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:
80874RRF.003A1

Test Report
USA FCC Part 27
CANADA RSS-Gen, RSS-130, RSS-139, RSS-199

(*) Identification of item tested	LTE Cat 1 bis data module
(*) Trademark	u-blox
(*) Model and /or type reference	LEXI-R10011D
Other identification of the product	FCC ID: XPYUBX24AD02 IC: 8595A-UBX24AD02
(*) Features	LTE Cat1 bis, Wi-fi Scan / Locate HW version: UBX-463AD0 SW version: 01.07.A01.00
Applicant	u-blox AG Zürcherstrasse 68, CH-8800 Thalwil, Switzerland
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, February 2019. CANADA RSS-139 Issue 4 September 2022, Amendment October 2022. CANADA RSS-199 Issue 4 July 2023 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	2025-04-25
Report template No.	FDT08_25 (*) "Data provided by the client"

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

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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 consists of a Cat1 bis data only module for industrial IoT applications.

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Usage of samples

Samples undergoing test have been selected by: The client.

Id	Control Number	Description	Model	Serial Nº	Date of Reception	Application
S/01	80874/013	LTE Cat 1 bis data module	LEXI-R10011D	-	2024-11-05	Element Under Test
S/01	80874/008	Antenna	-		2024-11-05	Auxiliary Element
S/01	80874/009	Antenna GPS	-		2024-11-05	Auxiliary Element
S/01	80874/010	AC/DC	-	-	2024-11-05	Auxiliary Element
S/01	80874/005	USB Cable	-	-	2024-11-05	Auxiliary Element
S/01	80874/011	USB Cable	-	-	2024-11-05	Auxiliary Element

Notes referenced to samples during the project:

Id	Type
S/01	Radiated and conducted tests.

Test sample description

Ports……:	Port name and description		Cable: Specified max length [m]	Cable: Attached during test	Cable: Shielded		
	USB		2	☒	☒		
Supplementary information to the ports……:	-						
Rated power supply ..... :	Voltage and Frequency		Reference poles: L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: Min: 3.3, Typical: 3.8, Max: 4.5					
Rated Power..... :	-						
Clock frequencies..... :	26 MHz						
Other parameters ..... :	-						
Software version..... :	01.07.A01.00						
Hardware version ..... :	UBX-463AD0						
Dimensions in cm (W x H x D) ... :	1.6 x 0.2 x 1.6						
Mounting position ..... :	☐	Table top equipment					
	☐	Wall/Ceiling mounted equipment					
	☐	Floor standing equipment					
	☐	Hand-held equipment					
	☒	Other: Industrial modem component					
Modules/parts..... :	Module/parts of test item		Type	Manufacturer			
	-		-	-			
Accessories (not part of the test item) ..... :	Description		Type	Manufacturer			
	Power supply unit		UUX324-1215	Unifive			
	Antenna		GSA.8835	Taoglass			
Documents as provided by the applicant..... :	Description		File name	Issue date			
	-		-	-			

Identification of the client

u-blox AG

Zürcherstrasse 68, CH-8800 Thalwil, Switzerland

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2024-01-30
Date (finish)	2025-02-19

Document history

Report number	Date	Description
80874RRF.003	2025-04-08	First release.
80874RRF.003A1	2025-04-25	Second release. Modification due to typos. This test reports cancels and replaces to 80874RRF.003

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: Antonio Maireles, Carmen Vázquez, Sergio Carrasco.

Used instrumentation:

Control No.	Equipment	Next Calibration
08002	TEMPERATURE CHAMBER BINDER MK 56	2026-02-12
09555	TWO CHANNEL POWER SUPPLY, 32V, 10/5A, 188W ROHDE AND SCHWARZ HMP2020	N/A
07794	SIGNAL AND SPECTRUM ANALYZER 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2025-04-21
08912	WIDEBAND RADIO COMMUNICATION TESTER ROHDE AND SCHWARZ CMW500	2025-10-05
06043	POWER DIVIDER, DC-26 GHZ TEKTRONIX 5333	N/A
06792	SHIELDED ROOM ETS LINDGREN S101	N/A
06609	TEMPERATURE AND HUMIDITY PROBE HW GROUP HWg-STE	2025-04-22
06615	TEMPERATURE AND HUMIDITY PROBE HW GROUP HWg-STE	2025-04-04
06165	EMI TEST RECEIVER 9 kHz-7 GHz ROHDE AND SCHWARZ ESR7	2025-12-27
07611	PREAMPLIFIER BOX INTERNO -	2026-01-23
04578	HYBRID BILOG ANTENNA 30 MHz - 6 GHz ETS LINDGREN 3142E	2026-06-01
07692	ATTENUATOR 3 dB, 2 W, DC, 18 GHz TECHNIWAVE TWTS2G	2026-02-03
04716	SIGNAL AND SPECTRUM ANALYZER 2 Hz - 50 GHz ROHDE AND SCHWARZ FSW50	2026-08-02
05705	PRE-AMPLIFIER G>40dB, 1-18 GHz BONN ELEKTRONIK BLMA 0118-1M	2025-07-18
04611	HORN ANTENNA 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2026-01-16
06157	SIGNAL AND SPECTRUM ANALYZER 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2025-01-18
08856	PRE-AMPLIFIER G>30 dB, 17-40 GHz BONN ELEKTRONIK BLMA 1840-4A	2025-02-27
04657	HORN ANTENNA 18-40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2026-06-12
04848	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

Appendix A: LTE Cat 1bis Bands 4, 7, 12, 13, 38, 41, 66.

FCC PART 27 / RSS-Gen, RSS-130, RSS-139, RSS-199		
Requirement – Test case	**Verdict**	**Remark**
FCC 27.50 / RSS-130 4.6, RSS-139 5.5, RSS-199 5.5: RF Output Power	P	
FCC 2.1047 / RSS-130 4.2, RSS-139 5.3, RSS199 5.3 : Modulation Characteristics	P	
FCC 27.54 / RSS-130 4.5, RSS-139 5.4, RSS-199 5.4: Frequency Stability	P	
FCC 2.1049 / RSS-Gen 6.7: Occupied Bandwidth	P	
FCC 27.53 / RSS-130 4.7, RSS-139 5.6, RSS-199 5.6: Spurious Emissions at Antenna Terminals	P	
FCC 27.53 / RSS-130 4.7, RSS-139 5.6, RSS-199 5.6: Spurious Emissions at Antenna Terminals at Block Edges	P	
FCC 27.53 / RSS-130 4.7, RSS-139 5.6, RSS-139 5.6: Radiated Emissions	P	
Supplementary information and remarks: None.		

Appendix A: Test results for FCC 27 / RSS-130, RSS-139 / RSS-199: LTE Cat 1bis Bands 4, 7, 12, 13, 38, 41, 66

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TEST CONDITIONS

(*): Declared by the Applicant.

POWER SUPPLY (*):

Vnominal: 3.8 Vdc
Vminimum: 3.3 Vdc
Vmaximum: 4.5 Vdc
Type of Power Supply: DC External (USB).

ANTENNA (*):

Low Bands	Gain (dBi)	Type of Antenna
LTE Cat 1bis 12	-1.41	External (Taoglass GSA_8835 (standard reference antenna provided with EVK))
LTE Cat 1bis 13	-1.41	External (Taoglass GSA_8835 (standard reference antenna provided with EVK))
High Bands	Gain (dBi)	Type
LTE Cat 1bis 4	-1.41	External (Taoglass GSA_8835 (standard reference antenna provided with EVK))
LTE Cat 1bis 7	-1.41	External (Taoglass GSA_8835 (standard reference antenna provided with EVK))
LTE Cat 1bis 38	-1.41	External (Taoglass GSA_8835 (standard reference antenna provided with EVK))
LTE Cat 1bis 41	-1.41	External (Taoglass GSA_8835 (standard reference antenna provided with EVK))
LTE Cat 1bis 66	-1.41	External (Taoglass GSA_8835 (standard reference antenna provided with EVK))

TEST FREQUENCIES:

LTE Cat 1bis Band 4. QPSK and 16QAM modulations:

	Channel per BW=(Frequency, MHz)					
	BW = 1.4 MHz	BW = 3 MHz	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Low	19957 (1710.7)	19965 (1711.5)	19975 (1712.5)	20000 (1715.0)	20025 (1717.5)	20050 (1720.0)
Middle	20175 (1732.5)	20175 (1732.5)	20175 (1732.5)	20175 (1732.5)	20175 (1732.5)	20175 (1732.5)
High	20393 (1754.3)	20385 (1753.5)	20375 (1752.5)	20350 (1750.0)	20325 (1747.5)	20300 (1745.0)

NOTE: LTE Cat 1bis Band 4 is completely included in LTE Cat 1bis Band 66, so the channels of LTE Cat 1bis Band 66 were tested to give conformity to the assigned block.

LTE Cat 1bis Band 7. QPSK and 16QAM modulations:

	Channel (Frequency, MHz)			
	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Low	20775 (2502.5)	20800 (2505)	20825 (2507.5)	20850 (2510)
Middle	21100 (2535)	21100 (2535)	21100 (2535)	21100 (2535)
High	21425 (2567.5)	21400 (2565)	21375 (2562.5)	21350 (2560)

NOTE: LTE Cat 1bis Band 7 is completely included in LTE Cat 1bis Band 41, so the channels of LTE Cat 1bis Band 41 were tested to give conformity to the assigned block.

LTE Cat 1bis Band 12. QPSK and 16QAM modulations:

	Channel (Frequency, MHz)			
	BW = 1.4 MHz	BW = 3 MHz	BW = 5 MHz	BW = 10 MHz
Low	23017 (699.7)	23025 (700.5)	23035 (701.5)	23060 (704.0)
Middle	23095 (707.5)	23095 (707.5)	23095 (707.5)	23095 (707.5)
High	23173 (715.3)	23165 (714.5)	23155 (713.5)	23130 (711.0)

LTE Cat 1bis Band 13. QPSK and 16QAM modulations:

	Channel (Frequency, MHz)	
	BW = 5 MHz	BW = 10 MHz
Low	23205 (779.5)	
Middle	23230 (782.0)	23230 (782.0)
High	23255 (784.5)	

LTE Cat 1bis Band 38. QPSK and 16QAM modulations:

	Channel (Frequency, MHz)			
	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Low	37775 (2572.5)	37800 (2575)	37825 (2577.5)	37850 (2580)
Middle	38000 (2595)	38000 (2595)	38000 (2595)	38000 (2595)
High	38225 (2617.5)	38200 (2615)	38175 (2612.5)	38150 (2610)

NOTE: LTE Cat 1bis Band 38 is completely included in LTE Cat 1bis Band 41, so the channels of LTE Cat 1bis Band 41 were tested to give conformity to the assigned block.

LTE Cat 1bis Band 41. QPSK and 16QAM modulations:

	Channel (Frequency, MHz)			
	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Low USA	39675 (2498.5)	39700 (2501)	39725 (2503.5)	39750 (2506)
Low CANADA	39715 (2502.5)	39740 (2505)	39765 (2507.5)	39790 (2510)
Middle	40620 (2593)	40620 (2593)	40620 (2593)	40620 (2593)
High	41565 (2687.5)	41540 (2685)	41515 (2682.5)	41490 (2680)

LTE Cat 1bis Band 66. QPSK and 16QAM modulations:

	Channel per BW=(Frequency, MHz)					
	BW = 1.4 MHz	BW = 3 MHz	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Low	131979 (1710.7)	131987 (1711.5)	131997 (1712.5)	132022 (1715.0)	132047 (1717.5)	132072 (1720.0)
Middle	132322 (1745)	132322 (1745)	132322 (1745)	132322 (1745)	132322 (1745)	132322 (1745)
High	132665 (1779.3)	132657 (1778.5)	132647 (1777.5)	132622 (1775)	132597 (1772.5)	132572 (1770)

RF Output Power

Limits

1. LTE Cat 1bis Band 12. 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.

2. LTE Cat 1bis Band 13. FCC §27.50 (b) (10) / RSS-130 Clause 4.6.

FCC §27.50 (b) (10):

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

RSS-130 4.6:

> 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.

3. LTE Cat 1bis Band 41. FCC §27.50 (h) (2) / RSS-199 Clause 5.5.

FCC §27.50 (h) (2):

> *Mobile and other user stations*. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

RSS-199 5.5:

> The maximum output power of the equipment shall comply with the limits specified in table 3. In this table, maximum power refers to the equivalent isotropically radiated power (e.i.r.p.) or total radiated power (TRP), measured in terms of average values.
>
> Subscriber equipment other than fixed subscriber equipment shall not exceed an e.i.r.p of 2W per channel bandwidth.
>
> Fixed subscriber equipment shall not exceed the following:

I. conducted power of 2W per channel bandwidth for all ports
II. e.i.r.p of 40 W per channel bandwidth

The maximum power limits for fixed station and base station are provided in Table 3. The limits in this RSS are specified for the purpose of certification and may not apply to all deployment scenarios. Consult SRSP-517 for more deployment details in the band 2500-2690 MHz.

Table 3: Maximum power of fixed station and base station in the band 2500-2690 MHz	
Equipment type	**Maximum power**
Non-AAS fixed station and base station	e.i.r.p of 1640 W /MHz
AAS fixed station and base station	TRP of 43 dBm /MHz

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 highest PAPR during periods of continuous transmission.

4. LTE Cat 1bis Band 66. FCC §27.50 (d) / RSS-139 5.5.

FCC §27.50 (d):

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

(5) In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

RSS-139 5.5:

The maximum output power of the equipment shall comply with the limits specified below. In the tables, maximum power refers to the equivalent isotropically radiated power (e.i.r.p.) or total radiated power (TRP), measured in terms of average values.

The limits in this RSS are specified for the purpose of certification and may not apply to all deployment scenarios. Consult SRSP-513 and SRSP-519 for more details on the bands 2110-2180 MHz and 2180-2200 MHz respectively.

Table 3: Maximum power of equipment in the band 1710-1780 MHz	
Equipment type	**Maximum power**
Fixed station and base station	30 dBm e.i.r.p./channel bandwidth
Subscriber equipment	30 dBm e.i.r.p./channel bandwidth

Table 4: Maximum power of equipment in the band 2110-2180 MHz	
Equipment type	**Maximum power**
Non-AAS fixed station and base station	65 dBm e.i.r.p./MHz
AAS fixed station and base station	46 dBm TRP/MHz
Subscriber equipment	30 dBm e.i.r.p./channel bandwidth

Table 5: Maximum power of equipment in the band 2180-2200 MHz	
Equipment type	**Maximum power**
Non-AAS base station	65 dBm e.i.r.p./MHz
AAS base station	46 dBm TRP/MHz

In addition, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1% of the time, using a signal that corresponds to the highest 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).

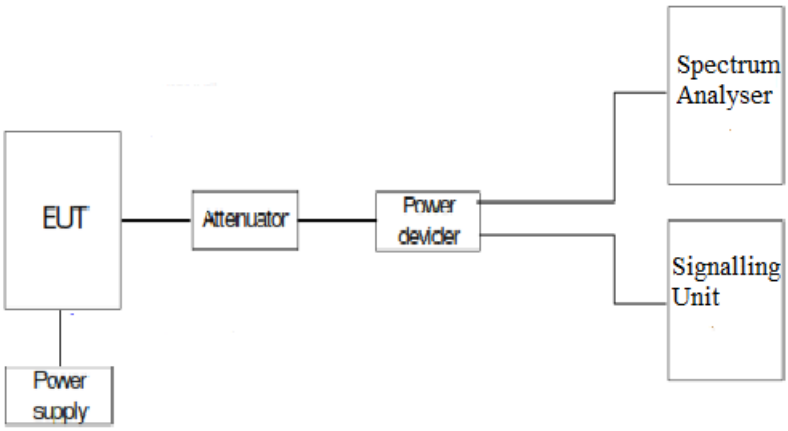
The maximum effective radiated power e.r.p. is calculated from the maximum equivalent isotropically radiated power (e.i.r.p.) by subtracting 2.15 dB:

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

Test Setup

1. CONDUCTED AVERAGE POWER:

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



Results

1. CONDUCTED AVERAGE POWER:

LTE Cat 1bis Band 12:

Worst-case of RF Power is BW=10 MHz, Low Channel, QPSK, RB Size=1, RB Offset=0.

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)
10	Low 23060	704	QPSK	1	0	23.46
				1	24	22.6
				1	49	22.74
				25	0	22.23
				25	12	21.9
				25	24	21.63
				50	0	21.98
			16-QAM	1	0	22.48
				1	24	21.75
				1	49	21.81
				25	0	21.32
				25	12	21.04
				25	24	20.79
				50	0	N/A
	Middle 23095	707,5	QPSK	1	0	22.9
				1	24	22.66
				1	49	23.19
				25	0	21.71
				25	12	21.77
				25	24	22.2
				50	0	22.03
			16-QAM	1	0	21.77
				1	24	21.49
				1	49	21.99
				25	0	20.92
				25	12	21.03
				25	24	21.3
				50	0	N/A
	High 23130	711	QPSK	1	0	22.4
				1	24	23.35
				1	49	22.34
				25	0	22.11
				25	12	22.24
				25	24	22.13
				50	0	22.09
			16-QAM	1	0	21.54
				1	24	22.5
				1	49	21.59
				25	0	21.26
				25	12	21.32
				25	24	21.23
				50	0	N/A

BW=10 MHz. QPSK:

MAX POWER	QPSK COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP (dBm)	RAD. POWER AVG ERP (dBm)
LOW	23.46	-1.41	22.05	19.9
MIDDLE	23.19	-1.41	21.78	19.63
HIGH	23.35	-1.41	21.94	19.79
MAX:	23.46		22.05	19.9

BW=10 MHz. 16QAM:

MAX POWER	16QAM COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP (dBm)	RAD. POWER AVG ERP (dBm)
LOW	22.48	-1.41	21.07	18.92
MIDDLE	21.99	-1.41	20.58	18.43
HIGH	22.5	-1.41	21.09	18.94
MAX:	22.5		21.09	18.94

LTE Cat 1bis Band 13:

Worst-case of RF Power is BW=10 MHz. Middle Channel. QPSK. RB Size=1. RB Offset=0.

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)
10	Middle 23230	782	QPSK	1	0	23.14
				1	24	22.58
				1	49	23.03
				25	0	22.02
				25	12	21.76
				25	24	21.75
				50	0	21.9
			16-QAM	1	0	22.16
				1	24	21.66
				1	49	22.06
				25	0	21.09
				25	12	20.87
				25	24	20.99
				50	0	N/A

BW=10 MHz. QPSK:

MAX POWER	QPSK COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP (dBm)	RAD. POWER AVG ERP (dBm)
MIDDLE	23.14	-1.41	21.73	19.58
MAX:	23.14		21.73	19.58

BW=10 MHz. 16QAM:

MAX POWER	16QAM COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP (dBm)	RAD. POWER AVG ERP (dBm)
MIDDLE	22.16	-1.41	20.75	18.6
MAX:	22.16		20.75	18.6

LTE Cat 1bis Band 41:

Worst-case of RF Power is BW=20 MHz. High Channel. QPSK. RB Size=1. RB Offset=0.

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)
20	Low FCC 39750	2506	QPSK	1	0	22.97
				1	49	22.95
				1	99	22.96
				50	0	21.98
				50	24	21.96
				50	49	21.97
				100	0	22.03
			16-QAM	1	0	21.98
				1	49	21.98
				1	99	21.91
				50	0	N/A
				50	24	N/A
				50	49	N/A
				100	0	N/A
	Middle 40620	2593	QPSK	1	0	23.15
				1	49	22.99
				1	99	22.73
				50	0	22.02
				50	24	21.89
				50	49	21.75
				100	0	21.98
			16-QAM	1	0	22.14
				1	49	21.93
				1	99	21.7
				50	0	N/A
				50	24	N/A
				50	49	N/A
				100	0	N/A
	High 41490	2680	QPSK	1	0	23.35
				1	49	23.33
				1	99	23
				50	0	22.31
				50	24	22.32
				50	49	22.2
				100	0	22.30
			16-QAM	1	0	22.29
				1	49	22.16
				1	99	21.97
				50	0	N/A
				50	24	N/A
				50	49	N/A
				100	0	N/A

BW=20 MHz. QPSK:

MAX POWER	QPSK COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP (dBm)	RAD. POWER AVG ERP (dBm)
LOW USA	22.03	-1.41	20.62	18.47
MIDDLE	23.15	-1.41	21.74	19.59
HIGH	22.30	-1.41	20.89	18.74
LOW CANADA	22.00	-1.41	20.59	18.44
MAX:	23.15		21.74	19.59

BW=20 MHz. 16QAM:

MAX POWER	16QAM COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP (dBm)	RAD. POWER AVG ERP (dBm)
LOW USA	21.98	-1.41	20.57	18.42
MIDDLE	22.14	-1.41	20.73	18.58
HIGH	22.29	-1.41	20.88	18.73
LOW CANADA	21.99	-1.41	20.58	18.43
MAX:	22.29		20.88	18.73

LTE Cat 1bis Band 66:

Worst-case of RF Power is BW=20 MHz. Low Channel. QPSK. RB Size=1. RB Offset=0.

