



REF. : H-P-ASP-MN- 3655

DATE : 18-09-2003

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COMPTE RENDU DE REUNION / MINUTES OF MEETING

LIEU / PLACE : CANNES

OBJET / PURPOSE :

CLASSIFICATION :

EMC WG meeting #16 - HERSCHEL

PARTICIPANTS ATTENDEES	SOCIETE FIRM	SIGNATURE SIGNATURE	PARTICIPANTS ATTENDEES	SOCIETE FIRM	SIGNATURE SIGNATURE
Bert-Joost van LEEUVEN	SRON		Martin von BERG	MPE	
Albert P.NABER	SRON		Clemens KALDE	ASTRIUM	
Doug GRIFFIN	RAL		André LUC	ASP	
John DELDERFIELD	RAL		Bob HIBBERD	ASP	
Bernard JACKSON	ESTEC		Claude BERTHOV	ASP	
Filippo MARLIANI	ESTEC				
REDACTEUR / WRITTEN BY :					

CONCLUSION :



DISTRIBUTION :
PARTICIPANTS /
ATTENDEES

POUR ACTION :
FOR FURTHER ACTION

POUR INFORMATION :
FOR INFORMATION

APPROUVE PAR / APPROVED BY

NOM / NAME				
SIGNATURE / SIGNATURE				

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COMpte RENDU DE REUNION / MINUTES OF MEETING		LIEU / PLACE : CANNES

SUITE / CONTINUED :

ACTION

AGENDA - SEE ATTACHMENT, DUE TO AVAILABILITY OF MRS BERTHOU (^{ESD} ~~ETC~~ EXPERT FROM ASP) IT IS DECIDED TO START WITH THE ESD MATTERS.

ESD PRESENTATION - SEE ATTACHED HANDOUT.

IT IS AGREED THAT DURING THE TRANSFER ORBIT WHEN ESD CHARGING IS POSSIBLE*, THE CRYOSTAT COVER IS CLOSED THEREFORE ANYTHING INSIDE THE CRYOSTAT IS NOT AT RISK FOR ESD.

TWO AREAS OF ^{ESD} INTEREST REMAIN FOR THE INSTRUMENTS & -

- HARNESS OUTSIDE OF THE CRYOSTAT
- DUST CONTAMINATION DUE TO CHARGING.

THE EXTERNAL HARNESSES ARE OVERSHIELDED ASTRIUM WILL CONFIRM THAT ALL EXTERNAL HARNESSES ARE EFFECTIVELY OVERSHIELDED

- ASP TO ENSURE THAT THE CRYOSTAT COVER IS CLOSED DURING THE TRANSFER ORBIT (PROCEDURES TO DEFINE THIS), ASP TO CHECK THE PRESENT STATUS / REQUIREMENTS OF COVER OPENING.

AI 1
ASTRIUM.
15/10/03

AI 2
ASI
30/9/03.

* CHARGING IS ONLY POSSIBLE DURING TRANSFER ORBIT, NO ^{SIGNIFICANT} CHARGING WILL OCCUR A 'L2'

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- HIFI IDENTIFIED A POTENTIAL PROBLEM WHEREBY THE LOCAL OSCILLATOR WINDOWS CAN CHARGE AND ATTRACT DUST AND CONTAMINANTS CHANGING THE WINDOW TRANSMISSION CHARACTERISTICS. HIFI WILL ADDRESS THIS POINT IN DETAIL DURING A FORTHCOMING HIFI / INDUSTRY INTERFACE MEETING.
- THE INSIDE OF THE LOU IS CONSIDERED AS EXTERNAL AS FAR AS ESD CHARGING IS CONCERNED.
- IT IS INTENDED TO TREAT ^{BLACK} (ANODIZE) THE EXTERNAL SURFACE OF PART OF THE CRYOSTAT. THIS COULD LEAD TO ESD / CHARGING / DUST CONTAMINATION PROBLEMS. ALTERNATIVE BLACK PAINTS HAVE MANUFACTURING / HANDLING / CLEANLINESS PROBLEMS. THE RECOMMENDATION OF THE EMC/ESD WORKING GROUP IS NOT TO PAINT/TREAT THE EXTERNAL CRYOSTAT SURFACE FOR EMC/ESD REASONS.

SUM - FOCAL PLANE COUPLING

SEE ATTACHEMENT WHICH CLOSES ACTION FROM LAST EMC WG MEETING.

EQM EMC TESTS FORESEEN:

SEE PRESENTATION FROM ASTRIUM.

CE/CS TESTS - THIS WG AGREES THAT WHERE THE INSTRUMENT IS ELECTRICALLY REPRESENTATIVE THEN ANY CE/CS TESTING MUST USE REPRESENTATIVE POWER SYSTEM (PCDU). AT PRESENT IT WOULD APPEAR THAT THIS IS NOT THE CASE, FOR THE HPLM. (PACS, SPIRE)

ONLY HIFI HAS 100% ELECTRICALLY REPRESENTATIVE INTERFACES.

THE PURPOSE OF THE CE/CS TESTING IS TO DEMONSTRATE COMPATIBILITY BETWEEN INSTRUMENTS AND INSTRUMENTS TO POWER SYSTEM. A FEASIBLE TEST WOULD USE THE LCL BREAKBOARDS (AND REPRESENTATIVE BUS CAPACITOR) SUPPLYING EACH INSTRUMENT DPU (INSTRUMENT DPUS ARE SIMILAR BUT NOT IDENTICAL), THIS WOULD CHARACTERISE PCDU → INSTRUMENT CE/CS, & INROSH CURRENT.

IN CASE OF THIS LIMITED TESTING, ^(CE/CS ON HPLM) THE RESULTS OBTAINED DURING INSTRUMENT LEVEL TESTING BECOME MORE CRITICAL AND PARTICULAR ATTENTION MUST BE GIVEN TO THESE TEST RESULTS, EVEN AT SYSTEM LEVEL.

RS TESTING:- ESA IS CONCERNED THAT IT WILL NOT BE POSSIBLE TO CONTROL THE 0.2mV/m IN THE FREQUENCY NOTCH (2.4-8GHz) IN A CLEAN ROOM WHICH IS PRESENTLY ALLOCATED FOR THE TESTING.

