPIRE-RAL-PRJ-000608, Issue 1.1 and updated pages, for harness bundles 4 and 6, identified by:
«SPIRE HDD 1.1 Deltas», ref SPIRE-RAL-NOT-001819, given in Annex 5
The Spire harnesses shall be compliant with the requirements specified in Annex 3 (Summary of SPIRE Cryo harness wiring functions)

Figure 5.10-1 : SPIRE harness layout
Figure 5.10-1 below gives an overview of the Spire harness layout.
Note that the Cryo-harness, i.e. series C, I, and S are ESA provided and not Spire flight H/W, whilst the T series apply only for instrument test and are not Spire flight items.

The two F harnesses (FPU sub-system F harness) between JFETs and FPU (HSFPU-HSJFP and HSFPU-HSJFS) are provided by SPIRE with the instrument units.

Figure 5.10-3 :SPIRE Grounding scheme

Summary of SPIRE Cryo Harness wiring functions typical

Name	128 Way Connector	FPU/JFS/JFP Unit Connector	Connector Label Type	Harness Connector Label	Harness Connector Type	Description	Number of Conductors excl. shields	Number of* inner Shields	Implementation	Max. R (W)	Impedance C(pF)	Impedance L(uH)	Max.Current in A. per Conductor	Av. Current in A. per Conductor	Max Volts
C1	**CVV 1**	HSJFS J5	MDM 25 P	HSJFS P5	MDM 25 S	Bolometer signals from JFS (SLW 1-12)	24	3 DS	12-ax	500	1000pF	0.08uH	1.0E-09	0.15.0E-10	0.1
Type 3						Anti-cross talk ground wires.	12 NA	NA		500	1000pF	0.08uH	0.0E+00	0.0E+00	0.1
						Cable Level Shields†	0	3	>80%						

SPIRE Compliance Matrix

SPIRE requirements		Reporting Document Title	Reporting Document Reference	Compliance	Comment
cryoharness interface pinout shall be compliant with RD-19, SPIRE-RAL-PRJ-000608, Issue 1.1		Cryo Harness Interconnection Diagram		c	see also SPIRE EICD; HP-2-ASED-IC-0016
for harness bundles 4 and 6, identified by: «SPIRE HDD 1.1 Deltas», ref SPIRE-RAL-NOT-001819, given in Annex 5		Cryo Harness Interconnection Diagram		c	see also SPIRE EICD; HP-2-ASED-IC-0016
SPIRE harness layout		Cryo Harness Interconnection Diagram			
ANNEX 3: SUMMARY OF SPIRE CRY O HARNESS WIRING FUNCTIONS		Harness Input to Thermal analysis	HP-2-ASED-TN-0010		
	Harness Connector Type	SPIRE EICD	HP-2-ASED-IC-0016	c	
	Number of Conductors excl. shields	SPIRE EICD	HP-2-ASED-IC-0016	c	

SPIRE requirements		Reporting Document Title	Reporting Document Reference	Compliance	Comment
	Number of* inner Shields	SPIRE EICD	HP-2-ASED-IC-0016	c	
	Max. R (W)	Harness Input to Thermal analysis	HP-2-ASED-TN-0010	c	Req. unclear Should R (W) read R (Ω) ?
	Impedance C(pF)	Harness Input to Thermal analysis	HP-2-ASED-TN-0010	c	Req. unclear Should Impedance read Capacitance?
	Impedance L(uH)	Harness Input to Thermal analysis	HP-2-ASED-TN-0010	Non conformance identified in HP-2-ASED-TN-0010 NCR raised	Req. unclear Should Impedance read Inductance?
	Max.Current in A. per Conductor	Relevant SCC Cable spec.		c	
	Av. Current in A. per Conductor	Relevant SCC Cable spec.		c	
	Max Volts	Relevant SCC Cable spec.		c	

