Title: **Cryo-Harness Description**

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1	19.04.04	75	Initial issue	

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1 Scope

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.

1.1 General Cryo-Harness Desription

In general the Cryo-harness consists of two main Sub-harness elements

- Cryo Control Harness (CCH) , including the Telescope & the Cryo-cover I/F Harness
- Scientific Instrument Harness (SIH) of HIFI, PACS and SPIRE
-

Both harness elements, the CCH and the SIH provide the electrical interconnections between the Service-Module (SVM) mounted warm units and the EPLM cold-units, as well as for the Cryo Instrumentations.

The CCH distribute power and signals between the Cryo Control Unit (CCU) within the SVM and all cryostat instrumentation CVV internal and external. In addition the CCH provide the all harness lines to the HPLM EGSE, SVM cone allocated Umbilical I/F-, Telescope I/F- & Cryo-cover I/F-connector-brackets.

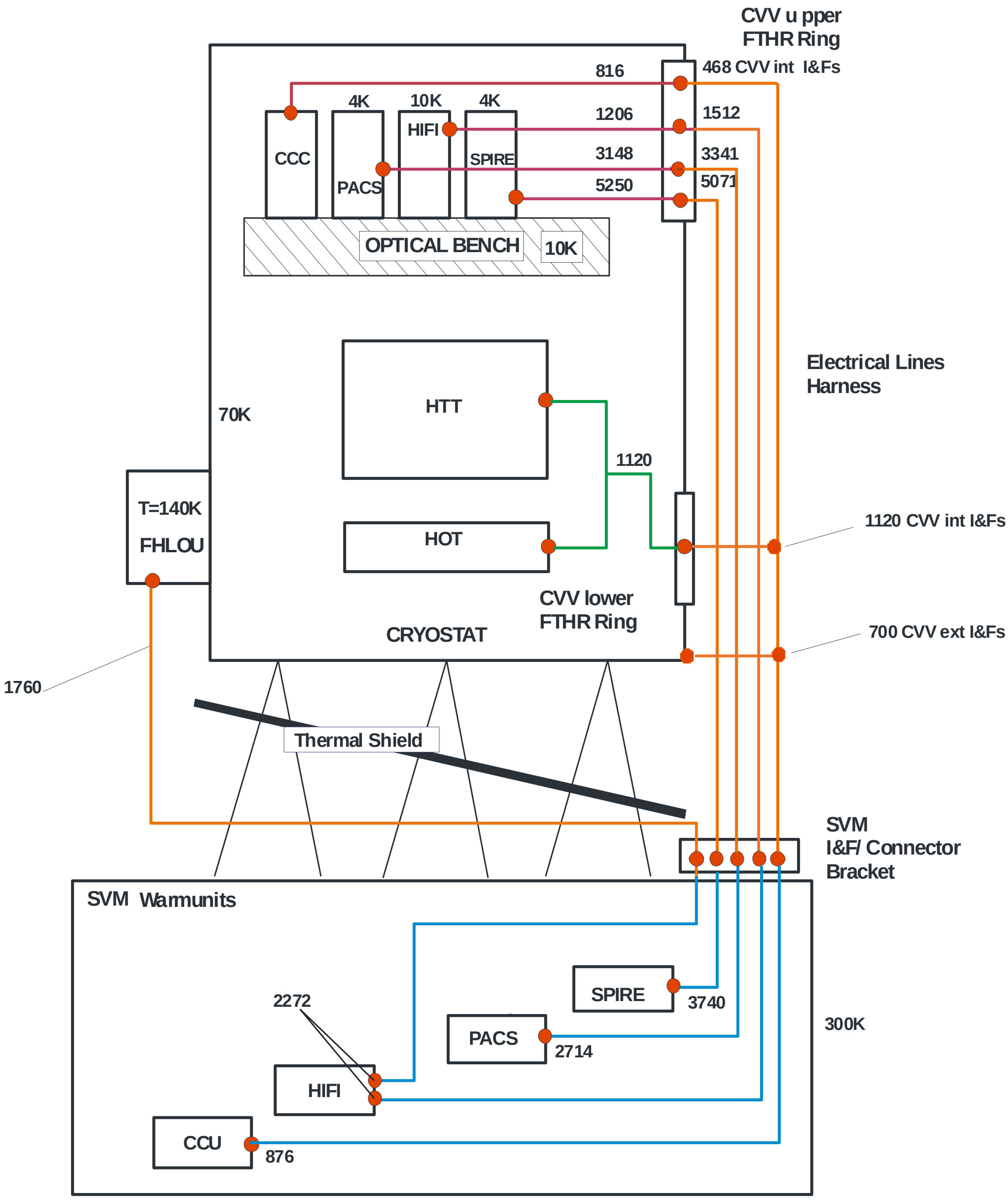
The harness between these SVM-cone I/F connector-brackets and the S/C umbilical is not part of the Cryo-harness.

The SIH provide the power, data and monitoring lines between the SVM allocated instrument warm units with a direct interface to the HPLM cold units. Harness between single instrument warm units within the SVM, are not part of the Cryo-harness containing Scientific Instrument Harness.

The CVV external allocated instrument unit is the HIFI LOU.

The CVV internal allocated instrument units are the HIFI-FPU, PACS-FPU, SPIRE-FPU and the SPIRE JFET-Photometer and JFET-Spectrometer.

In figure 12.3.1 the number of wire and shield interconnections within the Cryo-harness Segments and major harness interfaces are defined. The minor amounts of Cryo-cover and Telescope I/Fs are add to the CVV external part.



Overview of Cryo-Harness CCH and SIH Wire- and Shield-Interconnections

Figure 1.1.2.1-1 : Overview about Cryo-harness wire & shield Interconnections

1.1.1 CCH & SIH Connector Identification Codes

The connector coding, used by the Cryo-harness contains partially digits from the product tree number, connector allocations code, instrument identification code, Cryo-harness section code and Cryo-harness EICD relevant electrical circuitry code digits. The HPLM Cryo-harness use a 6-digit code, meanwhile Alenia and Alcatel use a 4-digit coding within the SVM and S/C.

The details are described in the PFM EICD ref. HP-2-ASED-IC-0001.

1.1.2 Mechanical Interfaces

1.1.2.1 SVM external I/F Connector-Brackets

Considering integration- and test-sequences on top of the SVM upper plate (+X direction) several mechanical interface brackets have been designed to separate the CVV external from the SVM internal Cryo-harness CCH and SIH segment. The SVM Plug-connectors will be mated to the fixed mounted CVV external harness receptacle connector. In addition the EGSE access to the CVV external & CVV internal Cryo-control instrumentation components and to the instrument cold-units are provided. Where the Cryo-harness is routed as I/F harness between the SVM-Cone I/F connector-brackets to the Cryo-cover or to the S/C umbilical commanded Cryo-Control components , the SVM upper closure panel allocated SVM I/F connector-brackets is designed as SKIN connector, which can be mated with RED-Tag & Green-Tag connectors for safety reasons.

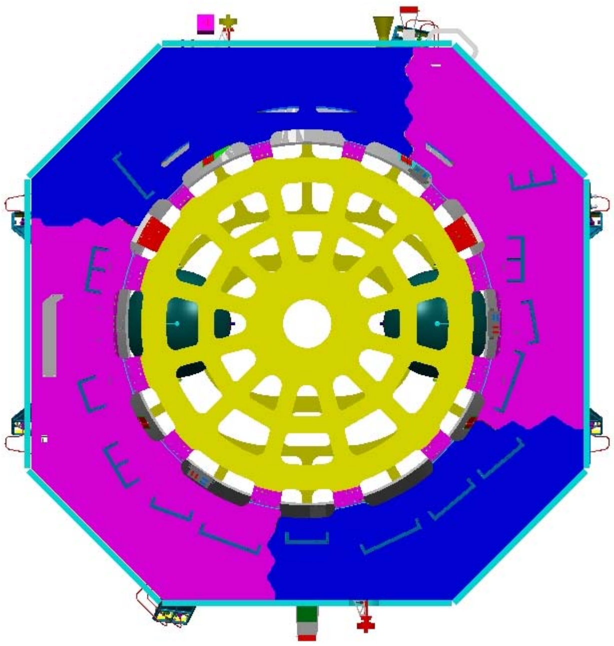


Figure 1.1.2.1-1: SVM external Interface connector-brackets

1.1.2.2 CVV Feed-Through Connectors

To perform the electrical connections between CVV external to internal area, hermetically sealed vacuum feed-through connectors will be used. These feed-through connectors will be mounted within the 3 CVV feed-through connector rings, the upper, mid and lower ring.

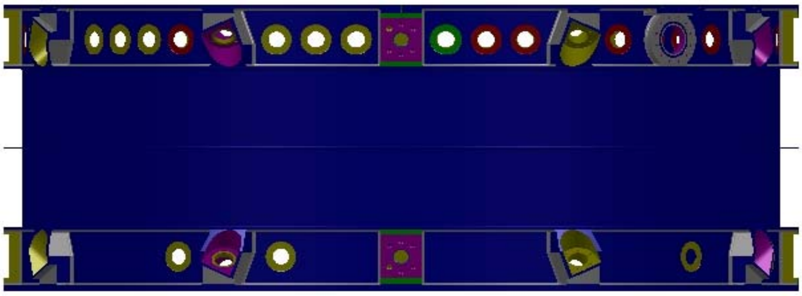


Figure 1.1.2.2-1: CVV ext. upper and lower feed-through connector I/F

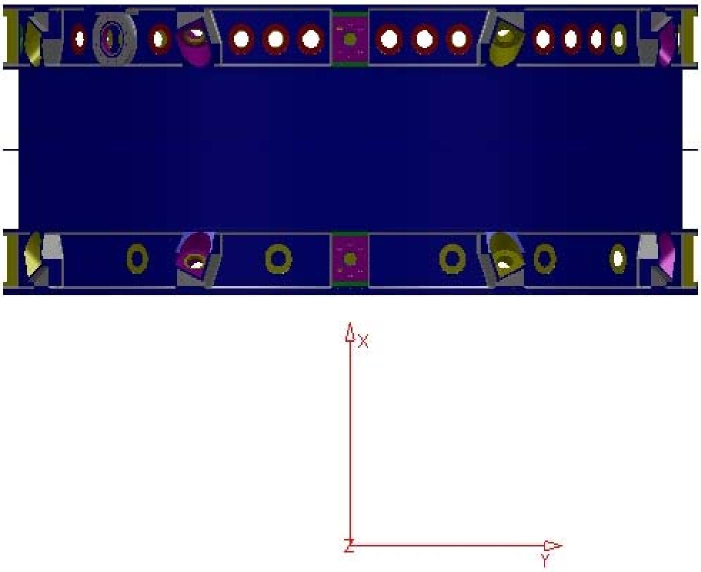


Figure 1.1.2.2-2: CVV ext. upper and lower feed-through connector I/F ring

1.1.2.2.1 Amount of CVV Feed-Through Connectors

Main driver for the amount of CVV feed-through connectors in the upper and lower feed-through connector rings have been the accessibility during harness integration. Several investigations w.r.t. feed-through connector sizes, need CCH and SIH feed-through lines and integration accessibility have been analysed by Astrium with support of ESA and former ISO Cryo-harness experts. The final number of used CVV feed-through connectors is given below:

- TOP (upper) feed-through connector ring ⇒ 37 Connectors for CCH & SIH
- BOTTOM (lower) feed-through connector ring ⇒ 8 + 1 Spare Connectors for CCH

Harness	Connector Qty	100 contacts	128 contacts	Size 128 for 4x CX FTHRs
PACS SIH	15	7	8	
HIFI SIH	5 + 4 RF Coax	4	1	1
SPIRE SIH	13		13	
CCH TOP ring	4	4		
CCH BOT ring	8 +1 spare	9		
Total	45 +1 spare + 4 Coax	24	22	1

Figure 1.1.2.2-3: Amount of CVV feed-through connectors

1.1.3 Cryo-Harness Routing Constraints

The harness branches routing have been designed to cover the separation of nominal and redundant bundles , as far as possible, but where the amount of interfaces exceed the physical capability of the limited number of accessible feed-through connectors , common harness feed-through connectors have been designed and settled together with the instrument and other acting Herschel EMC experts.

Harness crossings between sensitive instrument harness branches and parallel routing of other instrument or CCH branches, have been taken into account, where physical space was available. In special cases, like SPIRE, where several harness branches have to be routed like one big branch from an EMC point of view, a P-clamp harness attachment routing along the SVM struts have been designed, to enlarge the strut envelope and to route all branches in parallel along of it.

In figures below, the CVV external SIH lay-outs are provided, in addition the SPIRE and PACS P-clamp fixations along the subject SVM struts.

1.1.3.1 Routing within CVV external C-Profiles

Within the single CVV mounted C-profiles, the harness routing have been designed without branch crossings. The harness branches are laced to the slotted C-profile holes on all three wall shapes, to provide a soft, but good EMC bonding contact of the harness branch covering manganin over-shield braids. The braids are designed to cover the thermal, the electrical and the mechanical constraints / requirements which are sometimes counter productive from harness point of view.

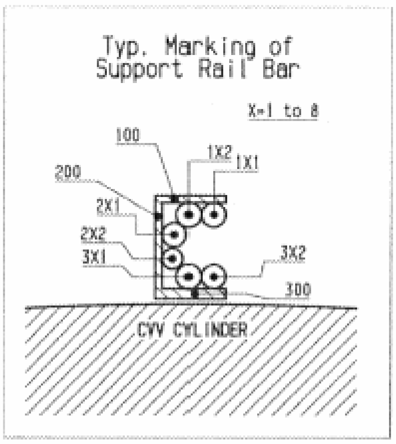


Figure : 1.1.3.1-1 : Harness routing and Attachment allocations within C-Profiles

1.1.3.2 Cryo-harness Routing Lay-outs

The Cryo-Harness routing lay-outs have been designed by CATIA 3D with all major harness attachment and fixation elements. The harness routing lay-out configurations are provided for each harness segment.

SVM harness Cryo-harness lay-out routing is defined in drawing ref. HP-2-ASED-ID-0083

CVV external Cryo-harness lay-out routing is defined in drawing, ref. HP-2-ASED-ID-0081

CVV internal Cryo-harness Lay-out routing is defined in drawing, ref. HP-2-ASED-ID-0085

The Cryostat harness lay-out is defined for the integration phase in drawing, ref. in HP-2-ID-0048

1.1.4 Cryo-Harness Branch Over-shields

All harness branches within the SVM and CVV external shall be over-shielded. The single harness over-shield methods have been investigated and designed to cover the HPLM and instrument requirements.

1.1.4.1 SVM Cryo-Harness Branch Over-shields

SVM internal Cryo-harness over-shield will be manufactured by use of pure aluminium foil, which is wrapped with 50 % over-lapping in both directions. This configuration forms one harness over-shield.

- The SVM SPIRE SIH branches will be manufactured with 2 isolated aluminium over-shields.
- All other CCH and SIH harness branches will have 1 aluminium over-shield.

1.1.4.2 CVV external Cryo-harness Branch Over-shields

CVV external branches will be covered with braided over-shields, made of AWG 44 cores of manganin, to reduce the thermal impact on the life-time.

- The SPIRE SIH branches, will be covered by use of 2 isolated over-shields. The inner over-shield forms the so called Faraday-cage, where both ends have to be routed via the outer insert contacts, isolated through the SVM I/F connector-brackets (CB) and CVV Feed-through connectors.
    - o The SPIRE SIH branch over-shields with its isolated braids have been manufactured and tested by CASA on a sample basis. During the continuity and the high resistance isolation test and several bends in between show no anomalies, like conductivity between the two braid-layers tested under ambient conditions.

- All other CCH and SIH branches will have 1 braided over-shield of manganin, where the outer over-shield will be fit to the “lamp-thread” back-shell outlets on both ends.
- CCH branches routed to the Cryo-Control Component I/F connectors, which are routed completely under MLI, will have no over-shield.
- CCH branches routed to the Cryo-Control Component (CCC) I/F-connectors, which are partially or not covered by MLI will be manufactured with 1 braided over-shield of manganin. These harness branch over-shield braids will be bonded at the CVV ext. SVM receptacle-connector side only, if the CCC I/F connector have to be wired to Nano-connector pig-tails.
- Within the CVV external harness routing and attachment C-profiles, the un-protected braided over-shield is electrically bonded to the profile, when the harness branch is fixed by use of lacing-cord to it and thermally bonded with the C-profile top mounted fixation bolt close to the upper feed-through connector ring.

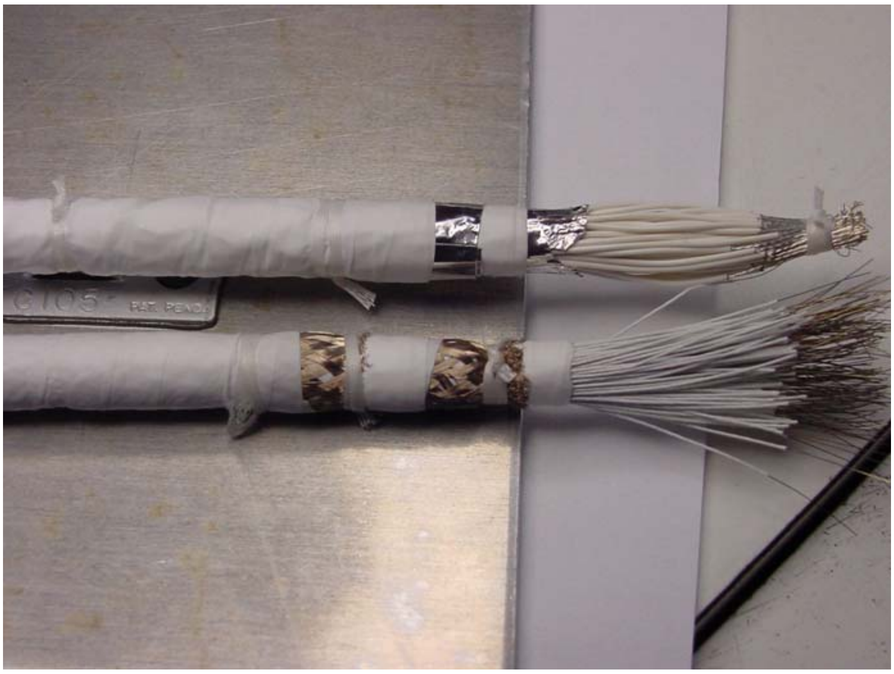


Figure 1.1.4.2-1: SPIRE SVM (Top) & CVV Over-shield Method (Bot

1.1.4.3 CVV internal Harness “over-shields”

CVV internal harness branch over-shields have been deleted w.r.t. lifetime after certain investigation at Alcatel, ESA and Astrium side, except for SPIRE.

- SPIRE SIH branches will be manufactured by use of double-shielded cables, which have been especially designed and procured by ASED accordingly. The wire & shield cores are of SST.

- o At the CVV feed-through connectors, the outer cable-shields are connected to all outer insert-contacts, the Faraday-cage contacts. The inner-cable-shields are combined in several daisy-chained cable-groups and wired to its ground-group contacts.
- o At the cold-unit side, the outer & the inner cable shields are bonded to the aluminium L-bracket back-shell by use of grounding-lugs.

1.1.5 CCH Description

The Cryo Control Instrumentation consists of the main groups of sensors, control elements as well as status indicators. The main groups consist itself of separate components which are distributed around the whole EPLM. These components are assigned to the groups "Orbit" and "Ground". The components of the group "Orbit" are operated by the CCU and the SVM Units. The group "Ground" is operated only on ground by the EGSE. Selected components from the "Ground" group must be actuated on the Launch PAD via Umbilical. The possibility to be able to connect the Orbit components also to the EGSE shall be given.

From this Cryo Control instrumentation important components exist redundant, other components are ordered by the arrangement here functionally redundant (e.g., Vent line). The components are assigned accordingly to both parts CCU A and B.

The Harness should be constructed that a pre-integration of parts of the Harness is possible.

Under these main viewpoints the CCH routing described in the following has been constructed.

The CCH is divided on 3 Interconnection diagrams. These show the routing of the bundles, the interfaces with the number of the plugs and the necessary contacts as well as the associated segments and bundles.

The diagrams are partitioned in:

- Upper ring ⇒ HP-2-ASED-ID-0088-01-0X_sheet-0Y_rev
- Lower ring ⇒ HP-2-ASED-ID-0088-02-0X-0Y
- External Harness ⇒ HP-2-ASED-ID-0088-03-0X-0Y

1.1.5.1 CCH Segments

Taking into account the EPLM main parts and the SVM is the CCH (acc. to the SIH) in the following segments divided:

1.1.5.1.1 SVM CCH

The CCH SVM Harness establish the connection between the SVM I/F-Bracket’s and the

- Cryo Control Unit (CCU)
- relevant SVM Units
- SVM Umbilical.

1.1.5.1.2 CVV external CCH

The CCH CVV external Harness establish the connection between the SVM I/F-Bracket’s and the

- CVV Cover and Cavity
- EPLM parts/components Telescope, Sunshade, SVM Shield
- CVV vacuum feed-throughs located on the CVV cylinder upper and lower connector ring
- Instrumentation component I/F connectors outside of the cryostat.

1.1.5.1.3 CVV internal CCH

The CVV internal CCH establish the connection between the CVV I/F vacuum feed-through connectors and the

- I/F-Brackets on the upper and lower Spatial-Framework (SFW)
- I/F-Brackets on the Thermal Shields
- I/F-Brackets on the Optical Bench (OB) Shield
- Instrumentation component I/F connectors inside of the cryostat.

By this partitioning and the appropriate subdivision and arrangement of the interfaces an installation of the Harness segments is possible independently of each other. The possibility to connect the Orbit components to EGSE is given at the SVM I/F Brackets.

To make possible also a pre-integration of the Harness on main parts of the EPLM (e.g. HTT) is extended the CCH by the following segment:

1.1.5.1.4 Component Harness

The Component Harness is connected to the CVV external harness and internal harness and establishes the connection between the single instrumentation components I/F connectors and the I/F-Brackets mounted on EPLM parts and CVV external and internal.

The following figure gives an overview of the CCH harness segments, where the harness is shown only schematically.

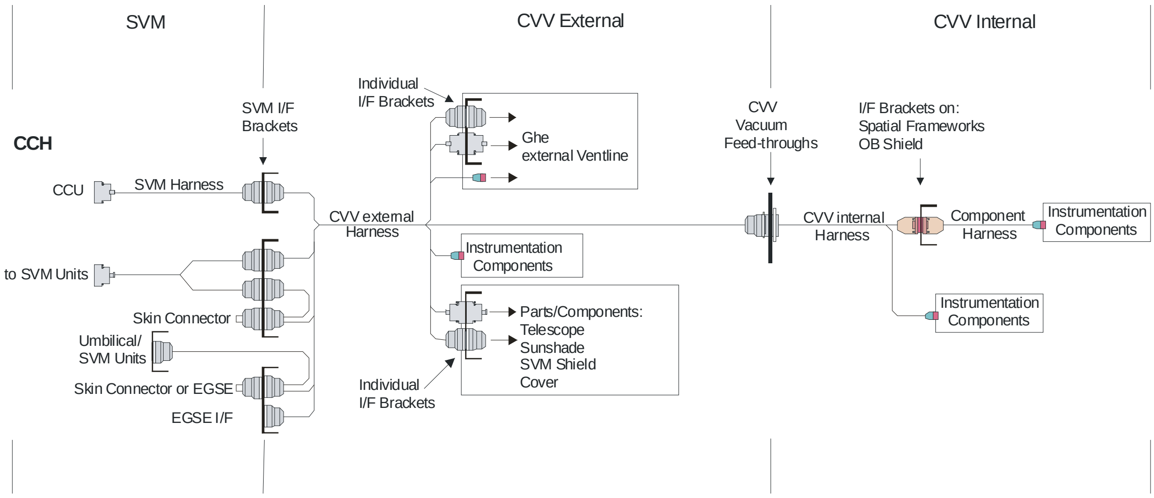


Figure 1.1.5.1-1: CCH Segment Overview

1.1.5.1.5 CCH Bundles

The segments described in the previous chapter are further divided in separate Harness bundles. By the subdivision of the bundles and the pertinent connectors the following main points were considered where it is possible:

- o Classification of the components to "power" and "signal" and accordingly of the bundles.
- o Distribution of the redundant components on separate bundles and plugs.
- o Allocation of the bundles to the components according to their grouping in "Orbit" and "Ground".
- o Other subdivision and allocation the "Orbit" group to CCU/A and CCU/B.
- o Separate connectors in the SVM I/F Bracket for the components which are actuated at the Launch PAD via the Umbilical, access in the SVM Bracket via Skin connector.