ASTRIUM TO ENSURE THAT THEIR FACILITIES ARE SUITABLE FOR A TEST WITH HIFI OVER THE NOTCHED RANGE, AI 3
ASTRIUM
15/10/03

HIFI / SPIRE / PACS HAVE TO DEFINE THE GO/NOGO CRITERIA FOR SUSCEPTIBILITY TESTS, AND TO EVALUATE THE TIME NEEDED DURING TESTING TO CHECK THEM.

RMS NOISE MEASUREMENT ON BUS: ASP TO CLARIFY TEST METHODS.

INSTRUMENTS / ESTEC / ASP TO COMMENT

ASTRIUM PRESENTATION.

AI 4/
30/11/03.

18-9-2003

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INSTRUMENTS:

- NO PRESENTATION / COMMENTS FROM SPIRE.
- THE CRYO HARNESS OF THE HIFI EQM HAS BEEN DISCUSSED, IT WAS AGREED THAT FOR UNUSED CHANNELS THE RETURN LINES AND SHIELDS / OVERSHIELD WILL BE CONNECTED BUT THE SIGNAL WIRE WILL BE LEFT NOT CONNECTED AT BOTH FCU AND FPU ENDS. THE UNUSED CHANNELS INPUTS & OUTPUTS WILL BE SHORT CIRCUITED TO THEIR RESPECTIVE GROUNDS AT FCU LEVEL (WARM HARNESS).
- HIFI WILL PROVIDE THEIR EMC TEST DOCUMENTATION (TEST PLAN) WITHIN THE NEXT 4 WEEKS, ESA/ASTRUM/ASP TO COMMENT.
- HIFI HAVE PREPARED AN ANALYSE 'HERSCHEL RS VERIFICATION' WHICH IDENTIFIES A NEED TO MEASURE THE SHIELDING EFFECTIVENESS OF THE CRYOSTAT. ASTRUM TO
DETAIL HOW THIS MEASUREMENT WILL BE PERFORMED. AI5
15/10/03
- PACS PRESENTATION - SEE ATTACHMENT.
- NEXT HERSCHEL EMC WG. MEETING PLANNED FOR
29/1/2004 IN CANNES.



EMC/Power WG meeting #16

Cannes, 18 September 2003

ANNEX 1

ASP HANDOUT



EMC/Power WG meeting #16

Cannes, 18 September 2003

AGENDA

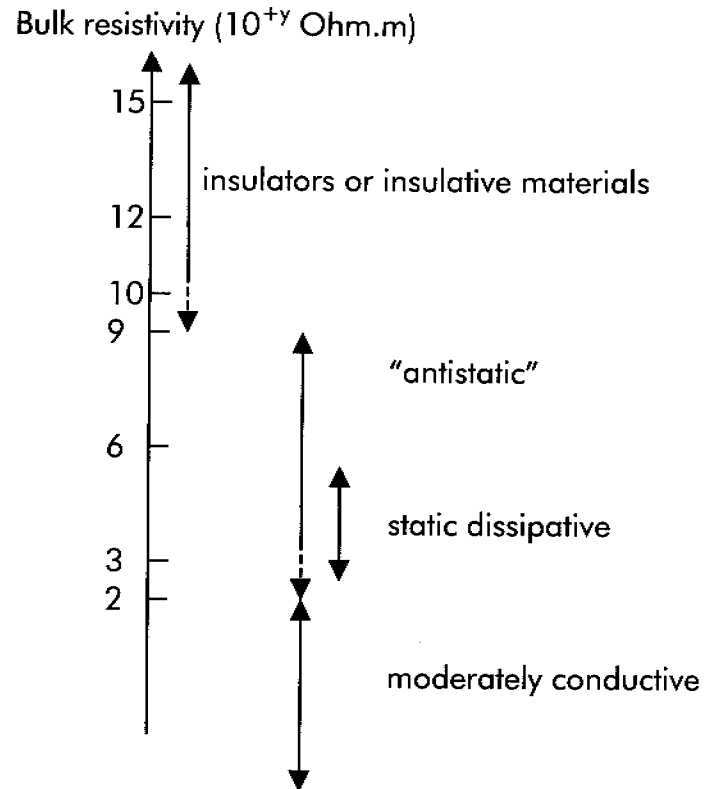
- ▼ Summary by each Instrument of their EMC status
 - Test plan
 - Compliance matrix
 - Analyses
 - Test results (if any)

EXTERNAL CHARGING can occur

- ▼ during geomagnetic storms
- ▼ close to the geostationary orbit

TO PREVENT charging (and discharges)

- ▼ grounding of all conductive elements
- ▼ use of 'antistatic in space' materials



- ▼ Material (bulk) resistivity can be obtained with 2 electrodes :



- ▼ Material surface resistance can be obtained with 2 electrodes :



