EADS astrium

# HERSCHEL FM SAT Radiated EMC Test Procedure

Herschel

Title: **HERSCHEL FM SAT RE / AutoComp EMC Test Procedure**

CI-No: 100000

| | | | |
|---|---|---|---|
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| Issue | Date | Sheet | Description of Change | Release |
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| 1 | 30.04.08 | All | Initial issue.<br>RS test separated from doc (see HP-2-ASED-TP-0222);<br>RE and AutoComp. test updated | |

## Table of Content

# 1 Scope

## 1.1 Objective

This procedure describes the activities to be carried out for the HERSCHEL Radiated Emission (RE) and AutoCompatibility tests in order to confirm the compatibility of the satellite itself.

## 1.2 Flow

The test flow is shown in figure 1.2-1.

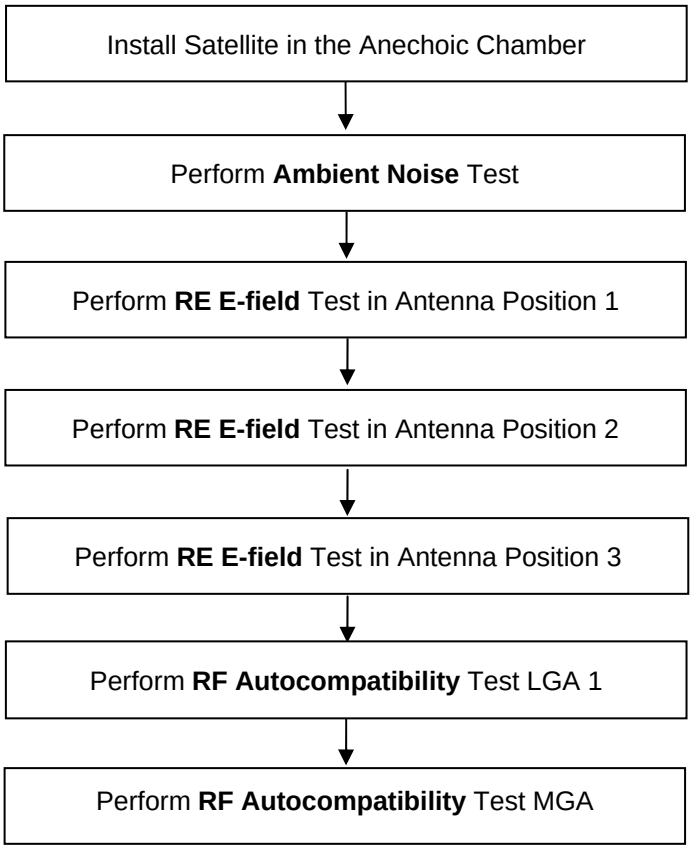


Figure 1.2-1: HERSCHEL FM Radiated EMC Test Flow

## 1.3 Test Specimen

The test specimen is the integrated HERSCHEL FM satellite.

## 1.4 Test objectives

The object of this test is to provide confirmation that the integrated spacecraft radiated emissions in operational mode are within acceptable limits measured at several positions around the spacecraft and that telecommands at lowest level are not disturbed by the S/C own radiation.

This information will be used in determining the system level RE/RS compatibility margins.

# 2 Documents/Drawings

The following documents in their latest issue are applicable to this procedure:

## 2.1 Applicable Documents

| | | |
|---|---|---|
| AD1 | HP-2-ASED-PL-00007 | Herschel PA Plan |
| AD2 | HP-2-ASED-PL-0023 | Herschel Contamination Control Plan |
| AD3 | H-P-2-ASP-SP-0939 | HERSCHEL IST Specification |
| AD4 | H-P-1-ASPI-PL-0038 | HERSCHEL/PLANCK EMC/ESD Control Plan |
| AD5 | HP-2-ASED-PR-116 | Herschel EGSE, Satellite & Instrument Procedure for EMC Radiated Test |
| AD6 | H-P-1-ASPI-SP-0037 | EMC Specification |
| AD7 | H-P-2-ASP-TS-0819 | HERSCHEL FM EMC Test Requirements Specification |
| AD8 | HP-2-ASED-PL-0013 | PLM EMC Control and Verification Plan |
| AD9 | HP-2-ASED-PL-0037 | Herschel EMC Test Plan |

## 2.2 Reference Documents

In this section all documents are given which either

- could serve as reference for the radiated tests, or
- may be referred in the test report for clarification/justification of an outcome (result) of the test.

| | | |
|---|---|---|
| RD1 | PACS-ME-TP-032 | PACS EMC Procedures |
| RD2 | SPIRE-RAL-PRC-003068 | SPIRE RE Most Emissive Mode EMC Test Procedures for IST |
| RD3 | SRON-G/HIFI/PR/2007-022 | HIFI radiated emissivity procedures for IST tests |
| RD4 | HP-2-ASED-PR-0123 | Helium Refilling |
| RD5 | HP-2-ASED-TP-0134 | Herschel IST leading Procedure |

# 3 Configuration

## 3.1 HERSCHEL Satellite FM Mechanical / Electrical Configuration

For the EMC RE test the Herschel satellite is mounted on the adapter ring. Both are than positioned on a wooden air pallet provided by the facility in order to be compliant with the floor load requirements of the Maxwell EMC chamber. The satellite is connected with the SCOE's via 30 m long cables. The setup is shown in sect. 3.5.

A hose for venting the cryostat has to be routed from the cryostat to the outside of the EMC chamber.

### *3.1.1 Cooling*

HIFI shall be cooled whenever it is in a higher mode than STB. This is performed with a mobile AirCon placed in the Rosetta cleanroom. The cold air is than ducted in a hose through the chamber wall close to the HIFI panel where it increases the convection.

### *3.1.2 Cryo conditions*

There is no constraint for He-I conditions from any FPU if temperatures are in the following range:

- Level 0 temperature (HTT upper bulkhead, T107): 4.2 - 6.5 K (4.2 - 7K at L0 I/F)
- Level 1 temperature (vent line, T231 - 237): 4.2 - 15 K
- Level 2 temperature (OBP, T254 T207): 5 - 30 K
- Level 3 temperature (Spire J-FET, T246 T247): 5 - 50 K
- No constraint on thermal shield and CVV
- Cryo cover temperature: 220 -260 K
- Temperatures might drift in the above given range during test.
- S/C is in vertical position and no movement during test.

### *3.1.3 Shielding and Grounding*

The SCOE cables shall be shielded with aluminum foil from the satellite to the point where they go into the holes for the tunnels to the Rosetta clean room respectively the wall of the EMC chamber, as applicable.

The facility clean ground shall be connected to the PCDU panel. This is a single point ground which also grounds the adapter ring. The ground strap shall be routed in parallel to the SCOE cabling. Figure 3.2-1 gives an overview of the grounding during the test.

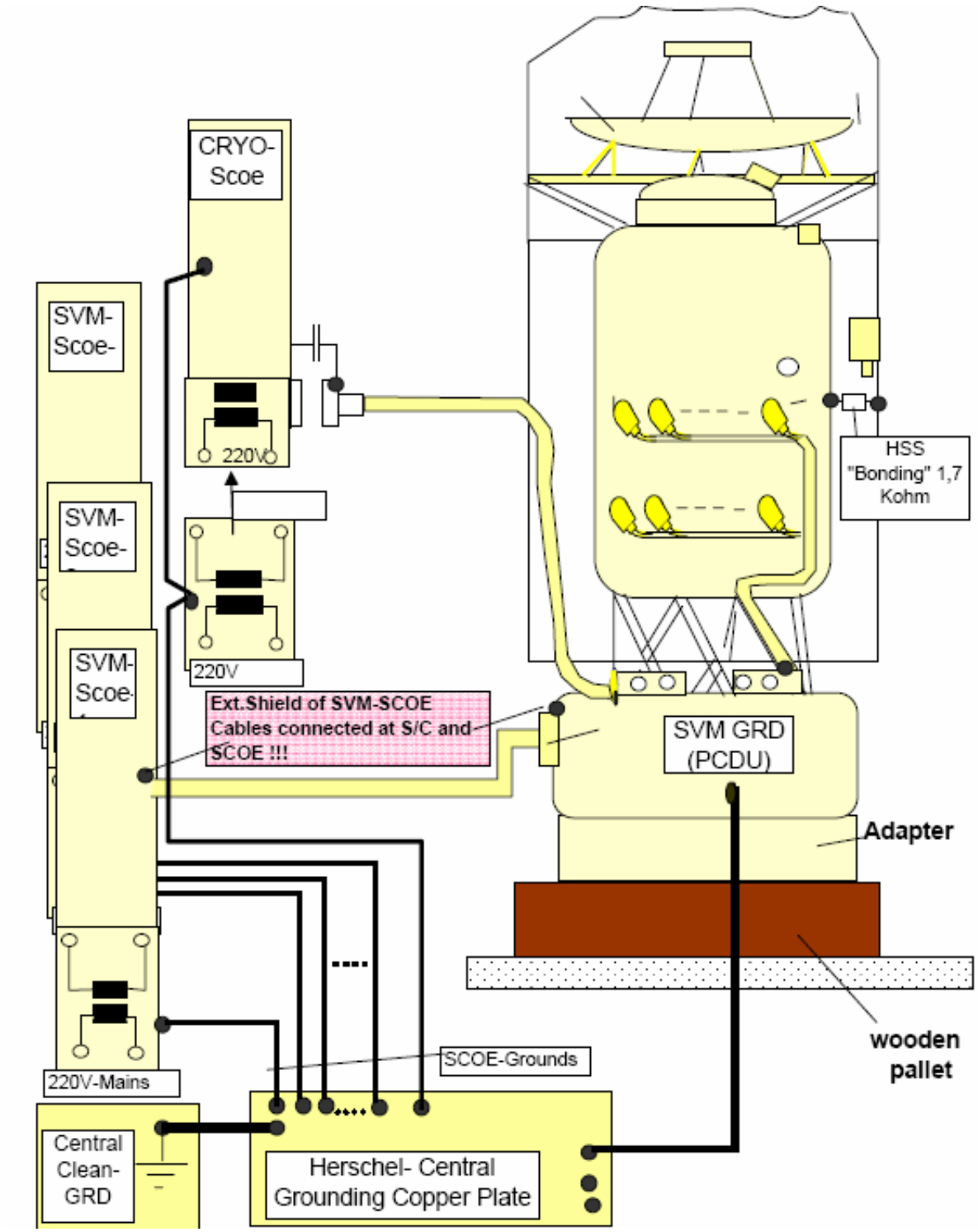


Figure 3.2-1: Grounding in EMC chamber

## 3.2 EGSE Configuration

The following SCOE's have to be located close to the S/C outside the EMC chamber (cable length 30m):

