SPIRE-AST-MOM-001725

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Minutes of Meeting

Herschel

Date: 28.5.07			
Doc.-No.:	HP-2-ASED-MN-0387		
Meeting place:	Astrium Otn	**Chairman:**	S. Idler
Date/Time:	28.5.03	**Secretary**	C. Schlosser
Agenda dated:	-	**Close of Meeting:**	-

Subject: Instrument AIT Meeting

Participants:	**Additional Distribution:**

Page: 1 of Page(s)

☐ Brief-Minutes (except following sheets) ☐ Summary of Results of Sheets 2 till

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Reference	Participants ~~Results~~		Remarks
	M. Kölle	ASED	
	C. Schlosser	ASED	
	S. [illegible]	ASED	
	K. J. WILDEMAN	SRON-G	
	D.A. Beintema	SRON	
	W. Luinge	SRON	
	M. von Berg	MPE	
	N. NIKOLAIZIG	ESTEC	
	O. PIERSANTI	ESA	
	C. Scharmberg	ESA	
	N. Geis	MPE	
	J. Schubert	MPE	
	B. Swinyard	RAL	
	O. Bauer	MPE	

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Reference	Results	Remarks
	Agenda according HP-ASED-FX-0440-03 1. Introduction 2. Instrument requirements for PLM / S/C level testing 3. Activity status of I-EG/E WG 4. Cryo Cover baseline concept 5. Electrical Integration Test 6. SFT, IMT/IST, SPT, TB/TV Test 7. EMC Test 8. AOB see ASED presentation in annex 1 1. Introduction Next issue of instrument AIT plan in June 2003. Need dates (relative) for inputs to instrument related procedures presented in hand-out. 2.1 HIFI presentation (see annex 2) of actual ILT status Continuity check of FPU / FCU will be done by HIFI after delivery. Herschel harness and proper connection of FCU will be done with a FPU simulator	

Reference	Results	Remarks
	2.2 PACS presentation (see annex 3) of CQM ILT programme.	
	2.3 SPIRE presentation (see annex 4) Revised model philosophy. CQM w/o spectrometer.	
	2.4. HIFI work around solution	
	HIFI presented a work around solution to be able to deliver the CQM beginning next year: testing of CQM with a LOU simulator. The disadvantage of this solution would be, that the CQM is tested the first time at Astrium together with the QM LOU!	
	3. Instrument EGSE Status	
	See annex 5 „Analysis System" of I-EGSE ~~needs~~ requires an external connection	
	ESA to check the possibility to deliver a CCS lite copy (S/W only) to the instruments in order to verify	AI 1 ESA

Reference	Results	Remarks
	the connection I-EGSE/CCS. Other ~~solutions~~ options would be to deliver a CCS simulator (already revised by ESA) or to perform a Communication check with the I-EGSE together with the CCS lite at Astrium/FN (Astrium preferred option) According to instrument/ASP agreements, the instruments deliver the data base information to ASP, where it will be implemented into the HPSDB. ASED to discuss this point with Alcatel during next H-EPLM PM.	
	<u>4. Cryo Cover Baseline concept</u> see annex 1	
	ASED to explain predicted instrument I/F temps (e.g. L2 temp. are much	AI2ASED

Reference	Results	Remarks
	(lower than orbit, but L1 temp. are much higher).	
	Instruments to check, whether an IST can be performed with the presented temperatures. (page 11 of annex 1)	AI 3 HIFI AI 4 PACS AI 5 SPIRE
	5. Electrical Integration Test see annex 1	
	Electrical I/F testing has to be performed for ~~E~~DMU FE (as part of the PLM EGSE) and the warm units prior to the Electrical Integration Test	
	ASED to check whether there is a cold test with the harness foreseen.	
	Warm unit output signal verification using T-adapters in between WU and FPU/LOU should not be done for safety reasons.	
	IDAS data base will be verified in advance using the test harness from the instruments used during ILT.	

Reference	Results	Remarks
	Test harness from PACS is available for a verification with IDAS. The scientific harness will then be checked with the verified IDAS (after SIH integration into cryostat). Grounding, shielding and isolation shall be checked vs FPU (SPIRE only). Grounding, shielding and isolation shall be checked vs. WU as it is written in the hand out (PACS only). This will be integrated in the next issue of the instrument AIT plan. 6. <u>Instrument Test Approach</u> see annex 1 The Instrument agrees on the SFT test approach. Except for the first test, instrument attendance is not needed (but always welcome). HIFI reduced standing wave test is a SPT, but should be repeated in a reduced version (tbc by HIFI)	

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Reference	Results	Remarks
	PACS spectrometer mode is missing in the IMT/IST flow. It is at the moment included in the „short functional test", but should be listed seperately in future. Instrument IST tests shall be defined by the instruments. SPT tests are tests which will be performed only once. HIFI „short functional tests" include analyse of science data and should be renamed to „short performance test" – (as example). Instruments do review the test flows. No sun simulation is foreseen during TB/TV test. Environmental conditions should be described more in detail. This will be done	

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Reference	Results	Remarks
	Instruments to specify "most sensitive" and "most noisiest" modes for EMC test.	AI 6 HIFI AI 7 PACS AI 8 SPIRE
	Conducted emission and suscept. test on prim. power not useful, since not representative (on PLM level)	
	Instruments to define prim. and sec. power lines to be tested.	AI 9 HIFI AI 10 PACS AI 11 SPIRE

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Action Item List

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Title:

Date: 28.5.03

No.:	Description:	Due Date	Originator Comp./Pers.	Actionee Comp./Pers.	Source	Completion
1	Check possibility to deliver CCS S/W to instr.	06.06.03	ASED/Idler	ESA/Piersanti		
2	Explain predicted instrument I/F temps.	27.06.03	SPIRE/Swinyard	ASED/Idler		
3	Check thermal environment during IST/IMT acceptable	27.06.03	ASED/Idler	HIFI/Luinge		
4	— " —	27.06.03	" /Schink	PACS/Bauer		
5	— " —	"	" / Faas	SPIRE/Swinyard		
6	Specify "worst noisiest/sensitive" mode	"	" / Idler	HIFI / Luinge		
7	— " —	"	" / Schink	PACS / Bauer		
8	— " —	"	" / Faas	SPIRE/Swinyard		
9	Define prim./sec. power lines to be tested	"	" / Idler	HIFI/ Luinge		
10		"	" / Schink	PACS / Bauer		
11		"	" / Faas	SPIRE/Swinyard		

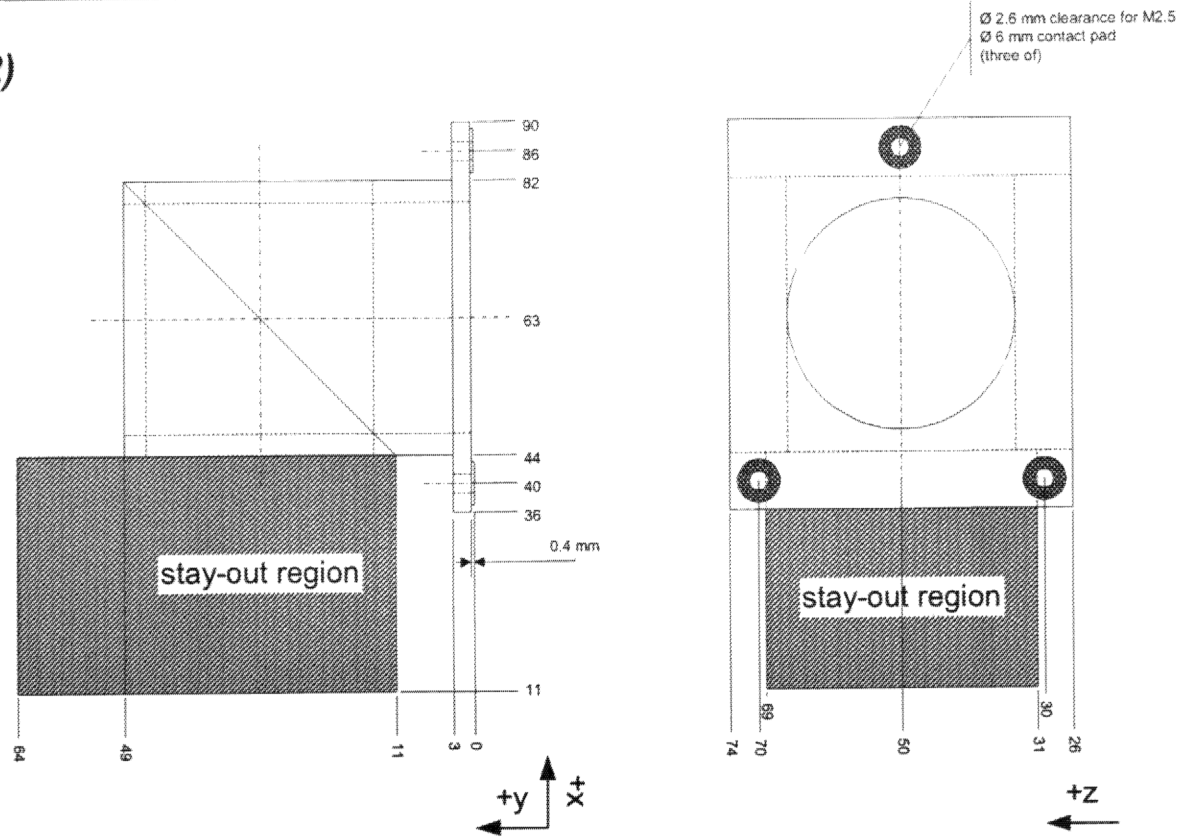
√ 3.6.
P.

HIFI LO EGSE for EMC test at EQM

Interfaces

- For HIFI EMC test – line source for verifying LO signal purity during CS & RS tests
- Comprises test source and beamsplitter for injecting signal into LO window of cryostat
- Single source (only band 3)
- Alignment not critical
    - Δx, $\Delta z < 2$ mm; $\Delta y < 200$ mm
    - $\Delta\Theta x$, $\Delta\Theta z < 1$ degrees; $\Delta\Theta y < 5$ degrees
- Mechanical interface to CVV side of CVV LOU support plate (see drawing)
- Driven by microwave (laboratory) synthesizer via coax cable (length < ~5 m)
- No other electrical interface
- Room temperature operation (0 – 40 C), < 15 mW dissipation
- Cannot be shaken!

Interfaces (2)



HIFI EQM test signal source - 20030530, ND Whyborn

<u>Notes</u>

1) The test source is aligned with HIFI LO window #3.
2) The indicated x and z coordinates are referenced to the telescope nominal focus position (see HIFI IID-B Section 5.8.2.2).
3) The indicated y coordinates have an arbitrary offset with respect to the focus position.
4) The "stay-out region" will contain the actual microwave harmonic generator.
5) The position of the SMA coax input connector is TBD but will be on the +y or -z face of the "stay-out region".

Status

- Proposal for mechanical interface
- Preliminary design of beamsplitter assembly in progress
- Test source built and tested

Future work and preliminary timeline

- Agree mechanical interface and complete preliminary design – 10 June 2003
- Complete detailed design – mid July 2003
- Manufacture and integrate beamsplitter assembly – end August 2003
- Test complete source in-house – mid September 2003
- Delivery to Astrium for fit check - TBD

Herschel

Instruments AIT Meeting

Siegmund Idler
28.05.2003

Instruments AIT Meeting - Introduction

Agenda (as per HP-ASED-FX-0440-03)

- Introduction
- Instrument requirements for PLM/spacecraft level testing (presented by instrument teams)
- Activity status of EGSE working group (presented by Otto Bauer)
- Cryo cover baseline concept / thermal environment
- Electrical integration test (test approach, IDAS)
- SFT, IMT/IST, SPT, TB/TV Test
- EMC Test
- AoB

Instruments AIT Meeting - Introduction

Documents

- Editorial deadline for HP-2-ASED-PL-0021, issue 2 is 06.06.2003. Document release within June.
- Inputs from instrument teams to PLM EQM level test procedures required by:

Title	Instrument Inputs required by	1st issue	Need date
Instrument Incoming Inspection Procedures	instr. del. - 2 months	instr. del. - 1 month	instr. del.
Instrument Hoisting and Handling Procedures	"	"	"
Instrument FPU Integration Procedures	"	"	"
Instrument Warm Units/LOU Integration Procedures	"	"	"
Instrument EGSE Setup and Verification Procedures	"	"	"
Instrument Electrical Integration Test Procedures	"	"	"
Instrument SFT Procedures	instr. del. + 1 month	instr. del. + 2 months	instr. del. + 3 months (start of test phase)
Instrument IMT/IST Procedures	"	"	"
Instrument SPT Procedures	"	"	"
Instrument EMC Test Procedures	"	"	"
Instrument SVT Procedures	"	"	"

- Inputs from instrument teams to database required 4 weeks prior to instrument delivery.

Instruments AIT Meeting - Instrument Requirements

Instrument requirements for PLM/spacecraft level testing

- See presentation of instrument teams

Instruments AIT Meeting - EGSE

Activity status of EGSE working group

- See presentation of Otto Bauer

Instruments AIT Meeting - Cryo Cover Baseline Concept

Requirement

- Allow on-ground testing under an environment which is as close as possible representative for in-orbit conditions.

Design

- Cryo cover which provides far infrared background radiation levels comparable to those induced by the telescope.

Instruments AIT Meeting - Cryo Cover Baseline Concept

Optical concept (1)

- PACS and SPIRE will view cold “plates” representing the Herschel Telescope.
- Level of thermal background radiation is dominated by the expected telescope radiation (temperature and emissivity).
- Problem: During on-ground testing straylight contributions from CVV environment could increase thermal background to levels above in-orbit conditions.
- Solution: Specific design of cold plates which perform self-imaging of instrument entrance holes, i. e.:
  - Cold plates consist of mirrors which are shaped such, that the instruments can only see their own cold entrance area. Other contributions of thermal radiation are highly suppressed.
  - Mirror temperature is 80 K (adjustable to in-orbit telescope temperature by control of LN2/LHe flow).
  - Mirror emissivity is 0.04 (corresponding to total telescope emissivity).

Instruments AIT Meeting - Cryo Cover Baseline Concept

Optical concept (2)

- Suitable mirror surface properties, i. e. $\varepsilon = 0.04$ will be selected via sample testing (samples with various surface finishes will be provided and their emissivity measured).

Instruments AIT Meeting - Cryo Cover Baseline Concept

principle:

SPIRE and PACS shall see inner experiment holes only (by specular reflection) when viewing the closed cryocover

realized by
spherical mirror for PACS
toroidal mirror for SPIRE

Instruments AIT Meeting - Thermal Environment

Thermal Environment (PFM)

	CVV	HTT	HOT	Cover	HS 2 Baffle	OB Plate (L2)	Remark
TMM Node						[376]	
Nominal Ground Tests	293 K	1.8 K	-	293 K	190 K	40 K	
TB/TV Step 1	(65-80) K (tbc)	1.7 K	-	80 K (tbc)	42 K (tbc)	10 K (tbc)	Active CVV cooling
TB/TV Step 2	(90-100) K	1.7 K	-	100 K (tbc)	-	-	
IMT/IST	293 K	1.8 K closed	4.2 K 100 mg/s	80 K	50 K	8-9 K	For limited duration
SPIRE Spectrom. Test (CVV rotated 90°)	293 K	1.8 K closed	closed	80 K			Transient warm-up
Orbit	68 K	1.65 K	-	open	42 K	9 K	

Instruments AIT Meeting - Thermal Environment

Predicted Instrument Interface Temperatures in [K] for IMT/IST

	PACS L0				**SPIRE L0**			**Hifi L0**	**Pacs L1**	**Spire L1**	**Hifi L1**	**OBP L2**	**Spire L3**
TMM Node	[723]	[721]	[761]	[762]	[814]	[815]	[816]	[949]	[814]	[814]	[939]	[376]	[814]
Mode 2 (PACS Photom. Mode)	1.92	1.86	1.88	1.95	2.01	1.83	1.82	2.04	6.6	6.5	4.7	7.8	8.0
Mode 4 (SPIRE Spectrom. Mode)	1.92	1.86	1.82	1.87	2.03	1.96	1.83	2.04	6.5	6.7	4.8	7.9	8.1
Mode 5 (HIFI on)	1.92	1.86	1.82	1.87	2.01	1.83	1.82	2.06	6.5	6.5	4.8	8.3	8.2

Uncertainties: +/- 0.05 K for L0, +/- 0.5 K (TBC) for L1/L2

PACS Blue Detector [723]

PACS Red Detector [721]

PACS Cooler Pump [761]

PACS Cooler Evaporator [762]

SPIRE SM Detector Enclosure [814]

SPIRE Cooler Pump HS [815]

SPIRE Cooler Evaporator [816]

Instruments AIT Meeting - Electrical Integration Test

Electrical integration test approach (1)

- Objective: Verification of warm units interconnections and of connections between FPU’s/LOU and warm units.
- Warm units interconnections:
  - Covered by warm units functional verification together with external (HIFI, SPIRE) or built-in (PACS) FPU simulators.
  - Warm units functional verification tests to be defined by instruments.
  - No dedicated interface measurements (already performed on instrument level with same interconnection harness).
- FPU's/LOU to warm units connections (via cryo harness):
  - Connection of cryo harness to warm units.
  - Warm units grounding, shielding and isolation verification via cryo harness with warm units off. FPU's/LOU are not connected to the cryo harness.
  - Warm units output signals verification via cryo harness with warm units powered. FPU's/LOU are not connected to the cryo harness.
  - Warm units output signals verification via cryo harness using T-adapters with warm units powered and connected to FPU/LOU simulators (TBC).
  - Connection of cryo harness to FPU's/LOU.

Electrical integration test approach (2)

- Measurements are performed versus the warm units only.
- Measurements of FPU output signals and measurements using T-adapters with connected FPU's are not planned, for safety reasons.
- Measurements are performed using the Integration Data Acquisition System (IDAS) and FPU/LOU simulators (HIFI, SPIRE).
- IDAS database is the EICD HP-2-ASED-IC-0001 which has been derived from the IID-B requirements. Same database is used for the cryo harness manufacturing.
- Signals to be checked and corresponding success criteria to be defined by the instruments.
- For all electrical integration tests the instruments (warm units) are controlled by the CCS (TBC).
- Note: Continuity check of integrated cryo harness will be done independently prior to the electrical integration test (with warm units and FPU's/LOU not connected).

IDAS Features

- See presentation of Andreas Grasl

Instruments AIT Meeting - SFT

SFT Approach

- Principle objective: Check of electrical integrity and operability (command and control) of the EPLM/spacecraft.
- Instrument related objectives: Instrument switch-on and functional verification of electrical instrument interfaces.
- Constraints:
  - No specific EPLM/spacecraft configuration/condition (e. g. cryostat orientation)
  - No specific instrument GSE.
  - Test duration in the range of 1 hour per instrument.
  - Test evaluation based on housekeeping data, i. e. no need of science data evaluation.
- Three different types of SFTs (tailored to tank temperature conditions):
  - SFT warm (tank without helium)
  - SFT cold He1 (tank with normal boiling helium)
  - SFT cold He2 (tank with supra fluid helium).

IMT/IST approach

- Principle objective: Verification of correct operation of the fully integrated EPLM/spacecraft in a series of representative mission modes.
- Instrument related objectives:
  - Verification of instruments functional performance.
  - Option: Verification of instruments measurement performance, as far as it is possible on EPLM/spacecraft level.
- Specific Constraints
  - EPLM/spacecraft tilting angles +20° to +y-direction (for PACS and SPIRE cooler recycles).
  - Nearly in-orbit representative thermal environment (by increased mass flow and specific cryo cover).
  - Option: EPLM/spacecraft tilting angles +90° to +y-direction (for SPIRE spectrometer mode).

Instruments AIT Meeting - IMT/IST

IMT/IST Flow						
Step	**HIFI**	**PACS**	**SPIRE**	**PLM Position**	**Duration**	**Remarks**
1	Off	Off	Off	No requirement	-	
2	SFT cold He2	Off	Off	No requirement	1 h	
3	IF Properties	Off	Off	No requirement	1 h	
4	Reduced Standing Wave Test	Off	Off	No requirement	1 day	TBC (SPT)
5	Off	Off	SFT cold He2	No requirement	6 h	
6	Off	Off	Cooler Recycle	20° to +y	3 h	
7			³He SFT	No requirement		
8	Off	Off	Ambient Background Verification test	No requirement	1 h	
9	Off	Off	Photometer Chopped Mode Test	No requirement	3 h	
10	Off	Off	Spectrometer Mode Test	90° to +y	3 h	Option
11	Off	Off	Photometer Operation	No requirement	3 h	
12	Off	Off	Switch between Spectrometer and Photometer mode	90° to +y	TBD	Option
13	Off	SFT cold He2	Standby	No requirement	TBD	
14	Off	PACS Cooler Recycle (TBC)	Standby	20° to +y	3 h	
15	Off	PACS/SPIRE Parallel Mode	PACS/SPIRE Parallel Mode	No requirement	TBD	
16	Off	Short Functional Test	Wait for Cooler Exhaustion	No requirement	TBD	
17		Wait for Cooler Exhaustion	Off	No requirement	TBD	
18	Off	AOT Tests	Off	No requirement	TBD	
19	Off	Off	Off	No requirement	-	

SPT approach (1)

- Objective: Verification of dedicated aspects of the instruments performance on EPLM/spacecraft level.
- Specific spacecraft configuration may be required.
- Tests are strongly based on instrument level tests in order to allow a quick and reliable performance assessment by comparing the EPLM level test results with the instrument level test results (no degradation with respect to instrument level test results, assuming that the environmental conditions are similar).

Instruments AIT Meeting - SPT

SPT approach (2)

- The following specific performance tests are defined:
  - HIFI
    - IF Properties Test
    - Radiometry Test
    - Reduced Standing Wave Test
  - PACS
    - Full Functional Test
    - Short Performance Test
    - Astronomical Observation Template (AOT) Tests
    - PACS/SPIRE Parallel Mode Test
  - SPIRE
    - Cooler Recycle
    - ^{3}He Short Functional Test
    - Photometer Chop Mode Test
    - Ambient Background Verification
    - Spectrometer Mode Test
    - PACS/SPIRE Parallel Mode Test

Instruments AIT Meeting - TB/TV Test

TB/TV test approach

- Instrument related objectives:
  - Instrument TMM validation.
  - Verification of functional performance of the instruments in nearly flight conditions (details TBD).
- TB/TV test is performed on satellite level only.
- Instruments tests comprise subset of IMT/IST and SPT procedures.
- Instrument tests will be carried out after temperature stabilisation in cold.
- During the TB/TV test all relevant instrument temperatures are continuously monitored.
- Verification of the PACS and SPIRE cooler hold time is possible.
- SPIRE spectrometer test inside LSS not feasible (requires 90° tilt).
- Cryo cover flushing is not foreseen.

