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 **Final Result**

OP-Mode Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method	Setup	Date	FCC	IC
CAT-M1, eFDD 13 QPSK, high channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-28	Passed	Passed
CAT-M1, eFDD 13 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-28	Passed	Passed
CAT-M1, eFDD 4 16QAM, high channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-27	Passed	Passed
CAT-M1, eFDD 4 16QAM, low channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-27	Passed	Passed
CAT-M1, eFDD 4 QPSK, high channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-27	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-27	Passed	Passed

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

Peak to Average Ratio

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 16QAM, high channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 12 16QAM, low channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 12 16QAM, mid channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 12 QPSK, high channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 12 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 12 QPSK, mid channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 13 16QAM, high channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 13 16QAM, low channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 13 16QAM, mid channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 13 QPSK, high channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 13 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 13 QPSK, mid channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 4 16QAM, high channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 4 16QAM, low channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 4 16QAM, mid channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 4 QPSK, high channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 4 QPSK, mid channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-29	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 16QAM, high channel, 1.4 MHz, 1, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 16QAM, high channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 16QAM, low channel, 1.4 MHz, 1, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 16QAM, low channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-31	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 16QAM, mid channel, 1.4 MHz, 1, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 16QAM, mid channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 QPSK, high channel, 1.4 MHz, 1, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 QPSK, high channel, 1.4 MHz, 3, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 QPSK, high channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 QPSK, low channel, 1.4 MHz, 3, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 1.4 MHz, 1, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 1.4 MHz, 3, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-31	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S **§ 2.1055 § 90.539**

Frequency Stability

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_AR11	2020-01-27	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, high channel, 1.4 MHz, 1, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 QPSK, low channel, 1.4 MHz, 1, conducted	S01_AR11	2020-01-31	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 1.4 MHz, 1, conducted	S01_AR11	2020-01-31	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S **§ 2.1049**

Emission and Occupied Bandwidth

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 16QAM, high channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-22	Passed	Passed
CAT-M1, eFDD 26 16QAM, low channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-22	Passed	Passed
CAT-M1, eFDD 26 16QAM, mid channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-22	Passed	Passed
CAT-M1, eFDD 26 QPSK, high channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-22	Passed	Passed

47 CFR CHAPTER I FCC PART 90 Subpart S **§ 2.1049**

Emission and Occupied Bandwidth
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, 6, conducted	S01_AR11	2020-01-22	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-22	Passed	Passed

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

Peak to Average Ratio
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 16QAM, high channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 26 16QAM, low channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 26 16QAM, mid channel, 1.4 MHz, 5, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 26 QPSK, high channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 26 QPSK, low channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-29	Passed	Passed
CAT-M1, eFDD 26 QPSK, mid channel, 1.4 MHz, 6, conducted	S01_AR11	2020-01-29	Passed	Passed

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

2 REVISION HISTORY

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2020-02-13	--	invalid
rev01	2020-02-25	Corrected RSS reference	valid

COMMENT: -

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

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

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| D-PL-12140-01-02 | D-PL-12140-01-03
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:	2019-12-16

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:	2020-02-25
Testing Period:	2020-01-21 to 2020-01-31

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: Address:	please see Applicant Data
Contact Person:	

4 TEST OBJECT DATA

4.1 GENERAL EUT DESCRIPTION

Kind of Device product description	LTE CAT-M1 module.
Product name	SARA-R510M8S
Type	-
Declared EUT data by the supplier	
Power Supply Type	DC
General product description	The EUT is LTE CAT-M1 module. It supports the relevant bands for FCC Approval LTE CAT-M1: eFDD2 / LTE eFDD4 / eFDD5 / eFDD12 / eFDD13 / eFDD25 /eFDD26
Nominal Voltage / Frequency	3.8 V DC

4.2 EUT MAIN COMPONENTS

Sample Name	**Sample Code**	**Description**
ar11	ar11	radiated & conducted sample
Sample Parameter	**Value**	
Serial No.	357862090047590	
HW Version	352D00	
SW Version	00.11	
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
Antenna	-	-

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_AR11	ar11	radiated & conducted sample

4.6 OPERATING MODES

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

4.6.1 TEST CHANNELS

FCC Part 24

LTE CAT-M1 eFDD 2	LOW	MID	HIGH
Channel	18607	18900	19193
Frequency [MHz]	1850.7	1880	1909.3

FCC Part 27

LTE CAT-M1 eFDD 4	LOW	MID	HIGH
Channel	19957	20175	20393
Frequency [MHz]	1710.7	1732.5	1754.3

FCC Part 22

LTE CAT-M1 eFDD 5	LOW	MID	HIGH
Channel	20407	20525	20643
Frequency [MHz]	824.7	836.5	848.3