Table 3-1 shows the configuration for the SCOE's.

| Subsystem | Electrical Configuration | Mechanical Configuration |
|---|---|---|
| SAS SCOE | • Online<br>• Voc = 43 V<br>• Isc = 2.0 A<br>• Rs = 0.1<br>• N = 100<br>• Vprot = 45 V<br>• Iprot (FPCS) less than 3.3 A<br>• AIT BDR 1 and BDR 2 = ON<br>• Separation Straps 1 to 8 = separated<br>• SA Temp simulation set to 110 °C<br>Battery Simulator Nominal Set: | 3 racks + PC |
| BS SCOE | • Online<br>• Vbat = 24 V<br>• Icharge = 10 A<br>• Idisch = 16 A<br>• OVP = 27 V<br>• OCP = ON | 1 rack + PC |
| TT&C SCOE | All instruments ON and RF cables connected to TT&C subsystem in order to provide<br>• RF downlink signal spectrum monitoring | 1 rack + PC |
| TM/TC DFE | • Online<br>• TM Chain A<br>• TC Chain A<br>• Archiving ON | 1 rack + PC |
| Cryo SCOE | • Data Acquisition | 1 rack + PC |

Table 3.2-1: EGSE Configuration

## 3.3 HERSCHEL Satellite FM Operational Configurations

Table 3.3-1 shows the SVM Operational Configurations and Table 3.3-2 the Instrument Configurations in RE and AutoComp for the used modes. The communication with the S/C shall be made via the umbilical.

| | Mode 1 | Mode 2 | Mode 3 |
|---|---|---|---|
| **Power Panel** | | | |
| CDMU | ON, NOM | ON, NOM | ON, NOM |
| ACC | ON, Standby | ON, Standby | ON, Standby |
| PCDU | ON | ON | ON |
| Battery | Not connected | Not connected | Not connected |
| **TTC Panel** | | | |
| EPC1 | ON | ON | ON |
| TWT1 | ON | ON | ON |
| EPC2 | OFF | OFF | OFF |
| TWT2 | OFF | OFF | OFF |
| XPND1 | ON, RX + TX | ON, RX + TX | ON, RX + TX |
| XPND2 | ON, but only RX | ON, but only RX | ON, but only RX |
| RFDN | / | / | / |
| **AOCS sensors** | | | |
| STR1 | ON | ON | ON |
| STR2 | OFF | OFF | OFF |
| CRS1 | ON | ON | ON |
| CRS2 | ON | ON | ON |
| RWL-1 | ON *) | ON *) | ON *) |
| RWL-2 | ON *) | ON *) | ON *) |
| RWL-3 | ON *) | ON *) | ON *) |
| RWL-4 | ON *) | ON *) | ON *) |
| GYRO A | ON | ON | ON |
| GYRO B | OFF | OFF | OFF |
| SAS | / | / | / |
| AAD | / | / | / |
| **Propulsion** | | | |
| PT | ON | ON | ON |
| 20N thrusters cat bed | OFF | OFF | OFF |
| Latch valve | OFF | OFF | OFF |
| **Miscellaneous** | | | |
| SREM | ON | ON | ON |
| VMC | ON | ON | ON |

*): Reaction wheels are ON but not rotating

Table 3.3-1: SVM Operational Configurations in RE / AutoComp.

| | Mode 1 | Mode 2 | Mode 3 |
|---|---|---|---|
| **PACS** | Safe Mode | Safe Mode | Safe Mode |
| **SPIRE** | Most Emissive Mode | Stand By | Stand By |
| **HIFI** | Stand By | Most Noisy Mode | Stand By |
| **PACS FPU** | OFF | OFF | OFF |
| **PACS Panel** | | | |
| FPSPU N | ON | ON | ON |
| FPSPU R | OFF | OFF | OFF |
| FPDPU N | ON | ON | ON |
| FPDPU R | OFF | OFF | OFF |
| FPDEC/MEC1 | ON | ON | ON |
| FPDEC/MEC2 | OFF | OFF | OFF |
| FPBOLC N | ON | ON | ON |
| FPBOLC R | OFF | OFF | OFF |
| **SPIRE FPU** | ON | OFF | OFF |
| **SPIRE Panel** | | | |
| HSDPU N | ON | ON | ON |
| HSDPU R | OFF | OFF | OFF |
| HSFCU N | ON | ON | ON |
| HSFCU R | OFF | OFF | OFF |
| HSDCU N | ON | ON | ON |
| HSDCU R | OFF | OFF | OFF |
| CCU A | ON | ON | ON |
| CCU B | ON | ON | ON |
| **HIFI LOU** | OFF | ON / warm | ON / warm |
| **HIFI FPU** | ON | ON / cold | ON / cold |
| **HIFI Panels** | | | |
| FHWEH | ON | ON | ON |
| FHWEV | ON | ON | ON |
| FHLCU N | ON | ON | ON |
| FHLCU R | OFF | OFF | OFF |
| FHHRH | ON | ON | ON |
| FHHRV | ON | ON | ON |
| FHICU N | ON | ON | ON |
| FHICU R | OFF | OFF | OFF |
| FHFCU N | ON | ON | ON |
| FHFCU R | OFF | OFF | OFF |

Table 3.3-2: Instrument Mode Configurations in RE / AutoComp.

## 3.4 GSE Calibration Status

All test hardware shall be calibrated and shall be within the calibration period during the test time. The test equipment list Table 3.4-1 shall be completed during the test and included in the test report.

| Test Equipment List | | | | | |
|---|---|---|---|---|---|
| **Item** | **Manuf.** | **Model No.** | **SN No.** | **Invent No.** | **Next Calib.** |
| | | | | | |

Table 3.4-1: Test Equipment List

## 3.5 Set-Up in Facility

The activities as detailed in this procedure shall be carried out in the Maxwell anechoic chamber of ESA/ ESTEC in Noordwijk, Netherland.

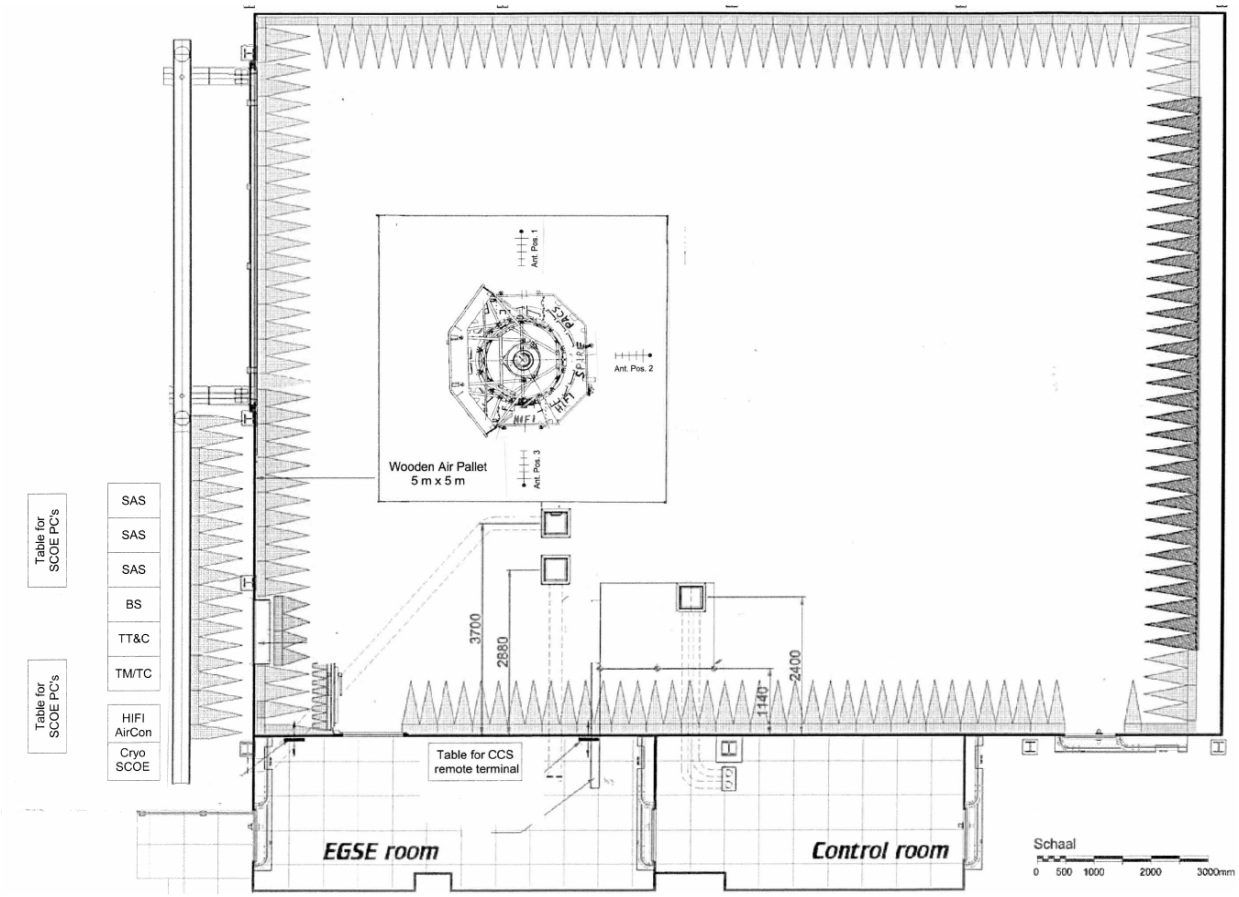


Figure 3.5-1 Arrangement of the EGSE and S/C in facility

## 3.6 General Requirements

- The handling of the test set-up shall be in accordance with controlled procedure only
- Handling, mechanical and electrical, has to be done only by qualified personnel

## 3.7 Environmental Conditions

All activities specified in the procedure have to be performed in the anechoic chamber, clean room class 100 000 environment.

Temperature: 22°C +/- 3°C

Relative Humidity: 40% to 55%

The cleanliness requirements will be observed throughout the activities, and the overall contamination control requirements identified in the Herschel Contamination Control Plan, AD2, will be observed.

