DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29507456

ISED CABid: ES1909
Lab. Company Number: 4621A

Test Report No:
75999RRF.001A1

Test Report
USA FCC Part 27

(*) Identification of item tested	LTE Cat-M/NB-IoT
(*) Trademark	Sequans Communications
(*) Model and /or type reference	GM02SP
(*) Derived model not tested	GM02S
Other identification of the product	FCC ID: 2AAGMGM02SA IC: 12732A-GM02SA
(*) Features	Dual-mode LTE-M / NB-IoT 3GPP LTE Release 14 LGA module form factor Cat M1: up to 590 kbps DL and 1.1 Mbps UL Cat NB1/NB2: up to 120.7 kbps DL and 160 kbps UL HW version: Rev3 SW version: LR8.2.0.3-60386
Applicant	SEQUANS COMMUNICATIONS 55 Boulevard Charles de Gaulle, 92700 Colombes, France
Test method requested, standard	USA FCC Part 27 (10-1-22 Edition). ANSI C63.26-2015. ANSI/TIA-603-E: 2016 KDB 971168 D01 Power Meas License Digital Systems v03r01, April. 2018.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	José Manuel Gómez Galván EMC Consumer & RF Lab. Manager Firmado digitalmente por 53680346W JOSE MANUEL GOMEZ (C:A29507456)
Date of issue	2024-04-26
Report template No.	FDT08_24 (*) "Data provided by the client"

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DEKRA Testing and Certification is an FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory, CABid: ES1909, Company Number: 4621A, with the appropriate scope of accreditation that covers the performed tests in this report.

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Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").

2. The sample GM02S is an LTE Cat M1/NB1/NB2 module based on Sequans' second generation Monarch 2 chip platform.

Declaration of similarity

Date: 12/02/2024

To whom it may concern:

We,

Sequans Communications
55 Boulevard Charles de Gaulle, 92700 Colombes, France

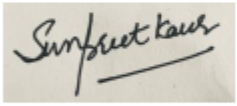
hereby declare that model GM02S Rev3 is a HW variant from model GM02SP.

One component from the BOM, an RF switch, is not present on GM02S' construction.

That component actually just allows an RF input for an external GNSS antenna on GM02SP.

Hence, GM02SP is considered the most complete version of both and testing performed on it can be considered as representative and applicable to GM02S Rev3.

Sincerely,



By:	Sunpreet Kaur
Title:	NAM & EMEA Certifications Manager
Telephone:	+1.206.248.6609
email:	skaur@sequans.com

Usage of samples

Samples undergoing test have been selected by: The client.

- Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
73966/001	Module	GM02SP	016169005002832	29-11-2022

Sample S/01 has undergone the following test(s): The radiated tests indicated in Appendix A.

- Sample S/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
73966/001	Module	GM02SP	016169005002832	29-11-2022
67117/012	SMA cable	-	-	03-02-2021

Sample S/02 has undergone the following test(s): The conducted tests indicated in Appendix A.

Test sample description

Ports……:	Port name and description		Cable: Specified max length [m]	Cable: Attached during test	Cable: Shielded	Cable: Coupled to patient(3)	
	USB			☒	☐	☐	
Supplementary information to the ports……:	-						
Rated power supply ..... :	Voltage and Frequency		Reference poles: L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☒	☐
	☐	AC:	☐	☐	☐	☒	☐
	☒	DC: 2.2v - 5.5v					
	☐	DC:					
Rated Power..... :	-						
Clock frequencies..... :	-						
Other parameters ..... :	-						
Software version..... :	-						
Hardware version ..... :	-						
Dimensions in cm (W x H x D) ... :	-						
Mounting position ..... :	☒	Table top equipment					
	☐	Wall/Ceiling mounted equipment					
	☐	Floor standing equipment					
	☐	Hand-held equipment					
	☐	Other:					
Modules/parts..... :	Module/parts of test item		Type		Manufacturer		
	NEKTAR-EVK		-		-		

Accessories (not part of the test item) ..... :	Description	Type	Manufacturer
	USB Cable	USB	-
	Antenna	Antenna	-
Documents as provided by the applicant ..... :	Description	File name	Issue date
	-	-	-

(3) Only for Medical Equipment

Identification of the client

SEQUANS COMMUNICATIONS
55 Boulevard Charles de Gaulle, 92700, Colombes, France

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2024-02-19
Date (finish)	2024-02-21

Document history

Report number	Date	Description
75999RRF.001	2024-03-22	First release.
75999RRF.001A1	2024-04-26	Second release. References are changed from Band 8 to Band 106 for clarity. Added Declaration of Similarity. This reports cancel and replaces 75999RRF.001.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

In the semi-anechoic chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC

Relative humidity	Min. = 20 % Max. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: Rafael Fernández, Valentín Andarias and Sergio Carrasco.

Used instrumentation:

Control No.	Equipment	Next Calibration
8002	Climatic Chamber BINDER MK 56	2024-03
6158	Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2026-02
9229	Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	2024-06
6794	Shielded Room ETS LINDGREN S101	N/A
7798	EMC/RF Testing SW ROHDE AND SCHWARZ WMS32	N/A
6791	Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N/A
6792	Shielded Room ETS LINDGREN S101	N/A
5641	HYBRID BILOG ANTENNA 30MHz-6GHz	2024-09
4612	Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2024-07
5705	PRE-AMPLIFIER G>40dB 1-18 GHz	2024-07
7817	SIGNAL AND SPECTRUM ANALYZER 2Hz-50GHz FSW50	2024-08
6667	Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	2024-06
4848	EMC/RF Testing SW ROHDE AND SCHWARZ EMC32	N/A

Testing verdicts

Not applicable:	N/A
Pass:	P
Fail:	F
Not measured:	N/M

Summary

FCC PART 27		
Requirement – Test case	**Verdict**	**Remark**
FCC 27.1507: RF Output Power	P	
FCC 2.1047: Modulation Characteristics	P	
FCC 27.54 & 2.1055: Frequency Stability	P	
FCC 2.1049: Occupied Bandwidth	P	
FCC 27.1509: Spurious Emissions at Antenna Terminals	P	
FCC 27.1509: Spurious Emissions at Antenna Terminals at Block Edges	P	
FCC 27.1509: Radiated Emissions	P	
Supplementary information and remarks: None.		

Appendix A: Test results for FCC 27

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TEST CONDITIONS

(*): Declared by the Applicant.

POWER SUPPLY (*):

Vnominal: 5.0 Vdc
Vminimum: 2.2 Vdc
Vmaximum: 5.5 Vdc

Type of Power Supply: DC External.

ANTENNA (*):

Band	Gain (dBi)	Type of Antenna
106	0.17	External (OmniLOG_90200)
	1.1	Internal (FR01-S4-210)

Pre-scan determines that internal antenna is worst case.

TEST FREQUENCIES (*):

Operating broadband system: 897.5-900.5 MHz

LTE Cat M1 Band 106: QPSK and 16QAM Modulation:

	Channel (Frequency, MHz)	
	BW = 1.4 MHz	BW = 3 MHz
Low	21632 (898.2)	
Middle		21640 (899)
High	21648 (899.8)	

RF Output Power

Limits

1. LTE Cat-M1 Band 106. FCC §27.1507 (a) & (d).

FCC §27.1507 (a) & (d):

(a) *Maximum ERP*. The power limits specified in this section are applicable to operations in areas more than 110 km (68.4 miles) from the U.S./Mexico border and 140 km (87 miles) from the U.S./Canada border.

(3) *Mobile, control and auxiliary test stations*. Mobile, control and auxiliary test stations must not exceed 10 watts ERP.

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

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

Method

The conducted RF output power measurements were made at the RF output terminals of the EUT using the power meter of the Universal Radio Communication tester CMW500, selecting maximum transmission power of the EUT and different modes of modulation.

The peak-to-average power ratio (PAPR) is measured using an attenuator, power splitter and spectrum analyser with a Complementary Cumulative Distribution Function implemented.

The maximum equivalent isotropically radiated power (e.i.r.p.) is calculated by adding the declared maximum antenna gain (dBi).

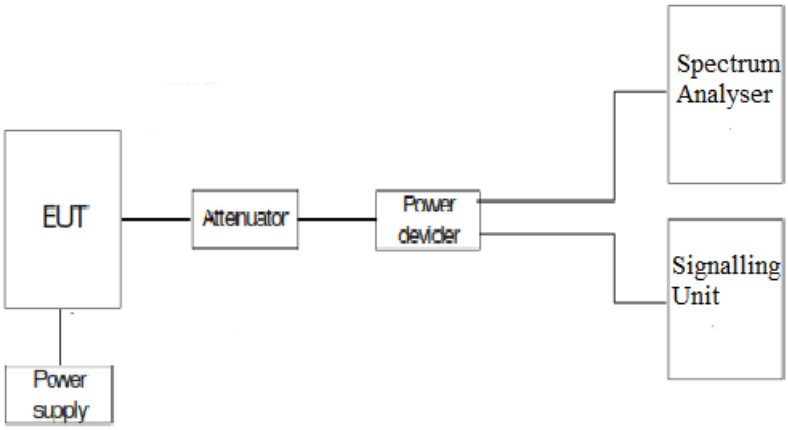
The maximum effective radiated power e.r.p. is calculated from the maximum equivalent isotropically radiated power (e.i.r.p.) by subtracting 2.15 dB:

E.R.P. = E.I.R.P. - 2.15 dB

Test Setup

1. CONDUCTED AVERAGE POWER:

2. PEAK-TO-AVERAGE POWER RATIO (PAPR) and Conducted Average power:



Results

1. CONDUCTED AVERAGE POWER:

LTE Cat. M1 Band 106

Preliminary measurements determined the narrow band = 1 and nominal bandwidth of 3 MHz as the worst case. The results in the next tables shows the results for this configuration.