FCC Part 27

LTE CAT-M1 eFDD 12	LOW	MID	HIGH
Channel	23017	23095	23173
Frequency [MHz]	699.7	707.5	715.3

FCC Part 27

LTE CAT-M1 eFDD 13	LOW	MID	HIGH
Channel	23205	23230	23255
Frequency [MHz]	777.7	780.3	786.3

FCC Part 24

LTE CAT-M1 eFDD 25	LOW	MID	HIGH
Channel	26047	26365	26683
Frequency [MHz]	1850.7	1882.5	1914.3

FCC Part 22

LTE CAT-M1 eFDD 26	LOW	MID	HIGH
Channel	26797	26915	27033
Frequency [MHz]	824.7	836.5	848.3

FCC Part 90

LTE CAT-M1 eFDD26	LOW	MID	HIGH
Channel	26697	26740	26783
Frequency [MHz]	814.7	819	823.3

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

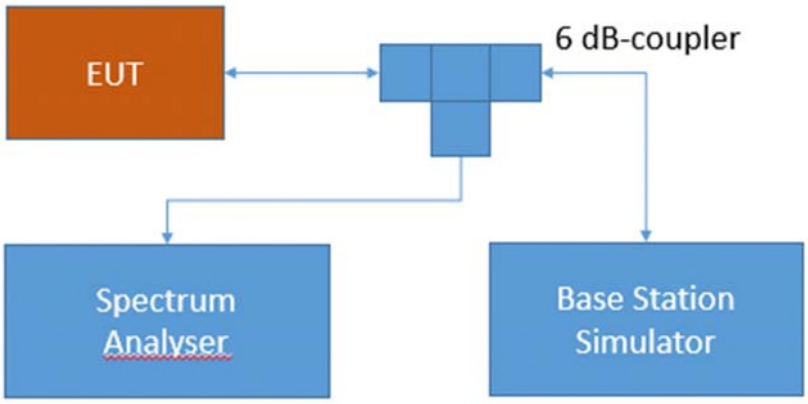
Standard **FCC PART 22 Subpart H**

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

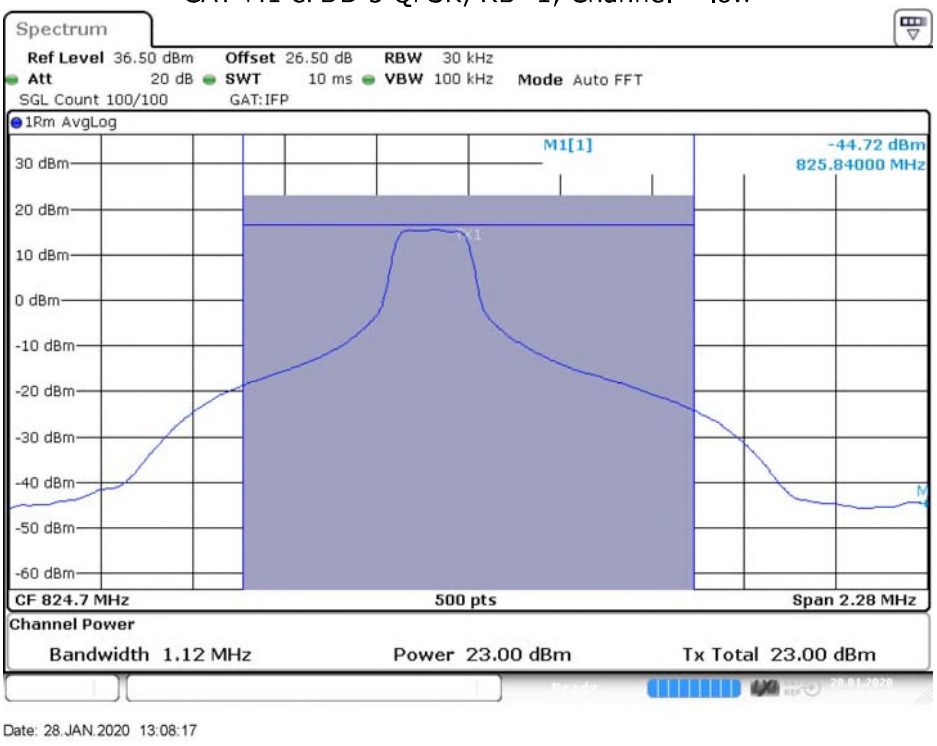
Temperature 22 °C
Humidity 36 %

Radio Technology	Channel	Ressource Blocks / Subcarrier	Band-width [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	23.00	11.5	11.5	17.6	17.6
CAT-M1 eFDD 5 QPSK	low	3	1.4	21.88	11.5	11.5	18.72	18.72
CAT-M1 eFDD 5 QPSK	low	6	1.4	20.84	11.5	11.5	19.76	19.76
CAT-M1 eFDD 5 QPSK	mid	1	1.4	22.81	11.5	11.5	17.79	17.79
CAT-M1 eFDD 5 QPSK	mid	3	1.4	21.83	11.5	11.5	18.77	18.77
CAT-M1 eFDD 5 QPSK	mid	6	1.4	20.93	11.5	11.5	19.67	19.67
CAT-M1 eFDD 5 QPSK	high	1	1.4	22.81	11.5	11.5	17.79	17.79
CAT-M1 eFDD 5 QPSK	high	3	1.4	21.85	11.5	11.5	18.75	18.75
CAT-M1 eFDD 5 QPSK	high	6	1.4	20.85	11.5	11.5	19.75	19.75
CAT-M1 eFDD 5 16QAM	low	1	1.4	21.63	11.5	11.5	18.97	18.97
CAT-M1 eFDD 5 16QAM	low	5	1.4	21.02	11.5	11.5	19.58	19.58
CAT-M1 eFDD 5 16QAM	mid	1	1.4	21.52	11.5	11.5	19.08	19.08
CAT-M1 eFDD 5 16QAM	mid	5	1.4	21.13	11.5	11.5	19.47	19.47
CAT-M1 eFDD 5 16QAM	high	1	1.4	21.72	11.5	11.5	18.88	18.88
CAT-M1 eFDD 5 16QAM	high	5	1.4	21.08	11.5	11.5	19.52	19.52
CAT-M1 eFDD 26 QPSK	low	1	1.4	22.57	11.5	11.5	18.03	18.03
CAT-M1 eFDD 26 QPSK	low	3	1.4	21.45	11.5	11.5	19.15	19.15
CAT-M1 eFDD 26 QPSK	low	6	1.4	20.38	11.5	11.5	20.22	20.22
CAT-M1 eFDD 26 QPSK	mid	1	1.4	22.36	11.5	11.5	18.24	18.24
CAT-M1 eFDD 26 QPSK	mid	3	1.4	21.39	11.5	11.5	19.21	19.21
CAT-M1 eFDD 26 QPSK	mid	6	1.4	20.49	11.5	11.5	20.11	20.11
CAT-M1 eFDD 26 QPSK	high	1	1.4	22.37	11.5	11.5	18.23	18.23
CAT-M1 eFDD 26 QPSK	high	3	1.4	21.40	11.5	11.5	19.2	19.2
CAT-M1 eFDD 26 QPSK	high	6	1.4	20.41	11.5	11.5	20.19	20.19
CAT-M1 eFDD 26 16QAM	low	1	1.4	21.26	11.5	11.5	19.34	19.34
CAT-M1 eFDD 26 16QAM	low	5	1.4	20.60	11.5	11.5	20	20
CAT-M1 eFDD 26 16QAM	mid	1	1.4	21.01	11.5	11.5	19.59	19.59
CAT-M1 eFDD 26 16QAM	mid	5	1.4	20.73	11.5	11.5	19.87	19.87
CAT-M1 eFDD 26 16QAM	high	1	1.4	21.14	11.5	11.5	19.46	19.46
CAT-M1 eFDD 26 16QAM	high	5	1.4	20.64	11.5	11.5	19.96	19.96

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

5.1.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

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



Date: 28.JAN.2020 13:08:17

5.1.5 TEST EQUIPMENT USED

- Radio Lab

5.2 FREQUENCY STABILITY

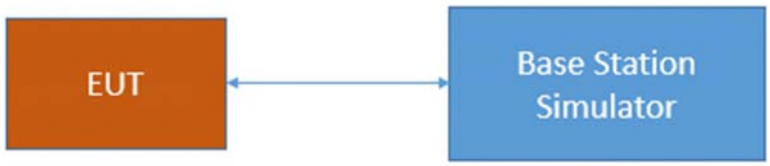
Standard **FCC PART 22 Subpart H**

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

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



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

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

5.2.2 TEST REQUIREMENTS / LIMITS

FCC Part 22, § 22.355

Except as otherwise provided in this part, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table C-1 of this section.

Table C-1—Frequency Tolerance for Transmitters in the Public Mobile Services

Frequency Range [MHz]	Mobile Devices > 3 W [ppm]	Mobile Devices ≤ 3 W [ppm]
25 – 50	20.0	50.0
50 – 450	5.0	50.0
450 – 512	5.0	5.0
821 – 896	2.5	2.5
928 - 929	n/a	n/a
929 – 960	n/a	n/a
2110 - 2220	n/a	n/a

RSS-132; 5.3 Frequency Stability

The carrier frequency shall not depart from the reference frequency in excess of ±2.5 ppm for mobile stations.

In lieu of meeting the above stability values, the test report may show that the frequency stability is sufficient to ensure that the occupied bandwidth stays within each of the sub-bands (see Section 5.1) when tested to the temperature and supply voltage variations specified in RSS-Gen.

5.2.3 TEST PROTOCOL

CAT-M1 eFDD 5 QPSK, RB=6, Channel = mid

Temp. °C	Duration min	Voltage	Limit Hz	Freq. error Average (Hz)	Freq. error Max. (Hz)	Verdict
-30	0	normal	2091.25	-2	-6	passed
-30	5			5	11	passed
-30	10			3	8	passed
-20	0	normal	2091.25	10	14	passed
-20	5			11	16	passed
-20	10			7	11	passed
-10	0	normal	2091.25	10	16	passed
-10	5			13	19	passed
-10	10			-4	-11	passed
0	0	normal	2091.25	-1	-7	passed
0	5			4	8	passed
0	10			5	9	passed
10	0	normal	2091.25	-4	-10	passed
10	5			6	11	passed
10	10			5	10	passed
20	0	low	2091.25	1	6	passed
20	5			-3	-8	passed
20	10			-4	-7	passed
20	0	normal	2091.25	-1	-7	passed
20	5			1	5	passed
20	10			-5	-9	passed
20	0	high	2091.25	-2	-6	passed
20	5			-3	-8	passed
20	10			-4	-9	passed
30	0	normal	2091.25	7	10	passed
30	5			6	9	passed
30	10			10	13	passed
40	0	normal	2091.25	-6	-9	passed
40	5			-4	-7	passed
40	10			2	6	passed
50	0	normal	2091.25	-2	-9	passed
50	5			4	14	passed
50	10			-1	-11	passed

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

COMMENT:
For eFDD26 the test "Frequency Stability" was preformed on Channel 26740 (819 MHz) which is covered by Part 90.

5.2.4 TEST EQUIPMENT USED

- Radio Lab

5.3 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

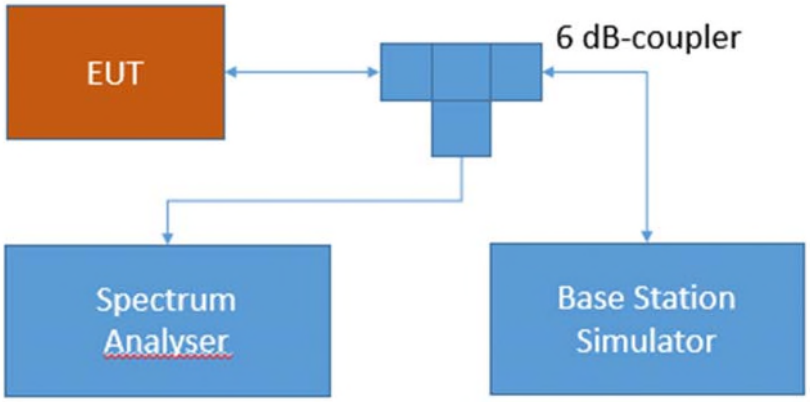
Standard **FCC PART 22 Subpart H**

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 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.

5.3.2 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.

5.3.3 TEST PROTOCOL

Ambient temperature: 24 °C
Relative humidity: 38 %

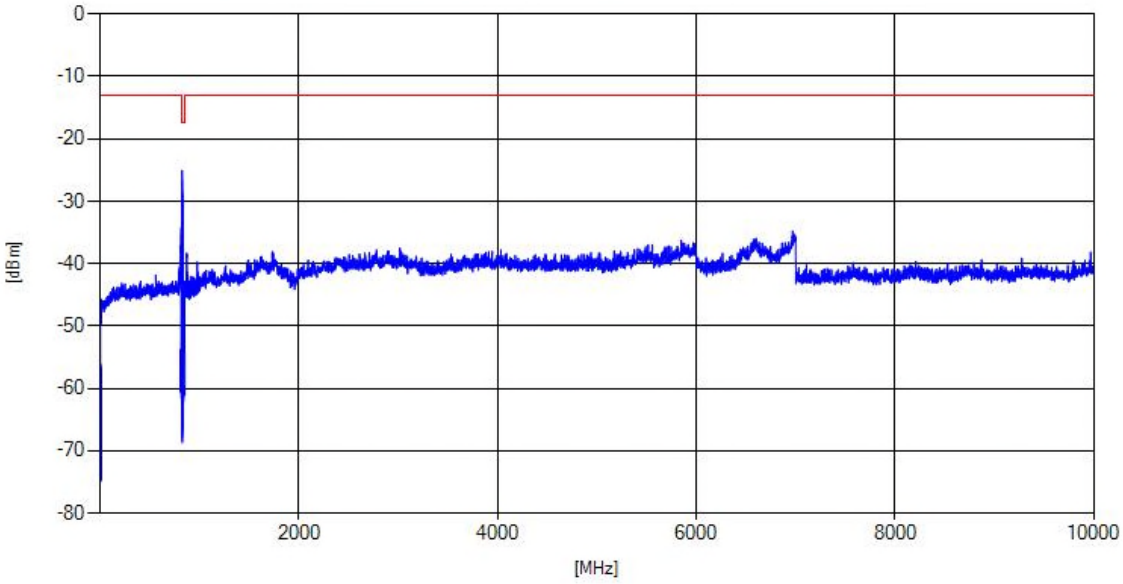
Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD5	low	rms	maxhold	5	823.9	-26.42	-17.5	8.92
CAT-M1 eFDD5	mid	rms	maxhold	-	-	-	-13	>20
CAT-M1 eFDD5	high	rms	maxhold	-	-	-	-13	>20

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD26	low	rms	maxhold	5	823.9	-25.06	-17.5	7.56
CAT-M1 eFDD26	mid	rms	maxhold	-	-	-	-13	>20
CAT-M1 eFDD26	high	rms	maxhold	-	-	-	-13	>20

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

5.3.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

CAT-M1 eFDD 26 QPSK, RB=1, Channel = low



5.3.5 TEST EQUIPMENT USED

- Radio Lab

5.4 FIELD STRENGTH OF SPURIOUS RADIATION

Standard **FCC PART 22 Subpart H**

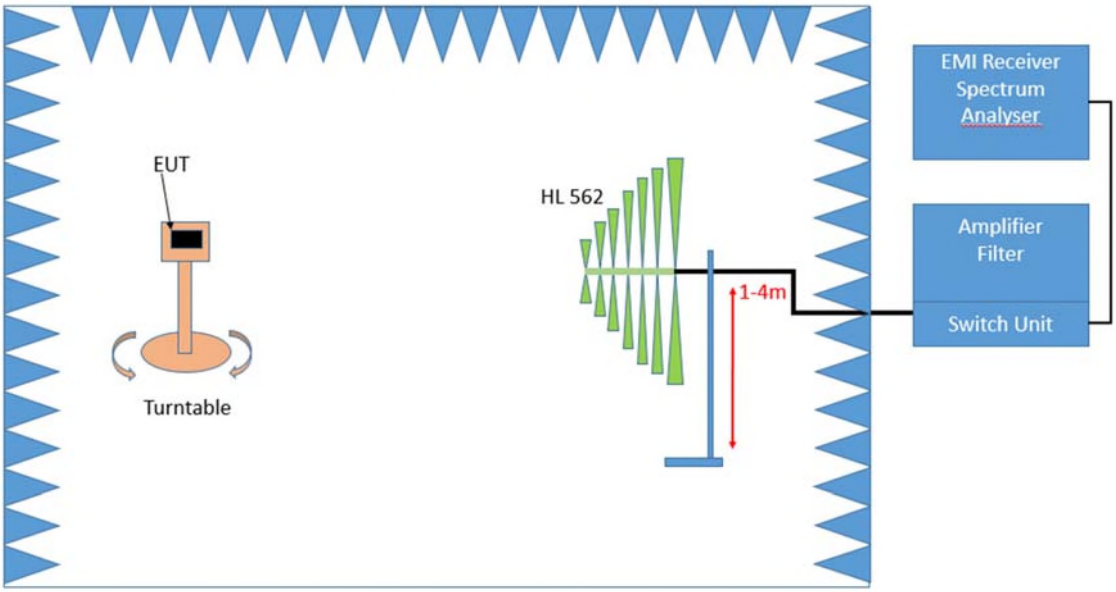
The test was performed according to:
ANSI C63.26: 2015

5.4.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable 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.

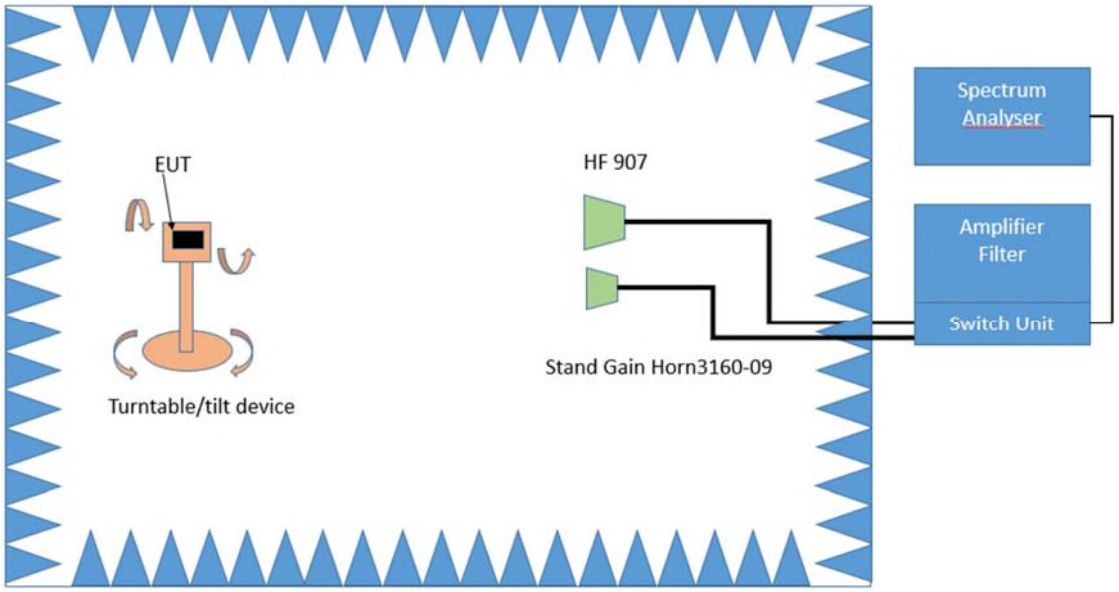
The EUT was connected to the test setup according to the following diagram:

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 45 °.
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 135°
- Turntable step size: 45°
- 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

5.4.2 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.

5.4.3 TEST PROTOCOL

Ambient temperature: 22 °C
Relative humidity: 35 %

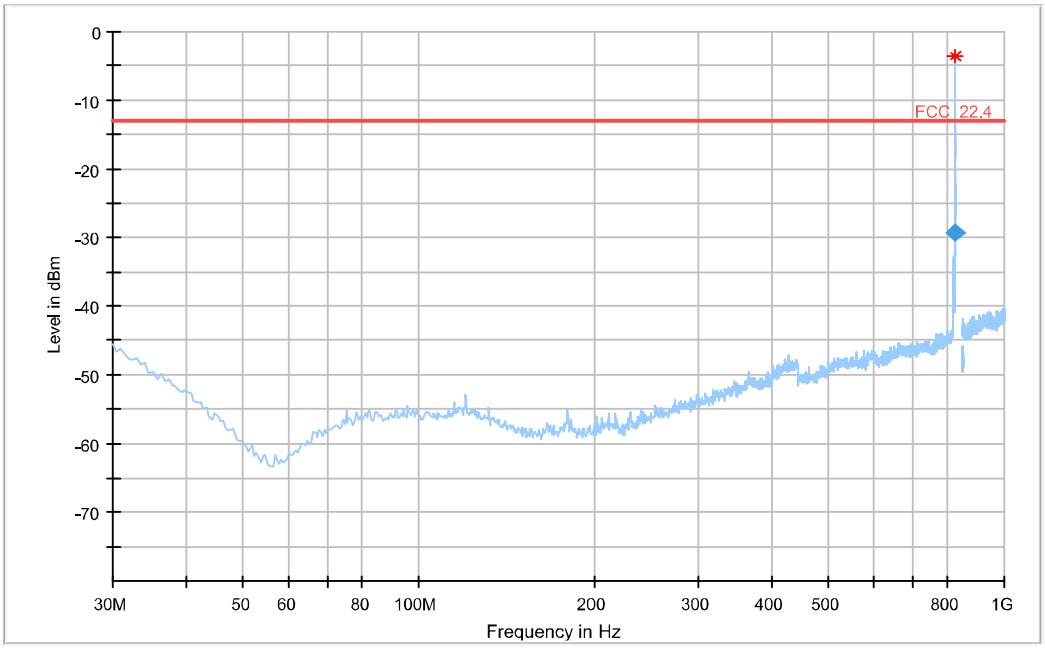
Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD5	low	rms	maxhold	50	823.9	-29.61	-13	16.61
CAT-M1 eFDD5	mid	rms	maxhold	-	-	-	-13	>20
CAT-M1 eFDD5	high	rms	maxhold	-	-	-	-13	>20

Radio Technology	Channel	Detector	Trace	Resolution Bandwidth /kHz	Frequency /MHz	Peak Value /dBm	Limit /dBm	Margin to Limit /dB
CAT-M1 eFDD26	low	rms	maxhold	50	824	-29.3	-13	16.3
CAT-M1 eFDD26	mid	rms	maxhold	-	-	-	-13	>20
CAT-M1 eFDD26	high	rms	maxhold	-	-	-	-13	>20

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

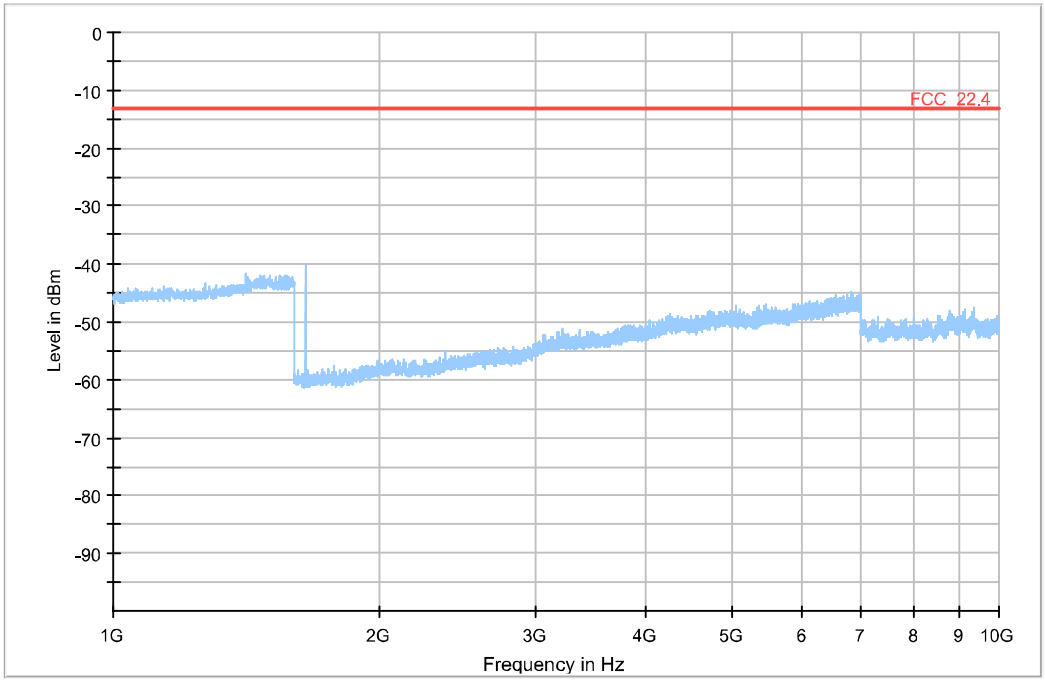
5.4.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

CAT-M1 eFDD 26 QPSK, RB=1, Channel = low
30 MHz – 1 GHz



Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
824.0	-29.30	-13.00	16.30	1000.0	50.000	110.0	H	80.0	-73.8

1 GHz – 10 GHz



5.4.5 TEST EQUIPMENT USED

- Radiated Emissions

5.5 EMISSION AND OCCUPIED BANDWIDTH

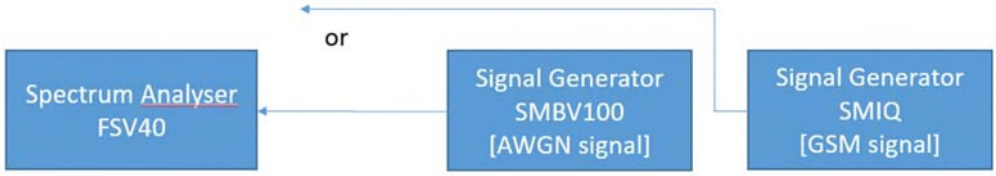
Standard **FCC PART 22 Subpart H**

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

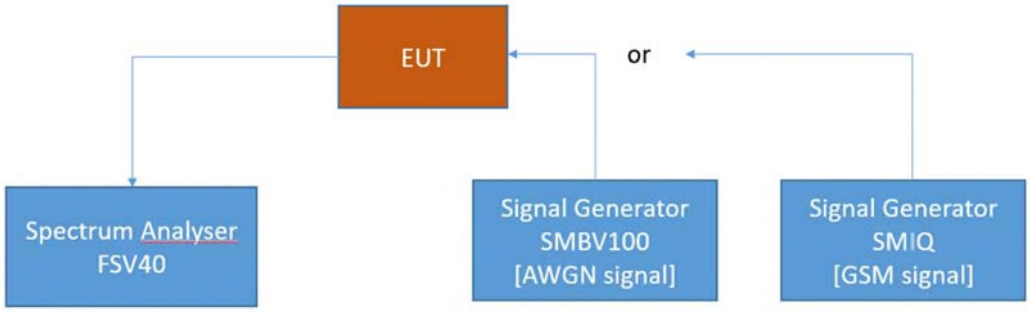
5.5.1 TEST DESCRIPTION

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

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



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



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

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

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

5.5.2 TEST REQUIREMENTS / LIMITS

FCC Part 2.1049; Occupied Bandwidth:

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

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

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

RSS-GEN; 6.6 Occupied Bandwidth

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

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

5.5.3 TEST PROTOCOL

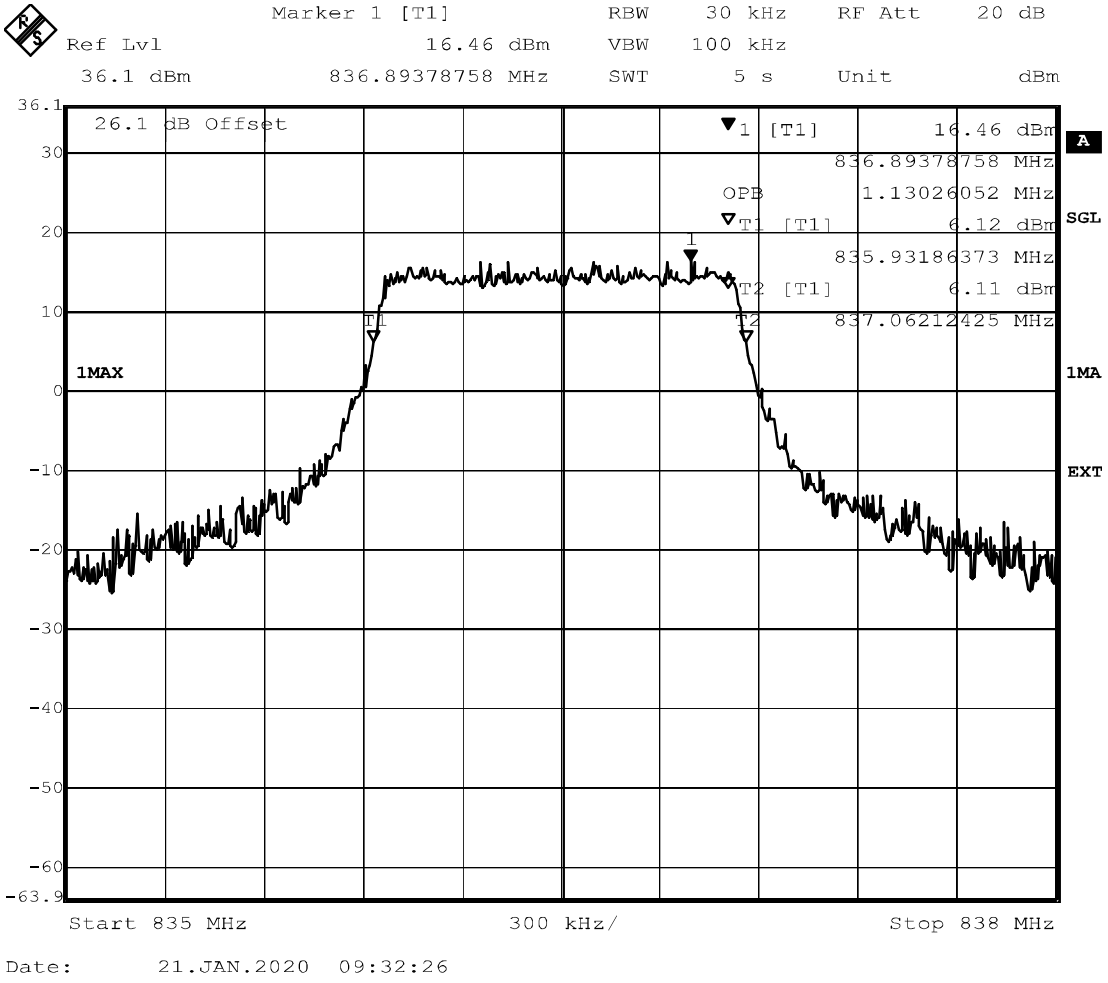
Ambient temperature: 22 °C
Relative humidity: 35 %

Radio Technology	Channel	Ressource Blocks / Subcarrier	Bandwidth [MHz]	Nominal BW [MHz]	99 % BW [kHz]	Verdict
CAT-M1 eFDD 5 QPSK	low	6	1.4	1.4	1118.24	Passed
CAT-M1 eFDD 5 QPSK	mid	6	1.4	1.4	1130.26	Passed
CAT-M1 eFDD 5 QPSK	high	6	1.4	1.4	1130.26	Passed
CAT-M1 eFDD 5 16QAM	low	5	1.4	1.4	967.94	Passed
CAT-M1 eFDD 5 16QAM	mid	5	1.4	1.4	967.94	Passed
CAT-M1 eFDD 5 16QAM	high	5	1.4	1.4	967.94	Passed
CAT-M1 eFDD 26 QPSK	low	6	1.4	1.4	1124.25	Passed
CAT-M1 eFDD 26 QPSK	mid	6	1.4	1.4	1130.26	Passed
CAT-M1 eFDD 26 QPSK	high	6	1.4	1.4	1130.26	Passed
CAT-M1 eFDD 26 16QAM	low	5	1.4	1.4	961.92	Passed
CAT-M1 eFDD 26 16QAM	mid	5	1.4	1.4	967.94	Passed
CAT-M1 eFDD 26 16QAM	high	5	1.4	1.4	967.94	Passed

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

5.5.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

CAT-M1 eFDD 5 QPSK, Channel = mid



5.5.5 TEST EQUIPMENT USED

- Radio Lab