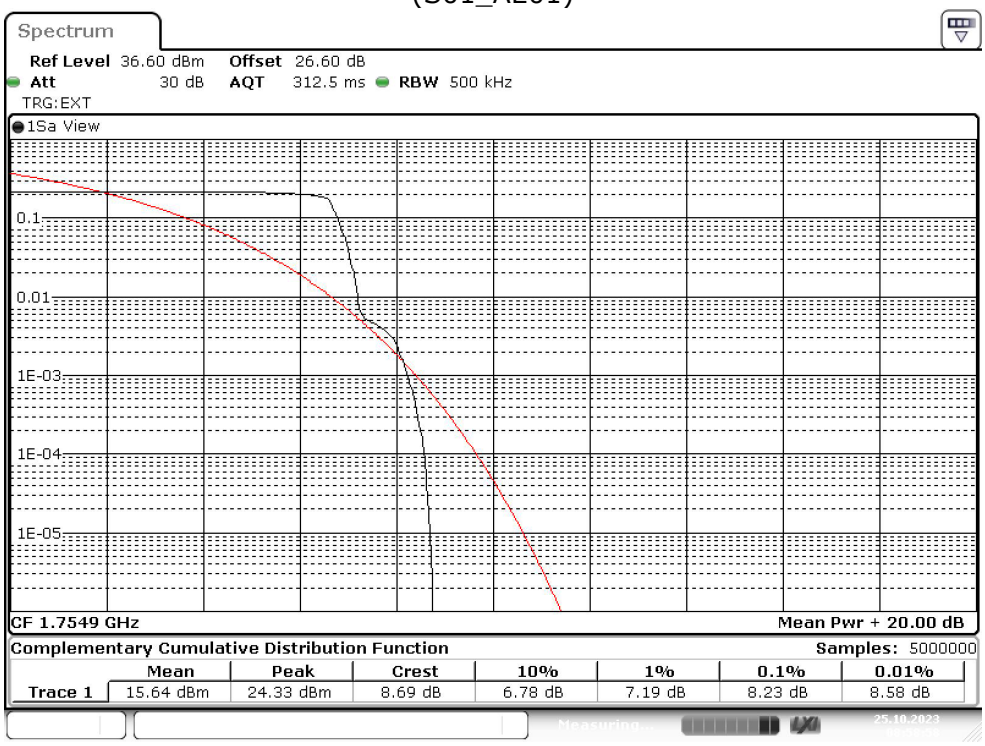
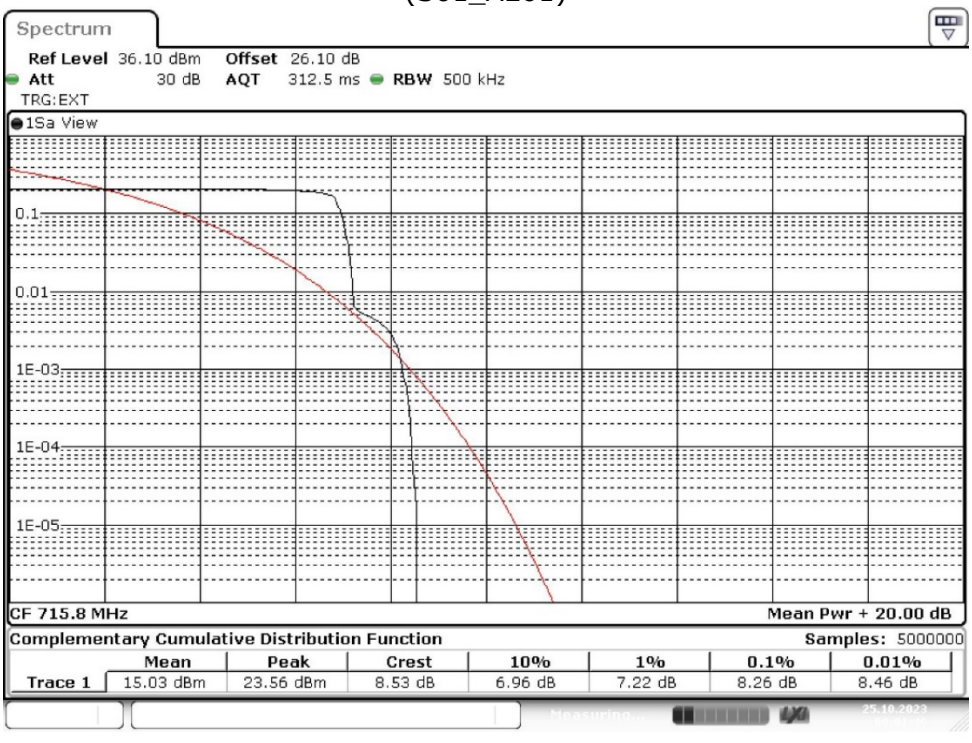
Technology = NB-IoT, Radio Technology = eFDD 4, Operating Frequency = high channel (S01_AE01)



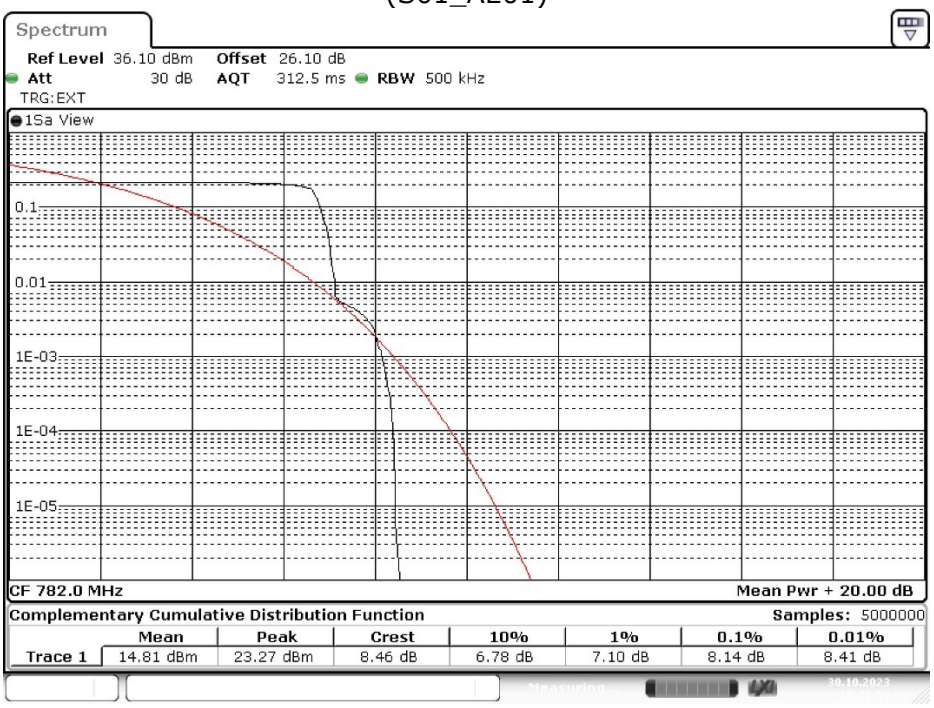
Date: 25.OCT.2023 08:58:58

Technology = NB-IoT, Radio Technology = eFDD 12, Operating Frequency = high channel (S01_AE01)



