

# FCC Measurement/Technical Report on

## Rear Seat Entertainment System

### BYOC RSE SYSTEM

FCC ID: Z3K-BYOCSRSE  
IC: 9930A-BYOCSRSE

**Test Report Reference:** MDE\_JET\_1905\_FCC\_03

**Test Laboratory:**

7layers GmbH  
Borsigstrasse 11  
40880 Ratingen  
Germany



Deutsche  
Akkreditierungsstelle  
D-PL-12140-01-01  
D-PL-12140-01-02  
D-PL-12140-01-03

**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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## 1 APPLIED STANDARDS AND TEST SUMMARY

### 1.1 APPLIED STANDARDS

#### **Type of Authorization**

Certification for an Intentional Radiator.

#### **Applicable FCC Rules**

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 15 (10-1-19 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

§ 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz

#### **Note:**

The tests were selected and performed with reference to the FCC Public Notice “Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under Section 15.247 of the FCC Rules, 558074 D01 15.247 Meas Guidance v05r02, 2019-04-02”. ANSI C63.10–2013 is applied.

## 1.2 FCC-IC CORRELATION TABLE

### Correlation of measurement requirements for FHSS (e.g. Bluetooth®) equipment from FCC and IC

#### FHSS equipment

| Measurement                                 | FCC reference                 | IC reference                                              |
|---------------------------------------------|-------------------------------|-----------------------------------------------------------|
| Conducted emissions on AC Mains             | § 15.207                      | RSS-Gen Issue 5: 8.8                                      |
| Occupied bandwidth                          | § 15.247 (a) (1)              | RSS-247 Issue 2: 5.1 (b)                                  |
| Peak conducted output power                 | § 15.247 (b) (1), (4)         | RSS-247 Issue 2: 5.4 (b)                                  |
| Transmitter spurious RF conducted emissions | § 15.247 (d)                  | RSS-Gen Issue 5: 6.13/8.9/8.10;<br>RSS-247 Issue 2: 5.5   |
| Transmitter spurious radiated emissions     | § 15.247 (d);<br>§ 15.209 (a) | RSS-Gen Issue 5: 6.13 / 8.9/8.10;<br>RSS-247 Issue 2: 5.5 |
| Band edge compliance                        | § 15.247 (d)                  | RSS-247 Issue 2: 5.5                                      |
| Dwell time                                  | § 15.247 (a) (1) (iii)        | RSS-247 Issue 2: 5.1 (d)                                  |
| Channel separation                          | § 15.247 (a) (1)              | RSS-247 Issue 2: 5.1 (b)                                  |
| No. of hopping frequencies                  | § 15.247 (a) (1) (iii)        | RSS-247 Issue 2: 5.1 (d)                                  |
| Hybrid systems (only)                       | § 15.247 (f);<br>§ 15.247 (e) | RSS-247 Issue 2: 5.3                                      |
| Antenna requirement                         | § 15.203 / 15.204             | RSS-Gen Issue 5: 8.3                                      |
| Receiver spurious emissions                 | —                             | -                                                         |

### 1.3 MEASUREMENT SUMMARY

#### 47 CFR CHAPTER I FCC PART 15 § 15.247 (d) Subpart C §15.247

Transmitter Spurious Radiated Emissions

The measurement was performed according to ANSI C63.10

#### Final Result

| OP-Mode                                                    | Setup    | Date       | FCC    | IC     |
|------------------------------------------------------------|----------|------------|--------|--------|
| Radio Technology, Operating Frequency, Measurement range   |          |            |        |        |
| Bluetooth BDR, high, 1 GHz - 26 GHz                        | S01_AM01 | 2020-08-10 | Passed | Passed |
| Bluetooth BDR, high, 30 MHz - 1 GHz                        | S01_AM01 | 2020-08-10 | Passed | Passed |
| Bluetooth BDR, low, 1 GHz - 26 GHz                         | S01_AM01 | 2020-08-10 | Passed | Passed |
| Bluetooth BDR, mid, 9 kHz - 30 MHz                         | S01_AM01 | 2020-08-10 | Passed | Passed |
| Bluetooth EDR 2, high, 1 GHz - 26 GHz<br>Remark: 1GHz-8GHz | S01_AM01 | 2020-08-10 | Passed | Passed |
| Bluetooth EDR 3, high, 1 GHz - 26 GHz<br>Remark: 1GHz-8GHz | S01_AM01 | 2020-08-10 | Passed | Passed |

#### 47 CFR CHAPTER I FCC PART 15 § 15.247 (d) Subpart C §15.247

Band Edge Compliance Radiated

The measurement was performed according to ANSI C63.10

#### Final Result

| OP-Mode                                          | Setup    | Date       | FCC    | IC     |
|--------------------------------------------------|----------|------------|--------|--------|
| Radio Technology, Operating Frequency, Band Edge |          |            |        |        |
| Bluetooth BDR, high, high                        | S01_AM01 | 2020-08-10 | Passed | Passed |
| Bluetooth EDR 2, high, high                      | S01_AM01 | 2020-08-10 | Passed | Passed |
| Bluetooth EDR 3, high, high                      | S01_AM01 | 2020-08-10 | Passed | Passed |

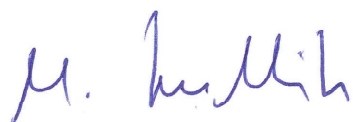
N/A: Not applicable

N/P: Not performed

## 2 REVISION HISTORY / SIGNATURES

| Report version control |              |                    |                  |
|------------------------|--------------|--------------------|------------------|
| Version                | Release date | Change Description | Version validity |
| initial                | 2020-11-13   | --                 | valid            |
| --                     | --           | --                 | --               |

COMMENT: according to customers demand only spot checks are performed.



(responsible for accreditation scope)  
Marco Kullik



(responsible for testing and report)  
Robert Machulec



7 layers GmbH, Borsigstr. 11  
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### 3 ADMINISTRATIVE DATA

#### 3.1 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-12140-01-01 | -02 | -03  
FCC Designation Number: DE0015  
FCC Test Firm Registration: 929146  
ISED CAB Identifier: DE0007; ISED#: 3699A

Responsible for accreditation scope: Marco Kullik

Report Template Version: 2020-06-15

#### 3.2 PROJECT DATA

Responsible for testing and report: Robert Machulec  
Employees who performed the tests: documented internally at 7Layers

Date of Report: 2020-11-13  
Testing Period: 2020-08-10 to 2020-08-10

#### 3.3 APPLICANT DATA

Company Name: JET Optoelectronics Co., Ltd.  
Address: 3F., No.300, Yangguang St.  
Neihu Dist., Taipei City 11491  
Taiwan (R.O.C.)  
Contact Person: Angie Kang

#### 3.4 MANUFACTURER DATA

Company Name: please see Applicant Data  
Address:  
Contact Person:

## 4 TEST OBJECT DATA

### 4.1 GENERAL EUT DESCRIPTION

|                                                 |                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Kind of Device<br>product description           | Rear Seat Entertainment System<br>10.1 inches Full HD entertainment system for rear-seat                                                                                                                                                                                                                          |
| Product name                                    | BYOC RSE SYSTEM                                                                                                                                                                                                                                                                                                   |
| Type                                            | -                                                                                                                                                                                                                                                                                                                 |
| <b>Declared EUT data by the supplier</b>        |                                                                                                                                                                                                                                                                                                                   |
| Voltage Type                                    | DC                                                                                                                                                                                                                                                                                                                |
| Voltage Level                                   | 12V                                                                                                                                                                                                                                                                                                               |
| Antenna / Gain                                  | Internal / 1dBi                                                                                                                                                                                                                                                                                                   |
| Tested Modulation Type                          | GFSK; $\pi/4$ DQPSK; 8-DPSK                                                                                                                                                                                                                                                                                       |
| General product<br>description                  | The "Bring Your Own Content "(BYOC) Rear Seat Entertainment System (RSE) is an infotainment feature that is available in the vehicle for the passenger to play audio and video media from the content provider of the user's choice, or stream content from portable devices via HDMI socket or USB memory device |
| Specific product<br>description for the EUT     | -                                                                                                                                                                                                                                                                                                                 |
| EUT ports (connected<br>cables during testing): | -                                                                                                                                                                                                                                                                                                                 |
| Tested data rates                               | 1Mbps; 2Mbps; 3Mbps                                                                                                                                                                                                                                                                                               |
| Special software used<br>for testing            | -                                                                                                                                                                                                                                                                                                                 |

### 4.2 EUT MAIN COMPONENTS

| Sample Name      | Sample Code     | Description                    |
|------------------|-----------------|--------------------------------|
| EUTam01          | DE1179003am01   | Rear Seat Entertainment System |
| Sample Parameter | Value           |                                |
| HW Version       | C1              |                                |
| SW Version       | 6.0.X           |                                |
| Serial No.       | W200424A0000040 |                                |
| Part Number      | 4N1.919.607     |                                |

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

#### 4.3 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 |
|--------|-------------------------------------------------|-------------|
| -      | -                                               | -           |

#### 4.4 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, Type Model, HW, SW, S / N) | Description |
|---------|------------------------------------------------------|-------------|
| Adaptor | , , -, -,                                            |             |

#### 4.5 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_AM01 | EUTam01, Adaptor,   |                           |

#### 4.6 OPERATING MODES / TEST CHANNELS

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

**BT Test Channels:**  
**Channel:**  
**Frequency [MHz]**

| 2.4 GHz ISM<br>2400 - 2483.5 MHz |      |      |
|----------------------------------|------|------|
| low                              | mid  | high |
| 0                                | 39   | 78   |
| 2402                             | 2441 | 2480 |

#### 4.7 PRODUCT LABELLING

##### 4.7.1 FCC ID LABEL

Please refer to the documentation of the applicant.

##### 4.7.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

## 5 TEST RESULTS

### 5.1 TRANSMITTER SPURIOUS RADIATED EMISSIONS

Standard **FCC Part 15 Subpart C**

**The test was performed according to:**  
ANSI C63.10

#### 5.1.1 TEST DESCRIPTION

The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The measurements were performed according the following sub-chapters of ANSI C63.10:

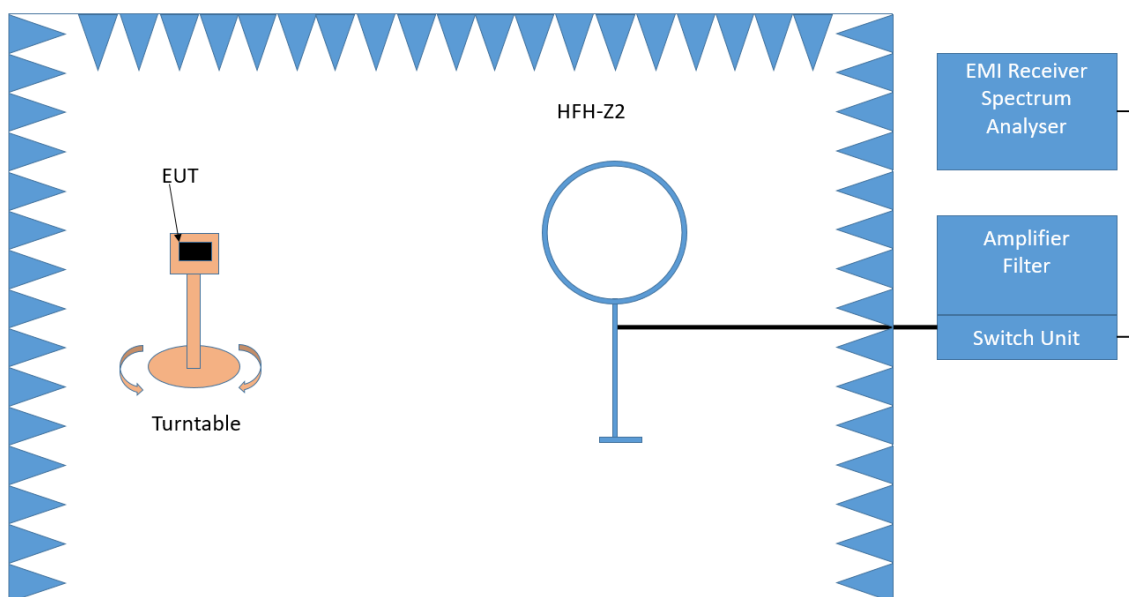
- < 30 MHz: Chapter 6.4
- 30 MHz – 1 GHz: Chapter 6.5
- > 1 GHz: Chapter 6.6 (procedure according 6.6.5 used)

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.

