FCC Measurement/Technical Report on

SARA-R520M10X

FCC ID: XPYUBX19KM01
IC: 8595A-UBX19KM01

Test Report Reference: MDE_UBLOX_2219_FCC_01_rev01

Test Laboratory:
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

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

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

Table of Contents

1 Applied Standards and Test Summary 4

1.1 Applied Standards 4

1.2 FCC-IC Correlation Table 6

1.3 Measurement Summary 10

2 Revision History / Signatures 17

3 Administrative Data 18

3.1 Testing Laboratory 18

3.2 Project Data 18

3.3 Applicant Data 18

3.4 Manufacturer Data 18

4 Test object Data 19

4.1 General EUT Description 19

4.2 EUT Main components 19

4.3 Ancillary Equipment 20

4.4 Auxiliary Equipment 20

4.5 EUT Setups 20

4.6 Operating Modes / Test Channels 20

4.7 Product labelling 23

5 Test Results 24

5.1 RF Output power 24

5.2 Spurious emissions at antenna terminals 28

5.3 Field strength of spurious radiation 32

5.4 Band edge compliance 38

5.5 RF Output power 41

5.6 Spurious emissions at antenna terminal 44

5.7 Field strength of spurious radiation 48

5.8 Band edge compliance 54

5.9 RF Output Power 58

5.10 Spurious emissions at antenna terminals 69

5.11 Field strength of spurious radiation 82

5.12 Band edge compliance 92

5.13 RF Output Power 104

5.14 Spurious Emissions at antenna terminals 107

5.15 Band Edge 110

6 Test Equipment 113

6.1 Test Equipment Hardware 113

6.2 Test Equipment Software 117

7 Antenna Factors, Cable Loss and Sample Calculations 118

7.1 LISN R&S ESH3-Z5 (150 kHz – 30 MHz) 118

7.2 Antenna R&S HFH2-Z2 (9 kHz – 30 MHz) 119

7.3 Antenna R&S HL562 (30 MHz – 1 GHz) 120

7.4 Antenna R&S HF907 (1 GHz – 18 GHz) 121
7.5 Antenna EMCO 3160-09 (18 GHz – 26.5 GHz) 122
7.6 Antenna EMCO 3160-10 (26.5 GHz – 40 GHz) 123

8 Measurement Uncertainties 124

9 Photo Report 125

1 APPLIED STANDARDS AND TEST SUMMARY

1.1 APPLIED STANDARDS

Type of Authorization
Certification for a cellular mobile device.

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 22, 24, 27, 90, (10-1-21 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 27; Miscellaneous Wireless Communications Services
Subpart C – Technical standards

§ 27.50 – Power and duty cycle limits
§ 27.53 – Emission limits
§ 27.54 – Frequency stability

Part 24, Subpart E – Broadband PCS

§ 24.232 – Power and antenna height limits
§ 24.235 – Frequency stability
§ 24.238 – Emission limitations for Broadband PCS equipment

Part 90; Private Land Mobile Radio Services

Subpart S—REGULATIONS GOVERNING LICENSING AND USE OF FREQUENCIES IN THE 806-824, 851-869, 896-901, AND 935-940 MHZ BANDS

Subpart R—REGULATIONS GOVERNING THE LICENSING AND USE OF FREQUENCIES IN THE 763-775 AND 793-805 MHZ BANDS

§ 90.635 – Limitations on power and antenna height
§ 90.543 – Emission limitations
§ 90.539 – Frequency stability

Part 22, Subpart H – Cellular Radiotelephone Service

§ 22.905 – Channels for cellular service
§ 22.913 – Effective radiated power limits
§ 22.917 – Emission limitations for cellular equipment

The tests were selected and performed with reference to:

- FCC Public Notice 971168 applying "Measurement guidance for certification of licensed digital transmitters" 971168 D01 v03r01, 2018-04-09

- ANSI C63.26: 2015

1.2 FCC-IC CORRELATION TABLE

Correlation of measurement requirements for Cellular Mobile Devices from FCC and ISED Canada

Measurement	FCC reference	ISED reference
RF Output Power	§ 2.1046 § 27.50	RSS-GEN Issue 5, 6.12 RSS-130 Issue 2, 4.6.2/4.6.3 RSS-139 Issue 4, 5.5 RSS-199 Issue 3, 4.4
Peak to Average-Ratio	§ 27.50	RSS-130 Issue 2: 4.6.1 RSS 139 Issue 4: 5.5 RSS-199 Issue 3, 4.4
Emission and Occupied bandwidth	§ 2.1049	RSS-GEN Issue 5, 6.7
Spurious Emission at Antenna Terminals	§ 2.1051 § 27.53	RSS-GEN Issue 5, 6.13 RSS-130 Issue 2: 4.7.1/4.7.2 RSS-139 Issue 4, 5.6 RSS-199 Issue 3, 4.5
Band Edge Compliance	§ 2.1051 § 27.53	RSS-GEN Issue 5, 6.13 RSS-130 Issue 2: 4.7.1/4.7.2 RSS-139 Issue 4, 5.6 RSS-199 Issue 3, 4.5
Frequency stability	§ 2.1055 § 27.54	RSS-GEN Issue 5, 6.11 RSS-130 Issue 2: 4.5 RSS-139 Issue 4: 5.4 RSS-199 Issue 3, 4.3
Field strength of spurious radiation	§ 2.1053 § 27.53	RSS-GEN Issue 5, 6.13 RSS-130 Issue 2: 4.7.1/4.7.2 RSS-139 Issue 4: 5.6 RSS-199 Issue 3, 4.5

Correlation of measurement requirements for Cellular Mobile Devices from FCC and ISED Canada

Measurement	FCC reference	ISED reference
RF Output Power	§ 2.1046 § 24.232	RSS-GEN Issue 5, 6.12 RSS-133 Issue 6, 6.4
Peak-Average-Ratio	§ 24.232	RSS 133 Issue 6: 6.4
Emission and Occupied bandwidth	§ 2.1049	RSS-GEN Issue 5, 6.7
Spurious Emission at Antenna Terminals	§ 2.1051 § 24.238	RSS-GEN Issue 5, 6.13 RSS-133 Issue 6, 6.5
Band Edge Compliance	§ 2.1051 § 24.238	RSS-GEN Issue 5, 6.13 RSS-133 Issue 6, 6.5
Frequency stability	§ 2.1055 § 24.235	RSS-GEN Issue 5, 6.11 RSS-133 Issue 6: 6.3
Field strength of spurious radiation	§ 2.1053 § 24.236	RSS-GEN Issue 5, 6.13 RSS-133 Issue 6: 6.5

Correlation of measurement requirements for Cellular Mobile Devices from FCC and ISED Canada

Measurement	FCC reference	ISED reference
RF Output Power	§ 2.1046 § 90.635	RSS-GEN Issue 5, 6.12 RSS-140 Issue 1, 4.3
Peak to Average-Ratio	§ 90.635	RSS-140 Issue 1, 4.3
Emission and Occupied bandwidth	§ 2.1049	RSS-GEN Issue 5, 6.7
Spurious Emission at Antenna Terminals	§ 2.1051 § 90.543	RSS-GEN Issue 5, 6.13 RSS-140 Issue 1, 4.4
Band Edge Compliance	§ 2.1051 § 90.543	RSS-GEN Issue 5, 6.13 RSS-140 Issue 1, 4.4
Frequency stability	§ 2.1055 § 90.539	RSS-GEN Issue 5, 6.11 RSS-140 Issue 1, 4.2
Field strength of spurious radiation	§ 2.1053 § 90.543	RSS-GEN Issue 5, 6.13 RSS-140 Issue 1, 4.4

Correlation of measurement requirements for Cellular Mobile Devices from FCC and ISED Canada

Measurement	FCC reference	ISED reference
RF Output Power	§ 2.1046 § 22.913	RSS-GEN Issue 5, 6.12 RSS-132 Issue 4, 5.4
Peak-Average-Ratio	-	RSS 132 Issue 4: 5.4
Emission and Occupied bandwidth	§ 2.1049	RSS-GEN Issue 5, 6.7
Spurious Emission at Antenna Terminals	§ 2.1051 § 22.917	RSS-GEN Issue 5, 6.13 RSS-132 Issue 4, 5.5
Band Edge Compliance	§ 2.1051 § 22.917	RSS-GEN Issue 4, 6.13 RSS-132 Issue 4, 5.5
Frequency stability	§ 2.1055 § 22.355	RSS-GEN Issue 5, 6.11 RSS-132 Issue 4: 5.3
Field strength of spurious radiation	§ 2.1053 § 22.917	RSS-GEN Issue 5, 6.13 RSS-132 Issue 4: 5.5

1.3 MEASUREMENT SUMMARY

47 CFR CHAPTER I FCC PART 22 Subpart H § 2.1046 § 22.913

RF Output power

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	**Setup**	**Date**	**FCC**	**IC**
CAT-M1, eFDD 26 QPSK, mid channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 1.4 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 10 MHz, 1, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 10 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 10 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 3 MHz, 1, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 3 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 3 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 5 MHz, 1, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 5 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 5 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 5 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 5 QPSK, low channel, 1.4 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 5 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 5 QPSK, low channel, 10 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 5 QPSK, low channel, 10 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 5 QPSK, low channel, 10 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 5 QPSK, low channel, 3 MHz, 1, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 5 QPSK, low channel, 3 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 5 QPSK, low channel, 3 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 5 QPSK, low channel, 5 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 5 QPSK, low channel, 5 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
NB-IoT, eFDD 5 BPSK, mid channel, 0.2 MHz, 1, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 5 QPSK, mid channel, 0.2 MHz, 1, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 5 QPSK, mid channel, 0.2 MHz, 12, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 5 QPSK, mid channel, 0.2 MHz, 3, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 5 QPSK, mid channel, 0.2 MHz, 6, conducted	S01_AA01	2022-12-20	Passed	Passed

47 CFR CHAPTER I FCC PART 22 Subpart H § 2.1051 § 22.917

Spurious emissions at antenna terminals

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	**Setup**	**Date**	**FCC**	**IC**
CAT-M1, eFDD 26 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-13	Passed	Passed
CAT-M1, eFDD 5 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-13	Passed	Passed
NB-IoT, eFDD 5 QPSK, high channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-20	Passed	Passed

47 CFR CHAPTER I FCC PART 22 Subpart H § 2.1053 § 22.917

Field strength of spurious radiation
The measurement was performed according to ANSI C63.26: 2015 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	FCC	IC
NB-IoT, eFDD 5 QPSK, mid channel, 0.2 MHz, 1, radiated	S01_ad01	2023-02-21	Passed	Passed

47 CFR CHAPTER I FCC PART 22 Subpart H § 2.1051 § 22.917

Band edge compliance
The measurement was performed according to ANSI C63.26: 2015 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	FCC	IC
CAT-M1, eFDD 26 QPSK, high channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 5 16QAM, low channel, 1.4 MHz, 5, conducted	S01_AA01	2023-01-20	Passed	Passed
NB-IoT, eFDD 5 BPSK, high channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E § 2.1046 § 24.232

RF Output power
The measurement was performed according to ANSI C63.26: 2015 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	FCC	IC
CAT-M1, eFDD 2 QPSK, mid channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 2 QPSK, mid channel, 1.4 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 2 QPSK, mid channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 2 QPSK, mid channel, 10 MHz, 1, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 2 QPSK, mid channel, 10 MHz, 3, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 2 QPSK, mid channel, 10 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 2 QPSK, mid channel, 3 MHz, 1, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 2 QPSK, mid channel, 3 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 2 QPSK, mid channel, 3 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 2 QPSK, mid channel, 5 MHz, 1, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 2 QPSK, mid channel, 5 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 2 QPSK, mid channel, 5 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 25 QPSK, mid channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 25 QPSK, mid channel, 1.4 MHz, 3, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 25 QPSK, mid channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-13	Passed	Passed
CAT-M1, eFDD 25 QPSK, mid channel, 10 MHz, 1, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 25 QPSK, mid channel, 10 MHz, 3, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 25 QPSK, mid channel, 10 MHz, 6, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 25 QPSK, mid channel, 3 MHz, 1, conducted	S01_AA01	2023-01-18	Passed	Passed
CAT-M1, eFDD 25 QPSK, mid channel, 3 MHz, 3, conducted	S01_AA01	2023-01-13	Passed	Passed
CAT-M1, eFDD 25 QPSK, mid channel, 3 MHz, 6, conducted	S01_AA01	2023-01-13	Passed	Passed
CAT-M1, eFDD 25 QPSK, mid channel, 5 MHz, 1, conducted	S01_AA01	2023-01-13	Passed	Passed
CAT-M1, eFDD 25 QPSK, mid channel, 5 MHz, 3, conducted	S01_AA01	2023-01-13	Passed	Passed
CAT-M1, eFDD 25 QPSK, mid channel, 5 MHz, 6, conducted	S01_AA01	2023-01-13	Passed	Passed
NB-IoT, eFDD 2 BPSK, low channel, 0.2 MHz, 1, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 2 QPSK, low channel, 0.2 MHz, 1, conducted	S01_AA01	2022-12-20	Passed	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E § 2.1046 § 24.232

RF Output power

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	FCC	IC
NB-IoT, eFDD 2 QPSK, low channel, 0.2 MHz, 12, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 2 QPSK, low channel, 0.2 MHz, 3, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 2 QPSK, low channel, 0.2 MHz, 6, conducted	S01_AA01	2022-12-20	Passed	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E § 2.1051 § 24.238

Spurious emissions at antenna terminal

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	FCC	IC
CAT-M1, eFDD 2 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-13	Passed	Passed
CAT-M1, eFDD 25 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-13	Passed	Passed
NB-IoT, eFDD 2 QPSK, high channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-20	Passed	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E § 2.1053 § 24.236

Field strength of spurious radiation

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	FCC	IC
CAT-M1, eFDD 2 QPSK, mid channel, 1.4 MHz, 1, radiated	S01_AD01	2023-02-21	Passed	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E § 2.1051 § 24.238

Band edge compliance

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	FCC	IC
CAT-M1, eFDD 2 16QAM, high channel, 1.4 MHz, 5, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 25 16QAM, low channel, 1.4 MHz, 5, conducted	S01_AA01	2023-01-12	Passed	Passed
NB-IoT, eFDD 2 BPSK, high channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1046 § 27.50

RF Output Power

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	FCC	IC
CAT-M1, eFDD 12 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1046 § 27.50

RF Output Power

The measurement was performed according to ANSI C63.26: 2015

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	Final Result FCC	 IC
CAT-M1, eFDD 12 QPSK, low channel, 1.4 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 12 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 12 QPSK, low channel, 10 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 12 QPSK, low channel, 10 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 12 QPSK, low channel, 10 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 12 QPSK, low channel, 3 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 12 QPSK, low channel, 3 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 12 QPSK, low channel, 3 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 12 QPSK, low channel, 5 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 12 QPSK, low channel, 5 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 12 QPSK, low channel, 5 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 13 QPSK, mid channel, 10 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 13 QPSK, mid channel, 10 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 13 QPSK, mid channel, 10 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 13 QPSK, mid channel, 5 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 13 QPSK, mid channel, 5 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 13 QPSK, mid channel, 5 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 10 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 10 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 10 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 3 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 3 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 3 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 5 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 5 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 5 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 66 QPSK, mid channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 66 QPSK, mid channel, 1.4 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 66 QPSK, mid channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 66 QPSK, mid channel, 10 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 66 QPSK, mid channel, 10 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 66 QPSK, mid channel, 10 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 66 QPSK, mid channel, 3 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 66 QPSK, mid channel, 3 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 66 QPSK, mid channel, 3 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 66 QPSK, mid channel, 5 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 66 QPSK, mid channel, 5 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 66 QPSK, mid channel, 5 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 71 QPSK, high channel, 10 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 71 QPSK, high channel, 10 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 71 QPSK, high channel, 10 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 71 QPSK, high channel, 5 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 71 QPSK, high channel, 5 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1046 § 27.50

RF Output Power

The measurement was performed according to ANSI C63.26: 2015

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	Final Result FCC	Final Result IC
CAT-M1, eFDD 71 QPSK, high channel, 5 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 8 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 8 QPSK, low channel, 1.4 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 8 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
NB-IoT, eFDD 12 BPSK, low channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 12 QPSK, low channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 12 QPSK, low channel, 0.2 MHz, 12, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 12 QPSK, low channel, 0.2 MHz, 3, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 12 QPSK, low channel, 0.2 MHz, 6, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 13 BPSK, high channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 13 QPSK, high channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 13 QPSK, high channel, 0.2 MHz, 12, cond.	S01_AA01	2022-12-21	Passed	Passed
NB-IoT, eFDD 13 QPSK, high channel, 0.2 MHz, 3, conducted	S01_AA01	2022-12-21	Passed	Passed
NB-IoT, eFDD 13 QPSK, high channel, 0.2 MHz, 6, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 4 BPSK, mid channel, 0.2 MHz, 1, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 4 QPSK, mid channel, 0.2 MHz, 1, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 4 QPSK, mid channel, 0.2 MHz, 12, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 4 QPSK, mid channel, 0.2 MHz, 3, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 4 QPSK, mid channel, 0.2 MHz, 6, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 66 BPSK, mid channel, 0.2 MHz, 1, conducted	S01_AA01	2022-12-21	Passed	Passed
NB-IoT, eFDD 66 QPSK, mid channel, 0.2 MHz, 1, conducted	S01_AA01	2022-12-21	Passed	Passed
NB-IoT, eFDD 66 QPSK, mid channel, 0.2 MHz, 12, conducted	S01_AA01	2022-12-21	Passed	Passed
NB-IoT, eFDD 66 QPSK, mid channel, 0.2 MHz, 3, conducted	S01_AA01	2022-12-21	Passed	Passed
NB-IoT, eFDD 66 QPSK, mid channel, 0.2 MHz, 6, conducted	S01_AA01	2022-12-21	Passed	Passed
NB-IoT, eFDD 71 BPSK, low channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 71 QPSK, low channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 71 QPSK, low channel, 0.2 MHz, 12, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 71 QPSK, low channel, 0.2 MHz, 3, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 71 QPSK, low channel, 0.2 MHz, 6, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 8 BPSK, mid channel, 0.2 MHz, 1, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 8 QPSK, mid channel, 0.2 MHz, 1, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 8 QPSK, mid channel, 0.2 MHz, 12, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 8 QPSK, mid channel, 0.2 MHz, 3, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 8 QPSK, mid channel, 0.2 MHz, 6, conducted	S01_AA01	2022-12-20	Passed	Passed
NB-IoT, eFDD 85 BPSK, mid channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 85 QPSK, mid channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 85 QPSK, mid channel, 0.2 MHz, 12, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 85 QPSK, mid channel, 0.2 MHz, 3, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 85 QPSK, mid channel, 0.2 MHz, 6, conducted	S01_AA01	2023-01-04	Passed	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1051 § 27.53

Spurious emissions at antenna terminals
The measurement was performed according to ANSI C63.26: 2015

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	Final Result FCC	IC
CAT-M1, eFDD 12 QPSK, mid channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-13	Passed	Passed
CAT-M1, eFDD 4 QPSK, high channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-13	Passed	Passed
CAT-M1, eFDD 66 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-13	Passed	Passed
CAT-M1, eFDD 71 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-13	Passed	Passed
CAT-M1, eFDD 8 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-13	Passed	Passed
NB-IoT, eFDD 12 QPSK, high channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-20	Passed	Passed
NB-IoT, eFDD 13 QPSK, mid channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-20	Passed	Passed
NB-IoT, eFDD 4 QPSK, low channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-20	Passed	Passed
NB-IoT, eFDD 66 QPSK, high channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-20	Passed	Passed
NB-IoT, eFDD 71 QPSK, low channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-20	Passed	Passed
NB-IoT, eFDD 8 QPSK, high channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-20	Passed	Passed
NB-IoT, eFDD 85 QPSK, low channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-20	Passed	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1053 § 27.53

Field strength of spurious radiation
The measurement was performed according to ANSI C63.26: 2015

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	Final Result FCC	IC
CAT-M1, eFDD 4 QPSK, mid channel, 1.4 MHz, 1, radiated	S01_AD01	2023-02-21	Passed	Passed
NB-IoT, eFDD 85 QPSK, mid channel, 0.2 MHz, 1, radiated	S01_AD01	2023-02-21	Passed	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1051 § 27.53

Band edge compliance
The measurement was performed according to ANSI C63.26: 2015

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	Final Result FCC	IC
CAT-M1, eFDD 12 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 13 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 66 16QAM, low channel, 1.4 MHz, 5, cond.	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 71 16QAM, low channel, 1.4 MHz, 5, cond.	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 8 16QAM, low channel, 1.4 MHz, 5, conducted	S01_AA01	2023-01-12	Passed	Passed
NB-IoT, eFDD 12 QPSK, high channel, 0.2 MHz, 12, cond.	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 13 QPSK, low channel, 0.2 MHz, 12, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 4 BPSK, high channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 66 BPSK, high channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 71 BPSK, low channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 8 BPSK, low channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed
NB-IoT, eFDD 85 BPSK, low channel, 0.2 MHz, 1, conducted	S01_AA01	2023-01-04	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S § 2.1046 § 90.635

RF Output Power

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	FCC	IC
CAT-M1, eFDD 26 QPSK, mid channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 1.4 MHz, 3, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 10 MHz, 1, conducted	S01_AA01	2023-01-20	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 10 MHz, 3, conducted	S01_AA01	2023-01-20	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 10 MHz, 6, conducted	S01_AA01	2023-01-20	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 5 MHz, 1, conducted	S01_AA01	2023-01-20	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 5 MHz, 3, conducted	S01_AA01	2023-01-20	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 5 MHz, 6, conducted	S01_AA01	2023-01-20	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S § 2.1051 § 90.543

Spurious Emissions at antenna terminals

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	FCC	IC
CAT-M1, eFDD 26 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AA01	2023-01-13	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S § 2.1051 § 90.543

Band Edge

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	FCC	IC
CAT-M1, eFDD 26 QPSK, high channel, 1.4 MHz, 6, conducted	S01_AA01	2023-01-12	Passed	Passed

N/A: Not applicable
N/P: Not performed

2 REVISION HISTORY / SIGNATURES

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2023-05-30	--	invalid
rev01	2023-09-22	Chapter 5.1.3 Test Protocol Table: Correction of IC EIRP Limit	valid
--	--	--	--

COMMENT:
Not all applicable tests were performed. Based on applicant's documentation 7layers has proposed and the applicant has agreed with the FCB/TCB to perform spot checks only.

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

(responsible for testing and report)
B.Sc. Jens Dörwald

7 layers
7 layers GmbH, Borsigstr. 11
40880 Ratingen, Germany
Phone +49 (0)2102 749 0

3 ADMINISTRATIVE DATA

3.1 TESTING LABORATORY

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

The test facility is accredited by the following accreditation organisation:

Laboratory accreditation no:	DAkkS D-PL-12140-01-01| -02 | -03
FCC Designation Number:	DE0015
FCC Test Firm Registration:	929146
ISED CAB Identifier	DE0007; ISED#: 3699A
Responsible for accreditation scope:	Dipl.Ing. Marco Kullik
Report Template Version:	2022-05-25

3.2 PROJECT DATA

Responsible for testing and report:	B.Sc. Jens Dörwald
Employees who performed the tests:	documented internally at 7Layers
Date of Report:	2023-09-22
Testing Period:	2022-12-20 to 2023-02-21

3.3 APPLICANT DATA

Company Name:	u-blox AG
Address:	Zürcherstrasse 68 8800 Thalwil Switzerland
Contact Person:	Mr. Giulio Comar

3.4 MANUFACTURER DATA

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

4 TEST OBJECT DATA

4.1 GENERAL EUT DESCRIPTION

Kind of Device product description	CAT-M1/NB-IoT Data Module
Product name	SARA-R520M10X
Type	SARA-R520M10X
Declared EUT data by the supplier	
General product description	The EUT is LTE CAT-M1 / NB-IoT module. It supports the following relevant bands for FCC/ISED approval eFDD2 / LTE eFDD4 / eFDD5 / eFDD8 / eFDD12 / eFDD13 / eFDD25 / eFDD26 / eFDD66 / eFDD71 eFDD85
Voltage Level	3.8 V DC
Voltage Type	DC

4.2 EUT MAIN COMPONENTS

Sample Name	**Sample Code**	**Description**
EUT A	DE1015162aa01	RF Sample
Sample Parameter	**Value**	
Serial No.	IMEI: 359521490011477	
HW Version	UBX-417002	
SW Version	05.04, A00.01	
Comment		

Sample Name	**Sample Code**	**Description**
EUT B	DE1015162ad01	Standard Sample
Sample Parameter	**Value**	
Serial No.	IMEI: 359521490011667	
HW Version	UBX-417002	
SW Version	05.04, A00.01	
Comment		

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

4.3 ANCILLARY EQUIPMENT

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

Device	**Details (Manufacturer, Type Model, OUT Code)**	**Description**
-	-	-

4.4 AUXILIARY EQUIPMENT

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

Device	**Details (Manufacturer, Type Model, HW, SW, S/N)**	**Description**
-	-	-

4.5 EUT SETUPS

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

Setup	**Combination of EUTs**	**Description and Rationale**
S01_AA01	EUT A	-
S01_AD01	EUT B	-

4.6 OPERATING MODES / TEST CHANNELS

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

		LOW	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**
CAT-M1 eFDD 2	Cell BW [MHz]	1.4	1.4	1.4	3	3	3	5	5	5
	CH no.	18607	18900	19193	18615	18900	19185	18625	18900	19175
	f [MHz]	1850.7	1880.0	1909.3	1851.5	1880.0	1908.5	1852.5	1880.0	1907.5
		LOW	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**
	Cell BW [MHz]	10	10	10	-	-	-	-	-	-
	CH no.	18650	18900	19150	-	-	-	-	-	-
	f [MHz]	1855.0	1880.0	1905.0	-	-	-	-	-	-

		LOW	MID	HIGH	LOW	MID	HIGH	LOW	MID	HIGH
CAT-M1 eFDD 4	Cell BW [MHz]	1.4	1.4	1.4	3	3	3	5	5	5
	CH no.	19957	20175	20393	19965	20175	20385	19975	20175	20375
	f [MHz]	1710.7	1732.5	1754.3	1711.5	1732.5	1753.5	1712.5	1732.5	1752.5
		LOW	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**
	Cell BW [MHz]	10	10	10	-	-	-	-	-	-
	CH no.	20000	20175	20350	-	-	-	-	-	-
	f [MHz]	1715.0	1732.5	1750.0	-	-	-	-	-	-

		LOW	MID	HIGH	LOW	MID	HIGH	LOW	MID	HIGH
CAT-M1 eFDD 5	Cell BW [MHz]	1.4	1.4	1.4	3	3	3	5	5	5
	CH no.	20407	20525	20643	20415	20525	20635	20425	20525	20625
	f [MHz]	824.7	836.5	848.3	825.5	836.5	847.5	826.5	836.5	846.5
		LOW	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**
	Cell BW [MHz]	10	10	10	-	-	-	-	-	-
	CH no.	20450	20525	20600	-	-	-	-	-	-
	f [MHz]	829.0	836.5	844.0	-	-	-	-	-	-

		LOW	MID	HIGH	LOW	MID	HIGH	LOW	MID	HIGH
CAT-M1 eFDD 8	Cell BW [MHz]	1.4	1.4	1.4	-	3	-	-	-	-
	CH no.	21632	21640	21648	-	20525	-	-	-	-
	f [MHz]	898.2	899.0	899.8	-	899.0	-	-	-	-
		LOW	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**
	Cell BW [MHz]	-	-	-	-	-	-	-	-	-
	CH no.	-	-	-	-	-	-	-	-	-
	f [MHz]	-	-	-	-	-	-	-	-	-

		LOW	MID	HIGH	LOW	MID	HIGH	LOW	MID	HIGH
CAT-M1 eFDD 12	Cell BW [MHz]	1.4	1.4	1.4	3	3	3	5	5	5
	CH no.	23017	23095	23173	23025	23095	23165	23035	23095	23155
	f [MHz]	699.7	707.5	715.3	700.5	707.5	714.5	701.5	707.5	713.5
		LOW	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**
	Cell BW [MHz]	10	10	10	-	-	-	-	-	-
	CH no.	23060	23095	23130	-	-	-	-	-	-
	f [MHz]	704.0	707.5	711.0	-	-	-	-	-	-

		LOW	MID	HIGH	LOW	MID	HIGH	LOW	MID	HIGH
CAT-M1 eFDD 13	Cell BW [MHz]	5	5	5	10	10	10	-	-	-
	CH no.	23205	23230	23255	-	23230	-	-	-	-
	f [MHz]	779.5	782.0	784.5	-	782.0	-	-	-	-
		LOW	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**
	Cell BW [MHz]	-	-	-	-	-	-	-	-	-
	CH no.	-	-	-	-	-	-	-	-	-
	f [MHz]	-	-	-	-	-	-	-	-	-

		LOW	MID	HIGH	LOW	MID	HIGH	LOW	MID	HIGH
CAT-M1 eFDD 25	Cell BW [MHz]	1.4	1.4	1.4	3	3	3	5	5	5
	CH no.	26047	26365	26683	26055	26365	26675	26065	26365	26665
	f [MHz]	1850.7	1882.5	1914.3	1851.5	1882.5	1913.5	1852.5	1882.5	1912.5
		LOW	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**
	Cell BW [MHz]	10	10	10	-	-	-	-	-	-
	CH no.	26090	26365	26640	-	-	-	-	-	-
	f [MHz]	1855.0	1882.5	1910.0	-	-	-	-	-	-

		LOW	MID	HIGH	LOW	MID	HIGH	LOW	MID	HIGH
CAT-M1 eFDD 26 (Part 22)	Cell BW [MHz]	1.4	1.4	1.4	3	3	3	5	5	5
	CH no.	26797	26915	27033	26805	26915	27025	26815	26915	27015
	f [MHz]	824.7	836.5	848.3	825.5	836.5	847.5	826.5	836.5	846.5
		LOW	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**
	Cell BW [MHz]	10	10	10	-	-	-	-	-	-
	CH no.	26840	26915	26990	-	-	-	-	-	-
	f [MHz]	829.0	836.5	844	-	-	-	-	-	-

		LOW	MID	HIGH	LOW	MID	HIGH	LOW	MID	HIGH
CAT-M1 eFDD 26 (Part 90)	Cell BW [MHz]	1.4	1.4	1.4	3	3	3	5	5	5
	CH no.	26697	26740	26783	26705	26740	26776	26715	26740	26766
	f [MHz]	814.7	819.0	823.3	815.5	819.0	822.5	816.5	819.0	821.5
		LOW	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**
	Cell BW [MHz]	-	10	-	-	-	-	-	-	-
	CH no.	-	26740	-	-	-	-	-	-	-
	f [MHz]	-	819.0	-	-	-	-	-	-	-

		LOW	MID	HIGH	LOW	MID	HIGH	LOW	MID	HIGH
CAT-M1 eFDD 66	Cell BW [MHz]	1.4	1.4	1.4	3	3	3	5	5	5
	CH no.	131979	132322	132665	131987	132322	132657	131997	132322	132647
	f [MHz]	1710.7	1745.0	1779.3	1711.5	1745.0	1778.5	1712.5	1745.0	1777.5
		LOW	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**
	Cell BW [MHz]	10	10	10	-	-	-	-	-	-
	CH no.	132022	132322	132622	-	-	-	-	-	-
	f [MHz]	1715.0	1745.0	1775.0	-	-	-	-	-	-

		LOW	MID	HIGH	LOW	MID	HIGH	LOW	MID	HIGH
CAT-M1 eFDD 71	Cell BW [MHz]	1.4	1.4	1.4	3	3	3	5	5	5
	CH no.	133129	133297	133465	133172	133297	133422	133197	133297	133397
	f [MHz]	663.7	680.5	697.3	668	680.5	693	670,5	680.5	690,5
		LOW	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**	**LOW**	**MID**	**HIGH**
	Cell BW [MHz]	10	10	10	-	-	-	-	-	-
	CH no.	133222	133297	133372	-	-	-	-	-	-
	f [MHz]	673	680.5	688	-	-	-	-	-	-

		LOW	MID	HIGH
NB-IoT eFDD 2	Cell BW [MHz]	0.2	0.2	0.2
	CH no.	18601	18900	19199
	f [MHz]	1850.1	1880.0	1909.9

		LOW	MID	HIGH
NB-IoT eFDD 4	Cell BW [MHz]	0.2	0.2	0.2
	CH no.	19951	20175	20399
	f [MHz]	1710.1	1745.5	1754.9

		LOW	MID	HIGH
NB-IoT eFDD 5	Cell BW [MHz]	0.2	0.2	0.2
	CH no.	20401	20525	20649
	f [MHz]	824.1	836.5	848.9

		LOW	MID	HIGH
NB-IoT eFDD 8	Cell BW [MHz]	0.2	0.2	0.2
	CH no.	21626	21640	21654
	f [MHz]	897.6	899.0	900.4

		LOW	MID	HIGH
NB-IoT eFDD 12	Cell BW [MHz]	0.2	0.2	0.2
	CH no.	23011	23095	23178
	f [MHz]	699.1	707.5	715.8

		LOW	MID	HIGH
NB-IoT eFDD 13	Cell BW [MHz]	0.2	0.2	0.2
	CH no.	23181	23230	23279
	f [MHz]	777.1	782.0	786.9

		LOW	MID	HIGH
NB-IoT eFDD 66	Cell BW [MHz]	0.2	0.2	0.2
	CH no.	131973	132322	132671
	f [MHz]	1710.1	1745.0	1779.9

		LOW	MID	HIGH
NB-IoT eFDD 71	Cell BW [MHz]	0.2	0.2	0.2
	CH no.	133124	133297	133470
	f [MHz]	663.2	680.5	697.8

		LOW	MID	HIGH
NB-IoT eFDD 85	Cell BW [MHz]	0.2	0.2	0.2
	CH no.	134004	134092	134180
	f [MHz]	698.2	707.0	715.8

4.7 PRODUCT LABELLING

4.7.1 FCC ID LABEL

Please refer to the documentation of the applicant.