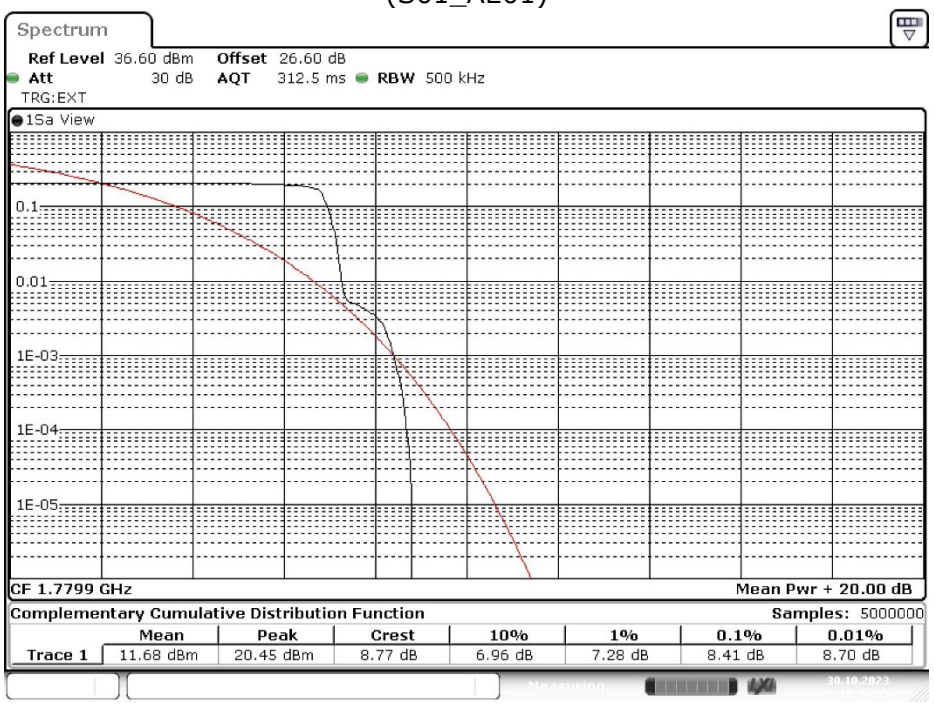
Date: 25.OCT.2023 09:01:49

Technology = NB-IoT, Radio Technology = eFDD 13, Operating Frequency = mid channel (S01_AE01)



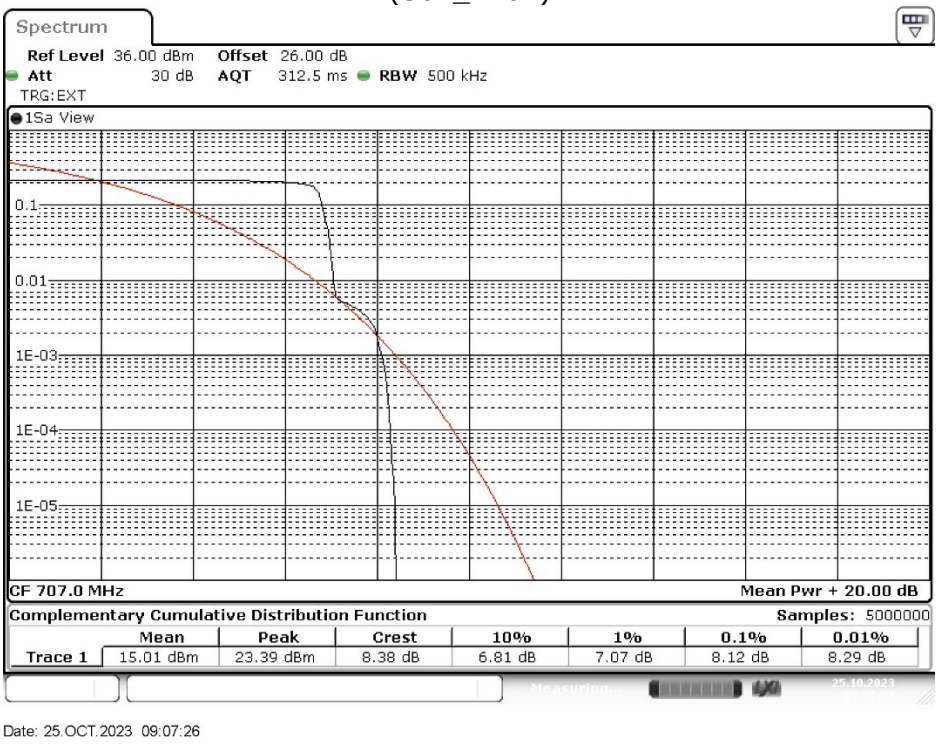
Date: 30.OCT.2023 10:46:59

Technology = NB-IoT, Radio Technology = eFDD 66, Operating Frequency = high channel (S01_AE01)



Date: 30.OCT.2023 10:45:05

Technology = NB-IoT, Radio Technology = eFDD 85, Operating Frequency = high channel (S01_AE01)



5.21.5 TEST EQUIPMENT USED

- Radio Lab

5.22 RF OUTPUT POWER

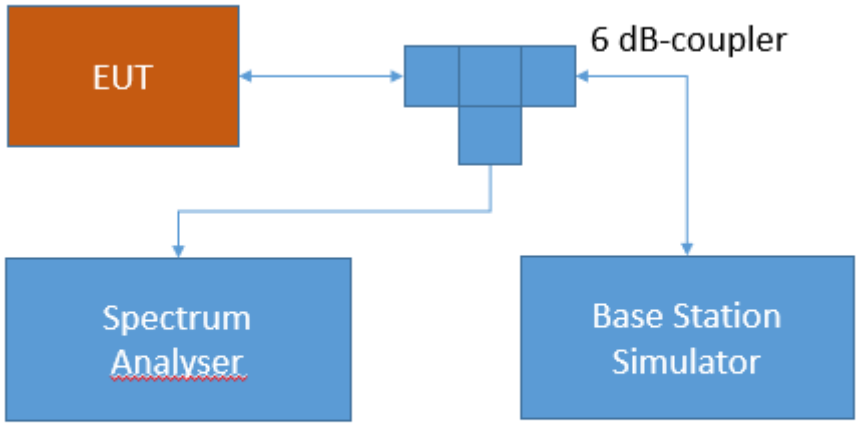
Standard **FCC PART 27 Subpart P**

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 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.