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)
20	Low 132072	1720	QPSK	1	0	23.61
				1	49	23.34
				1	99	23.03
				50	0	22.54
				50	24	22.36
				50	49	22.19
				100	0	22.37
			16-QAM	1	0	22.74
				1	49	22.47
				1	99	22.14
				50	0	N/A
				50	24	N/A
				50	49	N/A
				100	0	N/A
	Middle 132322	1745	QPSK	1	0	23.19
				1	49	23.51
				1	99	23.19
				50	0	22.53
				50	24	22.63
				50	49	22.63
				100	0	22.63
			16-QAM	1	0	22.15
				1	49	22.41
				1	99	22.16
				50	0	N/A
				50	24	N/A
				50	49	N/A
				100	0	N/A
	High 132572	1770	QPSK	1	0	22.94
				1	49	22.9
				1	99	23.14
				50	0	22.09
				50	24	22.16
				50	49	22.21
				100	0	22.16
			16-QAM	1	0	22.15
				1	49	22.08
				1	99	22.26
				50	0	N/A
				50	24	N/A
				50	49	N/A
				100	0	N/A

BW=20 MHz. QPSK:

MAX POWER	QPSK COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP (dBm)	RAD. POWER AVG ERP (dBm)
LOW	23.61	-1.41	22.2	20.05
MIDDLE	23.51	-1.41	22.1	19.95
HIGH	23.14	-1.41	21.73	19.58
MAX:	23.61		22.2	20.05

BW=20 MHz. 16QAM:

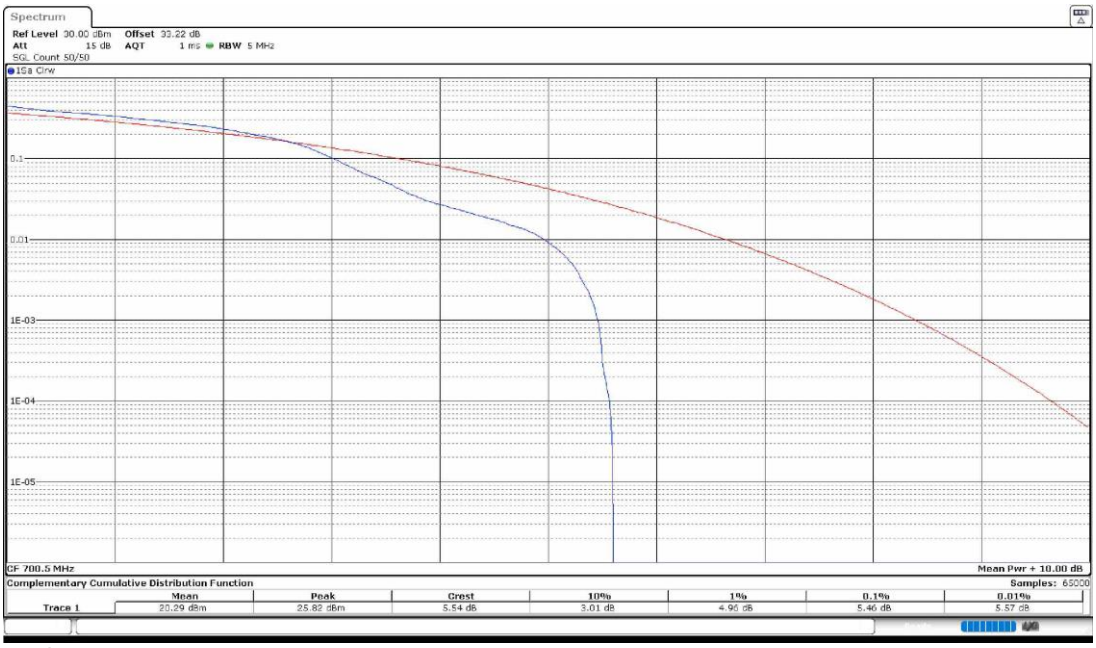
MAX POWER	16QAM COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP (dBm)	RAD. POWER AVG ERP (dBm)
LOW	22.74	-1.41	21.33	19.18
MIDDLE	22.41	-1.41	21	18.85
HIGH	22.26	-1.41	20.85	18.7
MAX:	22.74		21.33	19.18

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

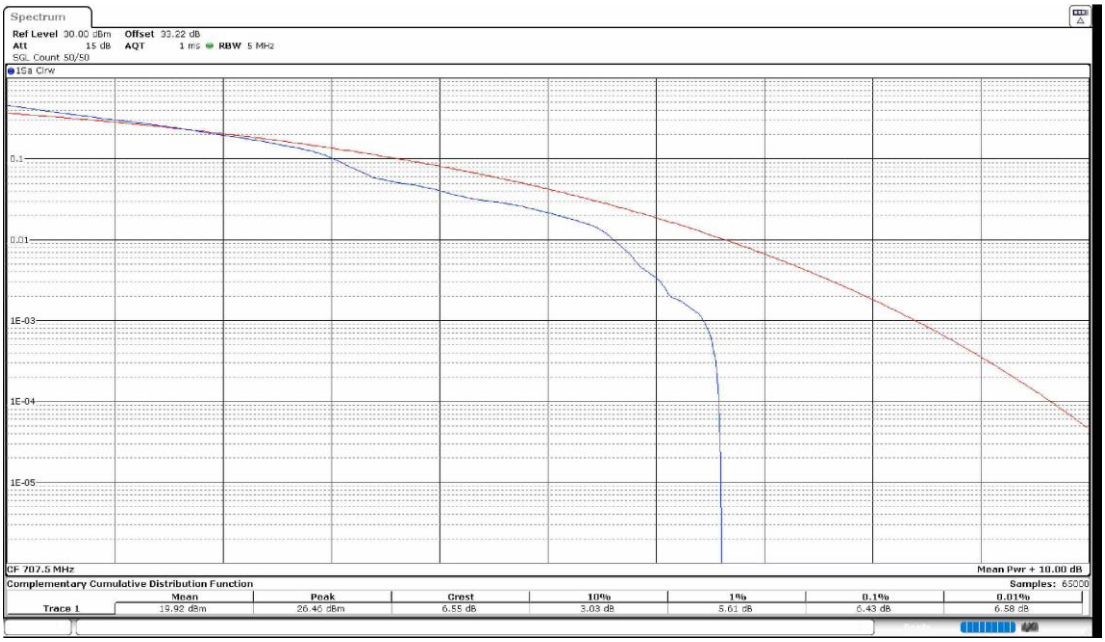
LTE Cat 1bis Band 12:

Worst-case of PAPR is BW=3 MHz. High Channel. 16QAM. RB Size=1. RB Offset=14.

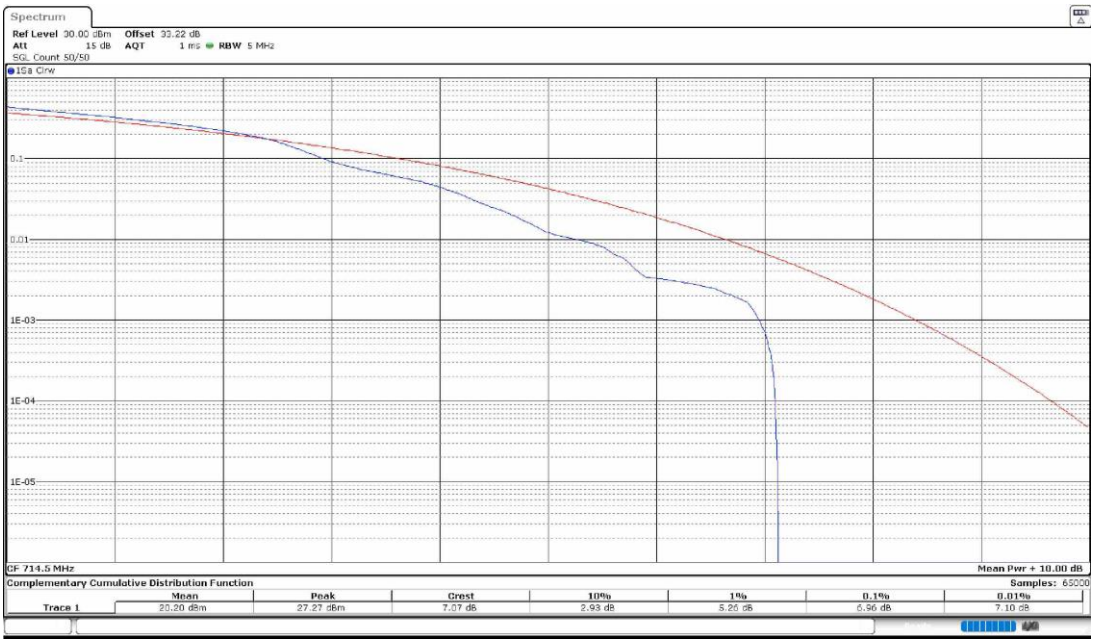
Low Channel:



Middle Channel:



High Channel:



16QAM	Low	Middle	High
PAPR (dB)	5.46	6.43	6.96

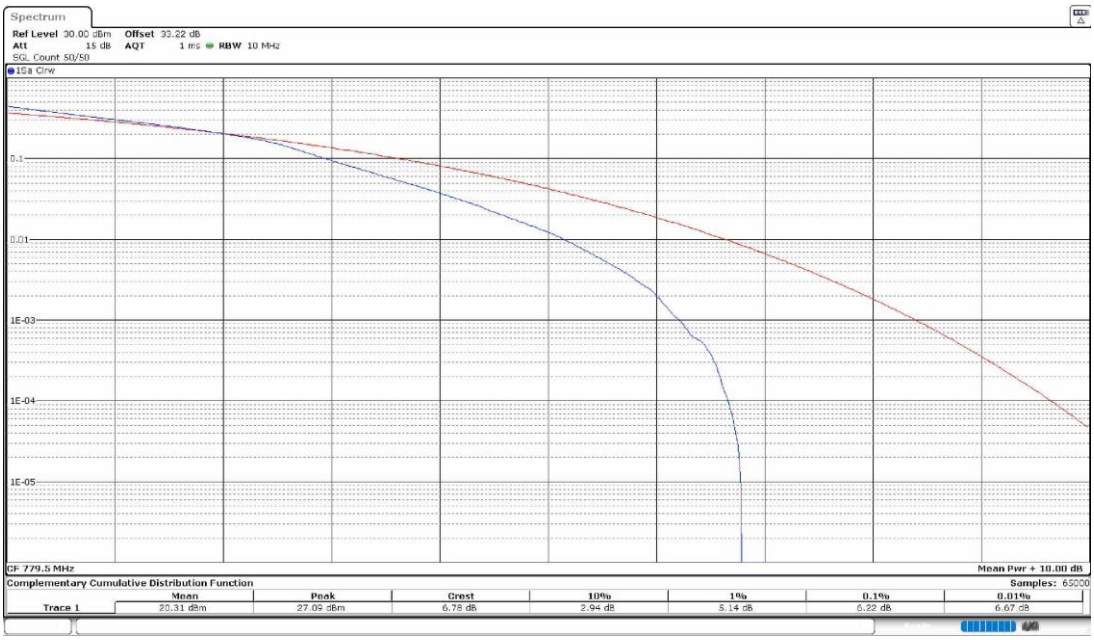
Verdict

Pass

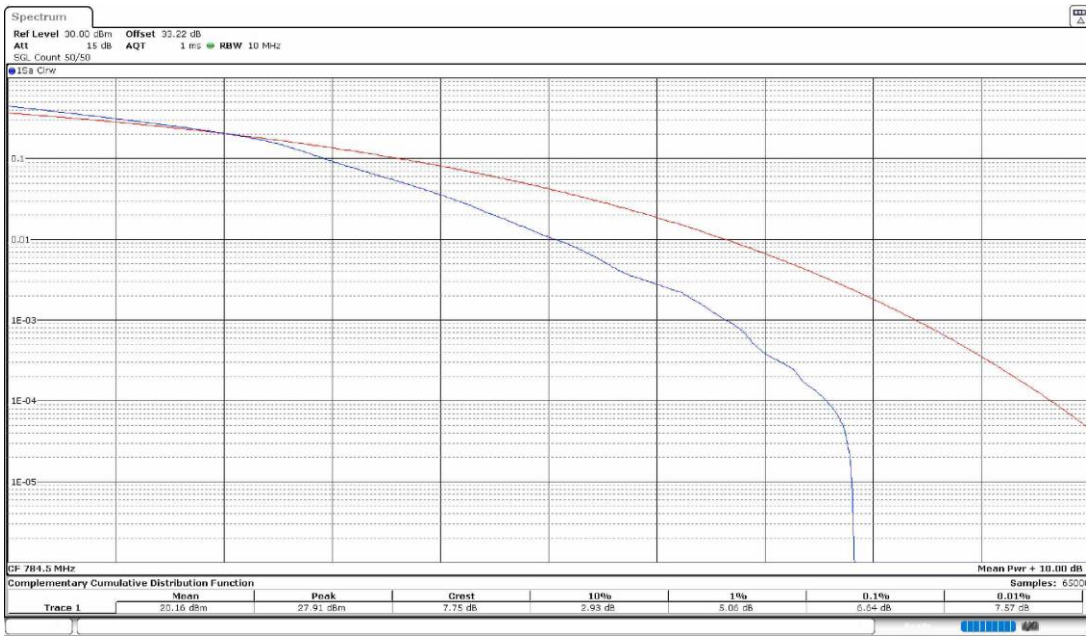
LTE Cat 1bis Band 13:

Worst-case of PAPR is BW= 5 MHz. High Channel. 16QAM. RB Size=12. RB Offset=6.

Low Channel:



High Channel:



16QAM	Low	High
PAPR (dB)	6.22	6.64

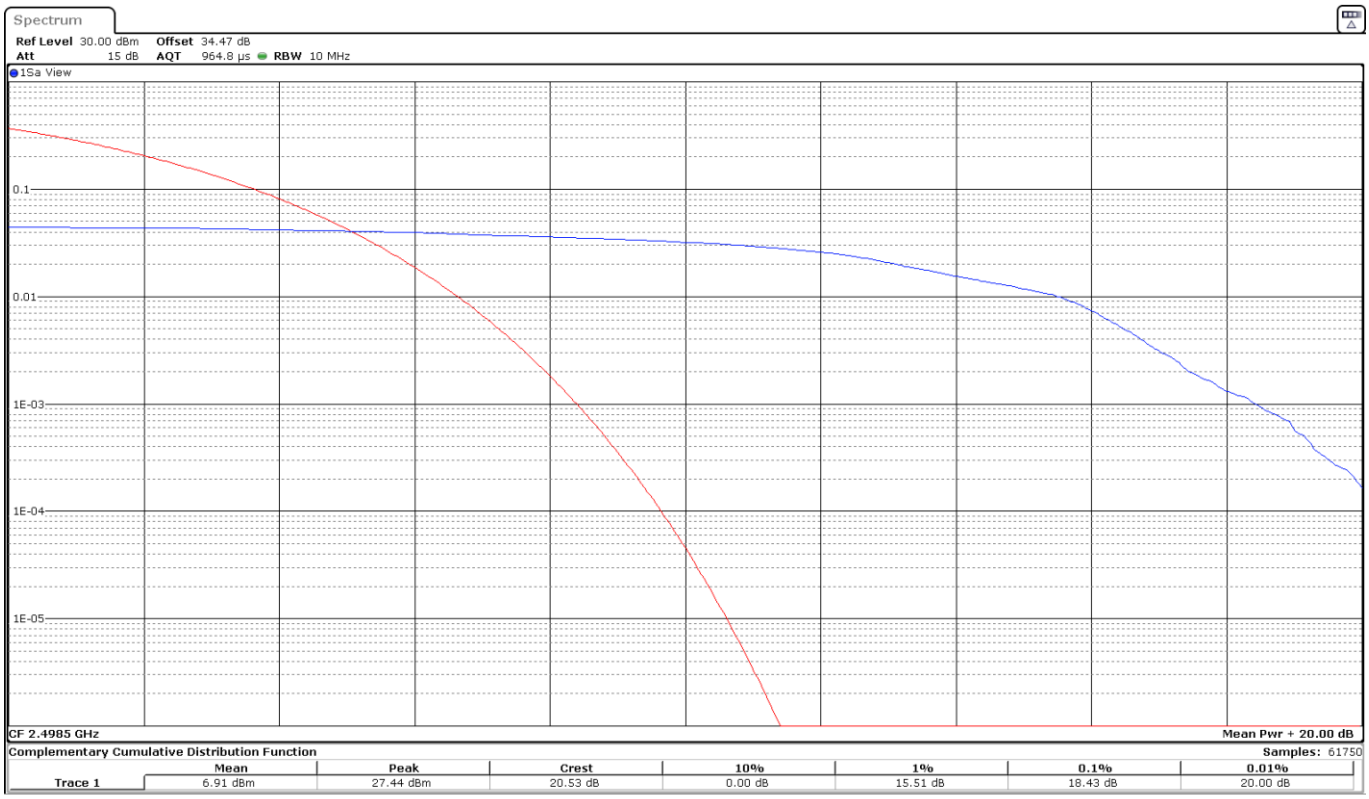
Verdict

Pass

LTE Cat 1bis Band 41:

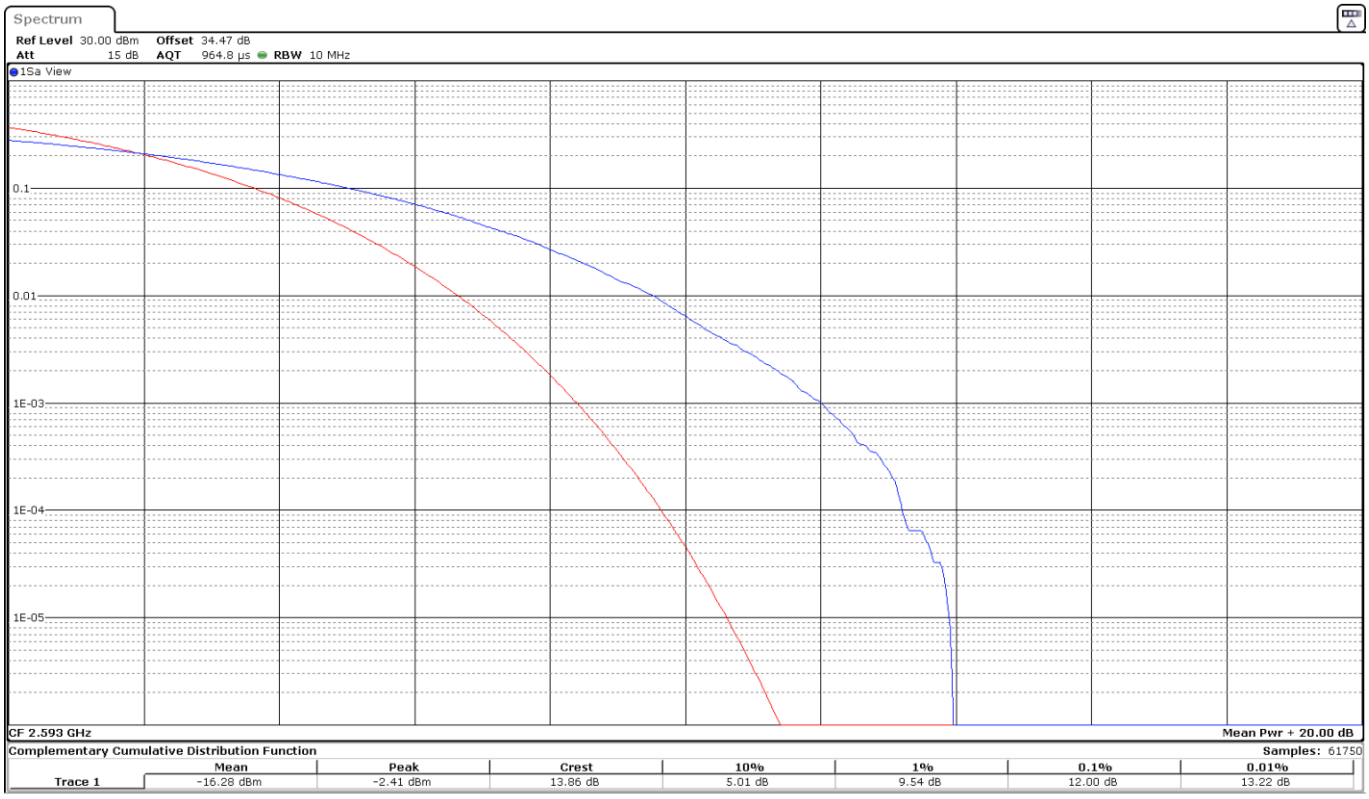
Worst-case of PAPR is BW= 5 MHz. Low Channel. 16QAM. RB Size=25. RB Offset=0.

Low Channel:



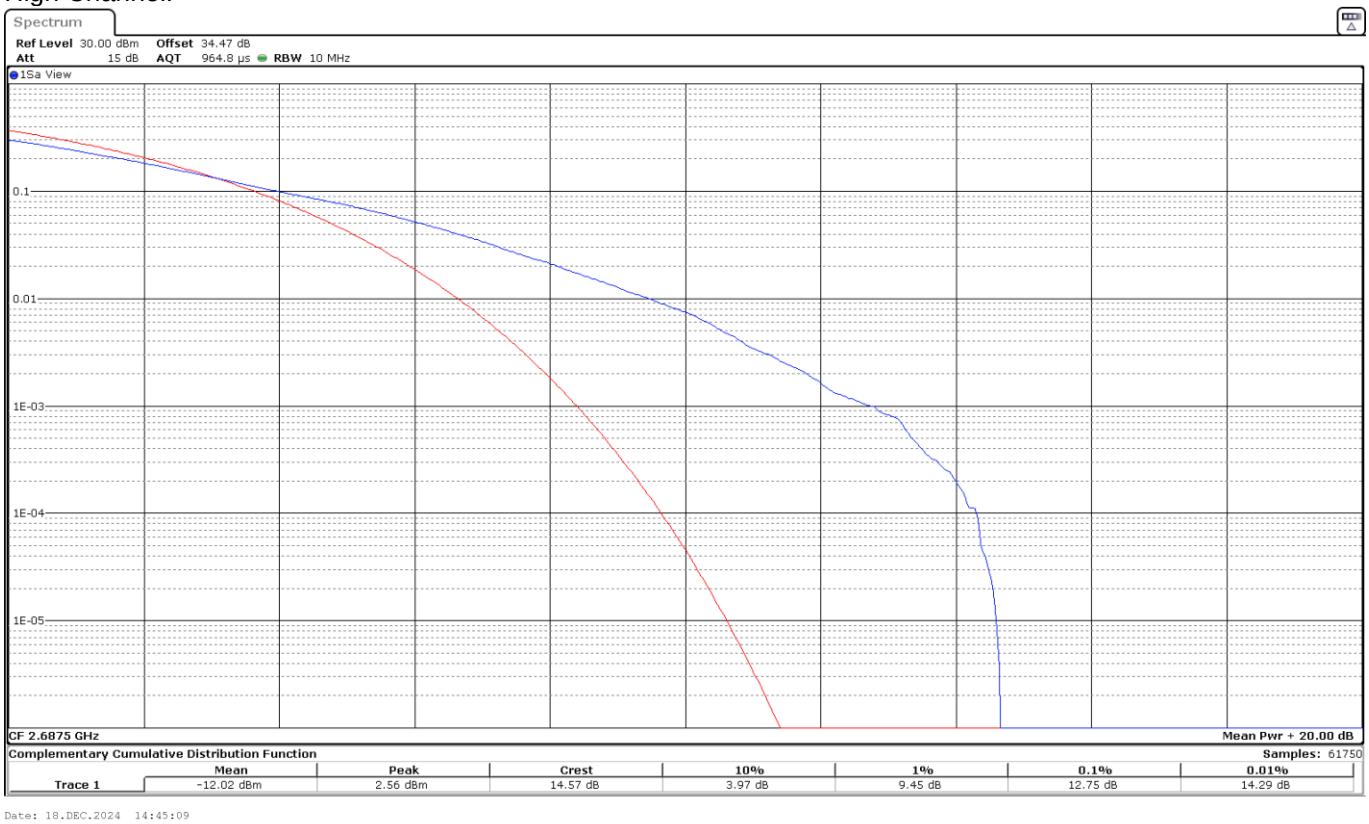
Date: 18.DEC.2024 14:39:03

Middle Channel:



Date: 18.DEC.2024 14:42:06

High Channel:



16QAM	Low	Middle	High
PAPR (dB)	18.43	12	12.75

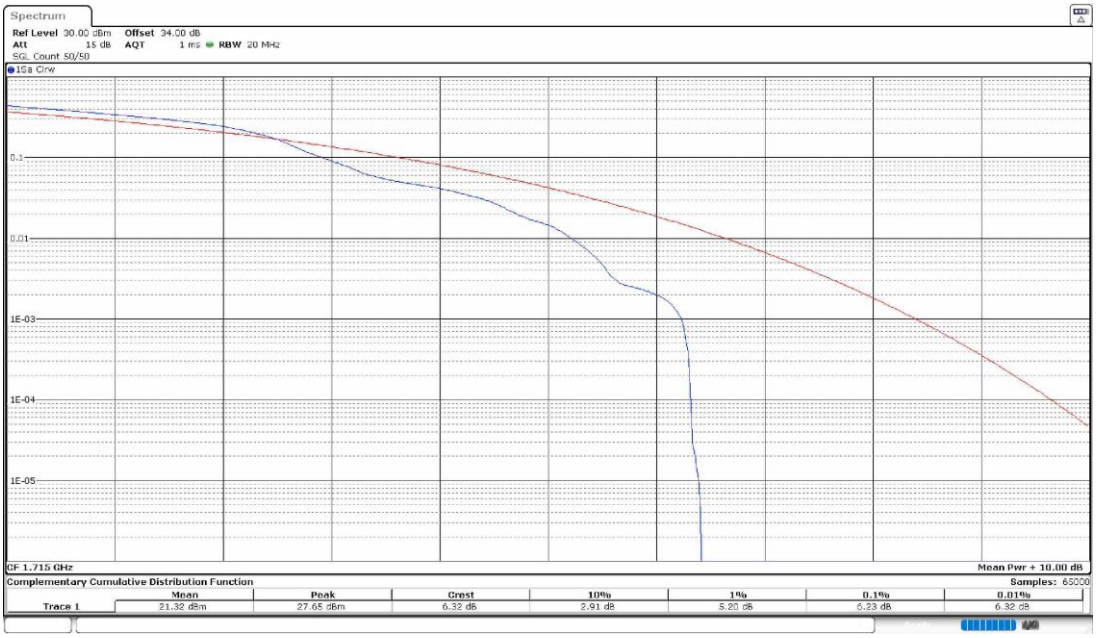
Verdict

Pass

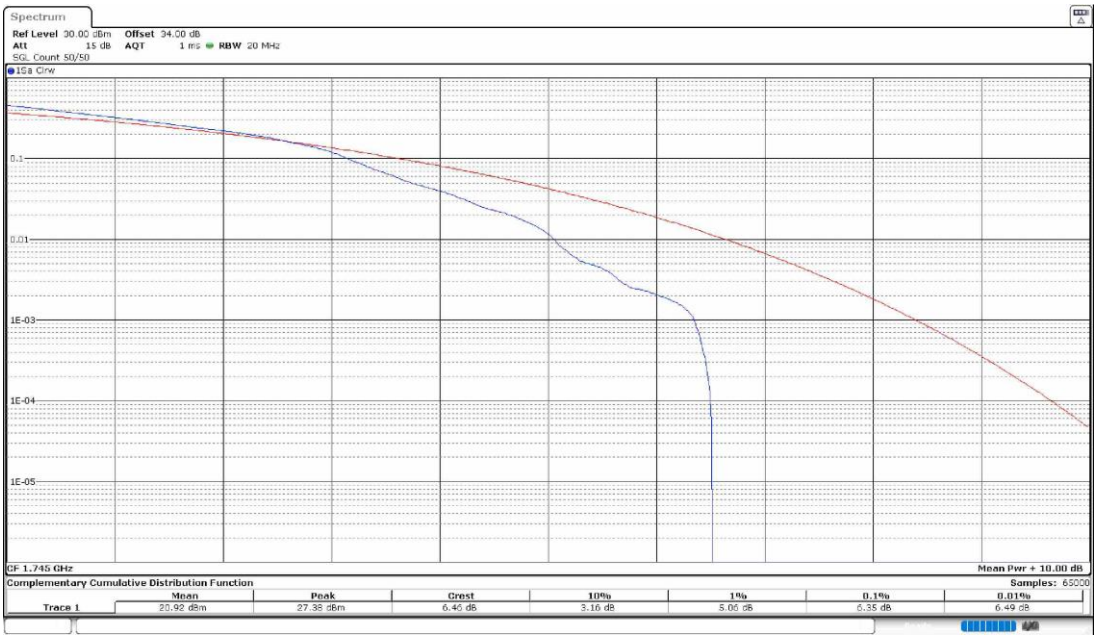
LTE Cat 1bis Band 66:

Worst-case of PAPR is BW=10 MHz. High Channel. 16QAM. RB Size=1. RB Offset=0.

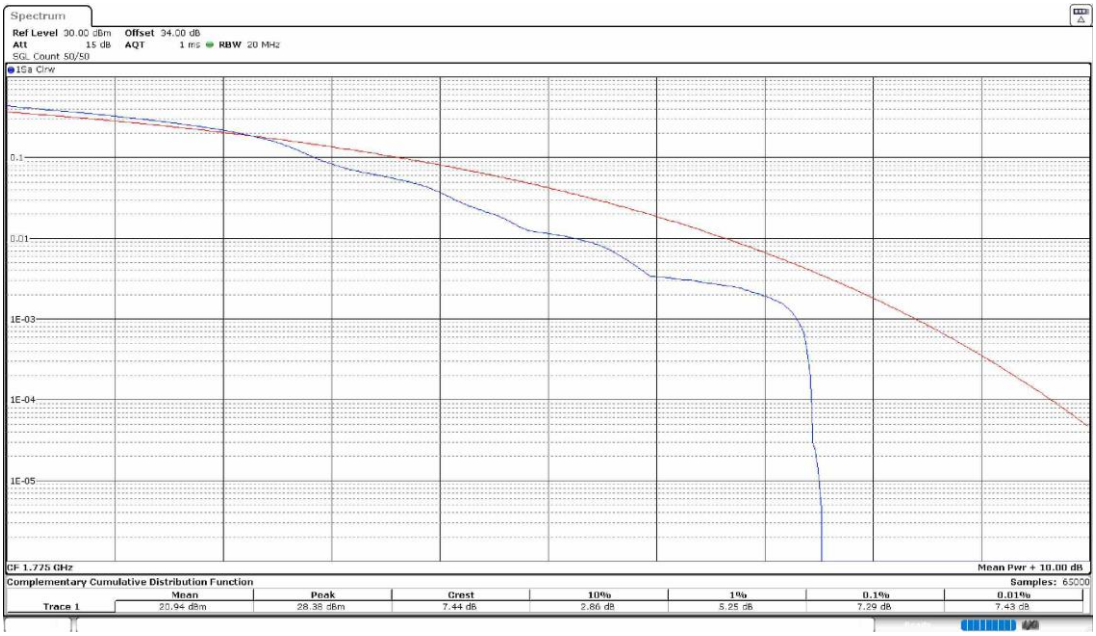
Low Channel:



Middle Channel:



High Channel:



16QAM	Low	Middle	High
PAPR (dB)	6.23	6.35	7.29

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 & RSS-139. 5.4. The frequency stability shall be sufficient to ensure that the occupied bandwidth stays within the operating frequency block or frequency block group when tested to 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.

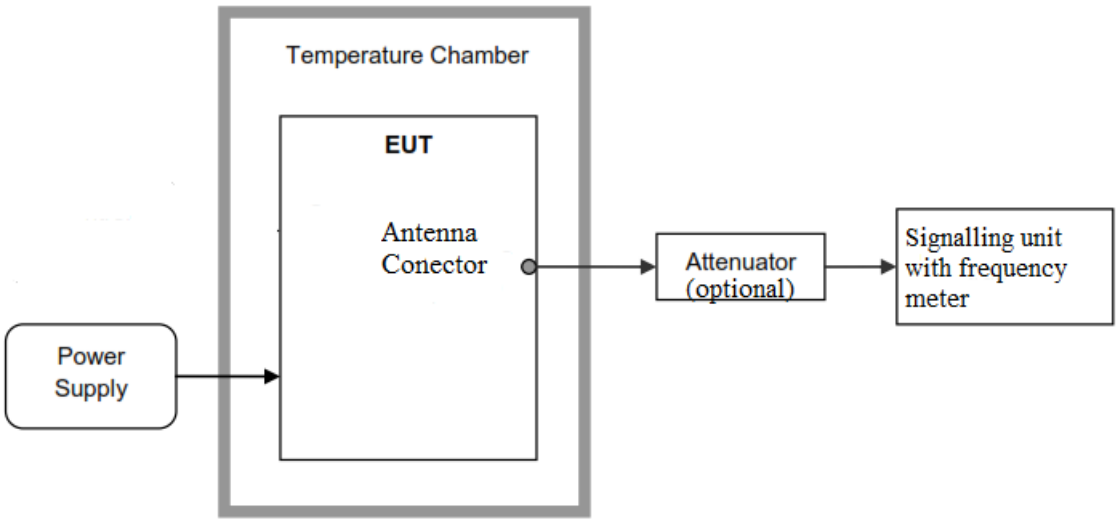
The EUT was set in “Radio Resource Control (RRC) mode” on the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter.
The worst case LTE mode for conducted power was used for the test.

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.

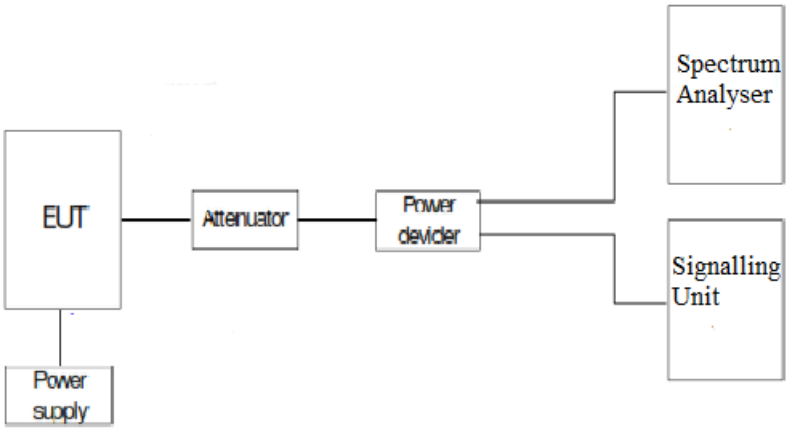
The reference point measurements were made at the RF output terminals of the EUT using an attenuator. power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

Test Setup

Frequency tolerance:



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



Results

1. FREQUENCY TOLERANCE:

LTE Cat 1bis Band 12:

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

- **Frequency stability over temperature variations:**

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)
+85 [#]	1.23	0.001738516
+80 [#]	0.49	0.00069258
+70 [#]	2.98	0.004212014
+60 [#]	1.27	0.001795053
+50	1.24	0.00175265
+40	0.82	0.001159011
+30	-0.46	-0.000650177
+20	1.23	0.001738516
+10	-0.24	-0.000339223
0	-0.92	-0.001300353
-10	-0.71	-0.001003534
-20	0.31	0.000438163
-30	1.77	0.002501767
-40 [#]	1.23	0.001738516

- **Frequency stability over voltage variations:**

Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	4.5	1.32	0.001865724
Vmin	3.3	1.26	0.001780919

LTE Cat 1bis Band 13:

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

- **Frequency stability over temperature variations:**

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)
+85 [#]	0.36	0.000460358
+80 [#]	-0.49	-0.000626598
+70 [#]	-0.29	-0.000370844
+60 [#]	-0.46	-0.000588235
+50	-0.29	-0.000370844
+40	0.34	0.000434783
+30	0.14	0.000179028
+20	-0.15	-0.000191816
+10	0.09	0.00011509
0	-0.47	-0.000601023
-10	0.51	0.000652174
-20	-0.27	-0.000345269
-30	-0.22	-0.00028133
-40 [#]	-0.84	-0.001074169

- **Frequency stability over voltage variations:**

Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	4.5	-0.3	-0.000383632
Vmin	3.3	0.17	0.000217391

LTE Cat 1bis Band 41:

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

- **Frequency stability over temperature variations:**

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)
+85 [#]	0.93	0.000358658
+80 [#]	-5.52	-0.002128808
+70 [#]	-4.85	-0.00187042
+60 [#]	-2.06	-0.000794447
+50	-0.11	-4.24219E-05
+40	0.82	0.000316236
+30	1.32	0.000509063
+20	0.1	3.85654E-05
+10	-4.95	-0.001908986
0	0.92	0.000354801
-10	1.77	0.000682607
-20	0.66	0.000254531
-30	1.77	0.000682607
-40 [#]	1.56	0.00060162

- **Frequency stability over voltage variations:**

Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	4.5	1.45	0.000559198
Vmin	3.3	0.86	0.000331662

LTE Cat 1bis Band 66:

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

- **Frequency stability over temperature variations:**

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)
+85 [#]	1.79	0.001025788
+80 [#]	1.6	0.000916905
+70 [#]	2.32	0.001329513
+60 [#]	-0.66	-0.000378223
+50	1.43	0.000819484
+40	0.63	0.000361032
+30	1.67	0.00095702
+20	1.22	0.00069914
+10	-0.63	-0.000361032
0	-0.34	-0.000194842
-10	-0.17	-9.74212E-05
-20	-0.27	-0.000154728
-30	-0.33	-0.000189112
-40 [#]	0.3	0.00017192

- **Frequency stability over voltage variations:**

Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	4.5	1.34	0.000767908
Vmin	3.3	-0.76	-0.00043553

2. REFERENCE FREQUENCY POINTS fL AND fH:

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

LTE Cat 1bis Band 12: BW=1.4 MHz. QPSK.

*f*L (MHz)	699.0309
*f*H (MHz)	715.9566

LTE Cat 1bis Band 13: BW=5 MHz. QPSK.

*f*L (MHz)	777.0751
*f*H (MHz)	786.9358

LTE Cat 1bis Band 41: BW=5 MHz. QPSK.

*f*L USA (MHz)	2496.0175
*f*L CANADA (MHz)	2500.0765
*f*H (MHz)	2689.9180

LTE Cat 1bis Band 66: BW=5 MHz. QPSK.

*f*L (MHz)	1710.0346
*f*H (MHz)	1779.9627

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.

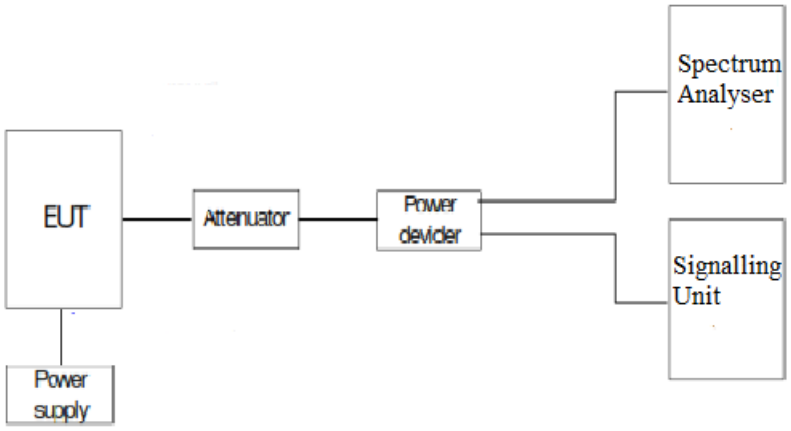
RSS-130. 4.2: Equipment certified under this standard shall employ digital modulation.

RSS-139. 5.3: Devices may use any type of modulation technique. The type of modulation shall be documented in the test report.

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

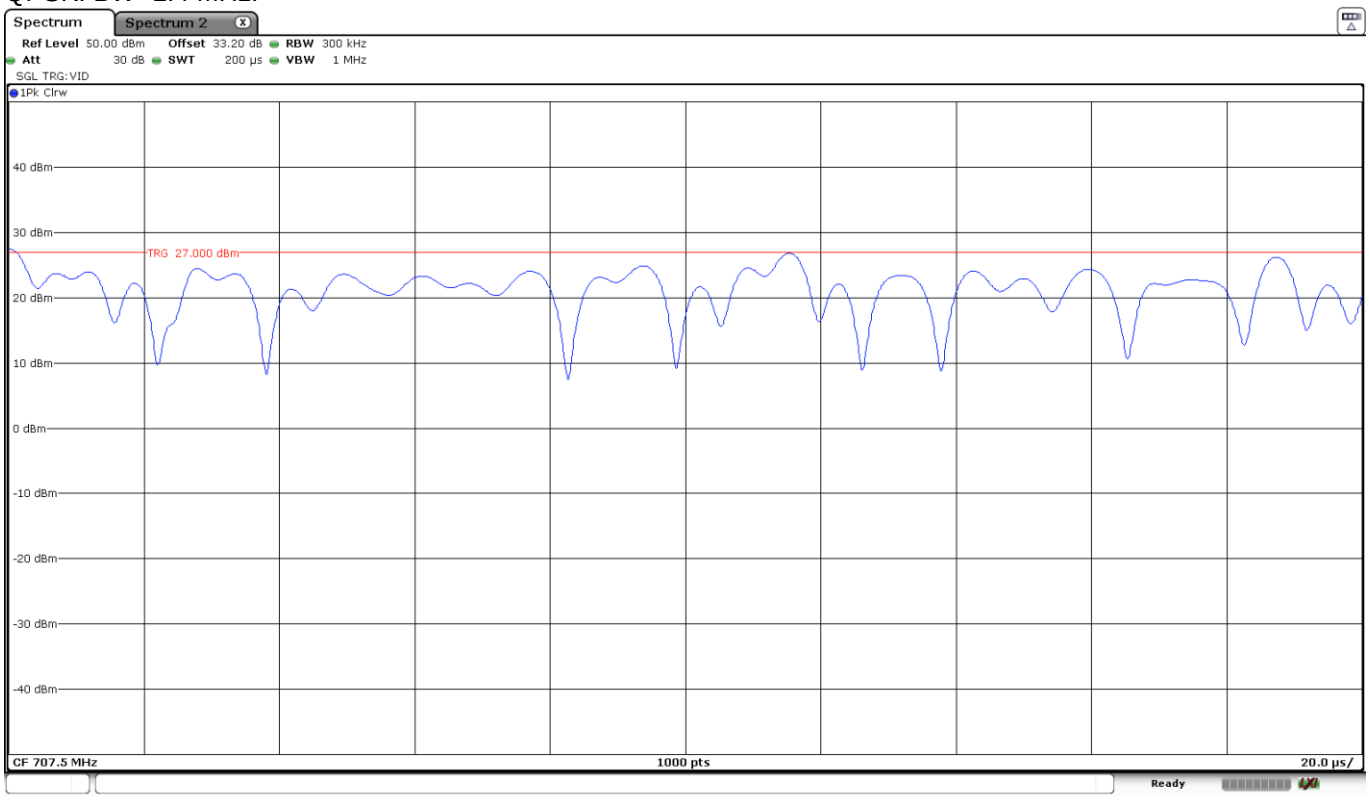


Results

The following plots show the modulation schemes in the EUT.

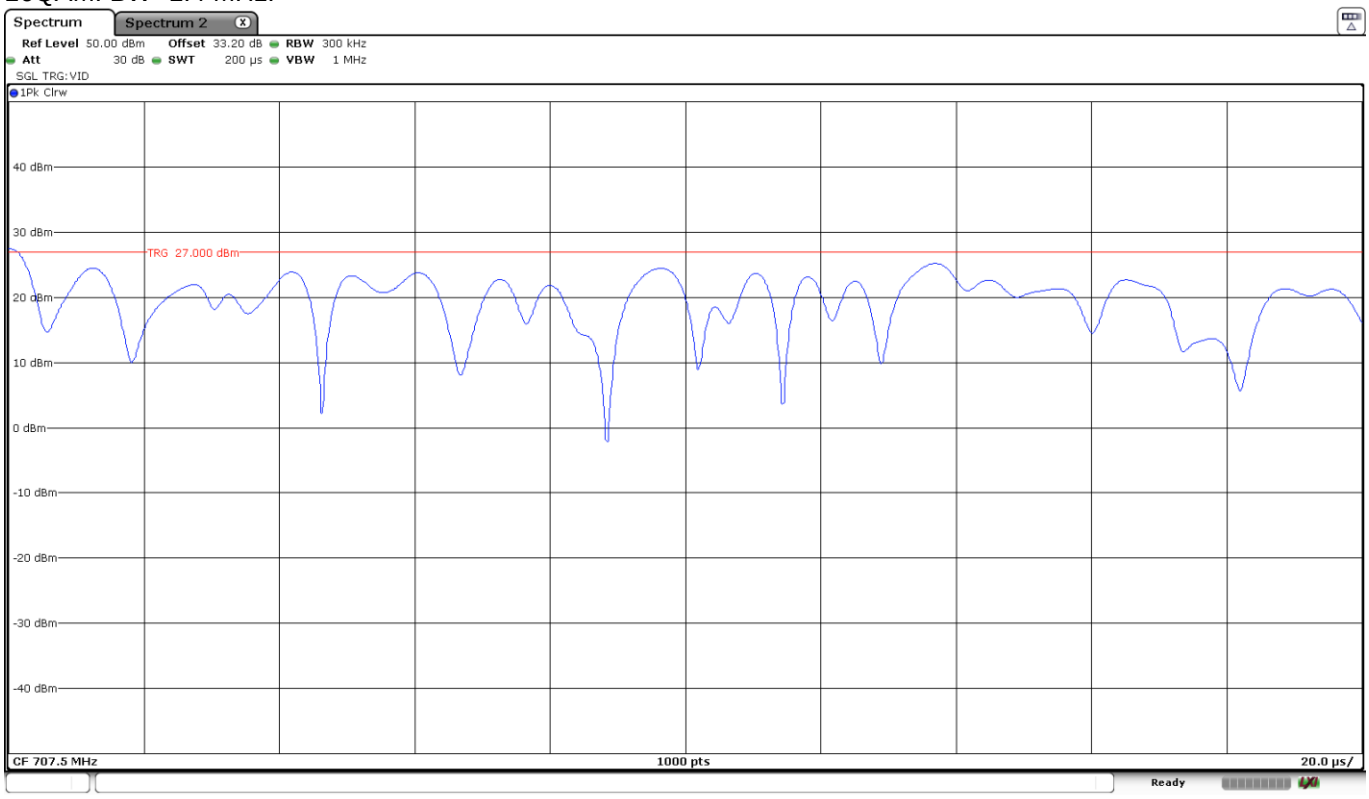
LTE Cat 1bis Band 12:

QPSK. BW=1.4 MHz.



