

# FCC Measurement/Technical Report on

## CAP H 7E/80-85/17E/19

### Cellular Repeater

FCC ID: XS5-CAPH7E817E19  
IC: 2237E-EH7E817E19

**Test Report Reference:** MDE\_BVNBG\_1806\_FCCd\_REV1

**Test Laboratory:**

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**Note:**

The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the test laboratory.

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## Applied Standards and Test Summary

### 1.1 APPLIED STANDARDS

#### **Type of Authorization**

Certification for an Industrial Signal Booster.

#### **Applicable FCC Rules**

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 20, 24, (10/1/18 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 20, Commercial Mobiles Serviced

§ 20.21 Signal Boosters

Part 24, Subpart E – Broadband PCS

§ 24.232 – Power and antenna height limits

§ 24.235 – Frequency stability

§ 24.238 – Emission limitations for Broadband PCS equipment

The tests were selected and performed with reference to:

- FCC Public Notice 935210 applying “Signal Boosters Basic Certification Requirements” 935210 D02 v04r01, 2018-06-19.
- FCC Public Notice 935210 applying “Measurement guidance for industrial and non-consumer signal booster, repeater and amplifier devices” 935210 D05 v01r02, 2017-10-27.
- FCC Public Notice 971168 applying “Measurement guidance for certification of licensed digital transmitters” 971168 D01 v03r01, 2018-04-09
- ANSI C63.26: 2015

## Summary Test Results:

The EUT complied with all performed tests as listed in chapter 1.3 Measurement Summary / Signatures.

## 1.2 FCC-IC CORRELATION TABLE

### Correlation of measurement requirements for Industrial Signal Booster from FCC and ISED Canada

| Measurement                                                        | FCC reference                                    | ISED reference                                                                                      |
|--------------------------------------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Effective radiated power, mean output power and zone enhancer gain | §2.1046<br>§24.232<br>KDB 935210 D05 v01r02: 3.5 | RSS-GEN Issue 5, 6.12<br>RSS-133 Issue 6, 6.4<br>SRSP-510, Issue 7, 5.1.1<br>RSS-131 Issue 3: 5.2.3 |
| Peak to Average Ratio                                              | §24.232                                          | RSS 133 Issue 6: 6.4                                                                                |
| Occupied bandwidth<br>Input-versus-output spectrum                 | §2.1049<br>KDB 935210 D05 v01r02: 3.4            | RSS-GEN Issue 5, 6.7<br>RSS-131 Issue 3: 5.2.2                                                      |
| Conducted spurious Emission at Antenna Terminal                    | §2.1051<br>§24.238                               | RSS-GEN Issue 5, 6.13<br>RSS-133 Issue 6, 6.5                                                       |
| Out-of-band emissions limits                                       | §2.1051<br>§24.238<br>KDB 935210 D05 v01r02: 3.6 | RSS-GEN Issue 5, 6.13<br>RSS-133 Issue 6, 6.5                                                       |
| Frequency stability                                                | §2.1055<br>§24.235                               | RSS-GEN Issue 5, 6.11<br>RSS-133 Issue 6: 6.3<br>RSS-131 Issue 3: 5.2.4                             |
| Field strength of spurious radiation                               | §2.1053<br>§24.236                               | RSS-GEN Issue 5, 6.13<br>RSS-133 Issue 6: 6.5                                                       |
| Out-of-band rejection                                              | KDB 935210 D05 v01r02: 3.3                       | RSS-131 Issue 3: 5.2.1                                                                              |

### 1.3 MEASUREMENT SUMMARY / SIGNATURES

#### 47 CFR CHAPTER I FCC PART 24 Subpart E §2.1046, §24.232, [Base Stations/Repeater] KDB 935210 D02 II (p)(4)

Effective Radiated Power, mean output power and zone enhancer gain

The measurement was performed according to ANSI C63.26, KDB 935210 D05 v01r02: 3.5

**Final Result**

| OP-Mode                                             | Setup | FCC | IC  |
|-----------------------------------------------------|-------|-----|-----|
| Frequency Band, Direction, Input Power, Signal Type |       |     |     |
| Band 2/25, RF downlink, 0.3 dB < AGC, Narrowband    | -     | N/P | N/P |
| Band 2/25, RF downlink, 0.3 dB < AGC, Wideband      | -     | N/P | N/P |
| Band 2/25, RF downlink, 3 dB > AGC, Narrowband      | -     | N/P | N/P |
| Band 2/25, RF downlink, 3 dB > AGC, Wideband        | -     | N/P | N/P |

#### 47 CFR CHAPTER I FCC PART 24 Subpart E §24.232 [Base Stations/Repeater]

Peak to Average Ratio

The measurement was performed according to ANSI C63.26

**Final Result**

| OP-Mode                                             | Setup | FCC | IC  |
|-----------------------------------------------------|-------|-----|-----|
| Frequency Band, Direction, Input Power, Signal Type |       |     |     |
| Band 2/25, RF downlink, 0.3 dB < AGC, Narrowband    | -     | N/P | N/P |
| Band 2/25, RF downlink, 0.3 dB < AGC, Wideband      | -     | N/P | N/P |
| Band 2/25, RF downlink, 3 dB > AGC, Narrowband      | -     | N/P | N/P |
| Band 2/25, RF downlink, 3 dB > AGC, Wideband        | -     | N/P | N/P |

#### 47 CFR CHAPTER I FCC PART 24 Subpart E §2.1049, [Base Stations/Repeater] KDB 935210 D02 II (p)(3)

Occupied Bandwidth / Input-versus-output Spectrum

The measurement was performed according to ANSI C63.26, KDB 935210 D05 v01r02: 3.4

**Final Result**

| OP-Mode                                             | Setup | FCC | IC  |
|-----------------------------------------------------|-------|-----|-----|
| Frequency Band, Direction, Input Power, Signal Type |       |     |     |
| Band 2/25, RF downlink, 0.3 dB < AGC, Narrowband    | -     | N/P | N/P |
| Band 2/25, RF downlink, 0.3 dB < AGC, Wideband      | -     | N/P | N/P |
| Band 2/25, RF downlink, 3 dB > AGC, Narrowband      | -     | N/P | N/P |
| Band 2/25, RF downlink, 3 dB > AGC, Wideband        | -     | N/P | N/P |

**47 CFR CHAPTER I FCC PART 24 Subpart E**  
**[Base Stations/Repeater]**

**§2.1051, §24.238**

Conducted spurious emissions at antenna terminals

The measurement was performed according to ANSI C63.26

**Final Result**

**OP-Mode**

Frequency Band, Test Frequency, Direction, Signal Type

Band 2/25, high, RF downlink, Narrowband

**Setup**

S01\_AA01

**FCC**

Passed

**IC**

Passed

Band 2/25, high, RF downlink, Wideband

S01\_AA01

Passed

Passed

Band 2/25, low, RF downlink, Narrowband

S01\_AA01

Passed

Passed

Band 2/25, low, RF downlink, Wideband

S01\_AA01

Passed

Passed

Band 2/25, mid, RF downlink, Narrowband

S01\_AA01

Passed

Passed

Band 2/25, mid, RF downlink, Wideband

S01\_AA01

Passed

Passed

**47 CFR CHAPTER I FCC PART 24 Subpart E**  
**[Base Stations/Repeater]**

**§2.1053, §24.238,**  
**KDB 935210 D02 II (p)(3)**

Out-of-band emission limits/Intermodulation

The measurement was performed according to ANSI C63.26, KDB  
 935210 D05 v01r02: 3.6

**Final Result**

**OP-Mode**

Band Edge, Frequency Band, Number of signals, Direction,  
 Input Power, Signal Type