Narrow band = 1

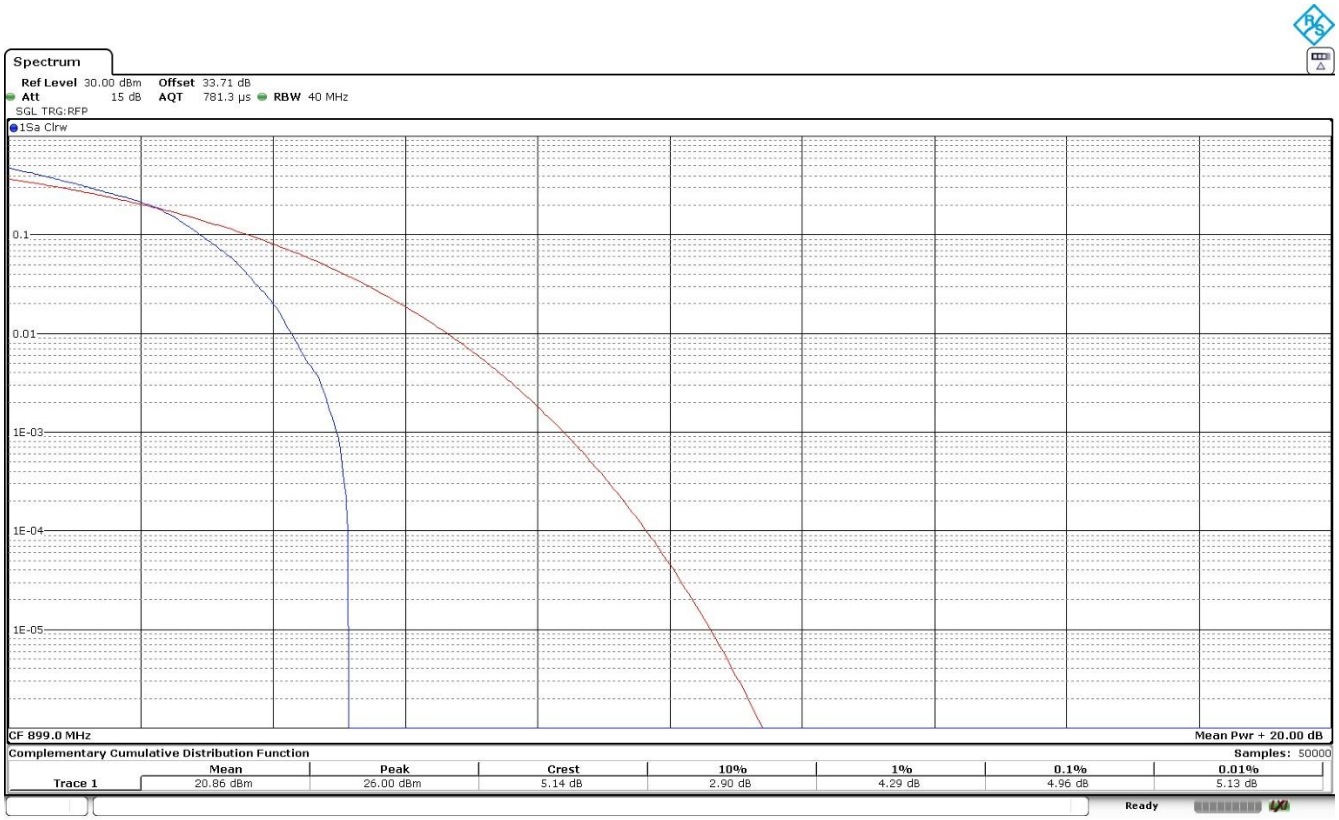
CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	PAPR (dB)
Middle 21640	899 MHz	QPSK	1	0	23,1	4,06
			1	2	23,05	3,48
			1	5	**23,14**	3,65
			3	0	22,32	4,17
			3	1	22,3	4,43
			3	3	22,33	3,8
			6	0	21,41	4,72
		16-QAM	1	0	22,15	4,52
			1	2	22,03	4,64
			1	5	22,16	4,32
			3	0	21,48	4,93
			3	1	21,4	**4,96**
			3	3	21,38	4,93

Measurement uncertainty (dB) <±1.11

2. PEAK-TO-AVERAGE POWER RATIO (PAPR)

LTE Cat. M1 Band 106:

Preliminary measurements determined the narrow band = 1. Worst-case of PAPR is BW=3 MHz, middle channel, 16QAM, RB Size=3, RB Offset=1.



Measurement uncertainty (dB) <±1.11

Verdict

Pass

Frequency Stability

Limits

1. LTE Cat. M1 Band 106.

* FCC §27.54: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

* FCC § 2.1055:

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From -30° to +50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(c) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

Method

The frequency tolerance measurements over temperature variations were made over the temperature range of –30ºC to +50ºC. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10ºC steps from –30ºC up to +50ºC.
The supply voltage was varied between 85% and 115% of nominal voltage.

Temperature and voltage range of testing has been extended to the maximum and minimum values declared by customer.

The EUT was set in “Radio Resource Control (RRC) mode” on the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter.
The worst case LTE mode for conducted power was used for the test.

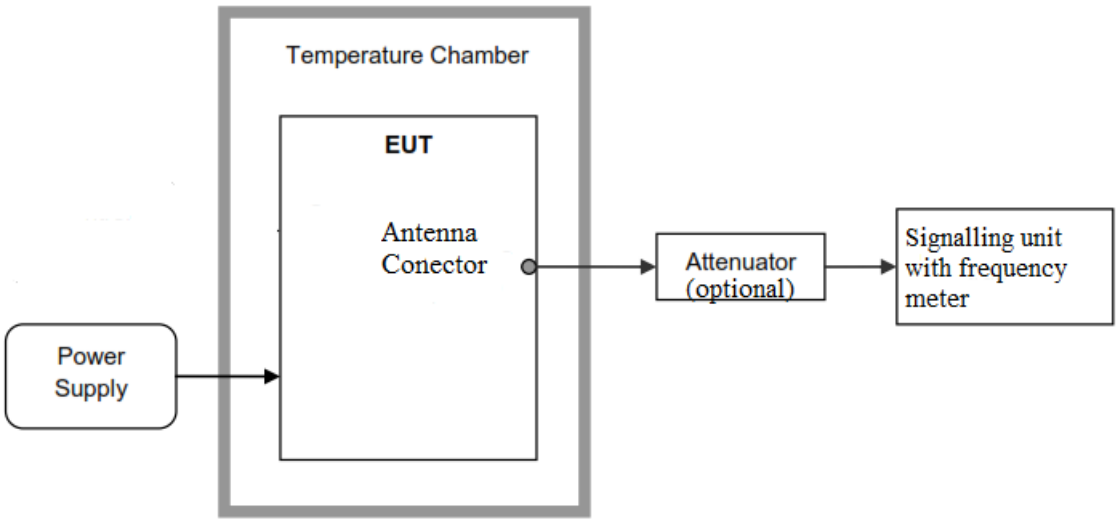
In order to check that the frequency stability is sufficient such that the fundamental emissions stay within the authorized bands of operation, a reference point is established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and highest channel of operation are identified as

fL and fH respectively. The worst-case frequency offset determined in the above methods is added or subtracted from the values of fL and fH to check that the resulting frequencies remain within the band.

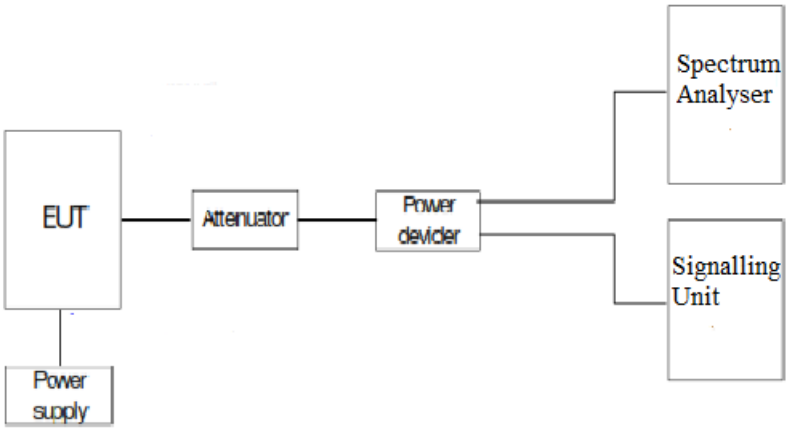
The reference point measurements were made at the RF output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

Test Setup

Frequency tolerance:



Reference points *f*L and *f*H:



Results

1. FREQUENCY TOLERANCE:

- **Frequency stability over temperature variations:**

  LTE Cat. M1 Band 106:

  The worst case in terms of Frequency Stability is NarrowBand =0, BW=3 MHz, QPSK.