#### **Below 1 GHz:**

The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

#### **1. Measurement up to 30 MHz**



Test Setup; Spurious Emission Radiated (SAC), 9 kHz – 30 MHz

The Loop antenna HFH2-Z2 is used.

**Step 1: pre measurement**

- Anechoic chamber
- Antenna distance: 3 m
- Antenna height: 1 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 - 0.15 MHz and 0.15 – 30 MHz
- Frequency steps: 0.05 kHz and 2.25 kHz
- IF-Bandwidth: 0.2 kHz and 9 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)

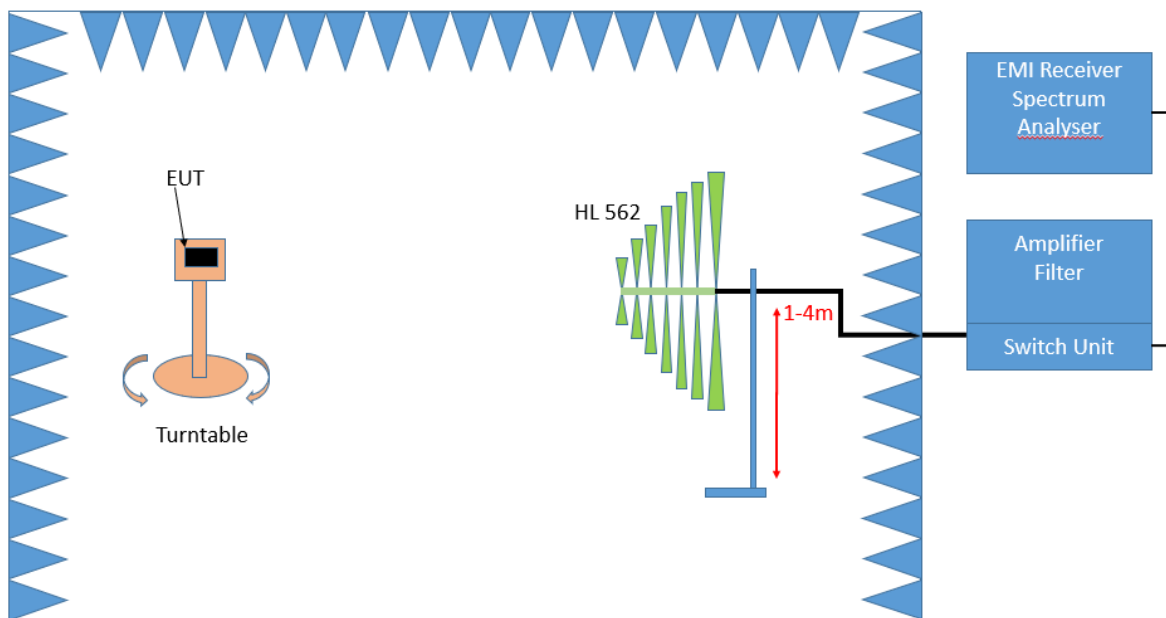
Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

**Step 2: final measurement**

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.

- Detector: Quasi-Peak (9 kHz – 150 kHz, Peak / Average 150 kHz- 30 MHz)
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF-Bandwidth: 0.2 - 10 kHz
- Measuring time / Frequency step: 1 s

**2. Measurement above 30 MHz and up to 1 GHz**



Test Setup; Spurious Emission Radiated (SAC), 30 MHz- 1GHz

**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 – 4 m
- Height variation step size: 1.5 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  $\pm 360^{\circ}$  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 1m to 4 m 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:  $360^{\circ}$
- Height variation range: 1 – 4 m
- Antenna Polarisation: max. value determined in step 1

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

With the settings determined in step 2, the final measurement will be performed:

EMI receiver settings for step 3:

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

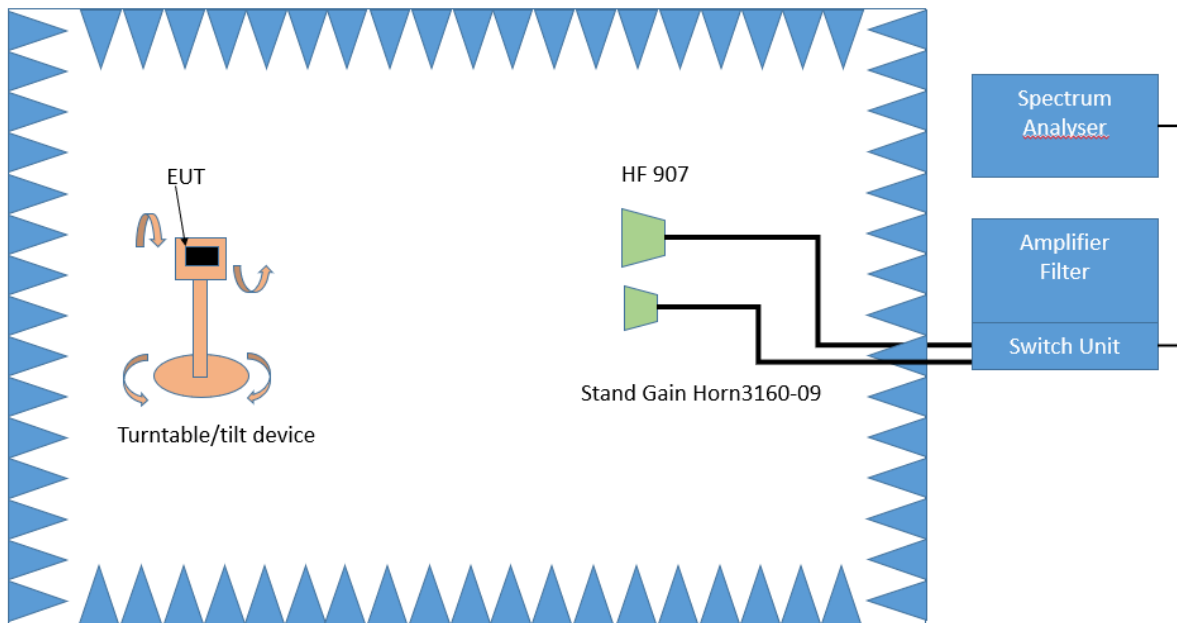
After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

### Above 1 GHz:

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.

### 3. Measurement above 1 GHz



Test Setup; Spurious Emission Radiated (FAC), 1 GHz-26.5 GHz

#### Step 1:

The EUT is turned during the preliminary measurement across the elevation axis, with a step size of 90 °.

The turn table step size (azimuth angle) for the preliminary measurement is 45 °.

Spectrum analyser settings:

- Detector: Peak, Average
- RBW = 1 MHz
- VBW = 3 MHz

#### Step 2:

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

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

Spectrum analyser settings:

- Detector: Peak

#### Step 3:

Spectrum analyser settings for step 3:

- Detector: Peak / CISPR Average
- Measured frequencies: in step 1 determined frequencies
- RBW = 1 MHz
- VBW = 3 MHz
- Measuring time: 1 s

## 5.1.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §15.247 (d)

... In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

| Frequency in MHz | Limit (μV/m)     | Measurement distance (m) | Limits (dBμV/m)    |
|------------------|------------------|--------------------------|--------------------|
| 0.009 – 0.49     | 2400/F(kHz)@300m | 3                        | (48.5 – 13.8)@300m |
| 0.49 – 1.705     | 24000/F(kHz)@30m | 3                        | (33.8 – 23.0)@30m  |
| 1.705 – 30       | 30@30m           | 3                        | 29.5@30m           |

The measured values are corrected with an inverse linear distance extrapolation factor (40 dB/decade) according FCC 15.31 (2).

| Frequency in MHz | Limit (μV/m) | Measurement distance (m) | Limits (dBμV/m) |
|------------------|--------------|--------------------------|-----------------|
| 30 – 88          | 100@3m       | 3                        | 40.0@3m         |
| 88 – 216         | 150@3m       | 3                        | 43.5@3m         |
| 216 – 960        | 200@3m       | 3                        | 46.0@3m         |
| 960 - 26000      | 500@3m       | 3                        | 54.0@3m         |
| 26000 - 40000    | 500@3m       | 1                        | 54.0@3m         |

The measured values above 26 GHz are corrected with an inverse linear distance extrapolation factor (20 dB/decade).

§15.35(b) ..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor:  $\text{Limit (dB}\mu\text{V/m)} = 20 \log (\text{Limit } (\mu\text{V/m})/1\mu\text{V/m})$

### 5.1.3 TEST PROTOCOL

Ambient temperature: 24-27 °C  
 Air Pressure: 1000-1013 hPa  
 Humidity: 37-44 %  
 BT GFSK (1-DH1)  
 Applied duty cycle correction (AV): 0 dB

| Ch. No. | Ch. Center Freq. [MHz] | Spurious Freq. [MHz] | Spurious Level [dBμV/m] | Detector | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] | Limit Type |
|---------|------------------------|----------------------|-------------------------|----------|-----------|----------------|----------------------|------------|
| 0       | 2402                   | 15600.3              | 55.9                    | PEAK     | 1000      | 74.0           | 18.1                 | RB         |
| 0       | 2402                   | 15600.3              | 41.2                    | AV       | 1000      | 54.0           | 12.8                 | RB         |
| 0       | 2402                   | 17806.2              | 59.4                    | PEAK     | 1000      | 74.0           | 14.6                 | RB         |
| 0       | 2402                   | 17822.9              | 45.2                    | AV       | 1000      | 54.0           | 8.8                  | RB         |
| 78      | 2480                   | 1300.0               | 33.5                    | AV       | 1000      | 54.0           | 20.5                 | RB         |
| 78      | 2480                   | 1300.3               | 54.6                    | PEAK     | 1000      | 74.0           | 19.4                 | RB         |
| 78      | 2480                   | 2485.5               | 36.6                    | PEAK     | 1000      | 74.0           | 37.4                 | RB         |
| 78      | 2480                   | 2485.5               | 51.1                    | AV       | 1000      | 54.0           | 2.9                  | RB         |
| 78      | 2480                   | 3897.8               | 55.2                    | PEAK     | 1000      | 74.0           | 18.8                 | RB         |
| 78      | 2480                   | 3900.0               | 36.0                    | AV       | 1000      | 54.0           | 18.0                 | RB         |

Ambient temperature: 24-27 °C  
 Air Pressure: 1000-1013 hPa  
 Humidity: 37-44 %  
 BT π/4 DQPSK (2-DH1)  
 Applied duty cycle correction (AV): 0 dB

| Ch. No. | Ch. Center Freq. [MHz] | Spurious Freq. [MHz] | Spurious Level [dBμV/m] | Detector | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] | Limit Type |
|---------|------------------------|----------------------|-------------------------|----------|-----------|----------------|----------------------|------------|
| -       | -                      | -                    | -                       | -        | -         | -              | -                    | -          |