13 Documentation and Status

13.1 Requirement by ASP and Instruments

See chapter 2, Applicable Documents

General Harness Requirements

H-EPLM Requirements Specification

General Design & Interface Requirements Specification

HPLM Interface Specification

Instrument Specific Requirements

IID – Parts B HIFI; SCI-PT-IIDB-HIFI-02125

IID – Parts B PACS; SCI-PT-IIDB-PACS-02126

IID – Parts B SPIRE; SCI-PT-IIDB-SPIRE-02124

Telescope Requirement

Herschel Telescope EICD; HER-NT-0187-T-ASTR

13.2 ASED Documents

13.2.1 ASED CIDLs

PFM Input Cryo Harness CIDL for CASA; HP-2-ASED-CD-0004;

This document reflects the as design status of the Herschel EPLM PFM CCH & SIH within the main harness sections as they are:

CVV Internal CCH & SIH,

CVV External CCH & SIH,

SVM Internal CCH & SIH

Cryo-Harness brackets & fixation elements for CCH & SIH

This document will be updated for each release of the addressed document. Status; issue 1.0, date 28.05.04,

EQM Input Cryo Harness CIDL for CASA; HP-2-ASED-CD-0005;

This document reflects the as design status of the Herschel EPLM PFM CCH & SIH within the main harness sections as they are:

CVV Internal CCH & SIH,

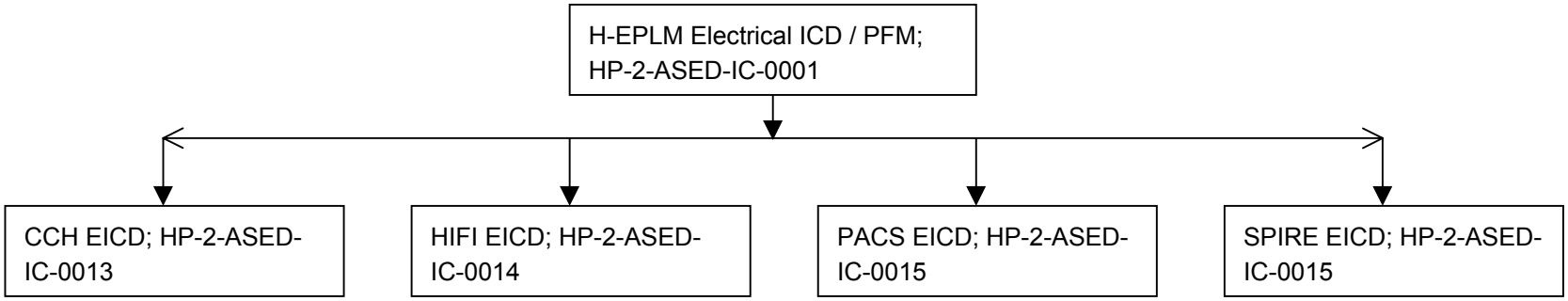
CVV External SIH,

SVM Internal SIH

Cryo-Harness brackets & fixation elements for CCH & SIH

This document will be updated for each release of the addressed document. Status; issue 1.0, date 02.08.04 ?

13.2.2 Electrical ICDS:



H-EPLM Electrical ICD / PFM; HP-2-ASED-IC-0001

This Interface Control Document (ICD) describes the electrical interfaces of the HERSCHEL **E**xtended **P**ay**l**oad **M**odule. (EPLM) PFM.

It will be the overall generic information source for the electrical interfaces.

Interfaces, which are under Experimenter Control (FPU internal Interfaces) or under SVM control (Warm Interconnecting Harness and S/C Interfaces), are not part of this document but particularly listed.

For information management a database (ACCESS based) called CAIE (**C**omputer **A**ided **I**nterface **E**ngineering) will be used. The HEPLM CAIE Data Base contents provides all the necessary information for supporting the automated verification of the electrical interfaces with (IDAS) an **I**ntegrated **D**ata **A**cquisition **S**ystem

System information for

- Harness Type
- Routing
- Pin Allocation
- Connectors
- etc

may be derived from this database.

By summarising the electrical interfaces within this document, the ICD will allow a crosscheck of the I/F (harness) design from both sides of an interface. By collecting the interface design description, the ICD will act as a reference for requirement verification and "third-party" interface design (e.g. electrical harness manufacture).

In this way the HERSCHEL EPLM electrical interfaces will be maintained under control.

Actual interface data (as designed/as built), after approval, shall become part of this Interface Control document.