Lower, Band 2/25, 1, RF downlink, 0.3 dB < AGC, Narrowband

**Setup**

-

N/P

N/P

Lower, Band 2/25, 1, RF downlink, 0.3 dB < AGC, Wideband

-

N/P

N/P

Lower, Band 2/25, 1, RF downlink, 3 dB > AGC, Narrowband

-

N/P

N/P

Lower, Band 2/25, 1, RF downlink, 3 dB > AGC, Wideband

-

N/P

N/P

Lower, Band 2/25, 2, RF downlink, 0.3 dB < AGC, Narrowband

-

N/P

N/P

Lower, Band 2/25, 2, RF downlink, 0.3 dB < AGC, Wideband

-

N/P

N/P

Lower, Band 2/25, 2, RF downlink, 3 dB > AGC, Narrowband

-

N/P

N/P

Lower, Band 2/25, 2, RF downlink, 3 dB > AGC, Wideband

-

N/P

N/P

Upper, Band 2/25, 1, RF downlink, 0.3 dB < AGC, Narrowband

-

N/P

N/P

Upper, Band 2/25, 1, RF downlink, 0.3 dB < AGC, Wideband

-

N/P

N/P

Upper, Band 2/25, 1, RF downlink, 3 dB > AGC, Narrowband

-

N/P

N/P

Upper, Band 2/25, 1, RF downlink, 3 dB > AGC, Wideband

-

N/P

N/P

Upper, Band 2/25, 2, RF downlink, 0.3 dB < AGC, Narrowband

-

N/P

N/P

Upper, Band 2/25, 2, RF downlink, 0.3 dB < AGC, Wideband

-

N/P

N/P

Upper, Band 2/25, 2, RF downlink, 3 dB > AGC, Narrowband

-

N/P

N/P

Upper, Band 2/25, 2, RF downlink, 3 dB > AGC, Wideband

-

N/P

N/P

**47 CFR CHAPTER I FCC PART 24 Subpart E**  
**[Base Stations/Repeater]**

**KDB 935210 D02 II (p)(2)**

Out-of-band rejection

The measurement was performed according to ANSI C63.26

**Final Result**

**OP-Mode**

Frequency Band, Direction

Band 2/25, RF downlink

**Setup**

-

**FCC**

N/P

**IC**

N/P

**47 CFR CHAPTER I FCC PART 24 Subpart E**  
**[Base Stations/Repeater]**

**§2.1053, §22.917**

Field strength of spurious radiation

The measurement was performed according to ANSI C63.26

**Final Result**

**OP-Mode**

Frequency Band, Test Frequency, Direction

Band 2/25, high, RF downlink

Band 2/25, low, RF downlink

Band 2/25, mid, RF downlink

**Setup**

S01\_AA01

S01\_AA01

S01\_AA01

**FCC**

Passed

Passed

Passed

**IC**

Passed

Passed

Passed

N/A: Not applicable

N/P: Not performed

Not all tests applicable for the EUT have been performed. The built-in radio module for this band have been already tested in the cellular repeater CAP H 17E/17E/19/19 F-AC-F1-APE (FCC ID: XS5-CAPH17E19, IC Number: 2237E-EH17E19). These results will be reused in accordance with KDB 484596 D01, v01.

For details please see 7layers test report:MDE\_BVNBG\_1806\_FCCa.

Due to this fact, only the test case:

- Field strength of spurious radiation

has been performed, to check the behaviour of the radio module in the different housing.

The test case frequency stability was not performed, since the EUT is not equipped with signal processing capabilities.

| Report version control |              |                                                                                                                                                                                                                                                                                                                                                                                                              |                  |
|------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Version                | Release date | Change Description                                                                                                                                                                                                                                                                                                                                                                                           | Version validity |
| initial                | 2019-03-11   | --                                                                                                                                                                                                                                                                                                                                                                                                           | invalid          |
| REV1                   | 2019-04-10   | <ul style="list-style-type: none"> <li>• Page 5-7: References to KDB document 935210 D02 added in test summary where applicable.</li> <li>• Page 6: "Intermodulation" added in name to test case "out-of-band emission limits".</li> <li>• Page 7: FCC / IC ID of the referenced device for test results added.</li> <li>• Page 7: Reference to KDB 484595 D01 v01 "Reuse of test results" added.</li> </ul> | valid            |



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(responsible for accreditation scope)  
 Dipl.-Ing. Marco Kullik

*D. Gall*

(responsible for testing and report)  
 Dipl.-Ing. Daniel Gall

## 2 ADMINISTRATIVE DATA

### 2.1 TESTING LABORATORY

Company Name: 7layers GmbH  
Address: Borsigstr. 11  
40880 Ratingen  
Germany

The test facility is accredited by the following accreditation organisation:

Laboratory accreditation no: DAKKS D-PL-12140-01-00  
FCC Designation Number: DE0015  
FCC Test Firm Registration: 929146  
ISED CAB Identifier: DE0007; ISED#:3699A  
Responsible for accreditation scope: Dipl.-Ing. Marco Kullik  
Report Template Version: 2019-03-11

### 2.2 PROJECT DATA

Responsible for testing and report: Dipl.-Ing. Daniel Gall  
Employees who performed the tests: documented internally at 7Layers  
Date of Report: 2019-04-10  
Testing Period: 2019-02-19 to 2019-02-21

### 2.3 APPLICANT DATA

Company Name: Commscope  
Andrew Wireless Systems GmbH  
Address: Industriering 10  
86675 Buchdorf  
Germany  
Contact Person: Mr. Frank Futter

### 2.4 MANUFACTURER DATA

Company Name: please see applicant data  
Address:

Contact Person:

### 3 TEST OBJECT DATA

#### 3.1 GENERAL EUT DESCRIPTION

|                                          |                                                                                                                                                                                                                                                                      |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Kind of Device<br>product description    | Cellular Repeater                                                                                                                                                                                                                                                    |
| Product name                             |                                                                                                                                                                                                                                                                      |
| Type                                     | ION-E System<br>CAP H 7E/80-85/17E/19                                                                                                                                                                                                                                |
| <b>Declared EUT data by the supplier</b> |                                                                                                                                                                                                                                                                      |
| General Product<br>Description           | The EUT is an industrial signal booster supporting the followings:<br>Band 2/25 / 1900 PCS<br>Band 4/10/66 / AWS 1<br>Band 5 / 850<br>Band 12 / 700 a<br>Band 13 / 700 c<br>Band 14 / 700 PS<br>Band 26 / 850+<br>A RF operation is only supported for the downlink. |
| Booster Type                             | Industrial Signal Booster                                                                                                                                                                                                                                            |
| Voltage Type                             | AC                                                                                                                                                                                                                                                                   |
| Voltage Level                            | 100 – 240 V, 50 – 60 Hz                                                                                                                                                                                                                                              |
| Maximum Output<br>Donor Port [Uplink]    | -                                                                                                                                                                                                                                                                    |
| Maximum Output<br>Server Port [Downlink] | Band 2/25 / 1900 PCS: 43.0 dBm                                                                                                                                                                                                                                       |
| Maximum Gain [Uplink]                    | -                                                                                                                                                                                                                                                                    |
| Maximum Gain<br>[Downlink]               | Band 2 / 1900 PCS: 28.0 dB                                                                                                                                                                                                                                           |

**The main components of the EUT are listed and described in chapter 3.2 EUT Main components.**

#### 3.2 EUT MAIN COMPONENTS

| Sample Name      | Sample Code                        | Description |
|------------------|------------------------------------|-------------|
| EUT A            | DE1277008aa01                      | FCC sample  |
| Sample Parameter | Value                              |             |
| Serial Number    | BGCHDA1851001                      |             |
| HW Version       | 7825719-0001 CAP H 7E/80-85/17E/19 |             |
| SW Version       | 7694174-12 SW V2.6.0.106           |             |
| Comment          | -                                  |             |

NOTE: The short description is used to simplify the identification of the EUT in this test report.

### 3.3 ANCILLARY EQUIPMENT

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

| Device | Details<br>(Manufacturer, Type Model, OUT Code) | Description |
|--------|-------------------------------------------------|-------------|
| -      | -                                               | -           |

### 3.4 AUXILIARY EQUIPMENT

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Auxiliary Equipment can influence the test results.

| Device | Details<br>(Manufacturer, HW, SW, S / N) | Description |
|--------|------------------------------------------|-------------|
| -      | -                                        | -           |

### 3.5 EUT SETUPS

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

| Setup    | Combination of EUTs | Description and Rationale |
|----------|---------------------|---------------------------|
| S01_AA01 | EUT A               | Setup for all tests       |

### 3.6 OPERATING MODES

This chapter describes the operating modes of the EUTs used for testing.

#### 3.6.1 TEST CHANNELS

| Band | Direction | Lower Frequency Band Edge [MHz] | Upper Frequency Band Edge [MHz] | Center Frequency [MHz] | Port  |
|------|-----------|---------------------------------|---------------------------------|------------------------|-------|
| 2/25 | downlink  | 1930.00                         | 1995.00                         | 1962.50                | Donor |

#### 3.6.2 AUTOMATIC GAIN CONTROL LEVELS

| AGC Levels |           |             |                     |                             |                           |                 |            |
|------------|-----------|-------------|---------------------|-----------------------------|---------------------------|-----------------|------------|
| Band       | Direction | Signal Type | AGC Start Pin [dBm] | AGC Start Pin -0.3 dB [dBm] | AGC Start Pin +3 dB [dBm] | Frequency [MHz] | Frequency  |
| 2/25       | downlink  | Narrowband  | 0.0                 | -                           | -                         | 1962.5          | Mid        |
| 2/25       | downlink  | Wideband    | -                   | -                           | -                         | -               |            |
| 2/25       | downlink  | Narrowband  | 1.0                 | -                           | -                         | 1930.0          | Low        |
| 2/25       | downlink  | Wideband    | -                   | -                           | -                         | -               |            |
| 2/25       | downlink  | Narrowband  | 1.2                 | -                           | -                         | 1995.0          | High       |
| 2/25       | downlink  | Wideband    | -                   | -                           | -                         | -               |            |
| 2/25       | downlink  | Narrowband  | -                   | -                           | -                         | -               | Max. Power |
| 2/25       | downlink  | Wideband    | -                   | -                           | -                         | -               |            |

### 3.7 PRODUCT LABELLING

#### 3.7.1 FCC ID LABEL

Please refer to the documentation of the applicant.

