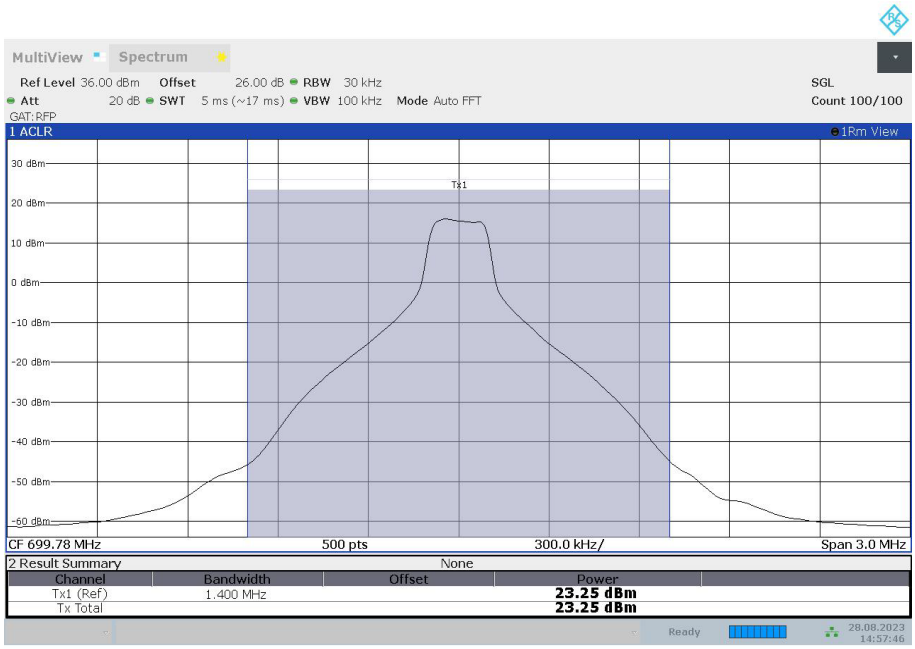
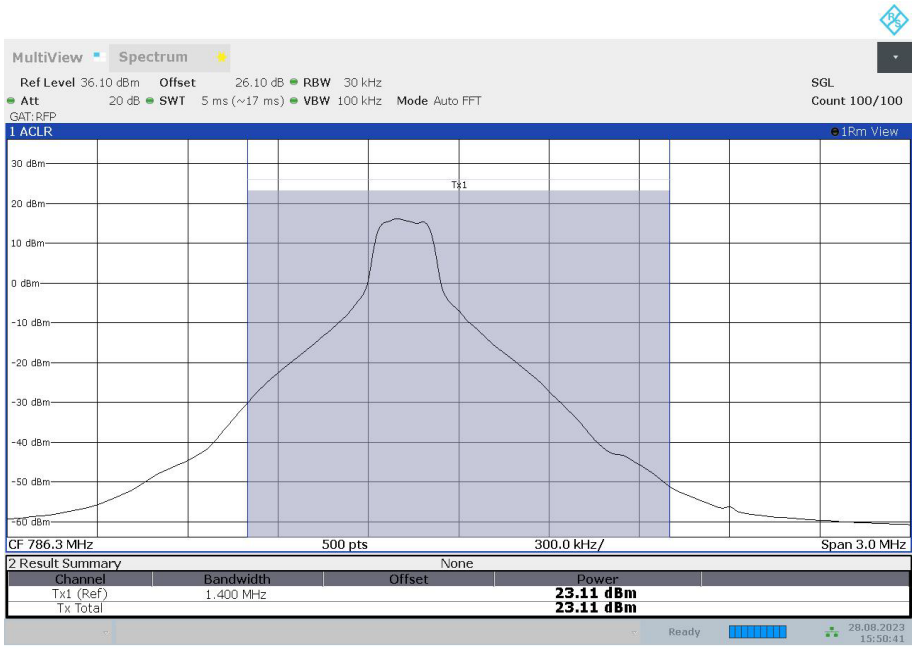
Technology = CAT-M1, Radio Technology = eFDD 12, Operating Frequency = low channel (S01_AB01)



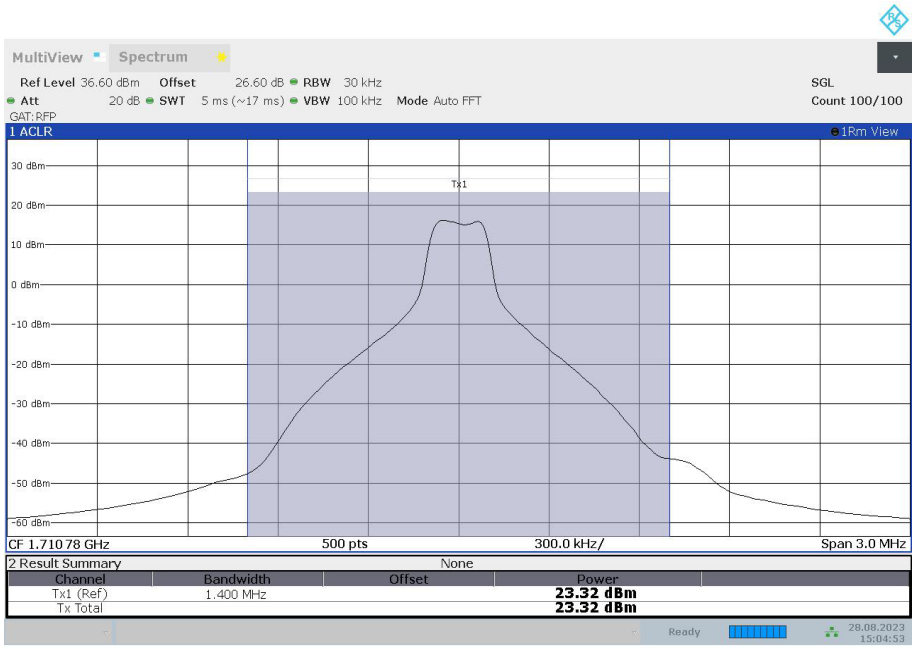
14:57:47 28.08.2023

Technology = CAT-M1, Radio Technology = eFDD 13, Operating Frequency = high channel (S01_AB01)



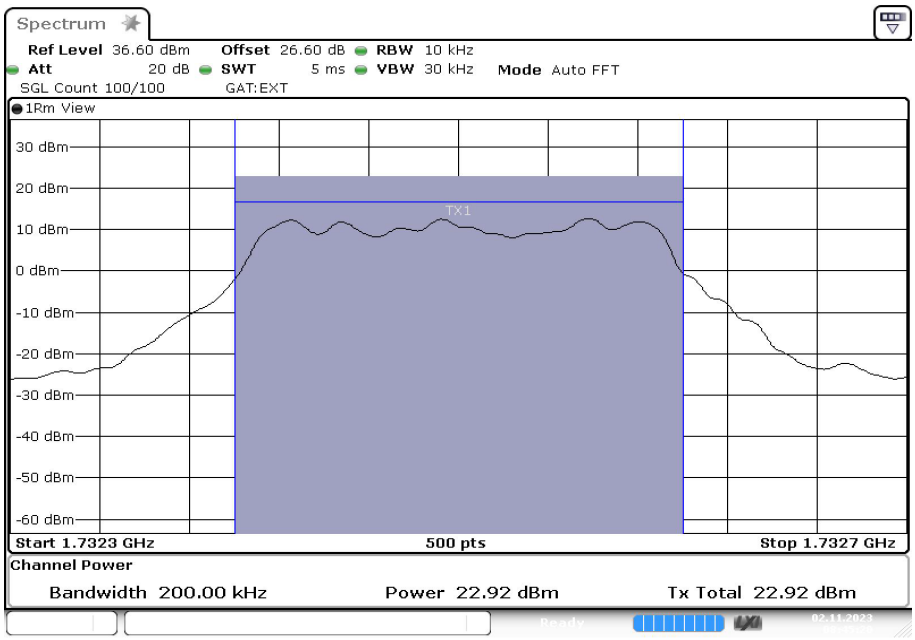
15:50:41 28.08.2023

Technology = CAT-M1, Radio Technology = eFDD 66, Operating Frequency = low channel (S01_AB01)



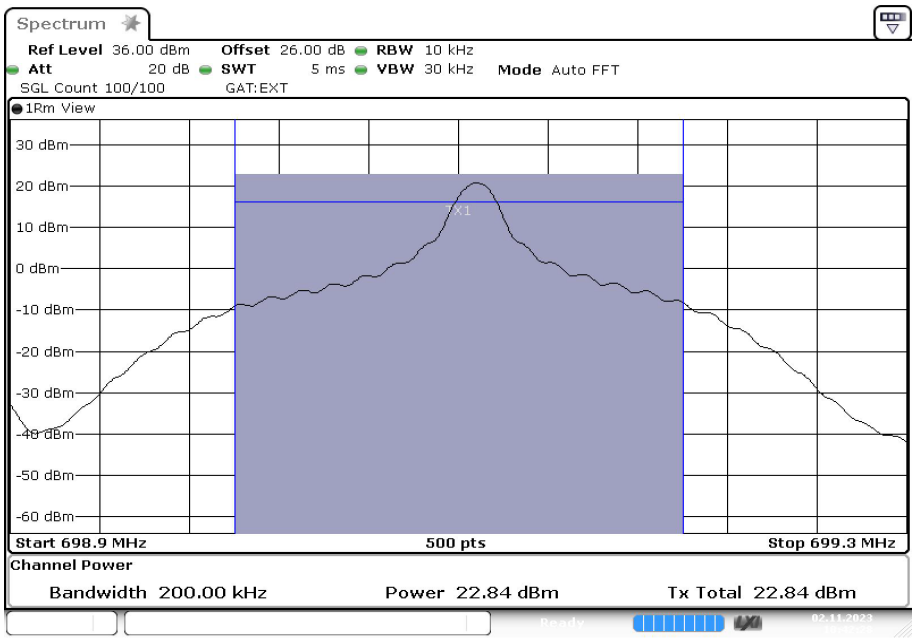
15:04:54 28.08.2023

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



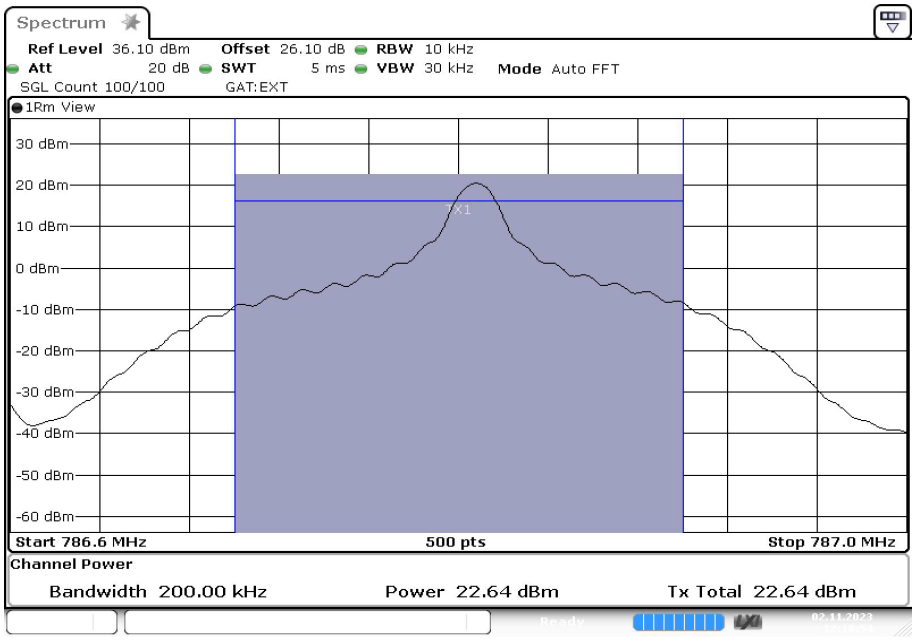
Date: 2.NOV.2023 08:45:20

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



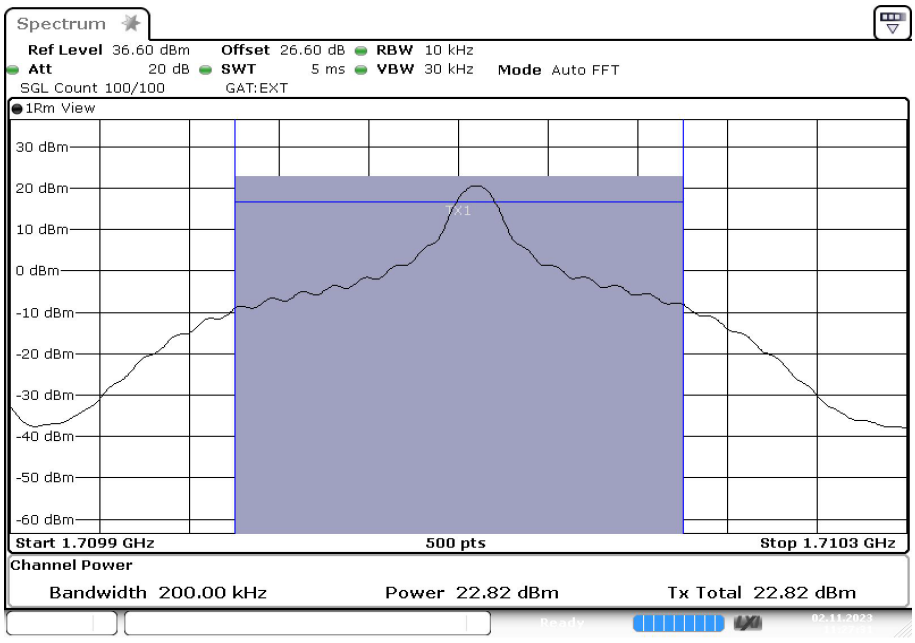
Date: 2.NOV.2023 10:42:28

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



Date: 2.NOV.2023 12:10:54

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



Date: 2.NOV.2023 11:27:32

5.15.5 TEST EQUIPMENT USED

- Radio Lab

5.16 FREQUENCY STABILITY

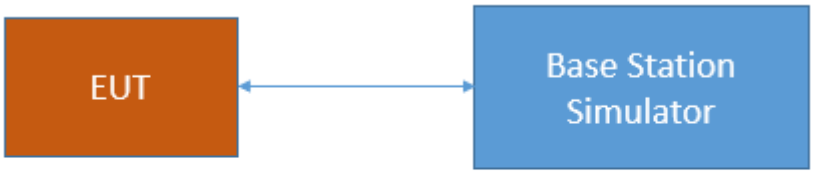
Standard **FCC PART 27 Subpart C**

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

5.16.1 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.