Instruments AIT Meeting - TB/TV Test

TB/TV Test Flow

Step	HIFI	PACS	SPIRE	PLM Position	Duration	Remarks
1	Off	Off	Off	No requirement	-	
2	SFT cold He2	Off	Off	No requirement	1 h	
3	IF Properties	Off	Off	No requirement	1 h	
4	Radiometry	Off	Off	No requirement	1 day	TBC
5	Reduced Standing Wave Test	Off	Off	No requirement	1 day	
6	Off	Off	SFT cold He2	No requirement	6 h	
7	Off	Off	Cooler Recycle	20° to +y	40 h (1 full cooler cycle)	
8			³He SFT	No requirement		
9	Off	Off	TBD by SPIRE	No requirement		
10	Off	Off	Photometer Chopped Mode Test	No requirement		
11	Off	Off	Photometer Operation	No requirement		
12	Off	Off	Wait for Cooler Exhaustion	No requirement		
13	Off	SFT cold He2	Standby	No requirement		
14	Off	PACS Cooler Recycle (TBC)	Standby	20° to +y		
15	Off	PACS/SPIRE Parallel Mode	PACS/SPIRE Parallel Mode	No requirement		
16	Off	Short Functional Test	Wait for Cooler Exhaustion	No requirement		
17		Wait for Cooler Exhaustion	Off	No requirement	Remaining time for PACS full cooler cycle (< 40 h)	
18	Off	Off	Off	No requirement	-	

Instruments AIT Meeting - EMC Test

EMC test approach

- see separate presentation of C. Kalde

AIT meeting

28 May 2003, ASED, Ottobrunn

Willem Luinge

Space Research Organization Netherlands (SRON)

Status of HIFI DM ILT program (1)

- Experience with the ILT program is a prerequisite for a proper definition of the CQM and PFM test program at Astrium

- We started with ILT program with:
  - EGSE integration test (I/F SCOS station with test control, RTA, router and ICC (with HCSS software))
  - Integration of CDMS simulator
  - Integration of WBS-PT (with TEI interface)
  - Integration of ICU (can be used, still bugs after refurbishment)
  - Integration of FCU and (RT) MAC simulator
  - Electrical transient test
  - Implementation of test script for Short Functional Test: debugging phase

Status of HIFI DM ILT program (2)

- Next:
  - Integration of ‘FPU’ (MSA 2, CLO, IF1, IF2, beamsplitter);
  - RT (continuity) check (HK, IVC, heater, magnet current)
  - Cooldown of the MA cryostat
  - Short Functional test with this configuration and external H/C
  - Exercising tuning algorithm for mixer magnet current, WBS attenuators
  - Integration of LO (to be delivered 2 June), FT with tinuning etc.

- Open: continue with test program in MAC or FPU cryostat

- FPU cryostat has been modified and is now prepared for optical stabilty test of the FPU (including COA)

- RT beam measurements at 480 GHz of COA in progress

Test	Duration EQM (new estimate)	Duration PFM (new estimate)	Remarks
8.1.1 HIFI Incoming inspection	1 day		1: 3 h seems short for 10 units 2: a post shipment test of the shipped units may not be practical because of required unit or subsystem EGSE
8.2.1 HIFI EGSE Check out	1 h		Check out of EGSE is common for all 3 instruments, provided there is one Common EGSE system (TBC)
8.3.1 HIFI Electrical Interface Test	2 days		To be performed by Astrium (actually to be estimated by Astrium); includes cryo harness check with FPU simulator
8.4.1 HIFI Alignment Test	?		Astrium's responsibilty; procedure by Astrium 2 days seem too long if procedure is validated.
8.5.1 HIFI Short Functional Test Warm	1 h	2 h	
8.6.1 HIFI Short Functional Test Cold	1 h	2 h	To be added in test description: measure power on mixer for minimum and maximum LO power settings
8.7.1 HIFI Short Functional Test He2	1 h	2 h	To be added in test description: measure power on mixer for minimum and maximum LO power settings
8.8.1 HIFI IF properties	1 h	2 h	3 bias settings per mixer
8.8.2 HIFI Receiver Tuning	0 h	0 h	Can be deleted: the test is split up between SFT and Radiometry Tests
8.8.3 HIFI Radiometry	1 day (TBC)	2 days (TBC)	a LO power scan is added (minimum to maximum power) at each frequency setting. It is input for the calibration table for the tuning procedure
8.8.4 HIFI Recuced Standing Wave Test	1 day	2 days (TBC)	Delete "Verification ... level" from the Success Criteria Objectives: add "from spectra"
8.9.1 HIFI Integrated Module Test	TBD days		It is the sum of the durations of SFT's and SPT's. Probaly a stabilty test has to be added.
8.10 HIFI EMC Test	1 day (TBC)	2 days (TBC)	

CQM integration at Astrium (1)

- First delivery: FPU, FCU and ‘SCOE – EGSE’, FPU simulator
- Incoming inspection (paper work)
- RT continuity check of FPU with FCU and SCOE (no connectors in container); check shipment: HIFI

  Note: handling procedure
- RT continuity check of Herschel harness with FPU simulator, FCU and SCOE: ASED
- Install FPU on optical bench (alignment, straps, harness hook up (procedure from HIFI)
- RT check FPU
- …….
- Second: LOU delivery
- RT check with LCU/LSU/unit S/S eqt (TBC; HIFI; purging; LOU sim: open)
- FPU/LOU alignment (ASED); before cooldown
- …
- Third delivery: panels with warm units (TBC)
- RT check WU’s
- …

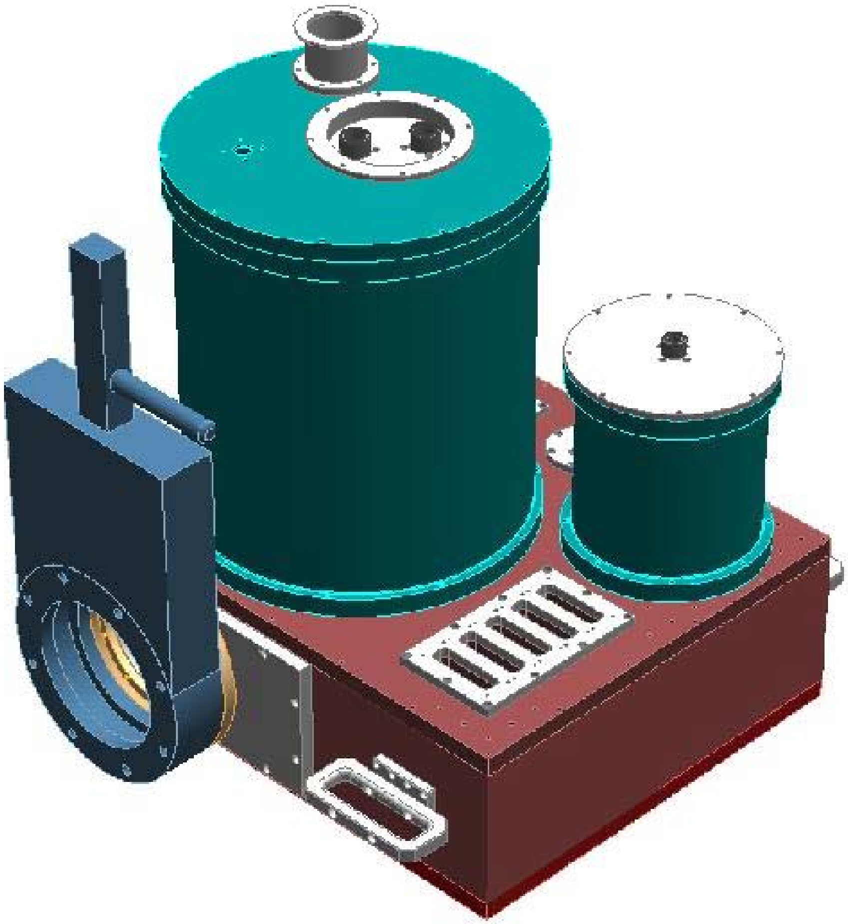
CQM integration at Astrium (2)

- Connection to FPU cryo connectors, incl. IF connectors (procedure)
- Connection to LOU (procedure)
- Connection to LSU (procedure)
- Connection of wave guides (LOU requirements?)
- LO check

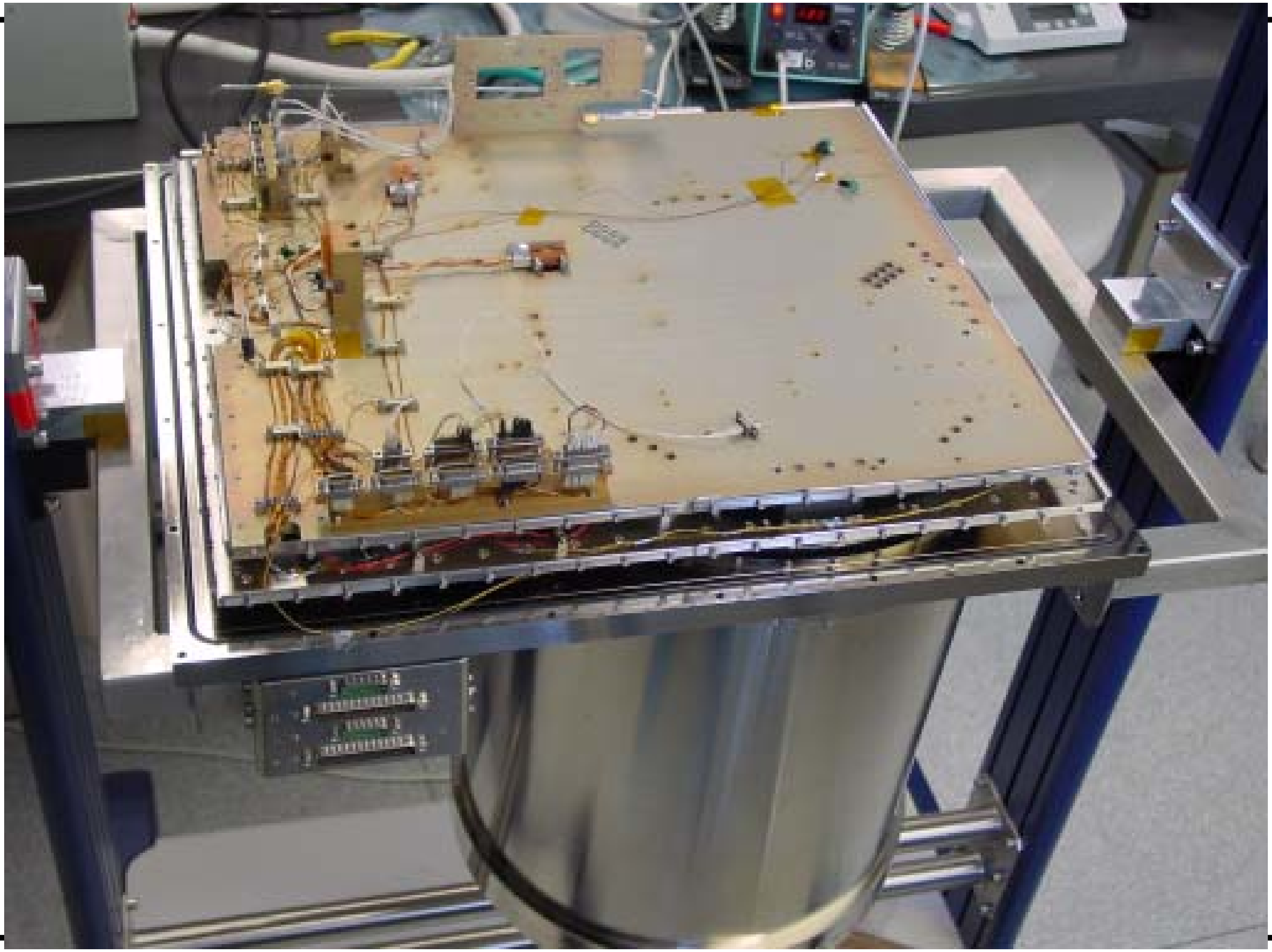
Tests on CQM at Astrium

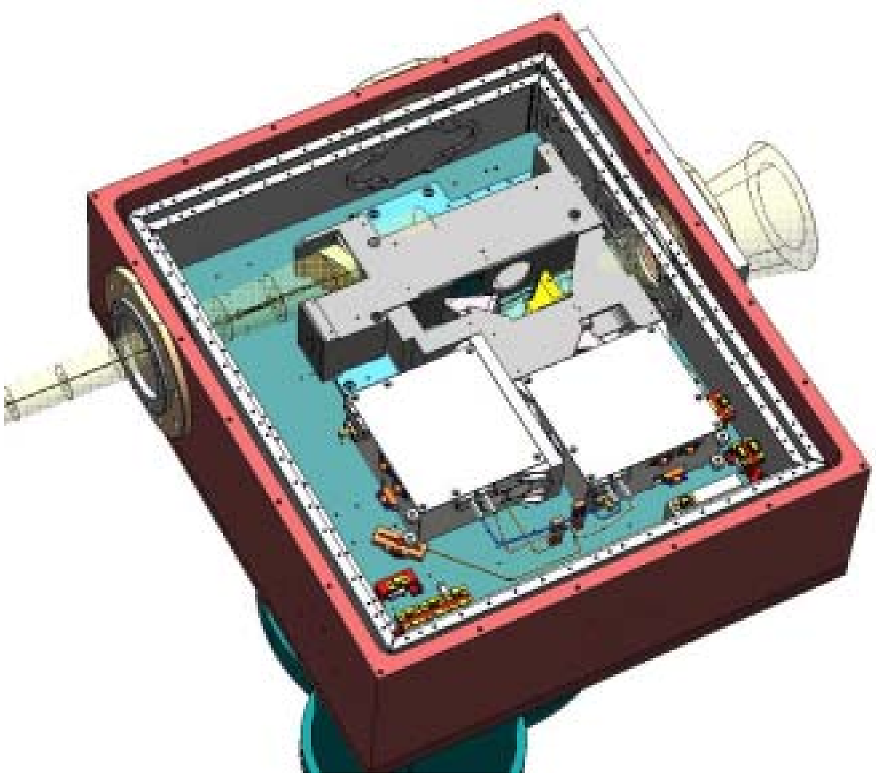
- According to AIT plan; test scripts to be validated
- No external stimulators, except for line source during EMC tests
- Aim: supply ASED with testscripts and evaluate results in Groningen

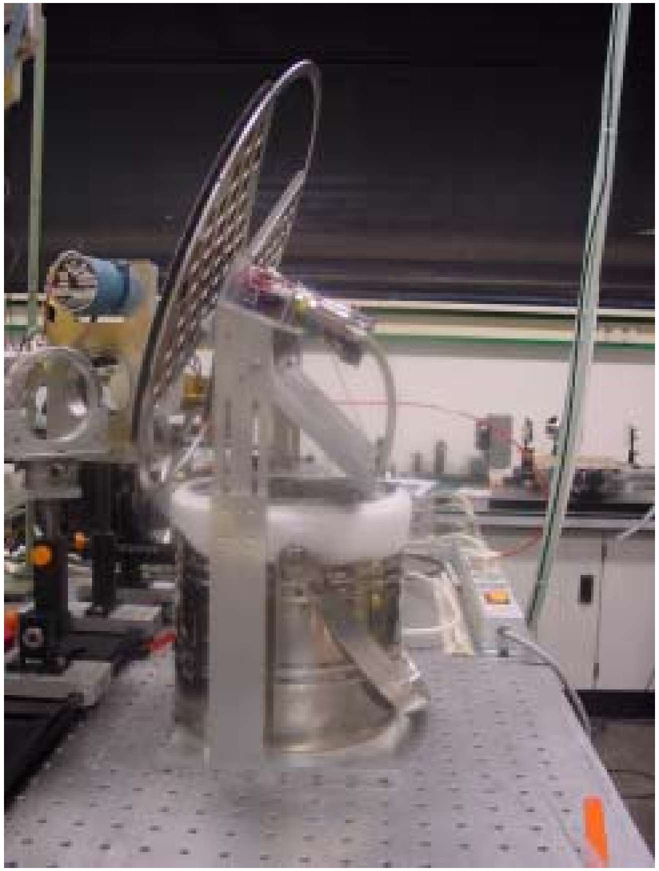
MA tests

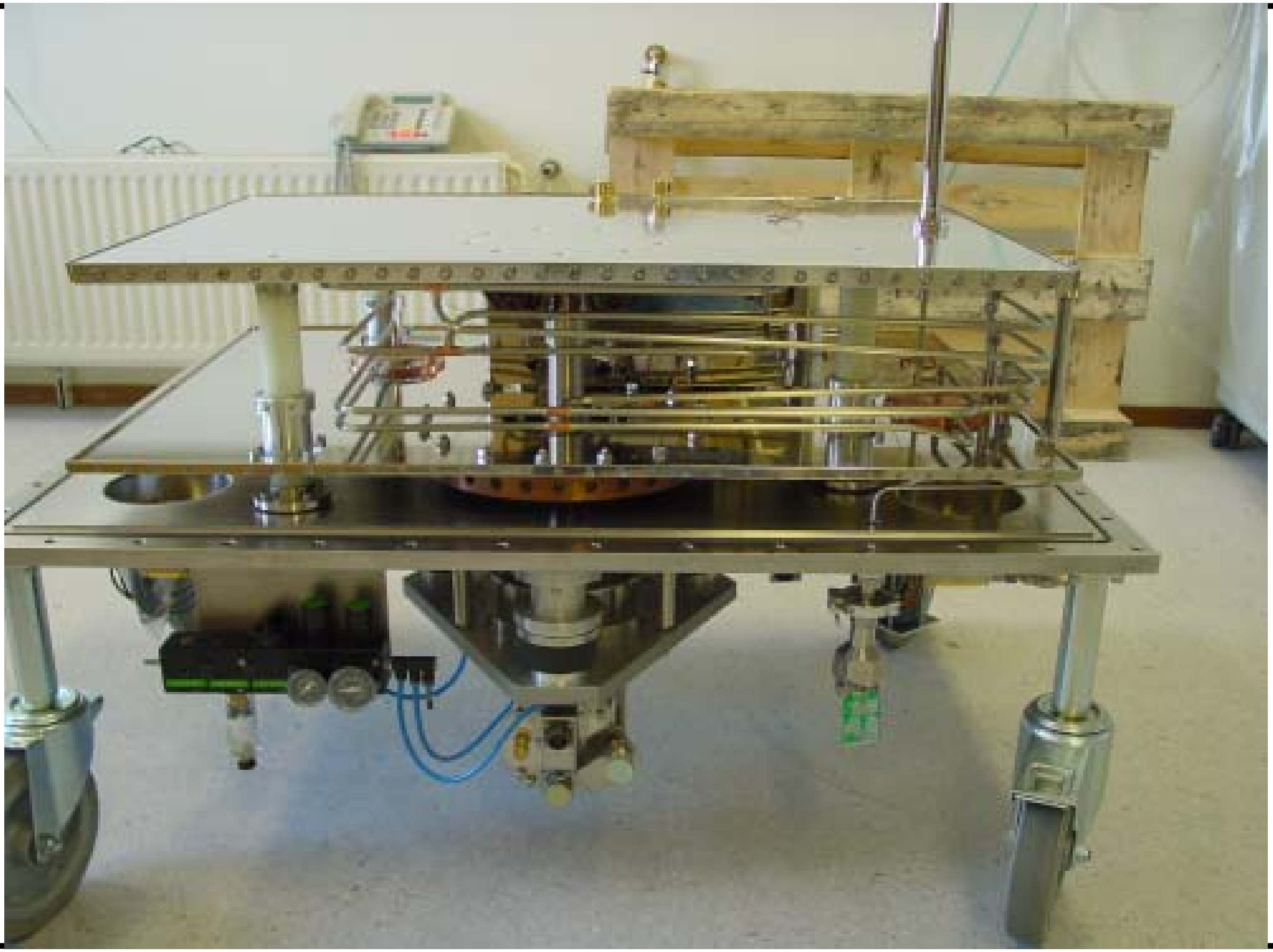


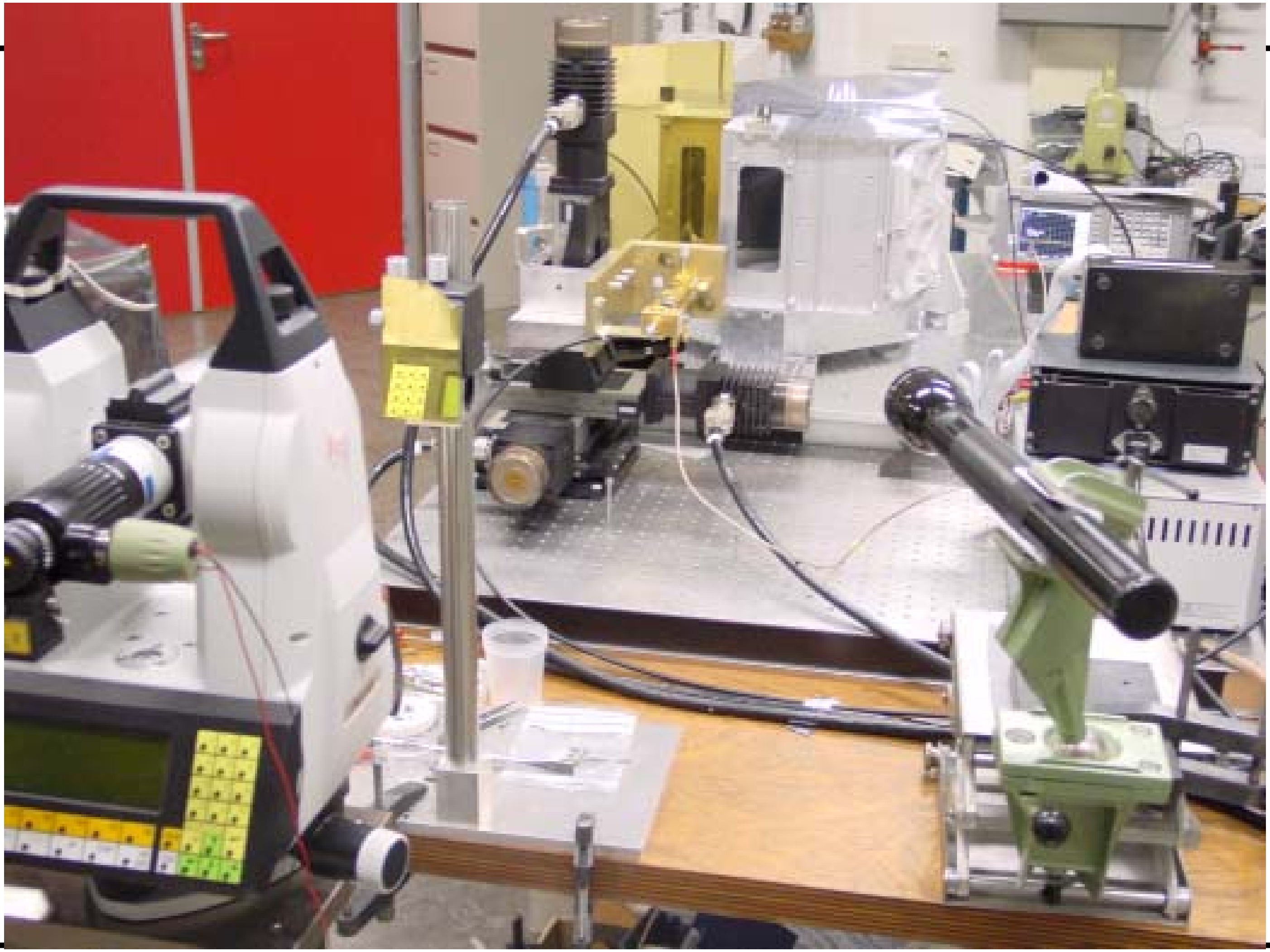
- FCU
- ICU
- EGSE
- CDMS sim
- (PD sim)
- Testcontrol
- Archiving
- Tuning
- QLA
- LOU + LCU (no AD)
- LSU sim
- WBS PT
- Funtional Test (reduced: ext. H/C)
- IF test