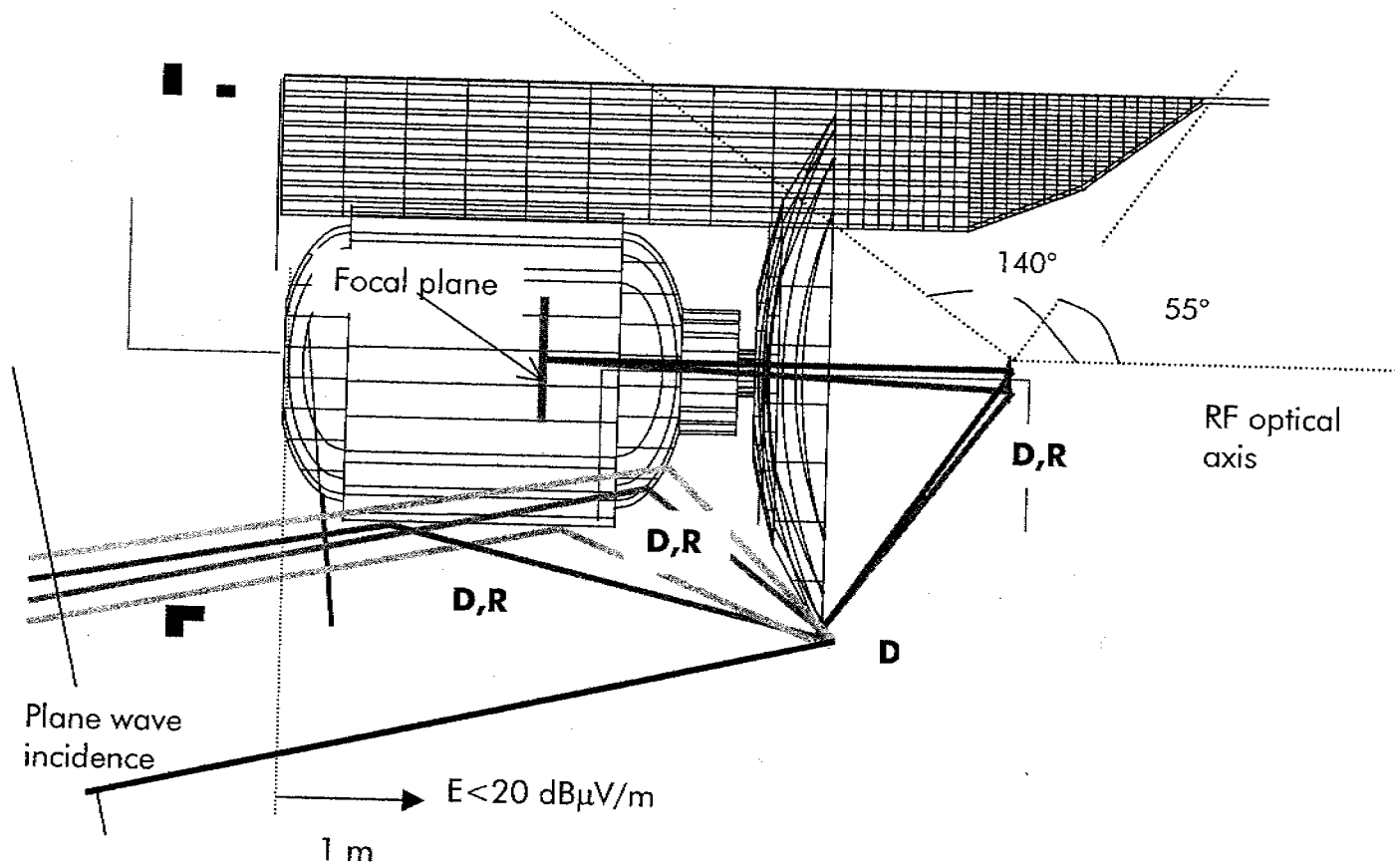
- ▼ resistivity and surface resistance characterize 2 different phenomena

- ▼ Electrostatic requirements are :
 - resistivity $r < 10^{+9}$ ohm.m
 - surface resistance $< 10^{+9}$ Ohm/square or $r \cdot t < 2 \cdot 10^{+9}$ Ohm-cm² (if grounded at the edges)
 - r is the resistivity in ohm.cm
 - t is the material thickness in cm
- ▼ black anodization surface resistance is very high
 $R_s = 10^{+14}$ Ohm/sq
- ▼ black anodization resistivity is not known but it should be less than 10^{+10} Ohm.m assuming 20 μm thickness ... improbable



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- ▼ Coupling between SVM and Focal Plane of the telescope :
 - An incident plane wave propagating from SVM to the telescope has been considered.
 - The amplitude has been scaled to obtain the specified amplitude of $20 \text{ dB}\mu\text{V/m}$ at 1 m from the SVM in the frequency range 2.4 up to 8 GHz.
 - E field levels have been computed with GTD and PO+PTD
 - The minimum value obtained for the decoupling between SVM and FP is 36 dB



GRASP 8 model : different paths for the GTD computation

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ANNEX 2

ASED HANDOUT

PLM EMC Test Programme

Agenda:

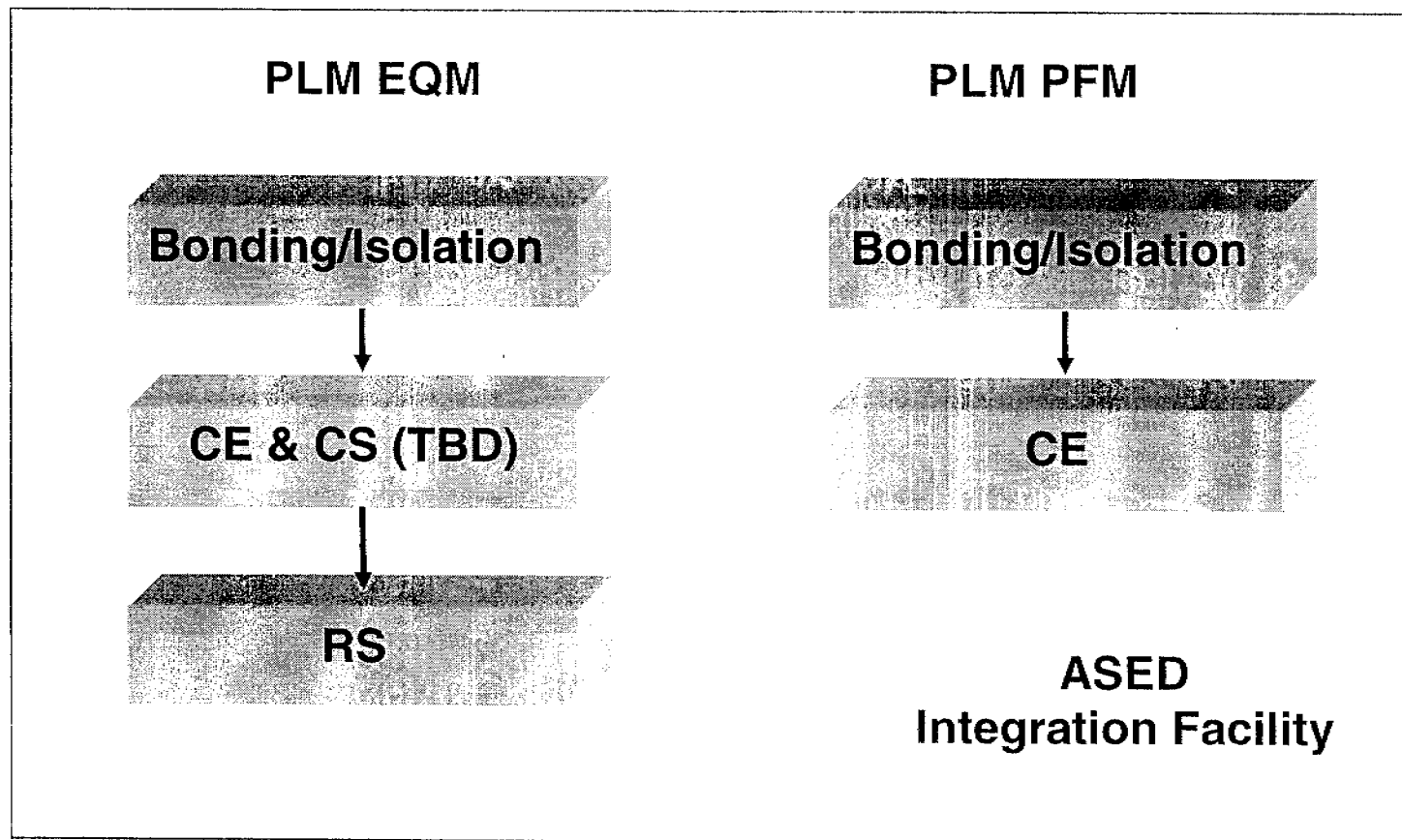
1. Test Philosophy
2. PLM EMC Test
3. SAT EMC Test
4. Open Points