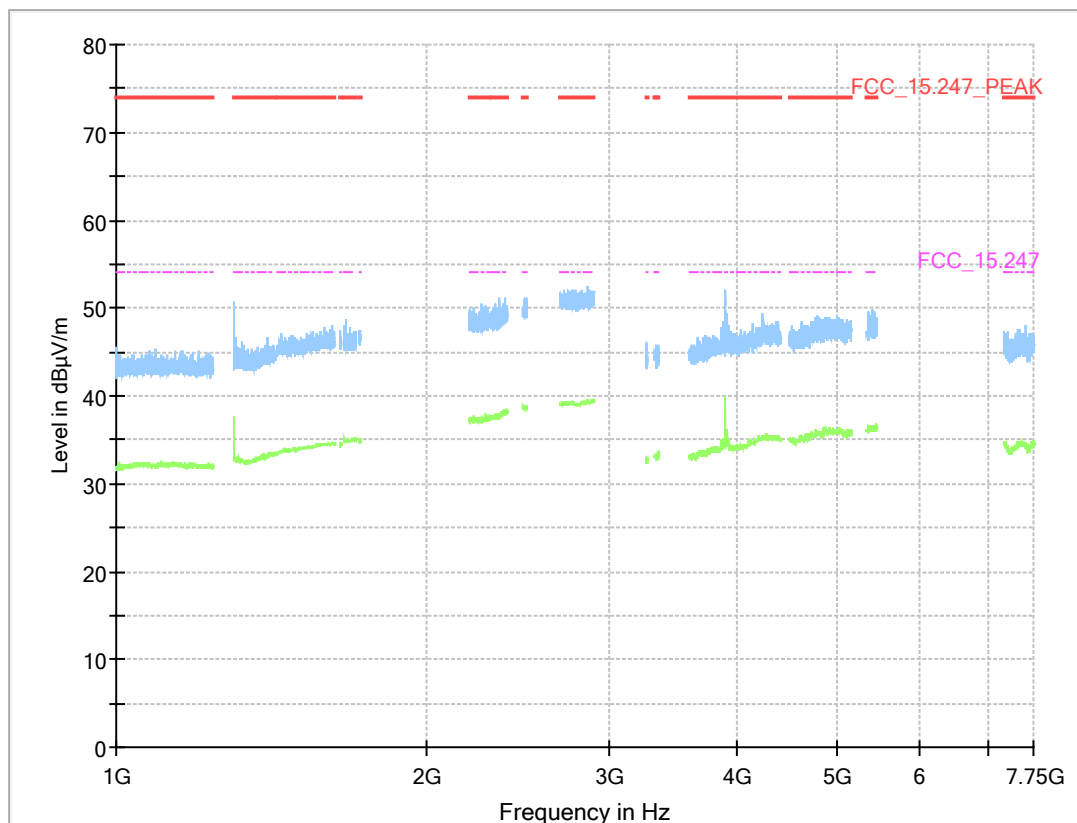
Ambient temperature: 24-27 °C  
 Air Pressure: 1000-1013 hPa  
 Humidity: 37-44 %  
 BT 8-DPSK (3-DH1)  
 Applied duty cycle correction (AV): 0 dB

| Ch. No. | Ch. Center Freq. [MHz] | Spurious Freq. [MHz] | Spurious Level [dBμV/m] | Detector | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] | Limit Type |
|---------|------------------------|----------------------|-------------------------|----------|-----------|----------------|----------------------|------------|
| -       | -                      | -                    | -                       | -        | -         | -              | -                    | -          |

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

#### 5.1.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Radio Technology = Bluetooth EDR 2, Operating Frequency = high, Measurement range = 1 GHz - 8 GHz (S01\_AM01)



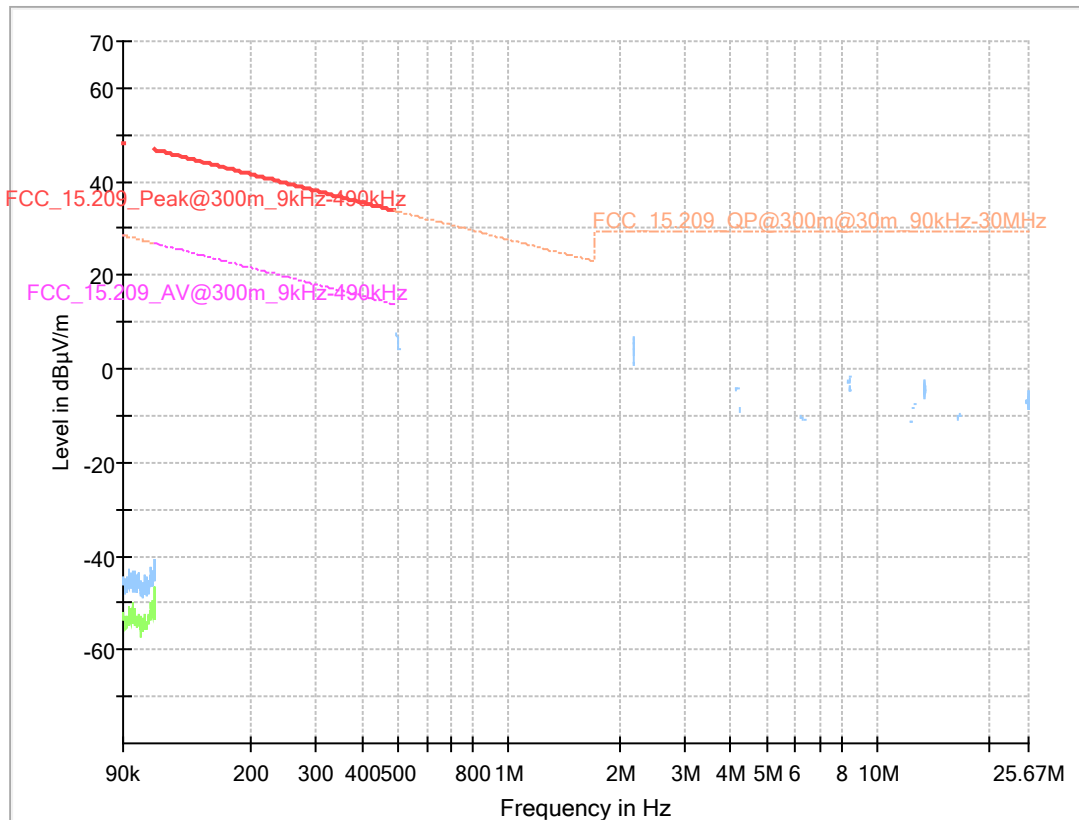
#### Critical\_Freqs

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin | Meas. Time (ms) | Bandwidth (h) | Height (t) | Pol | Azimuth (h) | Elevation (n) |
|-----------------|------------------|------------------|----------------|--------|-----------------|---------------|------------|-----|-------------|---------------|
| ---             | ---              | ---              | ---            | ---    | ---             | ---           | ---        | --- | ---         | ---           |

#### Final\_Result

| Frequency (MHz) | MaxPeak (dBµV/m) | CAverage (dBµV/m) | Limit (dBµV/m) | Margin | Meas. Time (ms) | Bandwidth (h) | Height (t) | Pol | Azimuth (h) | Elevation (n) |
|-----------------|------------------|-------------------|----------------|--------|-----------------|---------------|------------|-----|-------------|---------------|
| ---             | ---              | ---               | ---            | ---    | ---             | ---           | ---        | --- | ---         | ---           |

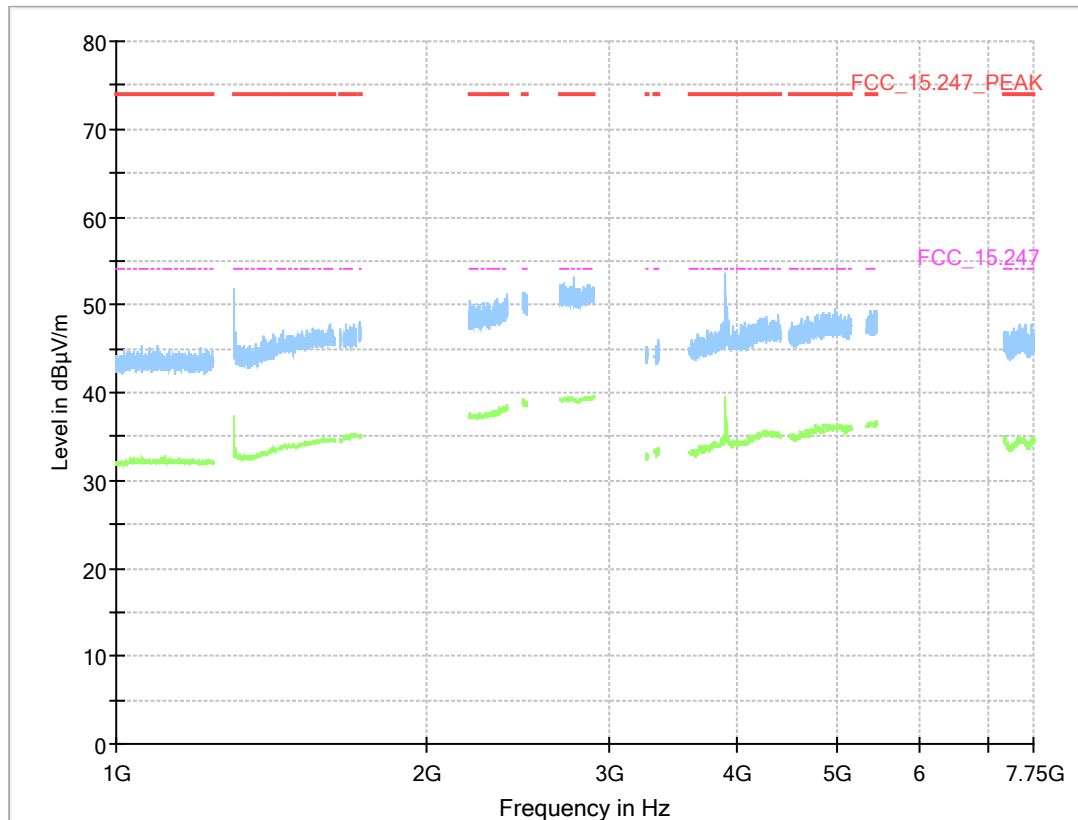
Radio Technology = Bluetooth BDR, Operating Frequency = mid, Measurement range = 9 kHz - 30 MHz (S01\_AM01)



## Final\_Result

| Frequency (MHz) | MaxPeak (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Azimuth (deg) | Corr. (dB/m) |
|-----------------|------------------|----------------|-------------|-----------------|-----------------|-------------|---------------|--------------|
| ---             | ---              | ---            | ---         | ---             | ---             | ---         | ---           | ---          |

Radio Technology = Bluetooth EDR 3, Operating Frequency = high, Measurement range = 1 GHz - 8 GHz (S01\_AM01)



