## 5.20 BAND EDGE COMPLIANCE

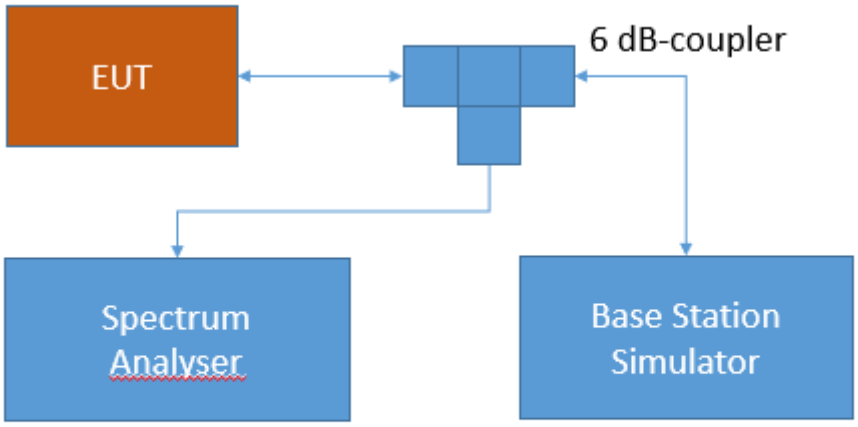
Standard **FCC PART 27 Subpart C**

**The test was performed according to:**
ANSI C63.26: 2015; 5.7.3

### 5.20.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission test case per § 2. 1051 and RSS-GEN 6.13. The limit comes from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

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




Test Setup FCC Part 22/24/27/90 Cellular;
Band edge compliance

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

### 5.20.2 TEST REQUIREMENTS / LIMITS

**FCC Part 2.1051; Measurement required: Spurious emissions at antenna terminal:**

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart C – Technical standards**

**§27.53 - Emission limits**

**Band 13**

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

**RSS-130; 4.7.1 General unwanted emissions limits**

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 $\log_{10}$ p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

**RSS-130; 4.7.2 Additional unwanted emissions limits**

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

   i. 76 + 10 $\log_{10}$ p (watts), dB, for base and fixed equipment and

   ii. 65 + 10 $\log_{10}$ p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

**Band 12:**

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

**RSS-130; 4.7.1 General unwanted emissions limits**

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 $\log_{10}$ p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

**RSS-130; 4.7.2 Additional unwanted emissions limits**

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

   i. 76 + 10 $\log_{10}$ p (watts), dB, for base and fixed equipment and

   ii. 65 + 10 $\log_{10}$ p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

**Band 4/10/66:**

(h) *AWS emission limits*— (1) *General protection levels.* Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 $\log_{10}$ (P) dB.

**RSS-139; 6.6 Transmitter Unwanted Emissions**

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

i. In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 $\log_{10}$ p (watts) dB.
ii. After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 $\log_{10}$ p (watts) dB.

**Band 7:**

(m) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts in accordance with the standards below. If a licensee has multiple contiguous channels, out-of-band emissions shall be measured from the upper and lower edges of the contiguous channels.

(4) For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

**RSS-199; 4.5 Transmitter unwanted emissions**

In the 1 MHz band immediately outside and adjacent to the channel edge, the unwanted emission power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth for base station and fixed subscriber equipment, and 2% for mobile subscriber equipment. Beyond the 1 MHz band, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% or 2% of the occupied bandwidth, as applicable.

Equipment shall comply with the following unwanted emission limits:

b. for mobile subscriber equipment, the power of any unwanted emissions measured as above shall be attenuated (in dB) below the transmitter power, P (dBW), by at least:

40 + 10 $\log_{10}$ p from the channel edges to 5 MHz away

43 + 10 $\log_{10}$ p between 5 MHz and X MHz from the channel edges, and

55 + 10 $\log_{10}$ p at X MHz and beyond from the channel edges

In addition, the attenuation shall not be less than 43 + 10 $\log_{10}$ p on all frequencies between 2490.5 MHz and 2496 MHz, and 55 + 10 $\log_{10}$ p at or below 2490.5 MHz.

In (b), p is the transmitter power measured in watts and X is 6 MHz or the equipment occupied bandwidth, whichever is greater.

**Band 17:**

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

**RSS-130; 4.7.1 General unwanted emissions limits**

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 $\log_{10}$ p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

**RSS-130; 4.7.2 Additional unwanted emissions limits**

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

   i. 76 + 10 $\log_{10}$ p (watts), dB, for base and fixed equipment and

   ii. 65 + 10 $\log_{10}$ p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

## 5.20.3 TEST PROTOCOL

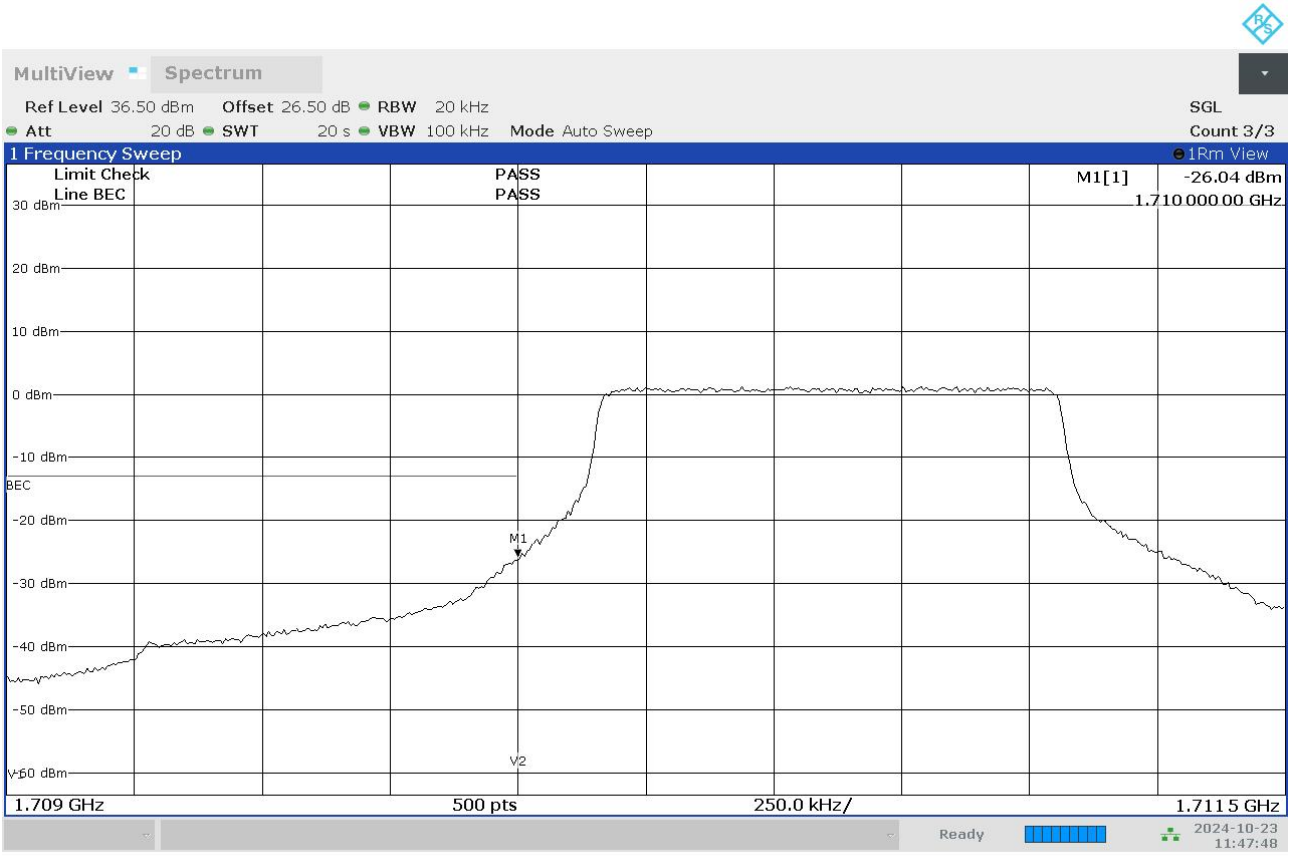
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

| Technology | Radio Technology | Channel | Ressource Blocks | Bandwidth [MHz] | RMS [dBm] | Limit /dBm | Margin to Limit /dB |
|---|---|---|---|---|---|---|---|
| CAT-M1 | eFDD 4 QPSK | low | 6 | 1.4 | -26.8 | -13 | 13.8 |
| CAT-M1 | eFDD 4 QPSK | high | 6 | 1.4 | -27.0 | -13 | 14.0 |
| CAT-M1 | eFDD 4 16QAM | low | 5 | 1.4 | -26.0 | -13 | 13.0 |
| CAT-M1 | eFDD 4 16QAM | high | 5 | 1.4 | -29.7 | -13 | 16.7 |
| CAT-M1 | eFDD 12 QPSK | low | 6 | 1.4 | -26.7 | -13 | 13.7 |
| CAT-M1 | eFDD 12 QPSK | high | 6 | 1.4 | -26.9 | -13 | 13.9 |
| CAT-M1 | eFDD 12 16QAM | low | 5 | 1.4 | -25.4 | -13 | 12.4 |
| CAT-M1 | eFDD 12 16QAM | high | 5 | 1.4 | -31.1 | -13 | 18.1 |
| CAT-M1 | eFDD 13 QPSK | low | 6 | 1.4 | -48.8 | -13 | 35.8 |
| CAT-M1 | eFDD 13 QPSK | high | 6 | 1.4 | -50.2 | -13 | 37.2 |
| CAT-M1 | eFDD 13 16QAM | low | 5 | 1.4 | -52.2 | -13 | 39.2 |
| CAT-M1 | eFDD 13 16QAM | high | 5 | 1.4 | -51.4 | -13 | 38.4 |
| CAT-M1 | eFDD 66 QPSK | low | 6 | 1.4 | -27.1 | -13 | 14.1 |
| CAT-M1 | eFDD 66 QPSK | high | 6 | 1.4 | -27.1 | -13 | 14.1 |
| CAT-M1 | eFDD 66 16QAM | low | 5 | 1.4 | -25.4 | -13 | 12.4 |
| CAT-M1 | eFDD 66 16QAM | high | 5 | 1.4 | -29.6 | -13 | 16.6 |
| CAT-M1 | eFDD 71 QPSK | low | 6 | 1.4 | -24.8 | -13 | 11.8 |
| CAT-M1 | eFDD 71 QPSK | high | 6 | 1.4 | -26.0 | -13 | 13.0 |
| CAT-M1 | eFDD 71 16QAM | low | 5 | 1.4 | -23.8 | -13 | 10.8 |
| CAT-M1 | eFDD 71 16QAM | high | 5 | 1.4 | -29.0 | -13 | 16.0 |
| CAT-M1 | eFDD 85 QPSK | low | 6 | 1.4 | -26.6 | -13 | 13.6 |
| CAT-M1 | eFDD 85 QPSK | high | 6 | 1.4 | -32.5 | -13 | 19.5 |
| CAT-M1 | eFDD 85 16QAM | low | 5 | 1.4 | -25.2 | -13 | 12.2 |
| CAT-M1 | eFDD 85 16QAM | high | 5 | 1.4 | -35.0 | -13 | 22.0 |

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

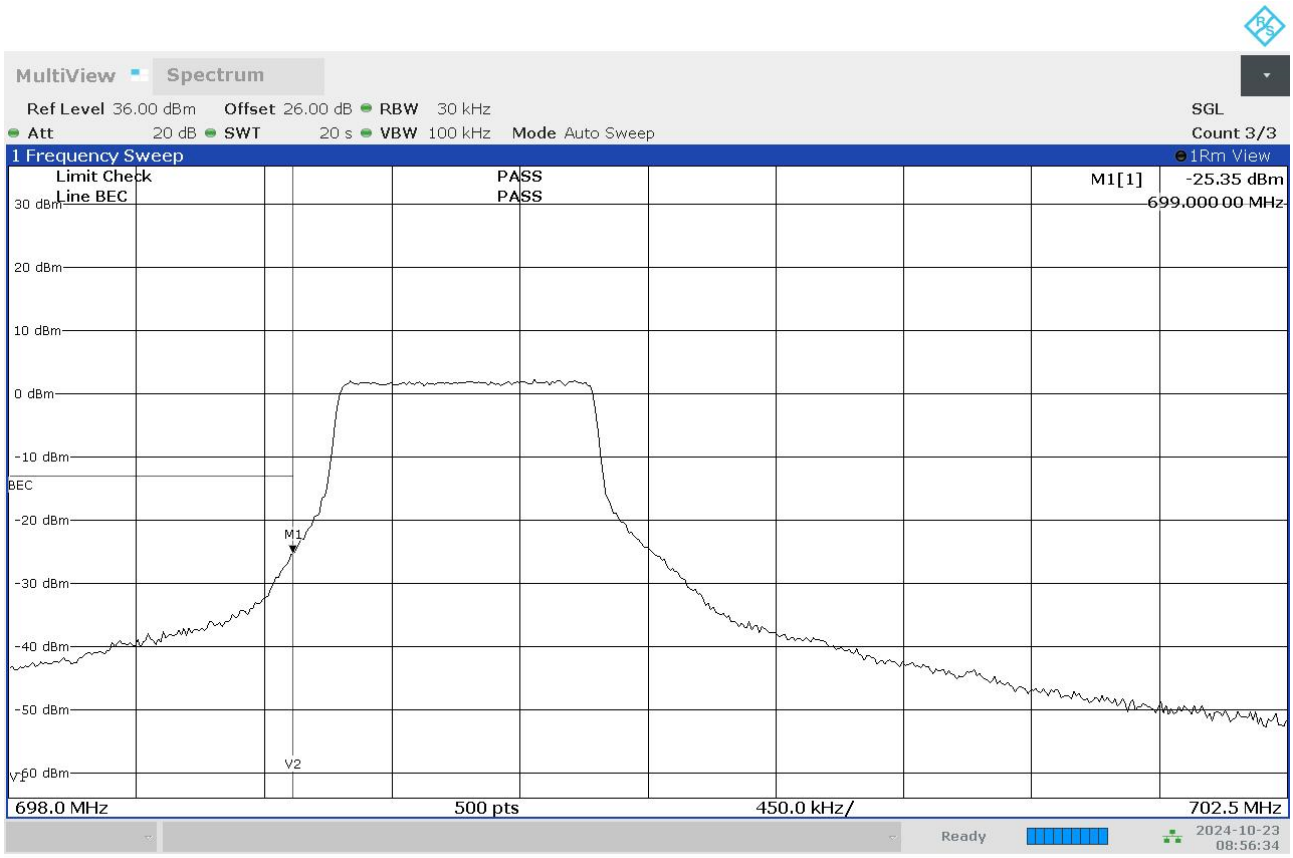
## 5.20.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Technology = CAT-M1, Radio Technology = eFDD 4 16QAM,
Operating Frequency = low channel
(S01_AF01)



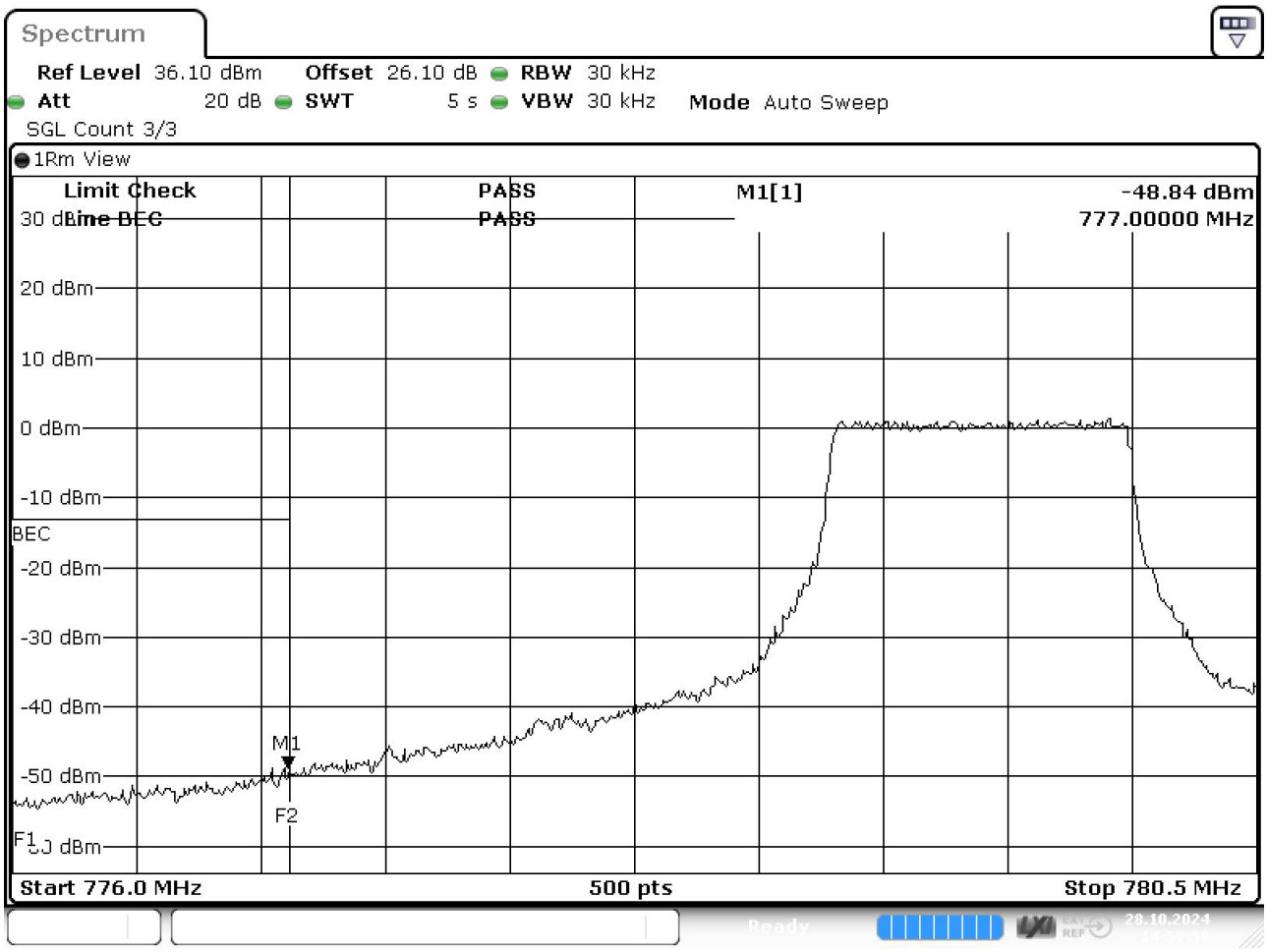

11:47:48 AM 10/23/2024

Technology = CAT-M1, Radio Technology = eFDD 12 16QAM,
Operating Frequency = low channel
(S01_AF01)



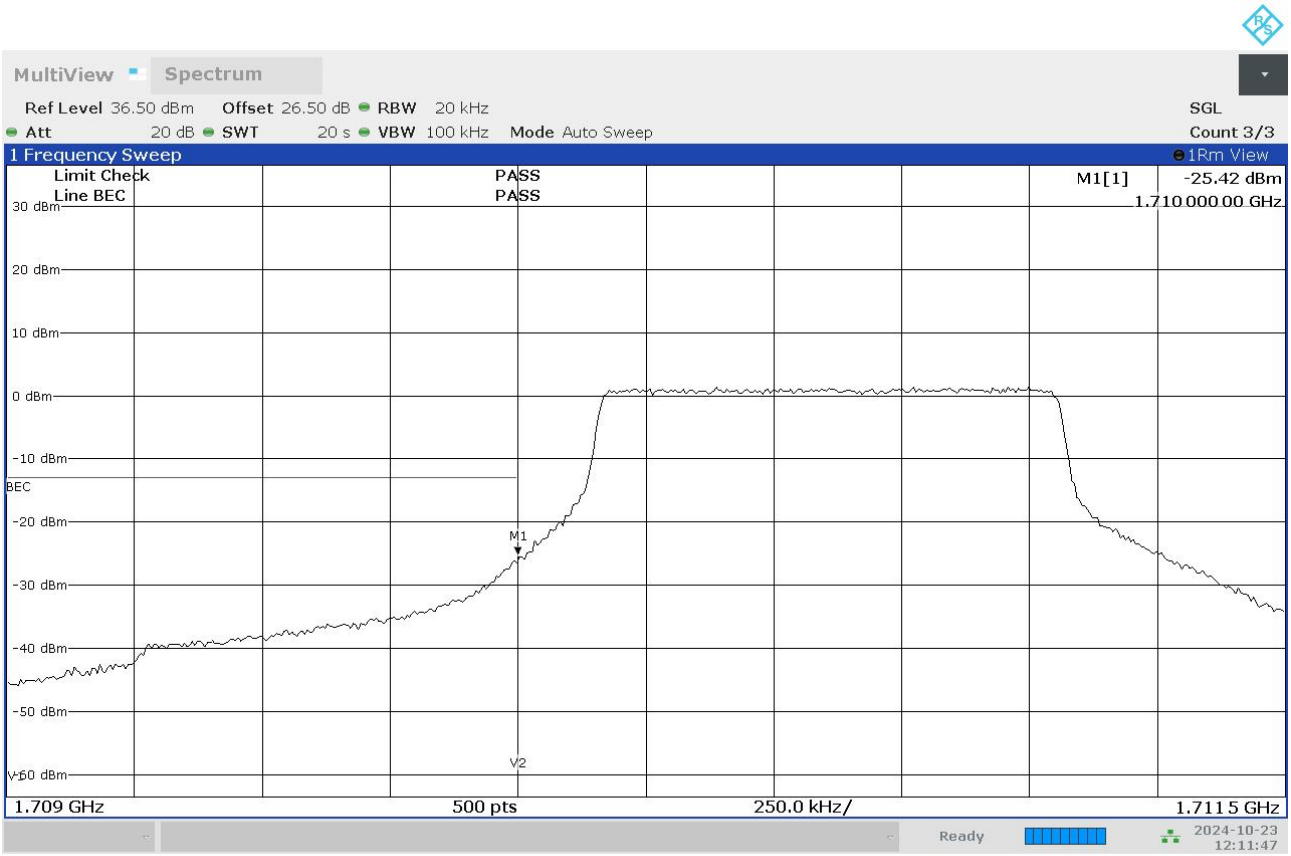

08:56:35 AM 10/23/2024

Technology = CAT-M1, Radio Technology = eFDD 13 QPSK,
Operating Frequency = low channel
(S01_AF01)



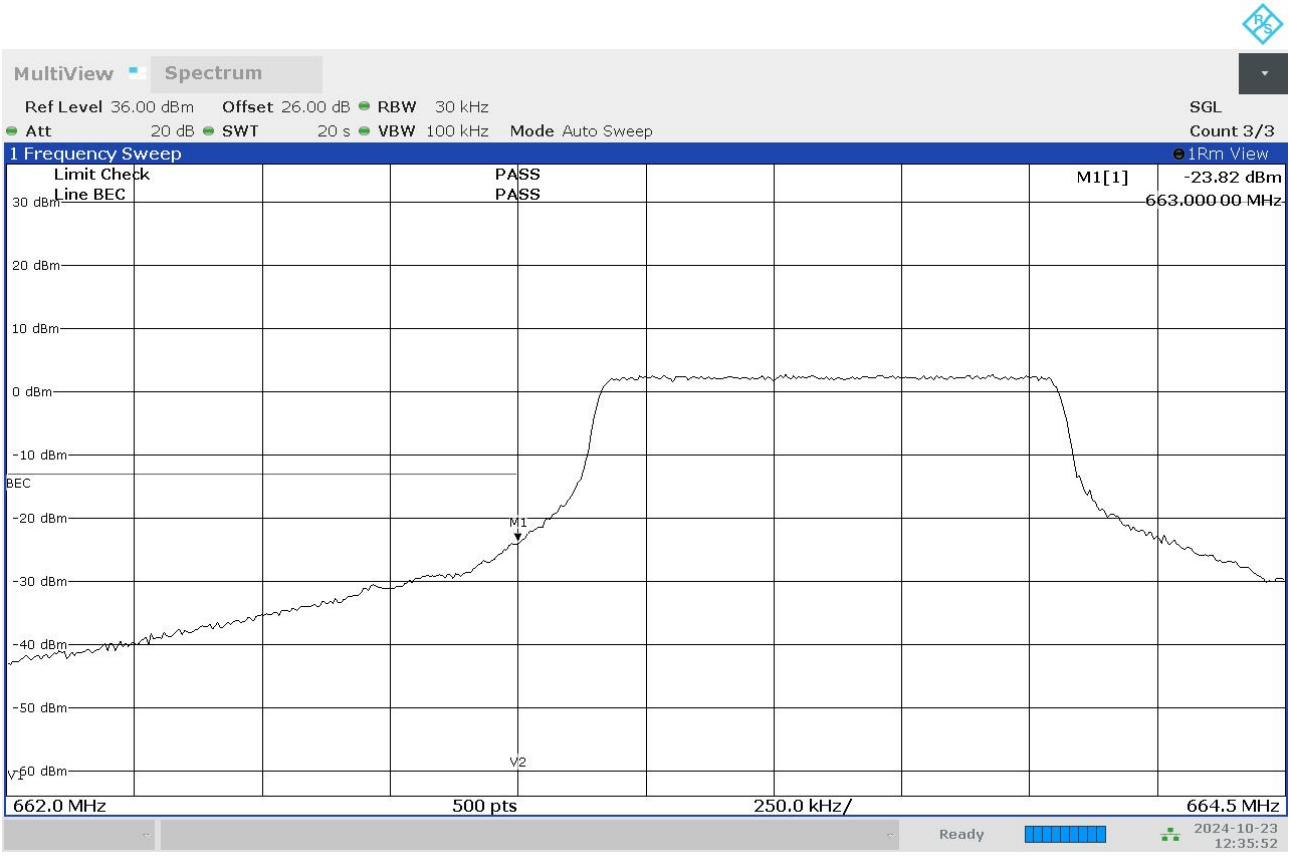

Date: 28.OCT.2024 14:59:59

Technology = CAT-M1, Radio Technology = eFDD 66 16QAM,
Operating Frequency = low channel
(S01_AF01)