Date: 14.JAN.2025 19:34:21

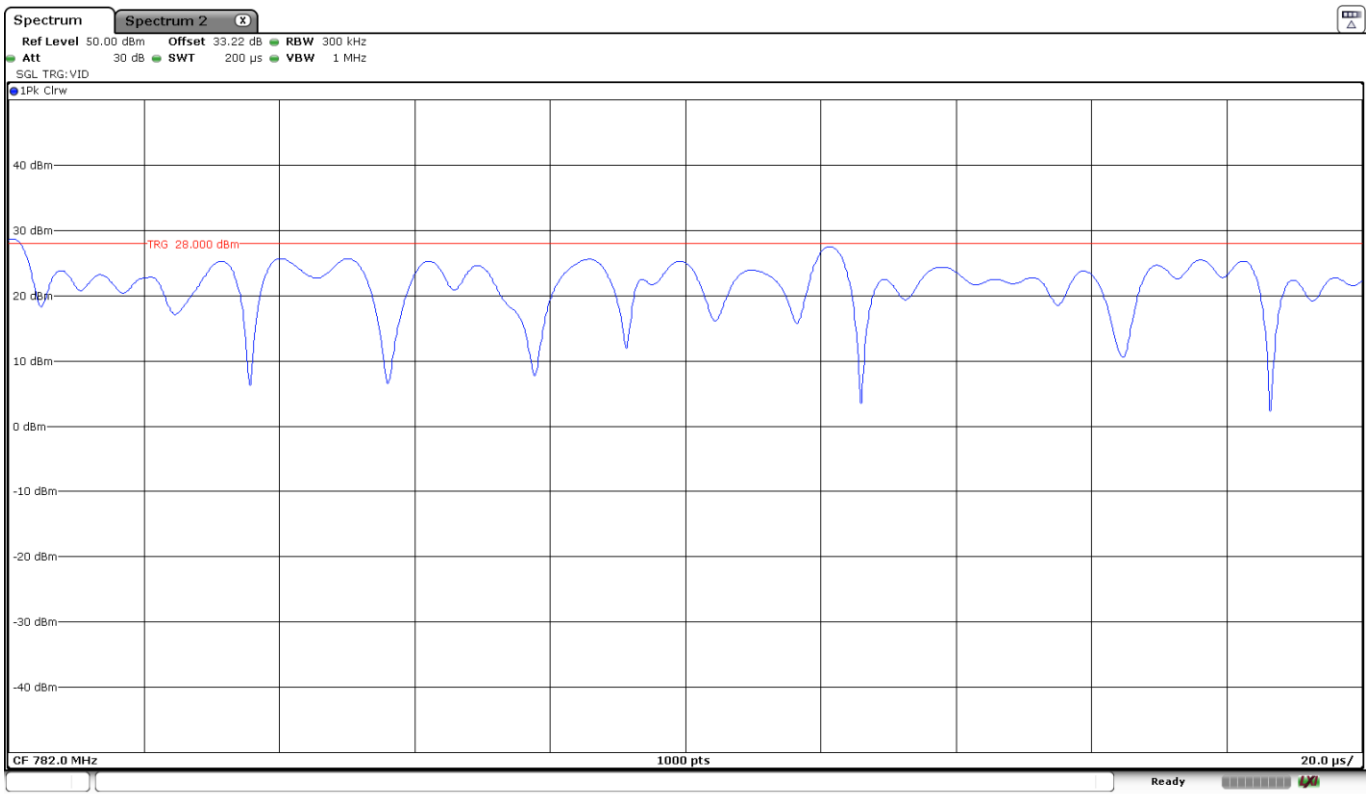
16QAM. BW=1.4 MHz.



Date: 14.JAN.2025 19:35:07

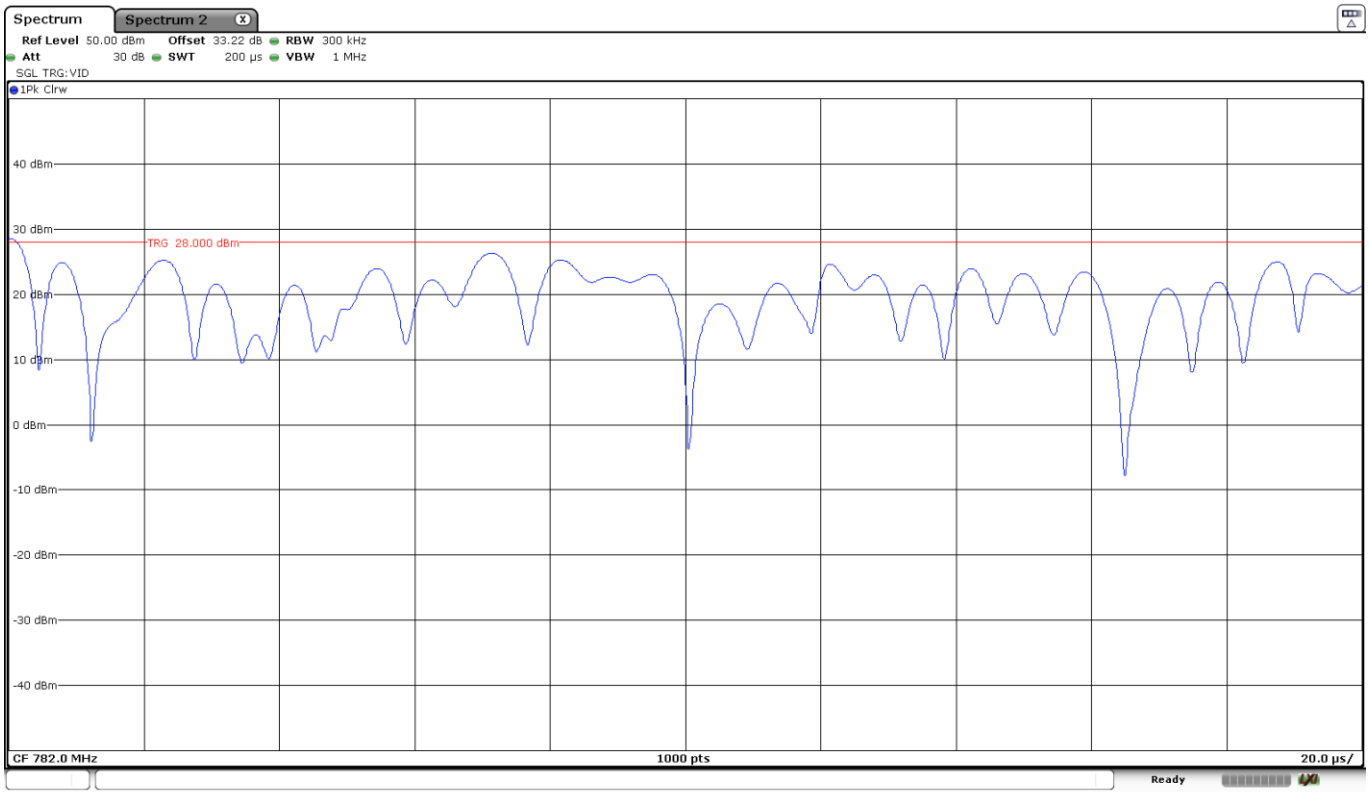
LTE Cat 1bis Band 13:

QPSK. BW=5 MHz.



Date: 14.JAN.2025 21:42:17

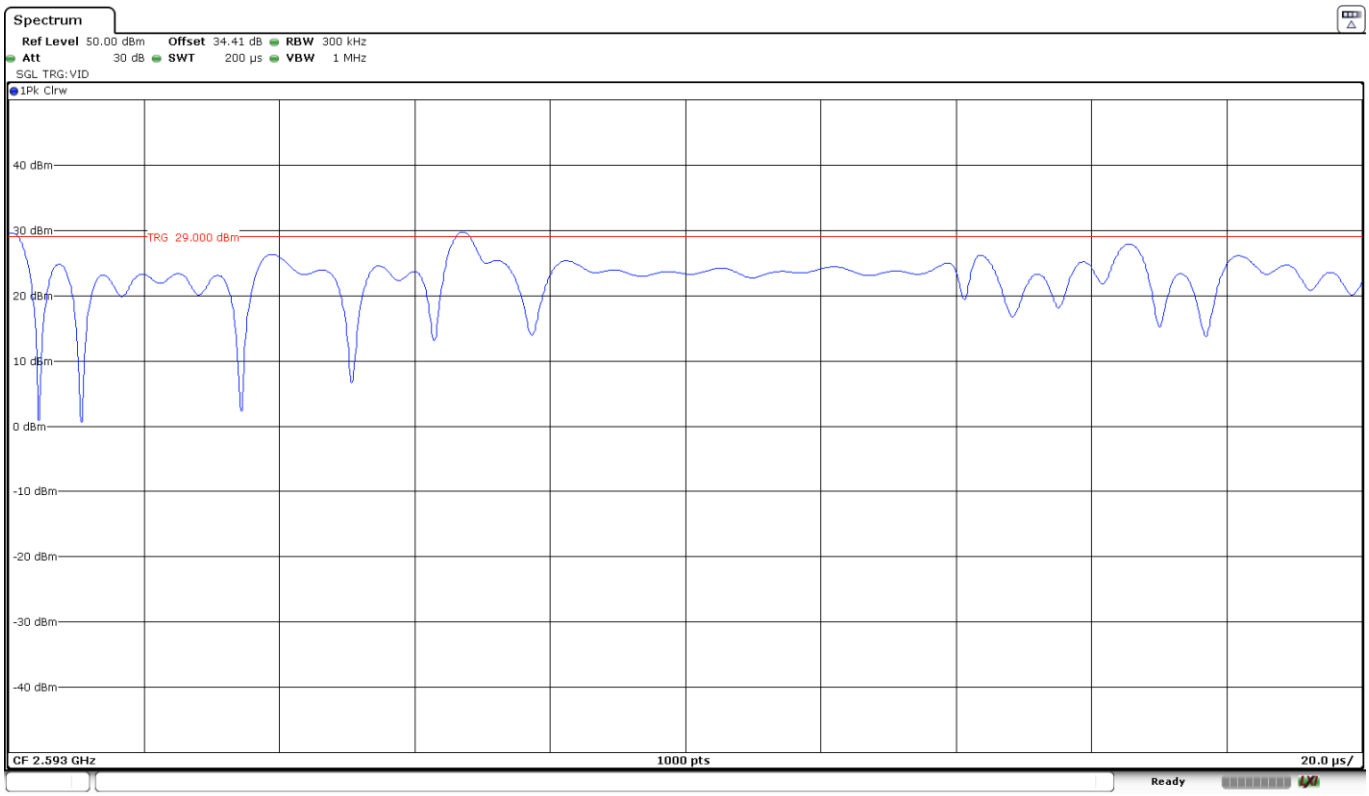
16QAM. BW=5 MHz.



Date: 14.JAN.2025 21:46:01

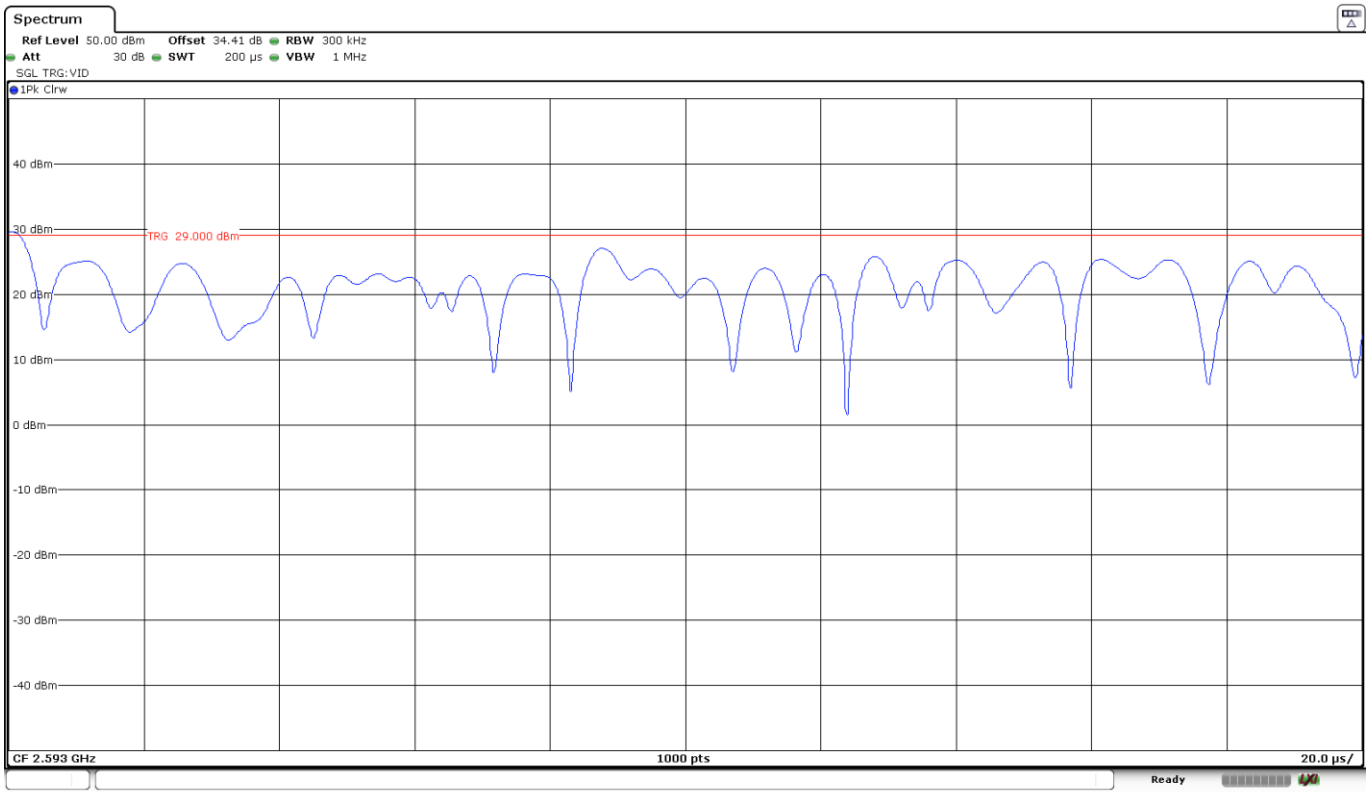
LTE Cat 1bis Band 41:

QPSK. BW=1.4 MHz.



Date: 29.JAN.2025 11:39:09

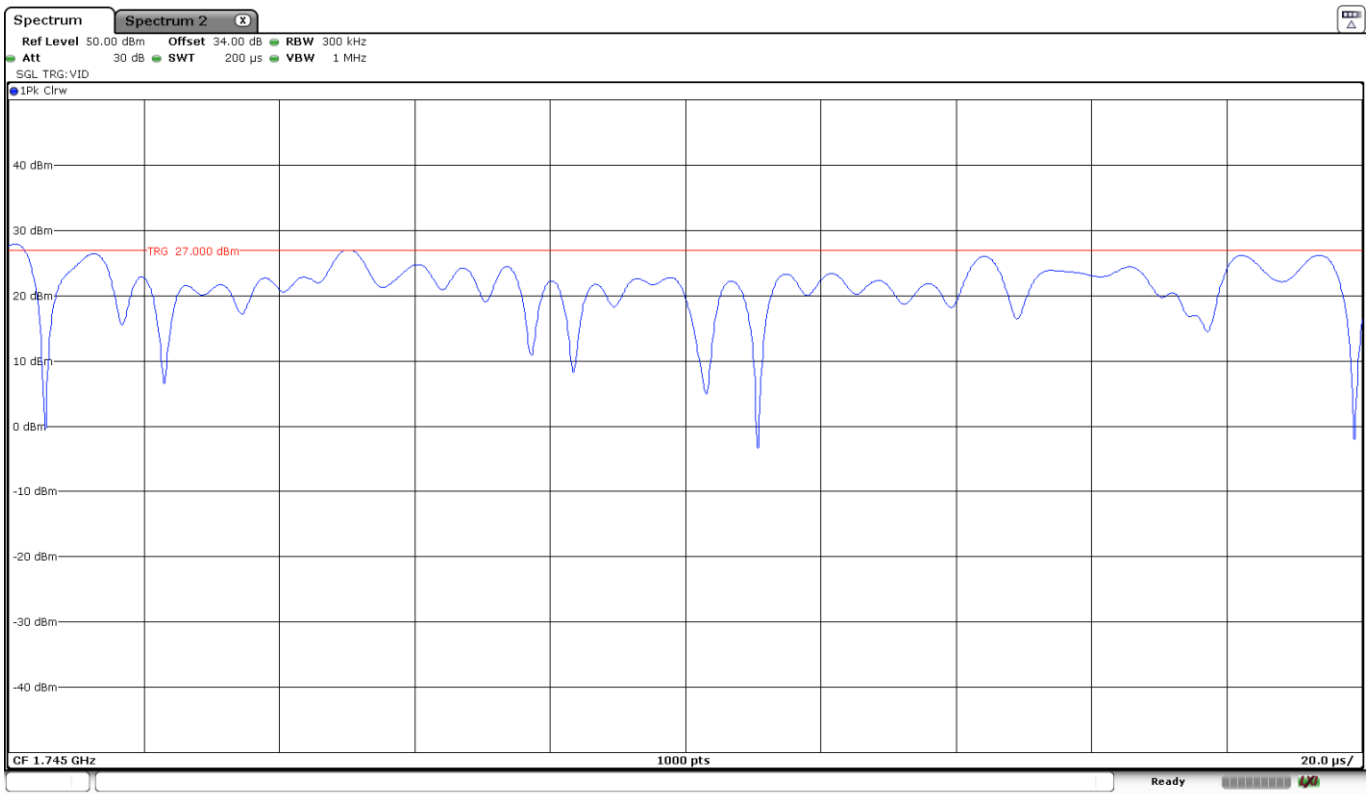
16QAM. BW=1.4 MHz.



Date: 29.JAN.2025 11:40:03

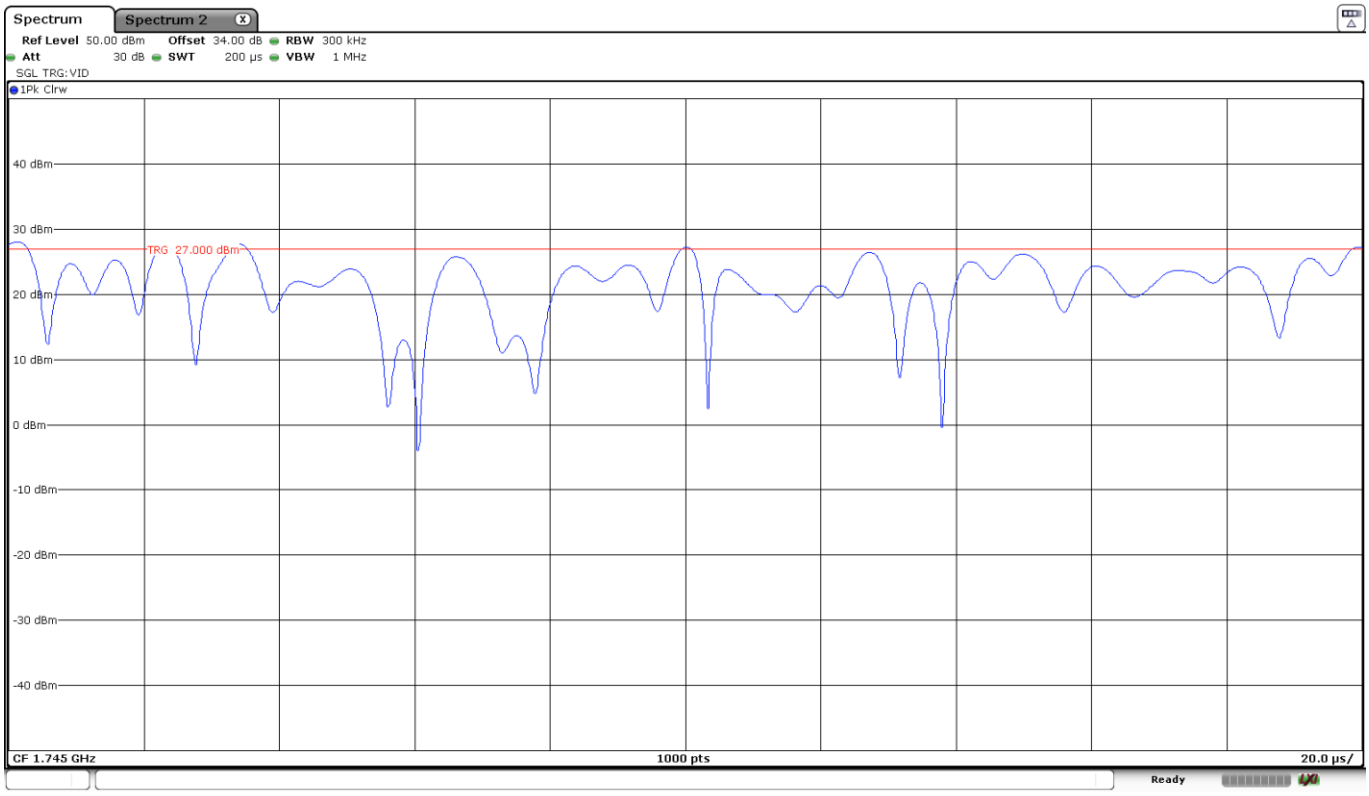
LTE Cat 1bis Band 66:

QPSK. BW=1.4 MHz.



Date: 14.JAN.2025 21:50:48

16QAM. BW=1.4 MHz.



Date: 14.JAN.2025 21:52:17

Occupied Bandwidth

Limits

FCC §2.1049: Measurements required: Occupied bandwidth.

RSS-Gen 6.7. The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

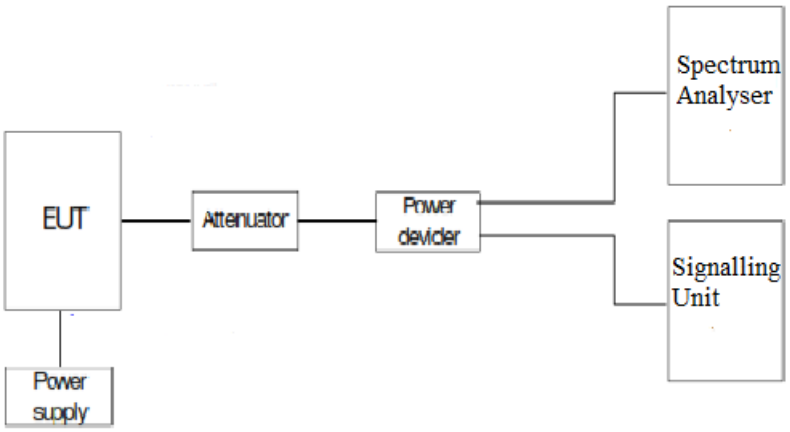
Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 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 of occupied bandwidth corresponds to all Resource Blocks (RB) offset 0 regardless the Bandwidth selected.

LTE Cat 1bis Band 12:

LTE Cat 1bis Band 12. BW=1.4 MHz. QPSK. RB Size 6.