4.7.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

5 TEST RESULTS

5.1 RF OUTPUT POWER

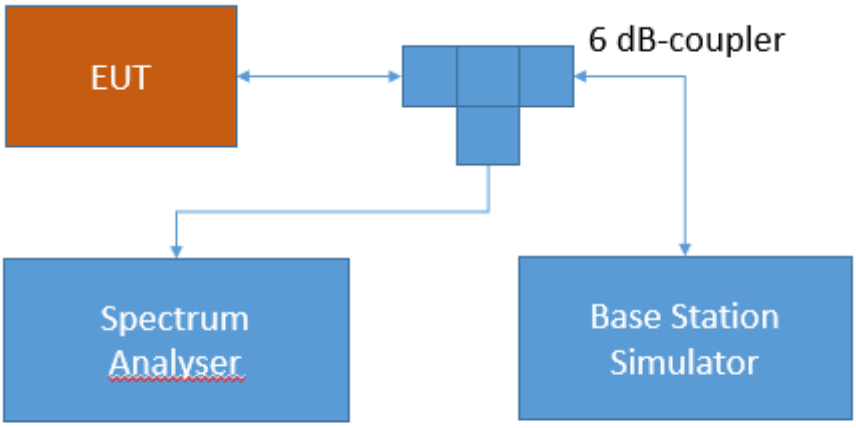
Standard **FCC PART 22 Subpart H**

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

5.1.1 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.

5.1.2 TEST REQUIREMENTS / LIMITS

FCC Part 22, § 22.913

(a) *Maximum ERP.* The ERP of transmitters in the Cellular Radiotelephone Service must not exceed the limits in this section.

(5) The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts.

RSS-132; 5.4 Transmitter Output Power and Equivalent Isotropically Radiated Power

The transmitter output power shall be measured in terms of average power. The equivalent isotropically radiated power (e.i.r.p.) for mobile equipment shall not exceed 11.5 watts.

5.1.3 TEST PROTOCOL

Ambient temperature: 25 °C
Relative humidity: 39 %

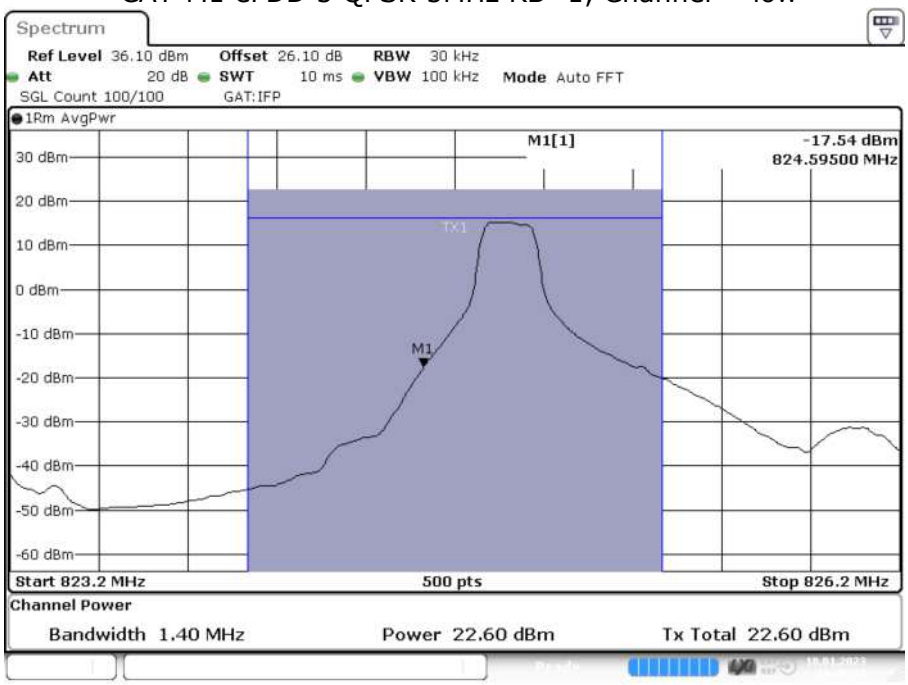
Radio Technology	Channel	Re-source Blocks / Subcarrier	Bandwidth [MHz]	RMS Cond. Power [dBm]	FCC EIRP Limit [W]	IC EIRP Limit [W]	Max. Antenna Gain FCC [dBi]	Max. Antenna Gain IC [dBi]
CAT-M1 eFDD 5 QPSK	Low	1	1.4	22.59	11.5	11.5	18.01	18.01
CAT-M1 eFDD 5 QPSK	Low	3	1.4	21.76	11.5	11.5	18.84	18.84
CAT-M1 eFDD 5 QPSK	Low	6	1.4	21.76	11.5	11.5	18.84	18.84
CAT-M1 eFDD 5 QPSK	Low	1	3	22.57	11.5	11.5	18.03	18.03
CAT-M1 eFDD 5 QPSK	Low	3	3	21.80	11.5	11.5	18.80	18.80
CAT-M1 eFDD 5 QPSK	Low	6	3	21.67	11.5	11.5	18.93	18.93
CAT-M1 eFDD 5 QPSK	Low	1	5	22.60	11.5	11.5	18.00	18.00
CAT-M1 eFDD 5 QPSK	Low	6	5	21.83	11.5	11.5	18.77	18.77
CAT-M1 eFDD 5 QPSK	Low	1	10	21.75	11.5	11.5	18.85	18.85
CAT-M1 eFDD 5 QPSK	Low	3	10	21.66	11.5	11.5	18.94	18.94
CAT-M1 eFDD 5 QPSK	Low	6	10	21.76	11.5	11.5	18.84	18.84
CAT-M1 eFDD 26 QPSK	Mid	1	1.4	21.88	11.5	11.5	18.72	18.72
CAT-M1 eFDD 26 QPSK	Mid	3	1.4	21.82	11.5	11.5	18.78	18.78
CAT-M1 eFDD 26 QPSK	Mid	6	1.4	21.90	11.5	11.5	18.70	18.70
CAT-M1 eFDD 26 QPSK	Mid	1	3	21.42	11.5	11.5	19.18	19.18
CAT-M1 eFDD 26 QPSK	Mid	3	3	21.75	11.5	11.5	18.85	18.85
CAT-M1 eFDD 26 QPSK	Mid	6	3	21.86	11.5	11.5	18.74	18.74
CAT-M1 eFDD 26 QPSK	Mid	1	5	21.49	11.5	11.5	19.11	19.11
CAT-M1 eFDD 26 QPSK	Mid	3	5	21.75	11.5	11.5	18.85	18.85
CAT-M1 eFDD 26 QPSK	Mid	6	5	21.82	11.5	11.5	18.74	18.74
CAT-M1 eFDD 26 QPSK	Mid	1	10	21.58	11.5	11.5	19.11	19.11
CAT-M1 eFDD 26 QPSK	Mid	3	10	21.74	11.5	11.5	18.85	18.85
CAT-M1 eFDD 26 QPSK	Mid	6	10	21.86	11.5	11.5	18.78	18.78
NB-IoT eFDD 5 QPSK	Mid	1	0.2	22.95	11.5	11.5	19.02	19.02
NB-IoT eFDD 5 QPSK	Mid	3	0.2	22.36	11.5	11.5	18.86	18.86
NB-IoT eFDD 5 QPSK	Mid	6	0.2	22.70	11.5	11.5	18.74	18.74
NB-IoT eFDD 5 QPSK	Mid	12	0.2	21.70	11.5	11.5	17.65	17.65
NB-IoT eFDD 5 BPSK	Mid	1	0.2	22.86	11.5	11.5	18.24	18.24

COMMENT:
Maximum antenna gain given in the table is in regard to the output power not in regard to SAR / MPE.

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

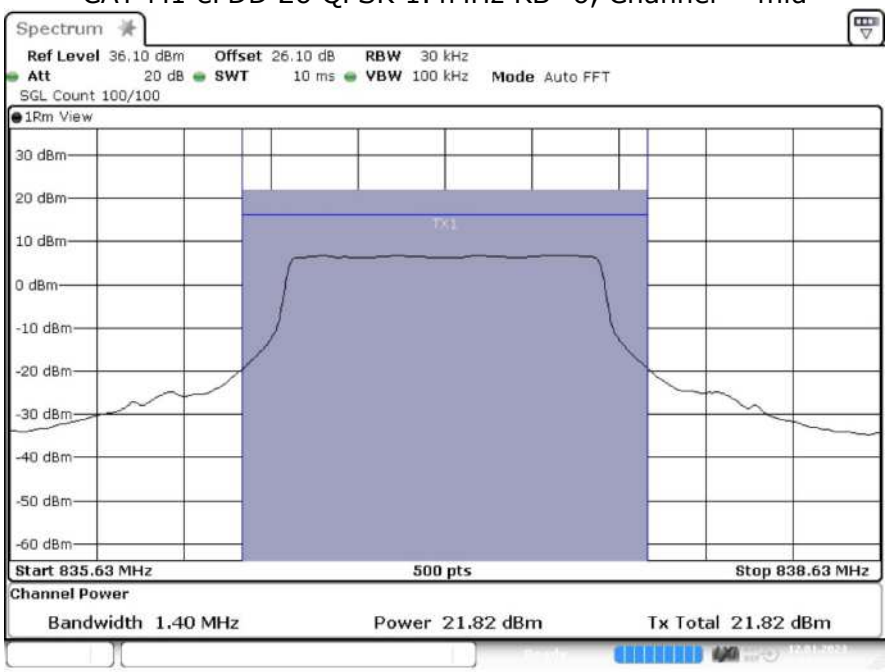
5.1.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

CAT-M1 eFDD 5 QPSK 5MHz RB=1, Channel = low



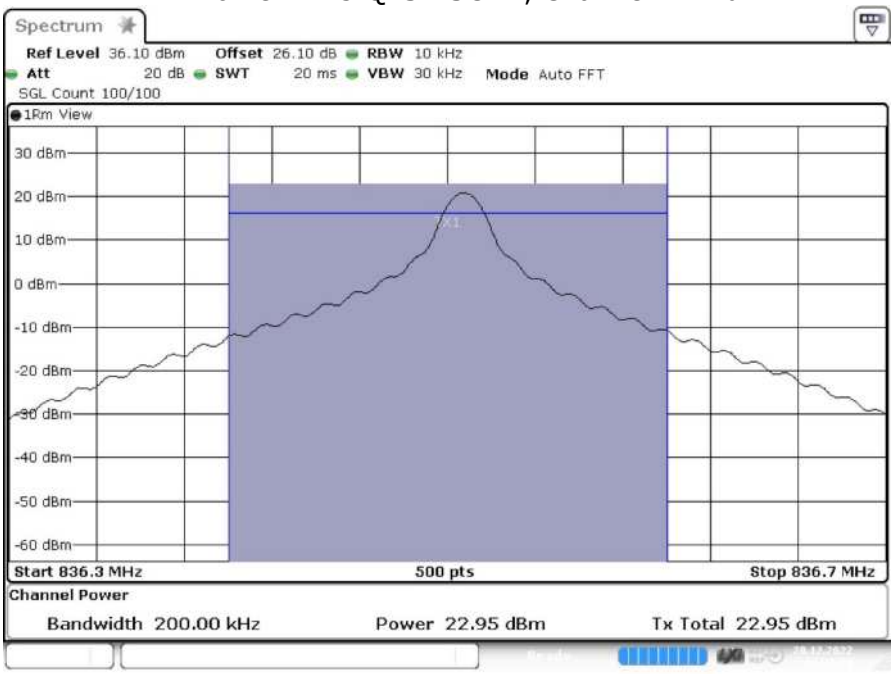
Date: 18.JAN.2023 18:45:37

CAT-M1 eFDD 26 QPSK 1.4MHz RB=6, Channel = mid



Date: 12.JAN.2023 10:56:26

NB-IoT eFDD 5 QPSK SC=1, Channel = mid



Date: 20.DEC.2022 14:08:39

5.1.5 TEST EQUIPMENT USED

- Radio Lab

5.2 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

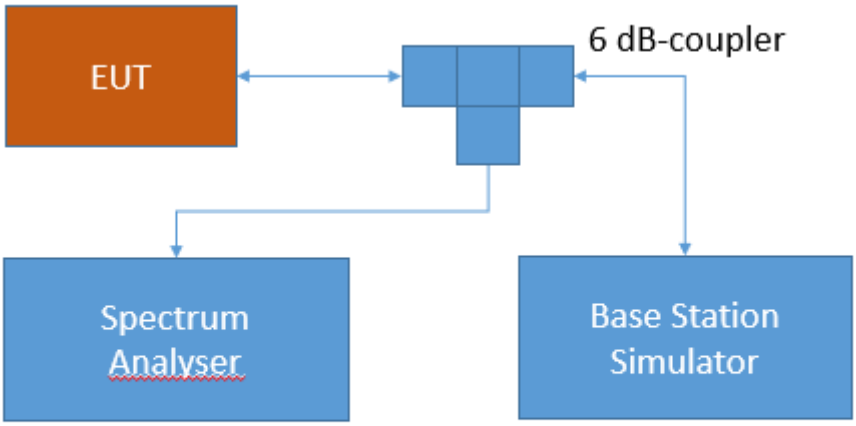
Standard **FCC PART 22 Subpart H**

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

5.2.1 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.

5.2.2 TEST REQUIREMENTS / LIMITS

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

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

Part 22, Subpart H – Cellular Radiotelephone Service

§22 917 – Emission limitations for cellular equipment

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

RSS-132; 5.5 Transmitter Unwanted Emissions

Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

1. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$p (watts).
2. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$ p (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

5.2.3 TEST PROTOCOL

Ambient temperature: 25 °C
Relative humidity: 39 %

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD5	low	rms	maxhold	-	-	-	-13	>20

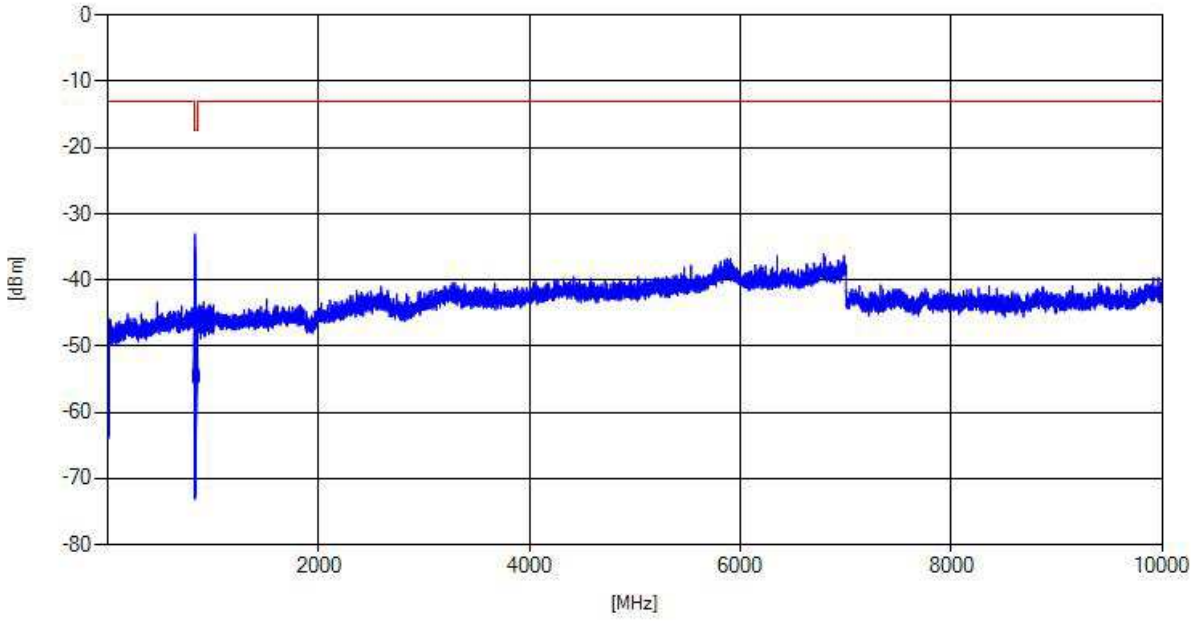
Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD26	low	rms	maxhold	-	-	-	-13	>20

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD5	high	rms	maxhold	2	849.0	-17.68	-13	4.68

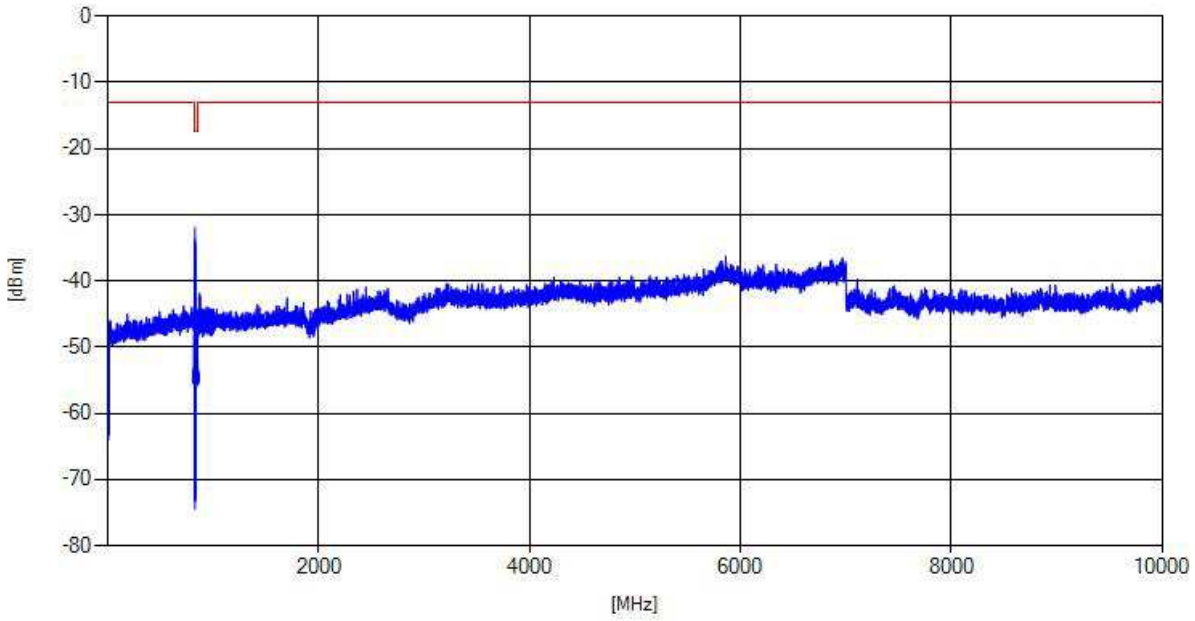
Remark: Please see next sub-clause for the measurement plot.

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

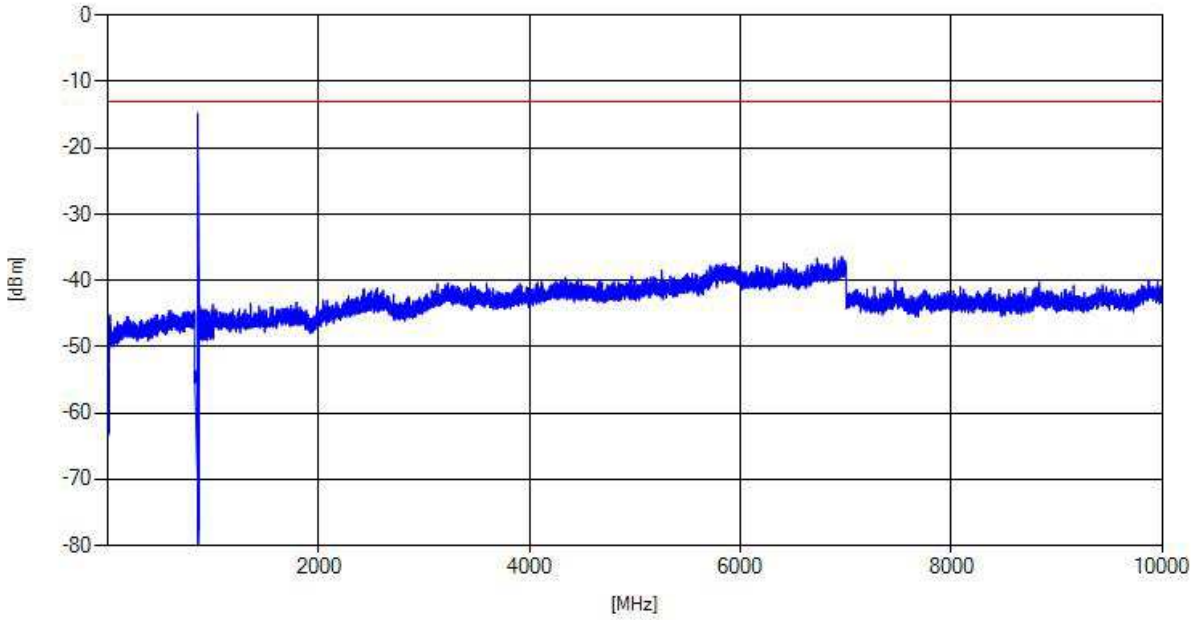
CAT-M1 eFDD5 Channel = low



CAT-M1 eFDD26 Channel = low



NB-IoT eFDD5 Channel = high



5.2.5 TEST EQUIPMENT USED

- Radio Lab

5.3 FIELD STRENGTH OF SPURIOUS RADIATION

Standard **FCC PART 22 Subpart H**

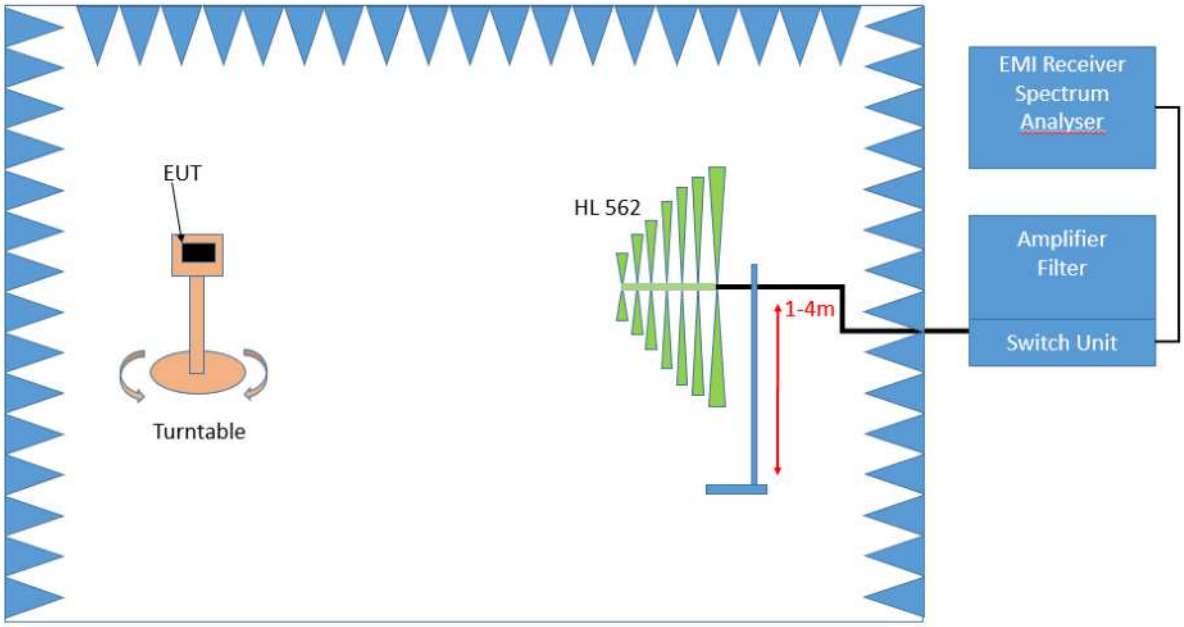
The test was performed according to:
ANSI C63.26: 2015

5.3.1 TEST DESCRIPTION

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

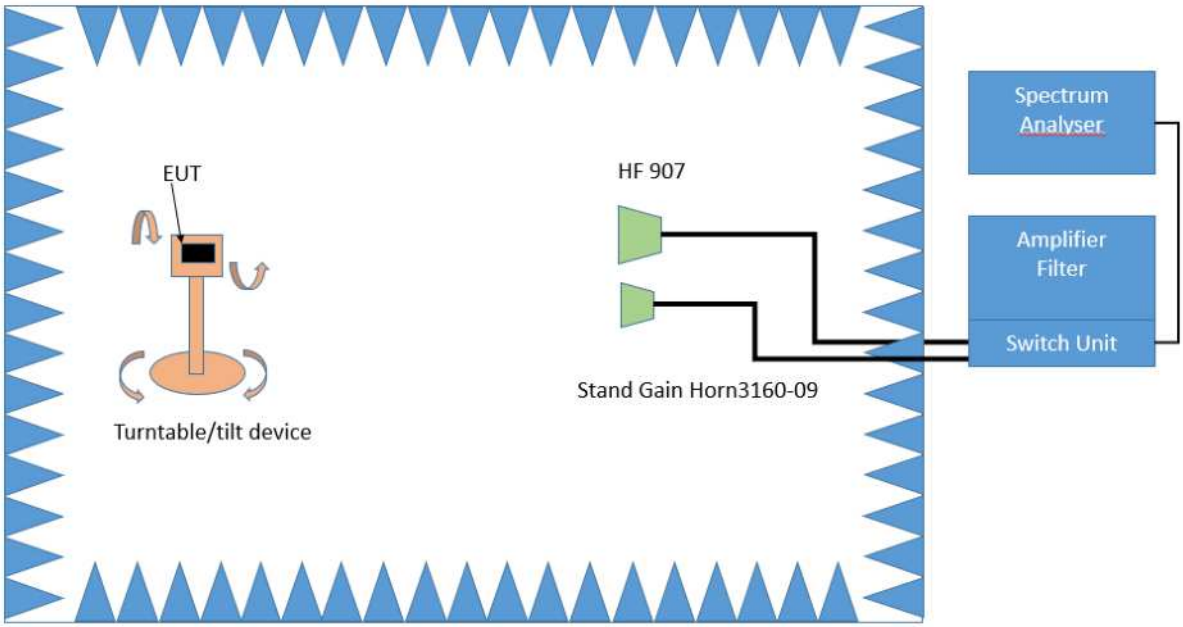
The EUT was connected to the test setup according to the following diagram:

Frequency Range: 30 MHz – 1 GHz:



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

Frequency Range: 1 GHz – 26.5 GHz



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

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

1. Measurement above 30 MHz and up to 1 GHz

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

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

Step 2: Adjustment measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by ± 45° around this value. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission

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

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

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

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

Step 2:
Due to the fact, that in this frequency range the test is performed in a fully anechoic room, the height scan of the receiving antenna instep 2 is omitted. Instead of this, a maximum search with a step size ± 45° for the elevation axis is performed.
The turn table azimuth will slowly vary by ± 22.5°.
The elevation angle will slowly vary by ± 45°
EMI receiver settings (for all steps):
- Detector: Peak,
- RBW: 1 MHz
- VBW: 3 MHz

- Sweep time: coupled

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

5.3.2 TEST REQUIREMENTS / LIMITS

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

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

Part 22, Subpart H – Cellular Radiotelephone Service

§ 22 917 – Emission limitations for cellular equipment

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

RSS-132; 5.5 Transmitter Unwanted Emissions

Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

1. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$p (watts).
2. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$ p (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

5.3.3 TEST PROTOCOL

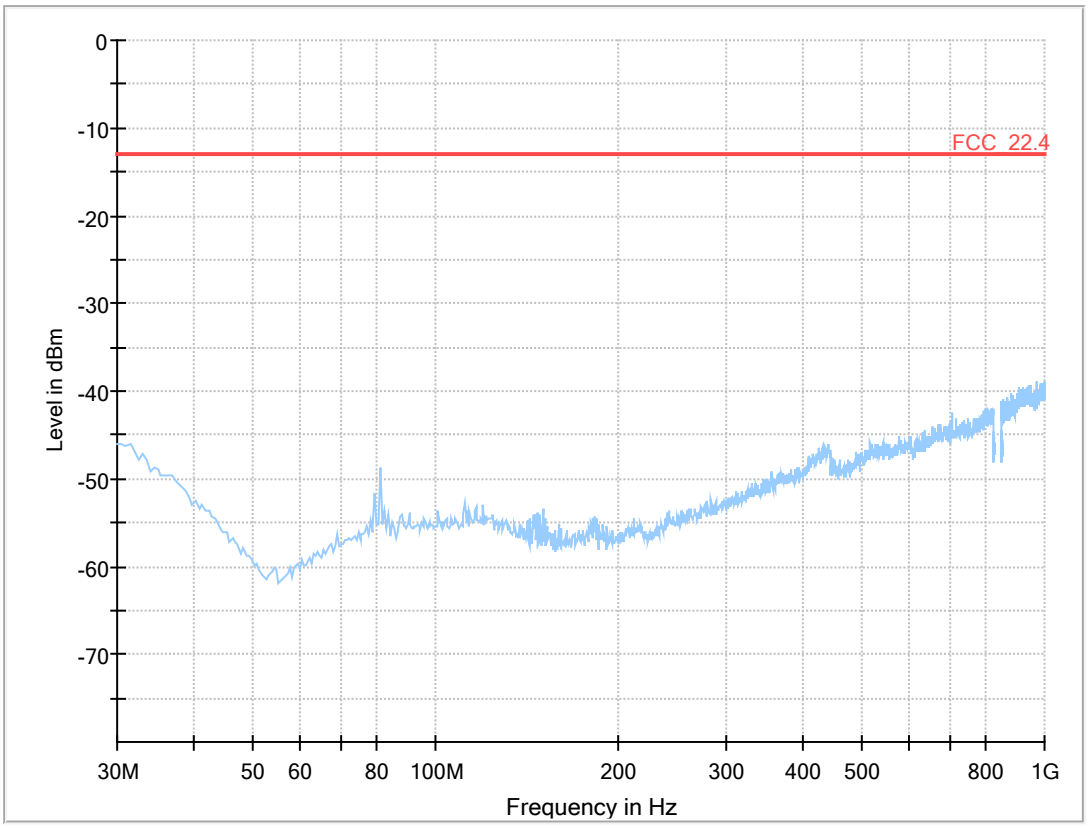
Ambient temperature: 25 °C
Relative humidity: 39 %

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD5	mid	rms	maxhold	-	-	-	-13	>20

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

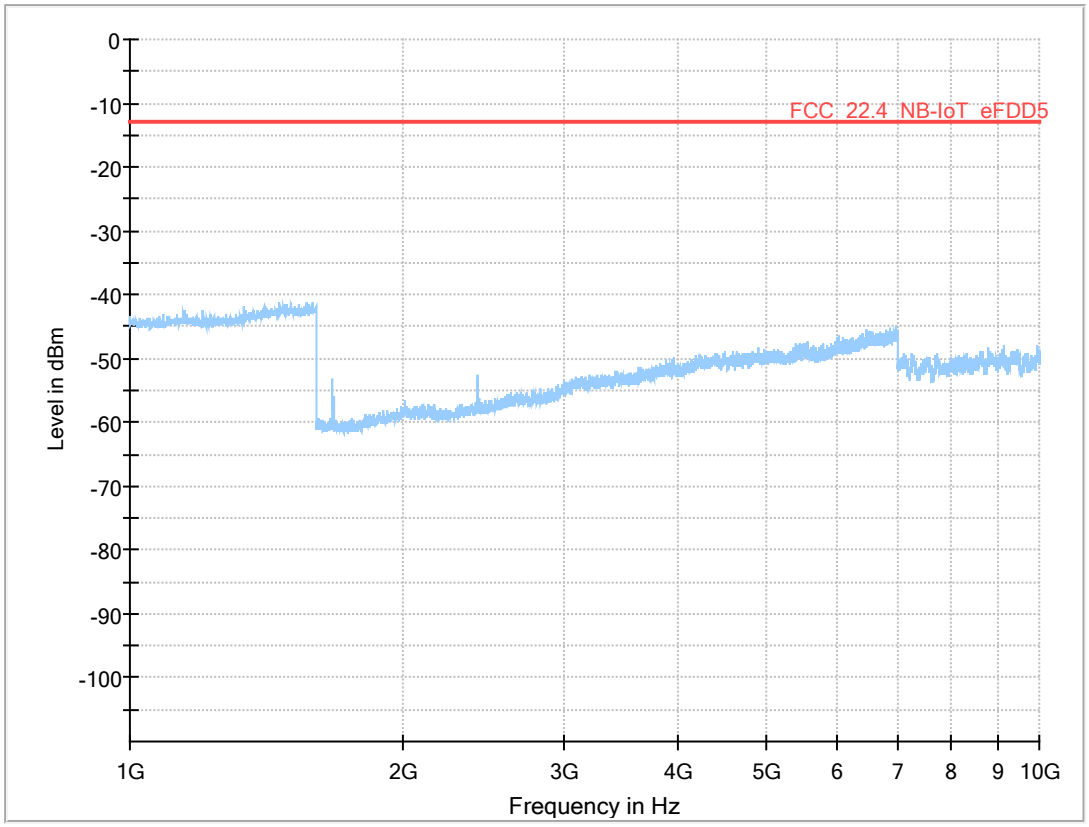
5.3.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

NB-IoT eFDD 5 QPSK, channel = mid



Final_Result

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



Final_Result

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

5.3.5 TEST EQUIPMENT USED

- Radiated Emissions

5.4 BAND EDGE COMPLIANCE

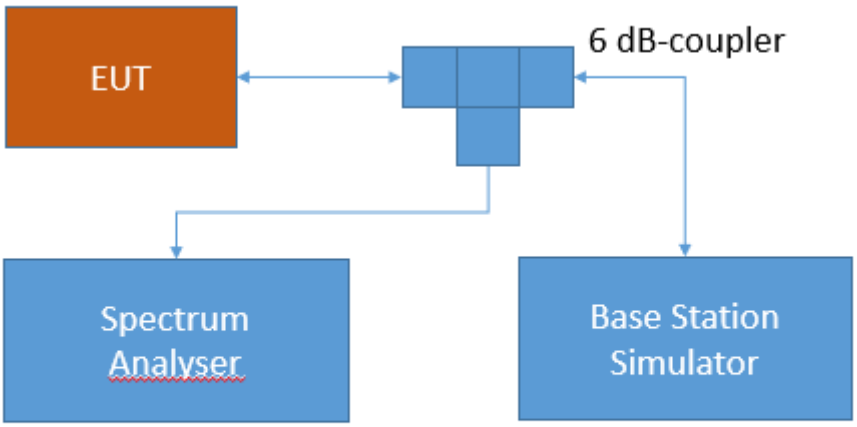
Standard **FCC PART 22 Subpart H**

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

5.4.1 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.