Any change of the ICD contents shall follow the rules of Configuration Control

The ICD presents a database about the electrical interfaces of the Extended Payload Module and its GSE. Interfaces in this context are all input/output interconnections mated via the ASED provided EPLM harness. For any such interface the ICD enables a fast identification of the interface harness design, the actually built interface circuits, and the main electrical parameters.

Within these features the main purpose of the ICD is:

- to act as a reference data base showing the present interface design (as designed/as built)
- to allow a quick compatibility check of any input/output interface interconnection ("on paper integration")
- to act as a supporting data base for the preparation and performance of the electrical/harness integration (IDAS)
- To facilitate failure investigations in the case of interface problems on EPLM level

For a more effective handling and tracing the HEPLM electrical ICD is separated in the following documents with this release.

- Electrical ICD - Main Part HP-2-ASED-IC-0001
- CCH ICD PFM HP-2-ASED-IC -0013
- HIFI SIH ICD PFM HP-2-ASED-IC -0014
- PACS SIH ICD PFM HP-2-ASED-IC -0015
- SPIRE SIH ICD PFM HP-2-ASED-IC -0016

Information given in the main part (HP-2-ASED-0001) are relevant for all sub ICD's.

CCH EICD; HP-2-ASED-IC-0013

This Interface Control Document (ICD) describes the electrical interfaces of the HERSCHEL EPLM
CCH PFM Harness Pin Allocation.
This document summarised the Harness Pin Allocation for Cryogenic Control Harness PFM.
All necessary pin to pin connections are described in the Data Base extract in chapter 3.
Due to the continuous DB update w.r.t. the external CCH, this release of HP-2-ASED-0013 reflects
only the CVV internal part of CCH presently. The external part will be included in the next issue.

HIFI EICD; HP-2-ASED-IC-0014

This Interface Control Document (ICD) describes the electrical interfaces of the HERSCHEL EPLM
HIFI SIH PFM Harness Pin Allocation.
This document summarises the Harness Pin Allocation for HIFI EPLM Scientific Harness PFM.

This release of HP-2-ASED-0014 presently reflects only the CVV internal and external part of the HIFI SIH. The SVM part is existing in handwritten form only and has to be edited into the database. The next release of HP-2-ASED-0014 will be a complete issue.

PACS EICD; HP-2-ASED-IC-0015

This Interface Control Document (ICD) describes the electrical interfaces of the HERSCHEL EPLM
PACS SIH PFM Harness Pin Allocation.
This document summarised the Harness Pin Allocation for PACS EPLM Scientific Harness PFM.
The document contains all information from the FPU to warm units in the SVM.

SPIRE EICD; HP-2-ASED-IC-0016

This Interface Control Document (ICD) describes the electrical interfaces of the HERSCHEL EPLM
SPIRE SIH PFM Harness Pin Allocation.
This document summarises the Harness Pin Allocation for SPIRE EPLM Scientific Harness PFM.
This release of HP-2-ASED-0016 presently reflects only the CVV internal and external part of the SPIRE SIH. The SVM part is existing in handwritten form only and has to be edited into the database. The next release of HP-2-ASED-0016 will be a complete issue.

13.2.3 Harness Definition Documents

Cryo-Harness Baseline Definition PFM; HP-2-ASED-TN-0100

This document presents the CAD database which defines the mech.interfaces for the PFM Herschel Cryo-Harness. The CAD database is a living document and will be updated with regard to the Herschel configuration developing and as-built during the manufacturing in progress.

The purpose of this document is to define the actual PFM Cryo-Harness and structural baseline CAD files and to document all future changes. The formal change control will be performed by document change notes (DCN) with regard to the new issues of this document.

Single new CAD-files will be sent via ftp-server and dispatch note. Complete sets of baseline CAD-files will be burnt on one or more CD-ROM(s) and sent to ESA, Alcatel and CASA by DHL.

Electrical Interfaces of Herschel Cryogenic Components to Harness; HP-2-ASED-TN-0063

This document contains the requirements and shows also the realisation for:
a) Electrical interfaces between the Herschel cryo components and its connectors and the S/C harness. Following components are affected:

- DLCM (LINDE-Component)
- PPS (LINDE Component)
- Liquid Level Sensors (LINDE Component)
- Heaters
- Herschel Temperature Sensors (C100 and Pt1000)
- Electrical Valves
- Accelerometers

b) Mechanical interfaces between the connectors and the S/C mechanical fixation areas.

c) Interface description to Herschel Harness.

