DEKRA Testing and Certification, S.A.U.
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C.I.F. A29507456

ISED CABid: ES1909
Lab. Company Number: 4621A

Test Report No:
81319RRF.001

Test Report
USA FCC Part 27
CANADA RSS-130

(*) Identification of item tested	LTE-M/NB-IoT Cellular communication module
(*) 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: LR8.2.1.0-61488
Applicant	SEQUANS COMMUNICATIONS 55 Boulevard Charles de Gaulle, 92700 Colombes, France
Test method requested, standard	USA FCC Part 27 (10-1-23 Edition). CANADA RSS-Gen Issue 5, April 2018, Amendment March 2019, Amendment February 2021. CANADA RSS-130 Issue 2 (2019). ANSI C63.26-2015. 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	2025-02-21
Report template No.	FDT08_24 (*) "Data provided by the client"

Tests conditions marked with "#" are
out of the scope of ENAC acreditation

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Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory accredited by the National Accreditation Body (ENAC - Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.
Test conditions marked with "#" are out of the scope of ENAC accreditation.

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.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification S.A.U. has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification S.A.U. at the time of performance of the test.

DEKRA Testing and Certification S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.
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General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
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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.DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

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
77734/001	Module	GM02SP	56H2349000129	18-03-2024

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
77734/001	Module	GM02SP	56H2349000129	18-03-2024
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]	Attached during test	Shielded	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:					
	☐	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			
	-		-	-			

Accessories (not part of the test item) ..... :	Description	Type	Manufacturer
	-	-	-
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)	2023-01-10
Date (finish)	2023-01-22

Document history

Report number	Date	Description
81319RRF.001	2025-02-21	First release.

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: Sergio Carrasco, Valentin Andarias.

Used instrumentation:

Control No.	Equipment	Model	Manufacturer	Next Calibration
6791	SEMIANECHOIC ABSORBER LINED	FACT 3 200 STP	ETS LINDGREN	N/A
6792	SHIELDED ROOM	S101	ETS LINDGREN	N/A
4578	Biconical/Log Antenna 30 MHz - 6 GHz	3142E	ETS LINDGREN	2026-06
4611	HORN ANTENNA 1-18 GHz	BBHA 9120 D	SCHWARZBECK	2026-01
7611	PREAMPLIFIER BOX	BLNA 0360-01N	BONN ELEKTRONIK	2025-01
5705	PRE-AMPLIFIER G>40dB 1-18 GHz	BLMA 0118-1M	BONN ELEKTRONIK	2025-07
04716	SIGNAL AND SPECTRUM ANALYZER 2Hz-50GHz	FSW50	ROHDE AND SCHWARZ	2026-08
9229	Wideband Radio Communication Tester	CMW500	ROHDE AND SCHWARZ	2025-10
7760	Digital Multimeter	175	FLUKE	2025-11
8002	TEMPERATURE CHAMBER MK56 BINDER	MK 56	BINDER	2025-01
5880	DC POWER SUPPLY 30V/5A	U8002A	KEYSIGHT TECHNOLOGIES	N/A
7794	SIGNAL AND SPECTRUM ANALYZER 10 Hz - 40 GHz	FSV40	ROHDE AND SCHWARZ	2025-04
6043	Power Divider DC-25 GHz	5333	TEKTRONIX	2025-07
7547	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2025-04
7548	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2025-04
6615	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2025-04
4848	SOFTWARE FOR EMC/RF TESTING	EMC32	ROHDE AND SCHWARZ	N/A

Testing verdicts

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

Summary

Appendix A: LTE Cat-M1 Band 85.

FCC PART 27 / RSS-130		
Requirement – Test case	**Verdict**	**Remark**
FCC 27.50 / RSS-130 4.6: RF Output Power	P	
FCC 2.1047 / RSS-130 4.2: Modulation Characteristics	P	
FCC 27.54 / RSS-130 4.5: Frequency Stability	P	
FCC 2.1049 / RSS-130 4.5: Occupied Bandwidth	P	
FCC 27.53 / RSS-130 4.7: Spurious Emissions at Antenna Terminals	P	
FCC 27.53 / RSS-130 4.7: Spurious Emissions at Antenna Terminals at Block Edges	P	
FCC 27.53 / RSS-130 4.7: Radiated Emissions	P	
Supplementary information and remarks: None.		

Appendix B: LTE Cat NB1 Band 85.

FCC PART 27 / RSS-130		
Requirement – Test case	**Verdict**	**Remark**
FCC 27.50 / RSS-130 4.6: RF Output Power	P	
FCC 2.1047 / RSS-130 4.2: Modulation Characteristics	P	
FCC 27.54 / RSS-130 4.5: Frequency Stability	P	
FCC 2.1049 / RSS-130 4.5: Occupied Bandwidth	P	
FCC 27.53 / RSS-130 4.7: Spurious Emissions at Antenna Terminals	P	
FCC 27.53 / RSS-130 4.7: Spurious Emissions at Antenna Terminals at Block Edges	P	
FCC 27.53 / RSS-130 4.7: Radiated Emissions	P	
Supplementary information and remarks: None.		

Appendix A: Test results for FCC 27 / RSS-130: LTE Cat-M1 Band 85

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TEST CONDITIONS

(*): Declared by the Applicant.

POWER SUPPLY (*):

Vnormal: 5 Vdc.
Vmin 2.2 Vdc
Vmax 5.5 Vdc
Type of Power Supply: External DC.

ANTENNA (*):

Band	Gain (dBi)	Type of Antenna
85	0.17	External (OmniLOG_90200)
	1.1	Internal (FR01-S4-210)

Pre-scan determines that internal antenna is worst case.

TEST FREQUENCIES:

LTE Cat-M1 Band 85. QPSK and 16QAM modulations:

	Channel (Frequency)	
	BW = 5 MHz	BW = 10 MHz
Low	134027 (700.5)	134052 (703.0)
Middle	134092 (707)	134092 (707)
High	134157 (713.5)	134132 (711.0)

RF Output Power

Limits

LTE Cat-M1 Band 85. FCC §27.50 (c) (10) / RSS-130 Clause 4.6.

FCC §27.50 (c) (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 Clause 4.6:

> 4.6.1 General
>
> The transmitter output power shall be measured in terms of average power. In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the High PAPR during periods of continuous transmission.
>
> 4.6.3 Frequency bands 698-756 MHz and 777-787 MHz
>
> The e.r.p. shall not exceed 30 watts for mobile equipment and outdoor fixed subscriber equipment. The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment.

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).

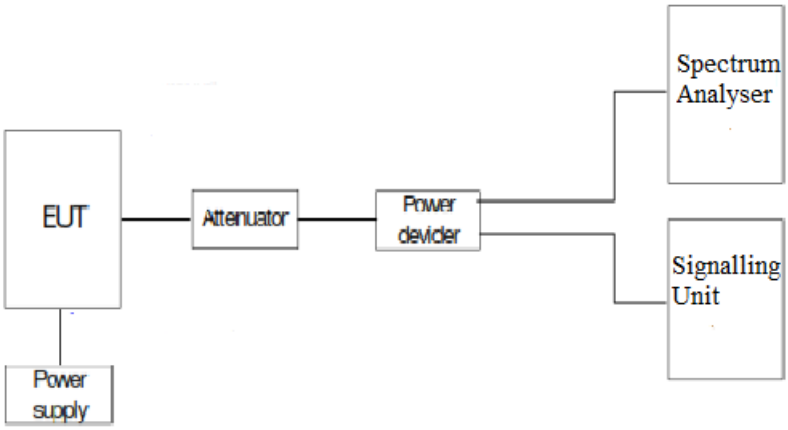
The maximum effective radiated power e.r.p. is calculated from the maximum equivalent isotropically radiated power (e.i.r.p.) by subtracting 2.15 dB:

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

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 85:

Worst-case of RF Power is BW=5 MHz, Low Channel, 16QAM, RB Size=1, RB Offset=5

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)
5	Low 134027	700,5	QPSK	1	0	23,48
				1	2	23,43
				1	5	23,53
				3	0	22,58
				3	1	22,56
				3	3	22,61
				6	0	22,58
			16-QAM	1	0	23,55
				1	2	23,51
				1	5	**23,58**
				3	0	23,19
				3	1	23,19
				3	3	23,27
				5	0	22,77
	Middle 134092	707	QPSK	1	0	23,5
				1	2	23,43
				1	5	23,55
				3	0	22,59
				3	1	22,61
				3	3	22,62
				6	0	22,58
			16-QAM	1	0	23,49
				1	2	23,38
				1	5	23,49
				3	0	22,51
				3	1	22,5
				3	3	22,55
				5	0	21,54
	High 134157	713,5	QPSK	1	0	23,46
				1	2	23,41
				1	5	23,5
				3	0	22,55
				3	1	22,53
				3	3	22,58
				6	0	22,53
			16-QAM	1	0	23,33
				1	2	23,23
				1	5	23,35
				3	0	22,44
				3	1	22,41
				3	3	22,45
				5	0	21,53

BW=5 MHz. 16QAM:

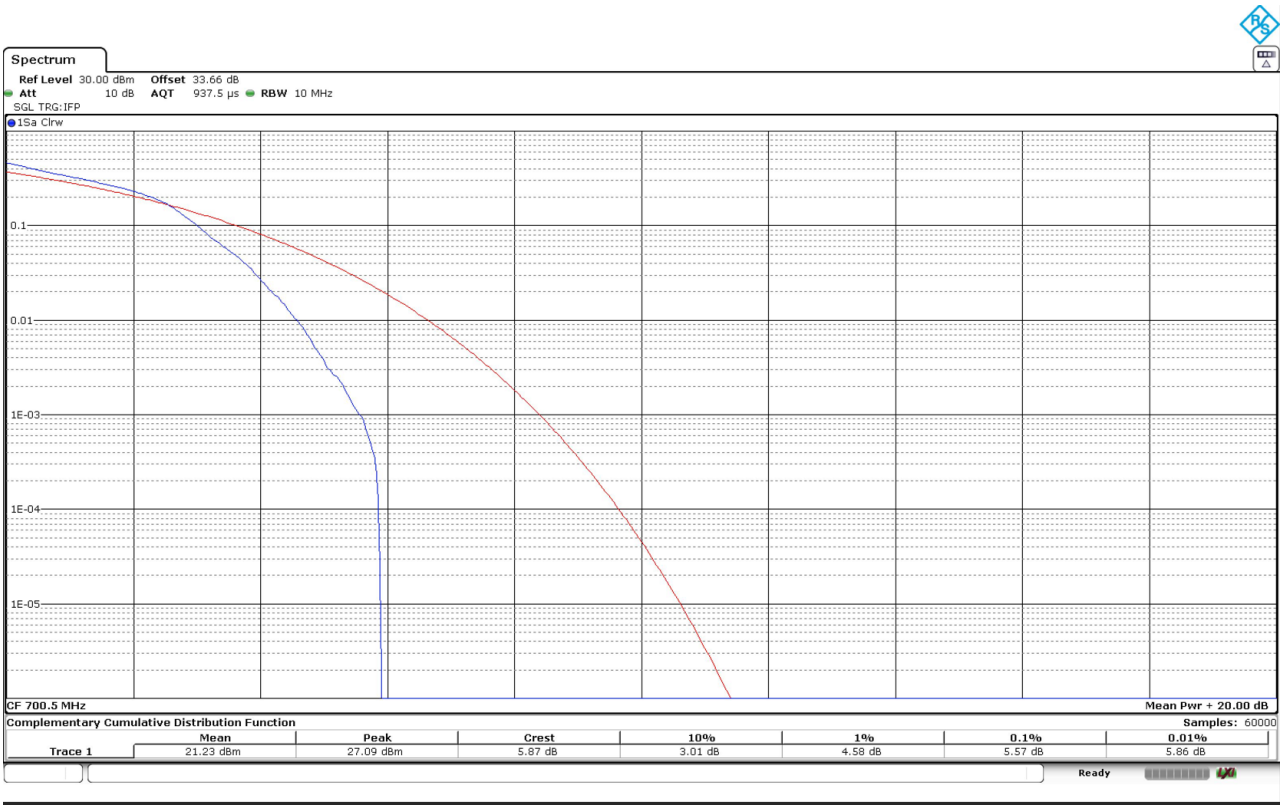
MAX POWER	16QAM COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP(dBm)
LOW	23.58	1.1	24.68
MIDDLE	23.55	1.1	24.65
HIGH	23.5	1.1	24.6
MAX:	23.58		24.68

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

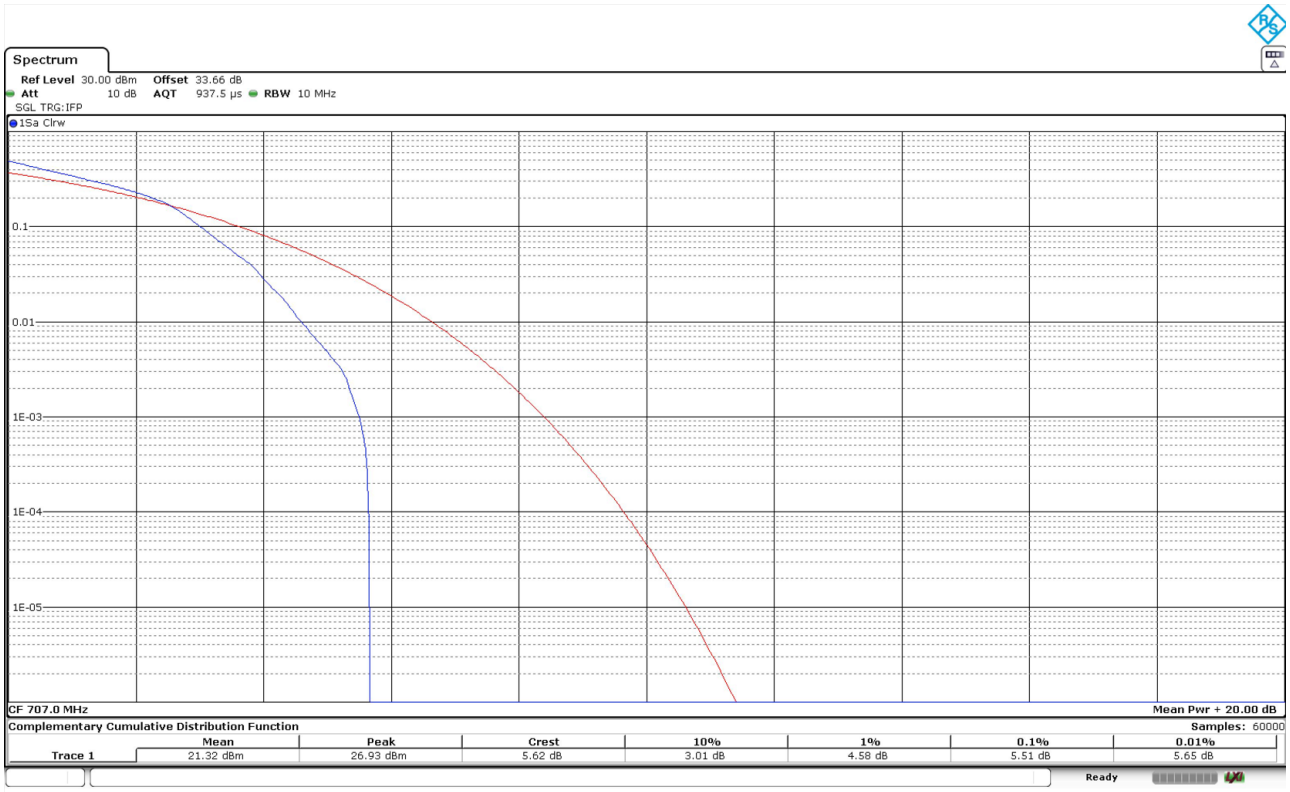
LTE Cat-M1 Band 85:

Worst-case of PAPR is BW=5 MHz, Low Channel, 16QAM, RB Size=5, RB Offset=0

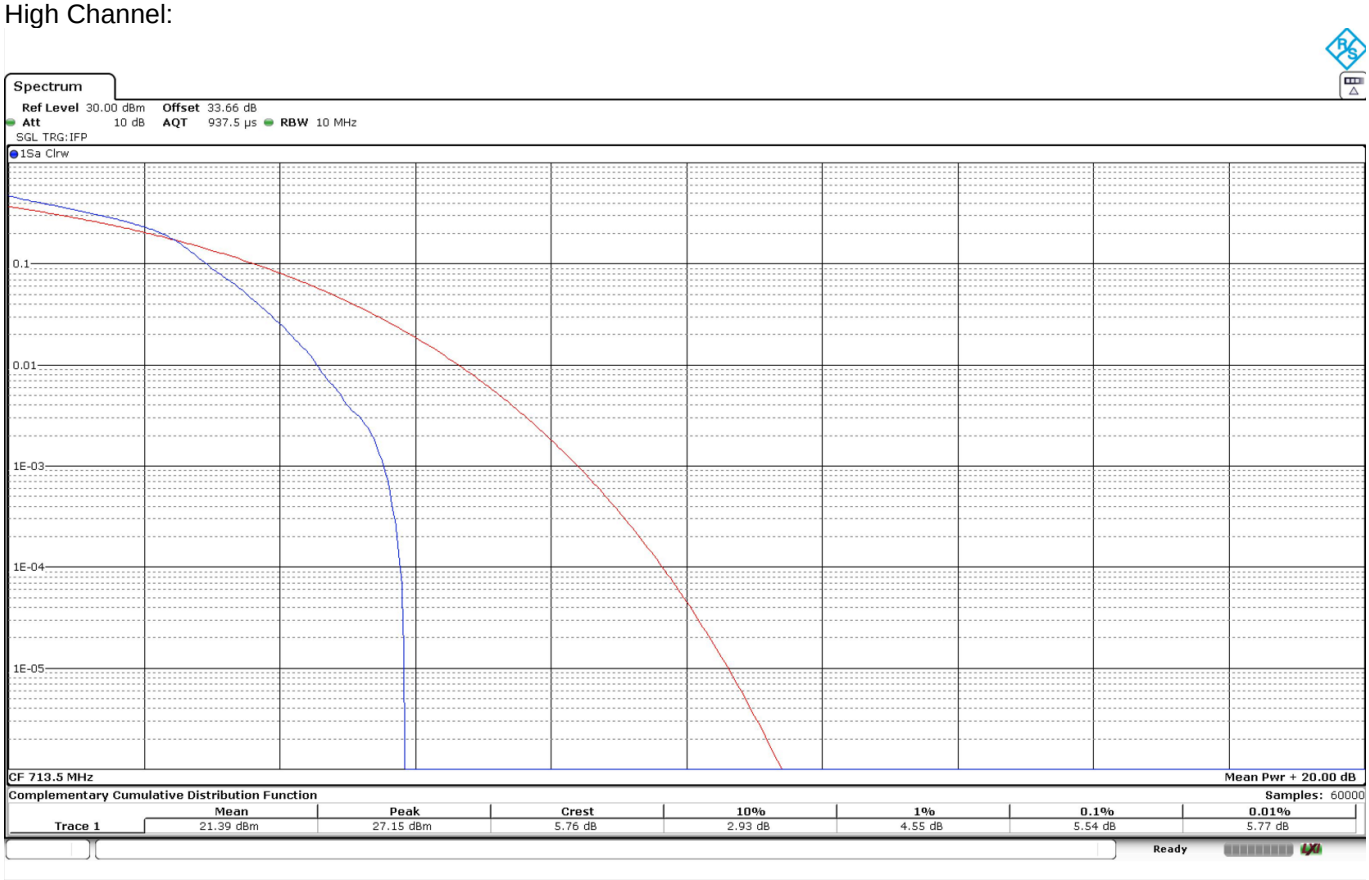
Low Channel:



Middle Channel:



High Channel:



16QAM	Low	Middle	High
PAPR (dB)	5.57	5.51	5.54

Verdict

Pass

Frequency Stability

Limits

* FCC §27.54 & §2.1055. The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

* RSS-130, Clause 4.5. The frequency stability shall be sufficient to ensure that the occupied bandwidth remains within each frequency block range when tested at the temperature and supply voltage variations specified in RSS-Gen.

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.

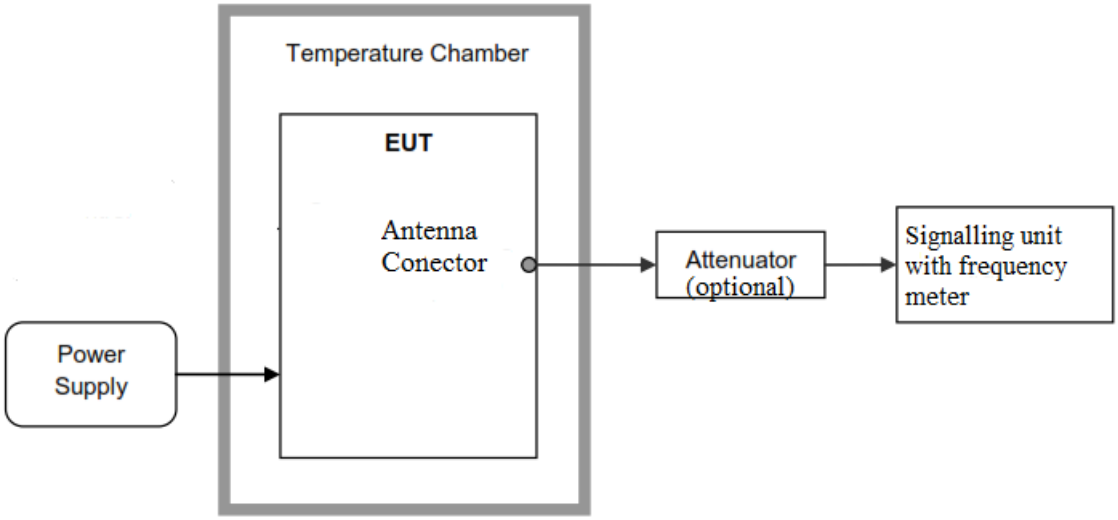
The EUT was set in “Radio Resource Control (RRC) mode” on the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter.
The worst case LTE mode for conducted power was used for the test.

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.

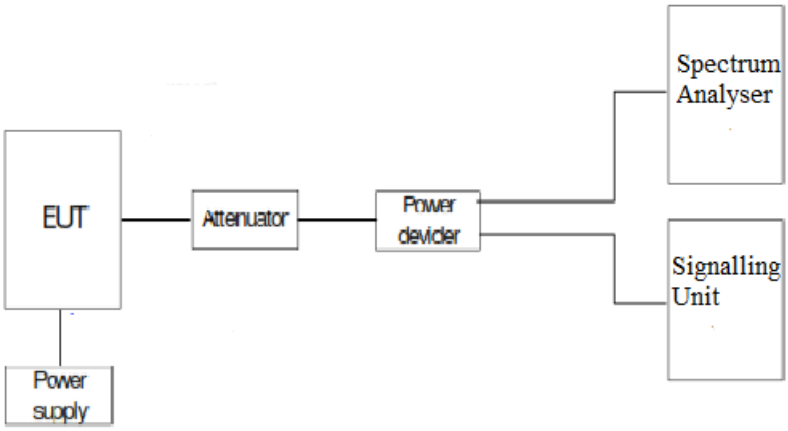
The reference point measurements were made at the RF output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

Test Setup

Frequency tolerance:



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



Results

1. FREQUENCY TOLERANCE:

- **Frequency stability over temperature variations:**

LTE Cat-M1 Band 85:

The worst case modulation in terms of Frequency Stability is BW=5 MHz, QPSK.

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)
+85 [#]	11,84	0,016746818
+80 [#]	-5,23	-0,007397454
+70 [#]	-24,01	-0,033960396
+60 [#]	-11,35	-0,016053748
+50	6,8	0,009618105
+40	-4,2	-0,005940594
+30	8,3	0,011739745
+20	-5,64	-0,007977369
+10	5,8	0,008203678
0	7,5	0,010608204
-10	-6,66	-0,009420085
-20	5,87	0,008302687
-30	8,2	0,011598303
-40 [#]	7,53	0,010650636

Test conditions marked with "#" are out of the scope of ENAC accreditation

Frequency stability over voltage variations:

LTE Cat-M1 Band 85:

The worst case modulation in terms of Frequency Stability is BW=5 MHz, QPSK.

Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	5,75	-15,76	-0,022291372
Vmin	2,2	-16,7	-0,023620934

2. REFERENCE FREQUENCY POINTS fL AND fH:

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

LTE Cat-M1 Band 85: BW=5 MHz. QPSK.

*f*L (MHz)	698,120876
*f*H (MHz)	715,893624

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

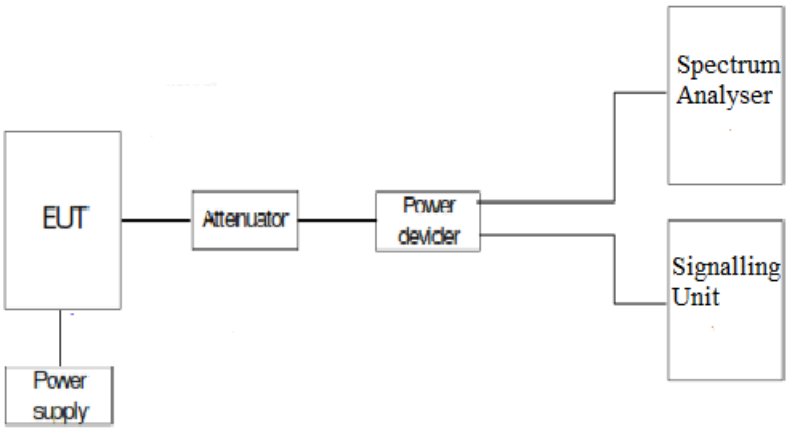
FCC §2.1047.

RSS-130, Clause 4.2: Equipment certified under this standard shall employ digital modulation.