1. HERSCHEL EMC TEST PHILOSOPHY
2. PLM EMC TESTS
3. SATELLITE EMC TESTS
4. GENERAL OPEN POINTS

1. HERSCHEL EMC TEST PHILOSOPHY

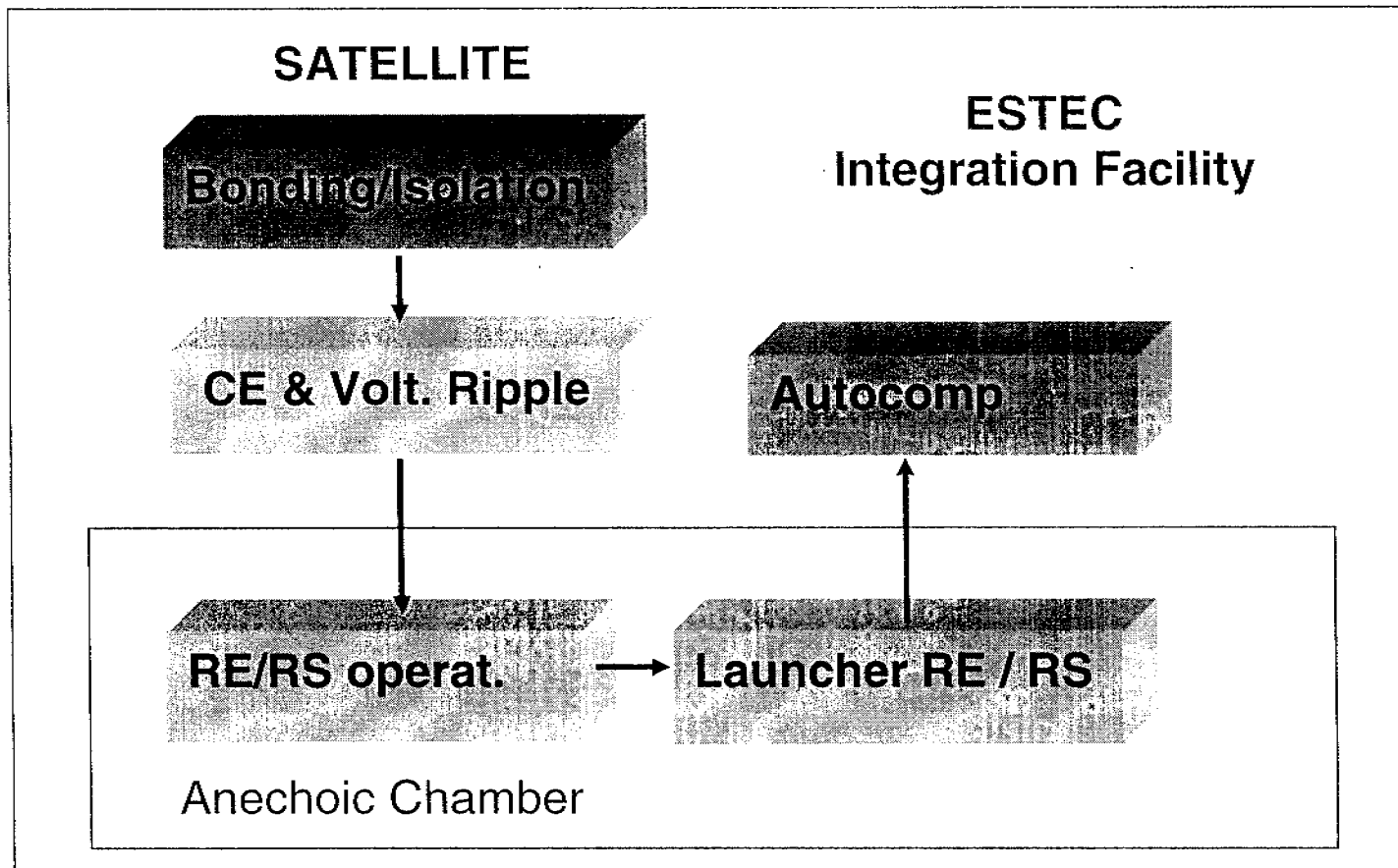
- Agenda:
1. Test Philosophy
 2. PLM EMC Test
 3. SAT EMC Test
 4. Open Points

1a) PLM Level EMC Tests



- Agenda:
- 1. Test Philosophy
 - 2. PLM EMC Test
 - 3. SAT EMC Test
 - 4. Open Points