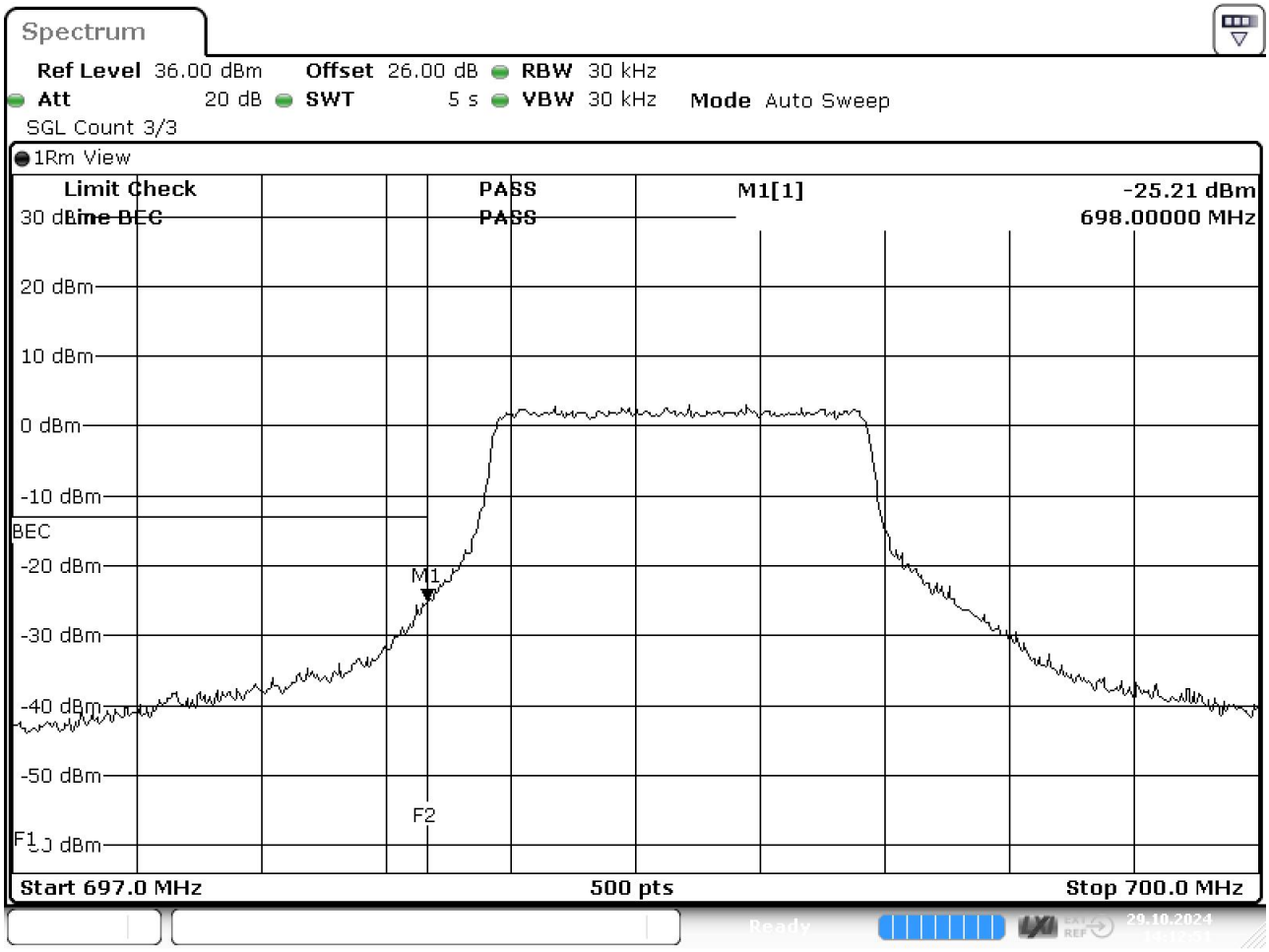

12:11:47 PM 10/23/2024

Technology = CAT-M1, Radio Technology = eFDD 71 16QAM,
Operating Frequency = low channel
(S01_AF01)




12:35:53 PM 10/23/2024

Technology = CAT-M1, Radio Technology = eFDD 85 16QAM,
Operating Frequency = low channel
(S01_AF01)




Date: 29.OCT.2024 14:12:52

## 5.20.5 TEST EQUIPMENT USED

- Radio Lab

## 5.21 PEAK TO AVERAGE RATIO

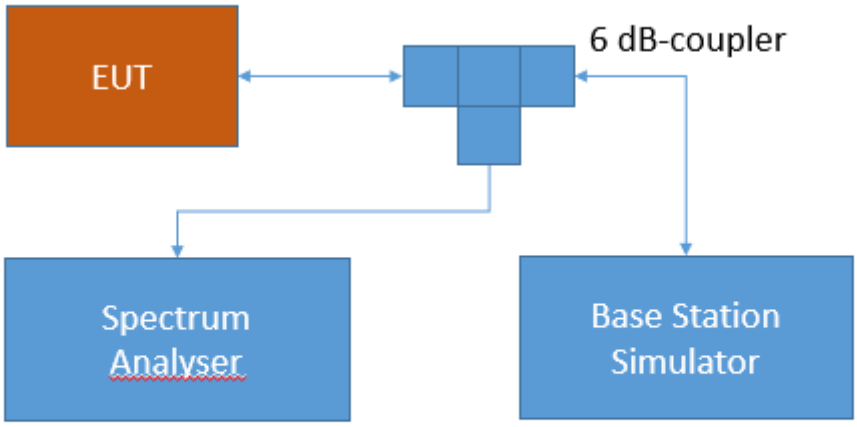
Standard **FCC PART 27 Subpart C**

**The test was performed according to:**
ANSI C63.26: 2015; 5.2.3.4 (broadband noise-like signal using CCDF [LTE, CAT-M1, NB-IoT])
5.2.6 (alternative procedure for PAPR [GSM, EDGE, WCDMA, HSDPA, HSUPA])

### 5.21.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance of the EUT to the peak-to-average limits and requirements of the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

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




Test Setup FCC Part 22/24/27/90 Cellular;
Peak-average ratio

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams. The internal CCDF (complementary cumulative distribution function) of the spectrum analyser is used for this measurement

### 5.21.2 TEST REQUIREMENTS / LIMITS

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart C – Technical standards**

## § 27.50 - Power limits and duty cycle

**Band 13:**

No applicable PAPR limit.

**RSS-130; 4.6.1 General**

The transmitter output power shall be measured in terms of average power. In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

**Band 12:**

No applicable PAPR limit.

**RSS-130; 4.6.1 General**

The transmitter output power shall be measured in terms of average power. In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

**Band 4/10/66:**

d) The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

(5) Equipment employed must be authorized in accordance with the provisions of §24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

**RSS-139; 6.5 Transmitter Output Power**

In addition, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1% of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

**Band 17:**

No applicable PAPR limit.

**RSS-130; 4.6.1 General**

The transmitter output power shall be measured in terms of average power. In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

**Band 7:**

No applicable PAPR limit.

**RSS-199; 4.4 Transmitter output power and equivalent isotropicall power (e.i.r.p.)**

In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

For equipment with multiple antennas, the transmitter output power and e.i.r.p shall be measured according to ANSI C63.26-2015.

## 5.21.3 TEST PROTOCOL

| | |
|---|---|
| Ambient temperature: | 20 - 28 °C |
| Relative humidity: | 30 - 40 % |

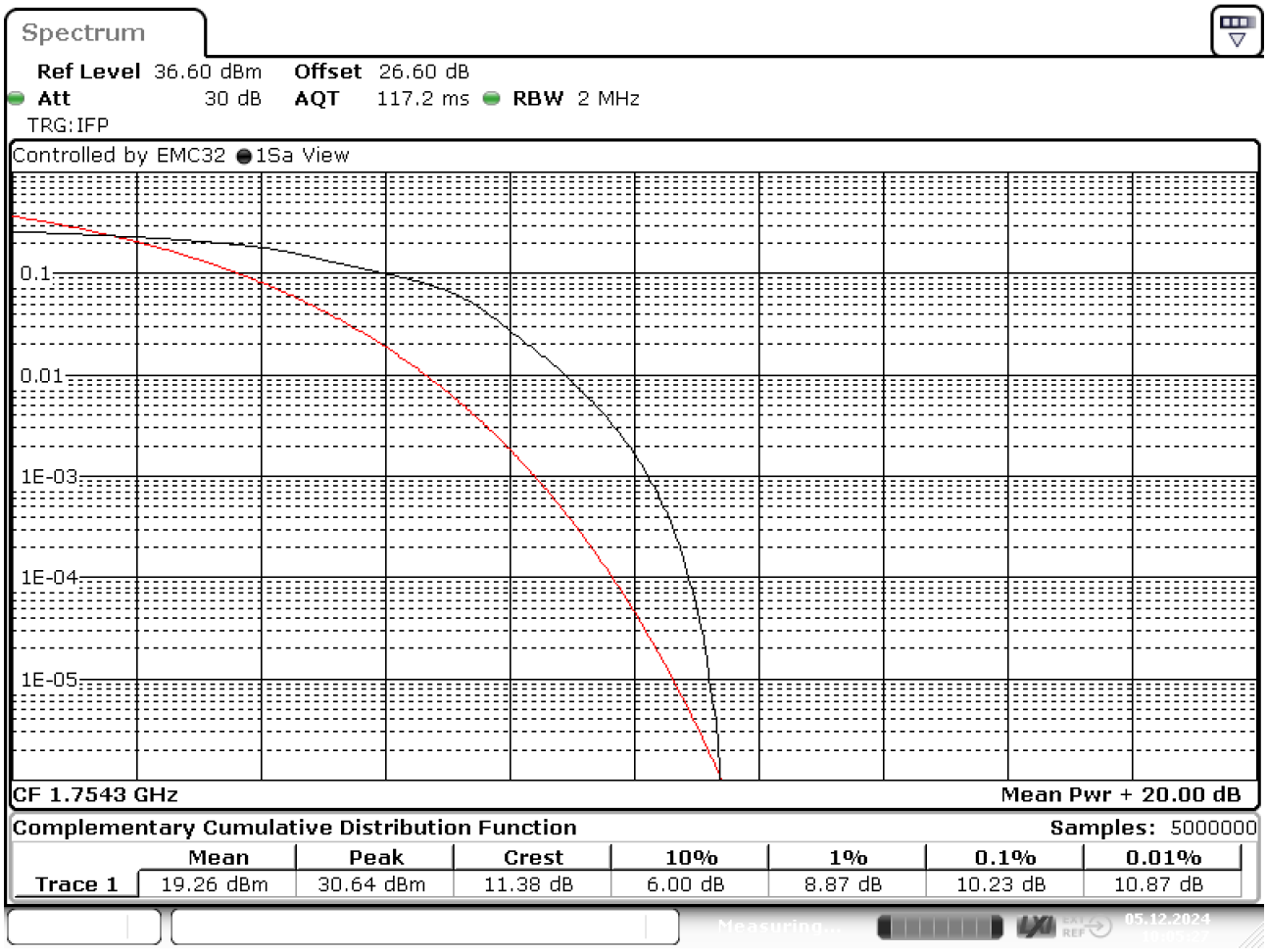
| Technology | Radio Technology | Channel | Ressource Blocks | Bandwidth [MHz] | Peak to Average Ratio | Limit (IC) [dB] |
|---|---|---|---|---|---|---|
| CAT-M1 | eFDD 4 QPSK | low | 6 | 1.4 | 9.8 | 13 |
| CAT-M1 | eFDD 4 QPSK | mid | 6 | 1.4 | 9.8 | 13 |
| CAT-M1 | eFDD 4 QPSK | high | 6 | 1.4 | 9.8 | 13 |
| CAT-M1 | eFDD 4 16QAM | low | 5 | 1.4 | 10.2 | 13 |
| CAT-M1 | eFDD 4 16QAM | mid | 5 | 1.4 | 10.2 | 13 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CAT-M1 | eFDD 4 16QAM | high | 5 | 1.4 | 10.2 | 13 |
| CAT-M1 | eFDD 12 QPSK | low | 6 | 1.4 | 10.1 | 13 |
| CAT-M1 | eFDD 12 QPSK | mid | 6 | 1.4 | 10.0 | 13 |
| CAT-M1 | eFDD 12 QPSK | high | 6 | 1.4 | 9.9 | 13 |
| CAT-M1 | eFDD 12 16QAM | low | 5 | 1.4 | 10.6 | 13 |
| CAT-M1 | eFDD 12 16QAM | mid | 5 | 1.4 | 10.8 | 13 |
| CAT-M1 | eFDD 12 16QAM | high | 5 | 1.4 | 10.4 | 13 |
| CAT-M1 | eFDD 13 QPSK | low | 6 | 1.4 | 9.9 | 13 |
| CAT-M1 | eFDD 13 QPSK | mid | 6 | 1.4 | 9.9 | 13 |
| CAT-M1 | eFDD 13 QPSK | high | 6 | 1.4 | 9.8 | 13 |
| CAT-M1 | eFDD 13 16QAM | low | 5 | 1.4 | 10.2 | 13 |
| CAT-M1 | eFDD 13 16QAM | mid | 5 | 1.4 | 11.9 | 13 |
| CAT-M1 | eFDD 13 16QAM | high | 5 | 1.4 | 12.4 | 13 |
| CAT-M1 | eFDD 66 QPSK | low | 6 | 1.4 | 9.8 | 13 |
| CAT-M1 | eFDD 66 QPSK | mid | 6 | 1.4 | 9.8 | 13 |
| CAT-M1 | eFDD 66 QPSK | high | 6 | 1.4 | 9.8 | 13 |
| CAT-M1 | eFDD 66 16QAM | low | 5 | 1.4 | 10.3 | 13 |
| CAT-M1 | eFDD 66 16QAM | mid | 5 | 1.4 | 10.3 | 13 |
| CAT-M1 | eFDD 66 16QAM | high | 5 | 1.4 | 10.6 | 13 |
| CAT-M1 | eFDD 71 QPSK | low | 6 | 1.4 | 10.4 | 13 |
| CAT-M1 | eFDD 71 QPSK | mid | 6 | 1.4 | 10.4 | 13 |
| CAT-M1 | eFDD 71 QPSK | high | 6 | 1.4 | 10.2 | 13 |
| CAT-M1 | eFDD 71 16QAM | low | 5 | 1.4 | 10.8 | 13 |
| CAT-M1 | eFDD 71 16QAM | mid | 5 | 1.4 | 10.8 | 13 |
| CAT-M1 | eFDD 71 16QAM | high | 5 | 1.4 | 10.7 | 13 |
| CAT-M1 | eFDD 85 QPSK | low | 6 | 1.4 | 10.1 | 13 |
| CAT-M1 | eFDD 85 QPSK | mid | 6 | 1.4 | 10.0 | 13 |
| CAT-M1 | eFDD 85 QPSK | high | 6 | 1.4 | 10.0 | 13 |
| CAT-M1 | eFDD 85 16QAM | low | 5 | 1.4 | 10.6 | 13 |
| CAT-M1 | eFDD 85 16QAM | mid | 5 | 1.4 | 10.6 | 13 |
| CAT-M1 | eFDD 85 16QAM | high | 5 | 1.4 | 10.4 | 13 |

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

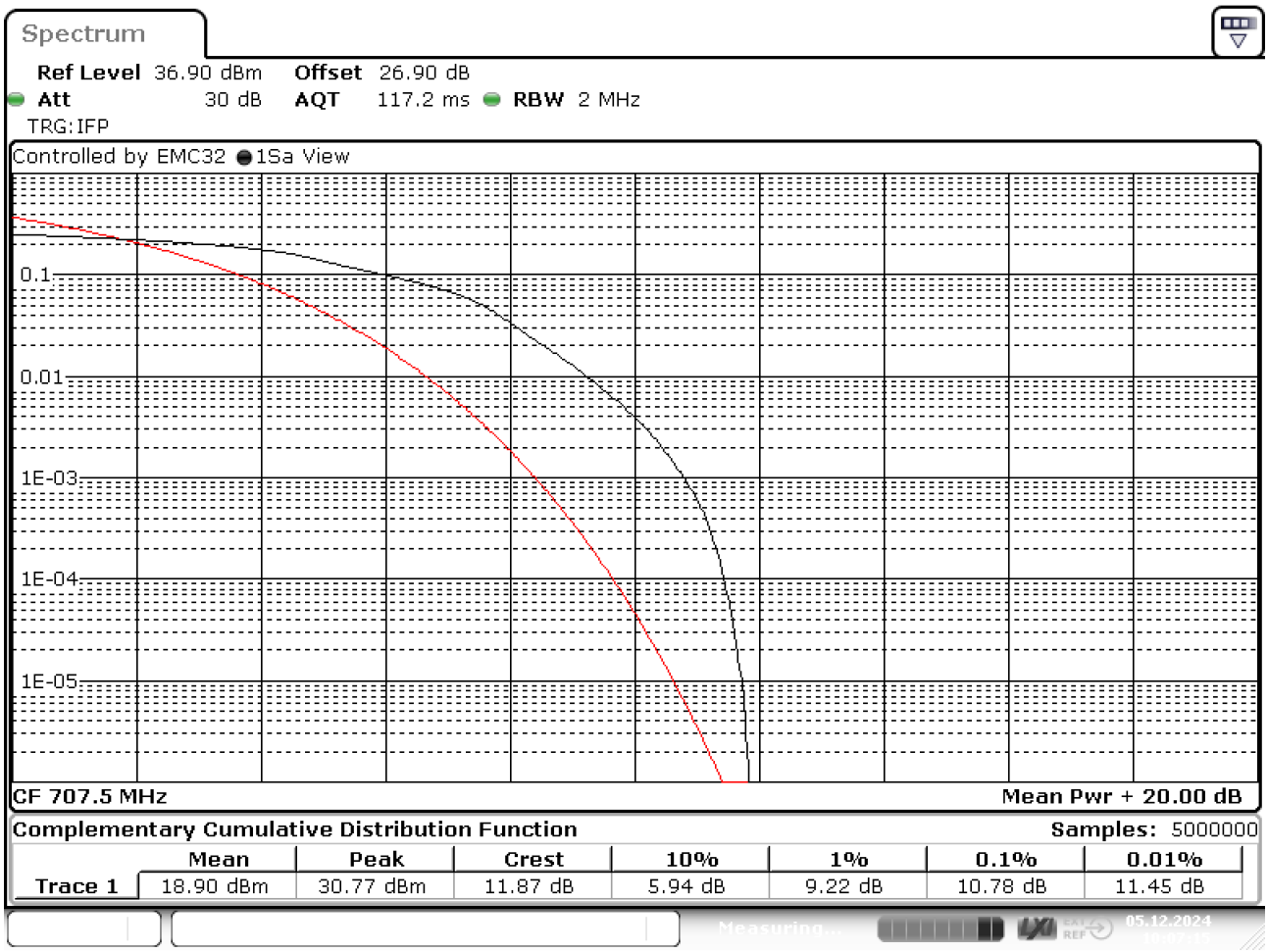
## 5.21.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Technology = CAT-M1, Radio Technology = eFDD 4 16QAM,
Operating Frequency = high channel
(S01_AF02)



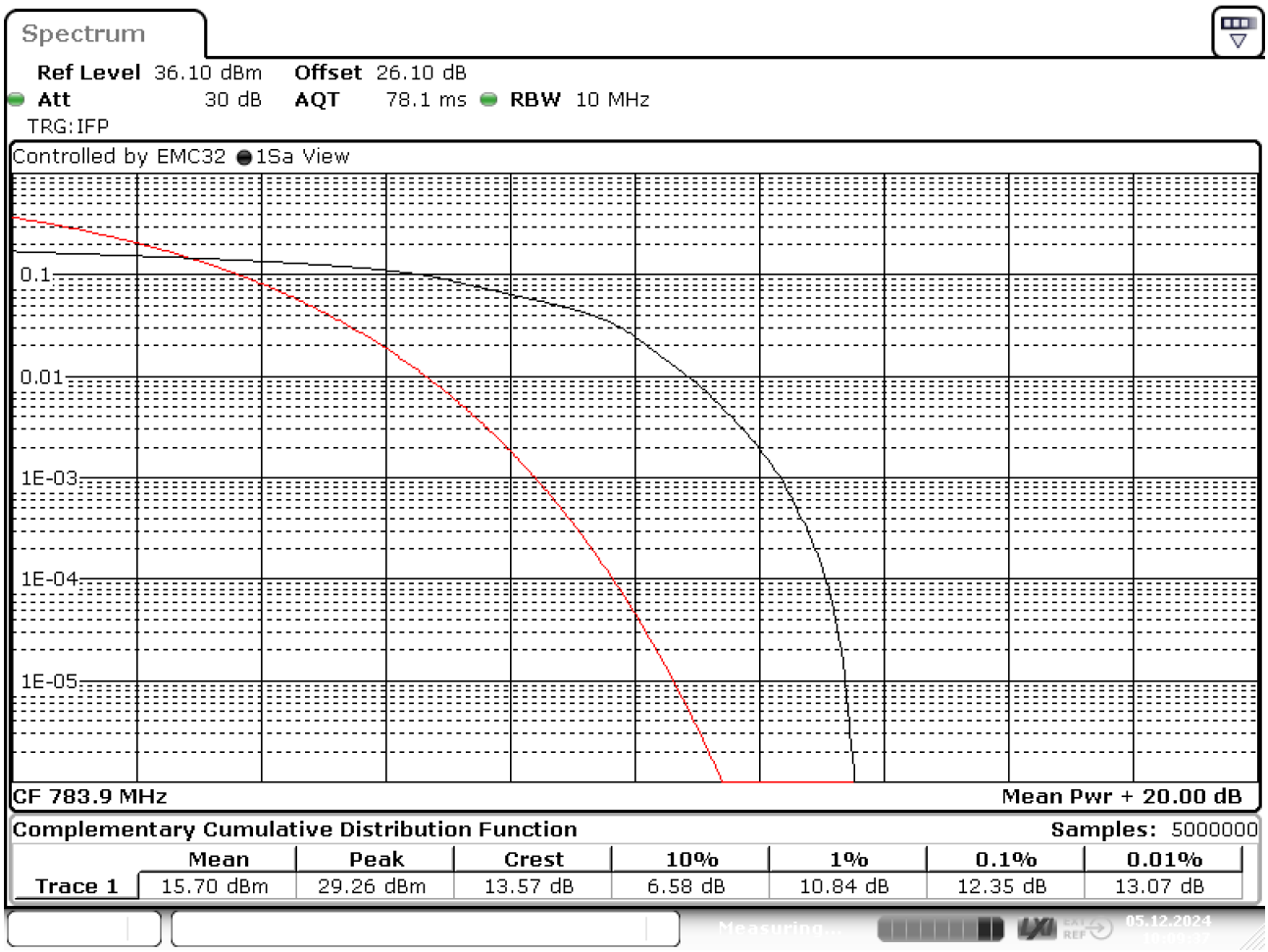

Date: 5.DEC.2024 10:05:28

Technology = CAT-M1, Radio Technology = eFDD 12 16QAM,
Operating Frequency = mid channel
(S01_AF02)