5.16.2 TEST REQUIREMENTS / LIMITS

FCC Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§ 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.

Band 12/13/17:

RSS-130; 4.5 Transmitter frequency stability

For equipment that is capable of transmitting numerous channels simultaneously for different applications (e.g. LTE and narrowband – Internet of Things (IoT)), the occupied bandwidth shall be the bandwidth representing the sum of the occupied bandwidths of these channels.

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

Band 4/66:

RSS-139; 5.4 Frequency Stability

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

5.16.3 TEST PROTOCOL

CAT-M1 eFDD4

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	4331.25	4	8	passed
-30	5			3	6	passed
-30	10			3	7	passed
-20	0	normal	4331.25	2	9	passed
-20	5			2	8	passed
-20	10			2	9	passed
-10	0	normal	4331.25	2	7	passed
-10	5			3	10	passed
-10	10			2	9	passed
0	0	normal	4331.25	2	8	passed
0	5			3	6	passed
0	10			2	11	passed
10	0	normal	4331.25	1	7	passed
10	5			2	8	passed
10	10			2	8	passed
20	0	low	4331.25	3	8	passed
20	5			3	7	passed
20	10			4	7	passed
20	0	high	4331.25	4	7	passed
20	5			4	10	passed
20	10			3	9	passed
20	0	high	4331.25	5	11	passed
20	5			6	16	passed
20	10			8	14	passed
30	0	normal	4331.25	2	8	passed
30	5			4	9	passed
30	10			3	7	passed
40	0	normal	4331.25	1	10	passed
40	5			2	6	passed
40	10			2	6	passed
50	0	normal	4331.25	3	7	passed
50	5			3	9	passed
50	10			2	9	passed

CAT-M1 eFDD12

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	1768.75	-4	-8	passed
-30	5			-3	-6	passed
-30	10			-4	-6	passed
-20	0	normal	1768.75	-3	-7	passed
-20	5			-4	-5	passed
-20	10			-4	-8	passed
-10	0	normal	1768.75	-5	-10	passed
-10	5			-4	-7	passed
-10	10			-3	-11	passed
0	0	normal	1768.75	-3	-8	passed
0	5			-4	-9	passed
0	10			-2	-7	passed
10	0	normal	1768.75	-1	-7	passed
10	5			-3	-7	passed
10	10			-4	-8	passed
20	0	low	1768.75	3	8	passed
20	5			3	6	passed
20	10			-2	-9	passed
20	0	high	1768.75	-1	-6	passed
20	5			-2	-7	passed
20	10			-1	-7	passed
20	0	high	1768.75	4	10	passed
20	5			6	14	passed
20	10			6	13	passed
30	0	normal	1768.75	0	4	passed
30	5			1	3	passed
30	10			-2	-8	passed
40	0	normal	1768.75	-3	-5	passed
40	5			-2	-7	passed
40	10			-2	-10	passed
50	0	normal	1768.75	2	-10	passed
50	5			2	-12	passed
50	10			-1	-8	passed

CAT-M1 eFDD13

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	1955	3	8	passed
-30	5			4	9	passed
-30	10			6	9	passed
-20	0	normal	1955	3	9	passed
-20	5			4	7	passed
-20	10			4	8	passed
-10	0	normal	1955	2	9	passed
-10	5			5	7	passed
-10	10			4	7	passed
0	0	normal	1955	3	8	passed
0	5			6	6	passed
0	10			7	9	passed
10	0	normal	1955	4	8	passed
10	5			4	9	passed
10	10			6	9	passed
20	0	low	1955	4	7	passed
20	5			3	7	passed
20	10			5	6	passed
20	0	high	1955	4	7	passed
20	5			6	9	passed
20	10			3	9	passed
20	0	high	1955	2	6	passed
20	5			5	6	passed
20	10			4	5	passed
30	0	normal	1955	1	10	passed
30	5			5	8	passed
30	10			4	7	passed
40	0	normal	1955	6	9	passed
40	5			6	9	passed
40	10			2	8	passed
50	0	normal	1955	3	7	passed
50	5			4	8	passed
50	10			4	9	passed

CAT-M1 eFDD66

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	4362.5	-12	-19	passed
-30	5			-14	-22	passed
-30	10			13	23	passed
-20	0	normal	4362.5	-11	-20	passed
-20	5			-13	-17	passed
-20	10			-10	-17	passed
-10	0	normal	4362.5	-9	-14	passed
-10	5			-8	-14	passed
-10	10			-14	-22	passed
0	0	normal	4362.5	12	19	passed
0	5			13	18	passed
0	10			-11	-16	passed
10	0	normal	4362.5	-13	-18	passed
10	5			-13	-19	passed
10	10			-15	-18	passed
20	0	low	4362.5	-9	-21	passed
20	5			12	16	passed
20	10			13	19	passed
20	0	high	4362.5	-14	-21	passed
20	5			-8	-22	passed
20	10			-7	-18	passed
20	0	high	4362.5	5	10	passed
20	5			-8	-14	passed
20	10			-4	-9	passed
30	0	normal	4362.5	-7	-17	passed
30	5			-9	-15	passed
30	10			-8	-23	passed
40	0	normal	4362.5	10	13	passed
40	5			11	14	passed
40	10			10	14	passed
50	0	normal	4362.5	-12	-18	passed
50	5			-13	-16	passed
50	10			-16	-21	passed

NB-IoT eFDD4

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	4331.25	4	8	passed
-30	5			6	10	passed
-30	10			6	11	passed
-20	0	normal	4331.25	7	9	passed
-20	5			5	8	passed
-20	10			4	9	passed
-10	0	normal	4331.25	6	13	passed
-10	5			6	11	passed
-10	10			3	12	passed
0	0	normal	4331.25	7	14	passed
0	5			3	12	passed
0	10			5	15	passed
10	0	normal	4331.25	5	9	passed
10	5			5	7	passed
10	10			6	10	passed
20	0	low	4331.25	4	9	passed
20	5			4	9	passed
20	10			4	12	passed
20	0	high	4331.25	7	13	passed
20	5			6	12	passed
20	10			4	12	passed
20	0	high	4331.25	6	14	passed
20	5			6	15	passed
20	10			5	11	passed
30	0	normal	4331.25	8	14	passed
30	5			5	10	passed
30	10			6	11	passed
40	0	normal	4331.25	6	12	passed
40	5			6	11	passed
40	10			5	15	passed
50	0	normal	4331.25	9	13	passed
50	5			7	14	passed
50	10			6	10	passed

NB-IoT eFDD12

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	1768.75	9	15	passed
-30	5			13	19	passed
-30	10			14	18	passed
-20	0	normal	1768.75	10	13	passed
-20	5			11	21	passed
-20	10			8	13	passed
-10	0	normal	1768.75	11	17	passed
-10	5			10	16	passed
-10	10			13	19	passed
0	0	normal	1768.75	12	18	passed
0	5			12	17	passed
0	10			15	18	passed
10	0	normal	1768.75	14	16	passed
10	5			13	15	passed
10	10			13	19	passed
20	0	low	1768.75	9	14	passed
20	5			8	16	passed
20	10			8	14	passed
20	0	high	1768.75	11	18	passed
20	5			9	17	passed
20	10			12	18	passed
20	0	high	1768.75	11	18	passed
20	5			7	17	passed
20	10			7	12	passed
30	0	normal	1768.75	9	15	passed
30	5			10	17	passed
30	10			12	18	passed
40	0	normal	1768.75	11	17	passed
40	5			14	19	passed
40	10			13	20	passed
50	0	normal	1768.75	10	17	passed
50	5			8	22	passed
50	10			13	25	passed

NB-IoT eFDD13

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	1955	15	22	passed
-30	5			11	21	passed
-30	10			17	25	passed
-20	0	normal	1955	13	23	passed
-20	5			15	24	passed
-20	10			16	20	passed
-10	0	normal	1955	12	22	passed
-10	5			14	19	passed
-10	10			14	20	passed
0	0	normal	1955	11	21	passed
0	5			15	21	passed
0	10			13	20	passed
10	0	normal	1955	16	19	passed
10	5			12	18	passed
10	10			13	22	passed
20	0	low	1955	11	19	passed
20	5			14	21	passed
20	10			14	23	passed
20	0	high	1955	13	19	passed
20	5			10	23	passed
20	10			12	24	passed
20	0	high	1955	13	24	passed
20	5			14	18	passed
20	10			14	19	passed
30	0	normal	1955	11	28	passed
30	5			13	24	passed
30	10			14	25	passed
40	0	normal	1955	13	23	passed
40	5			14	24	passed
40	10			11	20	passed
50	0	normal	1955	13	22	passed
50	5			15	23	passed
50	10			14	25	passed

NB-IoT eFDD66

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	4362.5	-9	-22	passed
-30	5			-11	-21	passed
-30	10			-8	-24	passed
-20	0	normal	4362.5	-10	-18	passed
-20	5			-9	-16	passed
-20	10			-9	-15	passed
-10	0	normal	4362.5	-8	-17	passed
-10	5			-9	-20	passed
-10	10			-7	-21	passed
0	0	normal	4362.5	14	23	passed
0	5			12	20	passed
0	10			-7	-15	passed
10	0	normal	4362.5	10	26	passed
10	5			-9	-21	passed
10	10			-13	-22	passed
20	0	low	4362.5	-10	-15	passed
20	5			-9	-13	passed
20	10			-11	-13	passed
20	0	high	4362.5	-8	-19	passed
20	5			9	17	passed
20	10			9	18	passed
20	0	high	4362.5	12	15	passed
20	5			-10	-20	passed
20	10			-9	-16	passed
30	0	normal	4362.5	-7	-17	passed
30	5			12	20	passed
30	10			14	21	passed
40	0	normal	4362.5	-8	-19	passed
40	5			-9	-18	passed
40	10			10	15	passed
50	0	normal	4362.5	12	21	passed
50	5			-11	-23	passed
50	10			13	20	passed

NB-IoT eFDD85

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	5775	7	13	passed
-30	5			6	16	passed
-30	10			9	14	passed
-20	0	normal	5775	10	15	passed
-20	5			7	15	passed
-20	10			9	17	passed
-10	0	normal	5775	8	16	passed
-10	5			8	14	passed
-10	10			6	13	passed
0	0	normal	5775	9	13	passed
0	5			11	14	passed
0	10			12	18	passed
10	0	normal	5775	9	17	passed
10	5			9	16	passed
10	10			12	18	passed
20	0	low	5775	7	14	passed
20	5			10	13	passed
20	10			7	15	passed
20	0	high	5775	8	16	passed
20	5			7	16	passed
20	10			7	18	passed
20	0	high	5775	4	9	passed
20	5			4	10	passed
20	10			6	15	passed
30	0	normal	5775	10	17	passed
30	5			13	20	passed
30	10			9	15	passed
40	0	normal	5775	11	16	passed
40	5			8	21	passed
40	10			8	18	passed
50	0	normal	5775	12	18	passed
50	5			10	17	passed
50	10			8	15	passed

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

5.16.4 TEST EQUIPMENT USED

- Radio Lab

5.17 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

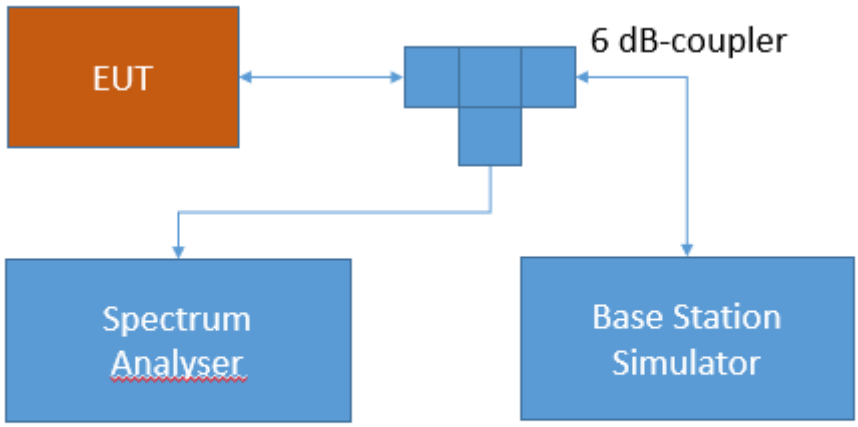
Standard **FCC PART 27 Subpart C**

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

5.17.1 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.