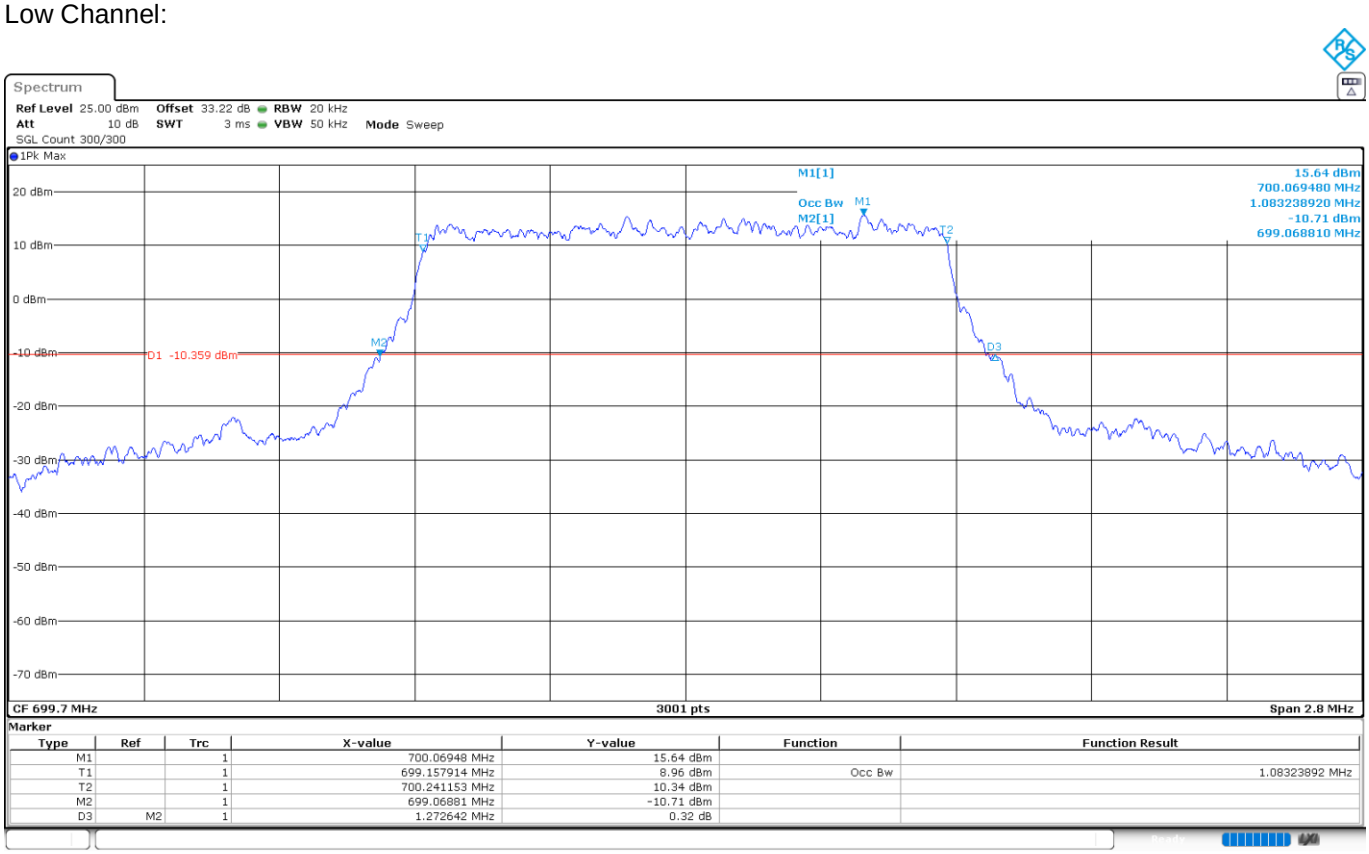
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	1.083238920	1.079506831	1.084171943
-26 dBc Bandwidth (MHz)	1.272642000	1.274508000	1.268910000
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 12. BW=1.4 MHz. 16QAM. RB Size 5.

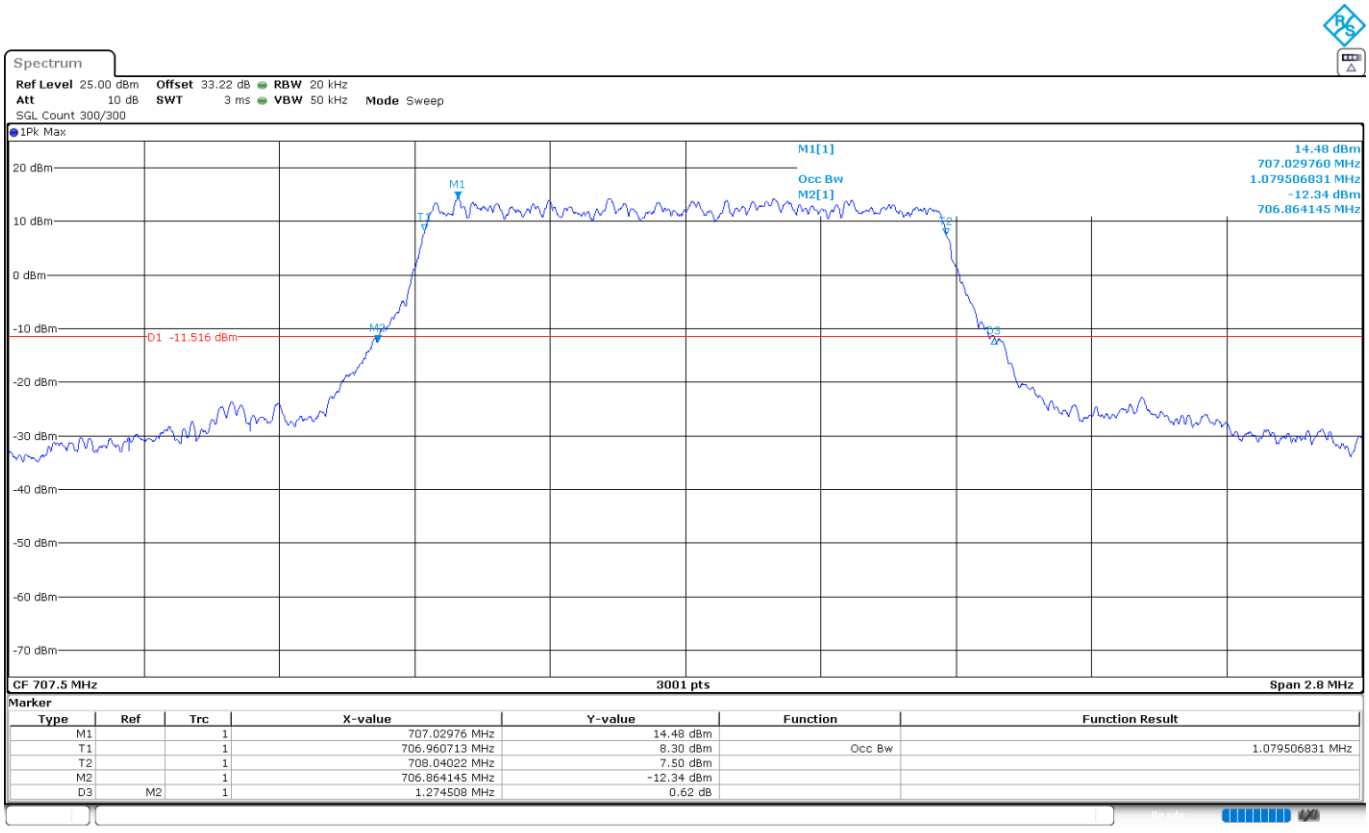
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	1.085104965	1.0841719430	1.0804398530
-26 dBc Bandwidth (MHz)	1.295968000	1.2819730000	1.2558480000
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 12. BW=1.4 MHz. QPSK. RB Size 6.

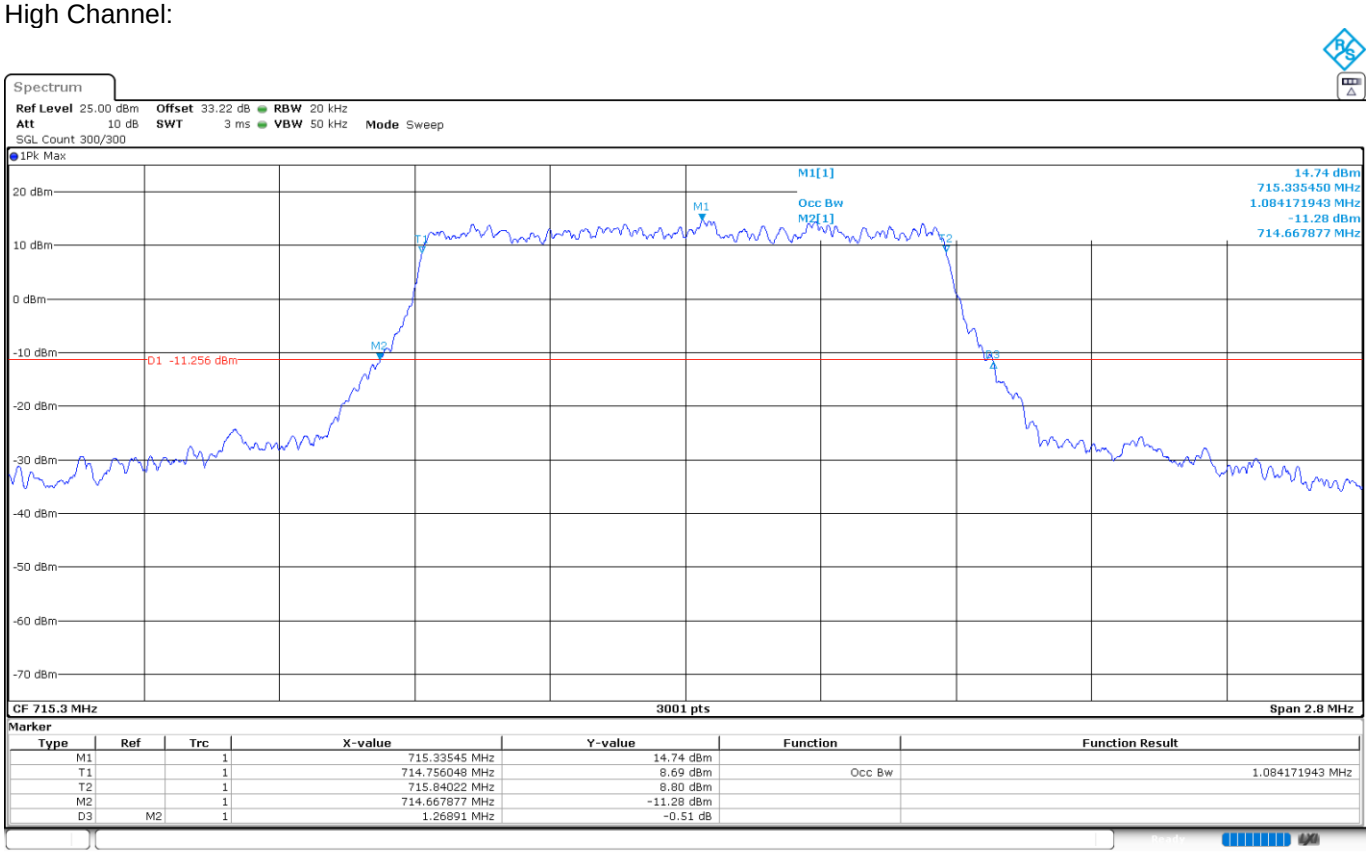
Low Channel:



Middle Channel:

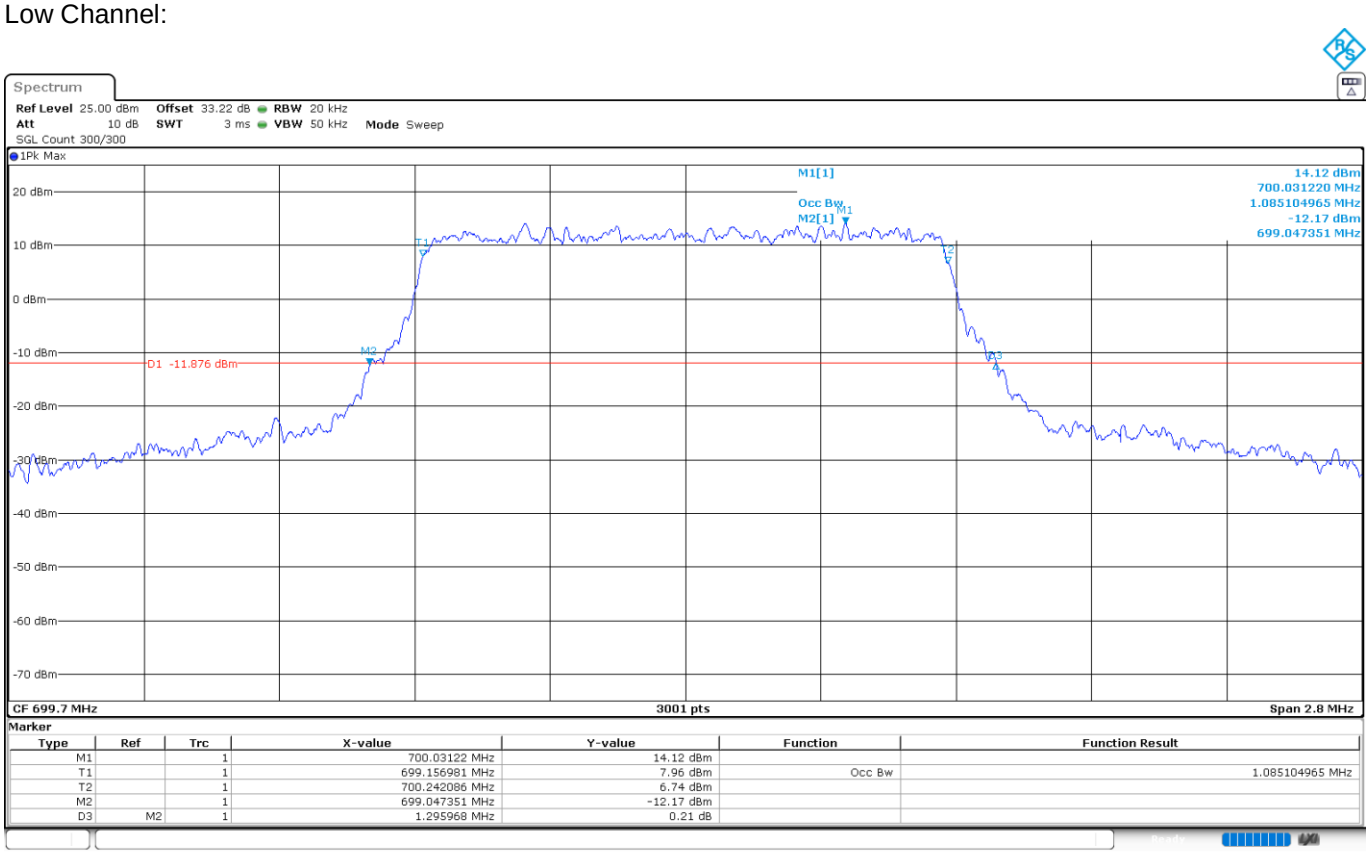


High Channel:

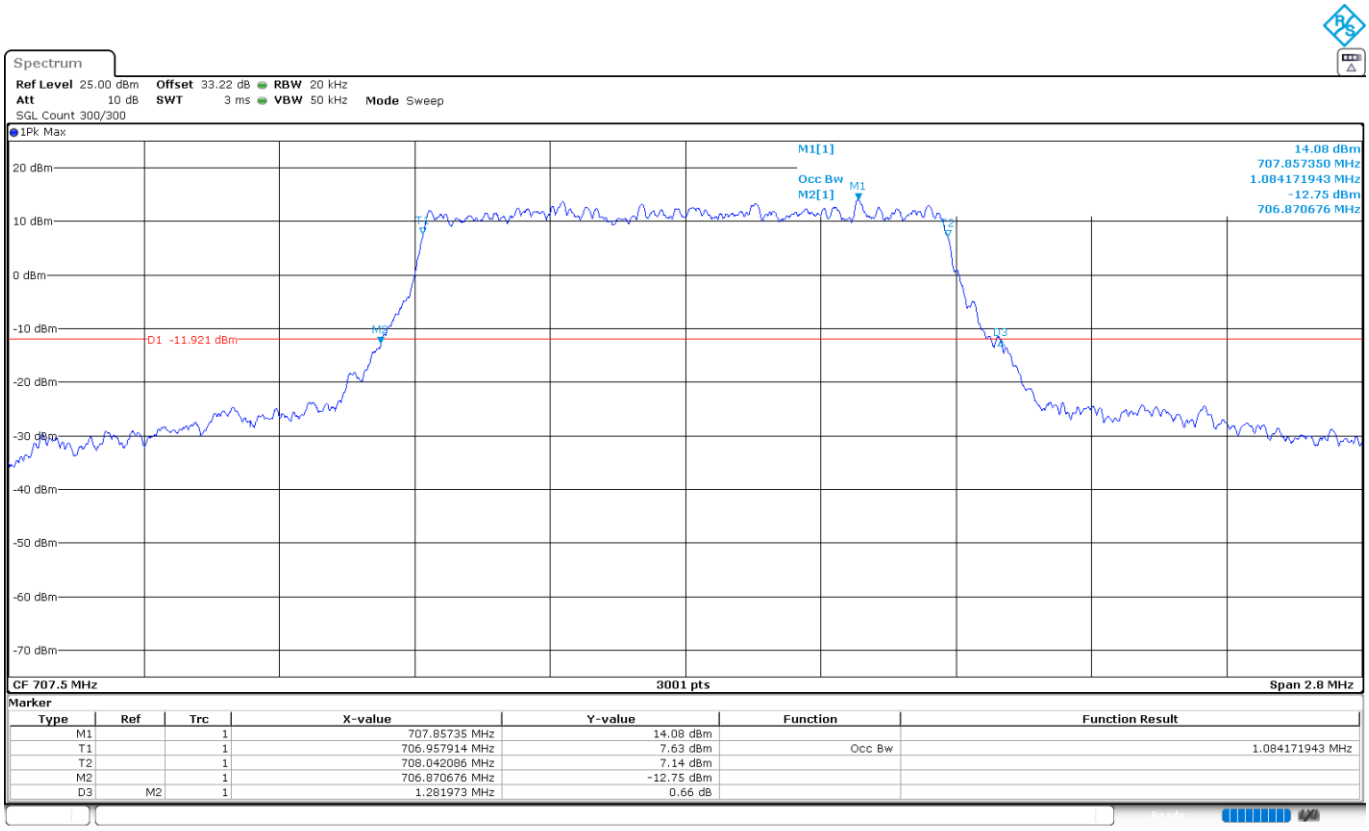


LTE Cat 1bis Band 12. BW=1.4 MHz. 16QAM. RB Size 5.

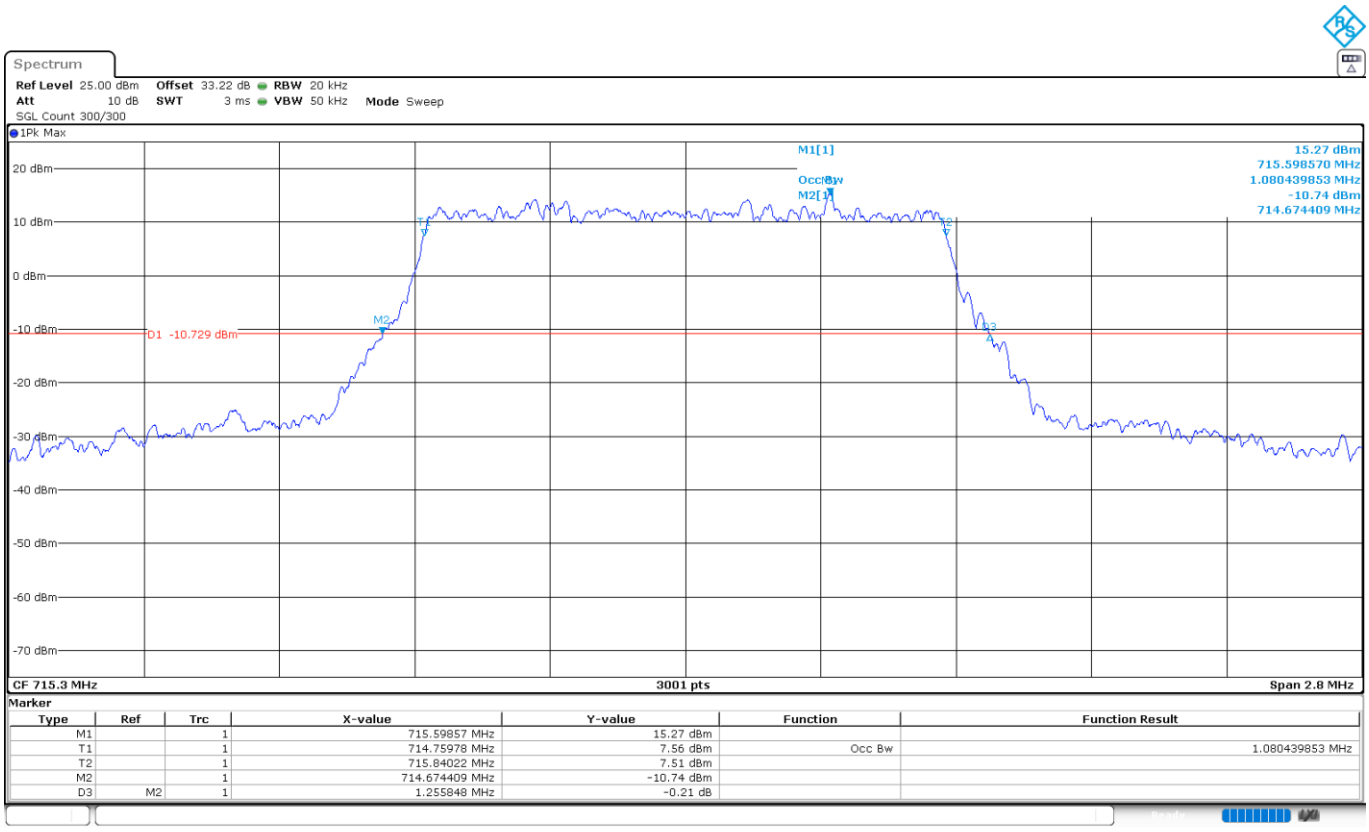
Low Channel:



Middle Channel:



High Channel:



LTE Cat 1bis Band 12. BW=3 MHz. QPSK. RB Size 6.

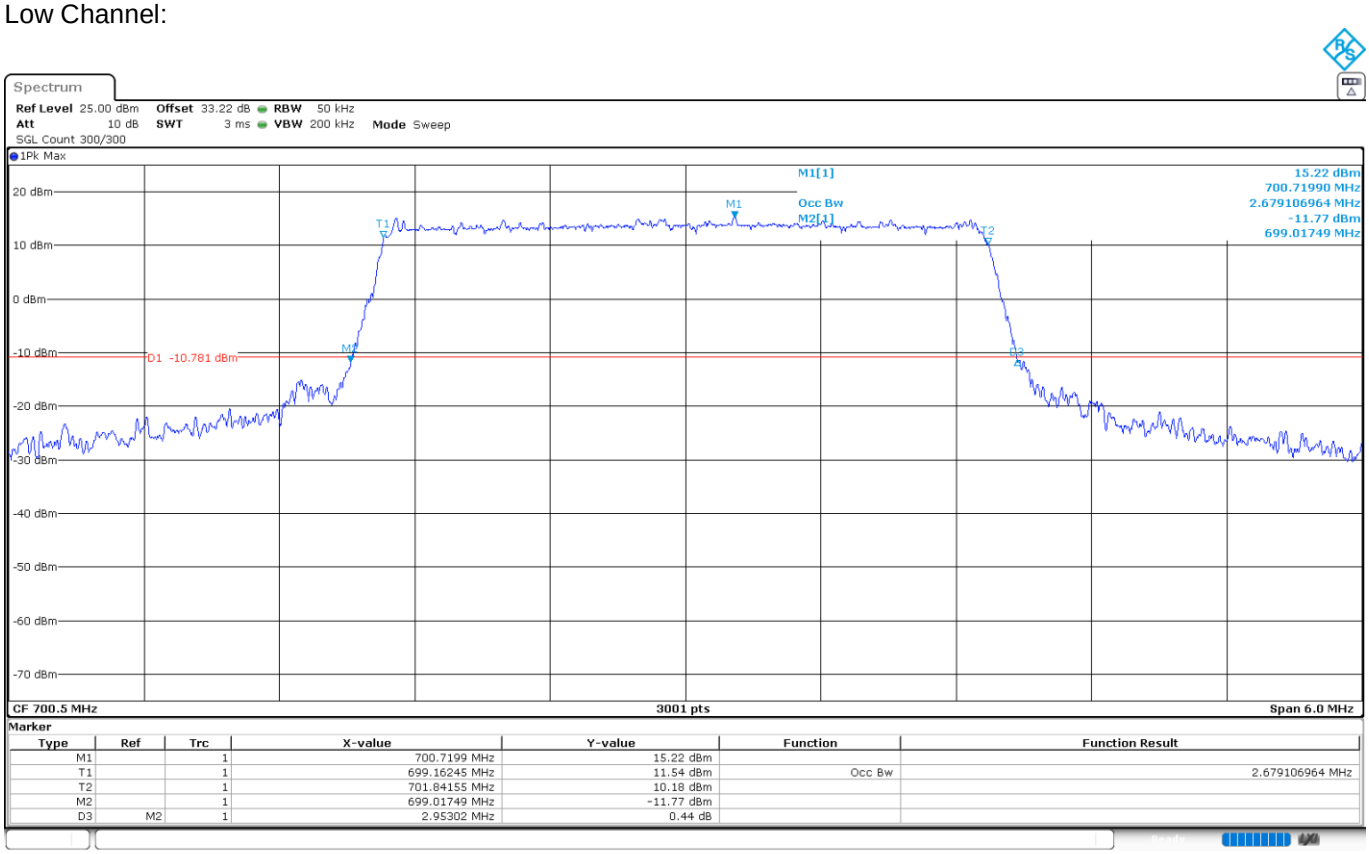
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	2.679106964	2.691102966	2.693102299
-26 dBc Bandwidth (MHz)	2.953020000	2.931020000	2.955010000
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 12. BW=3 MHz. 16QAM. RB Size 5.