#### 3.7.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

## 4 TEST RESULTS

### 4.1 FIELD STRENGTH OF SPURIOUS RADIATION

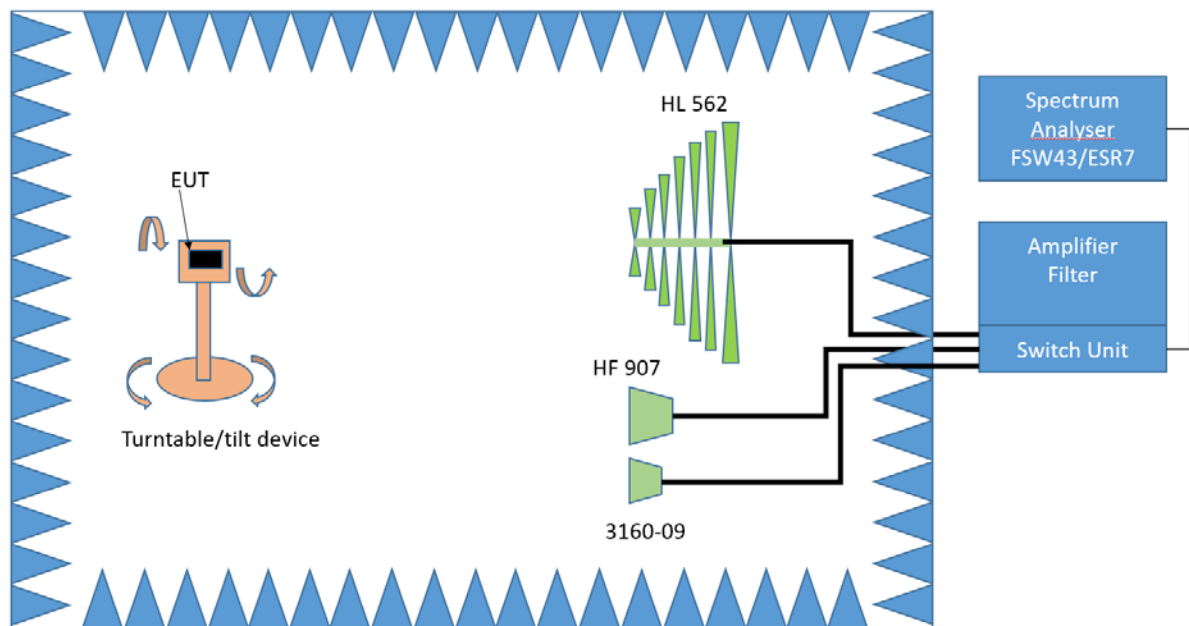
Standard FCC Part 24, §24.238

**The test was performed according to:**  
ANSI C63.26

#### 4.1.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable radiated spurious emission measurements per § 2.1053

The EUT was connected to the test setup according to the following diagram:



FCC Part 22/24/27/90; Industrial Signal Booster – Test Setup; Field Strength of Spurious Radiation

The test set-up was made in accordance to the general provisions of ANSI C63.4 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m<sup>2</sup> in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

The measurement procedure is implemented into the EMI test software EMC32 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is also performed at 3 axes. A pre-check is performed while the EUT is powered from a DC power source.

#### 1. Measurement above 30 MHz and up to 1 GHz

##### Step 1: Preliminary scan

This is a preliminary test to identify the highest amplitudes relative to the limit. Settings for step 1:

- Antenna distance: 3 m
- Detector: Peak-Maxhold / Quasipeak (FFT-based)
- Frequency range: 30 – 1000 MHz
- Frequency steps: 30 kHz
- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 ms
- Turntable angle range:  $-180^{\circ}$  to  $90^{\circ}$
- Turntable step size:  $90^{\circ}$
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

#### **Step 2: Adjustment measurement**

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by  $\pm 45^{\circ}$  around this value. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position, the antenna height will also slowly vary by  $\pm 100$  cm around the antenna height determined. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range:  $\pm 45^{\circ}$  around the determined value
- Height variation range:  $\pm 100$  cm around the determined value
- Antenna Polarisation: max. value determined in step 1

#### **Step 3: Final measurement with QP detector**

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak ( $< 1$  GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

### **3. Measurement above 1 GHz**

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

#### **Step 1:**

The Equipment Under Test (EUT) was set up on a non-conductive support (tilt device) at 1.5 m height in the fully-anechoic chamber.

All steps were performed with one height (1.5 m) of the receiving antenna only.

The EUT is turned during the preliminary measurement across the elevation axis, with a step size of  $90^{\circ}$ .

The turn table step size (azimuth angle) for the preliminary measurement is  $45^{\circ}$ .

#### **Step 2:**

Due to the fact, that in this frequency range the test is performed in a fully anechoic room, the height scan of the receiving antenna in step 2 is omitted. Instead of this, a maximum search with a step size  $\pm 45^\circ$  for the elevation axis is performed.

The turn table azimuth will slowly vary by  $\pm 22.5^\circ$ .

The elevation angle will slowly vary by  $\pm 45^\circ$

EMI receiver settings (for all steps):

- Detector: Peak, Average
- IF Bandwidth = 1 MHz

#### **Step 3:**

Spectrum analyser settings for step 3:

- Detector: Peak / Average
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 1 MHz
- Measuring time: 1 s

### **4.1.2 TEST REQUIREMENTS / LIMITS**

#### **FCC Part 2.1053; Measurement required: Field strength of spurious radiation:**

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate.

#### **Part 24, Subpart E – Broadband PCS, Band 2 / 25**

##### **§24.238 – Emission limitations for Broadband PCS equipment**

(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

### **RSS-133; 6.5 Transmitter Unwanted Emissions**

#### **6.5.1 Out-of-Block Emissions**

Equipment shall comply with the limits in (i) and (ii) below.

- In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least  $43 + 10 \log_{10}(P)$  (watts).
- After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least  $43 + 10 \log_{10}(P)$  (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

#### 4.1.3 TEST PROTOCOL

| Band 2/25, downlink; |                      |             |          |           |             |                      |
|----------------------|----------------------|-------------|----------|-----------|-------------|----------------------|
| Spurious Freq. [MHz] | Spurious Level [dBm] | Pin [dBm]   | Detector | RBW [kHz] | Limit [dBm] | Margin to Limit [dB] |
| -                    | -                    | 1.0/0.0/1.2 | RMS      | 100       | -13.0       | - - -                |
| -                    | -                    | 1.0/0.0/1.2 | RMS      | 100       | -13.0       | - - -                |
| -                    | -                    | 1.0/0.0/1.2 | RMS      | 100       | -13.0       | - - -                |
| -                    | -                    | 1.0/0.0/1.2 | RMS      | 100       | -13.0       | - - -                |
| -                    | -                    | 1.0/0.0/1.2 | RMS      | 100       | -13.0       | - - -                |

Remark: Please see next sub-clause for the measurement plot.

Only module 1 was tested

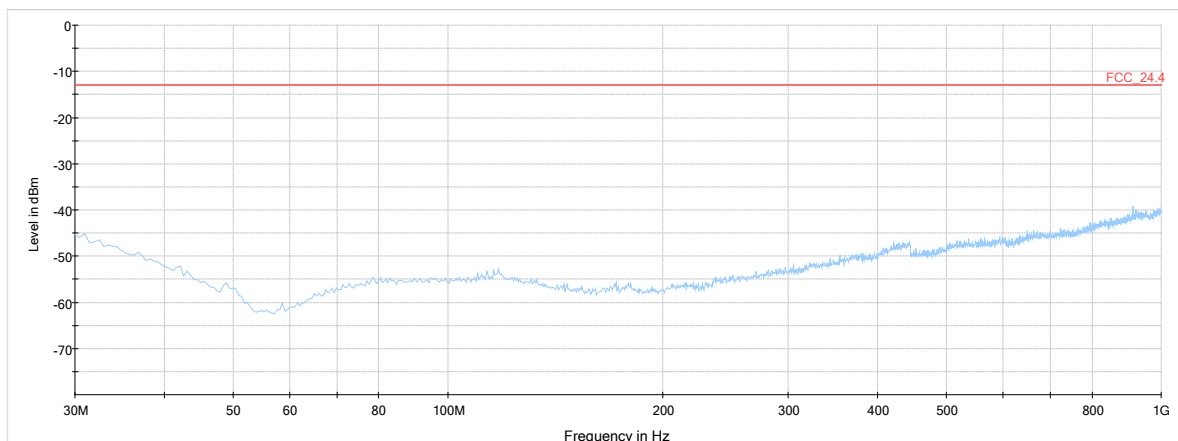
The three required test frequencies (low, mid, high) were injected simultaneously conducted into the EUT.