CRYO-HARNESS INPUT TO THERMAL ANALYSIS; HP-2-ASED-TN-0010

The Herschel instruments harness and cryo control harness data summarized within this document have been established as input to the thermal analysis.

The document provides per harness

The Cable number, Component Name , location, Harness Bundle, number of wires, number of shields, cable type, resistance per meter, capacitance per meter (for PACS and SPIRE only), inductance per meter (for SPIRE only), cross section, material, harness length, overall resistance, overall capacitance, overall inductance.

The overall resistance is calculated using the measured resistance per meter as provided by GORE multiplied with the harness length: The overall capacity and inductance, where requested, will be provided by using measured values per meter multiplied with the harness length.

The document will be a mirror of the harness tables of the instruments. The document provides the as designed status.

Cryo Harness Branch Characteristics; HP-2-ASED-TN-0085

The Herschel instruments harness and cryo control harness data summarized within this document have been established as input for harness routing, manufacturing, mass determination, cable quantity and connector size and backshell size definition.

The harness bundle dimensions are calculated in accordance to cable data from GORE (GORE data sheets GSC-05-82-xxx-oo).

The cable branch lengths have been taken from the 3D CATIA CH harness models. For the cable raw cutting, an attrition of 300 mm has been taken on top.

Cryo Harness Description; HP-2-ASED-TN-0103

The Harness description of this document will provide an overview about the design, development, qualifications and inputs to production processes established upon the scientific Instrument, HPLM & S/C requirements / constraints to get in final stage the PFM Cryo-harness. Harness activities performed on Sub-co manufacturing level are not part of this description.

Harness Routing Drawings; HP-2-ASED-ID-00XX

The harness routing drawings provide the detailed information of the routing and fixation of each individual harness bundle onto the H-EPLM structural elements.

Herschel PFM CRYOSTAT HARNESS, CVV INTERNAL, CCH & SIH	HP-2-ASED-ID-0085	2547-121430-100-01-0B
Herschel PFM CRYOSTAT HARNESS, CVV EXTERNAL, CCH & SIH	HP-2-ASED-ID-0081	2547-121430-200-01-0B
Herschel PFM CRYOSTAT HARNESS, SVM INTERNAL, CCH & SIH	HP-2-ASED-ID-0083	2547-121430-300-01-0B
Herschel EQM CRYOSTAT HARNESS, INTERNAL, CCH & SIH	HP-2-ASED-ID-0079	2547-151430-100-01-0B

13.3 CASA Documents

CVV Internal Harness Definition Document ;HP-2-CASA-TN-0001; issue 5; date 07.09.2004

This document is intended to release the present status definition of the Herschel CVV internal harness, based on the information available in EADS CASA Espacio. This means that the data contained herein define the present configuration for manufacturing of each bundle, coherent with the main manufacturing input documentation such as a Wiring List.

Cable Capacitance & Inductance Measurement Results; HP-2-CASA-RP-0016

This document provides the CASA measured electrical characteristics for all cables and wires used for the manufacturing of the Herschel Cryo Harness. The characteristic values for resistance, expressed in Ω/m, capacitance, expressed in pF/m, and inductance expressed in µH/m have been determined and documented for each cable.

CVV External Cryo Harness Definition Document HP-2 ASSE-TN 0007; issue 4

This document is intended to release the present status definition of the Herschel CVV external harness, based on the information available in EADS Astrium. This means that the data contained herein define the present configuration for manufacturing of each bundle, coherent with the main manufacturing input documentation such as a Wiring List.

14 Harness Verification Approach

14.1 Cryo Harness Working Meeting

A Cryo Harness working meeting has been performed at the 12th and 13h February 2004. See also HP-2-ASED-MN-0594. This working meeting was limited to the harness definition documentation of the CVV internal and external SIH available at the time of meeting. Not reviewed were the HIFI LOU harness and the SVM part of the SIH.

Prior this meeting, the harness definition files have been send to Instruments for review, in order to get a feed back and a confirmation of the harness design.