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

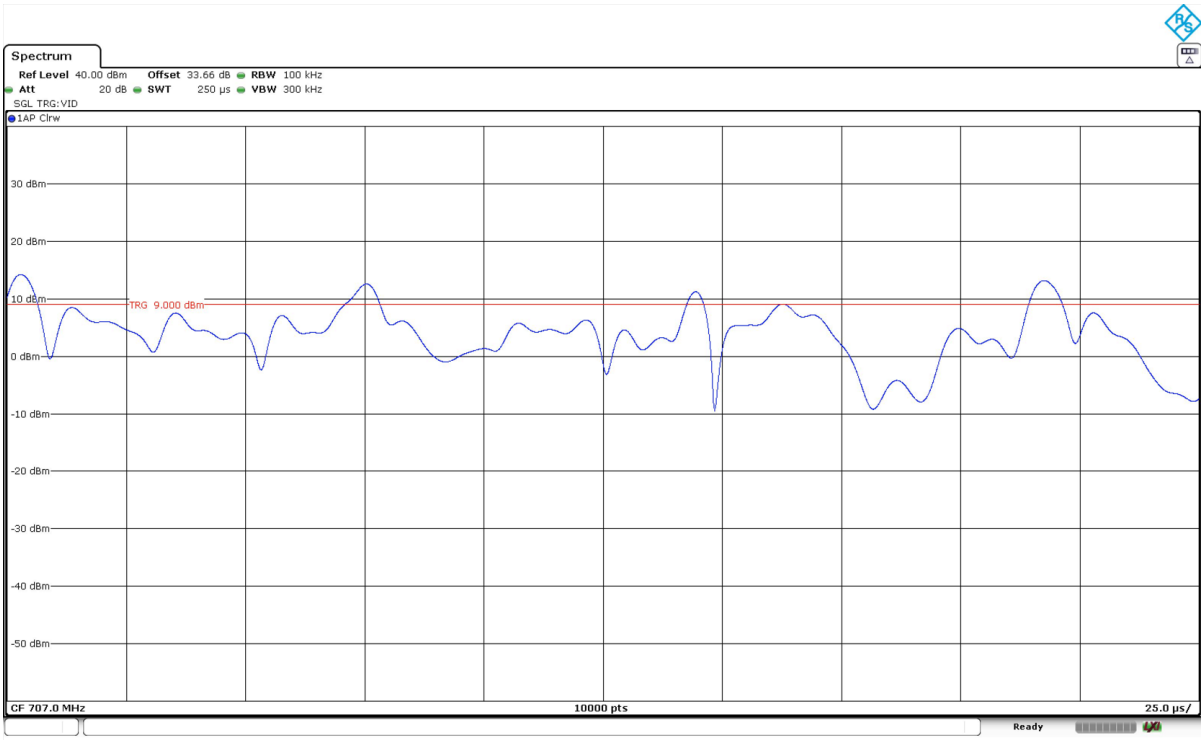


Results

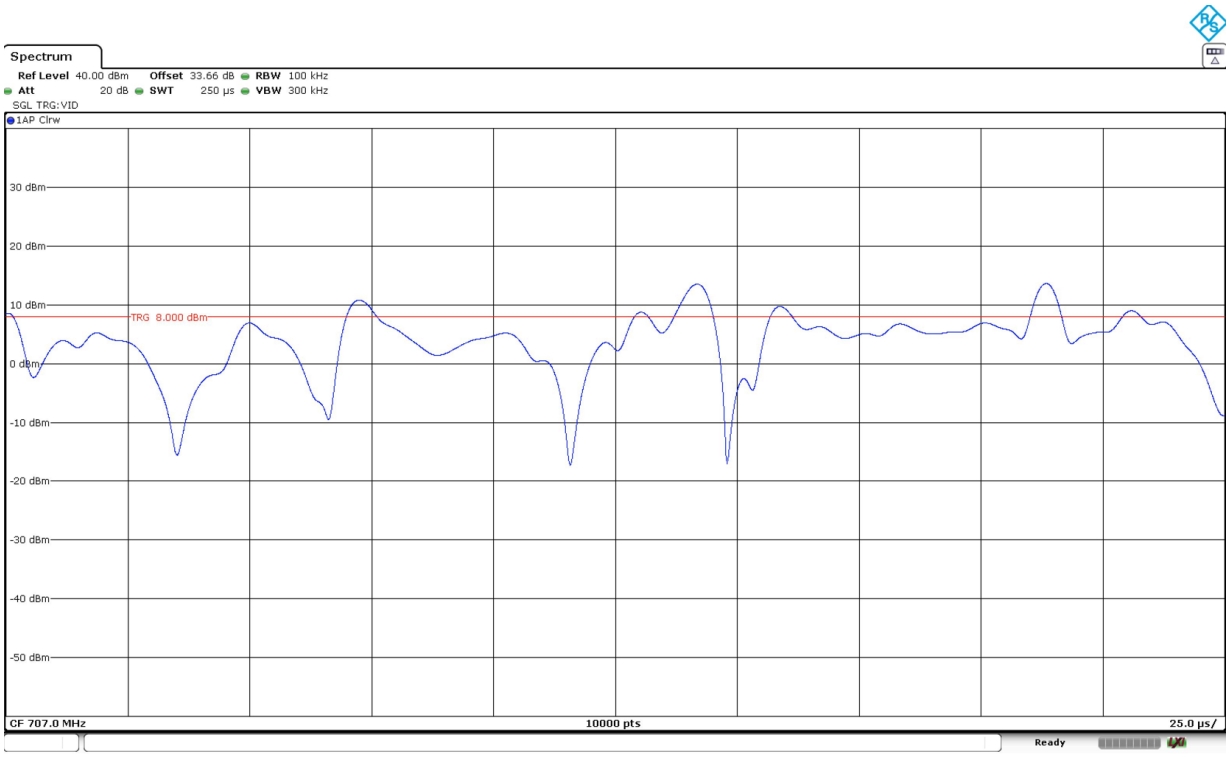
The following plots show the modulation schemes in the EUT.

<u>LTE Cat-M1 Band 85</u>:

QPSK. BW=5 MHz.



16QAM. BW=5 MHz.



Occupied Bandwidth

Limits

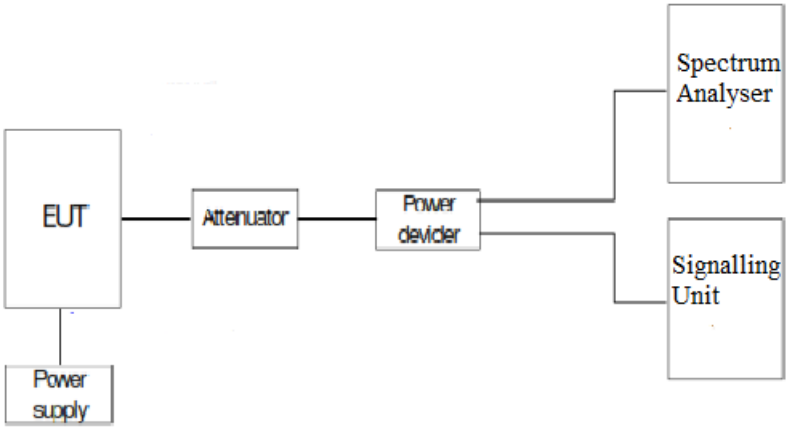
FCC §2.1049: Measurements required: Occupied bandwidth.

RSS-Gen, Clause 6.7.

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 all Resource Blocks (RB) offset 0 regardless either the Narrow Band or the Bandwidth selected.

LTE Cat-M1 Band 85:

LTE Cat-M1 Band 85. BW=5 MHz. QPSK. RB max.

Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	1,086	1,086	1,095
-26 dBc Bandwidth (MHz)	1,407	1,362	1,378
Measurement uncertainty (kHz)	<±3.75		

LTE Cat-M1 Band 85. BW=5 MHz. 16QAM. RB max.

Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	0,919	0,923	0,928
-26 dBc Bandwidth (MHz)	1,307	1,053	1,322
Measurement uncertainty (kHz)	<±3.75		

LTE Cat-M1 Band 85. BW=10 MHz. QPSK. RB max.

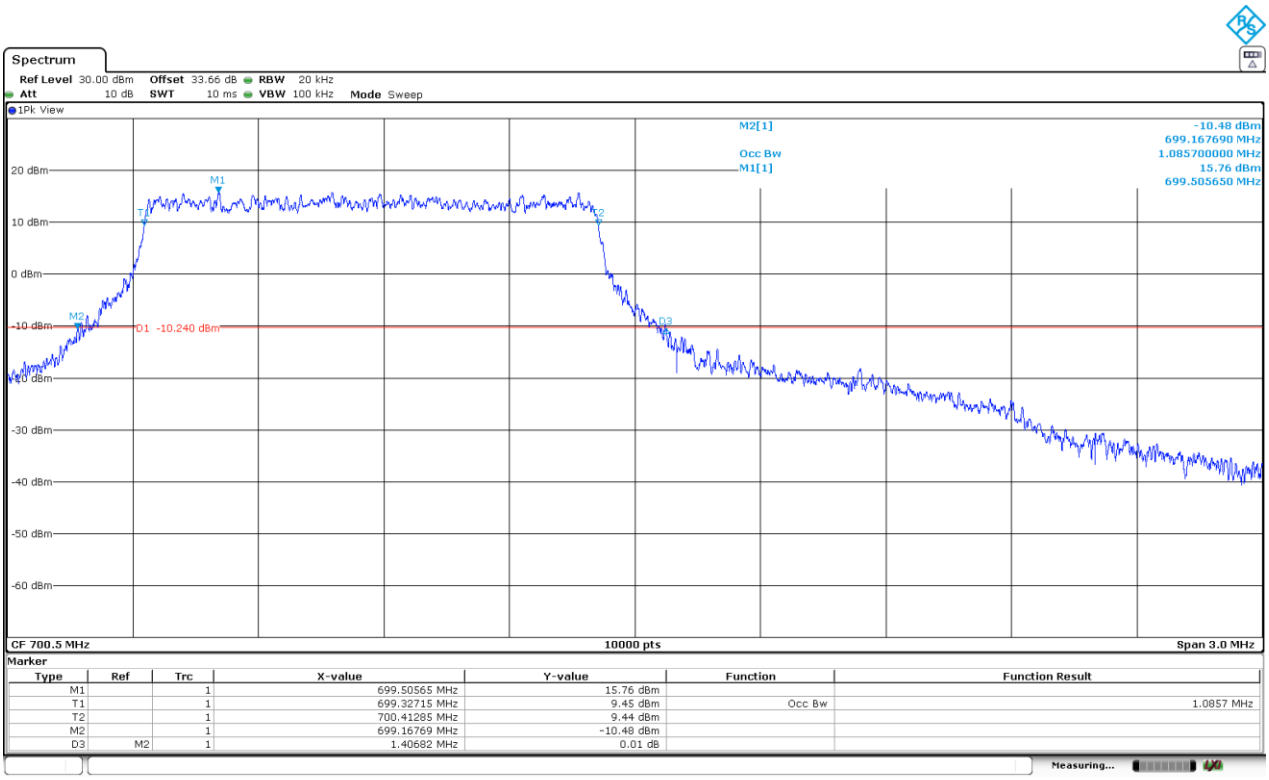
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	*1,091*	*1,093*	*1,090*
-26 dBc Bandwidth (MHz)	*1,353*	*1,397*	*1,346*
Measurement uncertainty (kHz)	<±3.75		

LTE Cat-M1 Band 85. BW=10 MHz. 16QAM. RB max.

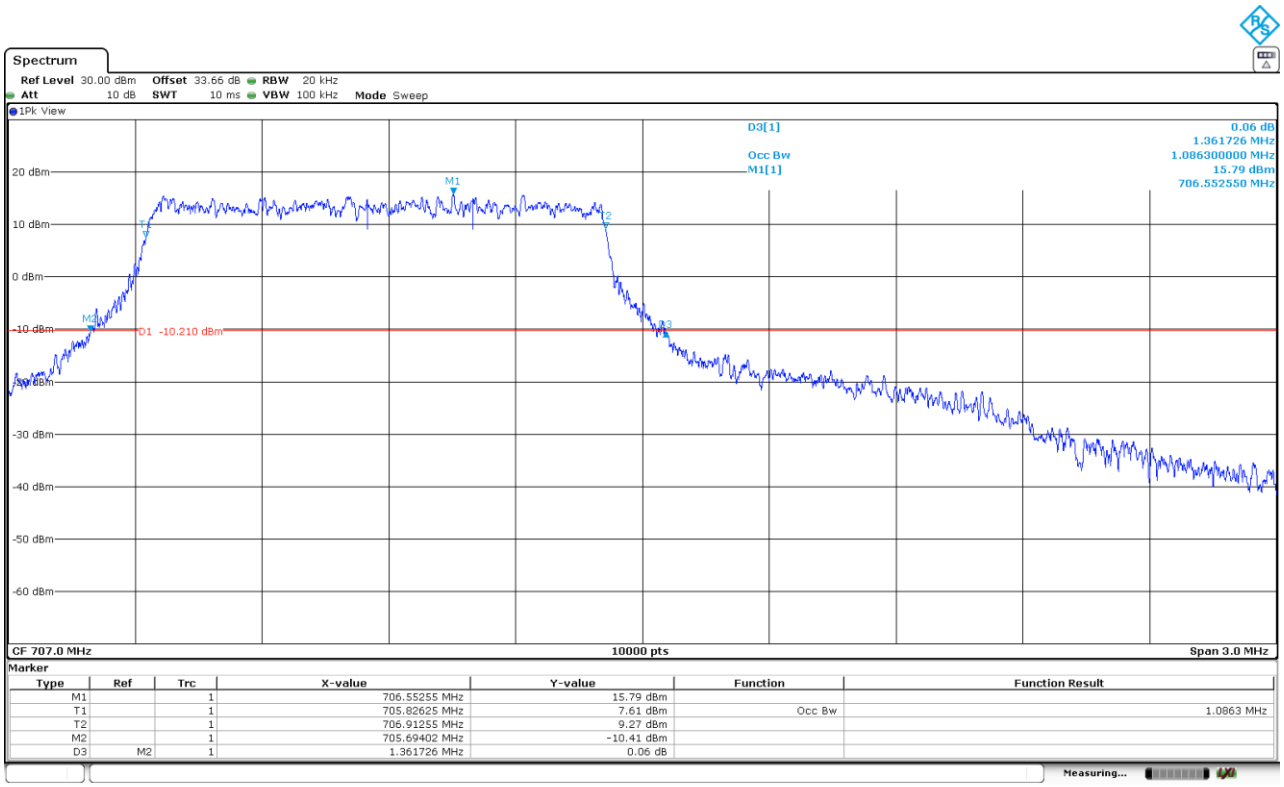
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	*0,935*	*0,924*	*0,931*
-26 dBc Bandwidth (MHz)	*1,308*	*1,277*	*1,365*
Measurement uncertainty (kHz)	<±3.75		

LTE Cat-M1 Band 85. BW=5 MHz. QPSK. RB max.