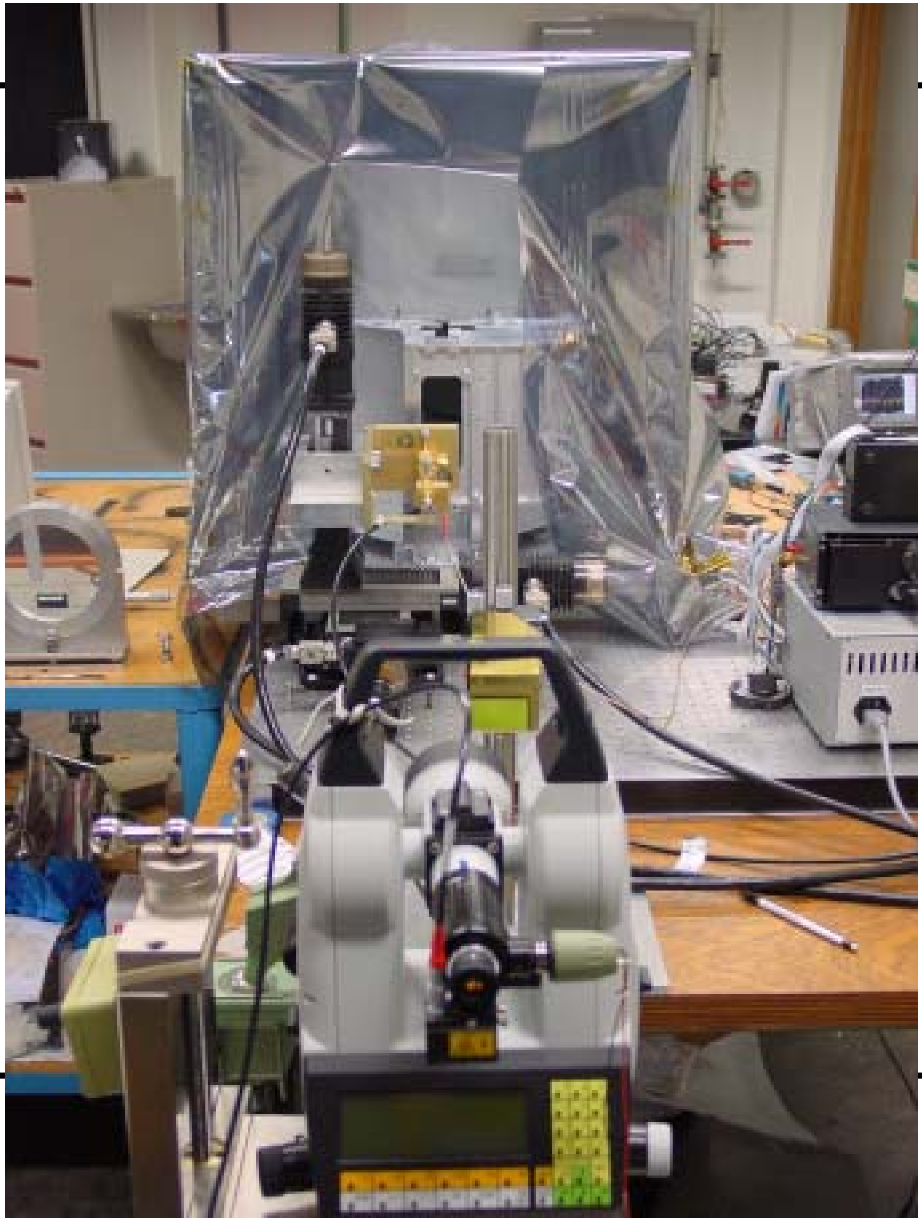






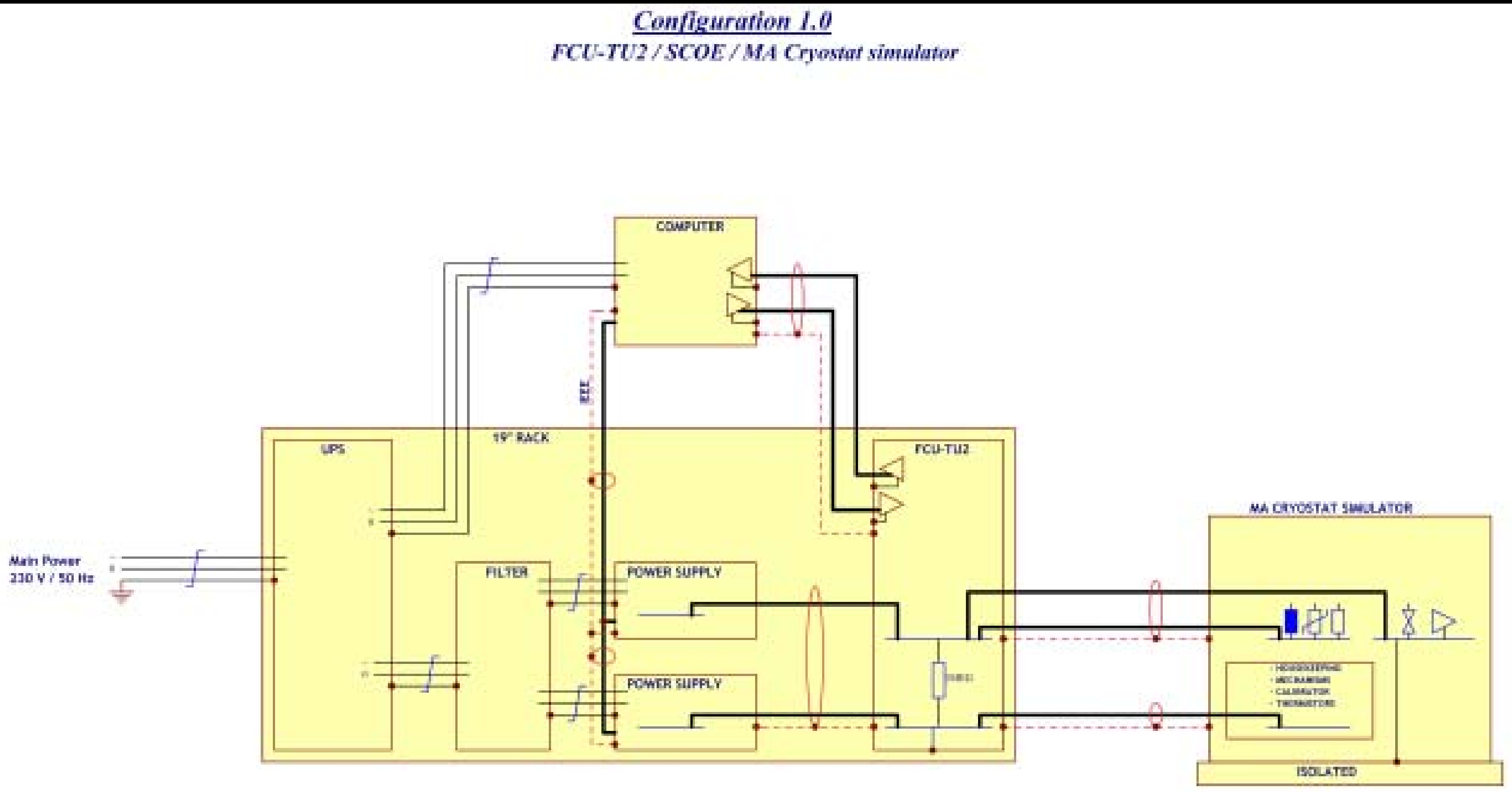




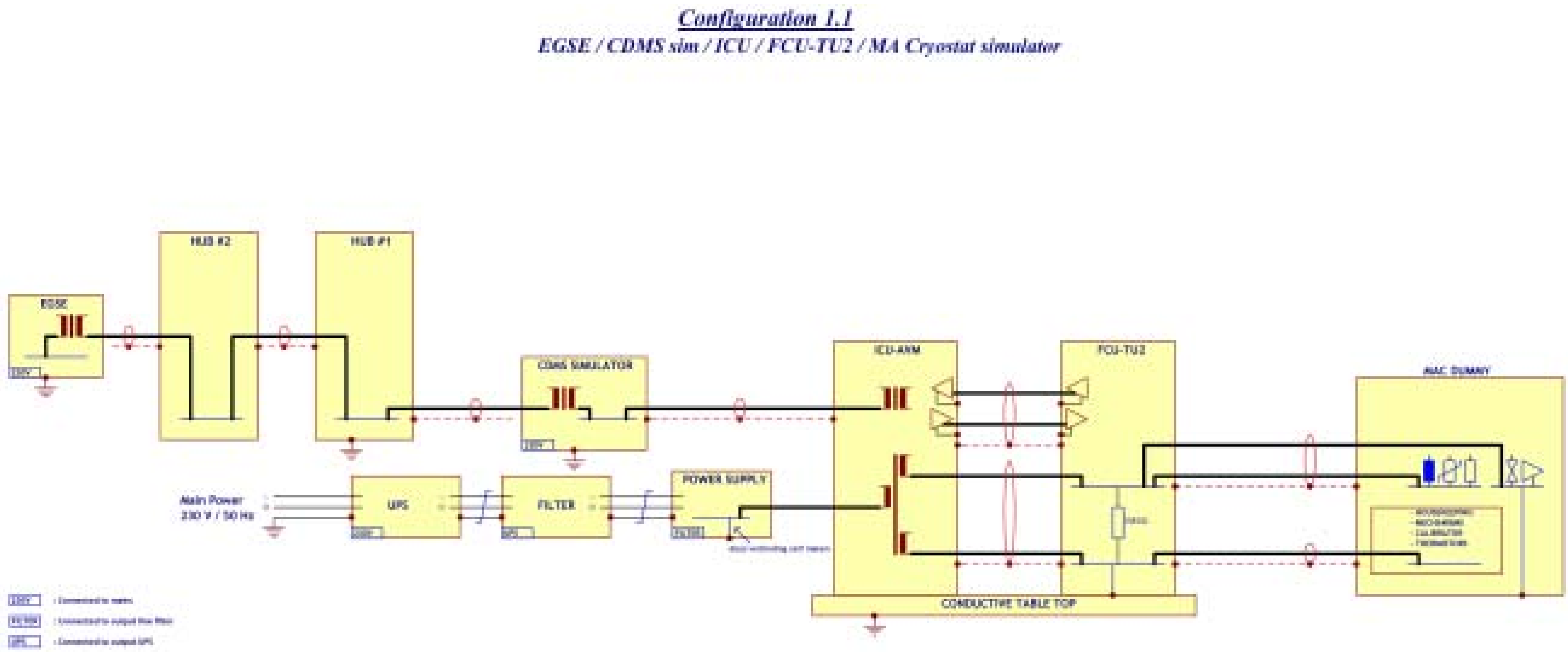


Safety (electrical integration tests)

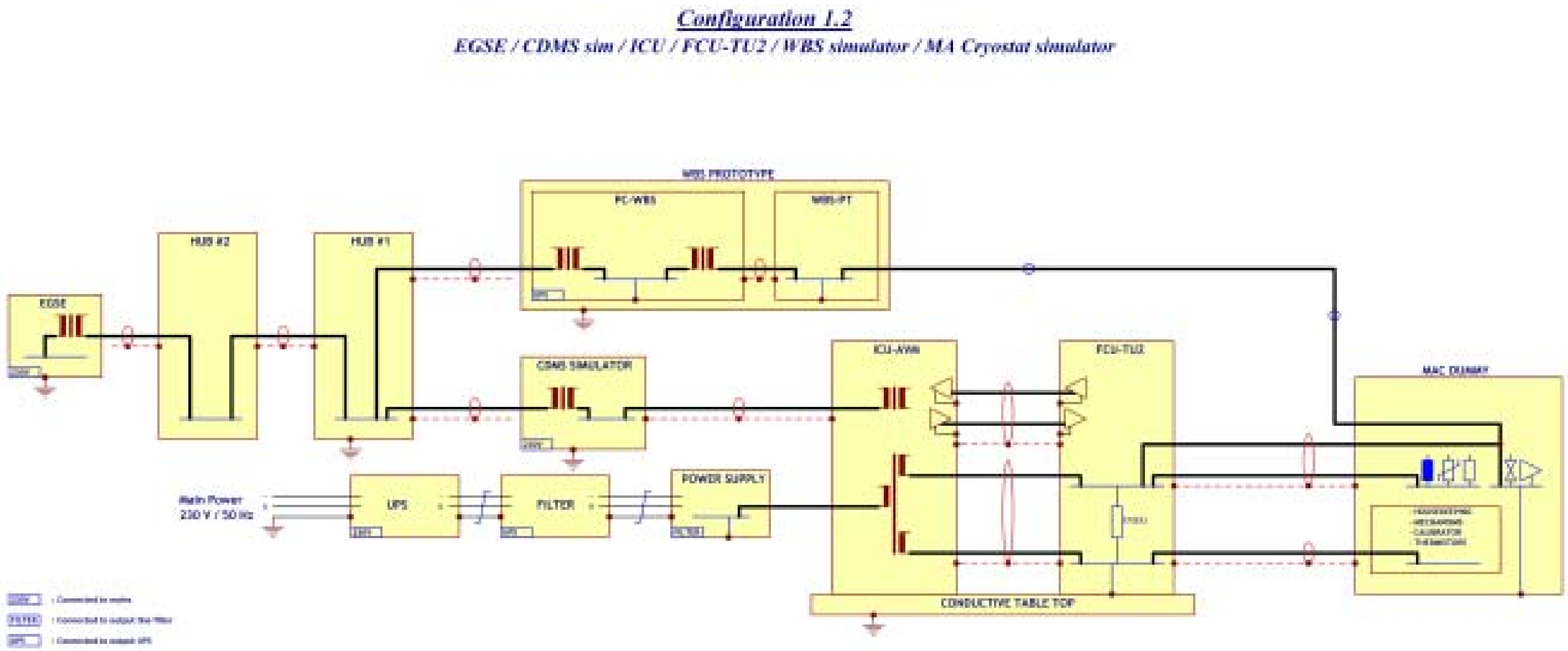
- I.e. safety of subsystems (units)
- from Test Readiness Review: grounding and shielding plans are insufficient
- ESD plan is insufficient
- Make sure that no tested subsystem is lost by electrical environment (transients, magnetic fields):
- Mixer Assembly Crostat simulator in place to check the effect of external electrical transients and to measure the common mode effect (signal injection in shield)
- Stimulators: borrowed piece of eqt to generate transients on mains (not far from CE standard?), pumps, heat Gunn, soldering iron, compressor cold head
- Additional, similar test for LOU?
- Applicable to ‘all’ configuration (Mixer assembly crostat, FPU cryostat, ..)
- Check every new configuration
- One person for electrical integration



Configuration 1.0: FCU-TU2, SCOE (Special checkout equipment) to control the FCUand MA Cryostat simulator

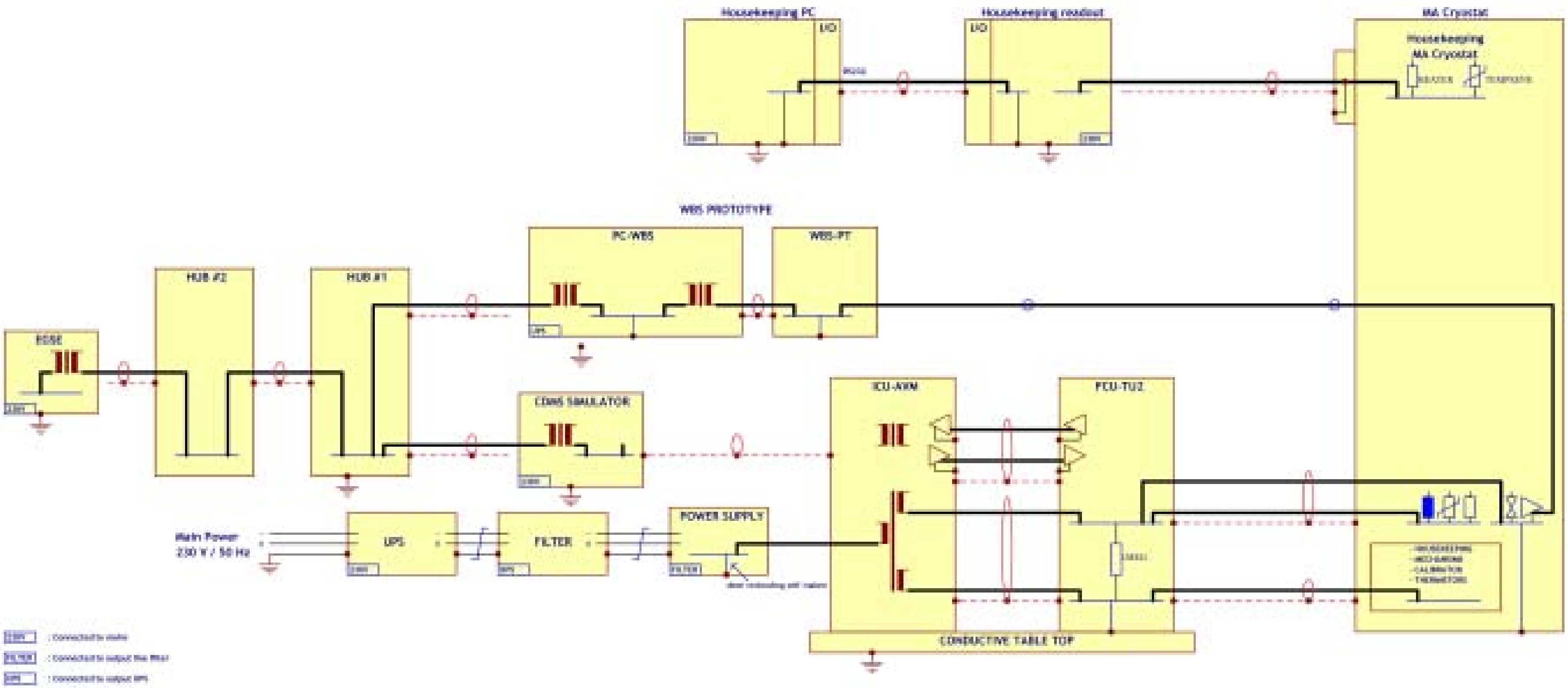


Configuration 1.1: FCU-TU2, ICU-AVM, PDU simulator or Delta power supply, CDMS simulator,EGSE and MA Cryostat simulator



Configuration 1.2: FCU-TU2, ICU-AVM, PDU simulator or in first instance Delta power supply, CDMS simulator, EGSE, WBS prototype, MA Cryostat simulator

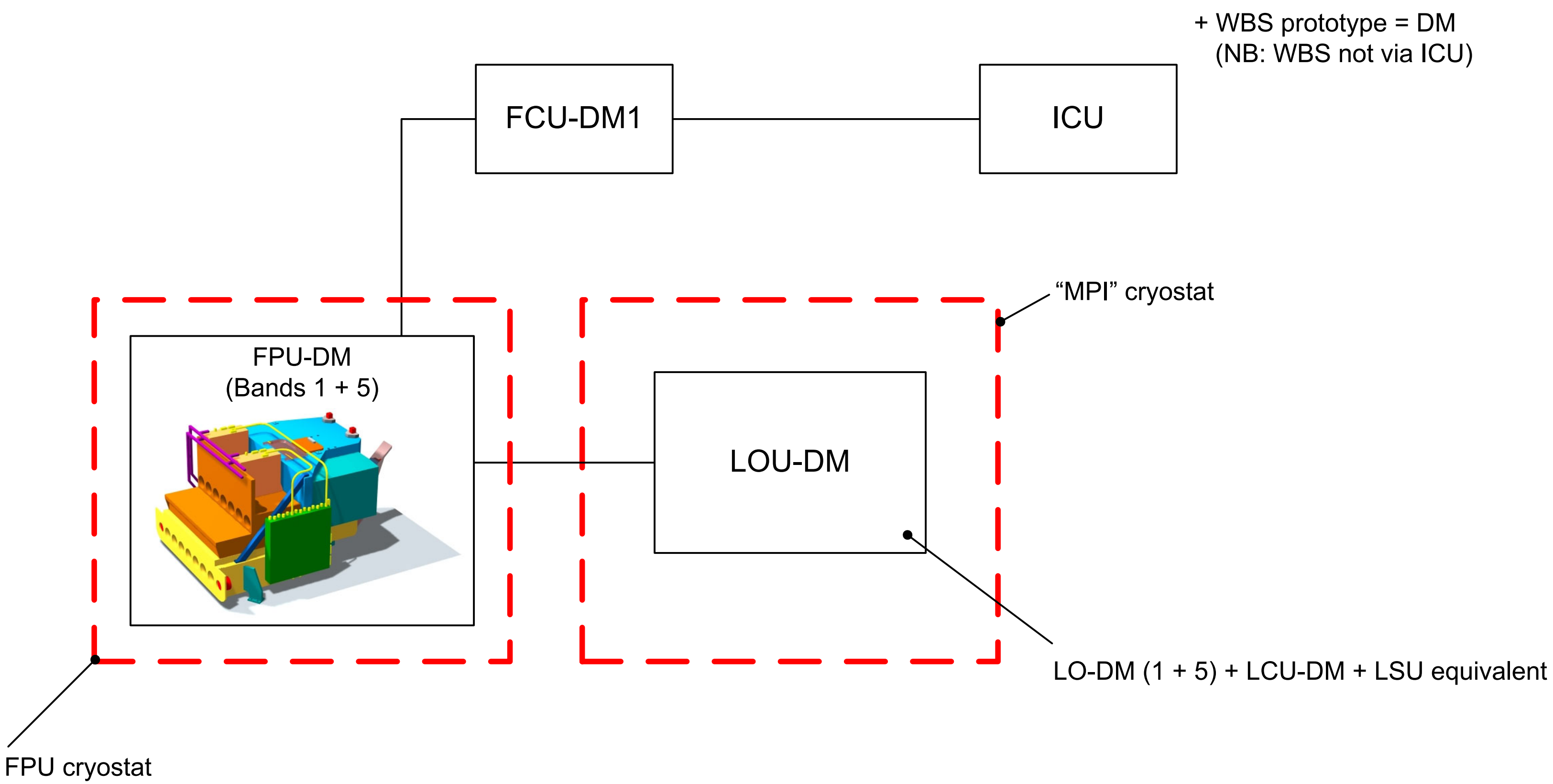
Configuration 2.0



Configuration 2.0: FCU-TU2, ICU-AVM, PDU simulator, CDMS simulator, EGSE, BWO, WBS prototype, MA-Cryostat

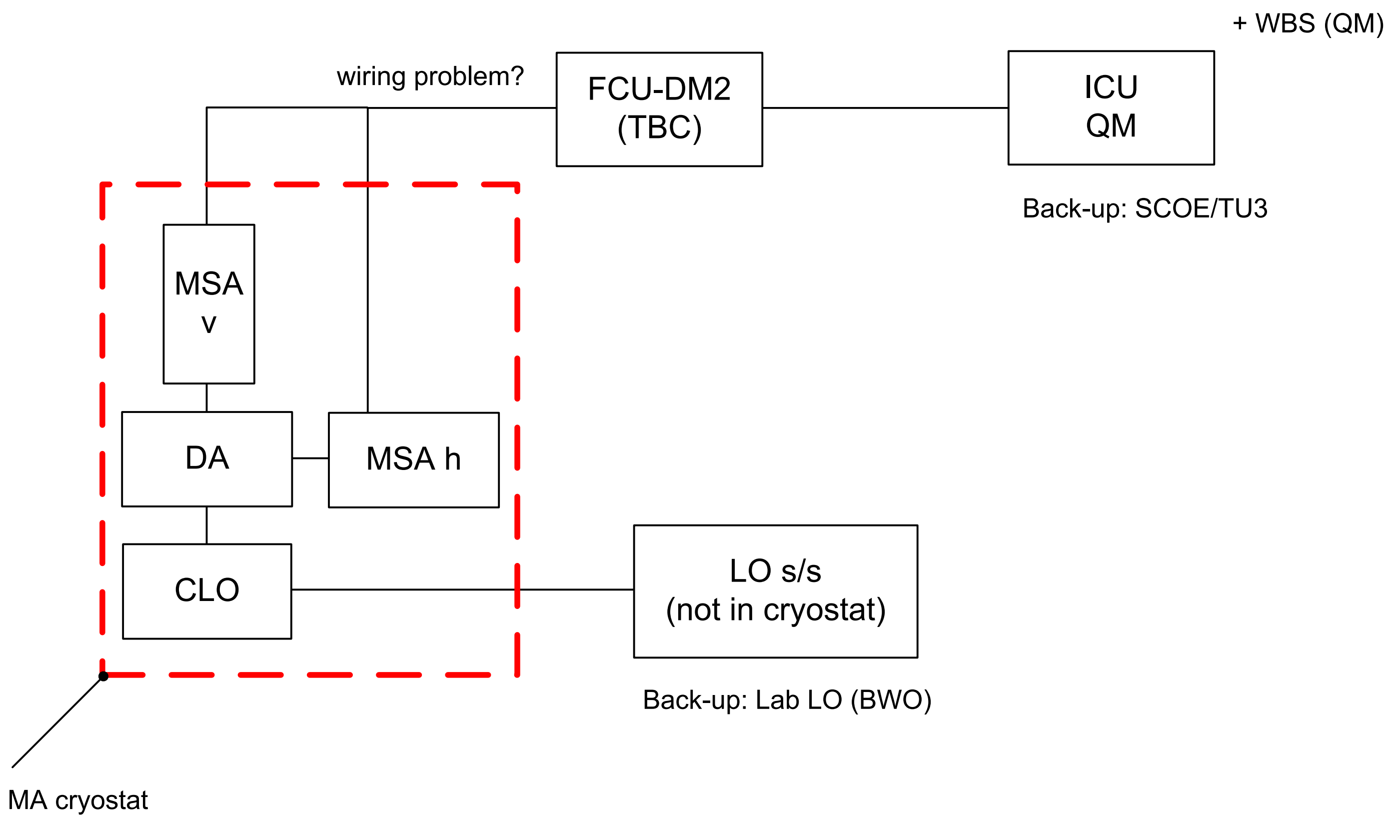
MAC configurations

- Configuration 3.0: FCU-TU2, ICU-AVM, PDU simulator, CDMS simulator, EGSE, BWO, Hot/cold chopper, WBS prototype, MA Cryostat
- Configuration 4.0: FCU-TU2, ICU-AVM, PDU simulator, CDMS simulator, EGSE, LOU Cryostat (instead of BWO), Hot/cold chopper, WBS prototype, MA Cryostat