- A simple bundle construction in regard to a simple manufacturing.
- Electrical access to all components at the SVM I/F-Bracket.
- Bundles which lead to the EGSE only, end in the SVM I/F-Bracket.
- Bundles, which server the On-ground AIT phase only, as the test I/F harness between the Cryo-Cover and the EGSE I/F-CB on the SVM upper closure panel, will be removed prior to last AIT HPLM launch preparation activities.

1.1.5.2 CCH Interconnection Diagram Upper Ring

The Figure 1.1.5.2-3 gives an overview about the CCH via the CVV Upper ring. This diagram includes all harness bundles between components located inside the cryostat on the:

OBA inclusive OB Shield

Upper bulkhead Thermal Shields

upper chain 08

upper Spatial Framework

on one side and to the

CCU/A

CCU/B

EGSE I/F-Bracket on the SVM upper plate

on the other side.

<u>Remarks:</u>

The main bundles are separated and routed as follows:

"Signal" bundles to CCU/A and CCU/B via chain 08

"Signal" bundles to EGSE via chain 08

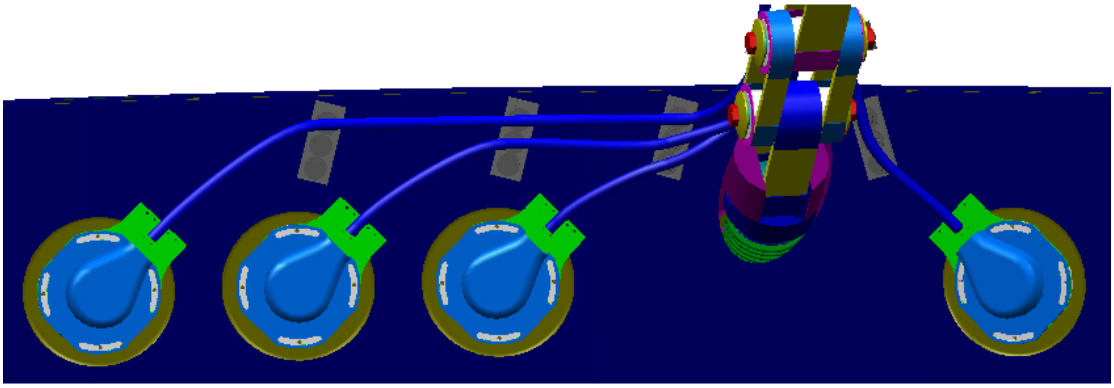


Figure 1.1.5.2-1: CCH J35-J38 to TSS 08

The upper bulkhead Thermal Shields and the OBA including OB Shield are equipped with component harness bundles. All component harness bundles coming from the upper side of the OB plate to the upper SFW are routed through the OB cut-outs. In the cut-outs the bundles are thermally coupled. Due to thermal reasons the component harness bundles to the L0 struts are routed from the upper SFW via the HTT along the struts to the temperature sensors.
These bundles are connected to the CVV internal harness bundles via the I/F-Brackets on the upper SFW, the OB Shield and the Thermal Shields.

The Sensors located on the upper SFW are connected directly to the relevant CVV internal harness bundle. All bundles of the CVV internal harness are routed via the TSS / chain 08 to keep the other upper chains free for the SIH. Each of the CVV internal harness bundles is thermally coupled to the first thermal shield except the bundles to the upper bulkhead thermal shields and the temperature sensors located directly on chain 08. From the CVV vacuum feed-through connectors, the CVV external harness bundles will be routed along the CVV within the C-profile cable rails and via the CVV-SVM struts to the relevant I/F-CBs on the SVM upper closure panel. The EGSE bundles end here.
From these Brackets the SVM CCH branches are routed through the SVM upper closure panel cut-outs to the CCU, which is allocated on the SVM internal lateral panel (-Z).

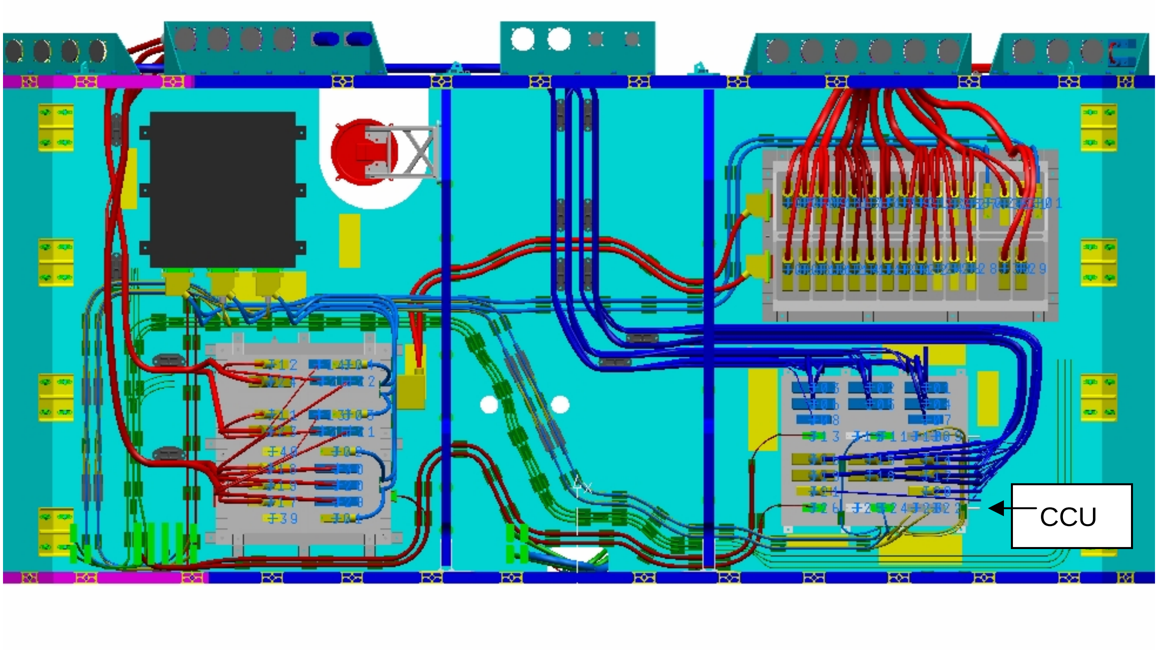


Figure 1.1.5.2-2 : CCU on SVM internal lateral panel (-Z), dark-blue-harness = CCH

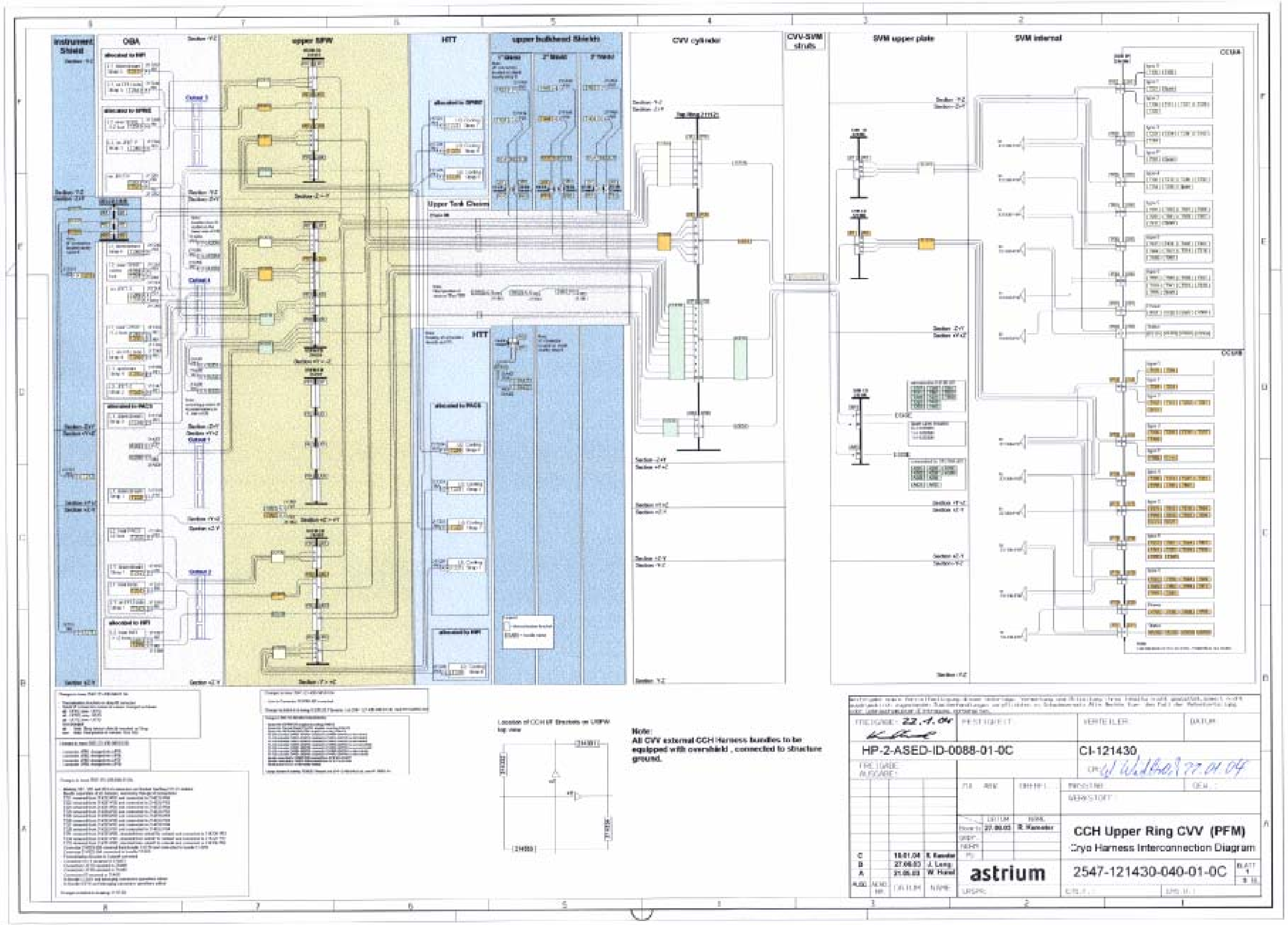


Figure 1.1.5.2-3 : Interconnection Diagram Upper Ring CVV

1.1.5.3 CCH Interconnection Diagram Lower Ring

The Figure 1.1.5.3-1 gives an overview about the CCH via the CVV Lower ring. This diagram includes the harness bundles between components located inside the cryostat on the:

- HTT
- HOT
- Cylinder Thermal Shields
- Lower Bulkhead Thermal Shields
- lower chains 18 and 14
- lower Spatial Framework

on one side and the

- CCU/A
- CCU/B
- Umbilical I/F-Bracket on the SVM Cone
- EGSE I/F-Bracket on the SVM upper plate

on the other side.

Remarks:

The bundles are separated and routed as follows:

- o "Signal" bundles to CCU/A and CCU/B via chain 18
- o "Power" bundles to CCU/A and CCU/B via chain 17
- o "Signal" bundles to EGSE via chain 11
- o "Power" bundles to EGSE via chain 16
- o "Spare" bundles via chain 14 (area hold free, hardware not installed)

The HTT, the HOT, the Cylinder Thermal Shields and the lower bulkhead Thermal Shields are equipped with component harness bundles. Bundles from the lower SFW to components located on the upper side of the HTT will be routed along the tank.

These bundles are connected to the CVV internal harness bundles via the I/F-Brackets on the lower SFW and the Thermal Shields.

The components located on the lower SFW are connected directly to the relevant CVV internal harness bundle. Each of the CVV internal harness bundles is thermally coupled to the first thermal shield except the bundles to the cylinder thermal shields and the lower bulkhead thermal shields.

From the CVV vacuum feed-through the CVV external harness bundles will be routed along the CVV via the CVV-SVM struts to the relevant I/F-Brackets on the SVM upper plate. The bundles EGSE end here.

From these Brackets the bundles are routed in the SVM to the CCU.

The bundles to the components which are actuated on the Launch PAD via Umbilical are routed in the SVM I/F-Bracket 321100 in separate plugs and from these plugs again out farther in the SVM in on the SVM I/F-Bracket 321400. On the opposite side of these connectors skin-connectors are connected to produce the connection. If the skin connector is removed, the access is given for the EGSE on these connectors.

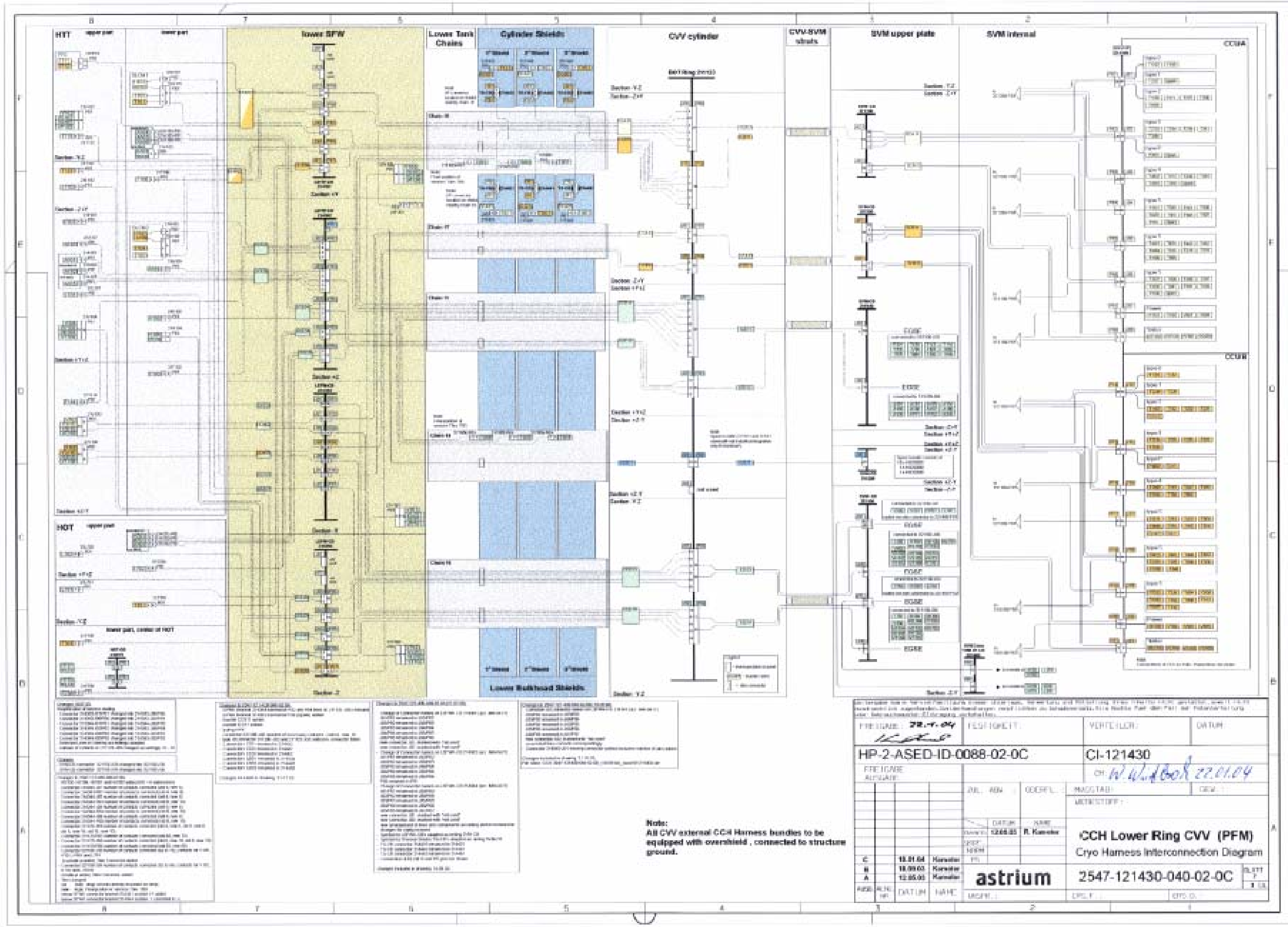


Figure 1.1.5.3-1: Interconnection Diagram Lower Ring CVV

1.1.5.4 CCH Interconnection Diagram CVV External

The Figure 1.1.5.4-1 gives an overview about the CCH via the CVV Lower ring. This diagram includes the harness bundles between components located and on the EPLM parts/components on the:

- Telescope
- Sunshade
- SVM Shield
- Cryostat Cover and Cavity
- Cryostat external Vent line
- Cryostat CVV outside (e.g. Radiator)

on one side and the

- CCU/A
- CCU/B
- SVM Units inside of the SVM
- Umbilical I/F-Bracket on the SVM Cone
- EGSE I/F-Bracket on the SVM upper plate

on the other side. The Cryo control instrumentation of the Sunshield is not connected to the CCH.

<u>Remarks:</u>
The bundles are separated and routed as follows:

- o "Signal" bundles to CCU/A and CCU/B
- o "Power" bundles to CCU/A and CCU/B
- o "Signal" bundles to EGSE
- o "Signal" bundles to SVM Units
- o "Power" bundles to SVM Units

Harnesses on Cover and Telescope itself are not part of the CCH, the CCH to Cover and Telescope ends on the relevant I/F-Bracket. For integration reasons the Sunshade and the SVM Shield are equipped with I/F-Brackets. Also for the vent line unit a separate I/F-Bracket is foreseen.

The CVV external harness bundles are routed will be routed along the CVV via the CVV-SVM struts to the relevant I/F-Brackets on the SVM upper plate. The bundles EGSE end here.

From these Brackets the bundles are routed in the SVM to the CCU.

The bundles to the components which are actuated on the Launch PAD via Umbilical are routed in the SVM I/F-Bracket 321100 in separate plugs and from these plugs again out farther in the SVM in on the SVM I/F-Bracket 321400. On the opposite side of these connectors skin-connectors are connected to produce the connection. If the skin connector is removed, the access is given for the EGSE on these connectors.
Also the bundles to components located on the cover are routed in the same manner to separate connectors on the SVM I/F-Bracket 314200 and from the same connector to the SVM I/F-Bracket 314100.

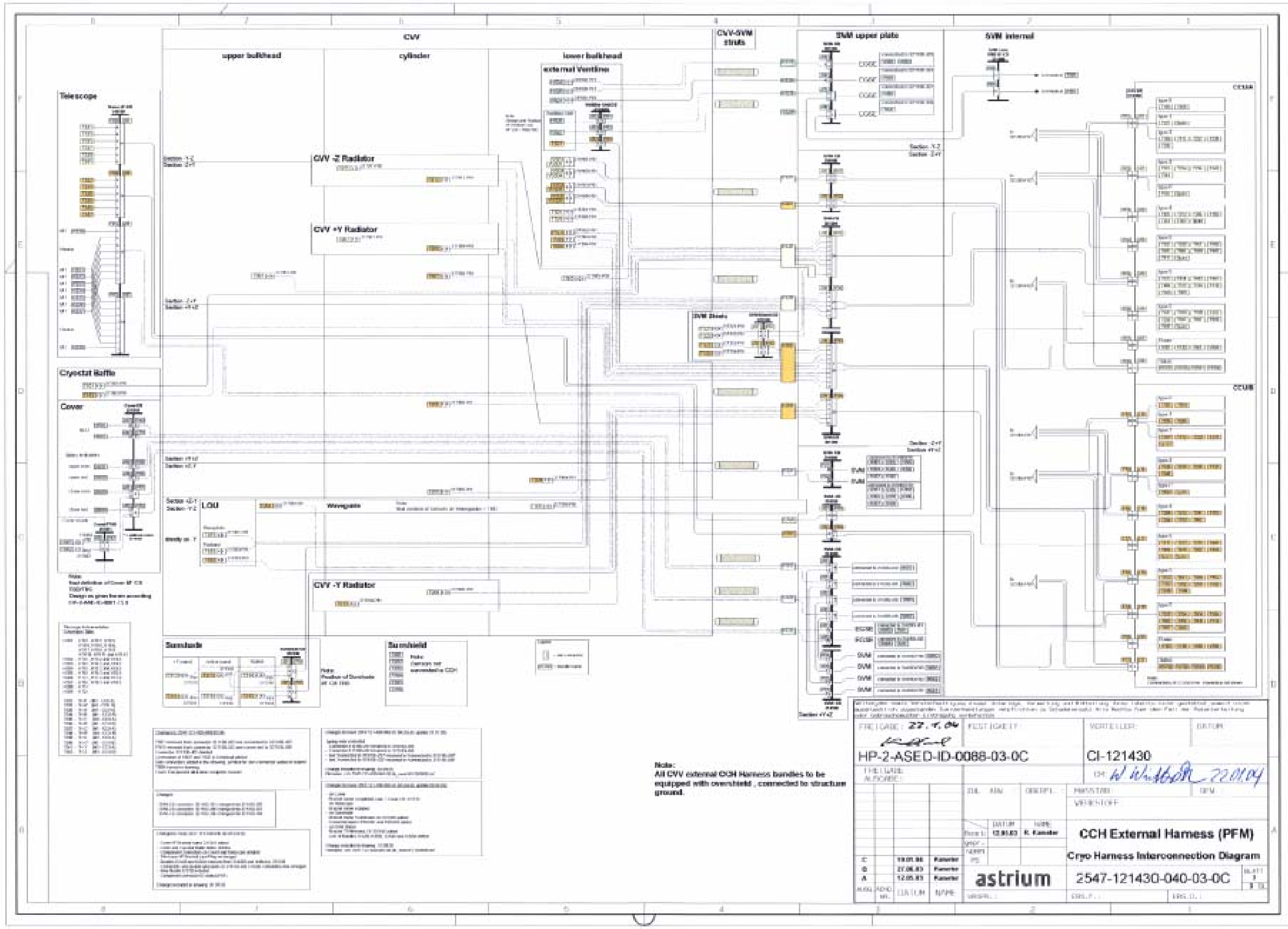


Figure 1.1.5.4-1: Interconnection Diagram External Harness

1.1.6 SIH Description

1.1.6.1 SIH Interconnection Diagrams

The instrument interconnections between the warm and the cold units are provided within the interconnection diagrams for all 3 instruments. All data defined are related to the Cryo-harness that means, that the connector types and sex are the harness connectors and not the unit connectors. In addition, harness branch identification has been correlated between those one used on instrument side plus on the Cryo-harness side. A harness branch code has been established , which identifies the single instrument, the Cryo-harness section and a common used harness branch number.