The RF output ports were terminated with 50 Ohm

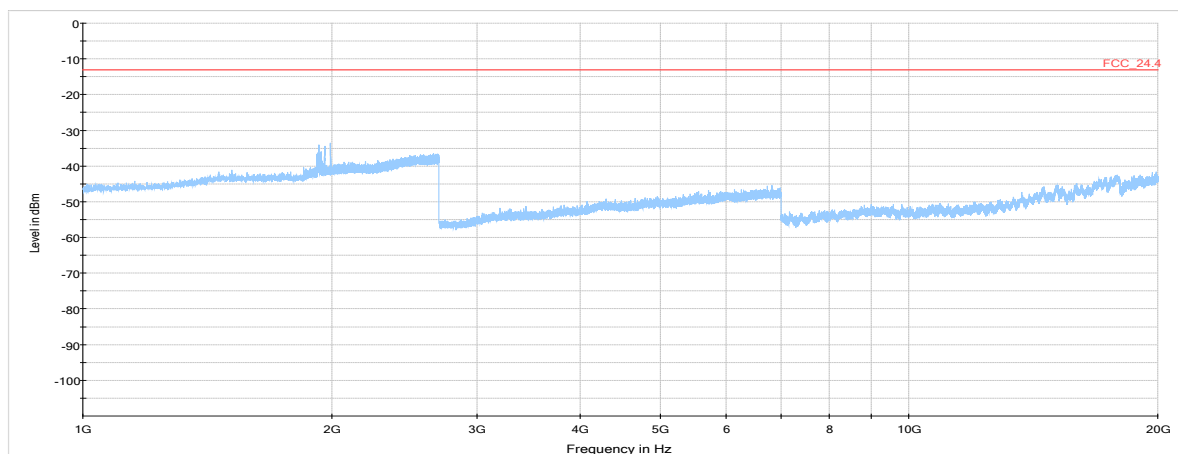
Pin: The single power of each of the three channels (bottom, middle, top).

#### 4.1.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

Frequency Band = Band 2/25, Test Frequency = high, Direction = RF downlink  
(S01\_AA01)

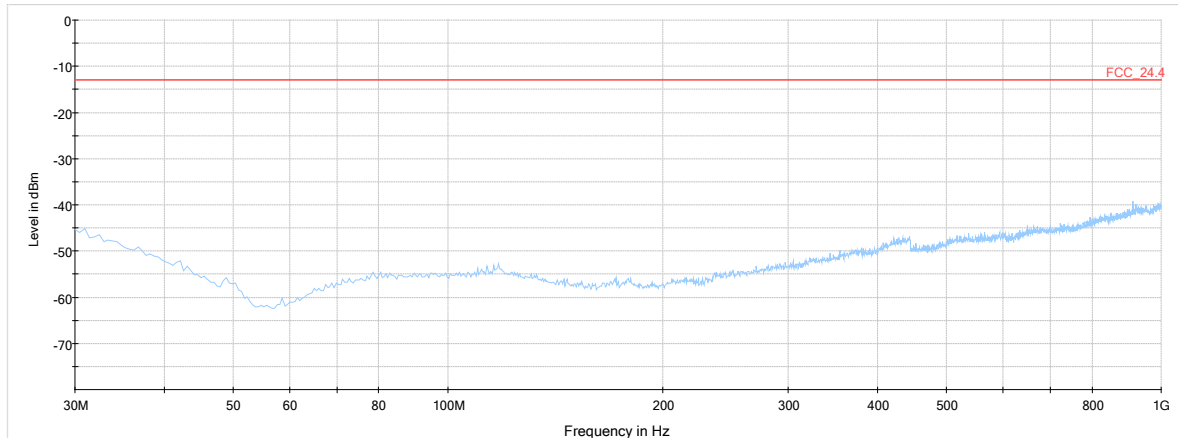


30 MHz - 1 GHz

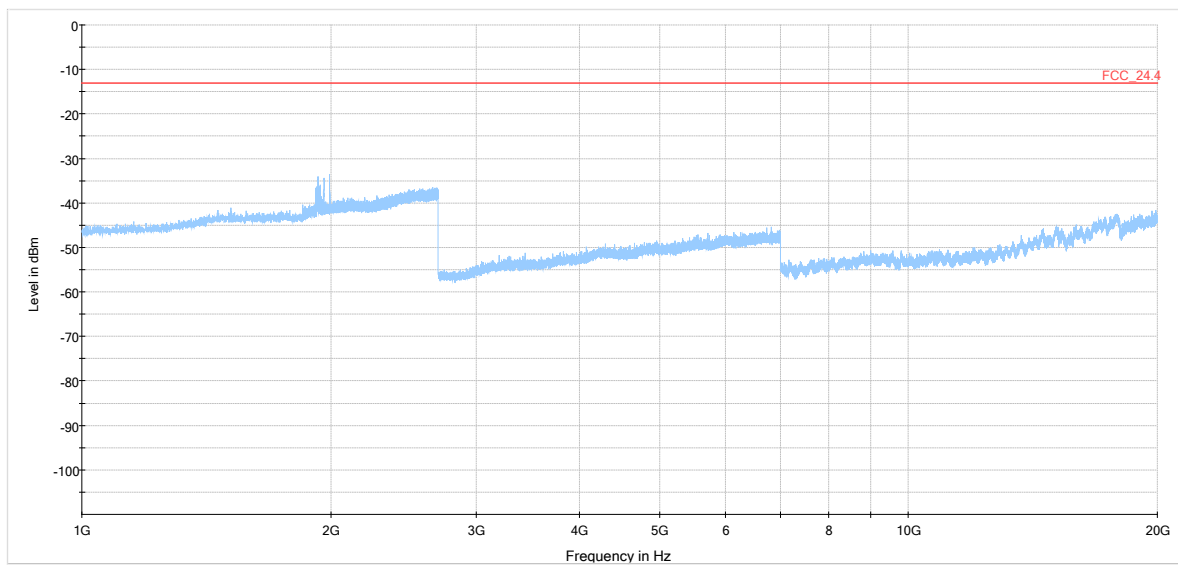


1 GHz - 20 GHz

Frequency Band = Band 2/25, Test Frequency = mid, Direction = RF downlink  
(S01\_AA01)

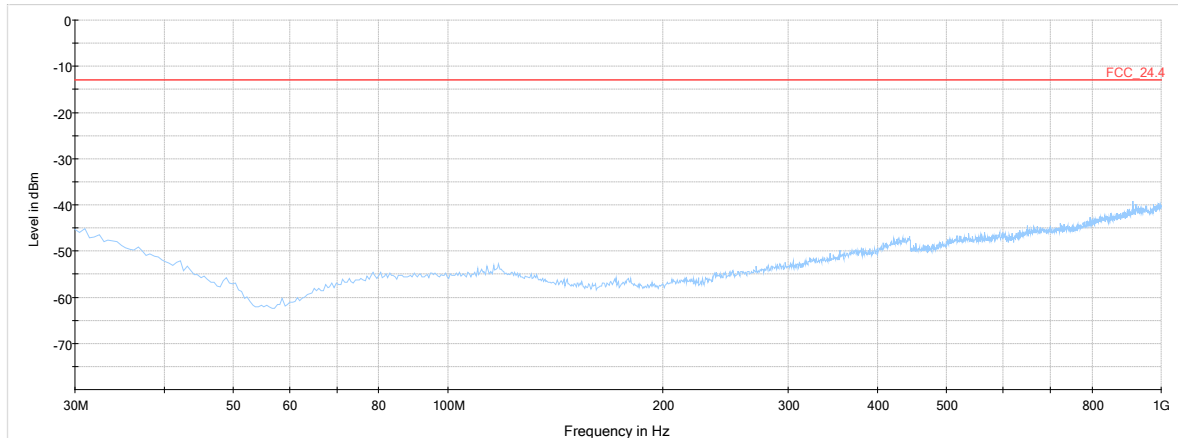


30 MHz - 1 GHz

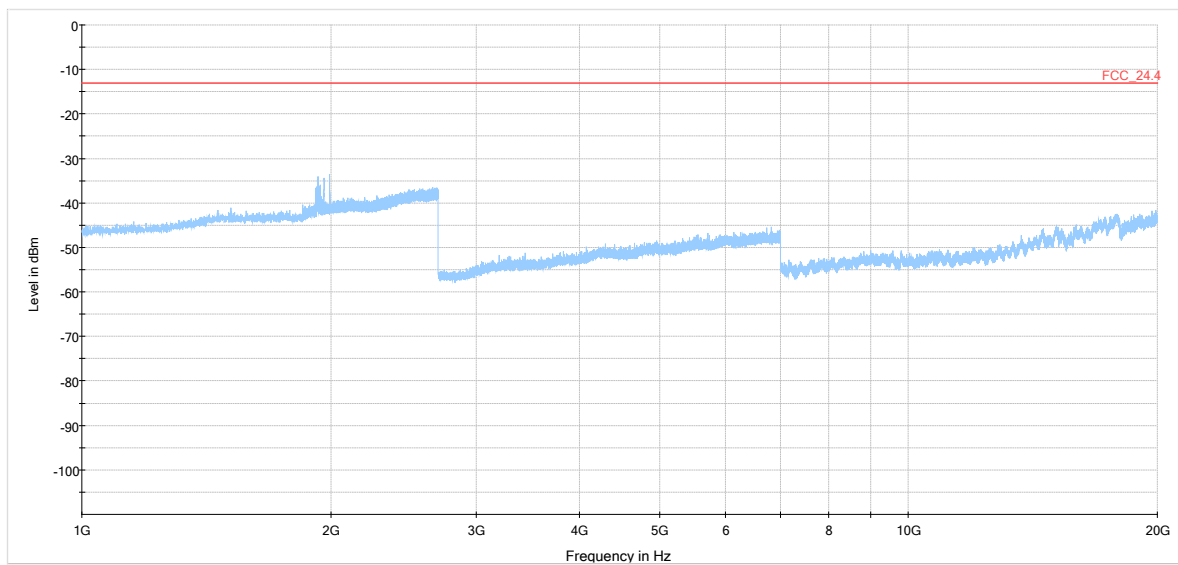


1 GHz - 20 GHz

Frequency Band = Band 2/25, Test Frequency = low, Direction = RF downlink  
(S01\_AA01)