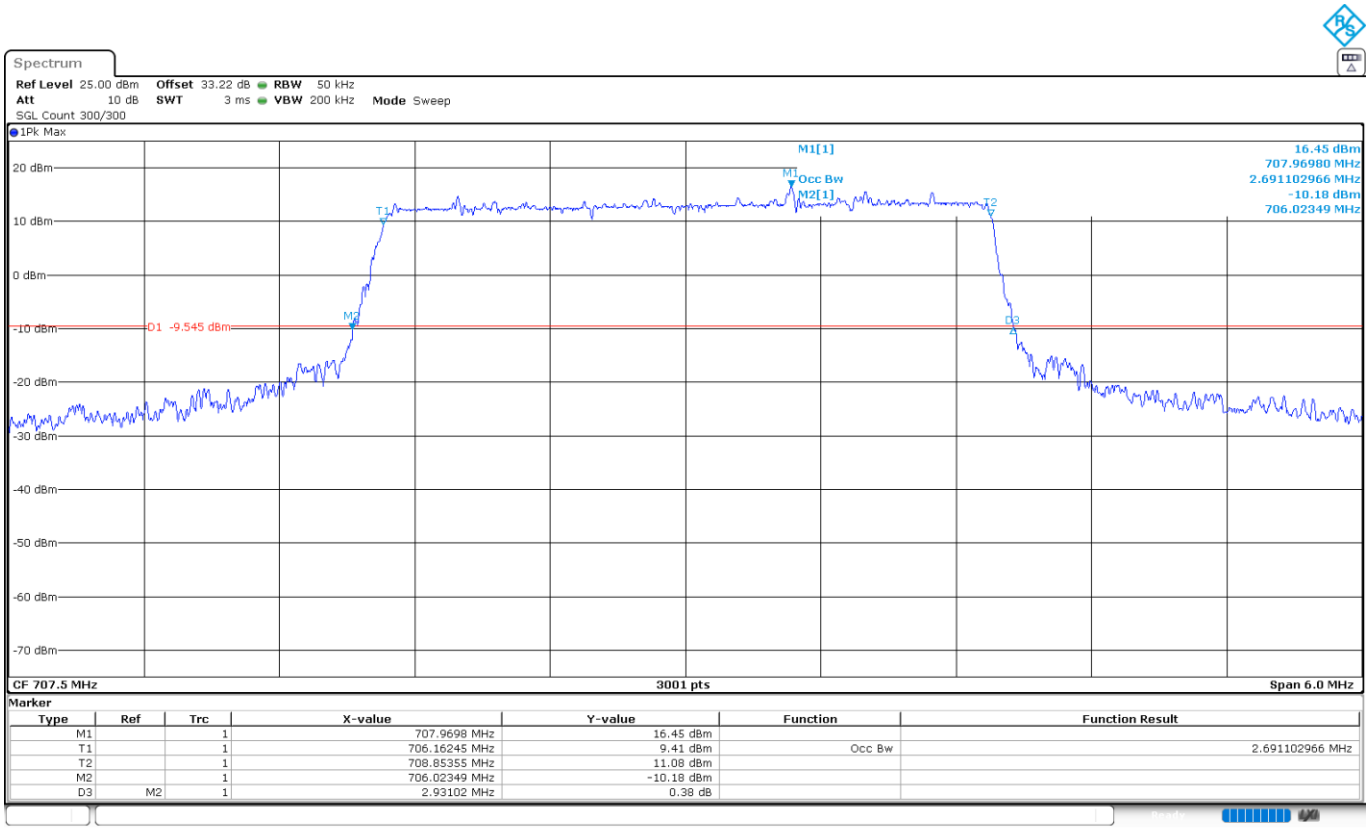
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	2.6771076	2.6911030	2.683105631
-26 dBc Bandwidth (MHz)	2.9370200	2.9410200	2.947020000
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 12. BW=3 MHz. QPSK. RB Size 6.

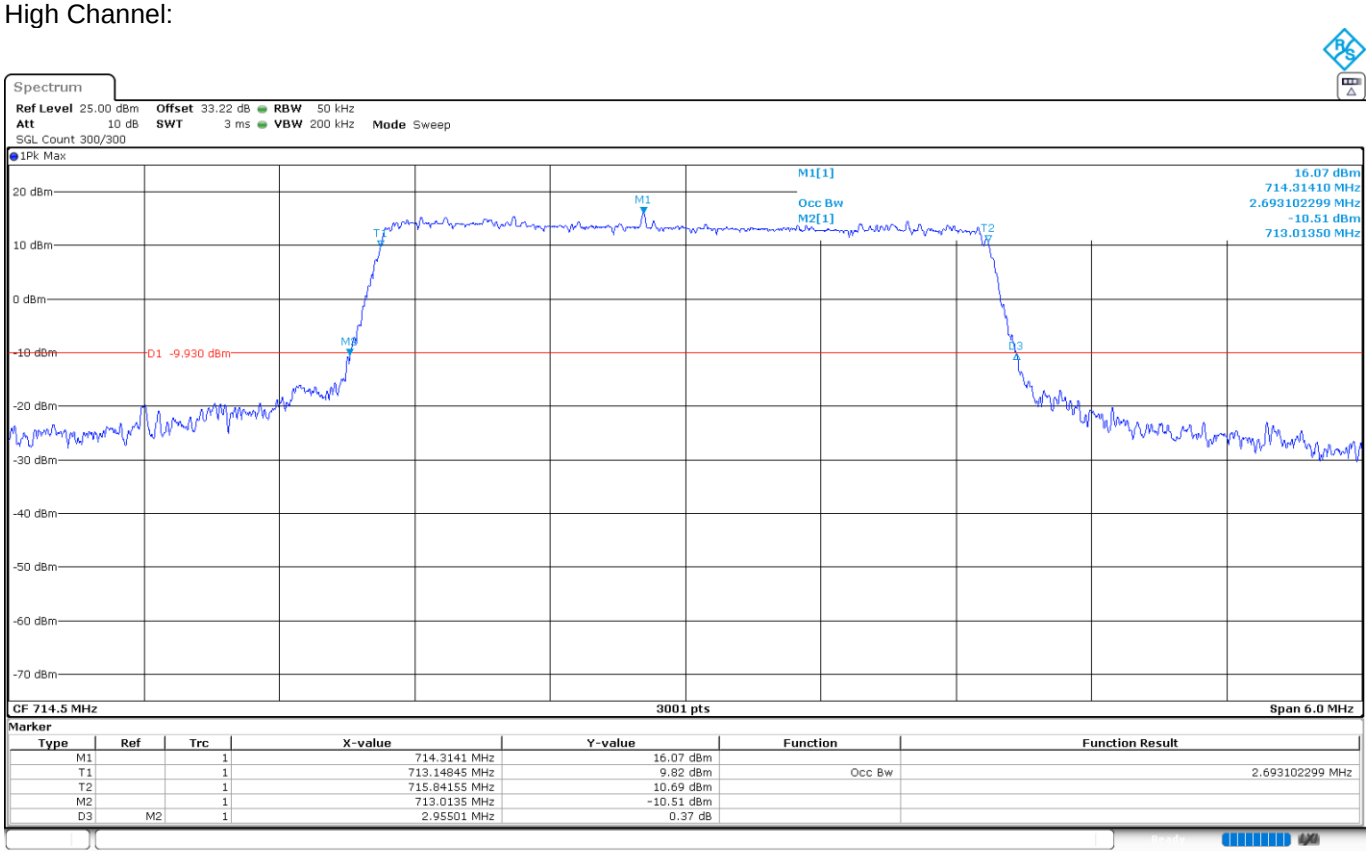
Low Channel:



Middle Channel:

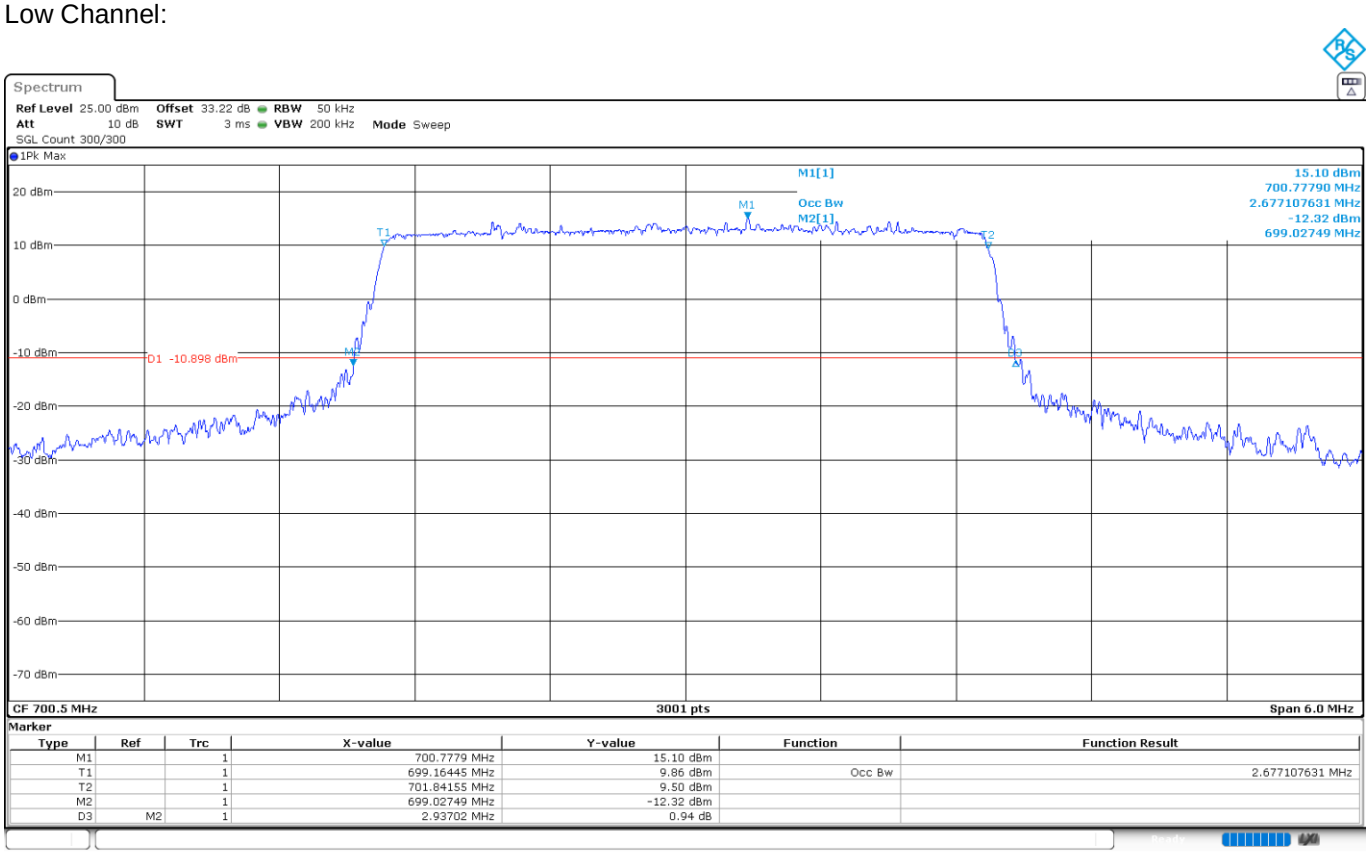


High Channel:

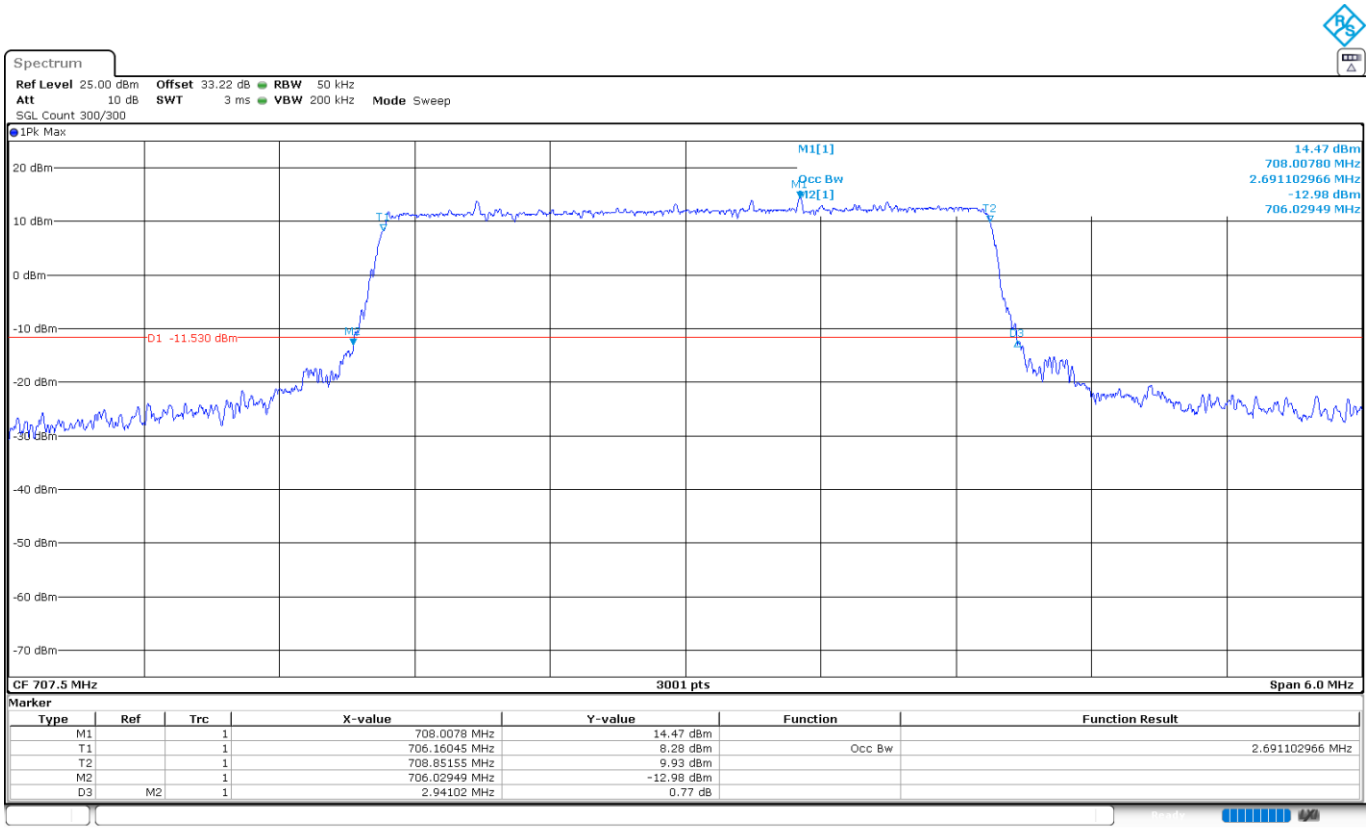


LTE Cat 1bis Band 12. BW=3 MHz. 16QAM. RB Size 5.

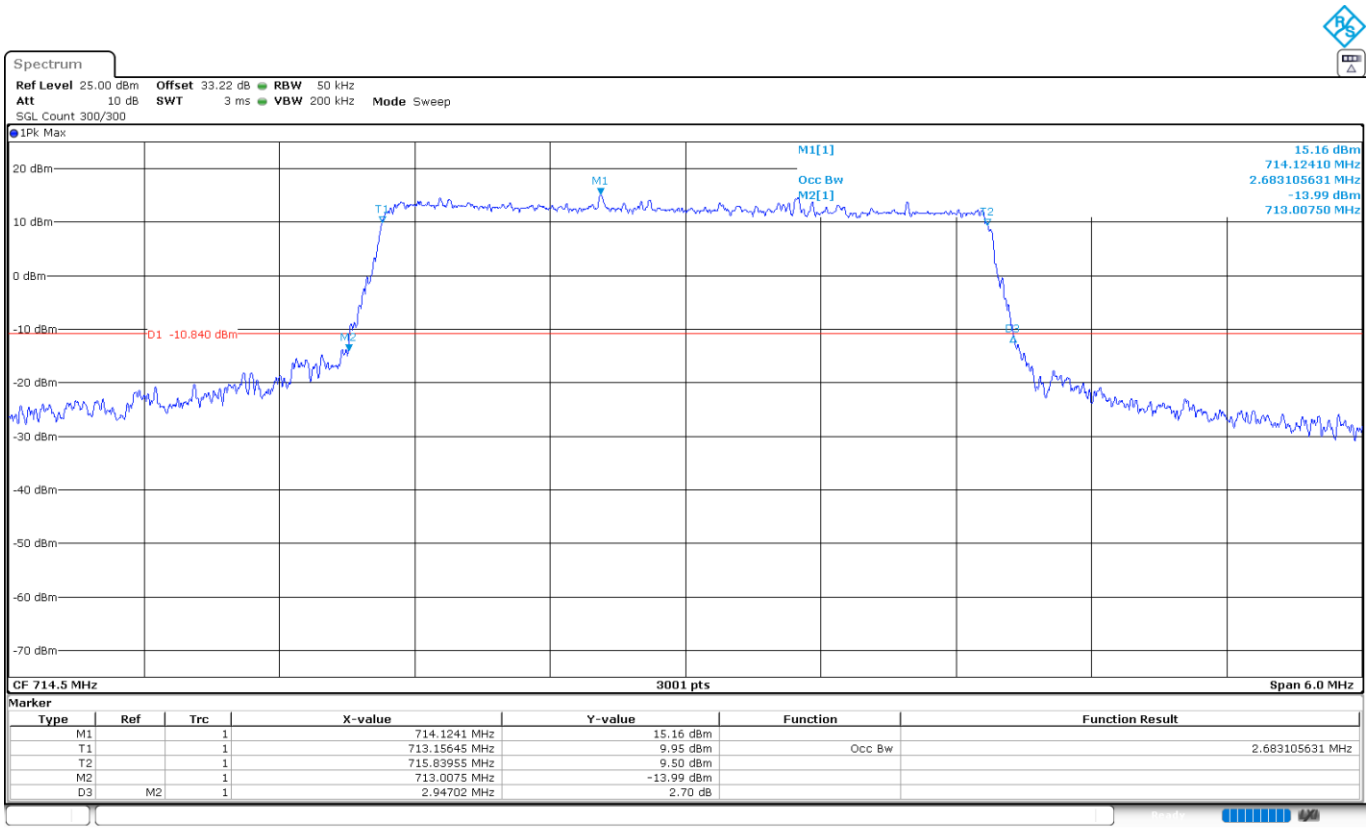
Low Channel:



Middle Channel:



High Channel:



LTE Cat 1bis Band 12. BW=5 MHz. QPSK. RB Size 6.

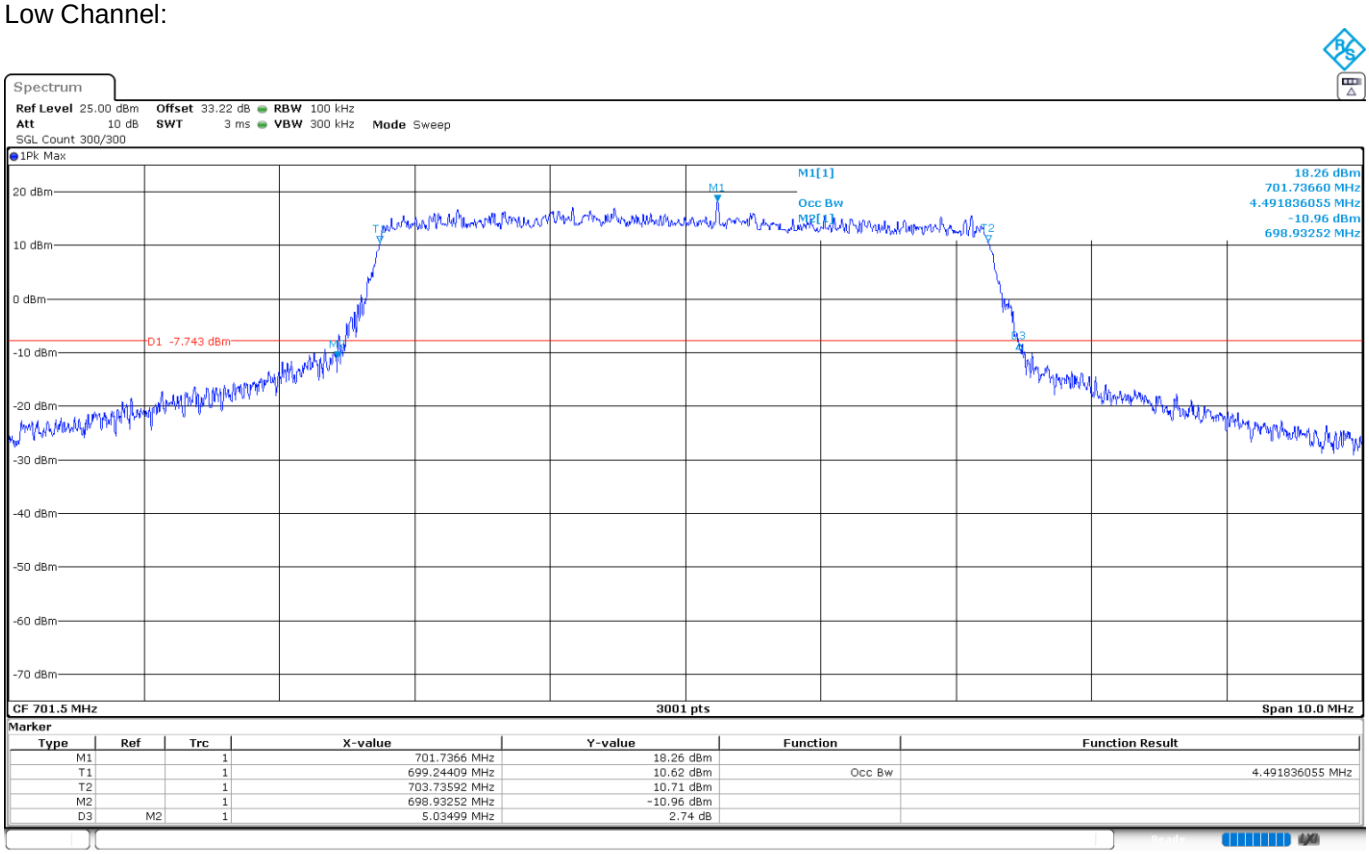
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	4.49183605500	4.51516161300	4.50516494500
-26 dBc Bandwidth (MHz)	5.03499000000	2.02166000000	5.15162000000
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 12. BW=5 MHz. 16QAM. RB Size 5.