The coding structure is explained on the example of SIH-CH-01 below:

SIH = Scientific Instrument Harness,

C= Cold ; I = Intermediate; S = SVM

H= HIFI ; P = PACS; S = SPIRE

01 = common used branch number

C = Cold harness are routed CVV internal

I = Intermediate harness are routed CVV external

S = SVM harness are routed SVM internal

For each instrument an interconnection diagram have been established to identify

- the source and drain of each SIH branch,
- the Cryo-harness & instrument commonly used branch number,
- the calculated branch diameter,
- the harness branch EMC-class,
- the harness connector type & size.
-

The SIH interconnection diagrams are as follows:

HIFI SIH ref. HP-2-ASED-ID-0092-0X-0Y; drawing ref. 2547-121430-010-0X-0Y

PACS SIH ref. HP-2-ASED-ID-0091-0X-0Y ; Drawing ref. 2547-121430-030-0X-0Y

SPIRE SIH ref. HP-2-ASED-ID-0089-0X-0Y; drawing ref. 2547-121430-020-0X-0Y

1.1.6.2 SIH Wiring-list Sample

Astrium GmbH — Project: HERSCHEL

Pin Allocation List
(Harness)

Doc.No.: HP-2-ASED-IC-0001
Issue: 3.1 Date: 02.04.2004
Sheet: PAL-1 (of 4)

Connector: 211121 P18 **Function:** UFThr 160.8° (HIFI XH-01) **Conn.-Type:** 197-012P22-35S (Plug)
Item: CVVUCR **Location:** 33 / CVV I/F CB Top PFM (CVVUCR) **Backshell:** G9254 F22 M / M22-03
EMC-Category: 2l/Sig H fr CVVFT to SVMCB

Pin	Signal Designation	Interface-Code Circuit	Signal	Pos.	Ch. ID	Wiring	Grouping: Shd	Cable	Twist	Comment	Target-Item	Location	Connector	Pin	New
096	HIFI MX1-H . B		HMX.-	-	H001	051SS-38	1			Steel 051SS38	HHSVMCB1	25	311100 J03	096	3. 3.
097	HIFI MX1-H . VM		HMX.-	-	H001	051SS-38	1				HHSVMCB1	25	311100 J03	097	
090	HIFI MX1-H . IM		HMX.-	-	H001	051SS-38	1				HHSVMCB1	25	311100 J03	090	
088	HIFI MX1-H . BRTN		HMX.-	-	H001	051SS-38	1				HHSVMCB1	25	311100 J03	088	
089	HIFI MX1-H . VMRTN		HMX.-	-	H001	051SS-38	1				HHSVMCB1	25	311100 J03	089	
095	HIFI MX1-H . SHD		HMX.-	-	H001	051SS-38	1			Cable Shield	HHSVMCB1	25	311100 J03	095	
-															
091	HIFI MX2-H . B		HMX.-	-	H002	051SS-38	2			Steel 051SS38	HHSVMCB1	25	311100 J03	091	3. 3.
099	HIFI MX2-H . VM		HMX.-	-	H002	051SS-38	2				HHSVMCB1	25	311100 J03	099	
100	HIFI MX2-H . IM		HMX.-	-	H002	051SS-38	2				HHSVMCB1	25	311100 J03	100	
092	HIFI MX2-H . BRTN		HMX.-	-	H002	051SS-38	2				HHSVMCB1	25	311100 J03	092	
093	HIFI MX2-H . VMRTN		HMX.-	-	H002	051SS-38	2				HHSVMCB1	25	311100 J03	093	
098	HIFI MX2-H . SHD		HMX.-	-	H002	051SS-38	2			Cable Shield	HHSVMCB1	25	311100 J03	098	
-															
069	HIFI MX3-H . B		HMX.-	-	H003	051SS-38	3			Steel 051SS38	HHSVMCB1	25	311100 J03	069	3. 3.
070	HIFI MX3-H . VM		HMX.-	-	H003	051SS-38	3				HHSVMCB1	25	311100 J03	070	
079	HIFI MX3-H . IM		HMX.-	-	H003	051SS-38	3				HHSVMCB1	25	311100 J03	079	
068	HIFI MX3-H . BRTN		HMX.-	-	H003	051SS-38	3				HHSVMCB1	25	311100 J03	068	
078	HIFI MX3-H . VMRTN		HMX.-	-	H003	051SS-38	3				HHSVMCB1	25	311100 J03	078	
087	HIFI MX3-H . SHD		HMX.-	-	H003	051SS-38	3			Cable Shield	HHSVMCB1	25	311100 J03	087	
-															
081	HIFI MX4-H . B		HMX.-	-	H004	051SS-38	4			Steel 051SS38	HHSVMCB1	25	311100 J03	081	3. 3.
072	HIFI MX4-H . VM		HMX.-	-	H004	051SS-38	4				HHSVMCB1	25	311100 J03	072	
073	HIFI MX4-H . IM		HMX.-	-	H004	051SS-38	4				HHSVMCB1	25	311100 J03	073	
080	HIFI MX4-H . BRTN		HMX.-	-	H004	051SS-38	4				HHSVMCB1	25	311100 J03	080	
082	HIFI MX4-H . VMRTN		HMX.-	-	H004	051SS-38	4				HHSVMCB1	25	311100 J03	082	
071	HIFI MX4-H . SHD		HMX.-	-	H004	051SS-38	4			Cable Shield	HHSVMCB1	25	311100 J03	071	
-															
076	HIFI MX5-H . B		HMX.-	-	H005	051SS-38	5			Steel 051SS38	HHSVMCB1	25	311100 J03	076	3. 3.
084	HIFI MX5-H . VM		HMX.-	-	H005	051SS-38	5				HHSVMCB1	25	311100 J03	084	
085	HIFI MX5-H . IM		HMX.-	-	H005	051SS-38	5				HHSVMCB1	25	311100 J03	085	
075	HIFI MX5-H . BRTN		HMX.-	-	H005	051SS-38	5				HHSVMCB1	25	311100 J03	075	
074	HIFI MX5-H . VMRTN		HMX.-	-	H005	051SS-38	5				HHSVMCB1	25	311100 J03	074	
083	HIFI MX5-H . SHD		HMX.-	-	H005	051SS-38	5			Cable Shield	HHSVMCB1	25	311100 J03	083	
-															
054	HIFI MX6-H . B		HMX.-	-	H006	051SS-38	6			Steel 051SS38	HHSVMCB1	25	311100 J03	054	3. 3.
055	HIFI MX6-H . VM		HMX.-	-	H006	051SS-38	6				HHSVMCB1	25	311100 J03	055	
064	HIFI MX6-H . IM		HMX.-	-	H006	051SS-38	6				HHSVMCB1	25	311100 J03	064	
065	HIFI MX6-H . BRTN		HMX.-	-	H006	051SS-38	6				HHSVMCB1	25	311100 J03	065	

Filter: [SICode] LIKE "211121*" And [SCon] LIKE 'P18*' And [ConWired] = -1 printed on 02.04.2004 / 14:29:02

Figure 1.1.6.2-1: SIH Wiring-list of CVV ext upper connector ring plug-connector 211121P18

1.1.6.3 SVM SI-Harness (SIH)

The instrument warm units are placed on 4 SVM lateral Side & Corner panels, 2 panels for HIFI, one for PACS and on another side panel for SPIRE with sharing CCU. The units are placed in local areas, which provide short harness distances to their CVV external and CVV internal cold units. The fixed mounted SVM I/F-CB receptacle-connectors are designed with same round connectors mating face as the CVV feed-through connectors, that AIT SCOE mating can be performed either direct on the SAV-CON protected CVV external feed-through connectors or at the CVV external harness receptacle-connectors mounted in the SVM upper closure panel I/F-CBs. Consequently both receptacle connectors, the CVV feed-through connectors and the CVV external SVM I/F-CB mounted receptacles are of the same sex. This is the same approach as used on the former ISO Cryo-harness.

SKIN connectors mounted within the SVM I/F-CB on the upper closure panel are designed with socket connectors, due to fact, that the electrical source & drain I/F are housed within one connector and due to higher level safety requirements for RED-Tag & Green-Tag plug-connectors.

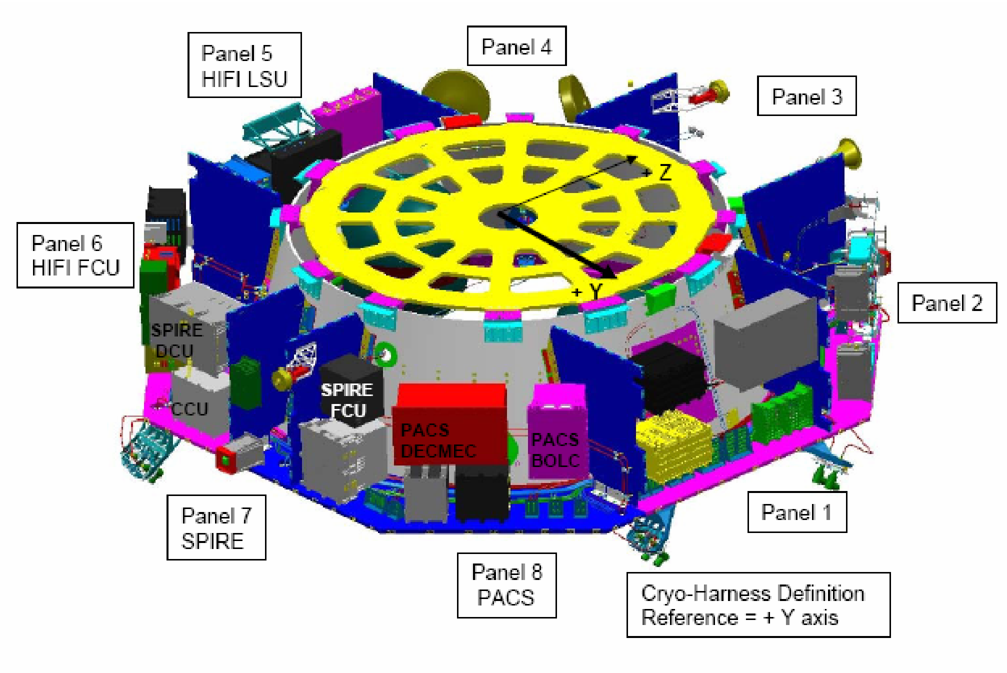


Figure 1.1.6.3-1 : SVM int. Warm-unit Layout (+Z/+Y)

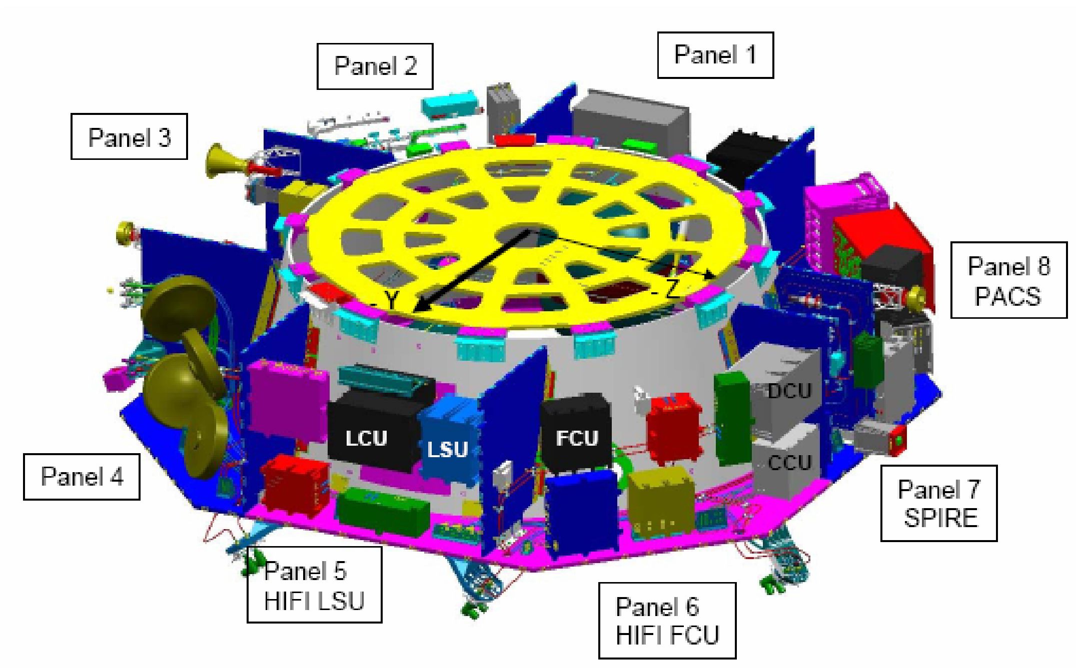


Figure 1.1.6.3-2 : SVM int. Warm-unit Layout (-Z/-Y)

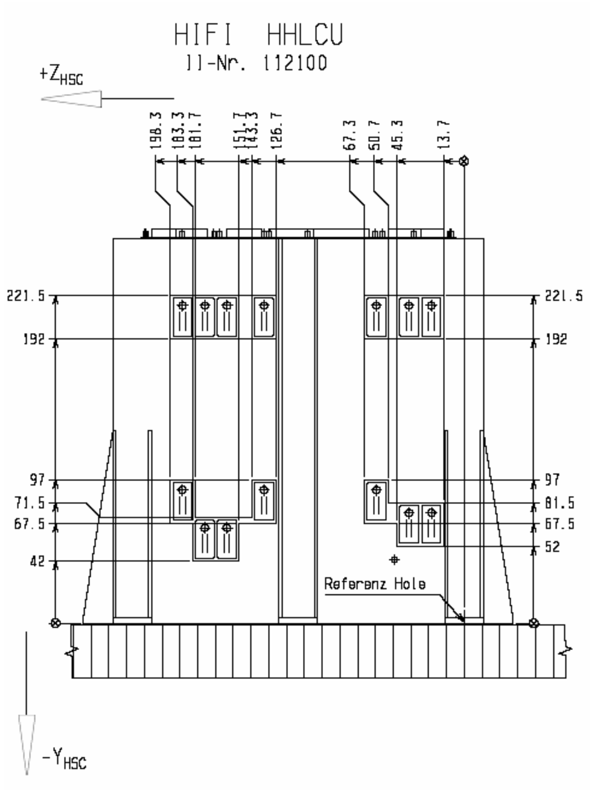


Figure 1.1.6.3-3 : SVM Cryo-harness Attachment Anchors (TC-105) on HIFI FCU

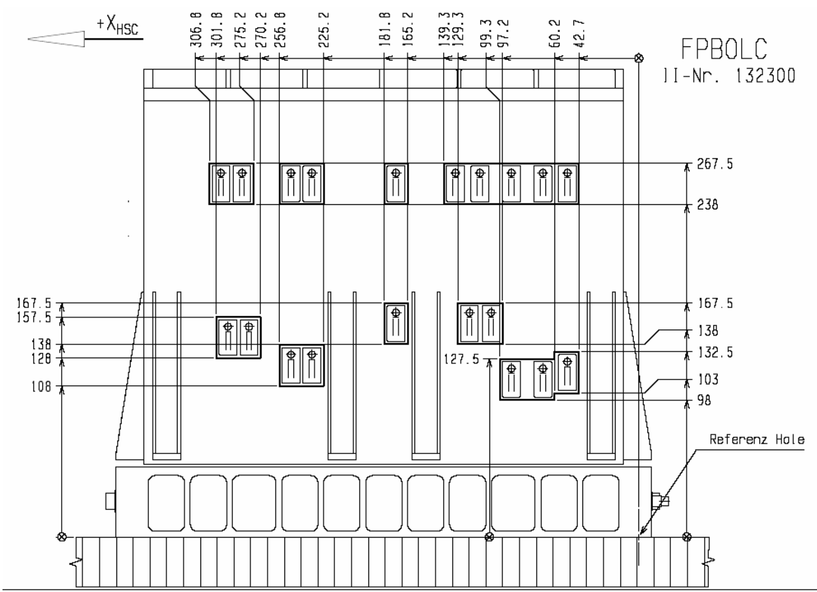


Figure 1.1.6.3-4 : SVM Cryo-harness Attachment on PACS BOLC

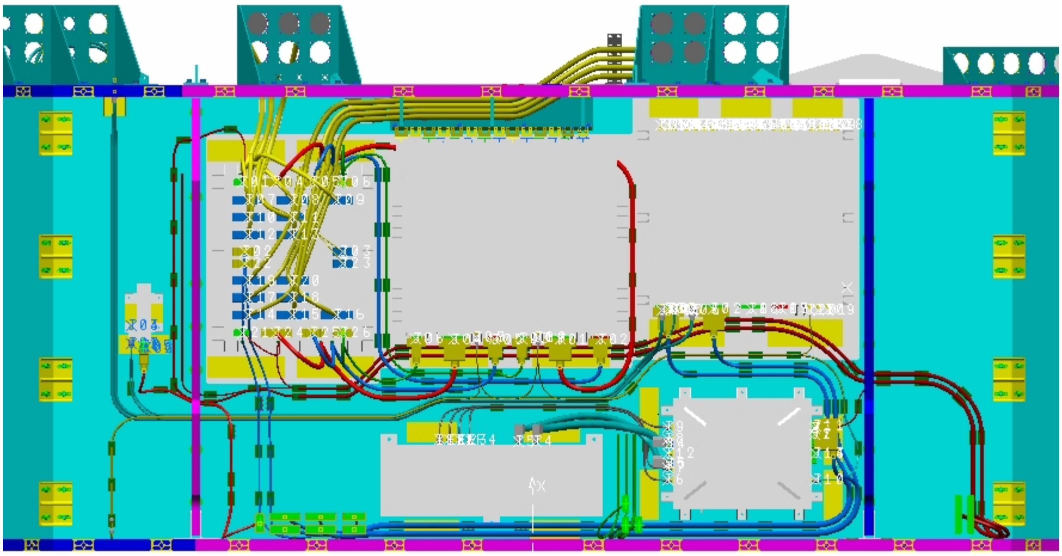


Figure 1.1.6.3-5 : SVM Lateral panel (-Y) with HIFI LCU SIH (yellow) ; HIFI 1 panel

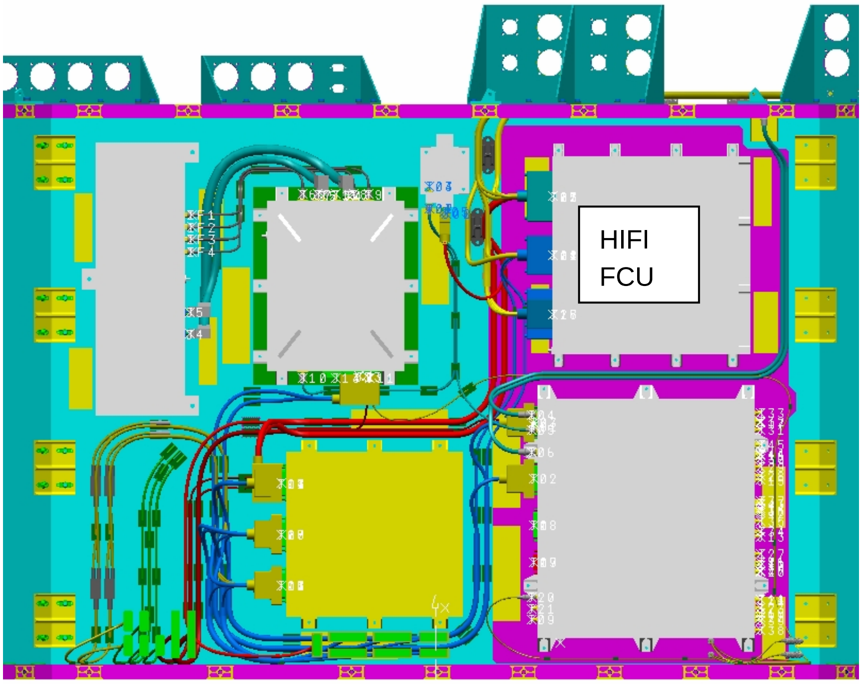


Figure 1.1.6.3-6 : SVM Lateral panel (-Y/-Z) with HIFI FCO ; HIFI 2 panel

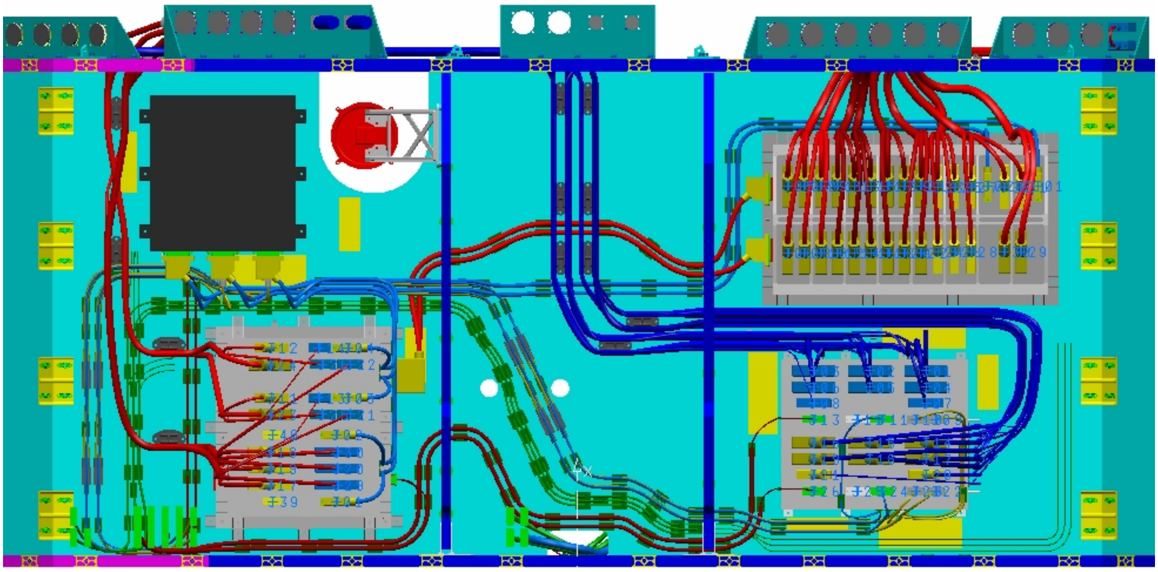


Figure 1.1.6.3-7: SVM Lateral panel (-Z) SPIRE SIH FCU_left-bottom; DCU_right-up

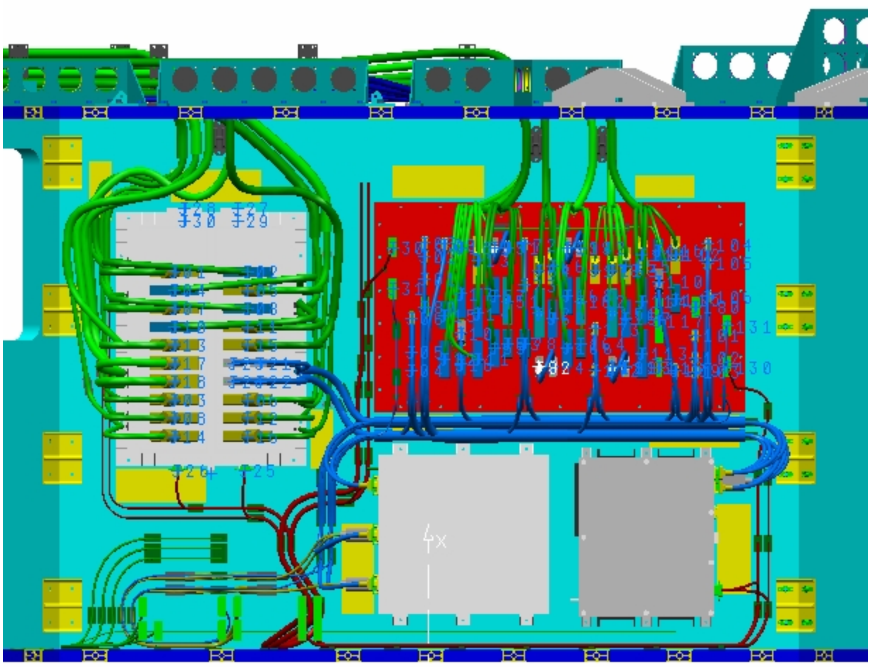


Figure 1.1.6.3-8: SVM Lateral panel (-Z / +Y) PACS SIH BOLC_left-up; DECMEC_right-up