5.22.2 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 %

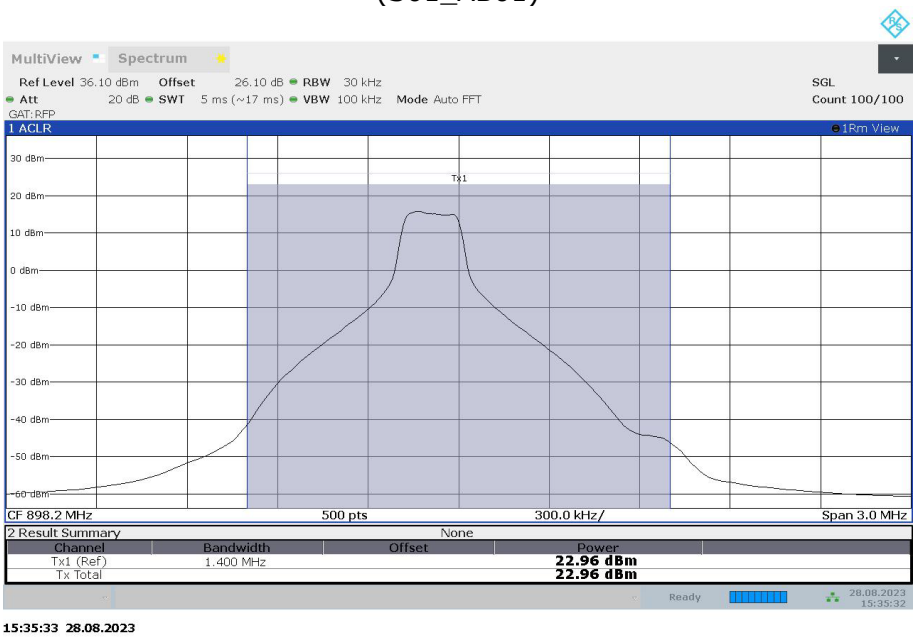
Radio Technology	Channel	Resource Blocks / Subcarrier	Band-width [MHz]	RMS Cond. Power (dBm)	FCC Limit (W)	IC Limit (W)	Maximum Antenna Gain FCC (dBi)	Maximum Antenna Gain IC (dBi)
CAT-M1 eFDD 8 QPSK	low	1	1.4	22.96	3 (ERP)	-	11.81	-
CAT-M1 eFDD 8 QPSK	low	3	1.4	21.93	3 (ERP)	-	12.84	-
CAT-M1 eFDD 8 QPSK	low	6	1.4	20.96	3 (ERP)	-	13.81	-
CAT-M1 eFDD 8 QPSK	mid	1	1.4	22.90	3 (ERP)	-	11.87	-
CAT-M1 eFDD 8 QPSK	mid	3	1.4	21.90	3 (ERP)	-	12.87	-
CAT-M1 eFDD 8 QPSK	mid	6	1.4	20.99	3 (ERP)	-	13.78	-
CAT-M1 eFDD 8 QPSK	high	1	1.4	22.90	3 (ERP)	-	11.87	-
CAT-M1 eFDD 8 QPSK	high	3	1.4	21.94	3 (ERP)	-	12.83	-
CAT-M1 eFDD 8 QPSK	high	6	1.4	20.94	3 (ERP)	-	13.83	-
CAT-M1 eFDD 8 16QAM	low	1	1.4	21.89	3 (ERP)	-	12.88	-
CAT-M1 eFDD 8 16QAM	low	5	1.4	20.84	3 (ERP)	-	13.93	-
CAT-M1 eFDD 8 16QAM	mid	1	1.4	21.68	3 (ERP)	-	13.09	-
CAT-M1 eFDD 8 16QAM	mid	5	1.4	20.74	3 (ERP)	-	14.03	-
CAT-M1 eFDD 8 16QAM	high	1	1.4	21.91	3 (ERP)	-	12.86	-
CAT-M1 eFDD 8 16QAM	high	5	1.4	20.76	3 (ERP)	-	14.01	-
CAT-M1 eFDD 8 QPSK	mid	1	3	22.90	3 (ERP)	-	11.87	-
CAT-M1 eFDD 8 QPSK	mid	3	3	21.79	3 (ERP)	-	12.98	-
CAT-M1 eFDD 8 QPSK	mid	6	3	20.82	3 (ERP)	-	13.95	-
CAT-M1 eFDD 8 16QAM	mid	1	3	21.90	3 (ERP)	-	12.87	-
CAT-M1 eFDD 8 16QAM	mid	5	3	20.71	3 (ERP)	-	14.06	-
NB-IoT eFDD 8 QPSK	low	1	0.2	22.09	3 (ERP)	3 (ERP)	12.68	12.68
NB-IoT eFDD 8 QPSK	low	3	0.2	21.57	3 (ERP)	3 (ERP)	13.20	13.20
NB-IoT eFDD 8 QPSK	low	6	0.2	21.66	3 (ERP)	3 (ERP)	13.11	13.11
NB-IoT eFDD 8 QPSK	low	12	0.2	21.50	3 (ERP)	3 (ERP)	13.27	13.27
NB-IoT eFDD 8 QPSK	mid	1	0.2	22.12	3 (ERP)	3 (ERP)	12.65	12.65
NB-IoT eFDD 8 QPSK	mid	3	0.2	21.55	3 (ERP)	3 (ERP)	13.22	13.22
NB-IoT eFDD 8 QPSK	mid	6	0.2	21.58	3 (ERP)	3 (ERP)	13.19	13.19
NB-IoT eFDD 8 QPSK	mid	12	0.2	21.49	3 (ERP)	3 (ERP)	13.28	13.28
NB-IoT eFDD 8 QPSK	high	1	0.2	22.11	3 (ERP)	3 (ERP)	12.66	12.66
NB-IoT eFDD 8 QPSK	high	3	0.2	21.56	3 (ERP)	3 (ERP)	13.21	13.21
NB-IoT eFDD 8 QPSK	high	6	0.2	21.58	3 (ERP)	3 (ERP)	13.19	13.19
NB-IoT eFDD 8 QPSK	high	12	0.2	21.48	3 (ERP)	3 (ERP)	13.29	13.29
NB-IoT eFDD 8 BPSK	low	1	0.2	22.13	3 (ERP)	3 (ERP)	12.64	12.64
NB-IoT eFDD 8 BPSK	mid	1	0.2	22.10	3 (ERP)	3 (ERP)	12.67	12.67
NB-IoT eFDD 8 BPSK	high	1	0.2	22.13	3 (ERP)	3 (ERP)	12.64	12.64
NB-IoT eFDD 85 QPSK	mid	3	0.2	21.96	3 (ERP)	3 (ERP)	12.81	12.81
NB-IoT eFDD 85 QPSK	mid	6	0.2	21.98	3 (ERP)	3 (ERP)	12.79	12.79
NB-IoT eFDD 85 QPSK	mid	12	0.2	22.03	3 (ERP)	3 (ERP)	12.74	12.74
NB-IoT eFDD 85 QPSK	high	1	0.2	22.62	3 (ERP)	3 (ERP)	12.15	12.15
NB-IoT eFDD 85 QPSK	high	3	0.2	22.02	3 (ERP)	3 (ERP)	12.75	12.75
NB-IoT eFDD 85 QPSK	high	6	0.2	22.05	3 (ERP)	3 (ERP)	12.72	12.72
NB-IoT eFDD 85 QPSK	high	12	0.2	21.99	3 (ERP)	3 (ERP)	12.78	12.78
NB-IoT eFDD 85 BPSK	low	1	0.2	22.74	3 (ERP)	3 (ERP)	12.03	12.03
NB-IoT eFDD 85 BPSK	mid	1	0.2	22.52	3 (ERP)	3 (ERP)	12.25	12.25
NB-IoT eFDD 85 BPSK	high	1	0.2	22.60	3 (ERP)	3 (ERP)	12.17	12.17

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

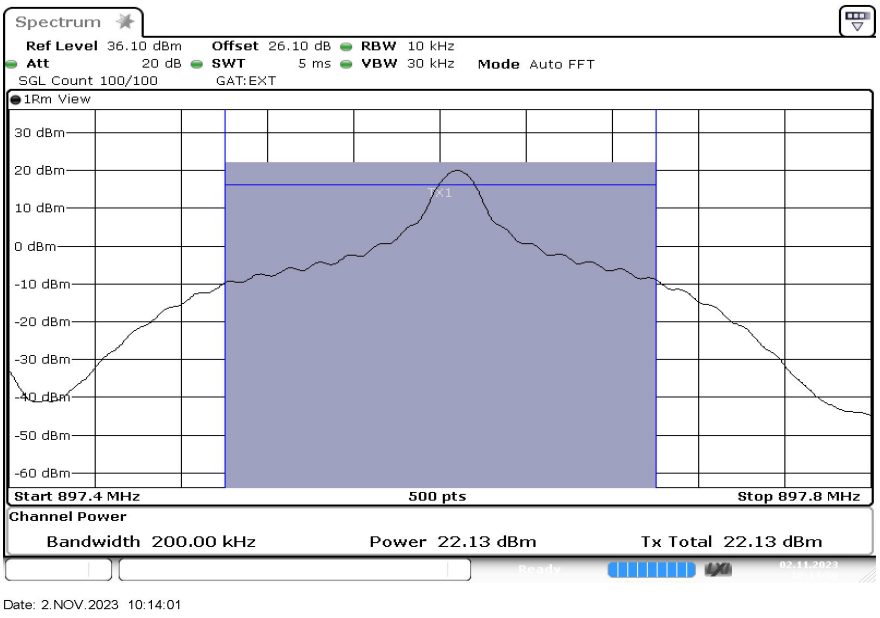
COMMENT: The max. antenna gain is regarding the output power not SAR / MPE.

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

Technology = CAT-M1, Radio Technology = eFDD 8, Operating Frequency = low channel (S01_AB01)



Technology = NB-IoT, Radio Technology = eFDD 8, Operating Frequency = low channel (S01_AE01)



5.22.5 TEST EQUIPMENT USED

- Radio Lab

5.23 FREQUENCY STABILITY

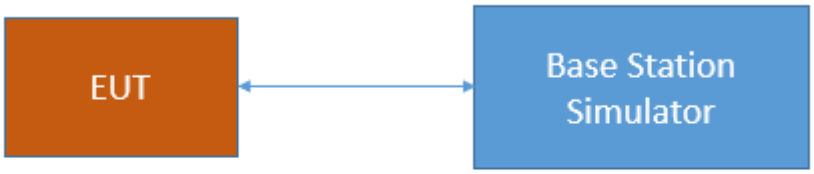
Standard **FCC PART 27 Subpart P**

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 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.