5.4.2 TEST REQUIREMENTS / LIMITS

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

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

Part 22, Subpart H – Cellular Radiotelephone Service

§22 917 – Emission limitations for cellular equipment

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

RSS-132; 5.5 Transmitter Unwanted Emissions

Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

1. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$p (watts).
2. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$ p (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

5.4.3 TEST PROTOCOL

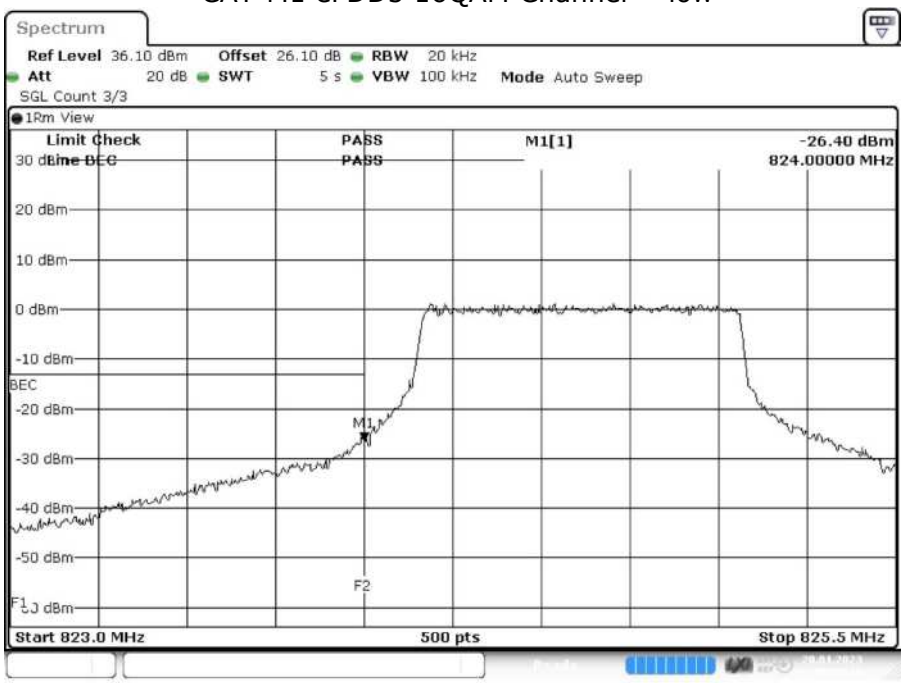
Ambient temperature: 25 °C
Relative humidity: 38 %

Radio Technology	Channel	Re-source Blocks	Band-width [MHz]	Peak [dBm]	Average [dBm]	RMS [dBm]	Limit [dBm]	Margin to Limit [dB]
CAT-M1 eFDD 5 16QAM	low	5	1.4	-10.15	-34.57	-26.40	-13	13.40
CAT-M1 eFDD 26 QPSK	high	6	1.4	-11.15	-35.96	-26.97	-13	13.97
NB-IoT eFDD 5 BPSK	high	1	0.2	-8.72	-19.38	-15.89	-13	2.89

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

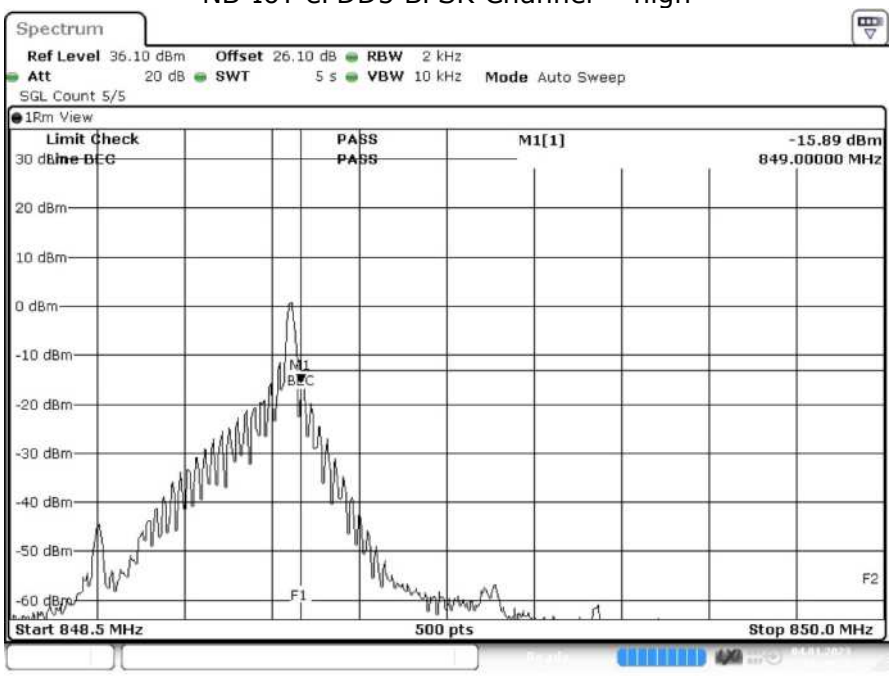
5.4.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

CAT-M1 eFDD5 16QAM Channel = low



Date: 20.JAN.2023 09:56:19

NB-IoT eFDD5 BPSK Channel = high



Date: 4.JAN.2023 14:44:29

5.4.5 TEST EQUIPMENT USED

- Radio Lab

5.5 RF OUTPUT POWER

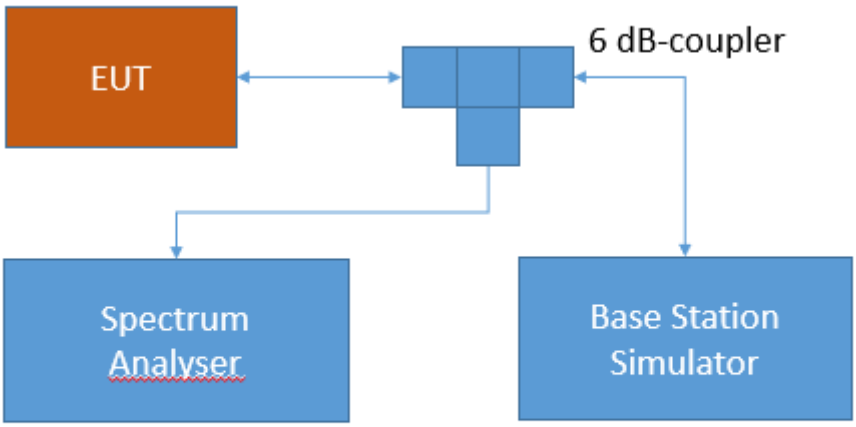
Standard **FCC PART 24 Subpart E**

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

5.5.1 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.

5.5.2 TEST REQUIREMENTS / LIMITS

FCC Part 24, § 24.232

(c) Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

RSS-133; 6.4 Transmitter Output Power and Equivalent Isotropically Radiated Power

The equivalent isotropically radiated power (e.i.r.p.) for transmitters shall not exceed the limits given in SRSP-510.

SRSP-510; 5.1.2 Radiated Power and Antenna Height Limits – Mobile Stations

Mobile stations and hand-held portables are limited to 2 watts maximum e.i.r.p. The equipment shall employ means to limit the power to the minimum necessary for successful communication.

5.5.3 TEST PROTOCOL

Ambient temperature: 25 °C
Relative humidity: 38 %

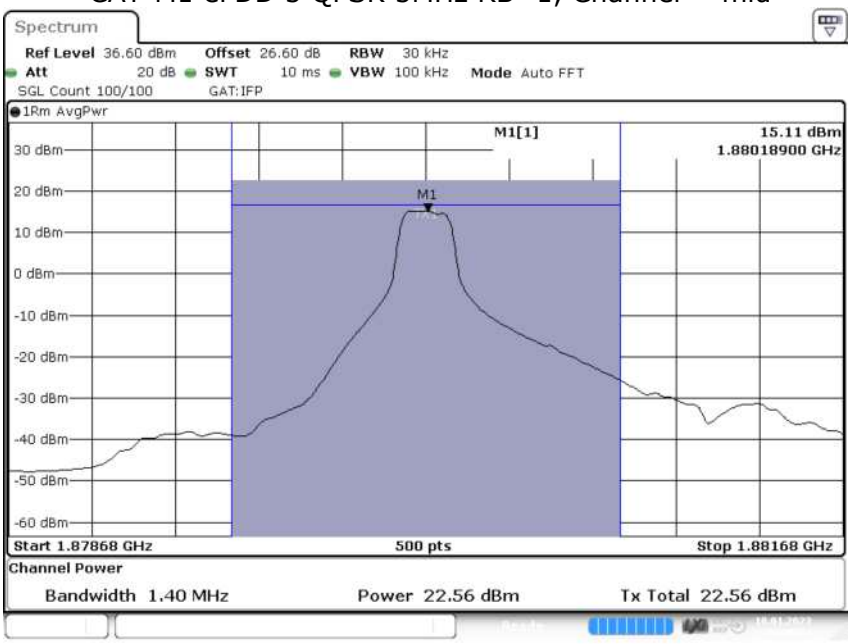
Radio Technology	Channel	Re-source Blocks	Band-width [MHz]	RMS Cond. Power [dBm]	FCC EIRP Limit [W]	IC EIRP Limit [W]	Maximum Antenna Gain FCC [dBi]	Maximum Antenna Gain IC [dBi]
CAT-M1 eFDD 2 QPSK	mid	1	1.4	22.48	2	2	10.52	10.52
CAT-M1 eFDD 2 QPSK	mid	3	1.4	21.77	2	2	11.23	11.23
CAT-M1 eFDD 2 QPSK	mid	6	1.4	21.86	2	2	11.14	11.14
CAT-M1 eFDD 2 QPSK	mid	1	3	22.47	2	2	10.53	10.53
CAT-M1 eFDD 2 QPSK	mid	3	3	21.78	2	2	11.22	11.22
CAT-M1 eFDD 2 QPSK	mid	6	3	21.90	2	2	11.10	11.10
CAT-M1 eFDD 2 QPSK	mid	1	5	22.56	2	2	10.44	10.44
CAT-M1 eFDD 2 QPSK	mid	3	5	21.77	2	2	11.23	11.23
CAT-M1 eFDD 2 QPSK	mid	6	5	21.88	2	2	11.12	11.12
CAT-M1 eFDD 2 QPSK	mid	1	10	22.49	2	2	10.51	10.51
CAT-M1 eFDD 2 QPSK	mid	3	10	22.33	2	2	10.67	10.67
CAT-M1 eFDD 2 QPSK	mid	6	10	21.88	2	2	11.12	11.12
CAT-M1 eFDD 25 QPSK	mid	1	1.4	22.59	2	2	10.41	10.41
CAT-M1 eFDD 25 QPSK	mid	3	1.4	21.82	2	2	11.18	11.18
CAT-M1 eFDD 25 QPSK	mid	6	1.4	21.91	2	2	11.09	11.09
CAT-M1 eFDD 25 QPSK	mid	1	3	22.62	2	2	10.38	10.38
CAT-M1 eFDD 25 QPSK	mid	3	3	21.61	2	2	11.39	11.39
CAT-M1 eFDD 25 QPSK	mid	6	3	21.71	2	2	11.29	11.29
CAT-M1 eFDD 25 QPSK	mid	1	5	22.60	2	2	10.40	10.40
CAT-M1 eFDD 25 QPSK	mid	3	5	21.61	2	2	11.39	11.39
CAT-M1 eFDD 25 QPSK	mid	6	5	21.73	2	2	11.27	11.27
CAT-M1 eFDD 25 QPSK	mid	1	10	22.51	2	2	10.49	10.49
CAT-M1 eFDD 25 QPSK	mid	3	10	22.38	2	2	10.62	10.62
CAT-M1 eFDD 25 QPSK	mid	6	10	21.73	2	2	11.27	11.27
NB-IoT eFDD 2 QPSK	low	1	0.2	22.85	2	2	10.15	10.15
NB-IoT eFDD 2 QPSK	low	3	0.2	22.54	2	2	10.46	10.46
NB-IoT eFDD 2 QPSK	low	6	0.2	22.80	2	2	10.20	10.20
NB-IoT eFDD 2 QPSK	low	12	0.2	21.85	2	2	11.15	11.15
NB-IoT eFDD 2 BPSK	low	1	0.2	22.89	2	2	10.11	10.11

COMMENT:
Maximum antenna gain given in the table is in regard to the output power not in regard to SAR / MPE.

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

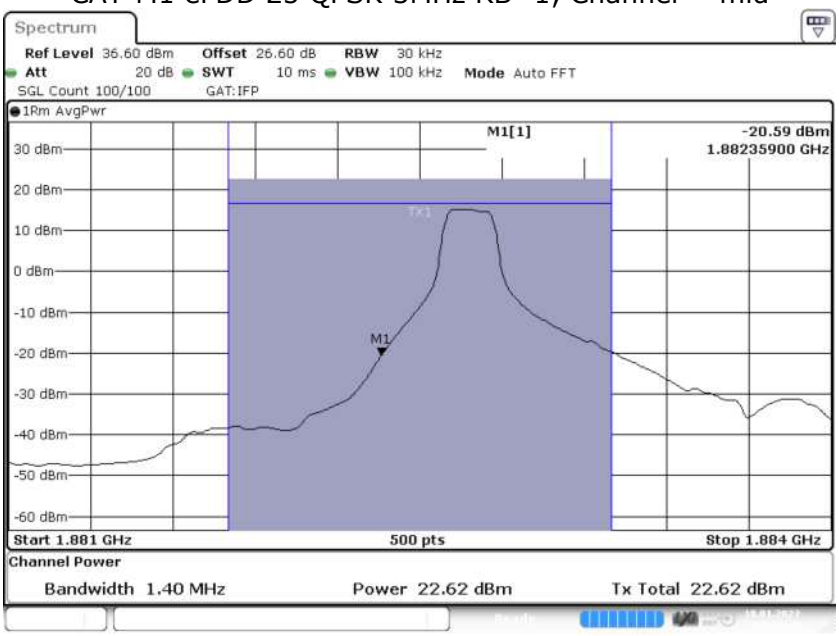
5.5.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

CAT-M1 eFDD 5 QPSK 5MHz RB=1, Channel = mid



Date: 18.JAN.2023 16:28:28

CAT-M1 eFDD 25 QPSK 3MHz RB=1, Channel = mid



Date: 18.JAN.2023 16:35:46

5.5.5 TEST EQUIPMENT USED

- Radio Lab

5.6 SPURIOUS EMISSIONS AT ANTENNA TERMINAL

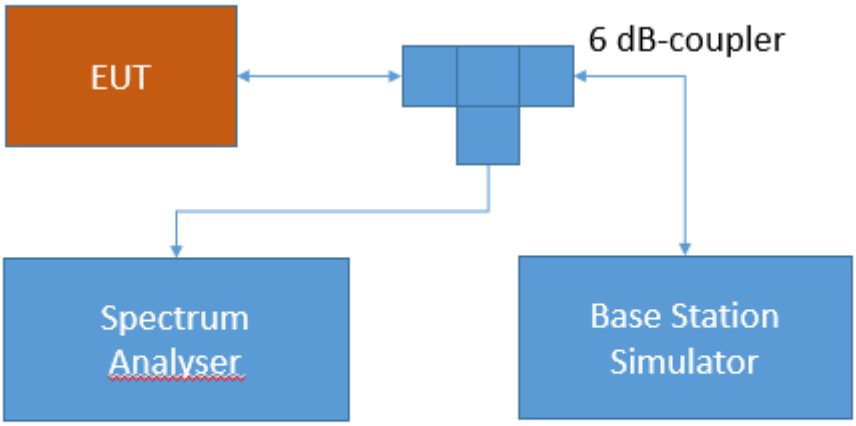
Standard **FCC PART 24 Subpart E**

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

5.6.1 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.

5.6.2 TEST REQUIREMENTS / LIMITS

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

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

Part 24, Subpart E – Broadband PCS; Band 2

§24.238 – Emission limitations for Broadband PCS equipment

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

RSS-133; 6.5 Transmitter Unwanted Emissions

6.5.1 Out-of-Block Emissions

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

i. In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p(watts).
ii. After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p(watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

5.6.3 TEST PROTOCOL

Ambient temperature: 25 °C
Relative humidity: 38 %

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD2	low	rms	maxhold	-	-	-	-13	>20

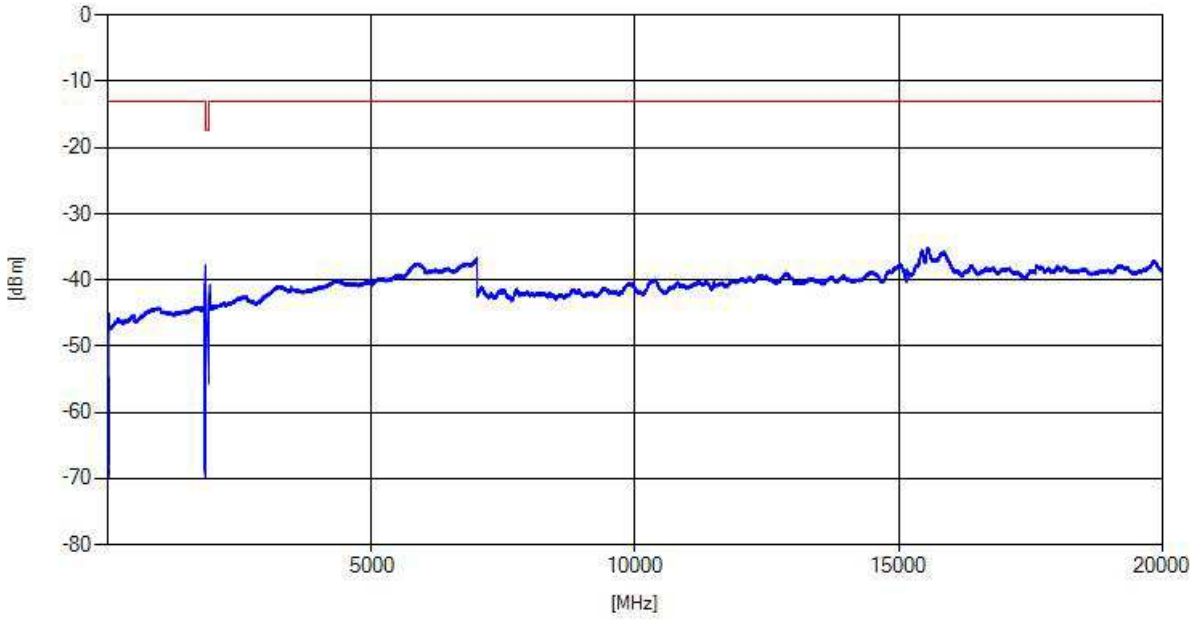
Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD25	low	rms	maxhold	-	-	-	-13	>20

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD2	high	rms	maxhold	-	-	-	-13	>20

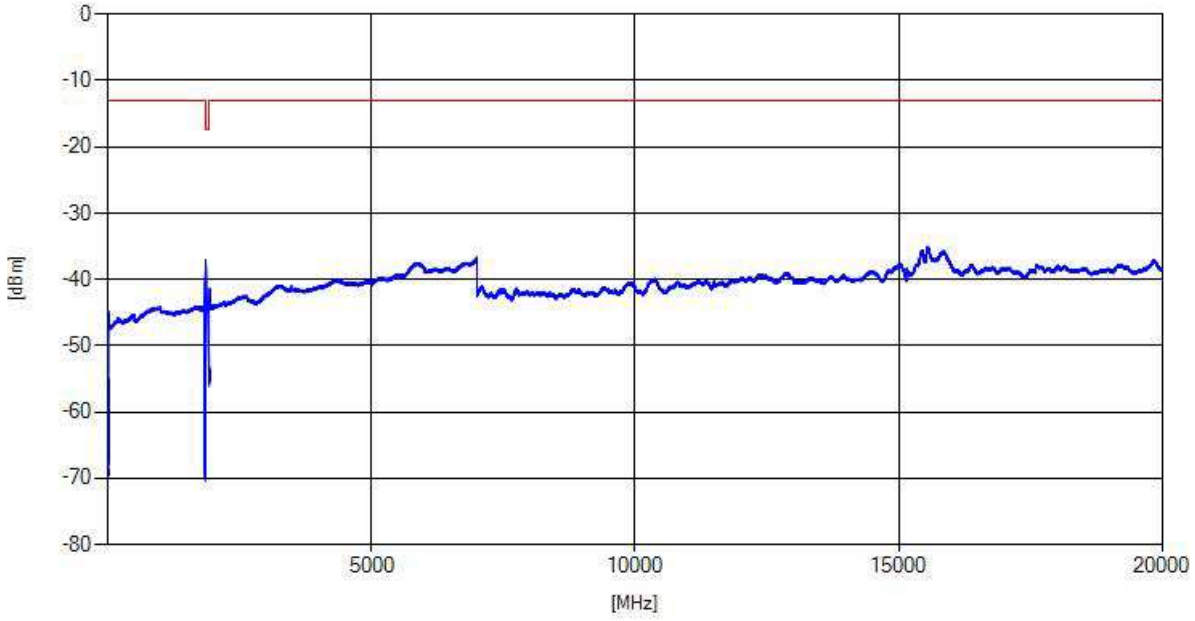
Remark: Please see next sub-clause for the measurement plot.

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

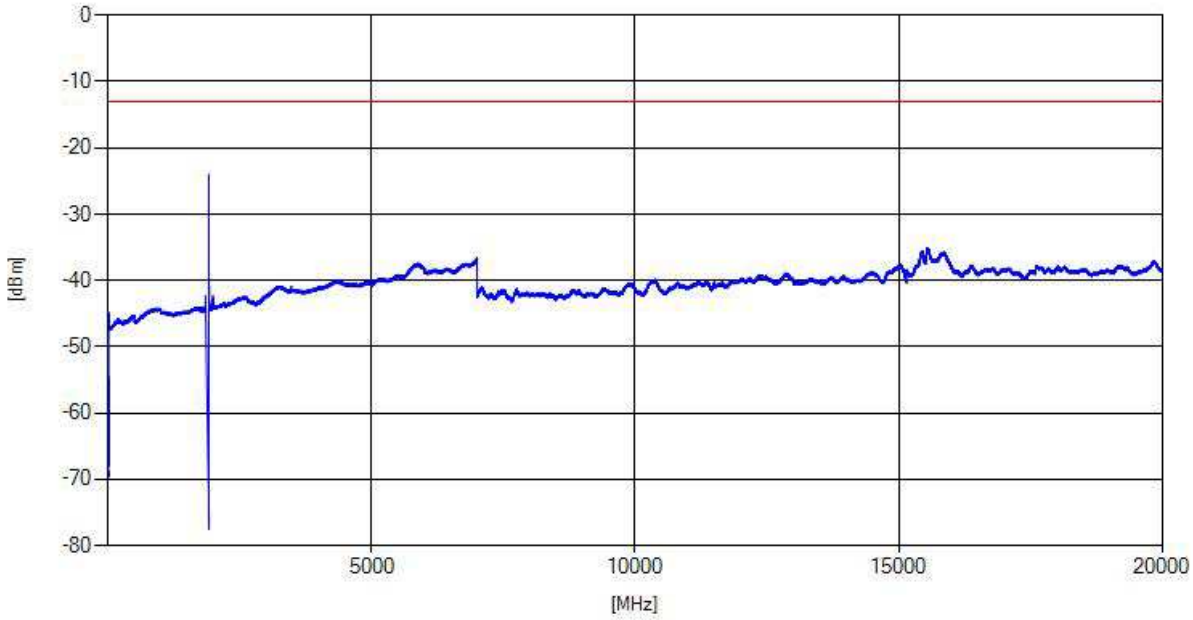
CAT-M1 eFDD2 Channel = low



CAT-M1 eFDD25 Channel = low



NB-IoT eFDD2 Channel = high



5.6.5 TEST EQUIPMENT USED

- Radio Lab

5.7 FIELD STRENGTH OF SPURIOUS RADIATION

Standard **FCC PART 24 Subpart E**

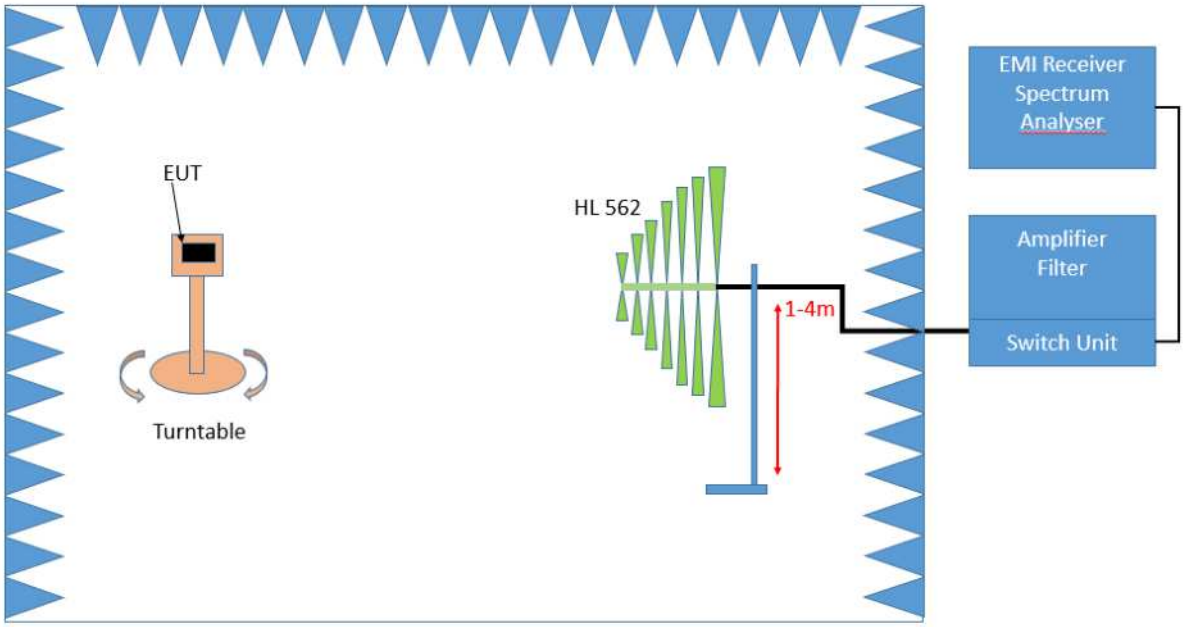
The test was performed according to:
ANSI C63.26: 2015

5.7.1 TEST DESCRIPTION

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

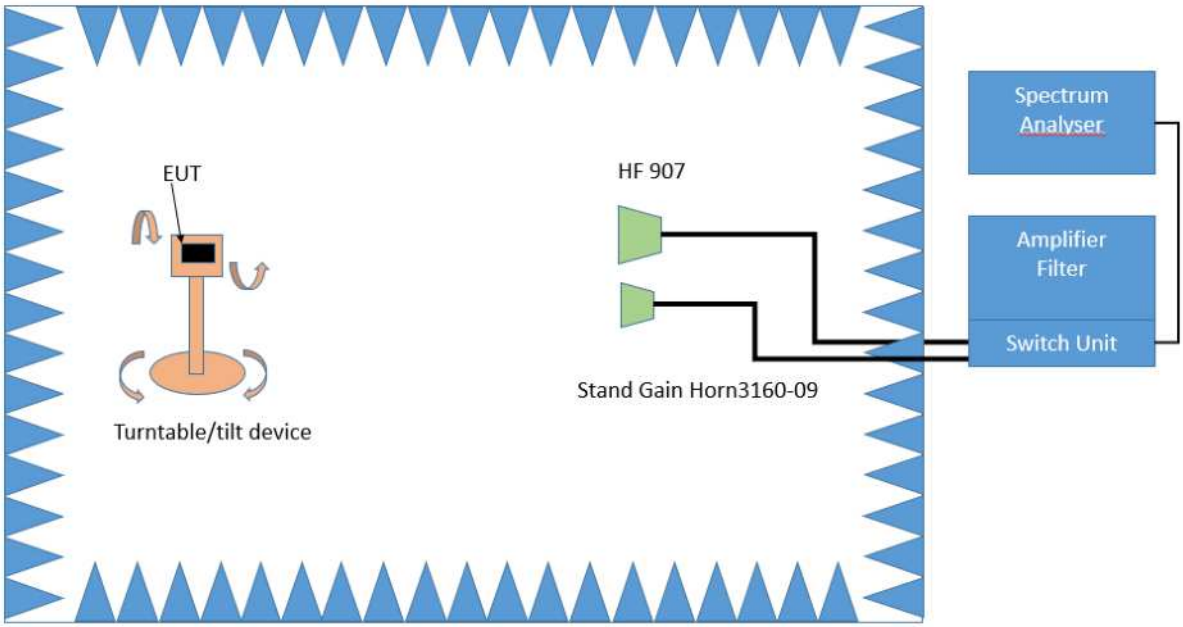
The EUT was connected to the test setup according to the following diagram:

Frequency Range: 30 MHz – 1 GHz:



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

Frequency Range: 1 GHz – 26.5 GHz



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

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

1. Measurement above 30 MHz and up to 1 GHz

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

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

Step 2: Adjustment measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by ± 45° around this value. During this action,

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

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

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

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

Step 2:
Due to the fact, that in this frequency range the test is performed in a fully anechoic room, the height scan of the receiving antenna instep 2 is omitted. Instead of this, a maximum search with a step size ± 45° for the elevation axis is performed.
The turn table azimuth will slowly vary by ± 22.5°.
The elevation angle will slowly vary by ± 45°
EMI receiver settings (for all steps):
- Detector: Peak,
- RBW: 1 MHz

- VBW: 3 MHz
- Sweep time: coupled

Step 3:

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

5.7.2 TEST REQUIREMENTS / LIMITS

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

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

Part 24, Subpart E – Broadband PCS

§ 24 238 – Emission limitations for Broadband PCS equipment

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

b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). 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.

RSS-133; 6.5 Transmitter Unwanted Emissions

Mobile and base station equipment shall comply with the limits in (1) and (2) below.