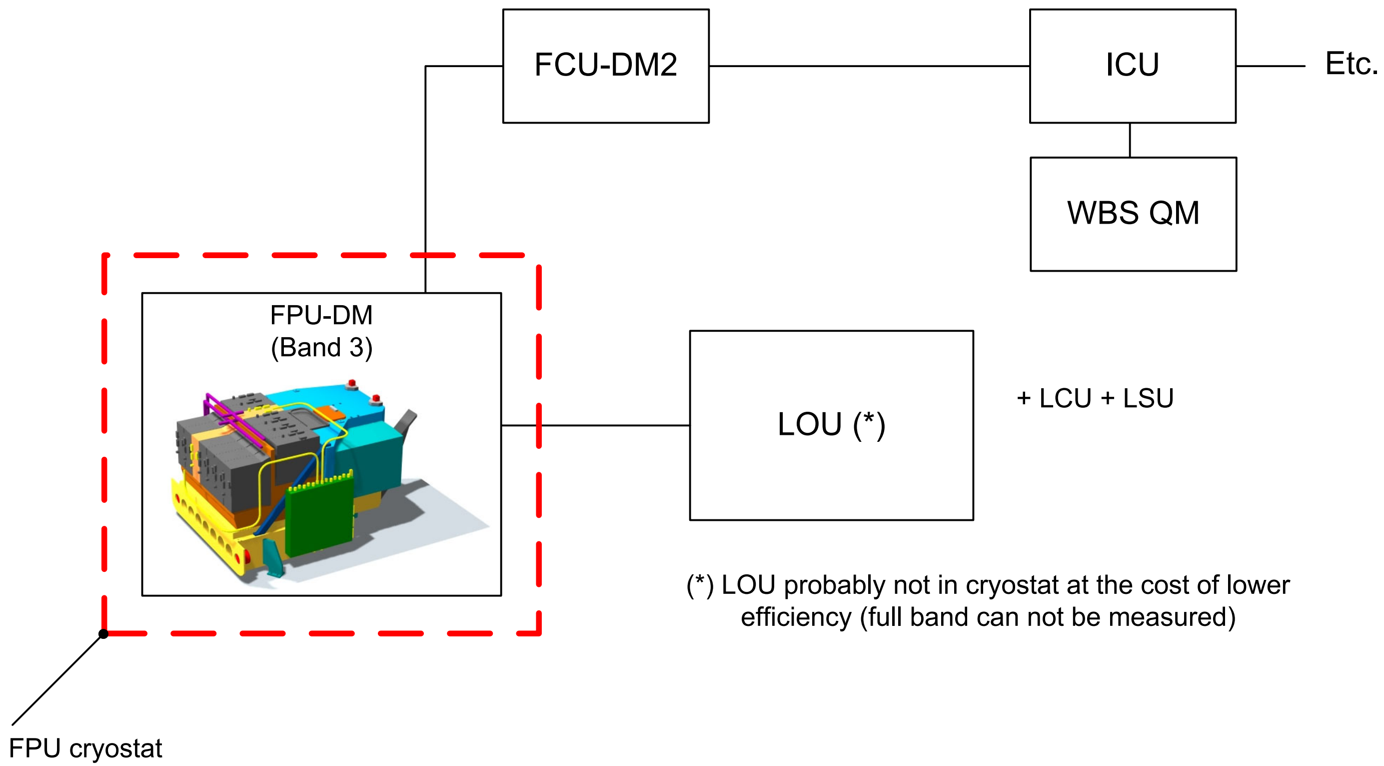
FPU/Instrument tests

DM configuration



FPU/Instrument tests

QM-MAC configuration



FPU/Instrument tests

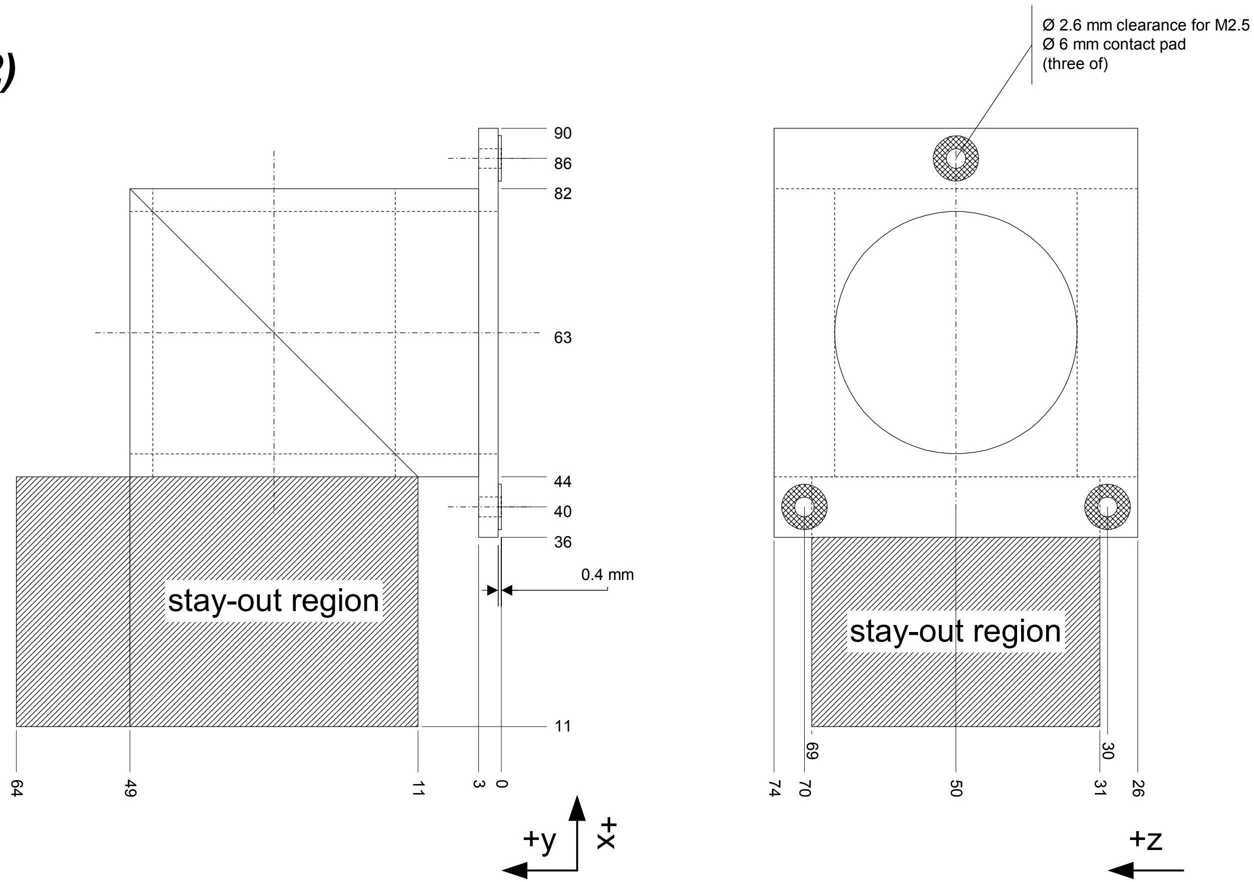
QM- FPU cryostat configuration

HIFI LO EGSE for EMC test at EQM

Interfaces

- For HIFI EMC test – line source for verifying LO signal purity during CS & RS tests
- Comprises test source and beamsplitter for injecting signal into LO window of cryostat
- Single source (only band 3)
- Alignment not critical
    - Δx, Δz < 2 mm; Δy < 200 mm
    - $\Delta\Theta x$, $\Delta\Theta z$ < 1 degrees; $\Delta\Theta y$ < 5 degrees
- Mechanical interface to CVV side of CVV LOU support plate (see drawing)
- Driven by microwave (laboratory) synthesizer via coax cable (length < ~5 m)
- No other electrical interface
- Room temperature operation (0 – 40 C), < 15 mW dissipation
- Cannot be shaken!

Interfaces (2)



HIFI EQM test signal source - 20030530, ND Whyborn

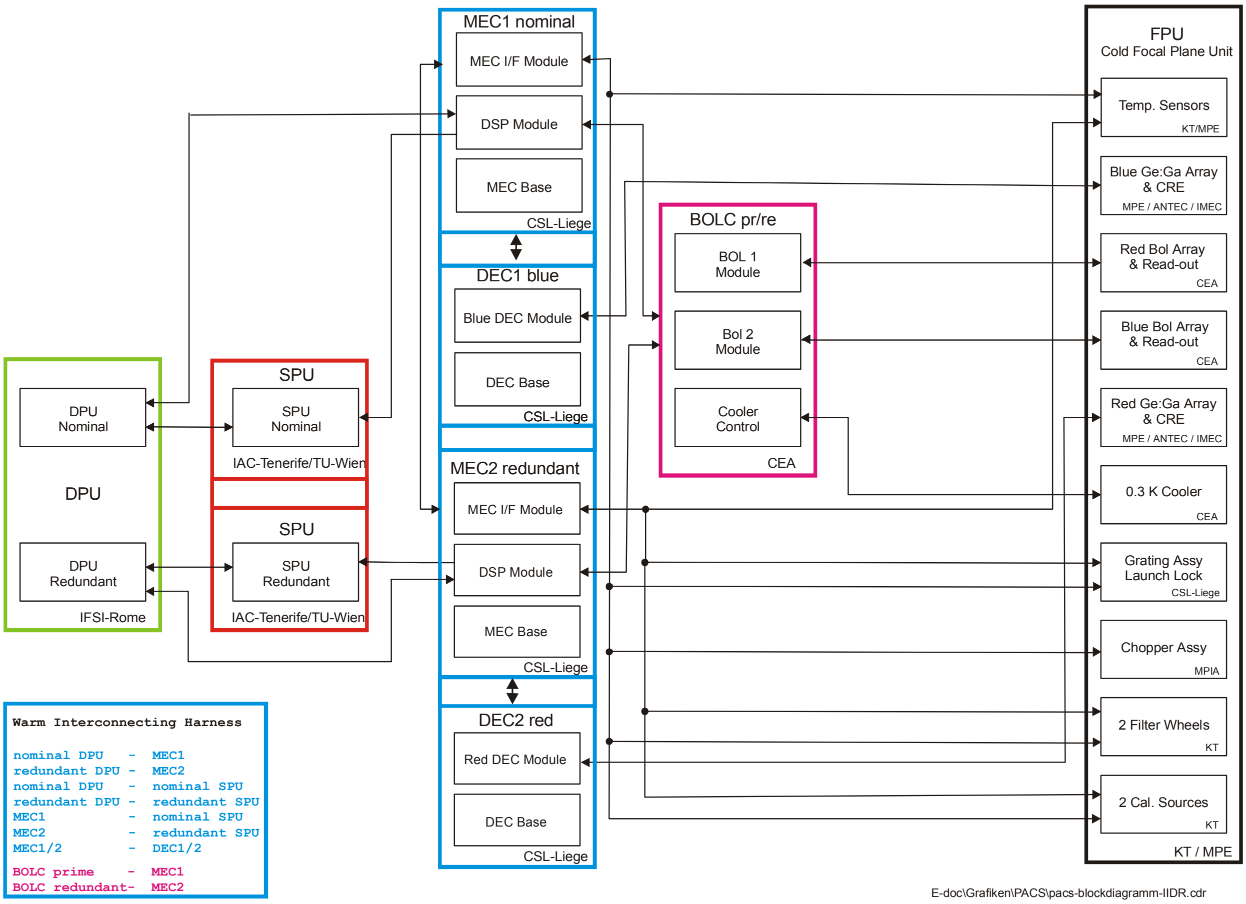
Notes
1) The test source is aligned with HIFI LO window #3.
2) The indicated x and z coordinates are referenced to the telescope nominal focus position (see HIFI IID-B Section 5.8.2.2).
3) The indicated y coordinates have an arbitrary offset with respect to the focus position.
4) The "stay-out region" will contain the actual microwave harmonic generator.
5) The position of the SMA coax input connector is TBD but will be on the +y or -z face of the "stay-out region".

Status

- Proposal for mechanical interface
- Preliminary design of beamsplitter assembly in progress
- Test source built and tested

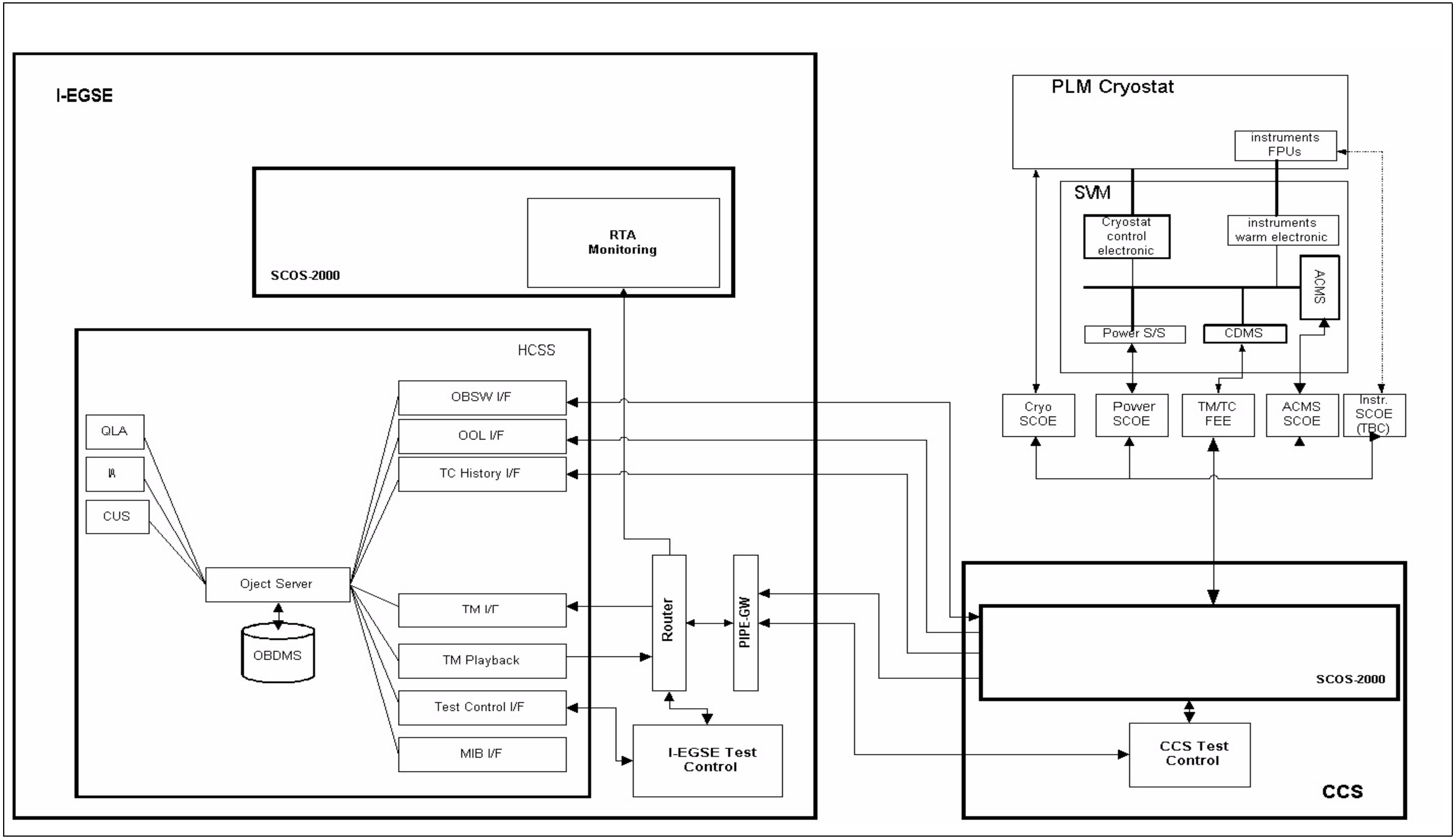
Future work and preliminary timeline

- Agree mechanical interface and complete preliminary design – 10 June 2003
- Complete detailed design – mid July 2003
- Manufacture and integrate beamsplitter assembly – end August 2003
- Test complete source in-house – mid September 2003
- Delivery to Astrium for fit check - TBD



PACS Instrument Block Diagram

Table 1: HGS IST



Introduction

The purpose of this document is to compile all requirements on PACS calibration and, on a high level, the corresponding implementation and analysis procedures in a central file. While the document is the master plan for the in-flight calibration, it addresses also ground-based related issues in order to achieve a complete calibration scheme of the instrument. Therefore, it is also an applicable document for ground tests, beside other relevant documentation like the "PACS Test Plan" (PACS-ME-PL-012). This shall ensure that all necessary prerequisites for in-flight calibration are met, by identifying all calibration activities that can only be done on ground. Furthermore, it will help checking out and optimizing in-flight procedures to some degree already on ground.

The document will also provide an overview on resources, both with regard to implementation efforts as well as observing time estimates per requirement. The assessment of calibration needs and their frequency will provide feedback to AOT and Logic design. The outline of the calibration analysis will provide feedback to the IA design.

The major part of the document is organized in the form of requirements which make up individual subsections. As a long term goal a general calibration philosophy shall be developed out of this document. This includes the identification of priorities and cross-links between individual requirements. Each requirement comprises the following items:

- Label & Title
- Objective
- Fulfilling or fulfilled by (identify cross links)
- Priority (3 classes)
  - A: core part of calibration system
  - B: necessary to achieve required accuracy
  - C: extension of instrument knowledge
- When performed / frequency (including ground tests)
- Required accuracy (driver for CIP design)
- Inputs, prerequisites
- Sources
- Calibration Implementation Procedure (high level only)
- Estimated time needed (from CIP)
- Calibration Analysis Procedure (high level only)
- Output, products
- Status / Version (some configuration control, in addition use of Concurrent Version System (CVS))

The requirements are grouped according to the following scheme:

1) Detector Systems
   - Bolometer Array Cameras
   - Photoconductor Array Cameras
2) Optical Components

- Filters
- Grating
- Chopper
- Imaging Optics
- Internal Reference Sources
- Telescope Pointing Quality

3) Full System Calibration Photometer
4) Full System Calibration Spectrometer
5) Optimized Observing Strategies for AOTs and Scientific Validation of AOTs
6) Cross-Calibration
7) Telescope
8) Space Weather effects
9) Interferences

Group 1) & 2) requirements cover those requirements where module level calibration makes up an essential contribution. These requirements are also driven by inputs needed for AOT logic, time estimator and Observer's Manual. Group 3) & 4) requirements cover the core inflight calibration. Due to their special nature, some requirements are put into separate sections. It is not the task of the PACS team to calibrate the Herschel telescope, on the other hand, detailed information on the telescope system, which has to come from other parties, is needed for the calibration of the PACS instrument. Therefore, from the PACS team side requirements concerning information on the telescope will be put into this section. The section Space Weather effects covers trends due to this factor, the section interferences is not an outline of EMC-type tests, but addressess calibration issues in case certain interferences should occur or remain in space.

Test articles in CQM ILT program

("Blue" means range of parameter settings reduced or test modified)

- F1.1 FPU integration with test cryostat and OGSE3, alignment
- F1.2 Electrical continuity check
- F1.3 Functional test exercising all mechanisms, temperature sensors, sources and detector array read-outs
- F1.4 Cool down to LHe
- F1.5 Functional test exercising all mechanisms, temperature sensors, sources and detector array read-out
- Q2.1 FPU Thermal behaviour
- Q2.2 Focus definition
- Q2.3 Relative alignment check spectrometer vs. photometer arrays after vibration respectively thermal cycling
- Q2.4 sensitivity
- Q2.5 spatial performance
- Q2.6 spectral performance
- E1.1 Instrument EMC tests
- C3.1 Absolute flux calibration, linearity
- C3.2 Flat field
- C3.3 Point spread function
- C3.4 Distortion, grating alignment
- C3.5 Relative Spectral Response Funct.
- C3.6 Wavelength-calibration using TUFIR replaced by vapour absorption cell
- C3.7 Instrumental profile (grating) measured with TUFIR replaced (however, some initial profile information from absorption line measurements are planned.
- C3.8 Ghosts (search for spectral ghosts) TUFIR only, maybe Ge laser?
- (C3.9) Stray light (ghosts) with Ge laser?
- C3.10 Detector time response, stability
- (C3.11) Definition of PACS pass bands with TUFIR (not possible with Ge laser)
- (C3.12) AOT try out

TEST-PROCEDURES

ILT Test Procedures
====================

Responsibility: Roland Vavrek

SFT and Performance Tests
==

Verify function of PACS Chopper
Performance test of PACS Chopper and synchronous operation with detectors
(incl. reproducibility aspects)
Characterize chopper position vs. PACS field of view (incl. max-min positions)
Verify function of internal calibration sources
Performance test of PACS internal calibration sources
Verify function of Ge:Ga detectors, CREs, detector heaters

==

Calibration:
==

Requirements from PCD, PACS-MA-GS-001, draft 2, 18-Feb-2002

1.2.1 Optimum detector bias settings
1.2.2 Optimum detector temperature settings
1.2.3 Dynamic range per selected integration capacitor
1.2.4 CRE check-out voltage
1.2.5 Signal-to-noise dependence on number of non-destructive read-outs per ramp
1.2.6 Detector dark current
1.2.8 Signal dependence on chopper frequency
1.2.11 Linearity of CRE readout
1.2.15 Time constant: switch-on spectrometer
1.2.16 Time constant: Bias change, spectrometer
1.2.17 Time constant: flux changes, spectrometer

2.3.1 Angular Calibration of the Focal Plane Chopper
2.3.2 Duty cycle of waveforms
2.3.3 Optimal Positioning of Chopper on Internal Reference Sources

2.5.1 Stability of PACS calibration sources
2.5.2 Homogeneity of PACS calibration sources over detector field-of-view
2.5.3 Time constants: heat-up and cool down times of PACS calibration sources

==

ILT Test Procedures
==

Responsibility: Pierre Royer

SFT and Performance Tests
==

Verify function of filter wheels
Characterize impact on detector signal during filter wheel operation
Verify function of grating (incl. launch lock)
Performance test of PACS grating and synchronous operation with detector readouts
and in combination with chopper (incl. reproducibility aspects)
Quick check of PACS spectrometer

==

Calibration:
==

Requirements from PCD, PACS-MA-GS-001, draft 2, 18-Feb-2002

2.2.1 Grating efficiency spectrometer

4.1.1 Spectrometer Central Pointing Position and Grating Alignment
4.1.2 Spectrometer Field of View Distortion
4.1.3 Spectrometer Point Spread Function
4.1.4 Spectrometer ghosts
4.1.5 Spectrometer stray-light
4.3.1 Absolute flux calibration internal sources, spectrometer
4.3.2 Flux reproducibility internal sources, spectrometer
4.3.3 Absolute flux calibration external sources, spectrometer

Test 0.7.7_01 Verify function of filter wheels

Objectives

Check that the filter wheel fulfils its requirement specifications.