## 3.8 Measurement Accuracies

### *3.8.1 Receiver Accuracies*

Table 4.3.1-1 gives a guideline for receiver measuring bandwidths. The actual bandwidth of the test equipment shall be provided by the facility personnel during the EMC tests.

| Frequency Range | Proposed 6 dB BW | Actual | Comment |
|---|---|---|---|
| 30 Hz - 1 kHz | 10 Hz | | |
| 1 kHz - 10 kHz | 100 Hz | | |
| 10 kHz - 150 kHz | 1 kHz | | |
| 150 kHz – 30 MHz | 10 kHz | | |
| 30 MHz - 1 GHz | 100 kHz | | |
| Above 1 GHz | 1 MHz | | Except notches *) |
| Frequency Accuracy | ± 2 % | | |
| Amplitude Accuracy | ± 2 dB | | |

*) The resolution bandwidth shall be selected so that the noise floor of the test equipment is 4 to 6 dB below the notch limit.

Table 3.8-1: Receiver Measurement Bandwidth

## 3.9 General Precautions and Safety

### *3.9.1 General Safety Requirements*

Except of radiation during the AutoComp test no special hazards are expected. The application of the standard technical rules for mechanical and electrical integration and test activities is sufficient.

Lower level procedures called up by this procedure may define their own safety requirement in the relevant chapters which must be respected accordingly

### *3.9.2 Radiation*

When test caps are not mounted and the S/C the is transmitting, the EMC chamber doors have to be closed and no persons are allowed in the EMC chamber.

### *3.9.3 ESD constraints*

In order to prevent ESD sensitive H/W from any possible damages by accidental electrostatic discharges an ESD protected area must be defined during ESD sensitive activities:

- Floor and test bench of the ESD protected area has to be covered with anti-static mats
- During all handling activities (as transport, mounting, mating/de-mating of connectors, measurements with individual measurement devices, etc.) the operator has to work on anti static mats with correct clothing and personal grounding-straps
- Adequate ESD clothing is required:
  - Anti static coat
  - Anti static gloves
  - Anti static boots

## 3.10 Activities Management

### *3.10.1 Pre-Test Activities*

At least the following tasks have to be successfully completed before start of integration and test activities according this procedure:

- This procedure released and accepted
- Formal release to start given by the board following review of relevant test procedures and test configurations.

### 3.10.2 Procedure Variation

Major activities deviating from the approved test procedure require the agreement of Project, AIV and PA responsible, and shall be documented via Activity Control Sheets (ACS). All ACS's generated in the frame of the execution of this procedure shall be listed in the ACS Summary Sheet in section 9.1 of this procedure.

### 3.10.3 Criteria for Failure

If the results of any test performed using this procedure or a lower level procedure which this procedure refers to yields a value which lies outside the specified limits, it shall be considered as a non-conformance. Initial analysis of the result will be applied to establish whether the result is due to measurement error or incorrect specification limits. A NCR will then be raised to report the non-conformance. Depending on the magnitude of the non-conformance, and its impact, either a minor or a major NCR will be raised. In case of major NCR the test shall be continued only upon written or verbal authorisation of Customer (TAS-F and ESA). All NCR's raised in the frame of the execution of this procedure shall be listed in the NCR Summary Sheet in section 7.3 of this procedure.

The NCR process is described in the Herschel PA Plan, AD1.

### 3.10.4 Test Completion and Post-Test Activities

All data that has been recorded during the test activities specified in this procedure shall be collected and retained in a centralised reference volume, and will include:

- PFM logbook
- Relevant CCS logs
- Photographs and plots
- Filled out test procedure
- Activity Control Sheets (ACS), if any
- Copies of NCR's, if any

All these test data shall be available for presentation at the Test Review Board (TRB) which will finally conclude on the test.

A test report shall be produced, whose contents shall be as follows:

- Brief summary of the test results
- PLM and instrument build standard summary
- "As-run" test procedure as an annex (this includes housekeeping data, temperature curves, etc.).

- List of NCR's raised
- List of ACS's generated.
- Relevant meeting minutes (e. g. TRR, TRB)
- Filled out Sign-off Sheet (see section 7.4 of this procedure).
- Evaluation of test results (might be in separate document)

### 3.11 PA Requirements

Quality Assurance shall monitor all operations (handling, transportation, disassembly, installation and test) as necessary to assure compliance with this procedure and the applicable requirements of the Herschel PA Plan, AD1.

In the course of this procedure PA shall pay particular attention to:

- the application of adequate protections to critical surfaces
- the records in the log-sheet
- the recording of the serial number of the test equipment used
- ensure that the test equipment used is within actual calibration cycle

PA has to make sure that NCR’s are raised when applicable and treated by NRB procedure as defined in the Herschel PA Plan, AD1.

After the conclusion that an activity is successfully completed, this activity has to be signed by the responsible AIT- and PA engineer in the step by step procedure. Also relevant log sheets have to be filled out and signed.

## 3.12 Personnel

| Title | Function | Name |
|---|---|---|
| Test Director | Overall responsible | Martin Priestley |
| Test Conductor | EMC Test Coordinator | Michael Hopfgarten |
| EGSE Expert (ASED) | EMC Test Responsibility | Klaus Tigges |
| EGSE Expert (TAS-F) | EMC Test result processing | Marc Burlas |
| EGSE Operator | Operate EGSE (CCS, PLM SCOE, CDMU DFE, Cryo SCOE) | |
| EGSE Expert (TAS-I) | Support EGSE operator and EMC set-up | |
| EMC Test Performance (ESTEC) | Responsible for the EMC facility and operations | |
| Mech. Operator(s) | All mech. Integration activities | |
| Cryo Operators | Operate the cryostat during testing and maintain the required temperatures | |
| ESA Support | Support and supervision of test activities | Filippo Marliani |
| HIFI Engineers | Support test activities | |
| PACS Engineers | Support test activities | |
| SPIRE Engineers | Support test activities | |
| PA Representative | To ensure PA requirements | |

Table 3.12-1: Personnel

# 4 Test Requirements

## 4.1 Radiated Emission (RE) E-field

The set-up and the performance of the test shall be similar to MIL Std 461E, RE 102.

- The satellite shall be set into the applicable operational configuration. See Table 3.3-1 and 3.3-2. The on board equipment shall be set to the most noisiest mode
- The on board LGA / MGA antennas shall be covered with test caps in order to limit the spurious emissions at TX frequency. The test caps shall be capable to handle the TX power without constraints.
- Each test antenna position shall coincide with the position of the harness of the respective instrument under test.
- Any test harness between satellite and EGSE shall be properly shielded before the test in order not to influence the test result.
- The Test chamber shall be free of other equipment and cabling than used during RE tests.
- The test antennas shall be placed at 1 metre distance to the satellite at predefined positions.

Before starting RE Test a kind of ambient /sniff tests will be performed with a portable spectrum analyser around the EGSE harness or any other critical item. An ambient test shall then be performed from 14kHz up to 1GHz in one polarisation (horizontal up from 30MHz) reduced to antenna position 2.

The selection of the RE test antennas shall be in accordance to Table 4.1-1.

| Frequency Range | Polarization | Antenna Type | Comment |
|---|---|---|---|
| 14 kHz – 30 MHz | V | Rod | Groundplane connected to S/C structure if feasible |
| 30 MHz – 1 GHz | V and H | Biconical+logper | May be combined; Absorbers beneath A. and S/C on the floor |
| 1 GHz – 18 GHz | V and H | Broadband horn | LNA is required for notches |

Table 4.1-1: Selection of RE Test Antennas

### *4.1.1 RE E-field in Operational Modes*

The operational satellite shall not exceed the E-field in the frequency range from

14 kHz to 18 GHz

Figure 4.1-1, Table 4.1-2 and Figure 4.1-2 show the limit and the TC notch for PACS and SPIRE, antenna positions 1 and 2.

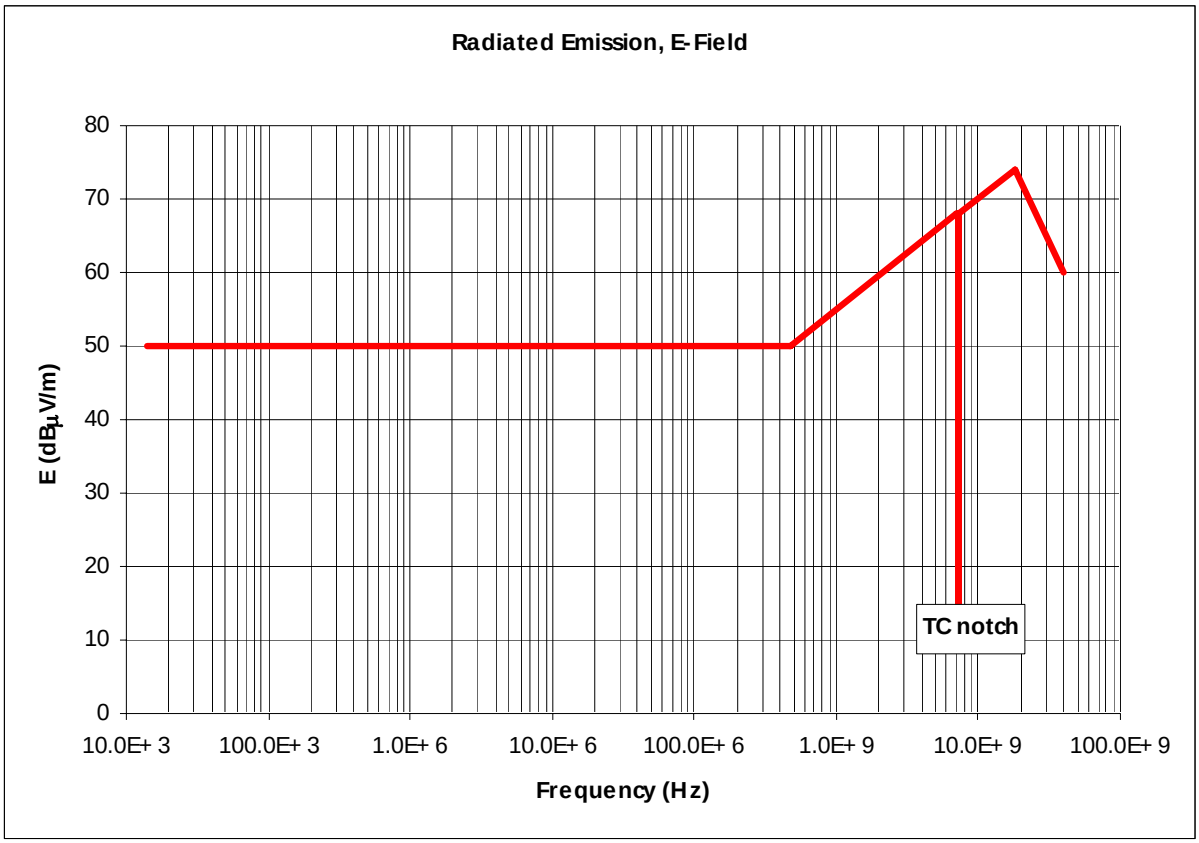


Figure 4.1-1: PACS and SPIRE RE E-Field General Limit

| Frequency (MHz) | Level (dBuV/m) |
|---|---|
| 7133 | 68 |
| 7186 | 45 |
| 7191 - 7213 | 15 |
| 7218 | 45 |
| 7271 | 68 |

