

ISED CABid: ES1909
Lab. Company Number: 4621A

Test Report No:
75461RRF.002

Test Report

USA FCC Part 24

CANADA RSS-133

(*) Identification of item tested	LTE Cat 1bis module
(*) Trademark	Sequans Communications
(*) Model and /or type reference	GC02S1-NA2
Other identification of the product	FCC ID: 2AAGMGC02SA IC: 12732A-GC02SA
(*) Features	4G LTE module HW version: Rev1 SW version: LR9.0.1.1-59215
Applicant	SEQUANS COMMUNICATIONS 55 Boulevard Charles de Gaulle, 92700 Colombes
Test method requested, standard	USA FCC Part 24 (10-1-21 Edition). CANADA RSS-133 Issue 6, Jan. 2018 Amendment 1. 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 
Date of issue	2023-11-09
Report template No	FDT08_24 (*) "Data provided by the client"

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Competences and guarantees

DEKRA Testing and Certification 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.

DEKRA Testing and Certification is an FCC-recognized accredited testing laboratory with appropriate scope of accreditation that covers the performed tests in this 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 has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification 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 at the time of performance of the test.

DEKRA Testing and Certification 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

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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 model is GC02S1-NA2. The Calliope 2 GC02S1 modules are based on Sequans's second-generation Calliope 2 silicon and delivers optimized 4G LTE Cat 1 connectivity for IoT, M2M and consumer devices such as wearables and hearables that require voice support and speed higher than LTE-M.

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
75461B/005 *	LTE Cat 1bis module	GC02S1-NA2	C2E230509001024	21-07-2023
75461B/008	Antenna Cable	-	-	21-07-2023
75461B/004 **	LTE Cat 1bis module	GC02S1-NA2	C2E230509001008	21-07-2023

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

* : Used in the conducted tests but the PAPR, Spurious Emissions at Antenna Terminals at Block Edge tests.

** : Used in the PAPR, Spurious Emissions at Antenna Terminals at Block Edge tests.

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

Control Nº	Description	Model	Serial Nº	Date of reception
75461B/006	LTE Cat 1bis module	GC02S1-NA2	-	21-07-2023
75461B/001	Antenna	OmniLOG 90200	20200100252	21-07-2023
75461B/012	Antenna Cable	-	-	21-07-2023

Sample S/02 has undergone the following test(s): The radiated 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				
	☐ AC:		☐	☐	☐	☐	☐
	☒ DC: 3.2 to 5.5 V						
Rated Power.....:	-						
Clock frequencies.....:	-						
Other parameters	-						
Software version.....:	LR9.0.1.1-59215						
Hardware version	Rev1						

Dimensions in cm (W x H x D) ... :	21 x 1.8 x 19.5 mm		
Mounting position	☒	Table top equipment	
	☐	Wall/Ceiling mounted equipment	
	☐	Floor standing equipment	
	☐	Hand-held equipment	
	☐	Other:	
Modules/parts	Module/parts of test item		Type
	-		-
Accessories (not part of the test item)	Description		Type
	USB Cables		USB
	Antennas		Antenna
Documents as provided by the applicant	Description		File name
	-		-

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)	2023-08-16
Date (finish)	2023-10-09

Document history

Report number	Date	Description
75461RRF.002	2023-11-09	First release.

Environmental conditions

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

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

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

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

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

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

Remarks and comments

The tests have been performed by the technical personnel: Antonio Maireles, Carmen Vázquez, Fernando Chito, Francisco López, Sergio Carrasco.

Used instrumentation:

Control No.	Equipment	Next Calibration
8002	Climatic Chamber BINDER MK 56	2024-03
6157	Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2023-10
9229	Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	2024-06
6794	Shielded Room ETS LINDGREN S101	N/A
6254	Attenuator 6 dB 2W DC-26.5 GHz, TECHNIWAVE TWSMAG2	2024-03
2214	Power Divider DC-25 GHz PICOSECOND PULSE LABS 5333-104	2023-12
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
6143	Biconical/Log Antenna 30 MHz - 6 GHz ETS LINDGREN 3142E	2023-10
4612	Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2024-07
3783	RF Preamplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A	2023-12
7817	EMI Test Receiver 2 Hz - 44 GHz, ROHDE AND SCHWARZ ESW44	2023-12
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

LTE Cat 1bis Bands 2, 25.

FCC 24 / RSS-133		
Requirement – Test case	Verdict	Remark
FCC 24.232 / RSS-133 6.4: RF Output Power	P	
FCC 2.1047 / RSS-133 6.2: Modulation characteristics	P	
FCC 24.235 / RSS-133 6.3: Frequency stability	P	
FCC 2.1049: Occupied Bandwidth	P	
FCC 24.238 / RSS-133 6.5: Spurious emissions at antenna terminals	P	
FCC 24.238 / RSS-133 6.5: Spurious emissions at antenna terminals at Block Edges	P	
FCC 24.238 / RSS-133 6.5: Radiated Emissions	P	
<u>Supplementary information and remarks:</u> None.		

Appendix A: Test results for FCC 24 / RSS-133

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TEST CONDITIONS

POWER SUPPLY (*):

Vnominal: 3.8 Vdc
Vminimum: 3.2 Vdc
Vmaximum: 5.5 Vdc

Type of Power Supply: DC External.

ANTENNA (*):

MIDDLE BAND		ANTENNA TYPE
LTE Cat 1bis Band 2	+2 dBi	External (OmniLOG 90200)
LTE Cat 1bis Band 2	+2.4 dBi	Internal (FR01-S4-210)
LTE Cat 1bis Band 25	+2 dBi	External (OmniLOG 90200)
LTE Cat 1bis Band 25	+2.4 dBi	Internal (FR01-S4-210)

Note: Pre-scan determines that external antenna is the worst case in terms of radiated spurious emissions.

TEST FREQUENCIES:

LTE Cat 1bis Band 2. QPSK and 16QAM:

	Channel per BW=(Frequency, MHz)			
	BW=5 MHz	BW=10 MHz	BW=15 MHz	BW=20 MHz
Low	18625 (1852.5)	18650 (1855)	18675 (1857.5)	18700 (1860)
Middle	18900 (1880)	18900 (1880)	18900 (1880)	18900 (1880)
High	19175 (1907.5)	19150 (1905)	19125 (1902.5)	19100 (1900)

NOTE: LTE Cat 1bis Band 2 is completely included in LTE Cat 1bis Band 25, so the channels of the LTE Cat 1bis Band 25 were tested to give conformity to the assigned block. BW=1.4 MHz and 3 MHz not supported.

LTE Cat 1bis Band 25. QPSK and 16QAM:

	Channel per BW=(Frequency, MHz)			
	BW=5 MHz	BW=10 MHz	BW=15 MHz	BW=20 MHz
Low	26065 (1852.5)	26090 (1855)	26115 (1857.5)	26140 (1860)
Middle	26365 (1882.5)	26365 (1882.5)	26365 (1882.5)	26365 (1882.5)
High	26665 (1912.5)	26640 (1910)	26615 (1907.5)	26590 (1905)

NOTE: BW=1.4 MHz and 3 MHz not supported.

RF Output Power

Limits

* FCC § 2.1046 and § 24.232:

Mobile/portable stations are limited to 2 Watts (33 dBm) Effective Isotropic Radiated Power (E.I.R.P.).
The peak-to-average ratio (PAR) of the transmission shall not exceed 13 dB.

* RSS-133 Clause 6.4:

Mobile stations and hand-held portables are limited to 2 watts maximum e.i.r.p. The peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the High PAPR during periods of continuous transmission.

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:

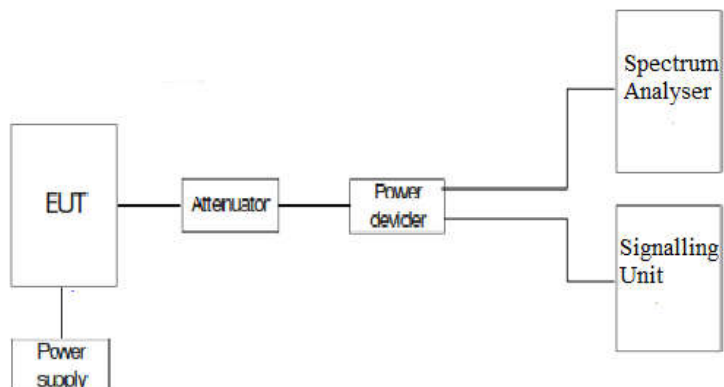
$$E.R.P. = E.I.R.P. - 2.15 \text{ dB}$$

Test Setup

1. CONDUCTED AVERAGE POWER:



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



Results

1. CONDUCTED AVERAGE POWER:

LTE Cat 1bis Band 25:

Worst-case of RF Power is BW=15 MHz, Middle Channel, QPSK, RB Size=1, RB Offset=37.

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)
15	Low 26115	1857.5	QPSK	1	0	22.04
				1	37	21.93
				1	74	21.73
				36	0	20.91
				36	18	20.93
				36	37	20.92
				75	0	20.88
			16-QAM	1	0	20.67
				1	37	20.99
				1	74	20.89
				25	0	19.94
				25	12	19.92
				25	24	19.97
				75	0	*
	Middle 26365	1882.5	QPSK	1	0	22.21
				1	37	22.65
				1	74	22.49
				25	0	21.35
				25	12	21.65
				25	24	21.25
				75	0	21.15
			16-QAM	1	0	21.13
				1	37	21.53
				1	74	21.48
				25	0	19.86
				25	12	20.44
				25	24	20.61
				75	0	*
	High 26615	1907.5	QPSK	1	0	22.6
				1	37	22.46
				1	74	22.09
				36	0	21.49
				36	18	21.43
				36	37	21.38
				75	0	20.61
			16-QAM	1	0	21.67
				1	37	21.63
				1	74	21.25
				25	0	20

				25	12	20.41
				25	24	20.41
				75	0	*

* Not supported.

BW=15 MHz. QPSK:

MAX POWER	QPSK COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP(dBm)	RAD. POWER AVG ERP(dBm)
LOW	22.04	2	24.04	21.89
MIDDLE	22.65	2	24.65	22.5
HIGH	22.6	2	24.6	22.45
MAX:	22.65		24.65	22.5

BW=15 MHz. 16QAM:

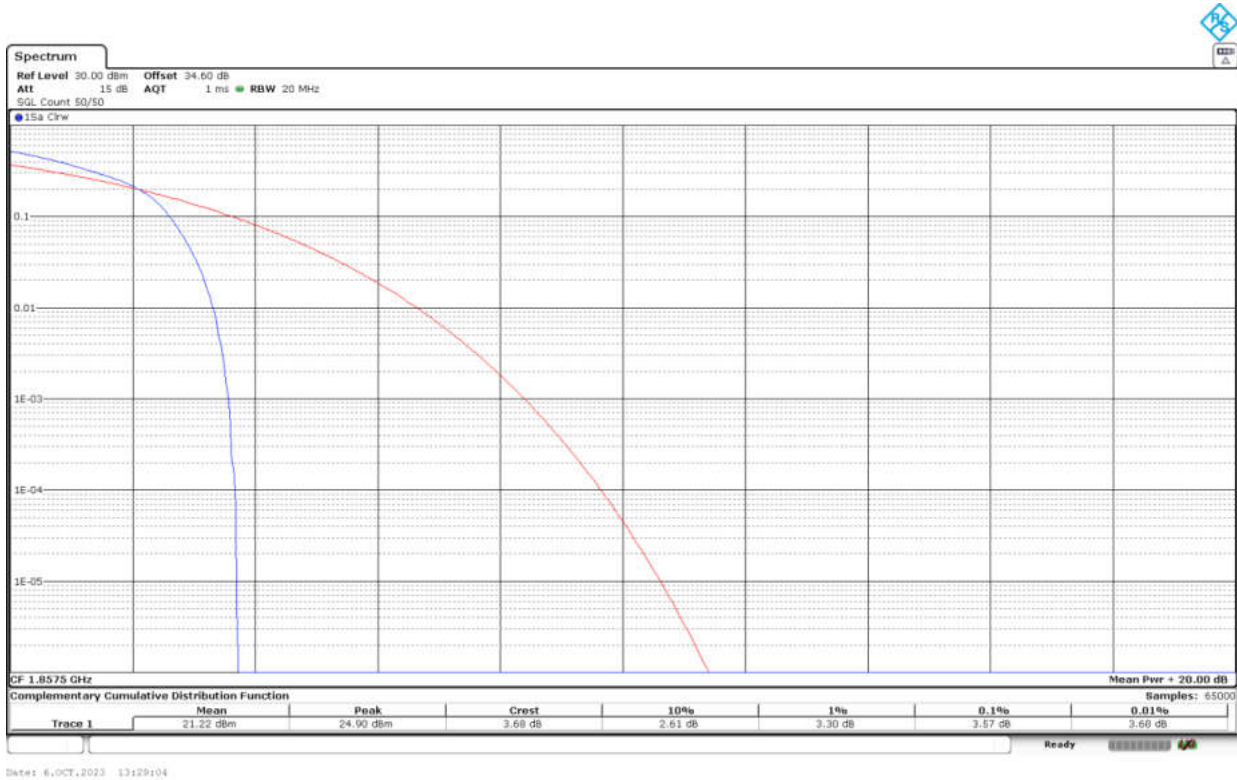
MAX POWER	16QAM COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP(dBm)	RAD. POWER AVG ERP(dBm)
LOW	20.99	2	22.99	20.84
MIDDLE	21.53	2	23.53	21.38
HIGH	21.67	2	23.67	21.52
MAX:	21.67		23.67	21.52

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

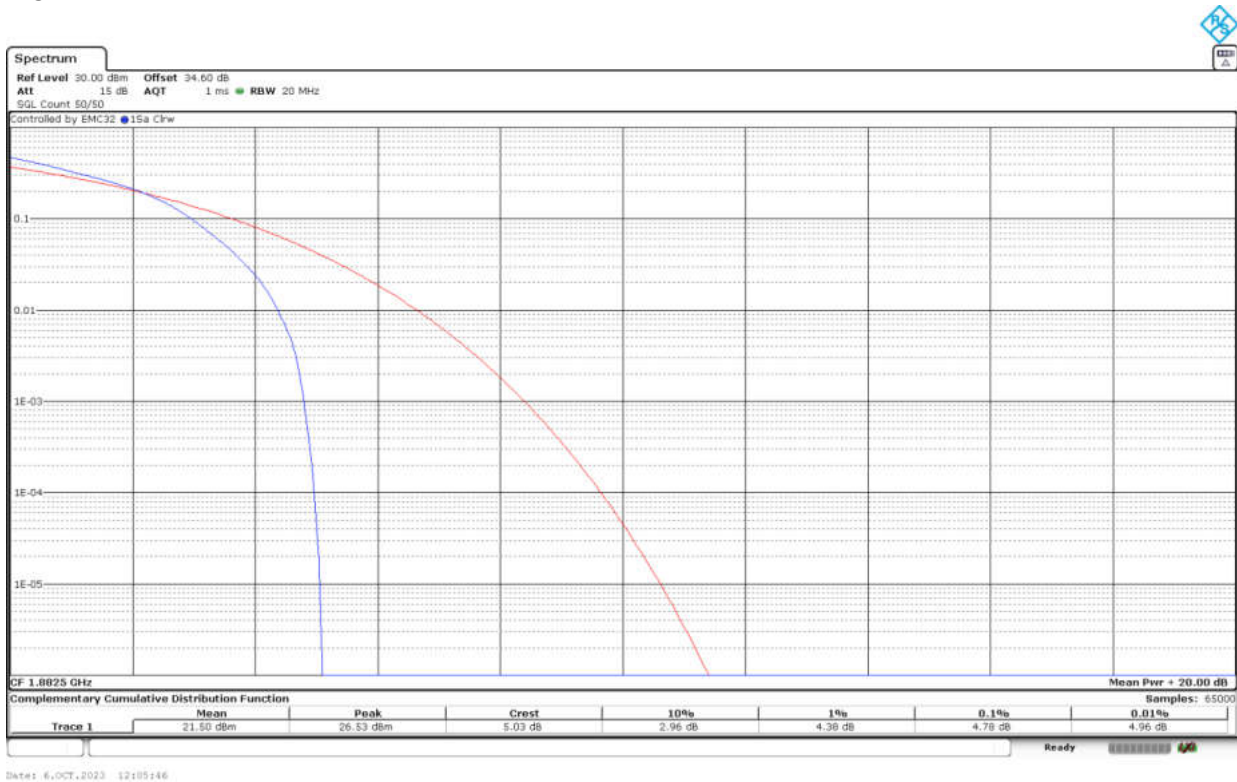
LTE Cat 1bis Band 25:

Worst-case of PAPR is BW=15 MHz, Middle Channel, 16QAM, RB Size=25, RB Offset=0.

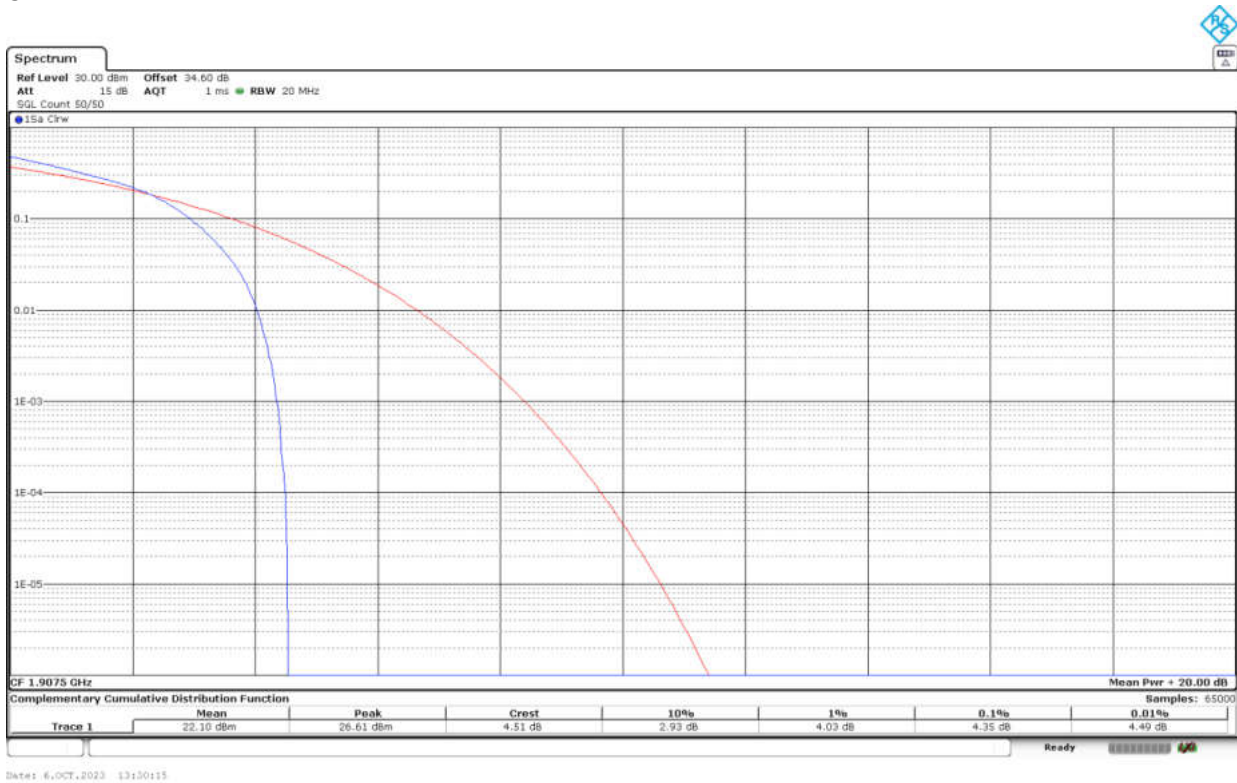
Low Channel:



Middle Channel:



High Channel:



16QAM	Low	Middle	High
PAPR (dB)	3.57	4.78	4.35

Verdict

Pass

Frequency Stability

Limits

* FCC §2.1055 and §24.235. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

* RSS-133, Clause 6.3. The carrier frequency shall not depart from the reference frequency in excess of ± 2.5 ppm for mobile stations.

Method

The frequency tolerance measurements over temperature variations were made over the temperature range of -30°C to $+50^{\circ}\text{C}$. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10°C steps from -30°C up to $+50^{\circ}\text{C}$.

The supply voltage was varied between 85% and 115% of nominal voltage.

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.

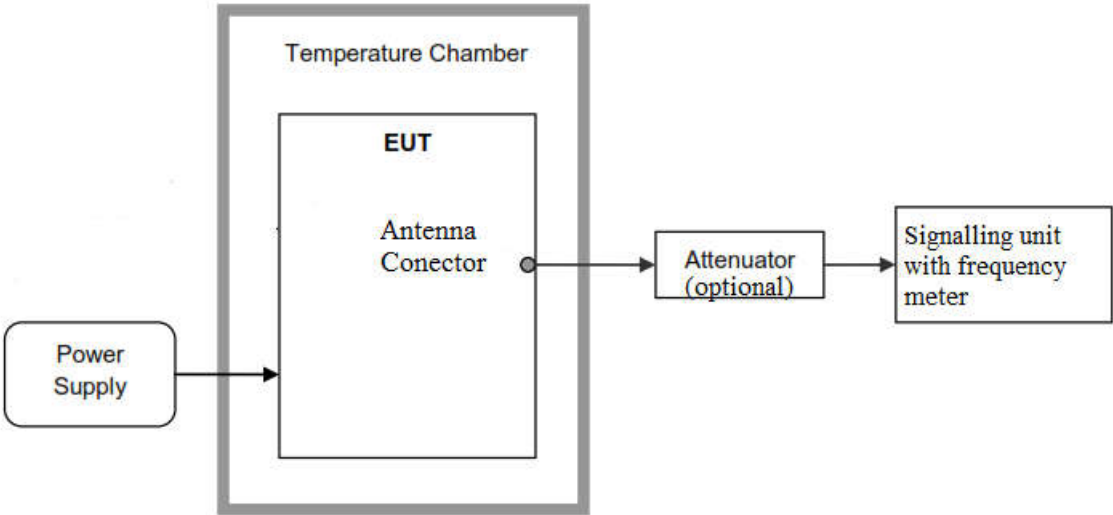
The worst case LTE mode for conducted power was used for the test.

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 channels 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.