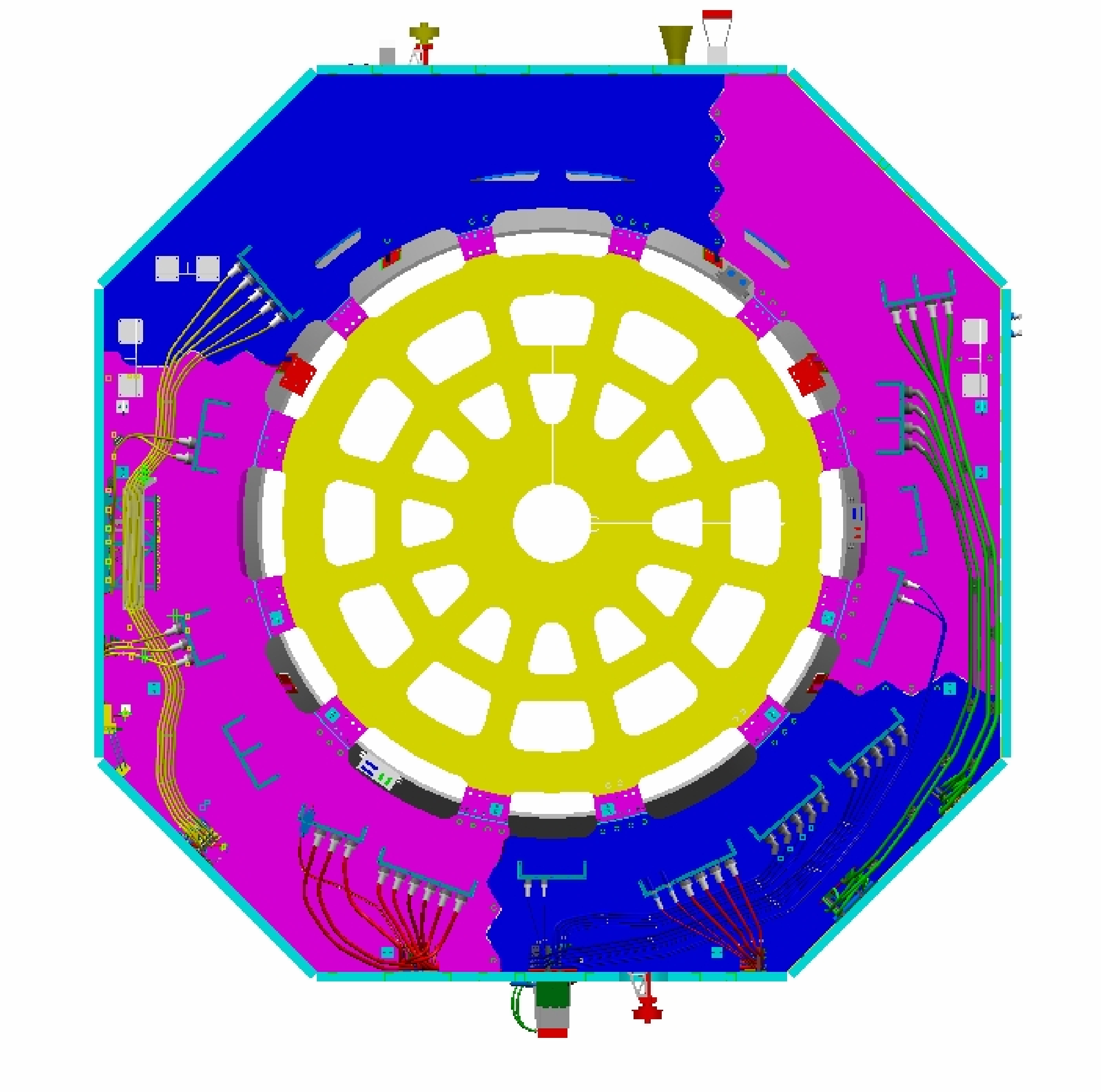


Figure 1.1.6.3-9: SVM upper closure panel I/F-connector-brackets (top-view)

1.1.6.4 CVV External SIH

The CVV external Harness establish the connection between the SVM Interface Bracket's on the SVM upper closure panel, the CVV external HIFI LOU and the CVV upper ring feed-through connectors.

The CVV external SIH bundles are routed

- from the SVM Interface connector-bracket on upper closure panel, to the next SVM-CVV strut
- along the strut to the strut fixation on CVV lower bulkhead
- via the C-shape cable rails upwards along the CVV cylinder to the upper connector ring feed-through I/F plug-connectors.

The harness routing and attachments are defined in the "Harness attachment and coordinate list, where all Cryo-harness connector positions, the harness attachments along the CVV external structural elements and within each C-profile is identified. To support the Cryo-harness integration and to control the harness routing first on the manufacturing mock-up and later on the original HPLM structures, this document have been established for.(ref. HP-2-ASED-TN-0086).

The SIH routing Lay-outs CVV external are provided on the following figures.

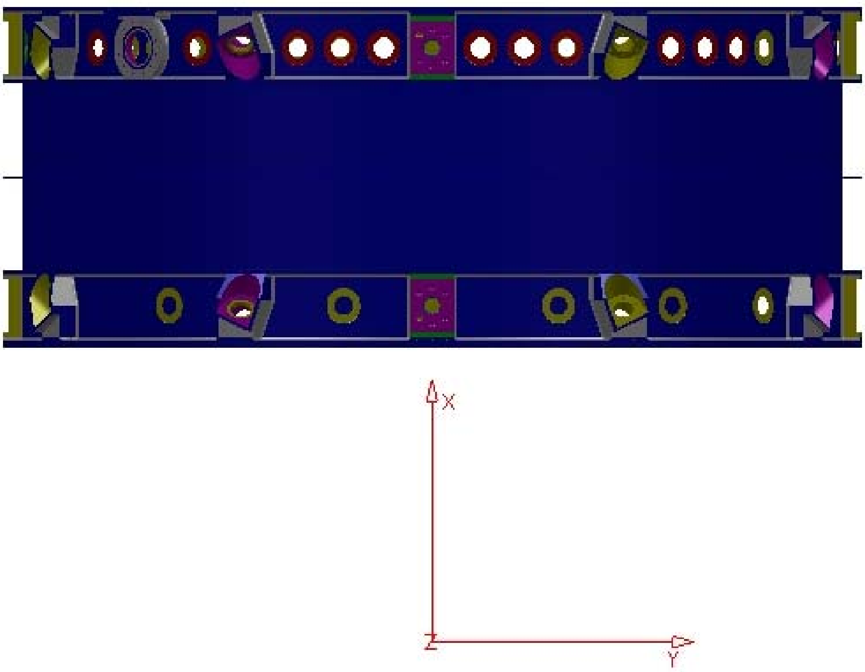


Figure 1.1.6.4-1: CVV ext. upper and lower feed-through connector I/F

1.1.6.4.1 CVV ext. SIH Routing Constraints

Harness crossings between sensitive instrument harness branches and parallel routing of other instrument branches or CCH branches, have been taken into account, where physical space was available. In special cases, like SPIRE, where several harness branches have to be routed like one big branch from an EMC point of view, a P-clamp harness attachment routing along the SVM struts have been designed, to enlarge the strut envelope and to route all branches in parallel along of it.

In figures below, the CVV external SIH lay-outs are provided, in addition the SPIRE and PACS P-clamp fixations along the subject SVM struts.

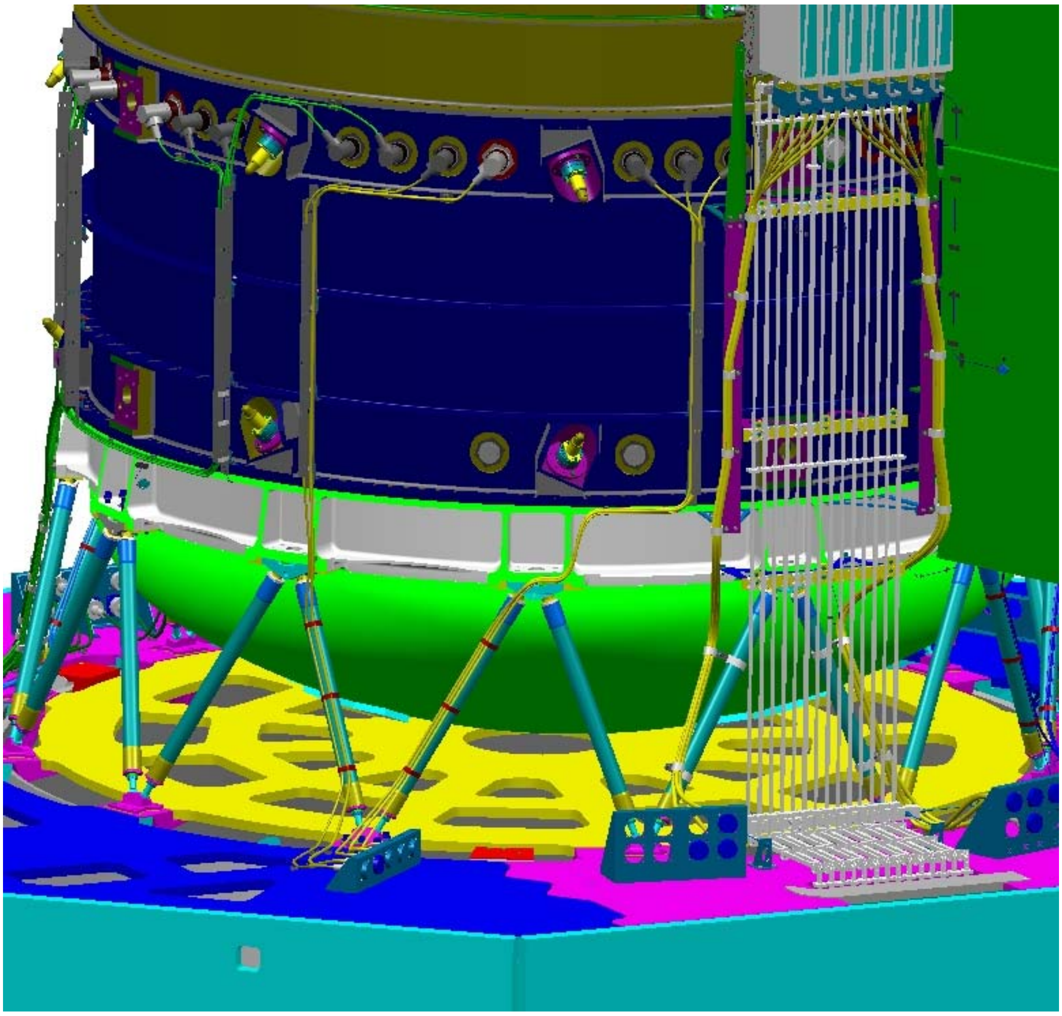


Figure 1.1.6.4-2: CVV ext. HIFI SIH

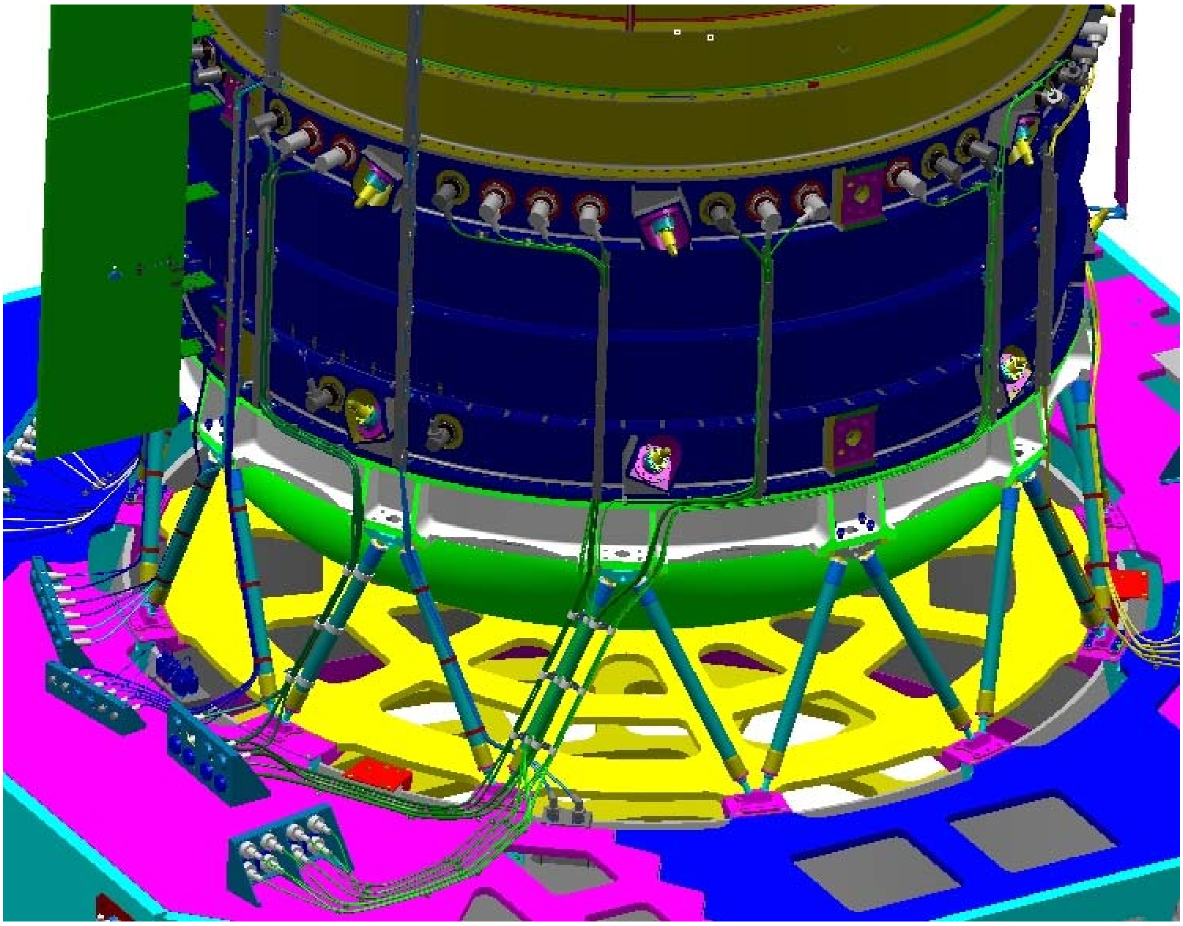


Figure 1.1.6.4-3: CVV ext. PACS SIH

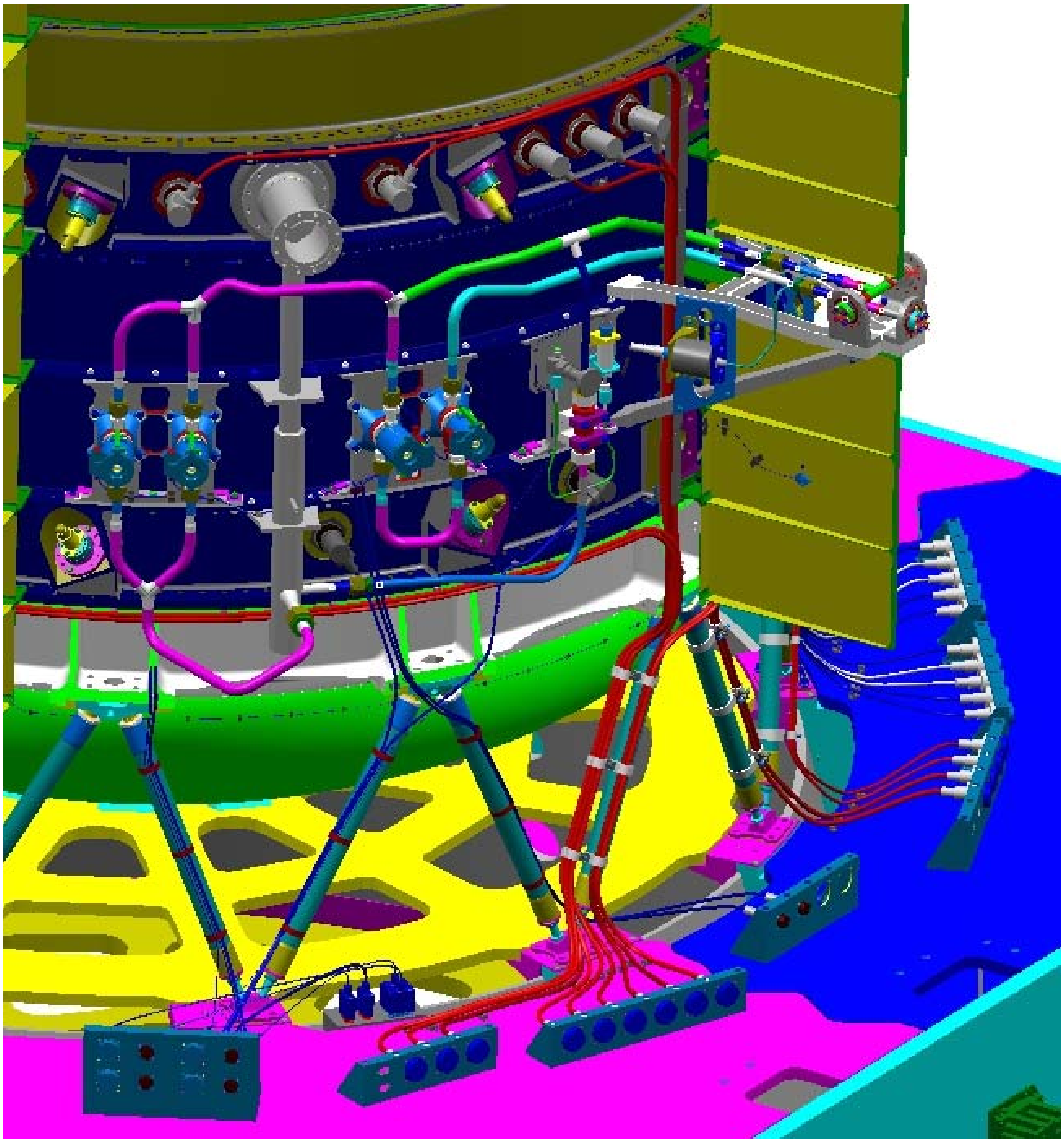


Figure 1.1.6.4-4: CVV ext. SPIRE SIH (-Z)

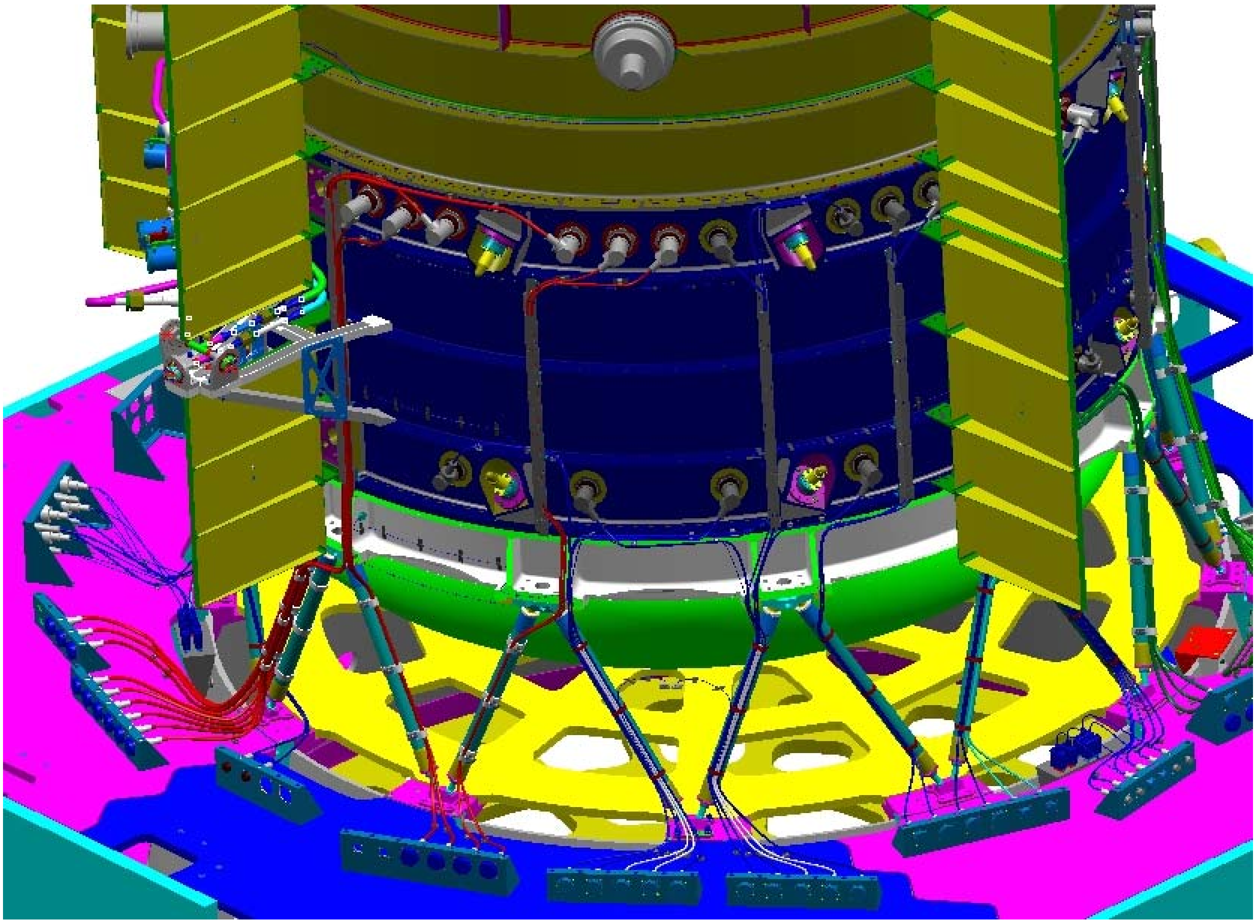


Figure 1.1.6.4-5: CVV ext. SPIRE SIH (-Z / +Y)