The response of the Instruments was as follows:

PACS:

Harness data package send to PACS June 2003. Response by PACS by e-mail, 1.7.2003, with corrections: Updated data package send to PACS 11-7-2004:. Response by PACS: OK, but new inconsistencies detected. These inconsistencies are closed in cooperation with PACS

SPIRE

H-EPLM EICD. Issu2.3 and 2.6 reviewed by Alcatel and SPIRE: SPIRE Agreement documented in SPIRE-RAL-NOT-001891, Issue 3.0. All comments incorporated in EICD issue 2.8: Response by SPIRE: Agreed see HP-ASP-MN-3961, issue 18.11.2003: Harness routing agreed by SPIRE see HP-ASP-MN-3961, issue 18.11.2003

HIFI

EICD and harness routing has been send to HIFI, HIFI response with correction by e-mail 6.6.2003, No response to corrected EICD by HIFI

14.2 ASED internal checks

The EICDs are red marked by the Harness Team incorporating the Instrument comments, the instrument changes, the comments received by the harness manufacturer and inconsistencies identified by ASED. In a second step the changes identified "the red marked" EICDs are introduced in the EICD data base. This data base has the following logical functions

- double pin assignment
- number of used / defined pins
- correct opposite connector (gender / pin number; except dummy with 0 pin)
- channel ID w.r.t. pin allocation according harness routing
- double naming for : connector; item; signal type etc.

- use of predefined general elements (cable type; connector type etc.
- indirect check (no warning) for equal signal (pin to pin)

A copy of the data base is returned to the harness team to verify, that all red marks are correctly introduced in the data base or to correct the inconsistencies identified by the data base. Before releasing the document, the compatibility with the IIDBs is checked by the harness team.

The document provided by CASA CVV Internal Harness Definition Document ;HP-2-CASA-TN-0001 and the ASSE document CVV External Cryo Harness Definition Document HP-2 ASSE-TN 0007; issue 4 is checked and if necessary corrected by the ASED harness team in close cooperation with the harness manufacturers.

14.3 Verification of the Cryo Harness R/C Requirements

The verification of Cryo Harness requirements related to cable resistance and capacitance will be done by a combination of analysis and measurements.

The Cryo Harness R/C requirements verification will be done in the following three steps:

1. **Prediction.** The predicted value for the cable resistance and capacitance is obtained by the multiplication of the related electrical cable characteristic (R in Ω/m; C in pF/m) and the predicted cable length as obtained from the Herschel CATIA model.
2. **Calculation.** The calculated value for the cable resistance and capacitance is obtained by the multiplication of the related electrical cable characteristic (R in Ω/m; C in pF/m) and the as built cable length as measured by the harness manufacturer (CASA or ASSE).
3. **Measurement.** The measured value for the cable resistance is obtained by a direct pin to pin test of the respective wire by injection of a test current. The cable resistance measurement will be done twice, during acceptance testing by the harness manufacturer (CASA or ASSE) and by ASED after PLM integration.

As already indicated above, the three step approach is only applied for the Cryo Harness resistance verification since the resistance measurement can be performed in an effective manner with the available test equipment (e.g. IDAS).

It is obvious that the capacitance verification will be not be done for the HIFI SIH and the CCH since no capacitance requirements have been given for these harnesses.

The capacitance verification will be done by performing the Prediction and Calculation steps only. In order to raise the confidence level for the verification of cable capacitance by calculation it was decided that the capacitance calculation

results will be checked against manually performed random sample measurements of selected wires of the PACS and SPIRE CVV int. SIH.

These tests have already been performed and a very good correspondence of the measurement results with the calculation results has been obtained.

Details are given in the following documents:

- PACS CVV int. SIH EQM HP-2-ASED-TR-0063
- PACS CVV int. SIH PFM HP-2-ASED-TR-00XX
- PACS CVV int. SIH PFM HP-2-ASED-TR-00XX

For the SPIRE CVV int. and ext. SIH there is also an inductance requirement (80 nH) given in the IIDB. During the cryo harness design phase, when the electrical cable characteristics for the cryo harness cables were determined, it became obvious that this requirement can never be met with the available cryo harness cables. A NCR (HP-121432-ASED-NC-0701) and a related RFD (HP-2--ASED-RD-0031) have been raised on that subject.