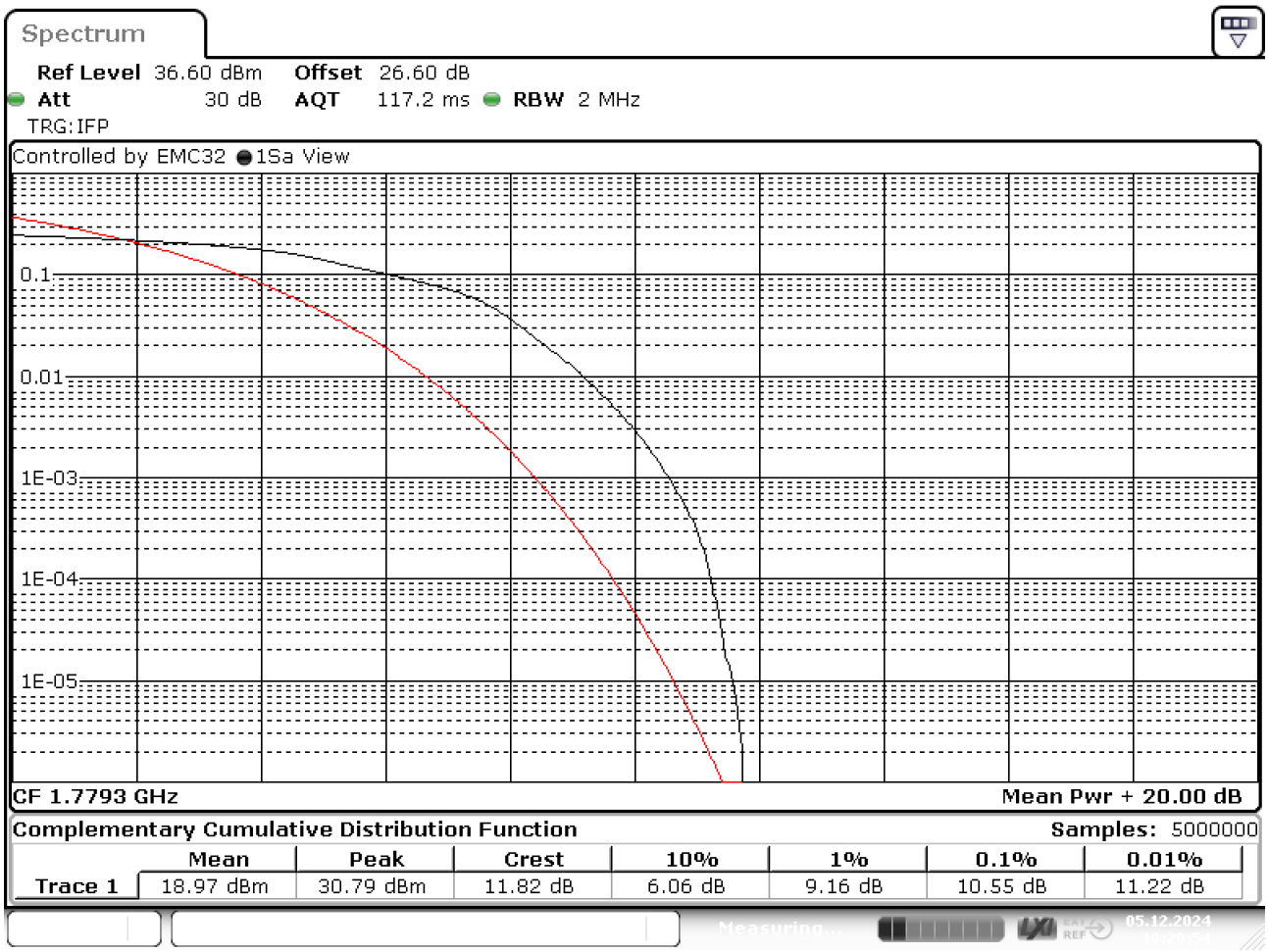

Date: 5.DEC.2024 10:07:15

Technology = CAT-M1, Radio Technology = eFDD 13 16QAM,
Operating Frequency = high channel
(S01_AF02)



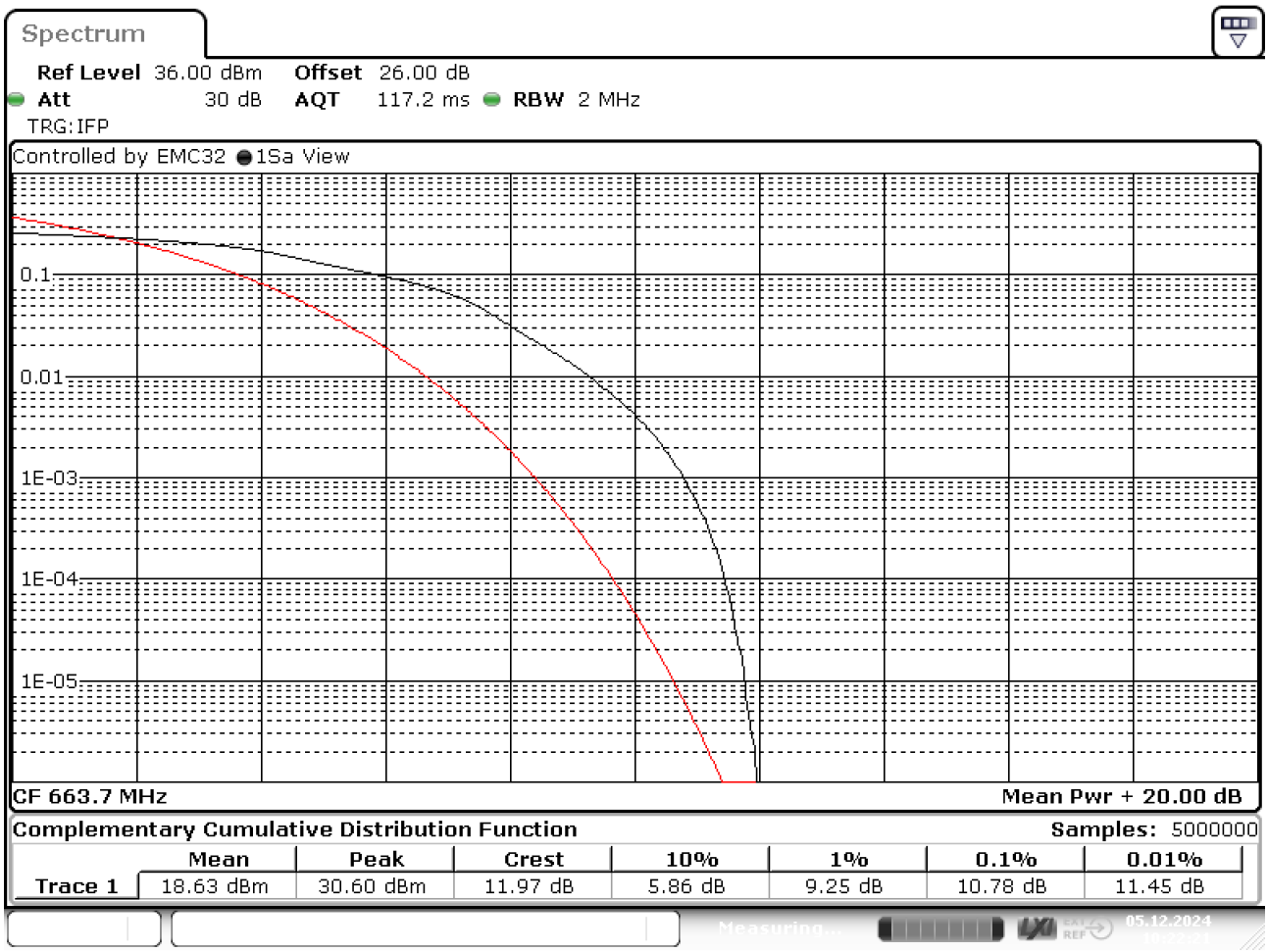

Date: 5.DEC.2024 10:09:38

Technology = CAT-M1, Radio Technology = eFDD 66 16QAM,
Operating Frequency = high channel
(S01_AF02)



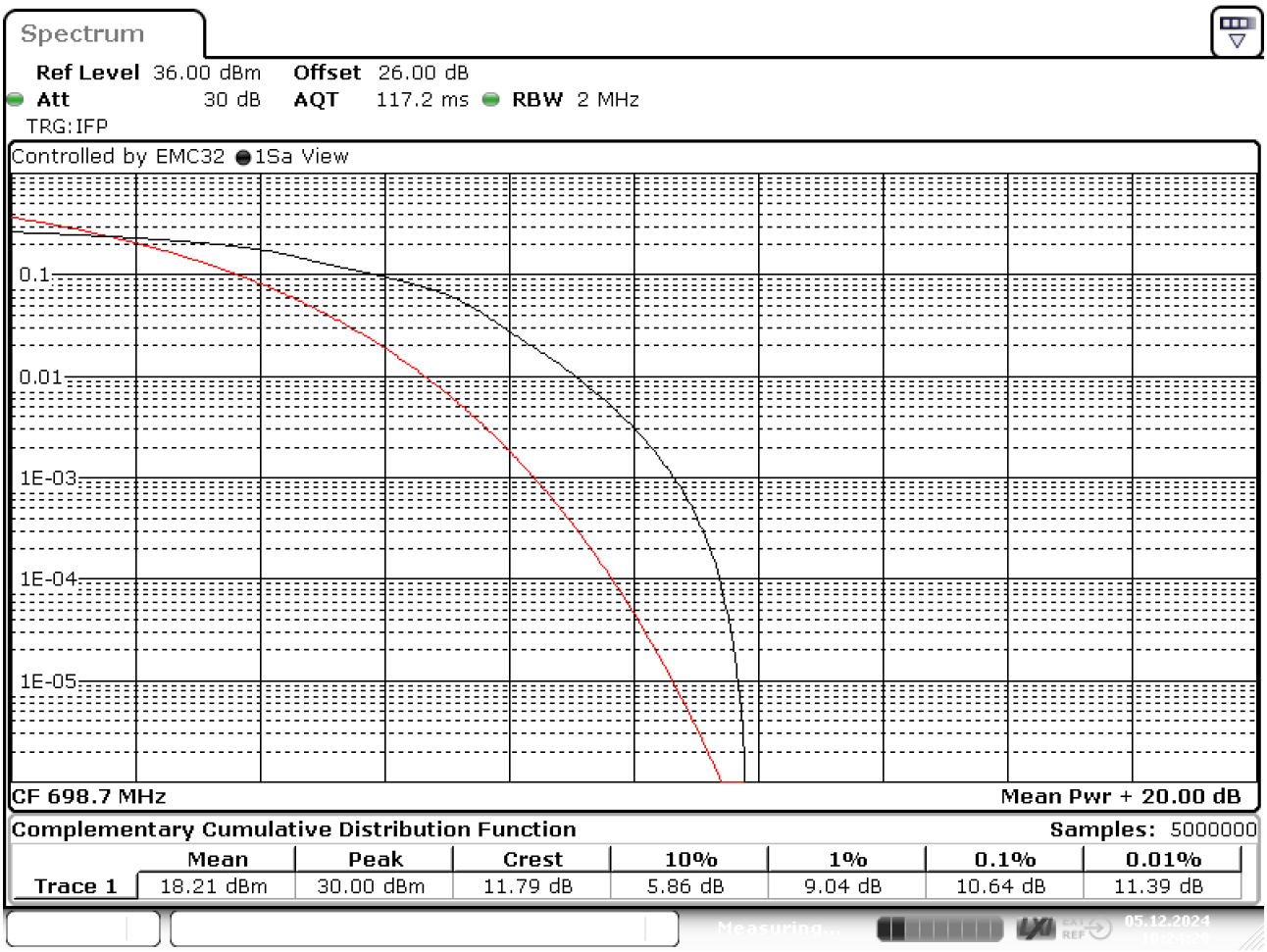

Date: 5.DEC.2024 10:20:55

Technology = CAT-M1, Radio Technology = eFDD 71 16QAM,
Operating Frequency = low channel
(S01_AF02)




Date: 5.DEC.2024 10:22:22

Technology = CAT-M1, Radio Technology = eFDD 85 16QAM,
Operating Frequency = low channel
(S01_AF02)




Date: 5.DEC.2024 10:24:30

## 5.21.5 TEST EQUIPMENT USED

- Radio Lab

## 5.22 RF OUTPUT POWER

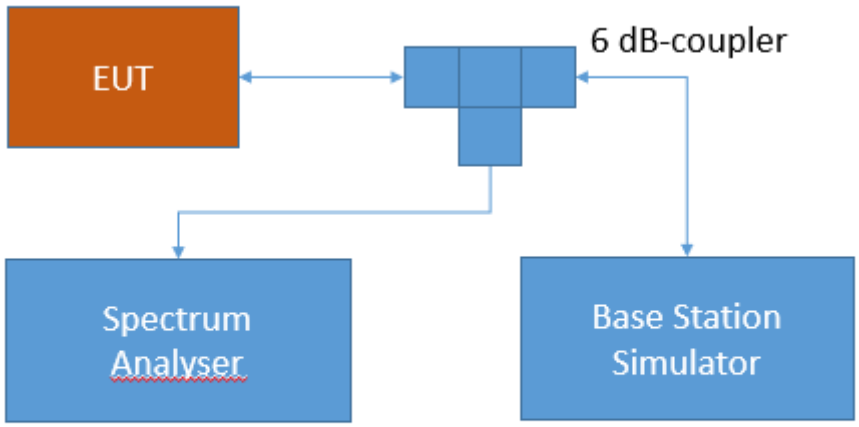
Standard **FCC PART 27 Subpart P**

**The test was performed according to:**
ANSI C63.26: 2015; 5.2.4.1, Wideband Signal: 5.2.4.4

### 5.22.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable RF Output power test case per § 2.1046. The limit and the requirements come from the applicable rule part for the operating band of the cellular device.

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




Test Setup FCC Part 22/24/27/90 Cellular;
RF Output power

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

### 5.22.2 TEST REQUIREMENTS / LIMITS

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart P – Regulations Governing Licensing and Use of 900 MHz Broadband Service in the 897.5–900.5 MHz and 936.5–939.5 MHz Bands**

**§ 27.1507 – Effective radiated power limits for 900 MHz broadband systems**

**Band 8:**

(a) (4) ***Portable stations.*** Portable stations must not exceed 3 watts ERP.

## 5.22.3 TEST PROTOCOL

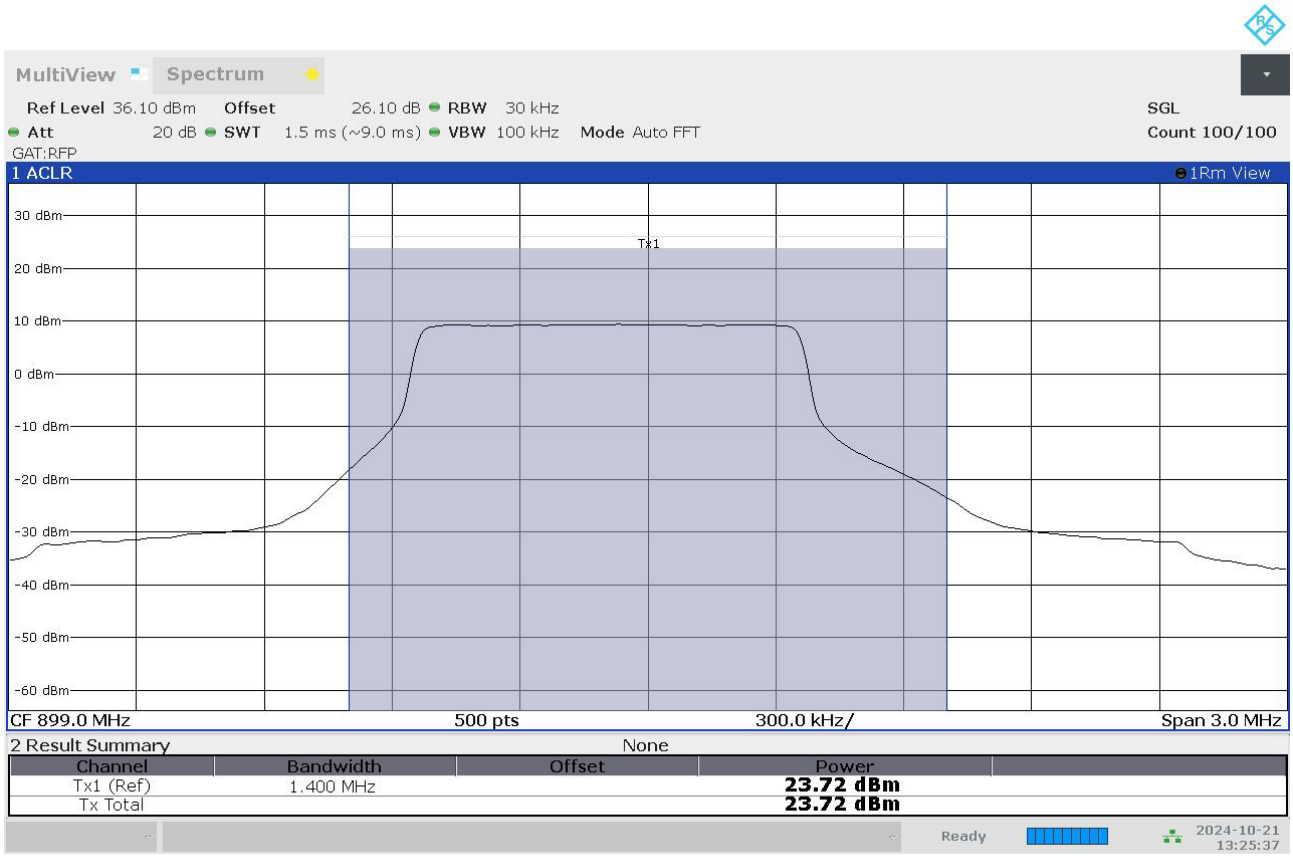
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

| Technology | Radio Technology | Channel | Ressource Blocks / Subcarrier | Bandwidth [MHz] | Peak Cond. Power [dBm] | Average Cond. Power [dBm] | RMS Cond. Power [dBm] | FCC ERP Limit [W] | IC ERP Limit [W] | Max. Antenna Gain FCC [dBi] | Max. Antenna Gain IC [dBi] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CAT-M1 | eFDD 8 QPSK | low | 1 | 1.4 | - | - | 23.6 | 3 | - | 11.2 | - |
| CAT-M1 | eFDD 8 QPSK | low | 3 | 1.4 | - | - | 23.5 | 3 | - | 11.3 | - |
| CAT-M1 | eFDD 8 QPSK | low | 6 | 1.4 | - | - | 23.5 | 3 | - | 11.3 | - |
| CAT-M1 | eFDD 8 QPSK | mid | 1 | 1.4 | - | - | 23.5 | 3 | - | 11.3 | - |
| CAT-M1 | eFDD 8 QPSK | mid | 3 | 1.4 | - | - | 23.5 | 3 | - | 11.3 | - |
| CAT-M1 | eFDD 8 QPSK | mid | 6 | 1.4 | - | - | 23.6 | 3 | - | 11.2 | - |
| CAT-M1 | eFDD 8 QPSK | high | 1 | 1.4 | - | - | 23.6 | 3 | - | 11.2 | - |
| CAT-M1 | eFDD 8 QPSK | high | 3 | 1.4 | - | - | 23.5 | 3 | - | 11.3 | - |
| CAT-M1 | eFDD 8 QPSK | high | 6 | 1.4 | - | - | 23.5 | 3 | - | 11.3 | - |
| CAT-M1 | eFDD 8 16QAM | low | 1 | 1.4 | - | - | 23.2 | 3 | - | 11.6 | - |
| CAT-M1 | eFDD 8 16QAM | low | 5 | 1.4 | - | - | 23.7 | 3 | - | 11.1 | - |
| CAT-M1 | eFDD 8 16QAM | mid | 1 | 1.4 | - | - | 23.3 | 3 | - | 11.5 | - |
| CAT-M1 | eFDD 8 16QAM | mid | 5 | 1.4 | - | - | 23.7 | 3 | - | 11.1 | - |
| CAT-M1 | eFDD 8 16QAM | high | 1 | 1.4 | - | - | 23.1 | 3 | - | 11.7 | - |
| CAT-M1 | eFDD 8 16QAM | high | 5 | 1.4 | - | - | 23.7 | 3 | - | 11.1 | - |
| CAT-M1 | eFDD 8 QPSK | mid | 1 | 3 | - | - | 23.5 | 3 | - | 11.3 | - |
| CAT-M1 | eFDD 8 QPSK | mid | 3 | 3 | - | - | 23.5 | 3 | - | 11.3 | - |
| CAT-M1 | eFDD 8 QPSK | mid | 6 | 3 | - | - | 23.5 | 3 | - | 11.3 | - |
| CAT-M1 | eFDD 8 16QAM | mid | 1 | 3 | - | - | 23.1 | 3 | - | 11.7 | - |
| CAT-M1 | eFDD 8 16QAM | mid | 5 | 3 | - | - | 23.7 | 3 | - | 11.1 | - |

Comment: The max. antenna gain is regarding the output power not SAR / MPE.
Remark: Please see next sub-clause for the measurement plot.

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

Technology = CAT-M1, Radio Technology = eFDD 8 16QAM, Operating Frequency = mid channel, ChBW = 1.4 MHz, Ressource Blocks = 5
(S01_AF01)




01:25:38 PM 10/21/2024

## 5.22.5 TEST EQUIPMENT USED

- Radio Lab

## 5.23 FREQUENCY STABILITY

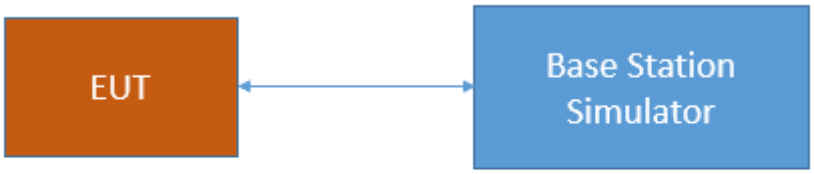
Standard **FCC PART 27 Subpart P**

**The test was performed according to:**
ANSI C63.26: 2015; 5.6

### 5.23.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable frequency stability test case per § 2.1055. The limit and the requirements come from the applicable rule part for the operating band of the cellular device.

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




Test Setup FCC Part 22/24/27/90 Cellular;
Frequency stability

The attenuation of the measuring / stimulus path is known for each measured frequency and are considered.

### 5.23.2 TEST REQUIREMENTS / LIMITS

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart P – Regulations Governing Licensing and Use of 900 MHz Broadband Service in the 897.5–900.5 MHz and 936.5–939.5 MHz Bands**

**§ 2.1055 - Frequency stability**

**All Bands**

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

## 5.23.3 TEST PROTOCOL

Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

CAT-M1 eFDD8

| Temp. °C | Duration min | Voltage | Limit Hz | Freq. error Average (Hz) | Freq. error Max. (Hz) | Verdict |
|---|---|---|---|---|---|---|
| -30 | 0 | normal | 1768.75 | -4 | -4 | passed |
| -30 | 5 | | | 0 | -2 | passed |
| -30 | 10 | | | -1 | -2 | passed |
| -20 | 0 | normal | 1768.75 | -15 | -19 | passed |
| -20 | 5 | | | 0 | -2 | passed |
| -20 | 10 | | | -3 | -5 | passed |
| -10 | 0 | normal | 1768.75 | -1 | 11 | passed |
| -10 | 5 | | | 5 | 8 | passed |
| -10 | 10 | | | 7 | 14 | passed |
| 0 | 0 | normal | 1768.75 | -2 | -5 | passed |
| 0 | 5 | | | 0 | -6 | passed |
| 0 | 10 | | | -5 | -6 | passed |
| 10 | 0 | normal | 1768.75 | 1 | 7 | passed |
| 10 | 5 | | | 5 | 20 | passed |
| 10 | 10 | | | 0 | -9 | passed |
| 20 | 0 | low | 1768.75 | -1 | -3 | passed |
| 20 | 5 | | | -1 | -3 | passed |
| 20 | 10 | | | 0 | -2 | passed |
| 20 | 0 | normal = high [1)] | 1768.75 | 12 | 20 | passed |
| 20 | 5 | | | -8 | -24 | passed |
| 20 | 10 | | | -1 | -5 | passed |
| 20 | 0 | high | 1768.75 | 0 | -3 | passed |
| 20 | 5 | | | 12 | 22 | passed |
| 20 | 10 | | | -1 | 2 | passed |
| 30 | 0 | normal | 1768.75 | 1 | 1 | passed |
| 30 | 5 | | | 2 | 4 | passed |
| 30 | 10 | | | 4 | 4 | passed |
| 40 | 0 | normal | 1768.75 | 3 | 5 | passed |
| 40 | 5 | | | 2 | 5 | passed |
| 40 | 10 | | | 5 | 14 | passed |
| 50 | 0 | normal | 1768.75 | 1 | 3 | passed |
| 50 | 5 | | | -2 | -14 | passed |
| 50 | 10 | | | -1 | -2 | passed |

## 5.23.4 TEST EQUIPMENT USED

- Radio Lab

## 5.24 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

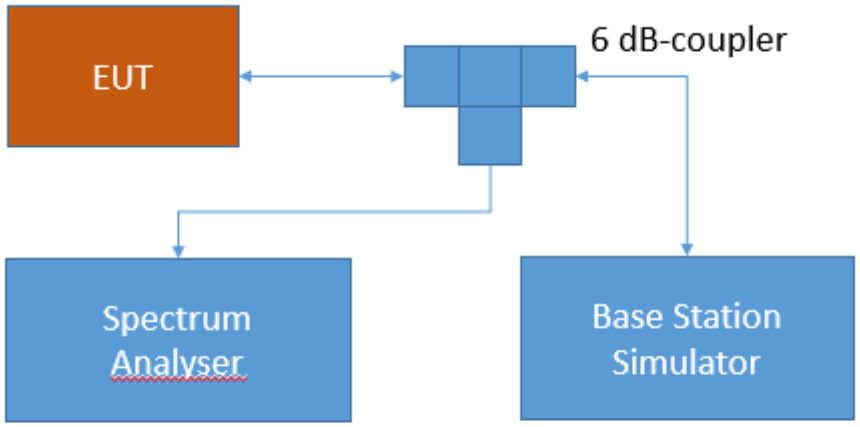
Standard **FCC PART 27 Subpart P**

**The test was performed according to:**
ANSI C63.26: 2015; 5.7.4

### 5.24.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission test case per § 2.1051. The limit comes from the applicable rule part for the operating band of the cellular device.