1b) Satellite EMC Tests

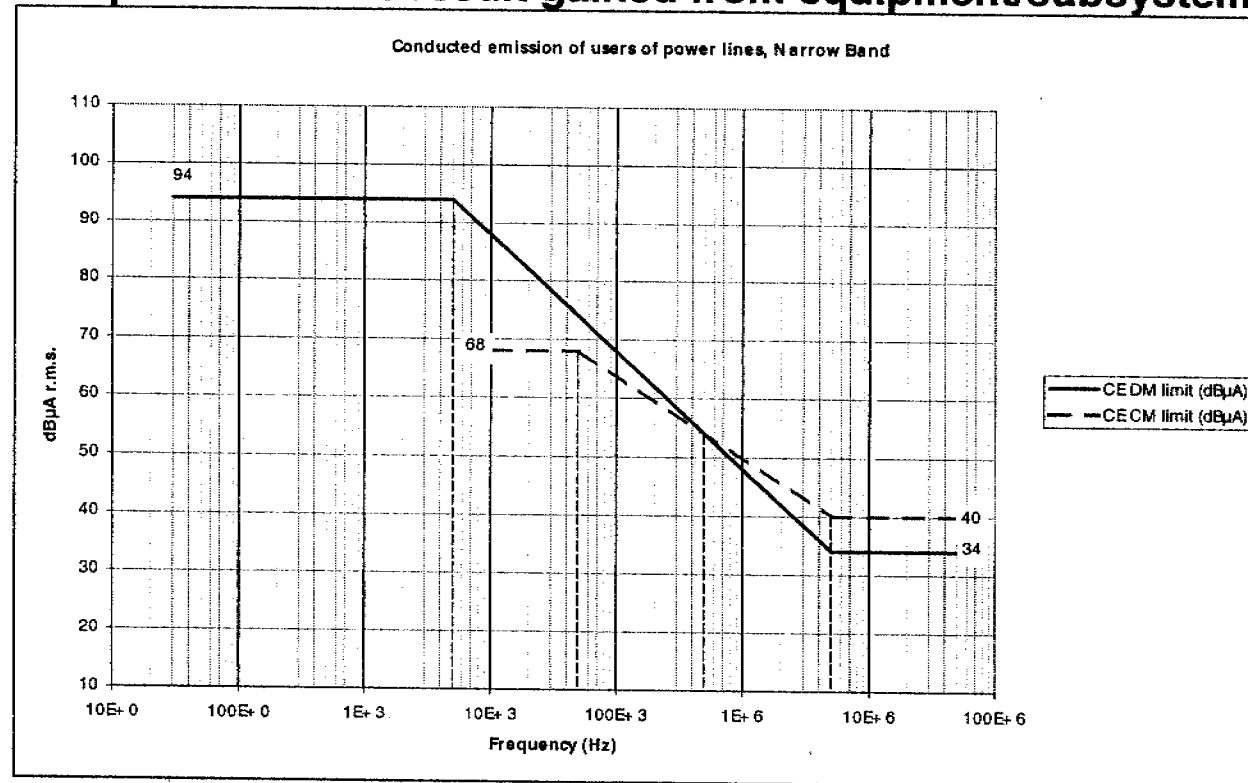


2. PLM EMC TESTS

2a) PLM Conducted Emission

CE Common Mode Current, spectrum analyzer measurement (NB).
Result shall be compared with the result gained from equipment/subsystem level.

- Agenda:**
- 1. Test Philosophy
 - 2. PLM EMC Test
 - 3. SAT EMC Test
 - 4. Open Points



CE of Users of Primary Power Lines (for reference only)

Q1:

WHICH POWER LINES ARE REPRESENTATIVE?

Agenda: 1. Test Philosophy 2. PLM EMC Test 3. SAT EMC Test 4. Open Points
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2b) PLM Conducted Susceptibility

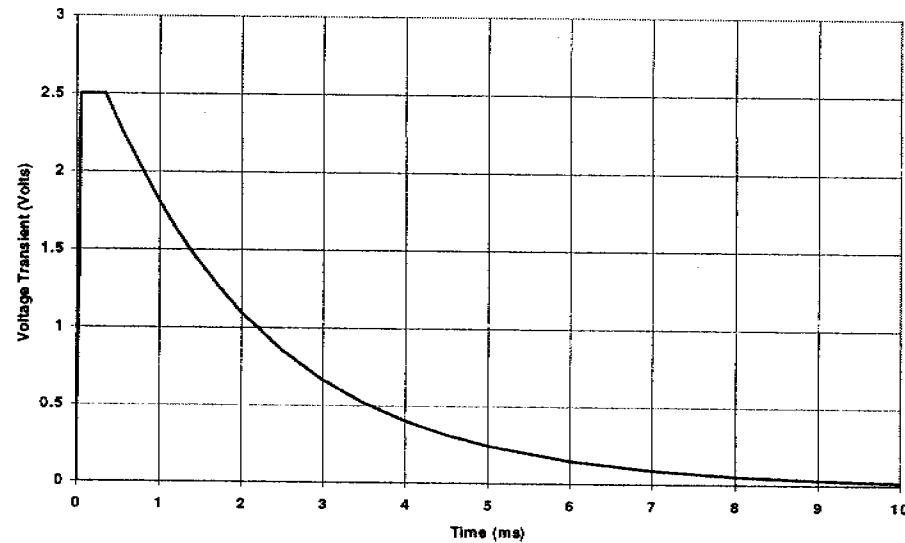
- CS Sine Wave DM
- CS Sine Wave CM
- CS Transient DM
- CS Transient CM

Modes/Operation for CE/CS

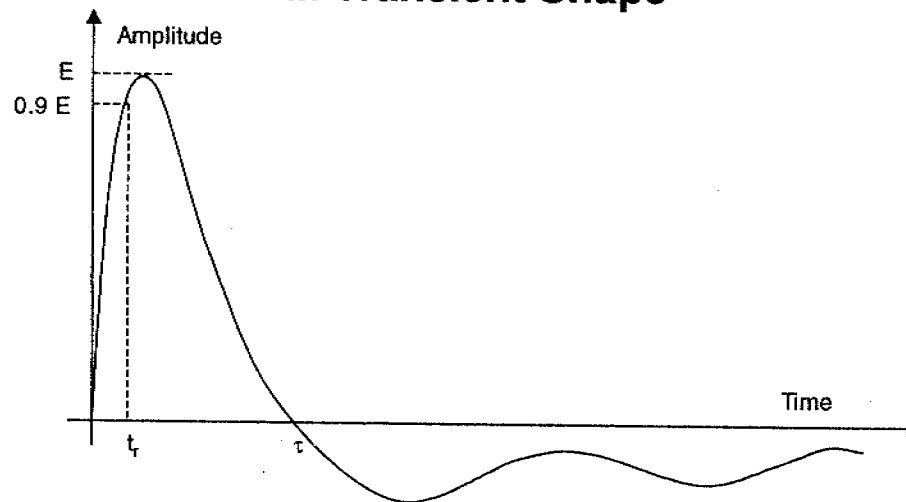
- Nominal modes to be applied
- PLM EQM with SVM Simulator
- PLM PFM with SVM Simulator (no accessibility of interfaces with SVM)
- PCDU powered main bus conditioner (*no PCDU av. for PLM ERM*)
- Use of break-out boxes to be limited (facility noise coupling)

Q2: MOST NOISIEST AND MOST SENSITIVE MODES TO BE DEFINED!