Requirements exist on :

- Minimum number of positions (4)
- Rotation angle (360°)
- Precision on stop position (< 10 arcmin)
- Transition time (< 5 seconds for any position change)

Heat dissipation is supposed to have been tested on component level and its consequences will be assessed in the test relative to impact of filter wheel operation on the data.

The filters are assumed to be in their positions during the tests. The fact that the empty positions will be openened or blocked during the tests is not yet fixed. Nevertheless, should they be blocked, the blocking material wouldn't present any deviation from the rest of the filter wheel (RK).

The filters are FBBP1 and FBBP2 for photometry and FBBS1 and FBBS2 for spectroscopy. For the sake of uniformity, we will call them F1 and F2 in this Test Description.

The wheels are supposed to turn in one single direction.
For the sake of simplicity, we will label the 4 possible stop positions 1 (=F1) - 2 - 3 (=F2) - 4.

The test is splitted in three :

0.7.7_01 trust the HK on filter wheel position, just check that it's values are those expected. This will allow to check the functionality of the filter wheel as well as to characterise the transition times between any two positions. If the position sensors and the corresponding HK are accurate enough, this could also characterise the precision on the stop position of the filter wheels.

0.7.7_02 observe calibration sources and check that the HK describes the actual position of the filters for the photometric wheel.

0.7.7_03 observe calibration sources and check that the HK describes the actual position of the filters for the spectroscopic wheel. The test description is extremely close to the one of 0.7.7_02, but the commanding will differ substantially, hence prompting to decouple both sub-tests.

This document refers to Test 0.7.7_01 only.

Priority

A

When performed / frequency

Applicability of the Test :
CQM-ILT
PFM-ILT
EQM-IST
PFM-IST

Inputs, prerequisites

Null.

Interconnections

Standalone

A. Fulfilled By

B. Fulfilling

OGSE Setup, astr. sources, OBSW Compr./Red.

No optical source needed, since this test is HK-based only.

Test Implementation Procedure (TIP)

Command filter wheel to positions 1-4-3-2-3-4-1-3-1 (i.e. steps of 3/4, 1/4 and 1/2 turn). Send a command every 10 seconds (max transition time requirement = 5 sec).

Repeat the sequence 5 times for each filter wheel, in order to assess the reproducibility of the transition time determination.

Estimated time needed

≤ 15 minutes per filter wheel.

Success criteria, required accuracy

Actual position becomes equal to set point in $\leq 5sec$.

Average difference between actual stop position and set point ≤ 10 arcmin (possibility to determine this is TBD).

Test Analysis Procedure (TAP)

A good precision on transition time measurements requires diagnostic HK, to be delivered at a high rate (e.g. 100 Hz) for the 5 HK parameters available for each wheel.

The analysis requires a way to convert the engineering values for positions to angles wrt a pre-determined position (set point for F1 for instance).

A way to compute the time elapsed between the sending of a command and the first appearence of “actual position = set point” in the HK is also needed. This also implies the possibility to easily compute averages and/or standard deviations on series of numbers).

One will also plot the (average transition time) $\leftrightarrow$ (size of move).

Output, products

A product of this test is a table quantifying the average transition time for the filter wheels between any position, including standard deviations for each step size.

Coding Strategy

Test 0.7.7 is split in two major parts
First one is ”trust HK, verify commanding chain and transition time”
Second one is ”perform actual measurements, verify that stop position is correct”
Each of these ”chuncks” is splitted in photometer and spectrometer
First part is coded in 0.7.7_01 (photo) and 0.7.7_04 (spectro):
the code for these is a very simple sequence of filter wheel movements.
Second part is coded in 0.7.7_02 (photo) and 0.7.7_03 (spectro):
the code for these comprises a loop on filter wheel movements, and, at every filter position, a chopping loop on both

OGSE BBs.

Version number

$Revision : 1.5$

```
# Missionphase  : PACS AVM ILT
#
# Purpose       : Grating Wavelength Calibration
#
# Author        : H. Feuchtgruber
#
# Arguments     : detector readouts per ramp
#                              filter wheel position
#                              grating start position
#                              grating step size
#                                      grating number of steps
#                                      chopper default position
#                                      grating default position
#
# Description   : This script assumes an already set-up PACS instrument,
#                 i.e. Ge:Ga detectors, mechanisms and compression/reduction
#                 configured and running. Once started, the arguments
#                 have to be given and then a grating up/down scan will be
#                 executed with 1 reset interval per grating position and no
#                 chopper movements. The other characteristics of the scan
#                 are described by the parameters.
#                       The duration can be calculated as the total of:
#                               13 x 0.5 sec
(individual commands)
#                           +  10(TBC) sec
(filter wheel)
#                     + 13 x 0.2 sec
(commands in OBCP)
#                     +  20(TBC) sec                                      (grat
time)
#                     + ((readouts per ramp)/256) x (number of steps) x 2
(sequence time)
#                     +  20(TBC) sec
(grating def. time)
#                     +       1 sec
(margin)
#                 (note however that the WaitTime command requires milliseconds)

# Comments      : If there is a need of more than 1 reset interval
#                 and less than 8 reset intervals per grating position
#                 another DMC sequence needs to be coded.
#
# Version       : 1.2
# History       : 1.0 / 21-Nov-2002 Initial version
#                 1.1 / 03-Dec-2002 minor bug corrections
#                 1.2 / 10-Jan-2003 Adapted to MIB for DPU OBSW V4 and new
variables
#                       for better readability
#

# @param read_per_ramp integer 64 Enter detector readouts per ramp
# @param filterwheelpos integer 1 Enter filter wheel position
# @param grat_start integer 10000 Enter grating start position
# @param grat_size integer 259 Enter grating step size
# @param grat_num integer 1000 Enter number of grating steps
# @param chop_def integer 0 Enter chopper default position
# @param grat_def integer 100000 Enter grating default position
# @author Helmut Feuchtgruber
# @date today
# @version 1.0
# @purpose Grating wavelength calibration
# @comment don't know what to write here
# @comment don't know what to write here
# @comment don't know what to write here

#DPU-SET-HK-LIST (SPEC for both channels)
TCsend PC003380 {PP005380 1} {PP025380 1}
WaitTime 500
```

```
# SPUS-STOP-REDUCT-COMPR
TCsend PC037400
WaitTime 500

# SPUL-STOP-REDUCT-COMPR
TCsend PC038390
WaitTime 500

# DMC-WRITE-BLU-SPEC-PARAM
set params [list {PP067420 32} [list PP067420  $read_per_ramp] {PP067420  0} \
    {PP067420 0} {PP067420 0} {PP067420 59999} {PP067420 0}  {PP067420 0}]
set chksum [getChkSum -d -32 $params]
eval TCsend PC174420 $params \{PP066420 $chksum\}
WaitTime 1000

# DMC-WRITE-RED-SPEC-PARAM
set params [list {PP067420 32} [list PP067420 $read_per_ramp] {PP067420  0} \
                {PP067420 0} {PP067420 0} {PP067420 59999} {PP067420 0}
{PP067420 0}]
set chksum [getChkSum -d -32 $params]
eval TCsend PC173420 $params \{PP066420 $chksum\}
WaitTime 1000

# DMC-SET-PARAM-BOTH-SPEC SET TIMING PARAMTERS FOR BOTH SPEC ARRAYs
TCsend PC094420
WaitTime 1000

# SPUS-START-REDUCT-COMPR
TCsend PC039400
WaitTime 500

# SPUL-START-REDUCT-COMPR
TCsend PC040390
WaitTime 500

# DMC-MOVE-SPEC-FIL-WH-LOC
TCsend PC134420 [list PP075420 $filterwheelpos]
WaitTime 10000

# DMC-MOVE-CHOPPER-ABS
TCsend PC123420 [list PP079420 $chop_def]
WaitTime 500

# Ask before you start the actual grating scan
WaitForGo "Everything ready to start the grating scan ?"

# DPU-START-OBCP Grating Line Scan Chopped
# (but calculate some essential parameters first)
#       PP012380 "PROCEDURE IDENTIFIER"
#       PP010380 "NUMBER OF TIMES"
#       PP011380 "PARAMETER ID"
#       PP017380 "PARAMETER VALUE"

set seq_time [expr round((2+$read_per_ramp/256.*$grat_num*2.0)*1000)]
set grat_size_neg [expr -1*$grat_size]
set compression 16
set num_updown 1
set num_chopread 0
set num_resets 1
set num_cal 0
set det_sync 1
set grat_time 20000
set grat_def_time 20000

TCsend PC012380 [list PP012380 8] [list PP010380 21]   \
    [list PP011380 1] [list PP017380 8]                \
    [list PP011380 2] [list PP017380 $seq_time]        \
```

```
    [list PP011380 3] [list PP017380 $num_updown]      \
    [list PP011380 4] [list PP017380 $grat_num]        \
    [list PP011380 5] [list PP017380 $num_chopread]    \
    [list PP011380 6] [list PP017380 $chop_def]        \
    [list PP011380 7] [list PP017380 $num_resets]      \
    [list PP011380 8] [list PP017380 $chop_def]        \
    [list PP011380 9] [list PP017380 $chop_def]        \
    [list PP011380 10] [list PP017380 $num_cal]        \
    [list PP011380 11] [list PP017380 $chop_def]       \
    [list PP011380 12] [list PP017380 $chop_def]       \
    [list PP011380 13] [list PP017380 $grat_size]      \
    [list PP011380 14] [list PP017380 $grat_size_neg]  \
    [list PP011380 15] [list PP017380 $det_sync]       \
    [list PP011380 16] [list PP017380 $grat_start]     \
    [list PP011380 17] [list PP017380 $grat_time]      \
    [list PP011380 18] [list PP017380 $compression]    \
    [list PP011380 19] [list PP017380 $grat_def]       \
    [list PP011380 20] [list PP017380 $chop_def]       \
    [list PP011380 21] [list PP017380 $grat_def_time]

# End of Procedure
```

Revised SPIRE AIV (models)

- SM – Structural Model:
  - used for early verification of mechanical integration and early (as possible) vibration level testing.
  - Build standard is flight for structure and optics, structural models for all other sub-systems
- AM – Alignment Model:
  - used for verification of optical alignment in the visible warm and cold.
  - Re-used SM structure and optics and fitted with OGSE
- CQM I – Cryogenic Qualification Model build I:
  - used for cold vibration; thermal verification; FIR optical performance; limited operational check out and photometer performance verification.
  - Re-used SM structure and optics; P/LW BDA; CQM cooler and calibrators; CQM/STM JFETs. Mechanisms are STM. QM1 electronics.

Revised SPIRE AIV (models ctd)

- CQM II – this will be delivered for EPLM testing.
  - Used for thermal verification and limited performance testing at EPLM level
  - There will be no spectrometer so some spectrometer components may be removed before delivery if required on PFM I
  - Status of what electronics are available is in some doubt – we are exploring the options with CEA and IFSI
- PFM I – **Proto** Flight Model build I.
  - Used for mechanism operation verification; further thermal performance testing and spectrometer performance testing.
  - Uses PFM structure and optics; PFM spectrometer BDAs; PFM Cooler (if available); PFM Calibrators;PFM JFETs;FPM BSM; CQM SMEC.
  - Status of electronics and cooler for this build are in some doubt.

Revised SPIRE AIV (models ctd)

- PFM II – **Proto** Flight Model build II.
  - Full flight model FPU
  - Initial test phase carried out using QM electronics
  - Complete flight electronics arrive late in programme.

Issues

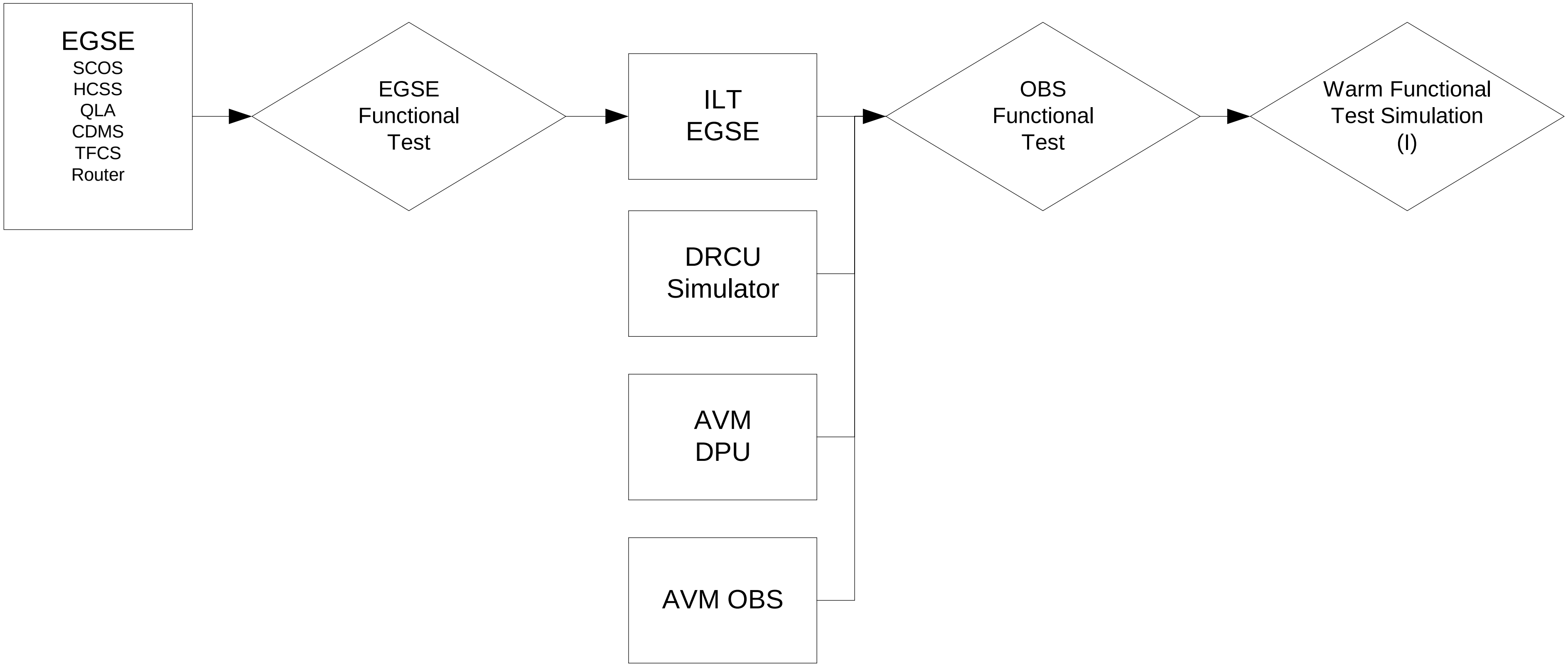
- Electronics
  - The present DRCU programme delivers “QM1” this summer and “QM2” next spring/summer.
  - This leaves us with no electronics to drive the PFM build I
  - Possibilities are to have a second QM1 standard unit (and no QM2) or to keep the existing QM1 until absolutely needed at Astrium.
- Cooler
  - The PFM cooler programme does not deliver in time for PFM build I
  - Possibilities are to accelerate the PFM cooler (with attendant risk) or to de-integrate the CQM cooler and keep the CQM II mothballed until the PFM cooler turns up.
- What is possible and sensible depends on when Astrium **really** needs the CQM and the outcome of the cooler test programme.

Pros and Cons

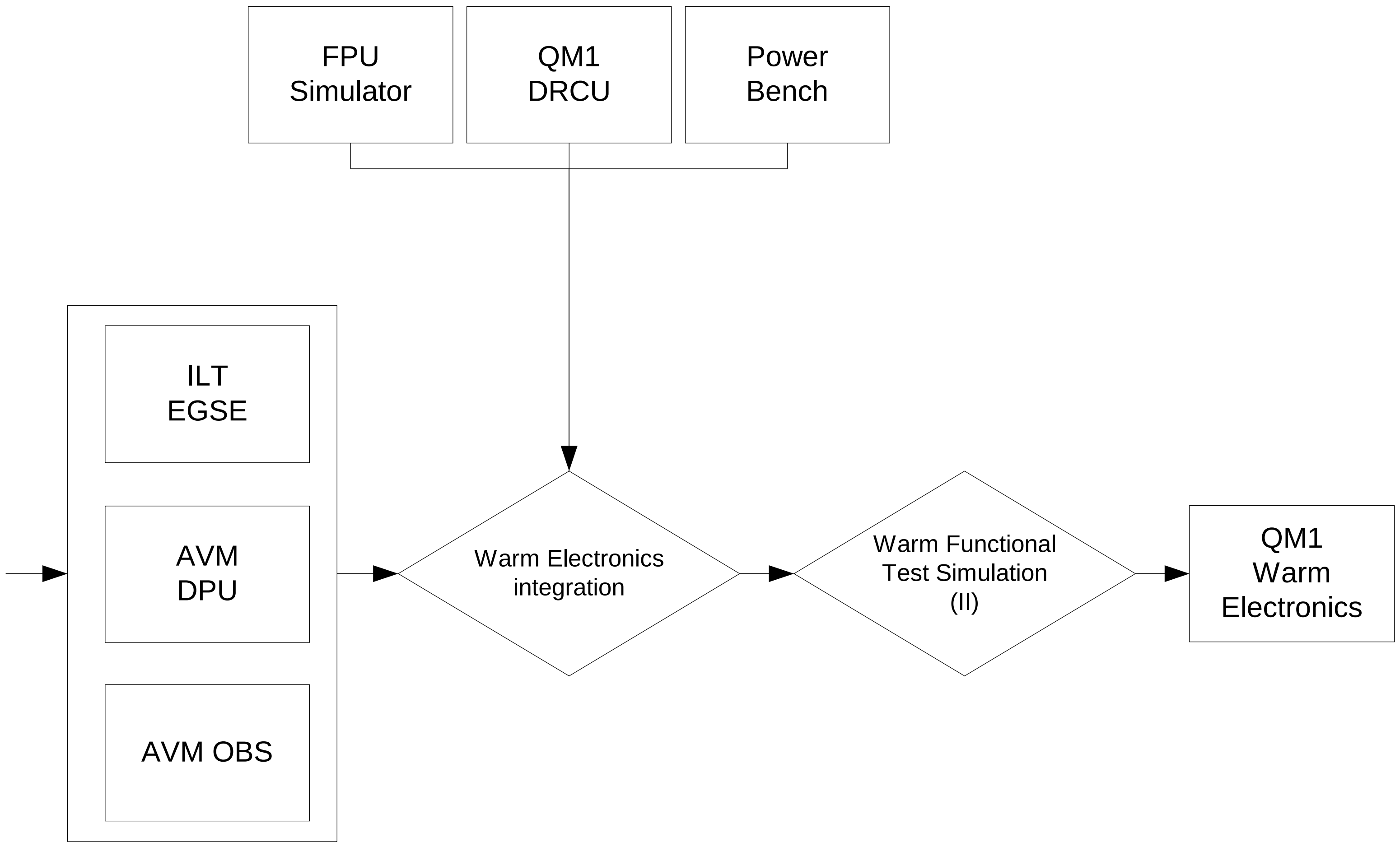
- Carry on as before
- Pro
  - Technical risk to PFM programme is reduced
  - CQM delivered for EPLM tests has high fidelity
- Con
  - CQM delivered in Summer 2004
  - PFM starts very late and programme compressed to beyond credibility
  - PFM realistic delivery not before Summer 2005

- New philosophy
- Pro
  - PFM programme starts on time
  - A CQM is delivered in early 2004
  - We get longer to test the PFM albeit in different build phases
- Con
  - Integration is more complex
  - Delivered CQM has reduced fidelity
  - Higher technical risk

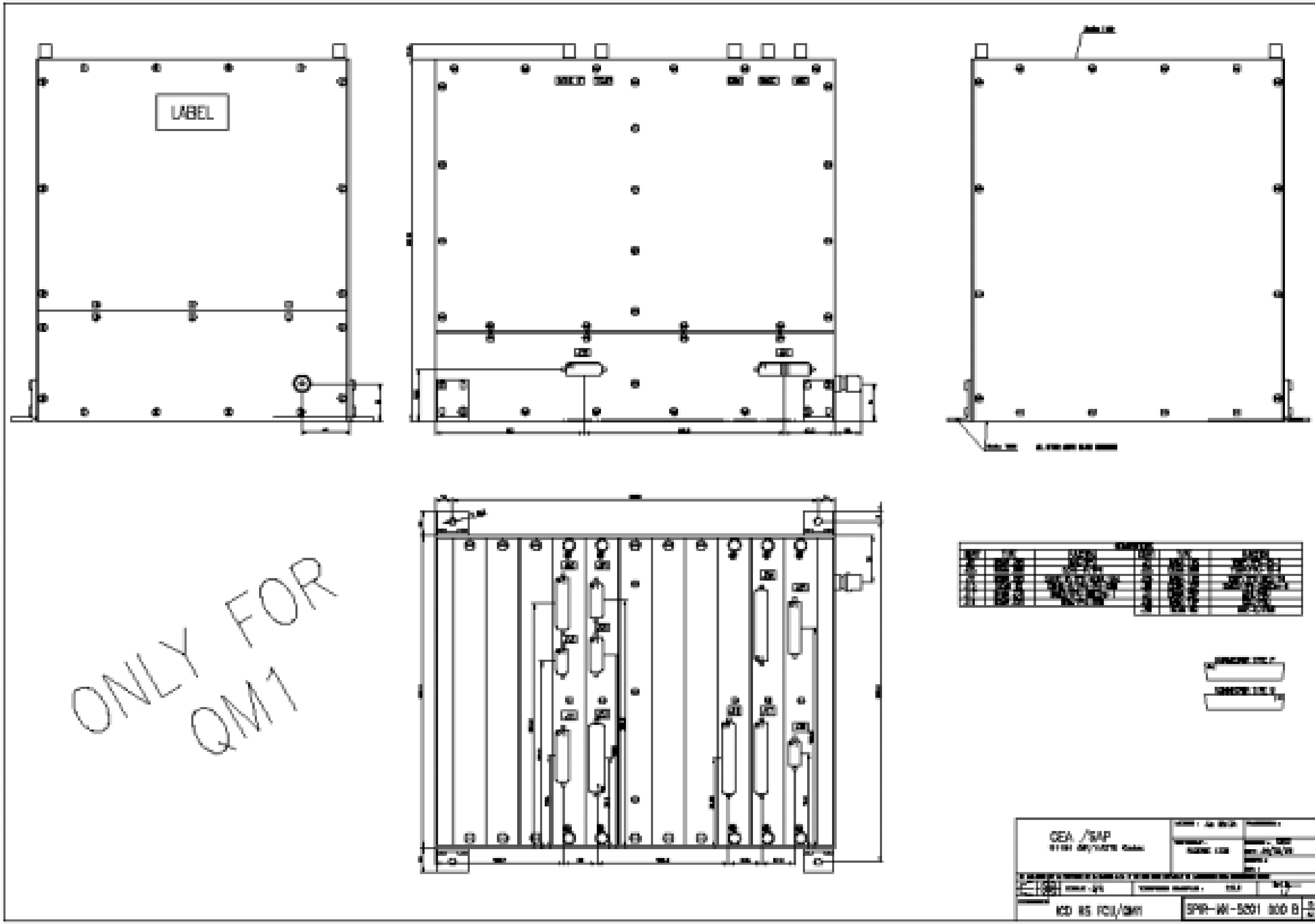
Warm Electronics Integration (DPU/OBS)