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




Test Setup FCC Part 22/24/27/90 Cellular;
Spurious Emissions at antenna terminal

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

### 5.24.2 TEST REQUIREMENTS / LIMITS

**FCC Part 2.1051; Measurement required: Spurious emissions at antenna terminal:**

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart P – Regulations Governing Licensing and Use of 900 MHz Broadband Service in the 897.5–900.5 MHz and 936.5–939.5 MHz Bands**

**§27.1509 – Emission limits**

**Band 8**

(a) For 900 MHz broadband operations in 897.5–900.5 MHz band by at least 43 + 10 log (P) dB.

(b) For 900 MHz broadband operations in the 936.5–939.5 MHz band, by at least 50 + 10 log (P) dB.

(c) Compliance with the provisions of paragraphs (a) and (b) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the licensee's band, a resolution bandwidth of at least 1 percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(d) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

(e) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

## 5.24.3 TEST PROTOCOL

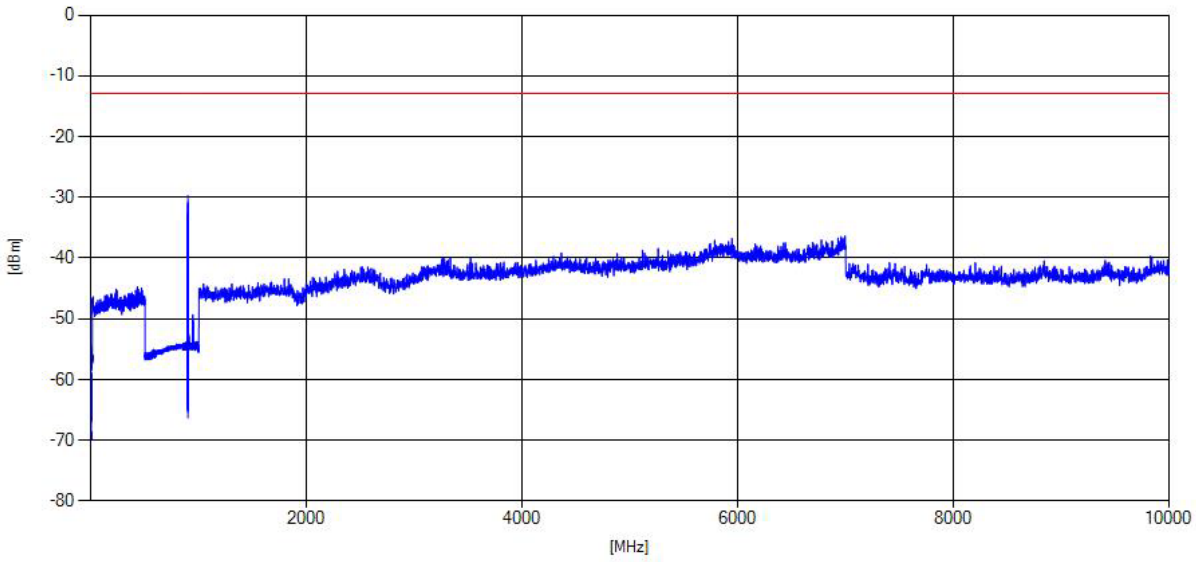
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

| Radio Technology | Channel | Detector | Trace | Resolution Bandwidth /kHz | Frequency /MHz | Peak Value /dBm | Limit /dBm | Margin to Limit /dB |
|---|---|---|---|---|---|---|---|---|
| CAT-M1 eFDD8 | low | rms | maxhold | 20 | 897.5 | -32.7 | -13 | >13 |
| CAT-M1 eFDD8 | mid | rms | maxhold | 100 | 5879.0 | -37.1 | -13 | >13 |
| CAT-M1 eFDD8 | high | rms | maxhold | 100 | 6931.0 | -36.3 | -13 | >13 |

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

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

Technology = CAT-M1, Radio Technology = eFDD 8, Operating Frequency = low channel (S01_AF01)




## 5.24.5 TEST EQUIPMENT USED

- Radio Lab

## 5.25 FIELD STRENGTH OF SPURIOUS RADIATION

Standard **FCC PART 27 Subpart P**

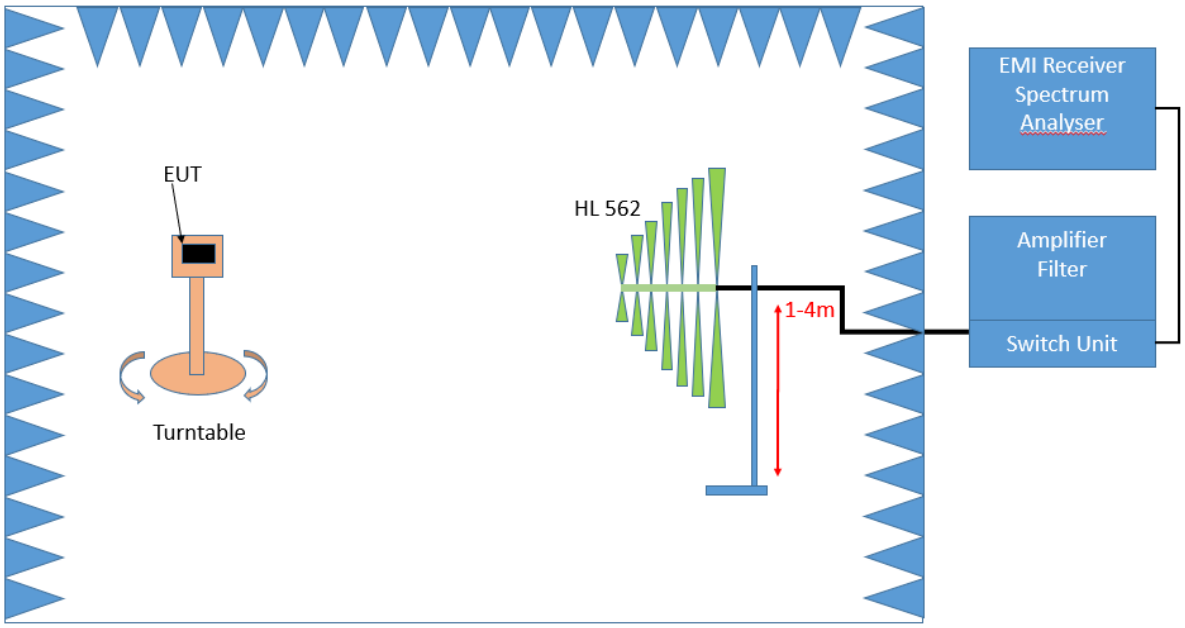
**The test was performed according to:**
ANSI C63.26: 2015; 5.5.2.3.1

### 5.25.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable radiated spurious emission measurements per § 2.1053. The limit and requirements come from the applicable rule part for the operating band of the cellular device.

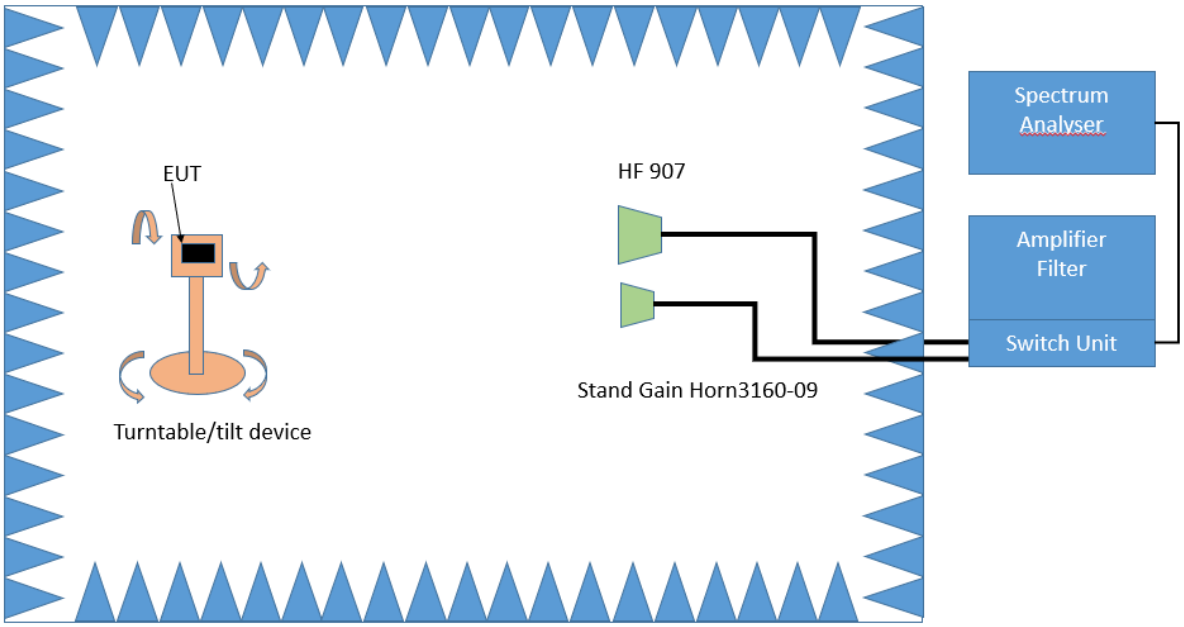
The EUT was connected to the test setup according to the following diagram:

Frequency Range: 30 MHz – 1 GHz:




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

Frequency Range: 1 GHz – 26.5 GHz




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

The test set-up was made in accordance to the general provisions of ANSI C63.26 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m² in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.
The measurement procedure is implemented into the EMI test software EMC32 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is also performed at 3 axes. A pre-check is performed while the EUT is powered from a DC power source.

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

**Step 1:** Preliminary scan
This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 3 m
- Detector: Peak
- RBW: 100 kHz
- VBW: 300 kHz
- Sweep time: coupled
- Turntable angle range: –180° to 90°
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

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

**Step 2:** Adjustment measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by ± 45° 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 ± 100 cm around the antenna height determined. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.
- Detector: Peak
- Measured frequencies: in step 1 determined frequencies
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep time: coupled
- Turntable angle range: ± 45 ° around the determined value
- Height variation range: ± 100 cm around the determined value
- Antenna Polarisation: max. value determined in step 1

**Step 3:** Final measurement with RMS detector
With the settings determined in step 3, the final measurement will be performed:
EMI receiver settings for step 4:
- Detector: RMQ
- Measured frequencies: in step 1 determined frequencies
- RBW: 100 kHz
- VBW: 300 kHz
- Sweep time: 1 s

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

**3. Measurement above 1 GHz**
The following modifications apply to the measurement procedure for the frequency range above 1 GHz:
**Step 1:**
The Equipment Under Test (EUT) was set up on a non-conductive support (tilt device) at 1.5 m height in the fully-anechoic chamber.
All steps were performed with one height (1.5 m) of the receiving antenna only.
The EUT is turned during the preliminary measurement across the elevation axis, with a step size of 90 °.
The turn table step size (azimuth angle) for the preliminary measurement is 45 °.
- Antenna distance: 3 m
- Detector: Peak
- RBW: 100 kHz
- VBW: 300 kHz
- Sweep time: coupled
- Turntable angle range: –180° to 90°
- Turntable step size: 90°
- Polarisation: Horizontal + Vertical

**Step 2:**
Due to the fact, that in this frequency range the test is performed in a fully anechoic room, the height scan of the receiving antenna instep 2 is omitted. Instead of this, a maximum search with a step size ± 45° for the elevation axis is performed.
The turn table azimuth will slowly vary by ± 22.5°.

The elevation angle will slowly vary by ± 45°
EMI receiver settings (for all steps):
- Detector: Peak,
- RBW: 100 kHz
- VBW: 300 kHz
- Sweep time: coupled

**Step 3:**
Spectrum analyser settings for step 3:
- Detector: RMS
- Measured frequencies: in step 1 determined frequencies
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep Time: 1 s

## 5.25.2 TEST REQUIREMENTS / LIMITS

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

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

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart P – Regulations Governing Licensing and Use of 900 MHz Broadband Service in the 897.5–900.5 MHz and 936.5–939.5 MHz Bands**

**§27.1508 – Field strength limits**

The predicted or measured median field strength must not exceed 40 dBµV/m at any given point along the geographic license boundary, unless the affected licensee agrees to a different field strength. This value applies to both the initially offered service areas and to partitioned service areas.

## 5.25.3 TEST PROTOCOL

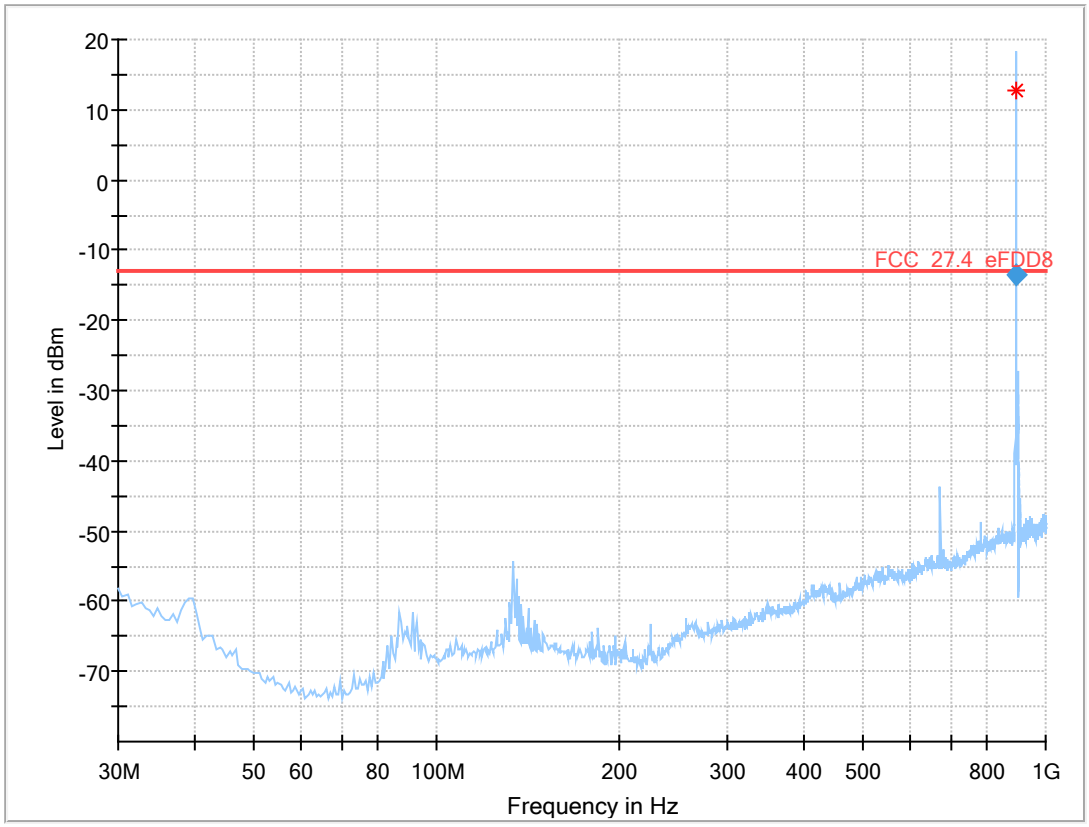
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

| Radio Technology | Channel | Detector | Trace | Resolution Bandwidth /kHz | Frequency /MHz | Peak Value /dBm | Limit /dBm | Margin to Limit /dB |
|---|---|---|---|---|---|---|---|---|
| CAT-M1 eFDD 8 | low | rms | maxhold | 100 | 896.3 | -13.5 | -13 | 0.5 |
| CAT-M1 eFDD 8 | mid | rms | maxhold | 100 | 900.6 | -34.5 | -13 | 21.5 |
| CAT-M1 eFDD 8 | high | rms | maxhold | 100 | 897.4 | -46.0 | -13 | 33.0 |
| CAT-M1 eFDD 8 | high | rms | maxhold | 100 | 900.6 | -18.5 | -13 | 5.5 |
| CAT-M1 eFDD 8 | high | rms | maxhold | 100 | 901.1 | -38.4 | -13 | 25.4 |
| CAT-M1 eFDD 8 | high | rms | maxhold | 100 | 902.7 | -45.1 | -13 | 32.1 |

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

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

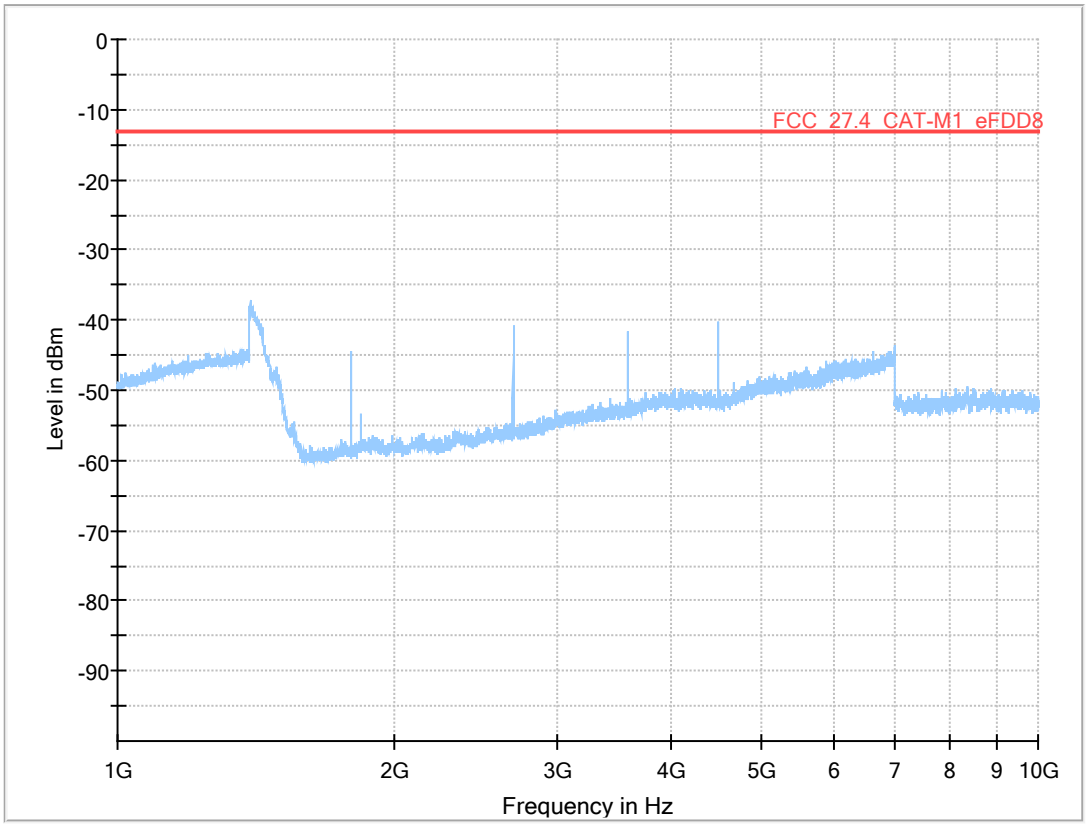
Technology = CAT-M1, Radio Technology = eFDD 8, Operating Frequency = low channel (S02_AF01)
30 MHz - 1 GHz




**Final_Result**

| Frequency (MHz) | RMS (dBm) | Limit (dBm) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 896.315750 | -13.47 | -13.00 | 0.47 | 1000.0 | 100.000 | 120.0 | V | 138.0 | -62.2 |

1 GHz - 10 GHz




**Final_Result**

| Frequency (MHz) | RMS (dBm) | Limit (dBm) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Elevation (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

## 5.25.5 TEST EQUIPMENT USED

- Radiated Emissions FAR: for measurements above 1GHz
- Radiated Emissions SAC: for measurements up to 1GHz in a semi anechoic room

## 5.26 EMISSION AND OCCUPIED BANDWIDTH

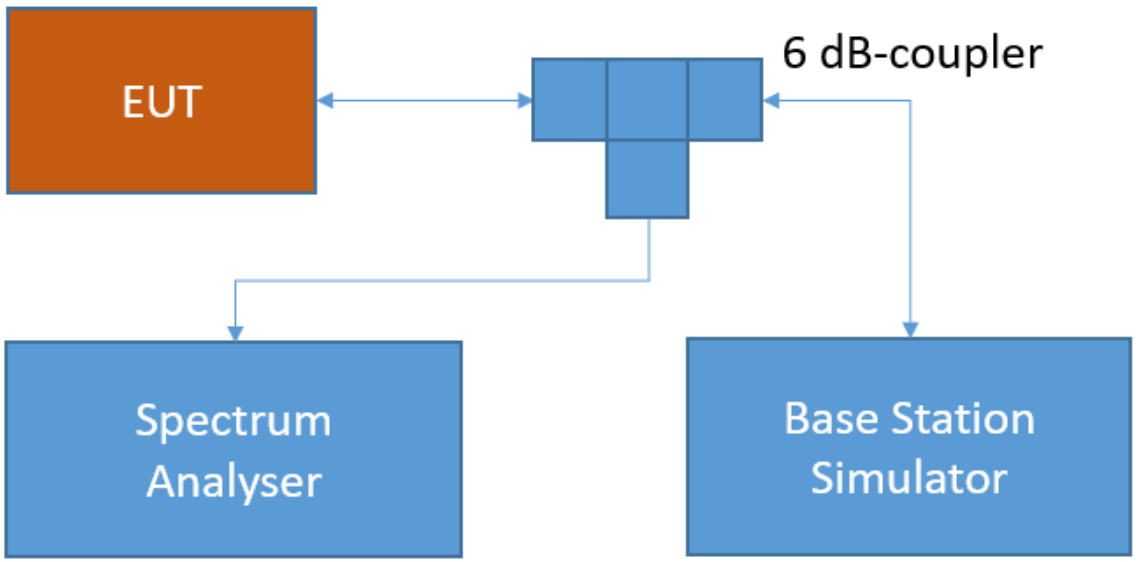
Standard **FCC PART 27 Subpart P**

**The test was performed according to:**
ANSI C63.26: 2015; 5.4.3 (relative meas. Procedure [26dB for GSM, EGDE, WCDMA, HSDPA, HSUPA]) 5.4.4 (Power bandwidth (99%))

### 5.26.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission test case per FCC §2.1049. The limit and the requirements come from the applicable rule part for the operating band of the cellular device.

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




Test Setup FCC / ISED Cellular;
Emission and occupied bandwidth

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

## 5.26.2 TEST REQUIREMENTS / LIMITS

**FCC Part 2.1049; Occupied Bandwidth:**

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

(h) Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

(i) Transmitters designed for other types of modulation—when modulated by an appropriate signal of sufficient amplitude to be representative of the type of service in which used. A description of the input signal should be supplied.

**§27.1506 – Frequencies**

The 897.5-900.5 MHz and 936.5-939.5 MHz band segments are available for licensing with an authorized bandwidth up to 3 megahertz paired channels. The 897.5-900.5 MHz segment must only be used for uplink transmissions. The 936.5-939.5 MHz segments must only be used for downlink transmissions.