- Agenda:**
- 1. Test Philosophy
 - 2. PLM EMC Test
 - 3. SAT EMC Test
 - 4. Open Points



DM Transient Shape



CM Transient Shape

Agenda:

1. Test Philosophy
2. PLM EMC Test
3. SAT EMC Test
4. Open Points

2c) PLM RS E-field injection, 14 kHz - 18 GHz

- 3 Instruments each with 3 antenna positions, @ $f > 30$ MHz H/V polarization => (18 tests)
- Injection Level: - 2 V/m, 1 m distance, 30 % AM with 1 kHz square wave,
- 18 V/m or 10 V/m in RF notches.
- Calibration of the E- Field- levels performed in the EMC Facility. Test in clean room
- Spot frequencies, 10 max. per decade.
- Measuring 5 min/frequency. Further time needed for noise evaluation not estimated.

Q: REFER TO LAST PAGE, 'General open points'

2d) PLM RS AC- H- Field injection, 30 Hz - 50 kHz

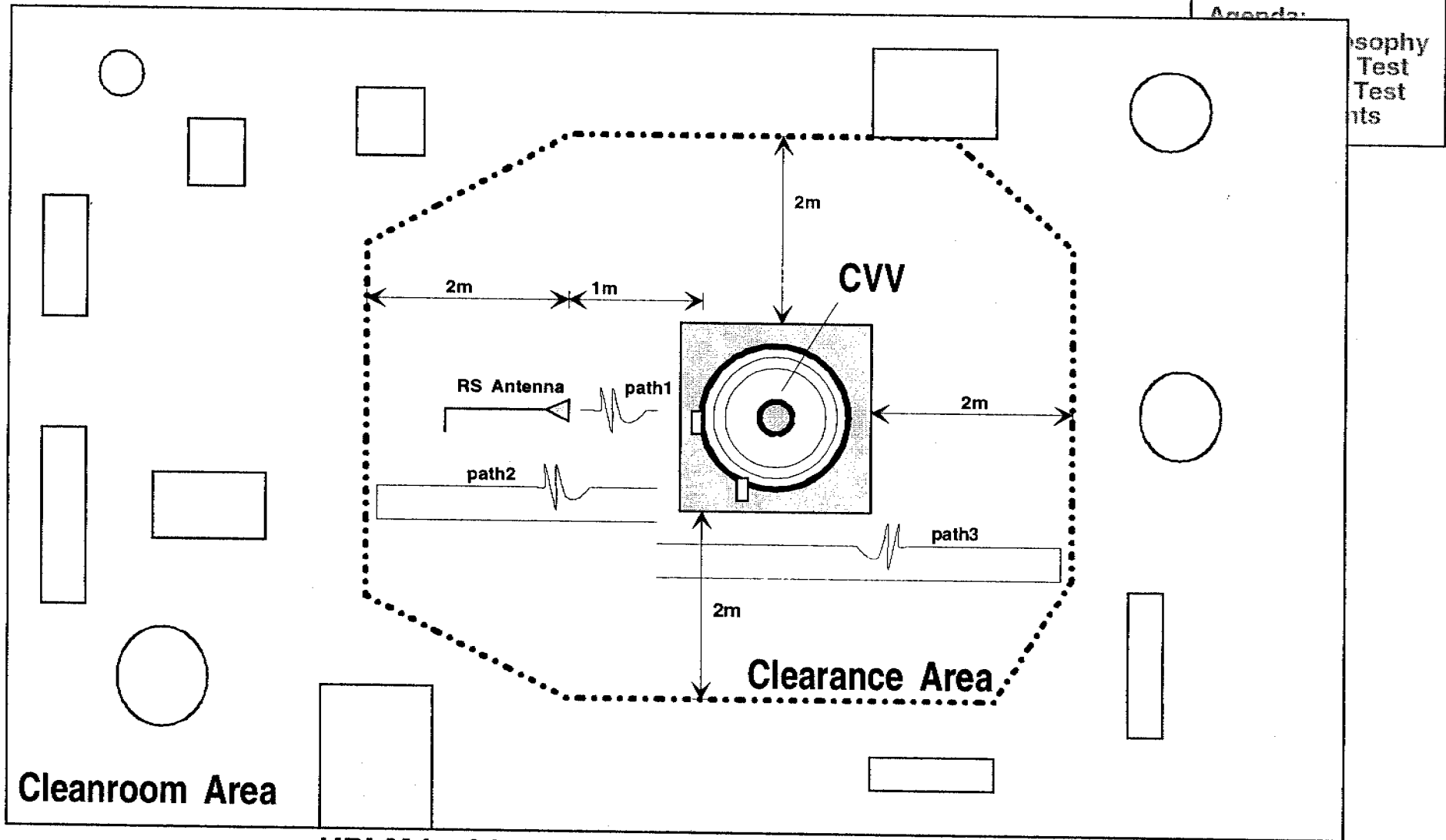
- 3 Instruments, for each 3 antenna locations/-orientations. 9 tests.
- Injection Level: 140 dBpT Sine wave, distance 1 m.
- Field Calibration in EMC Facility, test in clean room.
- Spot frequencies, < 10 per decade.
- The measuring time 5 min/frequency. Further time needed for noise evaluation not estimated.