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)
85	-2,46	-0,002736374
80	3,88	0,004315907
70	-4,34	-0,004827586
60	1,61	0,001790879
50	1,59	0,001768632
40	-4,32	-0,004805339
30	0,84	0,000934372
20	-3,7	-0,004115684
10	3,8	0,004226919
0	3,54	0,003937709
-10	-5,57	-0,006195773
-20	-1,37	-0,001523915
-30	-3,2	-0,003559511
-40	-1,03	-0,001145717

- **Frequency stability over voltage variations:**

  LTE Cat. M1 Band 106:

  The worst case modulation in terms of Frequency Stability is BW=1.4 MHz, QPSK.

Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	5.5	-15,88	-0,017664071
Vmin	2.2	-18,73	-0,02083426

2. REFERENCE FREQUENCY POINTS fL AND fH:

The worst-case frequency offsets added or subtracted per band and bandwidth:

LTE Cat. M1 Band 106: BW=3 MHz. QPSK.

*f*L (MHz)	897,5178
*f*H (MHz)	900,4722

The reference frequency points fL and fH stay within the authorized blocks for the band above.

Measurement uncertainty (Hz): <±207.77

Verdict

PASS

Modulation Characteristics

Limits

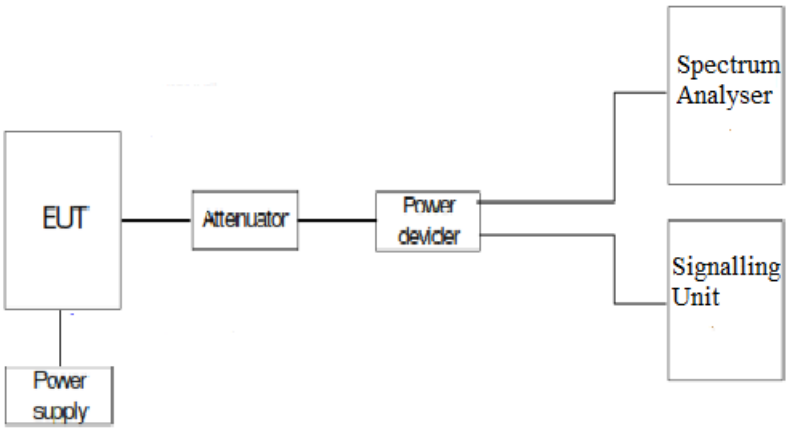
1. LTE Cat. M1 Band 106.

* FCC §2.1047 Measurements required: Modulation characteristics.

Method

For LTE the EUT operates with QPSK and 16QAM modulation modes in which the information is digitised and coded into a bit stream. The RF transmission is multiplexed using *Orthogonal Frequency Division Multiplexing (OFDM)* using different possible arrangement of subcarriers (Resource Blocks RB).

Test Setup

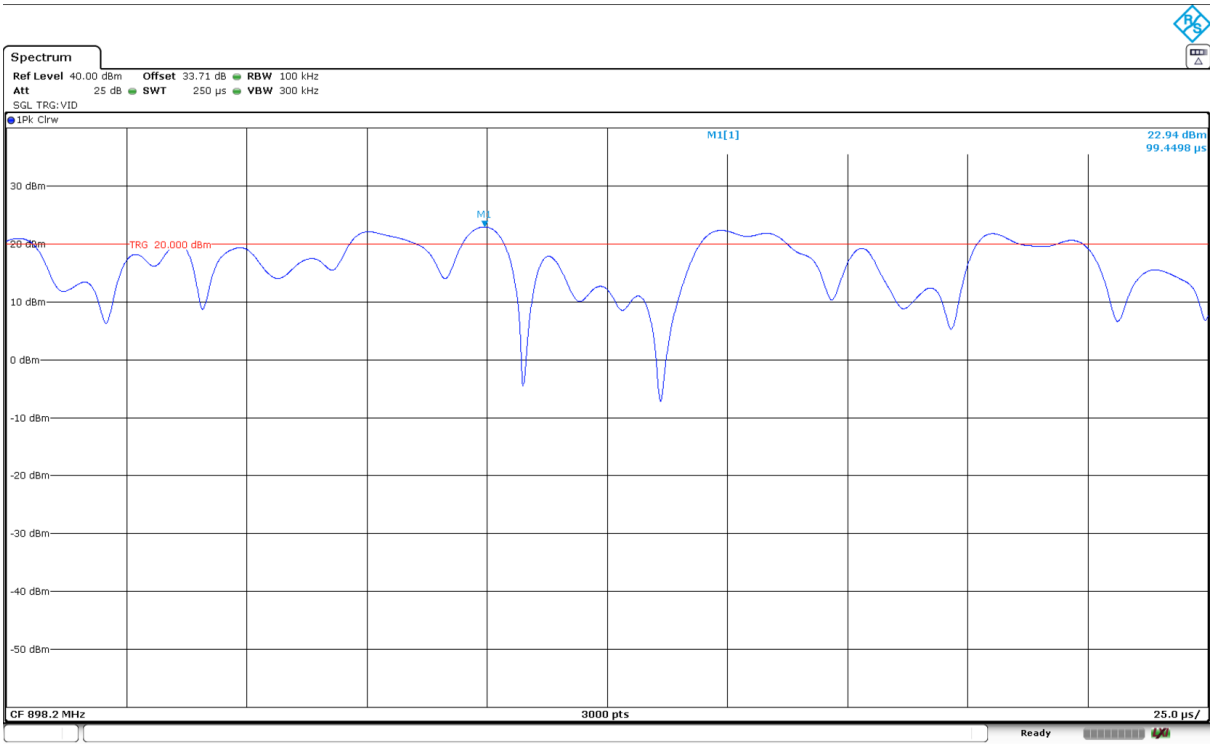


Results

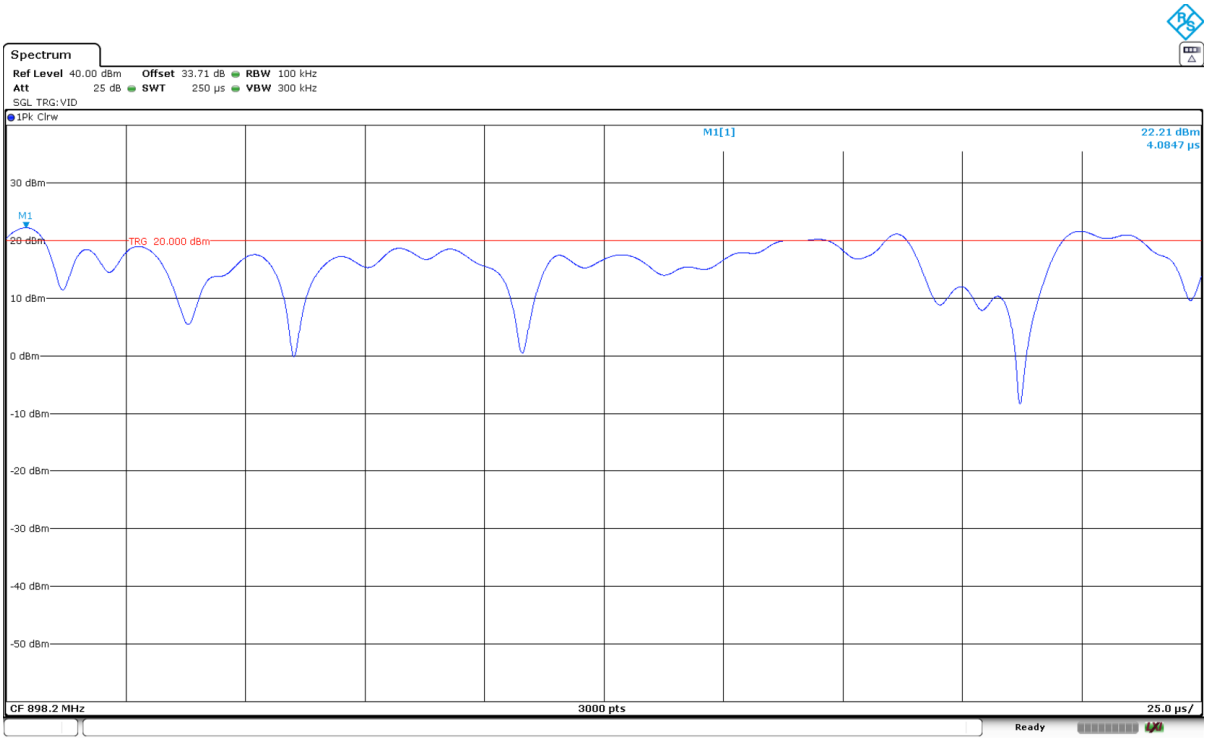
The following plots show the modulation schemes in the EUT.

LTE Cat. M1 Band 106:

QPSK. BW=1.4 MHz.



16QAM. BW=1.4 MHz.



Occupied Bandwidth

Limits

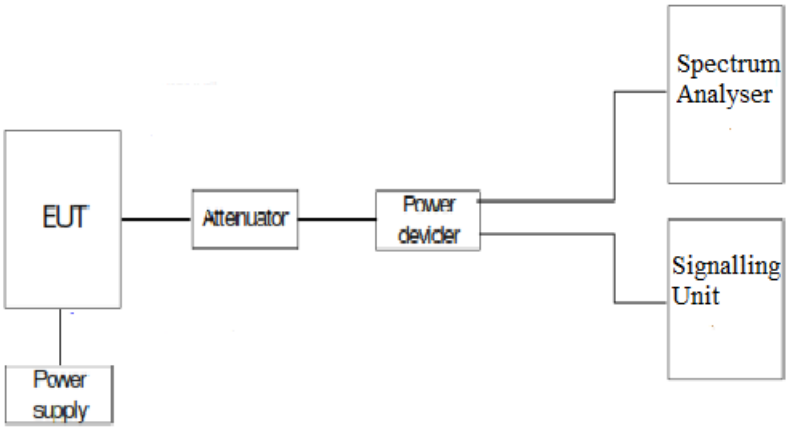
1. LTE Cat. M1 Band 106.

* FCC §2.1049: Measurements required: Occupied bandwidth.

Method

The occupied bandwidth measurement was performed at the output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The 99% occupied bandwidth and the -26 dBc bandwidth were measured directly using the built-in bandwidth measuring option of spectrum analyser.

Test Setup



Results

The worst case of occupied bandwidth corresponds to Resource Blocks (RB) Size All regardless the Bandwidth selected.

LTE Cat. M1 Band 106:

LTE Cat. M1 Band 106. BW=1.4 MHz. QPSK. RB Size=All.

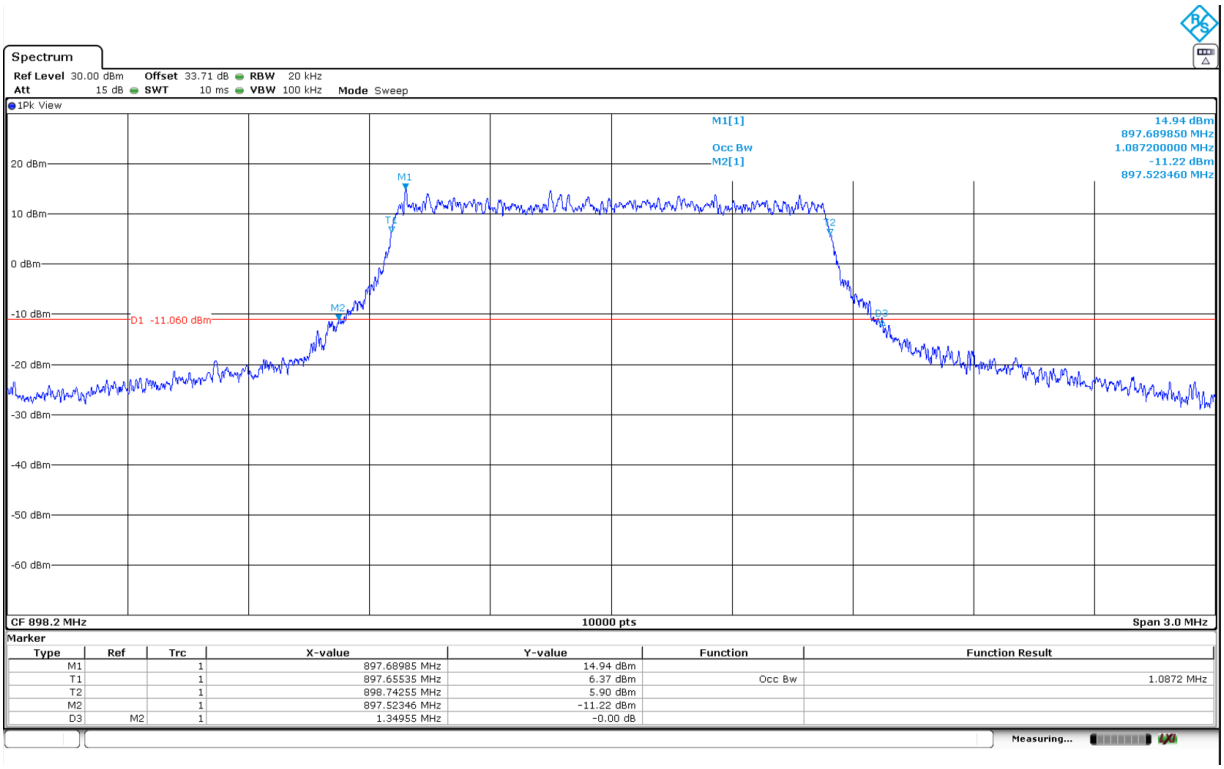
Channel	Low	High
99% Occupied Bandwidth (MHz)	1,087	1,090
-26 dBc Bandwidth (MHz)	1,350	1,359
Measurement uncertainty (kHz)	<±3.75	

LTE Cat. M1 Band 106. BW=1.4 MHz. 16QAM. RB Size=All.

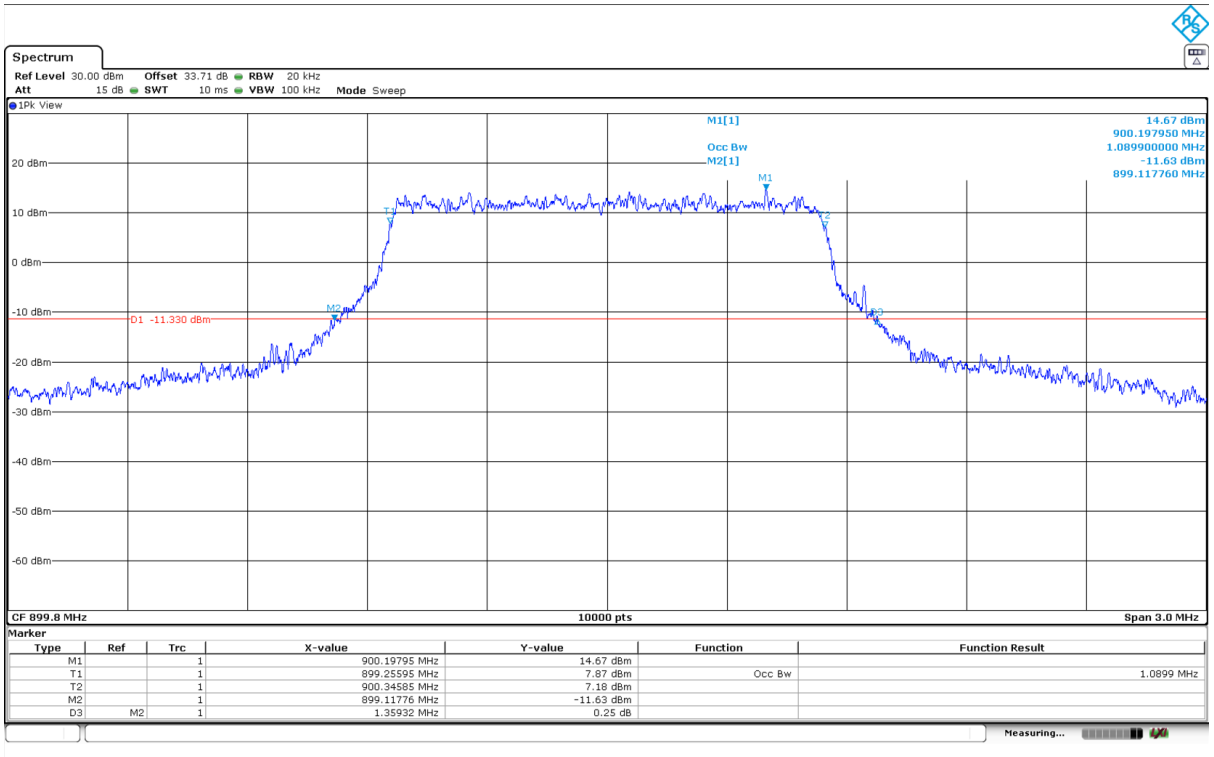
Channel	Low	High
99% Occupied Bandwidth (MHz)	0,925	0,925
-26 dBc Bandwidth (MHz)	1,340	1,311
Measurement uncertainty (kHz)	<±3.75	

LTE Cat. M1 Band 106. BW=1.4 MHz. QPSK. RB Size=All.