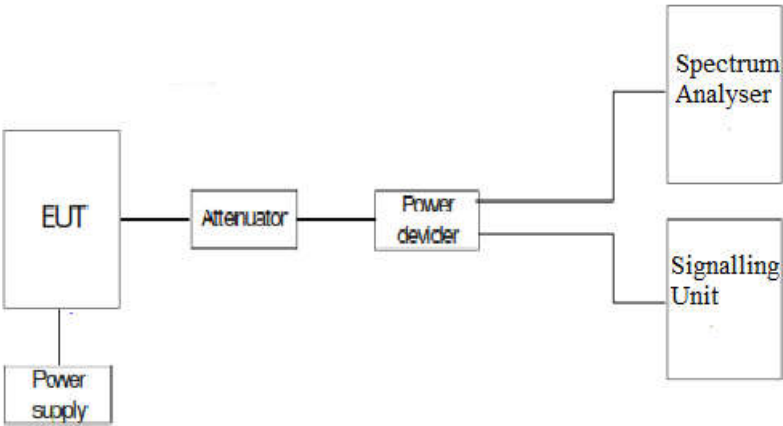
The reference point measurements were made at the RF output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

Test Setup

Frequency tolerance:



Reference points f_L and f_H :



Results

LTE Cat 1bis Band 25:

The worst case modulation in terms of Frequency Stability is BW=5 MHz, QPSK, RB Size=1, RB Offset=0.

1. FREQUENCY TOLERANCE:

- Frequency stability over temperature variations.

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
+85	0,16	8,49934E-05
+80	2,11	0,00112085
+70	-0,32	-0,000169987
+60	-1,46	-0,000775564
+50	3.05	0.001620186
+40	3.85	0.002045153
+30	3.47	0.001843293
+20	4.36	0.002316069
+10	0.48	0.00025498
0	3.41	0.001811421
-10	1.17	0.000621514
-20	2.41	0.001280212
-30	1.42	0.000754316

- Frequency stability over voltage variations.

Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	5.5	0.22	0.000116866
Vmin	3.2	1.84	0.000977424

2. REFERENCE FREQUENCY POINTS f_L AND f_H:

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

f _L (MHz)	1850.0140
f _H (MHz)	1914.8768

The reference frequency points f_L and f_H stay within the authorized blocks for the band above.

Measurement uncertainty (Hz): <±223.94

Verdict

PASS

Modulation Characteristics

Limits

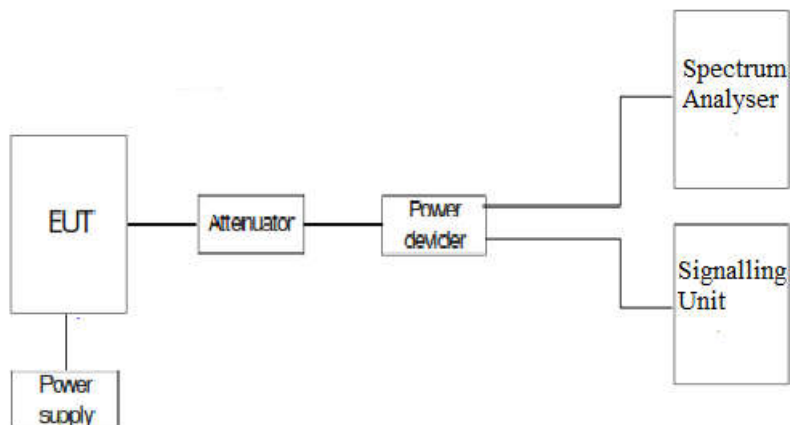
* FCC §2.1047.

* RSS-133. Clause 6.2. Equipment certified under this standard shall use digital modulation.

Method

For LTE the EUT operates with QPSK and 16QAM 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).

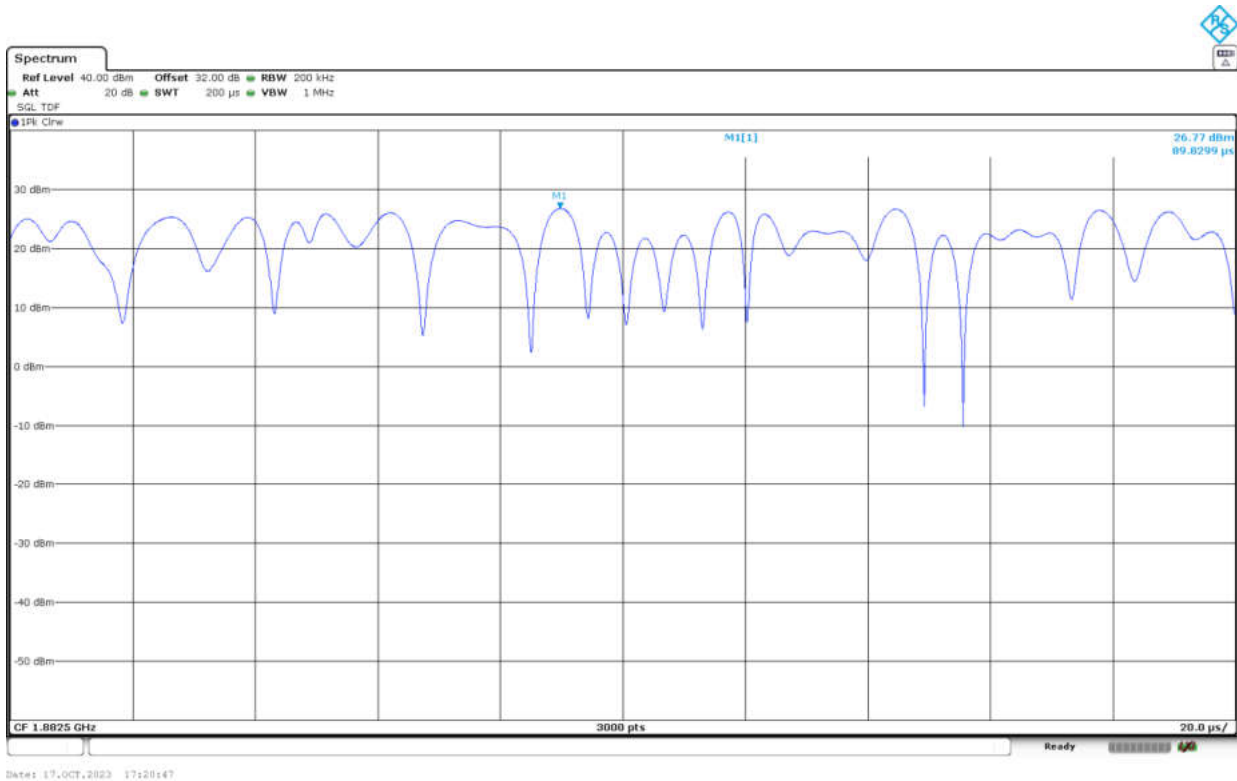
Test Setup



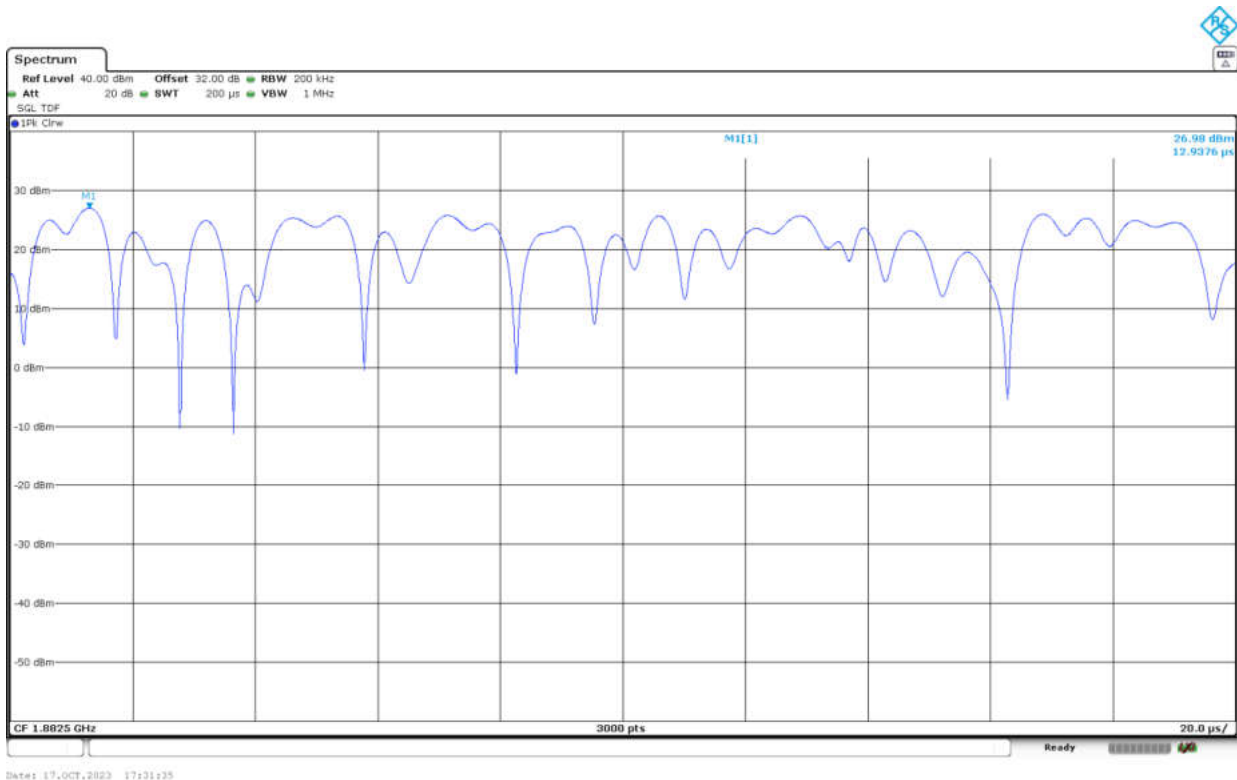
Results

The following plots show the modulation schemes in the EUT.

LTE Cat 1bis Band 25: BW=5 MHz. QPSK.



LTE Cat 1bis Band 25: BW=5 MHz. 16QAM.



Occupied Bandwidth

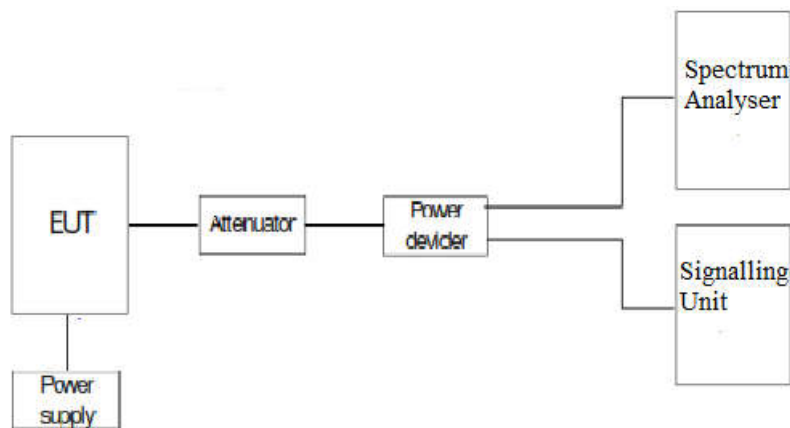
Limits

- * FCC §2.1049: Measurements required: Occupied bandwidth.
- * RSS-Gen, 6.7: Occupied bandwidth (or 99% emission 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 per modulation is:

LTE Cat 1bis Band 25:

LTE Cat 1bis Band 25. BW=5 MHz. QPSK. RB Size=All.

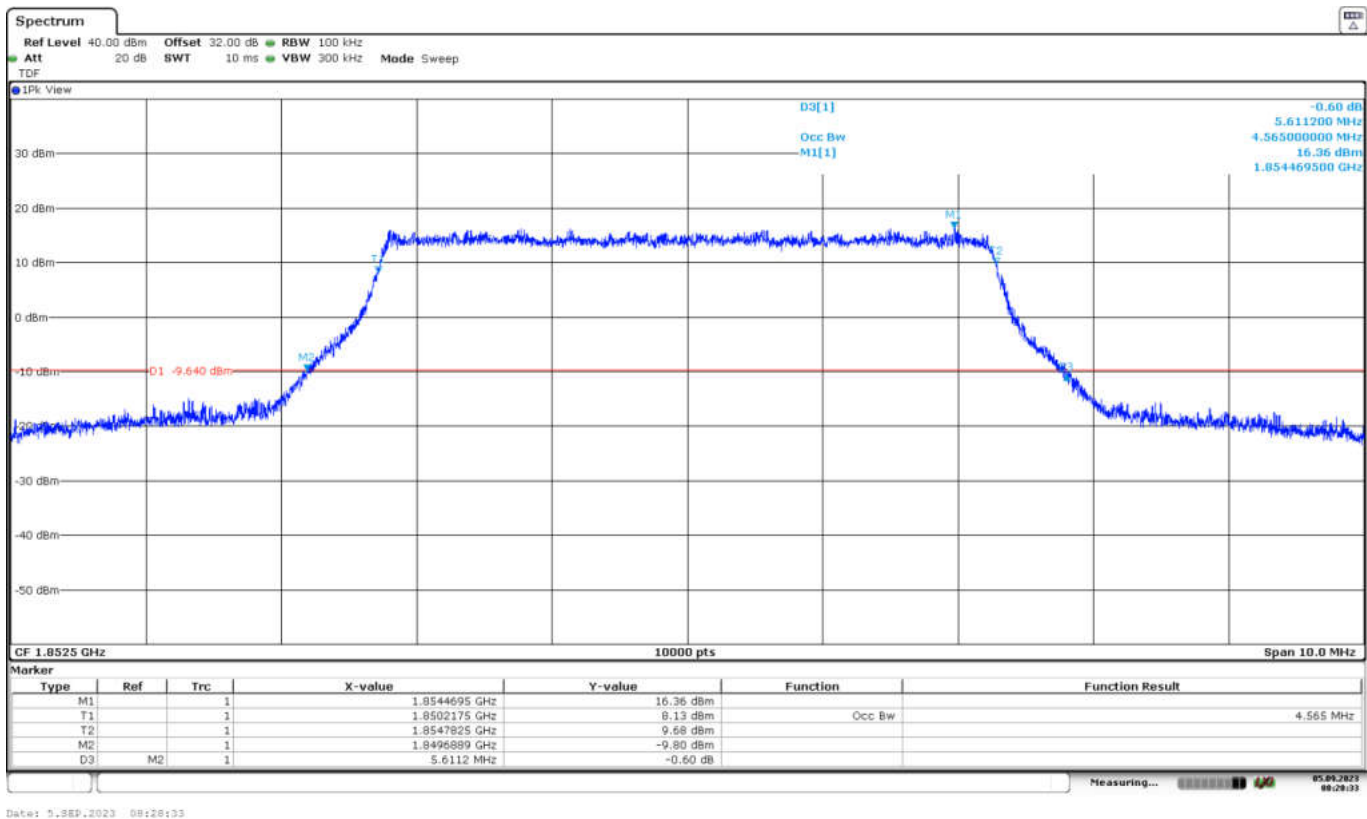
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	4.565	4.561	4.579
-26 dBc Bandwidth (MHz)	5.611	5.575	5.693
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 25. BW=5 MHz. 16QAM. RB Size=All.

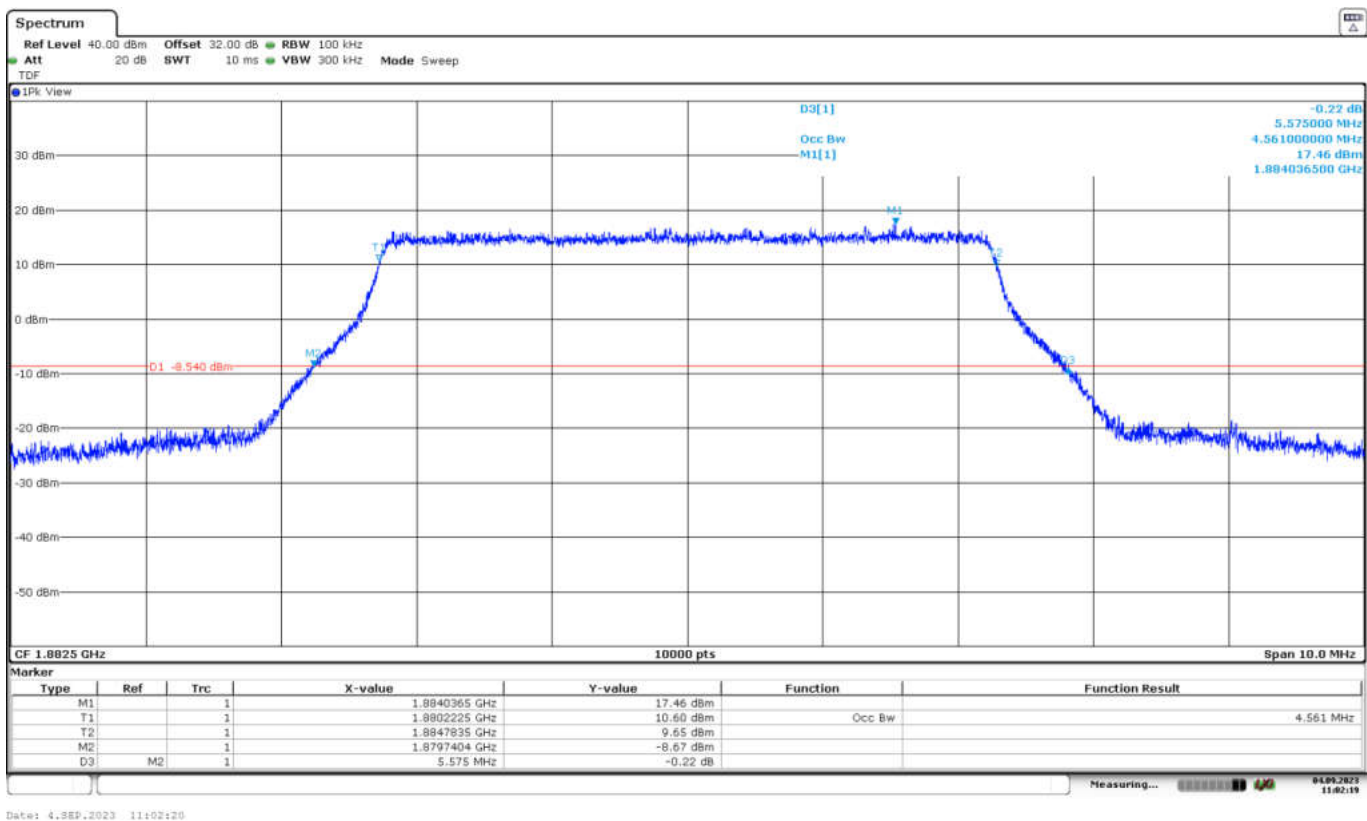
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	4.568	4.547	4.585
-26 dBc Bandwidth (MHz)	5.660	5.649	5.695
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 25. BW=5 MHz. QPSK. RB Size=All.

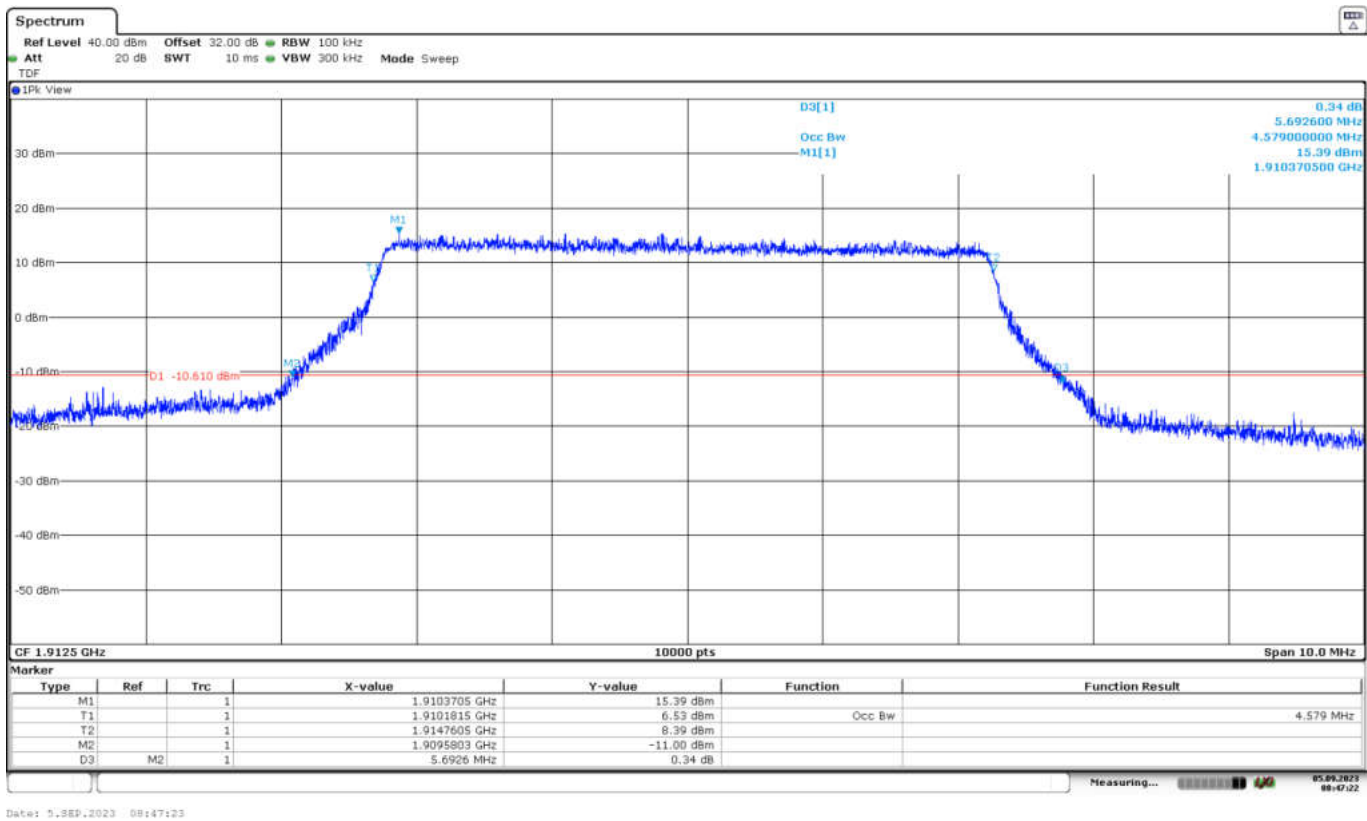
Low Channel:



Middle Channel:

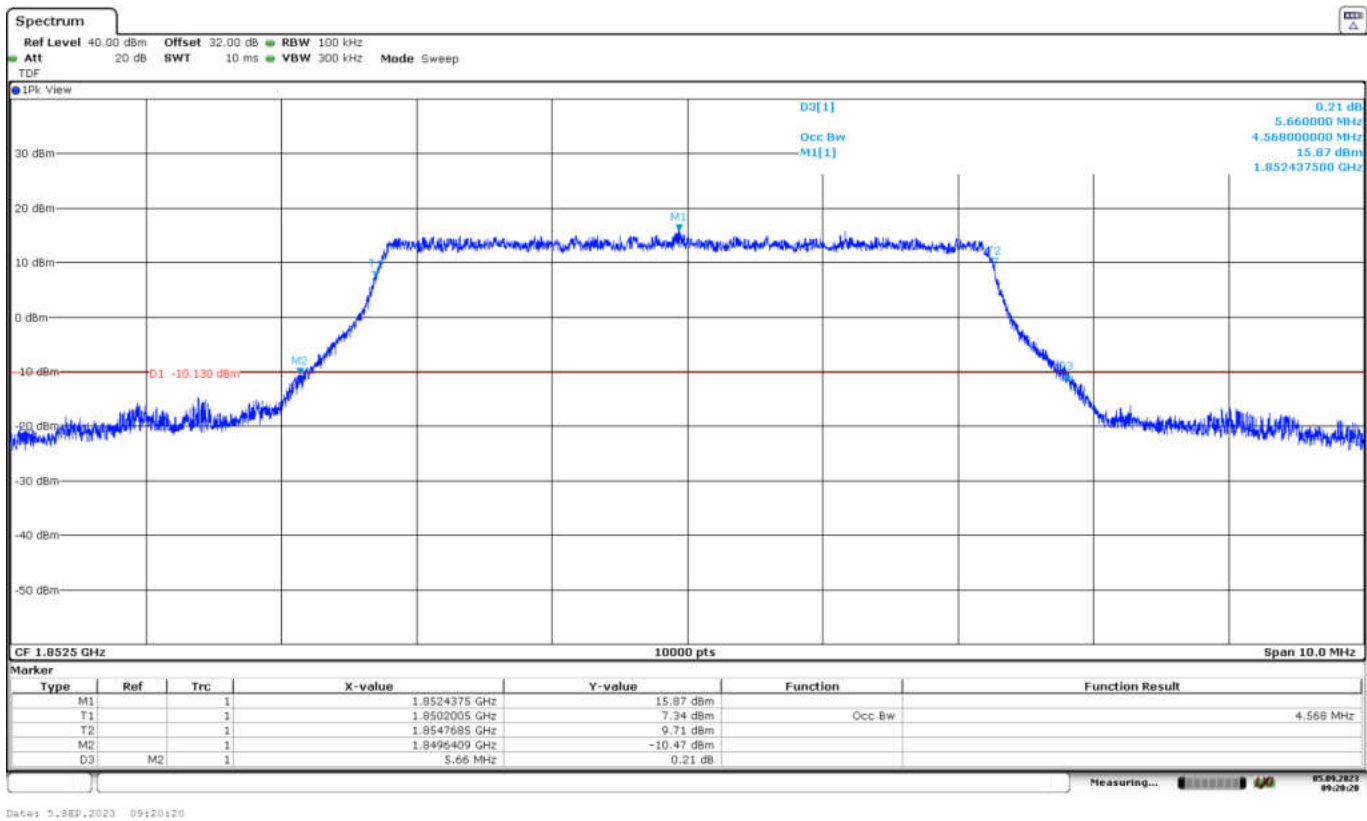


High Channel:

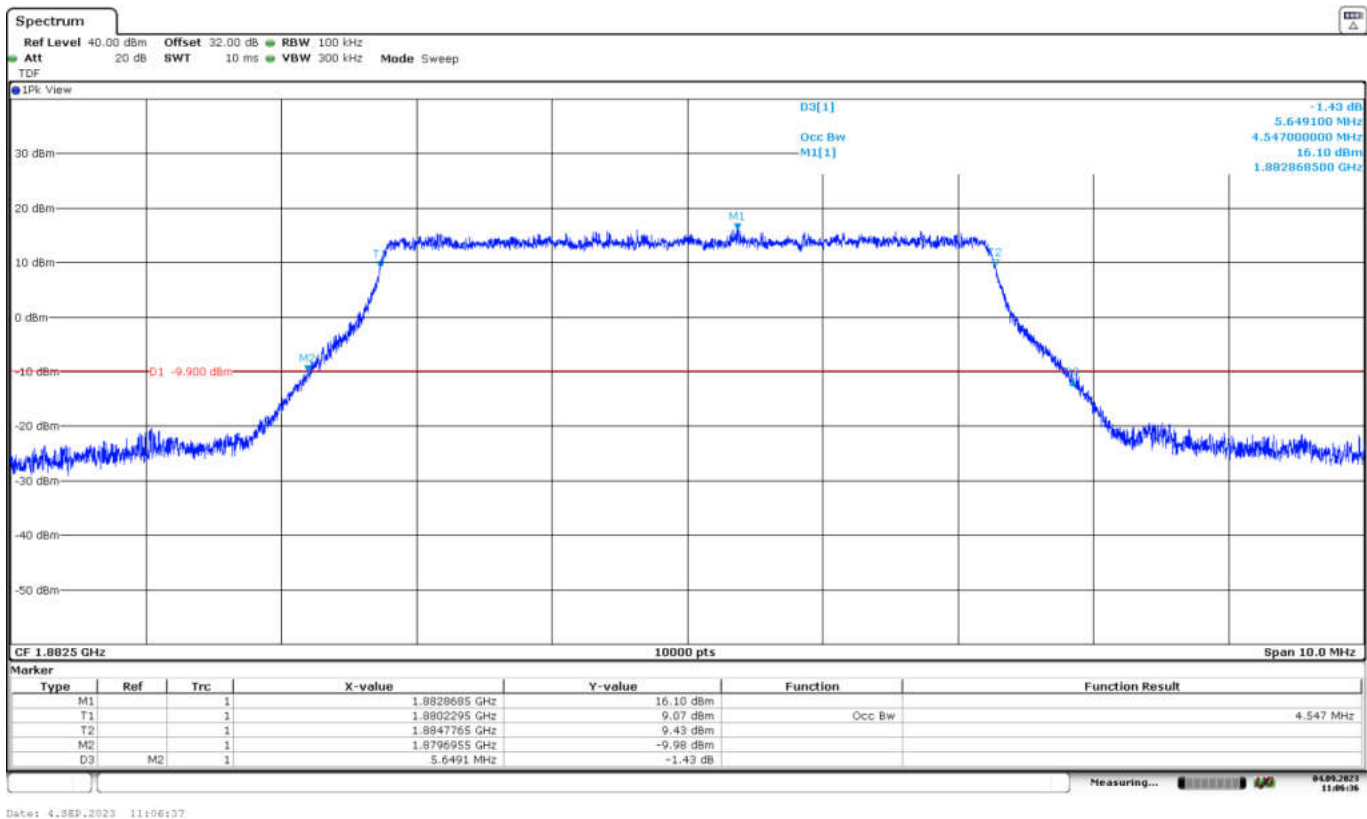


LTE Cat 1bis Band 25. BW=5 MHz. 16QAM. RB Size=All.

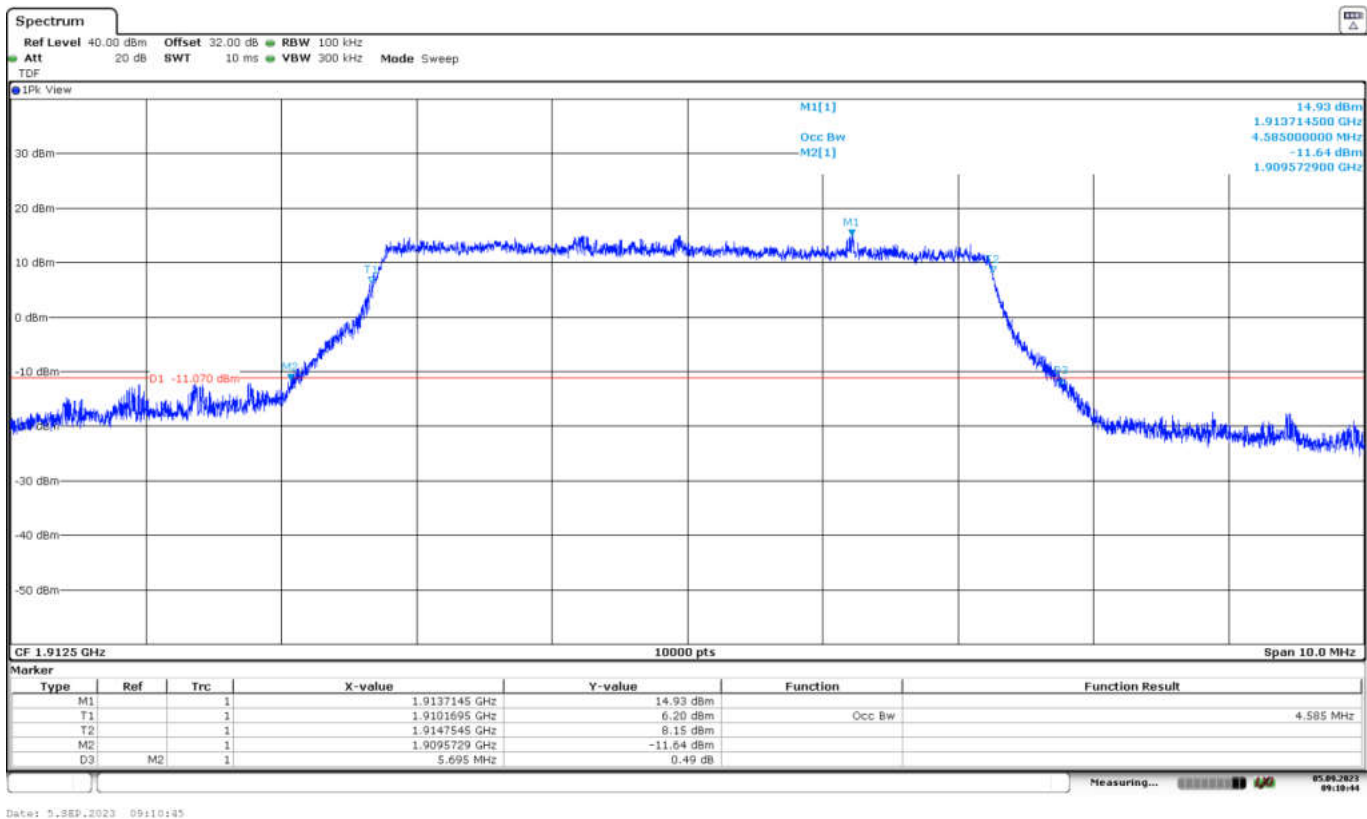
Low Channel:



Middle Channel:



High Channel:



LTE Cat 1bis Band 25. BW=10 MHz. QPSK. RB Size=All.

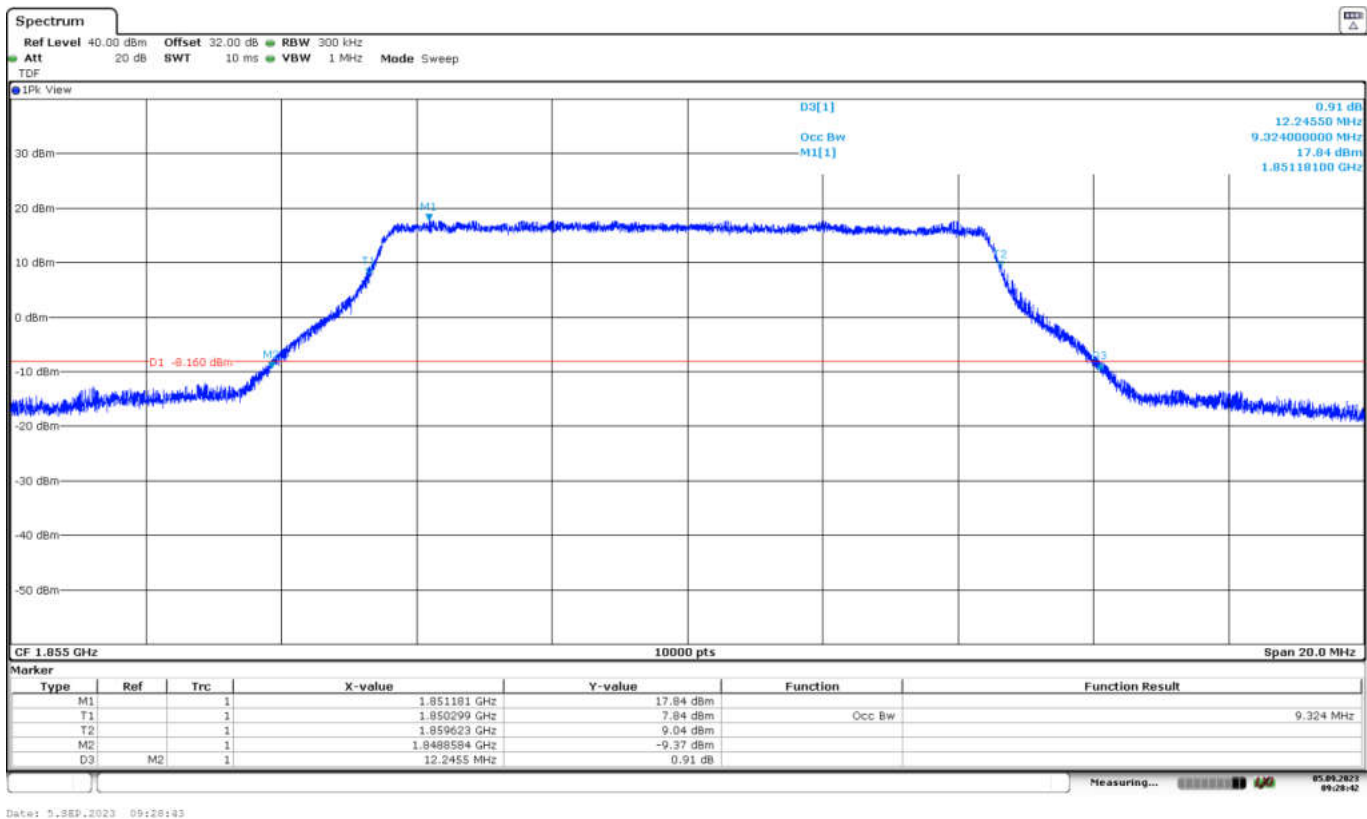
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	9.324	9.282	9.262
-26 dBc Bandwidth (MHz)	12.246	12.068	12.008
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 25. BW=10 MHz. 16QAM. RB Size=All.

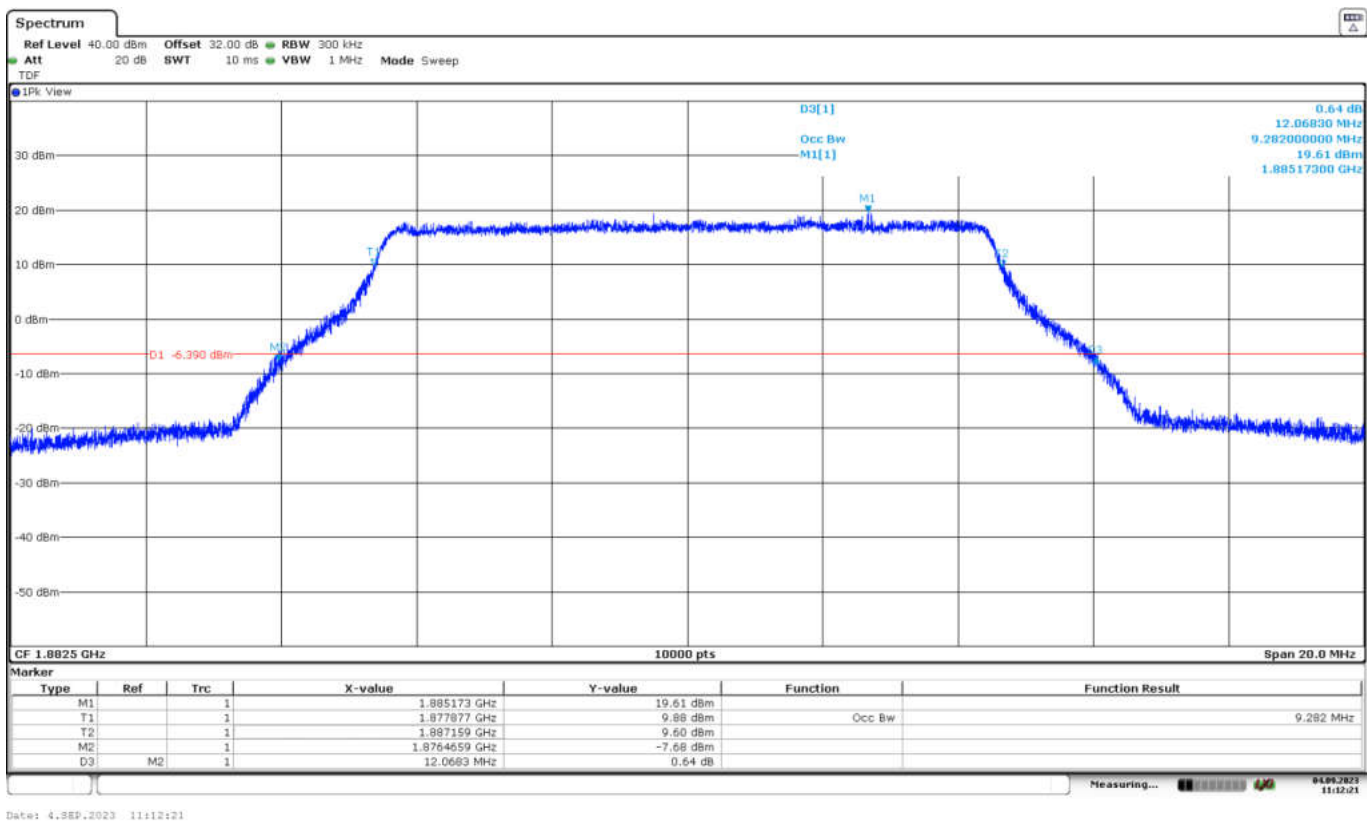
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	5.170	5.360	4.904
-26 dBc Bandwidth (MHz)	8.633	9.120	7.357
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 25. BW=10 MHz. QPSK. RB Size=All.

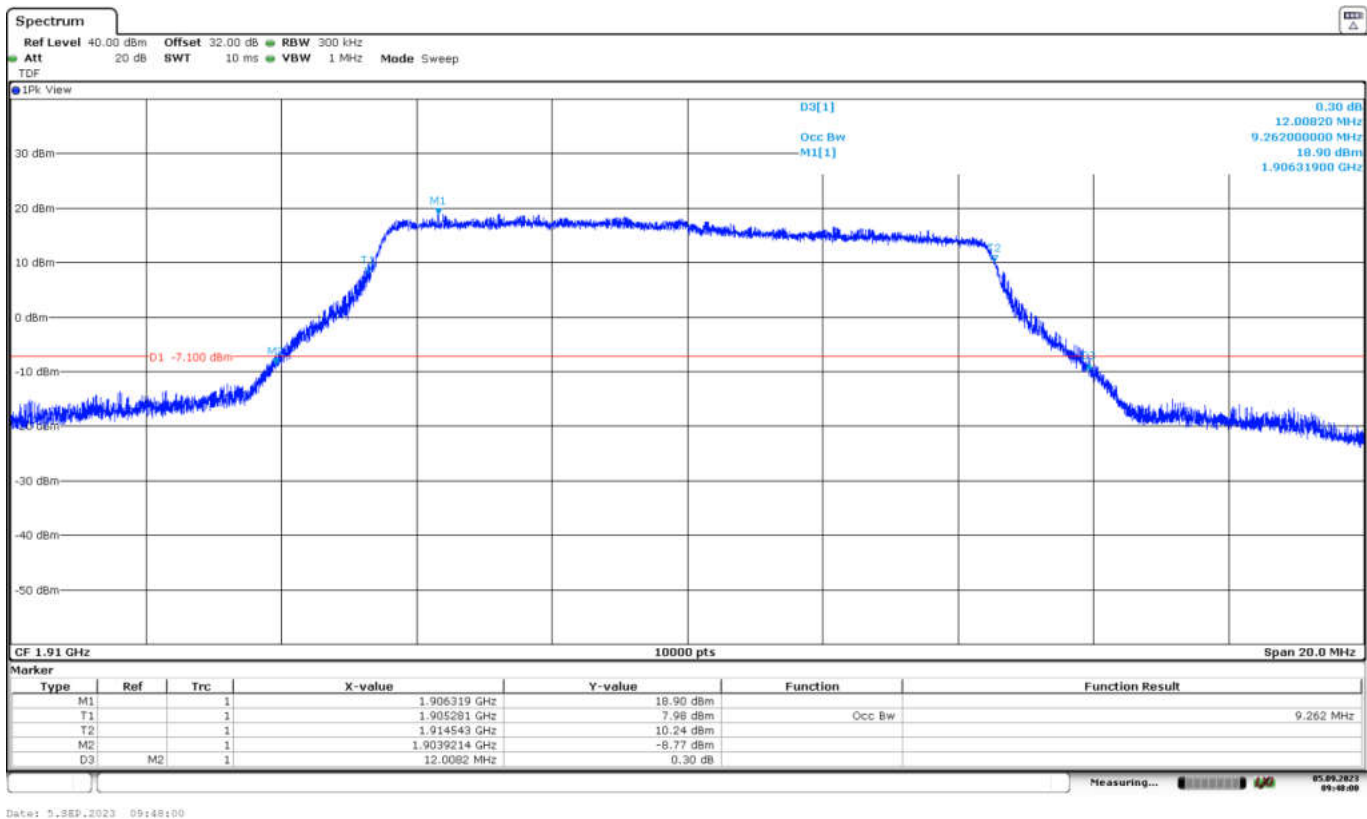
Low Channel:



Middle Channel:

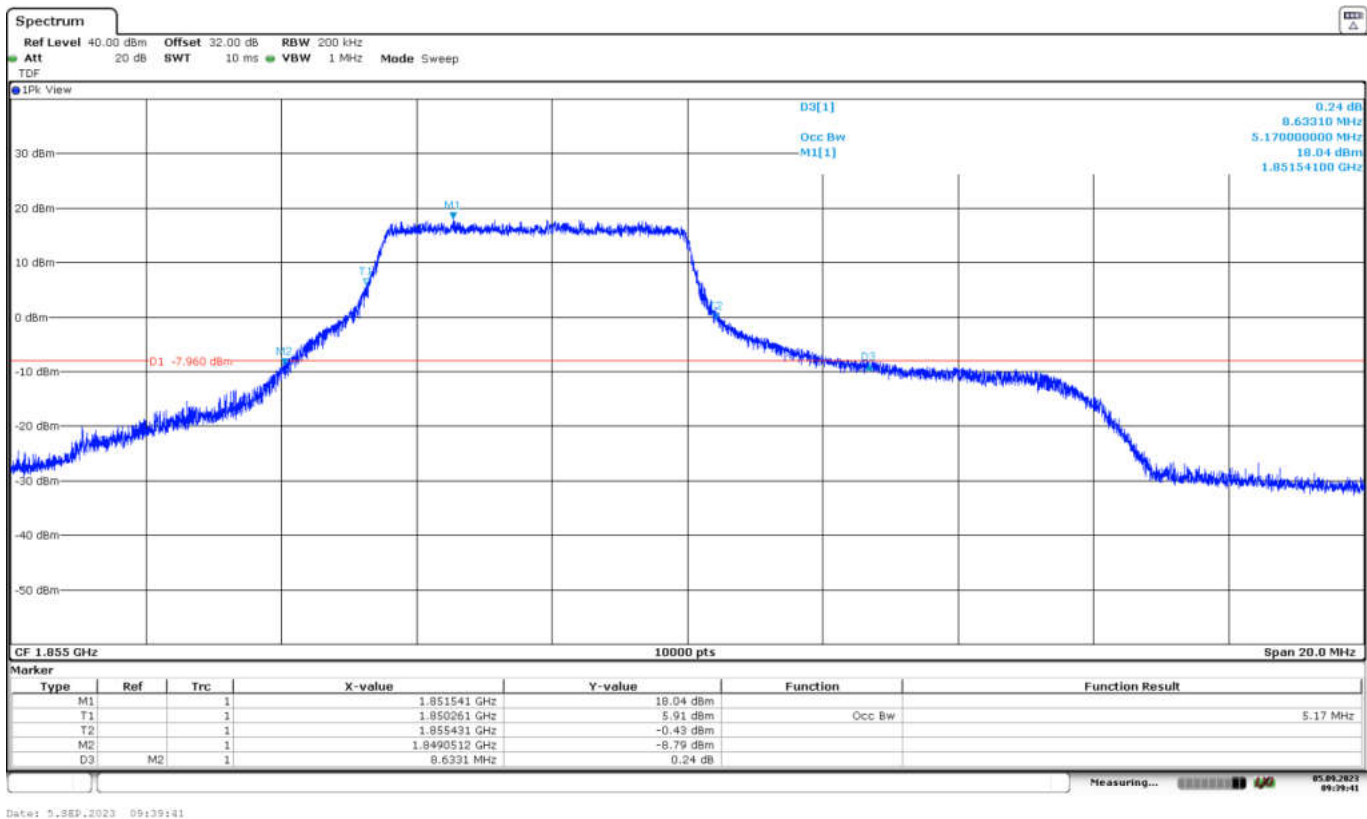


High Channel:

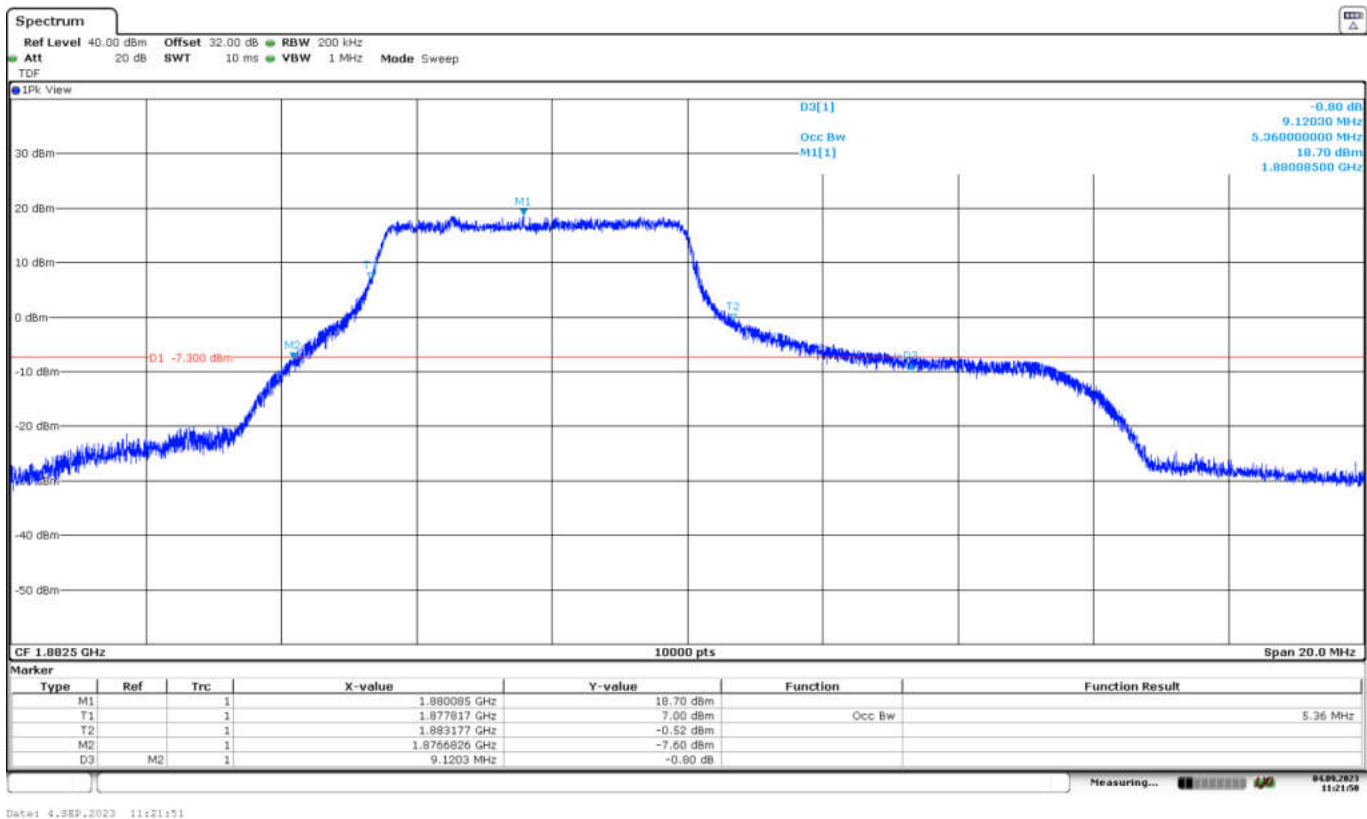


LTE Cat 1bis Band 25. BW=10 MHz. 16QAM. RB Size=All.

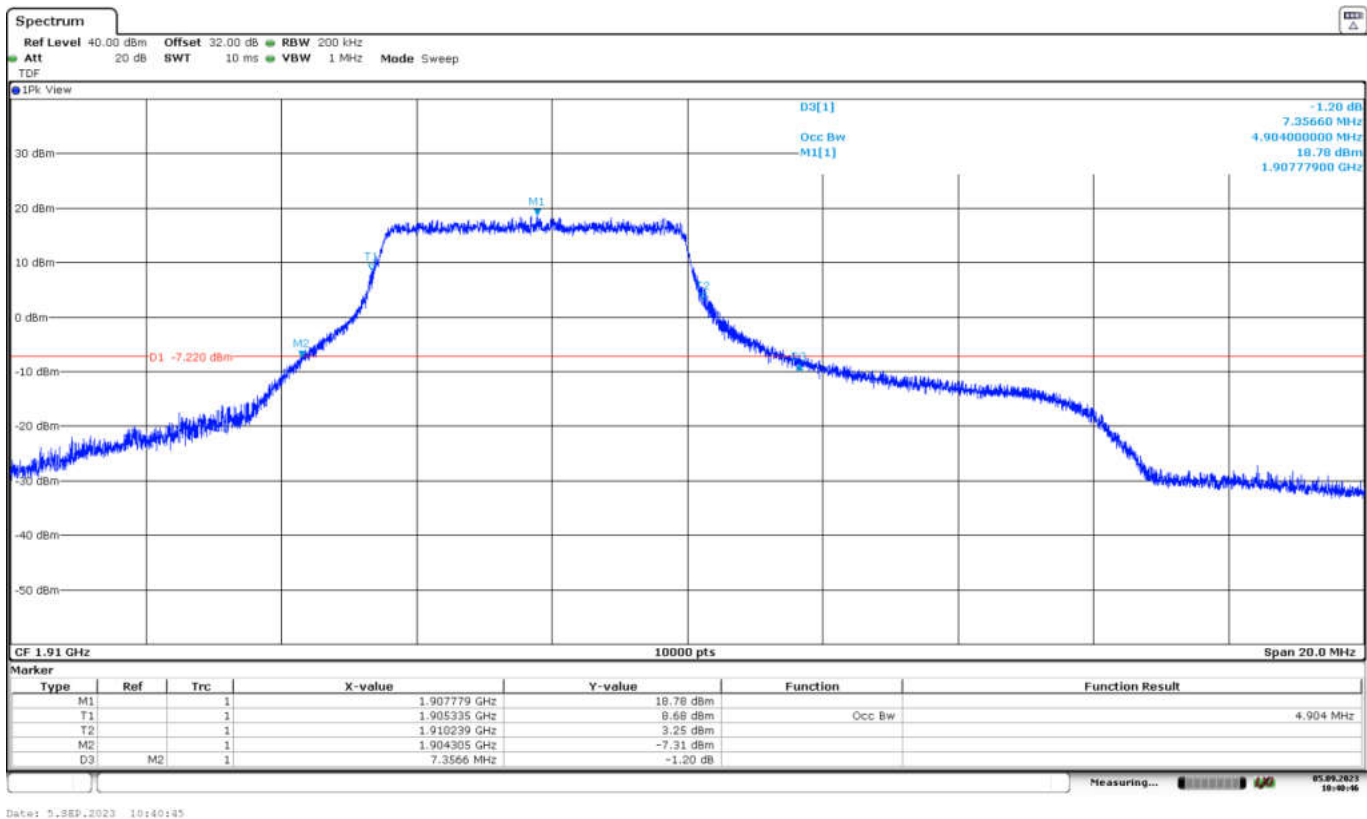
Low Channel:



Middle Channel:



High Channel:



LTE Cat 1bis Band 25. BW=15 MHz. QPSK. RB Size=All.

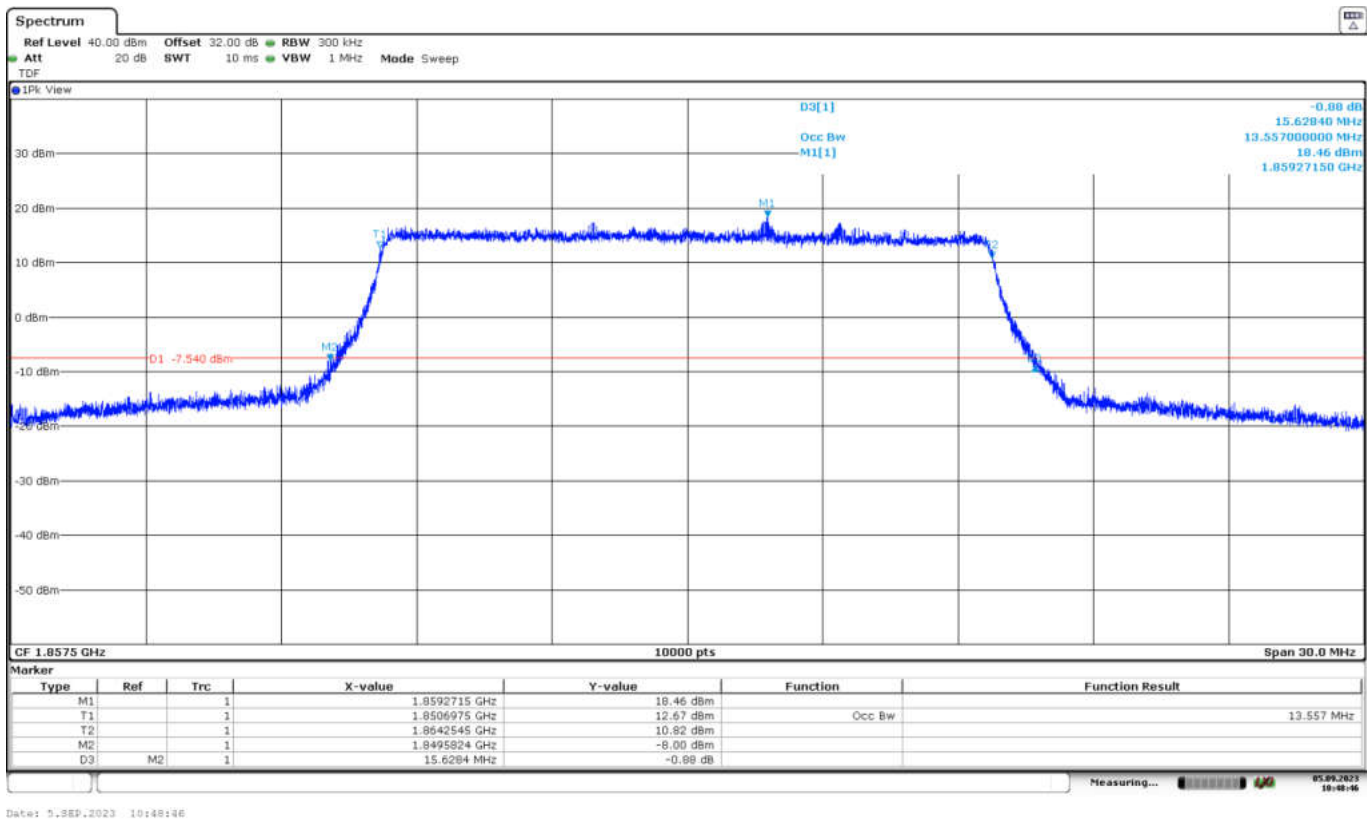
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	13.557	13.515	13.464
-26 dBc Bandwidth (MHz)	15.628	15.396	15.416
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 25. BW=15 MHz. 16QAM. RB Size=All.

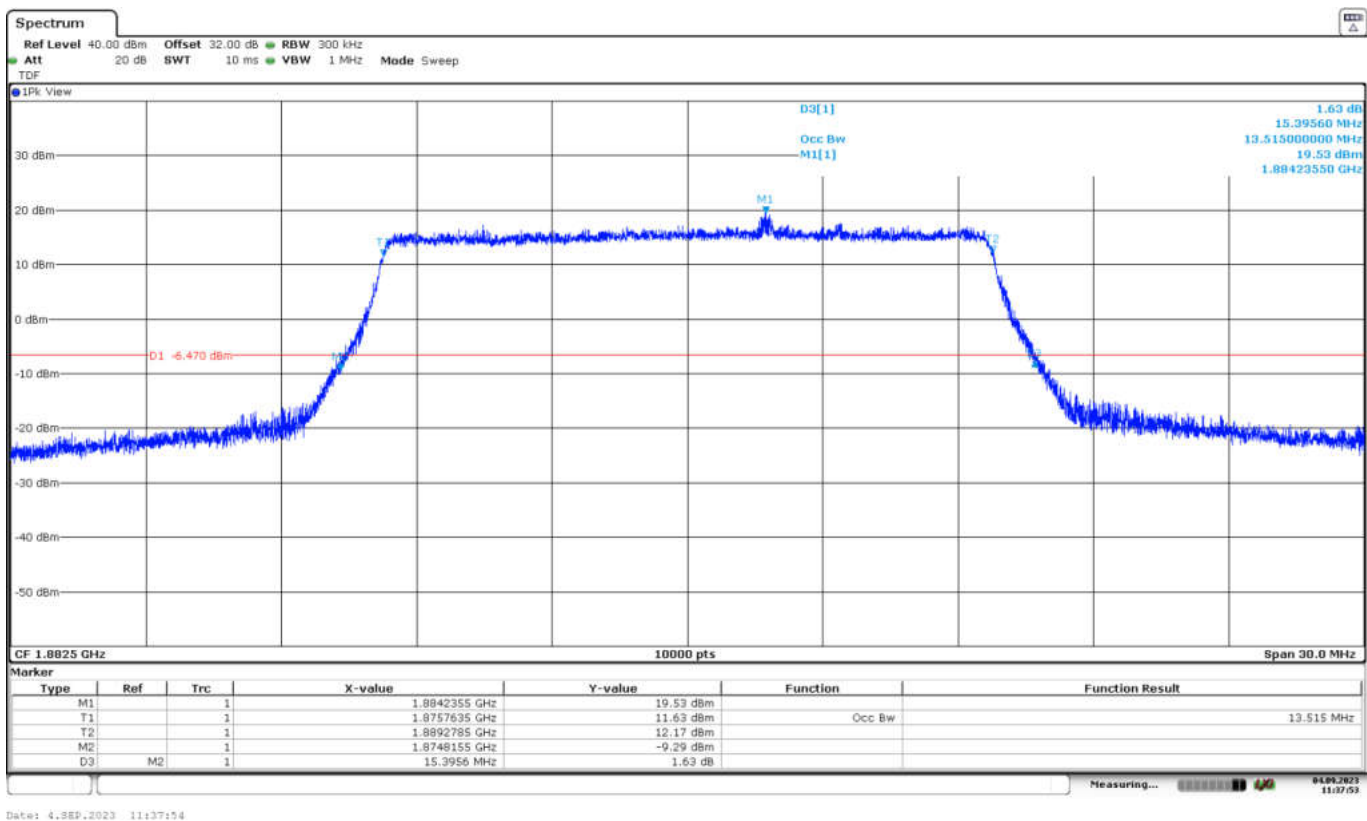
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	5.253	5.469	5.196
-26 dBc Bandwidth (MHz)	8.088	7.939	8.149
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 25. BW=15 MHz. QPSK. RB Size=All.

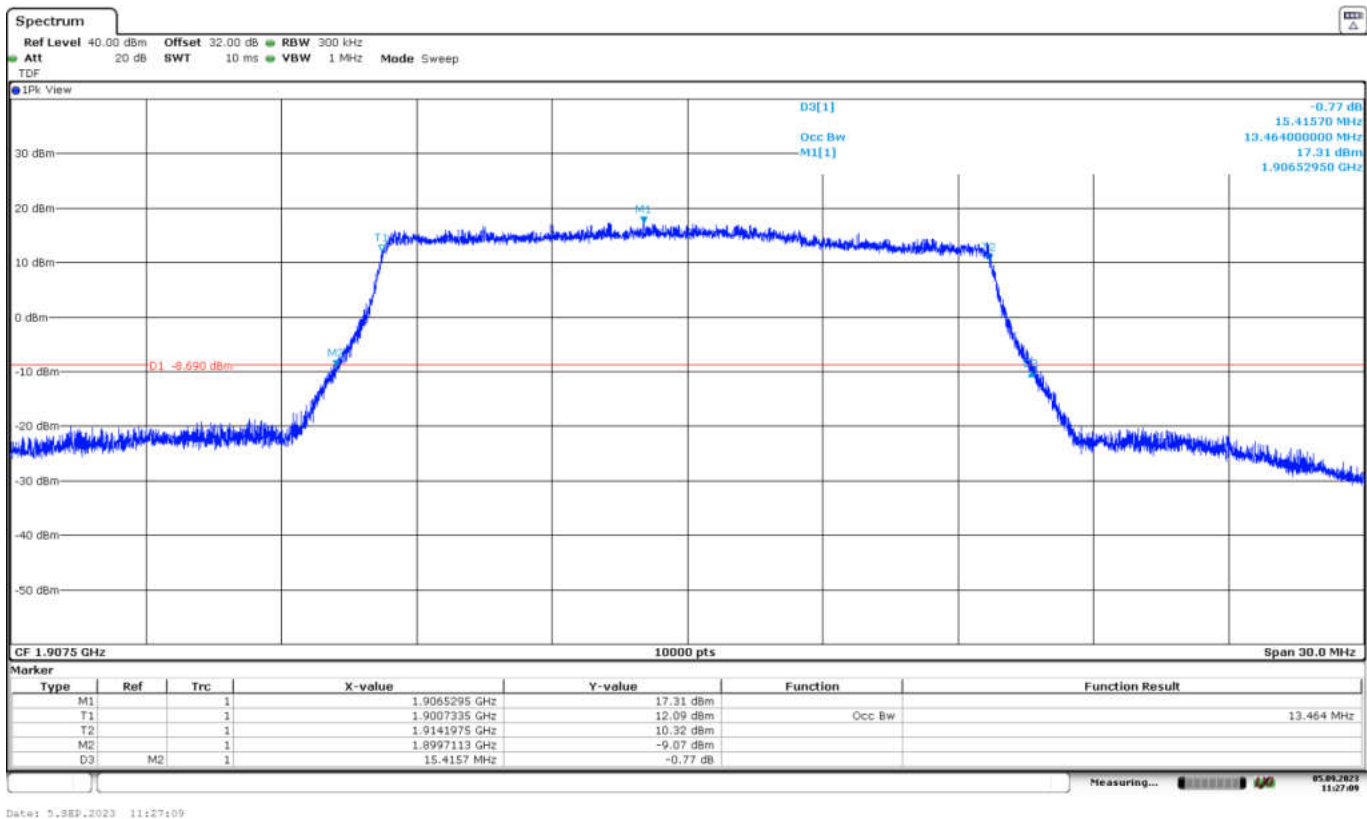
Low Channel:



Middle Channel:

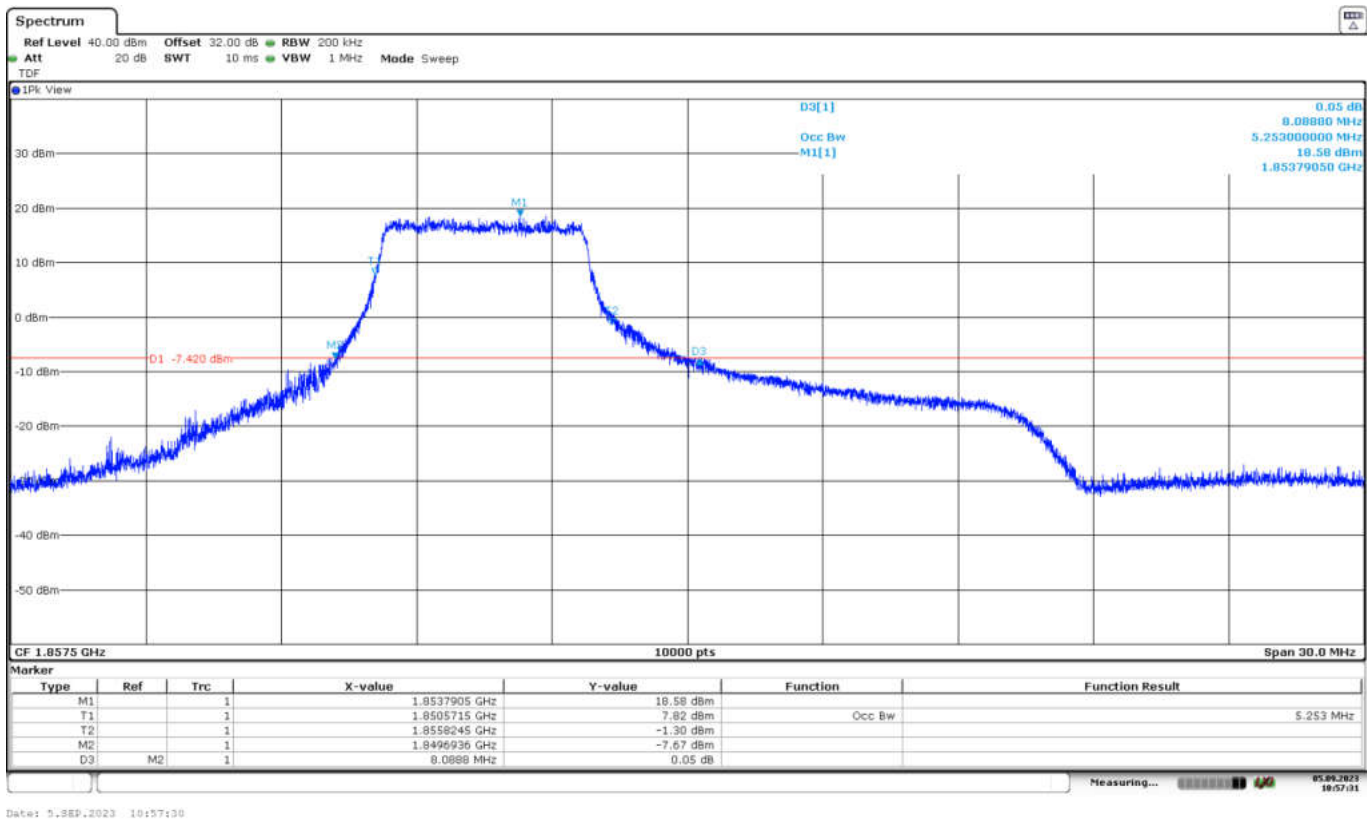


High Channel:

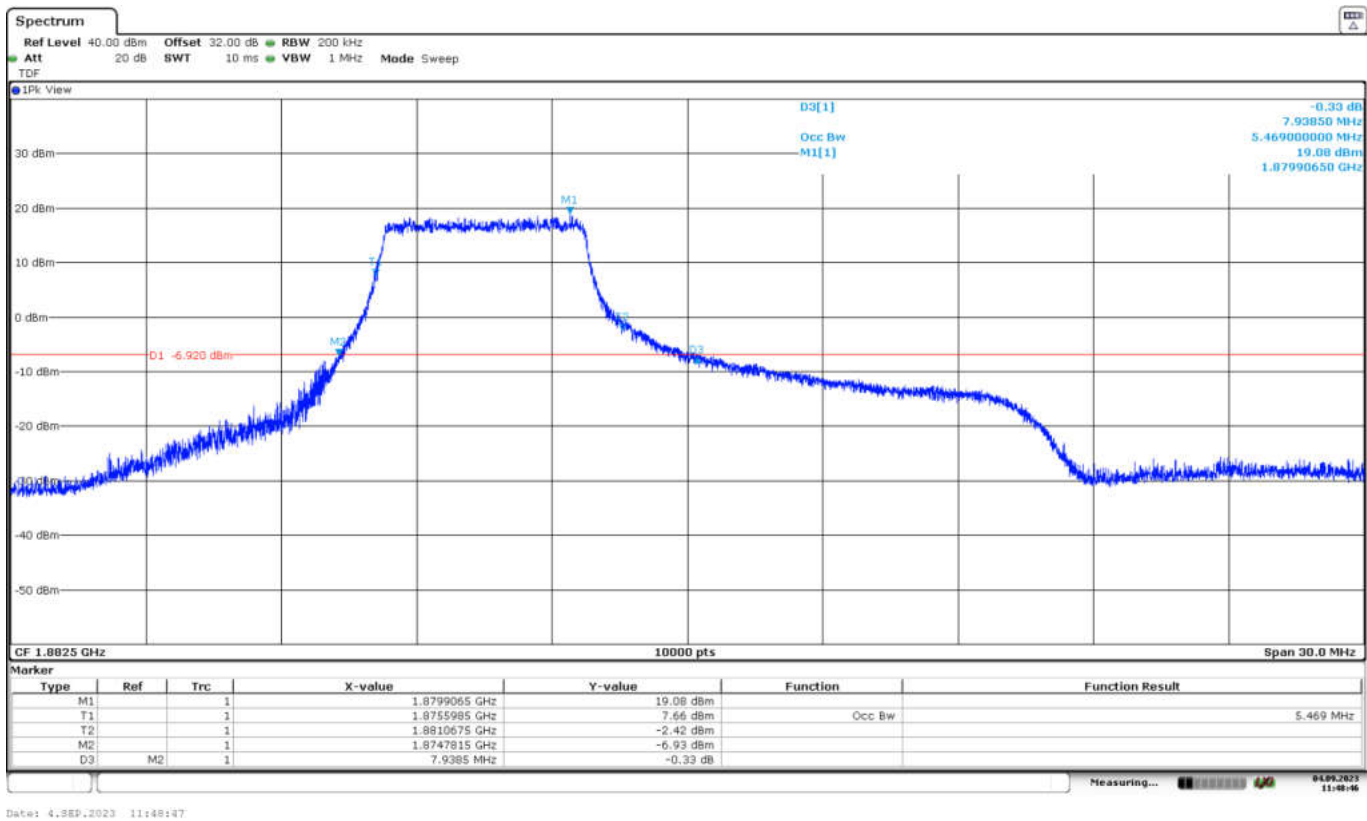


LTE Cat 1bis Band 25. BW=15 MHz. 16QAM. RB Size=All.

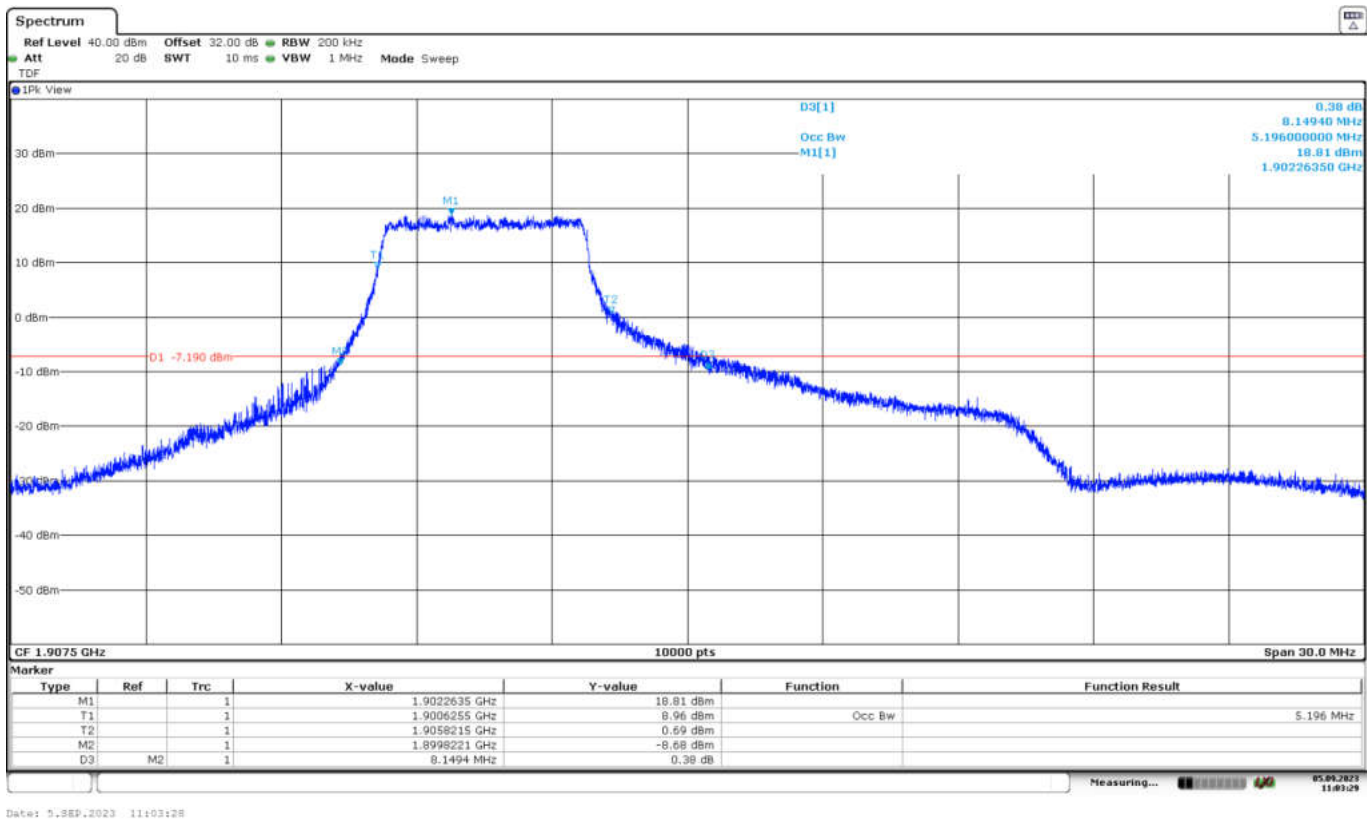
Low Channel:



Middle Channel:



High Channel:



LTE Cat 1bis Band 25. BW=20 MHz. QPSK. RB Size=All.

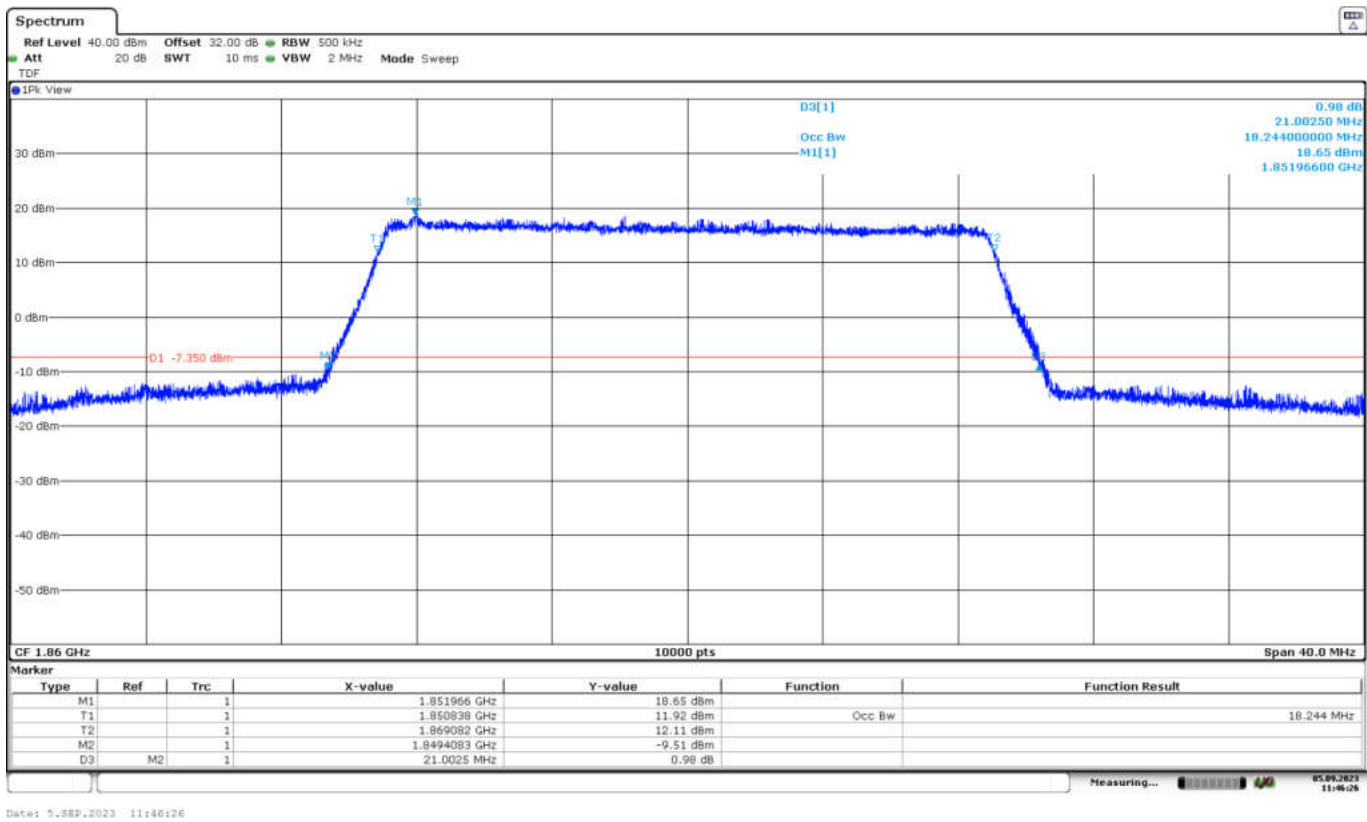
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	18.244	18.112	17.892
-26 dBc Bandwidth (MHz)	21.003	20.760	20.227
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 25. BW=20 MHz. 16QAM. RB Size=All.

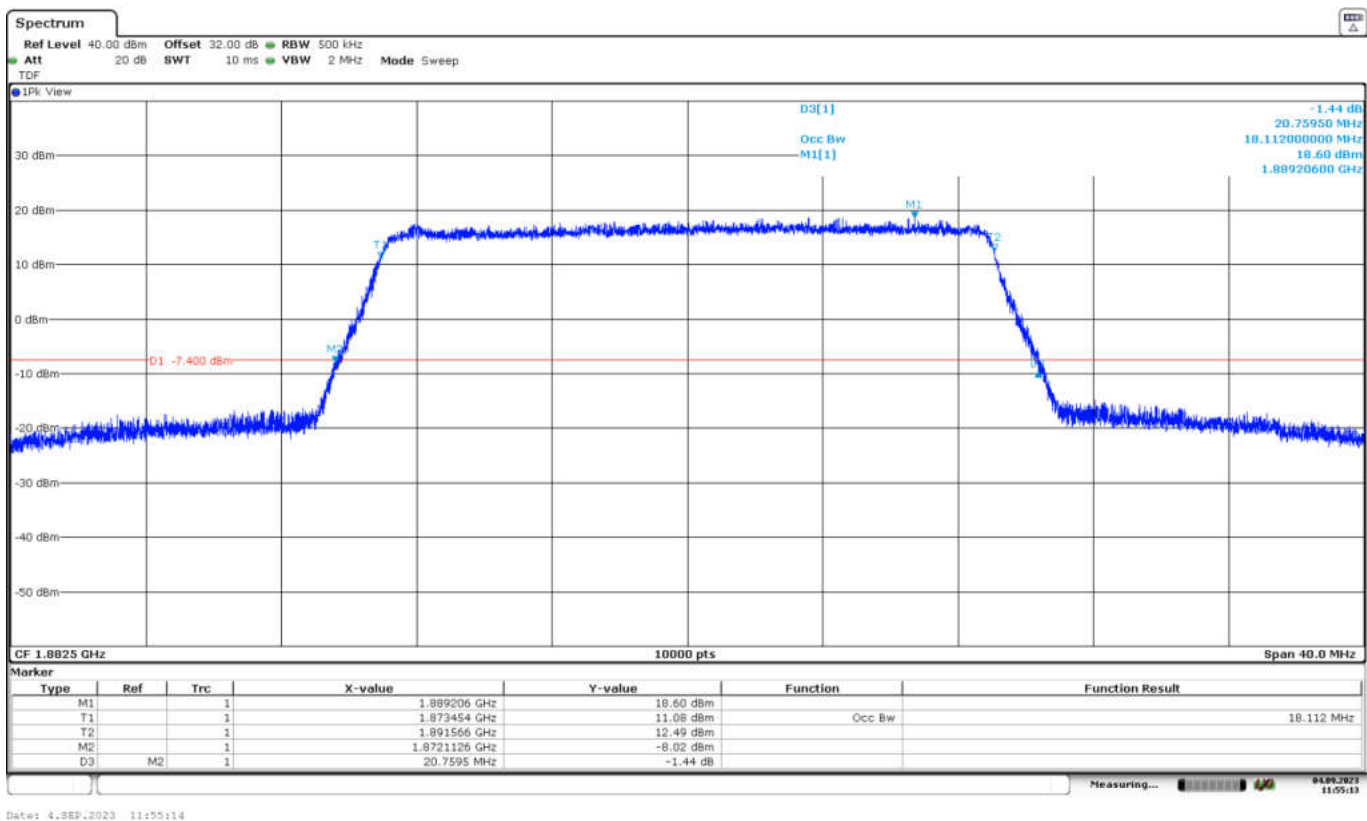
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	5.084	6.468	5.196
-26 dBc Bandwidth (MHz)	8.085	8.931	7.427
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 25. BW=20 MHz. QPSK. RB Size=All.

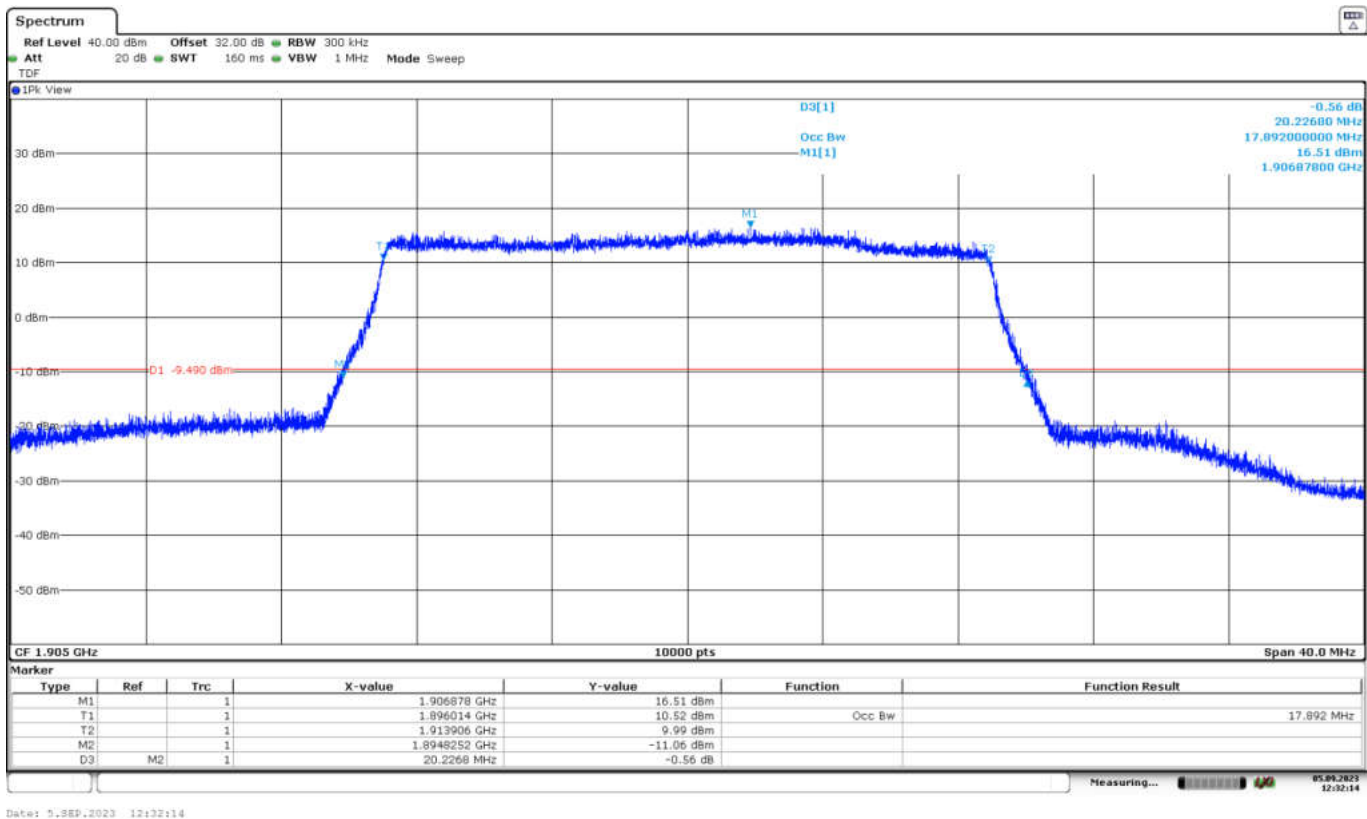
Low Channel:



Middle Channel:

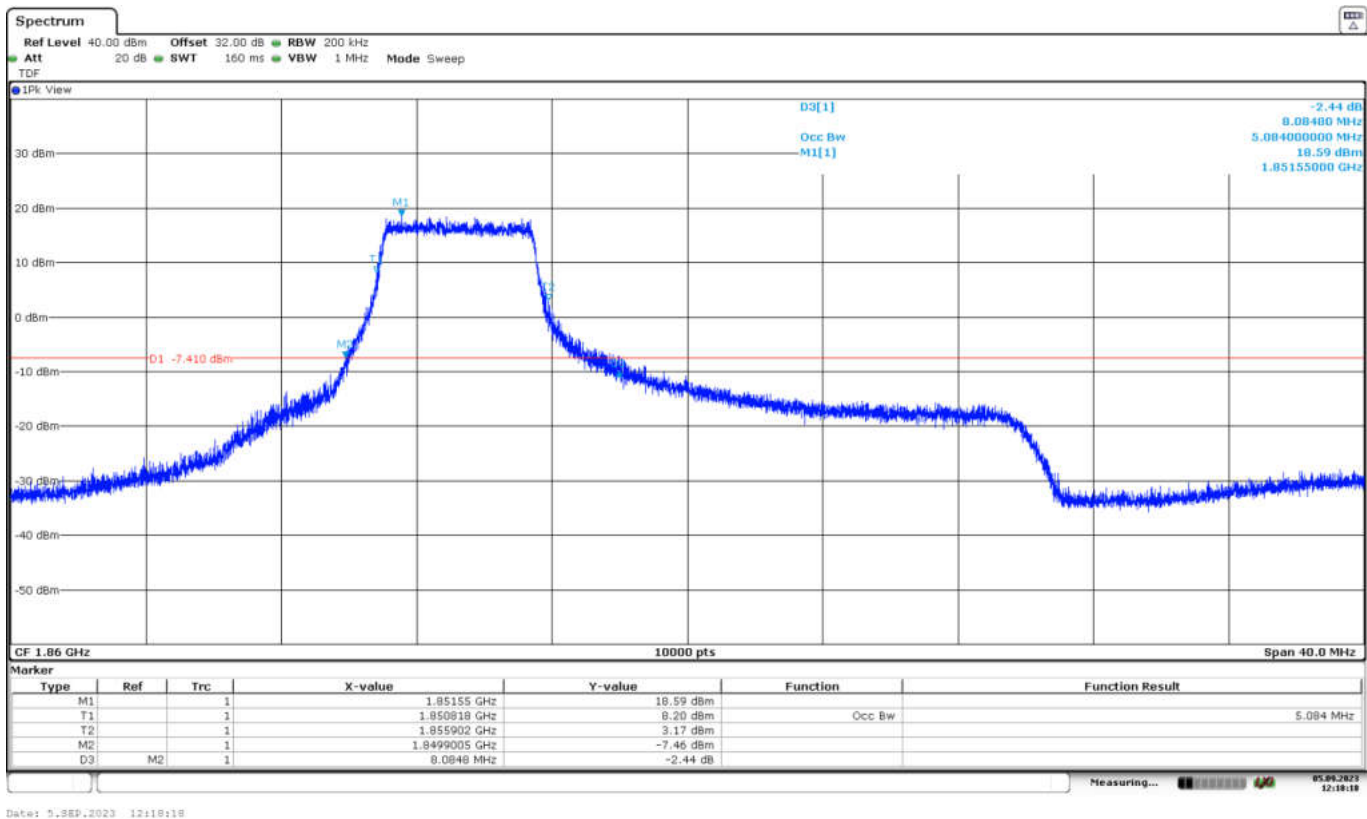


High Channel:

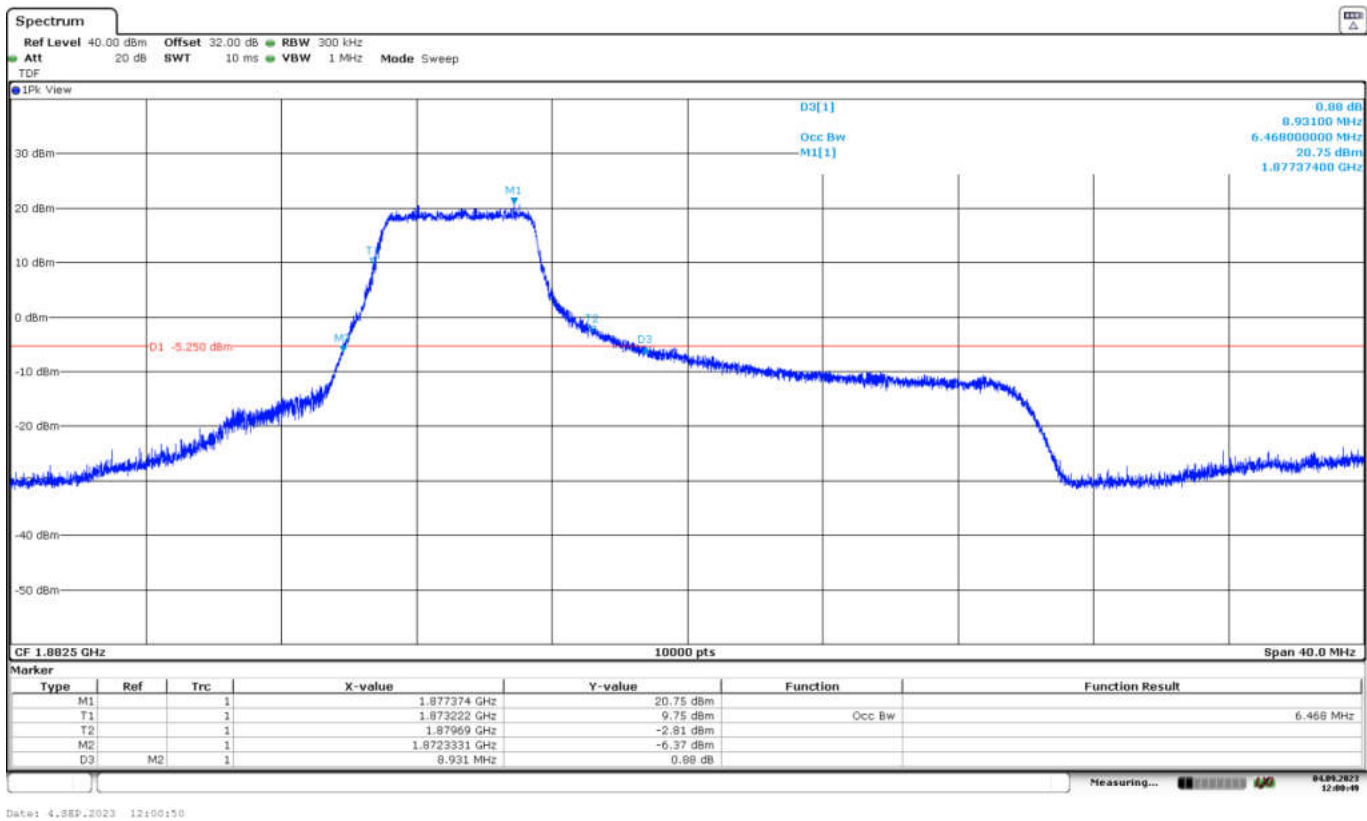


LTE Cat 1bis Band 25. BW=20 MHz. 16QAM. RB Size=All.

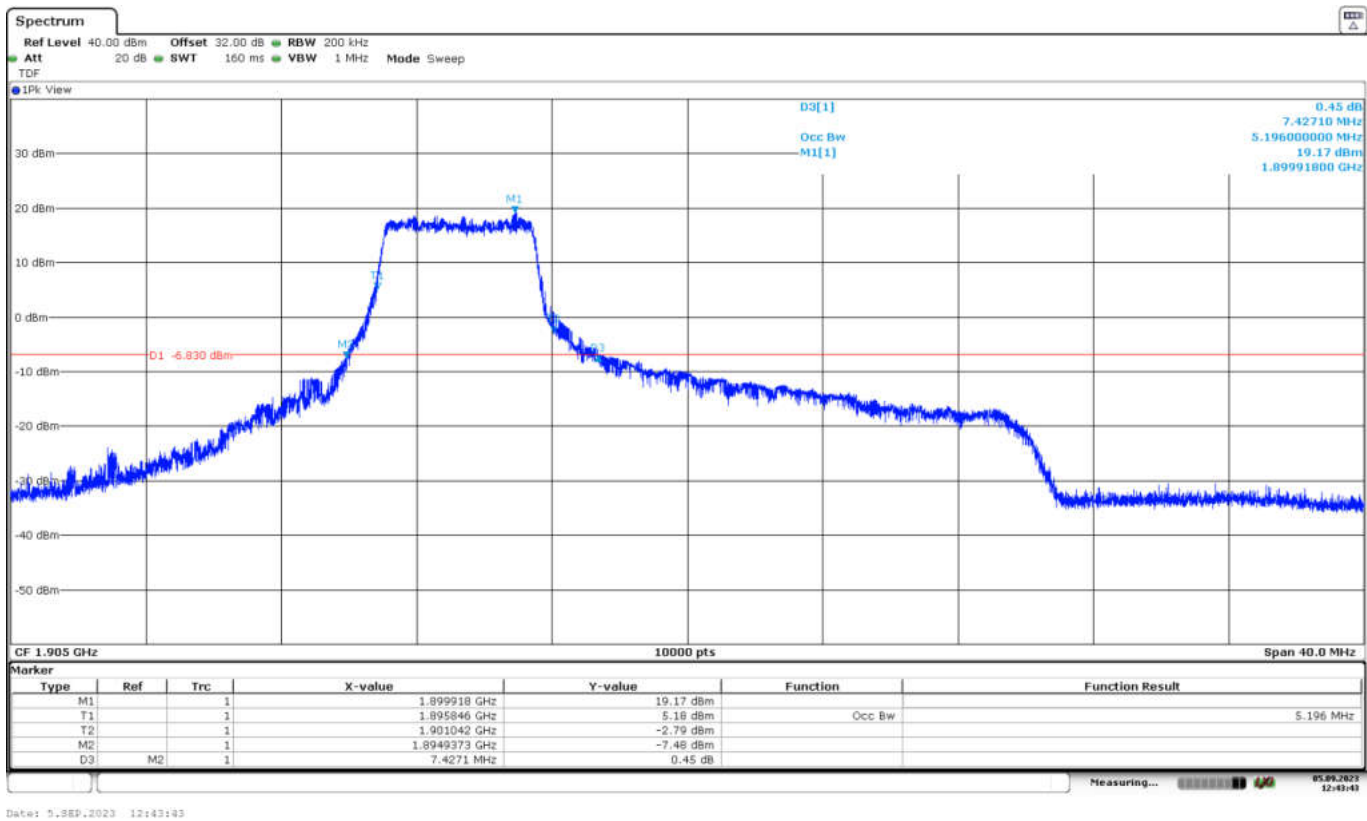
Low Channel:



Middle Channel:



High Channel:



Spurious emissions at antenna terminals

Limits

* FCC §2.1051 and §24.238. RSS-133, 6.5.

The power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log(P)$ dB. P in watts.

Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater.

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

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

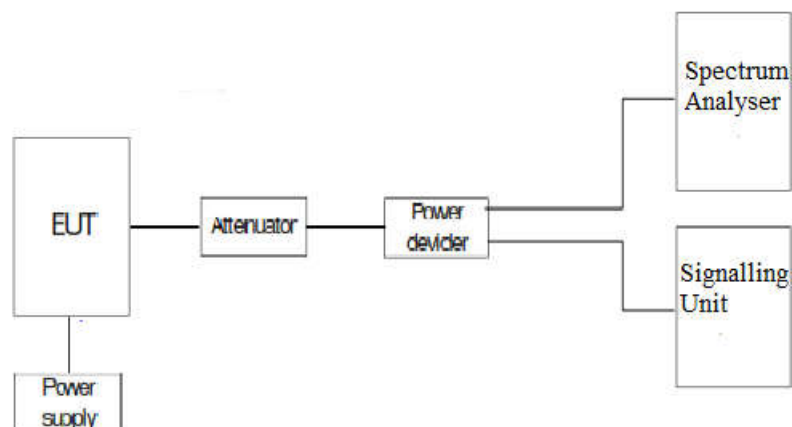
Method

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 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 1bis Band 25:

A preliminary scan determined the worst-case:

BW=15 MHz. QPSK. RB Size=1. RB Offset=37.

The next results are for this worst-case configuration.

Frequency range 9 KHz - 20 GHz:

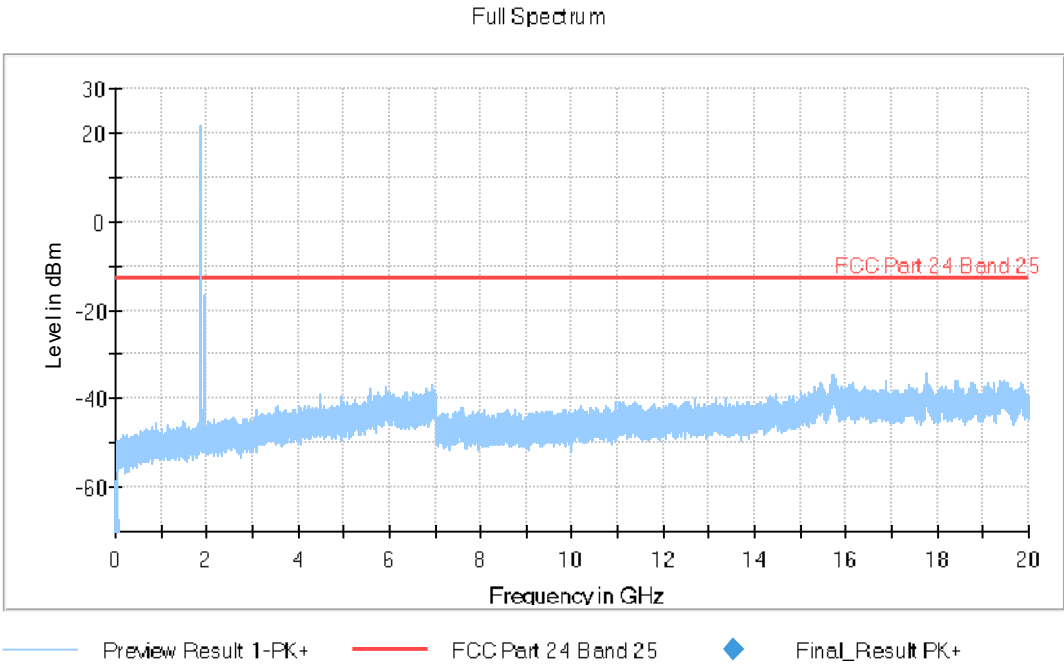
- Low Channel: No spurious frequencies at less than 20 dB below the limit.
- Middle Channel: No spurious frequencies at less than 20 dB below the limit.
- High Channel: No spurious frequencies at less than 20 dB below the limit.

Measurement uncertainty (dB): $<\pm 2.76$

Verdict: PASS

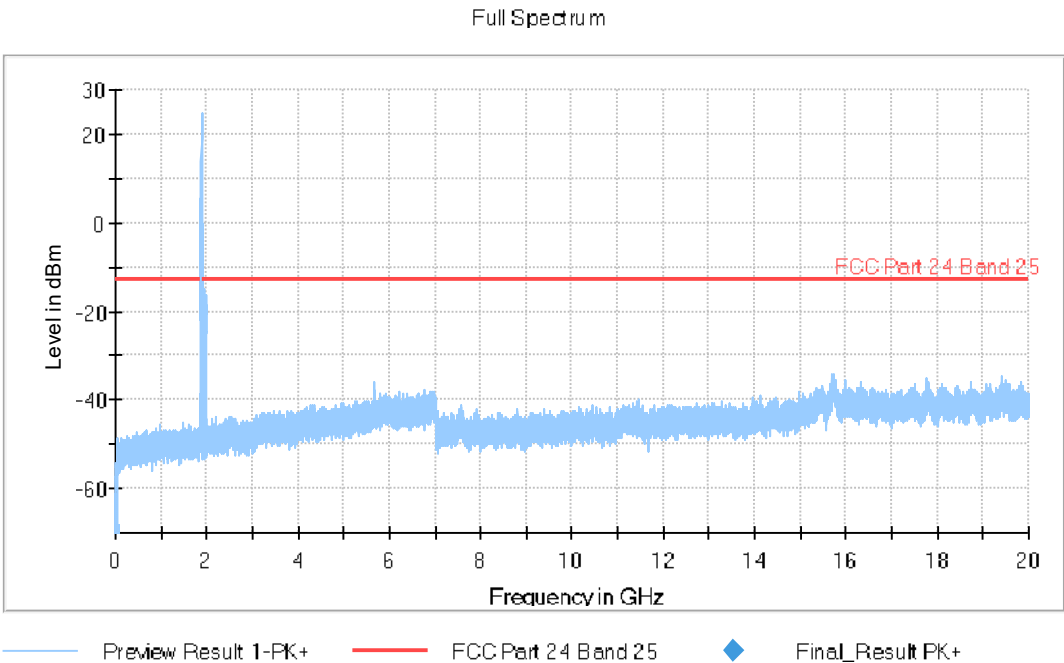
LTE Cat 1bis Band 25: BW=15 MHz. QPSK. RB Size=1. RB Offset=37.

Low Channel:



The peak above the limit is the carrier frequency.

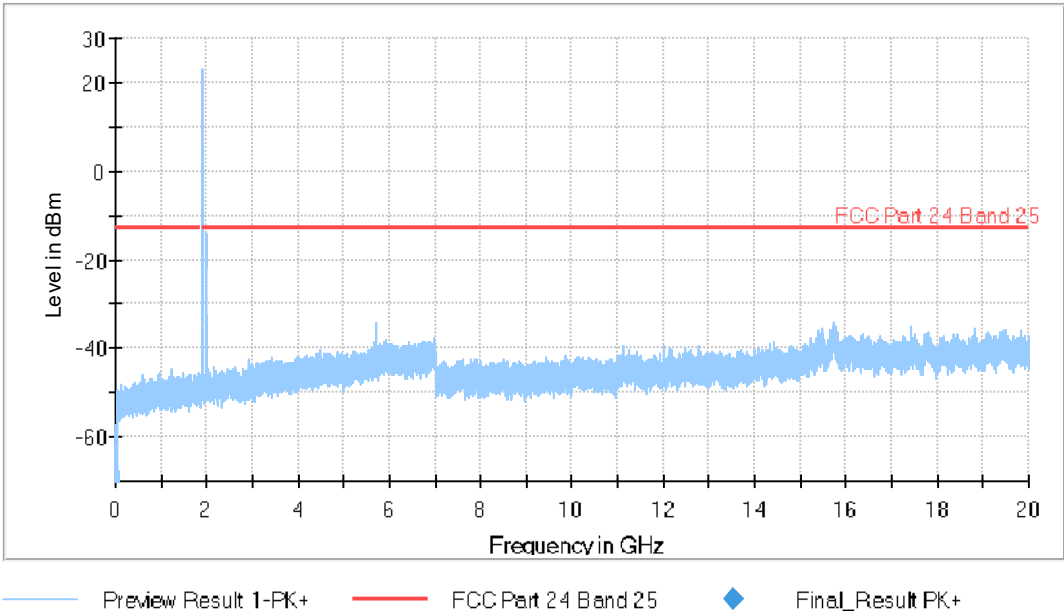
Middle Channel:



The peak above the limit is the carrier frequency.

High Channel:

Full Spectrum



The peak above the limit is the carrier frequency.

Spurious emissions at antenna terminals at Block Edges

Limits

* FCC §2.1051 and §24.238. RSS-133, 6.5.

The power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log(P)$ dB. P in watts.

Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater.

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

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

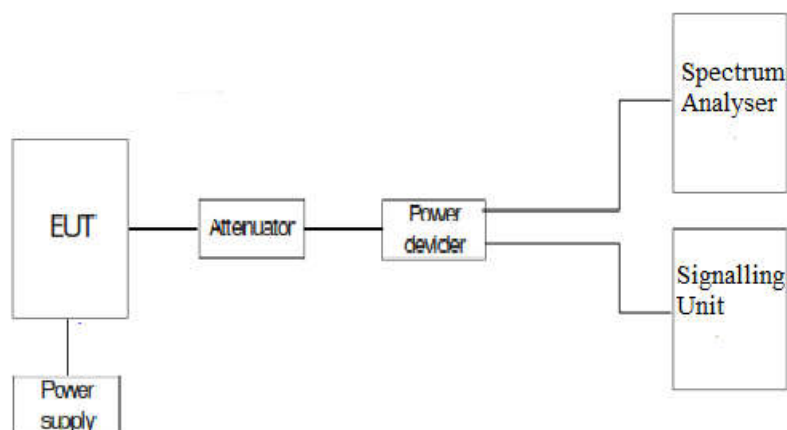
Method

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.

As stated in FCC part 24.238 / RSS-133 Clause 6.5, in the 1 MHz bands immediately outside and adjacent to the frequency block or band a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

Test Setup



Results

LTE Cat 1bis Band 2:

Note: Low Block Edge for LTE Cat 1bis Band 2 is the same as for Band 25.

Preliminary measurements determined QPSK, BW=5 MHz as the worst-case.

LTE Cat 1bis Band 2. QPSK.	RB=1. Offset =Max. BW=5 MHz	RB=1. Offset =Max. BW=10 MHz	RB=1. Offset =Max. BW=15 MHz	RB=1. Offset =Max. BW=20 MHz
Maximum measured level at <u>High Block Edge</u> at antenna port (dBm)	-17.93	-23.08	-27.47	-30.66

LTE Cat 1bis Band 2. QPSK.	RB=All. Offset=0. BW=5 MHz	RB=All. Offset=0. BW=10 MHz	RB=All. Offset=0. BW=15 MHz	RB=All. Offset=0. BW=20 MHz
Maximum measured level at <u>High Block Edge</u> at antenna port (dBm)	-18.41	-19.66	-20.66	-18.88

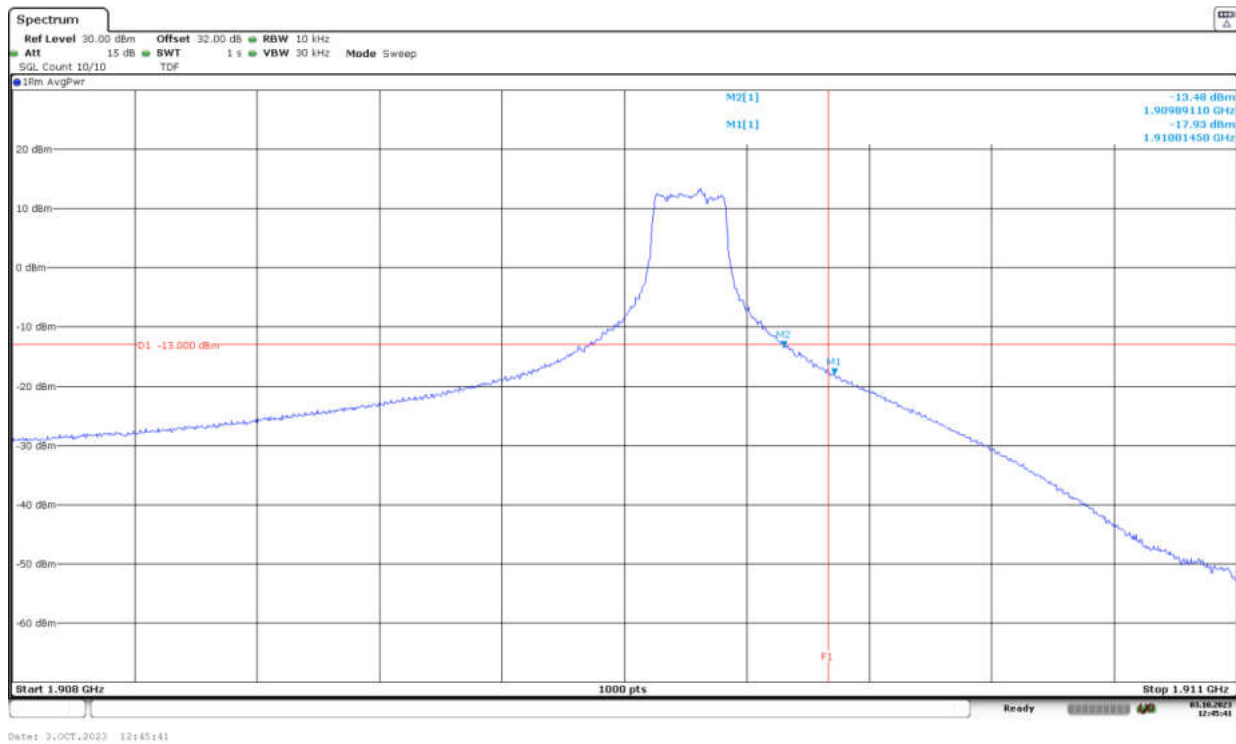
Measurement uncertainty (dB) $\leq \pm 2.76$

Verdict

PASS

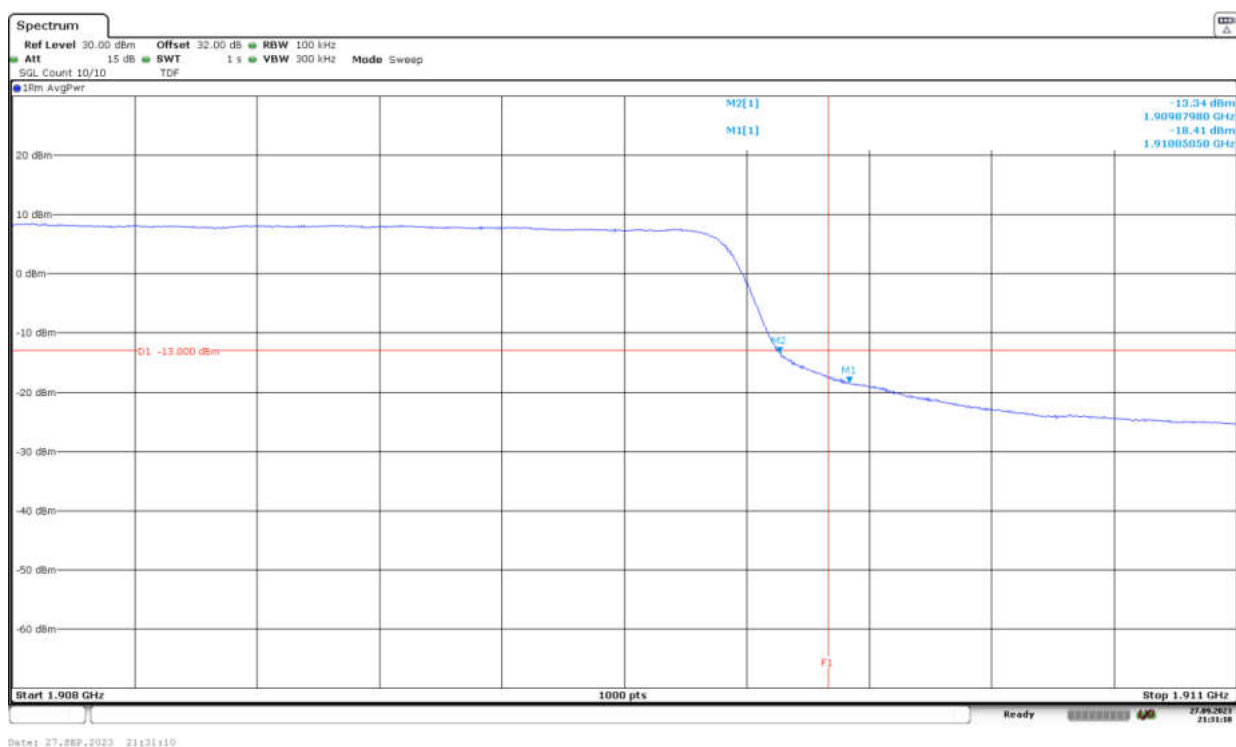
The plots below are for the worst case configuration specified before.