5.17.2 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 4/66:

(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; 5.6 Transmitter Unwanted Emissions

Unwanted emissions shall be measured in terms of average values.

For all equipment, the TRP or total conducted power (sum of conducted power across all antenna connectors) of the unwanted emissions outside the frequency block or frequency block group shall not exceed the limits shown in table 6.

Table 6: Unwanted emission limits	
Offset from the edge of the frequency	Unwanted emission limits
1 MHz	-13 dBm / (1% of occupied bandwidth)
> 1 MHz	-13 dBm / MHz

5.17.3 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 4	low	rms	maxhold	5	1709.9	-42.04	-17.5	24.54
CAT-M1 eFDD 4	mid	rms	maxhold	-	-	-	-	> 20
CAT-M1 eFDD 4	high	rms	maxhold	5	1755.0	-42.16	-17.5	24.66

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD 12	low	rms	maxhold	100	697.8	-40.12	-13	27.12
CAT-M1 eFDD 12	mid	rms	maxhold	-	-	-	-	> 20
CAT-M1 eFDD 12	high	rms	maxhold	30	716.0	-37.4	-13	24.40

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD 13	low	rms	maxhold	100	774.9	-45.12	-35	10.12
CAT-M1 eFDD 13	low	rms	maxhold	30	775.9	-44.01	-13	31.01
CAT-M1 eFDD 13	mid	rms	maxhold	-	-	-	-	> 20
CAT-M1 eFDD 13	high	rms	maxhold	30	787.0	-37.07	-13	24.07
CAT-M1 eFDD 13	high	rms	maxhold	100	794.7	-49.74	-35	14.74

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD 66	low	rms	maxhold	20	1710.0	-27.44	-17.5	9.94
CAT-M1 eFDD 66	mid	rms	maxhold	-	-	-	-	> 20
CAT-M1 eFDD 66	high	rms	maxhold	20	1780.0	-34.89	-17.5	17.39

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD 4	low	rms	maxhold	2	1709.9	-22.69	-13	9.69
NB-IoT eFDD 4	mid	rms	maxhold	-	-	-	-	> 20
NB-IoT eFDD 4	high	rms	maxhold	2	1755.0	-18.83	-13	5.83

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD 12	low	rms	maxhold	30	698.0	-57.05	-13	44.05
NB-IoT eFDD 12	mid	rms	maxhold	-	-	-	-	> 20
NB-IoT eFDD 12	high	rms	maxhold	30	716.0	-30.32	-13	17.32

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD 13	low	rms	maxhold	30	776.0	-57.84	-13	44.84
NB-IoT eFDD 13	mid	rms	maxhold	-	-	-	-	> 20
NB-IoT eFDD 13	high	rms	maxhold	30	788.0	-57.81	-13	44.81

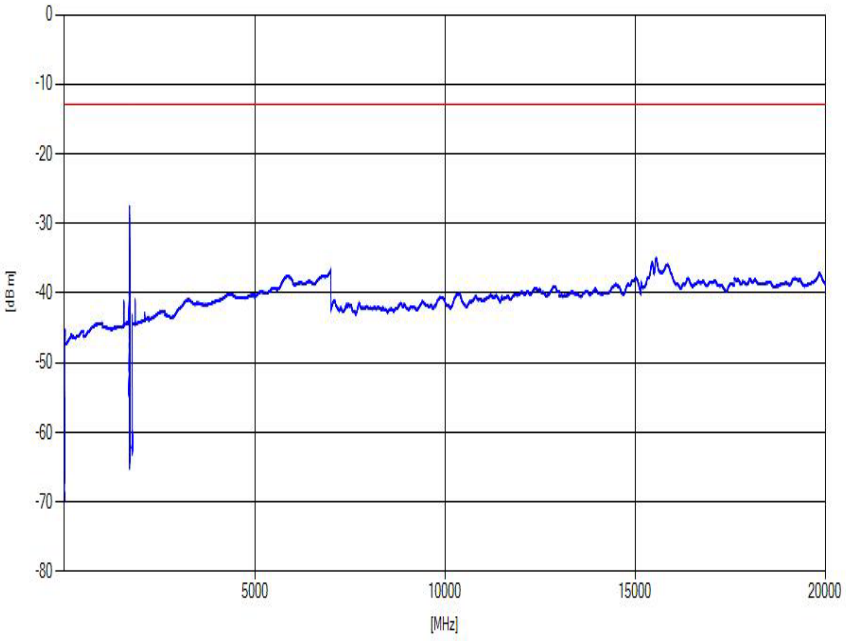
Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD 66	low	rms	maxhold	2	1710.0	-21.22	-13	8.22
NB-IoT eFDD 66	mid	rms	maxhold	-	-	-	-	> 20
NB-IoT eFDD 66	high	rms	maxhold	2	1780.0	-17.73	-13	4.73
NB-IoT eFDD 66	high	rms	maxhold	100	1781.0	-50.37	-23	27.37

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD 85	low	rms	maxhold	30	698.0	-30.38	-13	17.38
NB-IoT eFDD 85	mid	rms	maxhold	-	-	-	-	> 20
NB-IoT eFDD 85	high	rms	maxhold	30	716.0	-30.45	-13	17.45

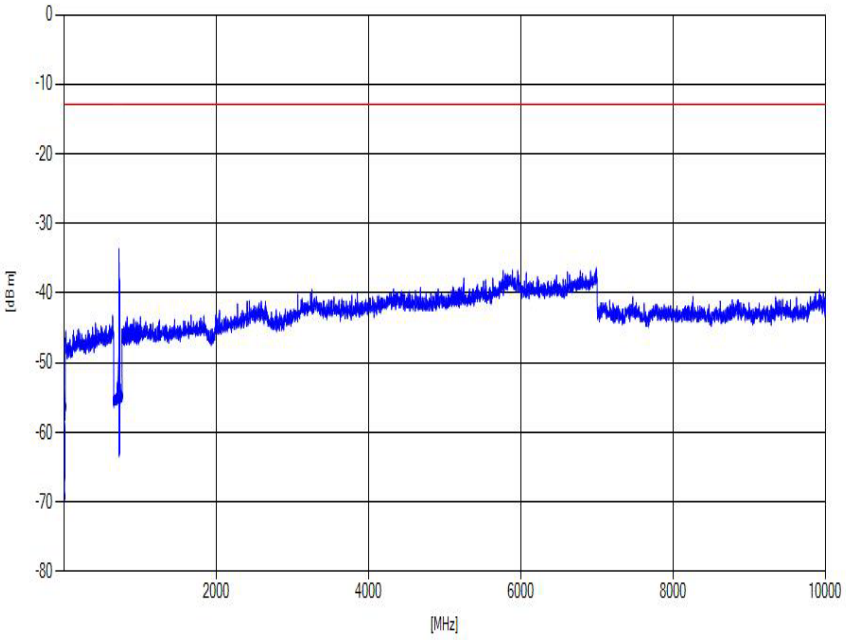
Remark: Please see next sub-clause for the measurement plot.

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

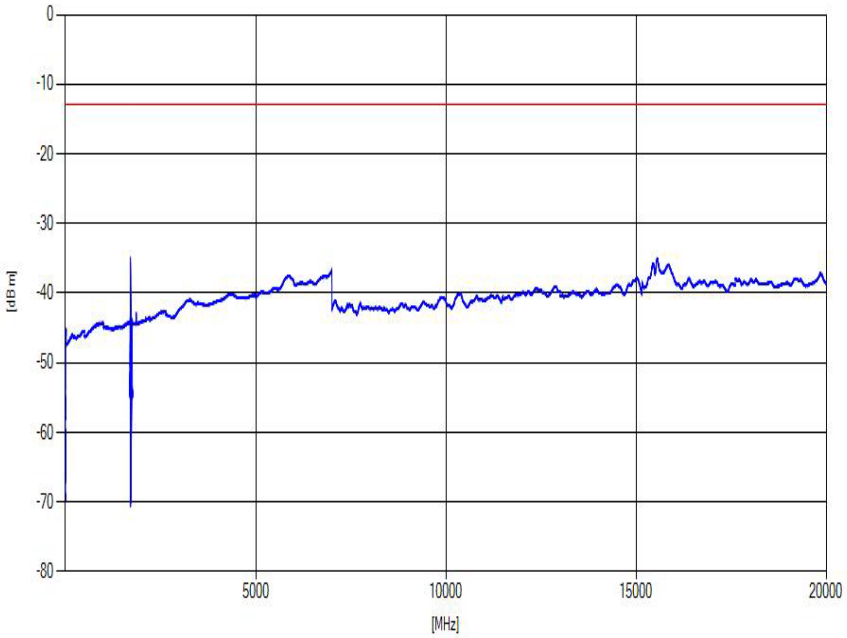
Technology = CAT-M1, Radio Technology = eFDD 66, Operating Frequency = low channel (S01_AB01)



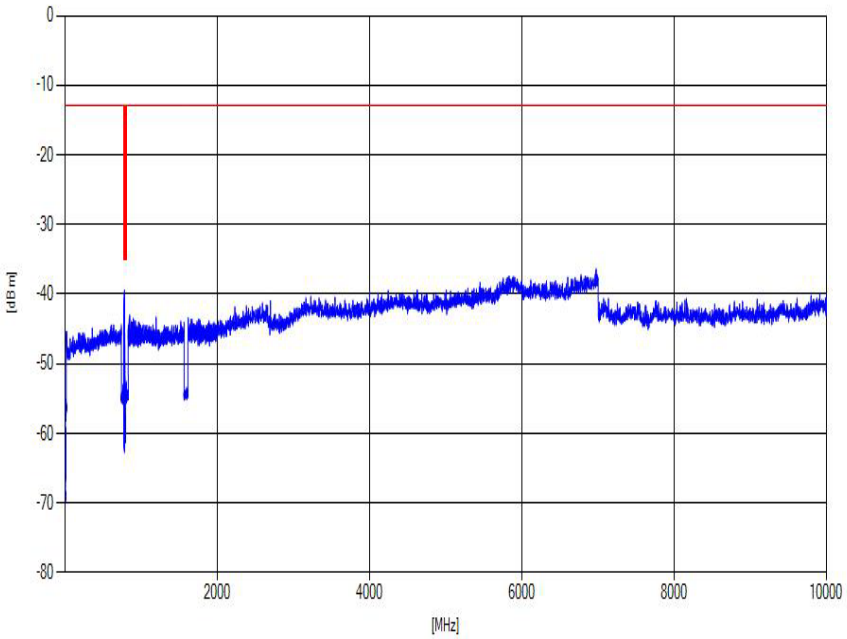
Technology = CAT-M1, Radio Technology = eFDD 12, Operating Frequency = high channel (S01_AB01)



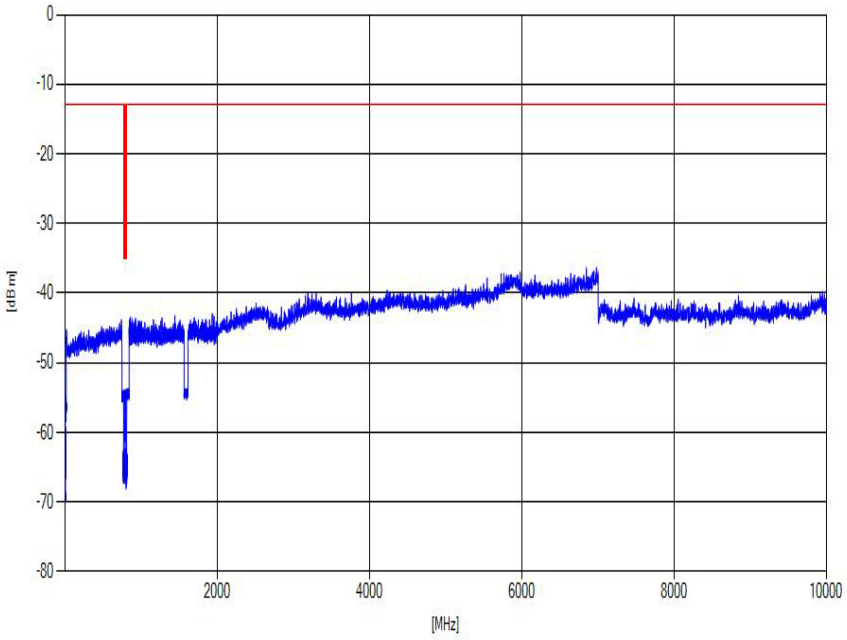
Technology = CAT-M1, Radio Technology = eFDD 4, Operating Frequency = low channel (S01_AB01)



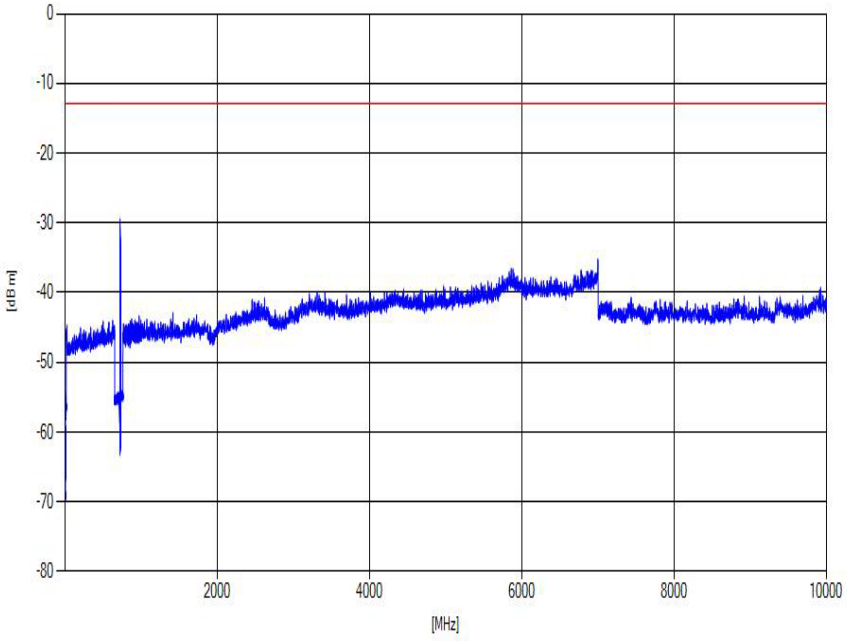
Technology = CAT-M1, Radio Technology = eFDD 13, Operating Frequency = low channel (S01_AB01)



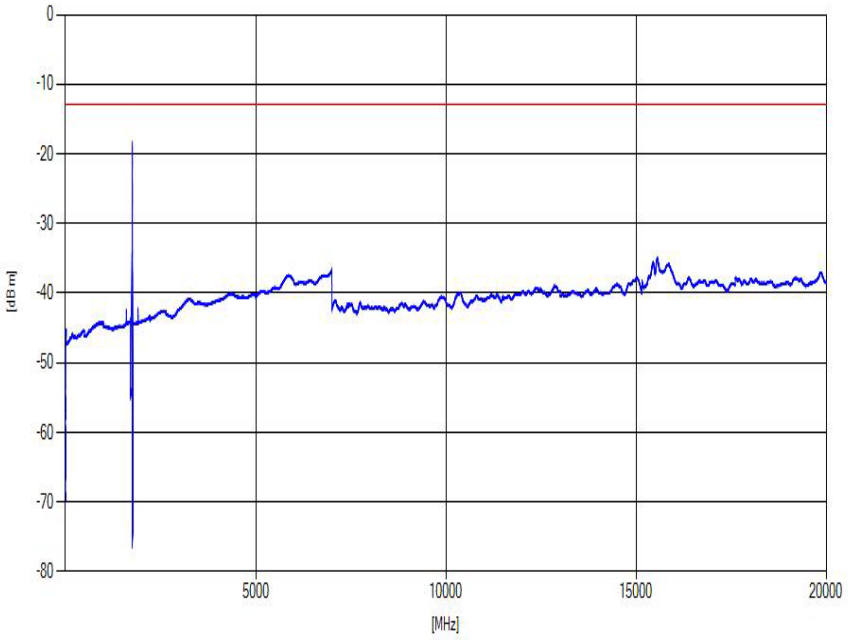
Technology = NB-IoT, Radio Technology = eFDD 13, Operating Frequency = high channel (S01_AE01)



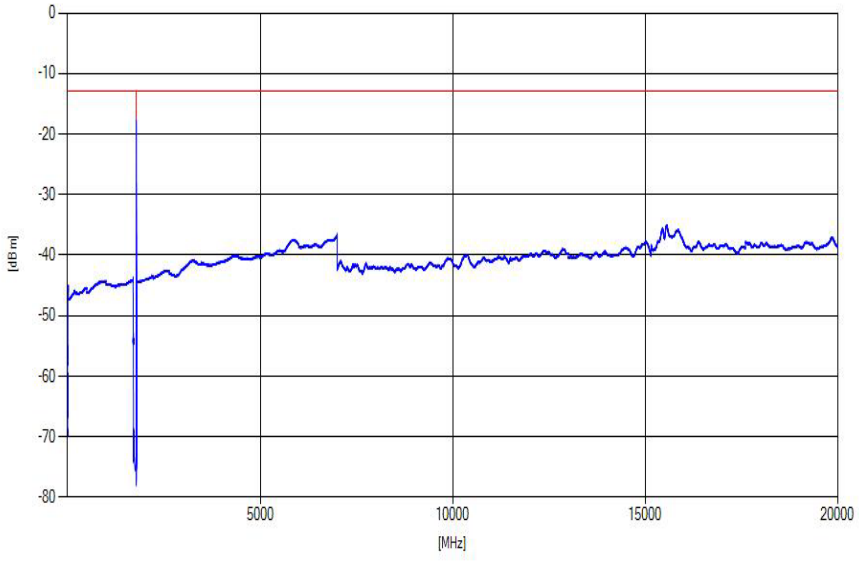
Technology = NB-IoT, Radio Technology = eFDD 12, Operating Frequency = high channel (S01_AE01)



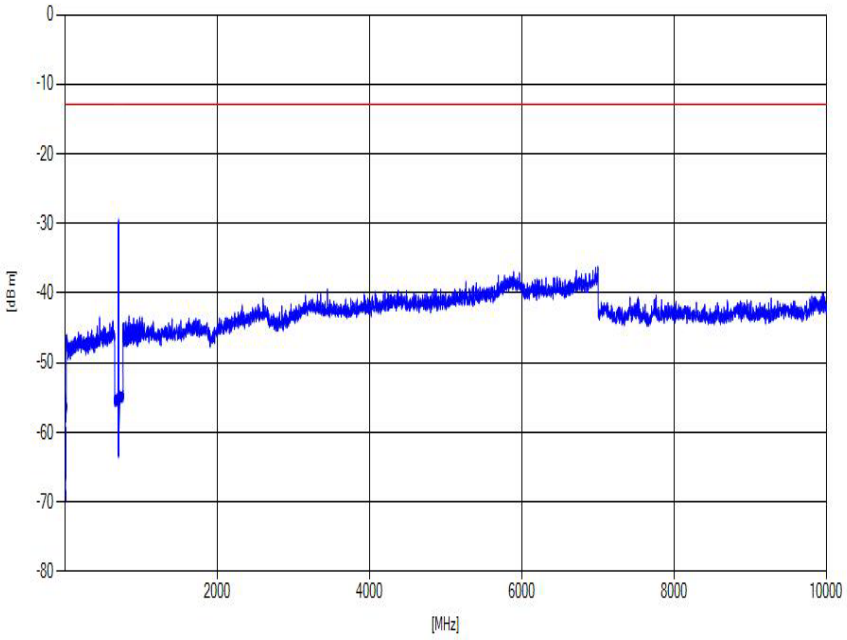
Technology = NB-IoT, Radio Technology = eFDD 4, Operating Frequency = high channel (S01_AE01)



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



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



5.17.5 TEST EQUIPMENT USED

- Radio Lab

5.18 FIELD STRENGTH OF SPURIOUS RADIATION

Standard **FCC PART 27 Subpart C**

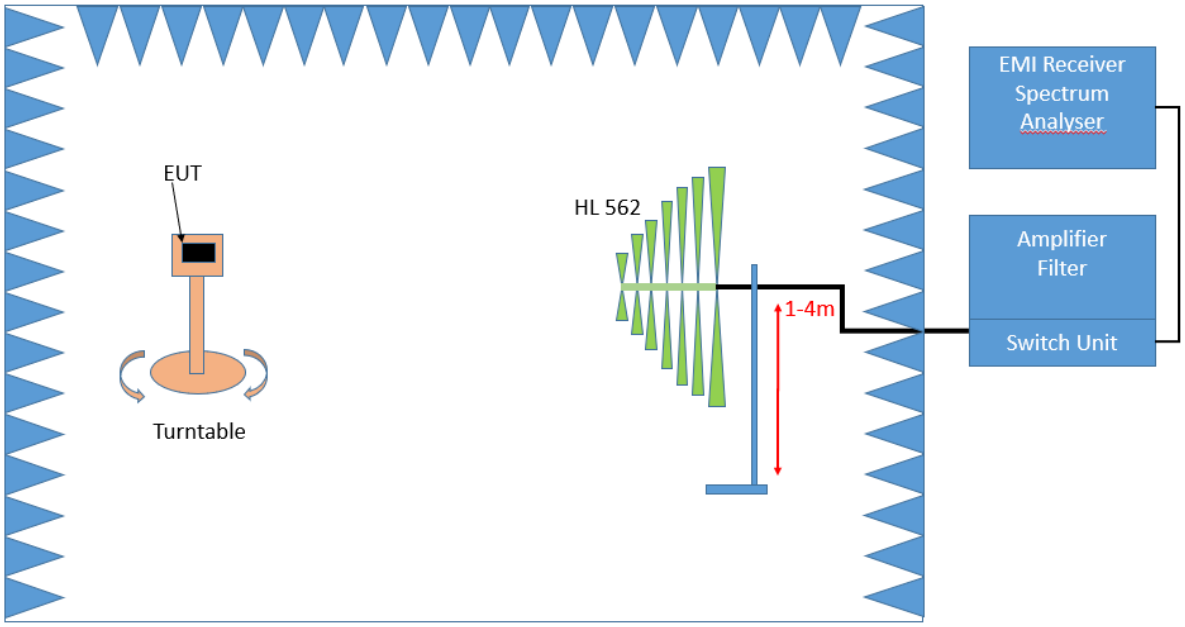
The test was performed according to:
ANSI C63.26: 2015; 5.5.2.3.1

5.18.1 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.

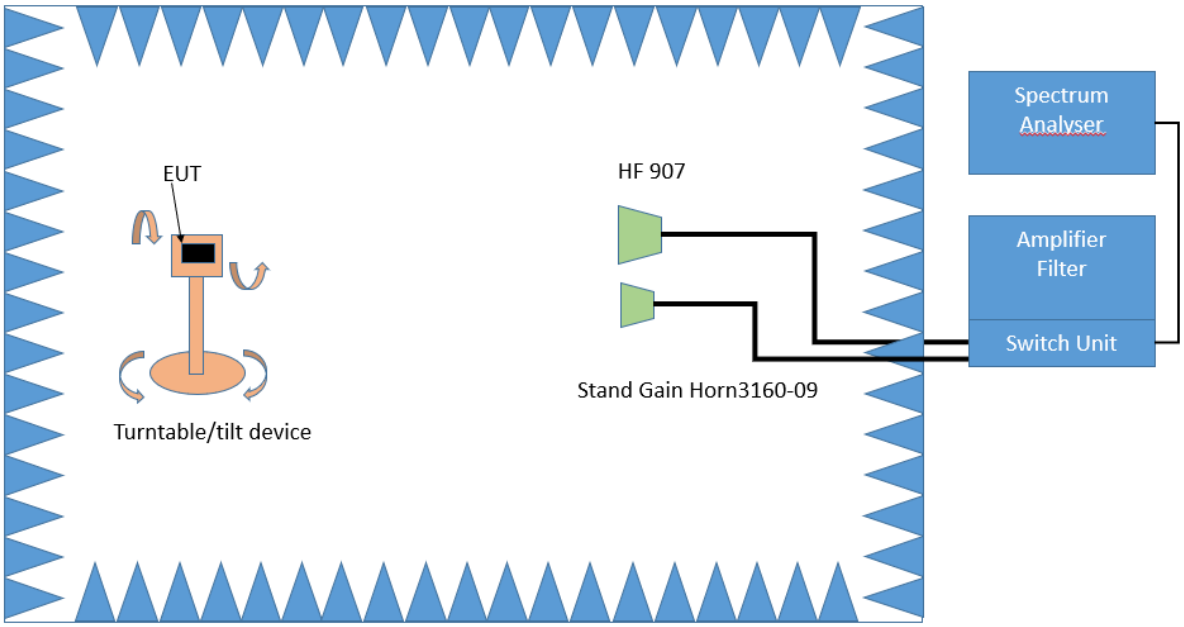
The EUT was connected to the test setup according to the following diagram:

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: 1 MHz
- VBW: 3 MHz
- 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: 1 MHz
- VBW: 3 MHz
- 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

5.18.2 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 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 4/66:

(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; 5.6 Transmitter Unwanted Emissions

Unwanted emissions shall be measured in terms of average values.

For all equipment, the TRP or total conducted power (sum of conducted power across all antenna connectors) of the unwanted emissions outside the frequency block or frequency block group shall not exceed the limits shown in table 6.

Table 6: Unwanted emission limits	
Offset from the edge of the frequency	Unwanted emission limits
1 MHz	-13 dBm / (1% of occupied bandwidth)
> 1 MHz	-13 dBm / MHz

5.18.3 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 4	low	rms	maxhold	20	1710.0	-21.6	-13	8.60
CAT-M1 eFDD 4	mid	rms	maxhold	-	-	-	-13	> 20
CAT-M1 eFDD 4	high	rms	maxhold	20	1755.0	-25	-13	12.00

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD 12	low	rms	maxhold	30	698.9	-38.92	-13	25.92
CAT-M1 eFDD 12	mid	rms	maxhold	-	-	-	-13	> 20
CAT-M1 eFDD 12	high	rms	maxhold	100	718.0	-53.56	-13	40.56

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD 13	low	rms	maxhold	100	774.9	-47.66	-35	12.66
CAT-M1 eFDD 13	mid	rms	maxhold	-	-	-	-13	> 20
CAT-M1 eFDD 13	high	rms	maxhold	100	773.6	-59.29	-35	24.29

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD 66	low	rms	maxhold	1000	1709.0	-14.5	-13	1.50
CAT-M1 eFDD 66	mid	rms	maxhold	-	-	-	-13	> 20
CAT-M1 eFDD 66	high	rms	maxhold	20	1780.0	-25.2	-13	12.20
CAT-M1 eFDD 66	high	rms	maxhold	100	1781.2	-28.3	-23	5.30

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD 4	low	rms	maxhold	2	1710.0	-17.28	-13	4.28
NB-IoT eFDD 4	mid	rms	maxhold	-	-	-	-13	> 20
NB-IoT eFDD 4	high	rms	maxhold	2	1755.0	-17.79	-13	4.79

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD 12	low	rms	maxhold	30	699.0	-66.47	-13	53.47
NB-IoT eFDD 12	mid	rms	maxhold	-	-	-	-13	> 20
NB-IoT eFDD 12	high	rms	maxhold	100	716.1	-38.62	-13	25.62

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD 13	low	rms	maxhold	-	-	-	-13	> 20
NB-IoT eFDD 13	mid	rms	maxhold	-	-	-	-13	> 20
NB-IoT eFDD 13	high	rms	maxhold	30	787.0	-28.32	-13	15.32

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD 66	low	rms	maxhold	2	1710.0	-17.2	-13	4.20
NB-IoT eFDD 66	mid	rms	maxhold	-	-	-	-13	> 20
NB-IoT eFDD 66	high	rms	maxhold	2	1780.0	-14.7	-13	1.70
NB-IoT eFDD 66	high	rms	maxhold	1000	1781.4	-15.6	-13	2.60

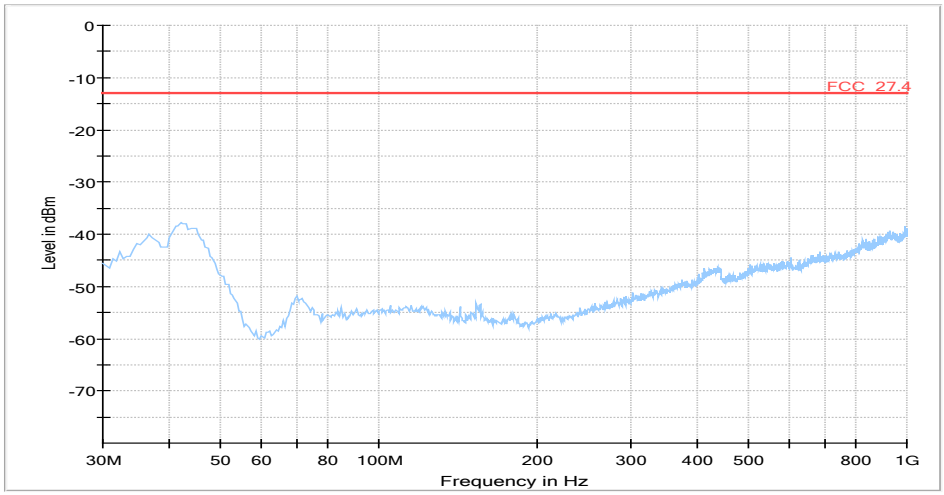
Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD 85	low	rms	maxhold	100	697.9	-37.83	-13	24.83
NB-IoT eFDD 85	mid	rms	maxhold	100	801.3	-32.91	-13	19.91
NB-IoT eFDD 85	high	rms	maxhold	100	716.1	-46.64	-13	33.64

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

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

Technology = CAT-M1, Radio Technology = eFDD 4, Operating Frequency = low channel (S01_AA01)

30 MHz – 1 GHz



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin	Meas. Time (ms)	Bandwidth	Height	Pol	Azimuth	Corr. (dB)	Comment
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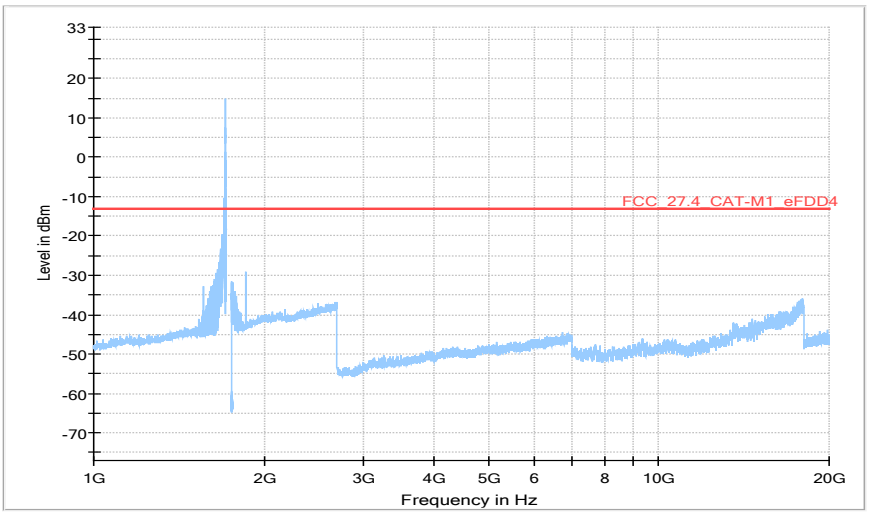
1 GHz – 20 GHz



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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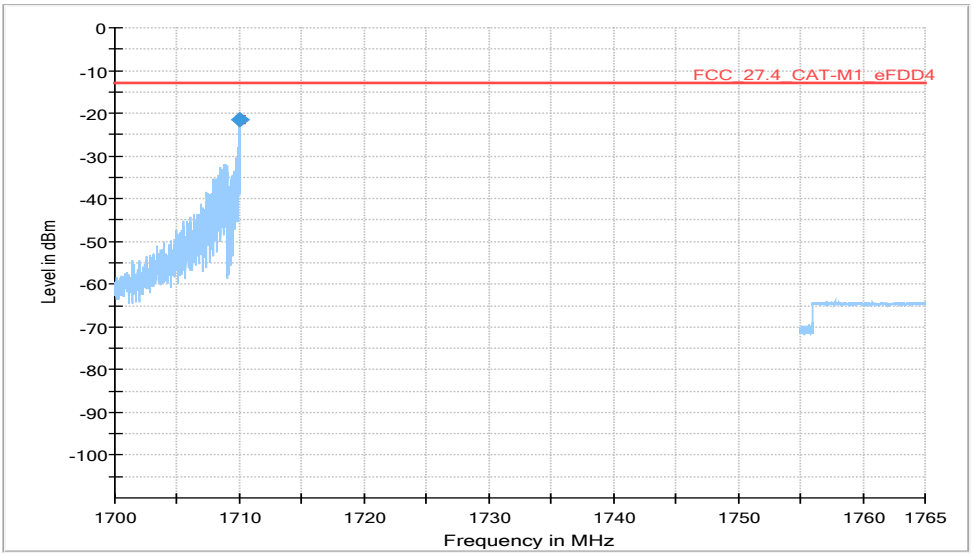
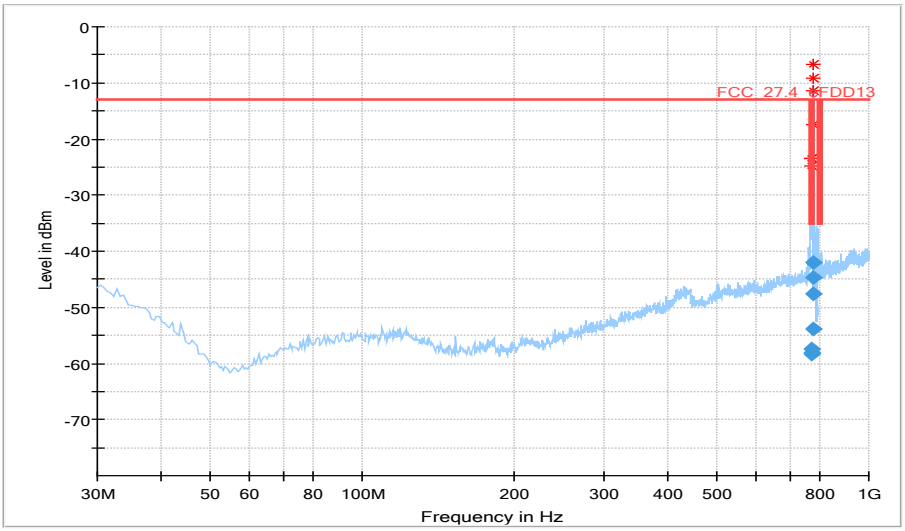
Re-measurement at band edge



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1709.991	-21.6	-13.00	8.60	1000.0	20.000	150.0	V	-135.0	90.0	-67.3

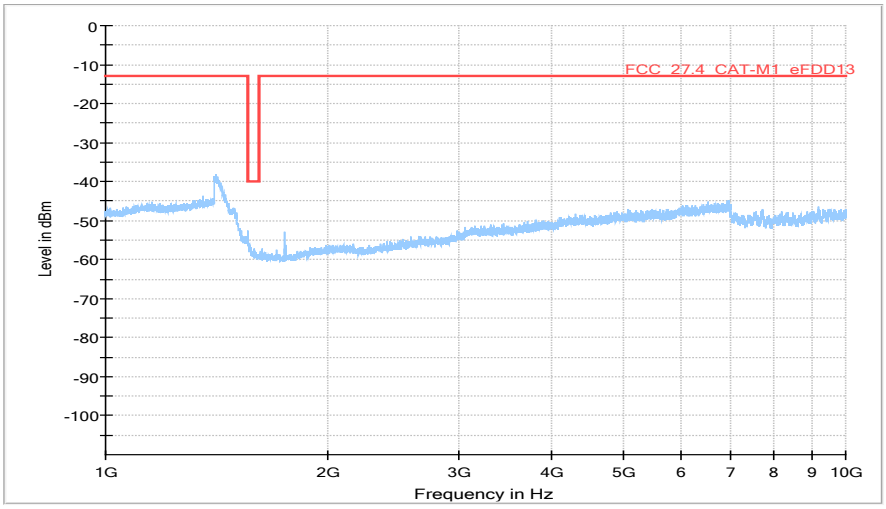
Technology = CAT-M1, Radio Technology = eFDD 13, Operating Frequency = low channel (S01_AA01)
30 MHz – 1 GHz



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
769.778813	-58.26	-35.00	23.26	1000.0	100.000	103.0	H	-59.0	-74.1
771.175500	-57.51	-35.00	22.51	1000.0	100.000	108.0	H	-57.0	-74.1
772.106625	-58.06	-35.00	23.06	1000.0	100.000	119.0	H	-69.0	-74.1
773.968875	-53.82	-35.00	18.82	1000.0	100.000	113.0	H	-42.0	-74.1
774.943167	-47.66	-35.00	12.66	1000.0	100.000	106.0	H	-52.0	-74.0
775.558333	-44.73	-13.00	31.73	1000.0	100.000	113.0	H	-43.0	-74.0
775.873333	-42.07	-13.00	29.07	1000.0	100.000	105.0	H	-70.0	-74.0

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)
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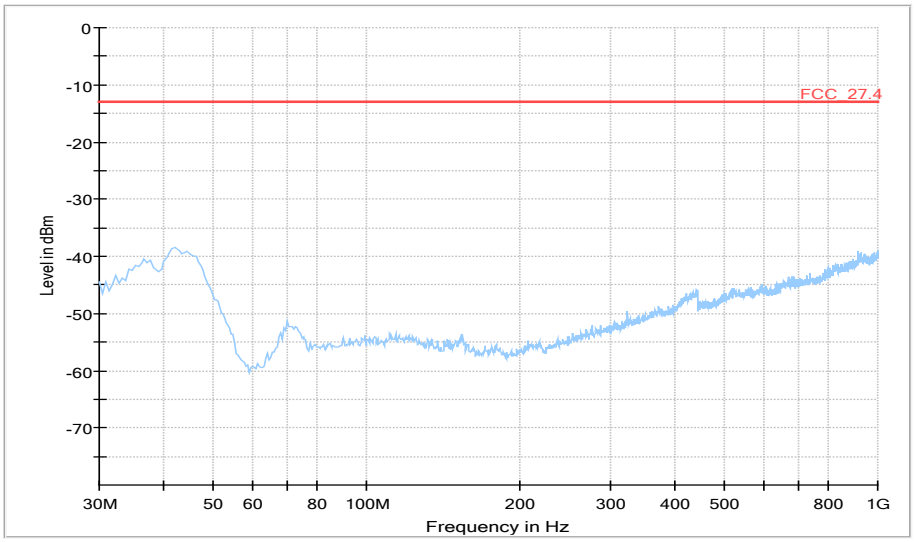
Technology = CAT-M1, Radio Technology = eFDD 66, Operating Frequency = low channel (S01_AA01)
30 MHz – 1 GHz



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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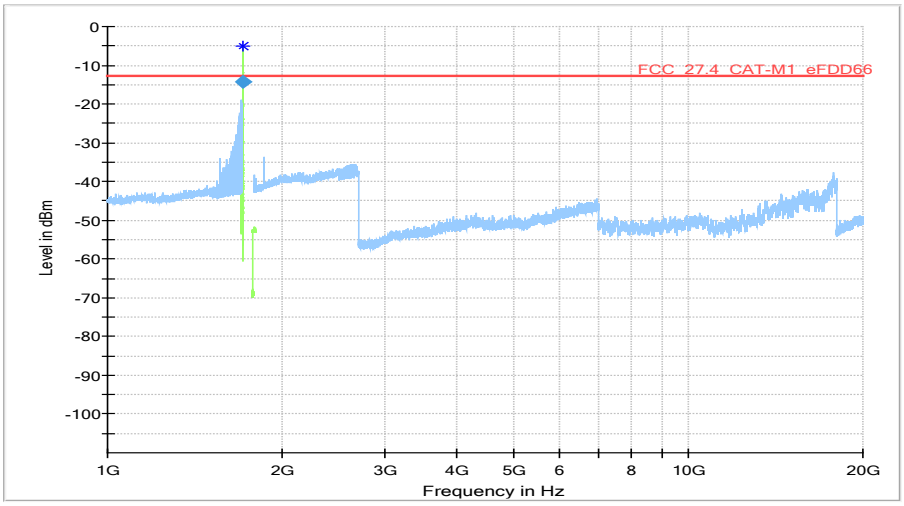
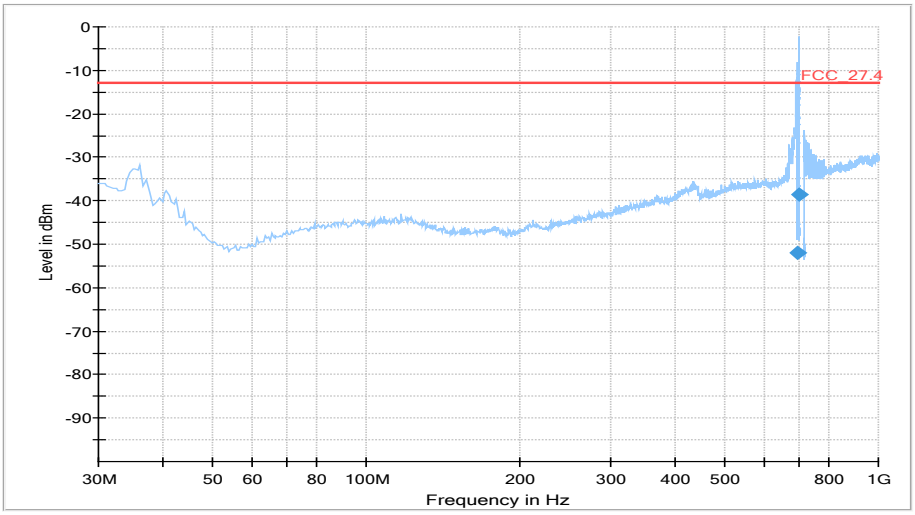
1 GHz – 20 GHz



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1708.993	-14.5	-13.00	1.52	1000.0	1000.000	150.0	H	82.0	-12.0	-65.7

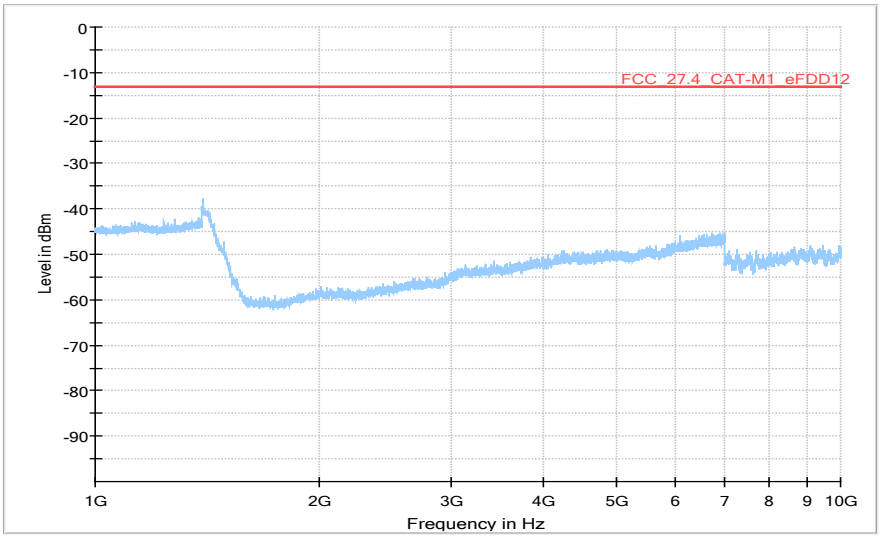
Technology = CAT-M1, Radio Technology = eFDD 12, Operating Frequency = low channel (S01_AA01)
30 MHz – 1GHz



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
695.483813	-52.34	-13.00	39.34	1000.0	100.000	115.0	H	217.0	-75.2
698.895000	-38.92	-13.00	25.92	1000.0	30.000	126.0	V	-183.0	-75.1

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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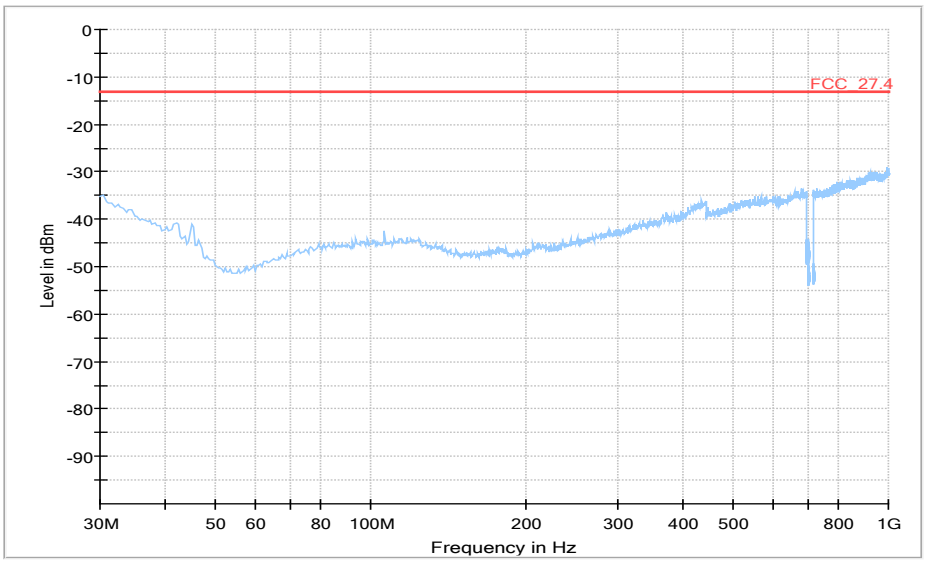
Technology = NB-IoT, Radio Technology = eFDD 85, Operating Frequency = mid channel (S01_AA01)
30 MHz – 1 GHz



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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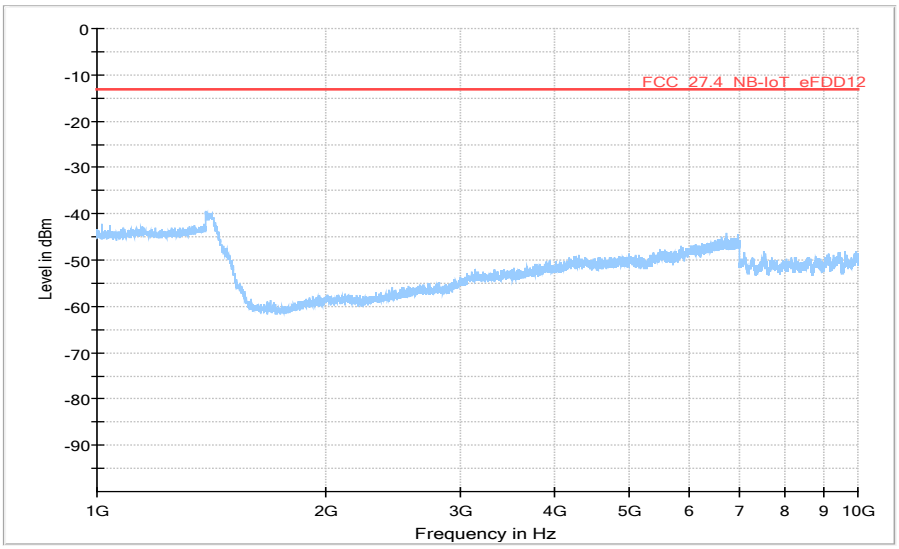
1 GHz – 10 GHz



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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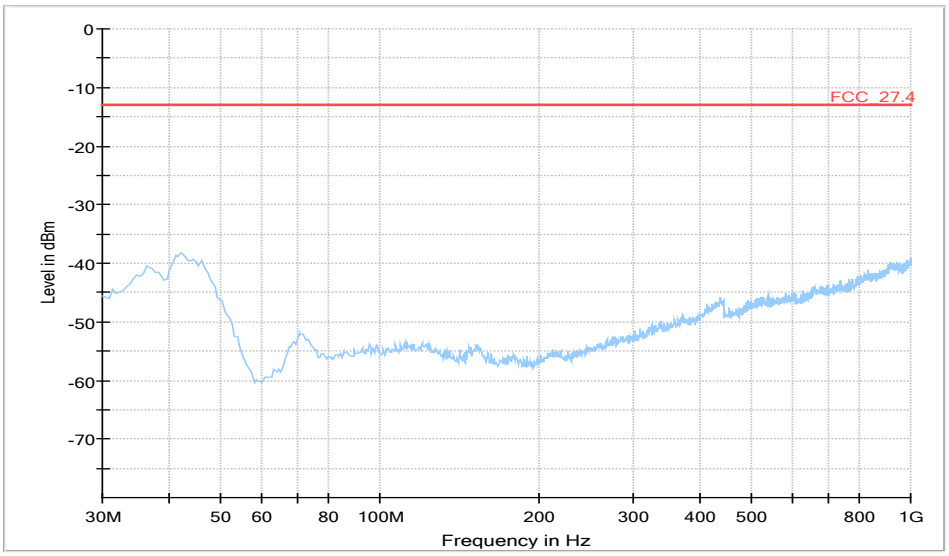
Technology = NB-IoT, Radio Technology = eFDD 66, Operating Frequency = high channel (S01_AA01)
30 MHz – 1 GHz



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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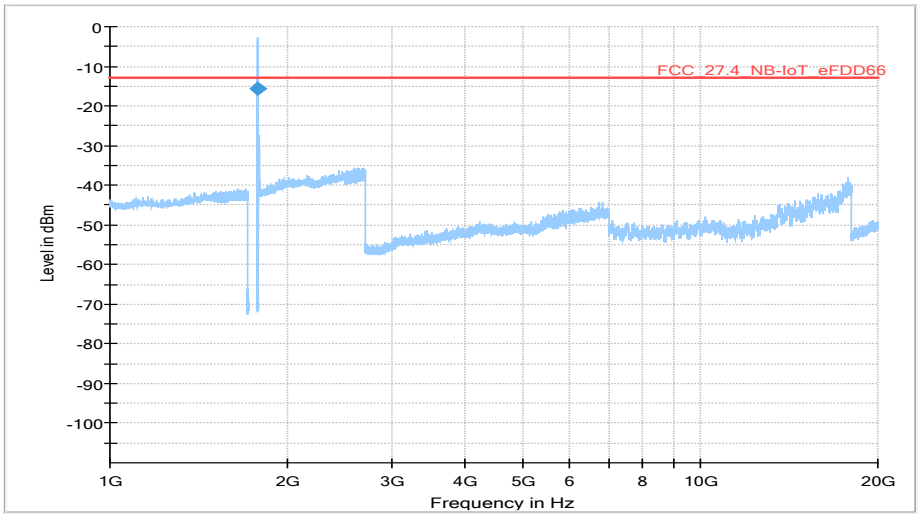
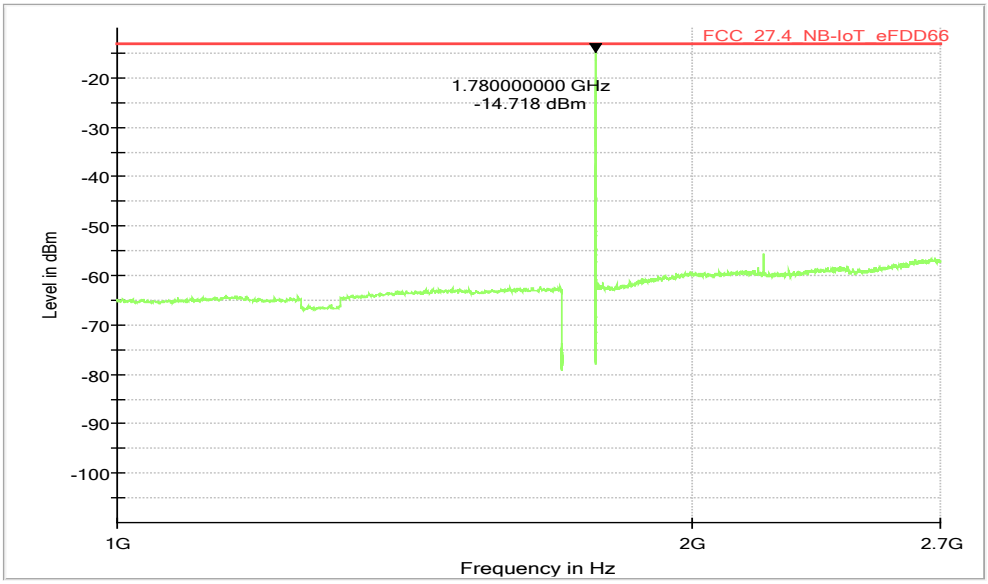
1 GHz – 20 GHz



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1781.360	-15.6	-13.00	2.62	1000.0	1000.000	150.0	V	-49.0	22.0	-65.6

Re-measurement at band edge



Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
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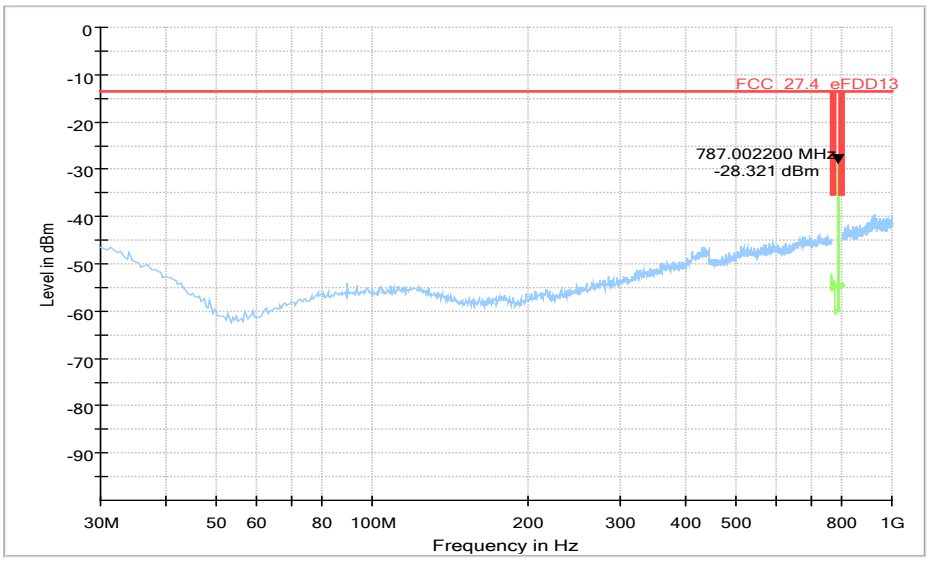
Technology = NB-IoT, Radio Technology = eFDD 13, Operating Frequency = high channel (S01_AA01)
30 MHz – 1 GHz



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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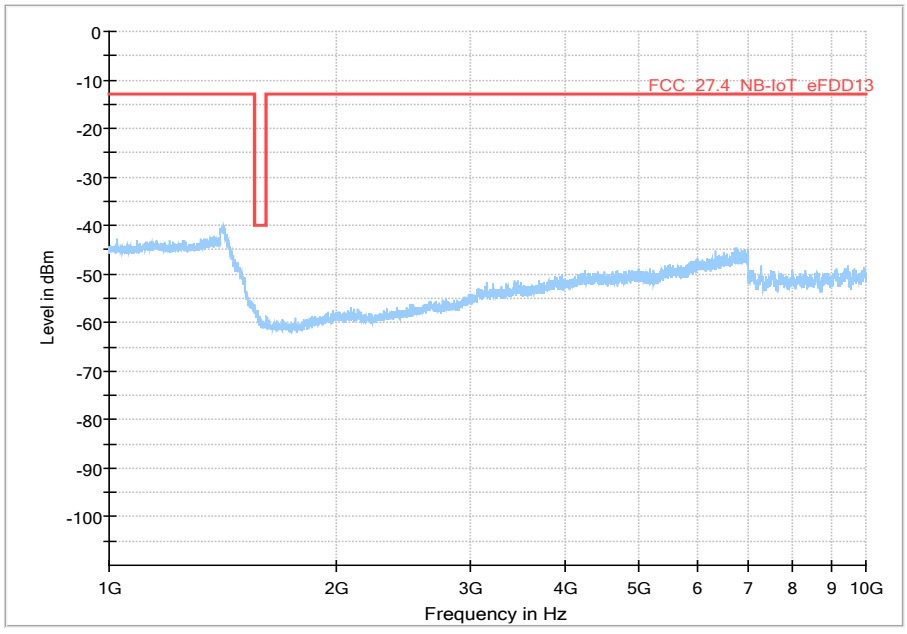
1 GHz – 10 GHz



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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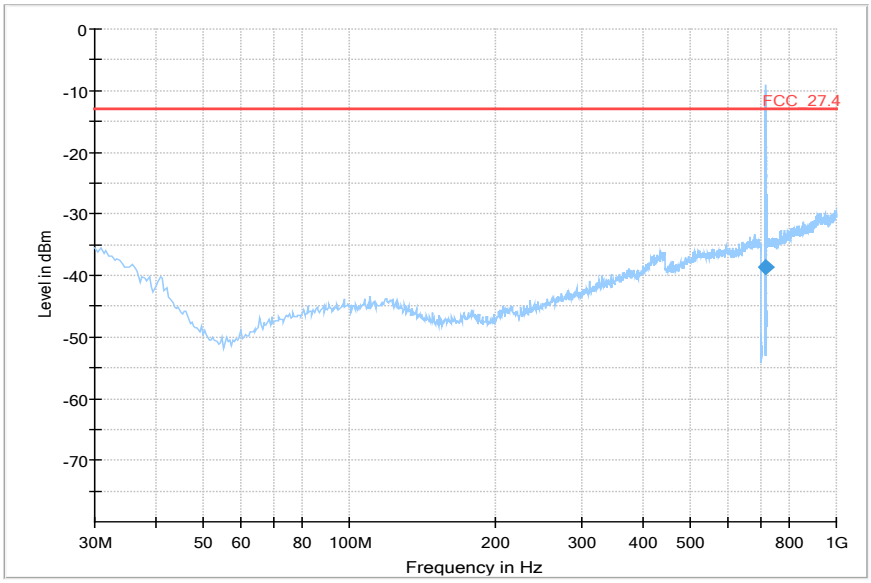
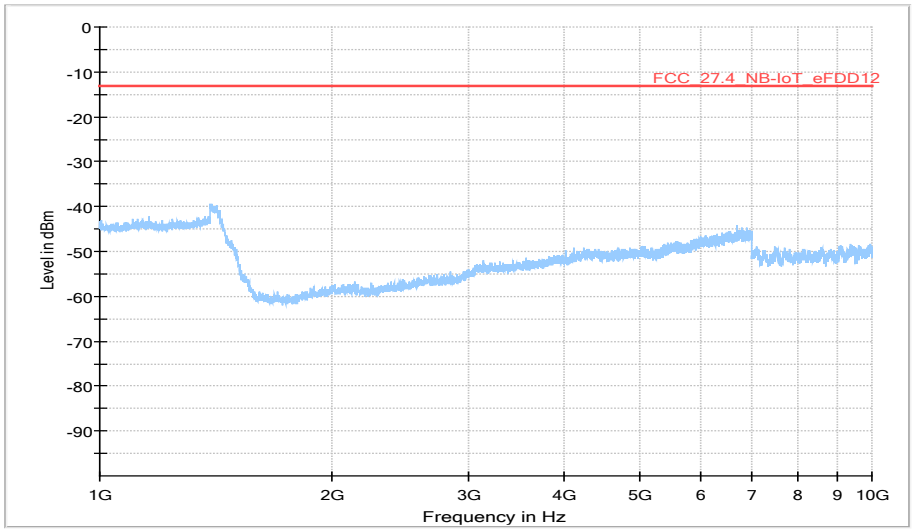
Technology = NB-IoT, Radio Technology = eFDD 12, Operating Frequency = high channel (S01_AA01)
30 MHz – 1 GHz



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
716.120667	-38.62	-13.00	25.62	1000.0	100.000	108.0	H	215.0	-74.7

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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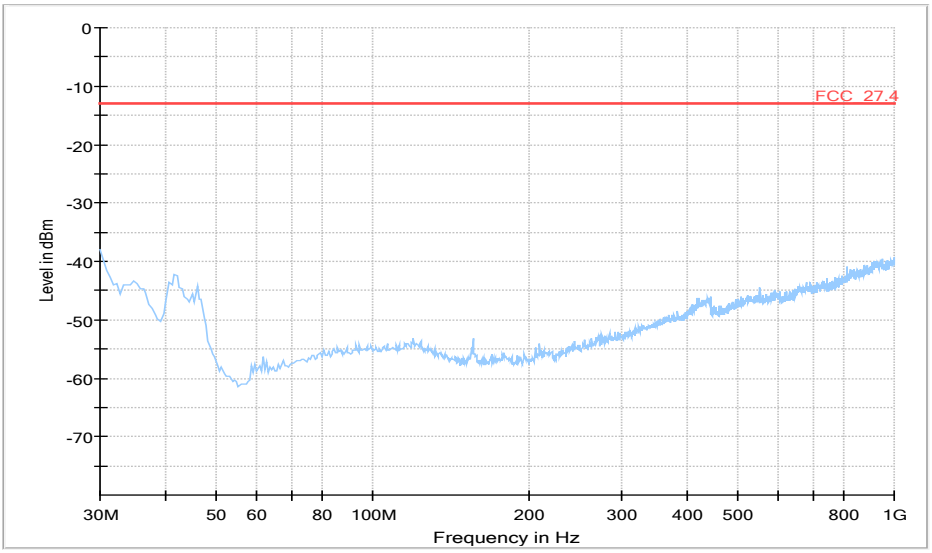
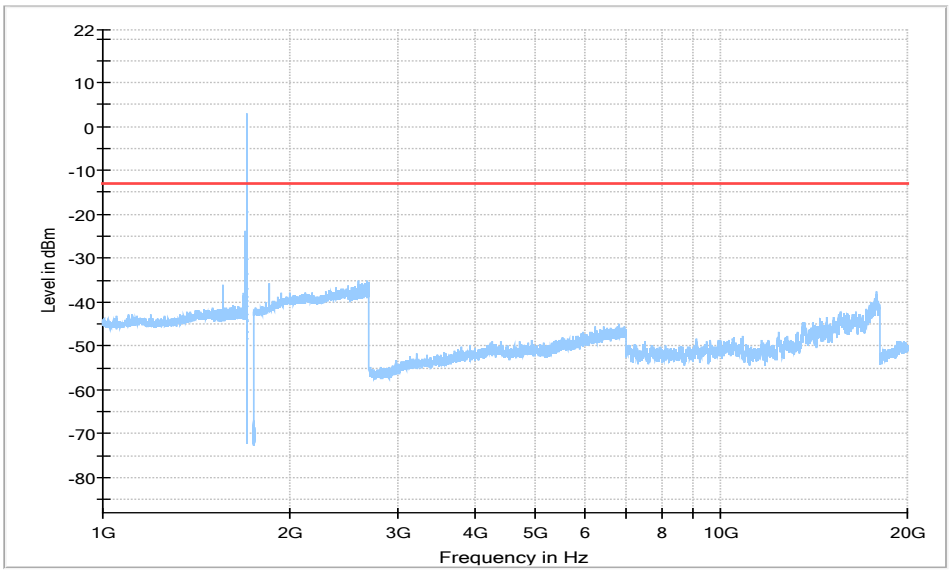
Technology = NB-IoT, Radio Technology = eFDD 4, Operating Frequency = low channel (S01_AA01)
30 MHz – 1 GHz



Final_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin	Meas. Time (ms)	Bandwidth	Height	Pol	Azimuth	Corr. (dB)	Comment
---	---	---	---	---	---	---		---	---	

1 GHz – 20 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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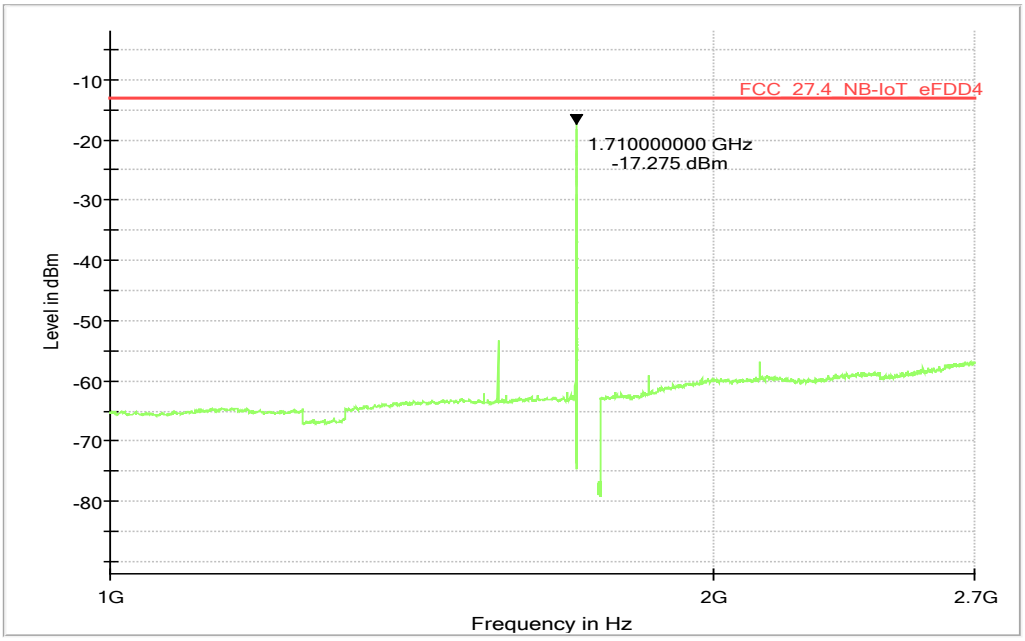
Re-measurement at band edge



Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
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5.18.5 TEST EQUIPMENT USED

- Radiated Emissions

5.19 EMISSION AND OCCUPIED BANDWIDTH

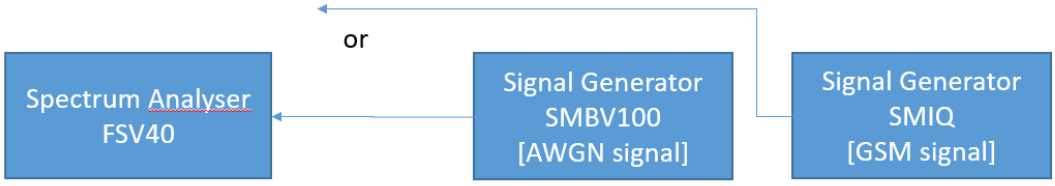
Standard **FCC PART 27 Subpart C**

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%))

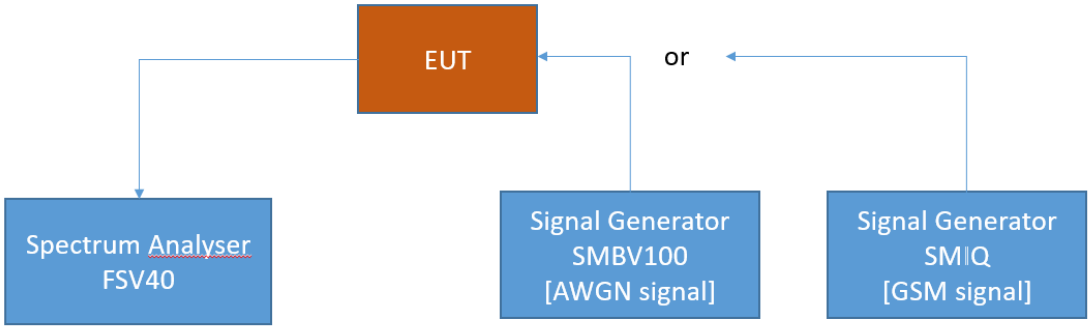
5.19.1 TEST DESCRIPTION

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.

5.19.2 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.

5.19.3 TEST PROTOCOL

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

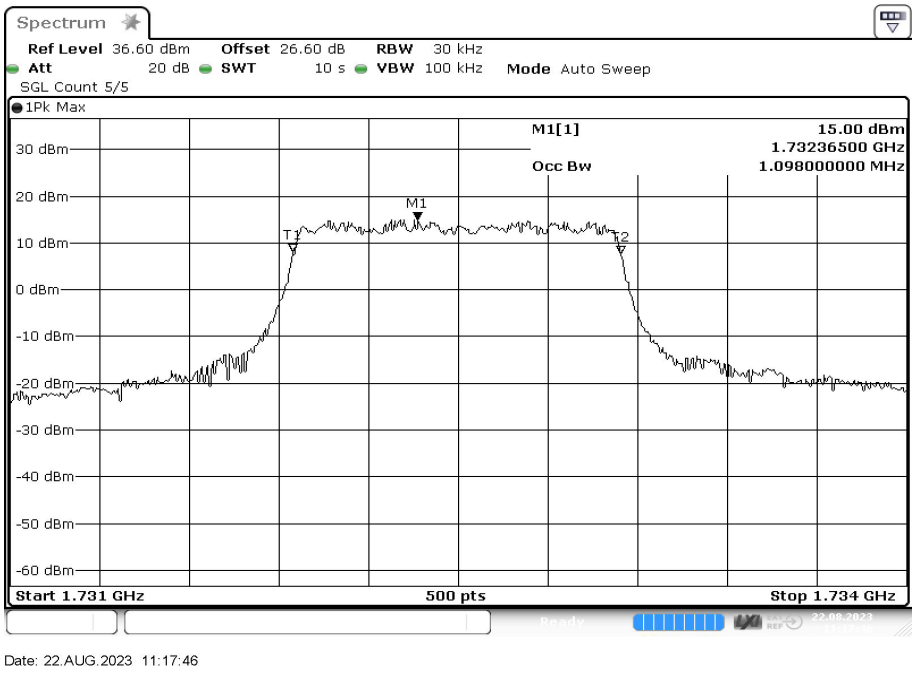
Radio Technology	Channel	Resource Blocks / Subcarrier	Bandwidth [MHz]	Nominal BW [MHz]	26 dB BW [kHz]	99 % BW [kHz]
CAT-M1 eFDD 4 QPSK	low	6	1.4	1	-	1098
CAT-M1 eFDD 4 QPSK	mid	6	1.4	1	-	1098
CAT-M1 eFDD 4 QPSK	high	6	1.4	1	-	1098
CAT-M1 eFDD 4 16QAM	low	5	1.4	1	-	930
CAT-M1 eFDD 4 16QAM	mid	5	1.4	1	-	924
CAT-M1 eFDD 4 16QAM	high	5	1.4	1	-	924
CAT-M1 eFDD 12 QPSK	low	6	1.4	1	-	1098
CAT-M1 eFDD 12 QPSK	mid	6	1.4	1	-	1100
CAT-M1 eFDD 12 QPSK	high	6	1.4	1	-	1101
CAT-M1 eFDD 12 16QAM	low	5	1.4	1	-	930
CAT-M1 eFDD 12 16QAM	mid	5	1.4	1	-	932
CAT-M1 eFDD 12 16QAM	high	5	1.4	1	-	936
CAT-M1 eFDD 13 QPSK	low	6	1.4	1	-	1098
CAT-M1 eFDD 13 QPSK	mid	6	1.4	1	-	1098
CAT-M1 eFDD 13 QPSK	high	6	1.4	1	-	1098
CAT-M1 eFDD 13 16QAM	low	5	1.4	1	-	936
CAT-M1 eFDD 13 16QAM	mid	5	1.4	1	-	930
CAT-M1 eFDD 13 16QAM	high	5	1.4	1	-	924
CAT-M1 eFDD 66 QPSK	low	6	1.4	1	-	1098
CAT-M1 eFDD 66 QPSK	mid	6	1.4	1	-	1098
CAT-M1 eFDD 66 QPSK	high	6	1.4	1	-	1098
CAT-M1 eFDD 66 16QAM	low	5	1.4	1	-	924
CAT-M1 eFDD 66 16QAM	mid	5	1.4	1	-	936
CAT-M1 eFDD 66 16QAM	high	5	1.4	1	-	936
NB-IoT eFDD 4 QPSK	low	12	0.2	0	-	184
NB-IoT eFDD 4 QPSK	mid	12	0.2	0	-	186
NB-IoT eFDD 4 QPSK	high	12	0.2	0	-	188
NB-IoT eFDD 4 BPSK	low	1	0.2	0	-	132
NB-IoT eFDD 4 BPSK	mid	1	0.2	0	-	136
NB-IoT eFDD 4 BPSK	high	1	0.2	0	-	132
NB-IoT eFDD 12 QPSK	low	12	0.2	0	-	186
NB-IoT eFDD 12 QPSK	mid	12	0.2	0	-	190
NB-IoT eFDD 12 QPSK	high	12	0.2	0	-	186
NB-IoT eFDD 12 BPSK	low	1	0.2	0	-	136
NB-IoT eFDD 12 BPSK	mid	1	0.2	0	-	134
NB-IoT eFDD 12 BPSK	high	1	0.2	0	-	134
NB-IoT eFDD 13 QPSK	low	12	0.2	0	-	188
NB-IoT eFDD 13 QPSK	mid	12	0.2	0	-	186
NB-IoT eFDD 13 QPSK	high	12	0.2	0	-	186
NB-IoT eFDD 13 BPSK	low	1	0.2	0	-	136
NB-IoT eFDD 13 BPSK	mid	1	0.2	0	-	138
NB-IoT eFDD 13 BPSK	high	1	0.2	0	-	132
NB-IoT eFDD 66 QPSK	low	12	0.2	0	-	186
NB-IoT eFDD 66 QPSK	mid	12	0.2	0	-	188

NB-IoT eFDD 66 QPSK	high	12	0.2	0	-	188
NB-IoT eFDD 66 BPSK	low	1	0.2	0	-	130
NB-IoT eFDD 66 BPSK	mid	1	0.2	0	-	130
NB-IoT eFDD 66 BPSK	high	1	0.2	0	-	136
NB-IoT eFDD 85 QPSK	low	12	0.2	0	-	186
NB-IoT eFDD 85 QPSK	mid	12	0.2	0	-	188
NB-IoT eFDD 85 QPSK	high	12	0.2	0	-	184
NB-IoT eFDD 85 BPSK	low	1	0.2	0	-	134
NB-IoT eFDD 85 BPSK	mid	1	0.2	0	-	134
NB-IoT eFDD 85 BPSK	high	1	0.2	0	-	130

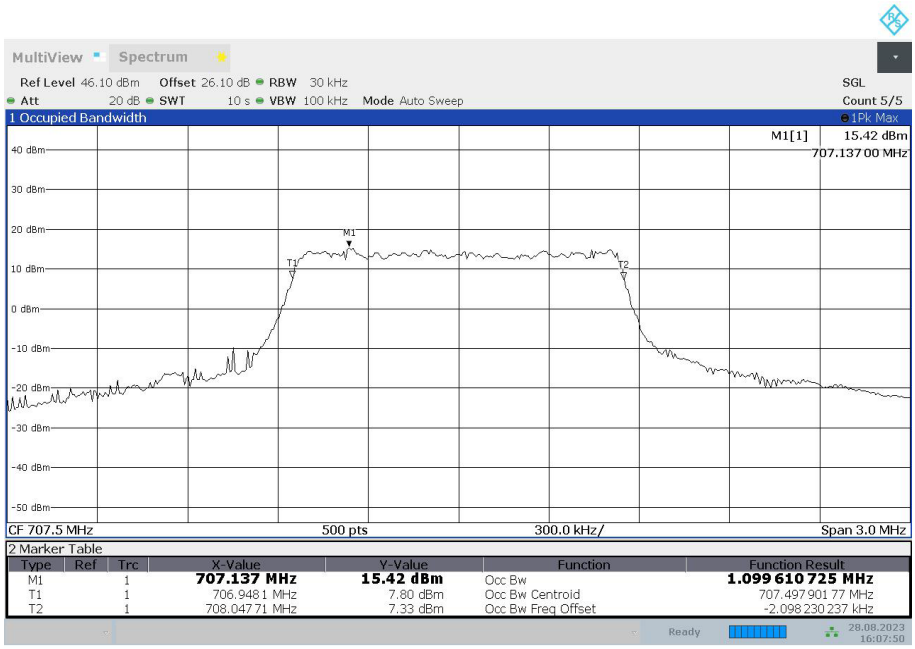
Remark: Please see next sub-clause for the measurement plot.

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

Technology = CAT-M1, Radio Technology = eFDD 4, Operating Frequency = mid channel (S01_AB01)



Technology = CAT-M1, Radio Technology = eFDD 12, Operating Frequency = mid channel (S01_AB01)



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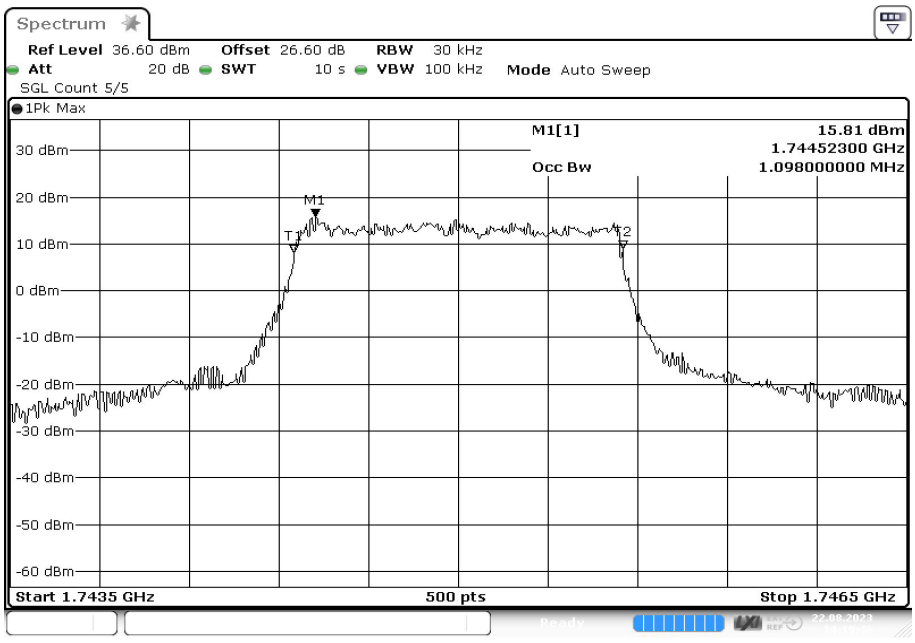
Technology = CAT-M1, Radio Technology = eFDD 66, Operating Frequency = mid channel (S01_AB01)



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