30 MHz - 1 GHz



1 GHz - 20 GHz

#### 4.1.5 TEST EQUIPMENT USED

- Radiated Emissions

## 5 TEST EQUIPMENT

1 R&S TS8997  
EN300328/301893/FCC cond. Test Lab

| Ref.No. | Device Name          | Description                                | Manufacturer                      | Serial Number  | Last Calibration | Calibration Due |
|---------|----------------------|--------------------------------------------|-----------------------------------|----------------|------------------|-----------------|
| 1.1     | SMB100A              | Signal Generator 9 kHz - 6 GHz             | Rohde & Schwarz                   | 107695         | 2017-07          | 2020-07         |
| 1.2     | MFS                  | Rubidium Frequency Standard                | Datum-Beverly                     | 5489/001       | 2018-07          | 2020-07         |
| 1.3     | 1515 / 93459         | Broadband Power Divider SMA (Aux)          | Weinschel Associates              | LN673          |                  |                 |
| 1.4     | FSV30                | Signal Analyzer 10 Hz - 30 GHz             | Rohde & Schwarz                   | 103005         | 2018-04          | 2020-04         |
| 1.5     | Fluke 177            | Digital Multimeter 03 (Multimeter)         | Fluke Europe B.V.                 | 86670383       | 2018-04          | 2020-04         |
| 1.6     | VT 4002              | Climatic Chamber                           | Vötsch                            | 58566002150010 | 2018-04          | 2020-04         |
| 1.7     | A8455-4              | 4 Way Power Divider (SMA)                  |                                   | -              |                  |                 |
| 1.8     | Opus10 THI (8152.00) | ThermoHygro Datalogger 03 (Environ)        | Lufft Mess- und Regeltechnik GmbH | 7482           | 2017-03          | 2019-03         |
| 1.9     | SMBV100A             | Vector Signal Generator 9 kHz - 6 GHz      | Rohde & Schwarz                   | 259291         | 2016-10          | 2019-10         |
| 1.10    | OSP120               | Switching Unit with integrated power meter | Rohde & Schwarz                   | 101158         | 2018-05          | 2021-05         |

2 Radiated Emissions  
Lab to perform radiated emission tests

| Ref.No. | Device Name           | Description                               | Manufacturer                      | Serial Number | Last Calibration | Calibration Due |
|---------|-----------------------|-------------------------------------------|-----------------------------------|---------------|------------------|-----------------|
| 2.1     | NRV-Z1                | Sensor Head A                             | Rohde & Schwarz                   | 827753/005    | 2018-07          | 2019-07         |
| 2.2     | MFS                   | Rubidium Frequency Normal MFS             | Datum GmbH                        | 002           | 2018-10          | 2020-10         |
| 2.3     | Opus10 TPR (8253.00)  | ThermoAirpressure Datalogger 13 (Environ) | Lufft Mess- und Regeltechnik GmbH | 13936         | 2017-04          | 2019-04         |
| 2.4     | ESW44                 | EMI Test Receiver                         | Rohde & Schwarz                   | 101603        | 2018-05          | 2019-05         |
| 2.5     | Anechoic Chamber      | 10.58 x 6.38 x 6.00 m <sup>3</sup>        | Frankonia                         | none          | 2018-06          | 2020-06         |
| 2.6     | HL 562                | Ultralog new biconicals                   | Rohde & Schwarz                   | 830547/003    | 2018-07          | 2021-07         |
| 2.7     | 5HC2700/12750 -1.5-KK | High Pass Filter                          | Trilithic                         | 9942012       |                  |                 |
| 2.8     | ASP 1.2/1.8-10 kg     | Antenna Mast                              | Maturo GmbH                       | -             |                  |                 |

| Ref.No. | Device Name                   | Description                                     | Manufacturer                      | Serial Number          | Last Calibration | Calibration Due |
|---------|-------------------------------|-------------------------------------------------|-----------------------------------|------------------------|------------------|-----------------|
| 2.9     | Fully Anechoic Room           | 8.80m x 4.60m x 4.05m (l x w x h)               | Albatross Projects                | P26971-647-001-PRB     | 2018-06          | 2020-06         |
| 2.10    | Fluke 177                     | Digital Multimeter 03 (Multimeter)              | Fluke Europe B.V.                 | 86670383               | 2018-04          | 2020-04         |
| 2.11    | JS4-18002600-32-5P            | Broadband Amplifier 18 GHz - 26 GHz             | Miteq                             | 849785                 |                  |                 |
| 2.12    | FSW 43                        | Spectrum Analyzer                               | Rohde & Schwarz                   | 103779                 | 2019-02          | 2021-02         |
| 2.13    | 3160-09                       | Standard Gain / Pyramidal Horn Antenna 26.5 GHz | EMCO Elektronik GmbH              | 00083069               |                  |                 |
| 2.14    | WHKX 7.0/18G-8SS              | High Pass Filter                                | Wainwright                        | 09                     |                  |                 |
| 2.15    | 4HC1600/12750-1.5-KK          | High Pass Filter                                | Trilithic                         | 9942011                |                  |                 |
| 2.16    | Chroma 6404                   | AC Power Source                                 | Chroma ATE INC.                   | 64040001304            |                  |                 |
| 2.17    | JS4-00102600-42-5A            | Broadband Amplifier 30 MHz - 26 GHz             | Miteq                             | 619368                 |                  |                 |
| 2.18    | TT 1.5 WI                     | Turn Table                                      | Maturo GmbH                       | -                      |                  |                 |
| 2.19    | HL 562 Ultralog               | Log.-per. Antenna                               | Rohde & Schwarz                   | 100609                 | 2016-04          | 2019-04         |
| 2.20    | 3160-10                       | Standard Gain / Pyramidal Horn Antenna 40 GHz   | EMCO Elektronik GmbH              | 00086675               |                  |                 |
| 2.21    | 5HC3500/18000-1.2-KK          | High Pass Filter                                | Trilithic                         | 200035008              |                  |                 |
| 2.22    | Opus10 THI (8152.00)          | ThermoHygro Datalogger 12 (Environ)             | Lufft Mess- und Regeltechnik GmbH | 12482                  | 2017-03          | 2019-03         |
| 2.23    | ESR 7                         | EMI Receiver / Spectrum Analyzer                | Rohde & Schwarz                   | 101424                 | 2019-01          | 2020-01         |
| 2.24    | JS4-00101800-35-5P            | Broadband Amplifier 30 MHz - 18 GHz             | Miteq                             | 896037                 |                  |                 |
| 2.25    | AS 620 P                      | Antenna mast                                    | HD GmbH                           | 620/37                 |                  |                 |
| 2.26    | Tilt device Maturo (Rohacell) | Antrieb TD1.5-10kg                              | Maturo GmbH                       | TD1.5-10kg/024/3790709 |                  |                 |
| 2.27    | PAS 2.5 - 10 kg               | Antenna Mast                                    | Maturo GmbH                       | -                      |                  |                 |
| 2.28    | AM 4.0                        | Antenna mast                                    | Maturo GmbH                       | AM4.0/180/11920513     |                  |                 |
| 2.29    | HF 907                        | Double-ridged horn                              | Rohde & Schwarz                   | 102444                 | 2018-07          | 2021-07         |

3 FCC Conducted Base Station / Repeater  
EN300328/301893/FCC cond. Test Lab

| Ref.No. | Device Name | Description                             | Manufacturer    | Serial Number | Last Calibration | Calibration Due |
|---------|-------------|-----------------------------------------|-----------------|---------------|------------------|-----------------|
| 3.1     | FSV40       | Signal Analyzer 10 Hz - 40 GHz          | Rohde & Schwarz | 100886        | 2018-10          | 2019-10         |
| 3.2     | SMBV100A    | Vector Signal Generator 9 kHz - 6 GHz   | Rohde & Schwarz | 255975        | 2017-08          | 2019-08         |
| 3.3     | SMIQ        | Vector Signal Generator 9 kHz - 3.3 GHz | Rohde & Schwarz | 831389/062    | 2018-10          | 2020-10         |

The calibration interval is the time interval between “Last Calibration” and “Calibration Due”

## 6 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

This chapter contains the antenna factors with their corresponding path loss of the used measurement path for all antennas as well as the insertion loss of the LISN.