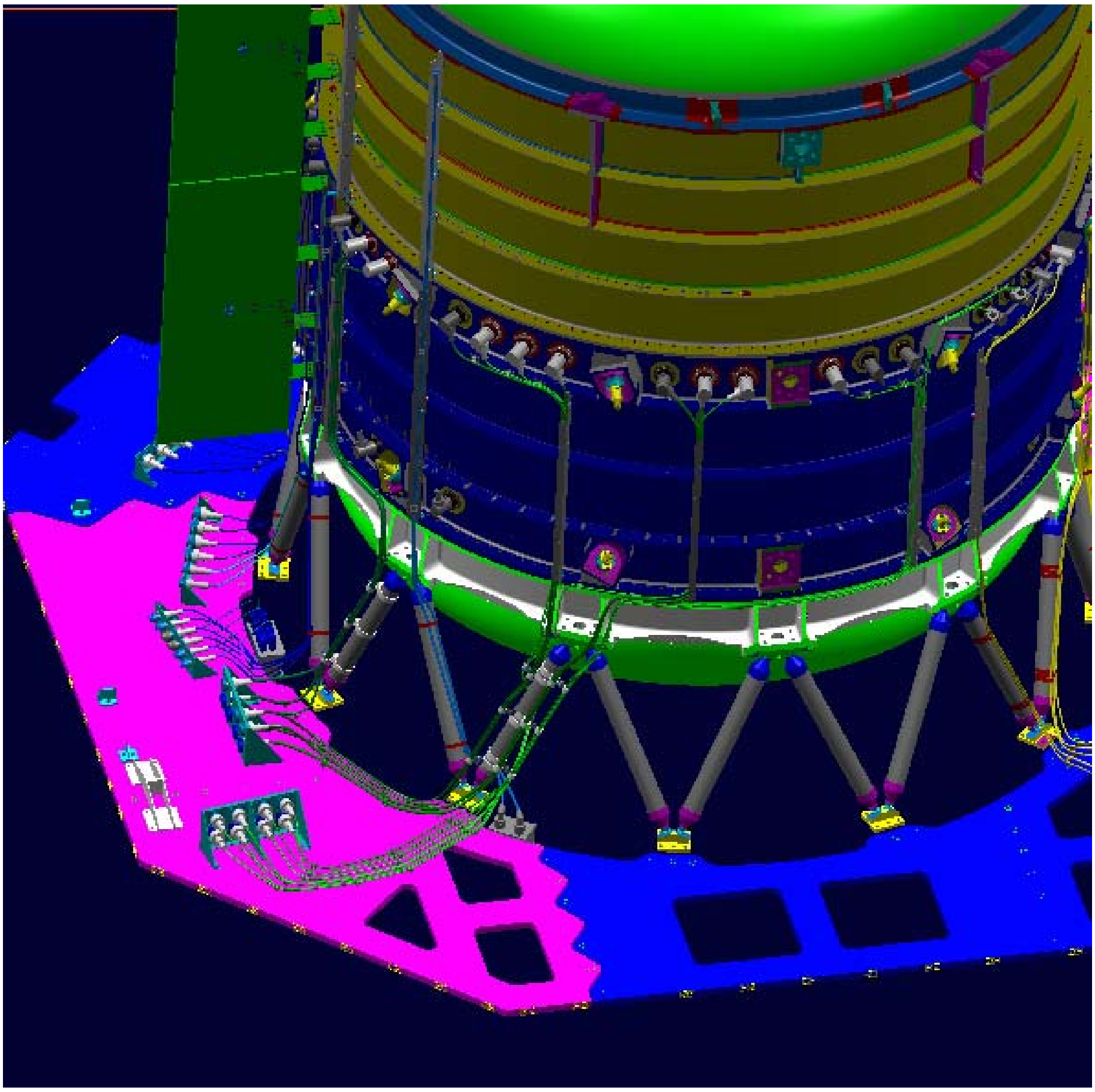


Figure 1.1.6.4-6: Overall View on PACS CVV External Harness

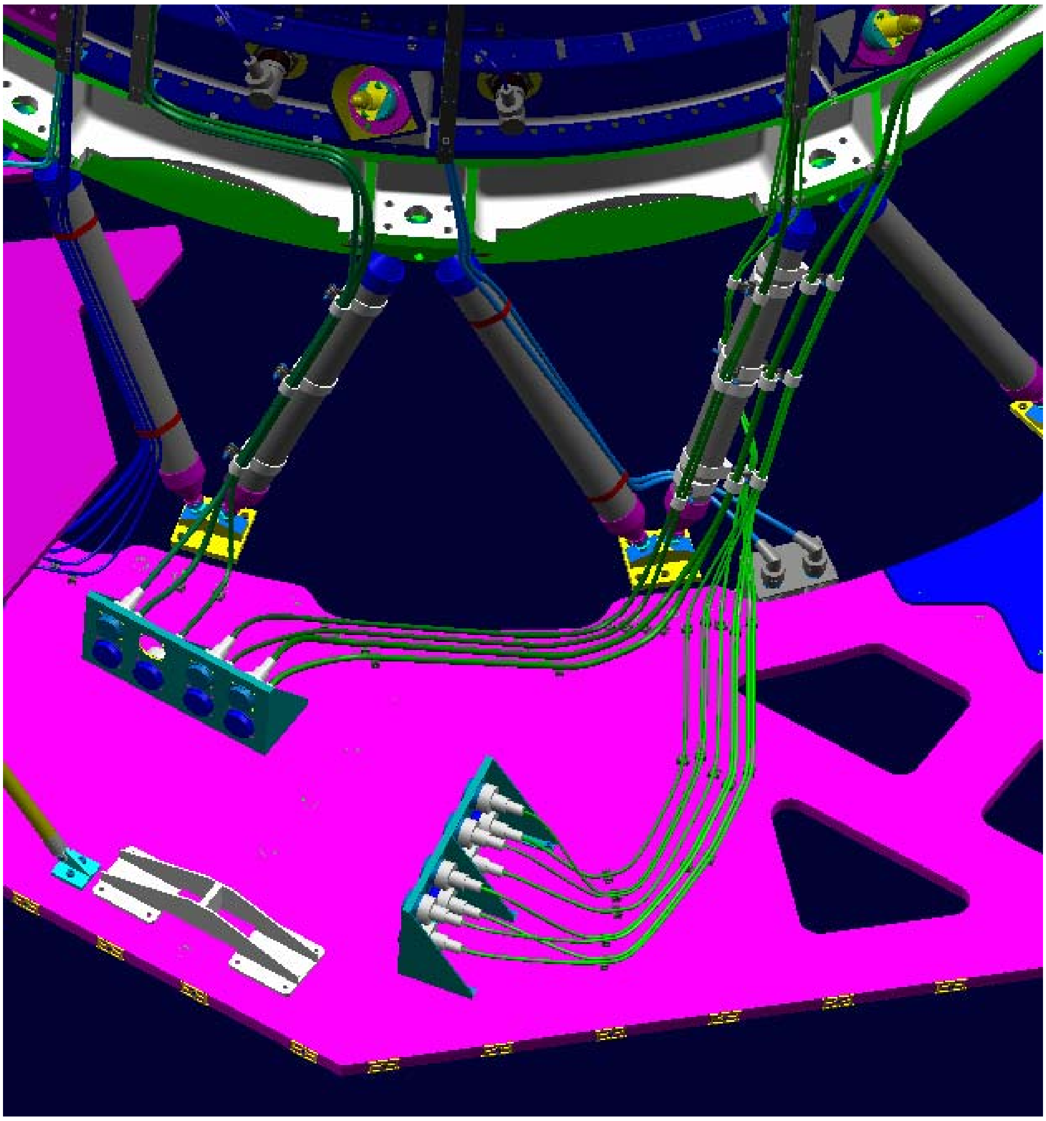


Figure 1.1.6.4-7: PACS P-Clamp attachment on PLM-SVM I/F-Struts

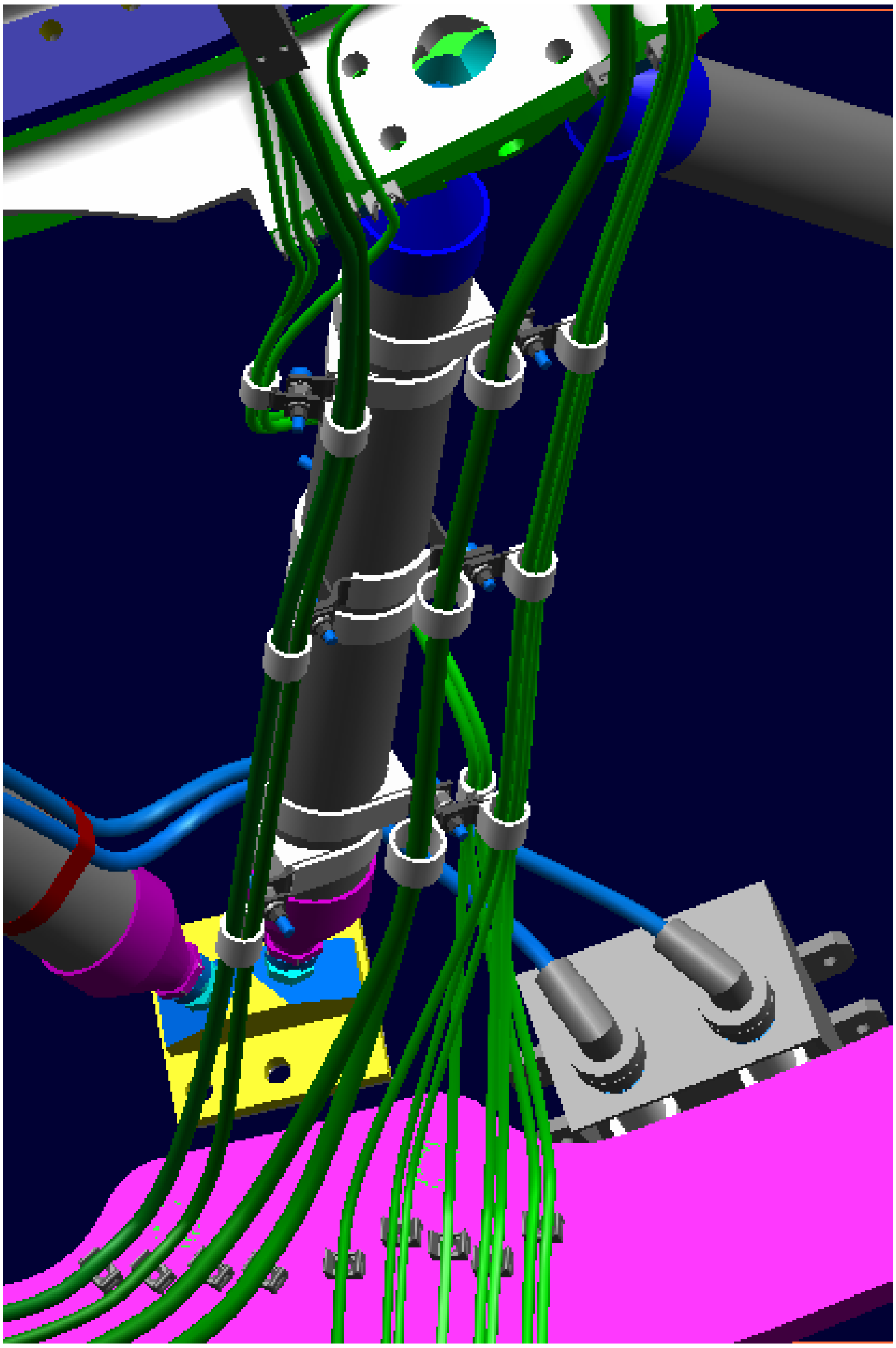


Figure 1.1.6.4-8: Overall View on PACS CVV External Harness (green branches)

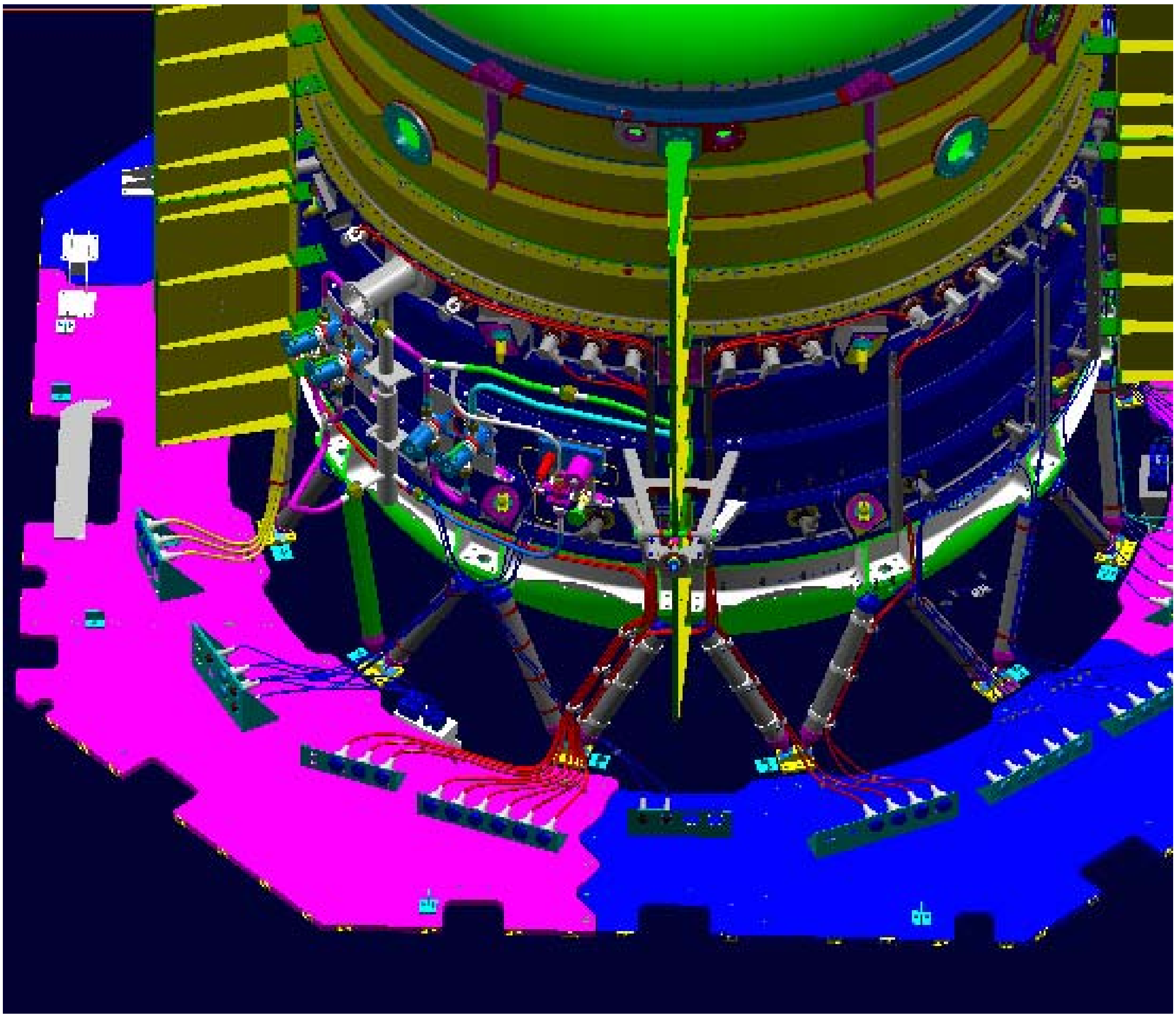


Figure 1.1.6.4-9: Overall View on SPIRE CVV External Harness (red branches)

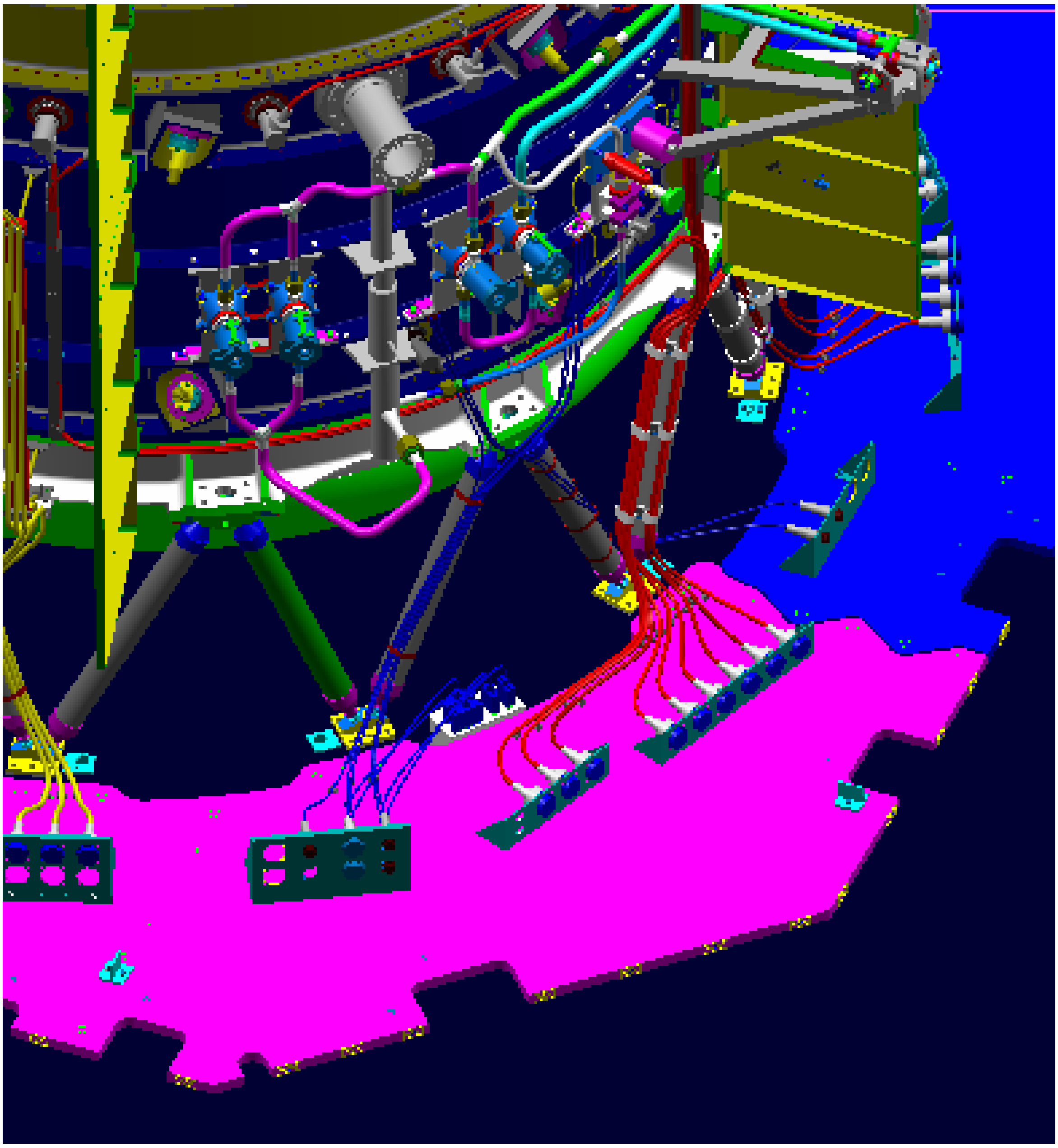


Figure 1.1.6.4-10: Overall View on SPIRE CVV External Harness (red branches)

1.1.6.5 CVV Internal SIH

The CVV internal Harness provides the connection between the CVV I/F vacuum feed-through connectors , the Instrument FPUs and JFETs inside the Cryostat.

In figure below the instrument cold-unit allocations and the main SIH paths are shown. The individual SIH lay-outs between the CVV internal feed-through connectors and the optical bench assembly (OBA) is provided Cryo-Harness design evaluations of routing, bundling, attachment and thermal bonding to the subject structures and the connector accommodation are under investigations

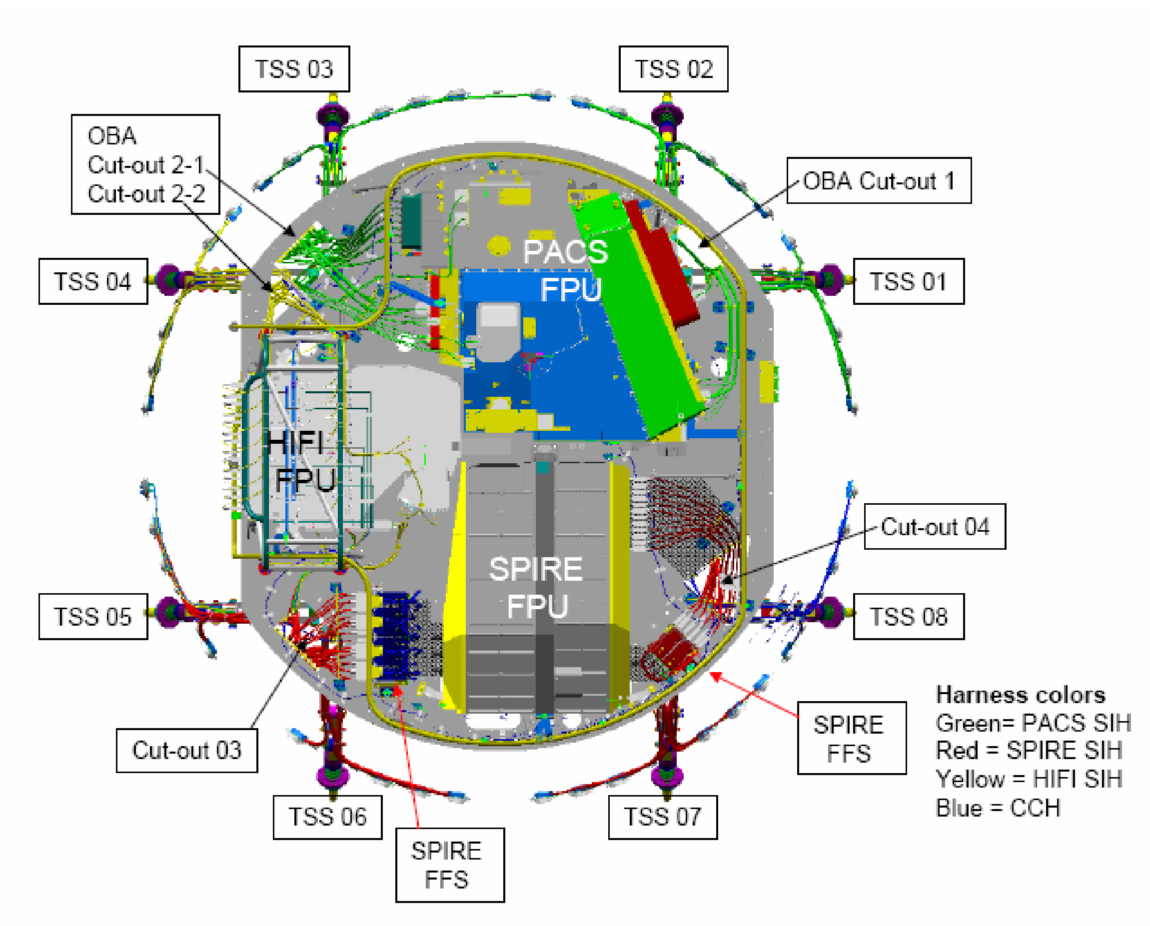


Figure 1.1.6.5-1: Principle SIH Routing on optical Bench

The SIH bundles are routed

- from the CVV feed-through connectors Tank supporting Straps (TSS) ,
- through the thermal brackets with and without thermal conductive potting adhesive
- below the optical bench close to the subject instrument cold unit allocation
- and through optical bench cut-out 01-05 and through the thermal brackets with and without thermal conductive potting, but all with light tight potting adhesive
- on the optical bench and over the “hand-rail” harness attachments to the subject instrument cold unit I/F connectors

On figures below, the SIH branches routed between the CVV feed-through connectors and the optical bench assembly (OBA) are shown.