5.23.2 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

§ 27.54 - 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

CAT-M1 eFDD8

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	6337.5	4	5	passed
-30	5			3	8	passed
-30	10			4	7	passed
-20	0	normal	6337.5	1	7	passed
-20	5			3	7	passed
-20	10			2	6	passed
-10	0	normal	6337.5	4	8	passed
-10	5			1	8	passed
-10	10			3	6	passed
0	0	normal	6337.5	4	7	passed
0	5			3	9	passed
0	10			1	8	passed
10	0	normal	6337.5	1	7	passed
10	5			2	6	passed
10	10			3	5	passed
20	0	low	6337.5	3	4	passed
20	5			3	5	passed
20	10			2	5	passed
20	0	high	6337.5	5	6	passed
20	5			3	7	passed
20	10			3	9	passed
20	0	high	6337.5	2	8	passed
20	5			2	8	passed
20	10			5	8	passed
30	0	normal	6337.5	4	7	passed
30	5			3	9	passed
30	10			4	9	passed
40	0	normal	6337.5	2	8	passed
40	5			2	7	passed
40	10			4	10	passed
50	0	normal	6337.5	1	9	passed
50	5			4	8	passed
50	10			3	9	passed

NB-IoT eFDD8

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	6337.5	4	8	passed
-30	5			4	8	passed
-30	10			4	9	passed
-20	0	normal	6337.5	3	10	passed
-20	5			4	11	passed
-20	10			4	10	passed
-10	0	normal	6337.5	5	9	passed
-10	5			4	10	passed
-10	10			3	8	passed
0	0	normal	6337.5	5	9	passed
0	5			5	9	passed
0	10			3	11	passed
10	0	normal	6337.5	4	8	passed
10	5			3	9	passed
10	10			4	9	passed
20	0	low	6337.5	4	9	passed
20	5			3	10	passed
20	10			3	7	passed
20	0	high	6337.5	5	12	passed
20	5			3	10	passed
20	10			3	11	passed
20	0	high	6337.5	5	12	passed
20	5			6	8	passed
20	10			6	9	passed
30	0	normal	6337.5	4	14	passed
30	5			5	9	passed
30	10			5	8	passed
40	0	normal	6337.5	3	9	passed
40	5			3	11	passed
40	10			4	12	passed
50	0	normal	6337.5	3	10	passed
50	5			5	10	passed
50	10			4	9	passed

5.23.4 TEST EQUIPMENT USED

- Radio Lab

5.24 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

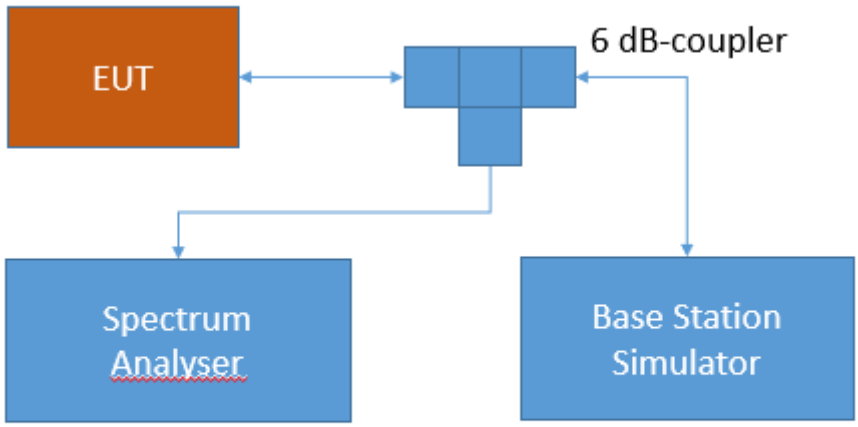
Standard **FCC PART 27 Subpart C**

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 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.

5.24.2 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 %

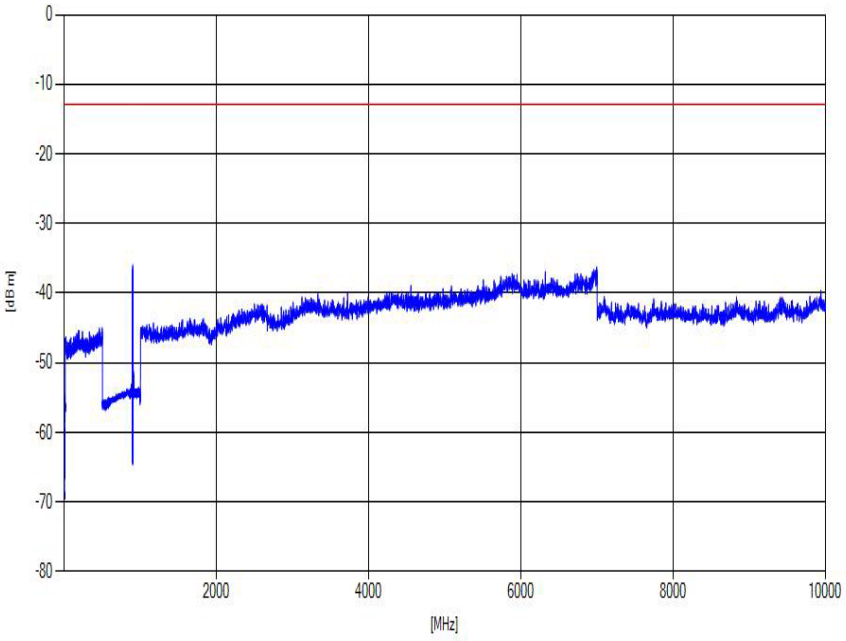
Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
low	rms	maxhold	20	897.5	-36	-13	23.00
mid	rms	maxhold	-	-	-	-	> 20
high	rms	maxhold	20	900.5	-37.1	-13	24.10

Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
low	rms	maxhold	2	897.5	-19.97	-13	6.97
mid	rms	maxhold	-	-	-	-	> 20
high	rms	maxhold	2	900.5	-15.67	-13	2.67

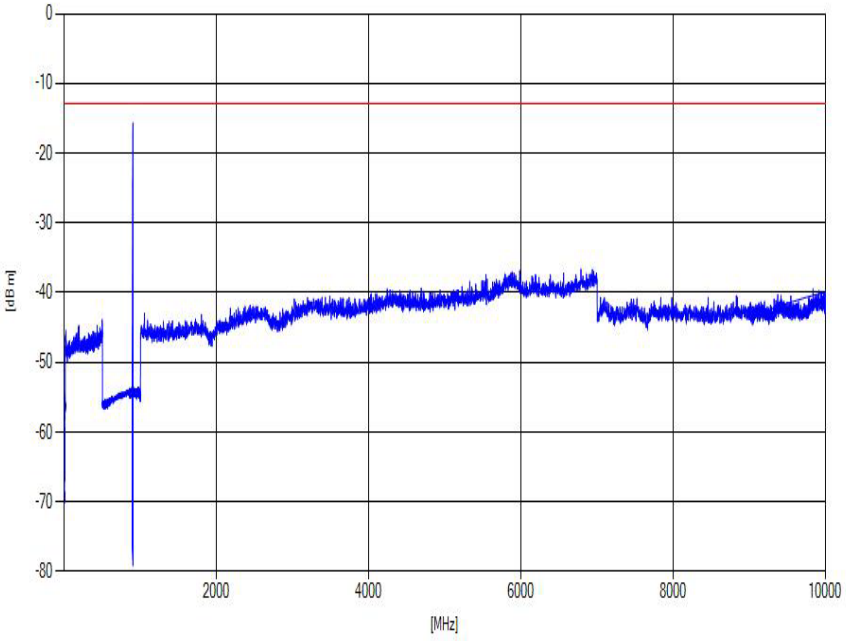
Remark: Please see next sub-clause for the measurement plot.