Table 4.1-2: PACS and SPIRE TC Notch Limit Frequencies

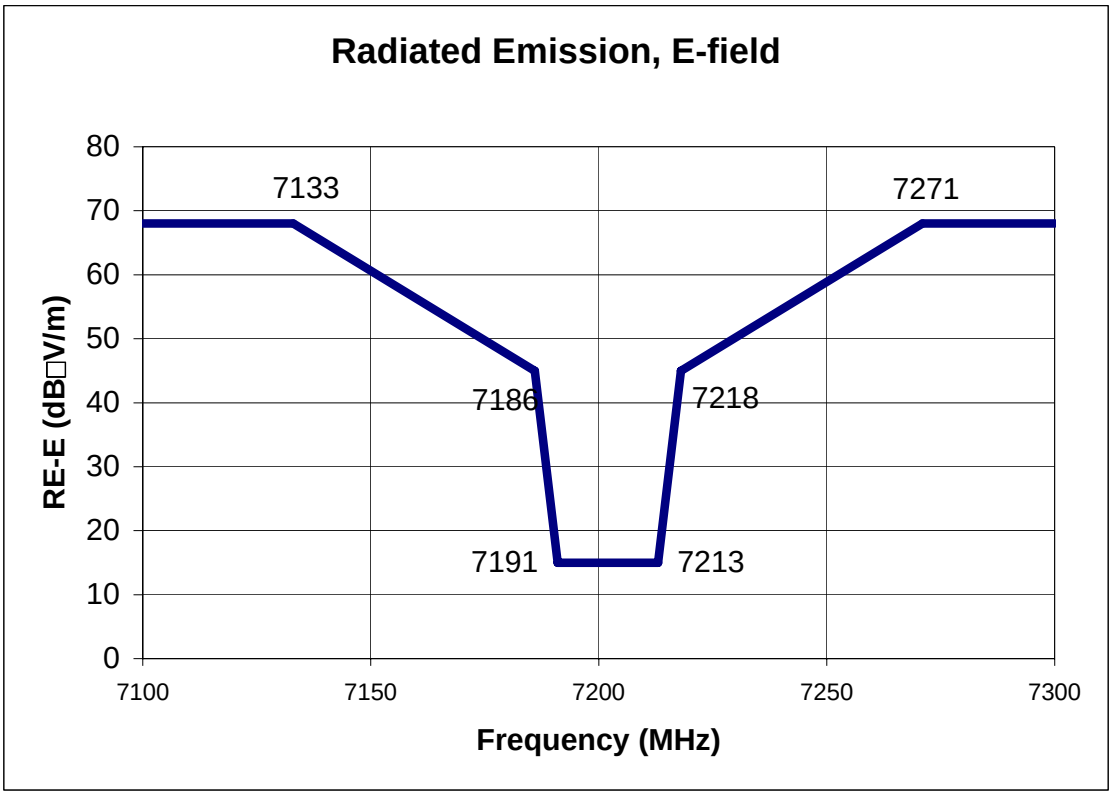


Figure 4.1-2: PACS and SPIRE RE E-Field TC Notch Limit

Figure 4.1-3, Table 4.1-3 and Figure 4.1-4 show the limit and the TC notch for HIFI, antenna position 3.

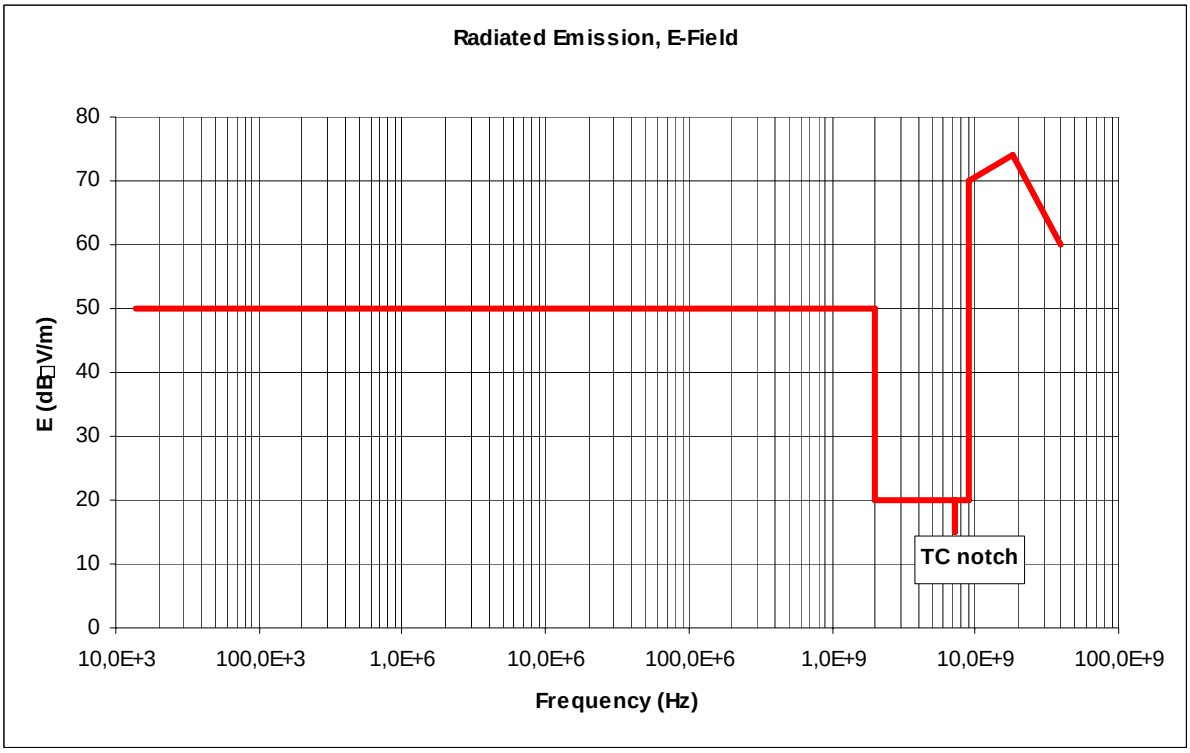


Figure 4.1-3: HIFI RE E-Field General Limit

| Frequency (MHz) | Level (dBuV/m) |
|---|---|
| < 2000 | 50 |
| 2000 - 7186 | 20 |
| 7191-7213 | 15 |
| 7218 - 9000 | 20 |

Table 4.1-3: HIFI TC Notch Limit Frequencies

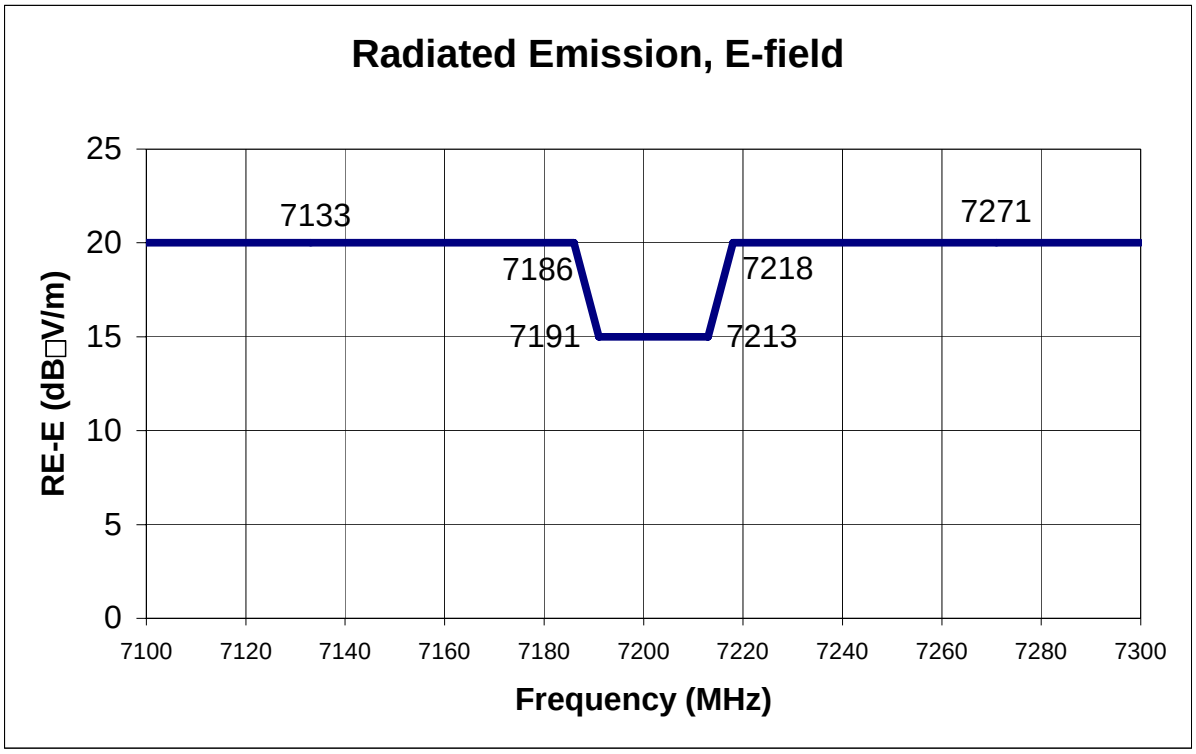


Figure 4.1-4: HIFI RE E-Field TC Notch Limit

Note:
The test equipment shall be capable to measure a level 6 dB below the defined limit.

- The measurement shall be taken for vertical (V) and horizontal (H) polarisations (below 30MHz only vert).
- The applicable spacecraft configurations are shown in Table 4.3-1
- In Figure 4.1-5 to 4.1-7 the three antenna positions are shown. The antennas are oriented to the harness of the measured instrument. See also floor plan Figure 3.5-1.