## 5.26.3 TEST PROTOCOL

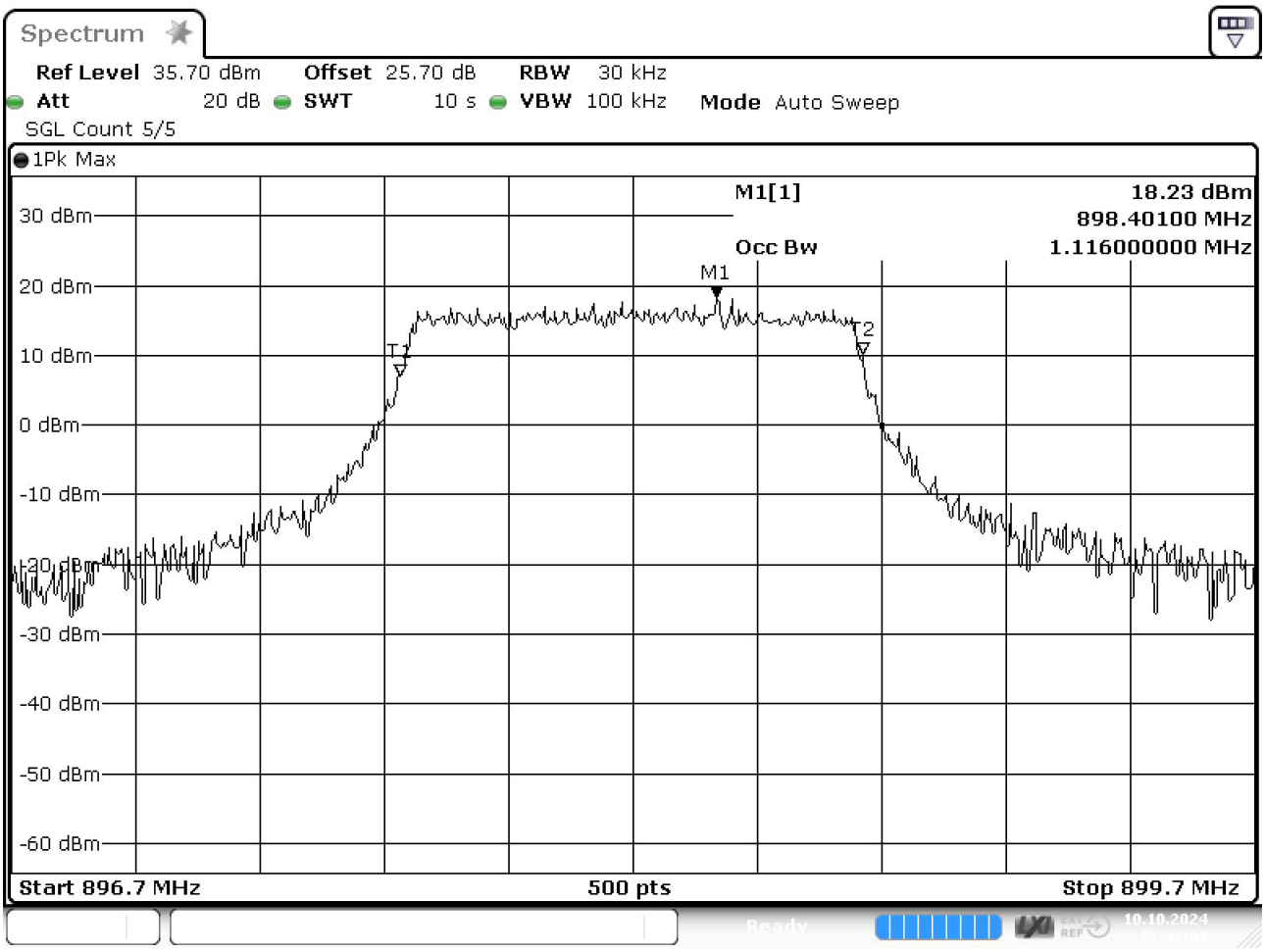
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

| Technology | Radio Technology | Channel | Ressource Blocks / Subcarrier | Bandwidth [MHz] | Nominal BW [MHz] | 26 dB BW [kHz] | 99 % BW [kHz] |
|---|---|---|---|---|---|---|---|
| CAT-M1 | eFDD 8 QPSK | low | 6 | 1.4 | 1.4 | - | 1116.0 |
| CAT-M1 | eFDD 8 QPSK | mid | 6 | 1.4 | 1.4 | - | 1110.0 |
| CAT-M1 | eFDD 8 QPSK | high | 6 | 1.4 | 1.4 | - | 1116.0 |
| CAT-M1 | eFDD 8 16QAM | low | 5 | 1.4 | 1.4 | - | 954.0 |
| CAT-M1 | eFDD 8 16QAM | mid | 5 | 1.4 | 1.4 | - | 954.0 |
| CAT-M1 | eFDD 8 16QAM | high | 5 | 1.4 | 1.4 | - | 942.0 |

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

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

Technology = CAT-M1, Radio Technology = eFDD 8 QPSK,
Operating Frequency = low channel
(S01_AA01)




Date: 10.OCT.2024 15:32:05

## 5.26.5 TEST EQUIPMENT USED

- Radio Lab

## 5.27 BAND EDGE COMPLIANCE

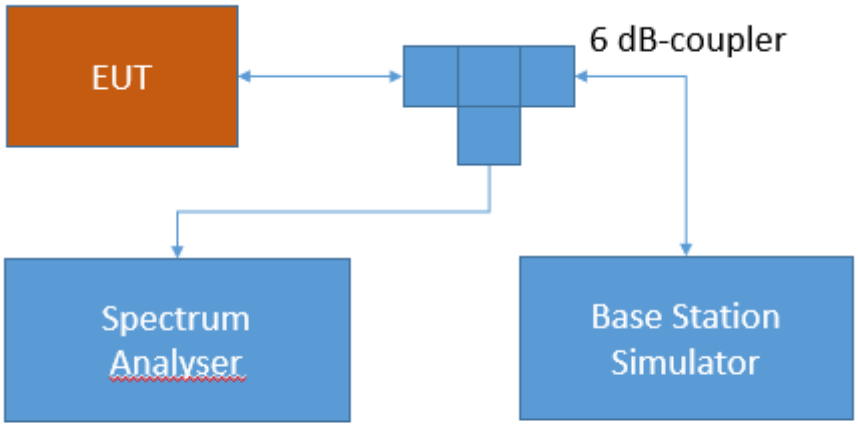
Standard **FCC PART 27 Subpart P**

**The test was performed according to:**
ANSI C63.26: 2015; 5.7.3

### 5.27.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission test case per § 2. 1051. The limit comes from the applicable rule part and for the operating band of the cellular device.

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




Test Setup FCC Part 22/24/27/90 Cellular;
Band edge compliance

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

### 5.27.2 TEST REQUIREMENTS / LIMITS

**FCC Part 2.1051; Measurement required: Spurious emissions at antenna terminal:**

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart P – Regulations Governing Licensing and Use of 900 MHz Broadband Service in the 897.5–900.5 MHz and 936.5–939.5 MHz Bands**

**§27.1509 – Emission limits**

**Band 8**

(a) For 900 MHz broadband operations in 897.5–900.5 MHz band by at least 43 + 10 log (P) dB.

(b) For 900 MHz broadband operations in the 936.5–939.5 MHz band, by at least 50 + 10 log (P) dB.

(c) Compliance with the provisions of paragraphs (a) and (b) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the licensee's band, a resolution bandwidth of at least 1 percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(d) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

(e) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

## 5.27.3 TEST PROTOCOL

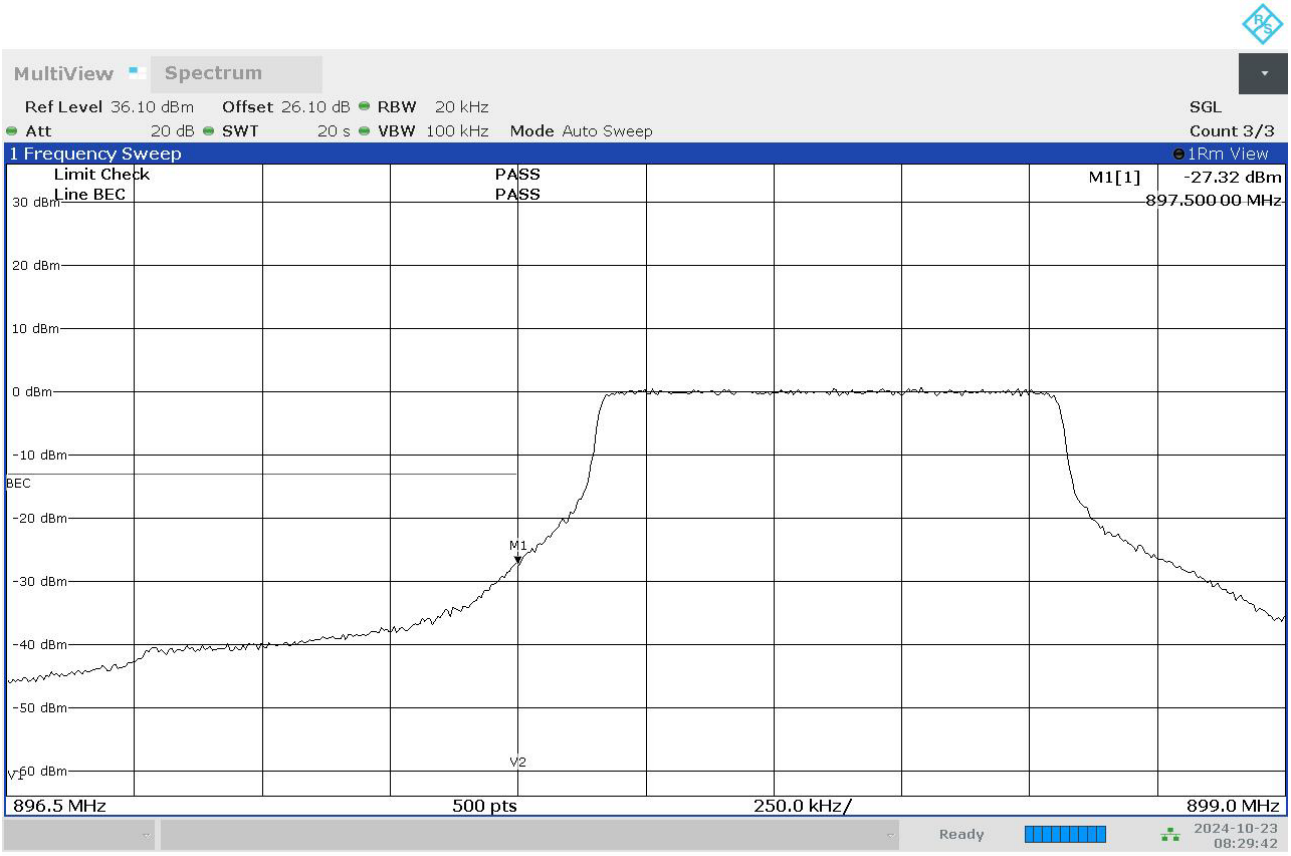
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

| Technology | Radio Technology | Channel | Ressource Blocks | Bandwidth [MHz] | RMS [dBm] | Limit /dBm | Margin to Limit /dB |
|---|---|---|---|---|---|---|---|
| CAT-M1 | eFDD 8 QPSK | low | 6 | 1.4 | -27.9 | -13 | 14.9 |
| CAT-M1 | eFDD 8 QPSK | high | 6 | 1.4 | -28.7 | -13 | 15.7 |
| CAT-M1 | eFDD 8 16QAM | low | 5 | 1.4 | -27.3 | -13 | 14.3 |
| CAT-M1 | eFDD 8 16QAM | high | 5 | 1.4 | -32.0 | -13 | 19.0 |

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

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

Technology = CAT-M1, Radio Technology = eFDD 8 16QAM,
Operating Frequency = low channel
(S01_AF01)




08:29:42 AM 10/23/2024

## 5.27.5 TEST EQUIPMENT USED

- Radio Lab

## 5.28 PEAK TO AVERAGE RATIO

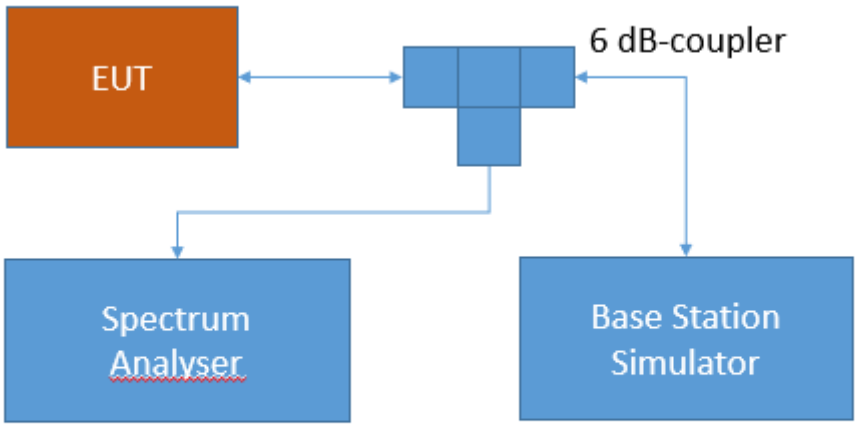
Standard **FCC PART 27 Subpart P**

**The test was performed according to:**
ANSI C63.26: 2015; 5.2.3.4 (broadband noise-like signal using CCDF [LTE, CAT-M1, NB-IoT])
5.2.6 (alternative procedure for PAPR [GSM, EDGE, WCDMA, HSDPA, HSUPA])

### 5.28.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance of the EUT to the peak-to-average limits and requirements of the applicable rule part and for the operating band of the cellular device.

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




Test Setup FCC Part 22/24/27/90 Cellular;
Peak-average ratio

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams. The internal CCDF (complementary cumulative distribution function) of the spectrum analyser is used for this measurement

### 5.28.2 TEST REQUIREMENTS / LIMITS

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart P – Regulations Governing Licensing and Use of 900 MHz Broadband Service in the 897.5–900.5 MHz and 936.5–939.5 MHz Bands**

**§27.1507 – Effective radiated power limits for 900 MHz broadband systems**

**Band 8:**

(d) ***PAR limit.*** The peak-to-average ratio (PAR) of the transmission must not exceed 13 dB.

## 5.28.3 TEST PROTOCOL

Ambient temperature: 20 - 28 °C

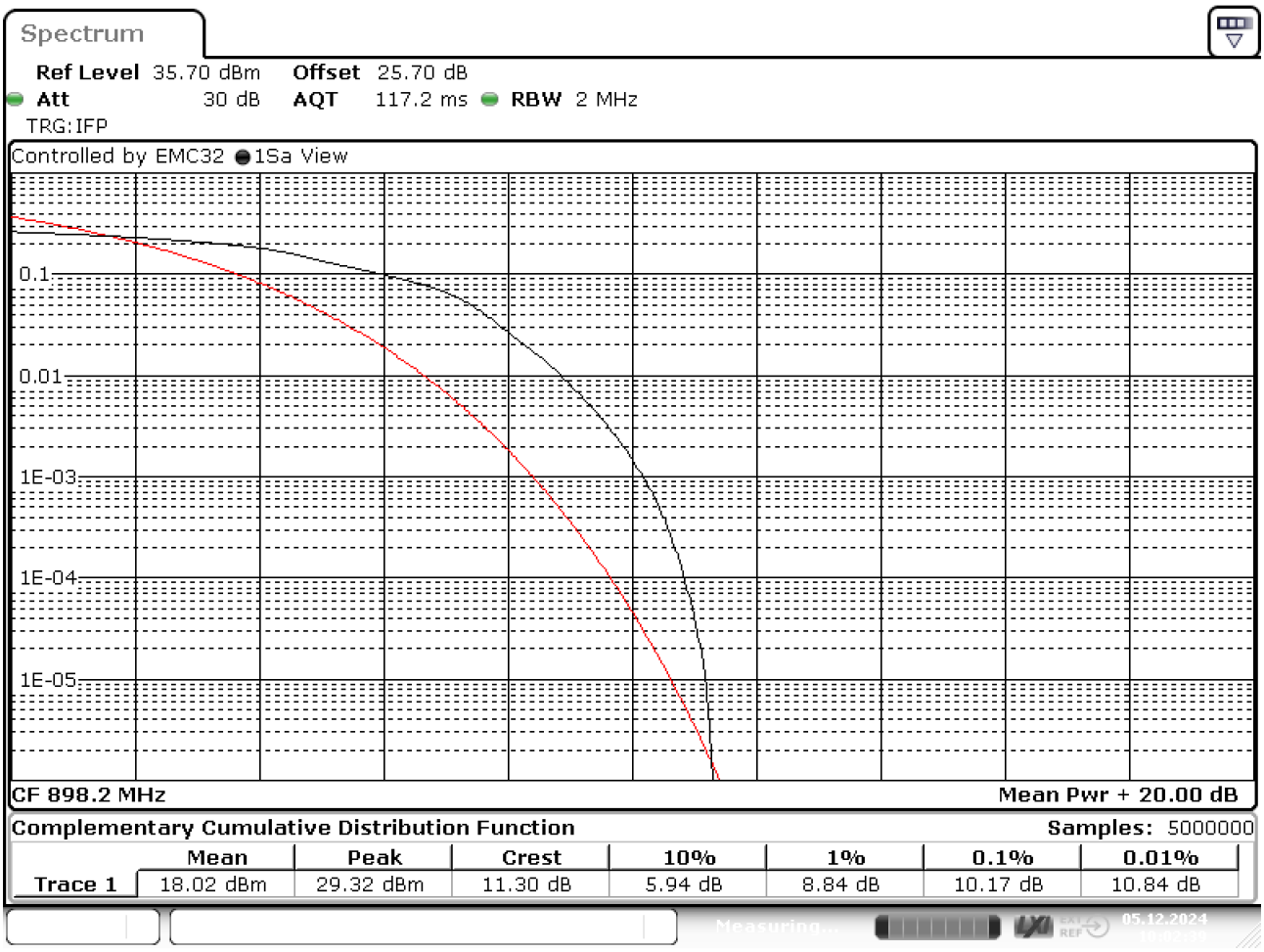
Relative humidity: 30 - 40 %

| Technology | Radio Technology | Channel | Ressource Blocks | Bandwidth [MHz] | Peak to Average Ratio | Limit (IC) [dB] |
|---|---|---|---|---|---|---|
| CAT-M1 | eFDD 8 QPSK | low | 6 | 1.4 | 9.7 | 13 |
| CAT-M1 | eFDD 8 QPSK | mid | 6 | 1.4 | 9.7 | 13 |
| CAT-M1 | eFDD 8 QPSK | high | 6 | 1.4 | 9.7 | 13 |
| CAT-M1 | eFDD 8 16QAM | low | 5 | 1.4 | 10.2 | 13 |
| CAT-M1 | eFDD 8 16QAM | mid | 5 | 1.4 | 10.1 | 13 |
| CAT-M1 | eFDD 8 16QAM | high | 5 | 1.4 | 10.2 | 13 |

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

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

Technology = CAT-M1, Radio Technology = eFDD 8 16QAM,
Operating Frequency = low channel
(S01_AF02)




Date: 5.DEC.2024 10:02:39

## 5.28.5 TEST EQUIPMENT USED

- Radio Lab

## 5.29 RF OUTPUT POWER

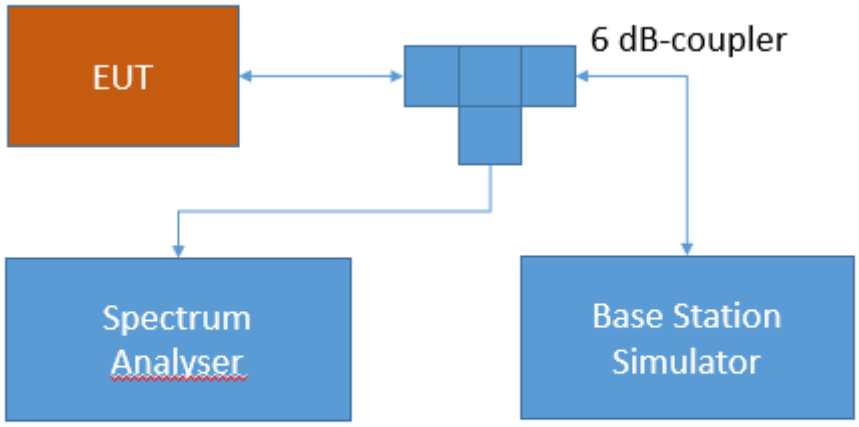
Standard **FCC PART 90 Subpart S**

**The test was performed according to:**
ANSI C63.26: 2015; 5.2.4.1, Wideband Signal: 5.2.4.4

### 5.29.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable RF Output power test case per § 2.1046 and RSS-GEN 6.12. The limit and the requirements come from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

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




Test Setup FCC Part 22/24/27/90 Cellular;
RF Output power

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

### 5.29.2 TEST REQUIREMENTS / LIMITS

**Part 90; PRIVATE LAND MOBILE RADIO SERVICES**

**Subpart S—Regulations Governing Licensing and Use of Frequencies in the 806-824, 851-869, 896-901, and 935-940 MHz Bands**

**§90.635 Limitations on power and antenna height.**

(b) The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).

**RSS-140; 4.3 Transmitter Output Power**

The equivalent radiated power (e.r.p.) for control and mobile equipment shall not exceed 30 W. The e.r.p. for portable equipment including handheld devices shall not exceed 3 W.

## 5.29.3 TEST PROTOCOL

Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

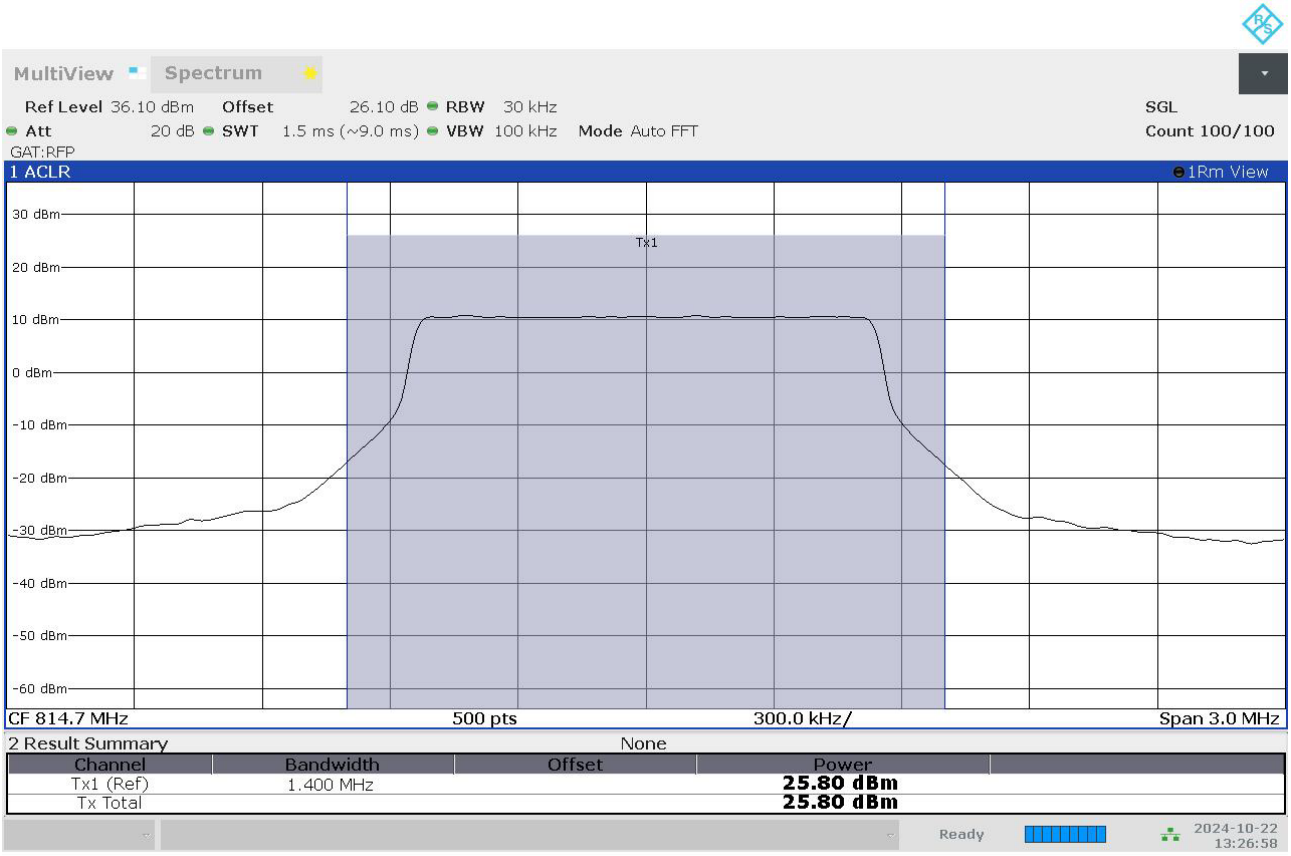
| Technology | Radio Technology | Channel | Ressource Blocks / Subcarrier | Bandwidth [MHz] | Peak Cond. Power [dBm] | Average Cond. Power [dBm] | RMS Cond. Power [dBm] | FCC ERP Limit [W] | IC ERP Limit [W] | Max. Antenna Gain FCC [dBi] | Max. Antenna Gain IC [dBi] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CAT-M1 | eFDD 26 QPSK | low | 1 | 1.4 | - | - | 25.1 | 100 | 3 | 24.9 | 9.7 |
| CAT-M1 | eFDD 26 QPSK | low | 3 | 1.4 | - | - | 24.9 | 100 | 3 | 25.1 | 9.9 |
| CAT-M1 | eFDD 26 QPSK | low | 6 | 1.4 | - | - | 25.8 | 100 | 3 | 24.2 | 9.0 |
| CAT-M1 | eFDD 26 QPSK | mid | 1 | 1.4 | - | - | 24.8 | 100 | 3 | 25.2 | 10.0 |
| CAT-M1 | eFDD 26 QPSK | mid | 3 | 1.4 | - | - | 24.9 | 100 | 3 | 25.1 | 9.9 |
| CAT-M1 | eFDD 26 QPSK | mid | 6 | 1.4 | - | - | 25.7 | 100 | 3 | 24.3 | 9.1 |
| CAT-M1 | eFDD 26 QPSK | high | 1 | 1.4 | - | - | 24.7 | 100 | 3 | 25.3 | 10.1 |
| CAT-M1 | eFDD 26 QPSK | high | 3 | 1.4 | - | - | 25.5 | 100 | 3 | 24.5 | 9.3 |
| CAT-M1 | eFDD 26 QPSK | high | 6 | 1.4 | - | - | 25.6 | 100 | 3 | 24.4 | 9.2 |
| CAT-M1 | eFDD 26 16QAM | low | 1 | 1.4 | - | - | 24.5 | 100 | 3 | 25.5 | 10.3 |
| CAT-M1 | eFDD 26 16QAM | low | 5 | 1.4 | - | - | 25.2 | 100 | 3 | 24.8 | 9.6 |
| CAT-M1 | eFDD 26 16QAM | mid | 1 | 1.4 | - | - | 24.5 | 100 | 3 | 25.5 | 10.3 |
| CAT-M1 | eFDD 26 16QAM | mid | 5 | 1.4 | - | - | 24.9 | 100 | 3 | 25.1 | 9.9 |
| CAT-M1 | eFDD 26 16QAM | high | 1 | 1.4 | - | - | 24.4 | 100 | 3 | 25.6 | 10.4 |
| CAT-M1 | eFDD 26 16QAM | high | 5 | 1.4 | - | - | 24.3 | 100 | 3 | 25.7 | 10.5 |
| CAT-M1 | eFDD 26 QPSK | low | 1 | 5 | - | - | 24.3 | 100 | 3 | 25.7 | 10.5 |
| CAT-M1 | eFDD 26 QPSK | low | 3 | 5 | - | - | 24.3 | 100 | 3 | 25.7 | 10.5 |
| CAT-M1 | eFDD 26 QPSK | low | 6 | 5 | - | - | 24.3 | 100 | 3 | 25.7 | 10.5 |
| CAT-M1 | eFDD 26 QPSK | mid | 1 | 5 | - | - | 24.2 | 100 | 3 | 25.8 | 10.6 |
| CAT-M1 | eFDD 26 QPSK | mid | 3 | 5 | - | - | 24.1 | 100 | 3 | 25.9 | 10.7 |
| CAT-M1 | eFDD 26 QPSK | mid | 6 | 5 | - | - | 24.2 | 100 | 3 | 25.8 | 10.6 |
| CAT-M1 | eFDD 26 QPSK | high | 1 | 5 | - | - | 24.3 | 100 | 3 | 25.7 | 10.5 |
| CAT-M1 | eFDD 26 QPSK | high | 3 | 5 | - | - | 24.2 | 100 | 3 | 25.8 | 10.6 |
| CAT-M1 | eFDD 26 QPSK | high | 6 | 5 | - | - | 24.2 | 100 | 3 | 25.8 | 10.6 |
| CAT-M1 | eFDD 26 16QAM | low | 1 | 5 | - | - | 24.0 | 100 | 3 | 26.0 | 10.8 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CAT-M1 | eFDD 26 16QAM | low | 5 | 5 | - | - | 24.5 | 100 | 3 | 25.5 | 14.0 |
| CAT-M1 | eFDD 26 16QAM | mid | 1 | 5 | - | - | 23.8 | 100 | 3 | 26.2 | 14.7 |
| CAT-M1 | eFDD 26 16QAM | mid | 5 | 5 | - | - | 24.3 | 100 | 3 | 25.7 | 14.2 |
| CAT-M1 | eFDD 26 16QAM | high | 1 | 5 | - | - | 23.9 | 100 | 3 | 26.1 | 14.6 |
| CAT-M1 | eFDD 26 16QAM | high | 5 | 5 | - | - | 24.4 | 100 | 3 | 25.6 | 14.1 |
| CAT-M1 | eFDD 26 QPSK | mid | 1 | 10 | - | - | 24.2 | 100 | 3 | 25.8 | 14.3 |
| CAT-M1 | eFDD 26 QPSK | mid | 3 | 10 | - | - | 24.1 | 100 | 3 | 25.9 | 14.4 |
| CAT-M1 | eFDD 26 QPSK | mid | 6 | 10 | - | - | 24.2 | 100 | 3 | 25.8 | 14.3 |
| CAT-M1 | eFDD 26 16QAM | mid | 1 | 10 | - | - | 23.9 | 100 | 3 | 26.1 | 14.7 |
| CAT-M1 | eFDD 26 16QAM | mid | 5 | 10 | - | - | 24.3 | 100 | 3 | 25.7 | 14.2 |

Comment: The max. antenna gain is regarding the output power not SAR / MPE.
Remark: Please see next sub-clause for the measurement plot.