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

5.7.3 TEST PROTOCOL

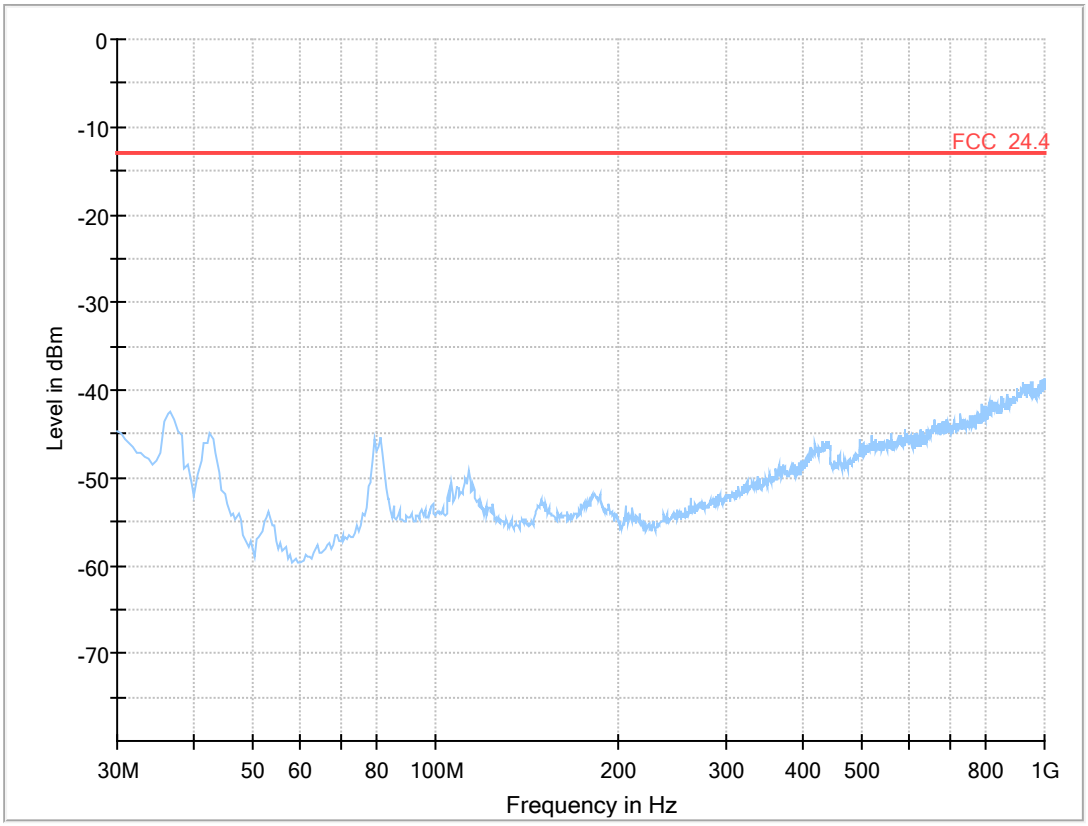
Ambient temperature: 25 °C
Relative humidity: 38 %

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD2	mid	rms	maxhold	-	-	-	-13	>20

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

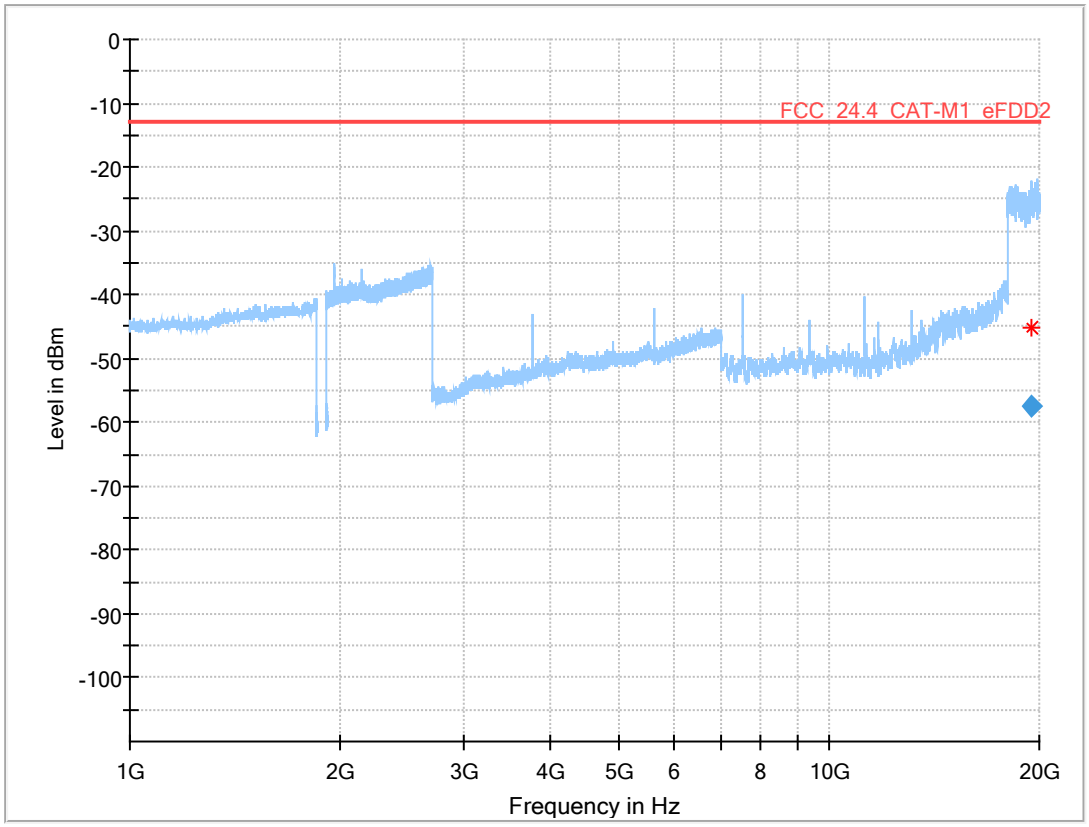
5.7.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

CAT-M1 eFDD 2 QPSK, channel = mid



Final_Result

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



Final_Result

Frequency (MHz)	RMS (dBm	Limit (dBm)	Margin	Meas. Time (ms)	Bandwidth	Height	Pol	Azimuth	Elevation	Corr. (dB)
19485.000	-57.4	-13.00	44.43	1000.0	1000.000	150.0	H	122.0	-26.0	-80.1

5.7.5 TEST EQUIPMENT USED

- Radiated Emissions

5.8 BAND EDGE COMPLIANCE

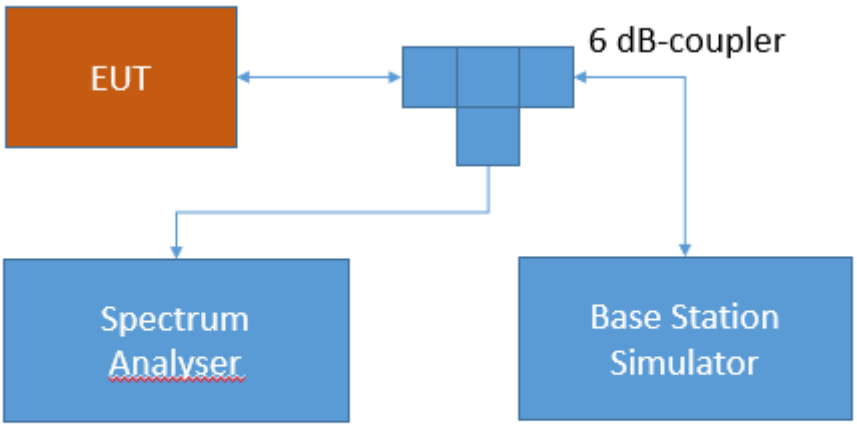
Standard **FCC PART 24 Subpart E**

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

5.8.1 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.

5.8.2 TEST REQUIREMENTS / LIMITS

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

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

Part 24, Subpart E – Broadband PCS

§24 238 – Emission limitations for Broadband PCS equipment

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

b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). 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.

RSS-133; 6.5 Transmitter Unwanted Emissions

Mobile and base station equipment shall comply with the limits in (1) and (2) below.

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

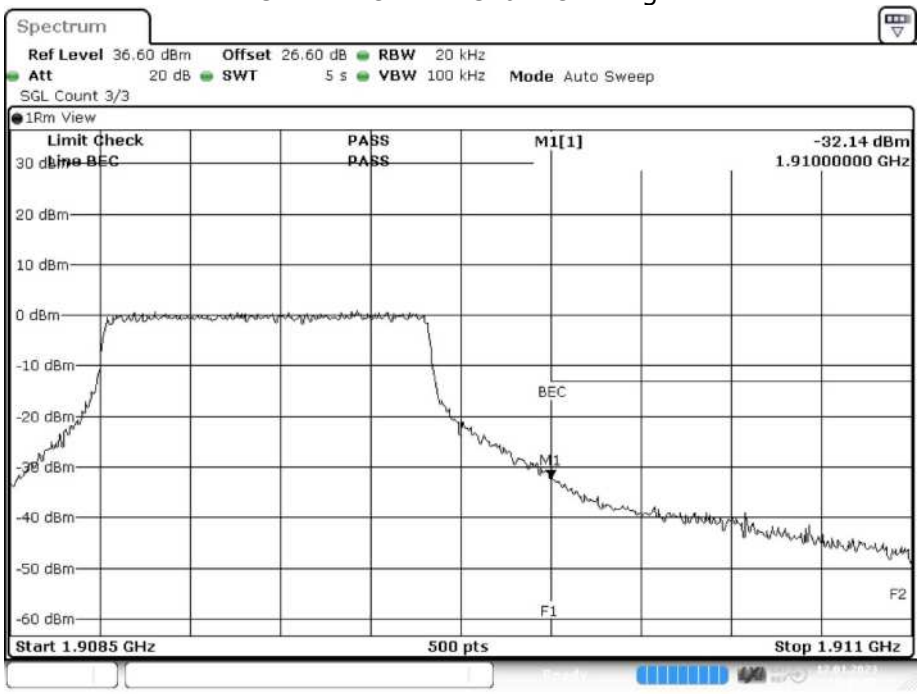
5.8.3 TEST PROTOCOL

Radio Technology	Channel	Re-source Blocks / Subcarrier	Band-width [MHz]	Peak [dBm]	Average [dBm]	RMS [dBm]	Limit [dBm]	Margin to Limit [dB]
CAT-M1 eFDD 2 16QAM	high	5	1.4	-17.53	-40.27	-32.14	-13	19.14
CAT-M1 eFDD 25 16QAM	low	5	1.4	-11.36	-35.18	-27.14	-13	14.14
NB-IoT eFDD 2 BPSK	high	1	0.2	-8.14	-18.61	-16.20	-13	3.20

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

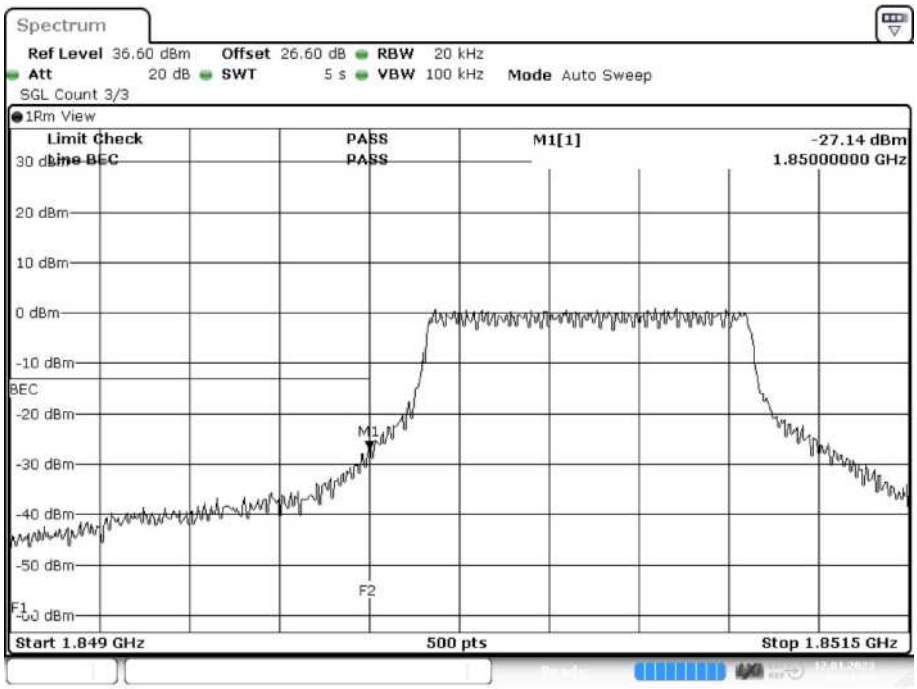
5.8.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

CAT-M1 eFDD2 Channel = high



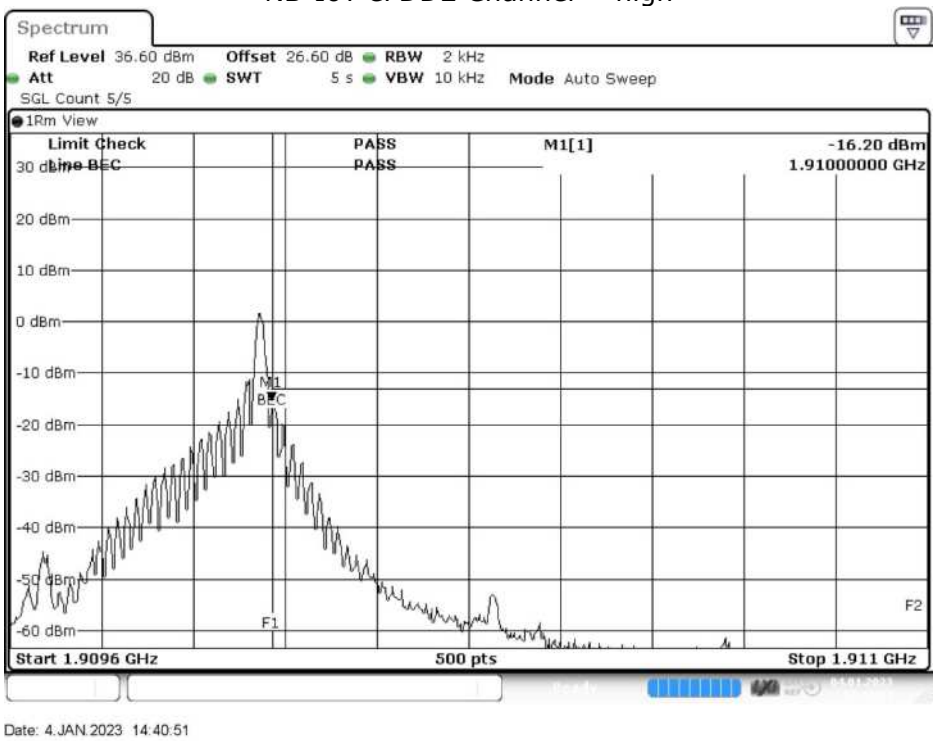
Date: 12.JAN.2023 15:15:02

CAT-M1 eFDD25 Channel = low



Date: 12.JAN.2023 15:31:45

NB-IoT eFDD2 Channel = high



5.8.5 TEST EQUIPMENT USED

- Radio Lab

5.9 RF OUTPUT POWER

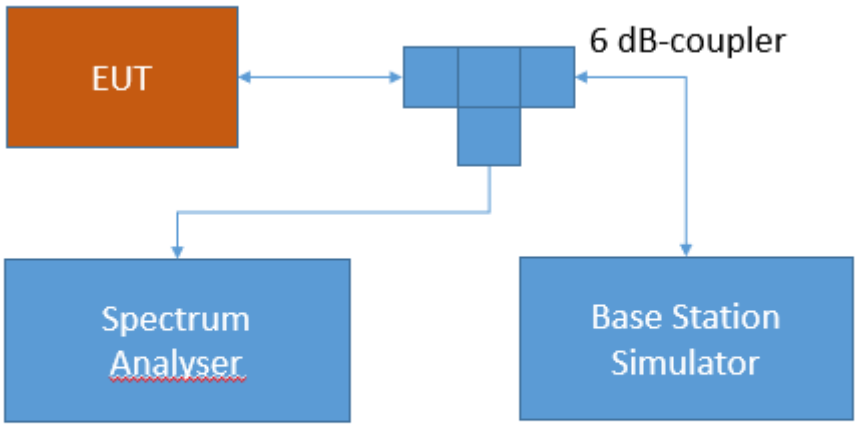
Standard **FCC PART 27 Subpart C**

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

5.9.1 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.

5.9.2 TEST REQUIREMENTS / LIMITS

FCC Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§ 27.50 - Power limits and duty cycle
Band 13:

(b) The following power limits apply to transmitters operating in the 746-758 MHz, 775-788 MHz and 805-806 MHz bands:

(10) Portable stations (hand-held devices) transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands are limited to 3 watts ERP.

RSS-130; 4.6.3 Transmitter Output Power

The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment.

Band 12:

c) The following power and antenna height requirements apply to stations transmitting in the 600 MHz band and the 698-746 MHz band:

(10) Portable stations (hand-held devices) in the 600 MHz uplink band and the 698-746 MHz band, and fixed and mobile stations in the 600 MHz uplink band are limited to 3 watts ERP.

RSS-130; 4.6.3 Transmitter Output Power

The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment.

Band 4/10/66:

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

(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum.

RSS-139; 6.5 Transmitter Output Power

The equivalent isotropically radiated power (e.i.r.p.) for mobile and portable transmitters shall not exceed one watt.

Band 17:

(c) The following power requirements apply to stations transmitting in the 600 MHz band and the 698-746 MHz band:

(10) Portable stations (hand-held devices) in the 600 MHz uplink band and the 698-746 MHz band, and fixed and mobile stations in the 600 MHz uplink band are limited to 3 watts ERP.

RSS-130; 4.6.3 Transmitter Output

The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment.

Band 7:

(h) The following power limits shall apply in the BRS and EBS:

(2) Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

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

The transmitter output power shall be measured in terms of average value.

For mobile subscriber equipment, the e.i.r.p. shall not exceed 2 W. For fixed subscriber equipment, the transmitter output power shall not exceed 2 W and the e.i.r.p. shall be limited to 40 W.

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

5.9.3 TEST PROTOCOL

Ambient temperature: 24 °C
Relative humidity: 37 %

Radio Technology	Ch	Re-source Blocks	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 4 QPSK	low	1	1.4	22.56	1 (EIRP)	1 (EIRP)	7.44	7.44
CAT-M1 eFDD 4 QPSK	low	3	1.4	21.94	1 (EIRP)	1 (EIRP)	8.06	8.06
CAT-M1 eFDD 4 QPSK	low	6	1.4	21.46	1 (EIRP)	1 (EIRP)	8.54	8.54
CAT-M1 eFDD 4 QPSK	low	1	3	22.57	1 (EIRP)	1 (EIRP)	7.43	7.43
CAT-M1 eFDD 4 QPSK	low	3	3	21.88	1 (EIRP)	1 (EIRP)	8.12	8.12
CAT-M1 eFDD 4 QPSK	low	6	3	21.43	1 (EIRP)	1 (EIRP)	8.57	8.57
CAT-M1 eFDD 4 QPSK	low	1	5	22.50	1 (EIRP)	1 (EIRP)	7.50	7.50
CAT-M1 eFDD 4 QPSK	low	3	5	21.88	1 (EIRP)	1 (EIRP)	8.12	8.12
CAT-M1 eFDD 4 QPSK	low	6	5	21.90	1 (EIRP)	1 (EIRP)	8.10	8.10
CAT-M1 eFDD 4 QPSK	low	1	10	22.49	1 (EIRP)	1 (EIRP)	7.51	7.51
CAT-M1 eFDD 4 QPSK	low	3	10	22.50	1 (EIRP)	1 (EIRP)	7.50	7.50
CAT-M1 eFDD 4 QPSK	low	6	10	21.92	1 (EIRP)	1 (EIRP)	8.08	8.08
CAT-M1 eFDD 8 QPSK	low	1	1.4	22.06	3 (ERP)	-	12.71	-
CAT-M1 eFDD 8 QPSK	low	3	1.4	21.99	3 (ERP)	-	12.78	-
CAT-M1 eFDD 8 QPSK	low	6	1.4	21.37	3 (ERP)	-	13.40	-
CAT-M1 eFDD 8 QPSK	low	1	3	22.02	3 (ERP)	-	12.75	-
CAT-M1 eFDD 8 QPSK	low	3	3	21.95	3 (ERP)	-	12.82	-
CAT-M1 eFDD 8 QPSK	low	6	3	21.34	3 (ERP)	-	13.43	-
CAT-M1 eFDD 12 QPSK	low	1	1.4	21.91	3 (ERP)	3 (ERP)	12.86	12.86
CAT-M1 eFDD 12 QPSK	low	3	1.4	21.58	3 (ERP)	3 (ERP)	13.19	13.19
CAT-M1 eFDD 12 QPSK	low	6	1.4	21.64	3 (ERP)	3 (ERP)	13.13	13.13
CAT-M1 eFDD 12 QPSK	low	1	3	21.91	3 (ERP)	3 (ERP)	12.86	12.86
CAT-M1 eFDD 12 QPSK	low	3	3	21.22	3 (ERP)	3 (ERP)	13.55	13.55
CAT-M1 eFDD 12 QPSK	low	6	3	21.18	3 (ERP)	3 (ERP)	13.59	13.59
CAT-M1 eFDD 12 QPSK	low	1	5	21.87	3 (ERP)	3 (ERP)	12.90	12.90
CAT-M1 eFDD 12 QPSK	low	3	5	21.60	3 (ERP)	3 (ERP)	13.17	13.17
CAT-M1 eFDD 12 QPSK	low	6	5	21.62	3 (ERP)	3 (ERP)	13.15	13.15
CAT-M1 eFDD 12 QPSK	low	1	10	21.89	3 (ERP)	3 (ERP)	12.88	12.88
CAT-M1 eFDD 12 QPSK	low	3	10	21.70	3 (ERP)	3 (ERP)	13.07	13.07
CAT-M1 eFDD 12 QPSK	low	6	10	21.74	3 (ERP)	3 (ERP)	13.03	13.03
CAT-M1 eFDD 13 QPSK	mid	1	5	22.51	3 (ERP)	3 (ERP)	12.26	12.26
CAT-M1 eFDD 13 QPSK	mid	3	5	21.71	3 (ERP)	3 (ERP)	13.06	13.06
CAT-M1 eFDD 13 QPSK	mid	6	5	21.81	3 (ERP)	3 (ERP)	12.96	12.96
CAT-M1 eFDD 13 QPSK	mid	1	10	22.00	3 (ERP)	3 (ERP)	12.77	12.77
CAT-M1 eFDD 13 QPSK	mid	3	10	22.25	3 (ERP)	3 (ERP)	12.52	12.52
CAT-M1 eFDD 13 QPSK	mid	6	10	21.80	3 (ERP)	3 (ERP)	12.97	12.97
CAT-M1 eFDD 66 QPSK	mid	1	1.4	22.85	1 (EIRP)	1 (EIRP)	7.15	7.15
CAT-M1 eFDD 66 QPSK	mid	3	1.4	22.10	1 (EIRP)	1 (EIRP)	7.90	7.90
CAT-M1 eFDD 66 QPSK	mid	6	1.4	22.16	1 (EIRP)	1 (EIRP)	7.84	7.84
CAT-M1 eFDD 66 QPSK	mid	1	3	22.89	1 (EIRP)	1 (EIRP)	7.11	7.11
CAT-M1 eFDD 66 QPSK	mid	3	3	21.97	1 (EIRP)	1 (EIRP)	8.03	8.03
CAT-M1 eFDD 66 QPSK	mid	6	3	22.09	1 (EIRP)	1 (EIRP)	7.91	7.91
CAT-M1 eFDD 66 QPSK	mid	1	5	23.08	1 (EIRP)	1 (EIRP)	6.92	6.92
CAT-M1 eFDD 66 QPSK	mid	3	5	21.97	1 (EIRP)	1 (EIRP)	8.03	8.03
CAT-M1 eFDD 66 QPSK	mid	6	5	22.09	1 (EIRP)	1 (EIRP)	7.91	7.91
CAT-M1 eFDD 66 QPSK	mid	1	10	22.65	1 (EIRP)	1 (EIRP)	7.35	7.35
CAT-M1 eFDD 66 QPSK	mid	3	10	22.68	1 (EIRP)	1 (EIRP)	7.32	7.32
CAT-M1 eFDD 66 QPSK	mid	6	10	22.07	1 (EIRP)	1 (EIRP)	7.93	7.93
CAT-M1 eFDD 71 QPSK	high	1	5	21.89	3 (ERP)	3 (ERP)	12.88	12.88

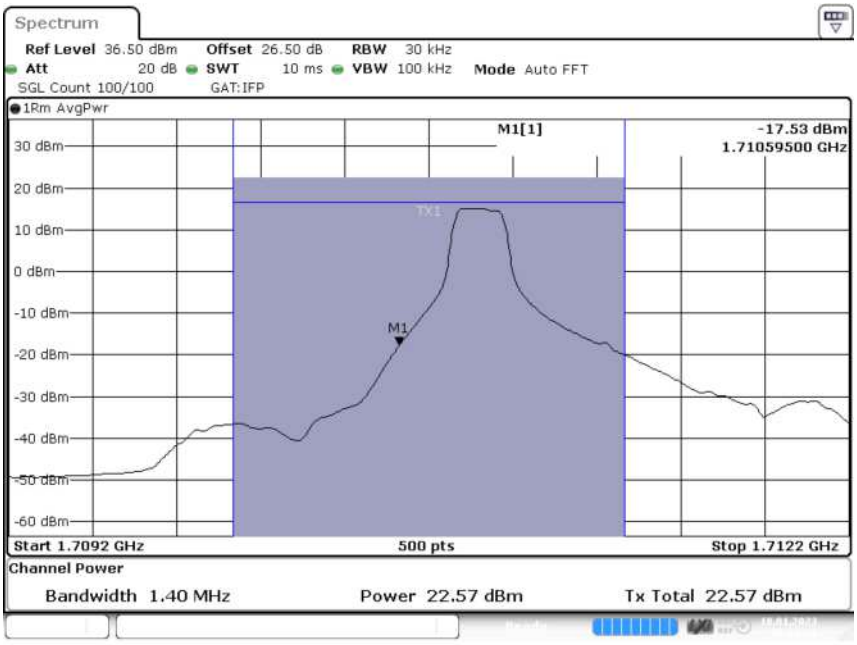
CAT-M1 eFDD 71 QPSK	high	3	5	21.74	3 (ERP)	3 (ERP)	13.03	13.03
CAT-M1 eFDD 71 QPSK	high	6	5	21.86	3 (ERP)	3 (ERP)	12.91	12.91
CAT-M1 eFDD 71 QPSK	high	1	10	22.02	3 (ERP)	3 (ERP)	12.75	12.75
CAT-M1 eFDD 71 QPSK	high	3	10	21.74	3 (ERP)	3 (ERP)	13.03	13.03
CAT-M1 eFDD 71 QPSK	high	6	10	21.82	3 (ERP)	3 (ERP)	12.95	12.95
NB-IoT eFDD 4 QPSK	mid	1	0.2	22.87	1 (EIRP)	1 (EIRP)	7.13	7.13
NB-IoT eFDD 4 QPSK	mid	3	0.2	22.37	1 (EIRP)	1 (EIRP)	7.63	7.63
NB-IoT eFDD 4 QPSK	mid	6	0.2	22.71	1 (EIRP)	1 (EIRP)	7.29	7.29
NB-IoT eFDD 4 QPSK	mid	12	0.2	21.71	1 (EIRP)	1 (EIRP)	8.29	8.29
NB-IoT eFDD 4 BPSK	mid	1	0.2	22.97	1 (EIRP)	1 (EIRP)	7.03	7.03
NB-IoT eFDD 12 QPSK	low	1	0.2	23.13	3 (ERP)	3 (ERP)	11.64	11.64
NB-IoT eFDD 12 QPSK	low	3	0.2	22.31	3 (ERP)	3 (ERP)	12.46	12.46
NB-IoT eFDD 12 QPSK	low	6	0.2	22.59	3 (ERP)	3 (ERP)	12.18	12.18
NB-IoT eFDD 12 QPSK	low	12	0.2	21.46	3 (ERP)	3 (ERP)	13.31	13.31
NB-IoT eFDD 12 BPSK	low	1	0.2	22.96	3 (ERP)	3 (ERP)	11.81	11.81
NB-IoT eFDD 13 QPSK	high	1	0.2	22.57	3 (ERP)	3 (ERP)	12.20	12.20
NB-IoT eFDD 13 QPSK	high	3	0.2	22.11	3 (ERP)	3 (ERP)	12.66	12.66
NB-IoT eFDD 13 QPSK	high	6	0.2	22.45	3 (ERP)	3 (ERP)	12.32	12.32
NB-IoT eFDD 13 QPSK	high	12	0.2	21.37	3 (ERP)	3 (ERP)	13.40	13.40
NB-IoT eFDD 13 BPSK	high	1	0.2	22.55	3 (ERP)	3 (ERP)	12.22	12.22
NB-IoT eFDD 8 QPSK	mid	1	0.2	23.05	3 (ERP)	3 (ERP)	11.72	11.72
NB-IoT eFDD 8 QPSK	mid	3	0.2	22.78	3 (ERP)	3 (ERP)	11.99	11.99
NB-IoT eFDD 8 QPSK	mid	6	0.2	22.88	3 (ERP)	3 (ERP)	11.89	11.89
NB-IoT eFDD 8 QPSK	mid	12	0.2	21.88	3 (ERP)	3 (ERP)	12.89	12.89
NB-IoT eFDD 8 BPSK	mid	1	0.2	23.03	3 (ERP)	3 (ERP)	11.74	11.74
NB-IoT eFDD 66 QPSK	mid	1	0.2	22.91	1 (EIRP)	1 (EIRP)	7.09	7.09
NB-IoT eFDD 66 QPSK	mid	3	0.2	22.68	1 (EIRP)	1 (EIRP)	7.32	7.32
NB-IoT eFDD 66 QPSK	mid	6	0.2	23.01	1 (EIRP)	1 (EIRP)	6.99	6.99
NB-IoT eFDD 66 QPSK	mid	12	0.2	22.00	1 (EIRP)	1 (EIRP)	8.00	8.00
NB-IoT eFDD 66 BPSK	mid	1	0.2	22.93	1 (EIRP)	1 (EIRP)	7.07	7.07
NB-IoT eFDD 71 QPSK	low	1	0.2	22.99	3 (ERP)	3 (ERP)	11.78	11.78
NB-IoT eFDD 71 QPSK	low	3	0.2	22.71	3 (ERP)	3 (ERP)	12.06	12.06
NB-IoT eFDD 71 QPSK	low	6	0.2	22.87	3 (ERP)	3 (ERP)	11.90	11.90
NB-IoT eFDD 71 QPSK	low	12	0.2	21.82	3 (ERP)	3 (ERP)	12.95	12.95
NB-IoT eFDD 71 BPSK	low	1	0.2	22.93	3 (ERP)	3 (ERP)	11.84	11.84
NB-IoT eFDD 85 QPSK	mid	1	0.2	22.84	3 (ERP)	3 (ERP)	11.93	11.93
NB-IoT eFDD 85 QPSK	mid	3	0.2	22.19	3 (ERP)	3 (ERP)	12.58	12.58
NB-IoT eFDD 85 QPSK	mid	6	0.2	22.48	3 (ERP)	3 (ERP)	12.29	12.29
NB-IoT eFDD 85 QPSK	mid	12	0.2	21.39	3 (ERP)	3 (ERP)	13.38	13.38
NB-IoT eFDD 85 BPSK	mid	1	0.2	22.89	3 (ERP)	3 (ERP)	11.88	11.88

COMMENT:
Maximum antenna gain given in the table is in regard to the output power not in regard to SAR / MPE.