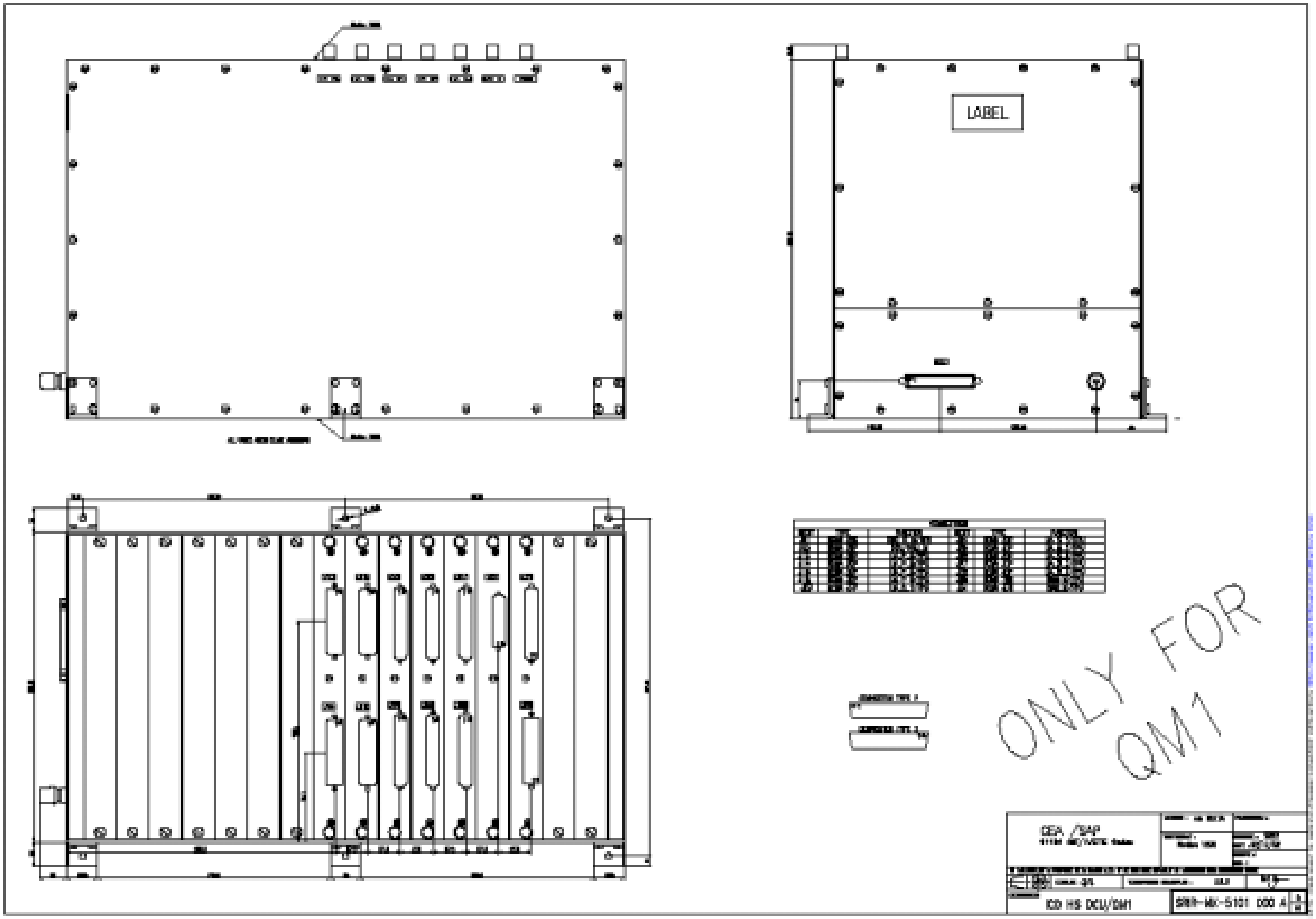
Warm Electronics Integration (DPU/DRCU)



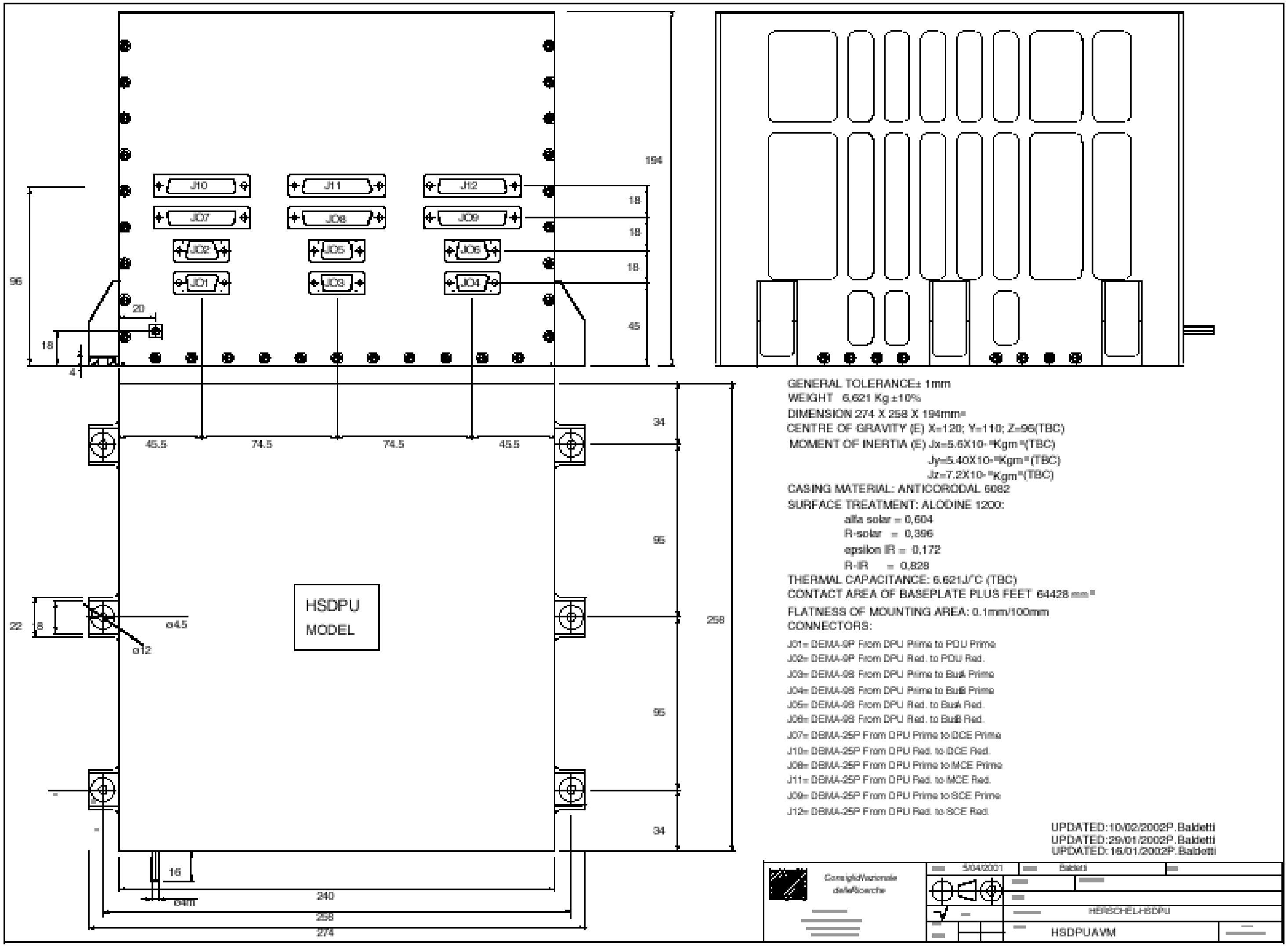
DCU QM1 Interface



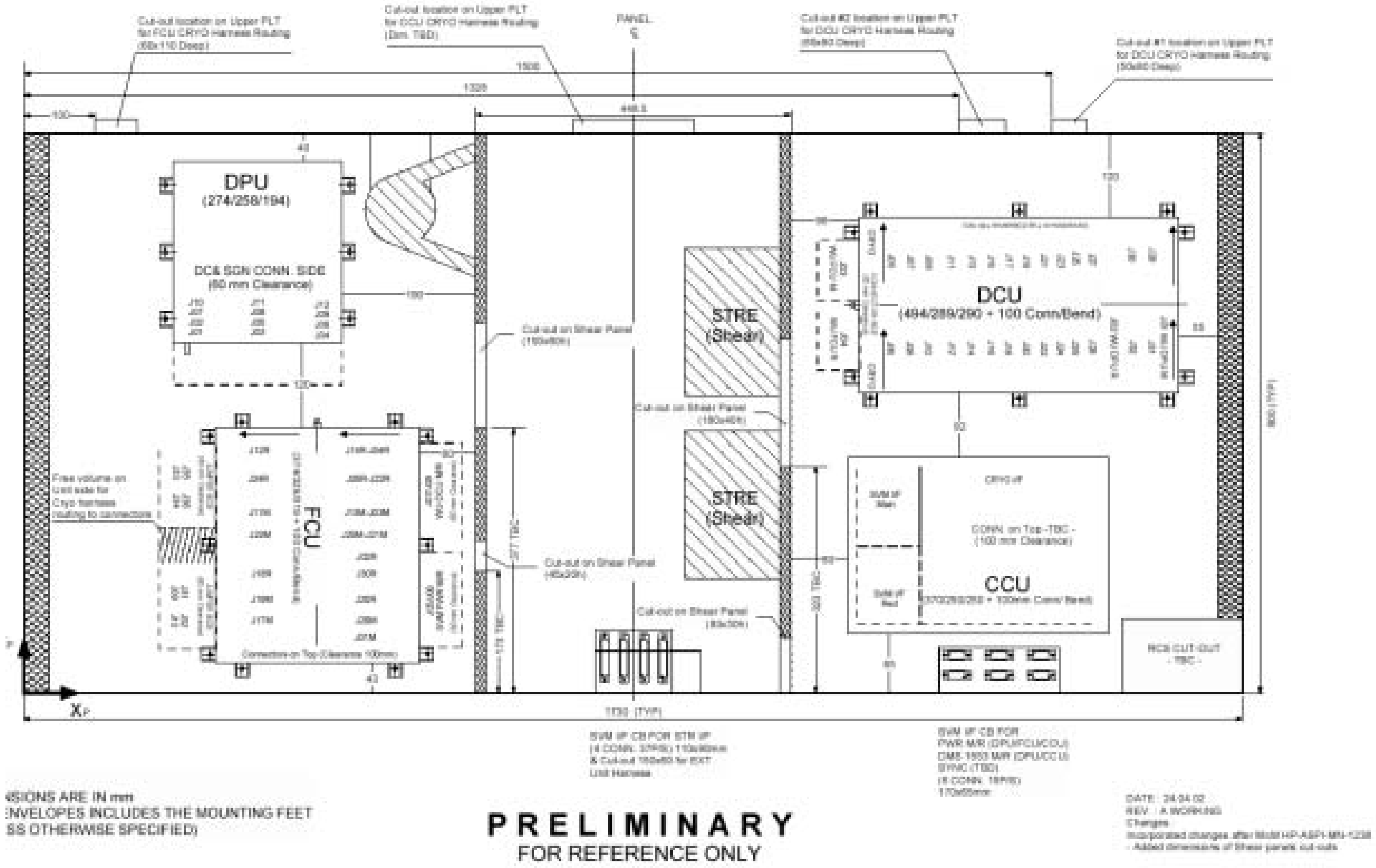
FCU QM1 Interface



DPU AVM Interface



Layout as per IID-A v3 (plus power bench)

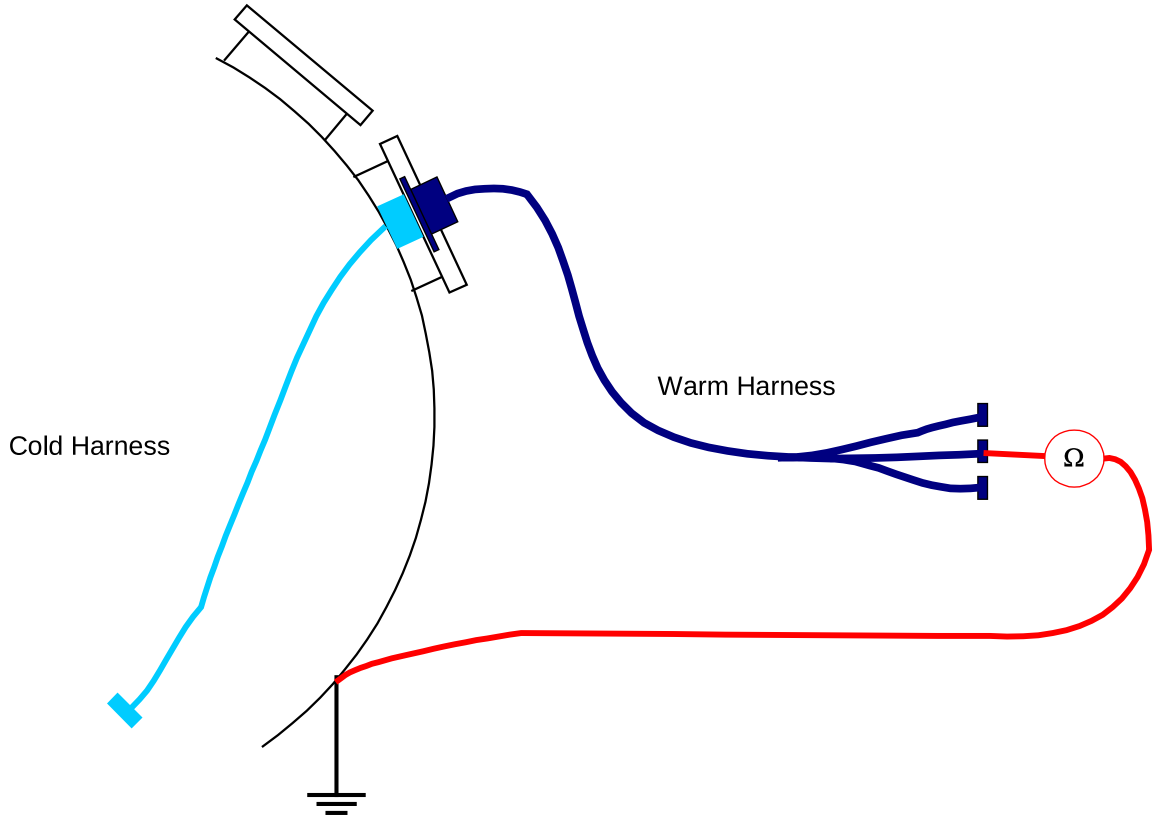


Power Bench

- Replaces function of PSU for QM1
- 19 inch rack standard height unit
- Runs from 220 V
- Must be within 3 m of DCU and FCU
- Harness will be provided with QM1
- Weighs ~20 kg
- Specification available (en français)

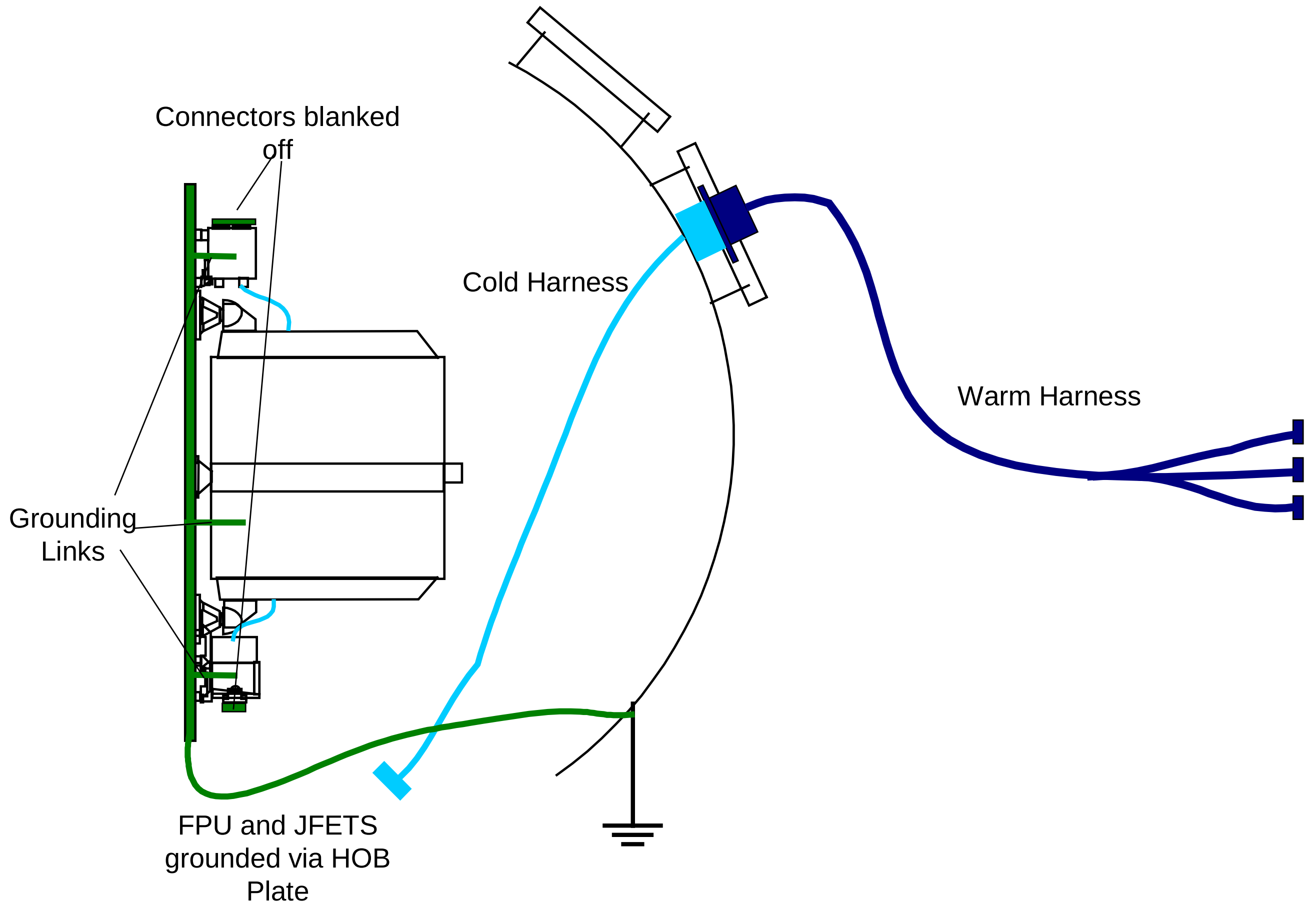
Instrument/Harness Integration (1)

- Measure shorts to ground of installed harness



Instrument/Harness Integration (2)

- Move SPIRE into cryostat

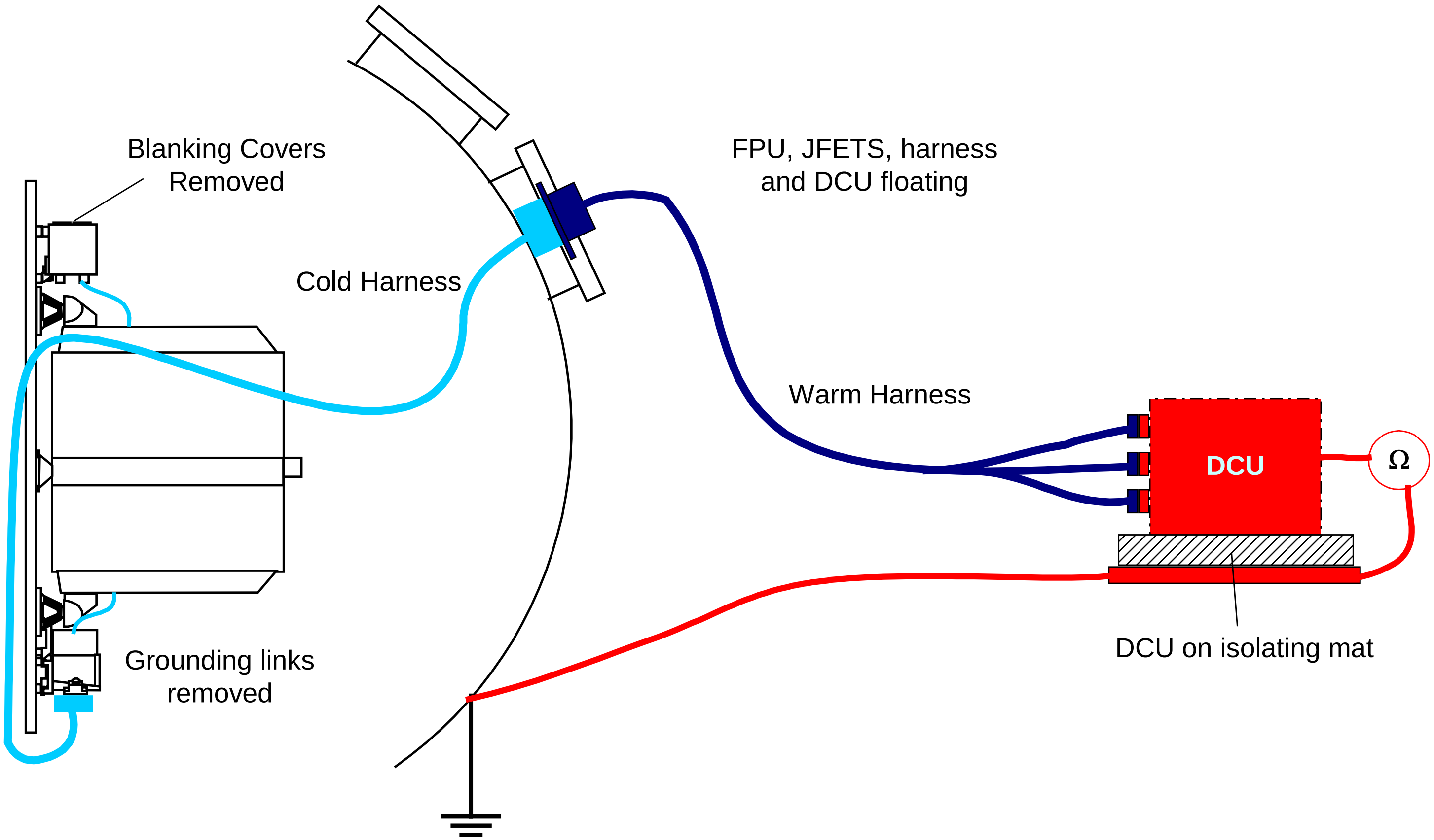


Instrument/Harness Integration (3)

- Connect Cold Harness to SPIRE.
- Now the cold harness will be connected to the JFETS first with the bias connector blanked off. After all JFETS have been connected, the bias harness will be connected to the bias connectors. The warm harness will then be connected with the DRCU mounted on an isolating sheet.

Instrument/Harness Integration (4)

- Measure Isolation.