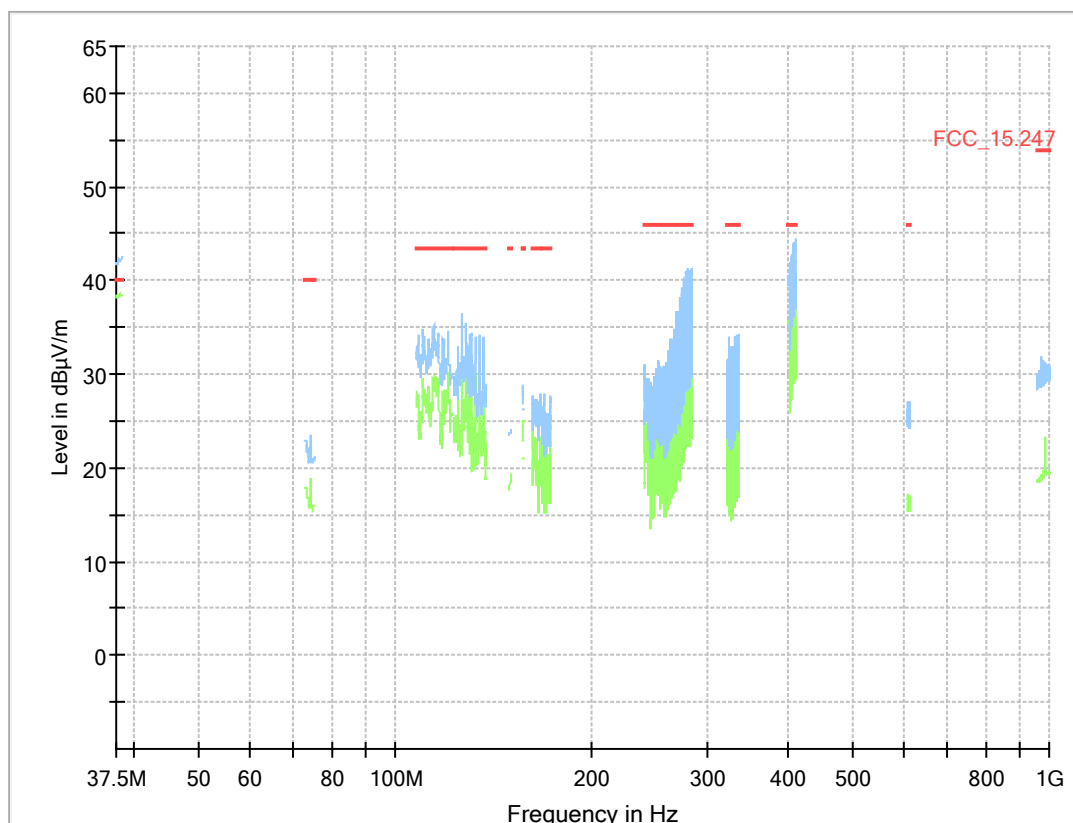
### Critical\_Freqs

| Frequency (MHz) | MaxPeak (dBμV/m) | Average (dBμV/m) | Limit (dBμV/m) | Margin | Meas. Time (ms) | Bandwidth (h) | Height | Pol | Azimuth | Elevation |
|-----------------|------------------|------------------|----------------|--------|-----------------|---------------|--------|-----|---------|-----------|
| ---             | ---              | ---              | ---            | ---    | ---             | ---           | ---    | --- | ---     | ---       |

### Final\_Result

| Frequency (MHz) | MaxPeak (dBμV/m) | CAverage (dBμV/m) | Limit (dBμV/m) | Margin | Meas. Time (ms) | Bandwidth (h) | Height | Pol | Azimuth | Elevation |
|-----------------|------------------|-------------------|----------------|--------|-----------------|---------------|--------|-----|---------|-----------|
| ---             | ---              | ---               | ---            | ---    | ---             | ---           | ---    | --- | ---     | ---       |

Radio Technology = Bluetooth BDR, Operating Frequency = high, Measurement range = 30 MHz - 1 GHz (S01\_AM01)



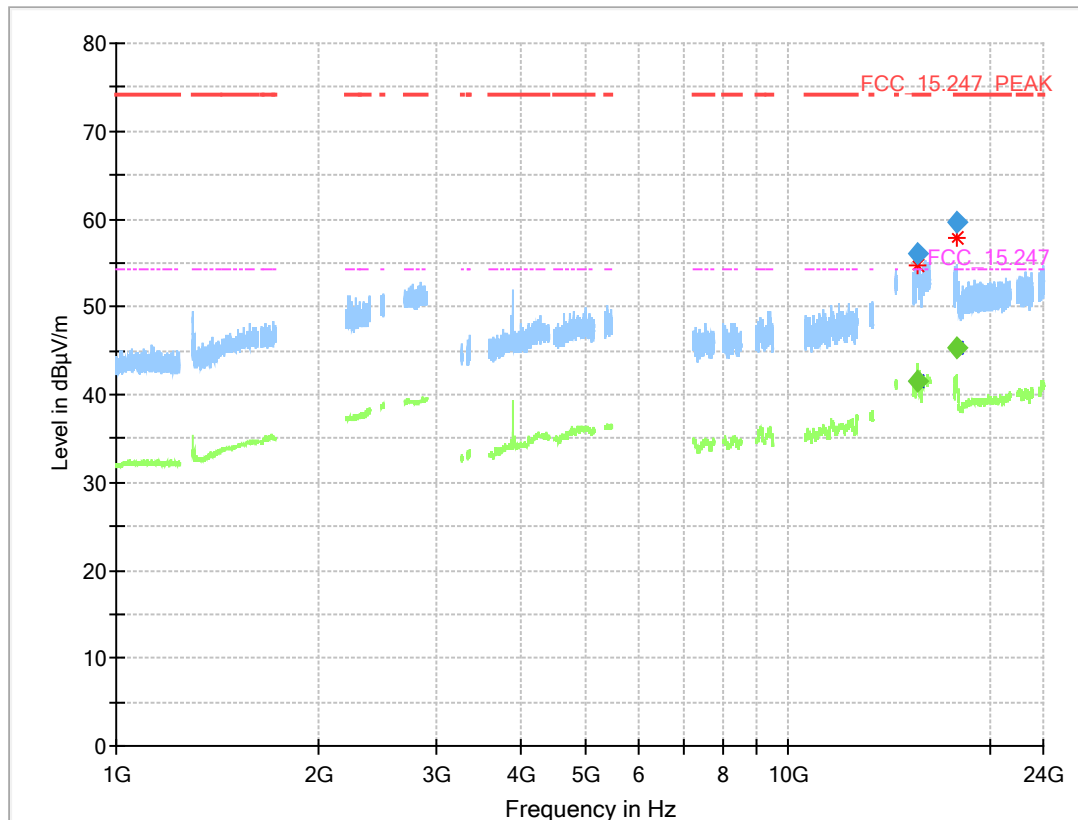
### Critical\_Freqs

| Frequency (MHz) | MaxPeak (dBμV/m) | QuasiPeak (dBμV/m) | Limit (dBμV/m) | Margin | Meas. Time (ms) | Bandwidth (h) | Height | Pol | Azimuth | Corr. (dB/m) |
|-----------------|------------------|--------------------|----------------|--------|-----------------|---------------|--------|-----|---------|--------------|
| ---             | ---              | ---                | ---            | ---    | ---             | ---           | ---    | --- | ---     | ---          |

### Final\_Result

| Frequency (MHz) | QuasiPeak (dBμV/m) | Limit (dBμV/m) | Margin | Meas. Time (ms) | Bandwidth (h) | Height | Pol | Azimuth | Corr. (dB/m) | Comment |
|-----------------|--------------------|----------------|--------|-----------------|---------------|--------|-----|---------|--------------|---------|
| ---             | ---                | ---            | ---    | ---             | ---           | ---    | --- | ---     | ---          | ---     |

Radio Technology = Bluetooth BDR, Operating Frequency = low, Measurement range = 1 GHz - 26 GHz (S01\_AM01)



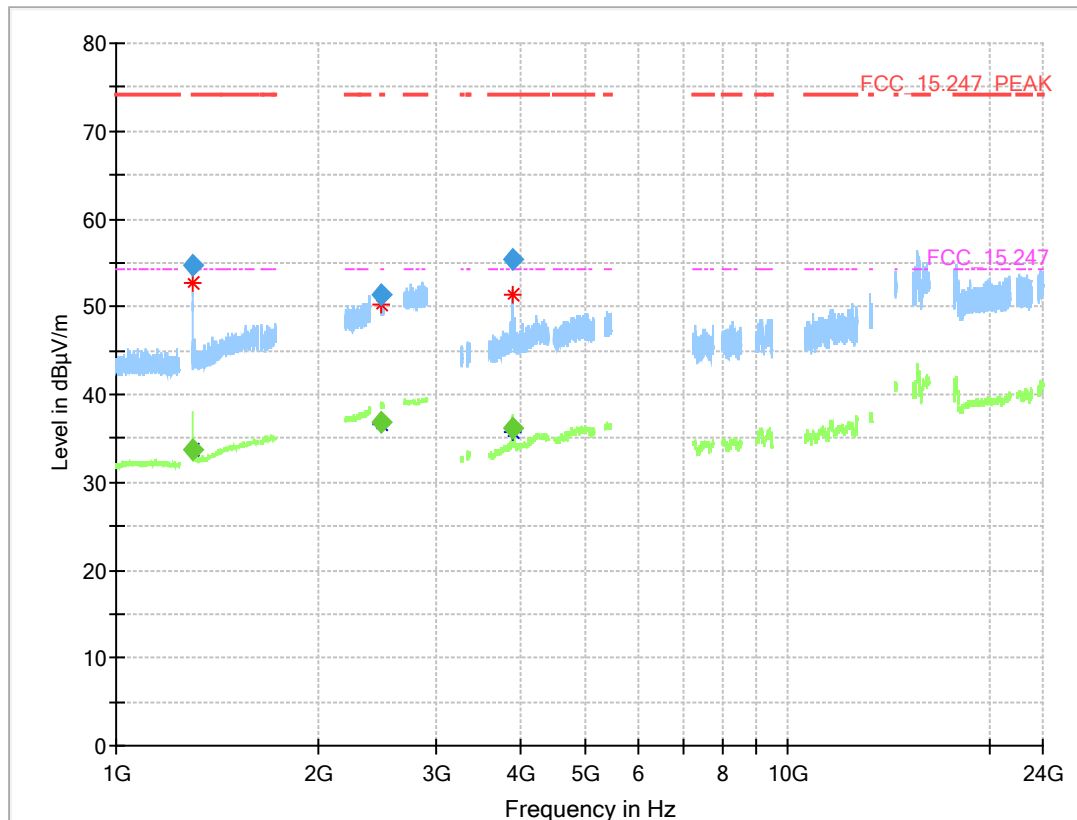
### Critical\_Freqs

| Frequency (MHz) | MaxPeak (dBμV/m) | Average (dBμV/m) | Limit (dBμV/m) | Margin | Meas. Time (ms) | Bandwidth | Height | Pol | Azimuth | Elevation |
|-----------------|------------------|------------------|----------------|--------|-----------------|-----------|--------|-----|---------|-----------|
| 15600.325       | 54.6             | ---              | 74.00          | 19.40  | ---             | ---       | 150.0  | V   | 6.0     | 79.0      |
| 15600.325       | ---              | 41.2             | 54.00          | 12.76  | ---             | ---       | 150.0  | H   | -84.0   | 103.0     |
| 17806.200       | 57.7             | ---              | 74.00          | 16.25  | ---             | ---       | 150.0  | H   | -53.0   | 7.0       |
| 17822.850       | ---              | 45.1             | 54.00          | 8.86   | ---             | ---       | 150.0  | V   | 64.0    | 15.0      |

### Final\_Result

| Frequency (MHz) | MaxPeak (dBμV/m) | CAverage (dBμV/m) | Limit (dBμV/m) | Margin | Meas. Time (ms) | Bandwidth | Height | Pol | Azimuth | Elevation |
|-----------------|------------------|-------------------|----------------|--------|-----------------|-----------|--------|-----|---------|-----------|
| 15600.325       | ---              | 41.2              | 54.00          | 12.75  | 1000.0          | 1000.000  | 150.0  | H   | -84.0   | 103.0     |
| 15600.325       | 55.9             | ---               | 74.00          | 18.05  | 1000.0          | 1000.000  | 150.0  | V   | 6.0     | 79.0      |
| 17806.200       | 59.4             | ---               | 74.00          | 14.64  | 1000.0          | 1000.000  | 150.0  | H   | -53.0   | 7.0       |
| 17822.850       | ---              | 45.2              | 54.00          | 8.84   | 1000.0          | 1000.000  | 150.0  | V   | 64.0    | 15.0      |