### 6.1 LISN R&S ESH3-Z5 (150 KHZ – 30 MHZ)

| Frequency |  | Corr. | LISN<br>insertion<br>loss<br>ESH3-<br>Z5 | cable<br>loss<br>(incl. 10<br>dB<br>atten-<br>uator) |
|-----------|--|-------|------------------------------------------|------------------------------------------------------|
| MHz       |  | dB    | dB                                       | dB                                                   |
| 0.15      |  | 10.1  | 0.1                                      | 10.0                                                 |
| 5         |  | 10.3  | 0.1                                      | 10.2                                                 |
| 7         |  | 10.5  | 0.2                                      | 10.3                                                 |
| 10        |  | 10.5  | 0.2                                      | 10.3                                                 |
| 12        |  | 10.7  | 0.3                                      | 10.4                                                 |
| 14        |  | 10.7  | 0.3                                      | 10.4                                                 |
| 16        |  | 10.8  | 0.4                                      | 10.4                                                 |
| 18        |  | 10.9  | 0.4                                      | 10.5                                                 |
| 20        |  | 10.9  | 0.4                                      | 10.5                                                 |
| 22        |  | 11.1  | 0.5                                      | 10.6                                                 |
| 24        |  | 11.1  | 0.5                                      | 10.6                                                 |
| 26        |  | 11.2  | 0.5                                      | 10.7                                                 |
| 28        |  | 11.2  | 0.5                                      | 10.7                                                 |
| 30        |  | 11.3  | 0.5                                      | 10.8                                                 |

#### Sample calculation

$$U_{\text{LISN}} (\text{dB } \mu\text{V}) = U (\text{dB } \mu\text{V}) + \text{Corr. (dB)}$$

U = Receiver reading

LISN Insertion loss = Voltage Division Factor of LISN

Corr. = sum of single correction factors of used LISN, cables, switch units (if used)

Linear interpolation will be used for frequencies in between the values in the table.

## 6.2 ANTENNA R&S HFH2-Z2 (9 KHZ – 30 MHZ)

| Frequency | AF       | Corr. | cable loss 1<br>(inside chamber) | cable loss 2<br>(outside chamber) | cable loss 3<br>(switch unit) | cable loss 4<br>(to receiver) | distance corr.<br>(-40 dB/decade) | d <sub>Limit</sub><br>(meas. distance (limit)) | d <sub>used</sub><br>(meas. distance (used)) |
|-----------|----------|-------|----------------------------------|-----------------------------------|-------------------------------|-------------------------------|-----------------------------------|------------------------------------------------|----------------------------------------------|
| MHz       | dB (1/m) | dB    | dB                               | dB                                | dB                            | dB                            | dB                                | m                                              | m                                            |
| 0.009     | 20.50    | -79.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -80                               | 300                                            | 3                                            |
| 0.01      | 20.45    | -79.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -80                               | 300                                            | 3                                            |
| 0.015     | 20.37    | -79.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -80                               | 300                                            | 3                                            |
| 0.02      | 20.36    | -79.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -80                               | 300                                            | 3                                            |
| 0.025     | 20.38    | -79.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -80                               | 300                                            | 3                                            |
| 0.03      | 20.32    | -79.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -80                               | 300                                            | 3                                            |
| 0.05      | 20.35    | -79.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -80                               | 300                                            | 3                                            |
| 0.08      | 20.30    | -79.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -80                               | 300                                            | 3                                            |
| 0.1       | 20.20    | -79.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -80                               | 300                                            | 3                                            |
| 0.2       | 20.17    | -79.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -80                               | 300                                            | 3                                            |
| 0.3       | 20.14    | -79.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -80                               | 300                                            | 3                                            |
| 0.49      | 20.12    | -79.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -80                               | 300                                            | 3                                            |
| 0.490001  | 20.12    | -39.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 0.5       | 20.11    | -39.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 0.8       | 20.10    | -39.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 1         | 20.09    | -39.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 2         | 20.08    | -39.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 3         | 20.06    | -39.6 | 0.1                              | 0.1                               | 0.1                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 4         | 20.05    | -39.5 | 0.2                              | 0.1                               | 0.1                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 5         | 20.05    | -39.5 | 0.2                              | 0.1                               | 0.1                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 6         | 20.02    | -39.5 | 0.2                              | 0.1                               | 0.1                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 8         | 19.95    | -39.5 | 0.2                              | 0.1                               | 0.1                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 10        | 19.83    | -39.4 | 0.2                              | 0.1                               | 0.2                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 12        | 19.71    | -39.4 | 0.2                              | 0.1                               | 0.2                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 14        | 19.54    | -39.4 | 0.2                              | 0.1                               | 0.2                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 16        | 19.53    | -39.3 | 0.3                              | 0.1                               | 0.2                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 18        | 19.50    | -39.3 | 0.3                              | 0.1                               | 0.2                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 20        | 19.57    | -39.3 | 0.3                              | 0.1                               | 0.2                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 22        | 19.61    | -39.3 | 0.3                              | 0.1                               | 0.2                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 24        | 19.61    | -39.3 | 0.3                              | 0.1                               | 0.2                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 26        | 19.54    | -39.3 | 0.3                              | 0.1                               | 0.2                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 28        | 19.46    | -39.2 | 0.3                              | 0.1                               | 0.3                           | 0.1                           | -40                               | 30                                             | 3                                            |
| 30        | 19.73    | -39.1 | 0.4                              | 0.1                               | 0.3                           | 0.1                           | -40                               | 30                                             | 3                                            |

### Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$

U = Receiver reading

AF = Antenna factor

Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)

distance correction =  $-40 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

Linear interpolation will be used for frequencies in between the values in the table.

Table shows an extract of values

### 6.3 ANTENNA R&S HL562 (30 MHz – 1 GHz)

( $d_{\text{Limit}} = 3 \text{ m}$ )

| Frequency | AF<br>R&S<br>HL562 | Corr. |
|-----------|--------------------|-------|
| MHz       | dB (1/m)           | dB    |
| 30        | 18.6               | 0.6   |
| 50        | 6.0                | 0.9   |
| 100       | 9.7                | 1.2   |
| 150       | 7.9                | 1.6   |
| 200       | 7.6                | 1.9   |
| 250       | 9.5                | 2.1   |
| 300       | 11.0               | 2.3   |
| 350       | 12.4               | 2.6   |
| 400       | 13.6               | 2.9   |
| 450       | 14.7               | 3.1   |
| 500       | 15.6               | 3.2   |
| 550       | 16.3               | 3.5   |
| 600       | 17.2               | 3.5   |
| 650       | 18.1               | 3.6   |
| 700       | 18.5               | 3.6   |
| 750       | 19.1               | 4.1   |
| 800       | 19.6               | 4.1   |
| 850       | 20.1               | 4.4   |
| 900       | 20.8               | 4.7   |
| 950       | 21.1               | 4.8   |
| 1000      | 21.6               | 4.9   |

| cable<br>loss 1<br>(inside<br>chamber) | cable<br>loss 2<br>(outside<br>chamber) | cable<br>loss 3<br>(switch<br>unit) | cable<br>loss 4<br>(to<br>receiver) | distance<br>corr.<br>(-20 dB/<br>decade) | $d_{\text{Limit}}$<br>(meas.<br>distance<br>(limit)) | $d_{\text{used}}$<br>(meas.<br>distance<br>(used)) |
|----------------------------------------|-----------------------------------------|-------------------------------------|-------------------------------------|------------------------------------------|------------------------------------------------------|----------------------------------------------------|
| dB                                     | dB                                      | dB                                  | dB                                  | dB                                       | m                                                    | m                                                  |
| 0.29                                   | 0.04                                    | 0.23                                | 0.02                                | 0.0                                      | 3                                                    | 3                                                  |
| 0.39                                   | 0.09                                    | 0.32                                | 0.08                                | 0.0                                      | 3                                                    | 3                                                  |
| 0.56                                   | 0.14                                    | 0.47                                | 0.08                                | 0.0                                      | 3                                                    | 3                                                  |
| 0.73                                   | 0.20                                    | 0.59                                | 0.12                                | 0.0                                      | 3                                                    | 3                                                  |
| 0.84                                   | 0.21                                    | 0.70                                | 0.11                                | 0.0                                      | 3                                                    | 3                                                  |
| 0.98                                   | 0.24                                    | 0.80                                | 0.13                                | 0.0                                      | 3                                                    | 3                                                  |
| 1.04                                   | 0.26                                    | 0.89                                | 0.15                                | 0.0                                      | 3                                                    | 3                                                  |
| 1.18                                   | 0.31                                    | 0.96                                | 0.13                                | 0.0                                      | 3                                                    | 3                                                  |
| 1.28                                   | 0.35                                    | 1.03                                | 0.19                                | 0.0                                      | 3                                                    | 3                                                  |
| 1.39                                   | 0.38                                    | 1.11                                | 0.22                                | 0.0                                      | 3                                                    | 3                                                  |
| 1.44                                   | 0.39                                    | 1.20                                | 0.19                                | 0.0                                      | 3                                                    | 3                                                  |
| 1.55                                   | 0.46                                    | 1.24                                | 0.23                                | 0.0                                      | 3                                                    | 3                                                  |
| 1.59                                   | 0.43                                    | 1.29                                | 0.23                                | 0.0                                      | 3                                                    | 3                                                  |
| 1.67                                   | 0.34                                    | 1.35                                | 0.22                                | 0.0                                      | 3                                                    | 3                                                  |
| 1.67                                   | 0.42                                    | 1.41                                | 0.15                                | 0.0                                      | 3                                                    | 3                                                  |
| 1.87                                   | 0.54                                    | 1.46                                | 0.25                                | 0.0                                      | 3                                                    | 3                                                  |
| 1.90                                   | 0.46                                    | 1.51                                | 0.25                                | 0.0                                      | 3                                                    | 3                                                  |
| 1.99                                   | 0.60                                    | 1.56                                | 0.27                                | 0.0                                      | 3                                                    | 3                                                  |
| 2.14                                   | 0.60                                    | 1.63                                | 0.29                                | 0.0                                      | 3                                                    | 3                                                  |
| 2.22                                   | 0.60                                    | 1.66                                | 0.33                                | 0.0                                      | 3                                                    | 3                                                  |
| 2.23                                   | 0.61                                    | 1.71                                | 0.30                                | 0.0                                      | 3                                                    | 3                                                  |