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

Technology = CAT-M1, Radio Technology = eFDD 8, Operating Frequency = low channel (S01_AB01)



Technology = NB-IoT, Radio Technology = eFDD 8 QPSK, Operating Frequency = high channel (S01_AE01)



5.24.5 TEST EQUIPMENT USED

- Radio Lab

5.25 FIELD STRENGTH OF SPURIOUS RADIATION

Standard **FCC PART 27 Subpart P**

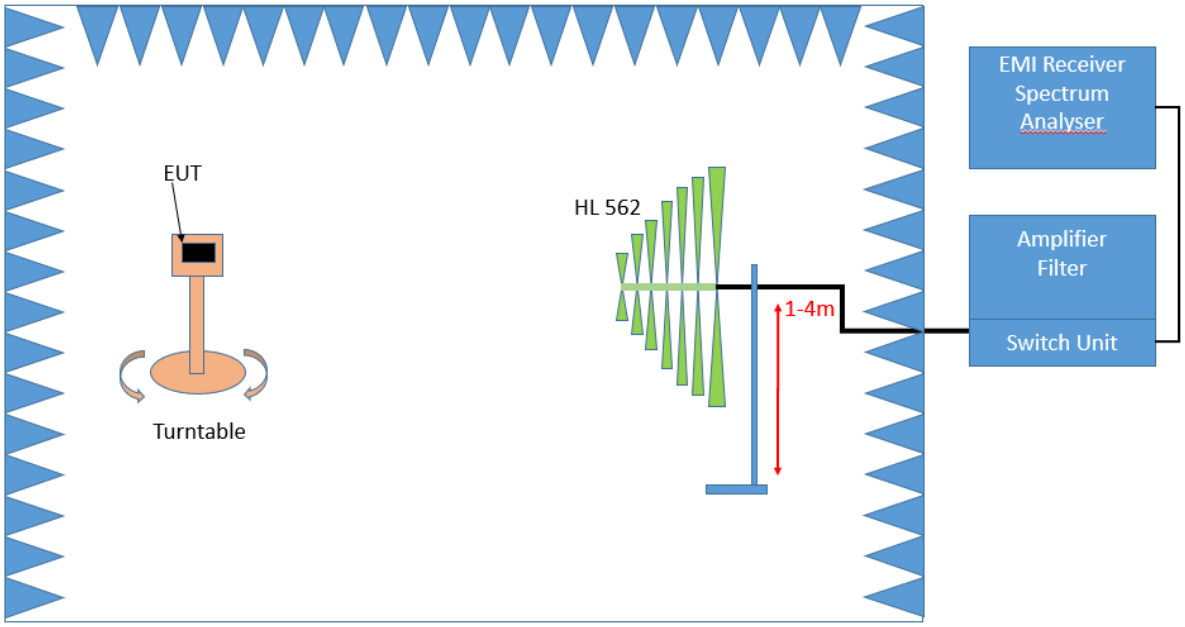
The test was performed according to:
ANSI C63.26: 2015; 5.5.2.3.1

5.25.1 TEST DESCRIPTION

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

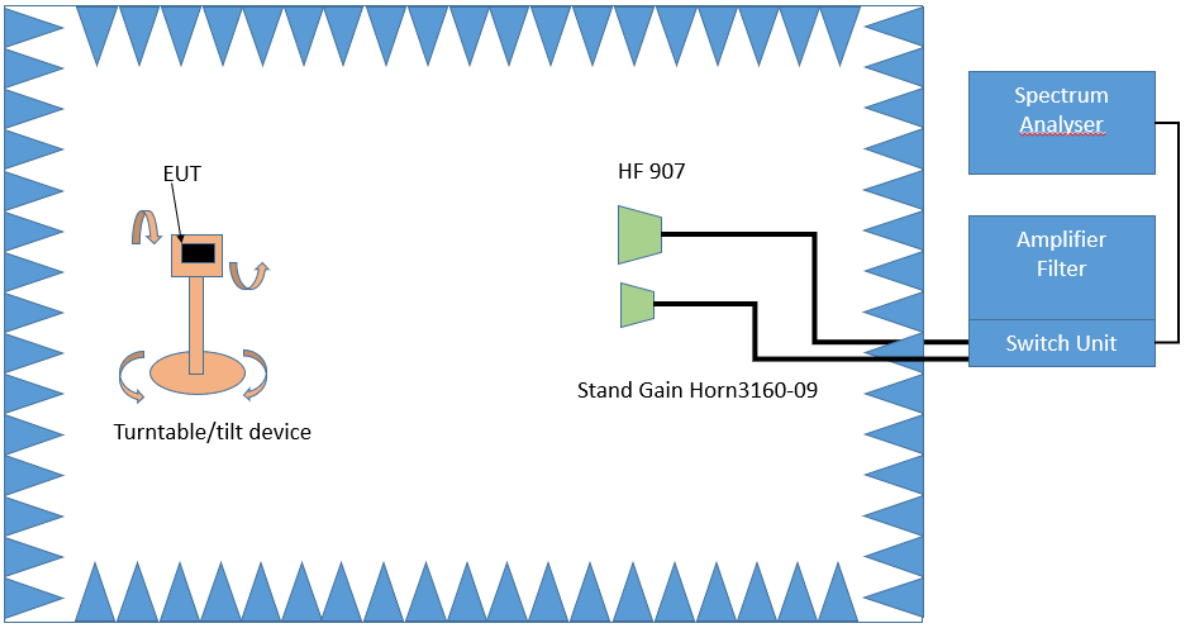
The EUT was connected to the test setup according to the following diagram:

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: 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

§27.1509 – 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.

5.25.3 TEST PROTOCOL

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

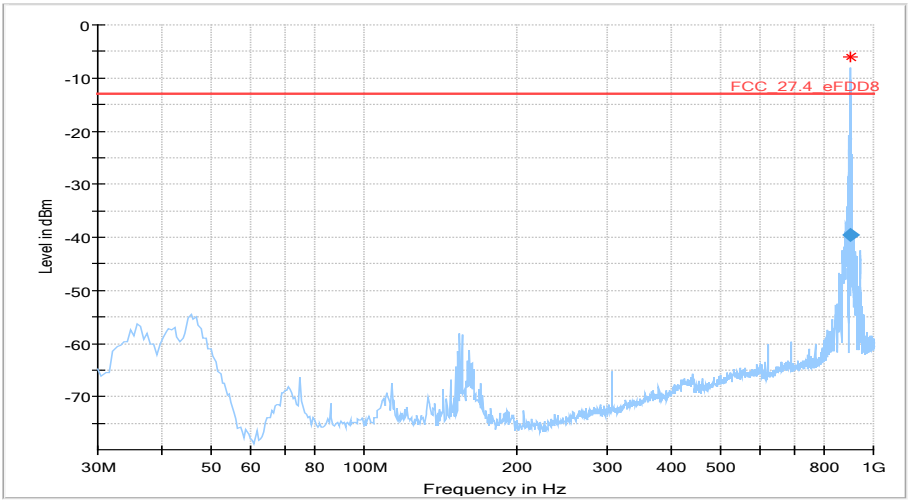
Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD 8	low	rms	maxhold	100	897.4	-41.2	-13	28.20
CAT-M1 eFDD 8	mid	rms	maxhold	-	-	-	-13	> 20
CAT-M1 eFDD 8	high	rms	maxhold	100	900.9	-39.63	-13	26.63

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD 8	low	rms	maxhold	2	897.5	-24.77	-13	11.77
NB-IoT eFDD 8	mid	rms	maxhold	-	-	-	-13	> 20
NB-IoT eFDD 8	high	rms	maxhold	2	900.5	-21.96	-13	8.96

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

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

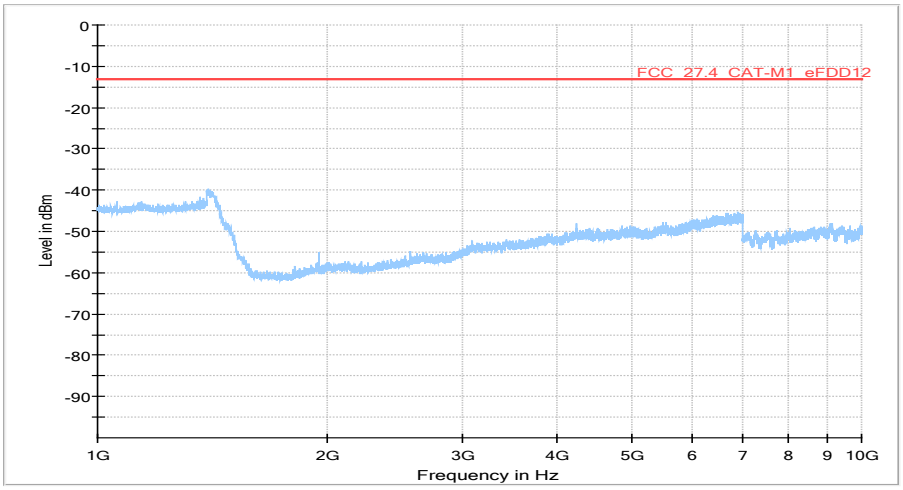
Technology = CAT-M1, Radio Technology = eFDD 8, Operating Frequency = high channel (S01_AA01)
30 MHz – 1 GHz