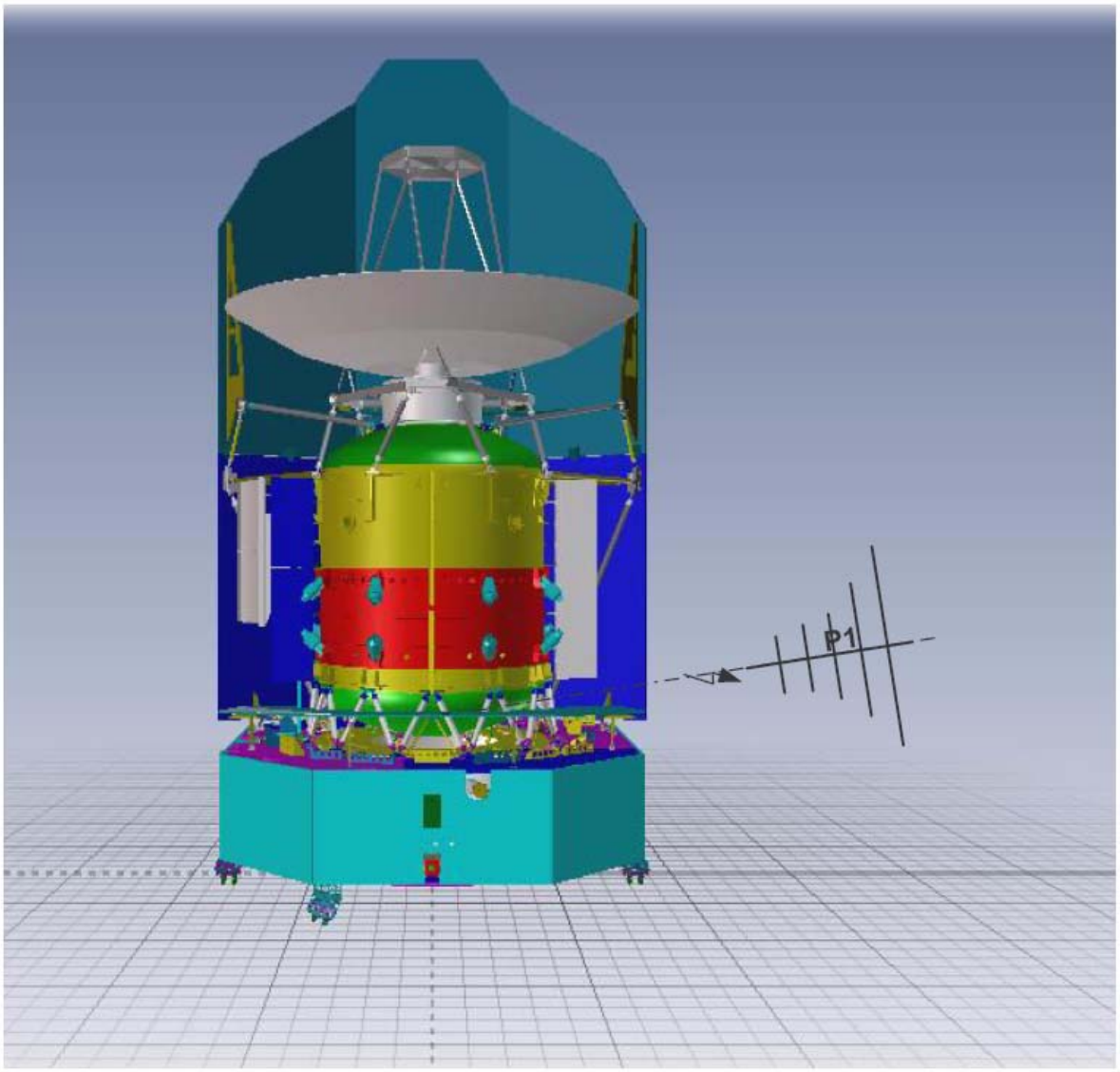


Figure 4.1-5: Antenna position P1 towards PACS

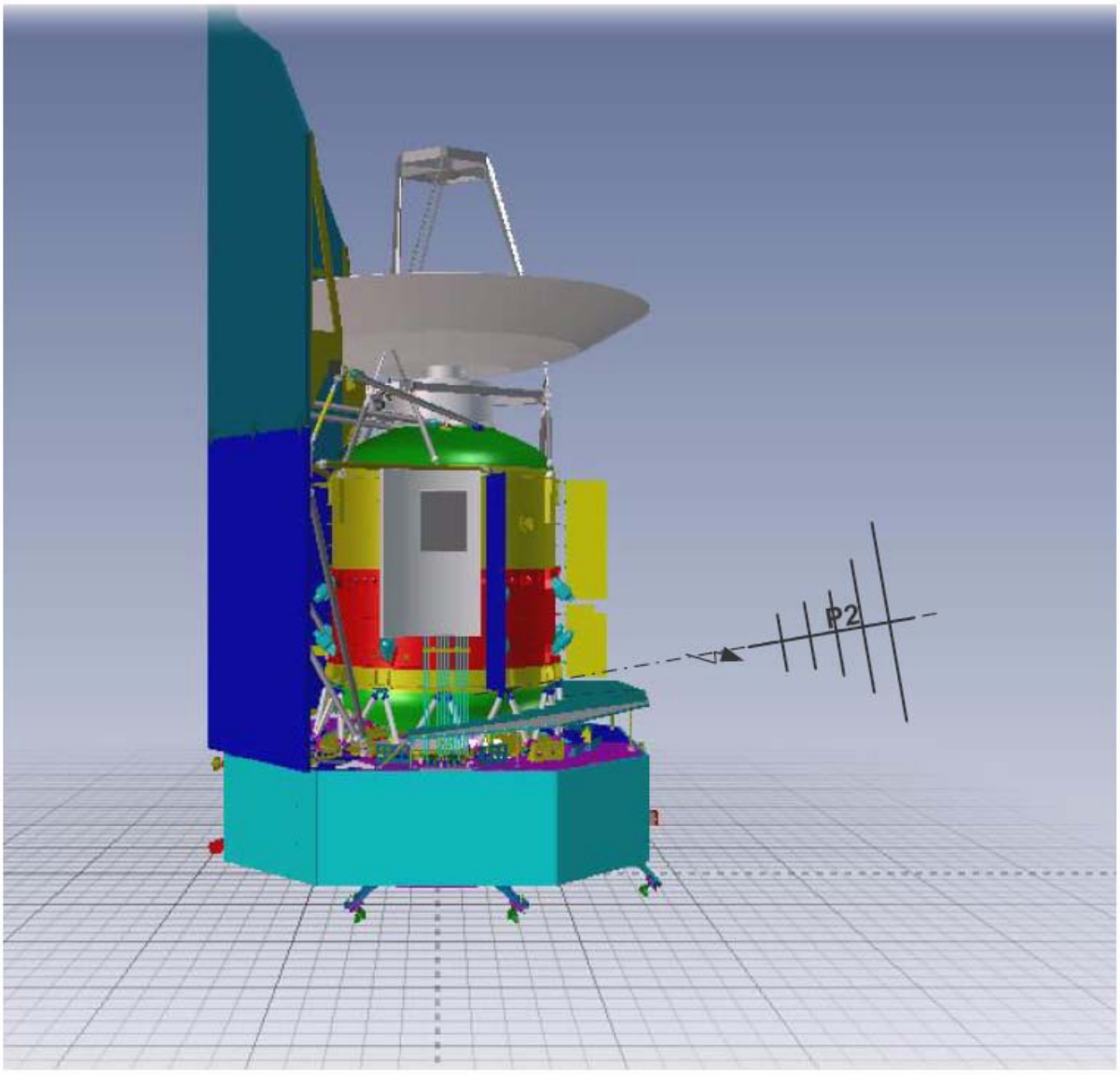


Figure 4.1-6: Antenna position P2 towards SPIRE

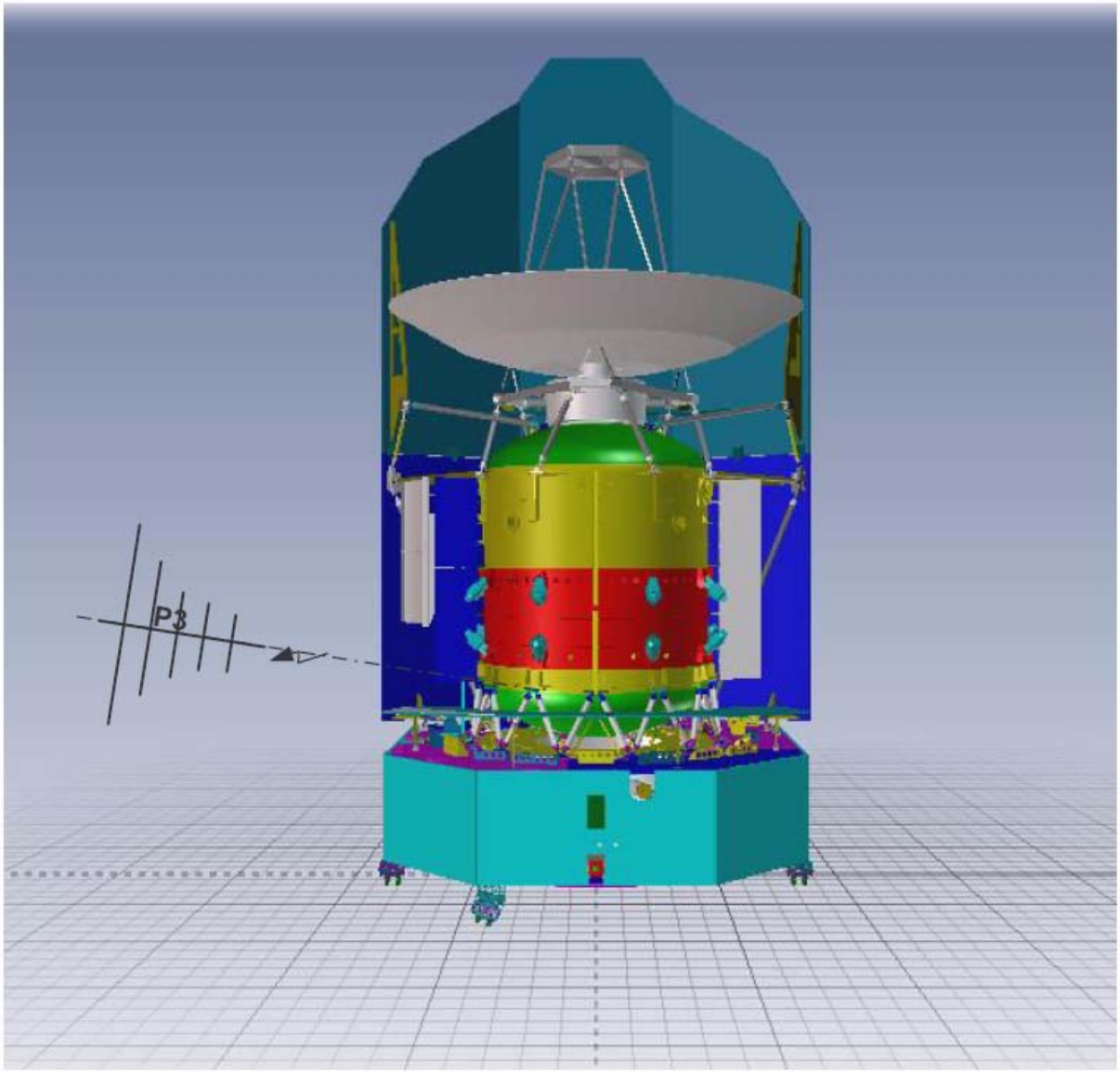


Figure 4.1-7: Antenna position P3 towards HIFI

## 4.2 Spacecraft RF Auto-Compatibility

The object of this test is to demonstrate that with a fully equipped and integrated spacecraft, with communications made through flight test couplers / umbilical, and free radiating antennas as shown in Figure 4.2-1, the following performances are satisfied:

1. When all equipment is operational and in most emissive mode, the X-band subsystem is capable to

- Receive telecommands at the lowest level which shall be experienced at L2
- Support low bit rate telecommand acquisition under 125 Hz Doppler effect at required level
- Receive and transmit ranging signal which can be properly measured. It will be verified that with delay results are compatible with the ranging calibrations gathered at transponder subsystem level.

and

2. While transmitting telemetry through the antennas all other equipment of the satellite is working properly.

The following points have to be considered for the test:

- The spacecraft shall be supplied (powered) by the SAS.
- Any test harness between satellite and EGSE shall be properly shielded before the test in order not to influence the test result. Other test equipment shall not be located in the anechoic chamber.
- The applicable spacecraft configuration is Mode 2. If AutoComp with HIFI implies a TC reception problem a test with Mode 3 is anticipated.

The EGSE connection between RF-EGSE and TTC Subsystem is shown in Figure 4.2-1.

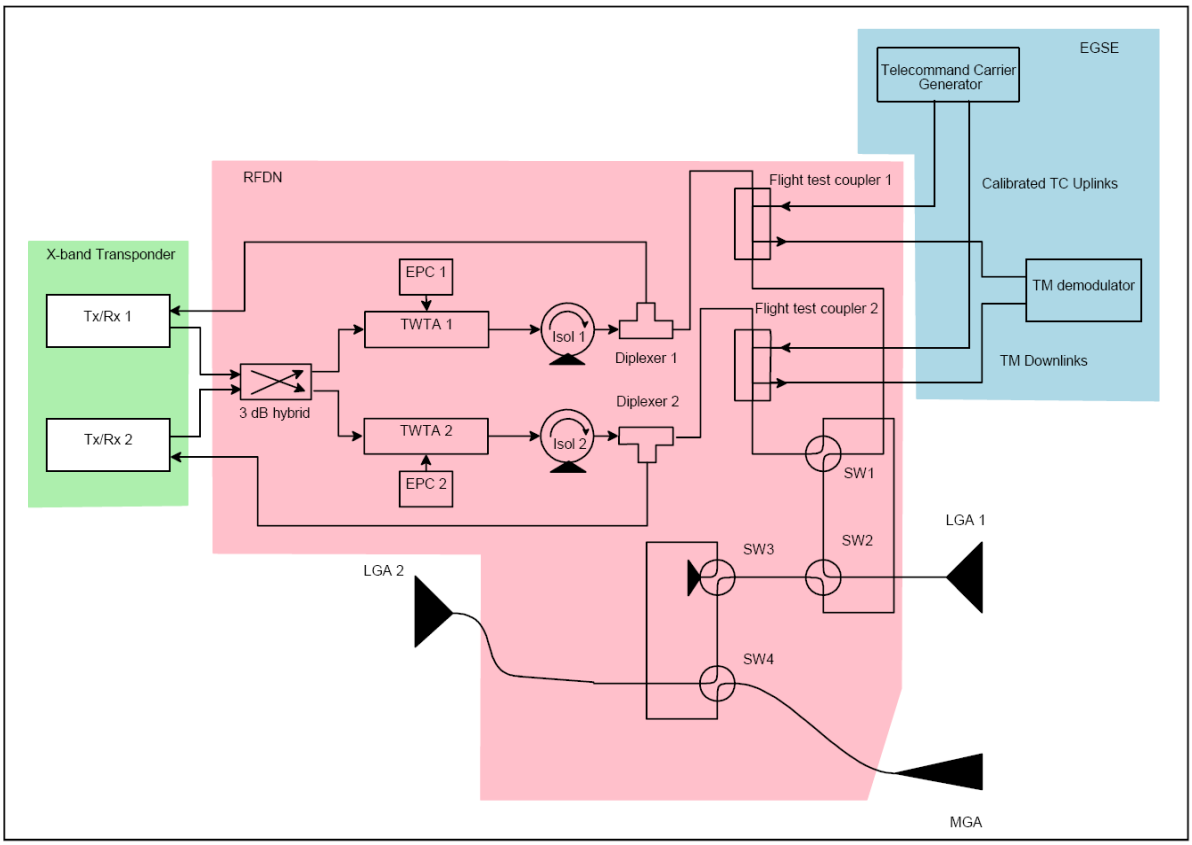


Figure 4.2-1: RF-EGSE and TTC Subsystem interconnection

## 4.3 Test overview

The following tables give an overview of the activities described in this procedure. The sections are test modules. Their sequence is not decisive i.e. it can be changed if required by test circumstances.

**5.1. Ambient, Antenna Position P2 (towards SPIRE)**

| **Step** | **Mode** | **Antenna** (1 m distance) |
|---|---|---|
| 1.1 | SVM & Instruments OFF | Portable Spectrum Analyzer; sniff test |
| 1.2 | SVM & Instruments OFF | P2, Vertical; 14kHz to 30MHz |
| 1.3 | SVM & Instruments OFF | P2, Horizontal; 30MHz to 1GHz |

**5.2. Antenna Position P1 (towards PACS)**

| **Step** | **Mode (see table 4.3-1)** | **Antenna** (1 m distance) |
|---|---|---|
| 2.1 | 1 | Vertical; 14kHz to 30MHz |
| 2.2 | 1 | Horizontal; 30MHz to 1GHz |
| 2.3 | 1 | Vertical; 30MHz to 1GHz |
| 2.4 | 1 | Horizontal; 1GHz to 18 GHz |
| 2.5 | 1 | Horizontal; 7133 MHz to 7271 MHz, Notch |
| 2.6 | 1 | Vertical; 1GHz to 18 GHz |
| 2.7 | 1 | Vertical; 7133 MHz to 7271 MHz, Notch |

**5.3. Antenna Position P2 (towards SPIRE)**

| **Step** | **Mode (see table 4.3-1)** | **Antenna** (1 m distance) |
|---|---|---|
| 3.1 | 1 | Vertical; 14kHz to 30MHz |
| 3.2 | 1 | Horizontal; 30MHz to 1GHz |
| 3.3 | 1 | Vertical; 30MHz to 1GHz |
| 3.4 | 1 | Horizontal; 1GHz to 18 GHz |
| 3.5 | 1 | Horizontal; 7133 MHz to 7271 MHz, Notch |
| 3.6 | 1 | Vertical; 1GHz to 18 GHz |
| 3.7 | 1 | Vertical; 7133 MHz to 7271 MHz, Notch |

### 5.4. Antenna Position P3 (towards HIFI)

| **Step** | **Mode (see table 4.3-1)** | **Antenna** (1 m distance) |
|---|---|---|
| 4.1 | 2 | Vertical; 14kHz to 30MHz |
| 4.2 | 2 | Horizontal; 30MHz to 1GHz |
| 4.3 | 2 | Vertical; 30MHz to 1GHz |
| 4.4 | 2 | Horizontal; 1GHz to 18 GHz |
| 4.5 | 2 | Horizontal; 2 GHz to 9 GHz, Notch |
| 4.6 | 2 | Vertical; 1GHz to 18 GHz |
| 4.7 | 2 | Vertical; 2 GHz to 9 GHz, Notch |

### 6.Autocompatibility Test

| **Step** | **Mode (see table 4.3-1)** | **Test item** |
|---|---|---|
| 1.1 | 2 | Perturbation LGA1 |
| 1.2 | 2 | Perturbation MGA |

Next step performed **only** if AutoComp with HIFI implies a TC reception problem:

| | | |
|---|---|---|
| 1.3 | 3 | AutoComp. Perturbation LGA1 |

| **Mode** | **PACS** | **SPIRE** | **HIFI** |
|---|---|---|---|
| 1 | Save mode | Most Noisy Mode | Stand By |
| 2 | Save mode | Stand By | Most Noisy Mode |
| 3 | Save mode | Stand By | Stand By |

Table 4.3-1: Instrument Modes

# 5 Step by Step Procedure RE Test

## 5.1 Ambient, Antenna Position P2 (towards SPIRE)

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| 1.1 | Install the calibrated EMC Instrumentation. | | | | | | | |
| 1.2 | Switch ON EGSE according AD5 | | | | | | | |
| 1.3 | Confirm with operator that the spacecraft is switched OFF and all EGSE is active. | | | | | | | |
| 1.4 | Perform sniff test with portable spectrum analyzer along the S/C to SCOE harness. | | | | | | | |
| 1.5 | Position P2. Antennas in 1 m distance from the SPIRE panel, directed to SPIRE harness. Perform the following measurements: | | | | | | | |
| 1.5.1 | Measure the ambient noise in the range from 14 kHz to 30 MHz for vertical polarisation. | | Figure 4.1-1 | | See Plot | | | |
| 1.5.2 | Measure the ambient noise in the range from 30 MHz to 1 GHz for vertical polarisation. | | Figure 4.1-1 | | See Plot | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1.6 | Collect excel frequency to amplitude sheet from facility. Store the result of the measurement and compare it with the requirements limit. The measured result shall be 6 dB below the measurement limit. | | | | | | | |

| Test location: | Operator | Product-Assurance: | Date: |
|---|---|---|---|
| | | | |