( $d_{\text{Limit}} = 10 \text{ m}$ )

|      |      |      |
|------|------|------|
| 30   | 18.6 | -9.9 |
| 50   | 6.0  | -9.6 |
| 100  | 9.7  | -9.2 |
| 150  | 7.9  | -8.8 |
| 200  | 7.6  | -8.6 |
| 250  | 9.5  | -8.3 |
| 300  | 11.0 | -8.1 |
| 350  | 12.4 | -7.9 |
| 400  | 13.6 | -7.6 |
| 450  | 14.7 | -7.4 |
| 500  | 15.6 | -7.2 |
| 550  | 16.3 | -7.0 |
| 600  | 17.2 | -6.9 |
| 650  | 18.1 | -6.9 |
| 700  | 18.5 | -6.8 |
| 750  | 19.1 | -6.3 |
| 800  | 19.6 | -6.3 |
| 850  | 20.1 | -6.0 |
| 900  | 20.8 | -5.8 |
| 950  | 21.1 | -5.6 |
| 1000 | 21.6 | -5.6 |

|      |      |      |      |       |    |   |
|------|------|------|------|-------|----|---|
| 0.29 | 0.04 | 0.23 | 0.02 | -10.5 | 10 | 3 |
| 0.39 | 0.09 | 0.32 | 0.08 | -10.5 | 10 | 3 |
| 0.56 | 0.14 | 0.47 | 0.08 | -10.5 | 10 | 3 |
| 0.73 | 0.20 | 0.59 | 0.12 | -10.5 | 10 | 3 |
| 0.84 | 0.21 | 0.70 | 0.11 | -10.5 | 10 | 3 |
| 0.98 | 0.24 | 0.80 | 0.13 | -10.5 | 10 | 3 |
| 1.04 | 0.26 | 0.89 | 0.15 | -10.5 | 10 | 3 |
| 1.18 | 0.31 | 0.96 | 0.13 | -10.5 | 10 | 3 |
| 1.28 | 0.35 | 1.03 | 0.19 | -10.5 | 10 | 3 |
| 1.39 | 0.38 | 1.11 | 0.22 | -10.5 | 10 | 3 |
| 1.44 | 0.39 | 1.20 | 0.19 | -10.5 | 10 | 3 |
| 1.55 | 0.46 | 1.24 | 0.23 | -10.5 | 10 | 3 |
| 1.59 | 0.43 | 1.29 | 0.23 | -10.5 | 10 | 3 |
| 1.67 | 0.34 | 1.35 | 0.22 | -10.5 | 10 | 3 |
| 1.67 | 0.42 | 1.41 | 0.15 | -10.5 | 10 | 3 |
| 1.87 | 0.54 | 1.46 | 0.25 | -10.5 | 10 | 3 |
| 1.90 | 0.46 | 1.51 | 0.25 | -10.5 | 10 | 3 |
| 1.99 | 0.60 | 1.56 | 0.27 | -10.5 | 10 | 3 |
| 2.14 | 0.60 | 1.63 | 0.29 | -10.5 | 10 | 3 |
| 2.22 | 0.60 | 1.66 | 0.33 | -10.5 | 10 | 3 |
| 2.23 | 0.61 | 1.71 | 0.30 | -10.5 | 10 | 3 |

#### Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + \text{AF (dB 1/m)} + \text{Corr. (dB)}$   
 $U$  = Receiver reading  
 $\text{AF}$  = Antenna factor  
 $\text{Corr.}$  = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)  
 $\text{distance correction} = -20 \cdot \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$   
 Linear interpolation will be used for frequencies in between the values in the table.  
 Tables show an extract of values.

#### 6.4 ANTENNA R&S HF907 (1 GHZ – 18 GHZ)

| Frequency | AF<br>R&S<br>HF907 | Corr. |
|-----------|--------------------|-------|
| MHz       | dB (1/m)           | dB    |
| 1000      | 24.4               | -19.4 |
| 2000      | 28.5               | -17.4 |
| 3000      | 31.0               | -16.1 |
| 4000      | 33.1               | -14.7 |
| 5000      | 34.4               | -13.7 |
| 6000      | 34.7               | -12.7 |
| 7000      | 35.6               | -11.0 |

| cable<br>loss 1<br>(relay +<br>cable<br>inside<br>chamber) | cable<br>loss 2<br>(outside<br>chamber) | cable<br>loss 3<br>(switch<br>unit,<br>atten-<br>uator &<br>pre-amp) | cable<br>loss 4 (to<br>receiver) |  |  |
|------------------------------------------------------------|-----------------------------------------|----------------------------------------------------------------------|----------------------------------|--|--|
| dB                                                         | dB                                      | dB                                                                   | dB                               |  |  |
| 0.99                                                       | 0.31                                    | -21.51                                                               | 0.79                             |  |  |
| 1.44                                                       | 0.44                                    | -20.63                                                               | 1.38                             |  |  |
| 1.87                                                       | 0.53                                    | -19.85                                                               | 1.33                             |  |  |
| 2.41                                                       | 0.67                                    | -19.13                                                               | 1.31                             |  |  |
| 2.78                                                       | 0.86                                    | -18.71                                                               | 1.40                             |  |  |
| 2.74                                                       | 0.90                                    | -17.83                                                               | 1.47                             |  |  |
| 2.82                                                       | 0.86                                    | -16.19                                                               | 1.46                             |  |  |

| Frequency | AF<br>R&S<br>HF907 | Corr. |
|-----------|--------------------|-------|
| MHz       | dB (1/m)           | dB    |
| 3000      | 31.0               | -23.4 |
| 4000      | 33.1               | -23.3 |
| 5000      | 34.4               | -21.7 |
| 6000      | 34.7               | -21.2 |
| 7000      | 35.6               | -19.8 |

| cable<br>loss 1<br>(relay<br>inside<br>chamber) | cable<br>loss 2<br>(inside<br>chamber) | cable<br>loss 3<br>(outside<br>chamber) | cable<br>loss 4<br>(switch<br>unit,<br>atten-<br>uator &<br>pre-amp) | cable<br>loss 5 (to<br>receiver) | used<br>for<br>FCC<br>15.247 |
|-------------------------------------------------|----------------------------------------|-----------------------------------------|----------------------------------------------------------------------|----------------------------------|------------------------------|
| dB                                              | dB                                     | dB                                      | dB                                                                   | dB                               |                              |
| 0.47                                            | 1.87                                   | 0.53                                    | -27.58                                                               | 1.33                             |                              |
| 0.56                                            | 2.41                                   | 0.67                                    | -28.23                                                               | 1.31                             |                              |
| 0.61                                            | 2.78                                   | 0.86                                    | -27.35                                                               | 1.40                             |                              |
| 0.58                                            | 2.74                                   | 0.90                                    | -26.89                                                               | 1.47                             |                              |
| 0.66                                            | 2.82                                   | 0.86                                    | -25.58                                                               | 1.46                             |                              |

| Frequency | AF<br>R&S<br>HF907 | Corr. |
|-----------|--------------------|-------|
| MHz       | dB (1/m)           | dB    |
| 7000      | 35.6               | -57.3 |
| 8000      | 36.3               | -56.3 |
| 9000      | 37.1               | -55.3 |
| 10000     | 37.5               | -56.2 |
| 11000     | 37.5               | -55.3 |
| 12000     | 37.6               | -53.7 |
| 13000     | 38.2               | -53.5 |
| 14000     | 39.9               | -56.3 |
| 15000     | 40.9               | -54.1 |
| 16000     | 41.3               | -54.1 |
| 17000     | 42.8               | -54.4 |
| 18000     | 44.2               | -54.7 |