1.1.6.5.1 CVV Int. HIFI SIH Feed-through connectors

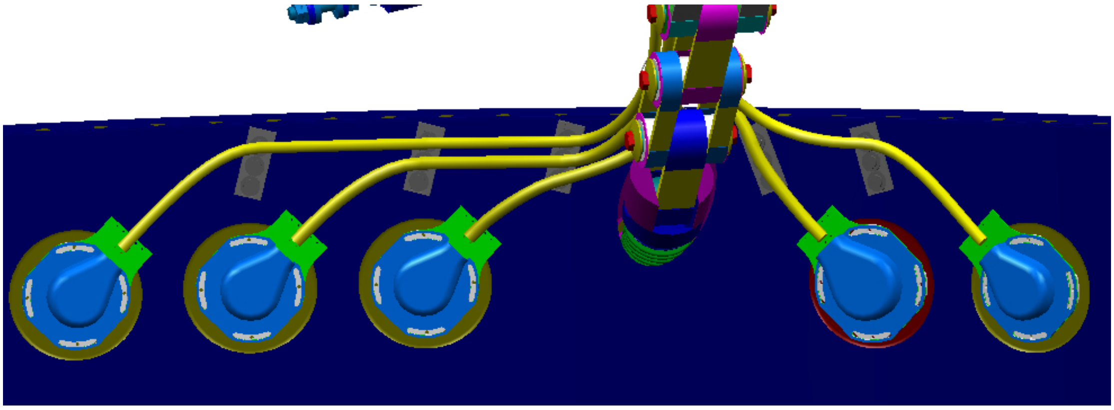


Figure 1.1.6.5-2: HIFI J16-J20 to TSS 04

1.1.6.5.2 CVV Int. SPIRE SIH Feed-through connectors

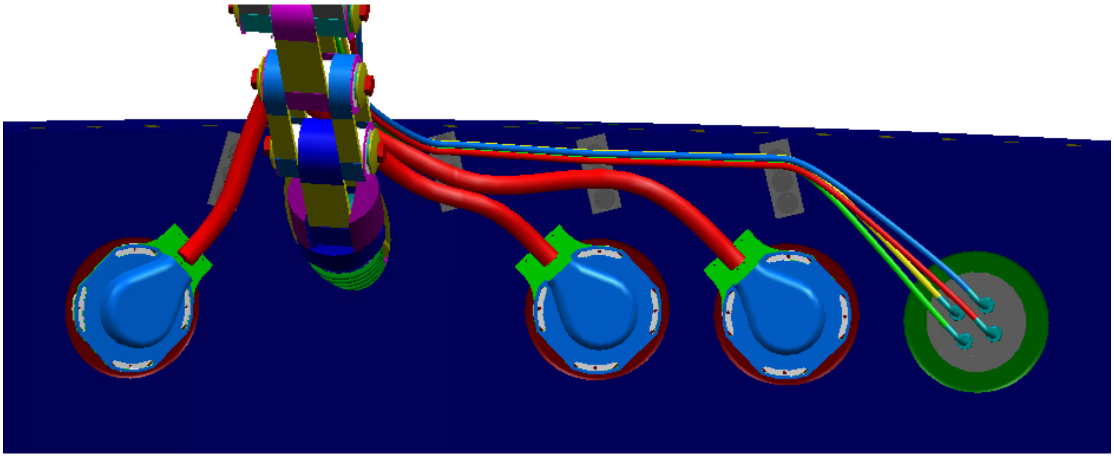


Figure 1.1.6.5-3: HIFI COAX J21 and SPIRE J22-J24 to TSS 05

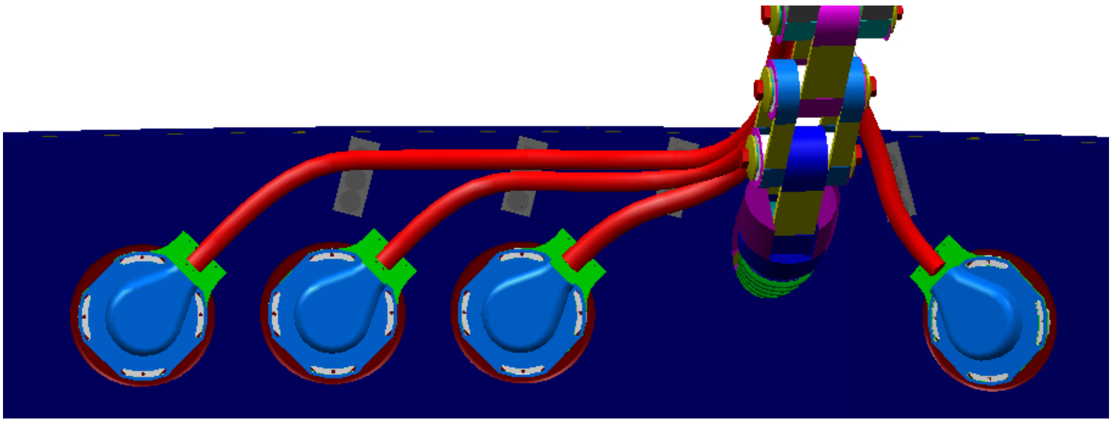


Figure 1.1.6.5-4: SPIRE J25-J28 to TSS 06

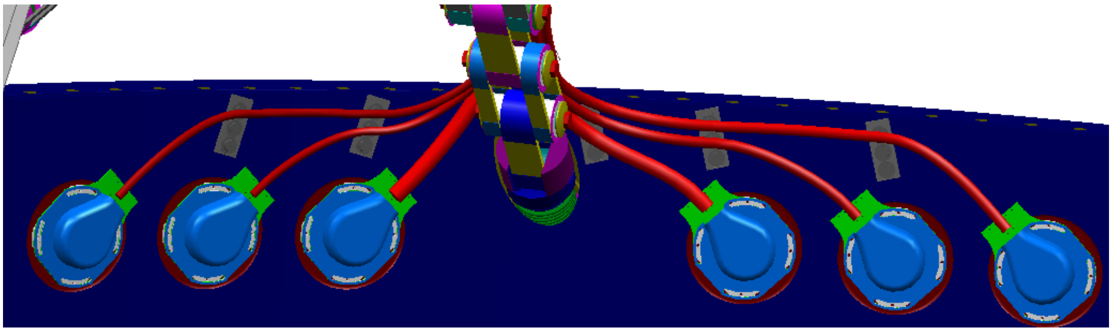


Figure 1.1.6.5-5: SPIRE J29-J34 to TSS 07

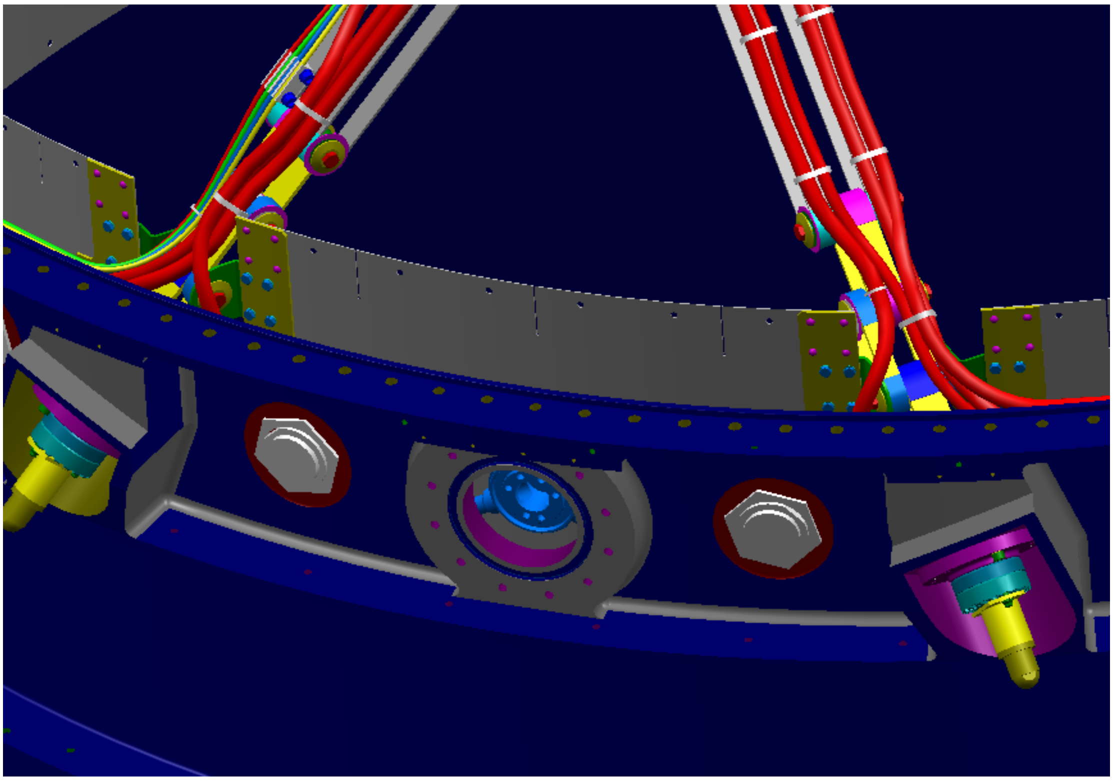


Figure 1.1.6.5-6 : Overall View on SPIRE CVV External Harness

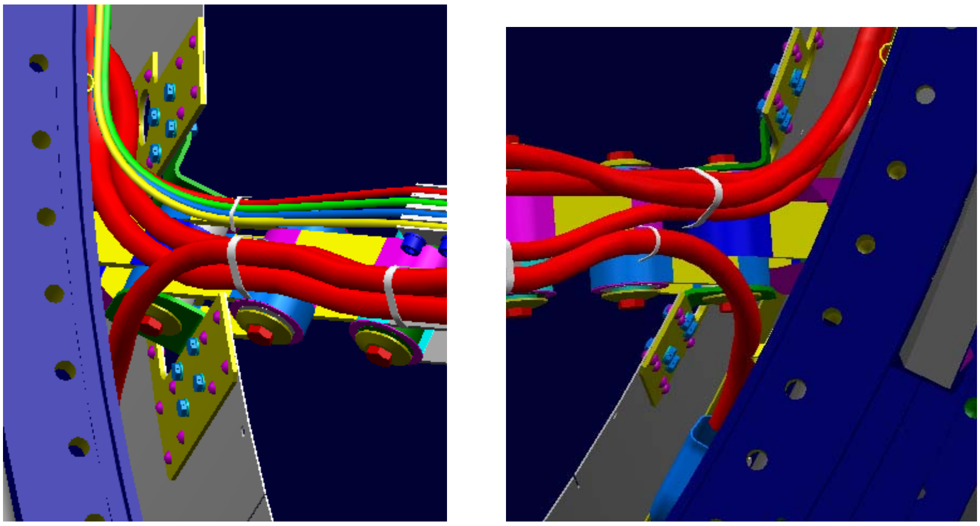


Figure 1.1.6.5-7: SPIRE SIH routed on TSS & HIFI Cx-braches through thermal brackets

1.1.6.5.3 CVV Int. PACS SIH Feed-through connectors

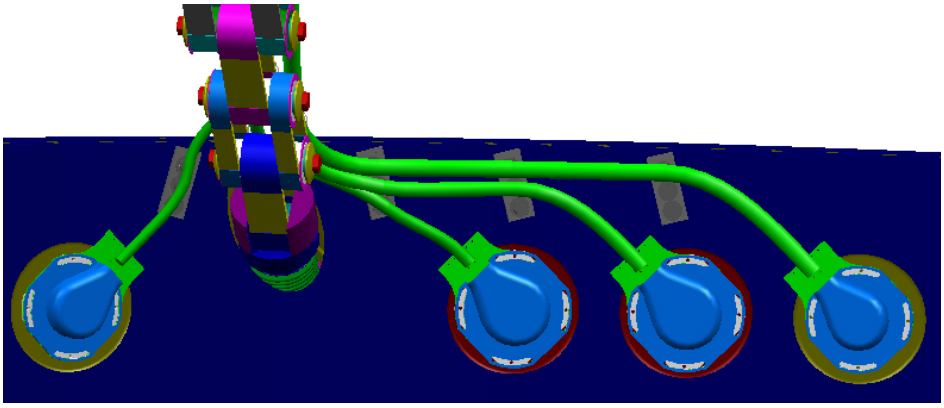


Figure 1.1.6.5-8: PACS J01-J04 to TSS 01

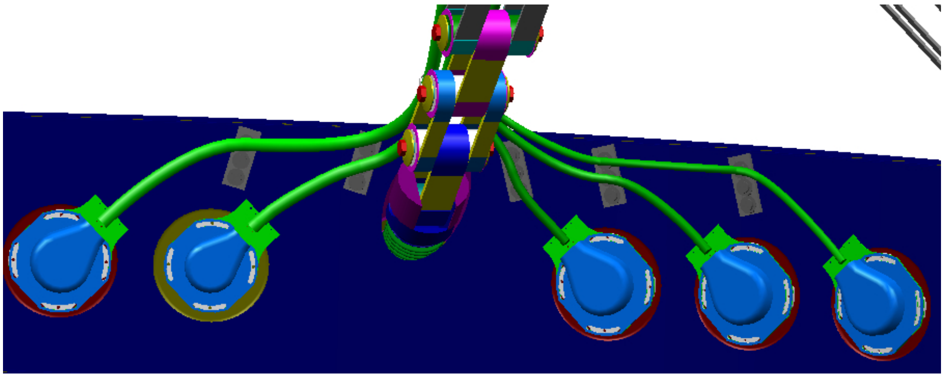


Figure 1.1.6.5-9: : PACS J05-J09to TSS 02

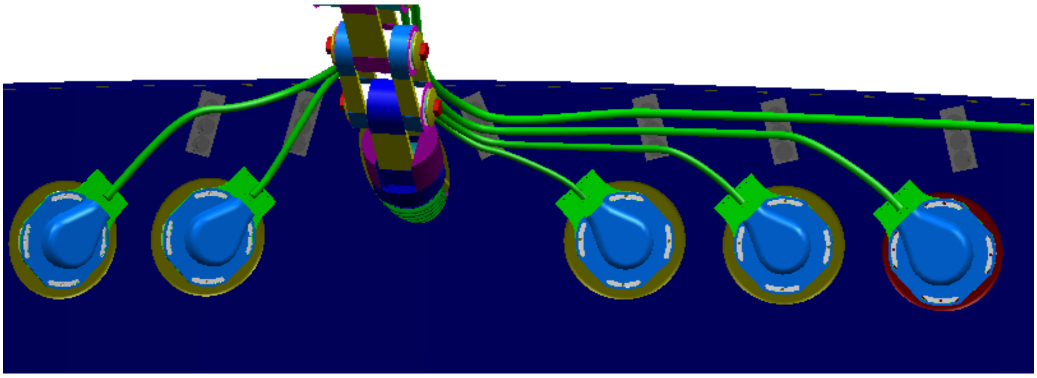


Figure 1.1.6.5-10: PACS J11-J15 to TSS 03

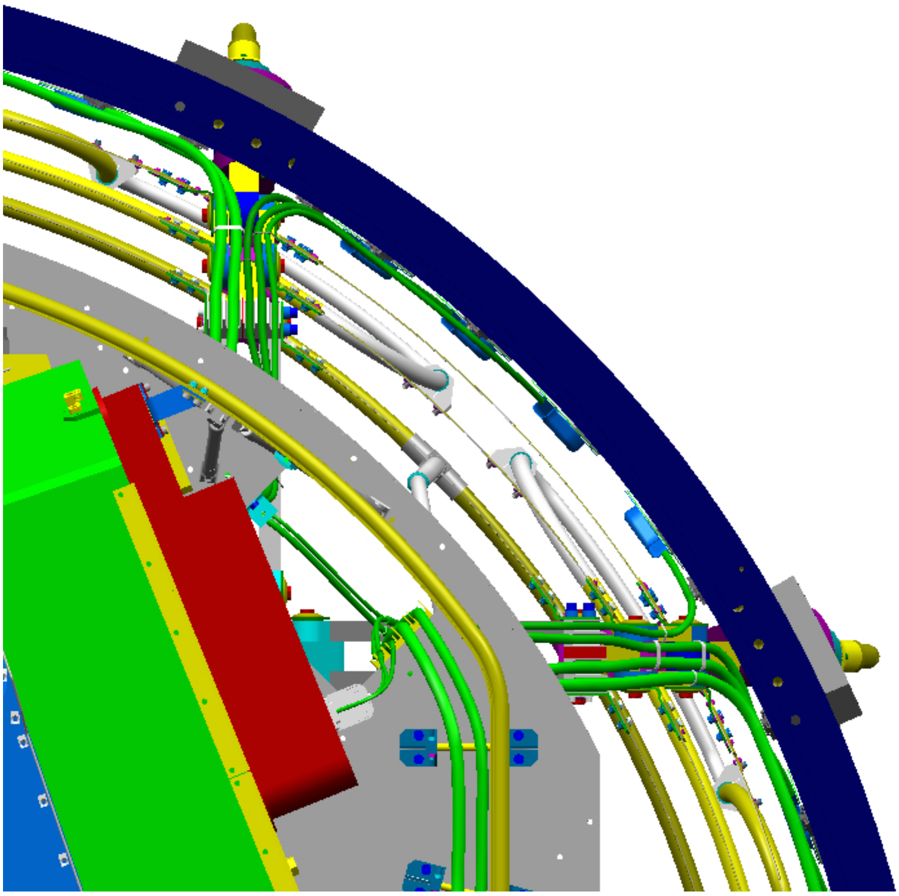


Figure 1.1.6.5-11: Internal PACS SIH over TSS 01 and TSS 02 to FPU

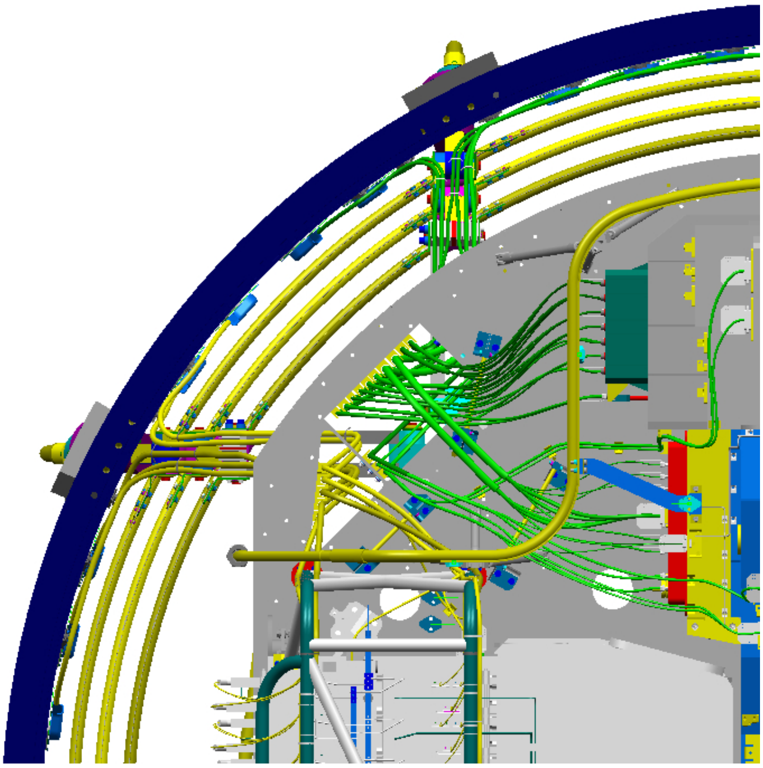


Figure 1.1.6.5-12: CVV Internal PACS SIH on TSS 03 & Cut-out 2-1–green and HIFI SIH on TSS 04 & Cut-out 2-2-yellow

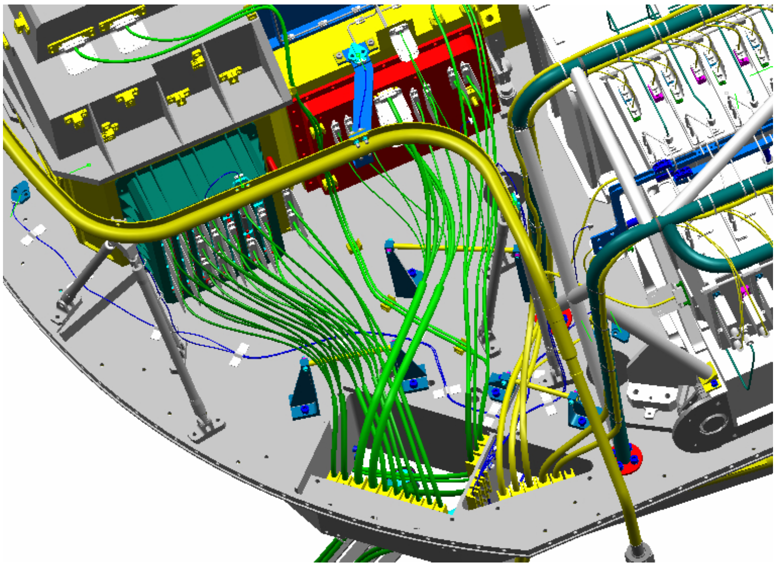


Figure 1.1.6.5-13: CVV int Harness through OBA cut-out 2 (PACS-green and HIFI FPU-yellow)

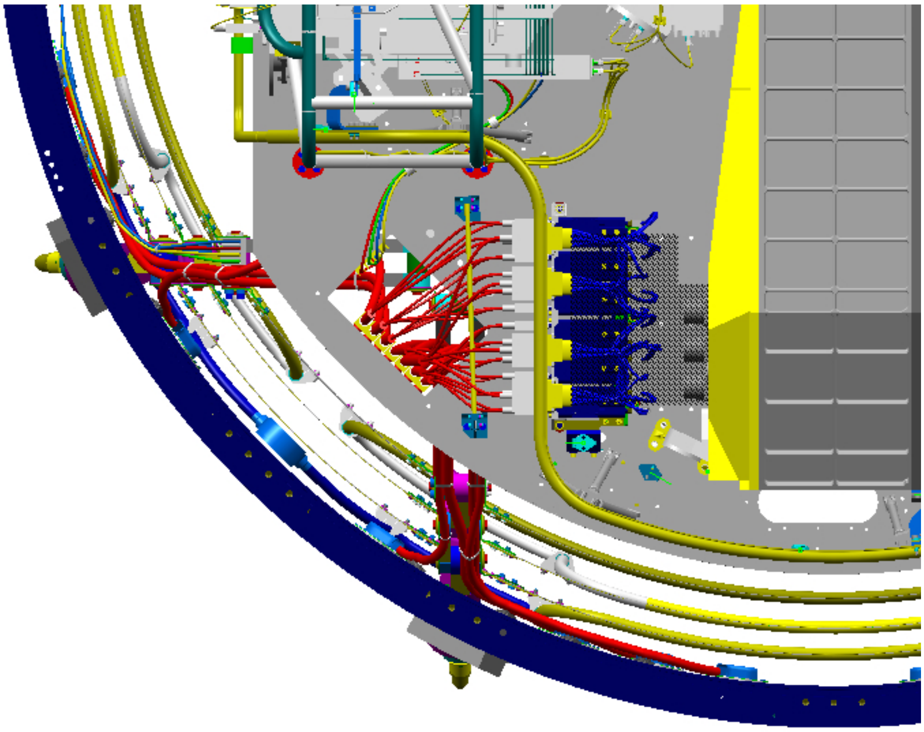


Figure 1.1.6.5-14: CVV Internal SPIRE SIH on TSS 05 & TSS 06 through Cut-out 03

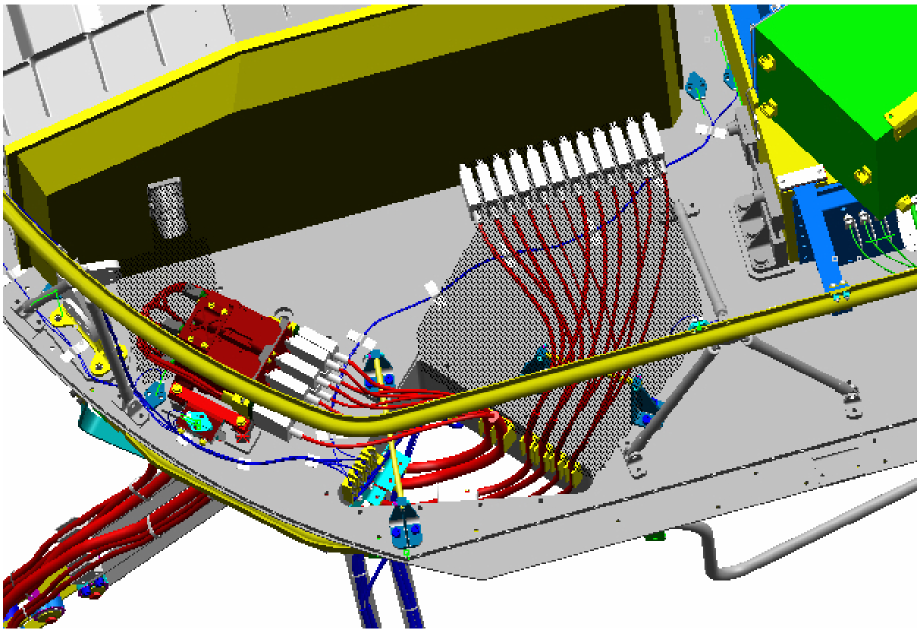


Figure 1.1.6.5-15: CVV int Harness through OBA cut-out 4 SPIRE (JFS and PACS FPU)