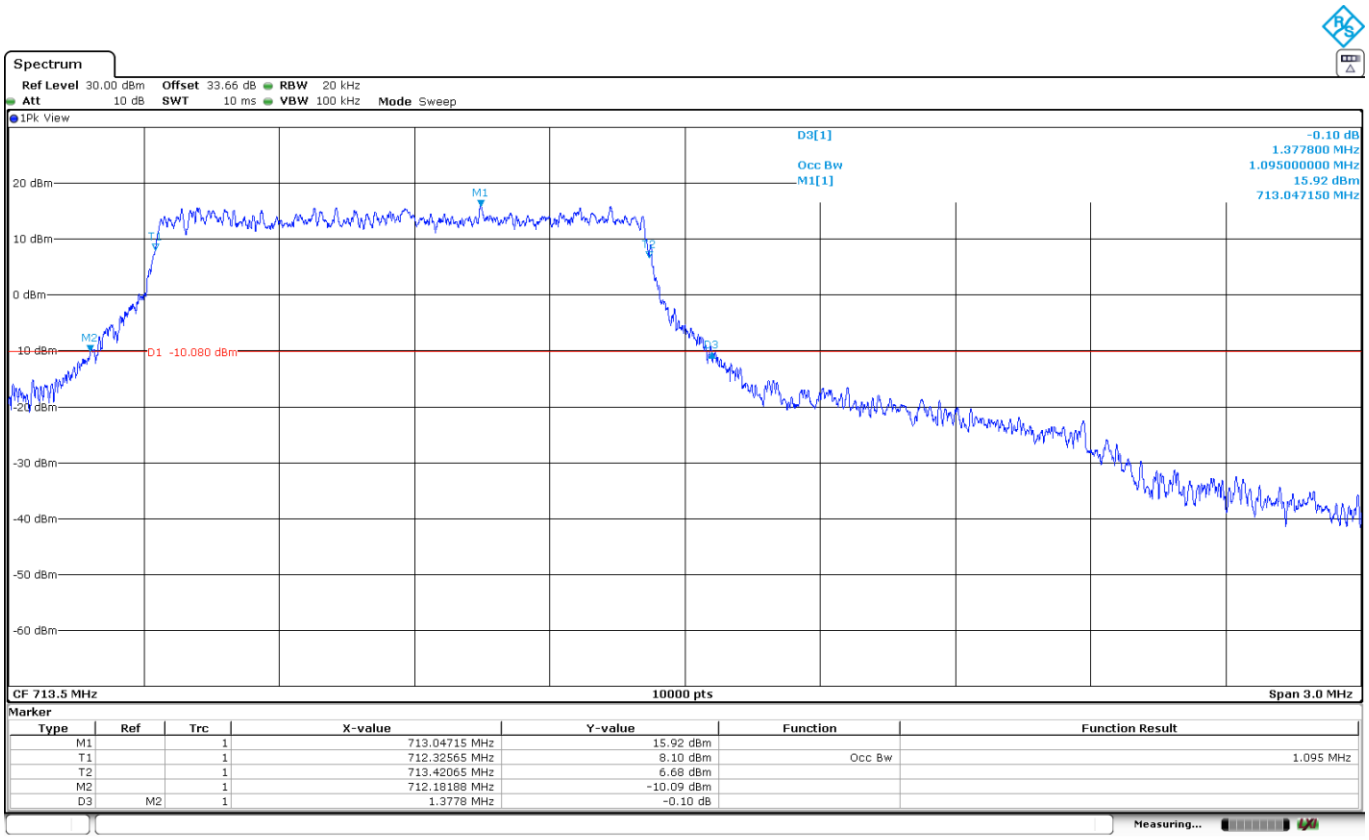
Low Channel:



Middle Channel:

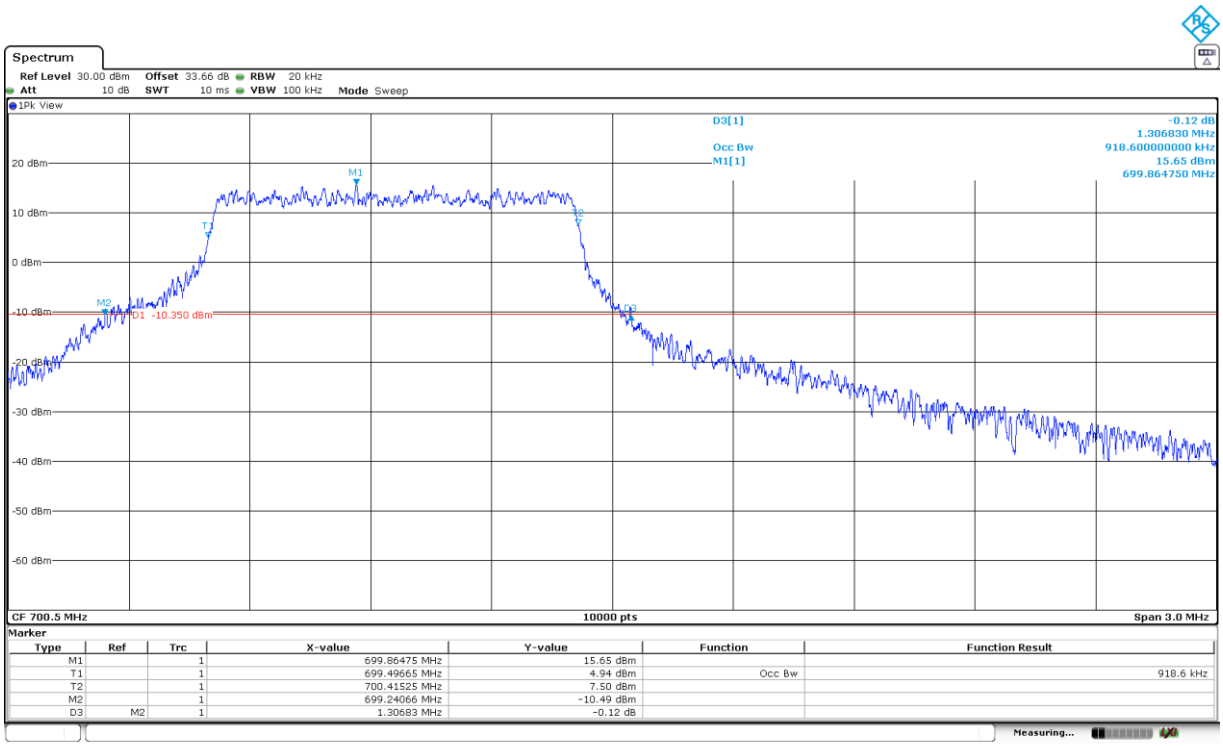


High Channel:

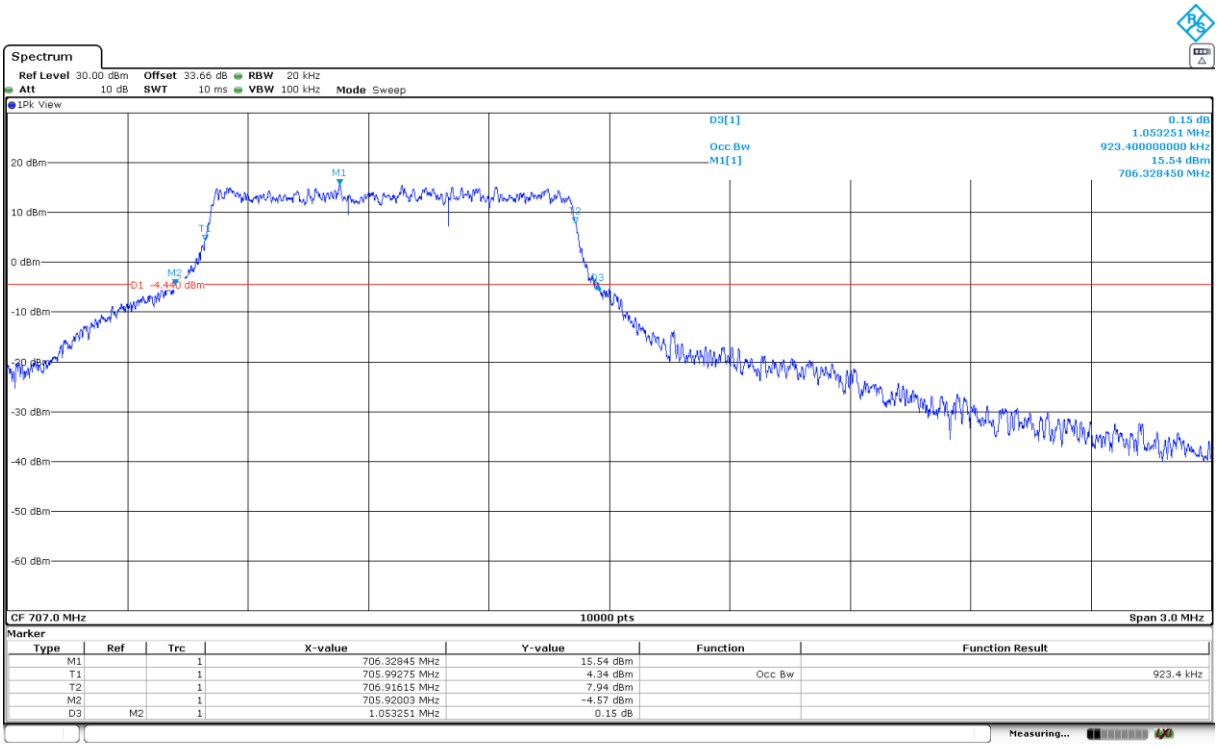


LTE Cat-M1 Band 85. BW=5 MHz. 16QAM. RB max.

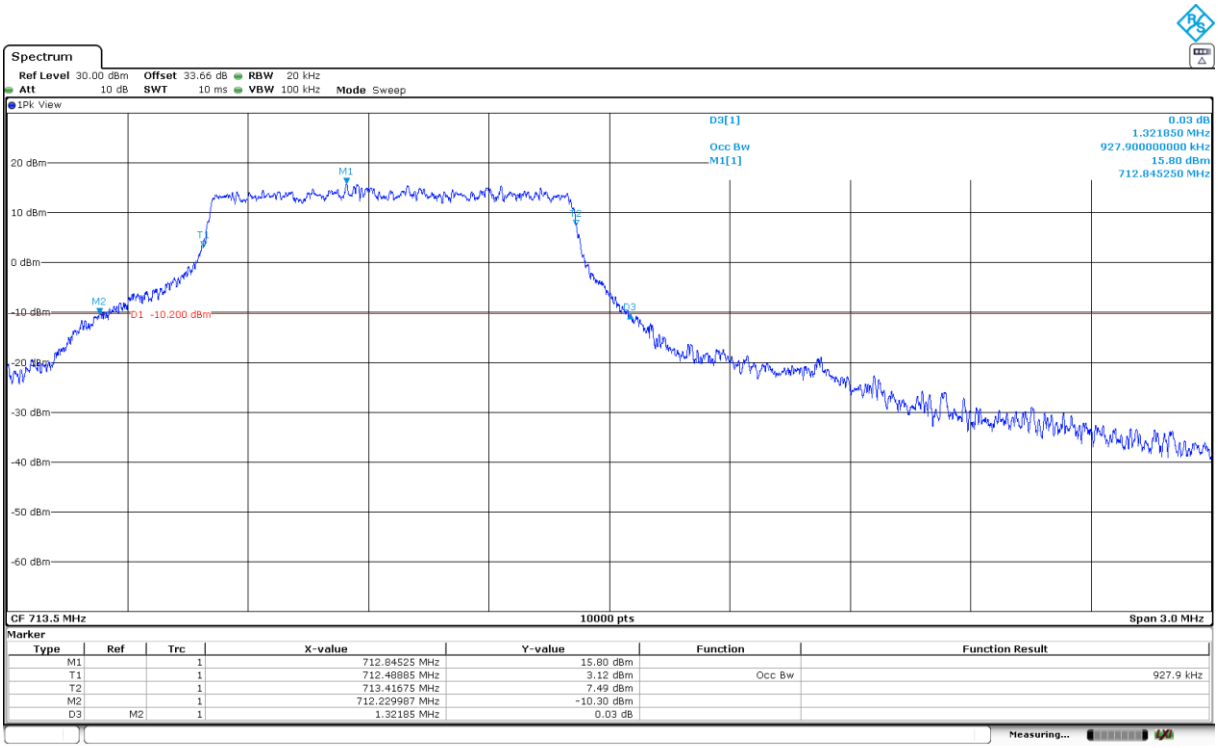
Low Channel:



Middle Channel:

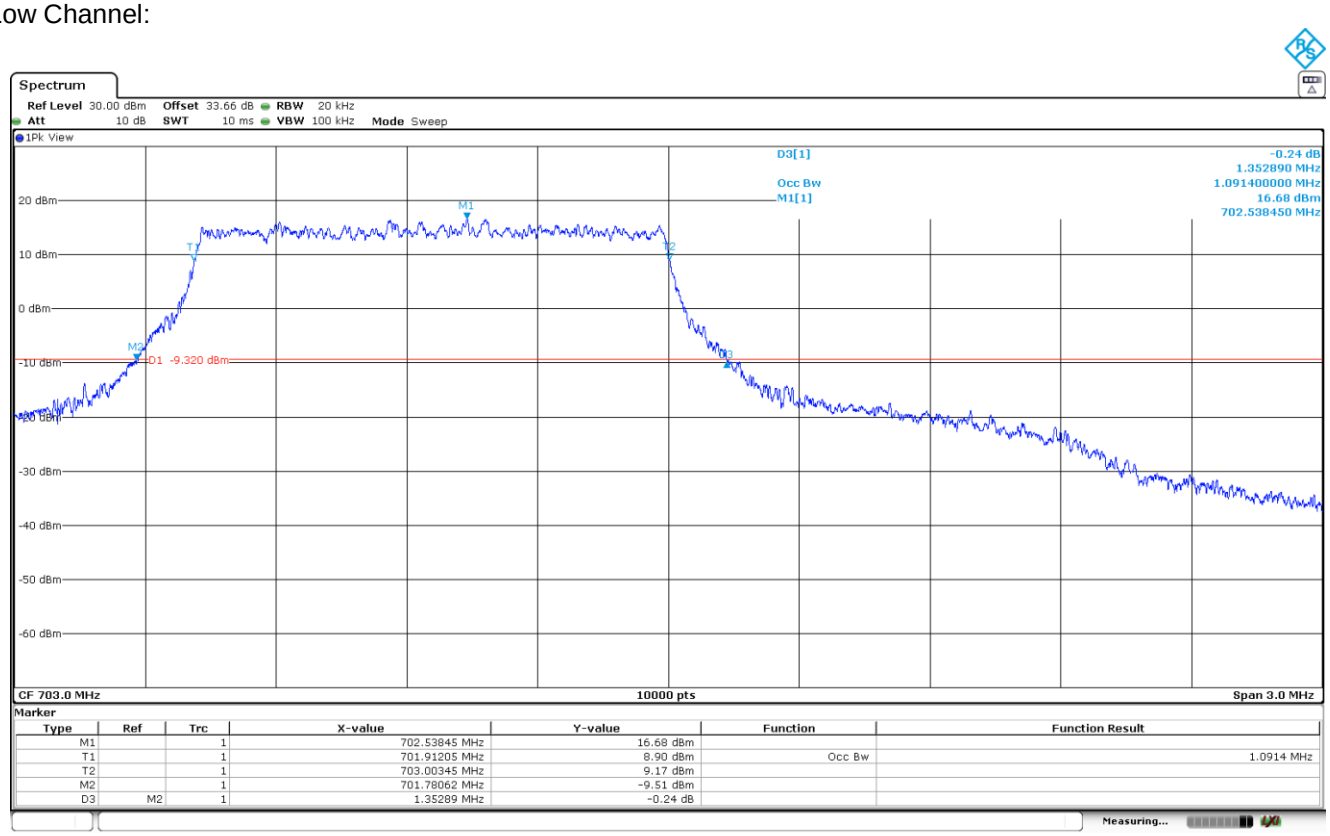


High Channel:

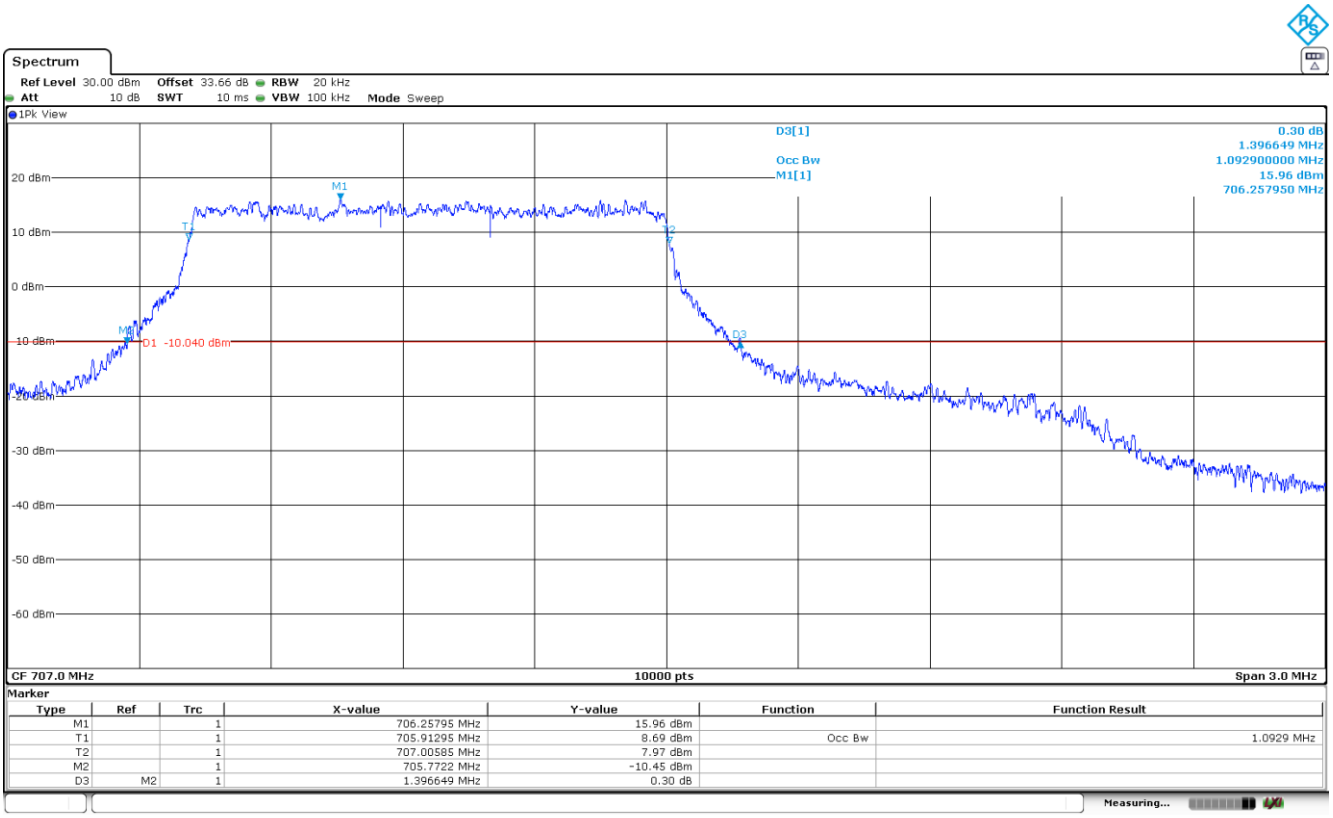


LTE Cat-M1 Band 85. BW=10 MHz. QPSK. RB max.

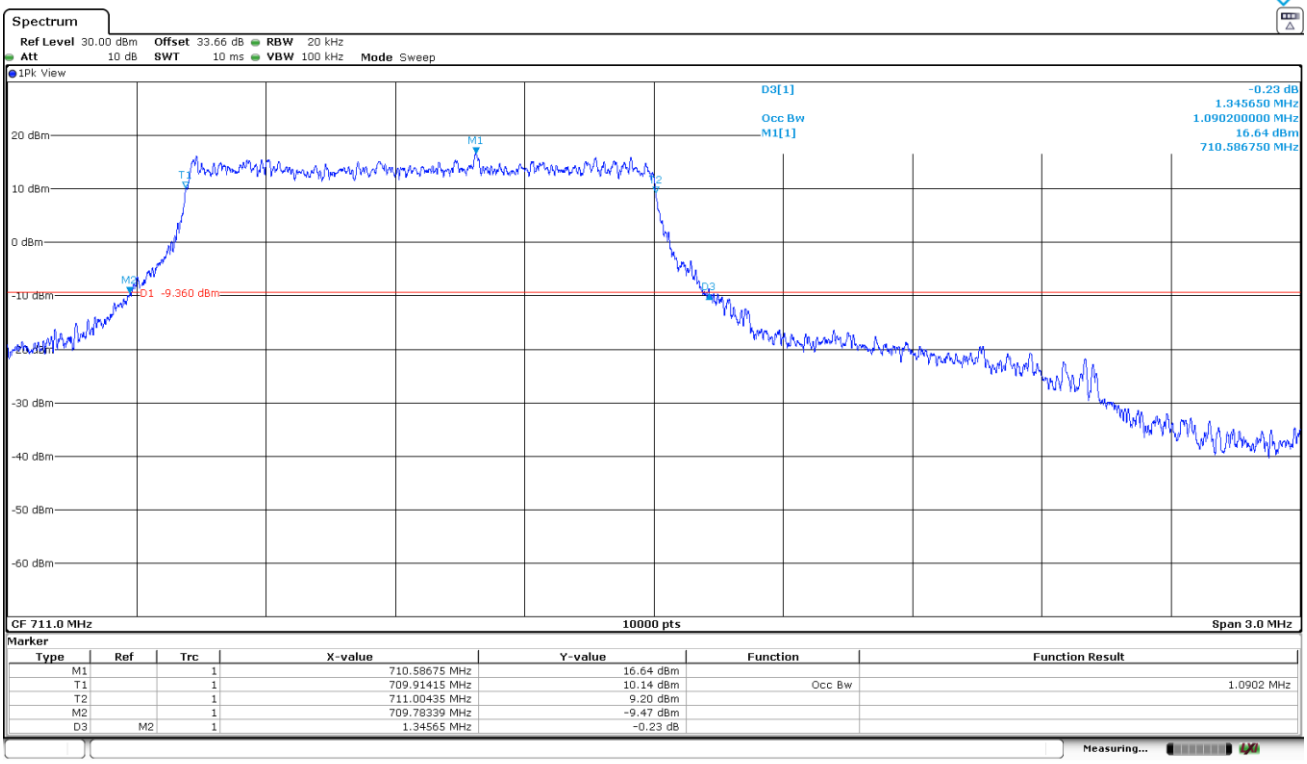
Low Channel:



Middle Channel:

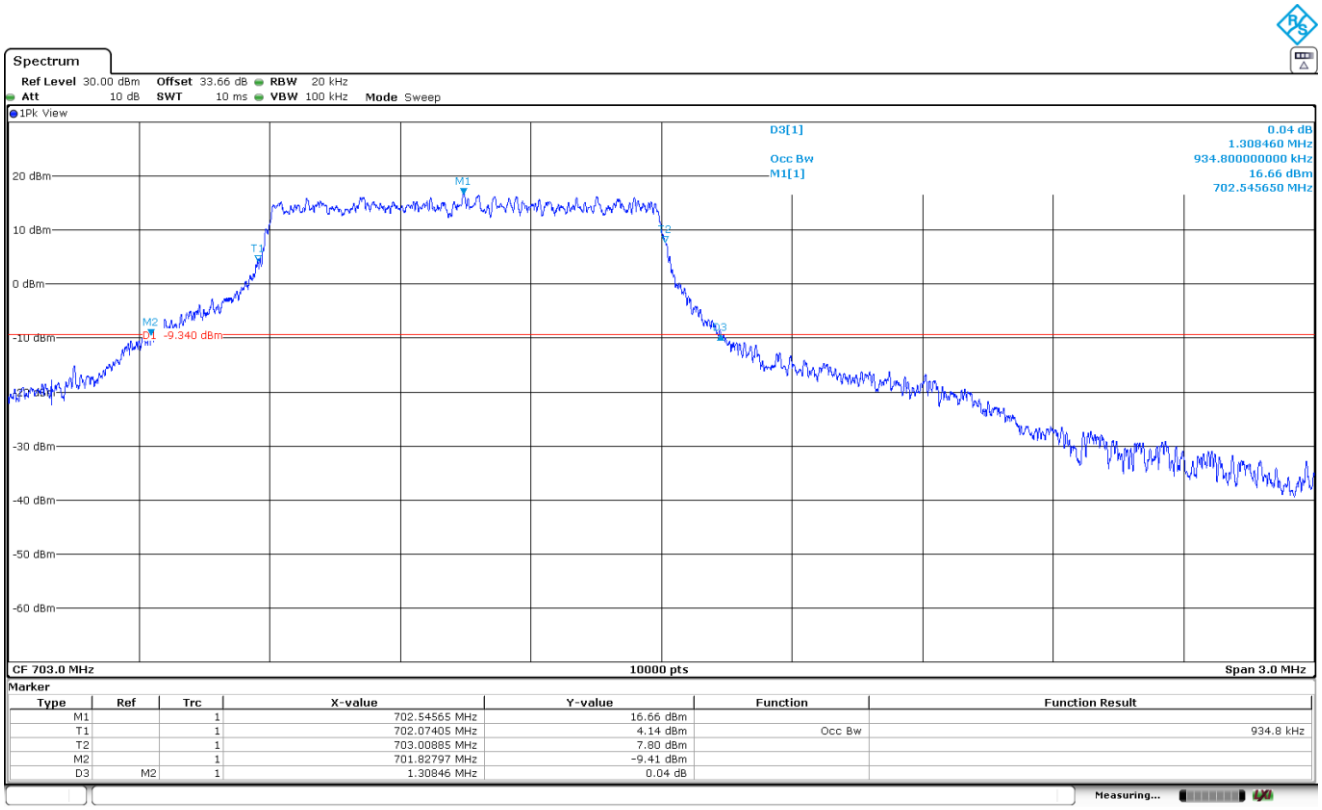


High Channel:

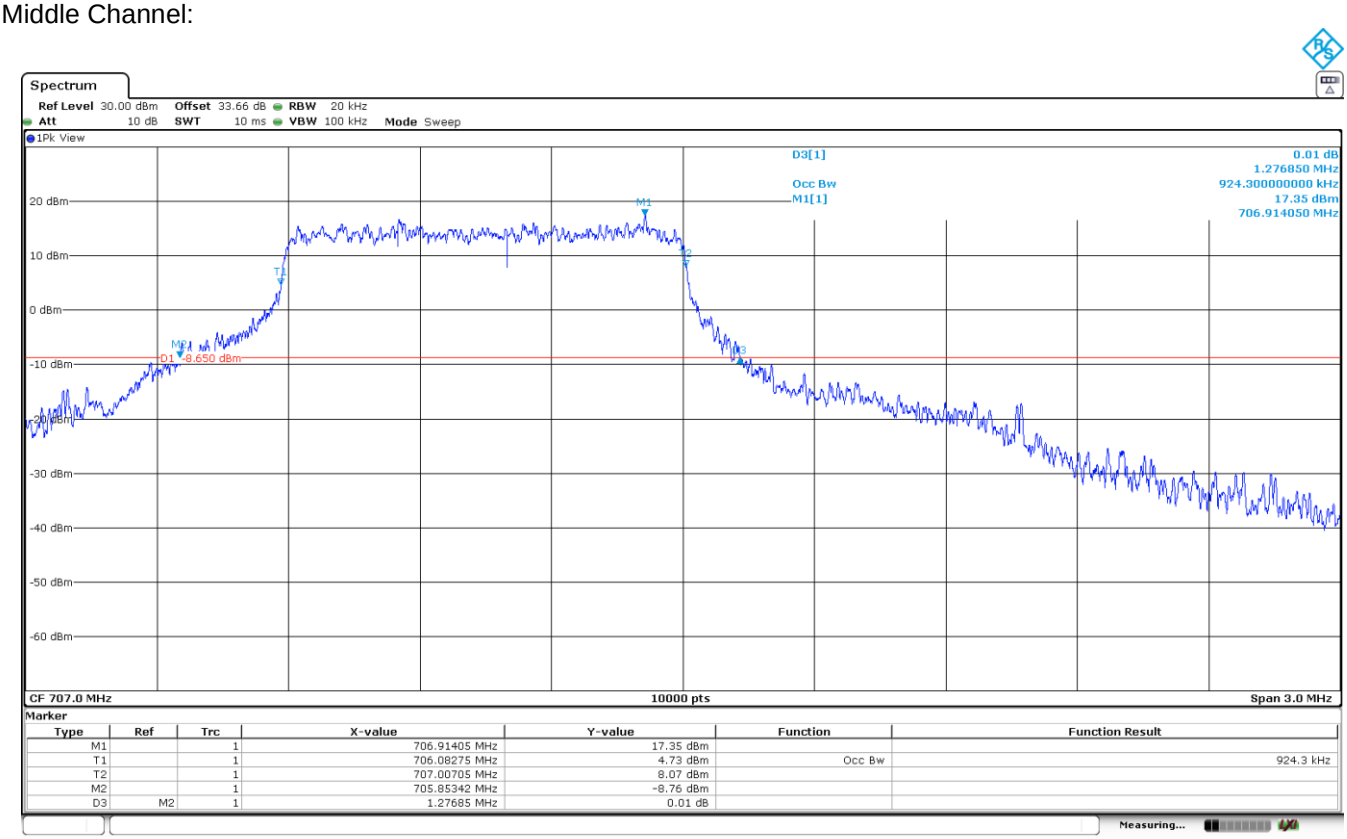

Spectrum
Ref Level 30.00 dBm Offset 33.66 dB RBW 20 kHz
Att 10 dB SWT 10 ms VBW 100 kHz Mode Sweep
1Pk View
D3[1]
-0.23 dB
1.345650 MHz
Occ Bw
1.090200000 MHz
M1[1]
16.64 dBm
710.586750 MHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
M1
T1
T2
M2
D1 -9.360 dBm
D3
CF 711.0 MHz
10000 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 710.58675 MHz 16.64 dBm
T1 1 709.91415 MHz 10.14 dBm Occ Bw 1.0902 MHz
T2 1 711.00435 MHz 9.20 dBm
M2 1 709.78339 MHz -9.47 dBm
D3 M2 1 1.34565 MHz -0.23 dB
Measuring...

LTE Cat-M1 Band 85. BW=10 MHz. 16QAM. RB max.

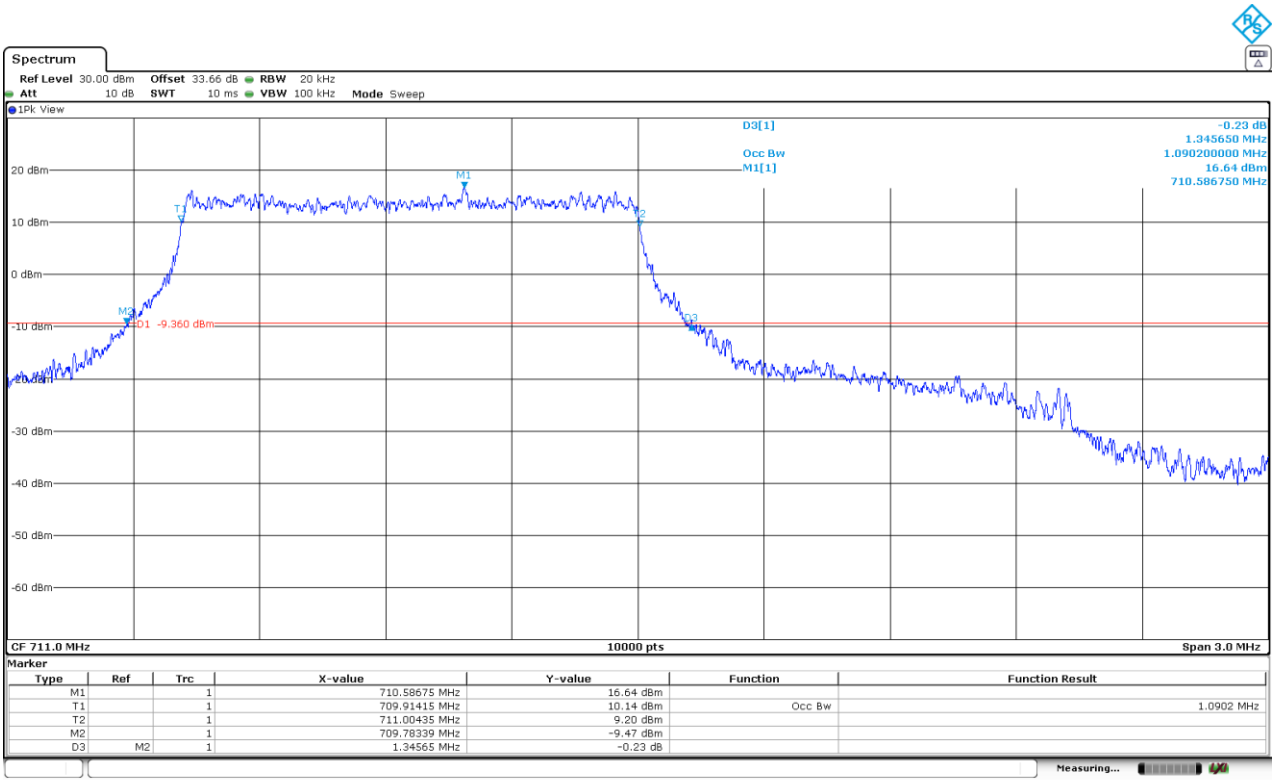
Low Channel:



Middle Channel:



High Channel:



Spurious Emissions at Antenna Terminals

Limits

LTE Cat-M1 Band 85.

FCC §27.53 (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.

RSS-130, Clause 4.7.1:

> 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.

At Po transmitting power, the specified minimum attenuation becomes 43+10 log (Po), and the level in dBm relative to Po becomes:

Po (dBm) – [43 + 10 log (Po in mW) - 30] = -13 dBm

At Po transmitting power, the specified minimum attenuation becomes 65+10 log (Po), and the level in dBm relative to Po becomes:

Po (dBm) – [65 + 10 log (Po in mW) - 30] = -35 dBm

Method

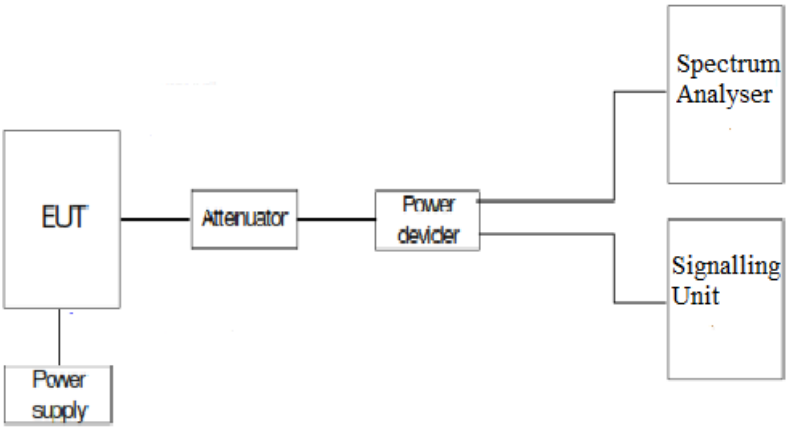
The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50-Ohm attenuator and a power divider.

The spectrum was investigated from 9 kHz to 10 GHz for LTE Cat M1 Band 85 and from 9 kHz to 20 GHz for LTE Cat M1 Band 66.

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


EUT
Attenuator
Power devider
Spectrum Analyser
Signalling Unit
Power supply

Results

<u>LTE Cat-M1 Band 85</u>: BW=5 MHz. 16QAM. RB Size 1, RB Offset 5.

- Low Channel: No spurious frequencies at less than 20 dB below the limit.
- Middle Channel: No spurious frequencies at less than 20 dB below the limit.
- High Channel: No spurious frequencies at less than 20 dB below the limit

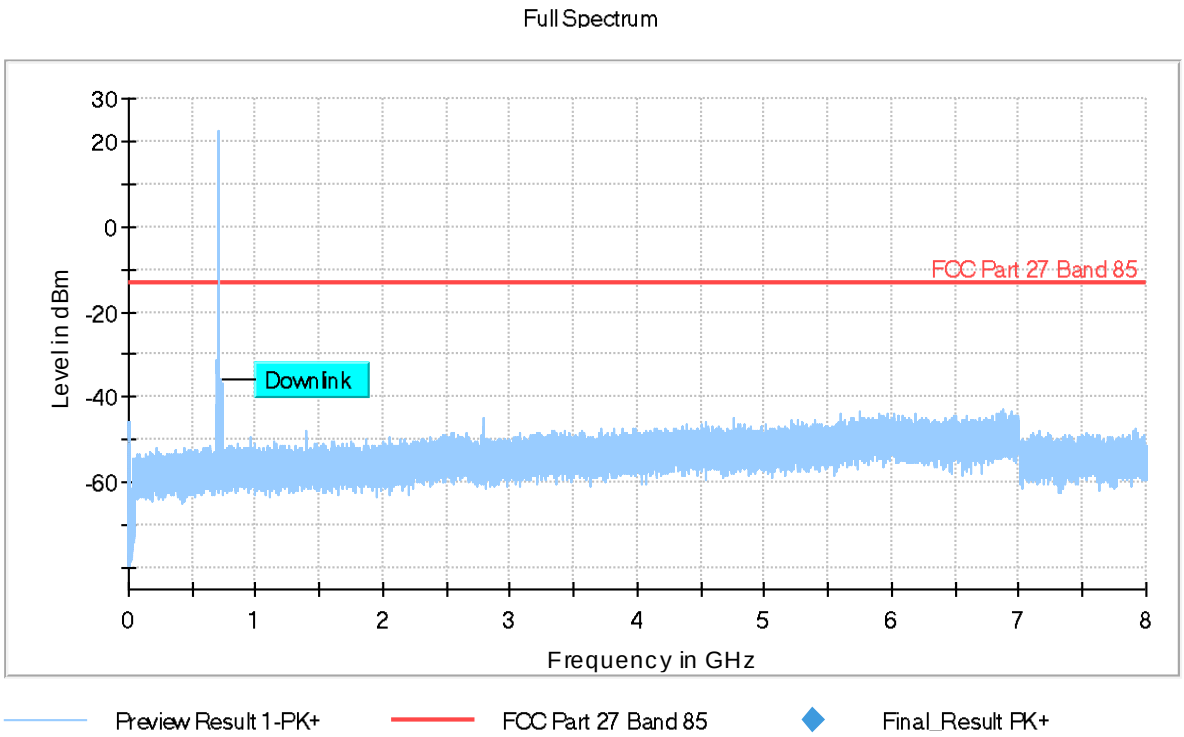
Measurement uncertainty (dB): <±2.76

Verdict

PASS

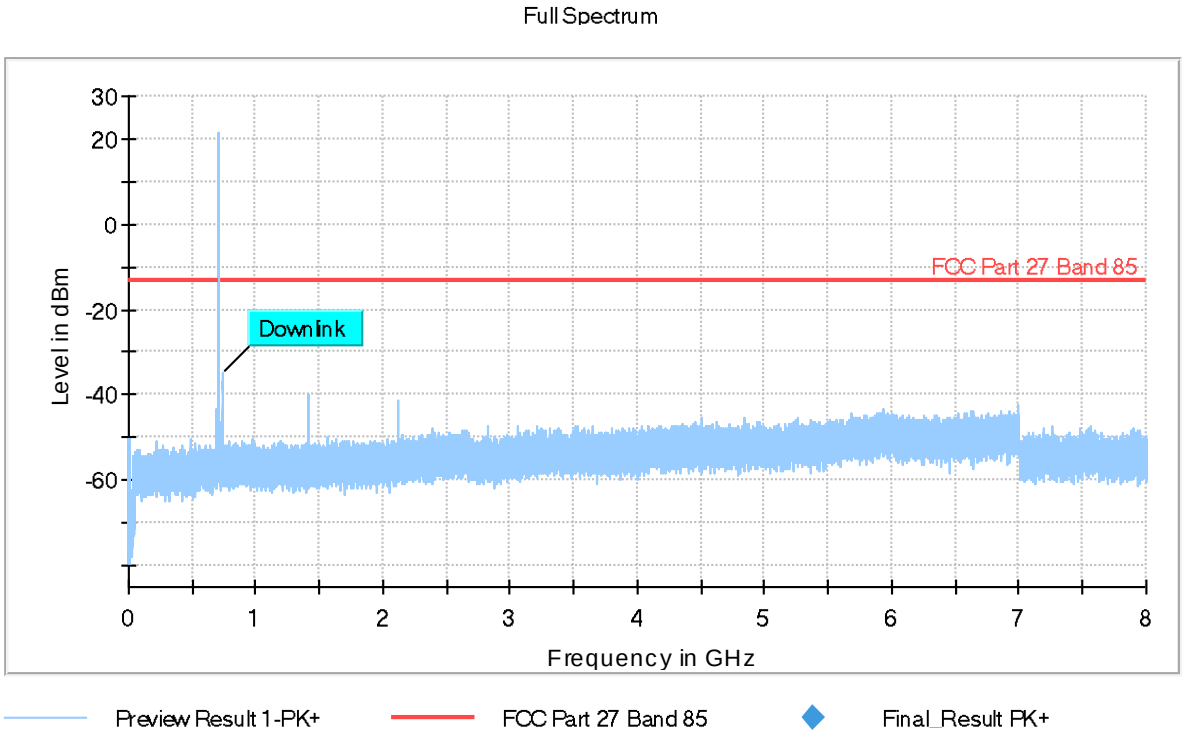
<u>LTE Cat-M1 Band 85</u>. BW=5 MHz. 16QAM. RB Size 1. RB Offset 5.

Low Channel:



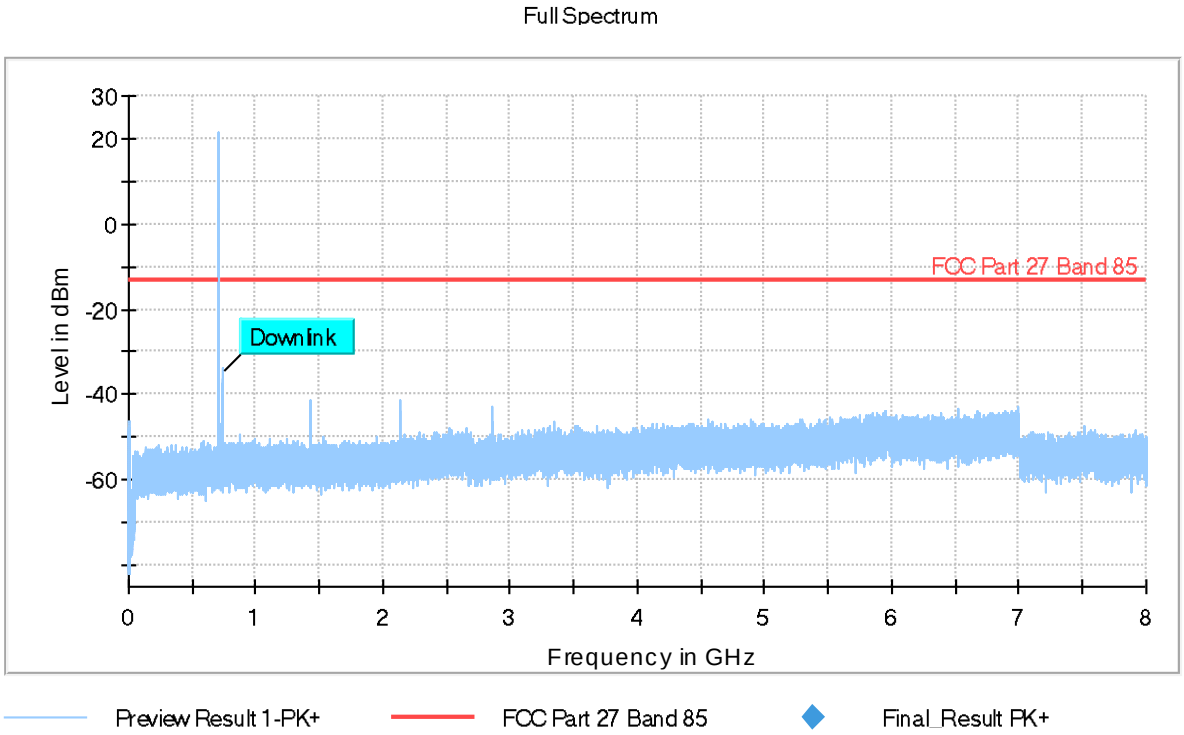
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

High Channel:



The peak above the limit is the carrier frequency.

Spurious Emissions at Antenna Terminals at Block Edges

Limits

LTE Cat-M1 Band 85.

FCC §27.53 (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.

RSS-130, Clause 4.7.1:

> 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.

At Po transmitting power, the specified minimum attenuation becomes 43+10 log (Po), and the level in dBm relative to Po becomes:

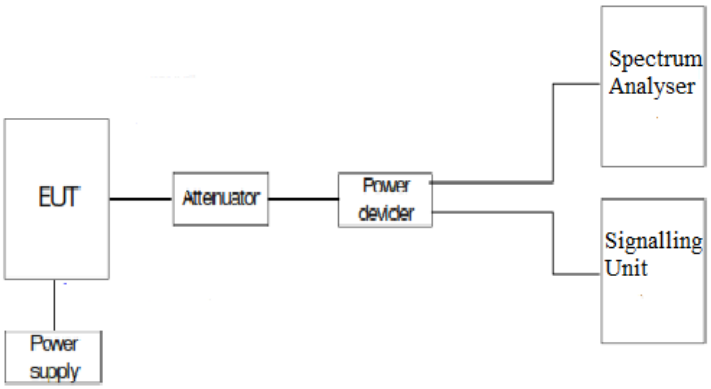
Po (dBm) – [43 + 10 log (Po in mW) - 30] = -13 dBm

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 85:

Preliminary measurements determined 16QAM, BW=5 MHz as the worst-case modulation in terms of band edge results. The next results are for this worst-case configuration.

Low Block Edge. Narrow Band= 0.

LTE 16QAM MODULATION:	RB=1. Offset = 0. BW = 5 MHz	RB=1. Offset = 0. BW = 10 MHz
Maximum measured level at Low Block Edge at antenna port (dBm)	-28,31	-33,39

LTE 16QAM MODULATION:	RB = 5. Offset = 0. BW = 5 MHz	RB = 5. Offset = 0. BW = 10 MHz
Maximum measured level at Low Block Edge at antenna port (dBm)	-24,29	-28,82

High Block Edge. Narrow Band= Max.

LTE 16QAM MODULATION:	RB=1. Offset=Max. BW = 5 MHz	RB=1. Offset=Max. BW = 10 MHz
Maximum measured level at High Block Edge at antenna port (dBm)	-16,97	-23,02

LTE 16QAM MODULATION:	RB = All. Offset = 0. BW = 5 MHz	RB = All. Offset = 0. BW = 10 MHz
Maximum measured level at High Block Edge at antenna port (dBm)	-19,51	-27,02

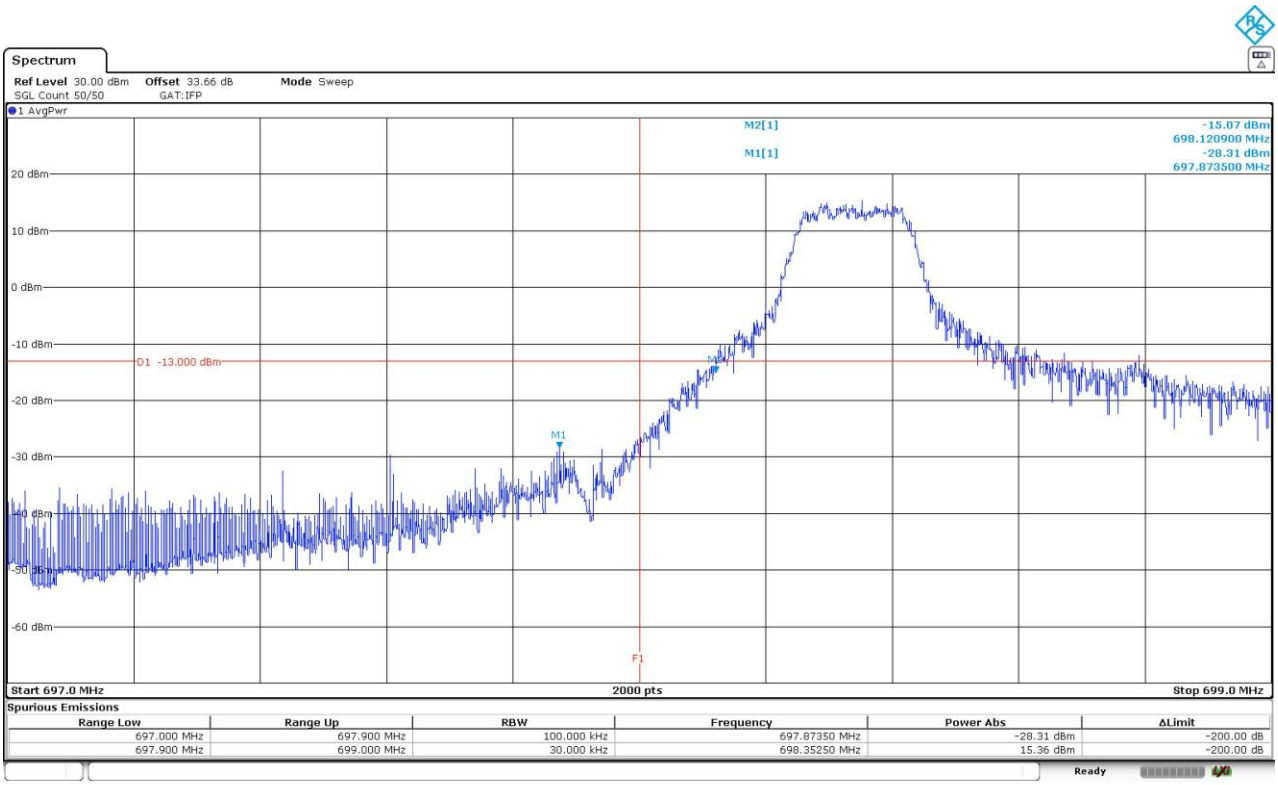
Measurement uncertainty: <±2.76 dB

Verdict

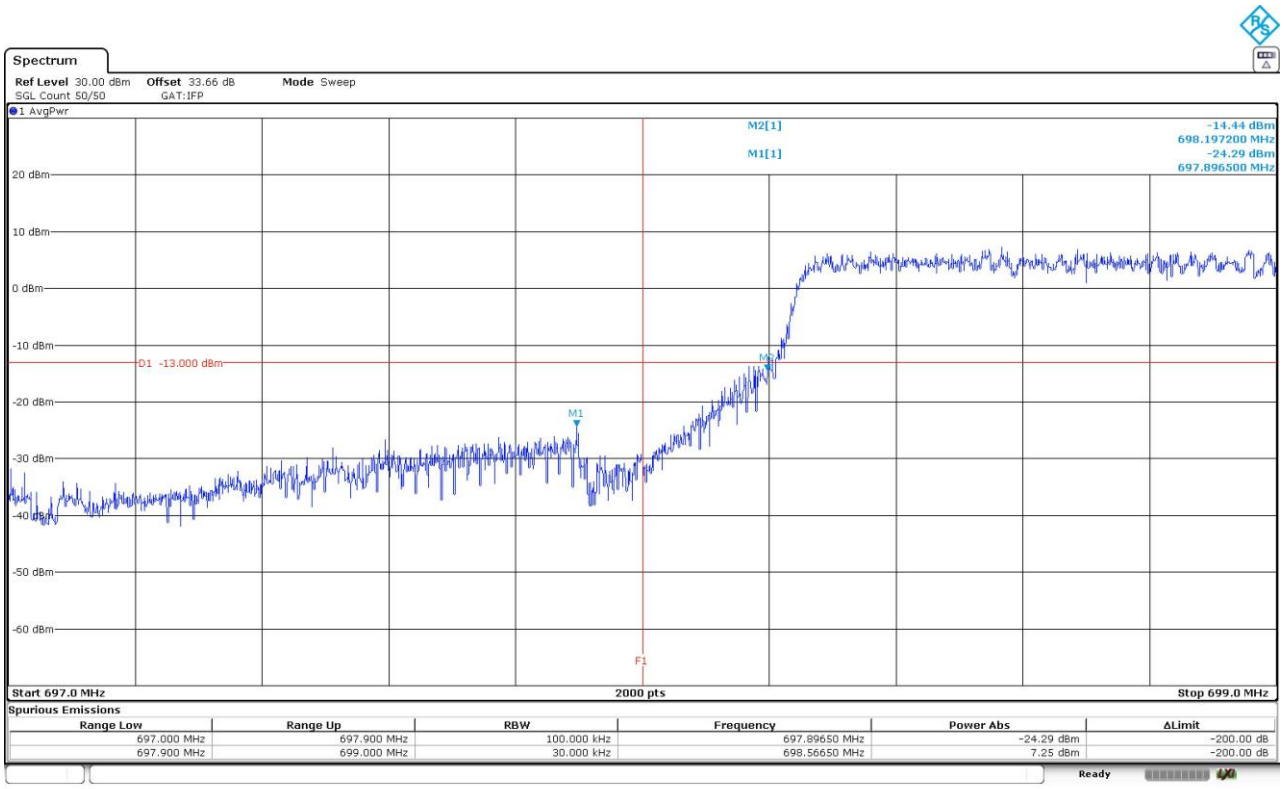
PASS

LTE Cat-M1 Band 85:

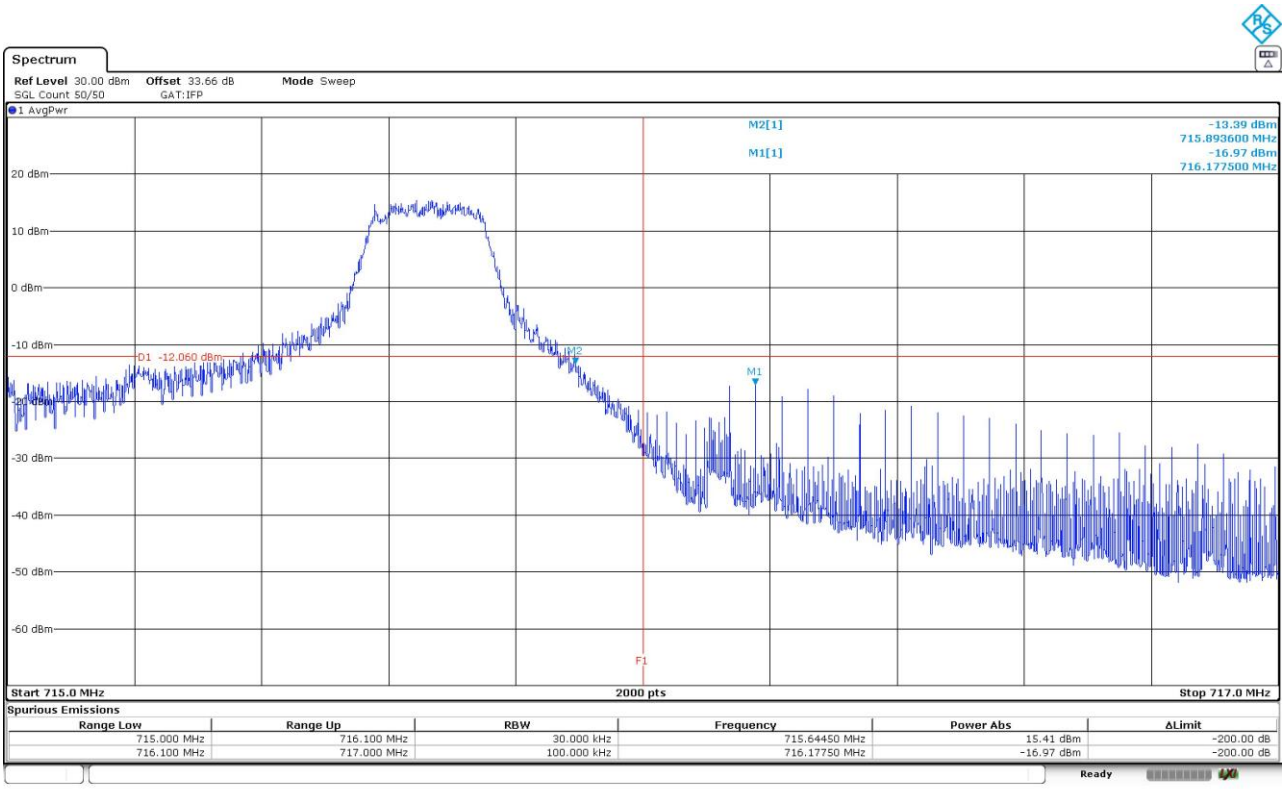
LTE Cat-M1 Band 85. BW=5 MHz. 16QAM. RB=1. Offset=0. Low Block Edge:



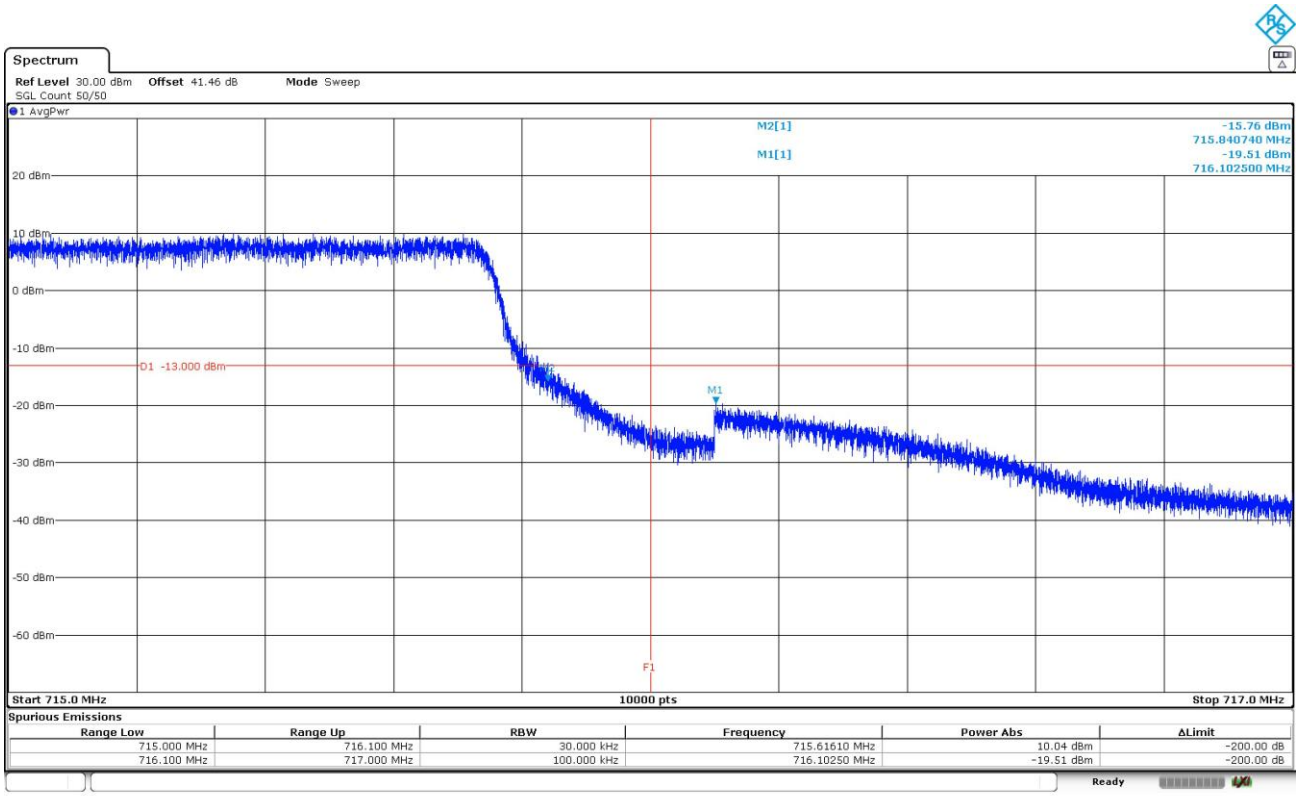
LTE Cat-M1 Band 85. BW=5 MHz. 16QAM. RB=All. Offset=0. Low Block Edge:



LTE Cat-M1 Band 85. BW=5 MHz. 16QAM. RB=1. Offset 5. High Block Edge:



LTE Cat-M1 Band 85. BW=5 MHz. 16QAM. RB=All. Offset 0. High Block Edge:



Radiated Emissions

Limits

LTE Cat-M1 Band 85. FCC §2.1053 & §27.53 (g) / RSS-130 Issue 2 Clause 4.7.

FCC §27.53 (g):

> (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 Issue 2 Clause 4.7:

> 4.7.1. 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 log10 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.

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 18 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 in mwatts) - 30] = -13 dBm

At Po transmitting power, the specified minimum attenuation 65 + 10 log10 p (watts) becomes:

Po (dBm) - [65 + 10 log (Po in mwatts) - 30] = -35 dBm

For operation in band 13, the e.i.r.p. in the band 1559-1610 MHz shall not exceed -70 dBW (-40 dBm) per MHz for wideband signals, and -80 dBW (-50 dBm) for discrete emissions of less than 700 Hz bandwidth.

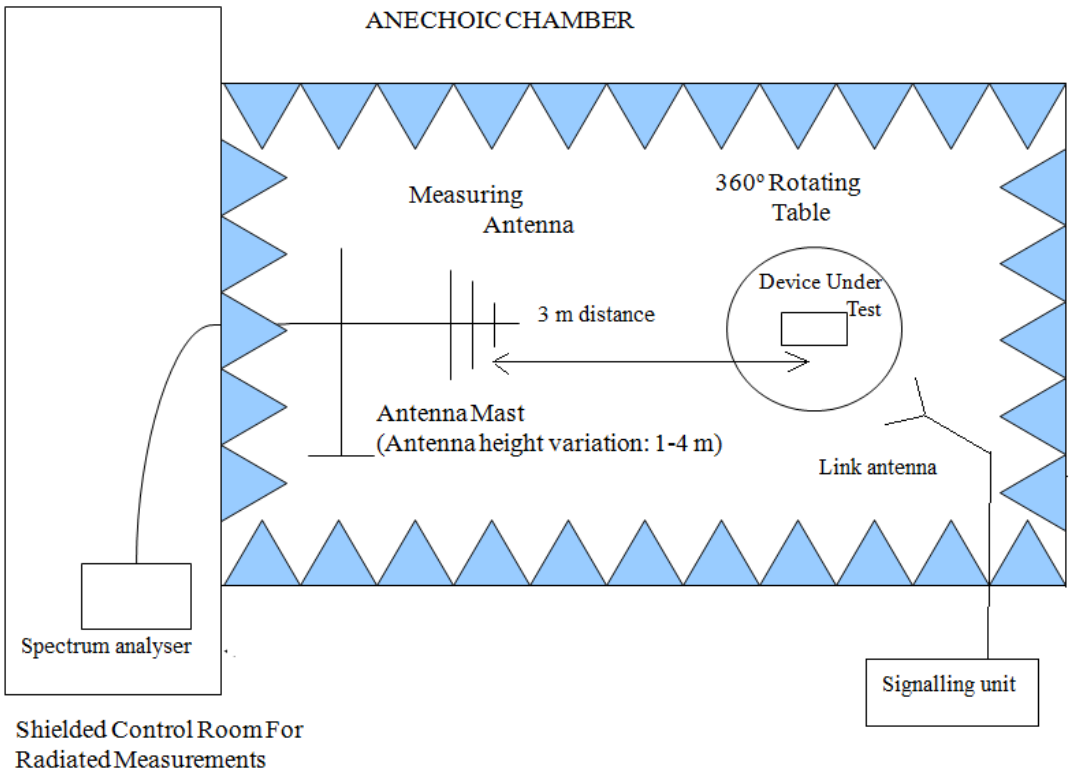
The maximum field strength (dBµV/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

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

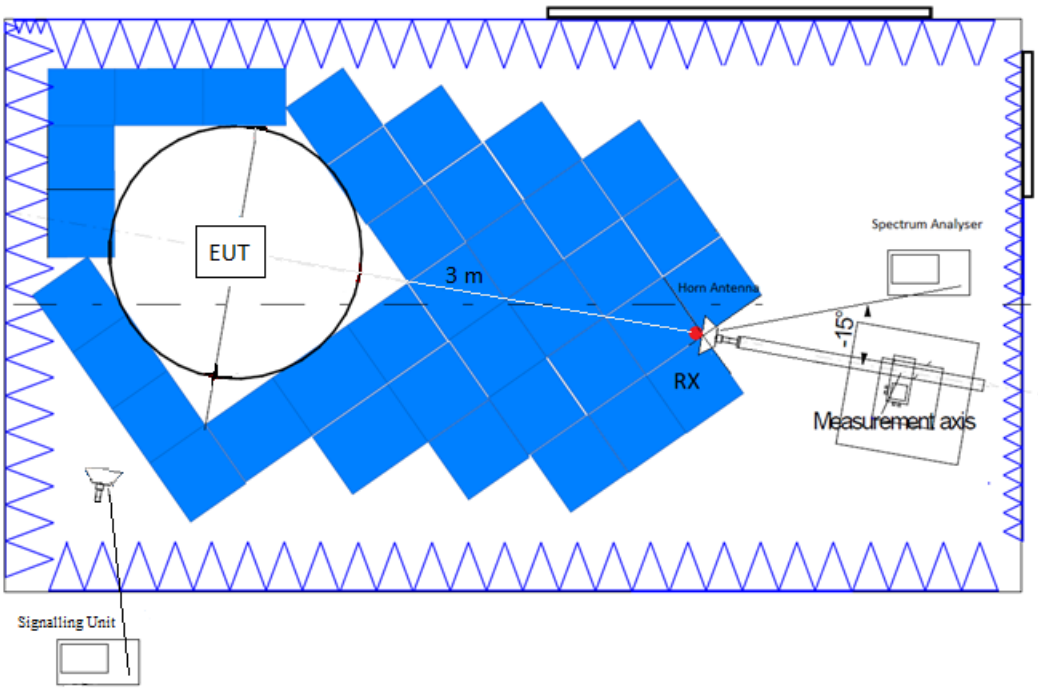
where D is the measurement distance (in the far field region) in m. D = 3m.

Test Setup

Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 18 GHz:



Results

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

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	30.312 kHz	PK+	1 MHz	1 s	0 dB
1 GHz - 3 GHz	62.5 kHz	PK+	1 MHz	1 s	0 dB
3 GHz - 18 GHz	468.75 kHz	PK+	1 MHz	1 s	0 dB

LTE Cat-M1 Band 85:

A preliminary scan determined the 16QAM modulation, BW=10 MHz, RB=1, Offset=2, Narrow Band=0 as the worst case. The next results are for this worst-case configuration.

- LOW CHANNEL:

Frequency range 30 MHz - 1 GHz:

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

Frequency range 1 - 8 GHz:

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

- MIDDLE CHANNEL:

Frequency range 30 MHz - 1 GHz:

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

Frequency range 1 - 8 GHz:

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

- HIGH CHANNEL:

Frequency range 30 MHz - 1 GHz:

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

Frequency range 1 - 8 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

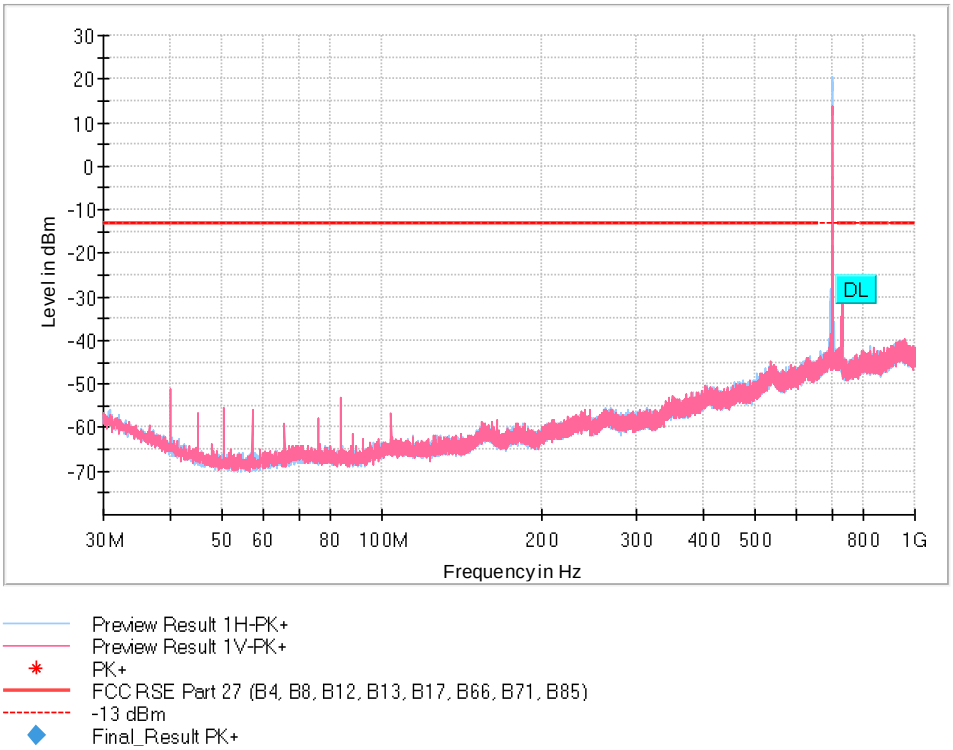
Verdict

Pass

LTE Cat-M1 Band 85:

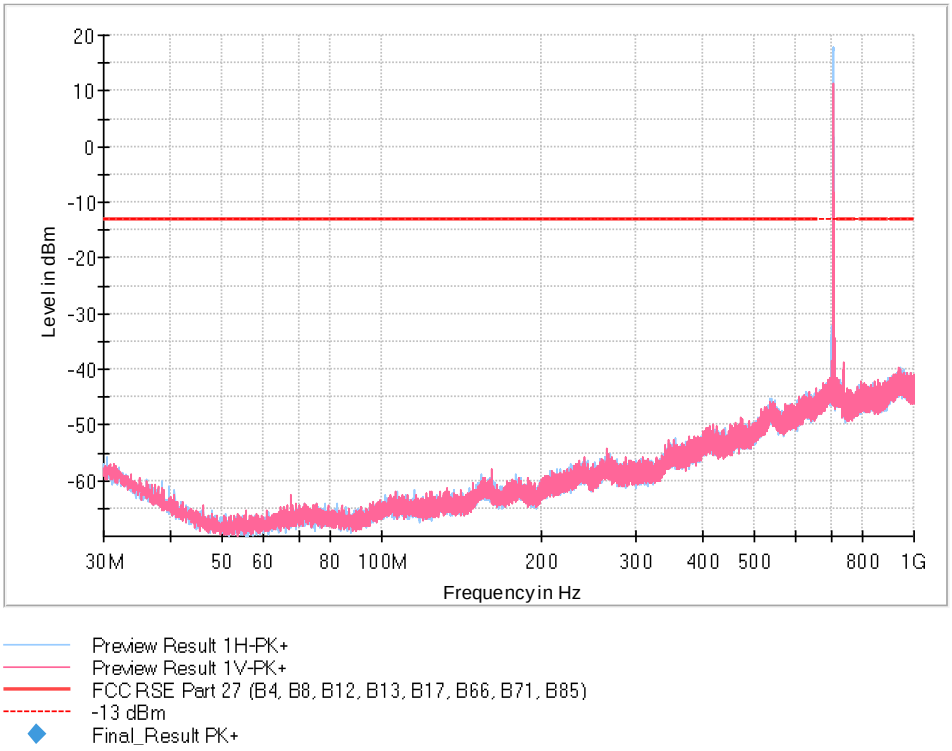
FREQUENCY RANGE 30 MHz - 1 GHz:

- LOW CHANNEL:



The peak above the limit is the LTE Cat-M1 Band 85 carrier frequency.

- MIDDLE CHANNEL:



The peak above the limit is the LTE Cat-M1 Band 85 carrier frequency.