LTE Cat 1bis Band 2. BW=5 MHz. QPSK. RB Size=1. RB Offset=Max. High Block Edge:



The equipment transmits at the maximum output power.

LTE Cat 1bis Band 2. BW=5 MHz. QPSK. RB Size=All. RB Offset=0. High Block Edge:



The equipment transmits at the maximum output power.

LTE Cat 1bis Band 25:

Preliminary measurements determined QPSK, BW=5 MHz as the worst-case.

LTE Cat 1bis Band 25. QPSK.	RB=1. Offset =0. BW=5 MHz	RB=1. Offset =0. BW=10 MHz	RB=1. Offset =0. BW=15 MHz	RB=1. Offset =0. BW=20 MHz
Maximum measured level at <u>Low Block Edge</u> at antenna port (dBm)	-19.63	-23.63	-29.16	-31.91

LTE Cat 1bis Band 25. QPSK.	RB=All. Offset=0. BW=5 MHz	RB=All. Offset=0. BW=10 MHz	RB=All. Offset=0. BW=15 MHz	RB=All. Offset=0. BW=20 MHz
Maximum measured level at <u>Low Block Edge</u> at antenna port (dBm)	-19.86	-21.34	-24.15	-24.74

LTE Cat 1bis Band 25. QPSK.	RB=1. Offset =Max. BW=5 MHz	RB=1. Offset =Max. BW=10 MHz	RB=1. Offset =Max. BW=15 MHz	RB=1. Offset =Max. BW=20 MHz
Maximum measured level at <u>High Block Edge</u> at antenna port (dBm)	-19.37	-23.97	-28.86	-32.1

LTE Cat 1bis Band 25. QPSK.	RB=All. Offset=1. BW=5 MHz	RB=All. Offset=1. BW=10 MHz	RB=All. Offset=1. BW=15 MHz	RB=All. Offset=1. BW=20 MHz
Maximum measured level at <u>High Block Edge</u> at antenna port (dBm)	-17.9	-20.81	-26.2	-25.76

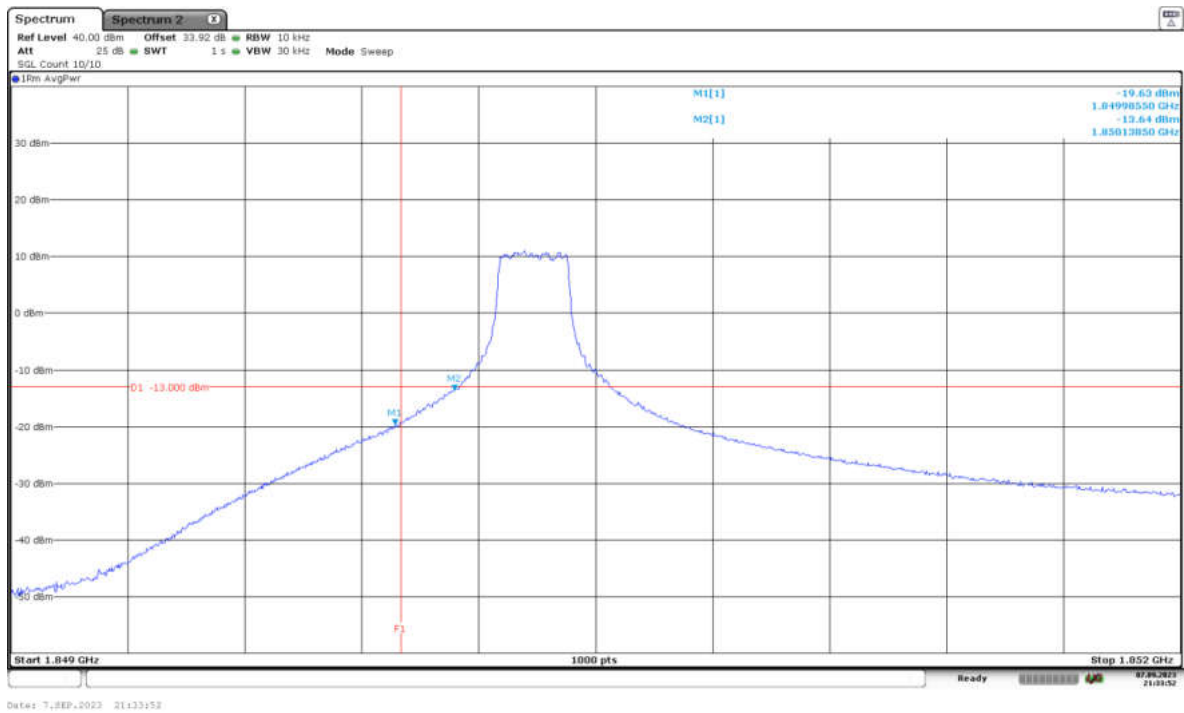
Measurement uncertainty (dB) $< \pm 2.76$

Verdict

PASS

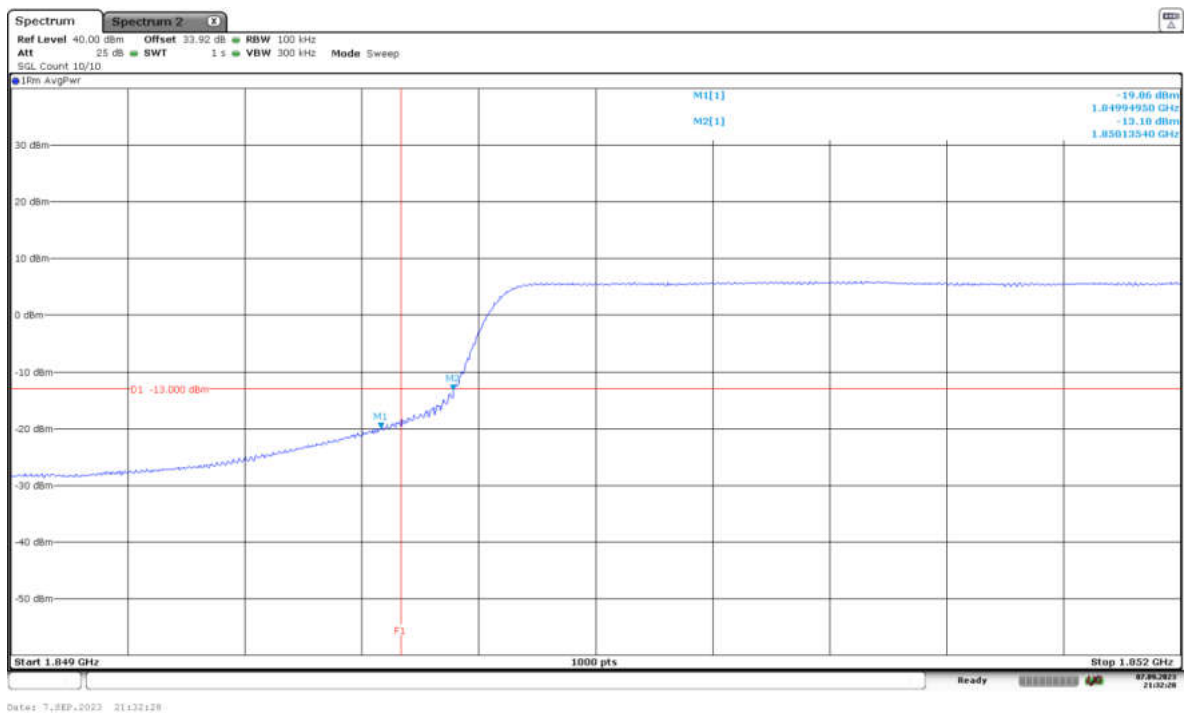
The plots below are for the worst case configuration specified before.

LTE Cat 1bis Band 25. BW=5 MHz. QPSK. RB Size=1. RB Offset=0. Low Block Edge:



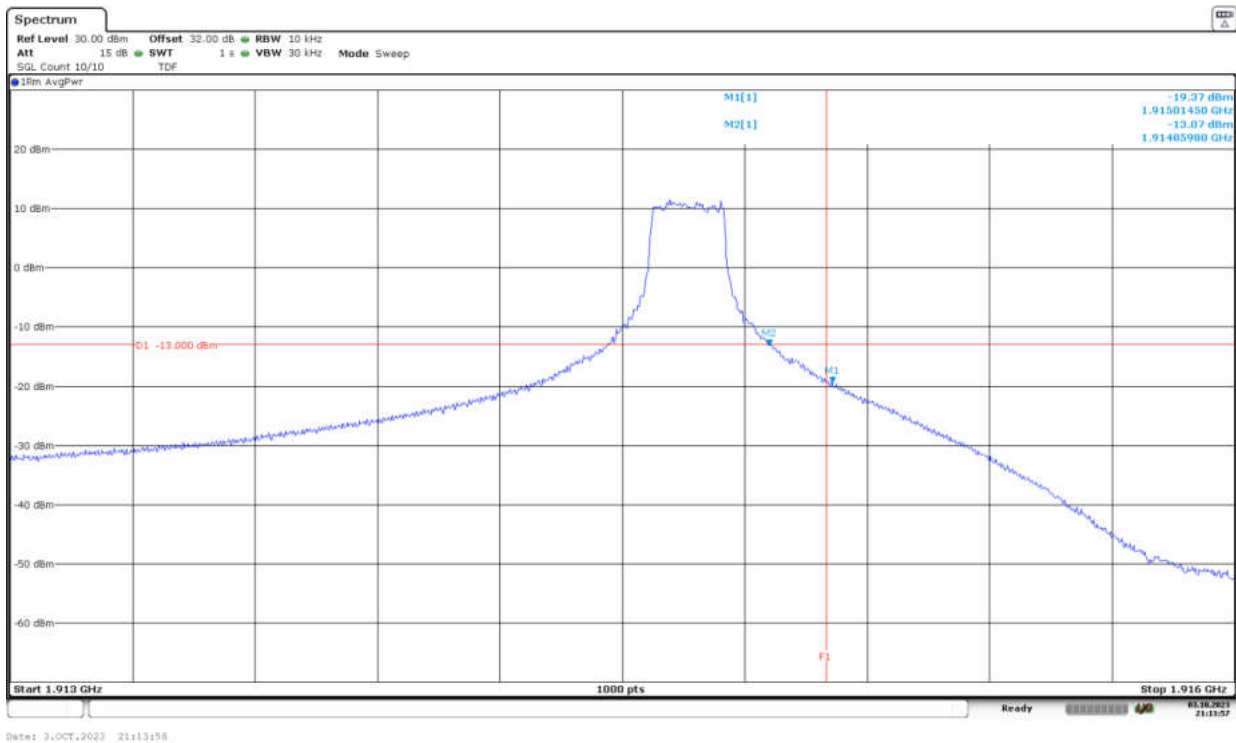
The equipment transmits at the maximum output power.

LTE Cat 1bis Band 25. BW=5 MHz. QPSK. RB Size=All. RB Offset=0. Low Block Edge:



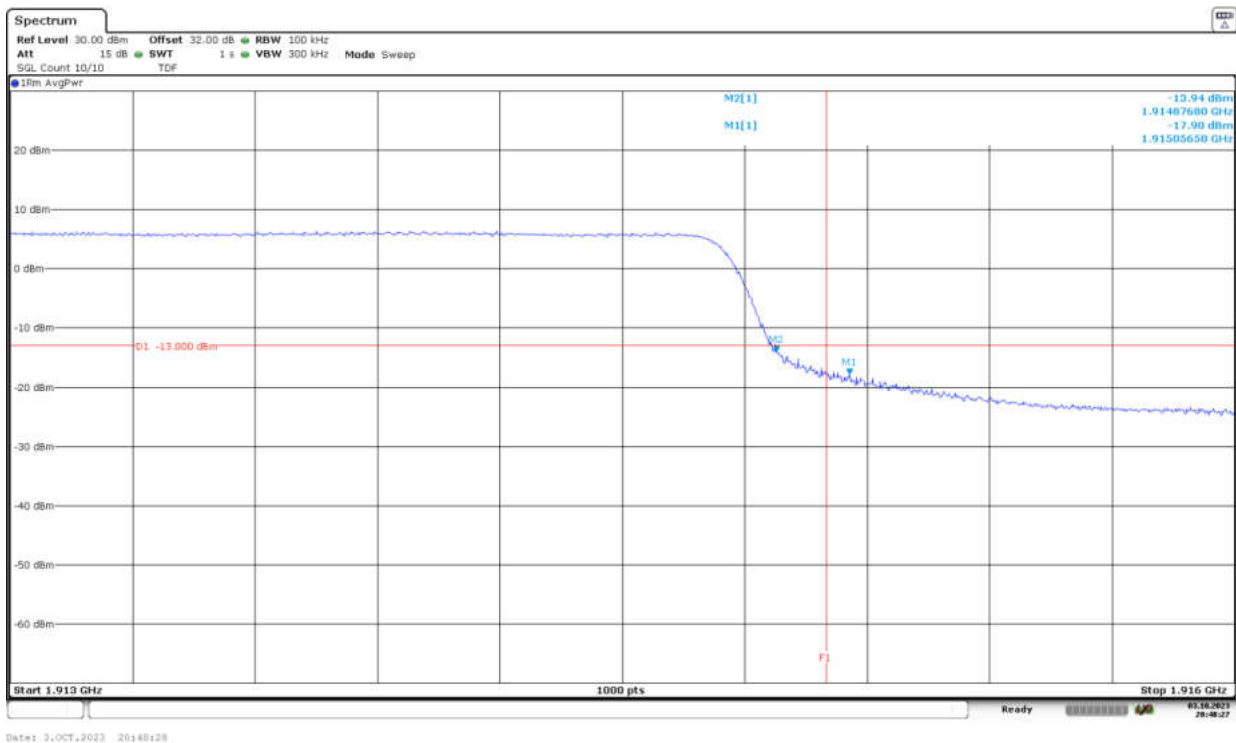
The equipment transmits at the maximum output power.

LTE Cat 1bis Band 25. BW=5 MHz. QPSK. RB Size=1. RB Offset=Max. High Block Edge:



The equipment transmits at the maximum output power.

LTE Cat 1bis Band 25. BW=5 MHz. QPSK. RB Size=All. RB Offset=0. High Block Edge:



The equipment transmits at the maximum output power.

Radiated emissions

Limits

* FCC §2.1051 and §24.238. RSS-133, Clause 6.5.

The power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log(P)$ dB. P in watts.

Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater.

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

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

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 High frequency generated within the equipment.

The EUT was placed on a non-conductive stand at 3-meter distance from the measuring antenna for measurements up to 18 GHz. Measurements above 18 GHz require the distance to be reduced to 1.5 meters.

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 Limit:

At P_o transmitting power. the specified minimum attenuation becomes $43 + 10 \log(P_o)$ and the level in dBm relative to P_o becomes:

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

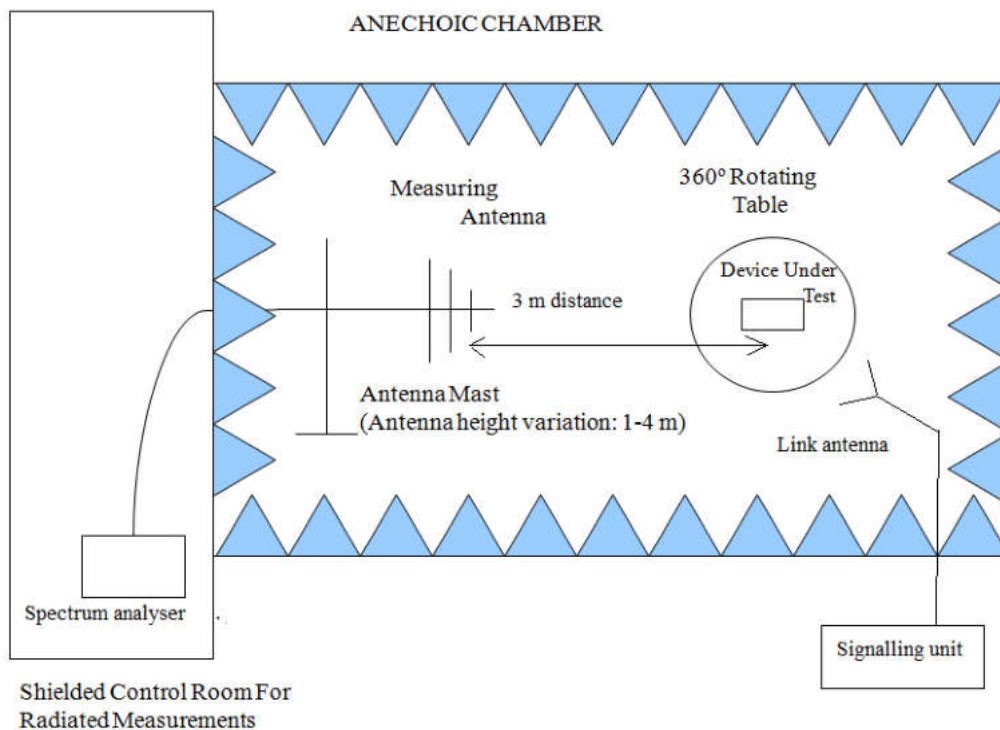
The maximum field strength (dB μ V/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

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

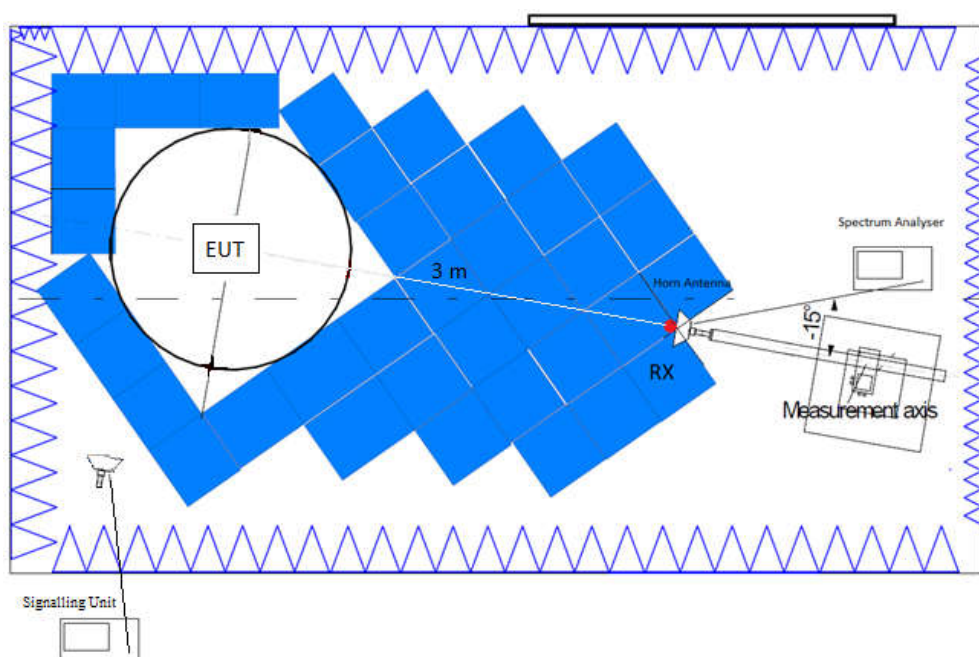
where D is the measurement distance (in the far field region) in m.

Test Setup

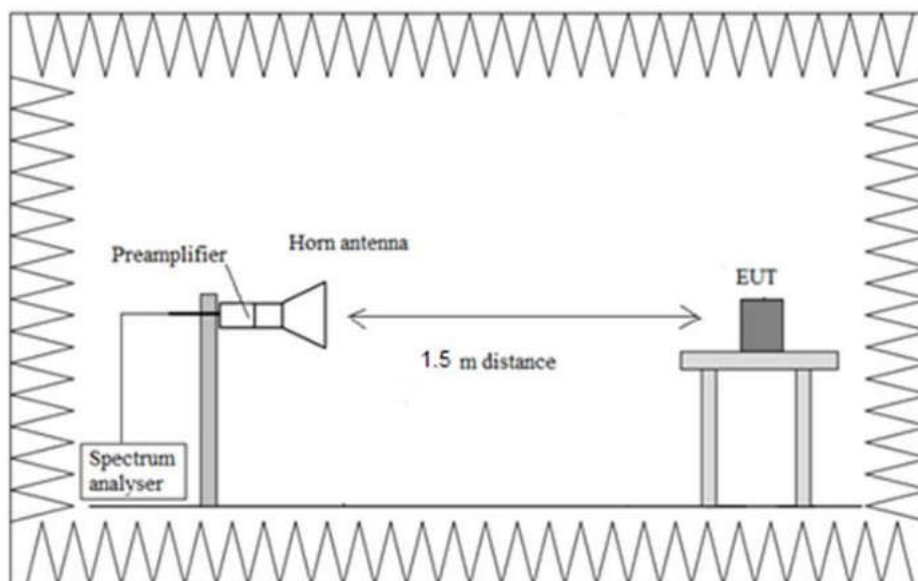
Radiated measurements below 1 GHz:



Radiated measurements above 1 GHz up to 18 GHz:



Radiated measurements above 18 GHz:



Results

LTE Cat 1bis Band 25:

A preliminary scan determined the BW=15 MHz, QPSK, RB Size=1, RB Offset=37 as the worst case. The following results are for this worst-case configuration.