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

Technology = CAT-M1, Radio Technology = eFDD 26 QPSK, Operating Frequency = low channel, ChBW = 1.4 MHz, Ressource Blocks = 6
(S01_AA01)




## 5.29.5 TEST EQUIPMENT USED

- Radio Lab

## 5.30 FREQUENCY STABILITY

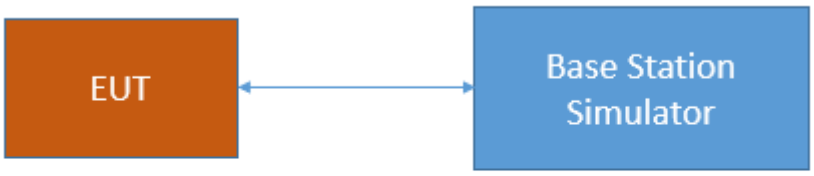
Standard **FCC PART 90 Subpart S**

**The test was performed according to:**
ANSI C63.26: 2015; 5.6

### 5.30.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable frequency stability test case per § 2.1055 and RSS-GEN 6.11. The limit and the requirements come from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

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




Test Setup FCC Part 22/24/27/90 Cellular; Frequency stability

The attenuation of the measuring / stimulus path is known for each measured frequency and are considered.

### 5.30.2 TEST REQUIREMENTS / LIMITS

**FCC Part 90,**

**§ 90.213**

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

Table Minimum Frequency Stability

[Parts per million (ppm)]

| Frequency range (MHz) | Mobile stations | |
|---|---|---|
| | Over 2 watts output power | 2 watts or less output power |
| 809-824 | 2.5 | 2.5 |
| 851-854 | 1.5 | 1.5 |

**RSS-140; 4.2 Frequency Stability**

The frequency stability shall be sufficient to ensure that the occupied bandwidth stays within the operating frequency block when tested at the temperature and supply voltage variations specified in RSS-Gen.

## 5.30.3 TEST PROTOCOL

Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

CAT-M1 eFDD26

| Temp. °C | Duration min | Voltage | Limit Hz | Freq. error Average (Hz) | Freq. error Max. (Hz) | Verdict |
|---|---|---|---|---|---|---|
| -30 | 0 | normal | 2047.5 | 2 | 3 | passed |
| -30 | 5 | | | -3 | -7 | passed |
| -30 | 10 | | | -2 | -6 | passed |
| -20 | 0 | normal | 2047.5 | -6 | -8 | passed |
| -20 | 5 | | | -3 | -4 | passed |
| -20 | 10 | | | -5 | -6 | passed |
| -10 | 0 | normal | 2047.5 | 12 | 18 | passed |
| -10 | 5 | | | 12 | 18 | passed |
| -10 | 10 | | | 14 | 23 | passed |
| 0 | 0 | normal | 2047.5 | 3 | 21 | passed |
| 0 | 5 | | | 6 | 9 | passed |
| 0 | 10 | | | 5 | 10 | passed |
| 10 | 0 | normal | 2047.5 | -1 | -5 | passed |
| 10 | 5 | | | 1 | 1 | passed |
| 10 | 10 | | | 9 | 17 | passed |
| 20 | 0 | low | 2047.5 | 12 | 18 | passed |
| 20 | 5 | | | 9 | 17 | passed |
| 20 | 10 | | | -1 | -3 | passed |
| 20 | 0 | normal = high [1)] | 2047.5 | -8 | -20 | passed |
| 20 | 5 | | | 0 | 5 | passed |
| 20 | 10 | | | -1 | 5 | passed |

| | | | | | | |
|---|---|---|---|---|---|---|
| 20 | 0 | high | 2047.5 | 1 | 20 | passed |
| 20 | 5 | | | 11 | 19 | passed |
| 20 | 10 | | | 8 | 9 | passed |
| 30 | 0 | normal | 2047.5 | 10 | 14 | passed |
| 30 | 5 | | | -3 | 22 | passed |
| 30 | 10 | | | 4 | 8 | passed |
| 40 | 0 | normal | 2047.5 | 1 | 3 | passed |
| 40 | 5 | | | 3 | 5 | passed |
| 40 | 10 | | | 2 | 4 | passed |
| 50 | 0 | normal | 2047.5 | -1 | -4 | passed |
| 50 | 5 | | | -2 | -5 | passed |
| 50 | 10 | | | -1 | -5 | passed |

## 5.30.4 TEST EQUIPMENT USED

- Radio Lab

## 5.31 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

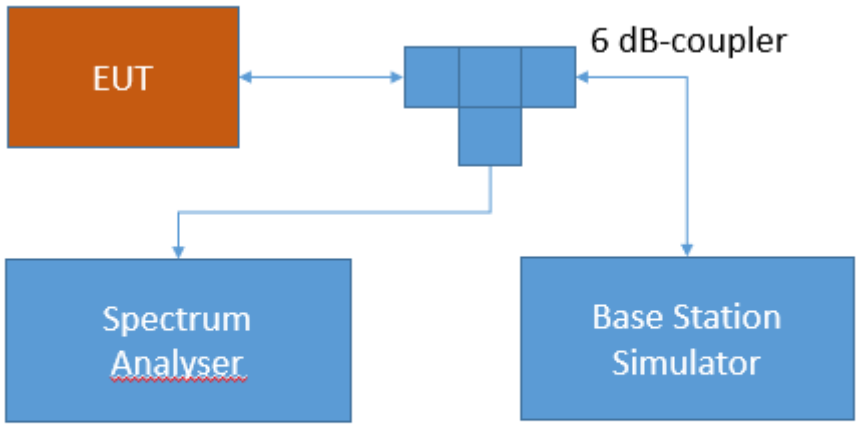
Standard **FCC PART 90 Subpart S**

**The test was performed according to:**
ANSI C63.26: 2015; 5.7.4

### 5.31.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission test case per § 2.1051 and RSS-GEN 6.13. The limit comes from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

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




Test Setup FCC Part 22/24/27/90 Cellular;
Spurious Emissions at antenna terminal

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

### 5.31.2 TEST REQUIREMENTS / LIMITS

**FCC Part 2.1051; Measurement required: Spurious emissions at antenna terminal:**

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

**Part 90; PRIVATE LAND MOBILE RADIO SERVICES**

**Subpart R—Regulations Governing the Licensing and Use of Frequencies in the 763-775 and 793-805 MHz Bands**

**§90.543 – Emission limitations.**

(a) The adjacent channel power (ACP) requirements for transmitters designed for various channel sizes are shown in the following tables. Mobile station requirements apply to handheld, car mounted and control station units. The tables specify a value for the ACP as a function of the displacement from the channel center frequency and measurement bandwidth. In the following tables, "(s)" indicates a swept measurement may be used.

**RSS-140; 4.4 Transmitter unwanted emission limits**

The power of any unwanted emission outside the bands 758-768 MHz and 788-798 MHz shall be attenuated below the transmitter output power P in dBW as follows, where p is the transmitter output power in watts:

For any frequency between 769-775 MHz and 799-806 MHz:

65 + 10 log (p), dB in a 6.25 kHz band for mobile and portable/hand-held equipment

For any frequency between 775-788 MHz, above 806 MHz, and below 758 MHz: 43 + 10 log (p), dB in a bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency bands 758-768 MHz and 788-798 MHz, a resolution bandwidth of 30 kHz may be employed.

In addition, the equivalent isotropically radiated power (e.i.r.p.) of all emissions, including harmonics in the band 1559-1610 MHz, shall not exceed −70 dBW/MHz for wideband emissions, and −80 dBW/kHz for discrete emissions of less than 700 Hz bandwidth.

## 5.31.3 TEST PROTOCOL

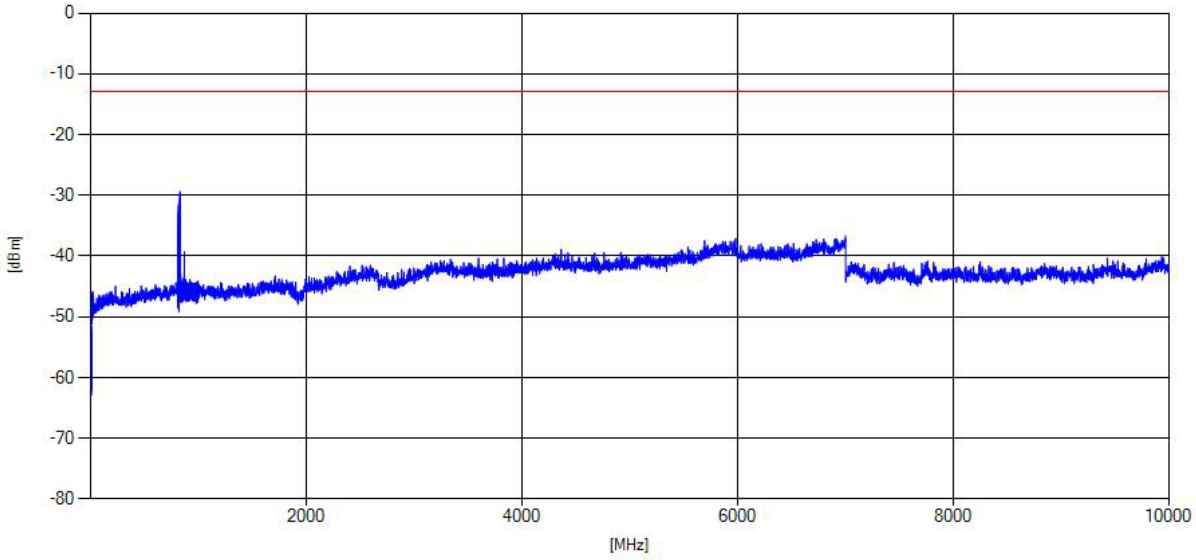
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

| Radio Technology | Channel | Detector | Trace | Resolution Bandwidth /kHz | Frequency /MHz | Peak Value /dBm | Limit /dBm | Margin to Limit /dB |
|---|---|---|---|---|---|---|---|---|
| CAT-M1 eFDD26 | low | rms | maxhold | 100 | 6989.0 | -36.9 | -13 | >13 |
| CAT-M1 eFDD26 | mid | rms | maxhold | 100 | 813.6 | -32.7 | -13 | >13 |
| CAT-M1 eFDD26 | high | rms | maxhold | 100 | 6859.0 | -36.4 | -13 | >13 |

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

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

Technology = CAT-M1, Radio Technology = eFDD 26, Operating Frequency = mid channel (S01_AF01)




## 5.31.5 TEST EQUIPMENT USED

- Radio Lab

## 5.32 FIELD STRENGTH OF SPURIOUS RADIATION

Standard **FCC PART 90 Subpart S**

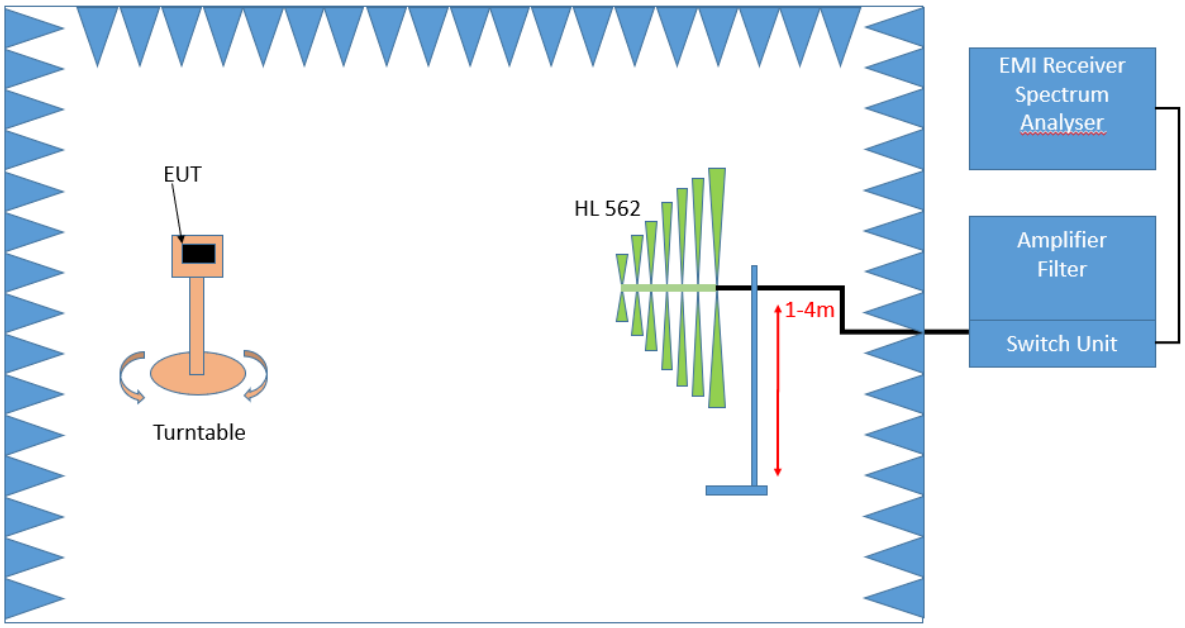
**The test was performed according to:**
ANSI C63.26: 2015; 5.5.2.3.1

### 5.32.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable radiated spurious emission measurements per § 2.1053 and RSS-GEN 6.13. The limit and requirements come from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

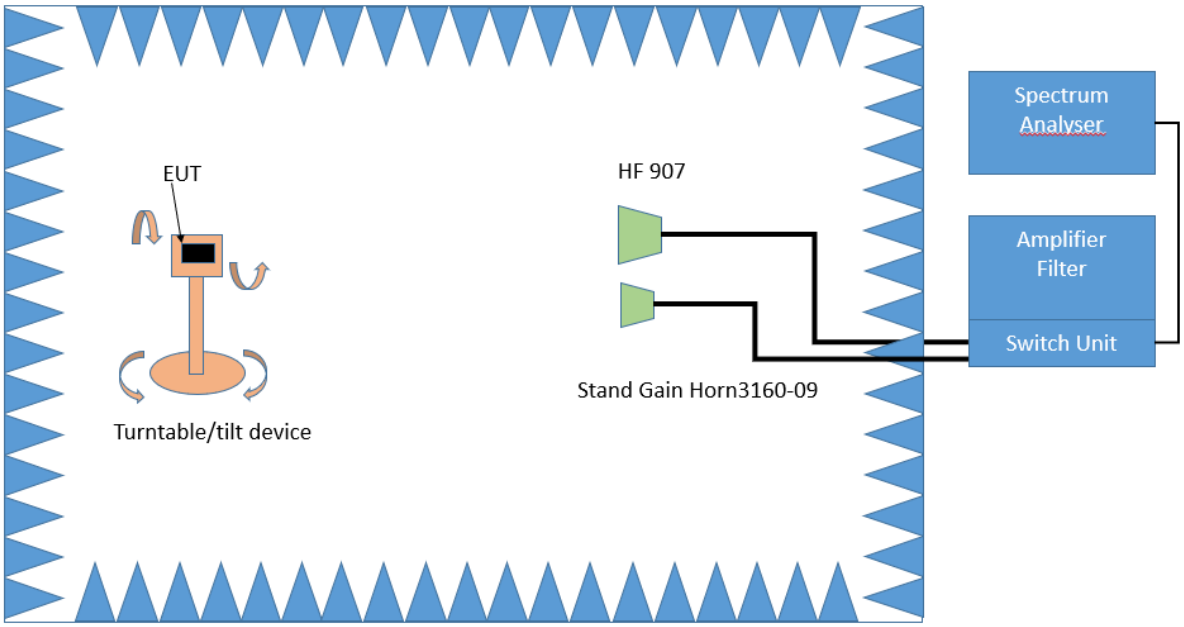
The EUT was connected to the test setup according to the following diagram:

Frequency Range: 30 MHz – 1 GHz:




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

Frequency Range: 1 GHz – 26.5 GHz




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

The test set-up was made in accordance to the general provisions of ANSI C63.26 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m² in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.
The measurement procedure is implemented into the EMI test software EMC32 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is also performed at 3 axes. A pre-check is performed while the EUT is powered from a DC power source.

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

**Step 1:** Preliminary scan
This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 3 m
- Detector: Peak
- RBW: 100 kHz
- VBW: 300 kHz
- Sweep time: coupled
- Turntable angle range: –180° to 90°
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

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

**Step 2:** Adjustment measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by ± 45° 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 ± 100 cm around the antenna height determined. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.
- Detector: Peak
- Measured frequencies: in step 1 determined frequencies
- RBW: 100 kHz
- VBW: 300 kHz
- Sweep time: coupled
- Turntable angle range: ± 45 ° around the determined value
- Height variation range: ± 100 cm around the determined value
- Antenna Polarisation: max. value determined in step 1

**Step 3:** Final measurement with RMS detector
With the settings determined in step 3, the final measurement will be performed:
EMI receiver settings for step 4:
- Detector: RMQ
- Measured frequencies: in step 1 determined frequencies
- RBW: 100 kHz
- VBW: 300 kHz
- Sweep time: 1 s

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

**3. Measurement above 1 GHz**
The following modifications apply to the measurement procedure for the frequency range above 1 GHz:
**Step 1:**
The Equipment Under Test (EUT) was set up on a non-conductive support (tilt device) at 1.5 m height in the fully-anechoic chamber.
All steps were performed with one height (1.5 m) of the receiving antenna only.
The EUT is turned during the preliminary measurement across the elevation axis, with a step size of 90 °.
The turn table step size (azimuth angle) for the preliminary measurement is 45 °.
- Antenna distance: 3 m
- Detector: Peak
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep time: coupled
- Turntable angle range: –180° to 90°
- Turntable step size: 90°
- Polarisation: Horizontal + Vertical

**Step 2:**
Due to the fact, that in this frequency range the test is performed in a fully anechoic room, the height scan of the receiving antenna instep 2 is omitted. Instead of this, a maximum search with a step size ± 45° for the elevation axis is performed.
The turn table azimuth will slowly vary by ± 22.5°.
The elevation angle will slowly vary by ± 45°

EMI receiver settings (for all steps):
- Detector: Peak,
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep time: coupled

**Step 3:**

Spectrum analyser settings for step 3:
- Detector: RMS
- Measured frequencies: in step 1 determined frequencies
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep Time: 1 s

## 5.32.2 TEST REQUIREMENTS / LIMITS

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

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

**Part 90; PRIVATE LAND MOBILE RADIO SERVICES**

**Subpart R—Regulations Governing the Licensing and Use of Frequencies in the 763-775 and 793-805 MHz Bands**

**§90.543 – Emission limitations.**

(a) The adjacent channel power (ACP) requirements for transmitters designed for various channel sizes are shown in the following tables. Mobile station requirements apply to handheld, car mounted and control station units. The tables specify a value for the ACP as a function of the displacement from the channel center frequency and measurement bandwidth. In the following tables, "(s)" indicates a swept measurement may be used.

**RSS-140; 4.4 Transmitter unwanted emission limits**

The power of any unwanted emission outside the bands 758-768 MHz and 788-798 MHz shall be attenuated below the transmitter output power P in dBW as follows, where p is the transmitter output power in watts:

For any frequency between 769-775 MHz and 799-806 MHz:

65 + 10 log (p), dB in a 6.25 kHz band for mobile and portable/hand-held equipment

For any frequency between 775-788 MHz, above 806 MHz, and below 758 MHz: 43 + 10 log (p), dB in a bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency bands 758-768 MHz and 788-798 MHz, a resolution bandwidth of 30 kHz may be employed.

In addition, the equivalent isotropically radiated power (e.i.r.p.) of all emissions, including harmonics in the band 1559-1610 MHz, shall not exceed −70 dBW/MHz for wideband emissions, and −80 dBW/kHz for discrete emissions of less than 700 Hz bandwidth.

## 5.32.3 TEST PROTOCOL

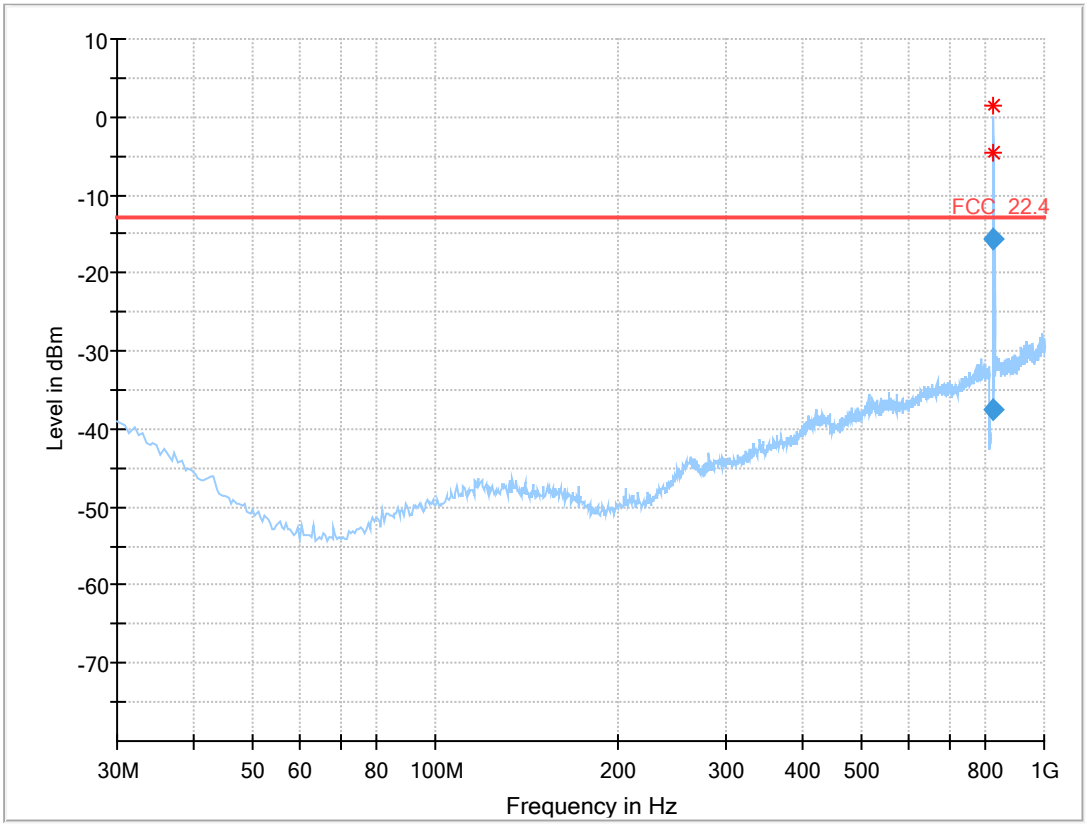
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

| Radio Technology | Channel | Detector | Trace | Resolution Bandwidth /kHz | Frequency /MHz | Peak Value /dBm | Limit /dBm | Margin to Limit /dB |
|---|---|---|---|---|---|---|---|---|
| CAT-M1 eFDD 26 | low | rms | maxhold | 100 | 813.0 | -38.4 | -13 | 25.4 |
| CAT-M1 eFDD 26 | low | rms | maxhold | 20 | 814.0 | -16.3 | -13 | 3.3 |
| CAT-M1 eFDD 26 | mid | rms | maxhold | - | - | - | -13 | >20 |
| CAT-M1 eFDD 26 | high | rms | maxhold | 20 | 824.0 | -15.8 | -13 | 2.8 |
| CAT-M1 eFDD 26 | high | rms | maxhold | 100 | 825.0 | -37.4 | -13 | 24.4 |

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

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

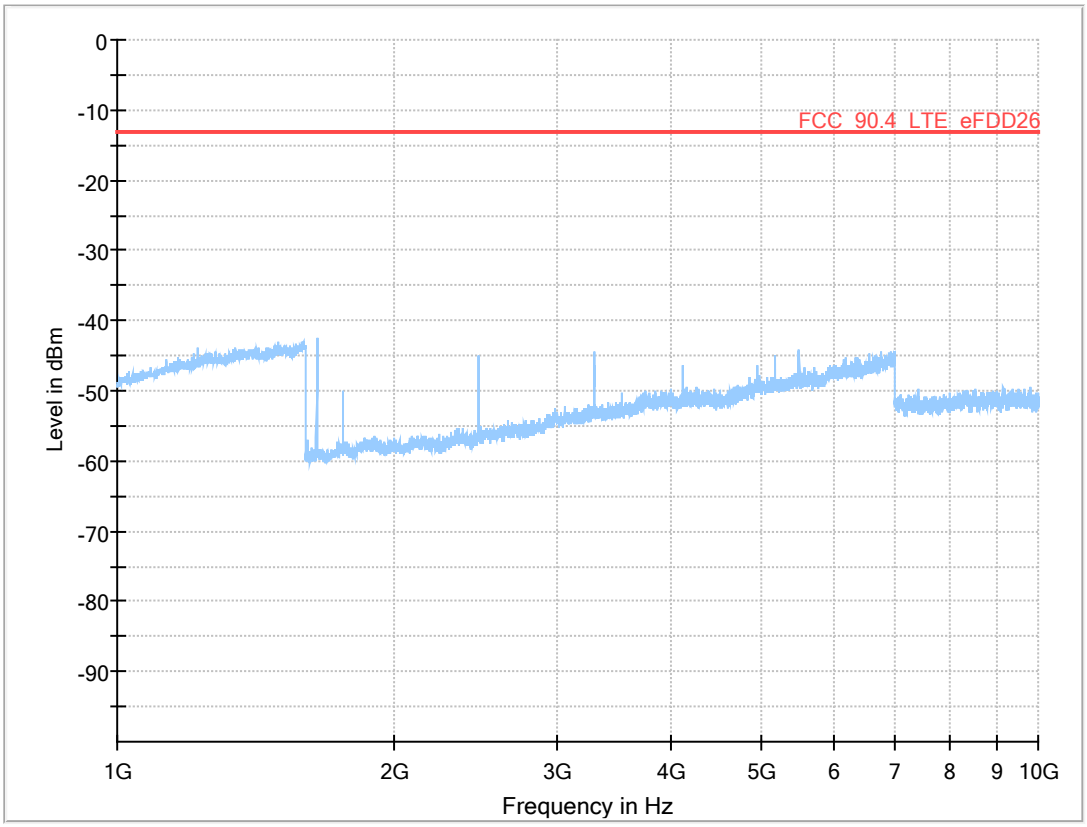
Technology = CAT-M1, Radio Technology = eFDD 26, Operating Frequency = high channel (S02_AF01)
30 MHz - 1 GHz




## Final_Result

| Frequency (MHz) | RMS (dBm) | Limit (dBm) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 824.006000 | -15.75 | -13.00 | 2.75 | 1000.0 | 20.000 | 113.0 | H | 15.0 | -63.0 |
| 825.000000 | -37.42 | -13.00 | 24.42 | 1000.0 | 100.000 | 109.0 | H | 22.0 | -63.0 |

1 GHz - 10 GHz




## Final_Result

| Frequency (MHz) | RMS (dBm) | Limit (dBm) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Elevation (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

## 5.32.5 TEST EQUIPMENT USED

- Radiated Emissions FAR: for measurements above 1GHz
- Radiated Emissions SAC: for measurements up to 1GHz in a semi anechoic room

## 5.33 EMISSION AND OCCUPIED BANDWIDTH

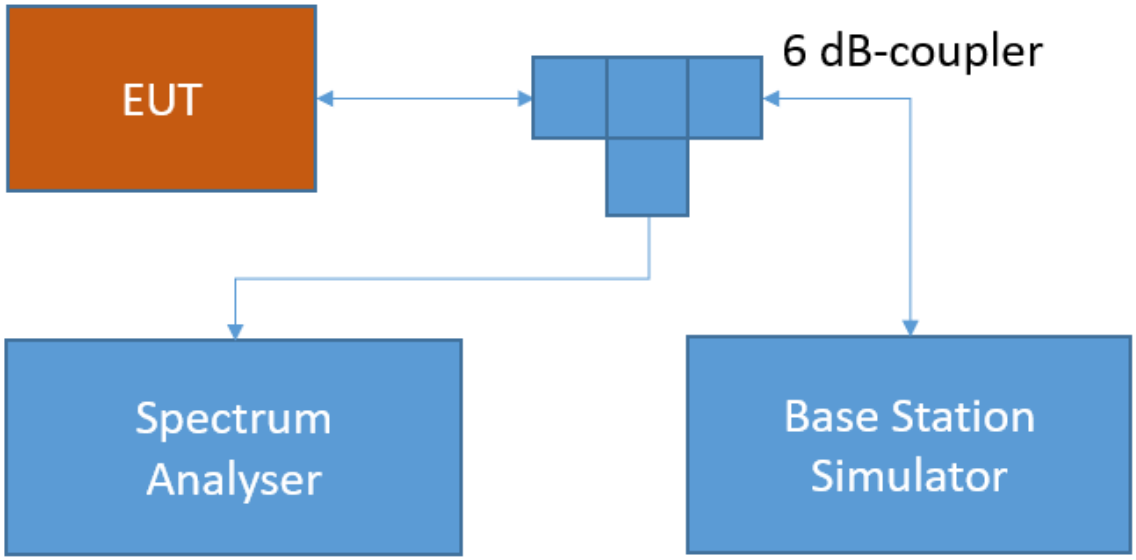
Standard **FCC PART 90 Subpart S**

**The test was performed according to:**
ANSI C63.26: 2015; 5.4.3 (relative meas. Procedure [26dB for GSM, EGDE, WCDMA, HSDPA, HSUPA]) 5.4.4 (Power bandwidth (99%))

### 5.33.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission test case per FCC §2.1049 and RSS-GEN 6.7. The limit and the requirements come from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

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




Test Setup FCC / ISED Cellular;
Emission and occupied bandwidth

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

## 5.33.2 TEST REQUIREMENTS / LIMITS

**FCC Part 2.1049; Occupied Bandwidth:**

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

(h) Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

(i) Transmitters designed for other types of modulation—when modulated by an appropriate signal of sufficient amplitude to be representative of the type of service in which used. A description of the input signal should be supplied.

**RSS-GEN; 6.7 Occupied Bandwidth**

The emission bandwidth (×dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated × dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3× the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3×RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.
The difference between the two recorded frequencies is the 99% occupied bandwidth.

## 5.33.3 TEST PROTOCOL

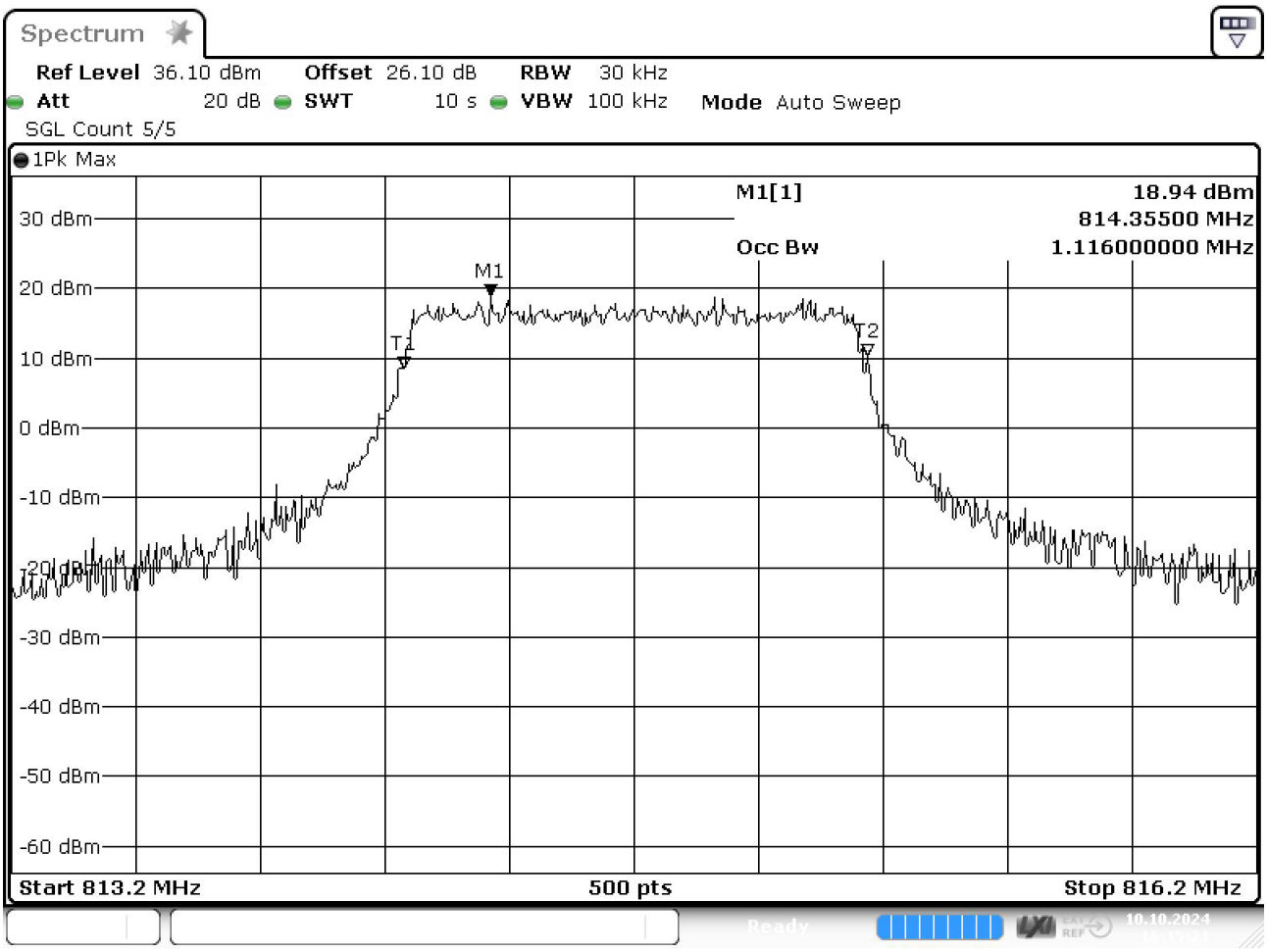
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

| Technology | Radio Technology | Channel | Ressource Blocks | Bandwidth [MHz] | Nominal BW [MHz] | 26 dB BW [kHz] | 99 % BW [kHz] |
|---|---|---|---|---|---|---|---|
| CAT-M1 | eFDD 26 QPSK | low | 6 | 1.4 | 1.4 | - | 1116.0 |
| CAT-M1 | eFDD 26 QPSK | mid | 6 | 1.4 | 1.4 | - | 1110.0 |
| CAT-M1 | eFDD 26 QPSK | high | 6 | 1.4 | 1.4 | - | 1116.0 |
| CAT-M1 | eFDD 26 16QAM | low | 5 | 1.4 | 1.4 | - | 954.0 |
| CAT-M1 | eFDD 26 16QAM | mid | 5 | 1.4 | 1.4 | - | 954.0 |
| CAT-M1 | eFDD 26 16QAM | high | 5 | 1.4 | 1.4 | - | 954.0 |

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

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

Technology = CAT-M1, Radio Technology = eFDD 26 QPSK,
Operating Frequency = low channel
(S01_AA01)

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## 5.33.5 TEST EQUIPMENT USED

- Radio Lab

## 5.34 BAND EDGE

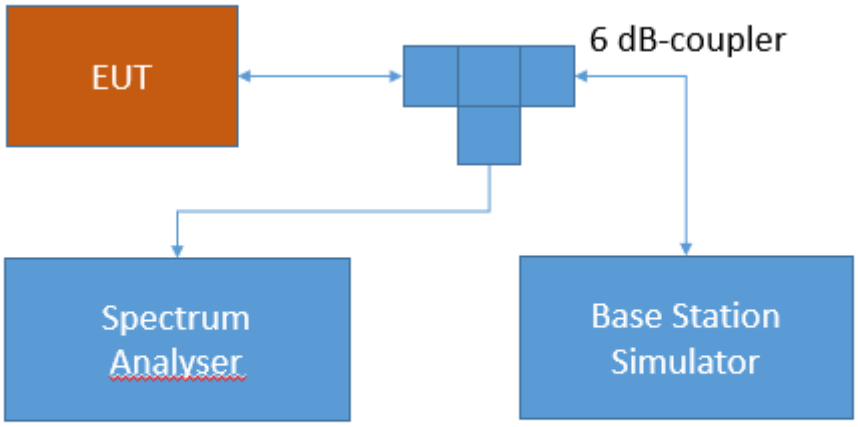
Standard **FCC PART 90 Subpart S**

**The test was performed according to:**
ANSI C63.26: 2015; 5.7.3

### 5.34.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission test case per § 2. 1051 and RSS-GEN 6.13. The limit comes from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

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




Test Setup FCC Part 22/24/27/90 Cellular;
Band edge compliance

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

### 5.34.2 TEST REQUIREMENTS / LIMITS

**FCC Part 2.1051; Measurement required: Spurious emissions at antenna terminal:**

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

**Part 90; PRIVATE LAND MOBILE RADIO SERVICES**

**Subpart R—Regulations Governing the Licensing and Use of Frequencies in the 763-775 and 793-805 MHz Bands**

**§90.543 – Emission limitations.**

(a) The adjacent channel power (ACP) requirements for transmitters designed for various channel sizes are shown in the following tables. Mobile station requirements apply to handheld, car mounted and control station units. The tables specify a value for the ACP as a function of the displacement from the channel center frequency and measurement bandwidth. In the following tables, "(s)" indicates a swept measurement may be used.

**RSS-140; 4.4 Transmitter unwanted emission limits**

The power of any unwanted emission outside the bands 758-768 MHz and 788-798 MHz shall be attenuated below the transmitter output power P in dBW as follows, where p is the transmitter output power in watts:

For any frequency between 769-775 MHz and 799-806 MHz:

65 + 10 log (p), dB in a 6.25 kHz band for mobile and portable/hand-held equipment

For any frequency between 775-788 MHz, above 806 MHz, and below 758 MHz: 43 + 10 log (p), dB in a bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency bands 758-768 MHz and 788-798 MHz, a resolution bandwidth of 30 kHz may be employed.

In addition, the equivalent isotropically radiated power (e.i.r.p.) of all emissions, including harmonics in the band 1559-1610 MHz, shall not exceed −70 dBW/MHz for wideband emissions, and −80 dBW/kHz for discrete emissions of less than 700 Hz bandwidth.

## 5.34.3 TEST PROTOCOL

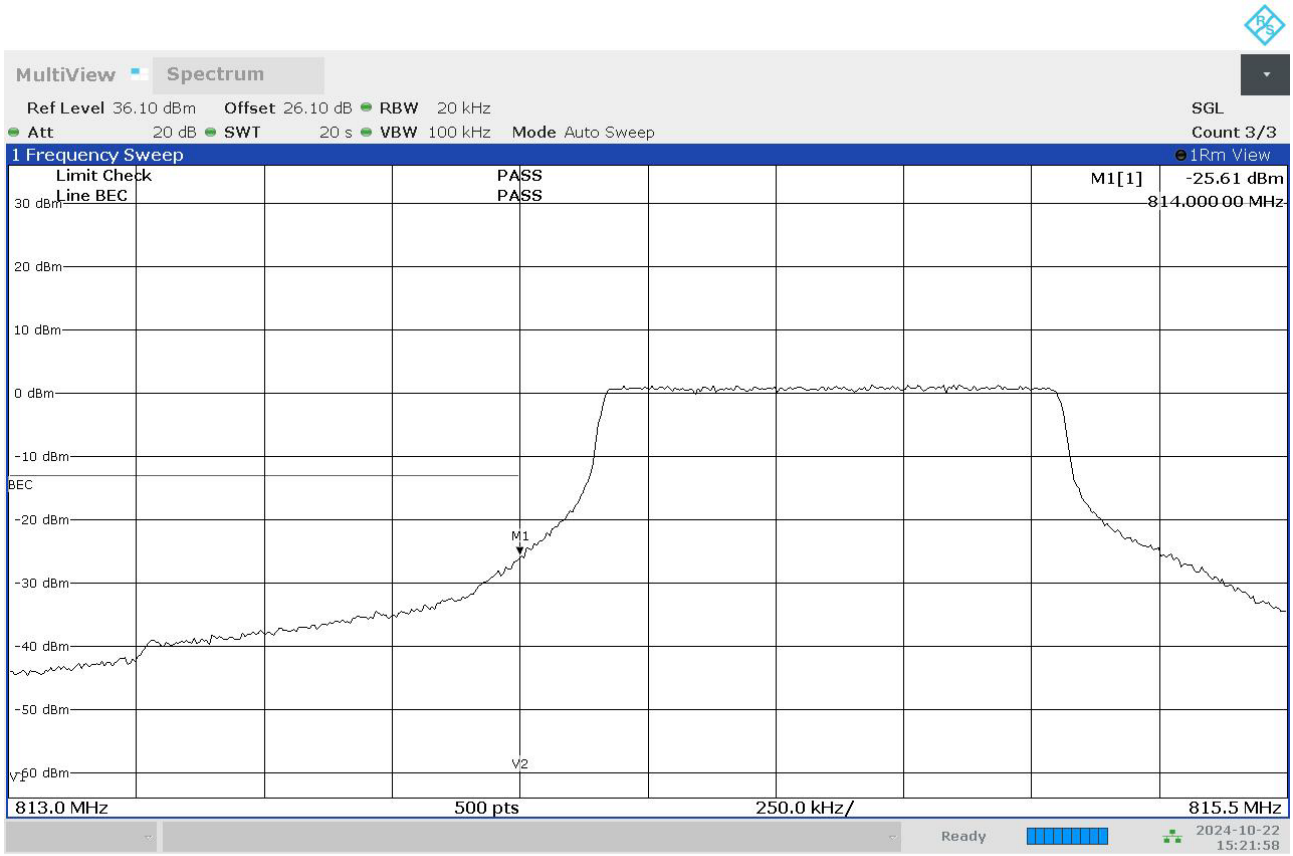
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

| Technology | Radio Technology | Channel | Ressource Blocks | Bandwidth [MHz] | RMS [dBm] | Limit /dBm | Margin to Limit /dB |
|---|---|---|---|---|---|---|---|
| CAT-M1 | eFDD 26 QPSK | low | 6 | 1.4 | -27.2 | -13 | 14.2 |
| CAT-M1 | eFDD 26 QPSK | high | 6 | 1.4 | -27.8 | -13 | 14.8 |
| CAT-M1 | eFDD 26 16QAM | low | 5 | 1.4 | -25.6 | -13 | 12.6 |
| CAT-M1 | eFDD 26 16QAM | high | 5 | 1.4 | -31.4 | -13 | 18.4 |

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

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

Technology = CAT-M1, Radio Technology = eFDD 26 16QAM,
Operating Frequency = low channel
(S01_AF01)

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## 5.34.5 TEST EQUIPMENT USED

- Radio Lab

## 5.35 PEAK TO AVERAGE RATIO

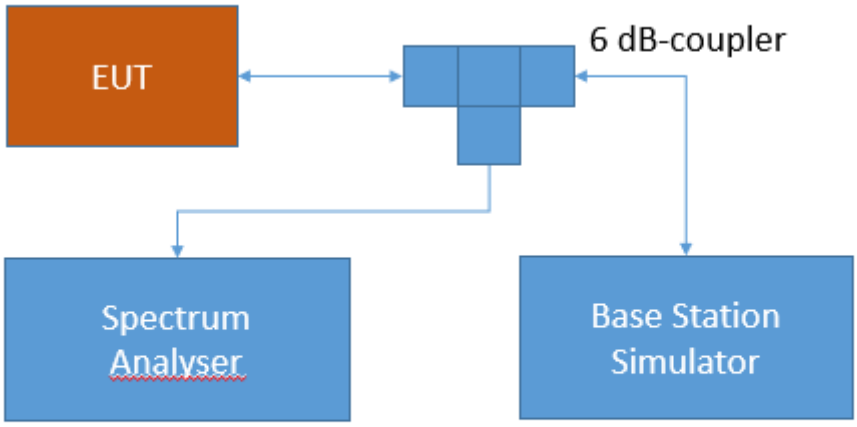
Standard **FCC PART 90 Subpart S**

**The test was performed according to:**
ANSI C63.26: 2015; 5.2.3.4 (broadband noise-like signal using CCDF [LTE, CAT-M1, NB-IoT])
5.2.6 (alternative procedure for PAPR [GSM, EDGE, WCDMA, HSDPA, HSUPA])

### 5.35.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance of the EUT to the peak-to-average limits and requirements of the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

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




Test Setup FCC Part 22/24/27/90 Cellular;
Peak-average ratio

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams. The internal CCDF (complementary cumulative distribution function) of the spectrum analyser is used for this measurement

## 5.35.2 TEST REQUIREMENTS / LIMITS

**Part 90; PRIVATE LAND MOBILE RADIO SERVICES**

**Subpart S—Regulations Governing Licensing and Use of Frequencies in the 806-824, 851-869, 896-901, and 935-940 MHz Bands**

**§90.635 Limitations on power and antenna height.**

(b) The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).

**RSS-140; 4.3 Transmitter Output Power**

The equivalent radiated power (e.r.p.) for control and mobile equipment shall not exceed 30 W. The e.r.p. for portable equipment including handheld devices shall not exceed 3 W.

## 5.35.3 TEST PROTOCOL

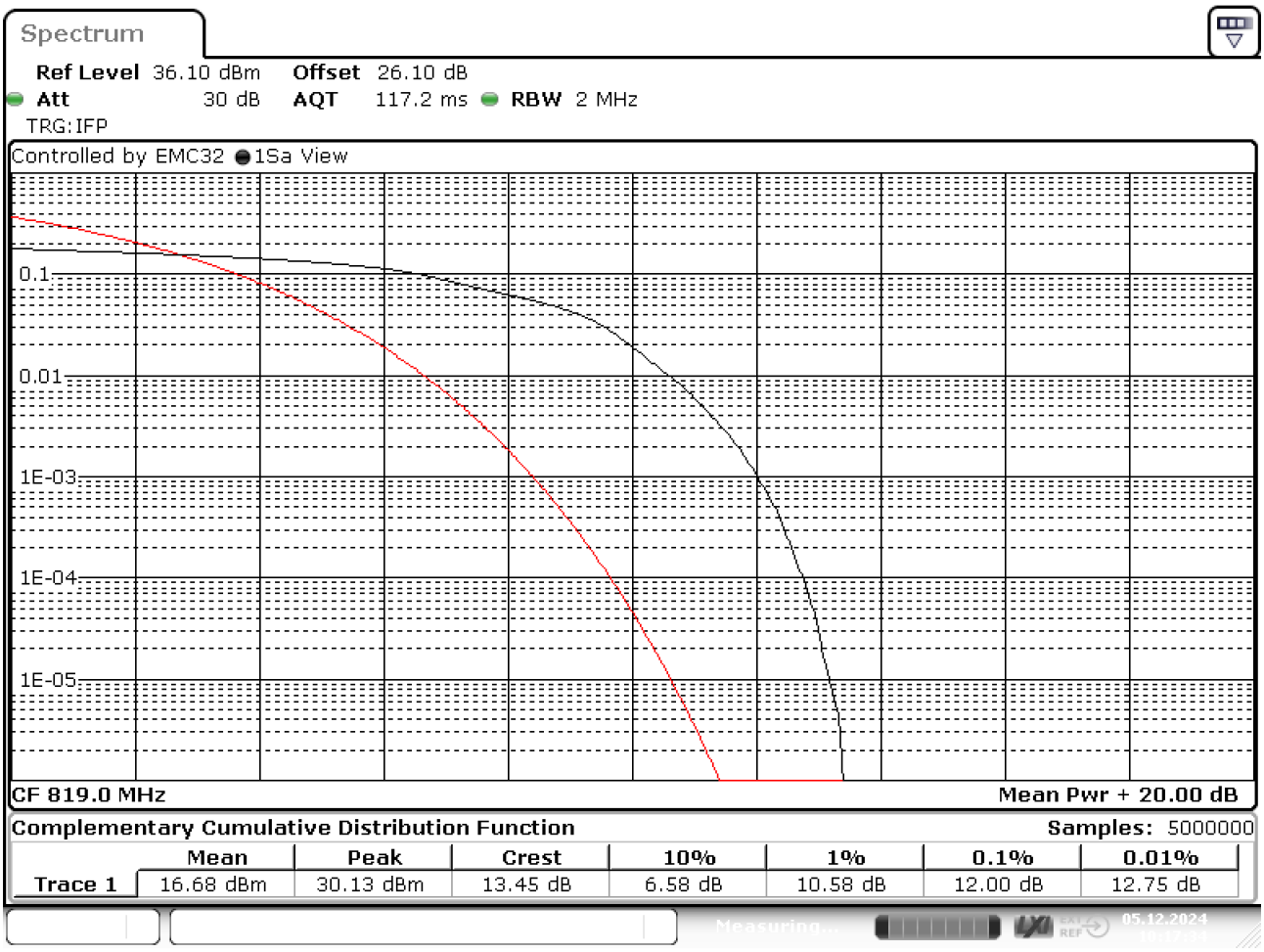
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

| Technology | Radio Technology | Channel | Ressource Blocks | Bandwidth [MHz] | Peak to Average Ratio | Limit (IC) [dB] |
|---|---|---|---|---|---|---|
| CAT-M1 | eFDD 26 QPSK | low | 6 | 1.4 | 9.6 | 13 |
| CAT-M1 | eFDD 26 QPSK | mid | 6 | 1.4 | 9.7 | 13 |
| CAT-M1 | eFDD 26 QPSK | high | 6 | 1.4 | 9.7 | 13 |
| CAT-M1 | eFDD 26 16QAM | low | 5 | 1.4 | 10.0 | 13 |
| CAT-M1 | eFDD 26 16QAM | mid | 5 | 1.4 | 12.0 | 13 |
| CAT-M1 | eFDD 26 16QAM | high | 5 | 1.4 | 10.1 | 13 |

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

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

Technology = CAT-M1, Radio Technology = eFDD 26 16QAM,
Operating Frequency = mid channel
(S01_AF02)

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## 5.35.5 TEST EQUIPMENT USED

- Radio Lab

# 6 TEST EQUIPMENT

## 6.1 TEST EQUIPMENT HARDWARE

1 Radiated Emissions FAR
Radiated Emissions in a fully anechoic room

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---|---|---|---|---|---|---|
| 1.1 | Opus10 TPR (8253.00) | T/P Logger 13 | Lufft Mess- und Regeltechnik GmbH | 13936 | 2023-12 | 2025-12 |
| 1.2 | Innco Systems CO3000 | Controller for bore sight mast FAC | innco systems GmbH | CO3000/1460/54740522/P | N/A | N/A |
| 1.3 | AMF-7D00101800-30-10P-R | Broadband Amplifier 100 MHz - 18 GHz | Miteq | | N/A | N/A |
| 1.4 | 5HC2700/12750-1.5-KK | High Pass Filter | Trilithic | 9942012 | N/A | N/A |
| 1.5 | ASP 1.2/1.8-10 kg | Antenna Mast | Maturo GmbH | - | N/A | N/A |
| 1.6 | Anechoic Chamber 03 | FAR, 8.80m x 4.60m x 4.05m (l x w x h) | Albatross Projects | P26971-647-001-PRB | N/A | N/A |
| 1.7 | Fluke 177 | Digital Multimeter 03 (Multimeter) | Fluke Europe B.V. | 86670383 | 2023-08 | 2025-08 |
| 1.8 | JS4-18002600-32-5P | Broadband Amplifier 18 GHz - 26 GHz | Miteq | 849785 | N/A | N/A |
| 1.9 | FSW43 | Spectrum Analyzer | Rohde & Schwarz GmbH & Co. KG | 103779 | 2023-04 | 2025-04 |
| 1.10 | 3160-09 | Standard Gain / Pyramidal Horn Antenna 26.5 GHz | EMCO Elektronic GmbH | 00083069 | N/A | N/A |
| 1.11 | 4HC1600/12750-1.5-KK | High Pass Filter | Trilithic | 9942011 | N/A | N/A |
| 1.12 | MA3000/0800-XP-ET-compact | Bore Sight Antenna Mast | innco systems GmbH | 9210522 | N/A | N/A |
| 1.13 | TT 1.5 WI | Turn Table | Maturo GmbH | - | N/A | N/A |
| 1.14 | VLFX-650+ | Low Pass Filter DC650 MHz | Mini-Circuits | 15542 | N/A | N/A |
| 1.15 | 5HC3500/18000-1.2-KK | High Pass Filter | Trilithic | 200035008 | N/A | N/A |
| 1.16 | Opus 20 THI (8120.00) | ThermoHygro Datalogger | Lufft Mess- und Regeltechnik GmbH | 115.0318.0802.033 | 2023-08 | 2025-08 |
| 1.17 | TD1.5-10kg | EUT Tilt Device (Rohacell) | Maturo GmbH | TD1.5-10kg/024/3790709 | N/A | N/A |
| 1.18 | AFS42-00101800-25-S-42 | Broadband Amplifier 25 MHz - 18 GHz | Miteq | 2035324 | N/A | N/A |
| 1.19 | HF 906 | Double-ridged horn | Rohde & Schwarz | 357357/002 | 2022-07 | 2025-07 |
| 1.20 | JUN-AIR Mod. 6-15 | Air Compressor | JUN-AIR Deutschland GmbH | 612582 | N/A | N/A |

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---|---|---|---|---|---|---|
| 1.21 | CS-RUB6 | Rubidium Frequency Standard | Rohde & Schwarz GmbH & Co. KG | 100321 | 2023-10 | 2025-10 |
| 1.22 | CMW500 | Callbox OIL-RE, SUA-160 MHz | Rohde & Schwarz GmbH & Co. KG | 167766-By | 2022-05 | 2025-05 |
| 1.23 | CMW500 | Callbox OIL-RE, SUA-160 MHz | Rohde & Schwarz GmbH & Co. KG | 168927-cv | 2023-08 | 2026-08 |

The calibration interval is the time interval between "Last Calibration" and "Calibration Due"

2 Radiated Emissions SAC
Radiated emission tests up to 1 GHz in a semi anechoic room

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---|---|---|---|---|---|---|
| 2.1 | N5000/NP | Filter for EUT, 2 Lines, 250 V, 16 A | ETS-LINDGREN | 241515 | N/A | N/A |
| 2.2 | Opus10 TPR (8253.00) | T/P Logger 13 | Lufft Mess- und Regeltechnik GmbH | 13936 | 2023-12 | 2025-12 |
| 2.3 | ESW44 | EMI Receiver / Spectrum Analyzer | Rohde & Schwarz GmbH & Co. KG | 101603 | 2024-03 | 2026-03 |
| 2.4 | Anechoic Chamber 01 | SAC/FAR, 10.58 m x 6.38 m x 6.00 m | Frankonia Germany EMC Solution GmbH | none | N/A | N/A |
| 2.5 | Chase CBL6111C + INMET 64671 18N-6dB | Hybrid Antenna with 6dB Attenuator | Chase | 2624 | 2023-03 | 2026-03 |
| 2.6 | Fluke 177 | Digital Multimeter 03 (Multimeter) | Fluke Europe B.V. | 86670383 | 2023-08 | 2025-08 |
| 2.7 | Opus10 THI (8152.00) | T/H Logger 10 | Lufft Mess- und Regeltechnik GmbH | 12488 | 2023-12 | 2025-12 |
| 2.8 | EP 1200/B, NA/B1 | AC Source, Amplifier with integrated variable Oscillator | Spitzenberger & Spies GmbH & Co. KG | B6278 | N/A | N/A |
| 2.9 | DS 420S | Turn Table 2 m diameter | HD GmbH | 420/573/99 | N/A | N/A |
| 2.10 | CS-RUB6 | Rubidium Frequency Standard | Rohde & Schwarz GmbH & Co. KG | 100321 | 2023-10 | 2025-10 |
| 2.11 | AM 4.0 | Antenna Mast 4 m | Maturo GmbH | AM4.0/180/11920513 | N/A | N/A |
| 2.12 | SB4-100.OLD20-3T/10 Airwin 2 x 1.5 kW | Air compressor (oil-free) | airWin Kompressoren UG | 901/00503 | N/A | N/A |

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---|---|---|---|---|---|---|
| 2.13 | CMW500 | Callbox OIL-RE, SUA-160 MHz | Rohde & Schwarz GmbH & Co. KG | 167766-By | 2022-05 | 2025-05 |
| 2.14 | CMW500 | Callbox OIL-RE, SUA-160 MHz | Rohde & Schwarz GmbH & Co. KG | 168927-cv | 2023-08 | 2026-08 |

The calibration interval is the time interval between "Last Calibration" and "Calibration Due"

3 Radio Lab
Conducted Radio Test Lab

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---|---|---|---|---|---|---|
| 3.1 | 1575 | Broadband Resistive Power Divider DC to 40 GHz | API Weinschel, Inc. | 4070 | N/A | N/A |
| 3.2 | FSV30 | Signal Analyzer 10 Hz - 30 GHz | Rohde & Schwarz | 103005 | 2023-08 | 2025-08 |
| 3.3 | Fluke 177 | Digital Multimeter 03 (Multimeter) | Fluke Europe B.V. | 86670383 | 2023-08 | 2025-08 |
| 3.4 | Temperature Chamber Weiss WT 64/75 | Temperature Chamber Vötsch 03 | Weiss | 59226066700010 | 2024-07 | 2026-07 |
| 3.5 | A8455-4 | 4 Way Power Divider (SMA) | - | - | N/A | N/A |
| 3.6 | FSW43 | Signal Analyser | Rohde & Schwarz GmbH & Co. KG | 102013 | 2023-07 | 2025-07 |
| 3.7 | Opus10 THI (8152.00) | T/H Logger 03 | Lufft Mess- und Regeltechnik GmbH | 7482 | 2023-12 | 2025-12 |
| 3.8 | CS-RUB6 | Rubidium Frequency Standard | Rohde & Schwarz GmbH & Co. KG | 100321 | 2023-10 | 2025-10 |
| 3.9 | CMW500 | Callbox OIL-RE, SUA-160 MHz | Rohde & Schwarz GmbH & Co. KG | 167766-By | 2022-05 | 2025-05 |
| 3.10 | CMW500 | Callbox OIL-RE, SUA-160 MHz | Rohde & Schwarz GmbH & Co. KG | 168927-cv | 2023-08 | 2026-08 |

The calibration interval is the time interval between "Last Calibration" and "Calibration Due"

## 6.2 TEST EQUIPMENT SOFTWARE

| **Semi-Anechoic Chamber:** | |
|---|---|
| Software | Version |
| EMC32 Measurement Software | 10.60.10 |
| INNCO Mast Controller | 1.02.62 |
| MATURO Mast Controller | 12.19 |
| MATURO Turn-Table Controller | 30.10 |
| **Fully-Anechoic Chamber:** | |
| Software | Version |
| EMC32 Measurement Software | 10.60.10 |
| MATURO Turn-Unit Controller | 11.10 |
| MATURO Mast Controller | 12.10 |
| MATURO Turntable Controller | 12.11 |
| INNCO Mast Controller | 1.02.62 |
| **FSW43:** | |
| Software | Version |
| Instrument Firmware | 5.21 |
| **FSV30:** | |
| Software | Version |
| Instrument Firmware | 3.70 |
| **CMW500:** | |
| Software | Version |
| Instrument Firmware | V4.0.140 |

# 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 insertion loss ESH3-Z5 | cable loss (incl. 10 dB atten-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**

$U_{LISN}$ (dB µV) = U (dB µV) + 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 HFH-Z2) | Corr. | cable loss 1 (inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit) | cable loss 4 (to receiver) | distance corr. (-40 dB/ decade) | $d_{Limit}$ (meas. distance (limit) | $d_{used}$ (meas. distance (used) |
|---|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB | m | m |
| 0.009 | 20.50 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.01 | 20.45 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.015 | 20.37 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.02 | 20.36 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.025 | 20.38 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.03 | 20.32 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.05 | 20.35 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.08 | 20.30 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.1 | 20.20 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.2 | 20.17 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.3 | 20.14 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.49 | 20.12 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.490001 | 20.12 | -39.6 | 0.1 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 0.5 | 20.11 | -39.6 | 0.1 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 0.8 | 20.10 | -39.6 | 0.1 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 1 | 20.09 | -39.6 | 0.1 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 2 | 20.08 | -39.6 | 0.1 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 3 | 20.06 | -39.6 | 0.1 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 4 | 20.05 | -39.5 | 0.2 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 5 | 20.05 | -39.5 | 0.2 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 6 | 20.02 | -39.5 | 0.2 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 8 | 19.95 | -39.5 | 0.2 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 10 | 19.83 | -39.4 | 0.2 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 12 | 19.71 | -39.4 | 0.2 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 14 | 19.54 | -39.4 | 0.2 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 16 | 19.53 | -39.3 | 0.3 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 18 | 19.50 | -39.3 | 0.3 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 20 | 19.57 | -39.3 | 0.3 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 22 | 19.61 | -39.3 | 0.3 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 24 | 19.61 | -39.3 | 0.3 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 26 | 19.54 | -39.3 | 0.3 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 28 | 19.46 | -39.2 | 0.3 | 0.1 | 0.3 | 0.1 | -40 | 30 | 3 |
| 30 | 19.73 | -39.1 | 0.4 | 0.1 | 0.3 | 0.1 | -40 | 30 | 3 |

**Sample calculation**

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (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 * LOG ($d_{Limit}$/ $d_{used}$)
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)

**($d_{Limit}$ = 3 m)**

| Frequency | AF R&S HL562 | Corr. | cable loss 1 (inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit) | cable loss 4 (to receiver) | distance corr. (-20 dB/ decade) | $d_{Limit}$ (meas. distance (limit) | $d_{used}$ (meas. distance (used) |
|---|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB | m | m |
| 30 | 18.6 | 0.6 | 0.29 | 0.04 | 0.23 | 0.02 | 0.0 | 3 | 3 |
| 50 | 6.0 | 0.9 | 0.39 | 0.09 | 0.32 | 0.08 | 0.0 | 3 | 3 |
| 100 | 9.7 | 1.2 | 0.56 | 0.14 | 0.47 | 0.08 | 0.0 | 3 | 3 |
| 150 | 7.9 | 1.6 | 0.73 | 0.20 | 0.59 | 0.12 | 0.0 | 3 | 3 |
| 200 | 7.6 | 1.9 | 0.84 | 0.21 | 0.70 | 0.11 | 0.0 | 3 | 3 |
| 250 | 9.5 | 2.1 | 0.98 | 0.24 | 0.80 | 0.13 | 0.0 | 3 | 3 |
| 300 | 11.0 | 2.3 | 1.04 | 0.26 | 0.89 | 0.15 | 0.0 | 3 | 3 |
| 350 | 12.4 | 2.6 | 1.18 | 0.31 | 0.96 | 0.13 | 0.0 | 3 | 3 |
| 400 | 13.6 | 2.9 | 1.28 | 0.35 | 1.03 | 0.19 | 0.0 | 3 | 3 |
| 450 | 14.7 | 3.1 | 1.39 | 0.38 | 1.11 | 0.22 | 0.0 | 3 | 3 |
| 500 | 15.6 | 3.2 | 1.44 | 0.39 | 1.20 | 0.19 | 0.0 | 3 | 3 |
| 550 | 16.3 | 3.5 | 1.55 | 0.46 | 1.24 | 0.23 | 0.0 | 3 | 3 |
| 600 | 17.2 | 3.5 | 1.59 | 0.43 | 1.29 | 0.23 | 0.0 | 3 | 3 |
| 650 | 18.1 | 3.6 | 1.67 | 0.34 | 1.35 | 0.22 | 0.0 | 3 | 3 |
| 700 | 18.5 | 3.6 | 1.67 | 0.42 | 1.41 | 0.15 | 0.0 | 3 | 3 |
| 750 | 19.1 | 4.1 | 1.87 | 0.54 | 1.46 | 0.25 | 0.0 | 3 | 3 |
| 800 | 19.6 | 4.1 | 1.90 | 0.46 | 1.51 | 0.25 | 0.0 | 3 | 3 |
| 850 | 20.1 | 4.4 | 1.99 | 0.60 | 1.56 | 0.27 | 0.0 | 3 | 3 |
| 900 | 20.8 | 4.7 | 2.14 | 0.60 | 1.63 | 0.29 | 0.0 | 3 | 3 |
| 950 | 21.1 | 4.8 | 2.22 | 0.60 | 1.66 | 0.33 | 0.0 | 3 | 3 |
| 1000 | 21.6 | 4.9 | 2.23 | 0.61 | 1.71 | 0.30 | 0.0 | 3 | 3 |

**($d_{Limit}$ = 10 m)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30 | 18.6 | -9.9 | 0.29 | 0.04 | 0.23 | 0.02 | -10.5 | 10 | 3 |
| 50 | 6.0 | -9.6 | 0.39 | 0.09 | 0.32 | 0.08 | -10.5 | 10 | 3 |
| 100 | 9.7 | -9.2 | 0.56 | 0.14 | 0.47 | 0.08 | -10.5 | 10 | 3 |
| 150 | 7.9 | -8.8 | 0.73 | 0.20 | 0.59 | 0.12 | -10.5 | 10 | 3 |
| 200 | 7.6 | -8.6 | 0.84 | 0.21 | 0.70 | 0.11 | -10.5 | 10 | 3 |
| 250 | 9.5 | -8.3 | 0.98 | 0.24 | 0.80 | 0.13 | -10.5 | 10 | 3 |
| 300 | 11.0 | -8.1 | 1.04 | 0.26 | 0.89 | 0.15 | -10.5 | 10 | 3 |
| 350 | 12.4 | -7.9 | 1.18 | 0.31 | 0.96 | 0.13 | -10.5 | 10 | 3 |
| 400 | 13.6 | -7.6 | 1.28 | 0.35 | 1.03 | 0.19 | -10.5 | 10 | 3 |
| 450 | 14.7 | -7.4 | 1.39 | 0.38 | 1.11 | 0.22 | -10.5 | 10 | 3 |
| 500 | 15.6 | -7.2 | 1.44 | 0.39 | 1.20 | 0.19 | -10.5 | 10 | 3 |
| 550 | 16.3 | -7.0 | 1.55 | 0.46 | 1.24 | 0.23 | -10.5 | 10 | 3 |
| 600 | 17.2 | -6.9 | 1.59 | 0.43 | 1.29 | 0.23 | -10.5 | 10 | 3 |
| 650 | 18.1 | -6.9 | 1.67 | 0.34 | 1.35 | 0.22 | -10.5 | 10 | 3 |
| 700 | 18.5 | -6.8 | 1.67 | 0.42 | 1.41 | 0.15 | -10.5 | 10 | 3 |
| 750 | 19.1 | -6.3 | 1.87 | 0.54 | 1.46 | 0.25 | -10.5 | 10 | 3 |
| 800 | 19.6 | -6.3 | 1.90 | 0.46 | 1.51 | 0.25 | -10.5 | 10 | 3 |
| 850 | 20.1 | -6.0 | 1.99 | 0.60 | 1.56 | 0.27 | -10.5 | 10 | 3 |
| 900 | 20.8 | -5.8 | 2.14 | 0.60 | 1.63 | 0.29 | -10.5 | 10 | 3 |
| 950 | 21.1 | -5.6 | 2.22 | 0.60 | 1.66 | 0.33 | -10.5 | 10 | 3 |
| 1000 | 21.6 | -5.6 | 2.23 | 0.61 | 1.71 | 0.30 | -10.5 | 10 | 3 |

**Sample calculation**

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (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 = -20 * LOG ($d_{Limit}$/ $d_{used}$)
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 R&S HF907 | Corr. | cable loss 1 (relay + cable inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit, atten-uator & pre-amp) | cable loss 4 (to receiver) | | |
|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | | |
| 1000 | 24.4 | -19.4 | 0.99 | 0.31 | -21.51 | 0.79 | | |
| 2000 | 28.5 | -17.4 | 1.44 | 0.44 | -20.63 | 1.38 | | |
| 3000 | 31.0 | -16.1 | 1.87 | 0.53 | -19.85 | 1.33 | | |
| 4000 | 33.1 | -14.7 | 2.41 | 0.67 | -19.13 | 1.31 | | |
| 5000 | 34.4 | -13.7 | 2.78 | 0.86 | -18.71 | 1.40 | | |
| 6000 | 34.7 | -12.7 | 2.74 | 0.90 | -17.83 | 1.47 | | |
| 7000 | 35.6 | -11.0 | 2.82 | 0.86 | -16.19 | 1.46 | | |

| Frequency | AF R&S HF907 | Corr. | cable loss 1 (relay inside chamber) | cable loss 2 (inside chamber) | cable loss 3 (outside chamber) | cable loss 4 (switch unit, atten-uator & pre-amp) | cable loss 5 (to receiver) | used for FCC 15.247 |
|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB | |
| 3000 | 31.0 | -23.4 | 0.47 | 1.87 | 0.53 | -27.58 | 1.33 | |
| 4000 | 33.1 | -23.3 | 0.56 | 2.41 | 0.67 | -28.23 | 1.31 | |
| 5000 | 34.4 | -21.7 | 0.61 | 2.78 | 0.86 | -27.35 | 1.40 | |
| 6000 | 34.7 | -21.2 | 0.58 | 2.74 | 0.90 | -26.89 | 1.47 | |
| 7000 | 35.6 | -19.8 | 0.66 | 2.82 | 0.86 | -25.58 | 1.46 | |

| Frequency | AF R&S HF907 | Corr. | cable loss 1 (relay inside chamber) | cable loss 2 (High Pass) | cable loss 3 (pre-amp) | cable loss 4 (inside chamber) | cable loss 5 (outside chamber) | cable loss 6 (to receiver) |
|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB | dB |
| 7000 | 35.6 | -57.3 | 0.56 | 1.28 | -62.72 | 2.66 | 0.94 | 1.46 |
| 8000 | 36.3 | -56.3 | 0.69 | 0.71 | -61.49 | 2.84 | 1.00 | 1.53 |
| 9000 | 37.1 | -55.3 | 0.68 | 0.65 | -60.80 | 3.06 | 1.09 | 1.60 |
| 10000 | 37.5 | -56.2 | 0.70 | 0.54 | -61.91 | 3.28 | 1.20 | 1.67 |
| 11000 | 37.5 | -55.3 | 0.80 | 0.61 | -61.40 | 3.43 | 1.27 | 1.70 |
| 12000 | 37.6 | -53.7 | 0.84 | 0.42 | -59.70 | 3.53 | 1.26 | 1.73 |
| 13000 | 38.2 | -53.5 | 0.83 | 0.44 | -59.81 | 3.75 | 1.32 | 1.83 |
| 14000 | 39.9 | -56.3 | 0.91 | 0.53 | -63.03 | 3.91 | 1.40 | 1.77 |
| 15000 | 40.9 | -54.1 | 0.98 | 0.54 | -61.05 | 4.02 | 1.44 | 1.83 |
| 16000 | 41.3 | -54.1 | 1.23 | 0.49 | -61.51 | 4.17 | 1.51 | 1.85 |
| 17000 | 42.8 | -54.4 | 1.36 | 0.76 | -62.36 | 4.34 | 1.53 | 2.00 |
| 18000 | 44.2 | -54.7 | 1.70 | 0.53 | -62.88 | 4.41 | 1.55 | 1.91 |

**Sample calculation**

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (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 EMCO 3160-09 | Corr. | cable loss 1 (inside chamber) | cable loss 2 (pre-amp) | cable loss 3 (inside chamber) | cable loss 4 (switch unit) | cable loss 5 (to 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 (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (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 EMCO 3160-10 | Corr. | cable loss 1 (inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit) | cable loss 4 (to receiver) | distance corr. (-20 dB/ decade) | $d_{Limit}$ (meas. distance (limit) | $d_{used}$ (meas. distance (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 (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (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 * LOG ($d_{Limit}$/ $d_{used}$)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

# 8 MEASUREMENT UNCERTAINTIES

| Test Case(s) | Parameter | Uncertainty |
|---|---|---|
| - Field strength of spurious radiation | Field Strength | ± 5.5 dB |
| - Emission and Occupied Bandwidth | Power<br>Frequency | ± 2.9 dB<br>± 11.2 kHz |
| - RF Output Power<br>- Peak to Average Ratio | Power | ± 2.2 dB |
| - Band Edge Compliance<br>- Spurious Emissions at Antenna Terminal | Power<br>Frequency | ± 2.2 dB<br>± 11.2 kHz |
| - Frequency Stability | Frequency | ± 25 Hz |

# 9 EMISSION AND OCCUPIED BANDWIDTH PHOTO REPORT

Please see separate photo report.

**********END OF TEST REPORT**********