## 5.2 Antenna Position P1 (towards PACS)

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| 2.1 | Install the calibrated EMC Instrumentation. Verify that the on board LGA / MGA antennas are covered with test caps. | | | | | | | |
| 2.2 | Set S/C into Mode 1 according tables 3.3-1 and 3.3-2 | | | | | | | |
| 2.2.1 | Switch ON EGSE and S /C. Execute test steps sect. 8.1.1 of AD5. | OP | | | | | | |
| 2.2.2 | Switch PACS from OFF into Safe Mode. Execute test steps of sect. 8.1.2.1 of AD5. | OP | | | | | | |
| 2.2.3 | Switch HIFI from OFF into STB. Execute test steps sect. of 8.1.4.1 of AD5. | OP | | | | | | |
| 2.2.4 | Switch SPIRE from OFF into STB. Execute test steps sect. of 8.1.3.1 of AD5. | OP | | | | | | |
| 2.2.5 | Switch SPIRE from STB into SPIRE Noisiest Mode. Execute test steps sect. of 8.1.3.2 of AD5. | OP | | | | | | |
| 2.3 | Verify correct Mode 1 with EGSE operator. | OP | | | | | | |
| 2.4. | Position P1. Antennas in 1 m distance from the PACS panel, directed to PACS harness. Perform the following measurements: | | | | | | | |
| 2.4.1 | Measure emissions in the range from 14 kHz to 30 MHz for vertical polarisation. | | Figure 4.1-1 | | See Plot | | | |

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| 2.4.2 | Measure emissions in the range from 30 MHz to 1 GHz for horizontal polarisation. | | Figure 4.1-1 | | See Plot | | | |
| 2.4.3 | Measure emissions in the range from 30 MHz to 1 GHz for vertical polarisation. | | Figure 4.1-1 | | See Plot | | | |
| 2.4.4 | Measure emissions in the range from 1 GHz to 18 GHz for horizontal polarisation. | | Figure 4.1-1 | | See Plot | | | |
| 2.4.5 | Measure emissions in the range from 7133 MHz to 7271 MHz for horizontal polarisation, notch. | | Figure 4.1-2 | | See Plot | | | |
| 2.4.6 | Measure emissions in the range from 1 GHz to 18 GHz for vertical polarisation. | | Figure 4.1-1 | | See Plot | | | |
| 2.4.7 | Measure emissions in the range from 7133 MHz to 7271 MHz for horizontal polarisation, notch. | | Figure 4.1-2 | | See Plot | | | |
| 2.5 | Collect excel frequency to amplitude sheet from facility. Store the result of the measurement and compare it with the requirements limit. The measured result shall be 6 dB below the measurement limit. | | | | | | | |
| | Perform following steps 2.6.x only if test will not be continued with another RE or AutoComp test. Depending on which test will follow the test conductor has to decide which steps will be executed and which not. | | | | | | | |
| 2.6 | Switch S/C and instruments OFF | | | | | | | |

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| 2.6.1 | Switch SPIRE from SPIRE Noisiest Mode into STB. Execute test steps sect. 8.1.3.3 of AD5. | OP | | | | | | |
| 2.6.2 | Switch SPIRE from STB into OFF. Execute test steps sect. 8.1.3.4 of AD5. | OP | | | | | | |
| 2.6.3 | Switch PACS from Safe Mode into OFF. Execute test steps of sect. 8.1.2.4 of AD5. | OP | | | | | | |
| 2.6.4 | Switch HIFI from STB into OFF. Execute test steps sect. 8.1.4.4 of AD5. | OP | | | | | | |
| 2.6.5 | Switch OFF EGSE and S /C. Execute test steps sect. 8.1.1 of AD5. | OP | | | | | | |
| 2.7 | Verify that S/C is OFF with EGSE operator. | OP | | | | | | |

| Test location: | Operator | Product-Assurance: | Date: |
|---|---|---|---|
| | | | |

### 5.3 Antenna Position P2 (towards SPIRE)

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| 3.1 | Install the calibrated EMC Instrumentation. Verify that the on board LGA / MGA antennas are covered with test caps. | | | | | | | |
| 3.2 | Set S/C into Mode 1 according tables 3.3-1 and 3.3-2. Depending on current mode the test conductor has to decide which steps will be executed and which not. | OP | | | | | | |
| 3.2.1 | Switch ON EGSE and S /C. Execute test steps sect. 8.1.1 of AD5. | OP | | | | | | |
| 3.2.2 | Switch PACS from OFF into Safe Mode. Execute test steps of sect. 8.1.2.1 of AD5. | OP | | | | | | |
| 3.2.3 | Switch HIFI from OFF into STB. Execute test steps sect. of 8.1.4.1 of AD5. | OP | | | | | | |
| 3.2.4 | Switch SPIRE from OFF into STB. Execute test steps sect. of 8.1.3.1 of AD5. | OP | | | | | | |
| 3.2.5 | Switch SPIRE from STB into SPIRE Noisiest Mode. Execute test steps sect. of 8.1.3.2 of AD5. | OP | | | | | | |
| 3.3 | Verify correct Mode 1 with EGSE operator. | OP | | | | | | |
| 3.4. | Position P2. Antennas in 1 m distance from the SPIRE panel, directed to SPIRE harness. Perform the following measurements: | | | | | | | |

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| 3.4.1 | Measure emissions in the range from 14 kHz to 30 MHz for vertical polarisation. | | Figure 4.1-1 | | See Plot | | | |
| 3.4.2 | Measure emissions in the range from 30 MHz to 1 GHz for horizontal polarisation. | | Figure 4.1-1 | | See Plot | | | |
| 3.4.3 | Measure emissions in the range from 30 MHz to 1 GHz for vertical polarisation. | | Figure 4.1-1 | | See Plot | | | |
| 3.4.4 | Measure emissions in the range from 1 GHz to 18 GHz for horizontal polarisation. | | Figure 4.1-1 | | See Plot | | | |
| 3.4.5 | Measure emissions in the range from 7133 MHz to 7271 MHz for horizontal polarisation, notch. | | Figure 4.1-2 | | See Plot | | | |
| 3.4.6 | Measure emissions in the range from 1 GHz to 18 GHz for vertical polarisation. | | Figure 4.1-1 | | See Plot | | | |
| 3.4.7 | Measure emissions in the range from 7133 MHz to 7271 MHz for horizontal polarisation, notch. | | Figure 4.1-2 | | See Plot | | | |
| 3.5 | Collect excel frequency to amplitude sheet from facility. Store the result of the measurement and compare it with the requirements limit. The measured result shall be 6 dB below the measurement limit. | | | | | | | |
| | Perform following steps 3.6.x only if test will not be continued with another RE or AutoComp test. Depending on which test will follow the test conductor has to decide which steps will be executed and which not. | | | | | | | |

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| 3.6 | Switch S/C and instruments OFF | | | | | | | |
| 3.6.1 | Switch SPIRE from SPIRE Noisiest Mode into STB. Execute test steps sect. 8.1.3.3 of AD5. | OP | | | | | | |
| 3.6.2 | Switch SPIRE from STB into OFF. Execute test steps sect. 8.1.3.4 of AD5. | OP | | | | | | |
| 3.6.3 | Switch PACS from Safe Mode into OFF. Execute test steps of sect. 8.1.2.4 of AD5. | OP | | | | | | |
| 3.6.4 | Switch HIFI from STB into OFF. Execute test steps sect. 8.1.4.4 of AD5. | OP | | | | | | |
| 3.6.5 | Switch OFF EGSE and S /C. Execute test steps sect. 8.1.1 of AD5. | OP | | | | | | |
| 3.7 | Verify that S/C is OFF with EGSE operator. | OP | | | | | | |

| Test location: | Operator | Product-Assurance: | Date: |
|---|---|---|---|
| | | | |

### 5.4 Antenna Position P3 (towards HIFI)

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| 4.1 | Install the calibrated EMC Instrumentation. Verify that the on board LGA / MGA antennas are covered with test caps. | | | | | | | |
| 4.2 | Set S/C into Mode 2 according tables 3.3-1 and 3.3-2. Depending on current mode the test conductor has to decide which steps will be executed and which not. | | | | | | | |
| 4.2.1 | Set S/C into Mode 2 according tables 3.3-1 and 3.3-2 | | | | | | | |
| 4.2.2 | Switch ON EGSE and S /C. Execute test steps sect. 8.1.1 of AD5. | OP | | | | | | |
| 4.2.3 | Switch PACS from OFF into Safe Mode. Execute test steps of sect. 8.1.2.1 of AD5. | OP | | | | | | |
| 4.2.4 | Switch SPIRE from OFF into STB. Execute test steps sect. of 8.1.3.1 of AD5. | OP | | | | | | |
| 4.2.5 | Switch HIFI from OFF into STB. Execute test steps sect. of 8.1.4.1 of AD5. | OP | | | | | | |
| 4.2 | Switch HIFI from STB into HIFI Noisiest Mode. Execute test steps sect. of 8.1.4.2 of AD5. | OP | | | | | | |
| 4.3 | Verify correct Mode 2 with EGSE operator. | OP | | | | | | |

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| 4.4. | Position P3. Antennas in 1 m distance from the HIFI panel, directed to HIFI harness. Perform the following measurements: | | | | | | | |
| 4.4.1 | Measure emissions in the range from 14 kHz to 30 MHz for vertical polarisation. | | Figure 4.1-3 | | See Plot | | | |
| 4.4.2 | Measure emissions in the range from 30 MHz to 1 GHz for horizontal polarisation. | | Figure 4.1-3 | | See Plot | | | |
| 4.4.3 | Measure emissions in the range from 30 MHz to 1 GHz for vertical polarisation. | | Figure 4.1-3 | | See Plot | | | |
| 4.4.4 | Measure emissions in the range from 1 GHz to 18 GHz for horizontal polarisation. | | Figure 4.1-3 | | See Plot | | | |
| 4.4.5 | Measure emissions in the range from 2 GHz to 9 GHz for horizontal polarisation, notch. | | Figure 4.1-4 | | See Plot | | | |
| 4.4.6 | Measure emissions in the range from 1 GHz to 18 GHz for vertical polarisation. | | Figure 4.1-3 | | See Plot | | | |
| 4.4.7 | Measure emissions in the range from 2 GHz to 9 GHz for vertical polarisation, notch. | | Figure 4.1-4 | | See Plot | | | |
| 4.5 | Collect excel frequency to amplitude sheet from facility. Store the result of the measurement and compare it with the requirements limit. The measured result shall be 6 dB below the measurement limit. | | | | | | | |