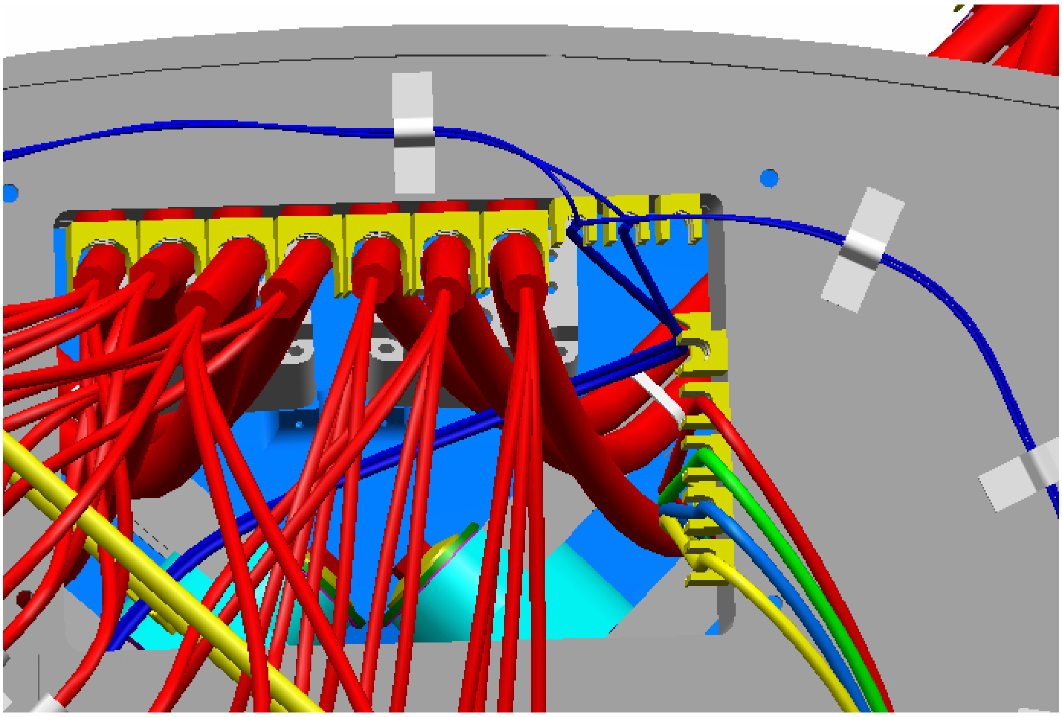


Figure 1.1.6.5-16: CVV internal SIH through OBA thermal brackets (OBA Top-view cut-out 3)

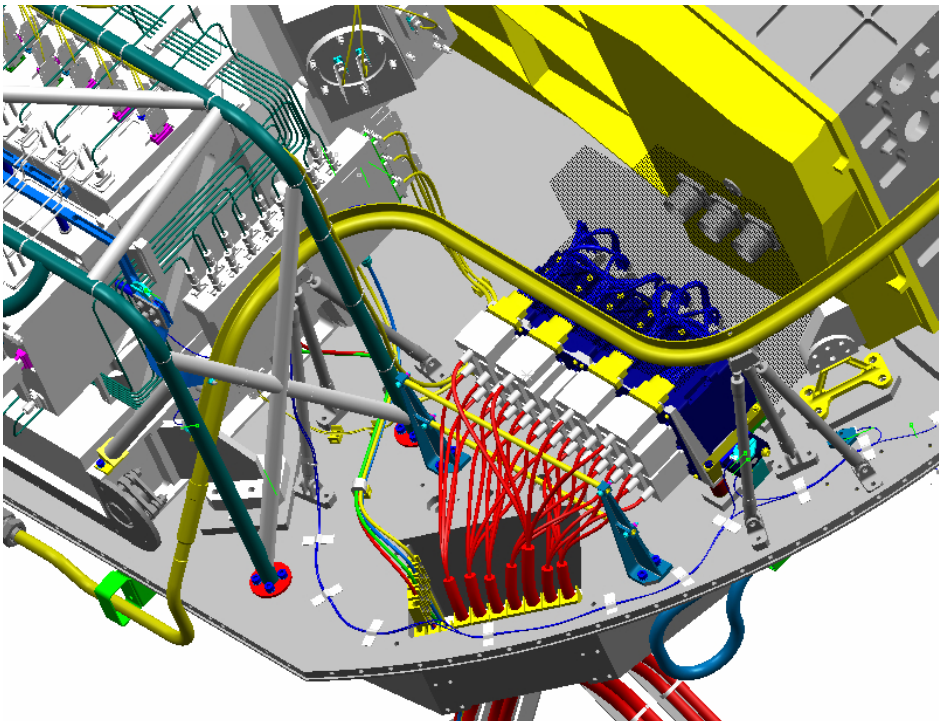


Figure 1.1.6.5-17: CVV int Harness through OBA cut-out 3 SPIRE (SPIRE JFP and HIFI Cx-cables)

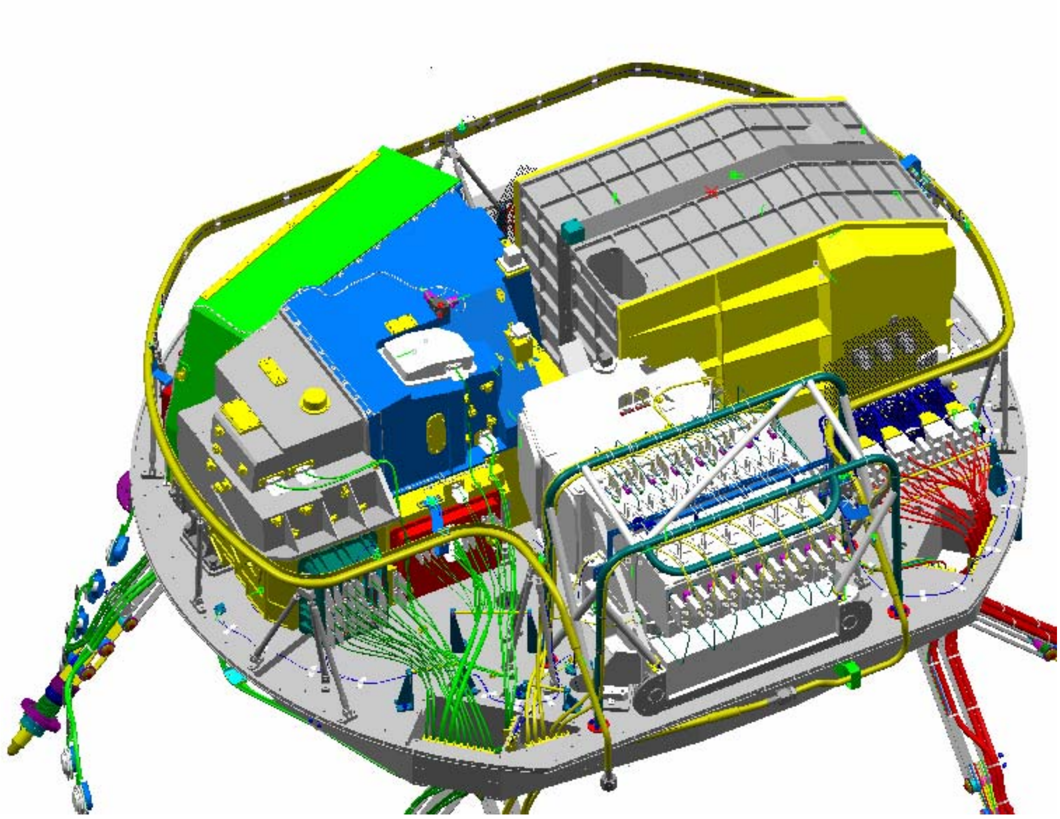


Figure 1.1.6.5-18: CVV internal Harness OBA (iso-view)

1.1.6.6 Cryo-Harness Connectors

The Cryo Harness is designed with ESA SCC standard rectangular and round connectors and special solid spill connectors for the cryogenic environment application, similar to those of the former ISO harness. In figures below some Cryo-harness typical wired solid spill connector interconnection are shown.

1.1.6.6.1 CVV Feed-through Solid-spill Connector

In heritage to the former program ISO, where all harness wire interconnections have been welded and soldered to connector solder terminals, the Herschel Cryo harness of solid wire contact connectors for CVV round connector hermetic feed-through and cold environmental rectangular MWDM connectors have been selected.

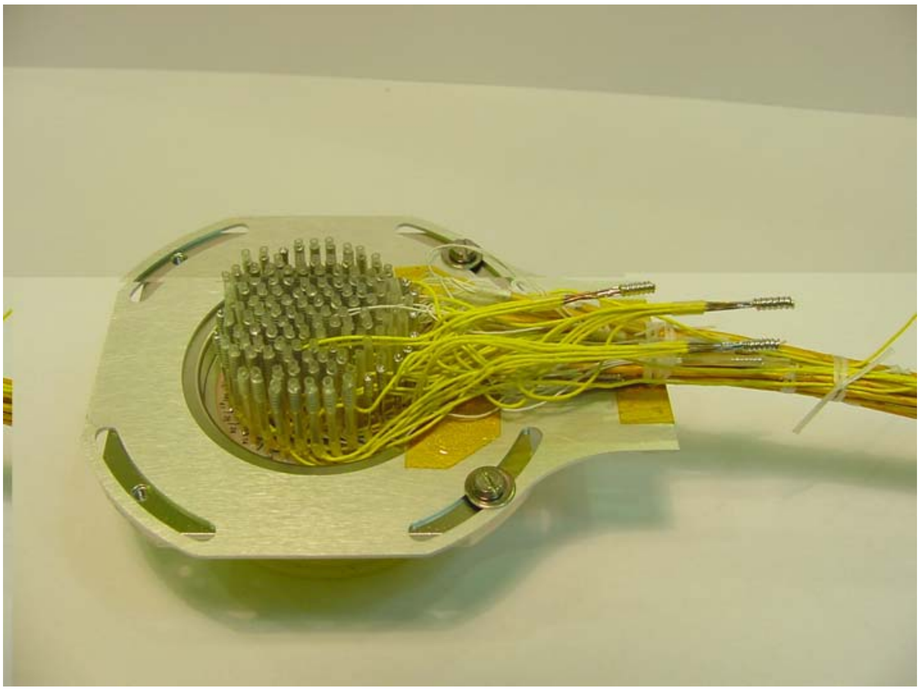


Figure 1.1.6.6-1: Wired CVV int 128 pol Feed-through connector of SPIRE SIH-CS-10

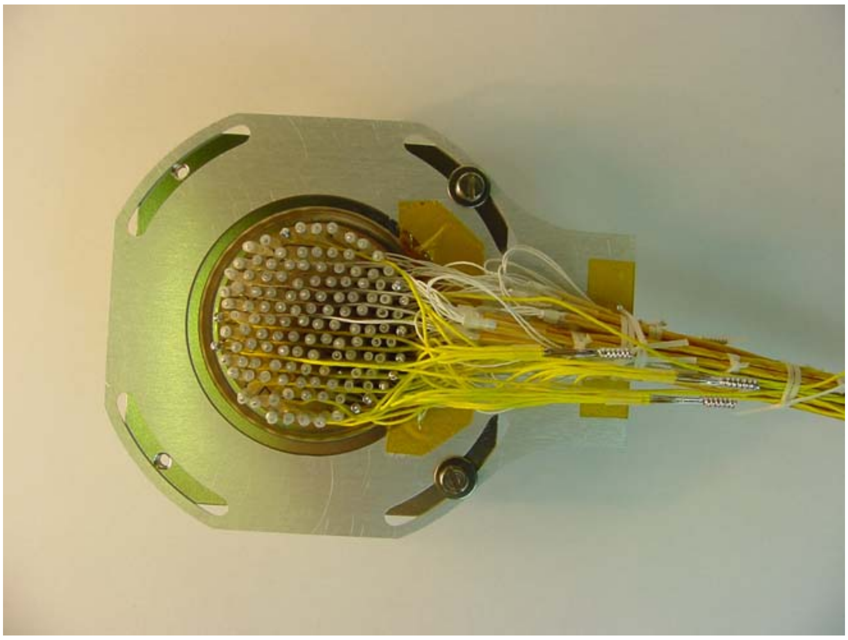


Figure 1.1.6.6-2: Wired Feed-through connector of SPIRE SIH-CS-10 (top-view)

1.1.6.6.2 Cold environmental Solid-spill MWDM Connectors

As cold unit I/F connectors and for the spatial frame-work connectors solid wire contact rectangular MWDM micro-connectors have been selected. Harness branches without requested EMC back-shell request, have been designed as the former cryogenic harness of ISO, with L-bracket back-shells.

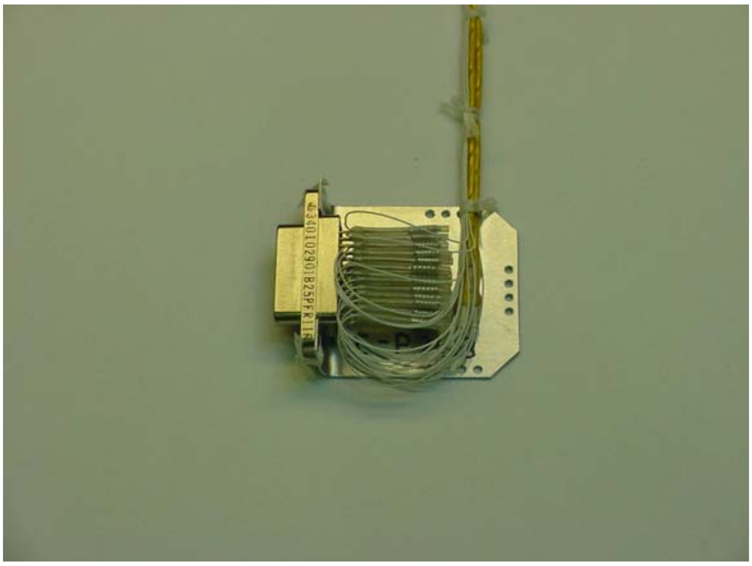


Figure 1.1.6.6-3: Typical CVV int. Cryo-harness solid spill connector interconnection

For SPIRE SIH with I/F to the cold unit side, special EMC back-shells have been designed for the solid-spill connectors and to cover the instrument EMC requirements.

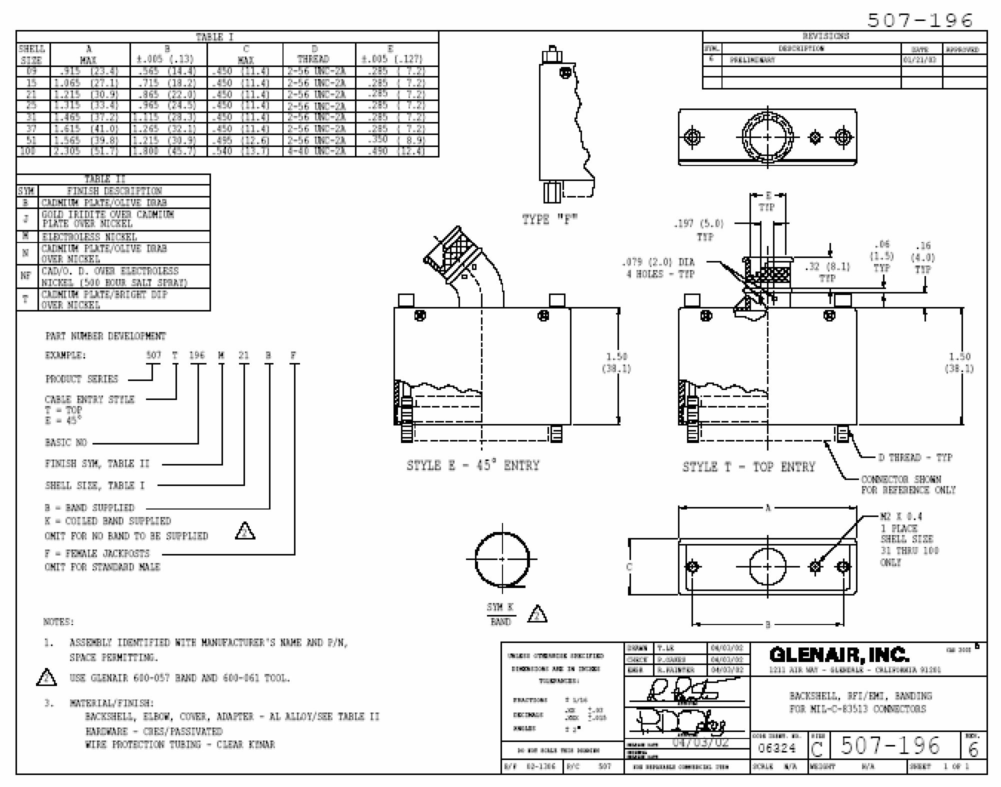


Figure 1.1.6.6-4: Typical CVV int. SIH Cold unit EMC I/F connector back-shell

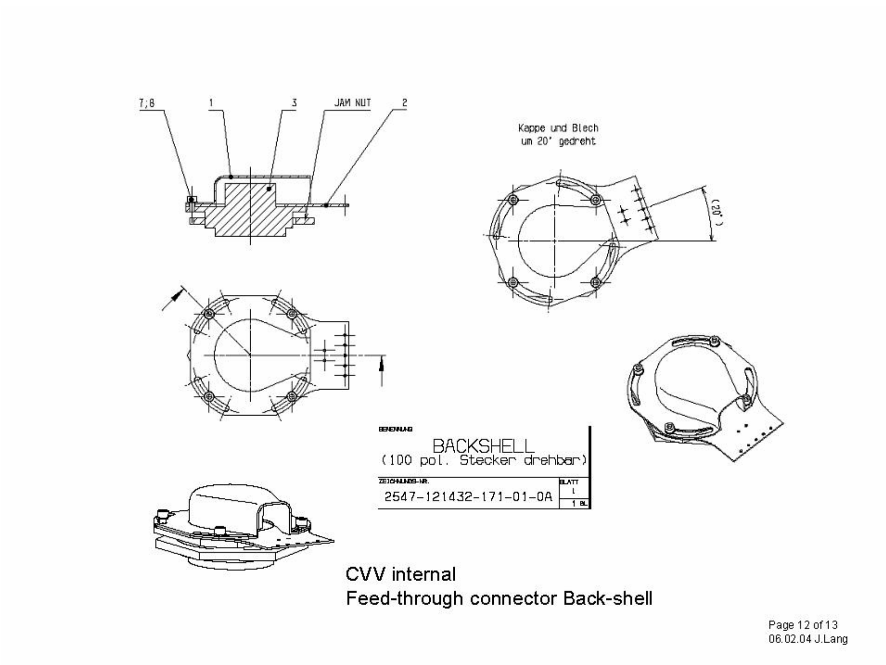


Figure 1.1.6.6-5: Typical CVV int. Feed-through connector back-shell

1.1.6.6.3 *Nano-Connectors for Cryo-Control Component Interfaces*

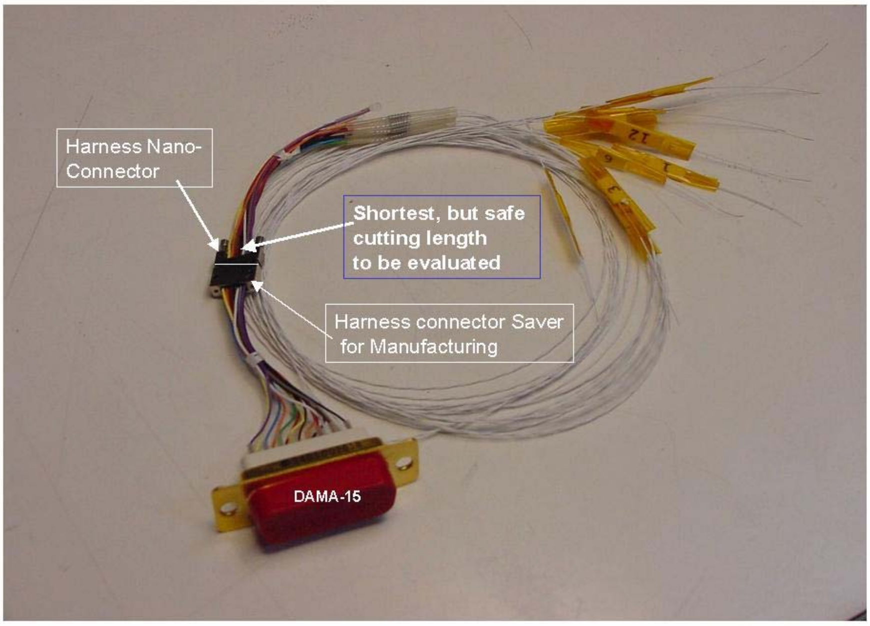


Figure 1.1.6.6-6: Typical wired CCH Nano-connector with manufacturing & test-saver

1.1.6.6.4 *Accelerometer Connectors*

Figure 1.1.6.6-7: Typical wired Accelerometer connector

1.1.7 Cryo-Harness Cables

The Herschel Cryo harness consist of copper, brass and stainless steel wire cores, pending on the thermal environment of the dedicated harness segment and electrical I/F requirements. In some cases with higher impacts on HPLM lifetime, cable-shields and over-shield material of manganin have been selected.

1.1.7.1 Cryo-harness Wire and Shield-cores

The Cryo-harness wire, cable & shield core materials, the sizes and allocations are identified in table below. More details are defined in the Cryo-harness wiring-lists of the electrical interface control document EICD.