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

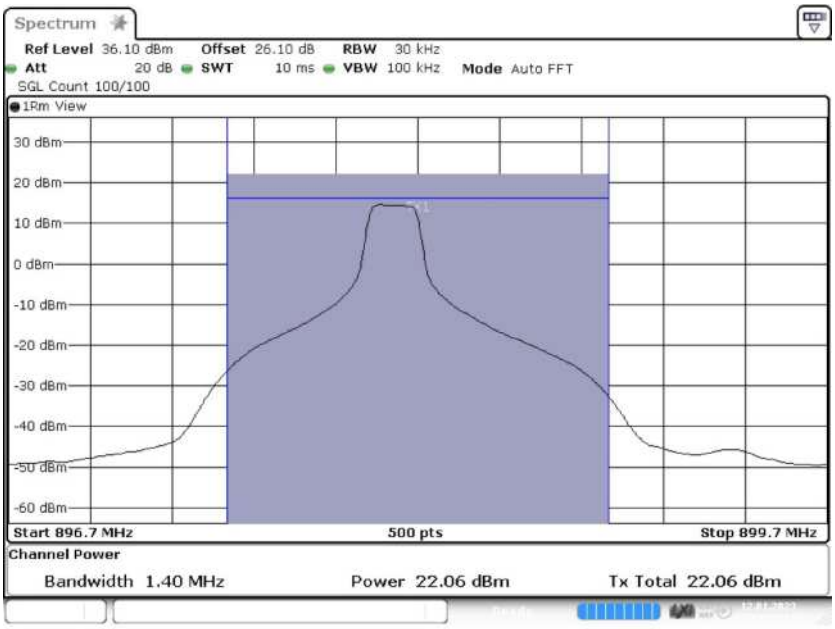
5.9.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

CAT-M1 eFDD4 3MHz RBs=1 Channel = low



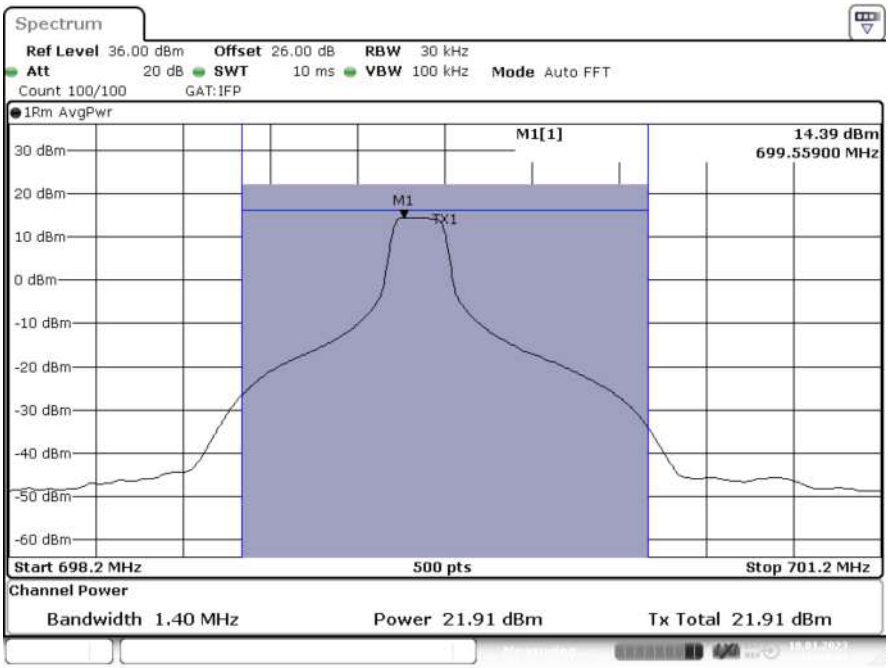
Date: 18.JAN.2023 17:50:36

CAT-M1 eFDD8 1.4MHz RBs=1 Channel = low



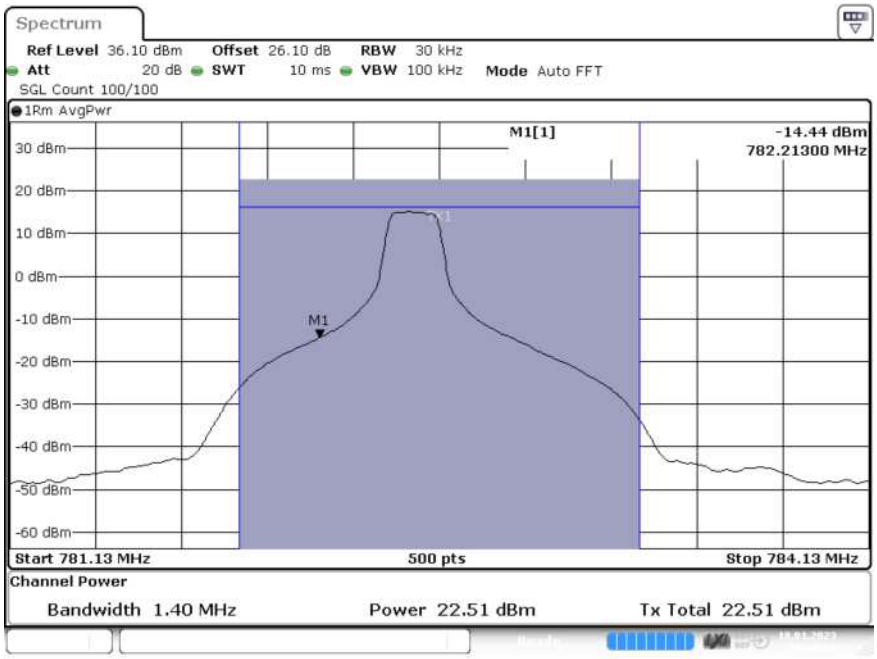
Date: 12.JAN.2023 11:25:13

CAT-M1 eFDD12 1.4MHz RBs=1 Channel = low



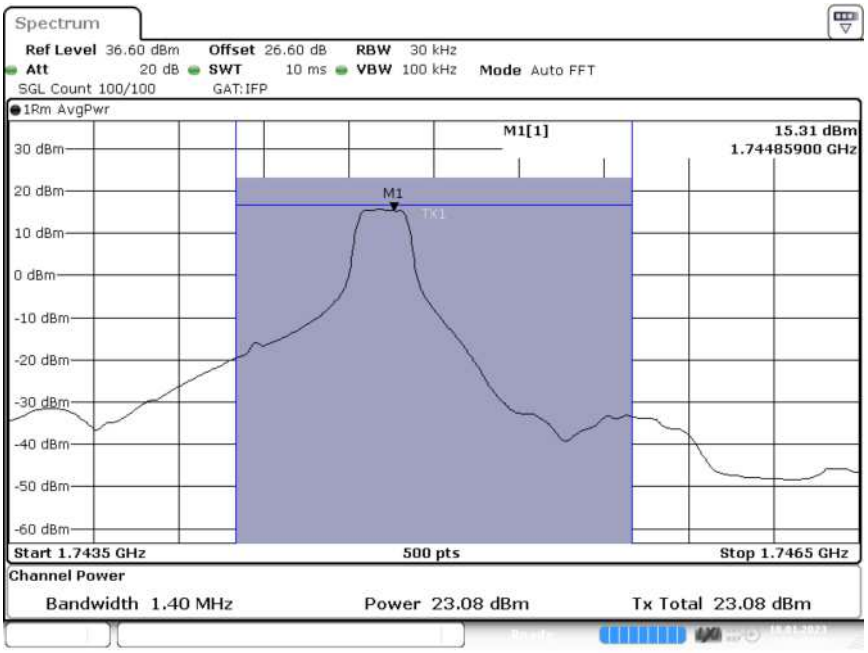
Date: 18.JAN.2023 18:54:37

CAT-M1 eFDD13 5MHz RBs=1 Channel = mid



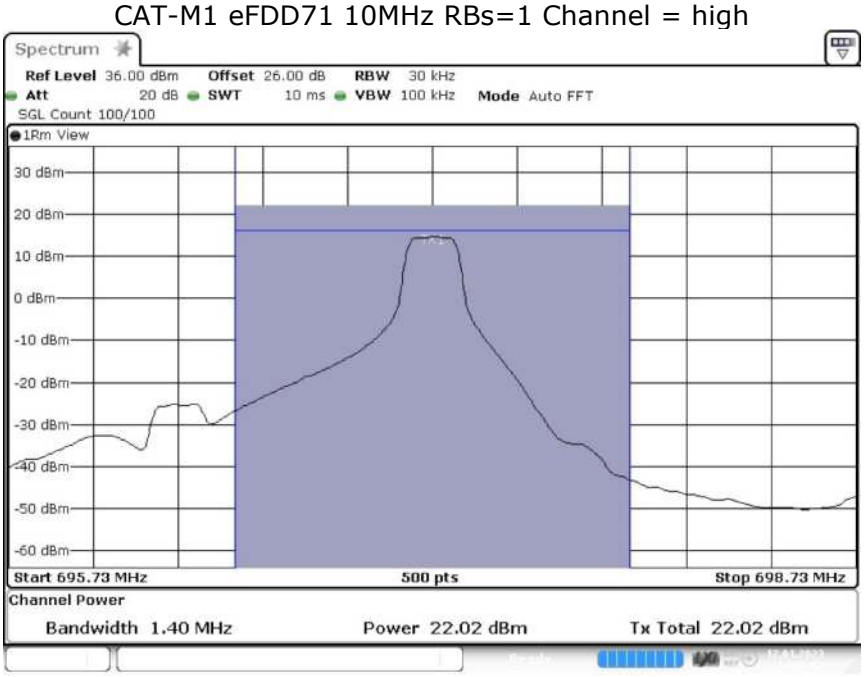
Date: 18.JAN.2023 16:46:01

CAT-M1 eFDD66 5MHz RBs=1 Channel = mid



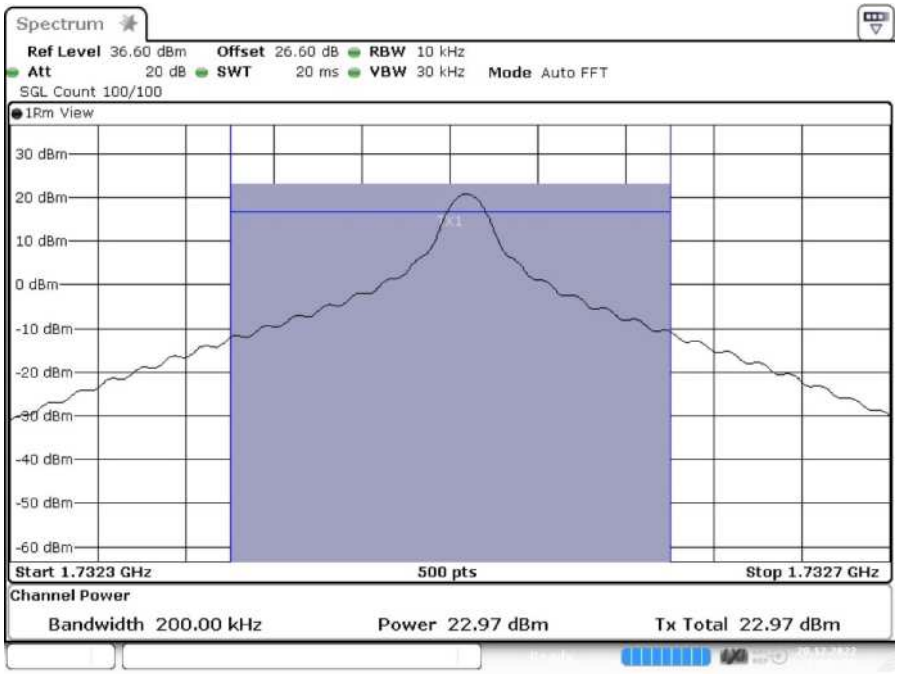
Date: 18.JAN.2023 17:40:21

CAT-M1 eFDD71 10MHz RBs=1 Channel = high



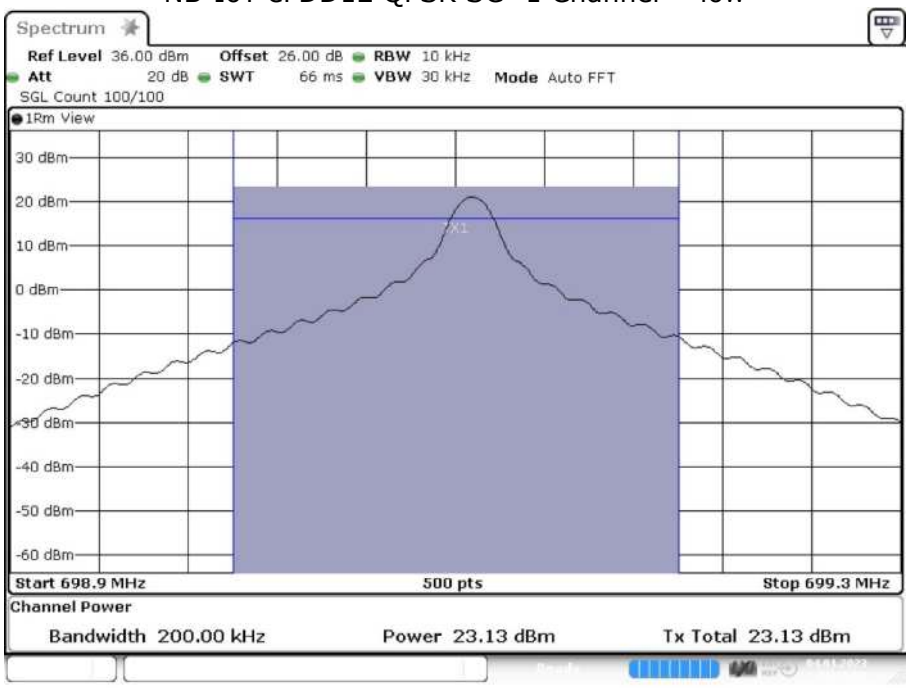
Date: 12.JAN.2023 14:57:52

NB-IoT eFDD4 BPSK SC=1 Channel = mid



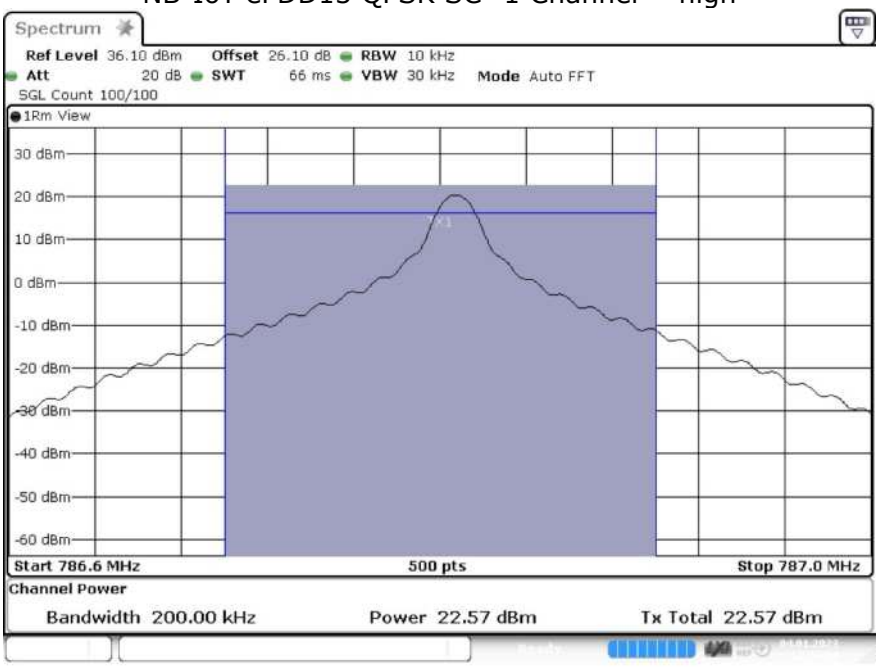
Date: 20.DEC.2022 14:06:35

NB-IoT eFDD12 QPSK SC=1 Channel = low



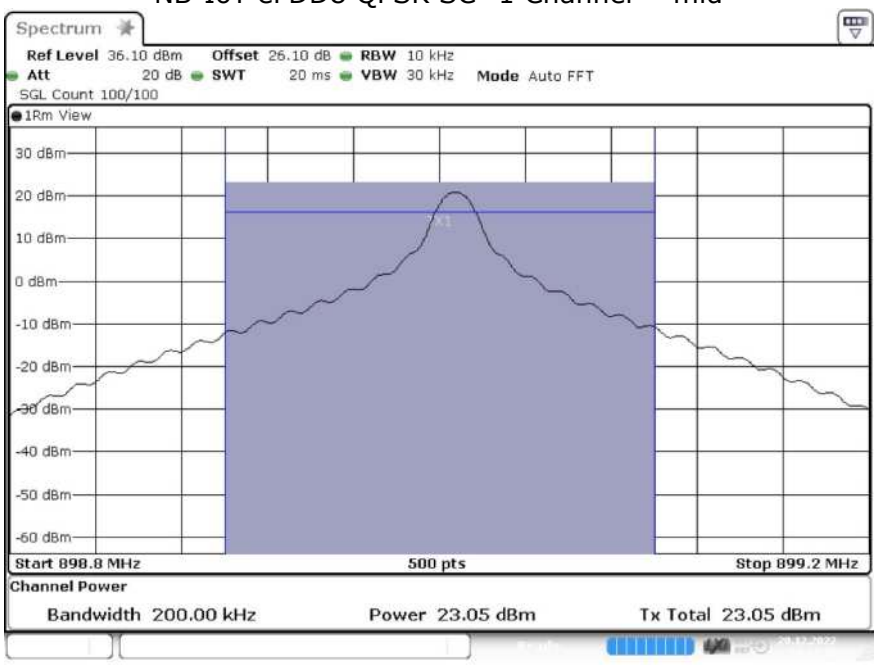
Date: 4.JAN.2023 11:25:55

NB-IoT eFDD13 QPSK SC=1 Channel = high



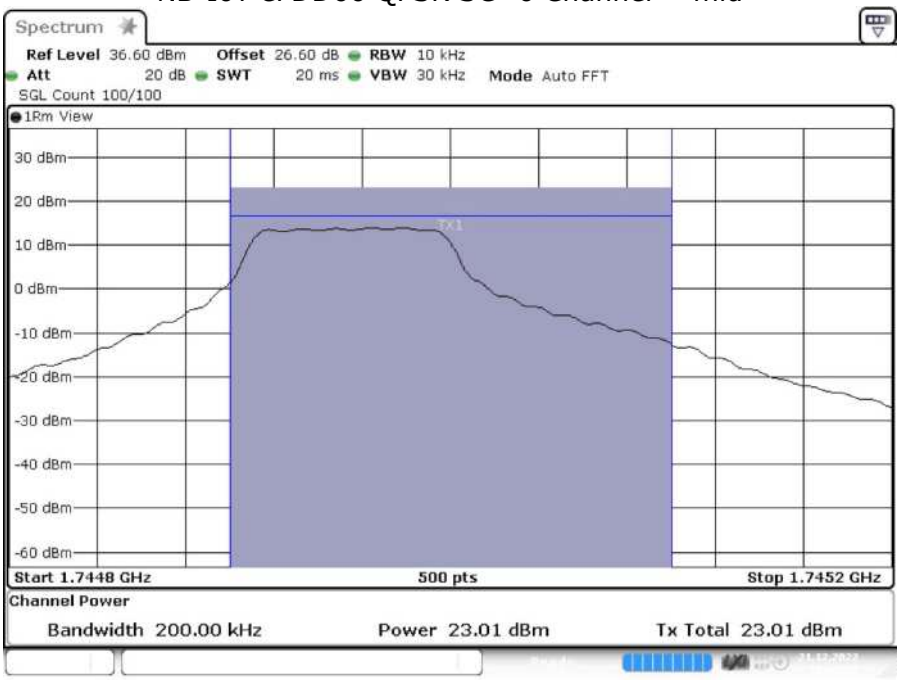
Date: 4.JAN.2023 11:50:38

NB-IoT eFDD8 QPSK SC=1 Channel = mid



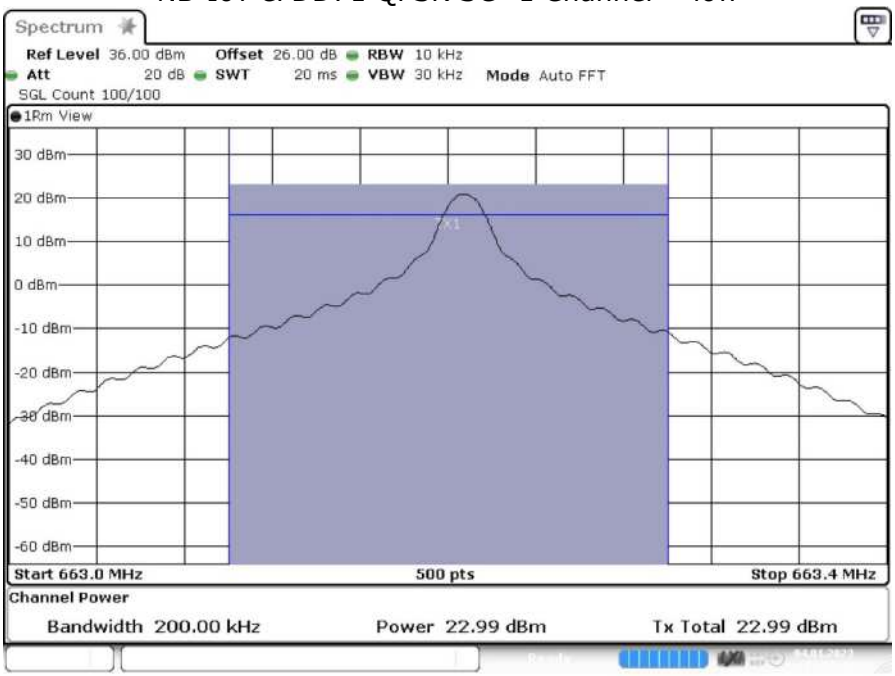
Date: 20.DEC.2022 14:11:10

NB-IoT eFDD66 QPSK SC=6 Channel = mid



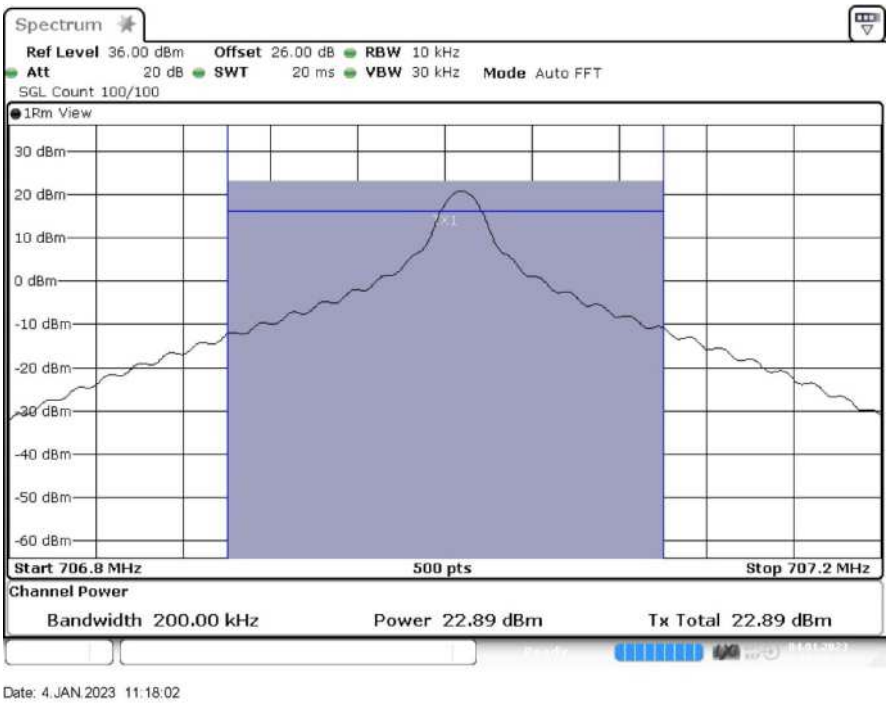
Date: 21.DEC.2022 10:32:22

NB-IoT eFDD71 QPSK SC=1 Channel = low



Date: 4.JAN.2023 11:12:48

NB-IoT eFDD85 BPSK SC=1 Channel = mid



5.9.5 TEST EQUIPMENT USED

- Radio Lab

5.10 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

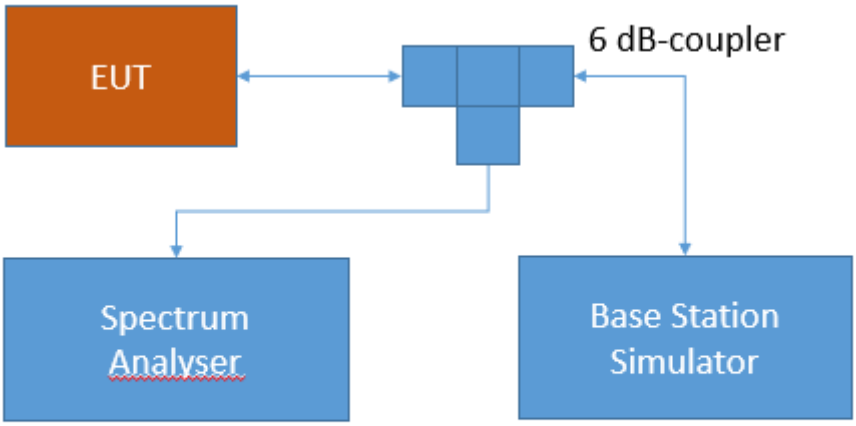
Standard **FCC PART 27 Subpart C**

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

5.10.1 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.

5.10.2 TEST REQUIREMENTS / LIMITS

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

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

FCC Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§27.53 – Emission limits

Band 13

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

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

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

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

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

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

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

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

RSS-130; 4.7.1 General unwanted emissions limits

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

RSS-130; 4.7.2 Additional unwanted emissions limits

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

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

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

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

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

Band 12:

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

RSS-130; 4.7.1 General unwanted emissions limits

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

RSS-130; 4.7.2 Additional unwanted emissions limits

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

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

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

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

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

Band 4/10/66:

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

RSS-139; 6.6 Transmitter Unwanted Emissions

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

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

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

Band 7:

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

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

RSS-199; 4.5 Transmitter unwanted emissions

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

Equipment shall comply with the following unwanted emission limits:

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

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

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

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

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

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

Band 17:

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

RSS-130; 4.7.1 General unwanted emissions limits

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

RSS-130; 4.7.2 Additional unwanted emissions limits

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

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

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

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

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

5.10.3 TEST PROTOCOL

Ambient temperature: 24 °C
Relative humidity: 37 %

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD4	high	rms	maxhold	-	-	-	-13	>20

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD8	low	rms	maxhold	20	897.5	-27.66	-13	14.66

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD12	mid	rms	maxhold	-	-	-	-13	>13

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD13	mid	rms	maxhold	-	-	-	-13	>20

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD66	low	rms	maxhold	20	1710	-28.68	-13	15.68

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD71	low	rms	maxhold	30	663	-26.11	-13	13.11

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD4	low	rms	maxhold	2	1710	-22.39	-13	9.39

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD66	high	rms	maxhold	2	1780	-20.38	-13	7.38

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD8	high	rms	maxhold	2	900.5	-22.67	-13	9.67

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD12	high	rms	maxhold	30	716.0	-18.45	-13	5.45

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD13	mid	rms	maxhold	-	-	-	-13	>20

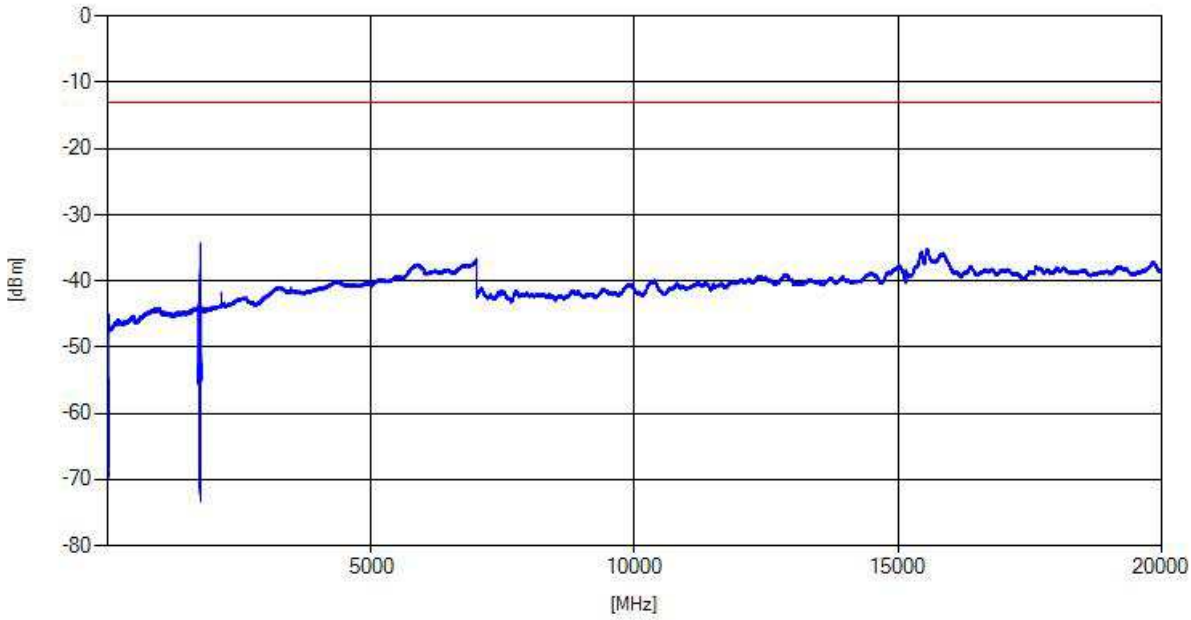
Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD71	low	rms	maxhold	30	663.0	-24.11	-13	11.11

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD85	low	rms	maxhold	30	698.0	-18.36	-13	5.36

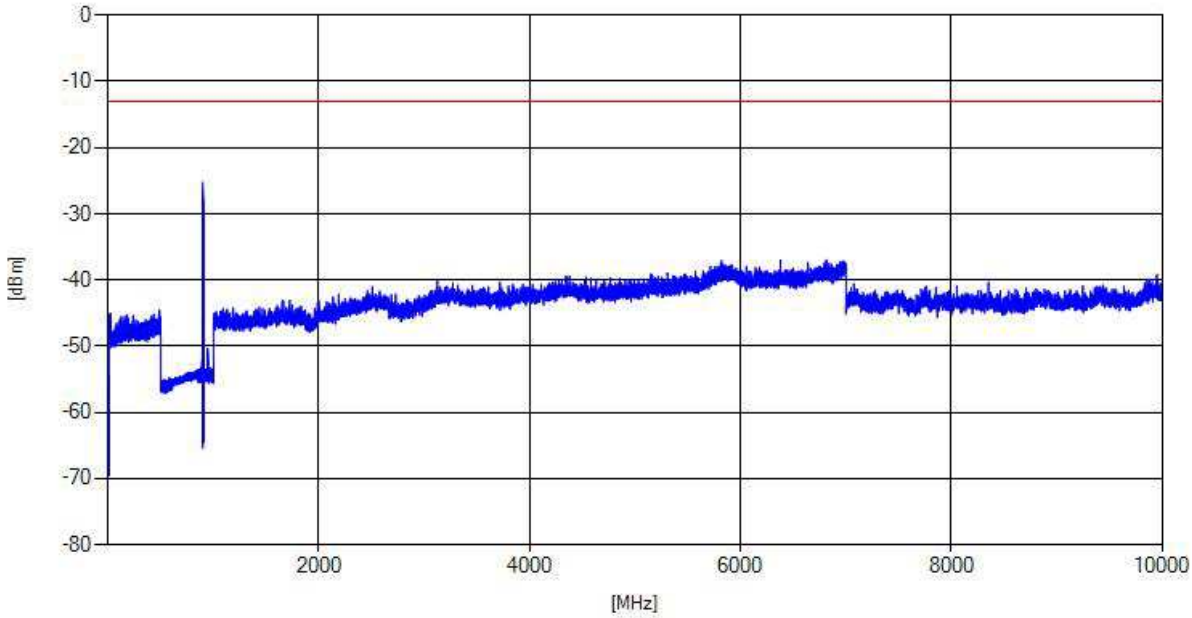
Remark: Please see next sub-clause for the measurement plot.