Radio Technology = Bluetooth BDR, Operating Frequency = high, Measurement range = 1 GHz - 26 GHz (S01\_AM01)



### Critical\_Freqs

| Frequency (MHz) | MaxPeak (dBμV/m) | Average (dBμV/m) | Limit (dBμV/m) | Margin | Meas. Time (ms) | Bandwidth | Height | Pol | Azimuth | Elevation |
|-----------------|------------------|------------------|----------------|--------|-----------------|-----------|--------|-----|---------|-----------|
| 1300.000        | ---              | 33.4             | 54.00          | 20.56  | ---             | ---       | 150.0  | H   | -90.0   | 105.0     |
| 1300.254        | 52.4             | ---              | 74.00          | 21.57  | ---             | ---       | 150.0  | H   | -83.0   | 105.0     |
| 2485.480        | 50.1             | ---              | 74.00          | 23.88  | ---             | ---       | 150.0  | V   | -22.0   | 88.0      |
| 2485.480        | ---              | 36.5             | 54.00          | 17.47  | ---             | ---       | 150.0  | V   | -64.0   | 95.0      |
| 3897.800        | 51.2             | ---              | 74.00          | 22.78  | ---             | ---       | 150.0  | H   | -5.0    | 88.0      |
| 3900.000        | ---              | 35.6             | 54.00          | 18.37  | ---             | ---       | 150.0  | H   | -28.0   | 87.0      |

### Final\_Result

| Frequency (MHz) | MaxPeak (dBμV/m) | CAverage (dBμV/m) | Limit (dBμV/m) | Margin | Meas. Time (ms) | Bandwidth | Height | Pol | Azimuth | Elevation |
|-----------------|------------------|-------------------|----------------|--------|-----------------|-----------|--------|-----|---------|-----------|
| 1300.000        | ---              | 33.5              | 54.00          | 20.49  | 1000.0          | 1000.000  | 150.0  | H   | -90.0   | 105.0     |
| 1300.254        | 54.6             | ---               | 74.00          | 19.42  | 1000.0          | 1000.000  | 150.0  | H   | -83.0   | 105.0     |
| 2485.480        | ---              | 36.6              | 54.00          | 17.45  | 1000.0          | 1000.000  | 150.0  | V   | -64.0   | 95.0      |
| 2485.480        | 51.1             | ---               | 74.00          | 22.87  | 1000.0          | 1000.000  | 150.0  | V   | -22.0   | 88.0      |
| 3897.800        | 55.2             | ---               | 74.00          | 18.80  | 1000.0          | 1000.000  | 150.0  | H   | -5.0    | 88.0      |
| 3900.000        | ---              | 36.0              | 54.00          | 18.01  | 1000.0          | 1000.000  | 150.0  | H   | -28.0   | 87.0      |

### 5.1.5 TEST EQUIPMENT USED

- Radiated Emissions

## 5.2 BAND EDGE COMPLIANCE RADIATED

Standard **FCC Part 15 Subpart C**

**The test was performed according to:**  
ANSI C63.10

### 5.2.1 TEST DESCRIPTION

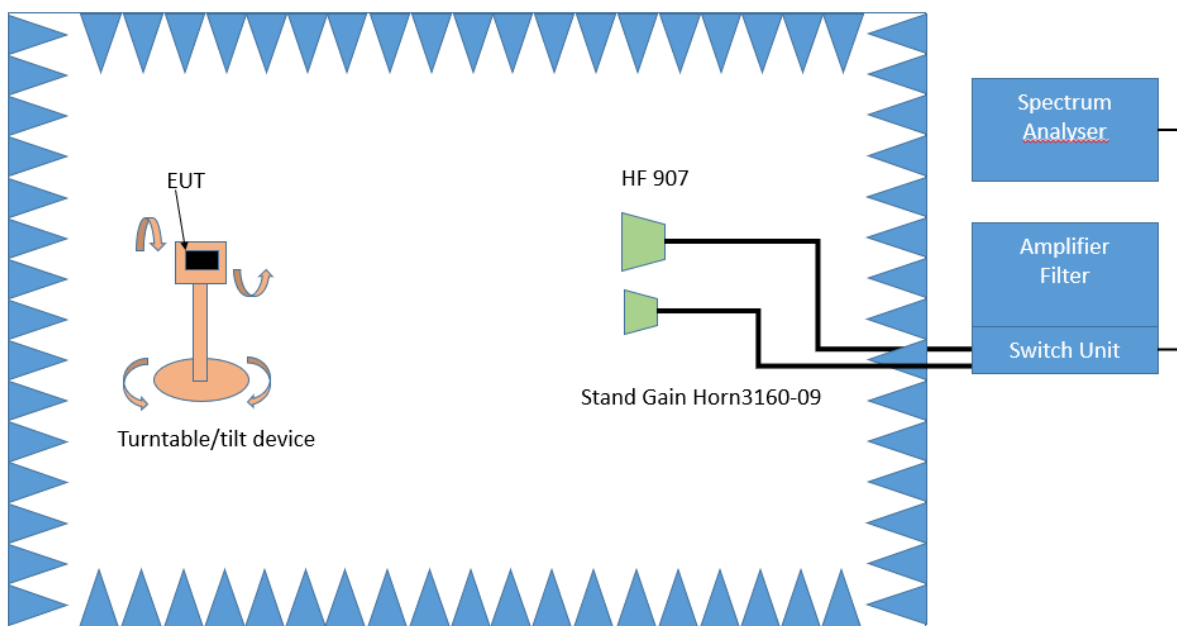
The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The measurements were performed according the following sub-chapter of ANSI C63.10:

- Chapter 6.10.5

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 (procedure according ANSI C63.10, chapter 6.6.5).

### 3. Measurement above 1 GHz



Test Setup; Spurious Emission Radiated (FAC), 1 GHz-26.5 GHz

#### Step 1:

The EUT is turned during the preliminary measurement across the elevation axis, with a step size of 90 °.

The turn table step size (azimuth angle) for the preliminary measurement is 45 °.

Spectrum analyser settings:

- Detector: Peak, Average
- RBW = 1 MHz
- VBW = 3 MHz

#### Step 2:

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

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

Spectrum analyser settings:

- Detector: Peak

### Step 3:

Spectrum analyser settings for step 3:

- Detector: Peak / CISPR Average
- Measured frequencies: in step 1 determined frequencies
- RBW = 1 MHz
- VBW = 3 MHz
- Measuring time: 1 s

## 5.2.2 TEST REQUIREMENTS / LIMITS

For band edges connected to a restricted band, the limits are specified in Section 15.209(a)

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

| Frequency in MHz | Limit ( $\mu\text{V}/\text{m}$ ) | Measurement distance (m) | Limits ( $\text{dB}\mu\text{V}/\text{m}$ ) |
|------------------|----------------------------------|--------------------------|--------------------------------------------|
| 0.009 – 0.49     | 2400/F(kHz)@300m                 | 3                        | (48.5 – 13.8)@300m                         |
| 0.49 – 1.705     | 24000/F(kHz)@30m                 | 3                        | (33.8 – 23.0)@30m                          |
| 1.705 – 30       | 30@30m                           | 3                        | 29.5@30m                                   |

The measured values are corrected with an inverse linear distance extrapolation factor (40 dB/decade) according FCC 15.31 (2).

| Frequency in MHz | Limit ( $\mu\text{V}/\text{m}$ ) | Measurement distance (m) | Limits ( $\text{dB}\mu\text{V}/\text{m}$ ) |
|------------------|----------------------------------|--------------------------|--------------------------------------------|
| 30 – 88          | 100@3m                           | 3                        | 40.0@3m                                    |
| 88 – 216         | 150@3m                           | 3                        | 43.5@3m                                    |
| 216 – 960        | 200@3m                           | 3                        | 46.0@3m                                    |
| 960 - 26000      | 500@3m                           | 3                        | 54.0@3m                                    |
| 26000 - 40000    | 500@3m                           | 1                        | 54.0@3m                                    |

The measured values above 26 GHz are corrected with an inverse linear distance extrapolation factor (20 dB/decade).

§15.35(b) ..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor:  $\text{Limit (dB}\mu\text{V}/\text{m)} = 20 \log (\text{Limit (}\mu\text{V}/\text{m)})/1\mu\text{V}/\text{m}$

### 5.2.3 TEST PROTOCOL

Ambient temperature: 24-27 °C  
 Air Pressure: 1000-1013 hPa  
 Humidity: 37-44 %  
 BT GFSK (1-DH1)  
 Applied duty cycle correction (AV): 0 dB

| Ch. No. | Ch. Center Freq. [MHz] | Band Edge Freq. [MHz] | Spurious Level [dBμV/m] | Detector | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] | Limit Type |
|---------|------------------------|-----------------------|-------------------------|----------|-----------|----------------|----------------------|------------|
| 78      | 2480                   | 2485.5                | 50.1                    | PEAK     | 1000      | 74.0           | 23.9                 | BE         |
| 78      | 2480                   | 2485.5                | 36.5                    | AV       | 1000      | 54.0           | 17.5                 | BE         |

BT π/4 DQPSK (2-DH1)  
 Applied duty cycle correction (AV): Fill out tab Duty Cycle Correction Factor! dB

| Ch. No. | Ch. Center Freq. [MHz] | Band Edge Freq. [MHz] | Spurious Level [dBμV/m] | Detector | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] | Limit Type |
|---------|------------------------|-----------------------|-------------------------|----------|-----------|----------------|----------------------|------------|
| 78      | 2480                   | 2483.5                | 50.2                    | PEAK     | 1000      | 74.0           | 23.8                 | BE         |
| 78      | 2480                   | 2483.5                | 38.8                    | AV       | 1000      | 54.0           | 15.2                 | BE         |

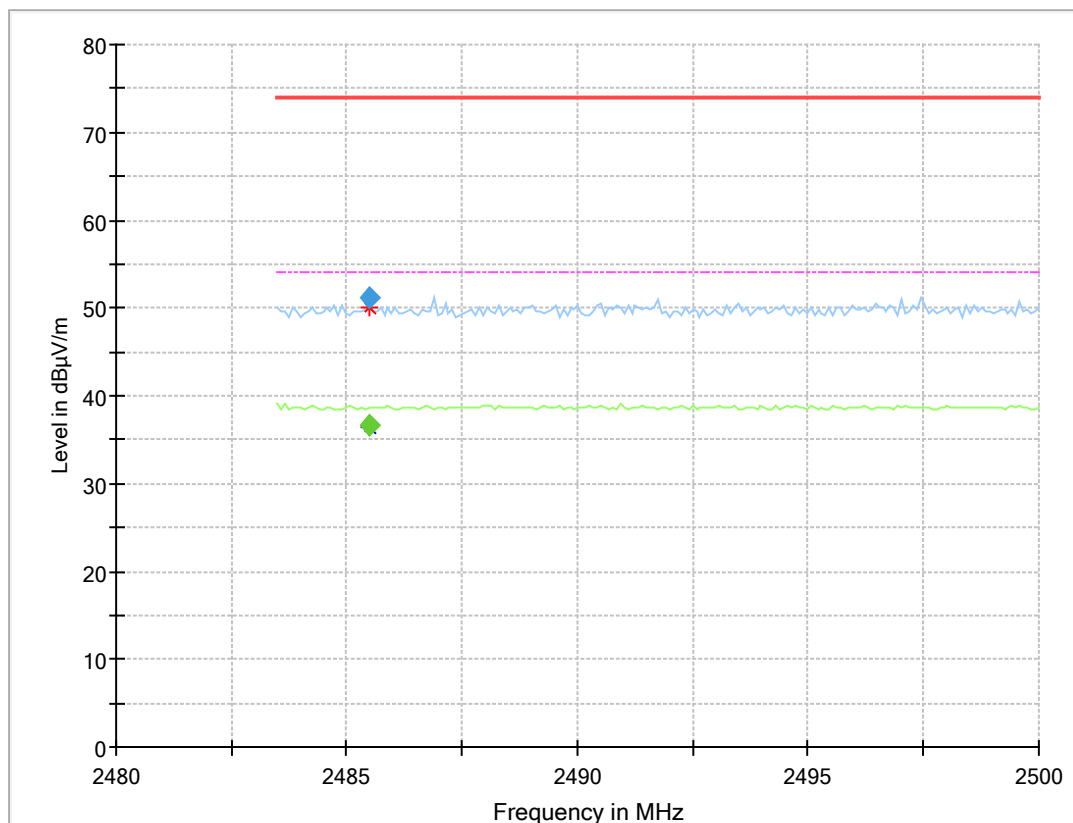
BT 8-DPSK (3-DH1)  
 Applied duty cycle correction (AV): Fill out tab Duty Cycle Correction Factor! dB

| Ch. No. | Ch. Center Freq. [MHz] | Band Edge Freq. [MHz] | Spurious Level [dBμV/m] | Detector | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] | Limit Type |
|---------|------------------------|-----------------------|-------------------------|----------|-----------|----------------|----------------------|------------|
| 78      | 2480                   | 2483.9                | 51.3                    | PEAK     | 1000      | 74.0           | 22.7                 | BE         |
| 78      | 2480                   | 2483.9                | 38.8                    | AV       | 1000      | 54.0           | 15.2                 | BE         |