Since no adverse impact on the Instrument performance due to an increased line inductance could be identified, it was decided that there is no need to verify this requirement by any test.

The results of the Cryo Harness R/C requirements verification will be documented in the technical note HP-2-ASED-TN-0124 which is currently in preparation at ASED.

14.4 Status of the PFM Cryo Harness R/C Requirements Verification

14.4.1 Prediction Status

The prediction of the cable resistance values for the HIFI (CVV int., CVV ext. and SVM part), PACS (CVV int., CVV ext. and SVM part) and SPIRE (CVV int., CVV ext. and SVM part) has been performed. All predicted cable resistance values were compared to the related requirements and have been found well in specification. No NCR was raised w.r.t. the predicted cable resistance values for the complete SIH.

The prediction of the cable capacitance values for the PACS (CVV int., CVV ext. and SVM part) and SPIRE (CVV int., CVV ext. and SVM part) has been performed. All predicted cable capacitance values were compared to the related requirements and have been found well in specification with one exception. The PACS triax cables overall inner shield to outer shield capacitance was predicted to a value of up to 2450 pF compared to specified max. value of 2000 pF overall. A NCR (HP-121432-ASED-NC-0697) and a related RFD (HP-2--ASED-RD-0030) have been raised on that subject.

14.4.2 Calculation Status

The calculation of the cable resistance values for the HIFI (CVV int. and CVV ext. part), PACS (CVV int. and CVV ext. part) and SPIRE (CVV int. part) has been performed. All calculated cable resistance values were compared to the related requirements and have been found well in specification. No NCR was raised w.r.t. the calculated cable resistance values for the so far completed SIH bundles.

The calculation of the cable capacitance values for the PACS (CVV int. and CVV ext. part) and SPIRE (CVV int. part) has been performed. Except for the already mentioned PACS triax cables overall inner shield to outer shield capacitance, all calculated cable capacitance values have been found well in specification. No NCR was raised w.r.t. the calculated cable capacitance values for the so far completed SIH bundles.

14.4.3 Measurement Status

The measurement of the cable resistance values for the HIFI (CVV int. and CVV ext. part), PACS (CVV int. and CVV ext. part) and SPIRE (CVV int. part) has been performed by CASA or ASSE. All measured cable resistance values were compared to the related requirements and have been found well in specification. No NCR was raised w.r.t. the measured cable resistance values for the so far completed SIH bundles.

After in the routing and the fixation of the harness into the H-EPLM, the following checks are performed by ASED:

- Insulation test with each wire to the structure with 100V
- Continuity test with the IDAS system to verify the resistance end to end. A deviation of ± 15% to the calculated value is considered acceptable, based on the ISO experience.

These ASED measurement tests after integration have been performed for the three CVV int. SIHs. No NCR was raised so far.

15 EICD Database Verification

15.1 Verification by Test Harness measurement

In order to increase the confidence in the SIH design as detailed in the related EICD's it was decided to verify the content of the end to end pin-function output files for three SIHs against the already existing instrument level test-harnesses. The content of the end to end pin-function output files for the three SIHs were transferred into the IDAS harness check out system. This check will identify inconsistencies between the existing test harness and our data base since a unwanted or missing pin to pin connection would be recognised as a so called 'non O.K' by the IDAS check out system.

This EICD Database Verification has been performed with the three existing instrument level test-harnesses.

A few inconsistencies have been detected and were discussed with the instrument experts for the HIFI and PACS SIHs. Most of the identified 'non O.K.s' could be explained and, if appropriate, will be considered in the next up-date of the related EICD. One NCR for HIFI (HP-121432-ASED-NC-1171) was raised since the inconsistency caused a change in the related harness.

The measurement of the SPIRE test harness was performed in CW 26/05. All detected NOK's have been identified as not existing connections of the instrument test-harness. The SPIRE EICD Database has been confirmed to be correctly implemented.