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
900.898200	-39.63	-13.00	26.63	1000.0	100.000	162.0	H	131.0	-72.3

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)
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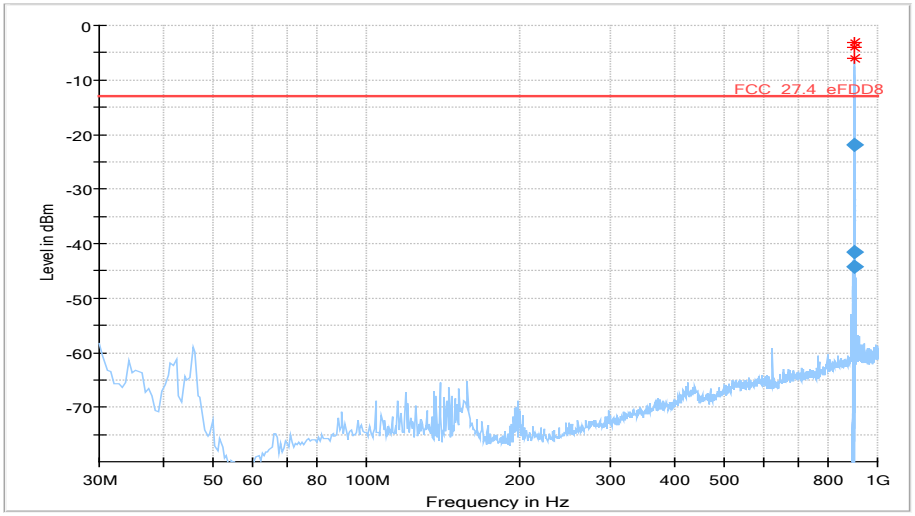
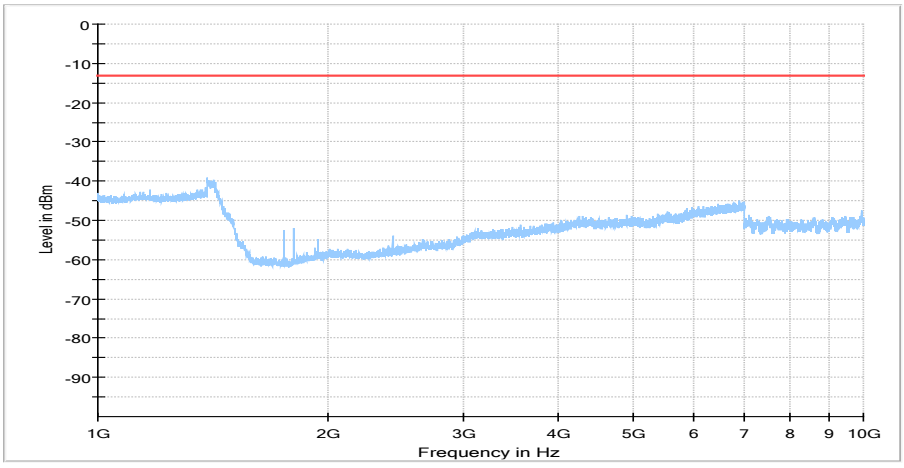
Technology = NB-IoT, Radio Technology = eFDD 8, Operating Frequency = high channel (S01_AA01)
30 MHz – 1 GHz



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
900.501900	-21.96	-13.00	8.96	1000.0	2.000	154.0	H	66.0	-72.3
900.699400	-41.50	-13.00	28.50	1000.0	100.000	149.0	H	56.0	-72.3
900.798800	-44.29	-13.00	31.29	1000.0	100.000	155.0	H	63.0	-72.3

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)
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5.25.5 TEST EQUIPMENT USED

- Radiated Emissions

5.26 EMISSION AND OCCUPIED BANDWIDTH

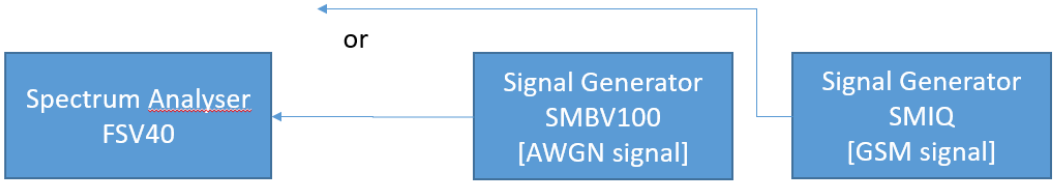
Standard **FCC PART 27 Subpart P**

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%))

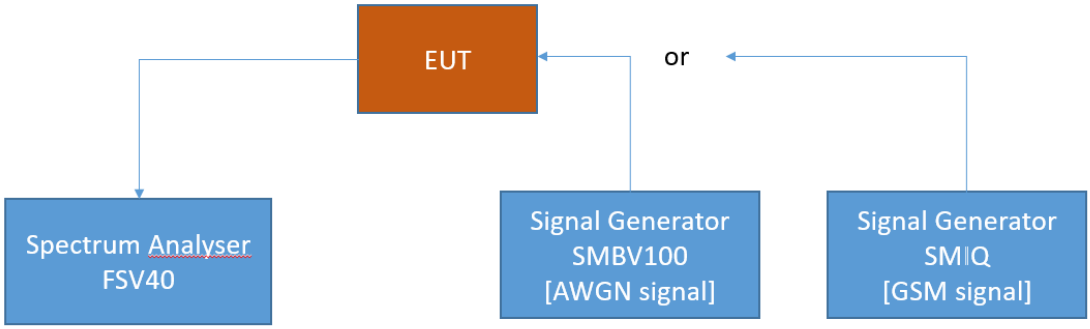
5.26.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission test case per FCC §2.1049 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:



FCC Part 22/24/27/90; Industrial Signal Booster
Test Setup step 1: Measuring characteristics of test signals



FCC Part 22/24/27/90; Industrial Signal Booster
Test Setup step 2; Occupied Bandwidth/Input-versus-output spectrum

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.

5.26.3 TEST PROTOCOL

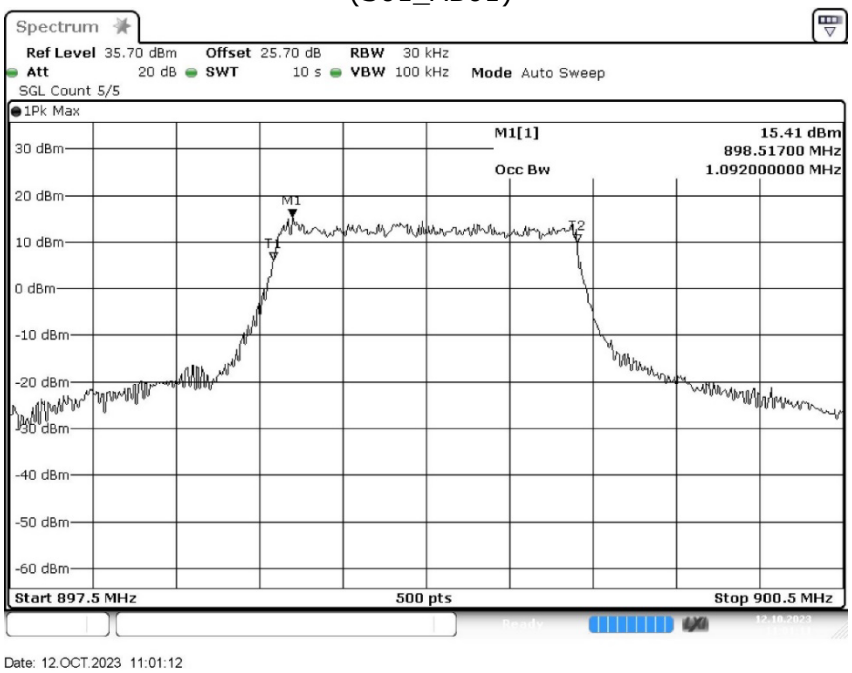
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