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

#### 5.2.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Radio Technology = Bluetooth BDR, Operating Frequency = high, Band Edge = high (S01\_AM01)



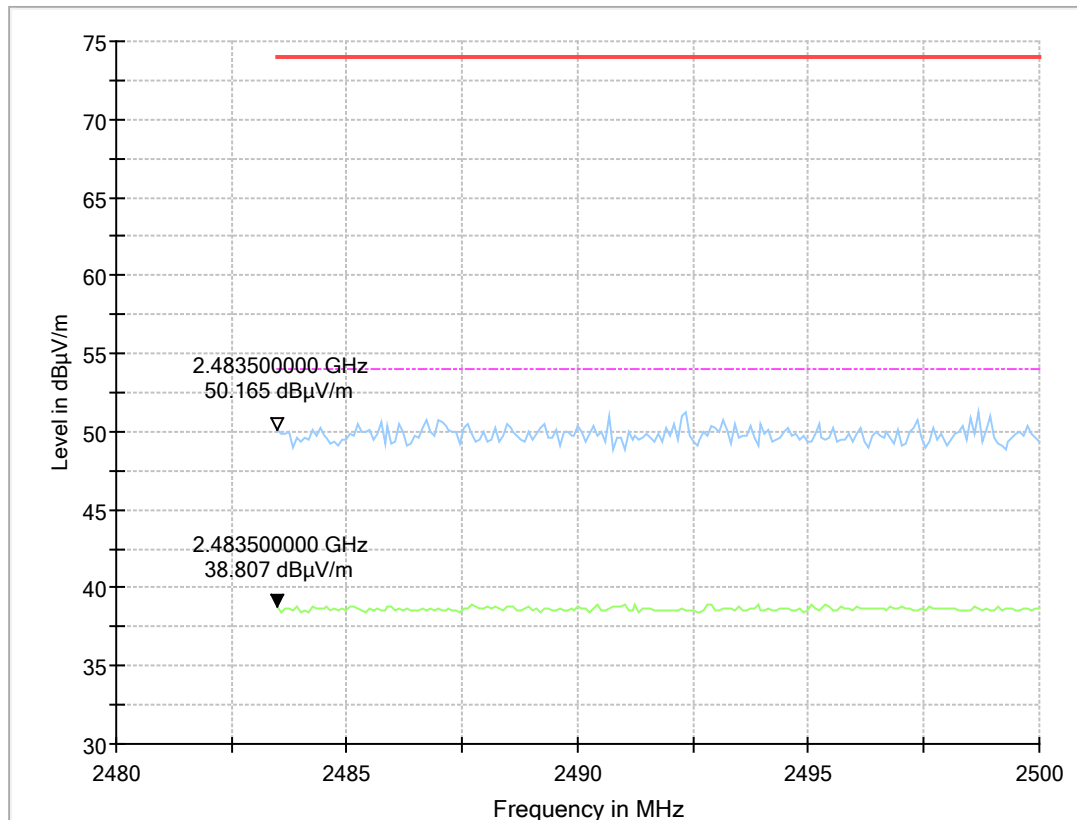
#### Critical\_Freqs

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin | Meas. Time (ms) | Bandwidth | Height | Pol | Azimuth | Elevation |
|-----------------|------------------|------------------|----------------|--------|-----------------|-----------|--------|-----|---------|-----------|
| 1300.000        | ---              | 33.4             | 54.00          | 20.56  | ---             | ---       | 150.0  | H   | -90.0   | 105.0     |
| 1300.254        | 52.4             | ---              | 74.00          | 21.57  | ---             | ---       | 150.0  | H   | -83.0   | 105.0     |
| 2485.480        | 50.1             | ---              | 74.00          | 23.88  | ---             | ---       | 150.0  | V   | -22.0   | 88.0      |
| 2485.480        | ---              | 36.5             | 54.00          | 17.47  | ---             | ---       | 150.0  | V   | -64.0   | 95.0      |
| 3897.800        | 51.2             | ---              | 74.00          | 22.78  | ---             | ---       | 150.0  | H   | -5.0    | 88.0      |
| 3900.000        | ---              | 35.6             | 54.00          | 18.37  | ---             | ---       | 150.0  | H   | -28.0   | 87.0      |

#### Final\_Result

| Frequency (MHz) | MaxPeak (dBµV/m) | CAverage (dBµV/m) | Limit (dBµV/m) | Margin | Meas. Time (ms) | Bandwidth | Height | Pol | Azimuth | Elevation |
|-----------------|------------------|-------------------|----------------|--------|-----------------|-----------|--------|-----|---------|-----------|
| 1300.000        | ---              | 33.5              | 54.00          | 20.49  | 1000.0          | 1000.000  | 150.0  | H   | -90.0   | 105.0     |
| 1300.254        | 54.6             | ---               | 74.00          | 19.42  | 1000.0          | 1000.000  | 150.0  | H   | -83.0   | 105.0     |
| 2485.480        | ---              | 36.6              | 54.00          | 17.45  | 1000.0          | 1000.000  | 150.0  | V   | -64.0   | 95.0      |
| 2485.480        | 51.1             | ---               | 74.00          | 22.87  | 1000.0          | 1000.000  | 150.0  | V   | -22.0   | 88.0      |
| 3897.800        | 55.2             | ---               | 74.00          | 18.80  | 1000.0          | 1000.000  | 150.0  | H   | -5.0    | 88.0      |
| 3900.000        | ---              | 36.0              | 54.00          | 18.01  | 1000.0          | 1000.000  | 150.0  | H   | -28.0   | 87.0      |

Radio Technology = Bluetooth EDR 2, Operating Frequency = high, Band Edge = high  
(S01\_AM01)



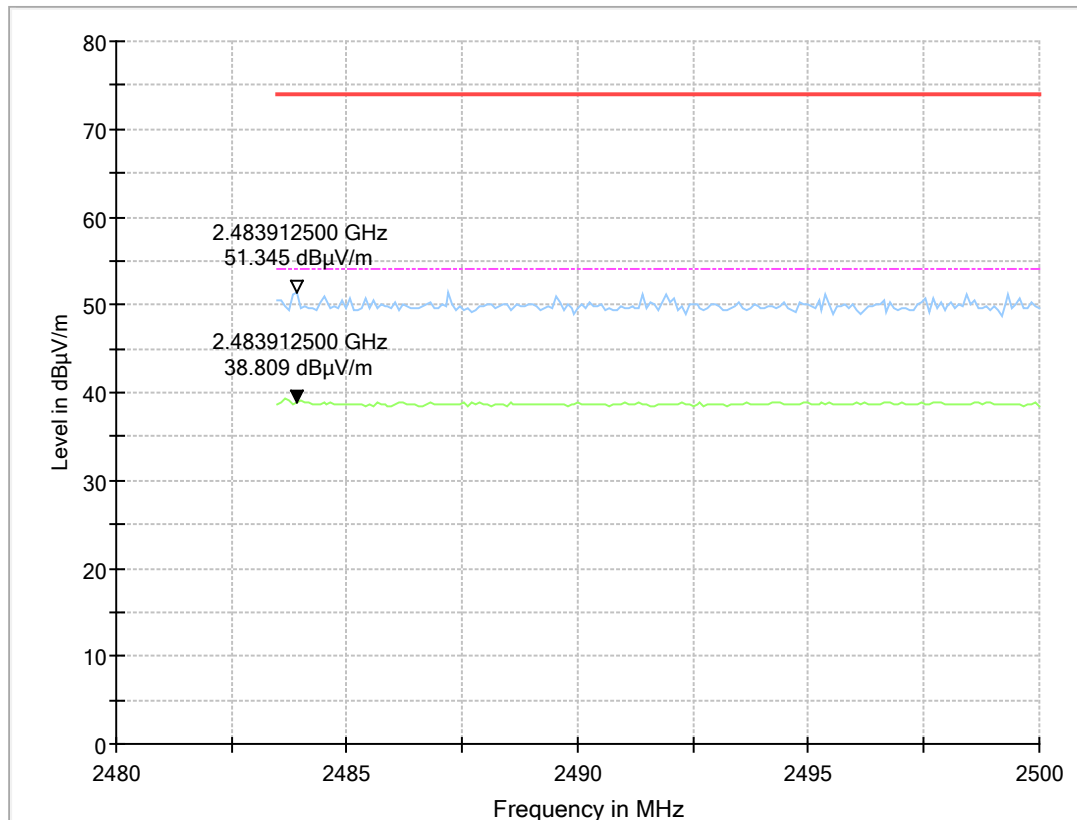
### Critical\_Freqs

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin | Meas. Time (ms) | Bandwidth | Height | Pol | Azimuth | Elevation |
|-----------------|------------------|------------------|----------------|--------|-----------------|-----------|--------|-----|---------|-----------|
| ---             | ---              | ---              | ---            | ---    | ---             | ---       | ---    | --- | ---     | ---       |

### Final\_Result

| Frequency (MHz) | MaxPeak (dBµV/m) | CAverage (dBµV/m) | Limit (dBµV/m) | Margin | Meas. Time (ms) | Bandwidth | Height | Pol | Azimuth | Elevation |
|-----------------|------------------|-------------------|----------------|--------|-----------------|-----------|--------|-----|---------|-----------|
| ---             | ---              | ---               | ---            | ---    | ---             | ---       | ---    | --- | ---     | ---       |

Radio Technology = Bluetooth EDR 3, Operating Frequency = high, Band Edge = high  
(S01\_AM01)



### Critical\_Freqs

| Frequency (MHz) | MaxPeak (dBμV/m) | Average (dBμV/m) | Limit (dBμV/m) | Margin | Meas. Time (ms) | Bandwidth (h) | Height | Pol | Azimuth (h) | Elevation (n) |
|-----------------|------------------|------------------|----------------|--------|-----------------|---------------|--------|-----|-------------|---------------|
| ---             | ---              | ---              | ---            | ---    | ---             | ---           | ---    | --- | ---         | ---           |

### Final\_Result

| Frequency (MHz) | MaxPeak (dBμV/m) | CAverage (dBμV/m) | Limit (dBμV/m) | Margin | Meas. Time (ms) | Bandwidth (h) | Height | Pol | Azimuth (h) | Elevation (n) |
|-----------------|------------------|-------------------|----------------|--------|-----------------|---------------|--------|-----|-------------|---------------|
| ---             | ---              | ---               | ---            | ---    | ---             | ---           | ---    | --- | ---         | ---           |

## 5.2.5 TEST EQUIPMENT USED

- Radiated Emissions

## 6 TEST EQUIPMENT

### 1 Radiated Emissions

Lab to perform radiated emission tests

| Ref.No. | Device Name             | Description                                                                | Manufacturer                      | Serial Number      | Last Calibration | Calibration Due |
|---------|-------------------------|----------------------------------------------------------------------------|-----------------------------------|--------------------|------------------|-----------------|
| 1.1     | MFS                     | Rubidium Frequency Normal MFS                                              | Datum GmbH                        | 002                | 2019-10          | 2020-11         |
| 1.2     | N5000/NP                | Filter for EUT, 2 Lines, 250 V, 16 A                                       | ETS-LINDGREN                      | 241515             |                  |                 |
| 1.3     | Opus10 TPR (8253.00)    | T/P Logger 13                                                              | Lufft Mess- und Regeltechnik GmbH | 13936              | 2019-05          | 2021-05         |
| 1.4     | ESW44                   | EMI Receiver / Spectrum Analyzer                                           | Rohde & Schwarz GmbH & Co. KG     | 101603             | 2019-12          | 2021-12         |
| 1.5     | Anechoic Chamber 01     | SAC/FAR, 10.58 m x 6.38 m x 6.00 m                                         | Frankonia                         | none               |                  |                 |
| 1.6     | HL 562 ULTRALOG         | Biconical-log-per antenna (30 MHz - 3 GHz) with HL 562E biconicals         | Rohde & Schwarz GmbH & Co. KG     | 830547/003         | 2018-07          | 2021-07         |
| 1.7     | AMF-7D00101800-30-10P-R | Broadband Amplifier 100 MHz - 18 GHz                                       | Miteq                             |                    |                  |                 |
| 1.8     | 5HC2700/12750-1.5-KK    | High Pass Filter                                                           | Trilithic                         | 9942012            |                  |                 |
| 1.9     | ASP 1.2/1.8-10 kg       | Antenna Mast                                                               | Maturo GmbH                       | -                  |                  |                 |
| 1.10    | Anechoic Chamber 03     | FAR, 8.80m x 4.60m x 4.05m (l x w x h)                                     | Albatross Projects                | P26971-647-001-PRB |                  |                 |
| 1.11    | SMBV100A                | Vector Signal Generator 9 kHz - 3.2 GHz (GNSS / Broadcast Signalling Unit) | Rohde & Schwarz GmbH & Co. KG     | 260001             | 2018-01          | 2021-01         |
| 1.12    | Fluke 177               | Digital Multimeter 03 (Multimeter)                                         | Fluke Europe B.V.                 | 86670383           | 2020-04          | 2022-04         |
| 1.13    | WRD1920/1980-5/22-5EESD | Tunable Band Reject Filter                                                 | Wainwright Instruments GmbH       | 11                 |                  |                 |
| 1.14    | TDS 784C                | Digital Oscilloscope [SA2] (Aux)                                           | Tektronix                         | B021311            |                  |                 |
| 1.15    | Opus10 THI (8152.00)    | T/H Logger 10                                                              | Lufft Mess- und Regeltechnik GmbH | 12488              | 2019-06          | 2021-06         |
| 1.16    | foRS232 Unit 2          | Fibre optic link RS232                                                     | PONTIS Messtechnik GmbH           | 4031516037         |                  |                 |

| Ref.No. | Device Name                    | Description                                     | Manufacturer                   | Serial Number  | Last Calibration | Calibration Due |
|---------|--------------------------------|-------------------------------------------------|--------------------------------|----------------|------------------|-----------------|
| 1.17    | PONTIS Con4101                 | PONTIS Camera Controller                        |                                | 6061510370     |                  |                 |
| 1.18    | NRVD                           | Power Meter                                     | Rohde & Schwarz GmbH & Co. KG  | 828110/016     | 2019-08          | 2020-08         |
| 1.19    | OLS-1 R                        | Fibre optic link USB 1.1                        | Ingenieurbüro Scheiba          | 018            |                  |                 |
| 1.20    | HF 906                         | Double-ridged horn                              | Rohde & Schwarz                | 357357/002     | 2018-09          | 2021-09         |
| 1.21    | JS4-18002600-32-5P             | Broadband Amplifier 18 GHz - 26 GHz             | Miteq                          | 849785         |                  |                 |
| 1.22    | FSW 43                         | Spectrum Analyzer                               | Rohde & Schwarz                | 103779         | 2019-02          | 2021-02         |
| 1.23    | 3160-09                        | Standard Gain / Pyramidal Horn Antenna 26.5 GHz | EMCO Elektronik GmbH           | 00083069       |                  |                 |
| 1.24    | foRS232 Unit 1                 | Fibre optic link RS232                          | PONTIS Messtechnik GmbH        | 4021516036     |                  |                 |
| 1.25    | FSP3                           | Spectrum Analyzer                               | Rohde & Schwarz GmbH & Co. KG  | 836722/011     |                  |                 |
| 1.26    | WHKX 7.0/18G-8SS               | High Pass Filter                                | Wainwright Instruments GmbH    | 09             |                  |                 |
| 1.27    | DS 420S                        | Turn Table 2 m diameter                         | HD GmbH                        | 420/573/99     |                  |                 |
| 1.28    | 4HC1600/12750-1.5-KK           | High Pass Filter                                | Trilithic                      | 9942011        |                  |                 |
| 1.29    | foUSB-M Converter 2            | Fibre optic link USB 2.0                        | PONTIS Messtechnik GmbH        | 4471520061     |                  |                 |
| 1.30    | WRCD1879.8-0.2/40-10EE         | Notch Filter Ultra Stable                       | Wainwright Instruments GmbH    | 16             |                  |                 |
| 1.31    | Temperature Chamber KWP 120/70 | Temperature Chamber Weiss 01                    | Weiss                          | 59226012190010 | 2020-05          | 2022-05         |
| 1.32    | FSIQ26                         | Signal Analyser 20 Hz to 26.5 GHz               | Rohde & Schwarz GmbH & Co. KG  | 840061/005     | 2019-06          | 2021-06         |
| 1.33    | SMB100A                        | Signal Generator 100 kHz - 40 GHz               | Rohde & Schwarz Vertriebs-GmbH | 181486         | 2019-11          | 2021-11         |
| 1.34    | JS4-00102600-42-5A             | Broadband Amplifier 30 MHz - 26 GHz             | Miteq                          | 619368         |                  |                 |
| 1.35    | TT 1.5 WI                      | Turn Table                                      | Maturo GmbH                    | -              |                  |                 |
| 1.36    | HL 562 ULTRALOG                | Biconical-log-per Antenna (30 MHz - 3 GHz)      | Rohde & Schwarz GmbH & Co. KG  | 100609         | 2019-05          | 2022-05         |
| 1.37    | HF 906                         | Double-ridged horn                              | Rohde & Schwarz                | 357357/001     | 2018-03          | 2021-03         |
| 1.38    | foCAN (v 4.0)                  | Fibre optic link CAN                            | Audivo GmbH (PONTIS EMC)       | 492 1607 014   |                  |                 |
| 1.39    | CMW500                         | Callbox OIL-RE, SUW                             | Rohde & Schwarz GmbH & Co. KG  | 155999-Ei      | 2019-09          | 2022-09         |

| Ref.No. | Device Name                                      | Description                                              | Manufacturer                                       | Serial Number  | Last Calibration | Calibration Due |
|---------|--------------------------------------------------|----------------------------------------------------------|----------------------------------------------------|----------------|------------------|-----------------|
| 1.40    | CMU 200                                          | "CMU1"<br>Universal<br>Radio<br>Communicatio<br>n Tester | Rohde & Schwarz<br>GmbH & Co. KG                   | 102366         | 2017-12          | 2020-12         |
| 1.41    | 3160-10                                          | Standard Gain<br>/ Pyramidal<br>Horn Antenna<br>40 GHz   | EMCO Elektronik<br>GmbH                            | 00086675       |                  |                 |
| 1.42    | MA4985-XP-ET                                     | Bore Sight<br>Antenna Mast                               | innco systems<br>GmbH                              | none           |                  |                 |
| 1.43    | Temperature<br>Chamber VT<br>4002                | Temperature<br>Chamber<br>Vötsch 03                      | Vötsch                                             | 58566002150010 | 2020-05          | 2022-05         |
| 1.44    | CBT                                              | Bluetooth<br>Tester "CBT-<br>02" incl. BLE-<br>Option    | Rohde & Schwarz                                    | 100302         | 2018-03          | 2021-03         |
| 1.45    | CMW500                                           | Callbox OIL-<br>RE, SUA                                  | Rohde & Schwarz<br>GmbH & Co. KG                   | 163529-bw      | 2020-07          | 2023-07         |
| 1.46    | CMW500                                           | Callbox OIL-<br>RE, SUA-160<br>MHz                       | Rohde & Schwarz<br>GmbH & Co. KG                   | 168927-cv      | 2020-05          | 2023-05         |
| 1.47    | A8455-4                                          | 4 Way Power<br>Divider (SMA)                             |                                                    | -              |                  |                 |
| 1.48    | JUN-AIR Mod. 6-<br>15                            | Air<br>Compressor                                        | JUN-AIR<br>Deutschland GmbH                        | 612582         |                  |                 |
| 1.49    | foEthernet_M                                     | Fibre optic link<br>Ethernet / Gb-<br>LAN                | PONTIS<br>Messtechnik GmbH                         | 4841516023     |                  |                 |
| 1.50    | 5HC3500/18000<br>-1.2-KK                         | High Pass<br>Filter                                      | Trilithic                                          | 200035008      |                  |                 |
| 1.51    | OLS-1 M                                          | Fibre optic link<br>USB 1.1                              | Ingenieurbüro<br>Scheiba                           | 018            |                  |                 |
| 1.52    | HFH2-Z2                                          | Loop Antenna                                             | Rohde & Schwarz                                    | 829324/006     | 2018-01          | 2021-01         |
| 1.53    | Voltcraft M-<br>3860M                            | Digital<br>Multimeter 01<br>(Multimeter)                 | Conrad                                             | IJ096055       |                  |                 |
| 1.54    | CMW 500                                          | callbox, 2G,<br>3G, LTE,<br>WLAN, BT,<br>Audio           | Rohde & Schwarz<br>GmbH & Co. KG                   | 149268-Qf      | 2018-04          | 2021-04         |
| 1.55    | FSU3                                             | Spectrum<br>Analyser (20<br>Hz to 3.6 GHz)               | Rohde & Schwarz<br>GmbH & Co. KG                   | 200046         |                  |                 |
| 1.56    | ESR 7                                            | EMI Receiver /<br>Spectrum<br>Analyzer                   | Rohde & Schwarz                                    | 101424         | 2019-01          | 2021-01         |
| 1.57    | SB4-<br>100.OLD20-<br>3T/10 Airwin 2 x<br>1.5 kW | Air compressor<br>(oil-free)                             | airWin<br>Kompressoren UG                          | 901/00503      |                  |                 |
| 1.58    | UNI-T UT195E                                     | True RMS<br>Digital<br>Multimeter                        | UNI-T UNI-TREND<br>TECHNOLOGY<br>(CHINA) CO., LTD. | C190729561     |                  |                 |
| 1.59    | foEthernet_M                                     | Fibre optic link<br>Ethernet / Gb-<br>LAN                | PONTIS<br>Messtechnik GmbH                         | 4841516022     |                  |                 |

| Ref.No. | Device Name             | Description                           | Manufacturer                          | Serial Number          | Last Calibration | Calibration Due |
|---------|-------------------------|---------------------------------------|---------------------------------------|------------------------|------------------|-----------------|
| 1.60    | JS4-00101800-35-5P      | Broadband Amplifier 30 MHz - 18 GHz   | Miteq                                 | 896037                 |                  |                 |
| 1.61    | AS 620 P                | Antenna Mast (pneumatic polarisation) | HD GmbH                               | 620/37                 |                  |                 |
| 1.62    | CMW500                  | Callbox OIL-RE, SUA-160 MHz           | Rohde & Schwarz GmbH & Co. KG         | 167766-By              |                  |                 |
| 1.63    | FSU26                   | Spectrum Analyser (20 Hz to 26.5 GHz) | Rohde & Schwarz GmbH & Co. KG         | 100136                 |                  |                 |
| 1.64    | 6005D (30 V / 5 A)      | Laboratory Power Supply 120 V 60 Hz   | PeakTech                              | 81062045               |                  |                 |
| 1.65    | TD1.5-10kg              | EUT Tilt Device (Rohacell)            | Maturo GmbH                           | TD1.5-10kg/024/3790709 |                  |                 |
| 1.66    | foUSB-M Converter 1     | Fibre optic link USB 2.0              | Audivo GmbH (PONTIS EMC)              | 4461520060             |                  |                 |
| 1.67    | Innco Systems CO3000    | Controller for bore sight mast SAC    | innco systems GmbH                    | CO3000/967/39371016/L  |                  |                 |
| 1.68    | NRV-Z1                  | Sensor Head B                         | Rohde & Schwarz GmbH & Co. KG         | 827753/006             | 2019-08          | 2020-08         |
| 1.69    | HF 907-2                | Double-ridged horn                    | Rohde & Schwarz                       | 102817                 | 2019-04          | 2022-04         |
| 1.70    | foCAN (v 4.0)           | Fibre optic link CAN                  | Audivo GmbH (PONTIS EMC)              | 492 1607 013           |                  |                 |
| 1.71    | PAS 2.5 - 10 kg         | Antenna Mast                          | Maturo GmbH                           | -                      |                  |                 |
| 1.72    | AFS42-00101800-25-S-42  | Broadband Amplifier 25 MHz - 18 GHz   | Miteq                                 | 2035324                |                  |                 |
| 1.73    | WRCA800/960-0.2/40-6EEK | Tunable Notch Filter                  | Wainwright Instruments GmbH           | 20                     |                  |                 |
| 1.74    | AM 4.0                  | Antenna Mast 4 m                      | Maturo GmbH                           | AM4.0/180/11920513     |                  |                 |
| 1.75    | HF 907                  | Double-ridged horn                    | Rohde & Schwarz                       | 102444                 | 2018-07          | 2021-07         |
| 1.76    | E4408B                  | Spectrum Analyser (9 kHz to 26.5 GHz) | Agilent Technologies Deutschland GmbH | MY45103714             |                  |                 |

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

## 7 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.

### 7.1 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.

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

| Frequency | AF       | Corr. | cable loss 1     | cable loss 2      | cable loss 3  | cable loss 4  | distance corr.  | d <sub>Limit</sub>       | d <sub>used</sub>       |
|-----------|----------|-------|------------------|-------------------|---------------|---------------|-----------------|--------------------------|-------------------------|
| MHz       | dB (1/m) | dB    | (inside chamber) | (outside chamber) | (switch unit) | (to receiver) | (-40 dB/decade) | (meas. distance (limit)) | (meas. distance (used)) |
|           |          |       | 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

### 7.3 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)  
 $\text{distance correction} = -20 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$   
 Linear interpolation will be used for frequencies in between the values in the table.  
 Tables show an extract of values.

#### 7.4 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.

## 7.5 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.

## 7.6 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                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 27.0      | 43.4                  | -11.2 | 4.4                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 28.0      | 43.4                  | -11.1 | 4.5                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 29.0      | 43.5                  | -11.0 | 4.6                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 30.0      | 43.5                  | -10.9 | 4.7                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 31.0      | 43.5                  | -10.8 | 4.7                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 32.0      | 43.5                  | -10.7 | 4.8                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 33.0      | 43.6                  | -10.7 | 4.9                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 34.0      | 43.6                  | -10.6 | 5.0                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 35.0      | 43.6                  | -10.5 | 5.1                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 36.0      | 43.6                  | -10.4 | 5.1                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 37.0      | 43.7                  | -10.3 | 5.2                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 38.0      | 43.7                  | -10.2 | 5.3                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 39.0      | 43.7                  | -10.2 | 5.4                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |
| 40.0      | 43.8                  | -10.1 | 5.5                                    |                                         |                                     |                                     | -9.5                                     | 3                                                    | 1.0                                                |

### 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)

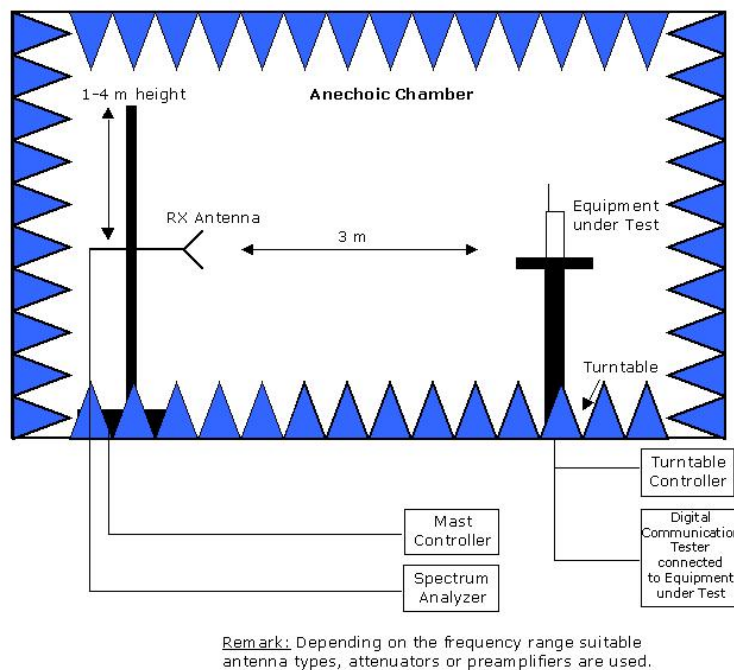
Linear interpolation will be used for frequencies in between the values in the table.

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

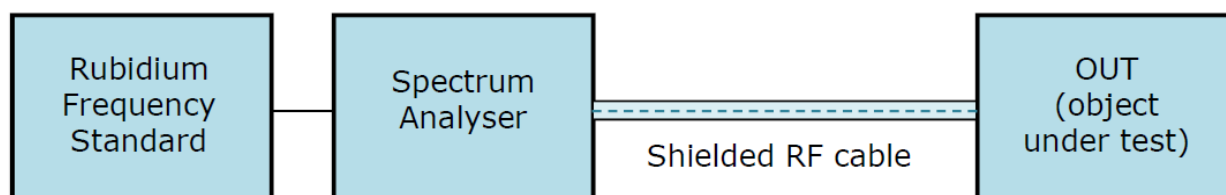
Linear interpolation will be used for frequencies in between the values in the table.

Table shows an extract of values.

## 8 SETUP DRAWINGS



**Drawing 1:** Setup in the Anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting groundplane.

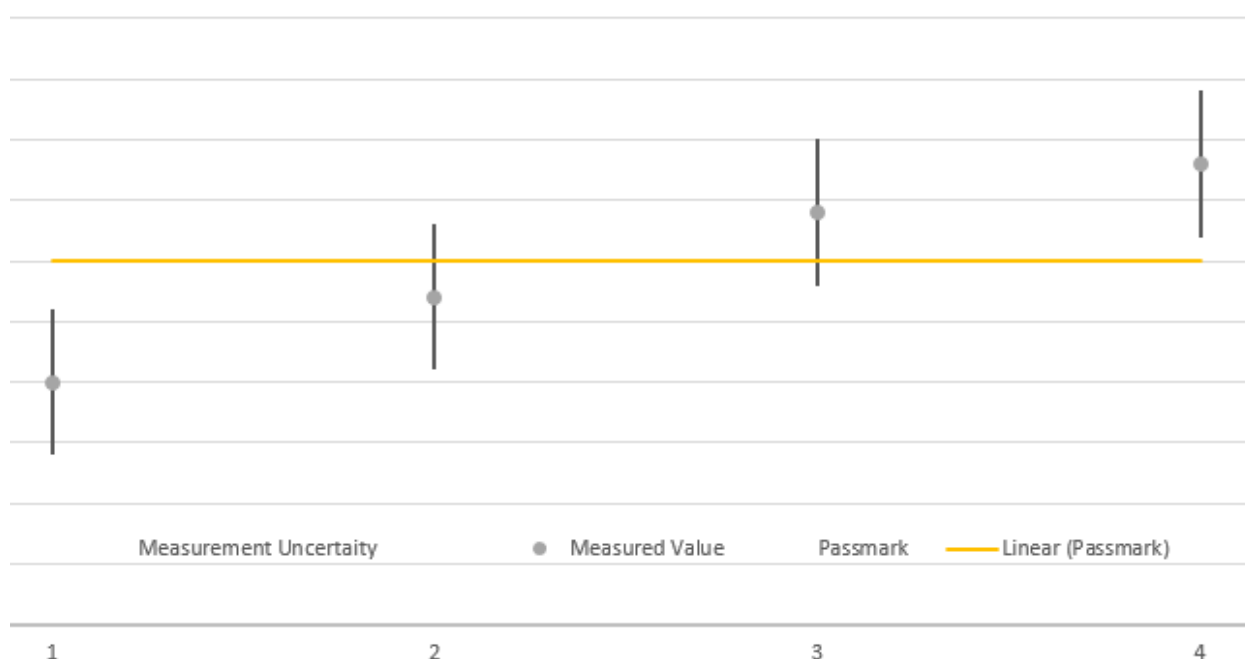


**Drawing 2:** Setup for conducted radio tests.

## 9 MEASUREMENT UNCERTAINTIES

| Test Case                            | Parameter          | Uncertainty                    |
|--------------------------------------|--------------------|--------------------------------|
| AC Power Line                        | Power              | $\pm 3.4$ dB                   |
| Field Strength of spurious radiation | Power              | $\pm 5.5$ dB                   |
| 6 dB / 26 dB / 99% Bandwidth         | Power<br>Frequency | $\pm 2.9$ dB<br>$\pm 11.2$ kHz |
| Conducted Output Power               | Power              | $\pm 2.2$ dB                   |
| Band Edge Compliance                 | Power<br>Frequency | $\pm 2.2$ dB<br>$\pm 11.2$ kHz |
| Frequency Stability                  | Frequency          | $\pm 25$ Hz                    |
| Power Spectral Density               | Power              | $\pm 2.2$ dB                   |

The measurement uncertainties for all parameters are calculated with an expansion factor (coverage factor)  $k = 1.96$ . This means, that the true value is in the corresponding interval with a probability of 95 %.



The verdicts in this test report are given according the above diagram:

| Case | Measured Value  | Uncertainty Range | Verdict |
|------|-----------------|-------------------|---------|
| 1    | below pass mark | below pass mark   | Passed  |
| 2    | below pass mark | within pass mark  | Passed  |
| 3    | above pass mark | within pass mark  | Failed  |
| 4    | above pass mark | above pass mark   | Failed  |

That means, the laboratory applies, as decision rule (see ISO/IEC 17025:2017), the so called shared risk principle.

## 10 PHOTO REPORT

Please see separate photo report.