15.2 Independent EICD Database Verification

A very detailed independent EICD database verification has been performed ASP by a careful comparison of each connection of the EICD database against the related requirements of the three instrument IIDB's. The findings of ASP have been discussed with ASED in various telecoms and meetings and are reported in the MoMs HP-2-ASP-MN-6069; HP-2-ASP-MN-6269 and HP-2-ASP-MN-6582. The inconsistencies found during this exercise, which had impact on the cryo harness hardware, finally led to the raise of four NCRs (HP-121432-ASED-NC-0896, 0941, 0995 and 0999). The dispositions of this NCRs were reflected in the next up-dates of the EICD database and the related modifications of the EQM and PFM cryo harness hardware have been implemented.

E N D O F D O C U M E N T

	Name	Dep./Comp.		Name	Dep./Comp.
	Alberti von Mathias Dr.	AOE22	X	Stritter Rene	AED11
	Barlage Bernhard	AED11	X	Thörmer Klaus-Horst Dr.	OTN/AED65
	Bayer Thomas	AOA52		Wagner Klaus	AOE22
	Fehringer Alexander	AOE13	x	Wietbrock Walter	AET12
X	Fricke Wolfgang Dr.	AED 63		Wöhler Hans	AOE22
	Geiger Hermann	AOA52		Wössner Ulrich	ASE442
	Gerner Willi	AED11			
	Grasl Andreas	OTN/AET52			
	Grasshoff Brigitte	AET12			
	Hauser Armin	AOE22	X	Alcatel	ASP
	Hendry David	Terma Resid.	x	ESA/ESTEC	ESA
	Hengstler Reinhold	AOA 5			
	Hinger Jürgen	AOE22		**Instruments:**	
	Hofmann Rolf	ASE442		MPE (PACS)	MPE
	Hohn Rüdiger	AED65		RAL (SPIRE)	RAL
	Huber Johann	AOA52		SRON (HIFI)	SRON
X	Hund Walter	ASE442			
	Idler Siegmund	AED432		**Subcontractors:**	
	Ivády von András	FAE22		Air Liquide, Space Department	AIR
	Jahn Gerd Dr.	AOE22		Air Liquide, Space Department	AIRS
	Kalde Clemens	APE3		Air Liquide, Orbital System	AIRT
	Kameter Rudolf	OTN/AET52		Alcatel Bell Space	ABSP
	Kettner Bernhard	AET42		Astrium Sub-Subsyst. & Equipment	ASSE
X	Knoblauch August	AET32		Austrian Aerospace	AAE
	Koelle Markus	AOA53		Austrian Aerospace	AAEM
X	Kroeker Jürgen	AED65		APCO Technologies S. A.	APCO
	Kunz Oliver Dr.	AOE22		Bieri Engineering B. V.	BIER
	Lamprecht Ernst	OTN/ASI21		BOC Edwards	BOCE
X	Lang Jürgen	ASE442		Dutch Space Solar Arrays	DSSA
	Langfermann Michael	AOA51		EADS CASA Espacio	CASA
	Mack Paul	OTN/AET52		EADS CASA Espacio	ECAS
	Müller Jörg	AOA52		EADS Space Transportation	ASIP
	Pastorino Michel	ASPI Resid.		Eurocopter	ECD
	Peltz Heinz-Willi	AOE13		European Test Services	ETS
	Pietroboni Karin	AED65		HTS AG Zürich	HTSZ
	Platzer Wilhelm	AED22		Linde	LIND
	Rebholz Reinhold	AOA51		Patria New Technologies Oy	PANT
	Reuß Friedhelm	AED62		Phoenix, Volkmarsen	PHOE
X	Rühe Wolfgang	AED65		Prototech AS	PROT
	Runge Axel	OTN/AET52		QMC Instruments Ltd.	QMC
	Sachsse Bernt	AED21		Rembe, Brilon	REMB
	Schink Dietmar	AED44		Rosemount Aerospace GmbH	ROSE
	Schlosser Christian	OTN/AET52		RYMSA, Radiación y Microondas S.A.	RYM
	Schmidt Rudolf	FAE22		SENER Ingenieria SA	SEN
	Schweickert Gunn	AOE22		Stöhr, Königsbrunn	STOE
	Sonn Nico	AOE51		Terma A/S, Herlev	TER
	Steininger Eric	AED44			