| cable<br>loss 1<br>(relay<br>inside<br>chamber) | cable<br>loss 2<br>(High<br>Pass) | cable<br>loss 3<br>(pre-<br>amp) | cable<br>loss 4<br>(inside<br>chamber) | cable<br>loss 5<br>(outside<br>chamber) | cable<br>loss 6<br>(to<br>receiver) |
|-------------------------------------------------|-----------------------------------|----------------------------------|----------------------------------------|-----------------------------------------|-------------------------------------|
| dB                                              | dB                                | dB                               | dB                                     | dB                                      | dB                                  |
| 0.56                                            | 1.28                              | -62.72                           | 2.66                                   | 0.94                                    | 1.46                                |
| 0.69                                            | 0.71                              | -61.49                           | 2.84                                   | 1.00                                    | 1.53                                |
| 0.68                                            | 0.65                              | -60.80                           | 3.06                                   | 1.09                                    | 1.60                                |
| 0.70                                            | 0.54                              | -61.91                           | 3.28                                   | 1.20                                    | 1.67                                |
| 0.80                                            | 0.61                              | -61.40                           | 3.43                                   | 1.27                                    | 1.70                                |
| 0.84                                            | 0.42                              | -59.70                           | 3.53                                   | 1.26                                    | 1.73                                |
| 0.83                                            | 0.44                              | -59.81                           | 3.75                                   | 1.32                                    | 1.83                                |
| 0.91                                            | 0.53                              | -63.03                           | 3.91                                   | 1.40                                    | 1.77                                |
| 0.98                                            | 0.54                              | -61.05                           | 4.02                                   | 1.44                                    | 1.83                                |
| 1.23                                            | 0.49                              | -61.51                           | 4.17                                   | 1.51                                    | 1.85                                |
| 1.36                                            | 0.76                              | -62.36                           | 4.34                                   | 1.53                                    | 2.00                                |
| 1.70                                            | 0.53                              | -62.88                           | 4.41                                   | 1.55                                    | 1.91                                |

#### Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$

U = Receiver reading

AF = Antenna factor

Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)

Linear interpolation will be used for frequencies in between the values in the table.

Tables show an extract of values.

## 6.5 ANTENNA EMCO 3160-09 (18 GHZ – 26.5 GHZ)

| Frequency | AF<br>EMCO<br>3160-09 | Corr. | cable<br>loss 1<br>(inside<br>chamber) | cable<br>loss 2<br>(pre-<br>amp) | cable<br>loss 3<br>(inside<br>chamber) | cable<br>loss 4<br>(switch<br>unit) | cable<br>loss 5<br>(to<br>receiver) |
|-----------|-----------------------|-------|----------------------------------------|----------------------------------|----------------------------------------|-------------------------------------|-------------------------------------|
| MHz       | dB (1/m)              | dB    | dB                                     | dB                               | dB                                     | dB                                  | dB                                  |
| 18000     | 40.2                  | -23.5 | 0.72                                   | -35.85                           | 6.20                                   | 2.81                                | 2.65                                |
| 18500     | 40.2                  | -23.2 | 0.69                                   | -35.71                           | 6.46                                   | 2.76                                | 2.59                                |
| 19000     | 40.2                  | -22.0 | 0.76                                   | -35.44                           | 6.69                                   | 3.15                                | 2.79                                |
| 19500     | 40.3                  | -21.3 | 0.74                                   | -35.07                           | 7.04                                   | 3.11                                | 2.91                                |
| 20000     | 40.3                  | -20.3 | 0.72                                   | -34.49                           | 7.30                                   | 3.07                                | 3.05                                |
| 20500     | 40.3                  | -19.9 | 0.78                                   | -34.46                           | 7.48                                   | 3.12                                | 3.15                                |
| 21000     | 40.3                  | -19.1 | 0.87                                   | -34.07                           | 7.61                                   | 3.20                                | 3.33                                |
| 21500     | 40.3                  | -19.1 | 0.90                                   | -33.96                           | 7.47                                   | 3.28                                | 3.19                                |
| 22000     | 40.3                  | -18.7 | 0.89                                   | -33.57                           | 7.34                                   | 3.35                                | 3.28                                |
| 22500     | 40.4                  | -19.0 | 0.87                                   | -33.66                           | 7.06                                   | 3.75                                | 2.94                                |
| 23000     | 40.4                  | -19.5 | 0.88                                   | -33.75                           | 6.92                                   | 3.77                                | 2.70                                |
| 23500     | 40.4                  | -19.3 | 0.90                                   | -33.35                           | 6.99                                   | 3.52                                | 2.66                                |
| 24000     | 40.4                  | -19.8 | 0.88                                   | -33.99                           | 6.88                                   | 3.88                                | 2.58                                |
| 24500     | 40.4                  | -19.5 | 0.91                                   | -33.89                           | 7.01                                   | 3.93                                | 2.51                                |
| 25000     | 40.4                  | -19.3 | 0.88                                   | -33.00                           | 6.72                                   | 3.96                                | 2.14                                |
| 25500     | 40.5                  | -20.4 | 0.89                                   | -34.07                           | 6.90                                   | 3.66                                | 2.22                                |
| 26000     | 40.5                  | -21.3 | 0.86                                   | -35.11                           | 7.02                                   | 3.69                                | 2.28                                |
| 26500     | 40.5                  | -21.1 | 0.90                                   | -35.20                           | 7.15                                   | 3.91                                | 2.36                                |

### Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$   
 U = Receiver reading  
 AF = Antenna factor  
 Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)  
 Linear interpolation will be used for frequencies in between the values in the table.  
 Table shows an extract of values.

## 6.6 ANTENNA EMCO 3160-10 (26.5 GHZ – 40 GHZ)

| Frequency | AF<br>EMCO<br>3160-10 | Corr. | cable<br>loss 1<br>(inside<br>chamber) | cable<br>loss 2<br>(outside<br>chamber) | cable<br>loss 3<br>(switch<br>unit) | cable<br>loss 4<br>(to<br>receiver) | distance<br>corr.<br>(-20 dB/<br>decade) | d <sub>Limit</sub><br>(meas.<br>distance<br>(limit)) | d <sub>used</sub><br>(meas.<br>distance<br>(used)) |
|-----------|-----------------------|-------|----------------------------------------|-----------------------------------------|-------------------------------------|-------------------------------------|------------------------------------------|------------------------------------------------------|----------------------------------------------------|
| GHz       | dB (1/m)              | dB    | dB                                     | dB                                      | dB                                  | dB                                  | dB                                       | m                                                    | m                                                  |
| 26.5      | 43.4                  | -11.2 | 4.4                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 27.0      | 43.4                  | -11.2 | 4.4                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 28.0      | 43.4                  | -11.1 | 4.5                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 29.0      | 43.5                  | -11.0 | 4.6                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 30.0      | 43.5                  | -10.9 | 4.7                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 31.0      | 43.5                  | -10.8 | 4.7                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 32.0      | 43.5                  | -10.7 | 4.8                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 33.0      | 43.6                  | -10.7 | 4.9                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 34.0      | 43.6                  | -10.6 | 5.0                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 35.0      | 43.6                  | -10.5 | 5.1                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 36.0      | 43.6                  | -10.4 | 5.1                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 37.0      | 43.7                  | -10.3 | 5.2                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 38.0      | 43.7                  | -10.2 | 5.3                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 39.0      | 43.7                  | -10.2 | 5.4                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |
| 40.0      | 43.8                  | -10.1 | 5.5                                    |                                         |                                     |                                     | -15.6                                    | 3                                                    | 0.5                                                |

### Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$

U = Receiver reading

AF = Antenna factor

Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)

Linear interpolation will be used for frequencies in between the values in the table.

distance correction =  $-20 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

Linear interpolation will be used for frequencies in between the values in the table.

Table shows an extract of values.

## 7 MEASUREMENT UNCERTAINTIES

| Test Case(s)                                                                                    | Parameter          | Uncertainty                    |
|-------------------------------------------------------------------------------------------------|--------------------|--------------------------------|
| - Field strength of spurious radiation                                                          | Power              | $\pm 5.5$ dB                   |
| - Out-of-band rejection<br>- Occupied Bandwidth<br>- Input versus output spectrum               | Power<br>Frequency | $\pm 2.9$ dB<br>$\pm 11.2$ kHz |
| - Effective radiated power, mean output power and zone enhancer gain<br>- Peak to Average Ratio | Power              | $\pm 2.2$ dB                   |
| - Out-of-band emission limits<br>- Conducted Spurious Emissions at Antenna Terminal             | Power<br>Frequency | $\pm 2.2$ dB<br>$\pm 11.2$ kHz |

## 8 PHOTO REPORT

Please see separate photo report.