Instrument/Harness Integration (5)

- Ground DRCU

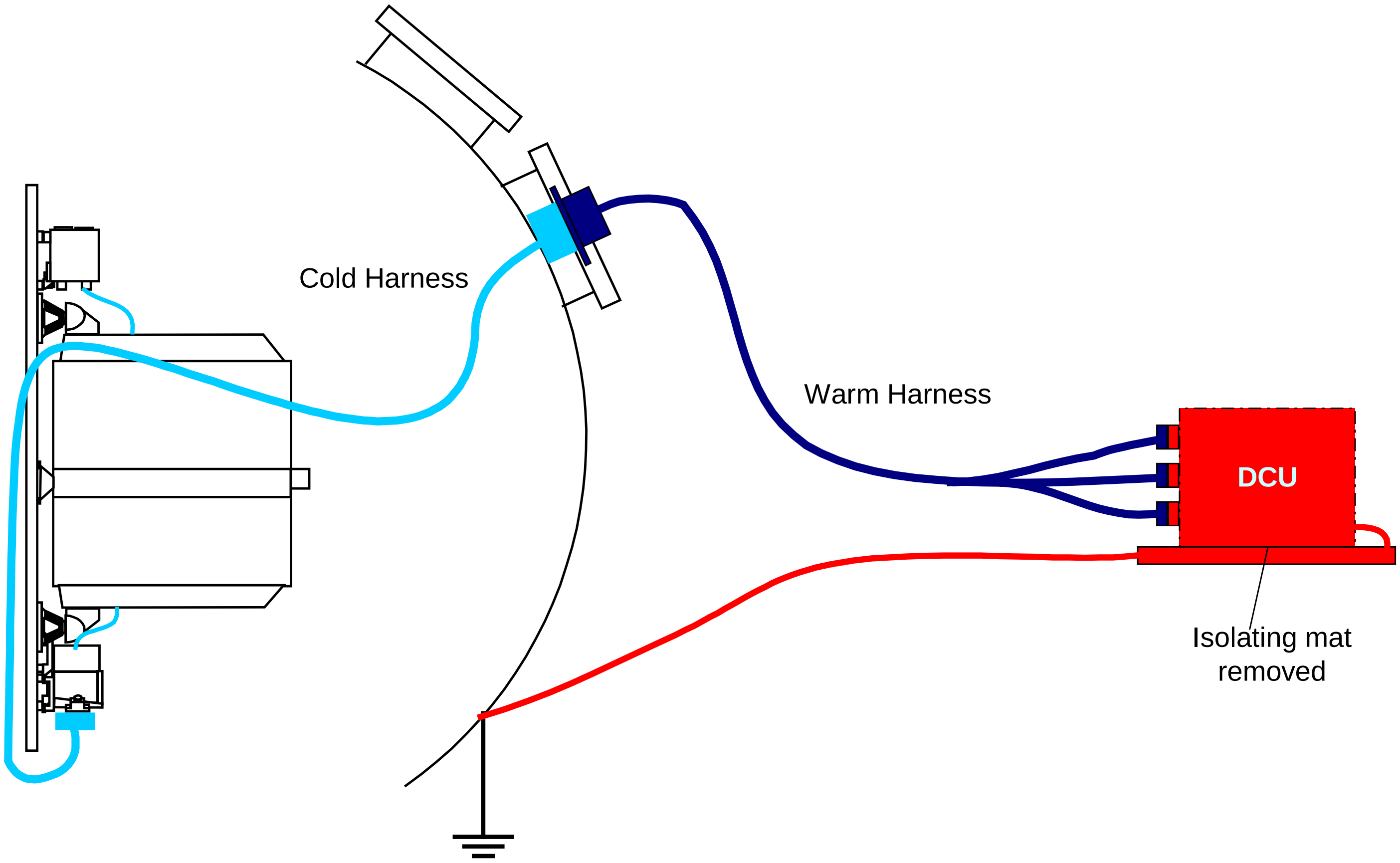


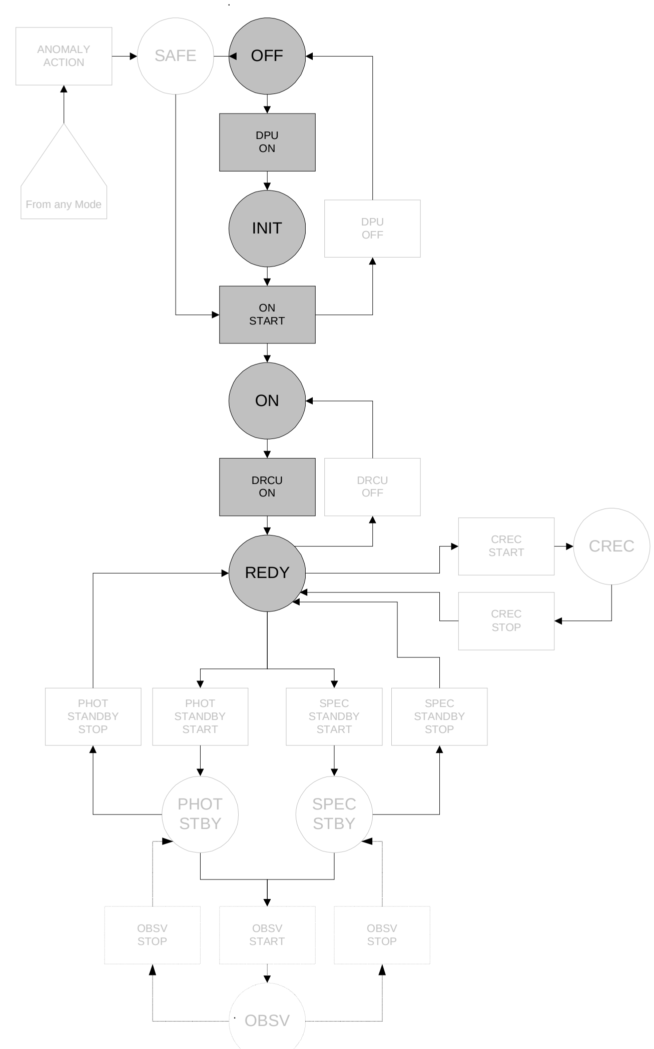
Table 7.1

Critical commands	None
Critical instrument H/K parameters	Define critical? Could be the same as for flight? In which case defined in Data ICD
ESD critical connectors	All JFET connectors Flying leads to detectors (TBD)
Red/green tagged items relevant to the test	FPU Aperture Cover
Specific handling constraints	See integration procedure
Protective covers to be used	FP Aperture cover to be left on until ready to close instrument shield Shorting sockets on JFETs to be removed as part of installation procedure only Possible shorting sockets on detector flying leads (TBD)
Warm-up times	TBD
Specific PLM orientations	20 degrees to +Y for cooler recycle

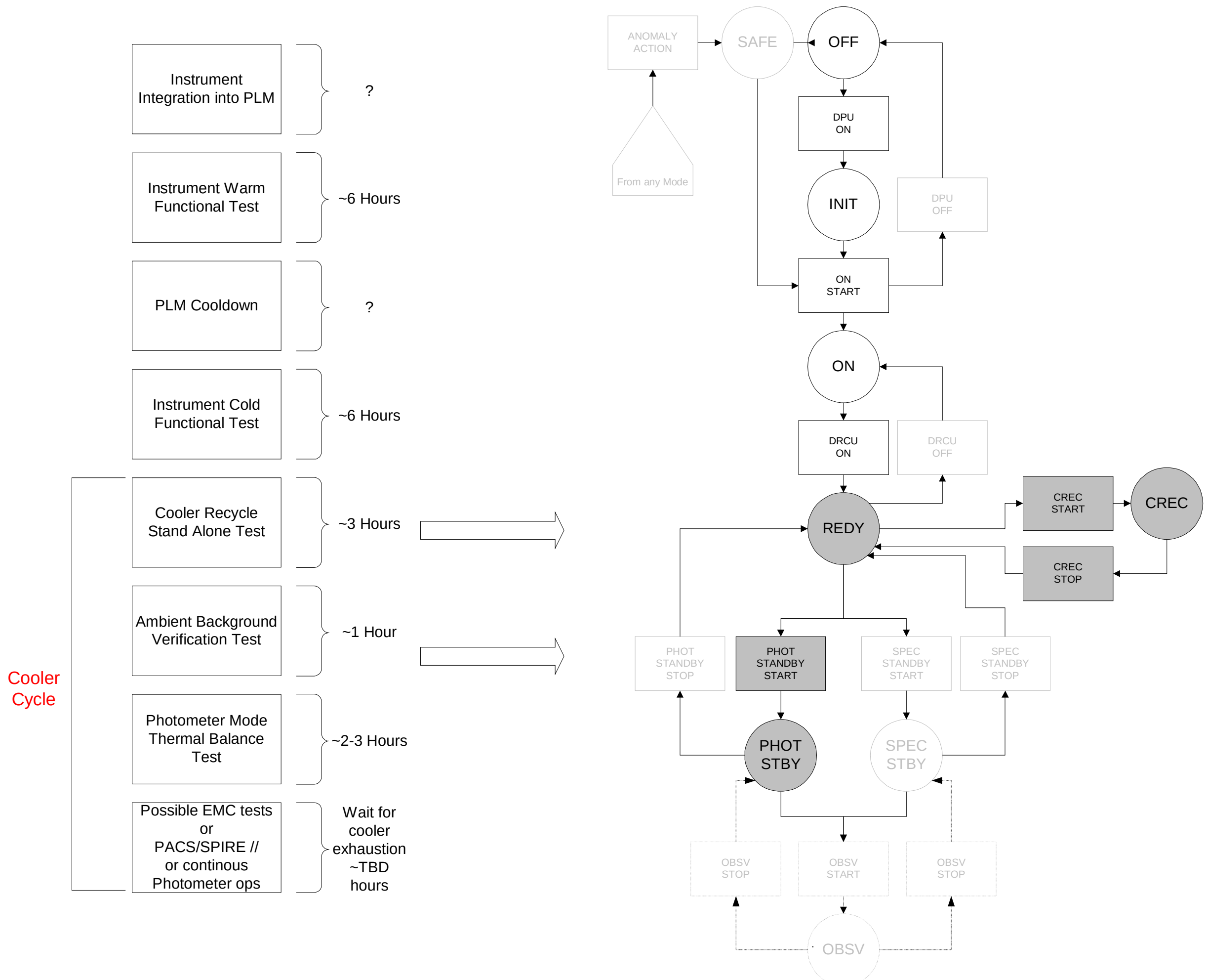
Test Flow – functional tests

Instrument Integration into PLM	?
Instrument Warm Functional Test	~6 Hours
PLM Cooldown	?
Instrument Cold Functional Test	~6 Hours
Cooler Recycle Stand Alone Test	~3 Hours
Ambient Background Verification Test	~1 Hour
Photometer Mode Thermal Balance Test	~2-3 Hours
Possible EMC tests or PACS/SPIRE // or continous Photometer ops	Wait for cooler exhaustion ~TBD hours

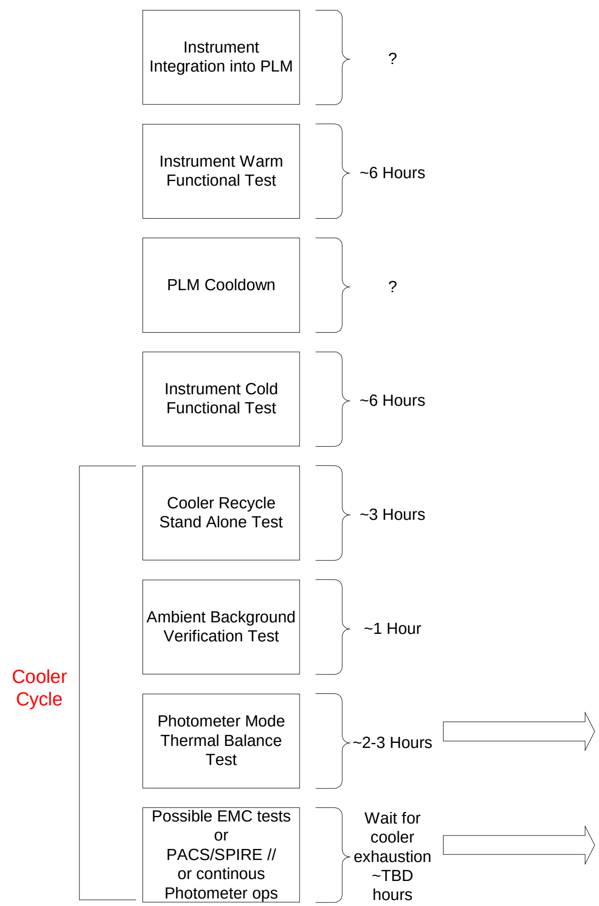
Cooler Cycle (covers the last four tests)

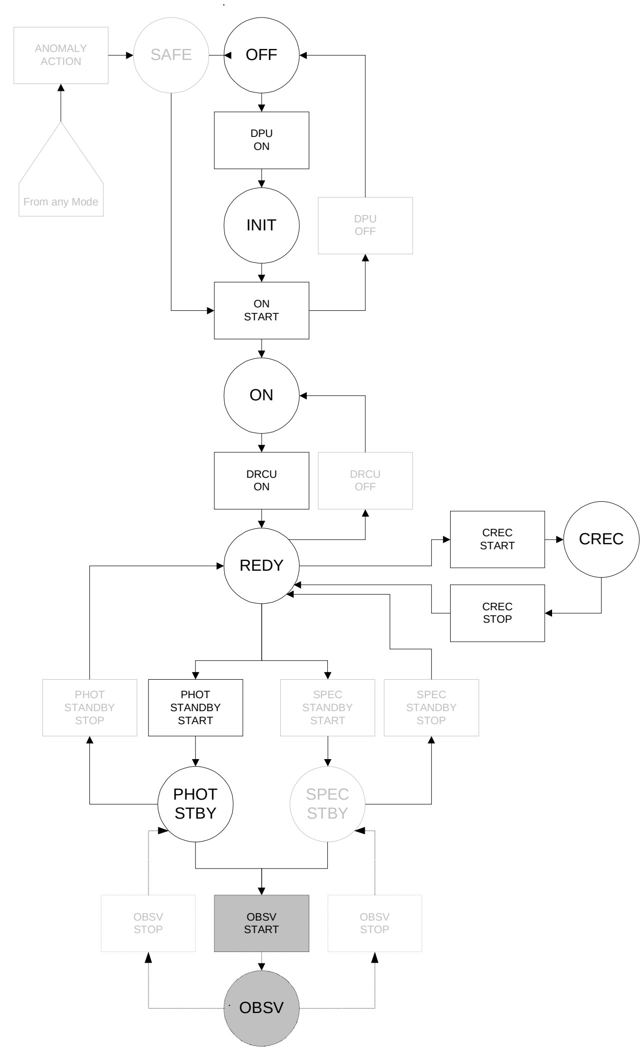


Test Flow – cooler and background tests



Test Flow – thermal and EMC tests





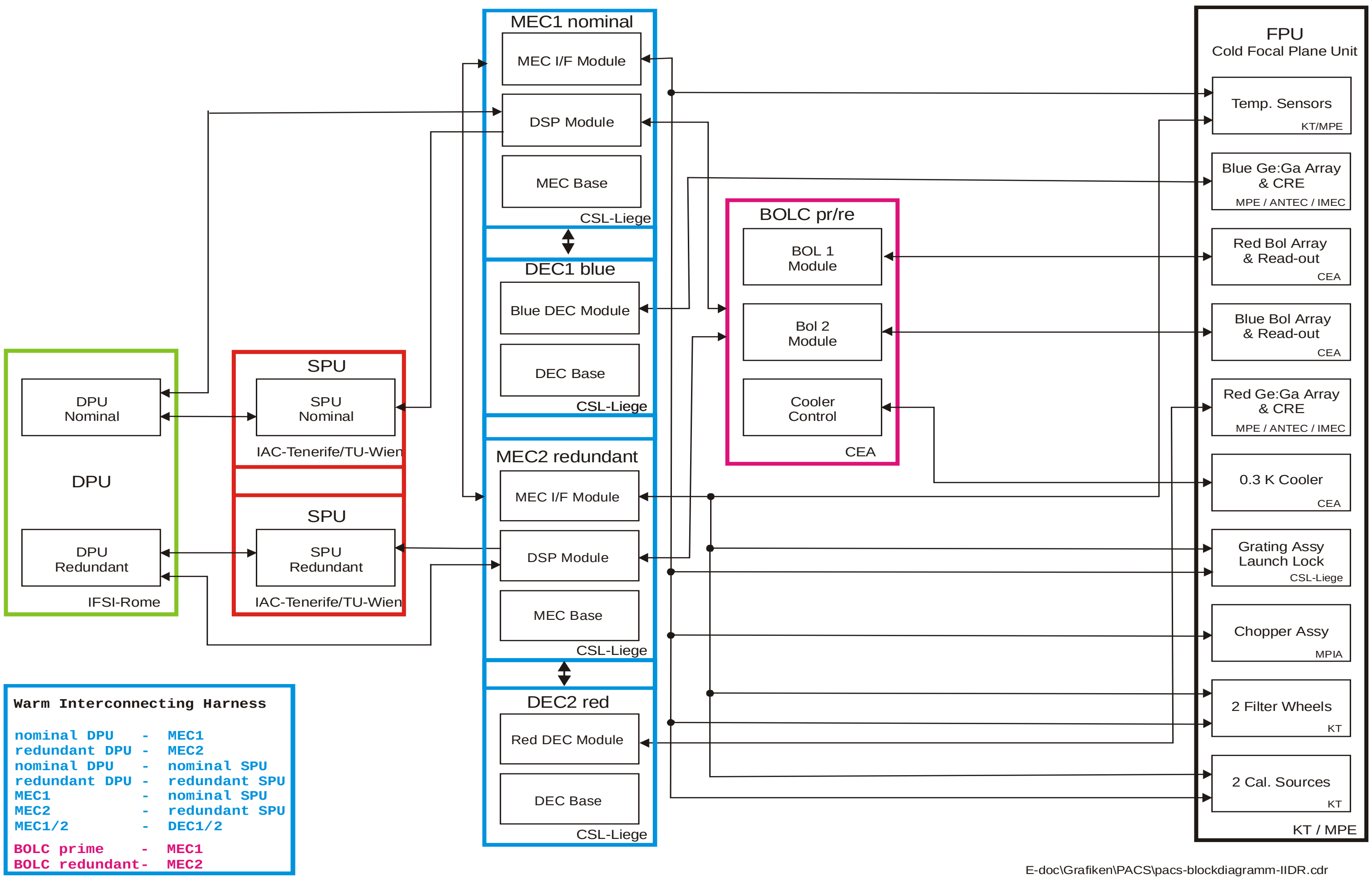
Present ILT Activities

- Structural Model of FPU built and vibrated
- Warm alignment now ongoing
- Cold alignment campaign starts in 2-3 weeks
- Cryostat has been cooled once at RAL and operational procedures are being debugged
- DPU/OBS acceptance and integration testing with IEGSE and DRCU simulator
- Definition of functional test procedure specification
- Left to do (wrt system level issues)
  - Define WFT and CFT
  - Define performance test sequence
  - Define thermal test sequence
  - Work through integration procedures for FPU and JFETs

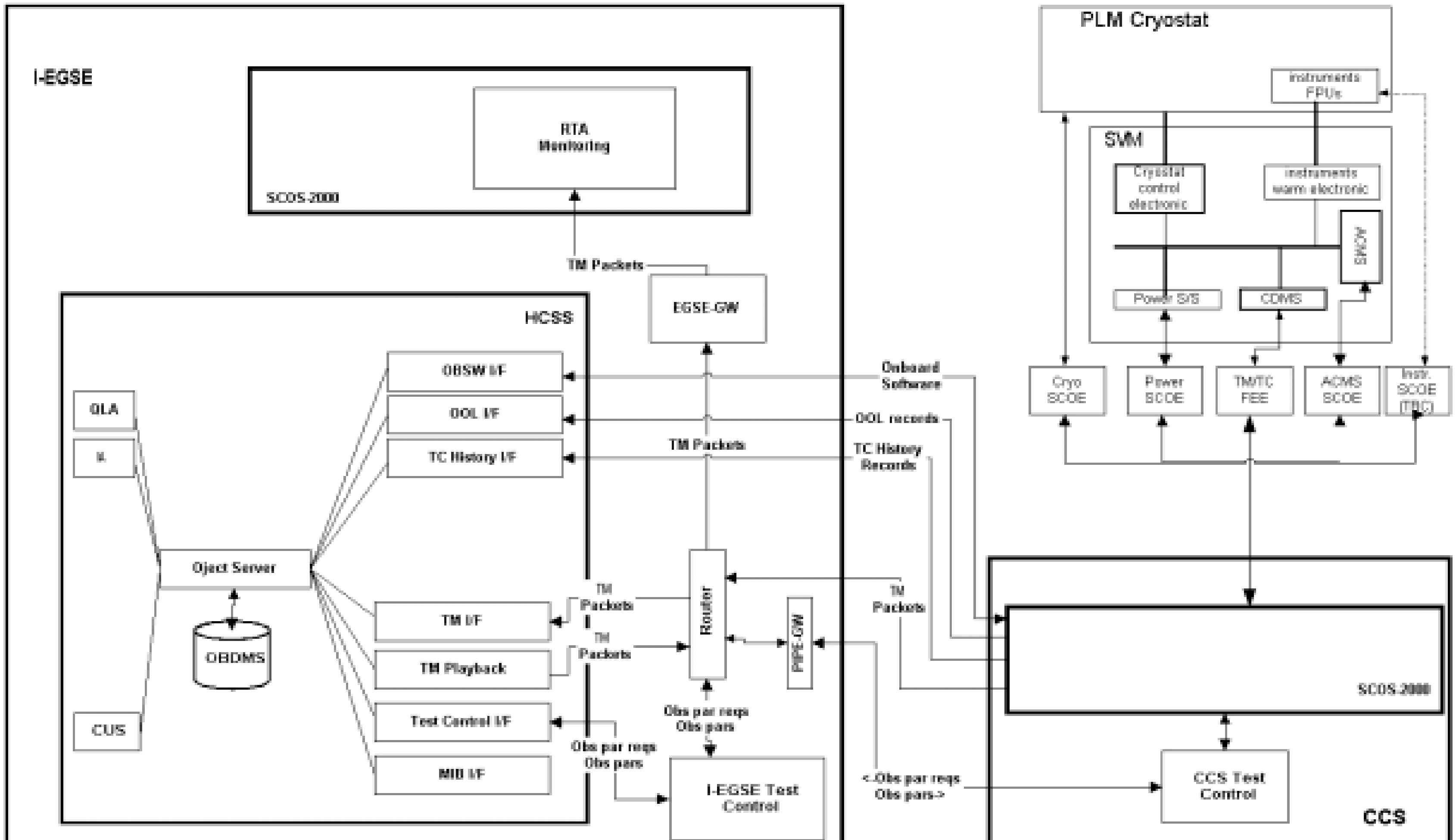
Instrument EGSE for AIT and its Interfaces to CCS

Otto H. Bauer, MPE Garching
Ken J. King, RAL
Kevin Galloway, ESTEC

Instrument Overview and Subsystem Responsibilities



IEGSE/CCS for IST



PIPE Interface

- This component interfaces to the CCS using the PIPE protocol (RD02). It handles three types of interaction:
  - Connection and setup of the interface.
  - Reception of telemetry packets from the CCS and their transport to the IEGSE Router, which distributes them to the rest of the IEGSE.
  - Reception of requests from the CCS for the values of parameters to be inserted into the command sequences, which are sent to the instrument. These requests are passed to the HCSS (CUS), which returns the values required and these are passed on to the CCS.

- SRON (A. De Jonge) will implement it.

  SoW available: PIPE GW SoW, 8 May 2003, SRON-U/HIFI/SP/2003-001

TOPE

- Starting point:

  Instrument TOPE procedures and the CCS ones were not compatible
- Four options possible:
  - Create TCL package implementing Instrument TOPE on top of CCS TOPE.
  - Develop an Instrument TOPE to CCS TOPE translator.
  - Instantiate CCS TOPE on IEGSE replacing the Instrument TOPE by a light CCS TOPE.
  - Upgrade Instrument TOPE to use language items of CCS TOPE (i.e. allow new commands to be executed on top of Instrument TOPE TCL and Corba layers

- Option 4 is preferred solution and Project agreed to it !!

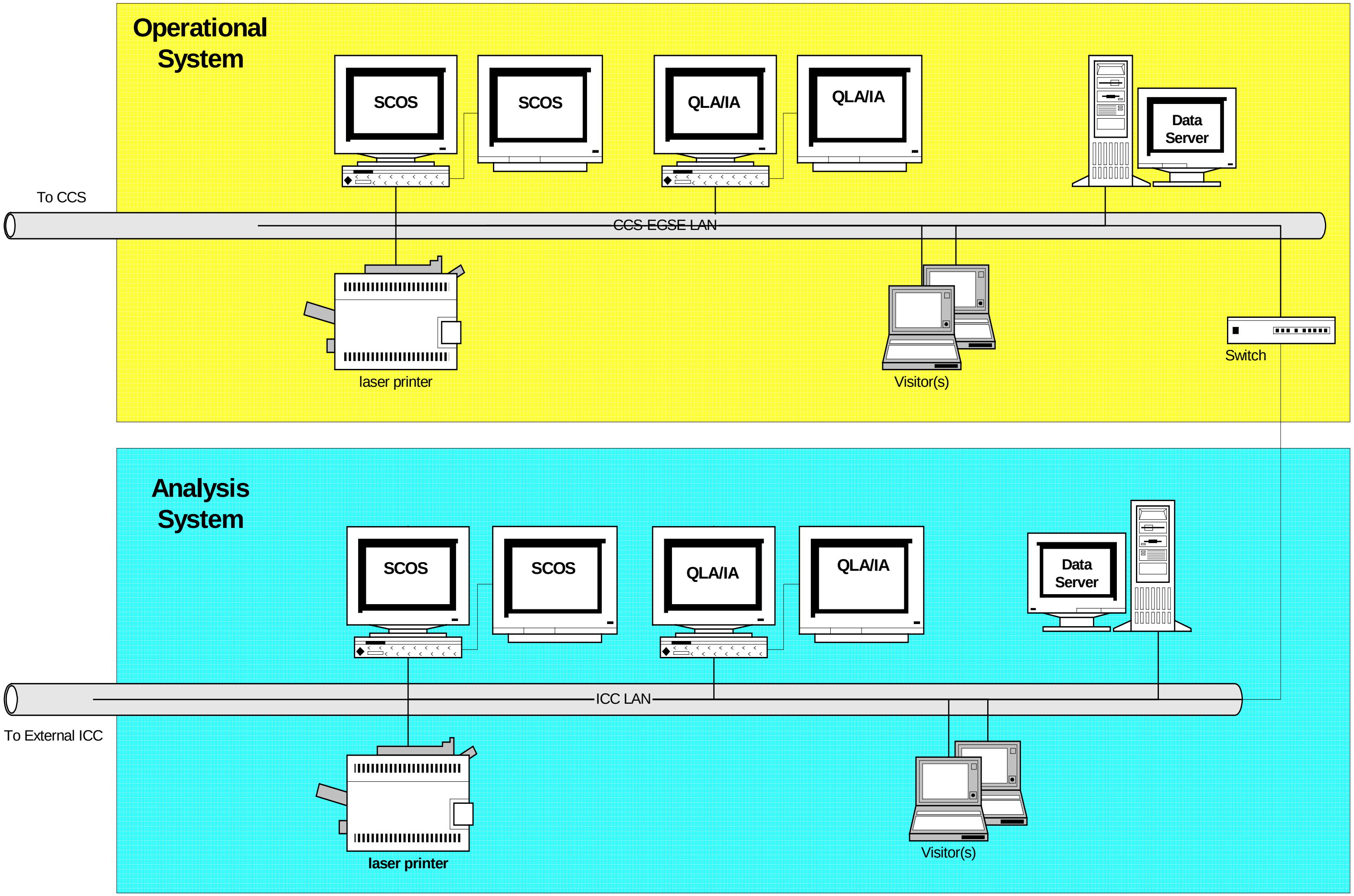
  (MoM: CCS and Instrument TOPE compatibility, 28 March 2003, ESA/ESTEC/TOS-EMG/SV/03.1251)

IEGSE H/W Configuration

- Two complete IEGSE systems will be provided. One is operated in real time during the testing, while the other may be used for analysis of previous test results and acts as a backup for the operational system.

- 6 different items are identified:
  - SCOS workstation – used primarily to run the SCOS-2000 software. This will be a PC running Linux with a dual display card driving two displays.
  - Analysis workstation – used to run the instrument analysis software (QLA/IA/PCSS). This will be a PC running Linux with a dual display card driving two displays.
  - Data Server – used primarily to run the HCSS software. This will be a PC running Linux with a single display and large disk drives with backup facility (to tape/CD TBD)
  - Colour laser printer
  - LAN switch - protects the Operational System from the Analysis System allowing access to the external internet from the Analysis System
  6. Laptops – used to run instrument specific analysis tools. These are not provided as part of the EGSE but may be used by instrument experts as necessary during testing.

Herschel Instrument EGSE Hardware Configuration for IST



Tentative Schedule

- CCS light should be delivered to Astrium in July (TBC).
- PIPE
  - TERMA will have the acceptance of the CCS PIPE protocol in June.
  - SRON needs a copy of CCS light to start implementation.
- TOPE
  - Implementation kick-off at Siemens/Vienna took place end April.
  - First draft of user documentation will be distributed end May.
  - Implementation will be completed end June.
  - Installation on IEGSE could take place in July.
- IEGSE
  - SRON will buy first SCOS station (Router, SCOS, TOPE, TestControl) in June: PC, Pentium IV, 2 Ghz, 1 GB RAM, 30 GB disk)

HERSCHEL PLM

AIT Meeting EMC

C. Kalde
28.05.2003

Presentation covers

1. HERSCHEL EMC TEST PHILOSOPHY

2. EMC TESTS on HERSCHEL PLM EQM CONFIGURATION

- **A) Tests**
- **B) Test Sequence**
- **C) Test Duration**

3. APPLICABLE EMC REQUIREMENTS for PLM

- **A) Bonding/Isolation**
- **B1) PLM Conducted Emission Primary Power**
- **B2) PLM Conducted Emission Secondary Power**
- **C) PLM Conducted Susceptibility**
- **D) PLM Radiated Susceptibility**

4. CONCLUSION / OUTLOOK

1. HERSCHEL EMC Test Philosophy

EQM:

PLM EQM equipped with the modified CVV of ISO. SVM represented by Avionics module. Only on PLM EQM representative susceptibility tests under cold conditions are performed !

PFM:

a) **PLM PFM** for testing under warm conditions (CE/CS). SVM represented by Avionics module or FM SVM.

b) **HERSCHEL** Satellite for testing under warm conditions (CE/CS TBD w.r.t I/F accessibility, RE/RS, Launcher compatibility

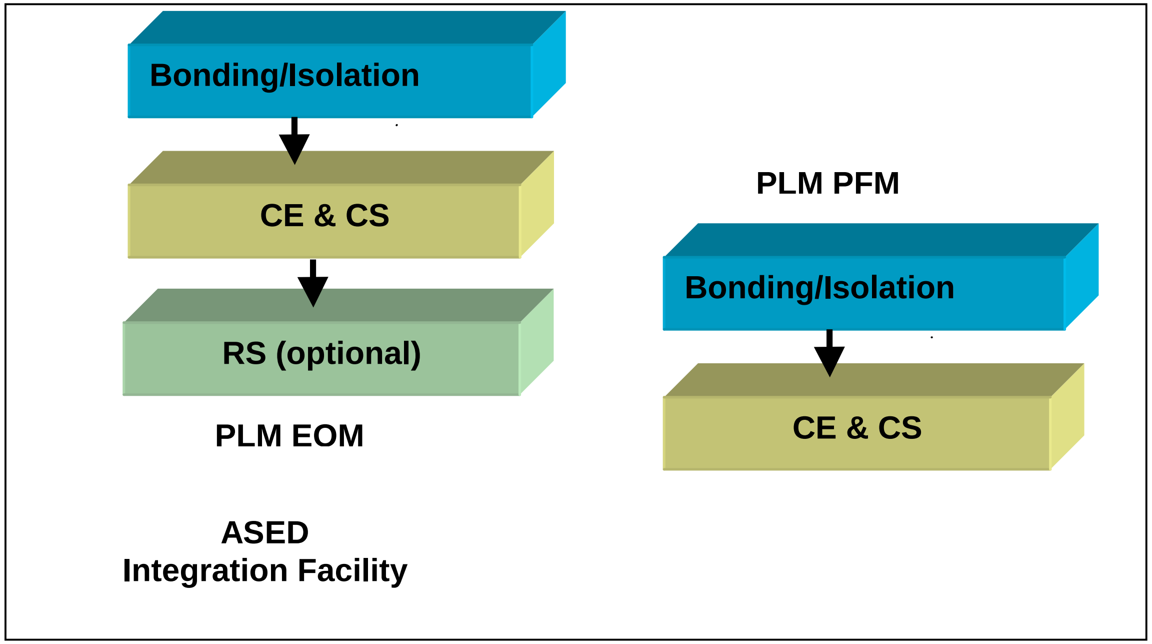


Fig.1-1: PLM Test Blocks

2. EMC Tests on HERSCHEL PLM EQM Configuration

- All tests performed in a standard integration facility (**no anechoic chamber**).
- Permission for RS tests to be requested from radio regulation community (Regulierungsbehörde für Telekommunikation und Post Konstanz) **at least 6 months prior to test**.
-

A) T E S T S :

EMC Spec	Subject	PLM EQM	PLM PFM
EMCPLM-000	CE CM Current on primary power lines between PLM and SVM	NA	NA
EMCPLM-010	CE CM and DM @ pre-amps & detector power lines (sec. power)	T	T
EMCEQ-500, -550, -560	CS DM Continuous & Transients	T	T
EMCEQ-520, -570	CS CM Continuous & Transient	T	T
EMCPLM-030	RS test (OPTION)	T	--

Table 2-2: EMC Tests

B) Test S E Q U E N C E:

- Due to long duration of the RS tests two test blocks are proposed: Block **'C'** and Bock **'R'**
- During Block R CS Retests and threshold determination can be performed for the particular instruments if necessary

C1: HIFI ON, PACS OFF, SPIRE OFF

1. **Reference test , MODE TBD by HIFI**
2. **CE's, noisiest MODE TBD by HIFI**
3. **CS's, sensitive MODE TBD by HIFI, quicklook capability TBD by HIFI, Performance data storage with reference to CS injection event/frequency: Capability to be checked: TBD by HIFI**

C2: PACS ON, HIFI OFF, SPIRE OFF

1. **Cooler recycle**
2. **Reference test , MODE TBD by PACS**
3. **CE's, noisiest MODE TBD by PACS**
4. **CS's, sensitive MODE TBD by PACS, quicklook capability TBD by PACS, Performance data storage with reference to CS injection event/frequency: Capability to be checked: TBD by PACS**

C3: SPIRE ON, HIFI OFF, PACS OFF

1. **Cooler recycle**
2. **Reference test , MODE TBD by SPIRE**
3. **CE's, noisiest MODE TBD by SPIRE**
4. **CS's, sensitive MODE TBD by SPIRE, quicklook capability TBD by SPIRE, Performance data storage with reference to CS injection event/frequency: Capability to be checked: TBD by SPIRE**

R1: HIFI ON, PACS OFF, SPIRE OFF

1. **Reference test , MODE TBD by HIFI**
2. **RS, sensitive MODE TBD by HIFI, quicklook capability TBD by HIFI, Performance data storage with reference to CS injection event/frequency: Capability to be checked: TBD by HIFI**

R2: PACS ON, HIFI OFF, SPIRE OFF

1. **Cooler recycle**
2. **Reference test , MODE TBD by PACS**
3. **RS, sensitive MODE TBD by PACS, quicklook capability TBD by PACS, Performance data storage with reference to CS injection event/frequency: Capability to be checked: TBD by PACS**

R3: SPIRE ON, HIFI OFF, PACS OFF

1. **Cooler recycle**
2. **Reference test , MODE TBD by SPIRE**
3. **RS, sensitive MODE TBD by SPIRE, quicklook capability TBD by SPIRE, Performance data storage with reference to CS injection event/frequency: Capability to be checked: TBD by SPIRE**

C) Test D U R A T I O N S ROM Estimation

1 x CE's = 2 d + **TBD** d for scientific instrument setting a + **TBD** d for CVV conditioning

1 x CS's = 4 d + **TBD** d for scientific instrument setting a + **TBD** d for CVV conditioning + **TBD** d for CVV conditioning

1 * RS = 6.5 d + **TBD** d for scientific instrument setting a + **TBD** d for CVV conditioning + **TBD** d for CVV conditioning

= 18 d + **TBD** + 20 d + **TBD**

The durations shall be defined in detail based on detailed test planning.

3. Applicable EMC Requirements for PLM

A) Bonding/Isolation

Subject of mechanical and electrical integration.

B1) PLM Conducted Emission Primary Power

On each primary power line the CE current on power lines of units receiving primary power.

Not applicable because PLM units do not use primary power.

B2) PLM Conducted Emission Secondary Power

a) CE measurements in differential mode: Voltage ripple in 50 Mhz measuring BW

b) CE measurements common mode ripple in NB from 30 Hz to 50 MHz

Instruments pre-amps and detector secondary power lines to be used for this test as well as the expected ripple/current emission **TBD by the scientific instruments suppliers, PACS HIFI SPIRE** **Action 1**

- most noisiest mode **TBD by the scientific instruments suppliers, PACS HIFI SPIRE** **Action 2**
- PLM EQM is equipped with the SVM Simulator fully loaded with the avionics modules, whereas the PLM PFM will be used with the SVM FM or AVM.
- PCDU will be powered with the solar array simulator (TBD) unit in order to provide for best representativity. Use of break-out boxes shall be limited because they allow the facility generated noise to enter the equipment. The antenna port shall all be matched loaded with a load that can handle the amount of RF power.

C) PLM Conducted Susceptibility

a) Differential mode sine wave: Injection on primary power lines of 1 Vrms from 30 Hz to150 kHz decreasing 6 dB/oct. up to 300 kHz and 0.5 Vrms from 300 kHz to 50 MHz (1 kHz AM modulated by 1 kHz square wave between 50 kHz and 50 MHz.

b) Common mode sine wave: Injection on primary power lines of 2 Vpp from 10 kHz to 50 MHz (1 kHz AM modulated by 1 kHz square wave between 50 kHz and 50 MHz) on primary power lines.

c) Differential Transient: Primary power lines subjected to + /- 2 Vp, 300 µs duration, rise time < 5 µs, time constant 2 ms, repetition rate 5 Hz … 10 Hz

d) Common mode Transient: Primary power lines subjected to + /- 28 Vp, > 5 µs duration, rise time < 100 ns, repetition rate 5 Hz … 10 Hz.

- most sensitive mode **TBD by PACS HIFI SPIRE** **Action 3**
- Success criteria have to be defined **TBD by PACS HIFI SPIRE** **Action 4**
- A table of relevant frequencies for the sine wave test **TBD by PACS HIFI SPIRE** **Action 5**
- PLM EQM is equipped with the AVM
- PCDU will be powered with the solar array simulator (TBD) unit in order to provide for best representativity.
- Use of break-out boxes shall be limited because they allow the facility generated noise to enter the equipment.
- Quicklook capability to be clarified
- Performance data to be correlated to the interference event (transient or CW frequency. Data to be checked **off-line** meanwhile testing and after the test (re-test possible during the RS campaign)

D) PLM Radiated Susceptibility

a) RS E-field levels

- 2 V/m in the frequency range from 14 kHz to 18 GHz. > 3 Frequencies per decade. Table of relevant frequencies **TBD by PACS HIFI SPIRE** **Action 6**
- 10 V/m and 18 V/m in particular notches

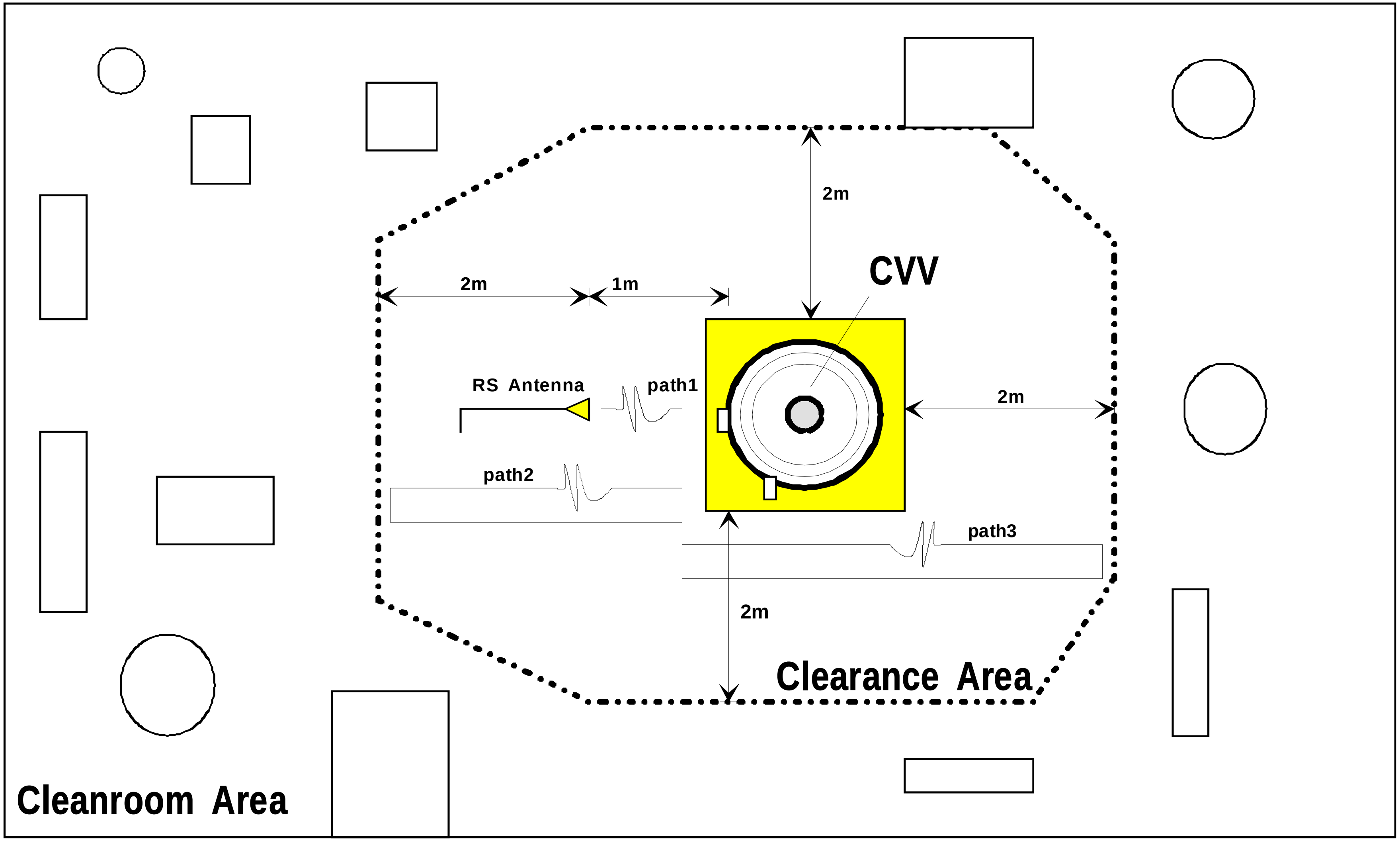
The sine wave signal shall be 30% amplitude modulated by 1 kHz square wave. Above 30 MHz the requirement shall be met both for horizontal and vertical polarization at 3 antenna positions. The test shall be performed as per MIL 462 RS03.

b) RS H-field

- 140 dBpT in the frequency range from 30 Hz to 50 MHz. > 3 Frequencies per decade. Table of relevant frequencies **TBD by PACS HIFI SPIRE** **Action 7**

General:

- Success criteria have to be defined **TBD by PACS HIFI SPIRE (see Action 4)**
- 3 antenna positions for both tests (RS E-field and RS H-field).
- Test in the standard integration facility (see also figure below). Absorber to be installed at least at opposite side of the radiating antenna as well as behind the antenna (minimize standing waves).
- Test harness to be specifically shielded with Al foil (integrate before test).
- most sensitive mode **TBD by PACS HIFI SPIRE (see Action 3)**
- PLM EQM is equipped with the SVM Simulator.
- PCDU will be powered with the solar array simulator (TBD)


2m
CVV
2m
1m
RS Antenna
path1
2m
path2
path3
2m
Clearance Area
Cleanroom Area

4. OUTLOOK

- **EMC Tests foreseen on the EQM PLM have been presented**
- **More detailed definition of the tests needs input from instruments supplier (e.g. which detector lines have to be subjected to tests, which frequencies are interesting from instruments supplier point of view)**
- **Respective requests for information (‘ACTION’) have been indicated in the presentation**
- **Detailed test planning shall be performed on receipt of the requested information’s**

	Name	Dep./Comp.		Name	Dep./Comp.
	Alberti von Mathias Dr.	SM 34	X	Schlosser Christian	OTN/EN 64
	Alo Hakan	OTN/LP 45		Schweickert Gunn	SM 34
	Barlage Bernhard	ED 11		Stauss Oliver	SM 33
X	Bayer Thomas	ED 541		Steininger Eric	ED 422
X	Faas Horst	EA 65		Stritter Rene	ED 11
	Fehringer Alexander	SM 33		Suttner Klaus	SM 32
	Frey Albrecht	ED 422		Tenhaeff Dieter	SM 34
	Gerner Willi	ED 11		Thörmer Klaus-Horst Dr.	OTN/ED 65
	Grasl Andreas	OTN/EN 64		Wagner Adalbert	OTN/LP 45
	Grasshoff Brigitte	ED 521		Wagner Klaus	SM 31
	Hartmann Hans Dr.	ED 422	X	Wietbrock, Walter	ED 521
X	Hauser Armin	SM 31		Wöhler Hans	SM 34
	Hinger Jürgen	SM 31		Zipf Ludwig	ACE 32
	Hohn Rüdiger	ED 541			
X	Hölzle Edgar	ED 421	X	Alcatel	ASP
	Huber Johann	ED 543	X	ESA/ESTEC	ESA
	Hund Walter	SE 76			
X	Idler Siegmund	ED 432		**Instruments:**	
	Ivády von András	ACE 32	X	MPE (PACS)	MPE
	Jahn Gerd Dr.	SM 31	X	RAL (SPIRE)	RAL
X	Kalde Clemens	ED 532	X	SRON (HIFI)	SRON
	Kameter Rudolf	OTN/EN 64		**Subcontractors:**	
X	Kersting Stefan	OTN/EN 63		Air Liquide, Space Department	AIR
	Kettner Bernhard	SM 34		Air Liquide, Space Department	AIRS
	Knoblauch August	ED 531		Air Liquide, Orbital System	AIRT
X	Koelle Markus	ED 523		Alcatel Bell Space	ABSP
	Kroeker Jürgen	ED 542		Astrium Sub-Subsyst. & Equipment	ASSE
	Kunz Oliver	SM 31		Austrian Aerospace	AAE
	Lamprecht Ernst	OTN/SM 222		Austrian Aerospace	AAEM
	Lang Jürgen	SE 76		APCO Technologies S. A.	APCO
	Langfermann Michael	ED 541		Astrium GmbH Space Infrastr.	ASIP
	Mack Paul	OTN/EN 64		Bieri Engineering B. V.	BIER
	Moritz Konrad Dr.	ED 65		BOC Edwards	BOCE
	Muhl Eckhard	OTN/EN 64		Dutch Space Solar Arrays	DSSA
X	Pastorino Michel	ASPI Resid.		EADS CASA Espacio	CASA
	Peitzker Helmut	ED 65		EADS CASA Espacio	ECAS
	Peltz Heinz-Willi	SM 33		Eurocopter	ECDE
	Peters, Gerhard	ED 531		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
	Reuß Friedhelm	ED 62		Prototech AS	PROT
X	Rühe Wolfgang	ED 6		Rembe, Brilon	REMB
	Runge Axel	OTN/EN 64		SENER Ingenieria SA	SEN
	Sachsse Bernt	ED 21		Stöhr, Königsbrunn	STOE
	Schäffler Johannes	OTN/EN 64		Rosemount Aerospace GmbH	ROSE
X	Schink Dietmar	ED 422		RYMSA, Radiación y Microondas S.A.	RYM