Q: REFER TO LAST PAGE, 'General open points'

Agenda:
1. Test Philosophy
2. PLM EMC Test
3. SAT EMC Test
4. Open Points

Modes/Operation for PLM RS

- **Nominal modes to be applied the equipment must be sensitive.**
- **Performance checks as usual, Susceptibility threshold to be predicted.**
- **PLM EQM with SVM Simulator, PCDU powered by main bus conditioner**
- **Use of break-out boxes to be limited (facility noise coupling)**
- **Test in standard integration facility.**
- **Clearance to facility at least 2 m. Absorber walls, minimize standing waves.**
- **Test harness to be overall shielded with aluminum foil where appropriate.**



HPLM Inside the Integration Facility during RS tests

3. SATELLITE EMC TESTS

Agenda:
1. Test Philosophy
2. PLM EMC Test
3. SAT EMC Test
4. Open Points

3a) Spacecraft CE

1. Spectral analysis of common and differential mode current on primary power lines in the frequency range from 30 Hz to 50 MHz. Details TBD ???
- 2. RMS noise measurement on primary power lines in a 10 MHz frequency bandwidth (measured with RMS voltmeter or digital oscilloscope capable to compute it). Details TBD ???
3. CE measurements on TBD links between service module and payload module.
4. The voltage ripple between SVM and PLM structures shall be measured.

The feasibility of those tests is still rather questionable so far break-out boxes are necessary. The accessibility of power lines in the SVM is questionable

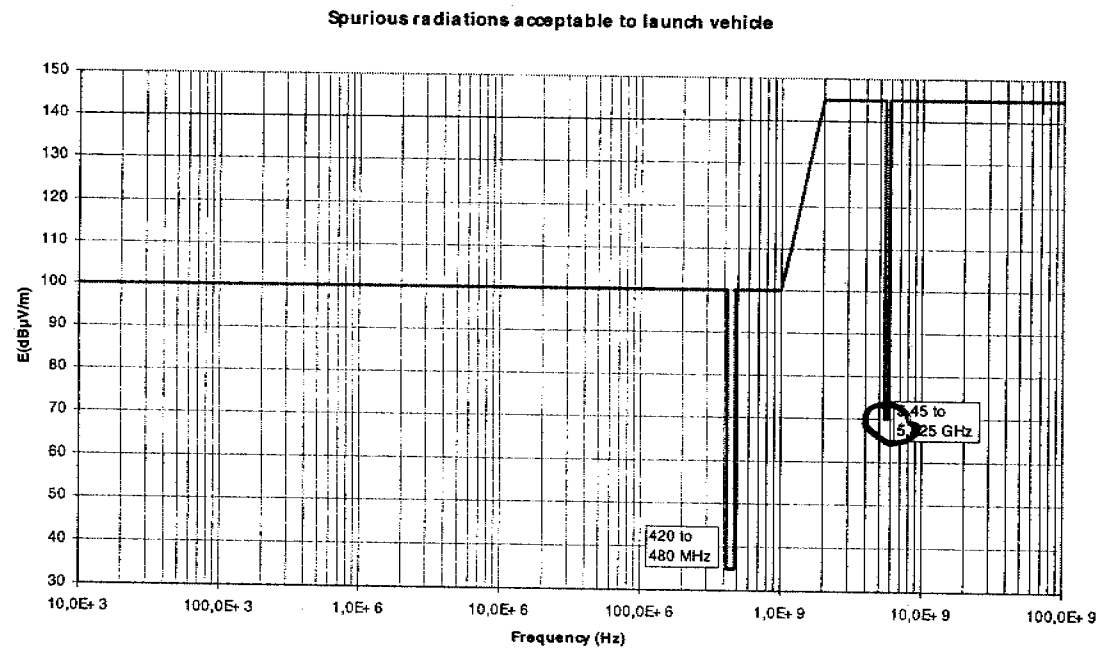
Modes/Configuration:

- Satellite Modes nominal, complete satellite.
- PCPU will be powered by SAS for representativity
- No break-out boxes.
- Spacecraft antennas must be covered with test caps that can handle the RF power

- Agenda:**
1. Test Philosophy
 2. PLM EMC Test
 3. SAT EMC Test
 4. Open Points

3b) Spacecraft RE

- Launch mode: Limit shown below.



Maximum tolerable E-field in Launch Mode

- Operational mode: No limit defined but the E-field to be measured from 3 different locations around the cryostat from 14 kHz to 18 GHz.

Agenda: 1. Test Philosophy 2. PLM EMC Test 3. SAT EMC Test 4. Open Points
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3c) Spacecraft RS

- RS E-field 2 V/m from 14 kHz to 18 GHz, 10 V/m and 18 V/m for notches. 30% amplitude modulation by 1 kHz square wave.
- Above 30 MHz horizontal and vertical polarization.
- The RS H-field level of 140 dBpT in the frequency range from 30 Hz to 50 kHz shall not lead to malfunction.

Modes/Configuration

- PCDU will be powered SAS for representativity
- RS E-field test both operational and launch mode.
- or RS H-field only operational mode.
- Performance checks as usual / Susceptibility threshold to be predicted.
- Anechoic chamber
- Operational Mode: 3 antenna positions direction harness and optical apertures
- Launch Mode: 1 antenna position direction separation interface.
- No break-out boxes.
- Spacecraft antennas must be covered with test caps that can handle RF power. Venting holes in caps to be closed.
- Test harness specifically shielded with Al foil (to be integrated before start of test).

<p>Agenda: 1. Test Philosophy 2. PLM EMC Test 3. SAT EMC Test 4. Open Points</p>

4. General OPEN POINTS

- Q3: IS A REFERENCE TEST NECESSITY BEFORE CS/RS TEST? JUSTIFY AND CLARIFY THE TIME DURATION AND INTERVALLS NEEDED FOR IT.**
- Q4: HOW LONG TO BE SUBJECTED TO THE CS/RS FREQUENCY?**
- Q5: HOW LONG WILL IT TAKE TO GATHER THE DATA FOR PERFORMANCE PREDICTION**
- Q6: WHICH KIND OF PERFORMANCE PARAMETER TO BE CHECKED**
- Q7: HOW LONG WILL OFF-LINE EVALUATION TAKE FOR ONE FREQUENCY STEP (CS AND RS)**
- Q8: CONSTRAINTS (EG ON EMC TEST DURATION; COOLER RECYCLE CONSTRAINS ETC TO BE CLARIFIED**