- LOW CHANNEL:

Frequency range 30 MHz - 1 GHz:

No spurious signals were found at less than 20 dB below the limit.

Frequency range 1 - 18 GHz:

No spurious signals were found at less than 20 dB below the limit.

Frequency range 18 - 20 GHz:

No spurious signals were found at less than 20 dB below the limit.

- MIDDLE CHANNEL:

Frequency range 30 MHz - 1 GHz:

No spurious signals were found at less than 20 dB below the limit.

Frequency range 1 - 18 GHz:

Spurious signals were found at less than 20 dB below the limit:

Spurious frequency (MHz)	E.I.R.P (dBm)	Polarization	Detector
3.76453125	-31.64	V	Peak
5.64703125	-30.15	H	Peak

Frequency range 18 - 20 GHz:

No spurious signals were found at less than 20 dB below the limit.

- HIGH CHANNEL:

Frequency range 30 MHz - 1 GHz:

No spurious signals were found at less than 20 dB below the limit.

Frequency range 1 - 18 GHz:

No spurious signals were found at less than 20 dB below the limit.

Frequency range 18 - 20 GHz:

No spurious signals were found at less than 20 dB below the limit.

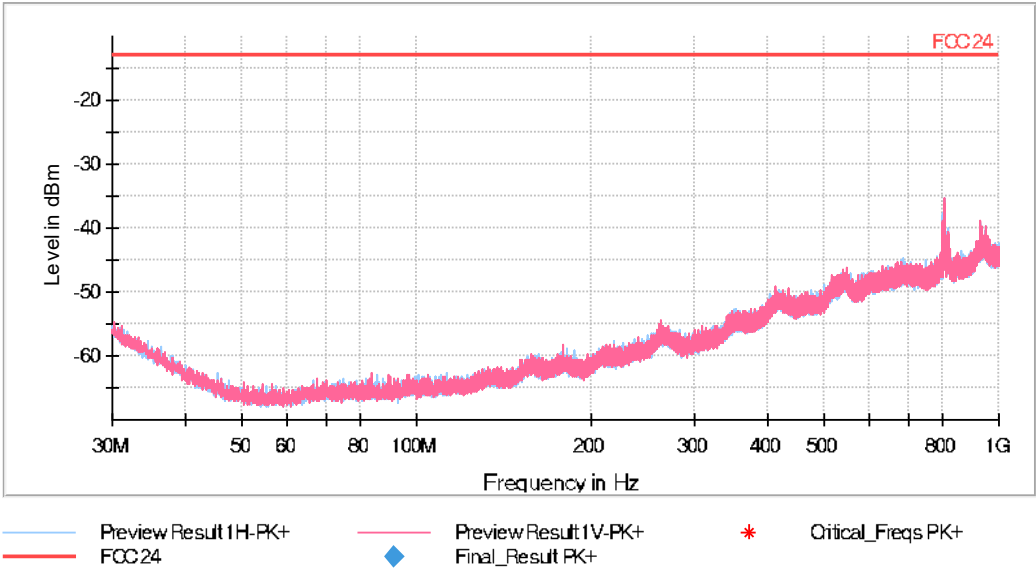
Measurement uncertainty (dB) $\leq \pm 5.03$ for $f < 1$ GHz
 $\leq \pm 4.32$ for $f \geq 1$ GHz up to 17 GHz
 $\leq \pm 4.58$ for $f \geq 17$ GHz up to 20 GHz

Verdict Pass

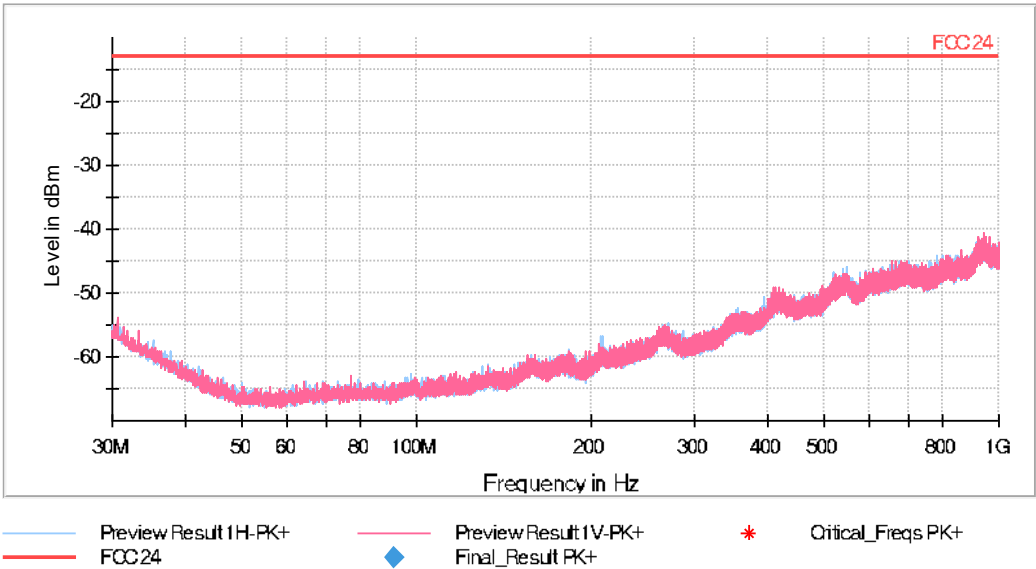
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	30.312 kHz	PK+	1 MHz	1 s	0 dB
1 GHz - 3 GHz	62.5 kHz	PK+	1 MHz	1 s	0 dB
3 GHz - 18 GHz	468.75 kHz	PK+	1 MHz	1 s	0 dB
18 GHz - 20 GHz	62.5 kHz	PK+	1 MHz	1 s	0 dB

FREQUENCY RANGE 30 MHz - 1 GHz:

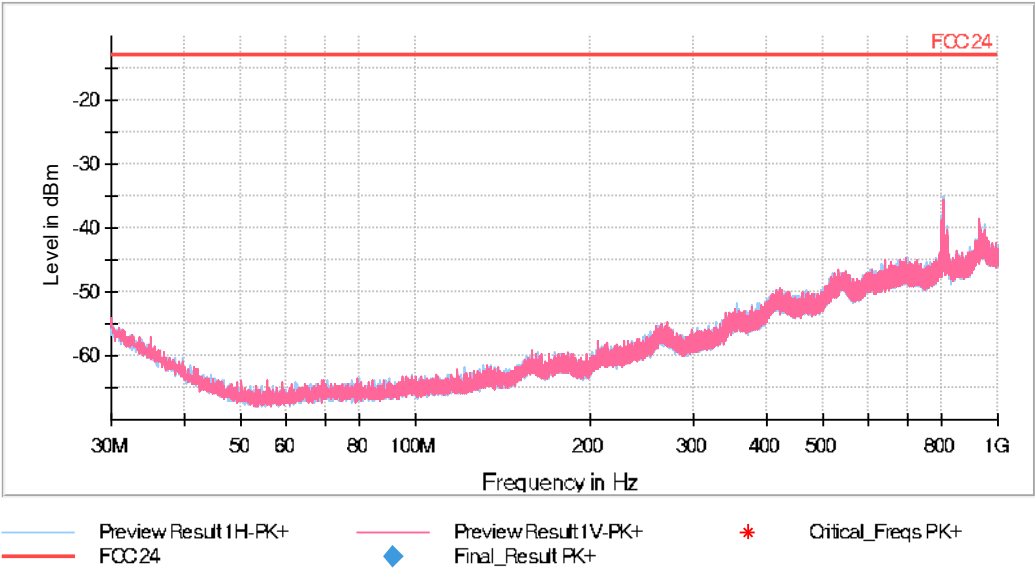
- Low Channel:



- Middle Channel:

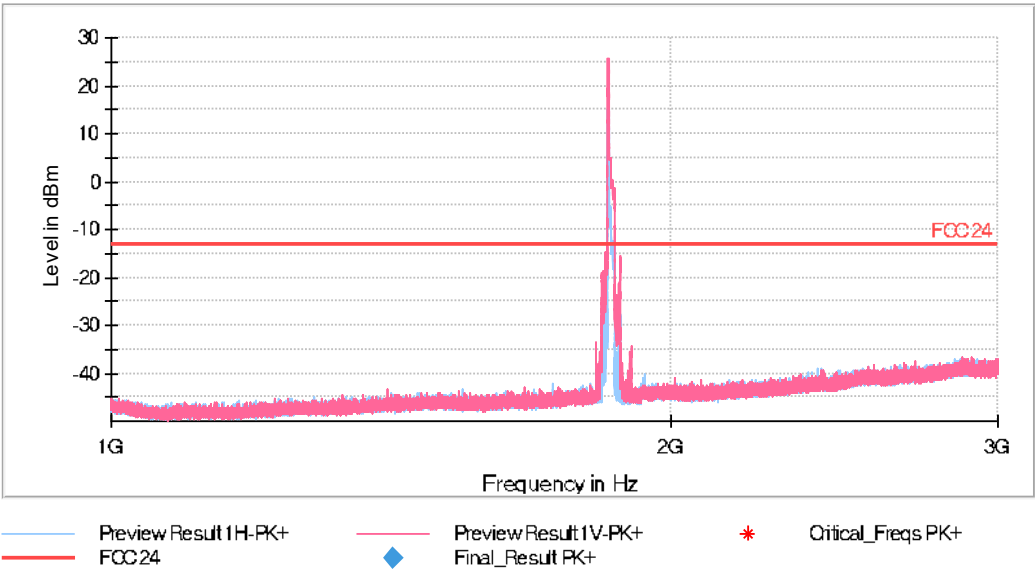


- High Channel:



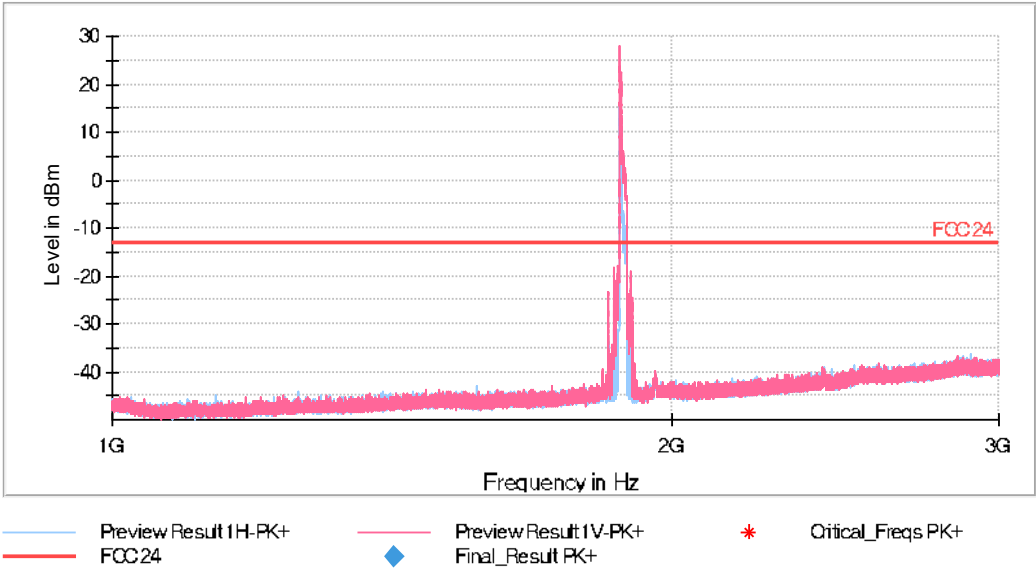
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



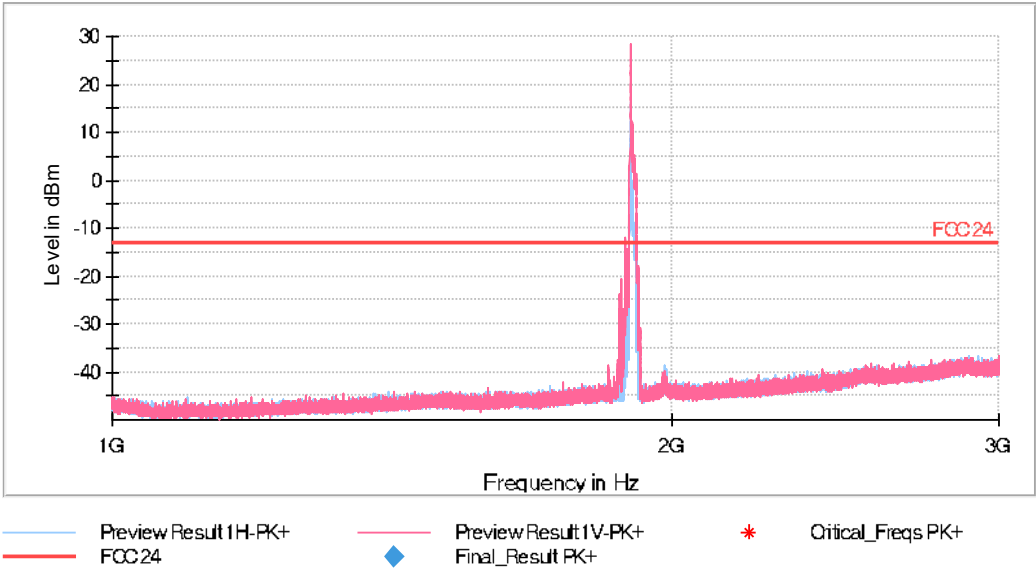
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

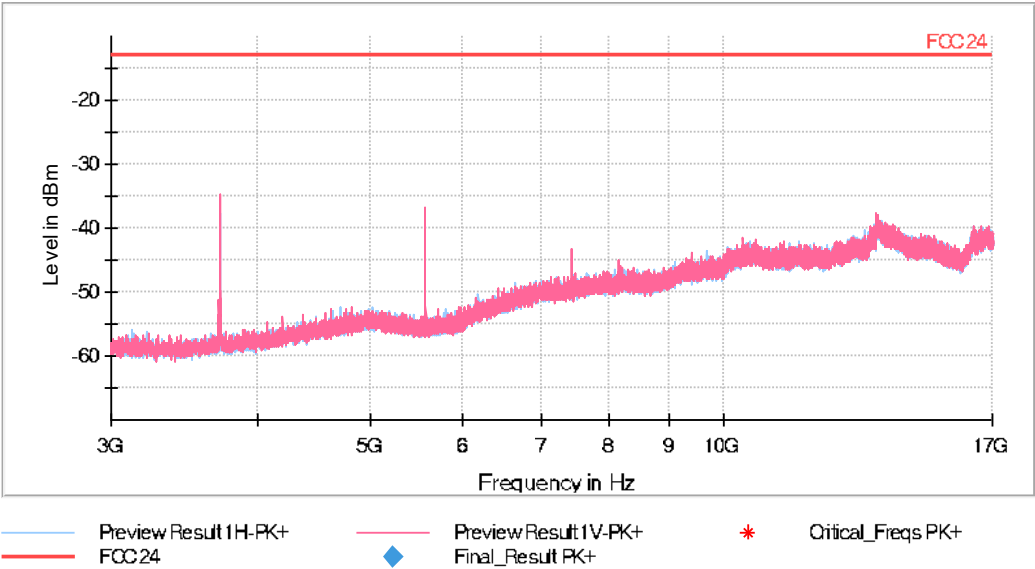
- High Channel:



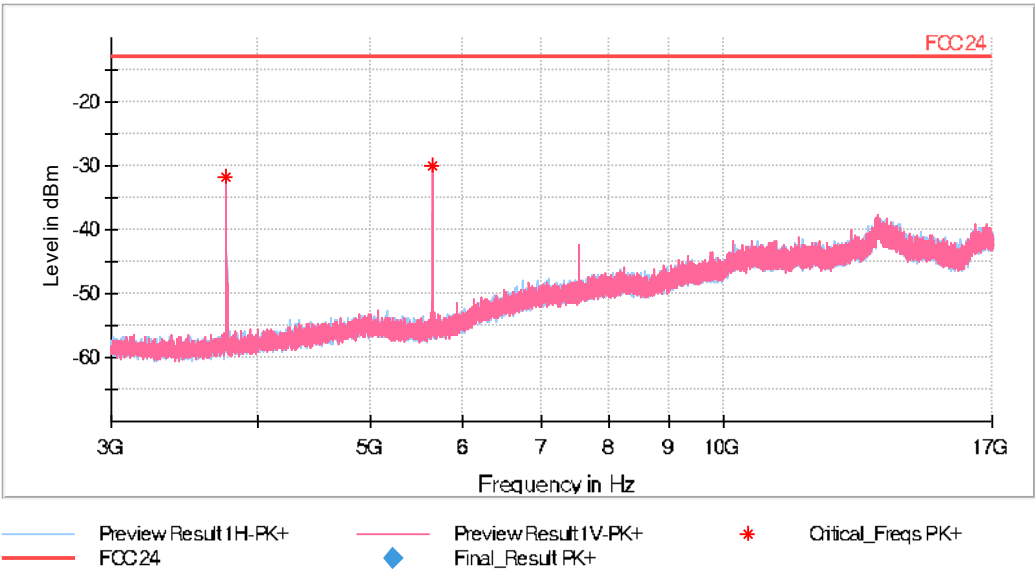
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 18 GHz:

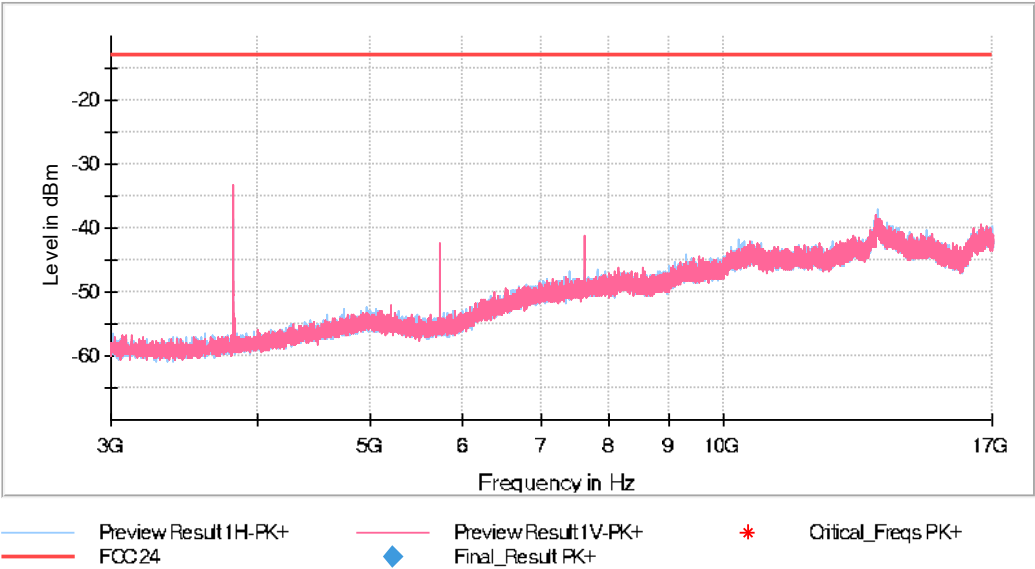
- Low Channel:



- Middle Channel:

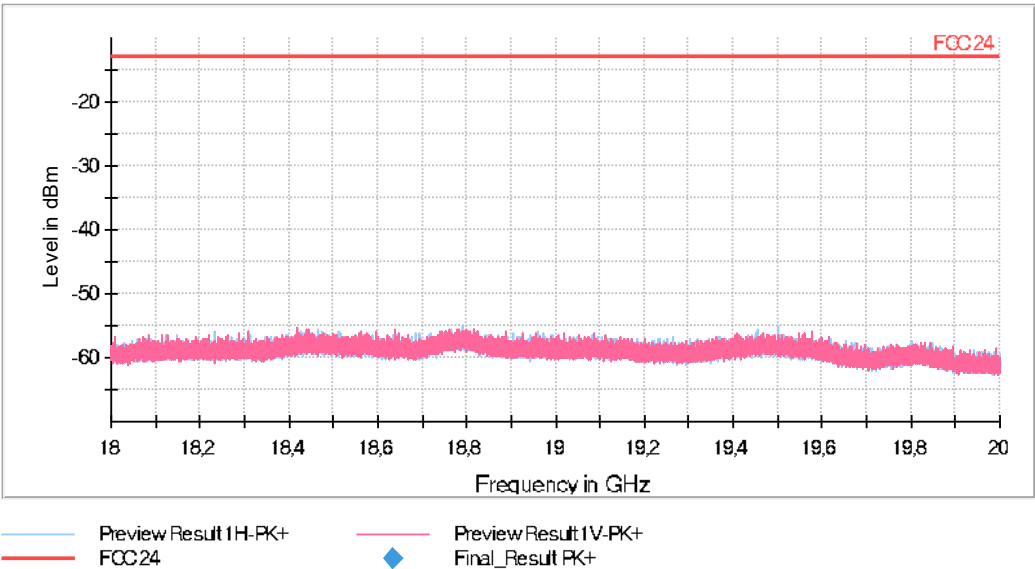


- High Channel:

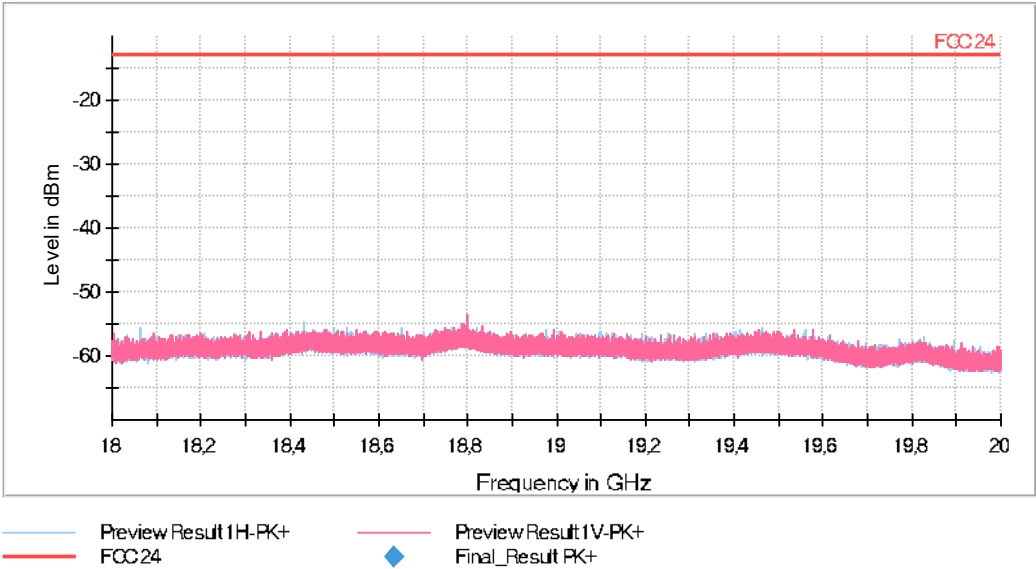


FREQUENCY RANGE 18 - 20 GHz:

- Low Channel:



- Middle Channel:



- High Channel:

