DaimlerChrysler Aerospace
Dornier

FIRST/PLANCK

SPIRE-REF-MOM-000317

DATAFAX

To:		
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	MPE	Dr. Poglitsch Dr. Katterloher
	QMW	Dr. Griffin
	RAL	Dr. Griffin Dr. Swinyard

From:
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FIRST/PLANCK Program Office SX2F
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07.09.1999
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Subect: **FIRST-PLM PM #2 Update of Instrument Interfaces**

Dear Sirs,

please find attached the Minutes of Meeting of PM2 dated 23.11.99.

Best regards

Dornier Satellitensysteme GmbH

i.A. Schupp

Minutes of Meeting

Besprechungsprotokoll

DaimlerChrysler Aerospace
Dornier
Dornier Satellitensysteme GmbH

Subject Thema: FIRST-PLM PM#2
Update of Instrument Interfaces

Location Ort: DSS / OTN

Date Datum: 23. Nov. 1999

Distribution Verteiler

Participants Teilnehmer	**Organ.**				
T. Paßvogel	ESA	A. Wagner	DASA	Beintema	SRON
G. Pilbratt	ESA	A. Hauser	DSS	B. Winter	UCL
B. Collaudin	ESA	R. Moritz	DSS		
B. Guillaume	ESA	B. Gröger	DSS		
A. Heske	ESA	M. Vogel	DSS		
Katterloher	MPE	F. Ziegler	DSS		
Kampf	KT	P. de Zoeten	DSS		
J. Schupp	DSS	Aarts	SRON		

Agreements, Statements Vereinbarungen, Feststellungen	**Action** verantwortlich
Agenda as in SCI-PT/IFI/07245	
Final Presentation at ESTEC shall take place on 20th. Dec (instead on 21st); tbc by ESTEC	ESTEC AI 04

Signatures Unterschriften | **Date** Datum | **Page** Seite 1 **of** von

4.1110/1198

Minutes of Meeting, continued pages
Besprechungsprotokoll, Fortsetzung

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Action
verantwortlich

2. Status of AI

Some of them will be revied during today's technical discussion

PM#1, AI 03:

SPIRE is modifying the FILTER-Box such that there is no conflict with the defined optical bench mounting interface.
⟹ AI closed

Kick-off:

AI-04 closed by update handed over (Annex 02)

AI-06/-07 closed by agreement in this PM#2

PM#2:

AI-02 closed; will be put in IID-A, point 3, with a tbc

AI-09 closed by PM#2 presentation

AI-10 closed by PM#2 presentation
but comment/feed back from SPIRE required — SPIRE AI 06 03.12.99

AI-11 closed by HIFI-Input annexed to MoM (Annex 07, -08)

AI-13 agreed -> closed

Signatures
Unterschriften

Date
Datum

1110-1/1198a

	Action verantwortlich
3. FIRST Optical Bench - Design	
The required 10 mm gap between the instruments may not be used completely, i.e. between SPIRE and HIFI. SPIRE, PACS, HIFI will provide updated dimensions of their instruments, including reference points	HIFI / PACS / SPIRE AI 01 26.11.99
PACS design is based on six fixation points (on optical bench) now.	
page 13 of H/O: level 0 thermal interface will have same principle design as for level 1, 2, but will run from the instrument through the optical bench directly to the tank.	
page 14 of H/O: the circumpherical length the connectors are placed on the CVV is about 1.6 m	
Present instrument design drawings are handed over by HIFI (see Annex 04, Annex 05) and by PACS (Annex 06)	
4. Optical Interfaces (Bram Pelton)	
see H/O, page 15	

Signatures
Unterschriften

Date
Datum

Action
verantwortlich

5. Optical Bench Analysis

5.1 Mechanical

see H/O; Following the requirement to achieve a 1st eigenfrequency > 80 Hz the analysis shows that this will be feasable with an Optical Bench made of Aluminium (see Version 9) or one made of CFC sandwich (see version 13).

Presentation by SPIRE: Dynamic Analysis of SPIRE; (see Annex 01 to this MoM)

Blades considered are stainless steel blades

The analysis shows that the mechanical loads on the detectors are similar for the 3 blades, 4 blades and 8 struts mounting concept of the SPIRE-Box.

5.2 Thermal

see H/O pages T-1 ff

to achieve required low temperature requires optical bench support made by CFRP blades. This has to be included in the mechanical model.

The rectangular shield is attached to the instrument shield (back reflecting upper surface)

	Action verantwortlich
The cooler dissipation values used for SPIRE and HIFI seem to be different (same cooler) SPIRE: 2 mW HIFI: 2.4 mW To be clarified by ESA	
H/O pages T-7 & T-8:	
- Instrument teams to check dissipation values for On-/Off-status	
- SPIRE to check mounting blades to be used in thermal model	
All instrument teams shall comment/check the tables containing the thermal design data as presented on pages T7, T8 and T9	HIFI/PACS/SPIRE AI02 01.12.99
Page T-10: The data are based on a share of available mass flow of one third for each instrument and contain the two sorption coolers continuously running	
6. Instrument Harness	
H/O page 12: HIFI and PACS hand over updated harness lists. (see Annex 02 for HIFI and Annex 03 for PACS)	

	Action verantwortlich
7. Local Oscillator Unit	
H/O, page 20:	
- mass figure of 13 kg covers both LO-Units	
- Dissipation value of 12 W shall apply	
- temperature stability not subject of PLM analysis	
→ Page 20 was updated in this meeting and is attached to the MoM (see Annex 07)	
The positions of the cryostat shields along the LO-Beam shall be provided	DSS AI04 closed by Annex 09
The cut-outs in the cryostat shields will be slightly oversized wrt optically required dimensions.	
DSS to propose routing, fixation of the LO-waveguides	DSS AI 05 03.12.99
LOU Optical Channel	
Transmission results are presented on page 26. The values for two quartz windows are conservative. The technique to build up a heat-filter by mesh technology has to be confirmed. Both	

Minutes of Meeting, continued pages
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versions to built up the LO-Channel (quartz/quartz or quartz/fused) seem to work wrt total transmission specification of 80%.

Alignment Budget for HIFI/LOU-Alignment shows that with precompensation applied for LOU the requirements may be fulfilled.

Action
verantwortlich

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4.1110-1/1198b

Annex 01

11/22/99

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Dynamic Analysis Design Options
Blade Mounted/Strut Mounted

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Contents of presentation

- Current state of the model
- Description of the analysed variations
- Margin Philosophy
- Analysis results
- Conclusions

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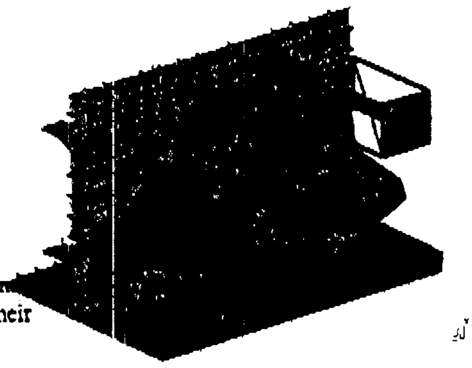
Current State of the Model

- Coarse model
- Detector Boxes Updated
- Cooler Updated
- Some mirror geometry included
- Secondary optical bench updated
- Detector boxes, FTS mechanism, Second optical bench 3 point mounted. Adding their mass to the system, not the stiffness.
- 10000 degrees of freedom



inside view of the FEM model including IR-ray pattern. S/C co-ordinates

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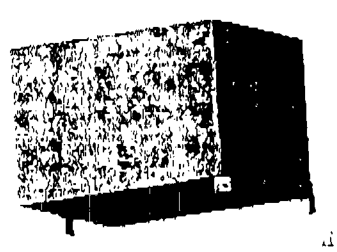
3-blades Model (issue 0.2)



3 blades				
	f [Hz]	Mx [%]	My [%]	Mz [%]
1	121.2	0.00	0.85	0.19
2	127.5	0.00	0.17	0.71
3	172.1	0.00	0.01	0.00
4	181.8	0.06	0.01	0.04
5	183.8	0.02	0.00	0.00
6	186.5	0.18	0.00	0.01
7	199.9	0.15	0.00	0.00

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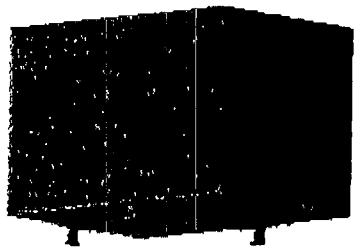
4-blades Model (issue 0.2)



	4 blades			
	f [Hz]	Mx [%]	My [%]	Mz [%]
1	122.0	0.00	**0.78**	0.03
2	142.3	0.00	0.02	**0.75**
3	170.7	0.00	0.02	0.01
4	179.9	0.02	0.01	0.04
5	181.8	0.01	0.00	0.00
6	184.9	0.11	0.00	0.00
7	186.4	0.02	0.01	0.04

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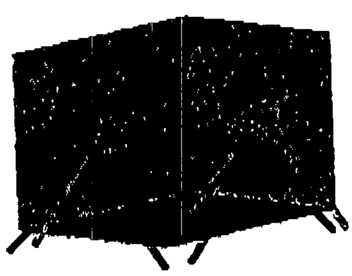
8-struts Model (issue 0.2)



	8 struts			
	f [Hz]	Mx [%]	My [%]	Mz [%]
1	120.3	0.00	**0.39**	**0.48**
2	127.7	0.00	**0.47**	**0.39**
3	155.7	0.01	0.00	0.00
4	163.1	0.06	0.00	0.00
5	166.7	0.01	0.00	0.00
6	173.1	**0.52**	0.00	0.00
7	176.3	0.10	0.02	0.03

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Margin Philosophy (sine test)

- Uncertainty on analysed eigenfrequency +/- 10% (FEM v.s. Hardware)
- Uncertainty on predicted responses +/- 20%
- Qualification input is 1.5 x flight for the whole structure (syst.)
- Present sine levels (all directions separately) 5 g flight, 7.5 g qual. 5-100 [Hz]
- Qualification factor 1.5 for sub-systems with respect to (system) life
- I/F qualification input acceleration definition for sub-system:
  - ⇨worst case eigenfrequency for system
  - ⇨frequency response of system subjected to qualification environment
  - ⇨including 1.5 qualification for subsystem
  - ⇨including 1.2 system response uncertainty

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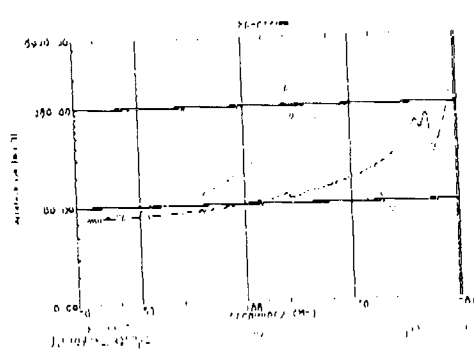
3-blades Det. I/F [g] Envelope



Frequency response 7.5 g input at SPIRE base between 5-200 Hz (modes taken into account up to 500 Hz)

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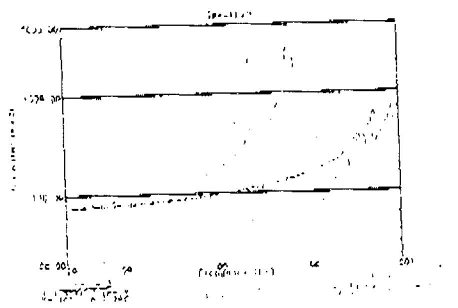
4-blades Det. I/F [g] Envelope



Frequency response 7.5 g input at SPIRE base between 5-200 Hz (modes taken into account up to 500 Hz)

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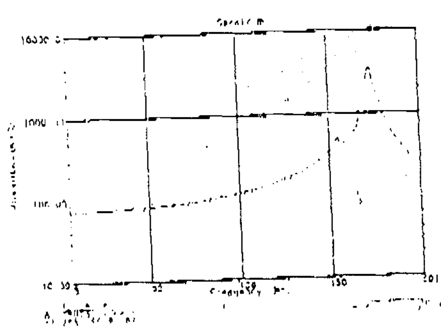
8-struts Det. I/F [g] Envelope



Frequency response 7.5 g input at SPIRE base between 5-200 Hz (modes taken into account up to 500 Hz)

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3-blades Detector Accel. input

Configuration; 3 steel blades, 40 x 40 x 1.15 mm^3
sine input 7.5 g
response envelopes

Detectors 100 Hz		resp. dir: [g] X	Y	Z	W.C. def. detector I/F
exc. Dir. 7.5 g	X	10.2	0.7	0.5	18 g
	Y	2.5	23.0	5.0	41 g
	Z	1.3	3.5	23.8	43 g

Detectors 110 Hz		resp. dir:[g] X	Y	Z	W.C. def. detector I/F
exc. Dir. 7.5 g	X	11.2	1.3	0.8	20 g
	Y	5.6	40.6	13.5	73 g
	Z	2.2	9.3	39.3	71 g

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4-blades Detector Accel. input

Configuration: 4 steel blades, 40 x 40 x .6 mm^3
sine input 7.5 g
response envelopes

Detectors 130 Hz		resp. dir: [g] X	Y	Z	Detector Qual input
exc. Dir. 7.5 g	X	9.8	0.4	0.4	18 g
	Y	3.0	22.6	4.2	41 g
	Z	0.6	2.8	16.8	30 g

Detectors 120 Hz		resp. dir:[g] X	Y	Z	Detector Qual Input
exc. Dir. 7.5 g	X	10.5	0.7	0.6	19 g
	Y	8.7	40.6	10.7	73 g
	Z	0.8	6.3	22.8	41 g

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8 struts - Detector Accel. input

Configuration: 4x2 struts, 300 x 20 x 2 (length. dia. thickness)
sine input 7.5 g
response envelopes

Detectors 130 Hz		resp. dir. (g) X	Y	Z	detector qual. input	
exc. Dir. 7.5 g	X	11.7	0.5	0.3	21	g
	Y	0.3	21.0	5.9	38	g
	Z	0.8	4.3	24.8	45	g

Detectors 120 Hz		resp. dir. (g) X	Y	Z	detector qual. input	
exc. Dir. 7.5 g	X	13.4	1.1	0.3	24	g
	Y	0.9	38.5	19.0	69	g
	Z	0.2	14.1	49.0	68	g

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Prosposed approach

- Aim for 130 Hz for the first eigenfrequency of the structure
- Accept 7.5 g qualification between 5-100 Hz
- Define qualification loads for detectors 50 g in each direction
- 50 g quasi-static defined in all directions separately covering both sine and quasi-static

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Conclusions

- Eigenfrequency requirement 130 Hz, including 10 % uncertainty
- 50 g qualification load for the detectors
- Preference for 3 or 4 blade mounting

Reminders:

- I/F force analysis required
- Mass impact of 130 Hz to assessed (not analysed yet)
- OBP envelope analysis required for definition FTS mechn. Spec (this will be worse then the detector spec!!!)

HIFI cryostat harness, version 4 19/11/1999

Table 1
HFPU to Optical Bench harness
HFPU Mixer Assembly band 1

Item No.	Name	Shielded cable # wires	Shielded cable twisted groups	Shielded cable # shields	Coax	Unshielded cable # wires	Unshielded cable twisted groups	FPU Interface connector
01.01	Mixer A Bias Vsupply	5	1 x 5	1				MDM9P
01.02	Mixer A Bias I/Vmon							(6)
01.03	Mixer B Bias Vsupply	5	1 x 5	1				MDM9P
01.04	Mixer B Bias I/Vmon							(6)
01.05	Mixer A Magnet	4	2 x 2	1				MDM15P
01.06	Mixer A Heater							
01.07	Mixer A Temperature sensor	4	2 x 2	1				(10)
01.08	Mixer B Magnet	4	2 x 2	1				MDM15P
01.09	Mixer B Heater							
01.10	Mixer B Temperature sensor	4	2 x 2	1				(10)
01.11	MA Diplexer A actuator	2	1 x 2	1				
01.12	MA Diplexer A LVDT A prim.	2	1 x 2	1				
01.13	MA Diplexer A LVDT A sec.	3	1 x 3	1				MDM21P
01.14	MA Diplexer B actuator	2	1 x 2	1				
01.15	MA Diplexer B LVDT prim.	2	1 x 2	1				(20)
01.16	MA Diplexer B LVDT sec.	3	1 x 3	1				
01.17	Mixer A 1st IF Amplifier bias	8	1 x 8	1				MDM21P
01.18	Mixer B 1st IF Amplifier bias	8	1 x 8	1				(18)
	Totals	56		14	0	0		

Table 2
HFPU to Optical Bench harness
HFPU Mixer Assembly band 2

Item No.	Name	Shielded cable # wires	Shielded cable twisted groups	Shielded cable # shields	Coax	Unshielded cable # wires	Unshielded cable twisted groups	FPU Interface connector
02.01	Mixer A Bias Vsupply	5	1 x 5	1				MDM9P
02.02	Mixer A Bias I/Vmon							(6)
02.03	Mixer B Bias Vsupply	5	1 x 5	1				MDM9P
02.04	Mixer B Bias I/Vmon							(6)
02.05	Mixer A Magnet	4	2 x 2	1				MDM15P
02.06	Mixer A Heater							
02.07	Mixer A Temperature sensor	4	2 x 2	1				(10)
02.08	Mixer B Magnet	4	2 x 2	1				MDM15P
02.09	Mixer B Heater							
02.10	Mixer B Temperature sensor	4	2 x 2	1				(10)
02.11	MA Diplexer A actuator	2	1 x 2	1				
02.12	MA Diplexer A LVDT A prim.	2	1 x 2	1				
02.13	MA Diplexer A LVDT A sec.	3	1 x 3	1				MDM21P
02.14	MA Diplexer B actuator	2	1 x 2	1				
02.15	MA Diplexer B LVDT prim.	2	1 x 2	1				(20)
02.16	MA Diplexer B LVDT sec.	3	1 x 3	1				
02.17	Mixer A 1st IF Amplifier bias	8	1 x 8	1				MDM21P
02.18	Mixer B 1st IF Amplifier bias	8	1 x 8	1				(18)
	Totals	56		14	0	0		

Table 3 HFPU to Optical Bench harness HFPU Mixer Assembly band 3								
Item No.	Name	Shielded cable			Coax	Unshielded cable		FPU
		# wires	twisted groups	# shields		# wires	twisted groups	Interface connector
03.01	Mixer A Bias Vsupply	5	1 x 5	1				MDM9P (6)
03.02	Mixer A Bias I/Vmon							
03.03	Mixer B Bias Vsupply	5	1 x 5	1				MDM9P (6)
03.04	Mixer B Bias I/Vmon							
03.05	Mixer A Magnet	4	2 x 2	1				MDM15P (10)
03.06	Mixer A Heater							
03.07	Mixer A Temperature sensor	4	2 x 2	1				MDM15P (10)
03.08	Mixer B Magnet	4	2 x 2	1				
03.09	Mixer B Heater							
03.10	Mixer B Temperature sensor	4	2 x 2	1				MDM21P (20)
03.11	MA Diplexer A actuator	2	1 x 2	1				
03.12	MA Diplexer A LVDT A prim.	2	1 x 2	1				
03.13	MA Diplexer A LVDT A sec.	3	1 x 3	1				
03.14	MA Diplexer B actuator	2	1 x 2	1				
03.15	MA Diplexer B LVDT prim.	2	1 x 2	1				
03.16	MA Diplexer B LVDT sec.	3	1 x 3	1				
03.17	Mixer A 1st IF Amplifier bias	8	1 x 8	1				MDM21P (18)
03.18	Mixer B 1st IF Amplifier bias	8	1 x 8	1				
	Totals	56		14	0	0		

Table 4 HFPU to Optical Bench harness HFPU Mixer Assembly band 4								
Item No.	Name	Shielded cable			Coax	Unshielded cable		FPU
		# wires	twisted groups	# shields		# wires	twisted groups	Interface connector
04.01	Mixer A Bias Vsupply	5	1 x 5	1				MDM9P (6)
04.02	Mixer A Bias I/Vmon							
04.03	Mixer B Bias Vsupply	5	1 x 5	1				MDM9P (6)
04.04	Mixer B Bias I/Vmon							
04.05	Mixer A Magnet	4	2 x 2	1				MDM15P (10)
04.06	Mixer A Heater							
04.07	Mixer A Temperature sensor	4	2 x 2	1				MDM15P (10)
04.08	Mixer B Magnet	4	2 x 2	1				
04.09	Mixer B Heater							
04.10	Mixer B Temperature sensor	4	2 x 2	1				MDM21P (20)
04.11	MA Diplexer A actuator	2	1 x 2	1				
04.12	MA Diplexer A LVDT A prim.	2	1 x 2	1				
04.13	MA Diplexer A LVDT A sec.	3	1 x 3	1				
04.14	MA Diplexer B actuator	2	1 x 2	1				
04.15	MA Diplexer B LVDT prim.	2	1 x 2	1				
04.16	MA Diplexer B LVDT sec.	3	1 x 3	1				
04.17	Mixer A 1st IF Amplifier bias	8	1 x 8	1				MDM21P (18)
04.18	Mixer B 1st IF Amplifier bias	8	1 x 8	1				
	Totals	56		14	0	0		

Table 5
HFPU to Optical Bench harness
HFPU Mixer Assembly band 5

Item No.	Name	Shielded cable			Coax	Unshielded cable		FPU
		# wires	twisted groups	# shields		# wires	twisted groups	Interface connector
05.01	Mixer A Bias Vsupply	5	1 x 5	1				MDM9P
05.02	Mixer A Bias I/Vmon							(6)
05.03	Mixer B Bias Vsupply	5	1 x 5	1				MDM9P
05.04	Mixer B Bias I/Vmon							(6)
05.05	Mixer A Magnet	4	2 x 2	1				MDM15P
05.06	Mixer A Heater							(10)
05.07	Mixer A Temperature sensor	4	2 x 2	1				MDM15P
05.08	Mixer B Magnet	4	2 x 2	1				
05.09	Mixer B Heater							(10)
05.10	Mixer B Temperature sensor	4	2 x 2	1				
05.11	MA Diplexer A actuator	2	1 x 2	1				
05.12	MA Diplexer A LVDT A prim.	2	1 x 2	1				MDM21P
05.13	MA Diplexer A LVDT A sec.	3	1 x 3	1				
05.14	MA Diplexer B actuator	2	1 x 2	1				
05.15	MA Diplexer B LVDT prim.	2	1 x 2	1				(20)
05.16	MA Diplexer B LVDT sec.	3	1 x 3	1				MDM21P
05.17	Mixer A 1st IF Amplifier bias	8	1 x 8	1				(18)
05.18	Mixer B 1st IF Amplifier bias	8	1 x 8	1				
	Totals	56		14	0	0		

Table 6
HFPU to Optical Bench harness
HFPU Mixer Assembly band 6

Item No.	Name	Shielded cable			Coax	Unshielded cable		FPU
		# wires	twisted groups	# shields		# wires	twisted groups	Interface connector
06.01	Mixer A Bias Vsupply	5	1 x 5	1				MDM9P
06.02	Mixer A Bias I/Vmon							(6)
06.03	Mixer B Bias Vsupply	5	1 x 5	1				MDM9P
06.04	Mixer B Bias I/Vmon							(6)
06.05	Mixer A Magnet	4	2 x 2	1				MDM15P
06.06	Mixer A Heater							(10)
06.07	Mixer A Temperature sensor	4	2 x 2	1				MDM15P
06.08	Mixer B Magnet	4	2 x 2	1				
06.09	Mixer B Heater							(10)
06.10	Mixer B Temperature sensor	4	2 x 2	1				
06.11	MA Diplexer A actuator	2	1 x 2	1				
06.12	MA Diplexer A LVDT A prim.	2	1 x 2	1				MDM21P
06.13	MA Diplexer A LVDT A sec.	3	1 x 3	1				
06.14	MA Diplexer B actuator	2	1 x 2	1				
06.15	MA Diplexer B LVDT prim.	2	1 x 2	1				(20)
06.16	MA Diplexer B LVDT sec.	3	1 x 3	1				MDM21P
06.17	Mixer A 1st IF Amplifier bias	8	1 x 8	1				(18)
06.18	Mixer B 1st IF Amplifier bias	8	1 x 8	1				
	Totals	56		14	0	0		

Table 7
HFPU to Optical Bench harness
HFPU Mixer Assembly band 7

Item No.	Name	Shielded cable # wires	Shielded cable twisted groups	Shielded cable # shields	Coax	Unshielded cable # wires	Unshielded cable twisted groups	FPU Interface connector
07.01	Mixer A Bias Vsupply	5	1 x 5	1				MDM9P (6)
07.02	Mixer A Bias I/Vmon							
07.03	Mixer B Bias Vsupply	5	1 x 5	1				MDM9P (6)
07.04	Mixer B Bias I/Vmon							
07.05	Mixer A Magnet	4	2 x 2	1				MDM15P (10)
07.06	Mixer A Heater							
07.07	Mixer A Temperature sensor	4	2 x 2	1				
07.08	Mixer B Magnet	4	2 x 2	1				MDM15P (10)
07.09	Mixer B Heater							
07.10	Mixer B Temperature sensor	4	2 x 2	1				
07.11	MA Diplexer A actuator	2	1 x 2	1				MDM21P (20)
07.12	MA Diplexer A LVDT A prim.	2	1 x 2	1				
07.13	MA Diplexer A LVDT A sec.	3	1 x 3	1				
07.14	MA Diplexer B actuator	2	1 x 2	1				
07.15	MA Diplexer B LVDT prim.	2	1 x 2	1				
07.16	MA Diplexer B LVDT sec.	3	1 x 3	1				
07.17	Mixer A 1st IF Amplifier bias	8	1 x 8	1				MDM21P (18)
07.18	Mixer B 1st IF Amplifier bias	8	1 x 8	1				
	Totals	56		14	0	0		

Table 8
HFPU to Optical Bench harness
HFPU IF box

Item No.	Name	Shielded cable # wires	Shielded cable twisted groups	Shielded cable # shields	Coax	Unshielded cable # wires	Unshielded cable twisted groups	FPU Interface connector
08.01	2nd IF amplifier 1A bias	11	1 x 11	1				MDM25P (24)
08.02	2nd IF amplifier 2A bias	11	1 x 11	1				
08.03	2nd IF amplifier 3A bias	11	1 x 11	1				MDM25P (24)
08.04	2nd IF amplifier 4A bias	11	1 x 11	1				
08.05	2nd IF amplifier 5A bias	11	1 x 11	1				MDM21P (17)
08.06	Temperature sensor A	4	2 x 2	1				
08.07	2nd IF amplifier 6A bias	11	1 x 11	1				MDM25P (24)
08.08	2nd IF amplifier 7A bias	11	1 x 11	1				
08.09	2nd IF amplifier 1B bias	11	1 x 11	1				MDM25P (24)
08.10	2nd IF amplifier 2B bias	11	1 x 11	1				
08.11	2nd IF amplifier 3B bias	11	1 x 11	1				MDM25P (24)
08.12	2nd IF amplifier 4B bias	11	1 x 11	1				
08.13	2nd IF amplifier 5B bias	11	1 x 11	1				MDM21P (17)
08.14	Temperature sensor B	4	2 x 2	1				
08.15	2nd IF amplifier 6B bias	11	1 x 11	1				MDM25P (24)
08.16	2nd IF amplifier 7B bias	11	1 x 11	1				
08.17	IF output HRS A				1			SMA female
08.18	IF output WBS A				1			SMA female
08.19	IF output HRS B				1			SMA female
08.20	IF output WBS B				1			SMA female
	Totals	162		16	4			

Table 9
HFPU to Optical Bench harness
HFPU Calibration source

Item No.	Name	Shielded cable # wires	Shielded cable twisted groups	Shielded cable # shields	Coax	Unshielded cable # wires	Unshielded cable twisted groups	FPU Interface connector
09.01	Heater 1					2	1 x 2	MDM25P
09.02	Heater 2					2	1 x 2	
09.03	Heater 3					2	1 x 2	
09.04	Temperature sensor 1	4	2 x 2	1				
09.05	Temperature sensor 2	4	2 x 2	1				
09.06	Temperature sensor 3	4	2 x 2	1				(21)
	Totals	12		3	0	6		

Table 10
HFPU to Optical Bench harness
HFPU Chopper mirror M3

Item No.	Name	Shielded cable # wires	Shielded cable twisted groups	Shielded cable # shields	Coax	Unshielded cable # wires	Unshielded cable twisted groups	FPU Interface connector
10.01	Chopper actuator 1	4	2 x 2	1				MDM15P
10.02	Chopper LVDT 1 prim.							
10.03	Chopper LVDT 1 sec.	3	1 x 3	1				(9)
10.04	Chopper actuator 2	4	2 x 2	1				MDM15P
10.05	Chopper LVDT 2 prim.							
10.06	Chopper LVDT 2 sec.	3	1 x 3	1				(9)
	Totals	14		4	0	0		

Table 11
HFPU to Optical Bench harness
HFPU Temperature sensors

Item No.	Name	Shielded cable # wires	Shielded cable twisted groups	Shielded cable # shields	Coax	Unshielded cable # wires	Unshielded cable twisted groups	FPU Interface connector
11.01	Temperature sensor 2K A	12	6 x 2	1				MDM15P
11.02	Temperature sensor 4K A							
11.03	Temperature sensor 15K A							(13)
11.04	Temperature sensor 2K B	12	6 x 2	1				MDM15P
11.05	Temperature sensor 4K B							
11.06	Temperature sensor 15K B							(13)
	Totals	24		2	0	0		

Table 12
HFPU to Optical Bench harness
HFPU He3 cooler

Item No.	Name	Shielded cable # wires	Shielded cable twisted groups	Shielded cable # shields	Coax	Unshielded cable # wires	Unshielded cable twisted groups	FPU Interface connector
12.01	Heat switch A still					2	1 x 2	MDM15P
12.02	Heat switch A pump					2	1 x 2	
12.03	Heater A pump					2	1 x 2	(11)
12.04	Temperature sensor 0.5K A	4	2 x 2	1				
12.05	Heat switch B still					2	1 x 2	MDM15P
12.06	Heat switch B pump					2	1 x 2	
12.07	Heater B pump					2	1 x 2	(11)
12.08	Temperature sensor 0.5K B	4	2 x 2	1				
	Totals	8		2		12		

Table 13

Optical Bench to Cryostat wall harness

Item No.	Name	HFPU item ref. no.	Shielded cable # wires	Shielded cable twisted groups	Shielded cable # shields	Coax	Unshielded cable # wires	Unshielded cable twisted groups
13.01	Mixers A Bias Vsupply	01.01 02.01 03.01 04.01 05.01 06.01 07.01	35	7 x 5	1			
	Mixers A Bias I/Vmon	01.02 02.02 03.02 04.02 05.02 06.02 07.02						
13.02	Mixers A Heater	01.06 02.06 03.06 04.06 05.06 06.06 07.06	28	14 x 2	1			
	Mixers A magnet	01.05 02.05 03.05 04.05 05.05 06.05 07.05						
13.03	Mixer A Temp. sensor	01,07 02.07 03.07 04.07 05.07 06.07 07.07	28	14 x 2	1			
13.04	Mixer A 1st IF Amp bias	01.17 02.17 03.17 04.17 05.17 06.17 07.17	56	7 x 8	1			
13.05	Mixers B Bias Vsupply	01.03 02.03 03.03 04.03 05.03 06.03 07.03	35	7 x 5	1			
	Mixers B Bias I/Vmon	01.04 02.04 03.04 04.04 05.04 06.04 07.04						

Table 13

Optical Bench to Cryostat wall harness

Item No.	Name	HPPU item ref. no.	Shielded cable # wires	Shielded cable twisted groups	Shielded cable # shields	Coax	Unshielded cable # wires	Unshielded cable twisted groups
13.06	Mixers B Heater	01.09 02.09 03.09 04.09 05.09 06.09 07.09	28	14 x 2	1			
	Mixers B magnet	01.08 02.08 03.08 04.08 05.08 06.08 07.08						
13.07	Mixers B Temp. sensor	01.10 02.10 03.10 04.10 05.10 06.10 07.10	28	14 x 2	1			
13.08	Mixers B 1st IF Amp bias	01.18 02.18 03.18 04.18 05.18 06.18 07.18	56	7 x 8	1			
13.09	MA Diplexer A actuator	01.11 02.11 03.11 04.11 05.11 06.11 07.11	14	7 x 2	1			
13.10	MA Diplexer A LVDT prim.	01.12 02.12 03.12 04.12 05.12 06.12 07.12	14	7 x 2	1			
13.11	MA Diplexer A LVDT sec.	01.13 02.13 03.13 04.13 05.13 06.13 07.13	21	7 x 3	1			
13.12	MA Diplexer B actuator	01.14 02.14 03.14 04.14 05.14 06.14 07.14	14	7 x 2	1			
13.13	MA Diplexer B LVDT prim.	01.15 02.15 03.15 04.15 05.15 06.15 07.15	14	7 x 2	1			

Table 13

Optical Bench to Cryostat wall harness

Item No.	Name	HFPU item ref. no.	Shielded cable			Coax	Unshielded cable	
			# wires	twisted groups	# shields		# wires	twisted groups
13.14	MA Diplexer B LVDT sec.	01.16 02.16 03.16 04.16 05.16 06.16 07.16	21	7 x 3	1			
13.15	IF box 2nd IF amplifiers A bias	08.01 08.02 08.03 08.04 08.05 08.07 08.08	77	7 x 11	1			
13.16	IF box 2nd IF amplifiers B bias	08.09 08.10 08.11 08.12 08.13 08.15 08.16	77	7 x 11	1			
13.17	Chopper actuator 1	10.01	2	1 x 2	1			
13.18	Chopper LVDT 1 prim.	10.02	2	1 x 2	1			
13.19	Chopper LVDT 1 sec.	10.03	3	1 x 3	1			
13.20	Chopper actuator 2	10.04	2	1 x 2	1			
13.21	Chopper LVDT 2 prim.	10.05	2	1 x 2	1			
13.22	Chopper LVDT 2 sec	10.06	3	1 x 3	1			
13.23	Temp sensor 2K A Temp sensor 4K A Temp sensor 15K A He3 cooler temp sensor 0.5K A IF box temp. sensor A	11.01 11.02 11.03 12.04 08.06	20	10 x 2	1			
13.24	Temp sensor 2K B Temp sensor 4K B Temp sensor 15K B He3 cooler temp sensor 0.5K B IF box temp. sensor B	11.04 11.05 11.06 12.08 08.14	20	10 x 2	1			
13.25	Cal. Source temp. sensor 1	09.04	4	2 x 2	1			
13.26	Cal. Source temp. sensor 2	09.05	4	2 x 2	1			
13.27	Cal. Source temp. sensor 3	09.06	4	2 x 2	1			
13.28	IF output HRS A	08.17				1		
13.29	IF output WBS A	08.18				1		
13.30	IF output HRS B	08.19				1		
13.31	IF output WBS B	08.20				1		
13.32	Cal. Source heater 1	09.01					2	1 x 2
13.33	Cal. Source heater 2	09.02					2	1 x 2
13.34	Cal. Source heater 3	09.03					2	1 x 2
13.35	He3 cooler switch A still	12.01					2	1 x 2
13.36	He3 cooler switch A pump	12.02					2	1 x 2
13.37	He3 cooler pump heater A	12.03					2	1 x 2
13.38	He3 cooler switch B still	12.05					2	1 x 2
13.39	He3 cooler switch B pump	12.06					2	1 x 2
13.40	He3 cooler pump heater B	12.07					2	1 x 2
		Totals	612		27	4	18	

Total number of wires and shields

With all seven mixer assemblies having the same configuration the harness between the Optical Bench and the cryostat wall connectors is:

Total number of wires:	634
Total number of shields:	27

Divided over the different type of cables:

Number of shielded cables:	27
Number wires in shielded cable:	612
Number of coaxial cables:	4
Number of unshielded cables:	9
Number of twisted wires in unshielded cables:	18

The required number of twists in the twisted groups of wires: 100-500 per meter.
Cables of redundant systems have to go through separate connectors.

Annex 03

→ DS

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Heat dissipation on PACS cryo harness

Table 1: Wiring within detector assemblies and wiring of heaters for short λ assy

Route	Wires	# of wires	# shields	Cross section SST [mm²] Conductors	PTFE Insulator	Length [m]	resistance [Ohms]	current [A]	ohmic dissipation [W]	Remarks
1.7K - 4K (on detector modules)	Detector signal	2 x 25 x 16	0	0.392	-	0.005	10	≤1n	negligible	
	Bias	2 x 25	0	0.025	-	0.005	10	≤20n	negligible	
	1.7K/2.5K-temp sens	2 x 25 x 4	0	0.1	-	0.005	10	10μ	negligible	current on 4 lines only
1.7K (2.5K) – 4K (short λ assy)	Heaters short λ assy	8	0	0.064	0.172	0.3	20	100μ	0.8μ	current on 4 lines only

Table 2: Detector assemblies to distribution boards)[1]

Route	Wires	# of wires	# shields	Cross section SST [mm²] Conductors	PTFE Insulator	Length [m]	resistance (max))[1] [Ohms]	current [A]	ohmic dissipation)[1] [W]	Remarks
4K - 4K (from det. assembl. to distrib. board)	Analog supplies	2 x 25 x 5	0	2.4	12.9	0.3	20	10μ	0.3μ	current on 150 lines only, GSC6782, 6777
	Digital supplies and control	2 x 25 x 6	0	2.4	12.9	0.3	20	40μ	1.6μ	current on 50 lines only, GSC 6790
	Clock	2 x 25	2 x 25	1.4	15.45	0.3	20	40μ	1.6μ	GSC6575
	Synch	2 x 25	2 x 25	1.4	15.45	0.3	20	15μ	0.2μ	GSC 6575
	Out	2 x 25	2 x 25 x 2	? 3.0 ?	? 35.0 ?	0.3	20	10μ	0.1μ	no cable type available
	Detector bias + other sensitive lines	2 x 25 x 7	2 x 25	7.05	60.4	0.3	40	≤20n	negligible	GSC 6790
	Temp. sensors 1.7K + 4.2K	2 x 25 x 8	0	3.2	17.2	0.3	20	10μ	0.2μ	current on 100 lines only, GSC 6782

)[1] No temperature gradient is expected along the harness between detector assemblies and distribution boards. Therefore pre-confectioned copper cables with very low resistance may be used; that means the total dissipation will be negligible.

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Table 3: Distribution boards to FPU connectors)[2]

Route	Wires	# of wires	# shields	Cross section SST [mm²] Conductors	PTFE Insulator	Length [m]	resistance (max))[1] [Ohms]	expected current [A]	ohmic dissipation)[2] [W]	Remarks
4K - 4K (from distr. board to FPU conn.)	Analog supplies	4 x 8	4	0.792	6.4	0.5	30	0.2m	14.4µ	4 x GSC 6792, curr. on 12 lines only
	Digital supplies and control	4 x 8	4	0.792	6.4	0.5	30	0.2m	4.8µ	4 x GSC 6792, curr. on 4 lines only
	Clock	4 x 2	4	3.8	38.5	0.5	30	0.2m	4.8µ	50 x GSC 6786
	Synch	4 x 2	4	3.8	38.5	0.5	30	0.2m	4.8µ	50 x GSC 6786
	Out	2 x 25	2 x 25 x 2	~3.0	~35	0.5	30	10µ	0.2µ	no cable type avail.
	Detector bias + resistor bias	2 x (14+13)	4	1.14	8.6	0.5	60	≤1µ	negligible	4 x GSC 6793
	Zero_Ref	2 x (13+12)	4	1.14	8.6	0.5	60	≤1µ	negligible	4 x GSC 6793
	Zero_Bias	2 x (13+12)	4	1.14	8.6	0.5	60	≤1µ	negligible	4 x GSC 6793
	Bias_Pres	2 x (13+12)	4	1.14	8.6	0.5	60	≤1µ	negligible	4 x GSC 6793
	GCM2	2 x (13+12)	4	1.14	8.6	0.5	60	≤1µ	negligible	4 x GSC 6793
	ORV	2 x (13+12)	4	1.14	8.6	0.5	60	≤1µ	negligible	4 x GSC 6793
	Temp. sensors 1.7/2.5/4.2 K, heaters short λ assy	16 + 24	2	0.65	4.8	0.5	60	10µ / 0.1m	2.4µ	GSC 6793 + GSC 6801

)[2] No temperature gradient is expected along the harness between distribution boards and FPU connectors. Therefore pre-confectioned copper cables with very low resistance may be used; that means the total dissipation will be negligible.

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Table 4: Harness of cryomechanics (actuators) to FPU connectors)[3]

Route	Wires	# of wires	# shields	Cross section SST [mm²] Conductors	PTFE Insulator	Length [m]	resistance)[3] [Ohms]	expected current [A]	ohmic dissip.)[3] [W]	Remarks
	Grating position sensors	3 x 2	3	~1.4	~3	0.5	5	5m	0.5m	no cable type avail.(similar to GSC 6786), current on 4 lines only
		3 x 1	3	0.084	0.927	0.5	50	1m	150µ	3 x GSC 6575
	Grating control sensors	2 x 6	2	0.282	2.416	0.5	50	1m	200µ	2 x GSC 6790, current on 4 lines only
4K - 4K	Grating drive coils)[5]	8	1	~0.4 (Brass)	~2	0.5	1	25m	5m	no cable type available, dissipation to 11K/15K level?
(from FPU internal units	Launch lock drive	4	1	~0.2 (Brass)	~1	0.5	1	0.1	negligible)[4]	no cable type available
to FPU conn.)	Mirror_Flip_1/2 drive coils	2 x 8	2	~0.8 (Brass)	~4	0.5	1	0.1	80µ	no cable type avail., duty cycle 0.05%
	Mirror_Flip control sensors	4 x 6	4	0.564	4.832	0.5	50	1m	0.2µ	4 x GSC 6790, current on 8 lines only, duty cycle 0.05%
	Mirror_Flip position sensors	2 x 6	2	0.282	2.416	0.5	50	1m	negligible	2 x GSC 6790, current on 4 lines only duty cycle 0.05%
	Filter_Wheel_1/2 drive coils	2 x 8	2	~0.8 (Brass)	~4	0.5	1	0.1	160µ	no cable type avail., duty cycle 0.1%
	Filter_Wheel control sensors	4 x 6	4	0.564	4.832	0.5	50	1m	0.4µ	4 x GSC 6790, current on 8 lines only, duty cycle 0.1%
	Filter_Wheel position sensors	2 x 6	2	0.282	2.416	0.5	50	1m	0.2µ	2 x GSC 6790, current on 4 lines only, duty cycle 0.1%
	Chopper drive coils	8	1	~0.4 (Brass)	~2	0.5	1	2.5m	25µ	no cable type available, current on 4 lines only
	Chopper position sensors	2 x 6	2	0.282	2.416	0.5	50	1m	0.2µ	2 x GSC 6790, current on 4 lines only
	Calibration sources	2 x 8	2	~0.8 (Brass)	~4	0.5	1	20m	1.6m	no cable type available, current on 4 lines only
	Temperature/launch lock sensors	21 + 18	2	0.65	4.8	0.5	50	10µ	0.1µ	GSC 6802, GSC 6793, current on 18 lines only

)[3] No temperature gradient is expected along the harness between FPU internal units and FPU connectors. Therefore pre-confectioned copper cables with very low resistance may be used; that means the total dissipation will be negligible.

)[4] To be activated only once

)[5] May be on the 11K/15K temperature level

Table 5: Detector harness, FPU connectors to connector bracket

Route	Wires	# of wires	# shields	Cross section SST [mm²] Conductors	PTFE Insulator	Length [m]	resistance [Ohms]	expected current [A]	ohmic dissipation [W]	Remarks
4K - 11K	Analog supplies	4 x 8	4	0.792	6.4	0.3	20	0.2m	9.5µ	4 x GSC 6792, curr. on 12 lines only
	Digital supplies and control	4 x 8	4	0.792	6.4	0.3	20	0.2m	3.2µ	4 x GSC 6792, curr. on 4 lines only
	Clock	4 x 2	4	3.8	38.5	0.3	20	0.2m	3.2µ	50 x GSC 6786
	Synch	4 x 2	4	3.8	38.5	0.3	20	0.2m	3.2µ	50 x GSC 6786
	Out	2 x 25	2 x 25 x 2	~3.0	~35	0.3	20	10µ	0.1µ	no cable type avail.
	Detector bias + resistor bias	2 x (14+13)	4	1.14	8.6	0.3	35	≤1µ	negligible	4 x GSC 6793
	Zero_Ref	2 x (13+12)	4	1.14	8.6	0.5	60	≤1µ	negligible	4 x GSC 6793
	Zero_Bias	2 x (13+12)	4	1.14	8.6	0.3	35	≤1µ	negligible	4 x GSC 6793
	Bias_Pres	2 x (13+12)	4	1.14	8.6	0.3	35	≤1µ	negligible	4 x GSC 6793
	GCM2	2 x (13+12)	4	1.14	8.6	0.3	35	≤1µ	negligible	4 x GSC 6793
	ORV	2 x (13+12)	4	1.14	8.6	0.3	35	≤1µ	negligible	4 x GSC 6793
	Temp. sensors 1.7/2.5/4.2 K, heaters short λ assy	16 + 24	2	0.65	4.8	0.3	35	10µ / 0.1m	1.4µ	GSC 6793 + GSC 6802

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Table 6: harness of cryomechanics, FPU connectors to connector bracket

Route	Wires	# of wires	# shields	Cross section SST [mm²] Conductors	PTFE Insulator	Length [m]	resistance (max))[1] [Ohms]	expected current [A]	ohmic dissip. [W]	Remarks
4K - 11K	Grating position sensors	3 x 2	3	~1.4	~3	0.3	3	5m	0.3m	no cable type avail (similar to GSC 6786), current on 4 lines only
		3 x 1	3	0.084	0.927	0.3	30	1m	90µ	3 x GSC 6575
	Grating control sensors	2 x 6	2	0.282	2.416	0.3	30	1m	120µ	2 x GSC 6790, current on 4 lines only
	Grating drive coils)[5]	8	1	~0.4 (Brass)	~2	0.3	0.6	25m	3m	no cable type available
	Launch lock drive	4	1	~0.2 (Brass)	~1	0.3	0.6	0.1	negligible)[4]	no cable type available
	Mirror_Flip_1/2 drive coils	2 x 8	2	~0.8 (Brass)	~4	0.3	0.6	0.1	48µ	no cable type avail., duty cycle 0.05%
	Mirror_Flip control sensors	4 x 6	4	0.564	4.832	0.3	30	1m	0.1µ	4 x GSC 6790, current on 8 lines only, duty cycle 0.05%
	Mirror_Flip position sensors	2 x 6	2	0.282	2.416	0.3	30	1m	negligible	2 x GSC 6790, current on 4 lines only duty cycle 0.05%
	Filter_Wheel_1/2 drive coils	2 x 8	2	~0.8 (Brass)	~4	0.3	0.6	0.1	96µ	no cable type avail., duty cycle 0.1%
	Filter_Wheel control sensors	4 x 6	4	0.564	4.832	0.3	30	1m	0.2µ	4 x GSC 6790, current on 8 lines only, duty cycle 0.1%
	Filter_Wheel position sensors	2 x 6	2	0.282	2.416	0.3	30	1m	0.1µ	2 x GSC 6790, current on 4 lines only, duty cycle 0.1%
	Chopper drive coils	8	1	~0.4 (Brass)	~2	0.3	0.6	2.5m	15µ	no cable type available, current on 4 lines only
	Chopper position sensors	2 x 6	2	0.282	2.416	0.3	30	1m	0.1µ	2 x GSC 6790, current on 4 lines only
	Calibration sources	2 x 8	2	~0.8 (Brass)	~4	0.3	0.6	20m	1m	no cable type available, current on 4 lines only
	Temperature/launch lock sensors	21 + 18	2	0.65	4.8	0.3	30	10µ	0.1µ	GSC 6802, GSC 6793, current on 18 lines only

)[4] To be activated only once
)[5] May be on the 11K/15K temperature level

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Table 7: Detector harness, connector bracket to warm electronics (via vessel feedthroughs)

Route	Wires	# of wires	# shields	Cross section SST $[mm^2]$ Conductors	PTFE Insulator	Length [m]	resistance [Ohms]	expected current [A]	ohmic dissipation [W]	Remarks
11K - 300K	Analog supplies	4 x 8	4	0.792	6.4	4.5	250	0.2m	120µ	4 x GSC 6792, curr. on 12 lines only
	Digital supplies and control	4 x 8	4	0.792	6.4	4.5	250	0.2m	40µ	4 x GSC 6792, curr. on 4 lines only
	Clock	4 x 2	4	3.8	38.5	4.5	250	0.2m	40µ	50 x GSC 6786
	Synch	4 x 2	4	3.8	38.5	4.5	250	0.2m	40µ	50 x GSC 6786
	Out	2 x 25	2 x 25 x 2	~3.0	~35	4.5	250	10µ	1µ	no cable type avail.
	Detector bias + resistor bias	2 x (14+13)	4	1.14	8.6	4.5		≤1µ	negligible	4 x GSC 6793
	Zero_Ref	2 x (13+12)	4	1.14	8.6	0.5	60	≤1µ	negligible	4 x GSC 6793
	Zero_Bias	2 x (13+12)	4	1.14	8.6	4.5	500	≤1µ	negligible	4 x GSC 6793
	Bias_Pres	2 x (13+12)	4	1.14	8.6	4.5	500	≤1µ	negligible	4 x GSC 6793
	GCM2	2 x (13+12)	4	1.14	8.6	4.5	500	≤1µ	negligible	4 x GSC 6793
	ORV	2 x (13+12)	4	1.14	8.6	4.5	500	≤1µ	negligible	4 x GSC 6793
	Temp. sensors 1.7/2.5/4.2 K, heaters short λ assy	16 + 24	2	0.65	4.8	4.5	500	10µ / 0.1m	14µ	GSC 6793 + GSC 6802

Max-Planck-Institut für Astronomie Heidelberg

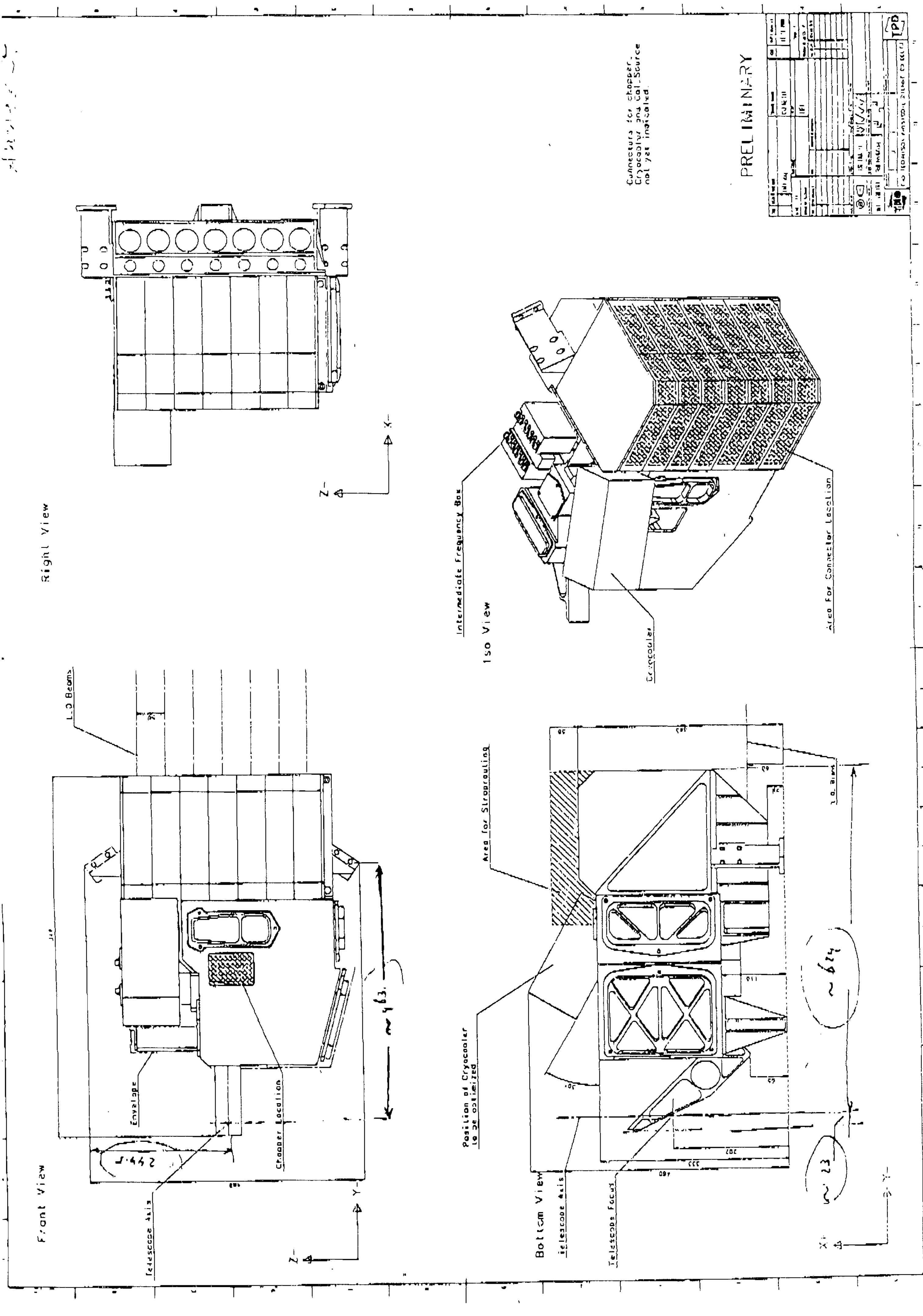
[illegible].doc 03 Nov 99

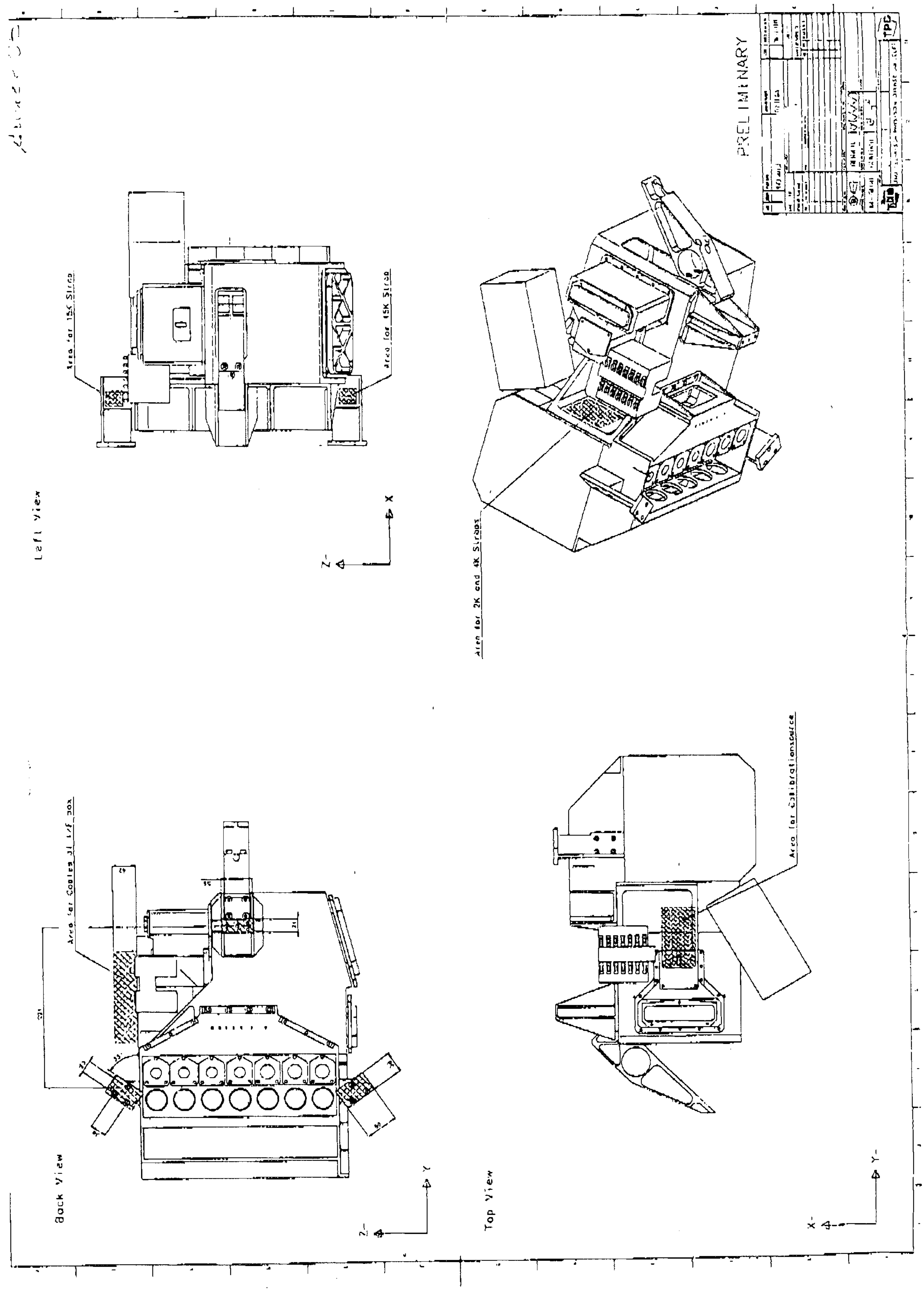
Table 8: harness of cryomechanics, connector bracket to warm electronics (via vessel feedthroughs)

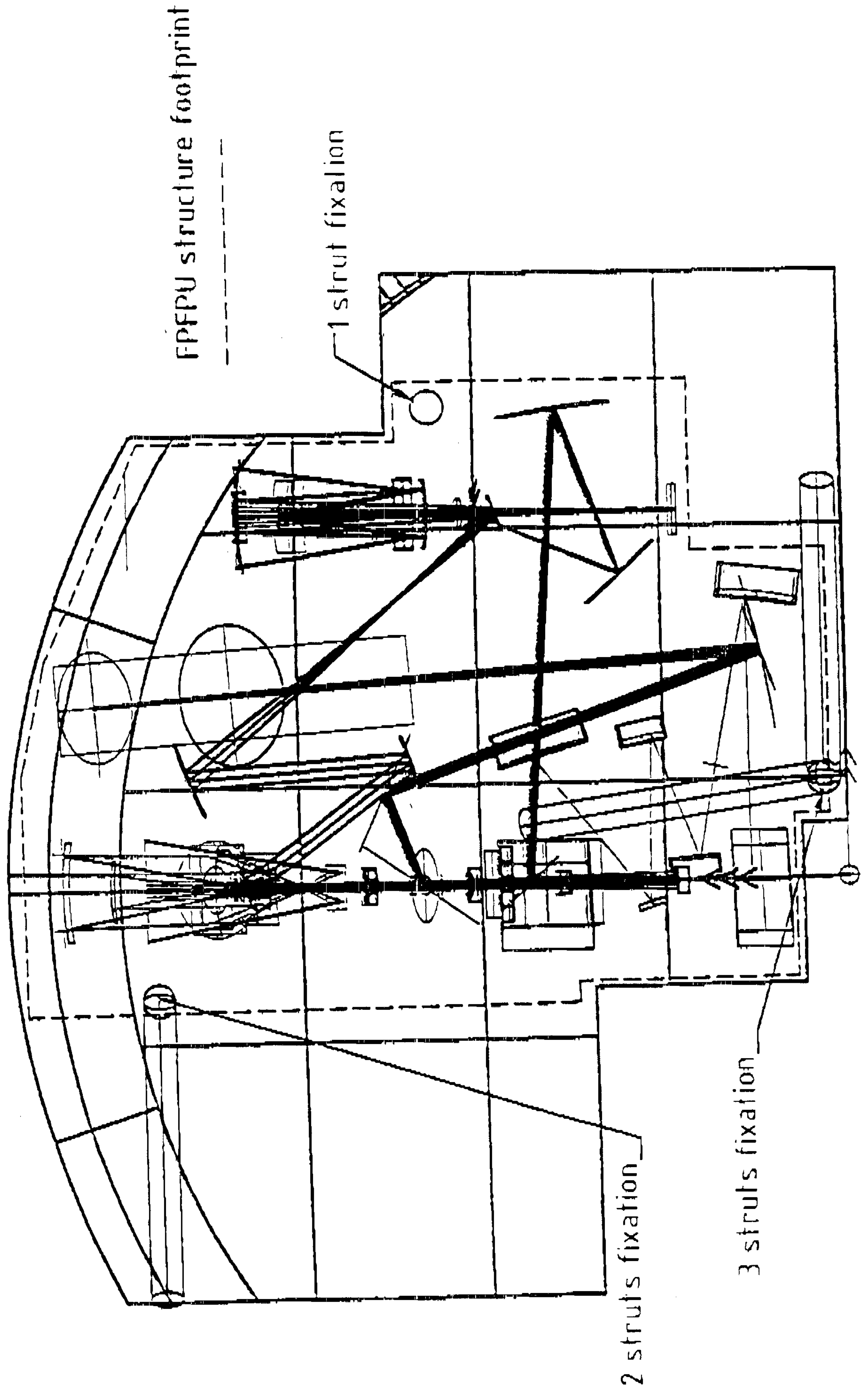
Route	Wires	# of wires	# shields	Cross section SST [mm²] Conductors	PTFE Insulator	Length [m]	resistance [Ohms]	expected current [A]	ohmic dissip. [W]	Remarks
	Grating position sensors	3 x 2	3	~1.4	~3	4.5	45	5m	4.5m	no cable type avail (similar to GSC 6786), current on 4 lines only
		3 x 1	3	0.084	0.927	4.5	500	1m	1.5m	3 x GSC 6575
	Grating control sensors	2 x 6	2	0.282	2.416	4.5	500	1m	2m	2 x GSC 6790, current on 4 lines only
11K - 300K	Grating drive coils	8	1	~0.4 (Brass)	~2	4.5	9	25m	45	no cable type available
	Launch lock drive	4	1	~0.2 (Brass)	~1	4.5	9	0.1	negligible)[4]	no cable type available
	Mirror_Flip_1/2 drive coils	2 x 8	2	~0.8 (Brass)	~4	4.5	9	0.1	0.7m	no cable type avail., duty cycle 0.05%
	Mirror_Flip control sensors	4 x 6	4	0.564	4.832	4.5	500	1m	2µ	4 x GSC 6790, current on 8 lines only, duty cycle 0.05%
	Mirror_Flip position sensors	2 x 6	2	0.282	2.416	4.5	500	1m	1µ	2 x GSC 6790, current on 4 lines only duty cycle 0.05%
	Filter_Wheel_1/2 drive coils	2 x 8	2	~0.8 (Brass)	~4	4.5	9	0.1	1.4m	no cable type avail., duty cycle 0.1%
	Filter_Wheel control sensors	4 x 6	4	0.564	4.832	4.5	500	1m	4µ	4 x GSC 6790, current on 8 lines only, duty cycle 0.1%
	Filter_Wheel position sensors	2 x 6	2	0.282	2.416	4.5	500	1m	0.5m	2 x GSC 6790, current on 4 lines only, duty cycle 0.1%
	Chopper drive coils	8	1	~0.4 (Brass)	~2	4.5	9	2.5m	225µ	no cable type available, current on 4 lines only
	Chopper position sensors	2 x 6	2	0.282	2.416	4.5	500	1m	2m	2 x GSC 6790, current on 4 lines only
	Calibration sources	2 x 8	2	~0.8 (Brass)	~4	4.5	9	20m	14.4m	no cable type available, current on 4 lines only
	Temperature/launch lock sensors	21 + 18	2	0.65	4.8	4.5	500	10µ	1µ	GSC 6802, GSC 6793, current on 18 lines only

)[4] To be activated only once

Σ wires 686
Σ shields 175
} 861 pins
?


PRELIMINARY
Connectors for chopper, Cryocooler and Cal. Source not yet indicated.
Right View
Iso View
Intermediate Frequency Box
Cryocooler
Area For Connector Location
Front View
LO Beams
Envelope
Chopper Location
Telescope Axis
Bottom View
Area for Strapcouling
Position of Cryocooler to be optimized
Telescope Axis
Telescope Focus
~ 463
~ 624
~ 23


PRELIMINARY
Left View
Area for 15K Strobe
Area for 15K Strobe
Area for 2K and 4K Strobes
Back View
Area for Cables at I/F Box
Top View
Area for Calibrationsource


FPFPU structure footprint
1 strut fixation
2 struts fixation
3 struts fixation

****
*** SENDEBERICHT ***
****

SENDUNG OK

SE/EM NR	4905
RUFNR. GEGENSTELLE	
NEBENADRESSE	
NAME GEGENSTELLE	
ANF.ZEIT	12/11 09:20
ÜB.ZEIT	02'21
S.	5
ERGEBNIS	OK

FAX: 566 , 5 page(s)

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Nov. 11, 99

RG-bx

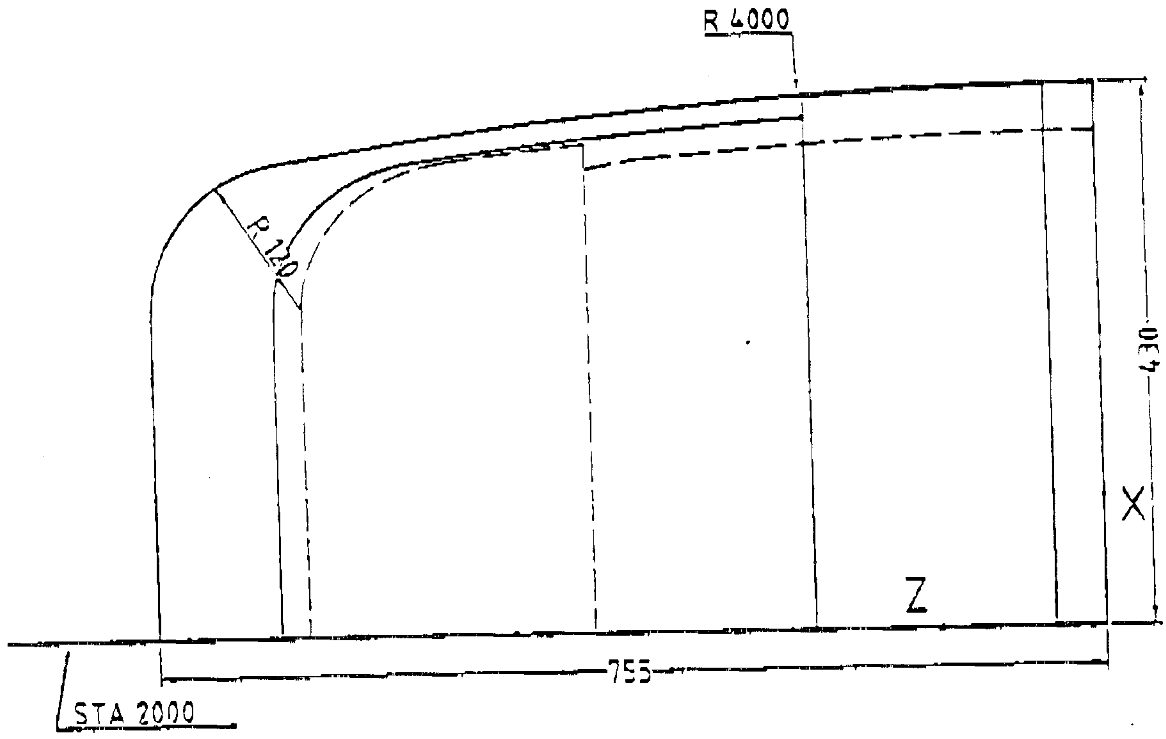
PACS-KT-LE-013
PACS - Detailed Design Envelope

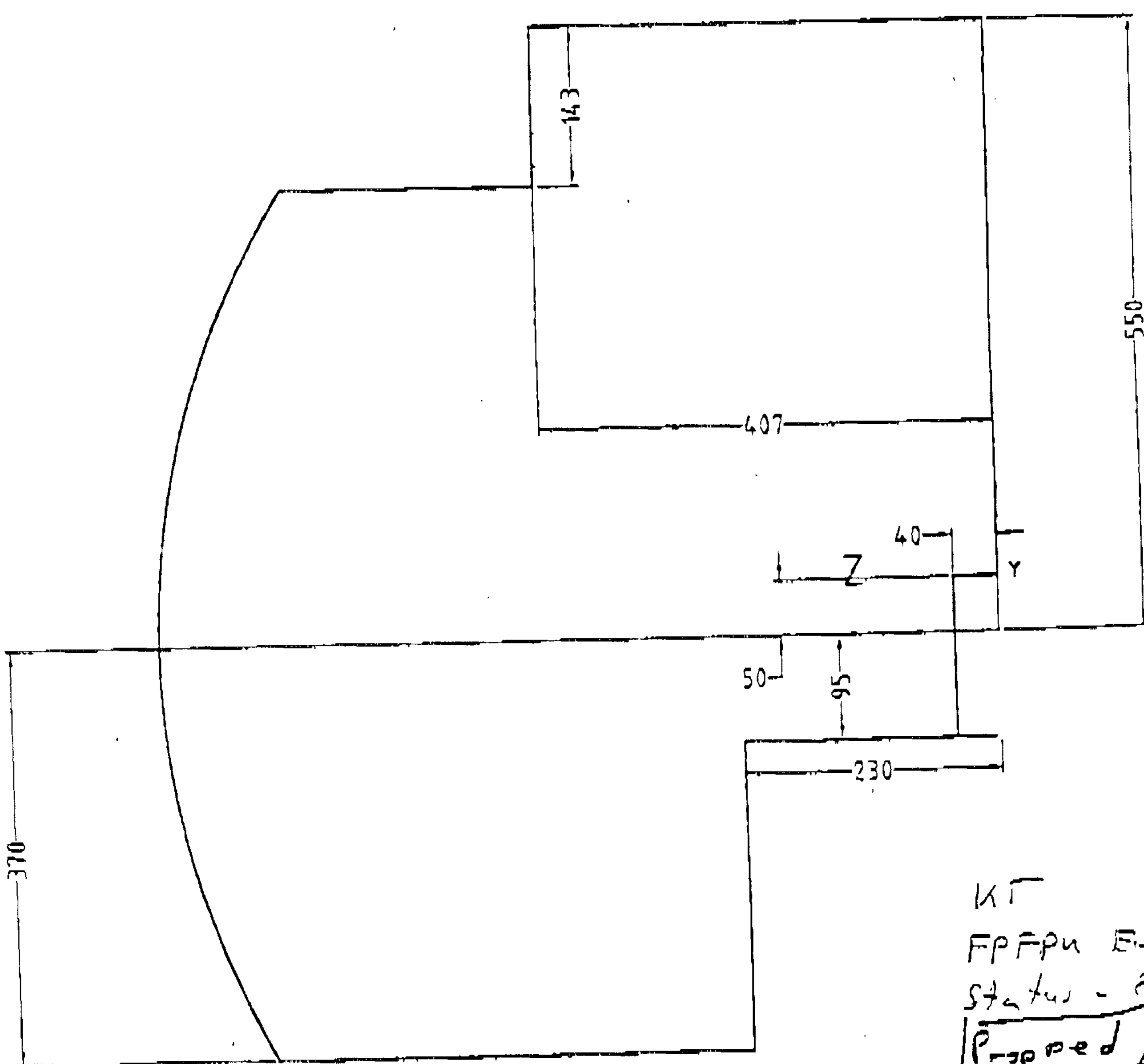
Dear Dr. Passvogel,

Attached you will find a more detailed design envelope of the FPFPU comprising the preliminary footprint of the housing, the suspension (OB interface) and the accommodation of the optical components. Thanks to the successful optical re-design a reduction of the total amount of optical components was feasible, compared to CM #8.

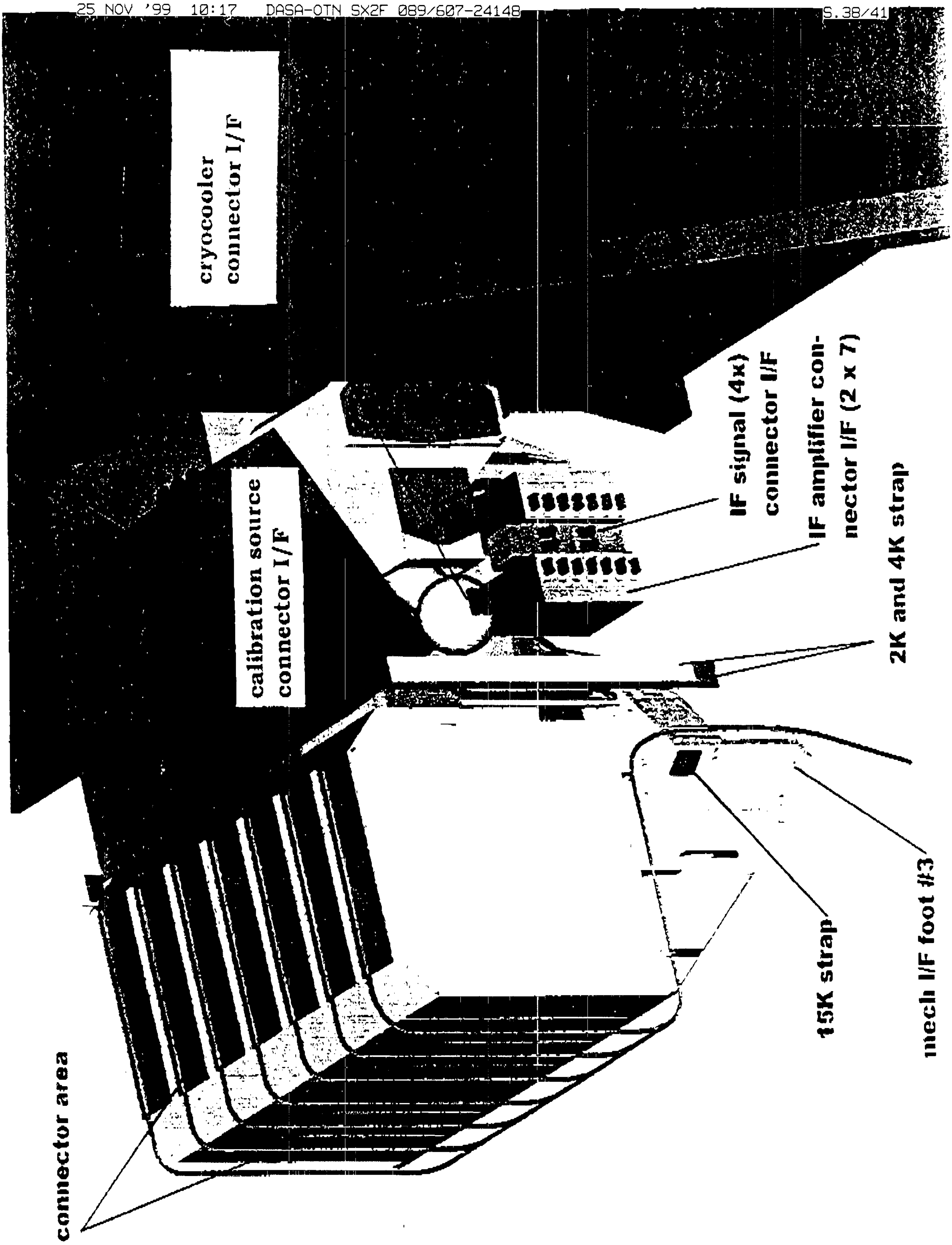
According to the current status, 54 optical components, 2 dichroics, 1 chopper and 1 grating form the optical trains. The solution for the mechanical suspension providing high margins with respect to the requested minimum fundamental frequency, is based on a classical isostatic suspension (3 vertical struts and 3 horizontal struts) to prevent tilting and focus displacements due to differential CTE between FPFPU and OB.

As already discussed, we propose to continue with the extended design envelope until the ISVR and to postpone the dedicated decision in order to avoid a continuous dynamic adaptation of the envelope in case of potentially necessary minor

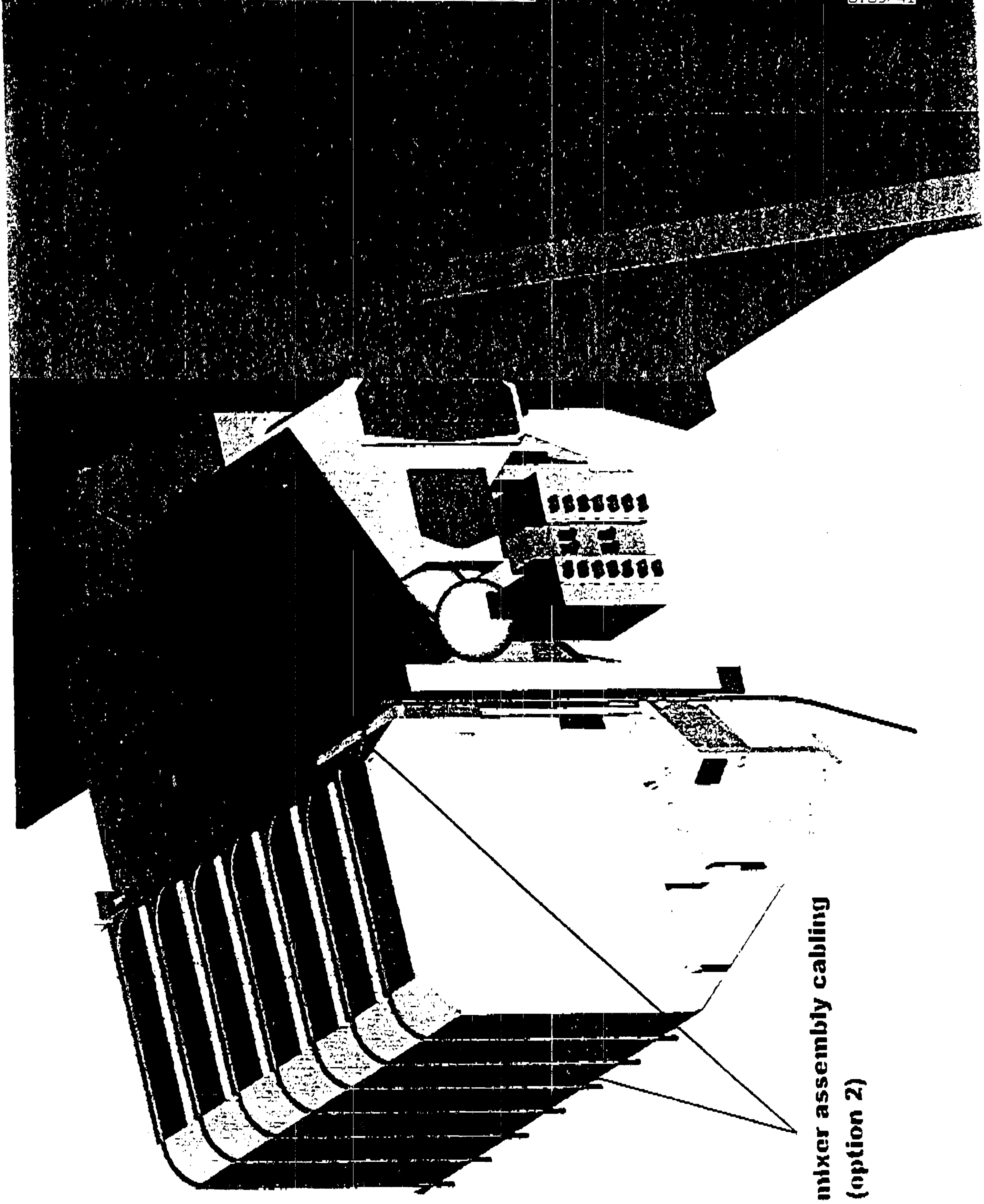




KT
FPFPu Envelope
Status - 22.10.9
Proposed


cryocooler connector I/F
calibration source connector I/F
IF signal (4x) connector I/F
IF amplifier connector I/F (2 x 7)
2K and 4K strap
mech I/F foot #3
15K strap
connector area

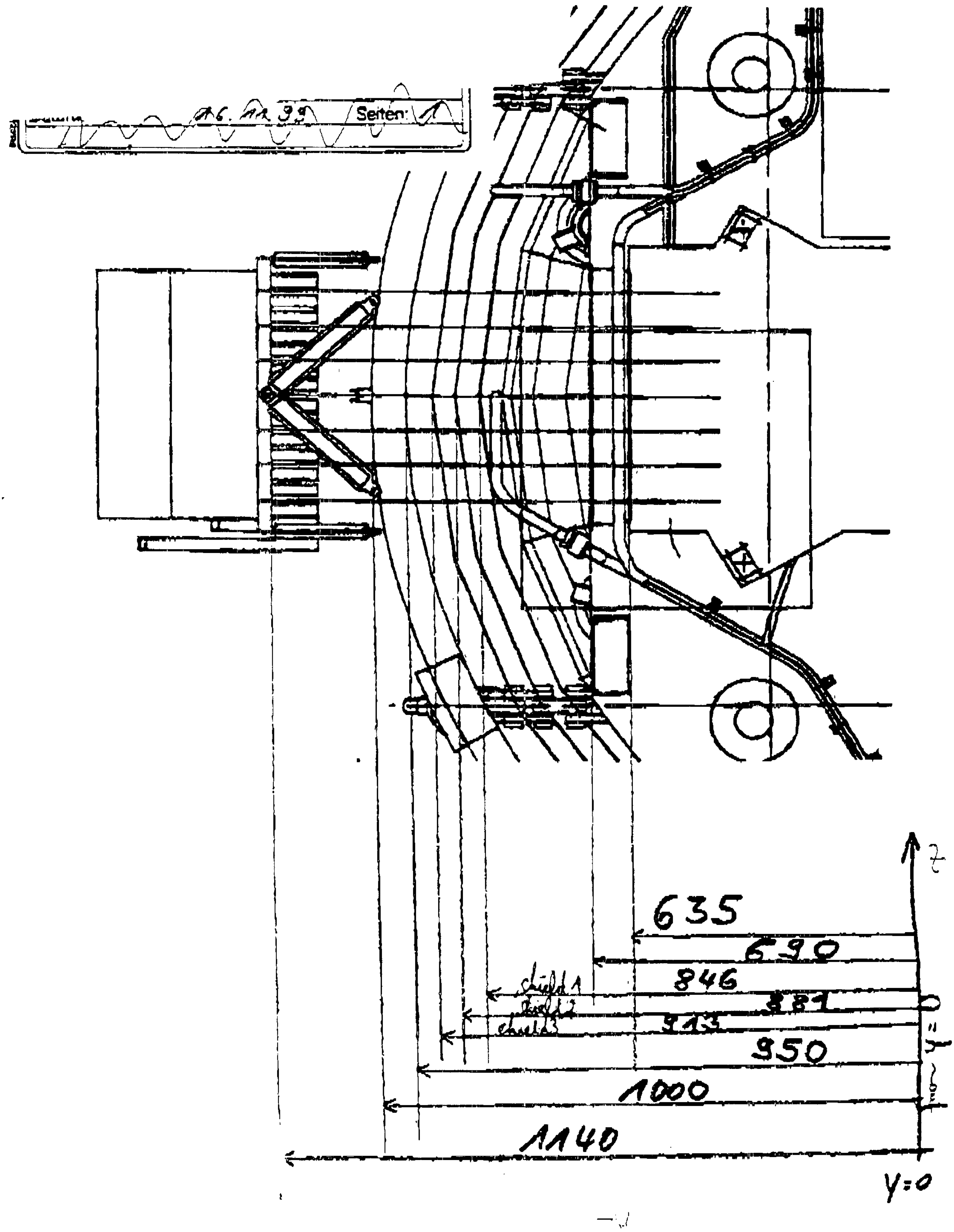
Annex 7



Annex 8

Annex 09

3710



7. Local Oscillator Unit

See MoM → LO unit

Updated LO requirements (tbc):

Mass	13 kg ~~+ radiator mass (?)~~
Dimension (x, z, y)	440 x 357 x 220 mm
Dissipation	1 W multiplier, ~~6 &~~ 12 W amplifier
Temperature (goal)	120 K multiplier, 200K amplifier
Temperature stability	? part of LO design
Alignment w.r.t FPU	±0,~~8~~ 66 mm, ± 70 mm, ±0,~~8~~ 66 mm, ± 0.02~~7~~ 3°, ± 0.38°, ± 0.02~~7~~ 3°
Align. stability w.r.t FPU / 100s	±0.0~~8~~ 66 mm, ± 0.002mm, ± 0.0~~8~~ 66 mm, ± 0.003°, ±0.04°, ± 0.003°,
Window diameter	Free inner diameter 30 mm, distance 50mm
Transmission	≥ ~~90~~ 80% ~~for each window and filter~~ total
Radiator area	2 x 0.25 m²
Waveguides to SVM	tbd