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

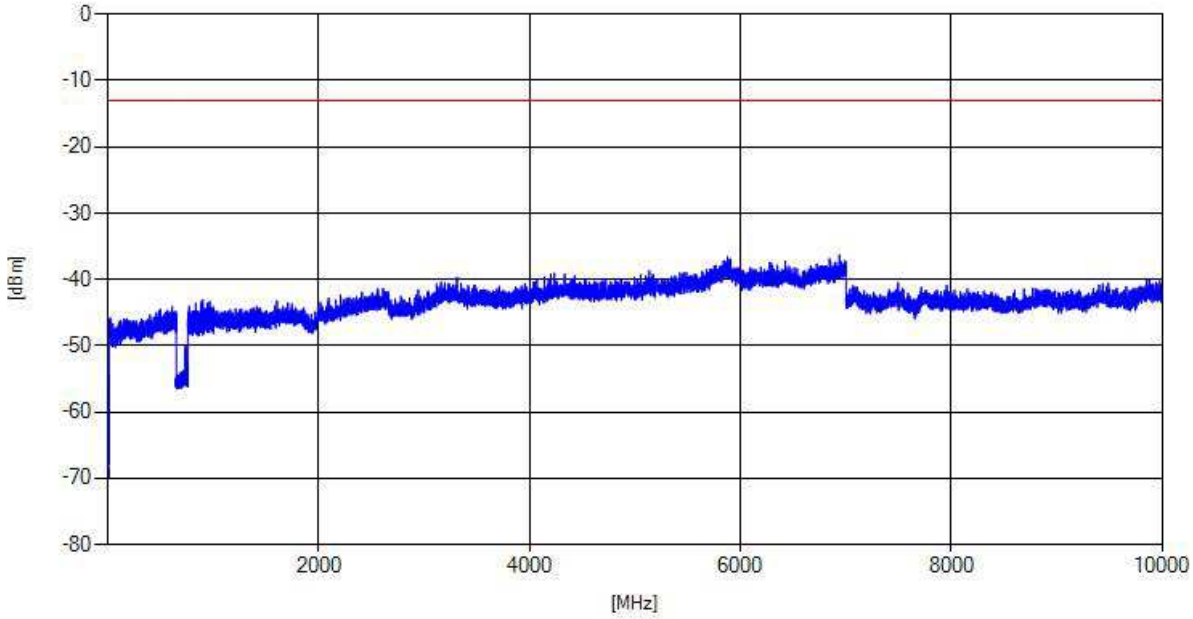
CAT-M1 eFDD4 Channel = high



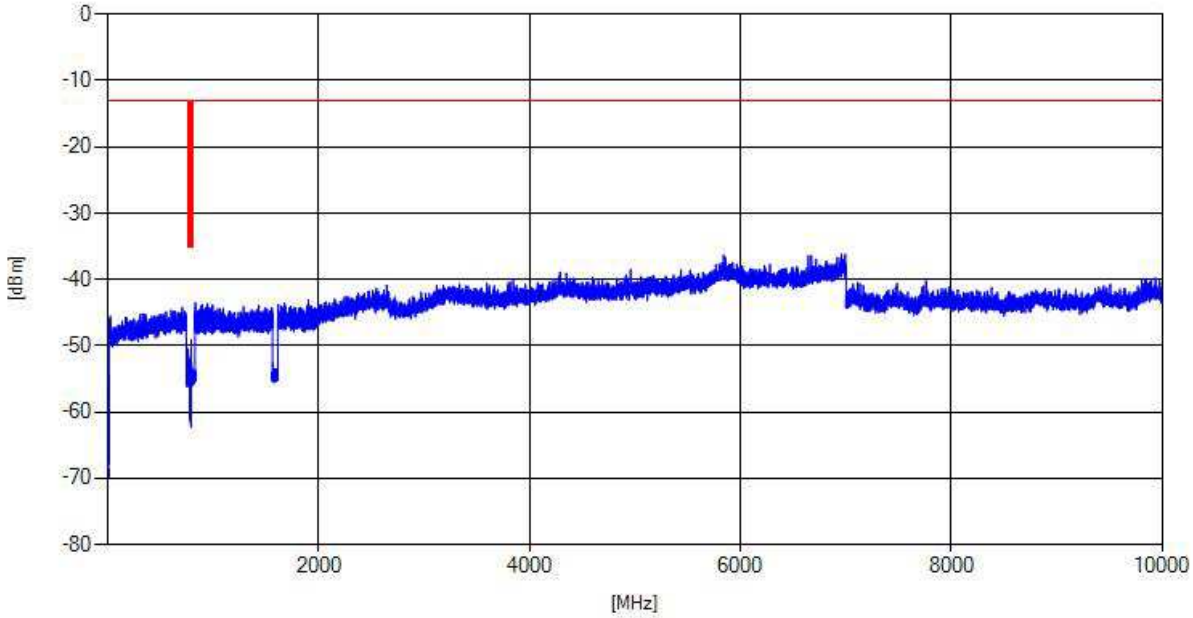
CAT-M1 eFDD8 Channel = low



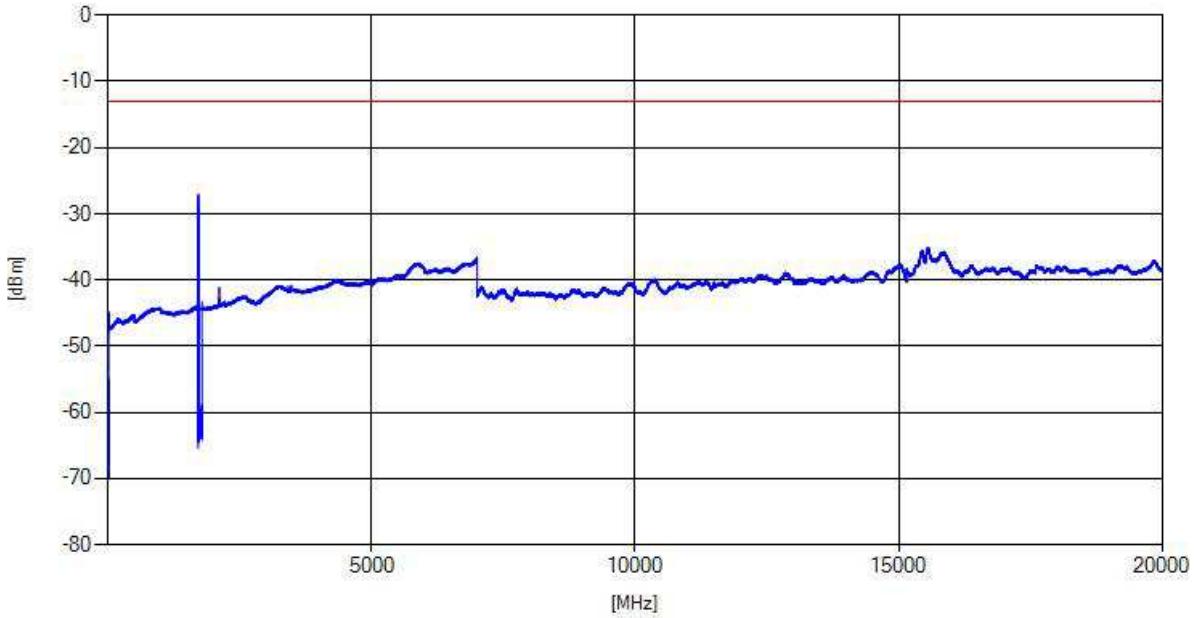
CAT-M1 eFDD12 Channel = mid



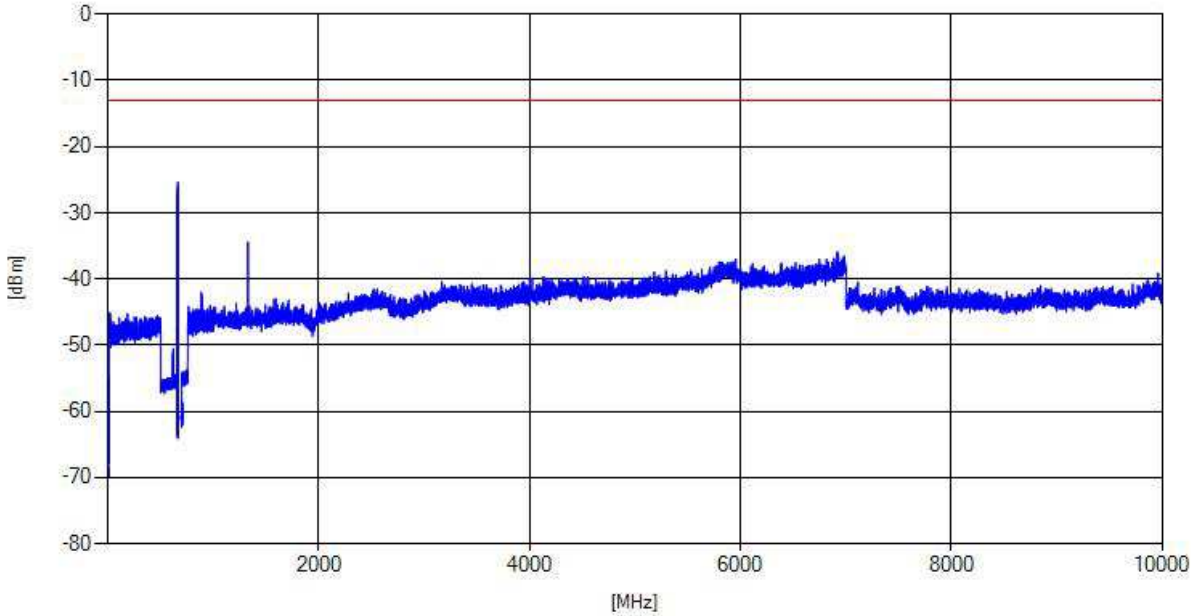
CAT-M1 eFDD13 Channel = mid



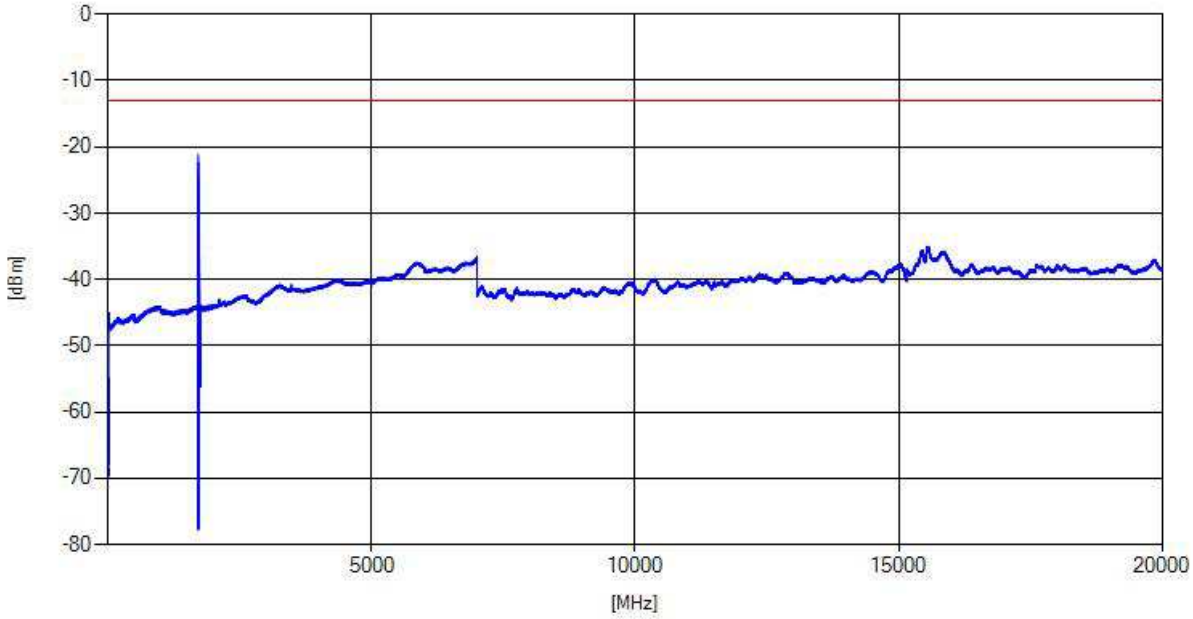
CAT-M1 eFDD66 Channel = low



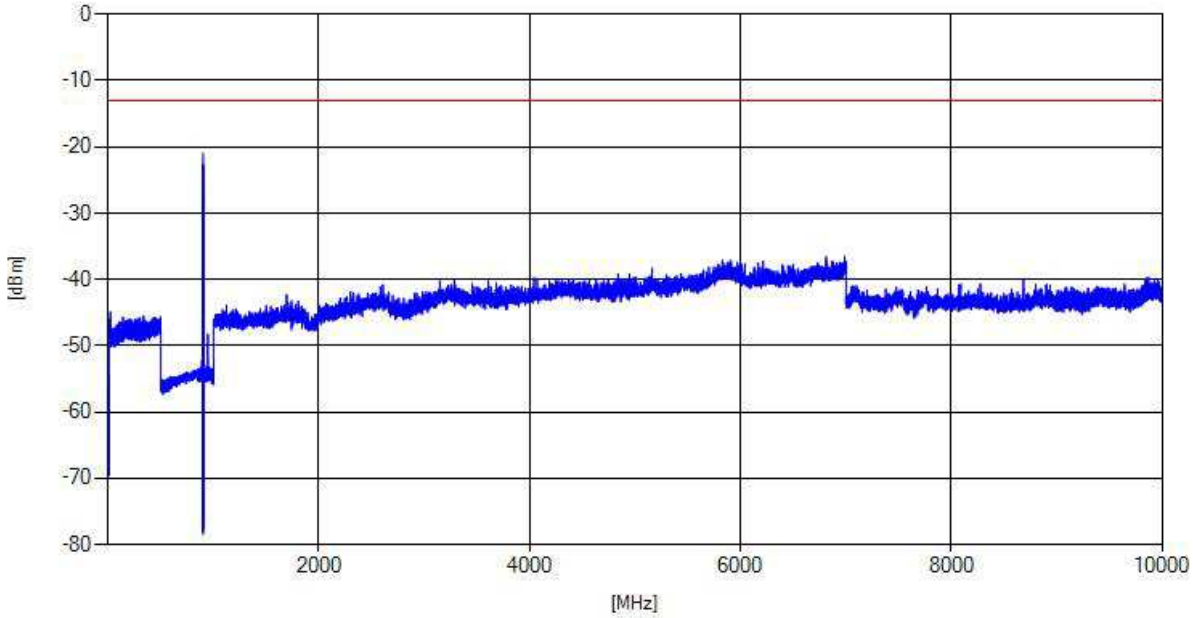
CAT-M1 eFDD71 Channel = low



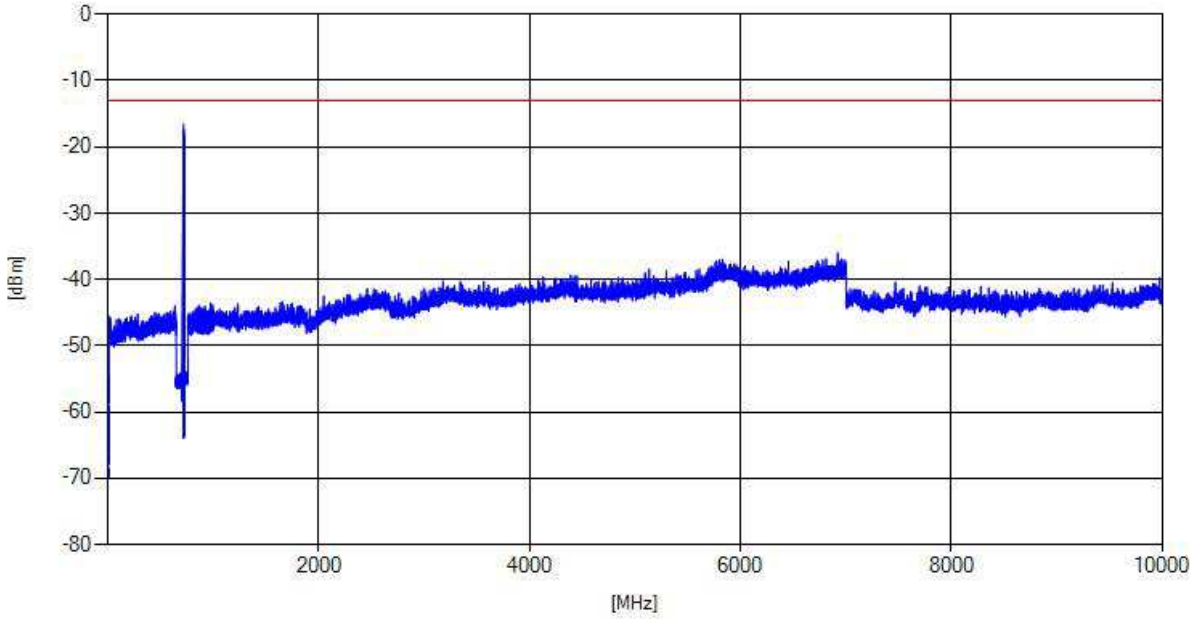
NB-IoT eFDD4 Channel = low



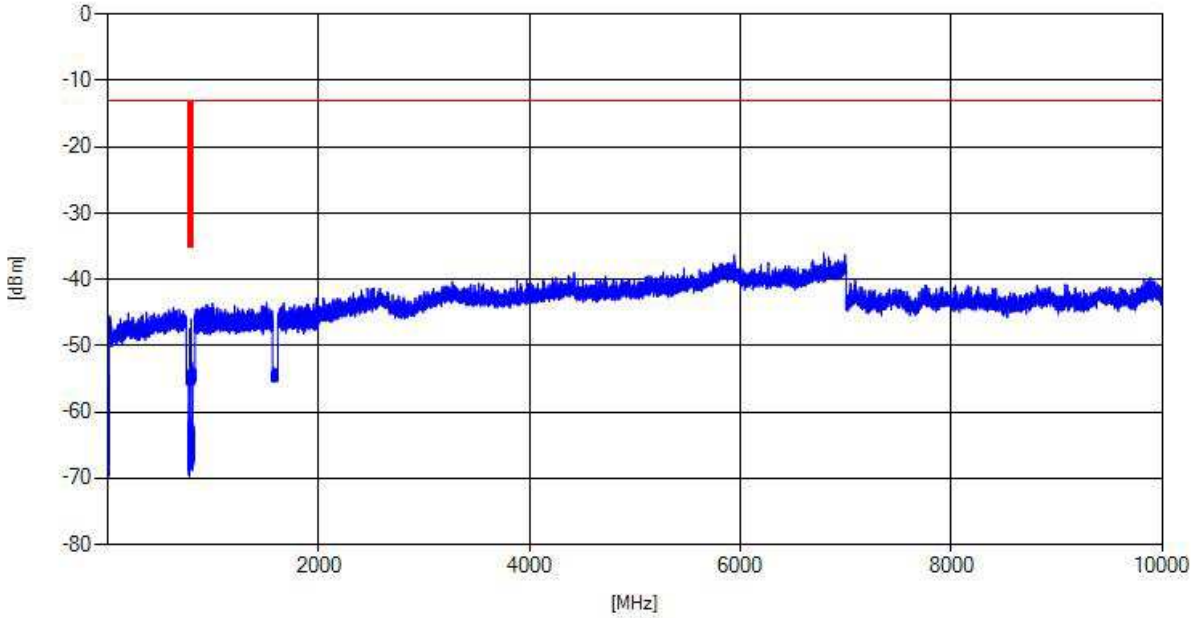
NB-IoT eFDD8 Channel = high



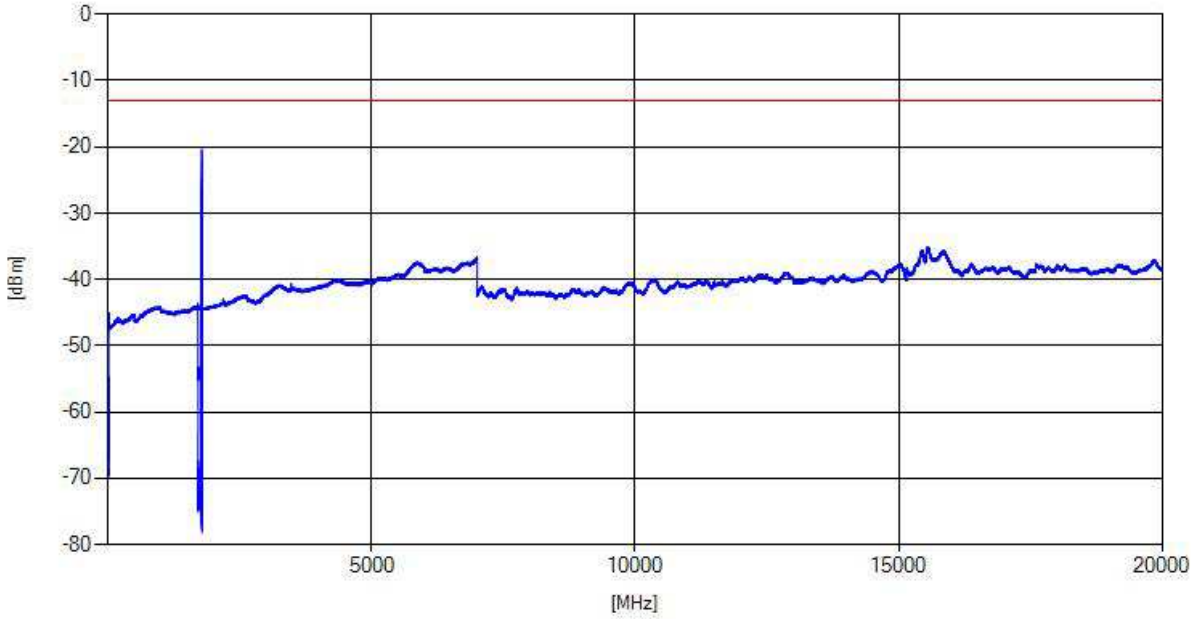
NB-IoT eFDD12 Channel = high



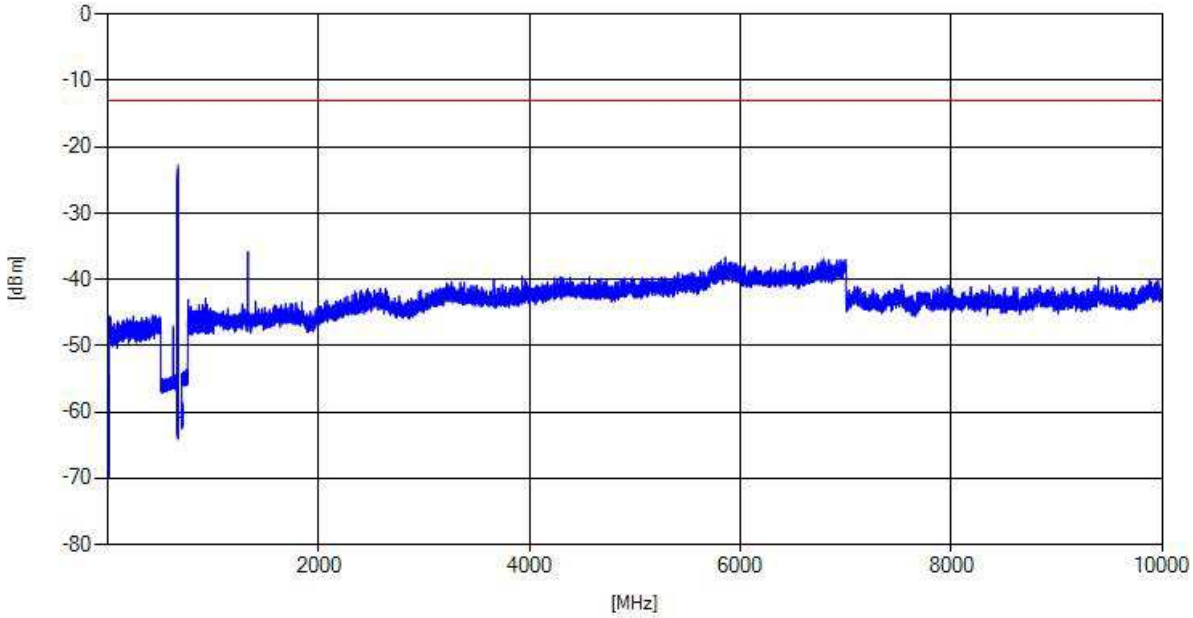
NB-IoT eFDD13 Channel = mid



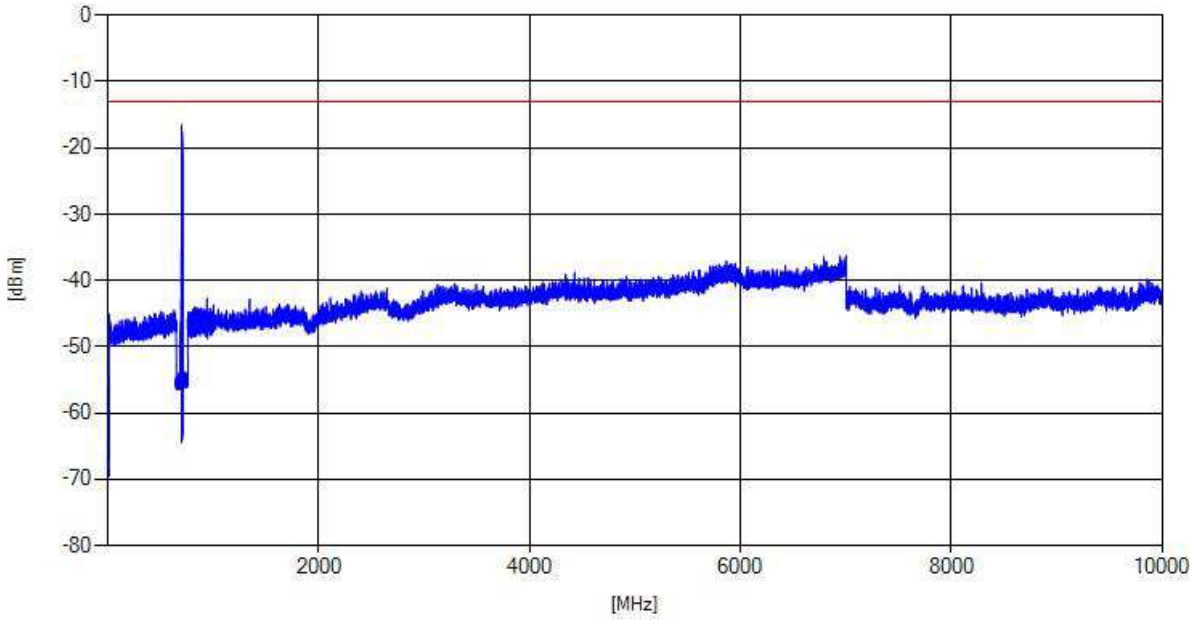
NB-IoT eFDD66 Channel = mid



NB-IoT eFDD71 Channel = low



NB-IoT eFDD85 Channel = low



5.10.5 TEST EQUIPMENT USED

- Radio Lab

5.11 FIELD STRENGTH OF SPURIOUS RADIATION

Standard **FCC PART 27 Subpart C**

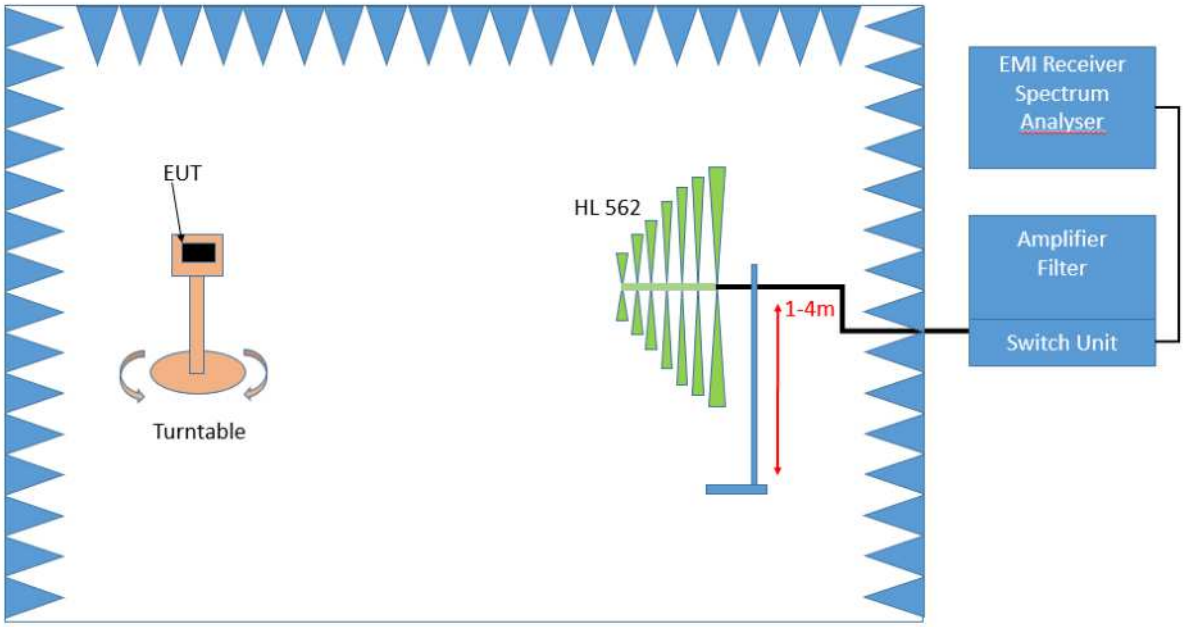
The test was performed according to:
ANSI C63.26: 2015

5.11.1 TEST DESCRIPTION

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

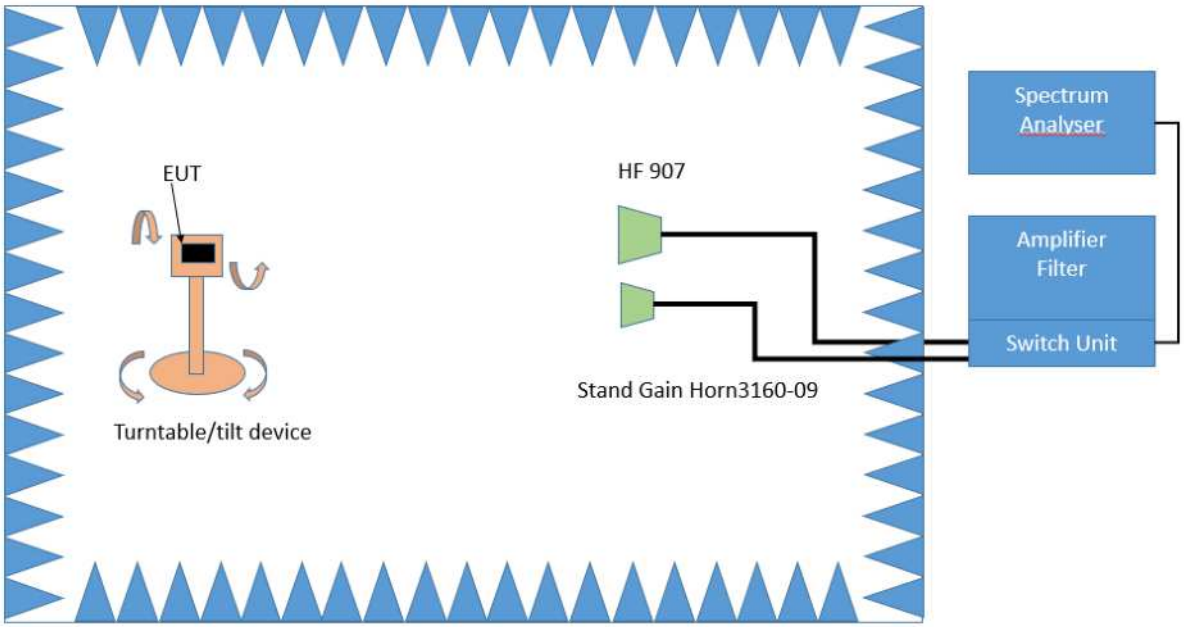
The EUT was connected to the test setup according to the following diagram:

Frequency Range: 30 MHz – 1 GHz:



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

Frequency Range: 1 GHz – 26.5 GHz



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

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

1. Measurement above 30 MHz and up to 1 GHz

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

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

Step 2: Adjustment measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by ± 45° around this value. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission

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

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

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

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

Step 2:
Due to the fact, that in this frequency range the test is performed in a fully anechoic room, the height scan of the receiving antenna instep 2 is omitted. Instead of this, a maximum search with a step size ± 45° for the elevation axis is performed.
The turn table azimuth will slowly vary by ± 22.5°.
The elevation angle will slowly vary by ± 45°
EMI receiver settings (for all steps):
- Detector: Peak,
- RBW: 1 MHz
- VBW: 3 MHz

- Sweep time: coupled

Step 3:

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

5.11.2 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 4/10/66:

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

RSS-139; 6.6 Transmitter Unwanted Emissions

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

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

Band 7:

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

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

RSS-199; 4.5 Transmitter unwanted emissions

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

Equipment shall comply with the following unwanted emission limits:

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

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

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

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

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

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

Band 17:

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

RSS-130; 4.7.1 General unwanted emissions limits

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be 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 attenuated addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

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

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

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

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

5.11.3 TEST PROTOCOL

Ambient temperature: 24 °C
Relative humidity: 37 %

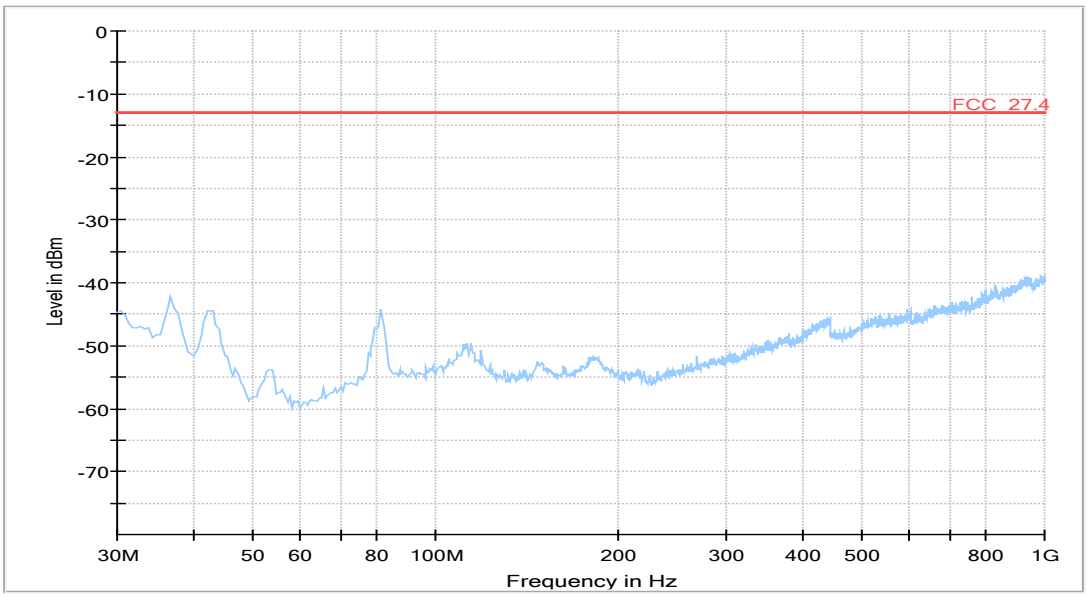
Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD4	mid	rms	maxhold	-	-	-	-13	>20