EMC/Power WG meeting #16 **Cannes, 18 September 2003**

ANNEX 3

PACS HANDOUT

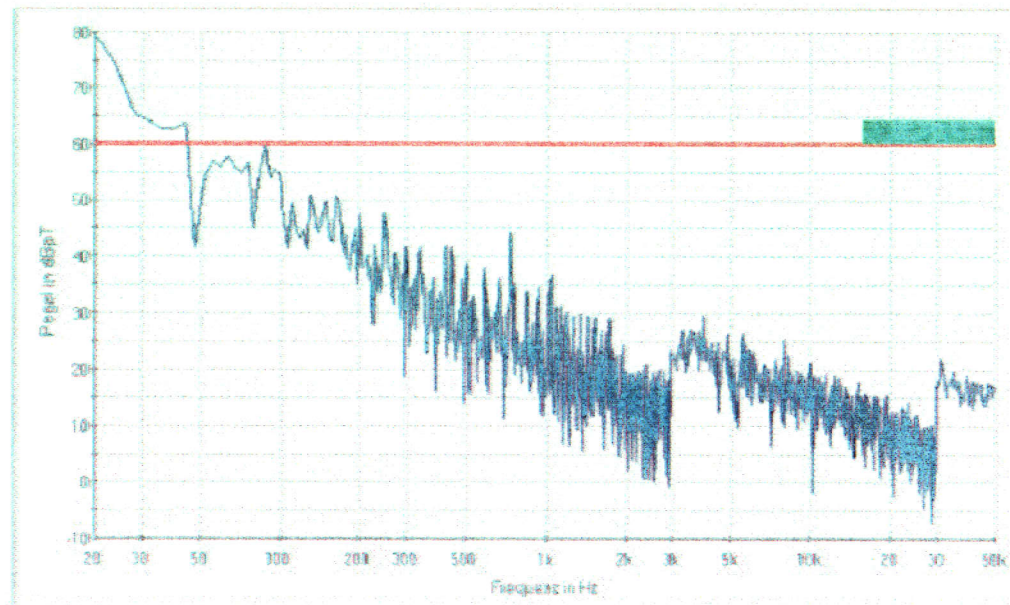
PACS

EMC Status

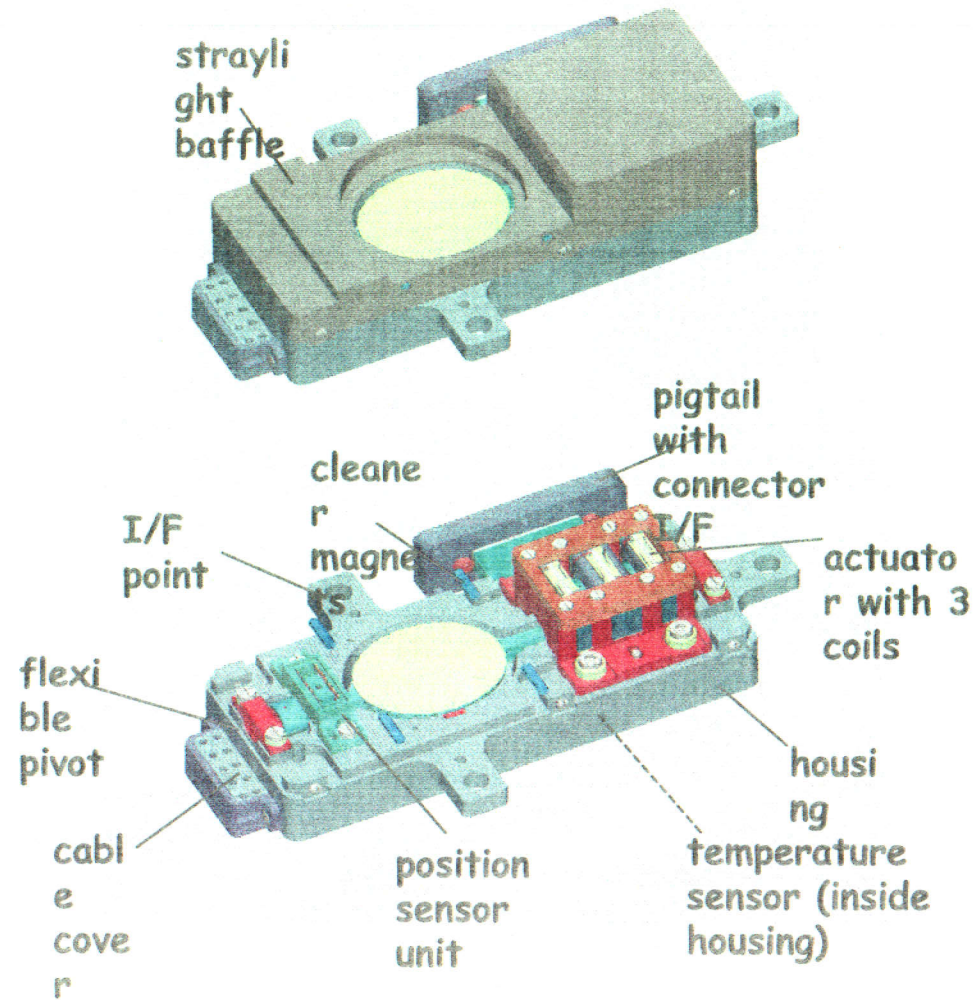
Martin von Berg

EMC Measurements I

- QM Chopper EMC (done at Zeiss Lab.)
 - NB RE-H above IID-A Limits (1m distance to Chopper)
 - Same is for Filterwheel and Grating expected



PACS Chopper



EMC Measurements II

- AVM SPU EMC (done at CRISA Lab.)
 - CE above the limits
 - Inrush Current close to 2 mC limit

- 1355 Problem investigation
 - AVM ILT Equipment in-line with IID-A except LVDS
 - LVDS CMV specified to 1.2 V max
 - IID-A §5.14.3.6. CS CM on signal reference requires 2V max. CMV

EMC Preparation for EQM ILT

- MPE EMC Measurements
 - Set-up different to PFM PACS
 - Cryostat, harness length, WU Box dimensions, PS
 - External PS, only DPU FFF
 - Only Conducted Measurements planned
- ^SAtrium EMC Measurements
 - SVM Panel not FFF,
 - Long harness between external PS not possible

EMC Documentation

- PACS Grounding Scheme
 - Was released and is up to date

- EMC Control Plan
 - Ready to 30 % but slow progress

- EMC / ESD Analysis
 - only for subunits (Chopper)
 - detector chain only for bolometers
 - Spectrometer still pending