Application	Material, core & wire sizes	Allocation
Isolation Material:	GORE-TEX PTFE & Polyimide Tape	SVM & CVV int.+ ext.
conductor:	SST AWG 38 (diameter = 0,10 mm)	CVV int. & ext.
conductor:	Brass AWG 38	CVV int. & ext.
conductor:	Brass AWG 30 (diameter = 0,25 mm)	CVV int. & ext.
conductor	Copper AWG 22	CVV ext. LOU (50 mΩ)
conductor	Copper AWG 22-28	SVM
Served-wire cable shield:	SST AWG 44 (diameter = 0,05 mm)	CVV int.& ext.
Braided- + served-wire cable shield	SST AWG 44 (diameter = 0,05 mm)	CVV in. & ext. PACS triax-cable
Braided cable shields	Manganin AWG 44	CVV ext. HIFI LOU
Over-shield	Manganin AWG 44	CVV external
Over-shield	Alu-foil 99%, 0,07 mm thickness	SVM

Figure 1.1.7.1-1: Cyro Harness Cable-wire and Shield Materials

1.1.7.2 Used Wire and Cable Materials per Cryo-harness Section

Cryo harness	segment	from	to	wire material
CCH	SVM	CCU	SVM I/F-CB	copper strands
CCH	SVM	UMB I/F-CB	EGSE I/F-CB	copper strands
SIH	SVM	Warm units	SVM I/F-CB	copper strands
CCH	CVV ext.	SVM I/F-CB	CVV FTHRs	solid brass & SST
CCH	CVV ext.	SVM I/F-CB	CVV envelope	solid brass & SST
Telescope heaters	CVV ext.	SVM I/F-CB	Telescope I/F-CB	copper strands
Telescope sensors	CVV ext.	SVM I/F-CB	Telescope I/F-CB	SST
NED PWR	CVV ext.	SVM I/F-CB	NCA I/F-CB	solid brass
NED Sensors	CVV ext.	SVM I/F-CB	NCA I/F-CB	solid brass
HSS sensors	CVV ext.	SVM I/F-CB	HSS I/F-CB	SST
SIH	CVV ext.	SVM I/F-CB	CVV FTHRs	solid brass
SIH PWR (50mΩ)	CVV ext.	SVM I/F-CB	HIFI LOU	copper strands
SIH	CVV ext.	SVM I/F-CB	HIFI LOU	solid brass & SST
SIH RF	CVV ext.	HIFI LSU	HIFI LOU	SST + Copper clad
CCH	CVV int.	CVV FTHRs	opt. Bench sensors	SST
CCH	CVV int.	CVV FTHRs	He-Tank + sensors	solid brass & SST
CCH	CVV int.	CVV FTHRs	radiation shield sensors	SST
SIH	CVV int.	CVV FTHRs	opt. Bench Cold units	solid brass & SST

Figure 1.1.7.2-1: Wire & cable materials per Cryo-harness CCH and SIH section

1.1.7.3 Cryo-Harness Cable-Types

For the Herschel Cryo-harness wire and cable and cable shield SST and Brass raw materials have been procured according same procurement specification as used for the former ISO Cryo-harness, ref. ESA/SCC ISO-K-101. Where PTFE as wire and cable isolation have to be used, the ESA SCC 3901/024 non cold-flow PTFE isolation material has been used. Main driver for the Herschel Cryo-harness multi-core cable configurations have been the design balancing between the electrical instrument harness design requirements on one side and the sometime counter productive HPLM lifetime requirements on the other side.

1.1.7.4 Generic Cryo-harness Cable-Code

During the harness design phase, a generic Cryo-harness wire and cable code have been established, to identify the cable configuration, the wire-core material & size and whether the cable is shielded or without. On one example, the generic cable code is explained below.

Cable code H05138BS means:

- H = Herschel;
- 05 = 5 cores (01 to 99);
- 38 = solid wire core size AWG 38;
- 1 = 1 cable shield
- solid wire core material B = Brass;
- shield-core material S = SST (stain-less steel)

1.1.7.5 Special Cryo-harness Solid-wire Cable Configuration-Code

- PACS triax-cable H01**2**38SS, cable with 1 core and **2** cable shields
  - o Inner shield type = braided shield & outer shield type = served wire shield
- PACS twisted-pair multi-core-cable H**02**-02**1**38SS
  - o **02** = number of twisted-pairs within the multi-core cable, with **1** multi-core cable shield
- PACS **mixed** wire-core configurations within same multi-core cable does not follow any structure and therefore the configurations are listed only . Generic identifier for the mixed cable-cores configuration is the letter "**X**" within the cable code.
- SPIRE 12-ax shielded multi-core cable : H**04**-**03**1**1**38SS
  - o **04 =** number of twisted [**3-cores**] with **1** multi-core cable shield

All cable codes are identified in the Cryo-harness EICD cable characteristics table and identified in the Cryo-harness interconnection schematics within the wiring-lists.

1.1.7.6 Cryo-harness Cable Procurement Code

The Herschel Cryo-harness wire and cables have been produced from GORE, same as before the former ISO Cryo-harness. The cables are identified in general by GORE with the ref. GSC-05-82XXX-00. The electrical and mechanical wire and cable data have been calculated by Gore first and after the sample production updated in very small tolerances according the measured data. In table below an example of the wire and cable data sheet is provided. Gore is current in progress to establish these cryogenic cables as ESA SCC standard, where all detailed cable configurations and data sheets within will be provided. The Astrium Cryo-harness used cable data are collected in document ref. HP-2-ASED-DS-0001, which will be finalized after completion of the new SPIRE doubled screened cables and shield constructions designed and produced on sample basis to get the final data.

1.1.7.7 Special Cryo-harness Stranded-wire Cable Configurations

1.1.7.7.1 CVV external SIH of HIFI LOU

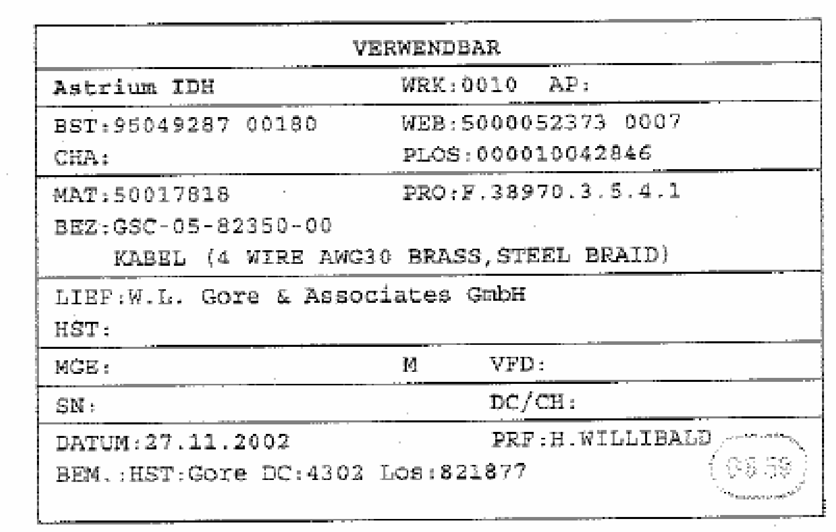
- stranded wire-cables according ESA SCC 3901/019 have been designed to cover the SIH electrical requirements, but due to thermal life-time constraints, the cable shield material has been changed from silver plated copper to manganin.

1.1.7.7.2 SVM SIH Branches,

- with more than 7 twisted wires
- with cable configurations as used within the CVV external Cryo-harness multi-core cables
- with smaller than AWG 26 wires have to be used,
    - the ESA SCC 3901 / 019 has been selected, but with modified configurations adopted on SIH needs.
- Cable production and controls have been performed by GORE in according to ESA SCC 3901 standards.

1.1.7.8 Cryo-harness Wire and Cable Incoming Inspection

All wire and cables procured by ASED have passed the incoming inspection and are identified with yellow ASED control labels, containing the reference of LOT-no, part material code (MAT) identification code, procurement order (BST), date-code (DC), incoming inspection date, stamp & signature of inspector.



VERWENDBAR

Astrium IDH WRK:0010 AP:

BST:95049287 00180 WEB:5000052373 0007
CHA: PLOS:000010042846

MAT:50017818 PRO:F.38970.3.5.4.1
BEZ:GSC-05-82350-00
KABEL (4 WIRE AWG30 BRASS,STEEL BRAID)

LIEF:W.L. Gore & Associates GmbH
HST:

MGE: M VFD:

SN: DC/CH:

DATUM:27.11.2002 PRF:H.WILLIBALD
BEM.:HST:Gore DC:4302 Los:821877

Figure 1.1.7.8-1: ASED Incoming Inspection Control TAG

Daimler-Benz Aerospace Dornier Dornier Satellitensysteme GmbH	**Prüfniederschrift**	PN:
		Ausgabe 25.11.2002 Datum:
Projekt: Herschel		Blatt: 1 von 1

Bauteil: Cable			Bestell-Nr.: 520/95049287
			WE-Nr.: 5000052621
Typ: GSC-05-82216-00		Wert: ______	MKZ: 50017762
Hersteller: Gore		Date Code: 04.11.02	Prot.-Lager: PL: 10043251
1	Bestellunterlagen	Best: H.Lang	Lieferant: Gore
		Lieferdatum: 13.11.02	Unterlagen: i.O.
		Projekt-Nr.: -	Zertifikate: i.O.
2	Verpackung:	Zustand: io	geöffnet am: 25.11.02
3	Stückzahl	Soll: 405 m	Ist: 405 m
4	Kennzeichnung: io		Stichprobe: 1 Sample
5	Oberfläche: io		Stichprobe: 1 Sample
6	Abmessungen: i.O.		Stichprobe: 1 Sample
7	Gewicht: i.O. (< 2,25 g/m)		Stichprobe: 1 Sample
8	Lötbarkeit		Stichprobe:
9	Umweltbedingungen:	9.1 Temperatur: 21 °C	9.2 Relat. Feuchte: 55 %
10	Prüfung elektr. Parameter: i.O.		Stichprobe: 1 Sample

	Parameter		zul. Toleranz	Prüfgerät	Inv. Nr.	Gut	Ausschuß
10.1	R pro Meter	Conductor	< 11 Ohm	Resistomat		7,96	
10.2		Shield	< 10,5 Ohm	Typ 2303		10,24	
10.3							
10.4							
10.5							
10.6							
10.7							
10.8							
10.9							

Bemerkungen:
Serien-Nr:
Los.-Nr.: 817218: 21m,83m,235m,39m,27m

Datum:	Prüfer:	Abteilung:
25.11.02	Willibald	ED13

Figure 1.1.7.8-2: Cable Data Record from ASED Incoming Inspection

W. L. Gore & Associates GmbH
Nordring 1
D-91785 Pleinfeld

Electronic Products Division

GORE

QUALITÄTSPRÜF-ZERTIFIKAT
CERTIFICATE OF CONFORMANCE

No. 2329-5

DIN 55350-18-4.2.1

Artikelnr./Item No.	10149919 (Description: GSC 05-82209-00 Rev. A ≙ HO1038SO)
Mitgeltende Dokumente/ Applicable Documents	------------------------
Kunde/Customer	Astrium GmbH An der Bundesstraße 31 88090 Immenstaad/Bodensee GERMANY
Kundenauftrags-Nr./Customer Order No.	520/95049287
Auftrags-Nr./ Order No.	11134617- 9
Gesamtmenge/Total Quantity	1815 m
Anzahl der Spulen/Number of Spools	14
Einzellängen/Single Lengths	85 m; 77 m; 200 m; 234 m; 57 m; 22 m; 87 m; 200 m; 123 m; 131 m; 200 m; 109 m; 116 m; 174 m;
Anmerkungen/Remarks	-------
Herstellungsdatum/Date of Manufacture	23.10.2002
Lieferdatum/Date of Shipment	Gem. Lieferschein / Acc. to Delivery Note

Wir bestätigen,daß diese Lieferung geprüft wurde und den Vereinbarungen bei der Bestellannahme entspricht.

We certify that this shipment has been tested and complies with the terms stated in the order contract.

W. L. Gore & Associates GmbH

Prüfbeauftragter/Inspection Official

29.10.02
Datum/Date

Unterschrift/Signature

QSF-0082/2.1

Figure 1.1.7.8-3: GORE COC of GSC-82209-00 alias H01038S0 cable (single core AWG 38 SST)

1.1.8 Cryo-harness Risk Mitigation

1.1.8.1 Manufacturing Operator Training & Qualification

For risk mitigation during the harness manufacturing, all manufacturing personnel have been trained & certified by an ESA qualified and accepted instructor.

Approved common manufacturing processes have been established and qualified on sample basis:

- HOT-Weezer stripping of Brass wire core AWG 38 , AWG 30 and SST AWG 38 (at CASA)
- Laser stripping for wire and cables (at ASSE)

Pre-treatment of SST wire cores of multi-core cables by use of special fluxes have been trained and examined on sample basis from all CASA / IMPELEC & ASSE operators and manufacturing inspectors.

All operator and inspector samples have been have been controlled for possible flux resign by use of SEM & EDX performed by TECNOLOGICA.

Before and during the whole manufacturing periods at CASA / IMPELEC and ASSE samples have to be manufactured by each operator. The samples of each operator will be frequently controlled by SEM / EDX analysis too.

The Astrium AIT personnel, handling the sensitive Cryo-Harness during the AIT will be instructed after harness manufacturing, when all harness branch sensitivities and allocations are known, upon sub-co guiding integration instructions.

The Operator Training and Certification Plan ref. HP-2-ASED-PL-0020, the Cryo Harness Interconnection Requirements and Qualification Plan ref. HP-2-ASTP-PL-0012 as well as the Welding Re-certification Plan ref. HP-2-ASTP-PL-0011 are the subject documents.

TRAINING REPORT	HP-2-CASA-RP-0003
CASA QUALIFICATION REPORT	HP-2-CASA-RP-0004
ASSE QUALIFICATION REPORT	HP-2-CASA-RP-0005
INSPECTION REPORT CONN 197-11	HP-2-CASA-RP-0006
INSPECTION REPORT CONN 197-12	HP-2-CASA-RP-0007

Figure 1.1.8.1-1: Personnel Training & Qualification Reports

1.1.8.2 Qualified Manufacturing Processes

SST core material, stripping of wire and cable isolations, cable-shield welding and interconnection processes have been established and will be commonly used by all operators.

HP-2-ASSE-PR-0001-E	PRETINNING AND CLEANING OF HIGH-QUALITY STEEL WIRES WITH FLUXING AGENT CASTOLIN 157 N
HP-2-ASSE-PR-0002-E	PRETINNING AND CLEANING OF BRASS WIRES
HP-2-ASSE-PR-0003-E	INTERCONNECTION METHOD A- HIGH QUALITY STEEL WIRES TO SOLID WIRE CONTACTS
HP-2-ASSE-PR-0004-E	INTERCONNECTION METHOD B- HIGH QUALITY STEEL WIRES TO SILVER PLATED COPPER WIRE
HP-2-ASSE-PR-0005-E	INTERCONNECTION METHOD C- REPAIR METHOD
HP-2-ASSE-PR-0006-E	INTERCONNECTION METHOD E- BRASS WIRES TO SOLID WIRE CONTACTS
HP-2-ASSE-PR-0007	SCHIRMTERMINIERUNG MITTELS PLASMA SCHWEISSEN
HP-2-CASA-PR-0001	INTERCONNECTION METHOD CASE F: SCREEN WELDING OF HIGH QUALITY STAINLESS STEEL SHIELDS BY PLASMA ARC METHOD

Figure 1.1.8.2-1: Qualified Processes

1.1.8.3 Testing of Cryo-Harness Parts

1.1.8.3.1 Testing of Connectors for cryogenic Environment

The Cry-Harness parts as the vacuum feed-through and CVV internal connectors modified to the former ISO program will be tested on a sample basis within the Astrium Test-Cryostats. Sample procurement has been already started and the test procedure and preparation of the test cryostat are in progress.

Qualification Test Procedure Herschel Connectors	HP-2-ASED-TP-0014
INSPECTION AND TEST: GLENAIR VACUUM FEED THROUGH CONNECTORS 197-011P24-35P DATE CODE 0346, SN01#30 (EQM. 128 POL)	HP-2-ASED-RP-0119
INSPECTION AND TEST: GLENAIR VACUUM FEED THROUGH CONNECTORS 197-011P24-35P-429H DATE CODE 0346, SN01#30 (PFM)	HP-2-CASA-RP-0120
INSPECTION & TEST: GLENAIRCONNECTORS 197-011P22-35P-429_DATE CODE 0331_SN01#53 (PFM)	HP-2-ASSE-RP-0121

Figure 1.1.8.3-1: Connector Qualification Test-Procedure and Reports

1.1.8.3.2 Wire and Cable Cold-bench and Wrap-Test

The Cryo-Harness wire and cable configurations for the Herschel use, have been designed and tested by Gore on a sample basis in accordance to

- ESA/SCC Detailed Specification for ISO-K-101, Issue 2/0 date 09.10.91.
- With Non cold-flow wire and cable isolation from ESA/SCC 3901/024 cables.
- This PTFE isolation material tested on a sample basis by Gore prior to production
- Cold bench test according ESA SCC 3901 § 9.17
- Wrap test at ambient temperature according ESA SCC 3901 § 9.13

All wires, multi-core cable and over-shield configuration drawings and the data sheets as also the physical data measured by Gore after the production are collected in the document ref. HP-2-ASED-DS-0001. Gore will issue the cables as new ESA SCC standard for cryogenic wire and cable applications when the Herschel Cryo-harness design is finished. The new double-shielded cable types from SPIRE CR-0039V3 will be implemented too.

1.1.8.3.3 Thermal Cycling Test of shrinkable Kynar-Sleeves

CASA performed successful a thermal cycling test with shrinkable Kynar-sleeve, which are used in cryogenic environment for wired solid-spill protections. As sample the manufactured EQM harness branch CV-26 has been used. The test results are provided in the report, ref. HP-2-CASA-RP-0009.

1.1.8.4 Cryo-harness Manufacturing-Test at Sub-co Level

After harness manufacturing at Sub-co level and before delivery to Astrium, the harness will be tested in accordance to the Electrical Interface Control Document (EICD) ref. HP-2-ASED-IC-0001, which is a part of the overall EPLM EICD Database. The Cryo-Harness EICD wiring-list will be extracted as Access data-file from the database and used for the electrical wire and cable Continuity & Isolation Resistance Test.

In addition the Cryo-harness has to pass the bake-out test, before the DRB, in a thermal vacuum chamber, to reduce the contamination.

All subject Cryo-Harness test-requirements are specified in the Cryo-Harness Procurement Specification ref. HP-2-ASED-PS-0024.

1.1.9 Cryo-harness Physical Data and Control

1.1.9.1 Cryo-harness Input for thermal Analysis

Starting the harness branch wire and cable developments & design upon HPLM and instrument requirements, each harness material portion CVV internal and CVV external have been calculated and optimized w.r.t. HPLM lifetime, electrical- and mass constraints. All material portions calculated, have been issued in Cryo-harness Inputs for thermal Analysis document, ref. HP-2-ASED-TN-0010.

1.1.9.2 Cryo-harness Characteristics

The single harness branch contents, designed upon HPLM and instrument requirements, harness routing lay-outs as designed by CATIA 3D, interconnection diagrams and EICD have been collected in the Cryo-harness Characteristics document, ref. HP-2-ASED-TN-0086.

1.1.9.3 Cryo-harness Mass

The Cryo-harness mass have been calculated first upon associated elements and ESA SCC connector and cable data first.

After machining of harness parts and wire and cable production & procurement, the calculated date will be exchanged by the measured values.

Harness lay-out routing as designed by CATIA 3D, will be exchanged by measured harness branch length, which have been measured when the harness branches are routed on the manufacturing mock-up.

All Cryo-harness attachment elements to be machined have been issued in the Cryo-harness machined data-package, ref. HP-2-ASED-DP-0028.

The Cryo-harness mass budgets are provided in report, ref. HP-2-ASED-TN-0054.

The current Cryo-harness mass is provided in table below.

		CVVint m_g	CVVext m_g	SVM m_g
SIH	SPIRE SIH (internal) CEU's to CVV I/F-CB	5361,92		
	SPIRE SIH (external) SVM-CB to CVV I/F-CB		6572,47	
	SPIRE SIH SVM-CVB to WEU's			8775,73
	PACS SIH (internal) CEU's to CVV I/F-CB	5159,09		
	PACS SIH (external) SVM-CB to CVV I/F-CB		6249,78	
	PACS SIH SVM-CVB to WEU's			16051,26
	HIFI SIH Harness(internal) CEU's to CVV I/F-CB	1983,62		
	HIFI SIH Harness(external) SVM-CB to CVV I/F-CB		6423,02	
	HIFI SIH Harness SVM-CB to WEU's			9178,75
CCH	CCH CVV internal (CB upper and lower ring to upper & lower SFW and to end items)	5619,42		
	CCH CVV I/F CB ext. (uppr and lower ring) to SVM-CB's (J-side)		7581,47	
	CCH SVM I/F CB to SVM-PANELS (WEU's)			3726,42
B/A	Harness Attachments and Brackets CVV internal	1556,49		
	Harness Attachments and Brackets CVV external		4298,00	
	SVM upper closure panel + SVM CONE + Telescope I/F-CBs			5097,60
	Harness Attachments and Brackets SVM			1679,00
	Cryo-Harness Mass per Cryo-Harness Section	19680,54	31124,74	44508,76
	Cryo-Harness Mass TOTAL		95314,04	

Figure 1.1.9.3-1: Current Cryo-harness Mass

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

	Name	Dep./Comp.		Name	Dep./Comp.
X	Alberti von Mathias Dr.	SM 34	X	Schweickert Gunn	SM 34
	Alo Hakan	OTN/LP 45		Stauss Oliver	SM 33
X	Barlage Bernhard	ED 11	X	Steininger Eric	ED 422
X	Bayer Thomas	ED 541	X	Stritter Rene	ED 11
X	Faas Horst	EA 65	X	Tenhaeff Dieter	SM 34
X	Fehringer Alexander	SM 33		Thörmer Klaus-Horst Dr.	OTN/ED 65
	Frey Albrecht	ED 422		Wagner Adalbert	OTN/LP 45
	Gerner Willi	ED 11		Wagner Klaus	SM 31
X	Grasl Andreas	OTN/EN 64	X	Wietbrock, Walter	ED 521
X	Grasshoff Brigitte	ED 521		Wöhler Hans	SM 34
	Hartmann Hans Dr.	ED 422			
X	Hauser Armin	SM 31			
X	Hinger Jürgen	SM 31	X	Alcatel	ASP
X	Hohn Rüdiger	ED 541	X	ESA/ESTEC	ESA
	Hölzle Edgar	ED 421			
	Huber Johann	ED 543		**Instruments:**	
X	Hund Walter	SE 76		MPE (PACS)	MPE
X	Idler Siegmund	ED 432		RAL (SPIRE)	RAL
	Ivády von András	ACE 32		SRON (HIFI)	SRON
	Jahn Gerd Dr.	SM 31		**Subcontractors:**	
X	Kalde Clemens	ED 532		Air Liquide, Space Department	AIR
X	Kameter Rudolf	OTN/EN 64		Air Liquide, Space Department	AIRS
	Kersting Stefan	OTN/EN 63		Air Liquide, Orbital System	AIRT
X	Kettner Bernhard	SM 34		Alcatel Bell Space	ABSP
X	Knoblauch August	ED 531		Astrium Sub-Subsyst. & Equipment	ASSE
	Koelle Markus	ED 523		Austrian Aerospace	AAE
X	Kroeker Jürgen	ED 542		Austrian Aerospace	AAEM
	Kunz Oliver	SM 31		APCO Technologies S. A.	APCO
X	Lamprecht Ernst	OTN/SM 222		Bieri Engineering B. V.	BIER
X	Lang Jürgen	SE 76		BOC Edwards	BOCE
	Langfermann Michael	ED 541		Dutch Space Solar Arrays	DSSA
	Mack Paul	OTN/EN 64	X	EADS CASA Espacio	CASA
	Muhl Eckhard	OTN/EN 64		EADS CASA Espacio	ECAS
X	Pastorino Michel	ASPI Resid.		EADS Space Transportation	ASIP
	Peitzker Helmut	ED 65		Eurocopter	ECD
X	Peltz Heinz-Willi	SM 33		HTS AG Zürich	HTSZ
	Pietroboni Karin	ED 65		Linde	LIND
	Puttlitz Joachim	OTN/EN 64		Patria New Technologies Oy	PANT
	Rebholz Reinhold	ED 541		Phoenix, Volkmarsen	PHOE
X	Reuß Friedhelm	ED 62		Prototech AS	PROT
X	Rühe Wolfgang	ED 65		QMC Instruments Ltd.	QMC
	Runge Axel	OTN/EN 64		Rembe, Brilon	REMB
	Sachsse Bernt	ED 21		SENER Ingenieria SA	SEN
	Schäffler Johannes	OTN/EN 64		Stöhr, Königsbrunn	STOE
X	Schink Dietmar	ED 422		Rosemount Aerospace GmbH	ROSE
X	Schlosser Christian	OTN/EN 64		Alcatel	ASP
	Schmidt Rudolf	ACE 32		RYMSA, Radiación y Microondas S.A.	RYM