Low Channel:

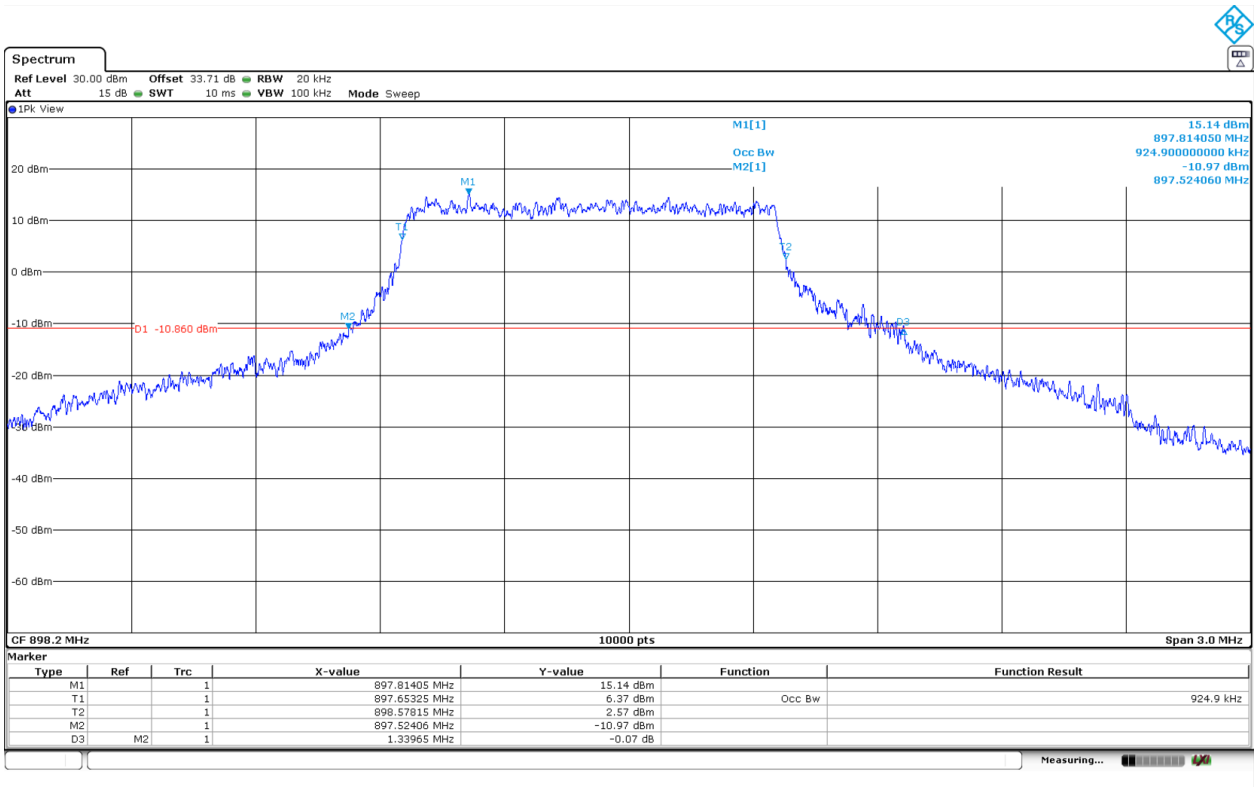


High Channel:

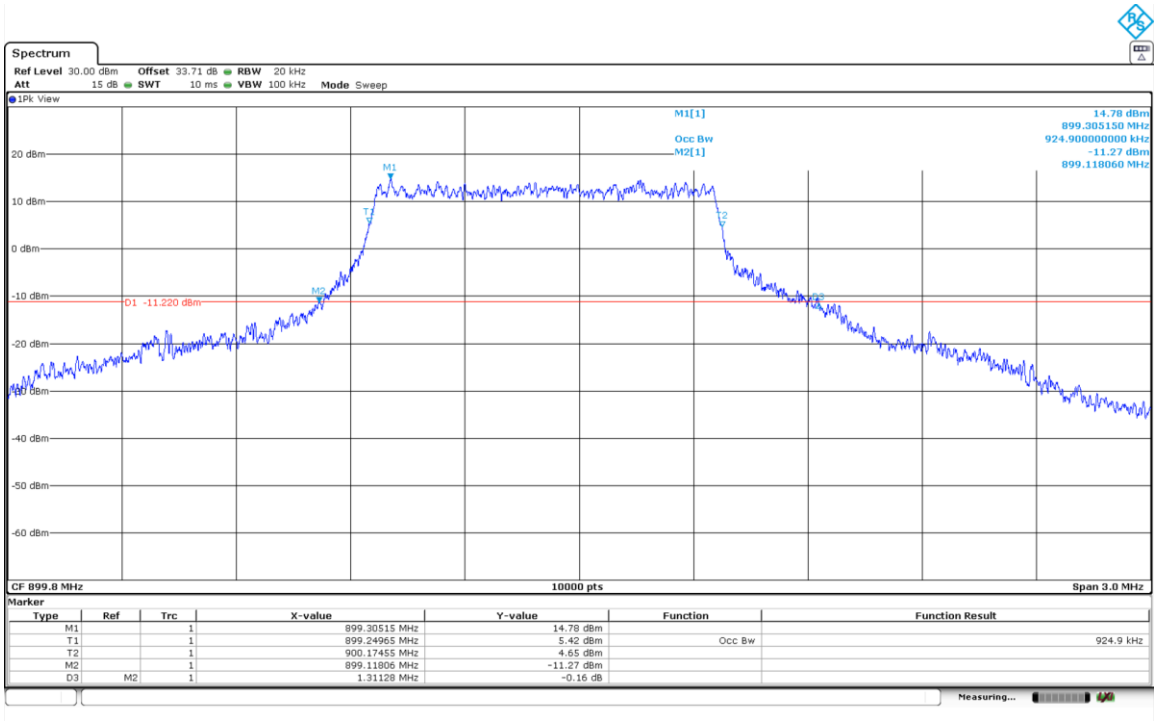


LTE Cat. M1 Band 106. BW=1.4 MHz. 16QAM. RB Size=All.

Low Channel:



High Channel:



Spurious Emissions at Antenna Terminals

Limits

1. LTE Cat. M1 Band 106. FCC §27.1509.

* FCC §27.1509:

The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) in watts by at least the following amounts:

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

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

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

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

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

Method

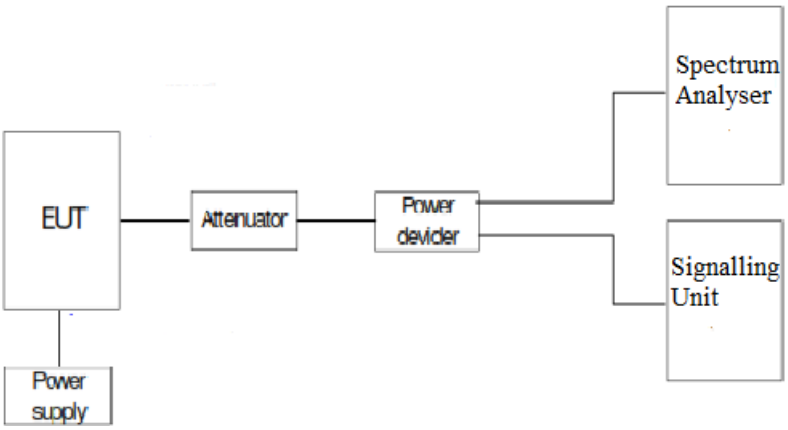
The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50-Ohm attenuator and a power divider.

The spectrum was investigated from 9 kHz to 10 GHz for LTE Cat-M1 Band 106.

The reading of the spectrum analyser is corrected with the attenuation loss of connection between output terminal of EUT and input of the spectrum analyser.

The configuration of Resource Blocks and modulation which is the worst case for conducted power was used.

Test Setup



Results

LTE Cat. M1 Band 106: NarrowBand=1 BW=3 MHz. QPSK. RB Size 1. RB Offset 5.

- Middle Channel:

Frequency (MHz)	MaxPeak (dBm)
6300.593750	-28.94

Measurement uncertainty (dB): <±2.76

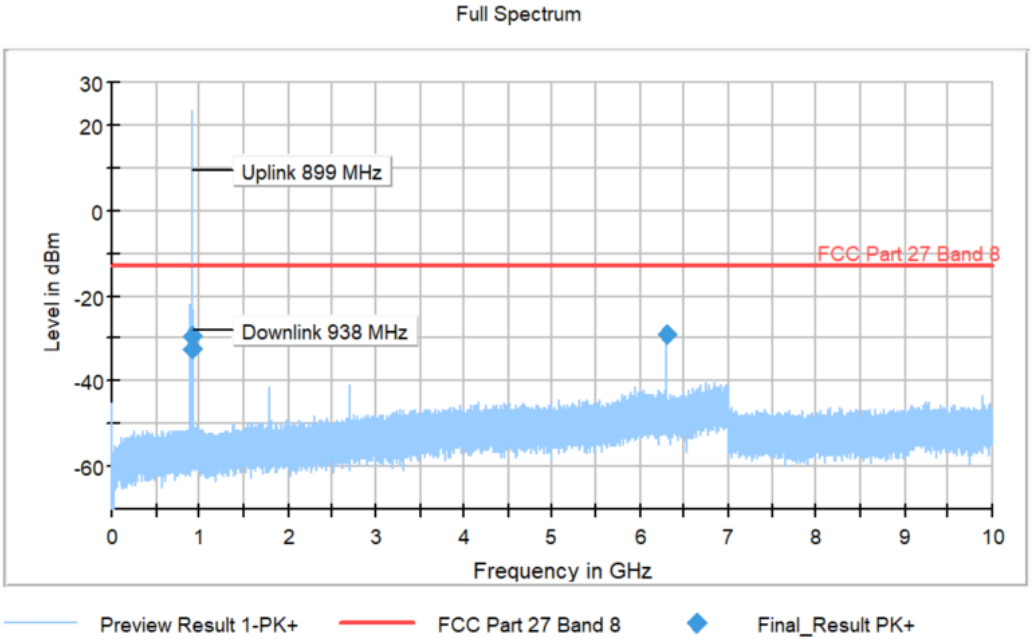
Verdict

PASS

LTE Cat. M1 Band 106. BW=1.4 MHz. QPSK. RB Size 3. RB Offset 0.

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40]					
9 kHz - 150 kHz	14,1 Hz	PK+	300 Hz	Coupled	0 dB
150 kHz - 30 MHz	932,812 Hz	PK+	10 kHz	Coupled	0 dB
30 MHz - 1 GHz	30,312 kHz	PK+	100 kHz	Coupled	0 dB
1 GHz - 2 GHz	31,25 kHz	PK+	100 kHz	Coupled	0 dB
2 GHz - 3 GHz	31,25 kHz	PK+	100 kHz	Coupled	0 dB
3 GHz - 4 GHz	31,25 kHz	PK+	100 kHz	Coupled	0 dB
4 GHz - 5 GHz	31,25 kHz	PK+	100 kHz	Coupled	0 dB
5 GHz - 6 GHz	31,25 kHz	PK+	100 kHz	Coupled	0 dB
6 GHz - 7 GHz	31,25 kHz	PK+	100 kHz	Coupled	0 dB
7 GHz - 8 GHz	31,25 kHz	PK+	100 kHz	Coupled	0 dB
8 GHz - 9 GHz	31,25 kHz	PK+	100 kHz	Coupled	0 dB
9 GHz - 10 GHz	31,25 kHz	PK+	100 kHz	Coupled	0 dB

Middle Channel:



Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)
6300.593750	-28.94	-13.00	15.94	5.0	100.000

Spurious Emissions at Antenna Terminals at Block Edges

Limits

1. LTE Cat. M1 Band 106. FCC §27.1509.

* FCC §27.1509:

The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) in watts by at least the following amounts:

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

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

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

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

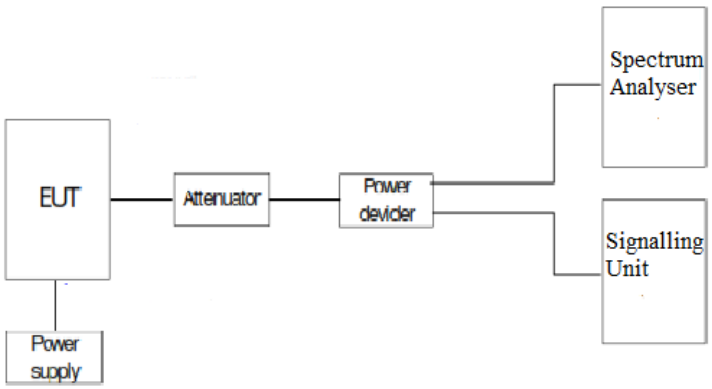
(e) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

Method

The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50-Ohm attenuator and a power splitter.

The reading of the spectrum analyser is corrected with the attenuation loss of connection between output terminal of EUT and input of the spectrum analyser.

Test Setup



Results

LTE Cat. M1 Band 106:

Preliminary measurements determined NarrowBand=1, QPSK, BW=1.4 MHz as the worst-case

LTE QPSK:	RB=1. Offset=0. BW = 1.4 MHz	RB=1. Offset=0. BW = 3 MHz
Maximum measured level at Low Block Edge at antenna port (dBm)	-17,47	-27,55

LTE QPSK:	RB = All. Offset = 0. BW = 1.4 MHz	RB = All. Offset = 0. BW = 3 MHz
Maximum measured level at Low Block Edge at antenna port (dBm)	-21,07	-23,33

LTE QPSK:	RB=1. Offset=Max. BW = 1.4 MHz	RB=1. Offset=Max. BW = 3 MHz
Maximum measured level at High Block Edge at antenna port (dBm)	-20,01	-27,17

LTE QPSK:	RB = All. Offset = 0. BW = 1.4 MHz	RB = All. Offset = 0. BW = 3 MHz
Maximum measured level at High Block Edge at antenna port (dBm)	-19,83	-22,16

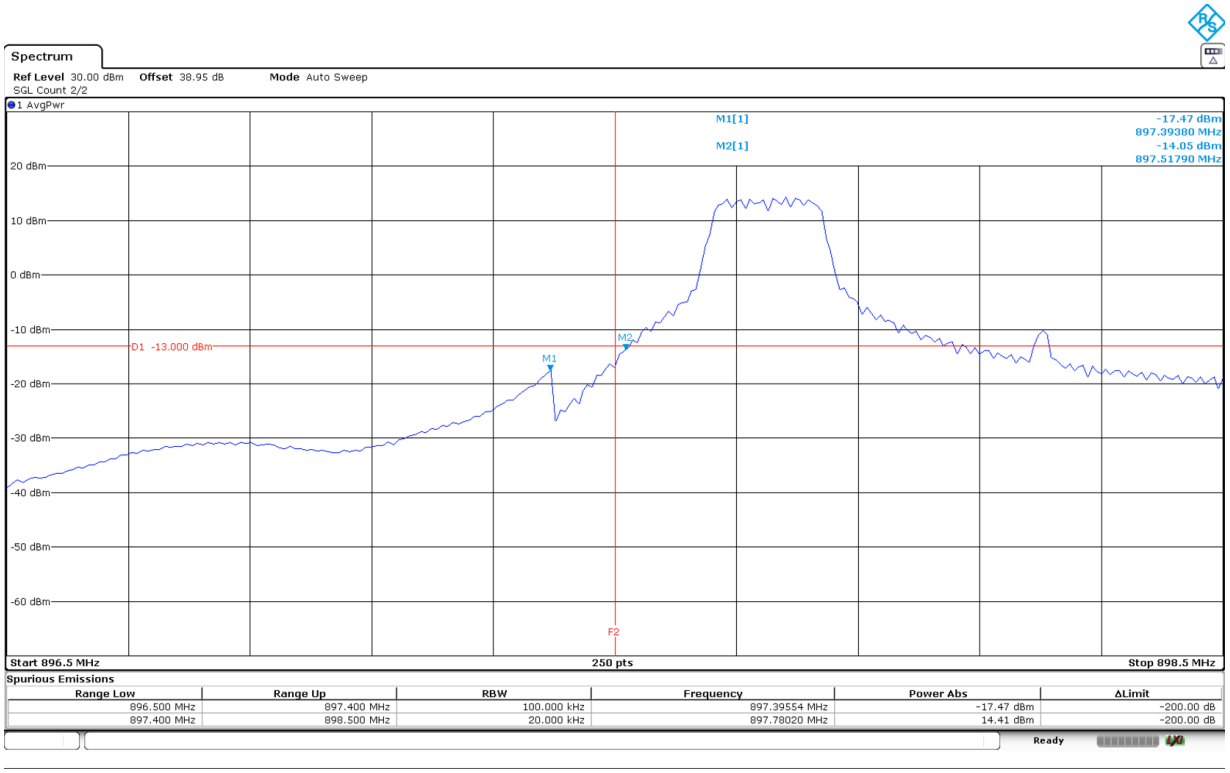
Measurement uncertainty: <±2.76 dB

Verdict

PASS

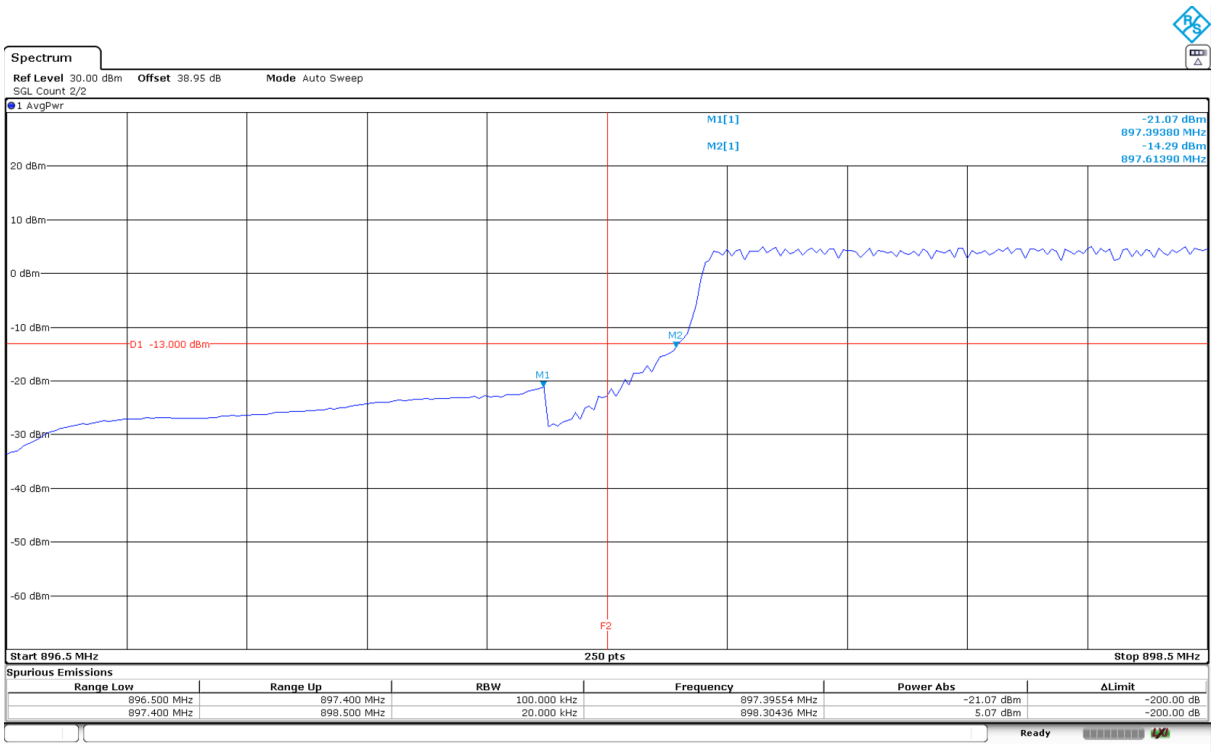
LTE Cat. M1 Band 106:

LTE Cat. M1 Band 106. NarrowBand=1 BW=1.4 MHz. QPSK. RB=1. Offset=0. Low Block Edge:



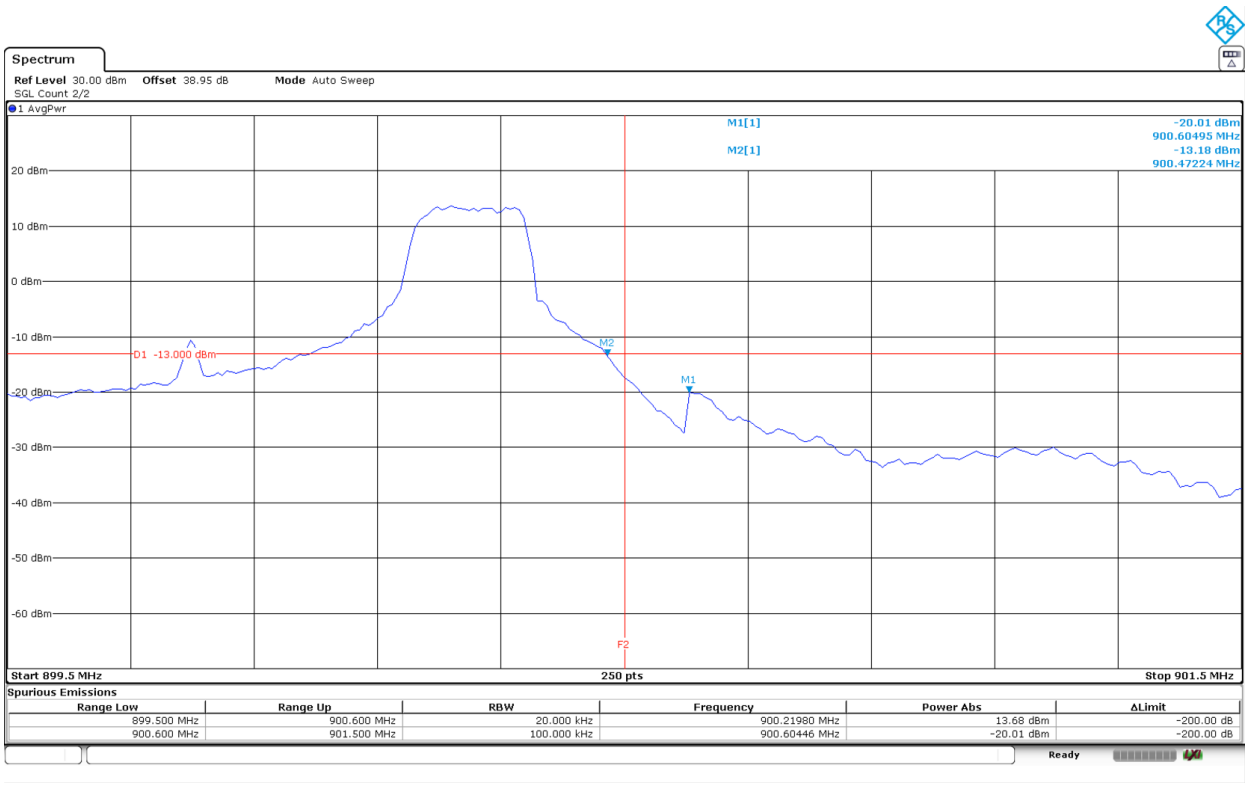
The equipment transmits at the maximum output power

LTE Cat. M1 Band 106. NarrowBand=1 BW=1.4 MHz. QPSK. RB=All. Offset=0. Low Block Edge:



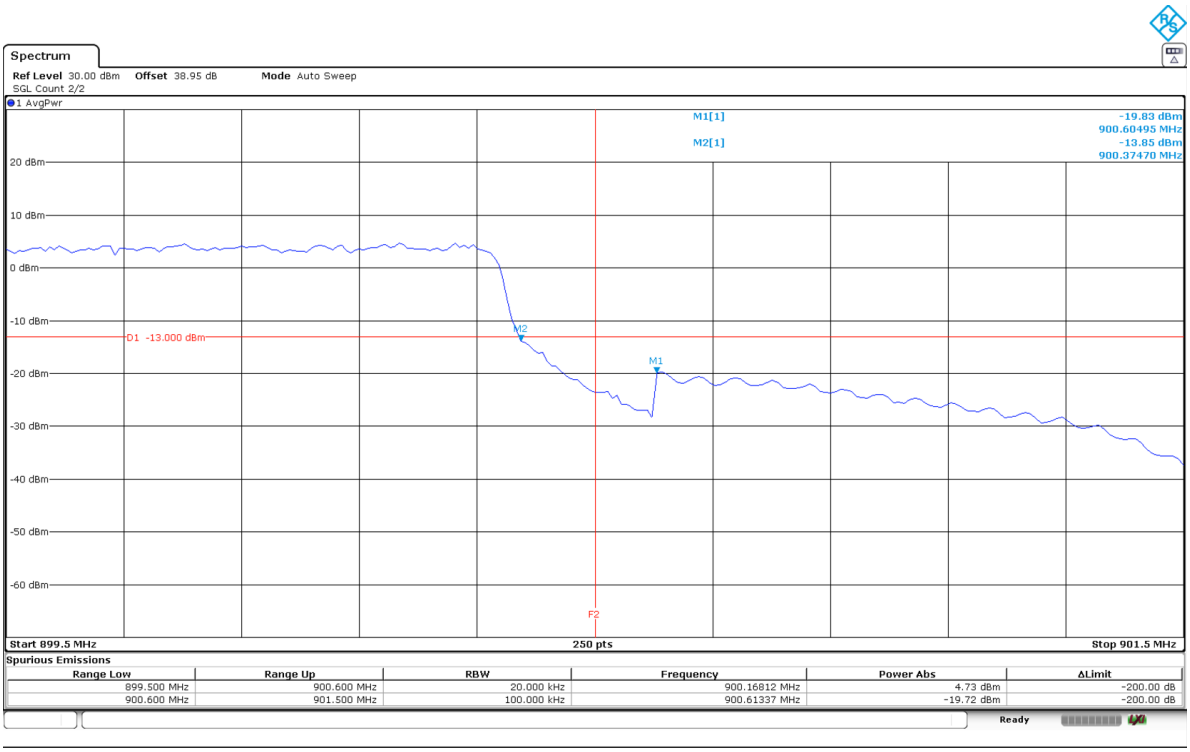
The equipment transmits at the maximum output power

LTE Cat. M1 Band 106. NarrowBand=1 BW=1.4 MHz. QPSK. RB=1. Offset=Max. High Block Edge:



The equipment transmits at the maximum output power

LTE Cat. M1 Band 106. NarrowBand=1 BW=1.4 MHz. QPSK. RB=All. Offset=0. High Block Edge:



The equipment transmits at the maximum output power

Radiated Emissions

Limits

1. LTE Cat-M1 Band 106. FCC §27.1509.

* FCC §27.1509:

The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) in watts by at least the following amounts:

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

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

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

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

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

Method

The measurement was performed with the EUT inside an anechoic chamber.
The spectrum was scanned from 30 MHz to at least the 10th harmonic of the highest frequency generated within the equipment.

The EUT was placed on a non-conductive stand at 3-meter distance from the measuring antenna for the frequency range 30 MHz to 10 GHz.

Detected emissions were maximized at each frequency by rotating the EUT and adjusting the height and polarization of the measuring antenna. The maximum meter reading was recorded.

Measurement Limits:

At Po transmitting power. the specified minimum attenuation 43 + 10 log10 p (watts) becomes:

$$Po\ (dBm) - [43 + 10 \log (Po \text{ in mwatts}) - 30] = -13\ dBm$$

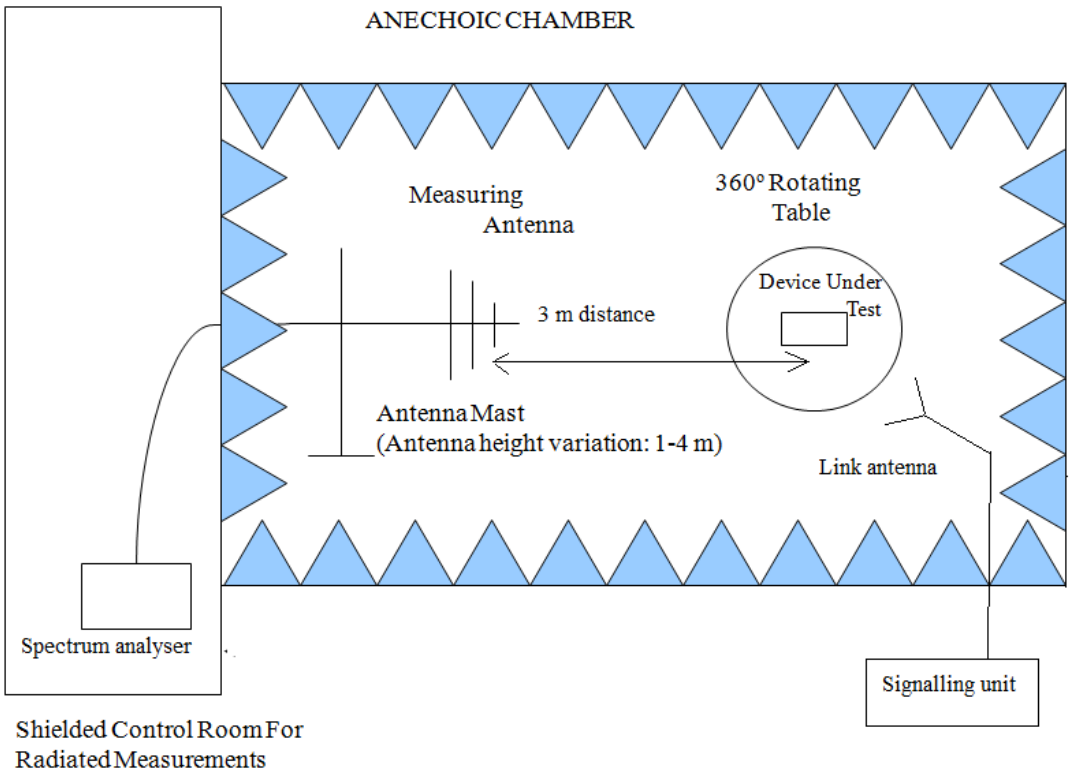
The maximum field strength (dBµV/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

$$EIRP\ (dBm) = E\ (dB\mu V/m) + 20 \log(D) - 104.8;$$

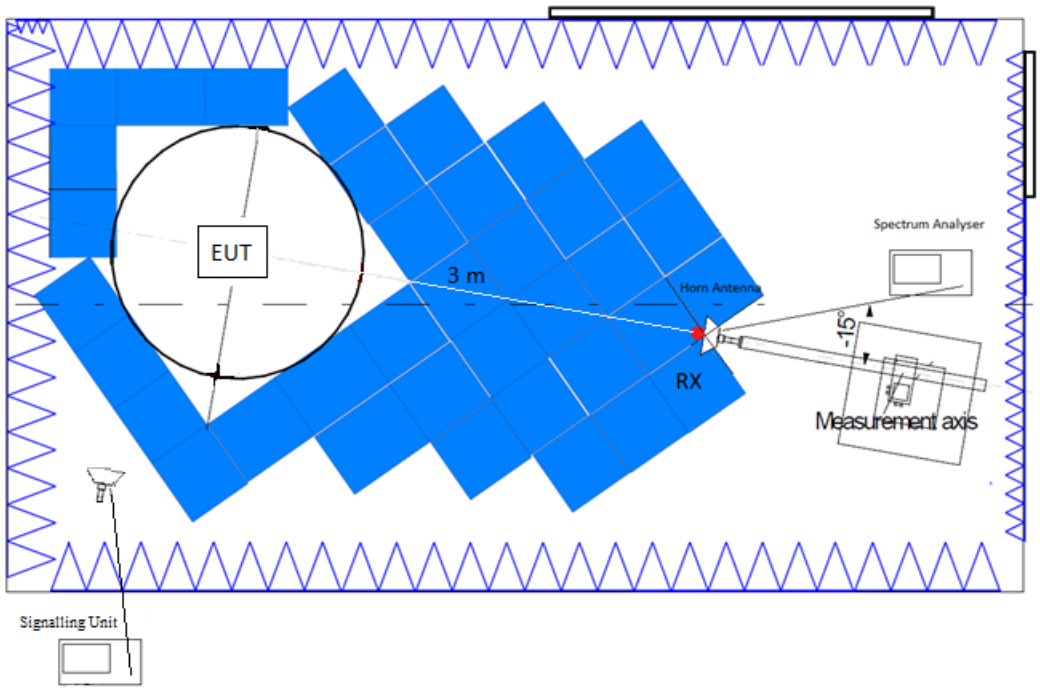
where D is the measurement distance (in the far field region) in m. D = 3m.

Test Setup

Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 10 GHz:



Results

Test was performed on worst-case channel in terms of radiated spurious emissions, determined by a preliminary scan for each band.

LTE Cat. M1 Band 106:

A preliminary scan determined the NarrowBand=1 QPSK, BW=3 MHz, RB=1, RB Offset=5 as the worst case. The next results are for this worst-case configuration.

- MIDDLE CHANNEL:

Frequency range 30 MHz - 1 GHz:

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 10 GHz:

No spurious frequencies at less than 20 dB below the limit.

Measurement uncertainty (dB)	< ±5.35 for f < 1 GHz < ±4.32 for f ≥ 1 GHz up to 8 GHz

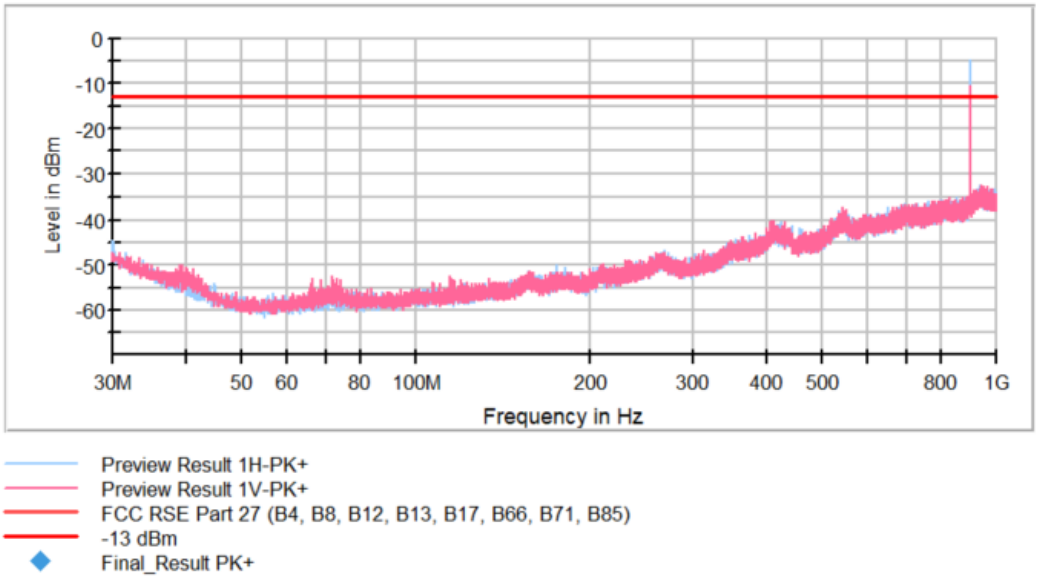
Verdict

Pass

LTE Cat. M1 Band 106:

FREQUENCY RANGE 30 MHz - 1 GHz:

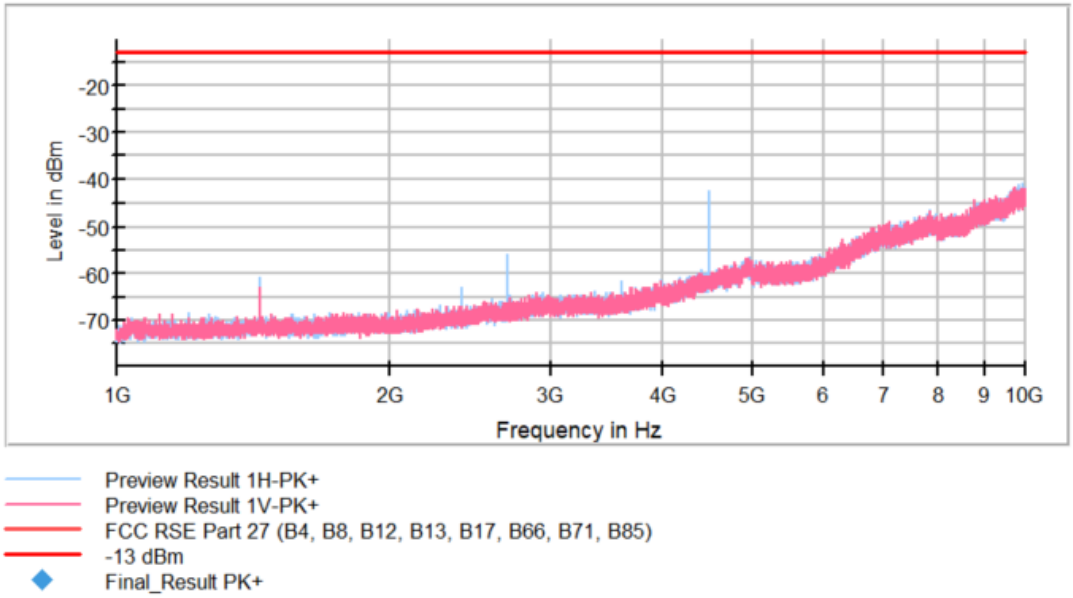
- MIDDLE CHANNEL:



The peak above the limit is the LTE Cat. M1 Band 106 carrier frequency.

FREQUENCY RANGE 1 GHz - 10 GHz

- MIDDLE CHANNEL:



Spectrum analyser settings:

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [FSW 50]					
30 MHz - 1 GHz	400 kHz	PK+	1 MHz	0,05 s	0 dB
1 GHz - 10 GHz	281,25 kHz	PK+	100 kHz	1 s	0 dB