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| | Perform following steps 4.6.x only if test will not be continued with another RE or AutoComp test. Depending on which test will follow the test conductor has to decide which steps will be executed and which not. | | | | | | | |
| 4.6 | Switch S/C and instruments OFF | | | | | | | |
| 4.6.1 | Switch SPIRE from STB into OFF. Execute test steps sect. 8.1.3.4 of AD5. | OP | | | | | | |
| 4.6.2 | Switch PACS from Safe Mode into OFF. Execute test steps of sect. 8.1.2.4 of AD5. | OP | | | | | | |
| 4.6.3 | Switch HIFI from Noisiest Mode into STB. Execute test steps of sect. 8.1.2.3 of AD5. | OP | | | | | | |
| 4.6.4 | Switch HIFI from STB into OFF. Execute test steps sect. 8.1.4.4 of AD5. | OP | | | | | | |
| 4.6.5 | Switch OFF EGSE and S /C. Execute test steps sect. 8.1.1 of AD5. | OP | | | | | | |
| 4.7 | Verify that S/C is OFF with EGSE operator. | OP | | | | | | |

| Test location: | Operator | Product-Assurance: | Date: |
|---|---|---|---|
| | | | |

# 6 Step by Step Procedure Auto-Compatibility Test

## 6.1 Nominal AutoComp Test

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| 1.1 | Remove test caps from on board LGA / MGA antennas. | | | | | | | |
| | Set S/C into Mode 2 according tables 3.3-1 and 3.3-2. Depending on current mode the test conductor has to decide which steps will be executed and which not. | | | | | | | |
| 1.2 | Set S/C into Mode 2 according tables 3.3-1 and 3.3-2 | | | | | | | |
| 1.2.1 | Switch ON EGSE and S /C. Execute test steps sect. 8.1.1 of AD5. | OP | | | | | | |
| 1.2.2 | Switch PACS from OFF into Safe Mode. Execute test steps of sect. 8.1.2.1 of AD5. | OP | | | | | | |
| 1.2.3 | Switch SPIRE from OFF into STB. Execute test steps sect. of 8.1.3.1 of AD5. | OP | | | | | | |
| 1.2.5 | Switch HIFI from OFF into STB. Execute test steps sect. of 8.1.4.1 of AD5. | OP | | | | | | |
| 1.2.4 | Switch HIFI from STB into HIFI Noisiest Mode. Execute test steps sect. of 8.1.4.2 of AD5. | OP | | | | | | |
| 1.3 | Verify correct Mode 2 with EGSE operator. | OP | | | | | | |

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| 1.4 | Perform AutoComp test according sect. of 8.1.7 of AD5. | | | | | | | |
| 1.5 | Switch S/C and instruments OFF | | | | | | | |
| 1.5.1 | Switch SPIRE from STB into OFF. Execute test steps sect. 8.1.3.4 of AD5. | OP | | | | | | |
| 1.5.2 | Switch PACS from Safe Mode into OFF. Execute test steps of sect. 8.1.2.4 of AD5. | OP | | | | | | |
| 1.5.3 | Switch HIFI from Noisiest Mode into STB. Execute test steps of sect. 8.1.2.3 of AD5. | OP | | | | | | |
| 1.5.4 | Switch HIFI from STB into OFF. Execute test steps sect. 8.1.4.4 of AD5. | OP | | | | | | |
| 1.5.5 | Switch OFF EGSE and S /C. Execute test steps sect. 8.1.1 of AD5. | OP | | | | | | |
| 1.6 | Verify that S/C is OFF with EGSE operator. | OP | | | | | | |

| Test location: | Operator | Product-Assurance: | Date: |
|---|---|---|---|
| | | | |

## 6.2 Optional AutoComp Test

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| 2.1 | Remove test caps from on board LGA / MGA antennas. | | | | | | | |
| | Set S/C into Mode 3 according tables 3.3-1 and 3.3-2. Depending on current mode the test conductor has to decide which steps will be executed and which not. | | | | | | | |
| 2.2 | Set S/C into Mode 3 according tables 3.3-1 and 3.3-2 | | | | | | | |
| 2.2.1 | Switch ON EGSE and S /C. Execute test steps sect. 8.1.1 of AD5. | OP | | | | | | |
| 2.2.2 | Switch PACS from OFF into Safe Mode. Execute test steps of sect. 8.1.2.1 of AD5. | OP | | | | | | |
| 2.2.3 | Switch SPIRE from OFF into STB. Execute test steps sect. of 8.1.3.1 of AD5. | OP | | | | | | |
| 2.2.4 | Switch HIFI from OFF into STB. Execute test steps sect. of 8.1.4.1 of AD5. | OP | | | | | | |
| 2.3 | Verify correct Mode 3 with EGSE operator. | OP | | | | | | |
| 2.4 | Perform AutoComp test according sect. of 8.1.7 of AD5. | | | | | | | |
| 2.5 | Switch S/C and instruments OFF | | | | | | | |
| 2.5.1 | Switch SPIRE from STB into OFF. Execute test steps sect. 8.1.3.4 of AD5. | OP | | | | | | |

| Step-No. | Integration-Step-Description | OP / EMC | Nom Val | Tol. | Act. Val. | Comment | P | N |
|---|---|---|---|---|---|---|---|---|
| 2.5.2 | Switch PACS from Safe Mode into OFF. Execute test steps of sect. 8.1.2.4 of AD5. | OP | | | | | | |
| 2.5.3 | Switch HIFI from STB into OFF. Execute test steps sect. 8.1.4.4 of AD5. | OP | | | | | | |
| 2.5.4 | Switch OFF EGSE and S /C. Execute test steps sect. 8.1.1 of AD5. | OP | | | | | | |
| 2.6 | Verify that S/C is OFF with EGSE operator. | OP | | | | | | |

| Test location: | Operator | Product-Assurance: | Date: |
|---|---|---|---|
| | | | |

# 7 Facility Report

## 7.1 Calibration Data

| Nr | manufacturer | equipment | Date | due |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
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| 8 | | | | |
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To be included if applicable

Summary Sheets

## 7.2 Procedure Variation Summary

| | | | |
|---|---|---|---|
| | Test Change | Curr. No.:<br>Date:<br>Page 1 of 1 | |
| Test designation<br>Herschel EMC Test | Test Procedure | Issue<br>1, dated | Rev. |
| Test step changed | Reason for Change | | |
| Test step changed | Reason for Change | | |
| Test step changed | Reason for Change | | |
| Test step changed | Reason for Change | | |
| | | | |
| Prepared by: | Resp. Test Leader | Project Engineer | |
| PA/QA | Prime | Customer | |

Table 7.2-1: Procedure Variation Sheet

## 7.3 Non Conformance Report (NCR) Summary

| NCR - No. | NCR - Title | Date | Open Closed | PA sig. |
|---|---|---|---|---|
| | | | | |

Table 7.3-1: Non-Conformance Record Sheet

## 7.4 Sign-off Sheet

| | Date | Signature |
|---|---|---|
| **Test Director** | | |
| **Test Conductor** | | |
| **EMC Expert** | | |
| **PA Responsible** | | |
| **ESA Representative** | | |

After the conclusion that an activity is successfully completed, this activity has to be signed by the responsible AIT- and PA engineer in the step by step procedure. Also relevant log sheets have to be filled out and signed.

| | Name | Dep./Comp. | | Name | Dep./Comp. |
|---|---|---|---|---|---|
| | Baldock Richard | FAE12 | x | Sonn Nico | ASG51 |
| x | Barlage Bernhard | AED13 | | Steininger Eric | AED32 |
| x | Bayer Thomas | ASA42 | x | Stritter Rene | AED11 |
| | Brune Holger | ASA45 | | Suess Rudi | OTN/ASA44 |
| | Chen Bing | HE Space | | Theunissen Martijn | DSSA |
| | Edelhoff Dirk | AED2 | | Vascotto Riccardo | HE Space |
| | Fehringer Alexander | ASG13 | x | Tigges Klaus | AED32 |
| X | Fricke Wolfgang Dr. | AED 65 | | Wagner Klaus | ASG23 |
| | Geiger Hermann | ASA42 | x | Wietbrock Walter | AET12 |
| | Grasl Andreas | OTN/ASA44 | | Wöhler Hans | ASG23 |
| | Grasshoff Brigitte | AET12 | | Wössner Ulrich | ASE252 |
| x | Hamer Simon | Terma | | Zumstein Armin | ASQ42 |
| | Hanka, Erhard | FI552 | | | |
| | Hendrikse Jeffrey | HE Space | | | |
| x | Hendry David | Terma | | | |
| | Hengstler Reinhold | ASA42 | | | |
| | Hinger Jürgen | ASG23 | | | |
| x | Hohn Rüdiger | AED65 | | | |
| | Hofmann Rolf | ASE252 | | | |
| x | Hopfgarten Michael | AED32 | | | |
| x | Huber Johann | ASA42 | | | |
| | Hund Walter | ASE252 | | | |
| x | Idler Siegmund | AED312 | | | |
| | Ivády von András | FAE12 | | | |
| | Jahn Gerd Dr. | ASG23 | | | |
| | Jolk Matthias | AET1 | X | ESA/ESTEC | ESA |
| | Klenke Uwe | ASG72 | X | Thales Alenia Space Cannes | TAS-F |
| x | Koelle Markus | ASA43 | X | Thales Alenia Space Torino | TAS-I |
| x | Koppe Axel | AED312 | | | |
| x | Kroeker Jürgen | AED65 | | **Instruments:** | |
| | La Gioia Valentina | Terma | x | MPE (PACS) | MPE |
| | Lang Jürgen | ASE252 | x | RAL (SPIRE) | RAL |
| | Langenstein Rolf | AED15 | x | SRON (HIFI) | SRON |
| x | Langfermann Michael | ASA41 | | | |
| | Liberatore Danilo | Rhea | | | |
| | Martin Olivier | ASA43 | | **Subcontractors:** | |
| | Maukisch Jan | ASA43 | | Austrian Aerospace | AAE |
| | Much Christoph | ASA43 | | Austrian Aerospace | AAEM |
| x | Müller Martin | ASA43 | | BOC Edwards | BOCE |
| | Pietroboni Karin | AED65 | | Dutch Space Solar Arrays | DSSA |
| | Platzer Wilhelm | AED2 | | EADS Astrium Sub-Subsyst. & Equipment | ASSE |
| x | Reichle Konrad | ASA42 | | EADS CASA Espacio | CASA |
| | Runge Axel | OTN/ASA44 | | EADS CASA Espacio | ECAS |
| | Sauer Maximilian Dr. | AED65 | x | European Test Services | ETS |
| | Schink Dietmar | AED32 | | Patria New Technologies Oy | PANT |
| | Schmidt Thomas | AED15 | | SENER Ingenieria SA | SEN |
| | Schweickert Gunn | ASG23 | | Thales Alenia Space, Antwerp | TAS-ETCA |