Radio Technology	Channel	Resource Blocks / Subcarrier	Bandwidth [MHz]	Nominal BW [MHz]	26 dB BW [kHz]	99 % BW [kHz]
CAT-M1 eFDD 8 QPSK	low	6	1.4	1	-	1098
CAT-M1 eFDD 8 QPSK	mid	6	1.4	1	-	1092
CAT-M1 eFDD 8 QPSK	high	6	1.4	1	-	1092
CAT-M1 eFDD 8 16QAM	low	5	1.4	1	-	924
CAT-M1 eFDD 8 16QAM	mid	5	1.4	1	-	930
CAT-M1 eFDD 8 16QAM	high	5	1.4	1	-	930
NB-IoT eFDD 8 QPSK	low	12	0.2	0	-	186
NB-IoT eFDD 8 QPSK	mid	12	0.2	0	-	188
NB-IoT eFDD 8 QPSK	high	12	0.2	0	-	184
NB-IoT eFDD 8 BPSK	low	1	0.2	0	-	138
NB-IoT eFDD 8 BPSK	mid	1	0.2	0	-	132
NB-IoT eFDD 8 BPSK	high	1	0.2	0	-	136

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

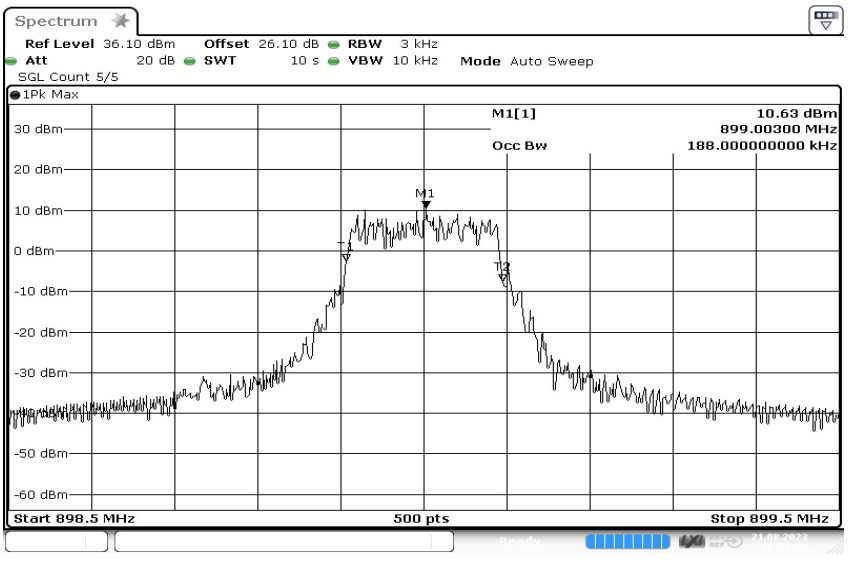
5.26.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Technology = CAT-M1, Radio Technology = eFDD 8 Operating Frequency = mid channel
(S01_AB01)



,

Technology = NB-IoT, Radio Technology = eFDD 8, Operating Frequency = mid channel
(S01_AB01)



5.26.5 TEST EQUIPMENT USED

- Radio Lab

5.27 BAND EDGE COMPLIANCE

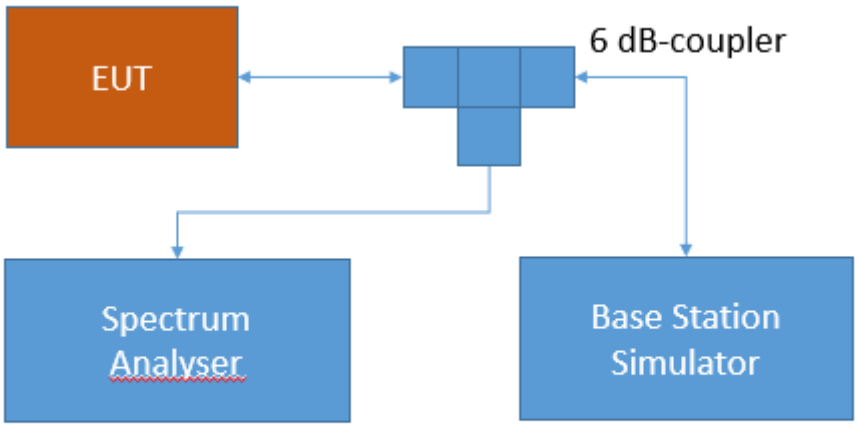
Standard **FCC PART 27 Subpart C**

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 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.

5.27.2 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

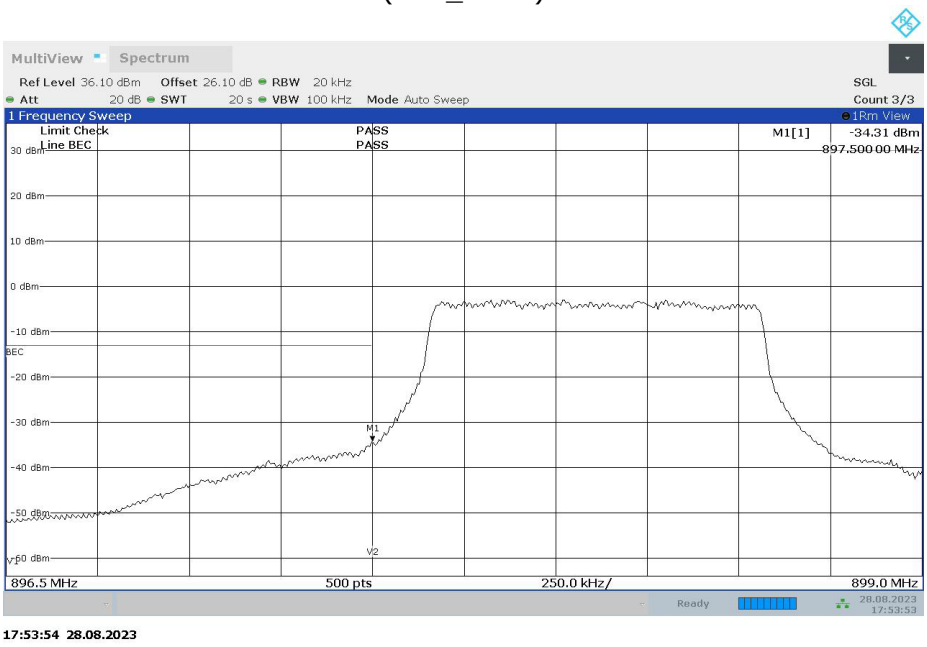
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

Radio Technology	Channel	Resource Blocks	Band-width [MHz]	Peak [dBm]	Average [dBm]	RMS [dBm]	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD 8 QPSK	low	6	1.4	-18.32	-46.50	-36.08	-13	23.08
CAT-M1 eFDD 8 QPSK	high	6	1.4	-17.31	-47.06	-36.85	-13	23.85
CAT-M1 eFDD 8 16QAM	low	5	1.4	-14.12	-44.76	-34.31	-13	21.31
CAT-M1 eFDD 8 16QAM	high	5	1.4	-18.05	-47.71	-39.38	-13	26.38
NB-IoT eFDD 8 QPSK	low	12	0.2	-8.88	-37.62	-69.93	-13	56.93
NB-IoT eFDD 8 QPSK	high	12	0.2	-8.09	-29.78	-24.70	-13	11.70
NB-IoT eFDD 8 BPSK	low	1	0.2	-13.05	-19.85	-17.28	-13	4.28
NB-IoT eFDD 8 BPSK	high	1	0.2	-12.36	-20.31	-23.72	-13	10.72

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

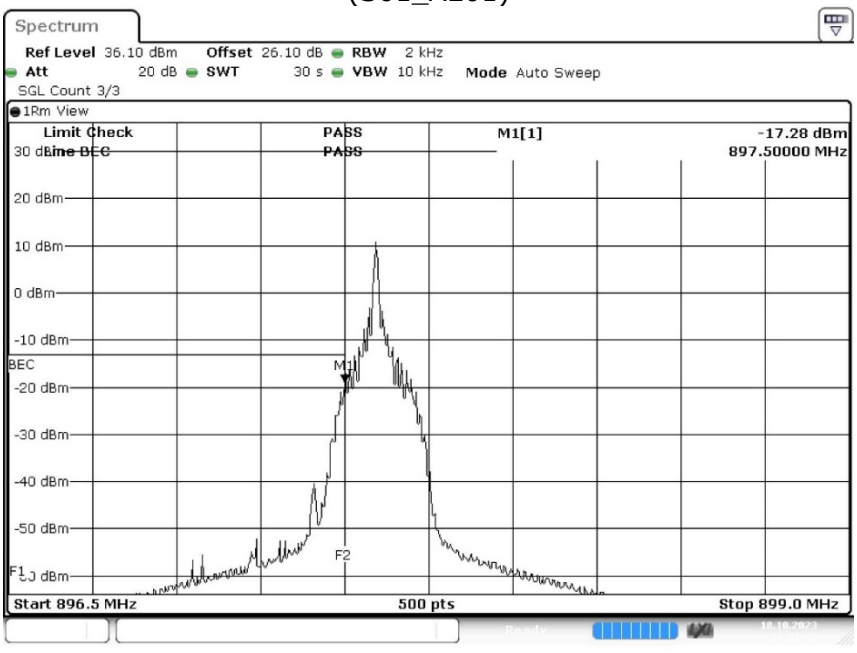
5.27.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Technology = CAT-M1, Radio Technology = eFDD 8, Operating Frequency = low channel (S01_AB01)



17:53:54 28.08.2023

Technology = NB-IoT, Radio Technology = eFDD 8, Operating Frequency = low channel (S01_AE01)



Date: 18.OCT.2023 16:31:47

5.27.5 TEST EQUIPMENT USED

- Radio Lab

5.28 PEAK TO AVERAGE RATIO

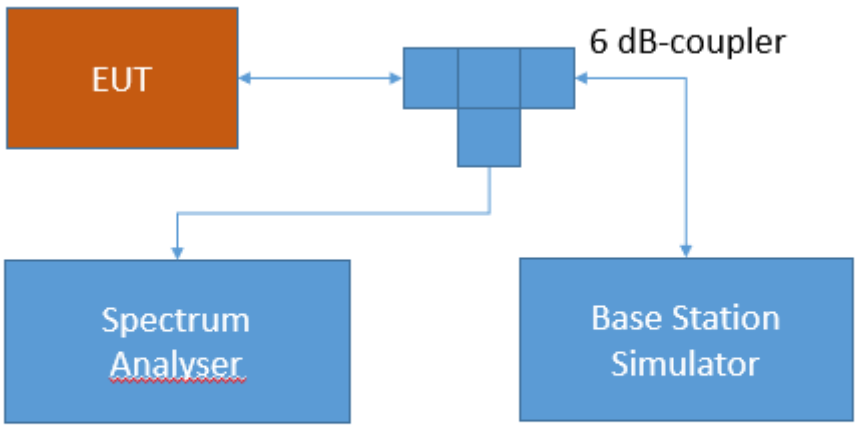
Standard **FCC PART 27 Subpart P**

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 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

5.28.2 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

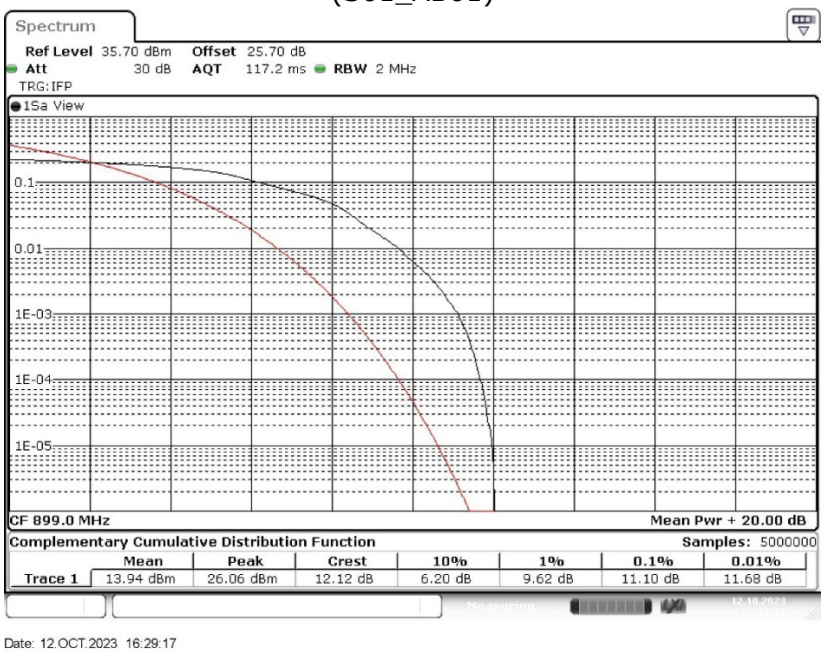
Ambient temperature: 20 - 28 °C
Relative humidity: 30 - 40 %

Radio Technology	Channel	Resource Blocks	Band-width [MHz]	Peak to Average Ratio	Limit (IC) [dB]
CAT-M1 eFDD 8 QPSK	low	6	1.4	10.23	13
CAT-M1 eFDD 8 QPSK	mid	6	1.4	10.29	13
CAT-M1 eFDD 8 QPSK	high	6	1.4	10.23	13
CAT-M1 eFDD 8 16QAM	low	5	1.4	11.10	13
CAT-M1 eFDD 8 16QAM	mid	5	1.4	11.10	13
CAT-M1 eFDD 8 16QAM	high	5	1.4	11.07	13
NB-IoT eFDD 8 QPSK	low	12	0.2	7.91	13
NB-IoT eFDD 8 QPSK	mid	12	0.2	7.94	13
NB-IoT eFDD 8 QPSK	high	12	0.2	7.94	13
NB-IoT eFDD 8 BPSK	low	1	0.2	8.23	13
NB-IoT eFDD 8 BPSK	mid	1	0.2	8.23	13
NB-IoT eFDD 8 BPSK	high	1	0.2	8.38	13

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

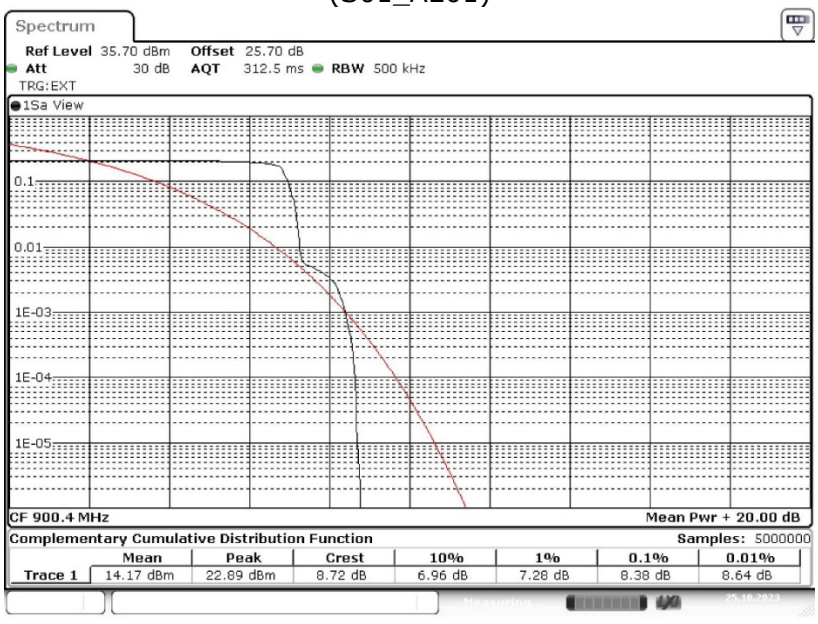
5.28.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Technology = CAT-M1, Radio Technology = eFDD 8, Operating Frequency = mid channel (S01_AB01)



Date: 12.OCT.2023 16:29:17

Technology = NB-IoT, Radio Technology = eFDD 8, Operating Frequency = high channel (S01_AE01)



Date: 25.OCT.2023 08:55:39

5.28.5 TEST EQUIPMENT USED

- Radio Lab