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
NB-IoT eFDD85	mid	rms	maxhold	-	-	-	-13	>20

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

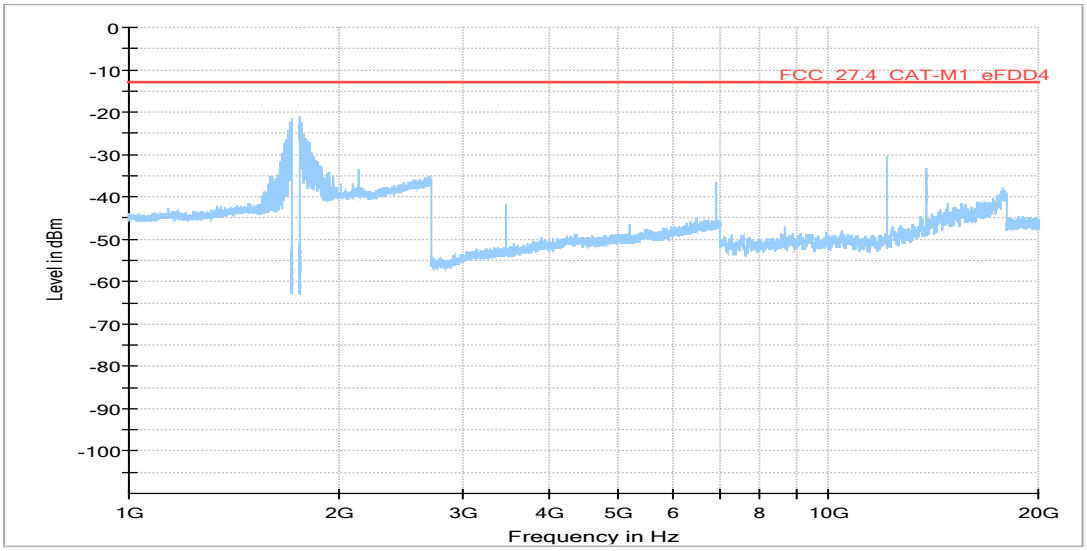
5.11.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

CAT-M1 eFDD 4 QPSK, Channel = mid



Final_Result

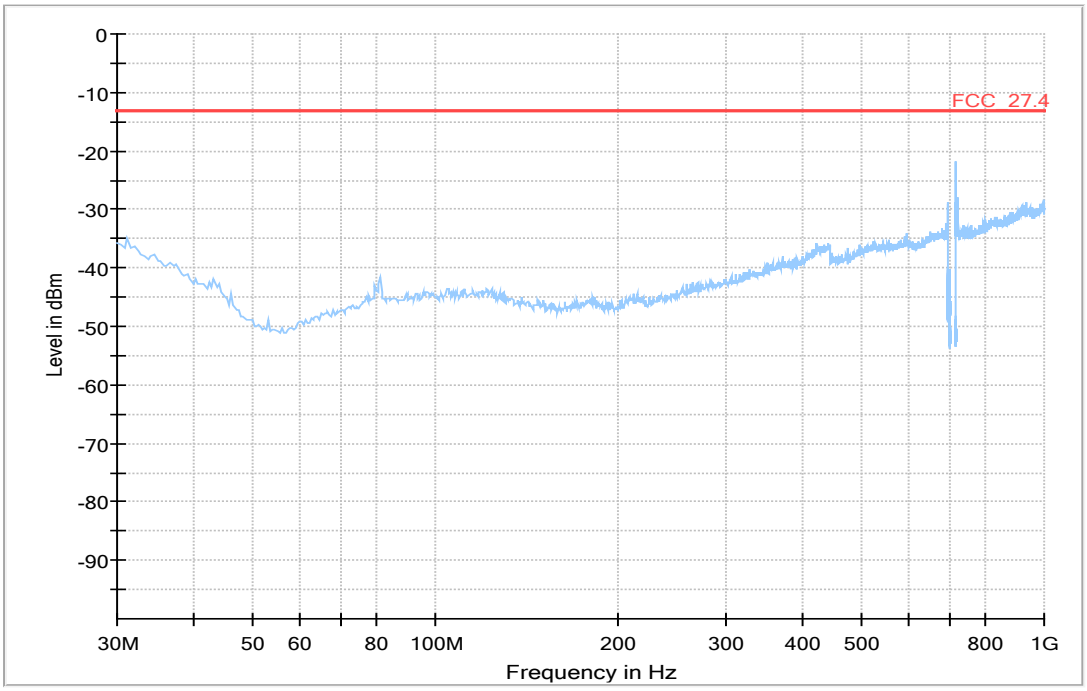
Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin	Meas. Time (ms)	Bandwidth	Height	Pol	Azimuth	Corr. (dB)	Comment
---	---	---	---	---	---	---		---	---	



Final_Result

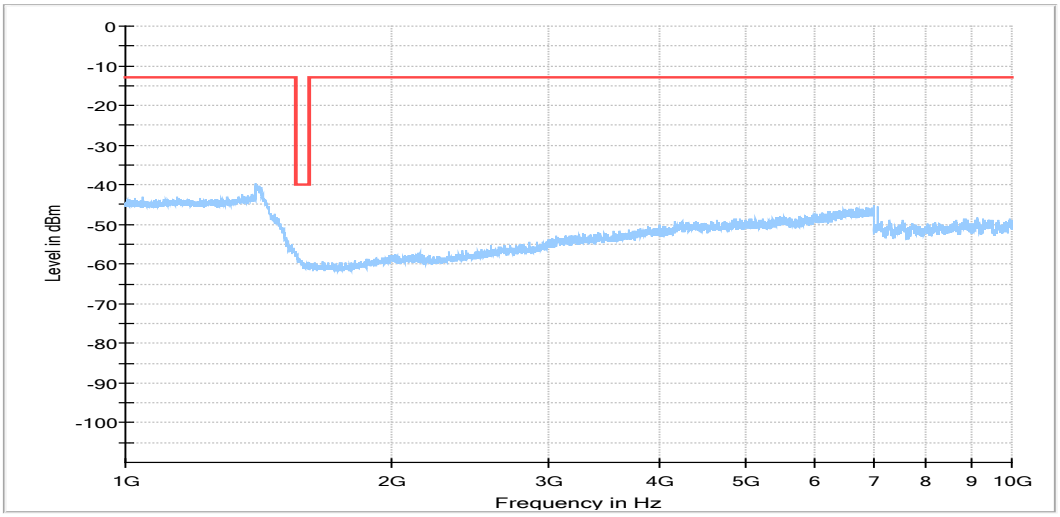
Frequency (MHz)	RMS (dBm	Limit (dBm	Margin	Meas. Time (ms)	Bandwidth	Height	Pol	Azimuth	Elevation	Corr. (dB)
---	---	---	---	---	---	---		---	---	---

NB-IoT eFDD 85 QPSK, Channel = mid



Final_Result

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



Final_Result

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

5.11.5 TEST EQUIPMENT USED

- Radiated Emissions

5.12 BAND EDGE COMPLIANCE

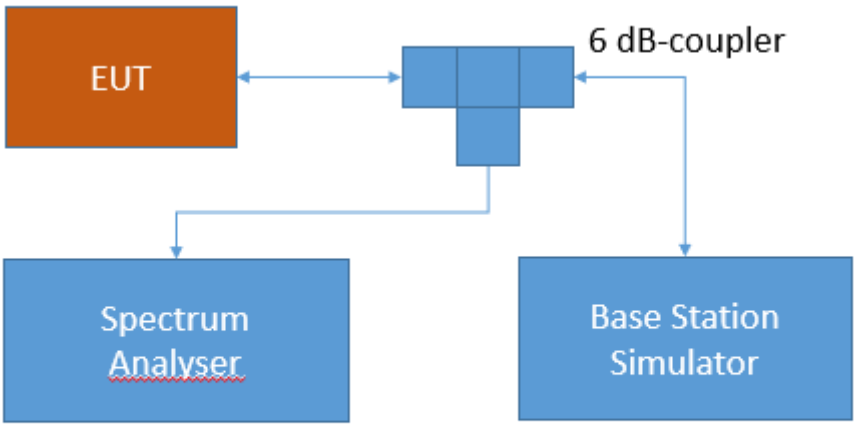
Standard **FCC PART 27 Subpart C**

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

5.12.1 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.

5.12.2 TEST REQUIREMENTS / LIMITS

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

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

FCC Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§27.53 - Emission limits

Band 13

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

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

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

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

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

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

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

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

RSS-130; 4.7.1 General unwanted emissions limits

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

RSS-130; 4.7.2 Additional unwanted emissions limits

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

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

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

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

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

Band 12:

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

RSS-130; 4.7.1 General unwanted emissions limits

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

RSS-130; 4.7.2 Additional unwanted emissions limits

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

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

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

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

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

Band 4/10/66:

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

RSS-139; 6.6 Transmitter Unwanted Emissions

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

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

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

Band 7:

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

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

RSS-199; 4.5 Transmitter unwanted emissions

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

Equipment shall comply with the following unwanted emission limits:

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

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

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

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

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

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

Band 17:

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

RSS-130; 4.7.1 General unwanted emissions limits

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

RSS-130; 4.7.2 Additional unwanted emissions limits

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

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

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

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

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

5.12.3 TEST PROTOCOL

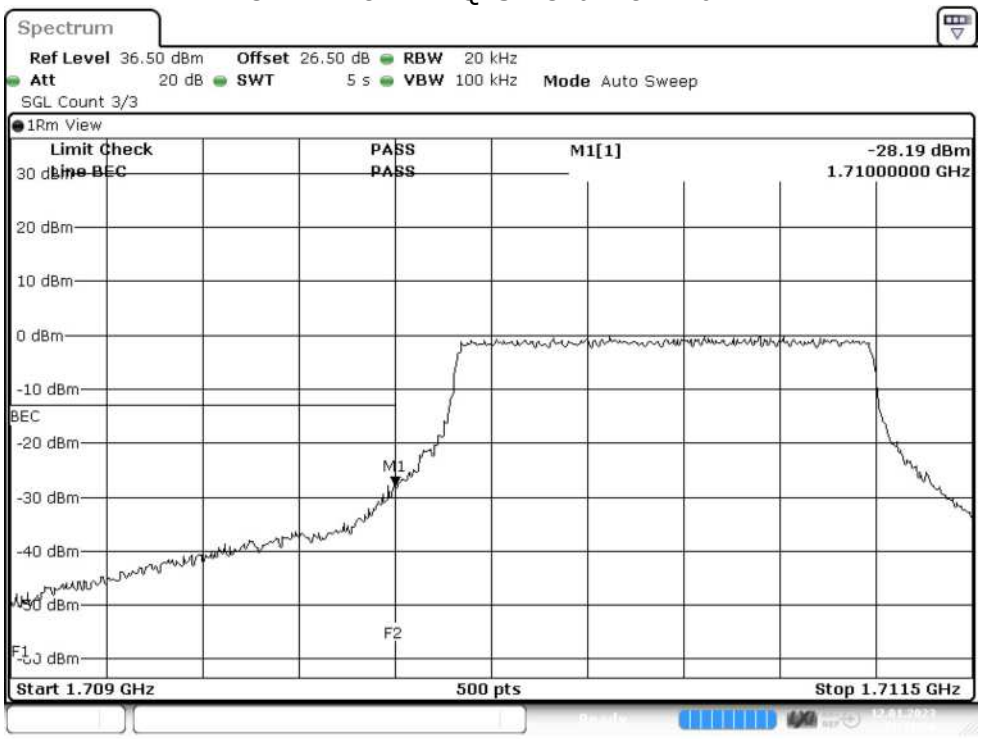
Ambient temperature: 24 °C
Relative humidity: 37 %

Radio Technology	Channel	Re-source Blocks	Band-width [MHz]	Peak [dBm]	Average [dBm]	RMS [dBm]	Limit [dBm]	Margin to Limit [dB]
CAT-M1 eFDD 4 QPSK	low	6	1.4	-9.71	-36.86	-28.19	-13	15.19
CAT-M1 eFDD 8 16QAM	low	5	1.4	-12.04	-33.13	-24.90	-13	11.90
CAT-M1 eFDD 12 QPSK	low	6	1.4	-4.88	-34.59	-26.79	-13	13.79
CAT-M1 eFDD 13 QPSK	low	6	1.4	-31.80	-52.98	-47.96	-13	34.96
CAT-M1 eFDD 66 16QAM	low	5	1.4	-9.54	-35.97	-27.29	-13	14.29
CAT-M1 eFDD 71 16QAM	low	5	1.4	-7.51	-35.76	-25.54	-13	12.54
NB-IoT eFDD 4 BPSK	high	1	0.2	-7.99	-15.73	-16.55	-13	3.55
NB-IoT eFDD 8 BPSK	low	1	0.2	-14.51	-19.41	-21.46	-13	8.46
NB-IoT eFDD 12 QPSK	high	12	0.2	-6.96	-45.01	-32.47	-13	19.47
NB-IoT eFDD 13 QPSK	low	12	0.2	-11.94	-42.61	-31.06	-13	18.06
NB-IoT eFDD 66 BPSK	high	1	0.2	-9.80	-14.13	-15.74	-13	2.74
NB-IoT eFDD 71 BPSK	low	1	0.2	-51.69	-45.97	-31.07	-13	18.07
NB-IoT eFDD 85 BPSK	low	1	0.2	-21.96	-42.03	-32.64	-13	19.64

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

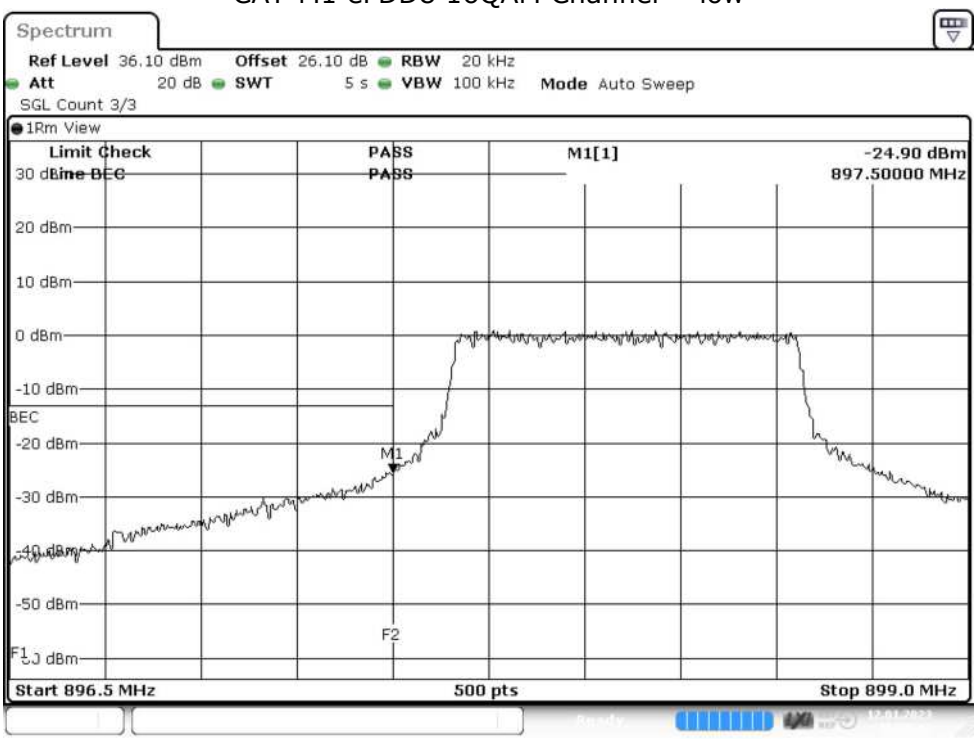
5.12.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

CAT-M1 eFDD4 QPSK Channel = low



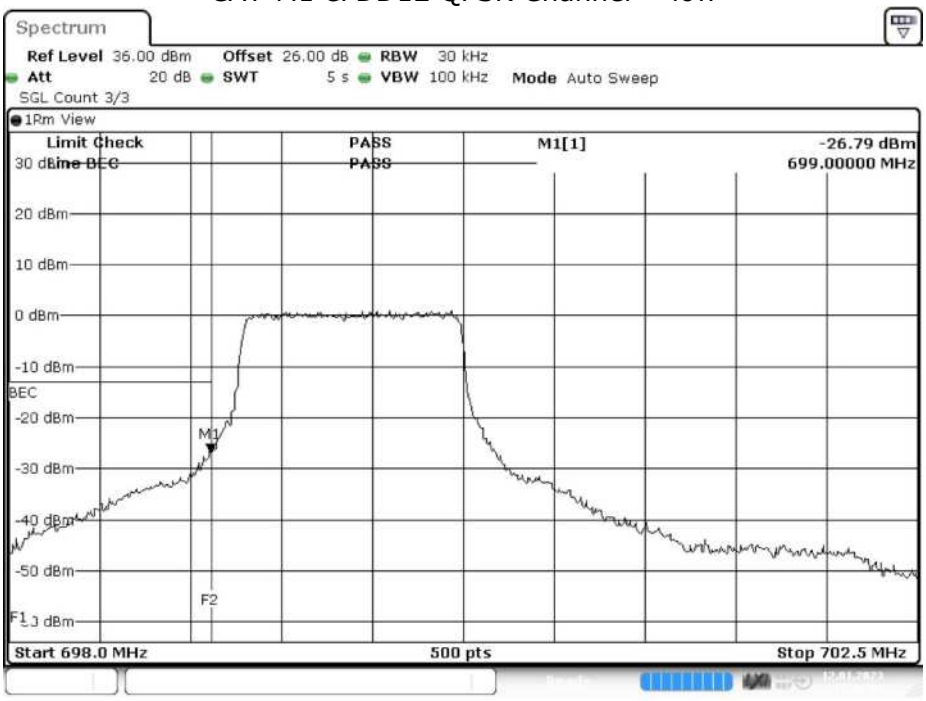
Date: 12.JAN.2023 15:17:38

CAT-M1 eFDD8 16QAM Channel = low



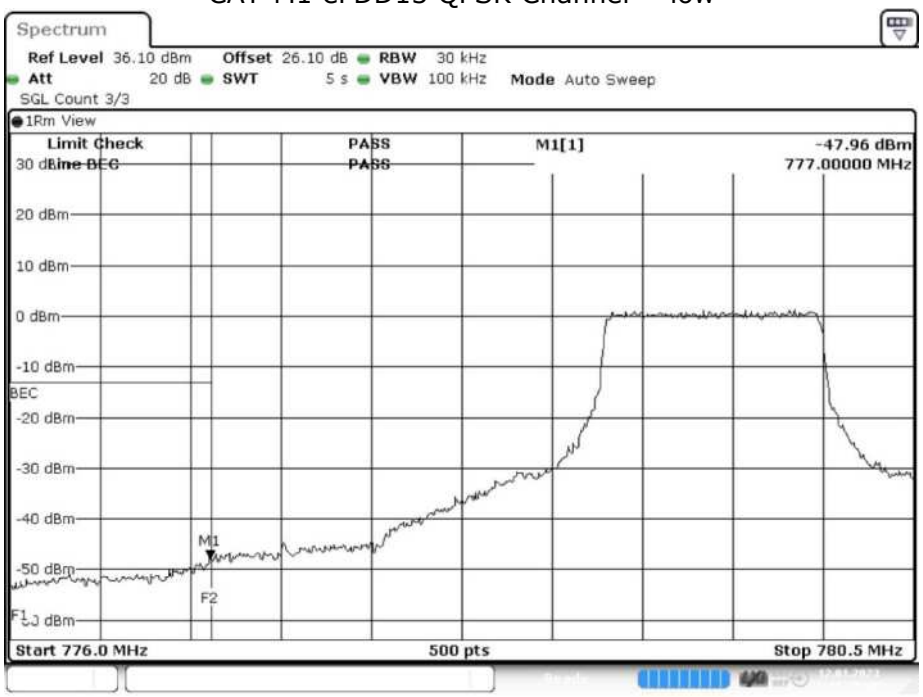
Date: 12.JAN.2023 15:20:13

CAT-M1 eFDD12 QPSK Channel = low



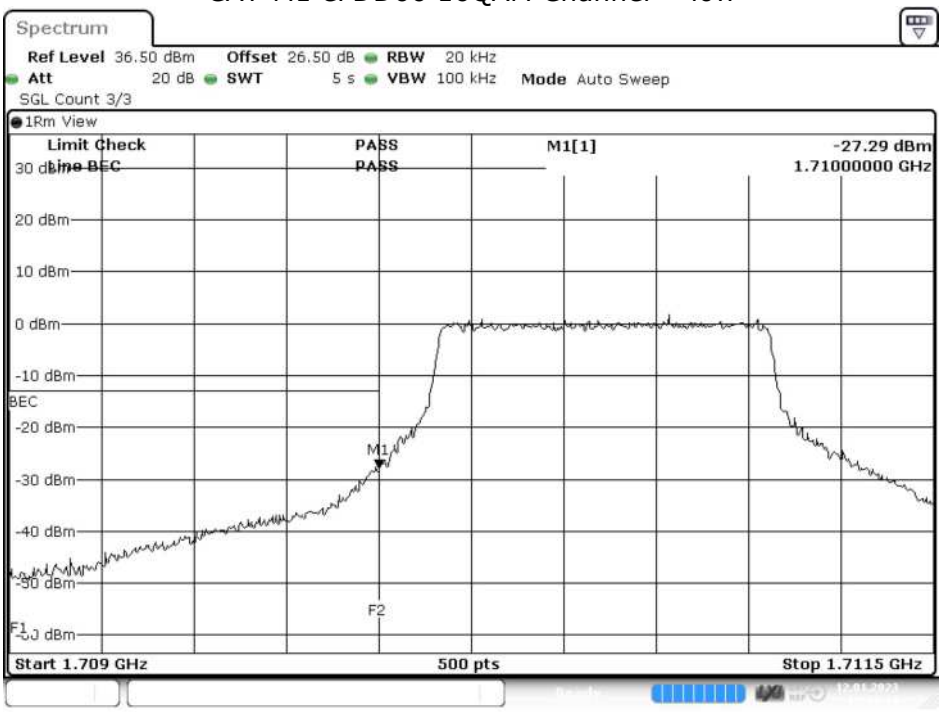
Date: 12.JAN.2023 15:22:53

CAT-M1 eFDD13 QPSK Channel = low



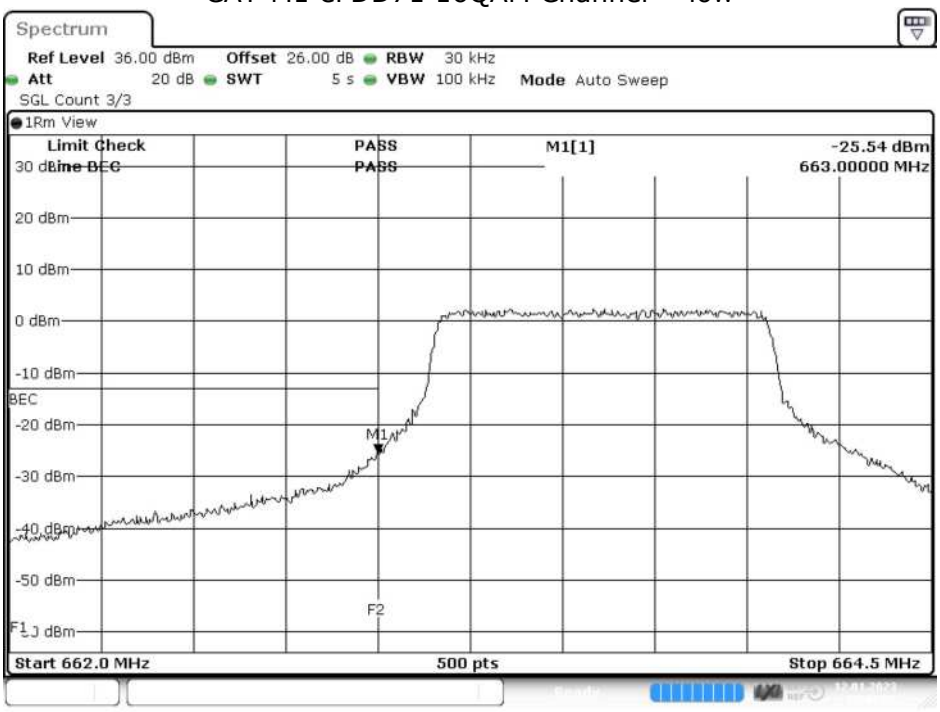
Date: 12.JAN.2023 15:25:31

CAT-M1 eFDD66 16QAM Channel = low



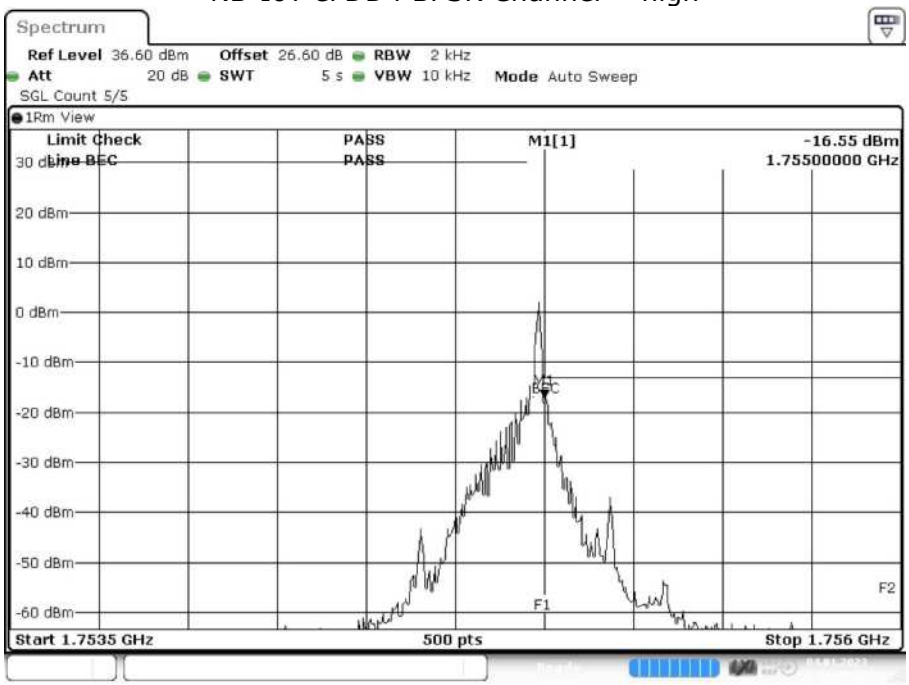
Date: 12.JAN.2023 15:39:19

CAT-M1 eFDD71 16QAM Channel = low



Date: 12.JAN.2023 15:41:58

NB-IoT eFDD4 BPSK Channel = high

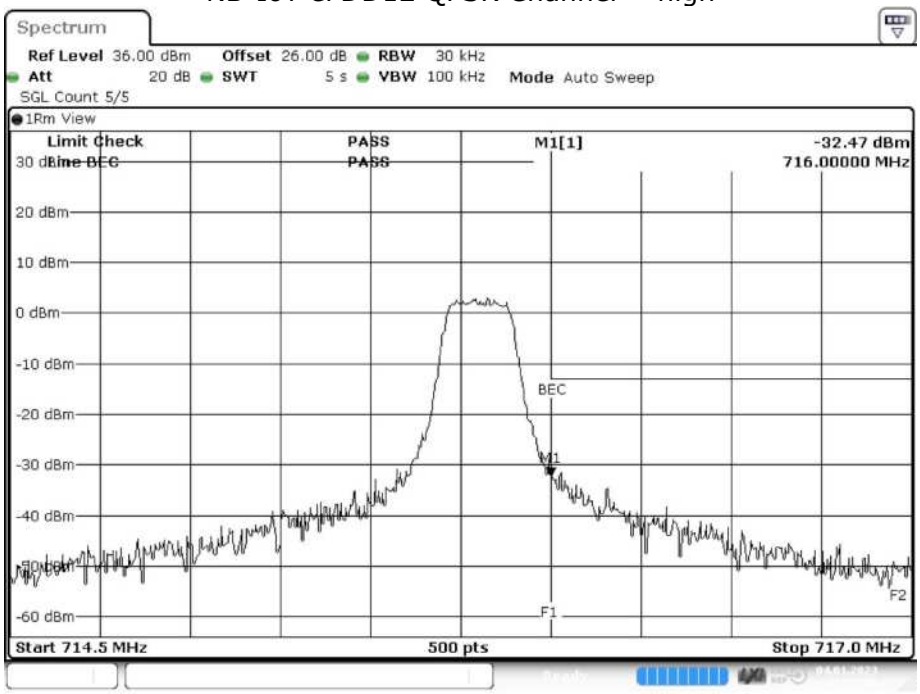


Date: 4.JAN.2023 14:42:40

NB-IoT eFDD8 BPSK Channel = low

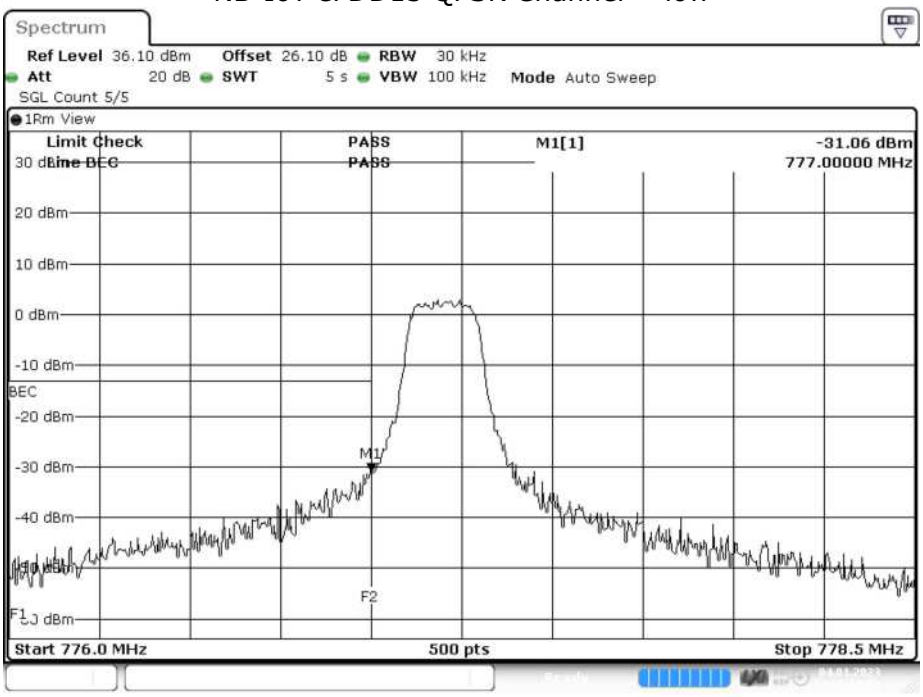
Date: 4.JAN.2023 14:46:55

NB-IoT eFDD12 QPSK Channel = high



Date: 4.JAN.2023 15:12:28

NB-IoT eFDD13 QPSK Channel = low

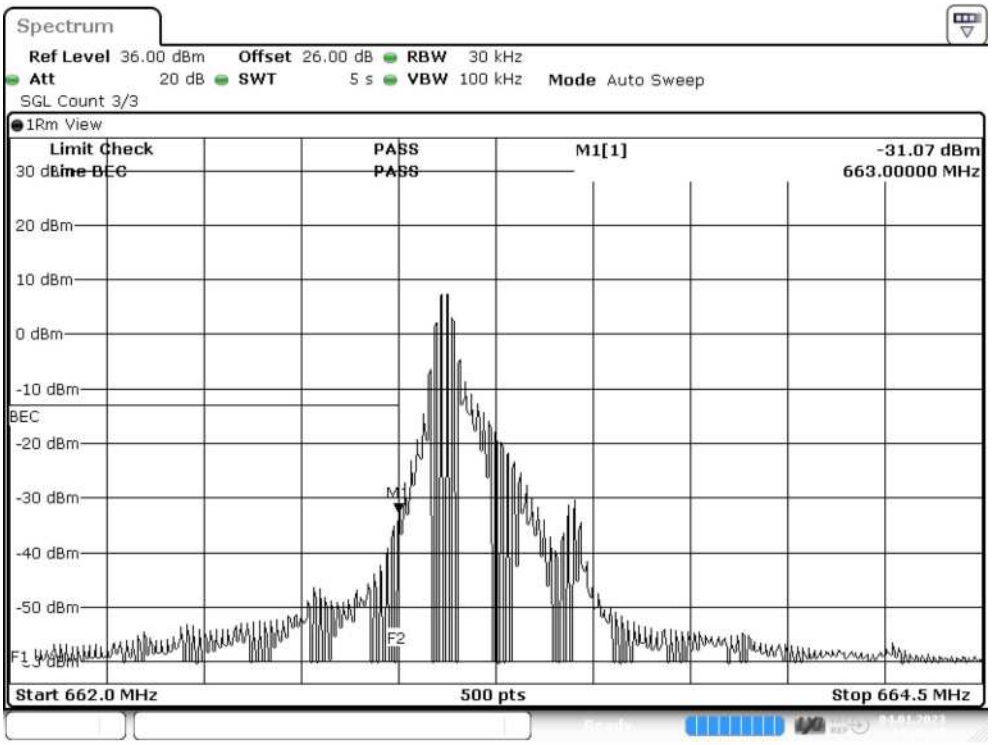


Date: 4.JAN.2023 15:14:22

NB-IoT eFDD66 BPSK Channel = high

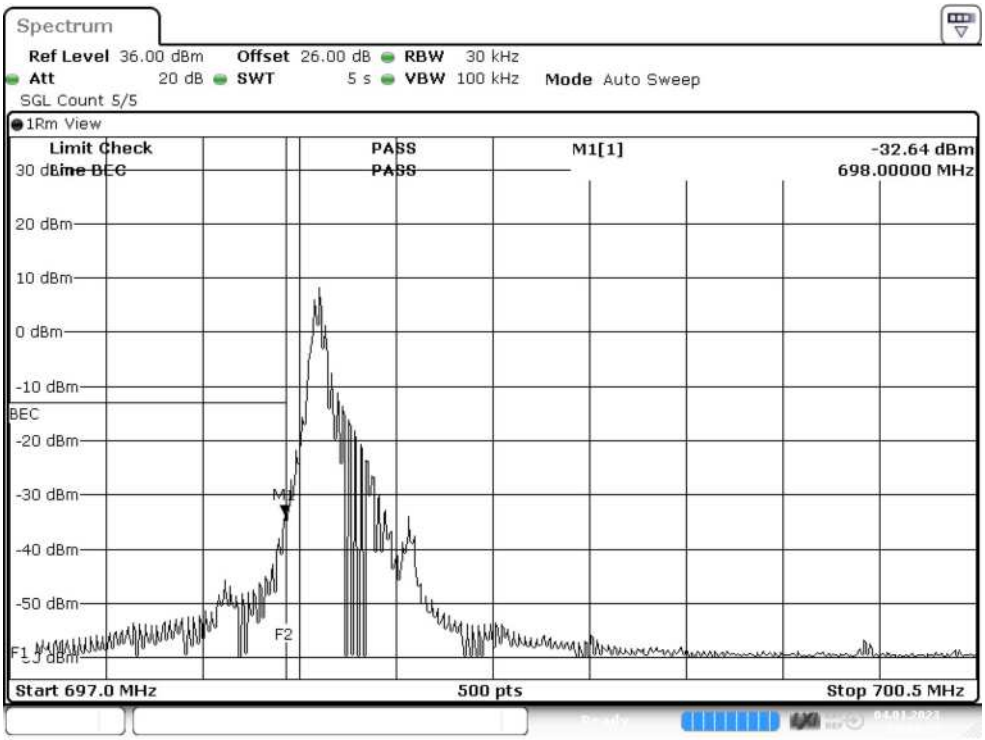
Date: 4.JAN.2023 15:15:52

NB-IoT eFDD71 BPSK Channel = low



Date: 4.JAN.2023 14:48:07

NB-IoT eFDD85 BPSK Channel = low



Date: 4.JAN.2023 15:34:55

5.12.5 TEST EQUIPMENT USED

- Radio Lab

5.13 RF OUTPUT POWER

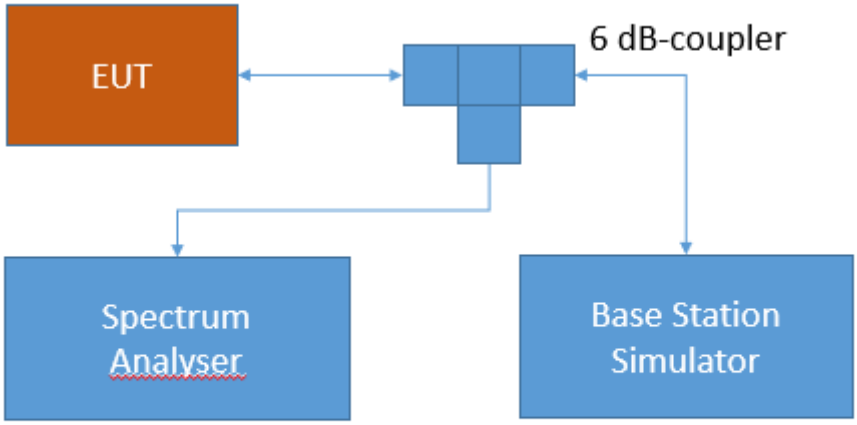
Standard **FCC PART 90 Subpart S**

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

5.13.1 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.

5.13.2 TEST REQUIREMENTS / LIMITS

Part 90; PRIVATE LAND MOBILE RADIO SERVICES

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

§90.635 Limitations on power and antenna height.

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

RSS-140; 4.3 Transmitter Output Power

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

5.13.3 TEST PROTOCOL

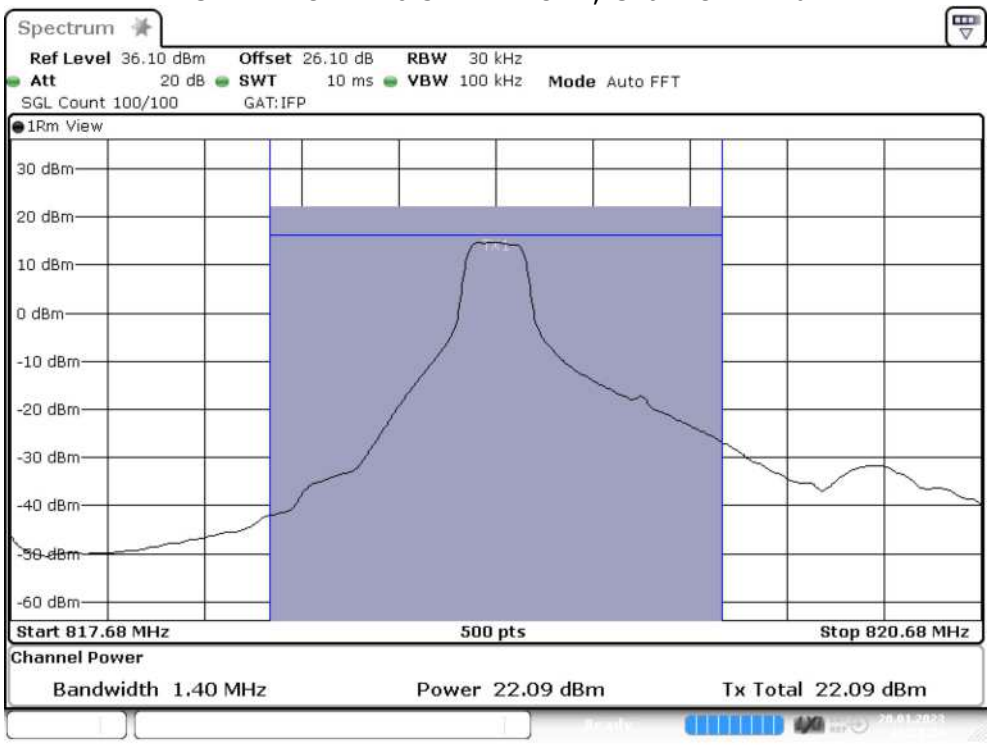
Ambient temperature: 24 °C
Relative humidity: 37 %

Radio Technology	Channel	Re-source Blocks	Band-width [MHz]	RMS Cond. Power [dBm]	FCC ERP Limit [W]	IC ERP Limit [W]	Maximum Antenna Gain FCC [dBi]	Maximum Antenna Gain IC [dBi]
CAT-M1 eFDD 26 QPSK	mid	1	1.4	21.77	3	-	13.00	-
CAT-M1 eFDD 26 QPSK	mid	3	1.4	21.75	3	-	13.02	-
CAT-M1 eFDD 26 QPSK	mid	6	1.4	21.59	3	-	13.18	-
CAT-M1 eFDD 26 QPSK	mid	1	3	22.09	3	-	12.68	-
CAT-M1 eFDD 26 QPSK	mid	3	3	21.76	3	-	13.01	-
CAT-M1 eFDD 26 QPSK	mid	6	3	21.57	3	-	13.20	-
CAT-M1 eFDD 26 QPSK	mid	1	5	22.03	3	-	12.74	-
CAT-M1 eFDD 26 QPSK	mid	3	5	21.70	3	-	13.07	-
CAT-M1 eFDD 26 QPSK	mid	6	5	21.79	3	-	12.98	-
CAT-M1 eFDD 26 QPSK	mid	1	10	22.07	3	-	12.70	-
CAT-M1 eFDD 26 QPSK	mid	3	10	21.92	3	-	12.85	-
CAT-M1 eFDD 26 QPSK	mid	6	10	21.80	3	-	12.97	-

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

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

CAT-M1 eFDD26 3MHz RBs=1, Channel = mid



Date: 20.JAN.2023 13:31:35

5.13.5 TEST EQUIPMENT USED

- Radio Lab

5.14 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

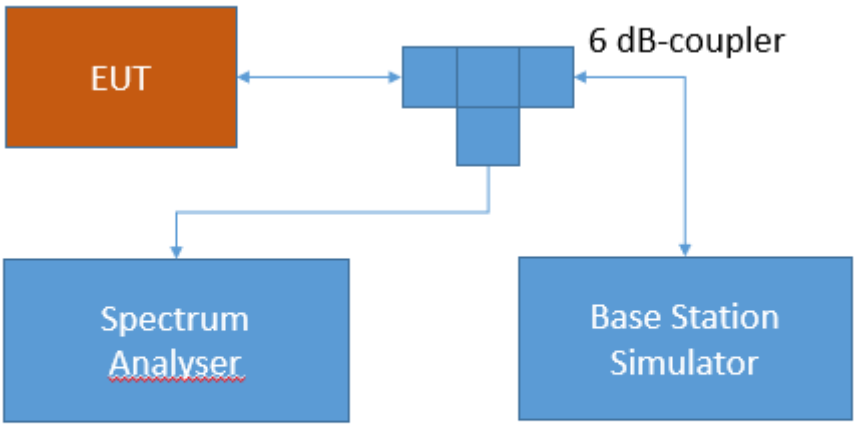
Standard **FCC PART 90 Subpart S**

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

5.14.1 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.

5.14.2 TEST REQUIREMENTS / LIMITS

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

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated

under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

Part 90; PRIVATE LAND MOBILE RADIO SERVICES

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

§90.543 – Emission limitations.

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

RSS-140; 4.4 Transmitter unwanted emission limits

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

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

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

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

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

5.14.3 TEST PROTOCOL

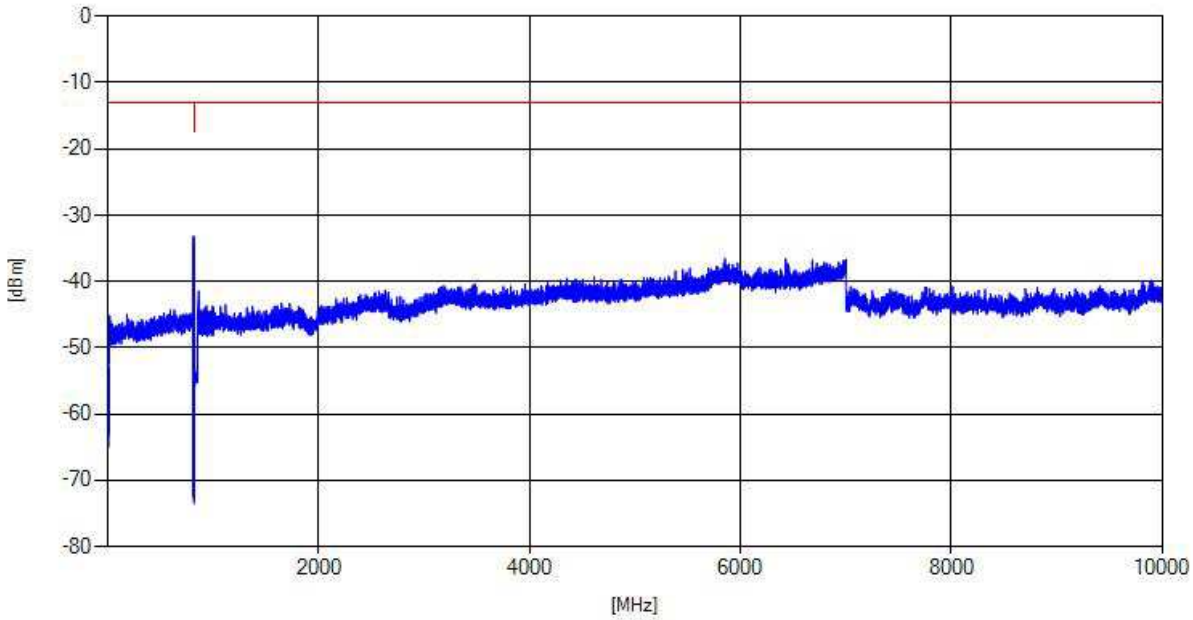
Ambient temperature: 24 °C
Relative humidity: 37 %

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD26	high	rms	maxhold	-	-	-	-13	>20

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

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

CAT-M1 eFDD26, Channel = low



5.14.5 TEST EQUIPMENT USED

5.15 BAND EDGE

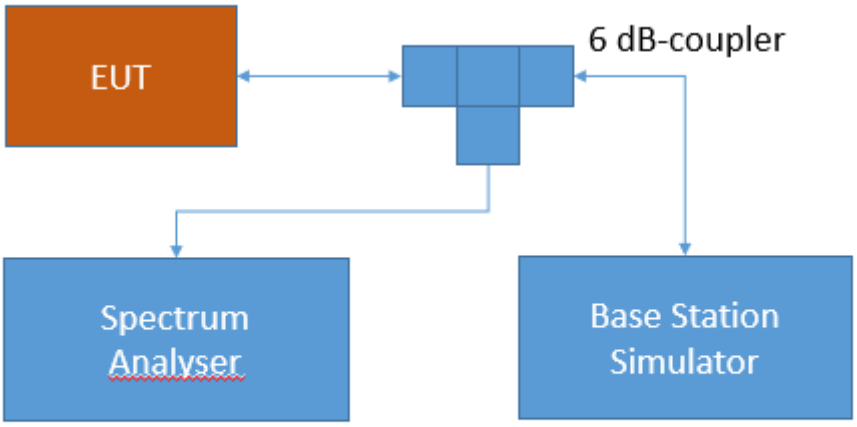
Standard **FCC PART 90 Subpart S**

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

5.15.1 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.

5.15.2 TEST REQUIREMENTS / LIMITS

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

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated

under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

Part 90; PRIVATE LAND MOBILE RADIO SERVICES

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

§90.543 – Emission limitations.

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

RSS-140; 4.4 Transmitter unwanted emission limits

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

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

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

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

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

5.15.3 TEST PROTOCOL

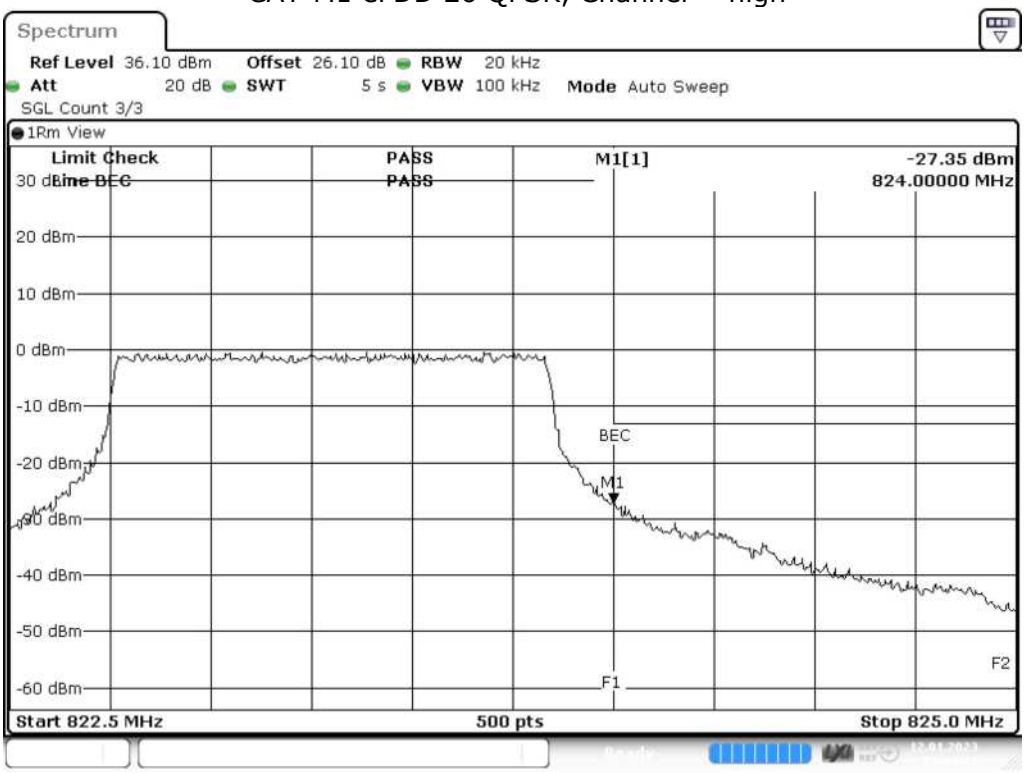
Ambient temperature: 24 °C
Relative humidity: 37 %

Radio Technology	CH	Re-source Blocks	Band-width [MHz]	Peak [dBm]	Average [dBm]	RMS [dBm]	Limit [dBm]	Margin to Limit [dB]
CAT-M1 eFDD 26 QPSK	high	6	1.4	-12.64	-35.67	-27.35	-13	14.35

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

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

CAT-M1 eFDD 26 QPSK, Channel = high



Date: 12.JAN.2023 15:34:19

5.15.5 TEST EQUIPMENT USED

- Radio Lab

6 TEST EQUIPMENT

6.1 TEST EQUIPMENT HARDWARE

1 Radiated Emissions
Lab to perform radiated emission tests

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515		
1.2	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2021-10	2023-10
1.3	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2022-01	2024-01
1.4	Anechoic Chamber 01	SAC/FAR, 10.58 m x 6.38 m x 6.00 m	Frankonia	none		
1.5	FS-Z60	Harmonic Mixer 40 - 60 GHz	Rohde & Schwarz Messgerätebau GmbH	100178	2020-03	2023-03
1.6	FS-Z220	Harmonic Mixer 140 - 220 GHz	Rohde & Schwarz Messgerätebau GmbH	101005	2020-03	2023-03
1.7	SGH-05	Standard Gain / Pyramidal Horn Antenna (140 - 220 GHz)	RPG-Radiometer Physics GmbH	075		
1.8	HL 562 ULTRALOG	Biconical-log-per antenna (30 MHz - 3 GHz) with HL 562E biconicals	Rohde & Schwarz GmbH & Co. KG	830547/003	2021-09	2024-09
1.9	AMF-7D00101800-30-10P-R	Broadband Amplifier 100 MHz - 18 GHz	Miteq			
1.10	5HC2700/12750-1.5-KK	High Pass Filter	Trilithic	9942012		
1.11	ASP 1.2/1.8-10 kg	Antenna Mast	Maturo GmbH	-		
1.12	Anechoic Chamber 03	FAR, 8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001-PRB	2021-04	2023-04
1.13	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2022-06	2024-06
1.14	Opus10 THI (8152.00)	T/H Logger 10	Lufft Mess- und Regeltechnik GmbH	12488	2021-08	2023-08
1.15	PONTIS Con4101	PONTIS Camera Controller		6061510370		
1.16	NRVD	Power Meter	Rohde & Schwarz GmbH & Co. KG	828110/016	2022-10	2023-10

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.17	HF 906	Double-ridged horn	Rohde & Schwarz	357357/002	2022-07	2025-07
1.18	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785		
1.19	FSW43	Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	103779	2022-11	2024-11
1.20	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278		
1.21	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronic GmbH	00083069		
1.22	SGH-19	Standard Gain / Pyramidal Horn Antenna (40 - 60 GHz)	RPG-Radiometer Physics GmbH	093		
1.23	WHKX 7.0/18G-8SS	High Pass Filter	Wainwright Instruments GmbH	09		
1.24	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99		
1.25	4HC1600/12750-1.5-KK	High Pass Filter	Trilithic	9942011		
1.26	Temperature Chamber KWP 120/70	Temperature Chamber Weiss 01	Weiss	59226012190010	2022-05	2024-05
1.27	JS4-00102600-42-5A	Broadband Amplifier 30 MHz - 26 GHz	Miteq	619368		
1.28	TT 1.5 WI	Turn Table	Maturo GmbH	-		
1.29	HL 562 ULTRALOG	Biconical-log-per Antenna (30 MHz - 3 GHz)	Rohde & Schwarz GmbH & Co. KG	100609	2022-06	2025-06
1.30	HF 906	Double-ridged horn	Rohde & Schwarz	357357/001	2021-08	2024-08
1.31	FS-Z325	Harmonic Mixer 220 - 325 GHz	Rohde & Schwarz Messgerätebau GmbH	101006	2020-03	2023-03
1.32	CMW500	Callbox OIL-RE, SUW	Rohde & Schwarz GmbH & Co. KG	155999-Ei		
1.33	CMU 200	"CMU1" Universal Radio Communicatio n Tester	Rohde & Schwarz GmbH & Co. KG	102366	2021-02	2024-02
1.34	3160-10	Standard Gain / Pyramidal Horn Antenna 40 GHz	EMCO Elektronic GmbH	00086675		
1.35	MA4985-XP-ET	Bore Sight Antenna Mast	innco systems GmbH	none		

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.36	SGH-08	Standard Gain / Pyramidal Horn Antenna (90 - 140 GHz)	RPG-Radiometer Physics GmbH	064		
1.37	Temperature Chamber VT 4002	Temperature Chamber Vötsch 03	Vötsch	58566002150010	2022-05	2024-05
1.38	CBT	Bluetooth Tester "CBT-02" incl. BLE-Option	Rohde & Schwarz	100302	2021-05	2024-05
1.39	CMW500	Callbox OIL-RE, SUA	Rohde & Schwarz GmbH & Co. KG	163529-bw	2023-01	2026-01
1.40	CMW500	Callbox OIL-RE, SUA-160 MHz	Rohde & Schwarz GmbH & Co. KG	168927-cv	2020-05	2023-05
1.41	SGH-12	Standard Gain / Pyramidal HornAntenna (60 - 90 GHz)	RPG-Radiometer Physics GmbH	326		
1.42	VLFX-650+	Low Pass Filter DC650 MHz	Mini-Circuits	15542		
1.43	JUN-AIR Mod. 6-15	Air Compressor	JUN-AIR Deutschland GmbH	612582		
1.44	5HC3500/18000-1.2-KK	High Pass Filter	Trilithic	200035008		
1.45	FS-Z140	Harmonic Mixer 90 -140 GHz	Rohde & Schwarz Messgerätebau GmbH	101007	2020-03	2023-03
1.46	HFH2-Z2	Loop Antenna + 3 Axis Tripod	Rohde & Schwarz GmbH & Co. KG	829324/006	2021-01	2024-01
1.47	Voltcraft M-3860M	Digital Multimeter 01 (Multimeter)	Conrad	IJ096055		
1.48	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2023-01	2025-01
1.49	SB4-100.OLD20-3T/10 Airwin 2 x 1.5 kW	Air compressor (oil-free)	airWin Kompressoren UG	901/00503		
1.50	UNI-T UT195E	True RMS Digital Multimeter	UNI-T UNI-TREND TECHNOLOGY (CHINA) CO., LTD.	C190729561		
1.51	JS4-00101800-35-5P	Broadband Amplifier 30 MHz - 18 GHz	Miteq	896037		
1.52	AS 620 P	Antenna Mast (pneumatic polarisation)	HD GmbH	620/37		
1.53	CMW500	Callbox OIL-RE, SUA-160 MHz	Rohde & Schwarz GmbH & Co. KG	167766-By	2022-05	2025-05
1.54	6005D (30 V / 5 A)	Laboratory Power Supply 120 V 60 Hz	PeakTech	81062045		

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.55	TD1.5-10kg	EUT Tilt Device (Rohacell)	Maturo GmbH	TD1.5-10kg/024/3790709		
1.56	SGH-03	Standard Gain / Pyramidal Horn Antenna (220 - 325 GHz)	RPG-Radiometer Physics GmbH	060		
1.57	FS-Z90	Harmonic Mixer 60 - 90 GHz	Rohde & Schwarz Messgerätebau GmbH	101686	2020-03	2023-03
1.58	Innco Systems CO3000	Controller for bore sight mast SAC	innco systems GmbH	CO3000/967/39371016/L		
1.59	NRV-Z1	Sensor Head B	Rohde & Schwarz GmbH & Co. KG	827753/006		
1.60	HF 907-2	Double-ridged horn	Rohde & Schwarz	102817	2022-07	2025-07
1.61	PAS 2.5 - 10 kg	Antenna Mast	Maturo GmbH	-		
1.62	CMX500	Radio Communication Tester New Radio 5G	Rohde & Schwarz GmbH & Co. KG	101305-LP	2020-04	2023-04
1.63	AM 4.0	Antenna Mast 4 m	Maturo GmbH	AM4.0/180/11920513		
1.64	HF 907	Double-ridged horn	Rohde & Schwarz	102444	2021-09	2024-09

2 Radio Lab
Conducted Radio Test Lab

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.1	1575	Broadband Resistive Power Divider DC to 40 GHz	API Weinschel, Inc.	4070		
2.2	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2022-06	2024-06
2.3	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2022-06	2024-06
2.4	SMP03	Signal Generator 2 GHz - 27 GHz	Rohde & Schwarz	833680/003		
2.5	Temperature Chamber KWP 120/70	Temperature Chamber Weiss 01	Weiss	59226012190010	2022-05	2024-05
2.6	FSIQ26	Signal Analyser 20 Hz to 26.5 GHz	Rohde & Schwarz GmbH & Co. KG	840061/005	2021-07	2023-07
2.7	SMB100A	Signal Generator 100 kHz - 40 GHz	Rohde & Schwarz Vertriebs-GmbH	181486		
2.8	Chroma 6404	AC Source	Chroma ATE INC.	64040001304		

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.9	EX520	Digital Multimeter 07	Extech Instruments Corp	06110393		
2.10	Temperature Chamber VT 4002	Temperature Chamber Vötsch 03	Vötsch	58566002150010	2022-05	2024-05
2.11	A8455-4	4 Way Power Divider (SMA)		-		
2.12	Opus10 THI (8152.00)	T/H Logger 03	Lufft Mess- und Regeltechnik GmbH	7482	2021-09	2023-09
2.13	SMIQ 03B	Vector Signal Generator	Rohde & Schwarz	100583		
2.14	FSU26	Spectrum Analyser (20 Hz to 26.5 GHz)	Rohde & Schwarz GmbH & Co. KG	100136		
2.15	Temperature Chamber VT 4002	Temperature Chamber Vötsch 05	Vötsch	58566080550010	2022-05	2024-05
2.16	CMX500	Radio Communicatio n Tester New Radio 5G	Rohde & Schwarz GmbH & Co. KG	101305-LP	2020-04	2023-04

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

6.2 TEST EQUIPMENT SOFTWARE

Semi-Anechoic Chamber:	
Software	Version
EMC32 Measurement Software	10.60.10
INNCO Mast Controller	1.02.62
MATURO Mast Controller	12.19
MATURO Turn-Table Controller	30.10
Fully-Anechoic Chamber:	
Software	Version
EMC32 Measurement Software	10.60.10
MATURO Turn-Unit Cotrolller	11.10
MATURO Mast Controller	12.10
MATURO Turntable Controller	12.11
Conducted AC Emissions:	
Software	Version
EMC32 Measurement Software	10.60.20

7 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

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

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

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

Sample calculation

U_{LISN} (dB µV) = U (dB µV) + Corr. (dB)
U = Receiver reading
LISN Insertion loss = Voltage Division Factor of LISN
Corr. = sum of single correction factors of used LISN, cables, switch units (if used)
Linear interpolation will be used for frequencies in between the values in the table.

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

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

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -40 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values

7.3 ANTENNA R&S HL562 (30 MHZ – 1 GHZ)

(d_{Limit} = 3 m)

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

(d_{Limit} = 10 m)

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

Sample calculation

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

7.4 ANTENNA R&S HF907 (1 GHZ – 18 GHZ)

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

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

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

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

7.5 ANTENNA EMCO 3160-09 (18 GHZ – 26.5 GHZ)

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

Sample calculation

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

7.6 ANTENNA EMCO 3160-10 (26.5 GHZ – 40 GHZ)

Frequency	AF EMCO 3160-10	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
GHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
26.5	43.4	-11.2	4.4				-9.5	3	1.0
27.0	43.4	-11.2	4.4				-9.5	3	1.0
28.0	43.4	-11.1	4.5				-9.5	3	1.0
29.0	43.5	-11.0	4.6				-9.5	3	1.0
30.0	43.5	-10.9	4.7				-9.5	3	1.0
31.0	43.5	-10.8	4.7				-9.5	3	1.0
32.0	43.5	-10.7	4.8				-9.5	3	1.0
33.0	43.6	-10.7	4.9				-9.5	3	1.0
34.0	43.6	-10.6	5.0				-9.5	3	1.0
35.0	43.6	-10.5	5.1				-9.5	3	1.0
36.0	43.6	-10.4	5.1				-9.5	3	1.0
37.0	43.7	-10.3	5.2				-9.5	3	1.0
38.0	43.7	-10.2	5.3				-9.5	3	1.0
39.0	43.7	-10.2	5.4				-9.5	3	1.0
40.0	43.8	-10.1	5.5				-9.5	3	1.0

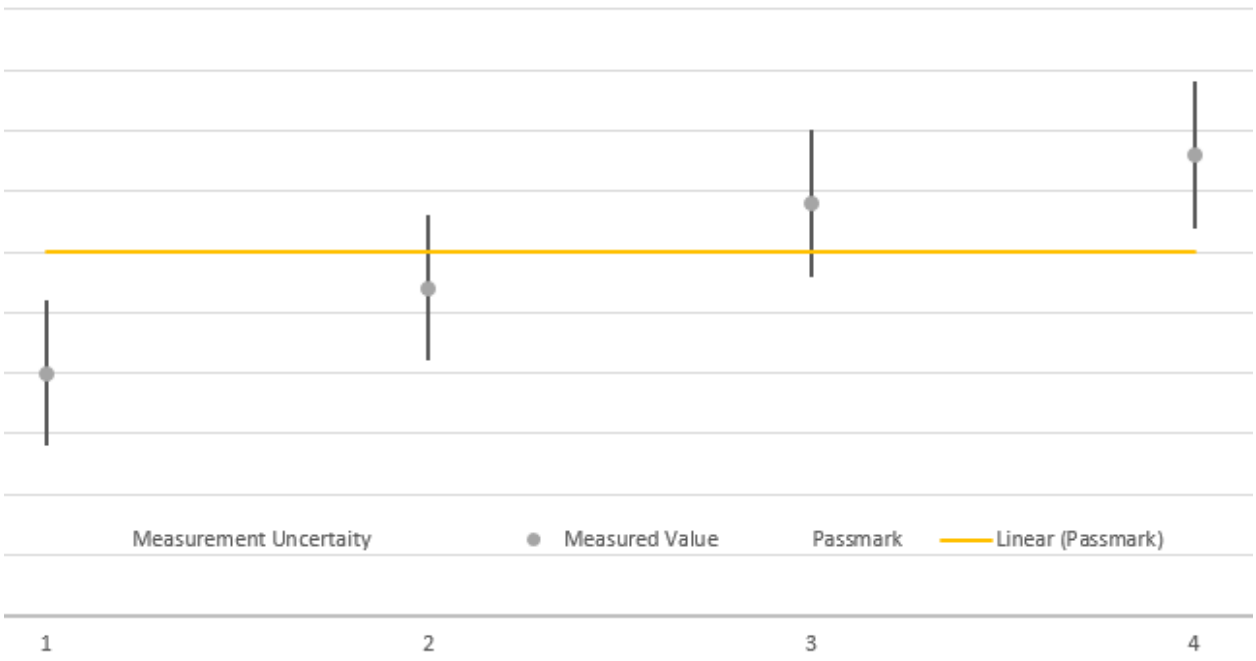
Sample calculation

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

8 MEASUREMENT UNCERTAINTIES

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

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



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

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

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

9 PHOTO REPORT

Please see separate photo report.