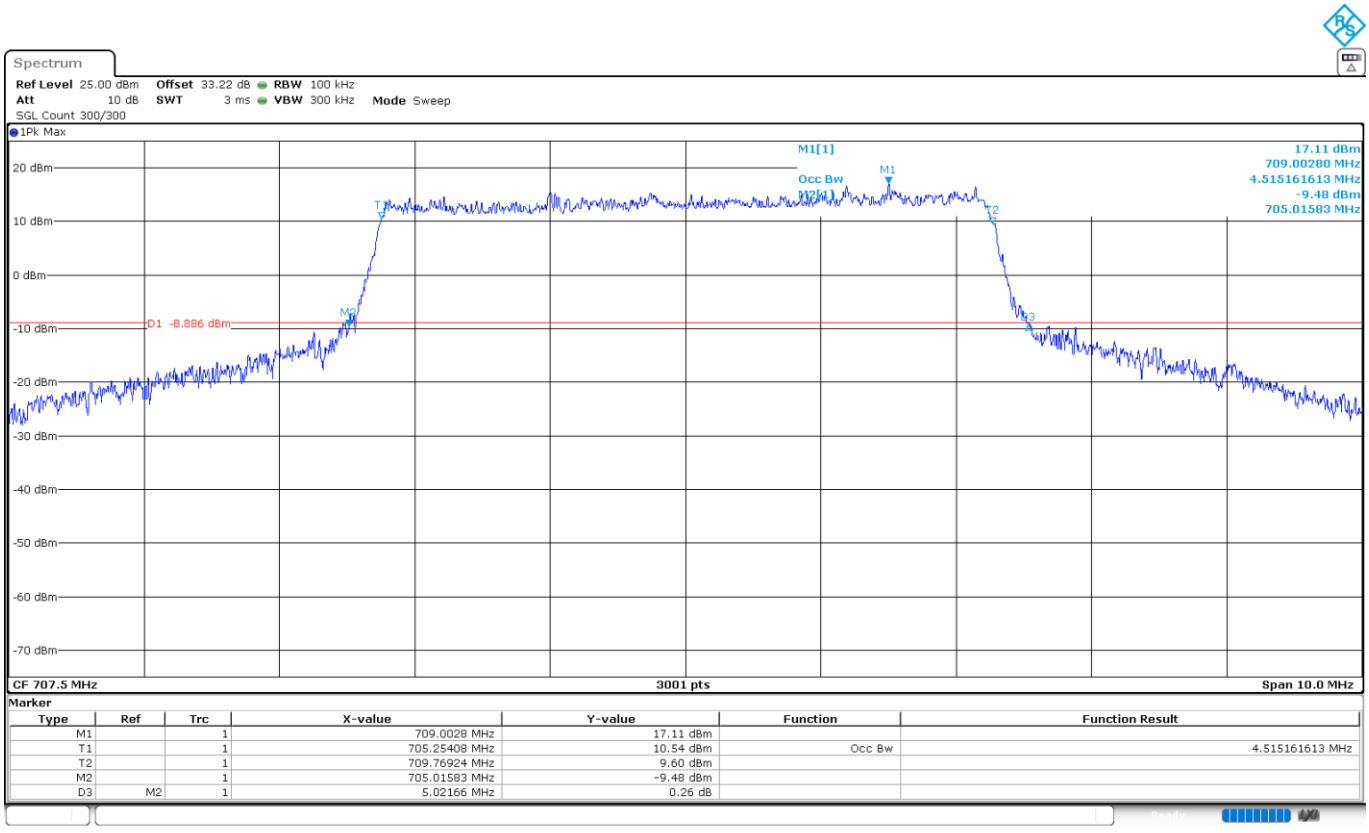
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	4.44951682770	4.52515828100	4.50849716800
-26 dBc Bandwidth (MHz)	4.95198000000	5.17494000000	5.10497000000
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 12. BW=5 MHz. QPSK. RB Size 6.

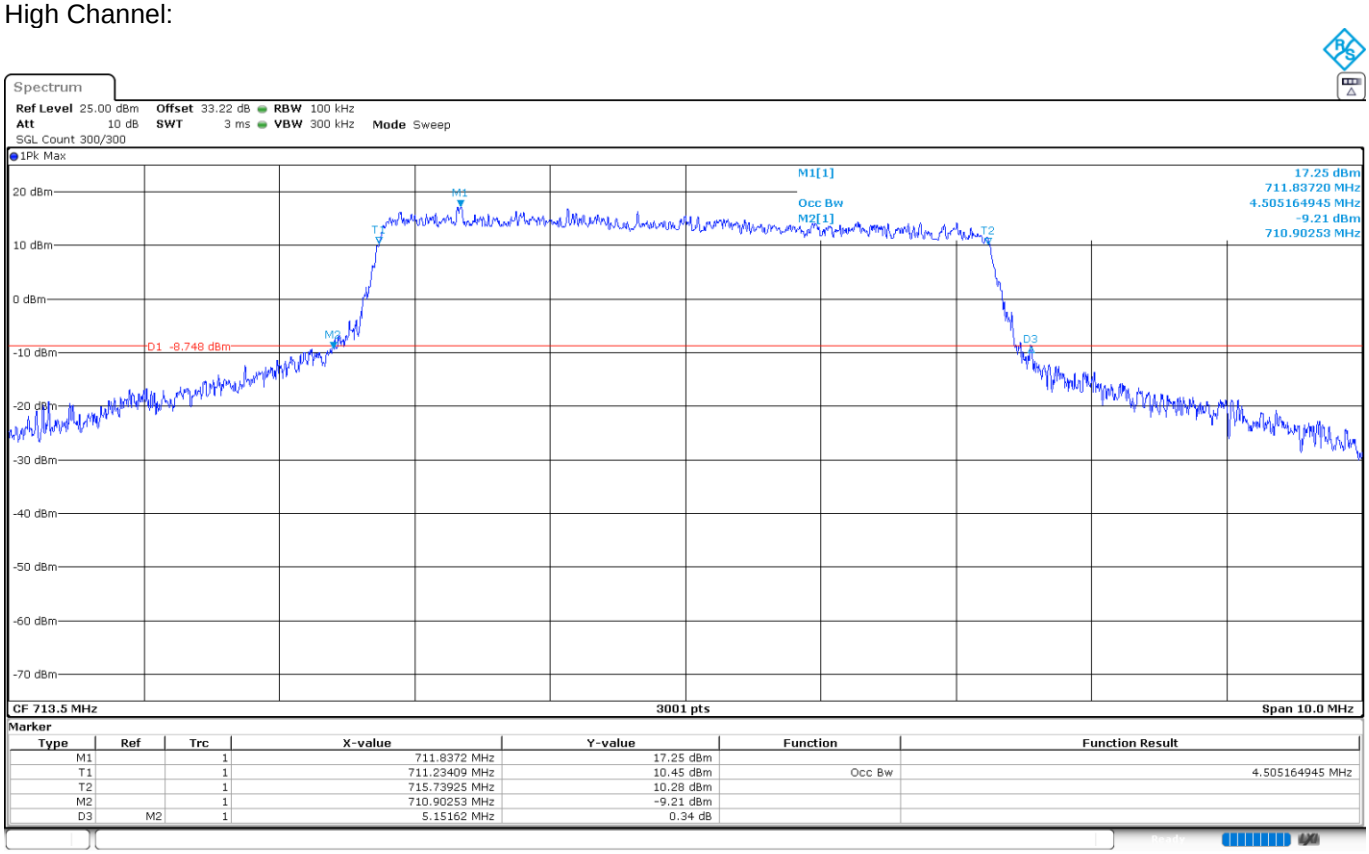
Low Channel:



Middle Channel:

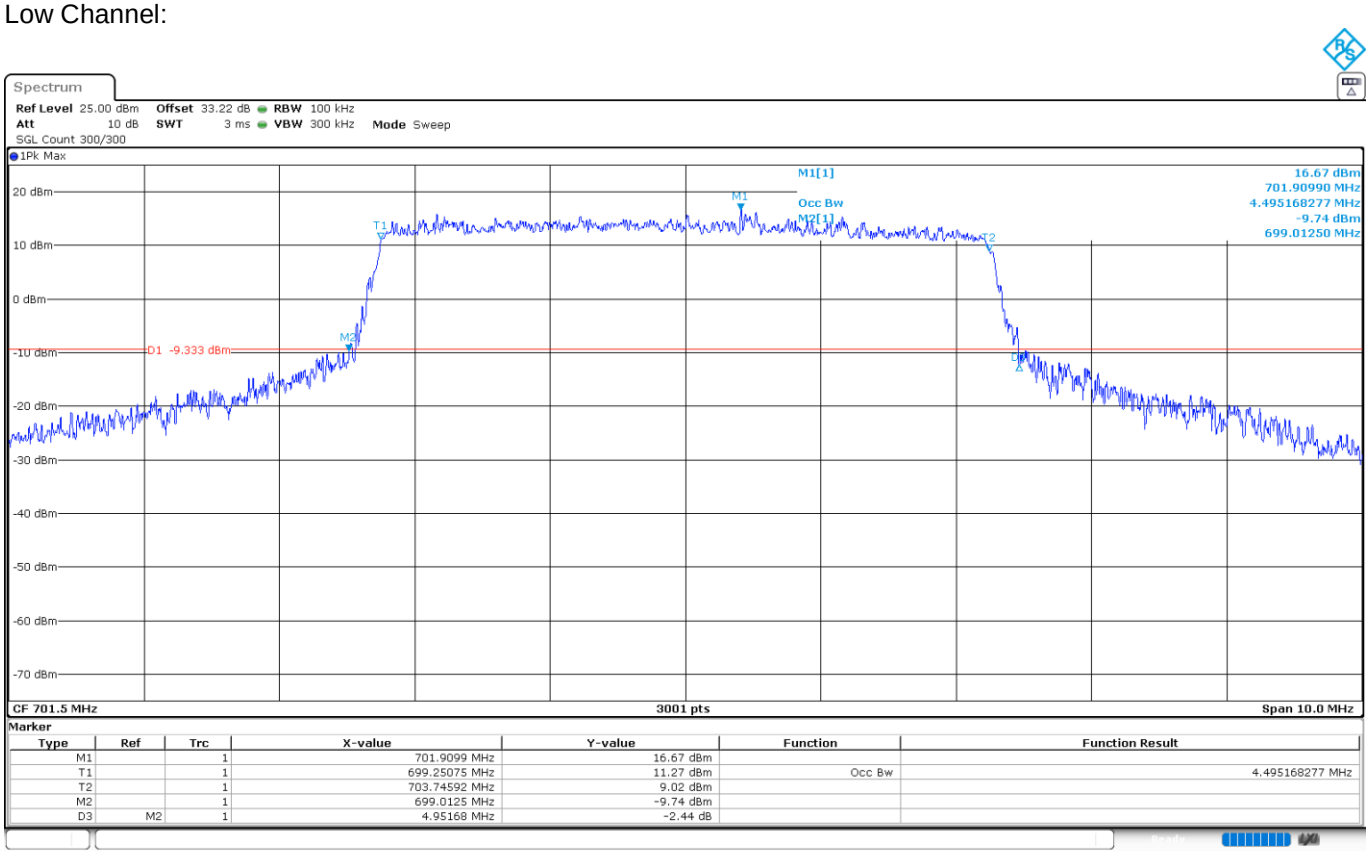


High Channel:

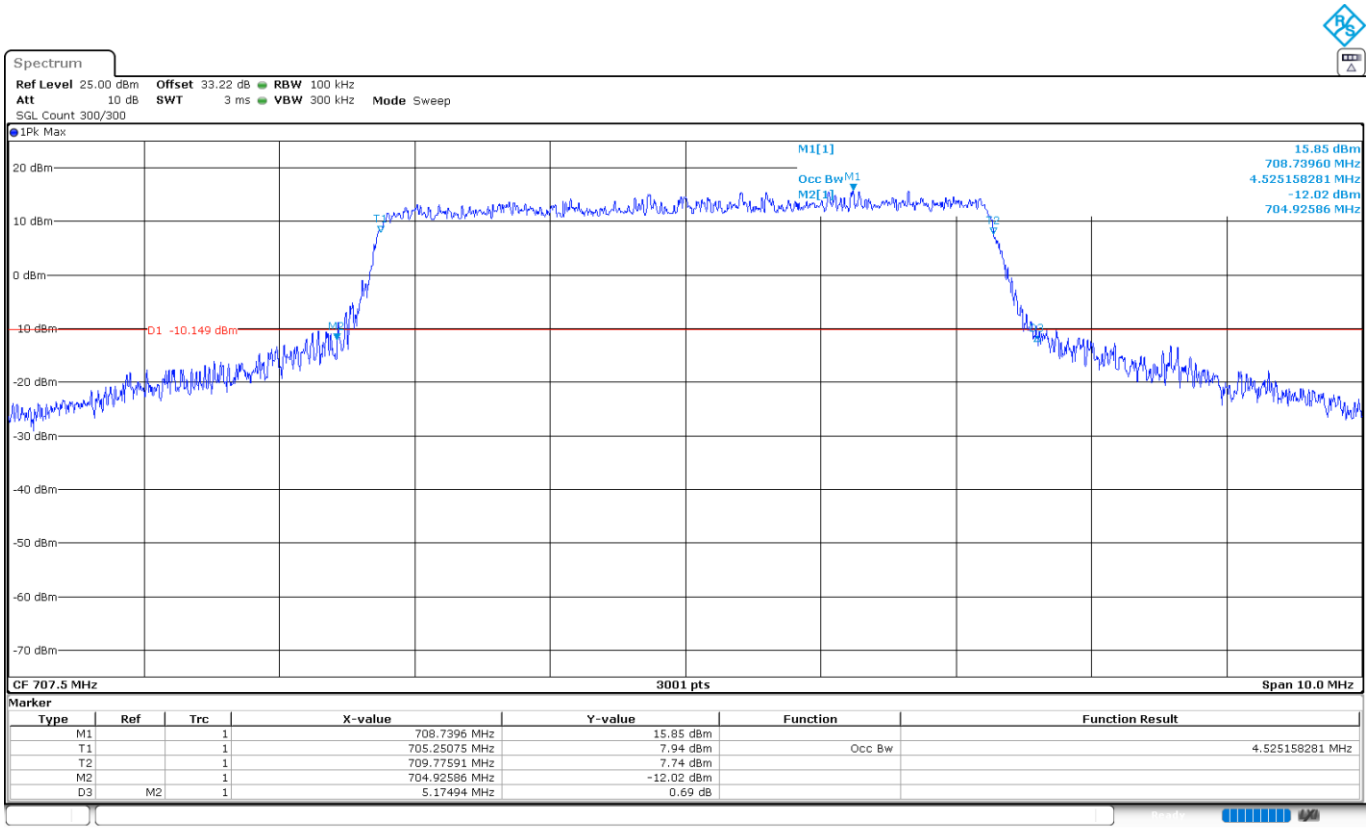


LTE Cat 1bis Band 12. BW=5 MHz. 16QAM. RB Size 5.

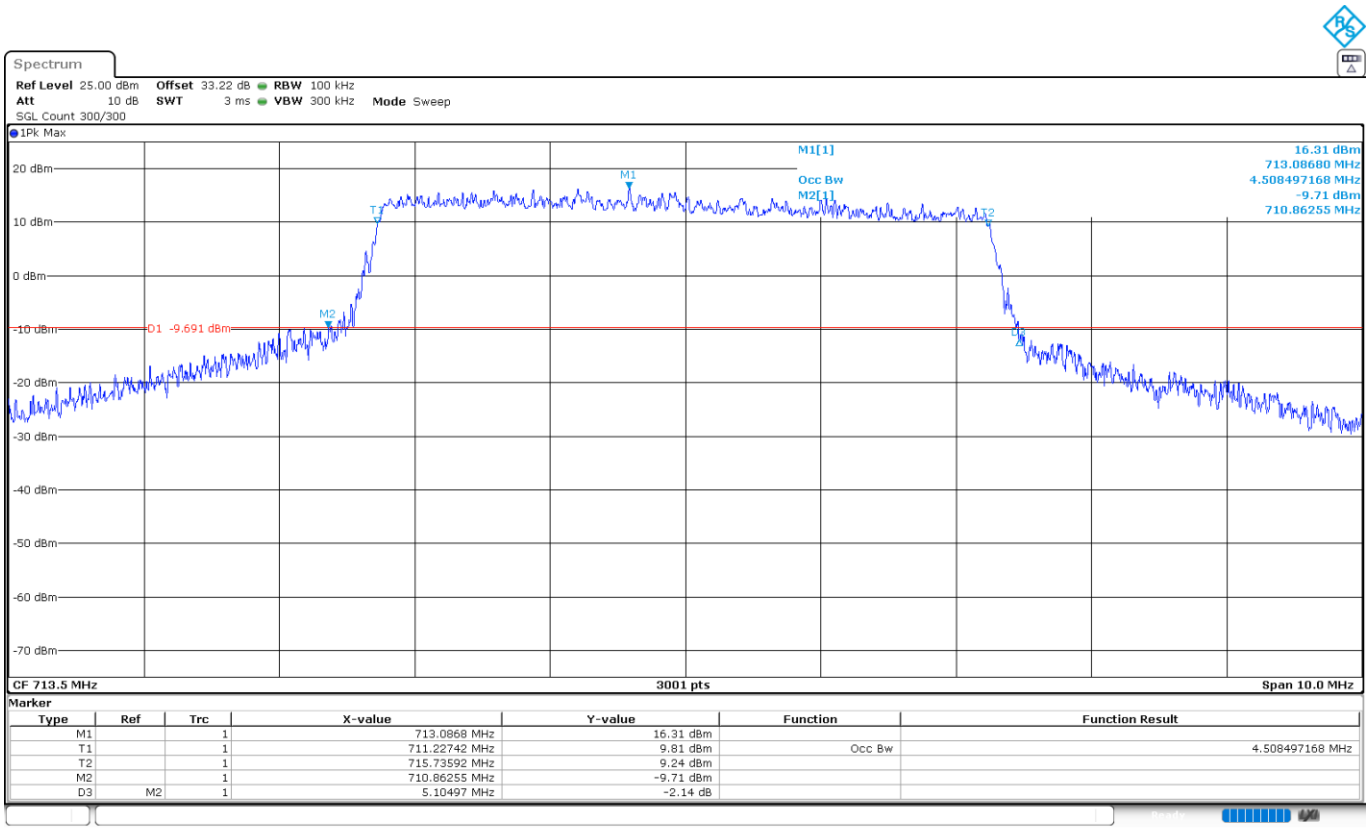
Low Channel:



Middle Channel:



High Channel:



LTE Cat 1bis Band 12. BW=10 MHz. QPSK. RB Size 6.

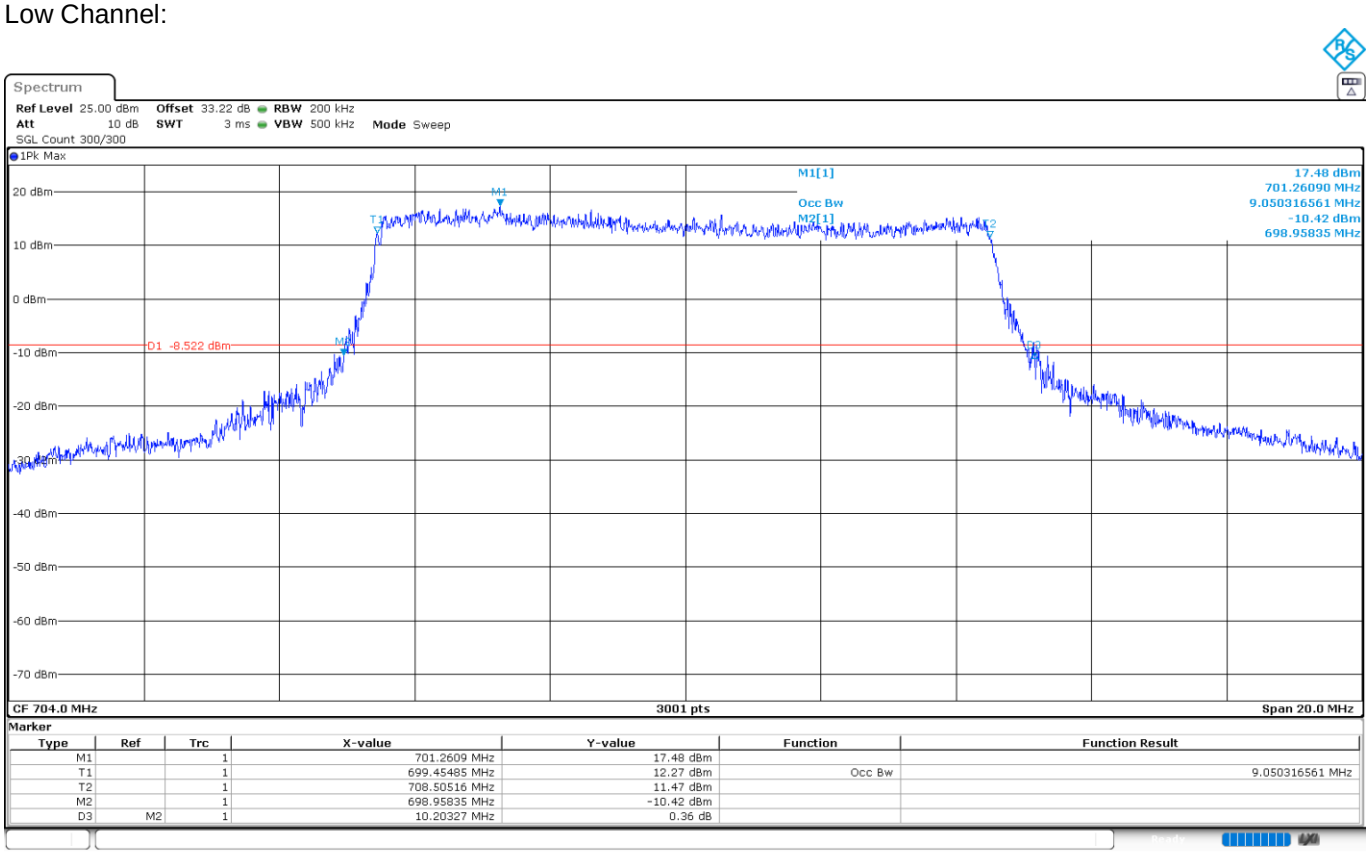
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	9.0503165561	9.0103298900	8.9103632120
-26 dBc Bandwidth (MHz)	10.2032700000	10.0699800000	9.9500200000
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 12. BW=10 MHz. 16QAM. RB Size 5.

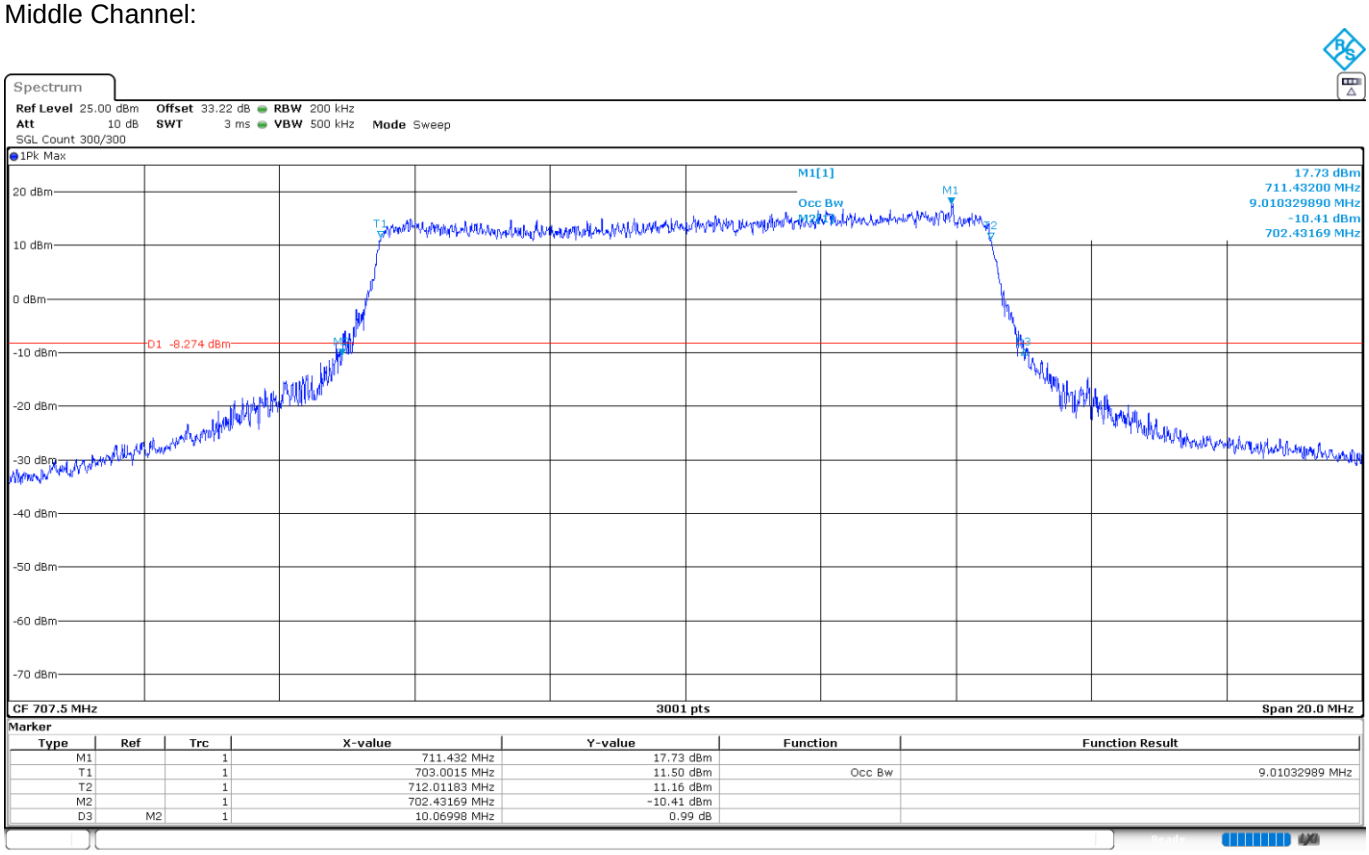
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	4.551816061	4.531822726	4.5451511616
-26 dBc Bandwidth (MHz)	5.451520000	5.318230000	5.404870000
Measurement uncertainty (kHz)	<±3.75		

LTE Cat 1bis Band 12. BW=10 MHz. QPSK. RB Size 6.

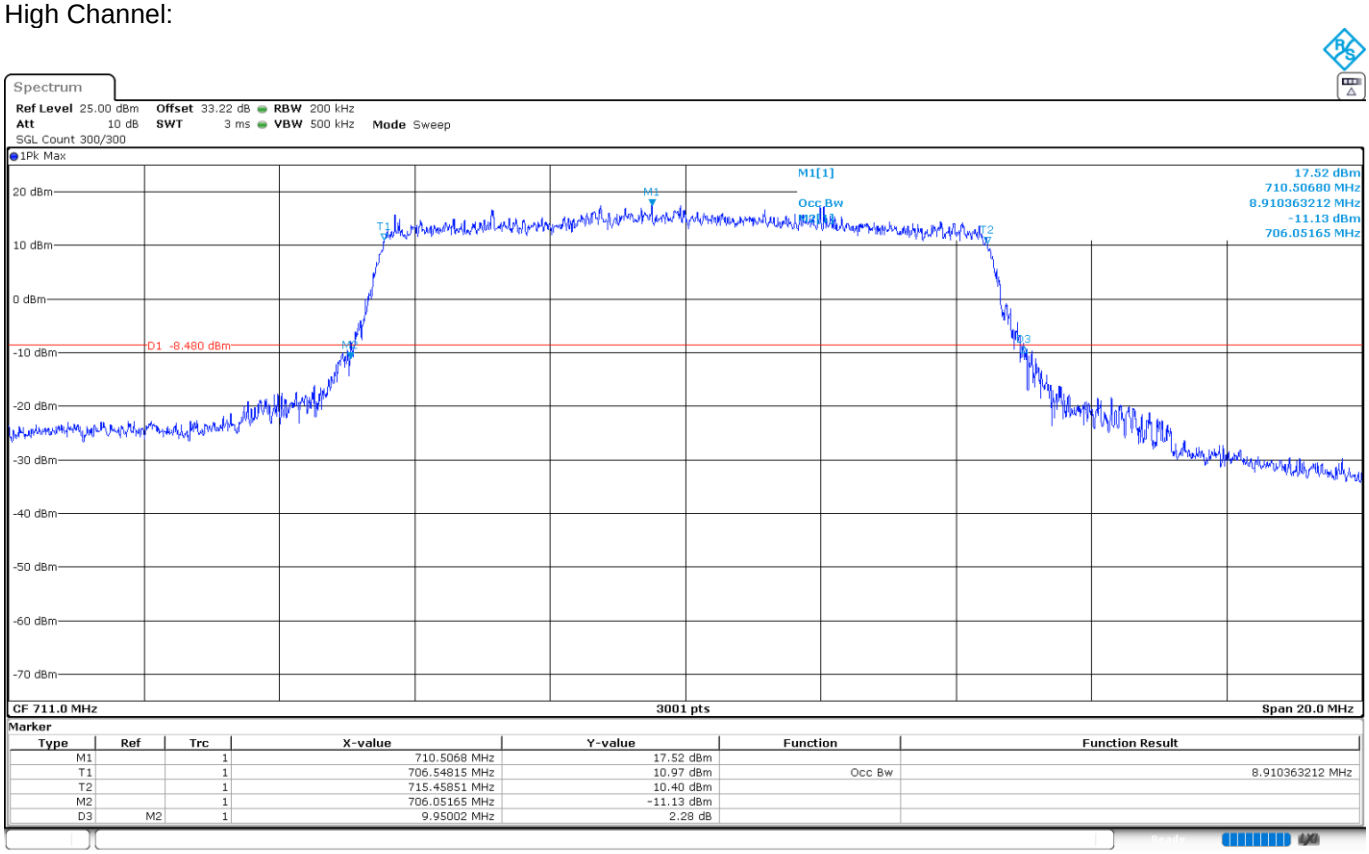
Low Channel:



Middle Channel:

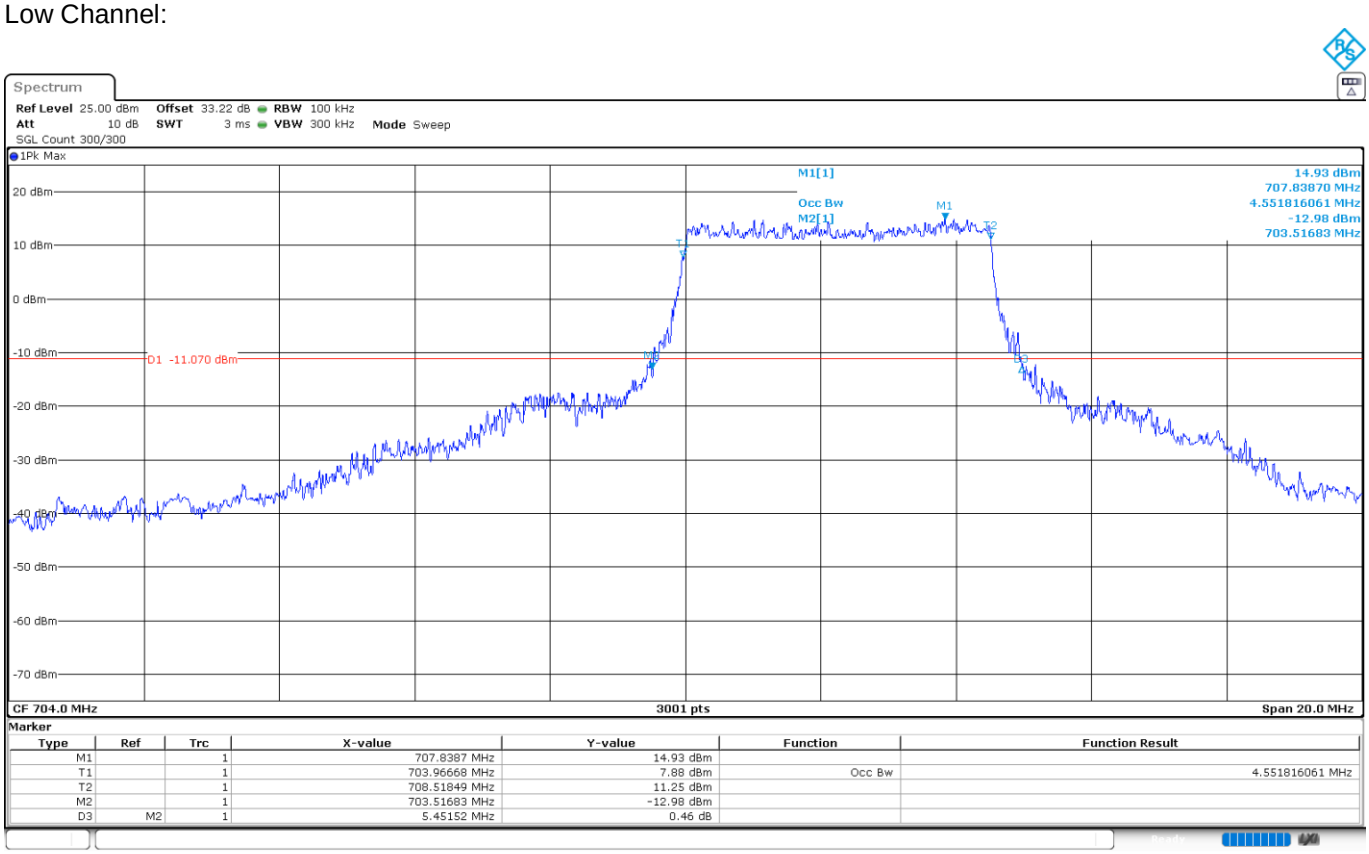


High Channel:

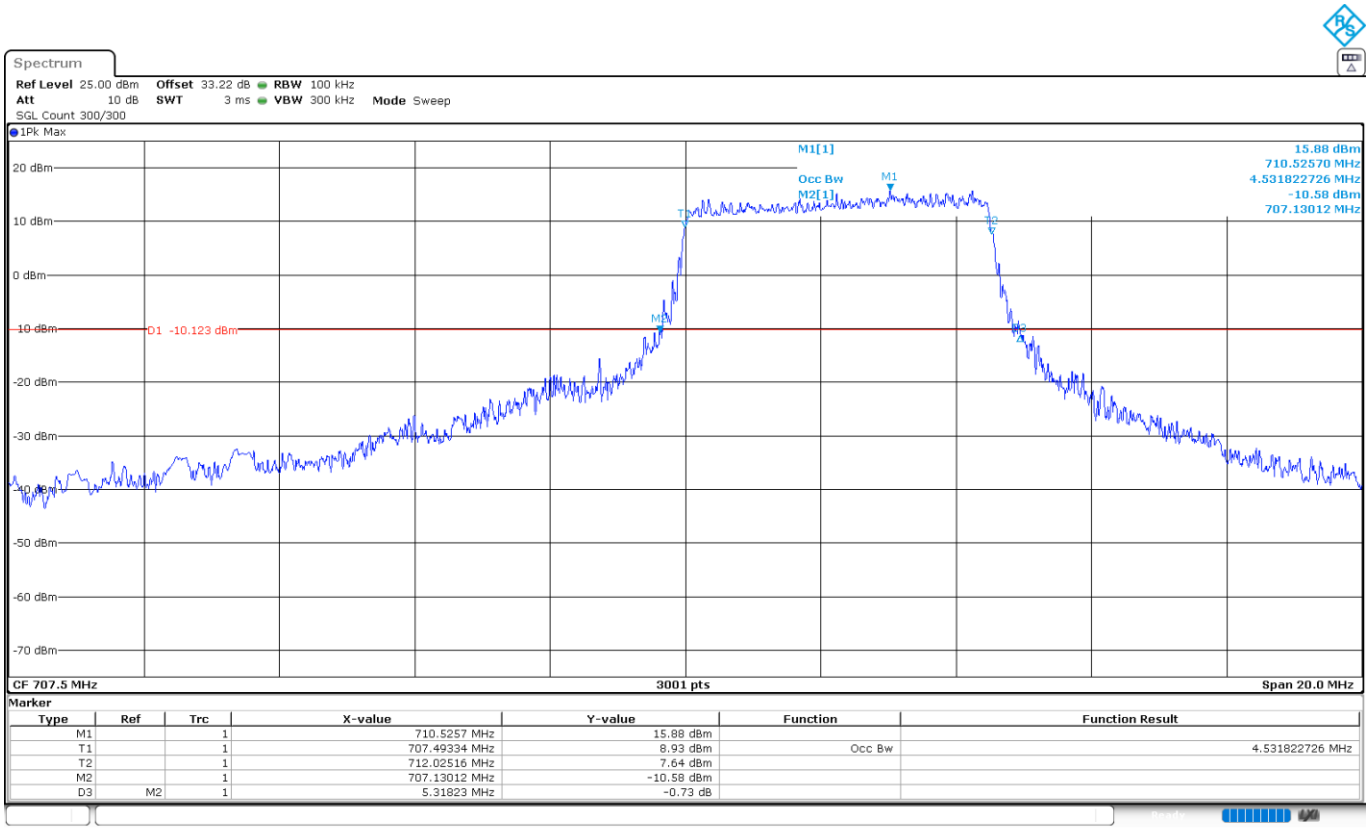


LTE Cat 1bis Band 12. BW=10 MHz. 16QAM. RB Size 5.

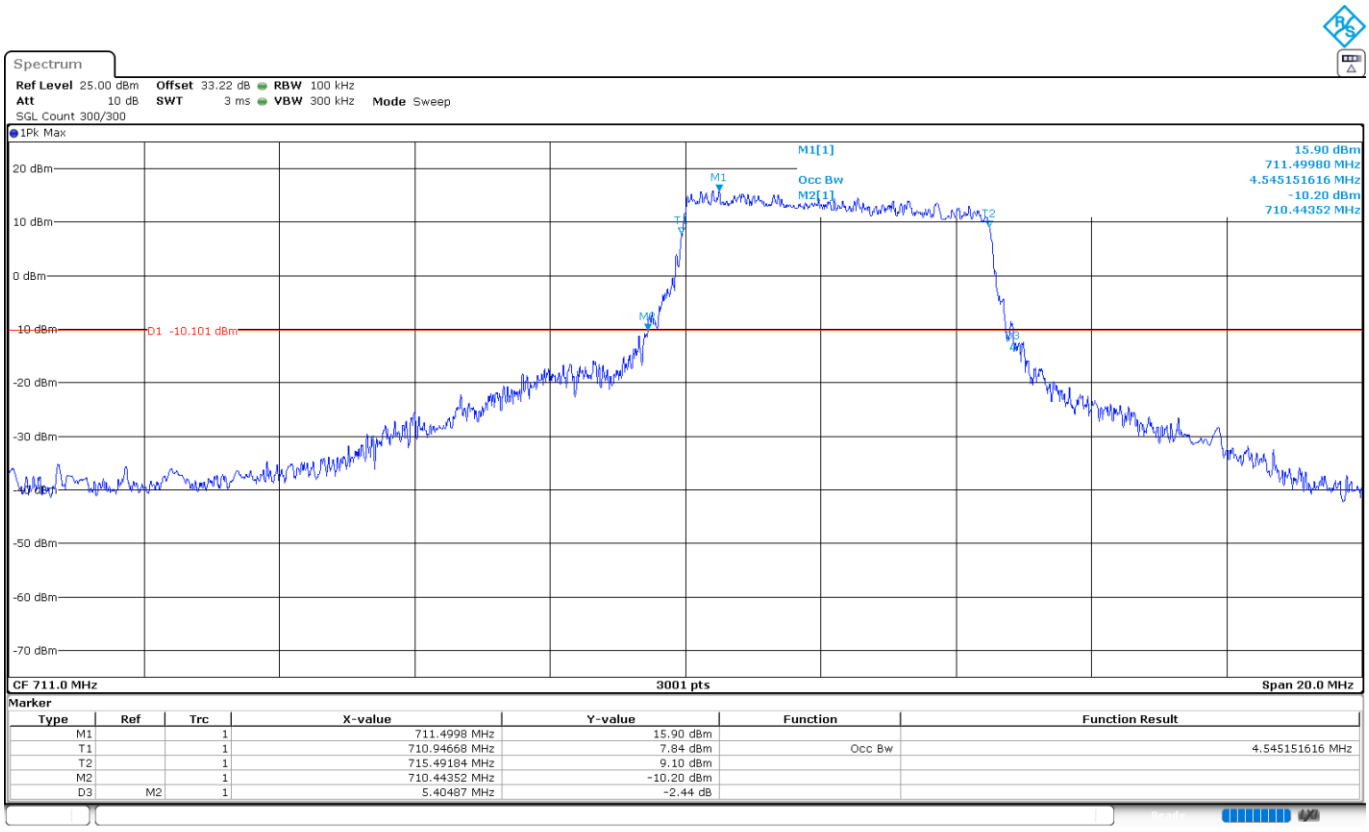
Low Channel:



Middle Channel:



High Channel:



LTE Cat 1bis Band 13:

LTE Cat 1bis Band 13. BW=5 MHz. QPSK. RB Size 6.

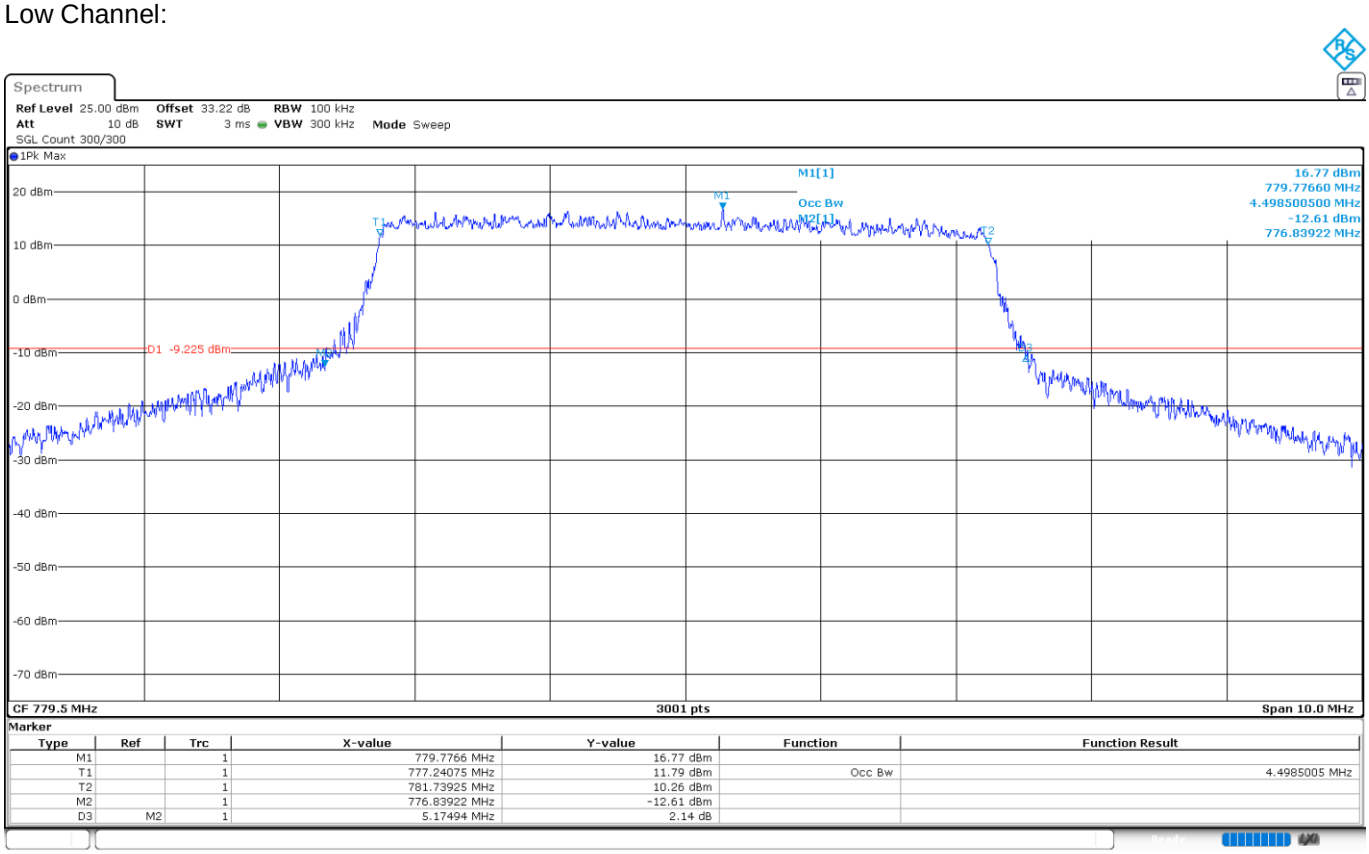
Channel	Low	High
99% Occupied Bandwidth (MHz)	4.498500500	4.528490503
-26 dBc Bandwidth (MHz)	5.174940000	5.158280000
Measurement uncertainty (kHz)	<±3.75	

LTE Cat 1bis Band 13. BW=5 MHz. 16QAM. RB Size 5.

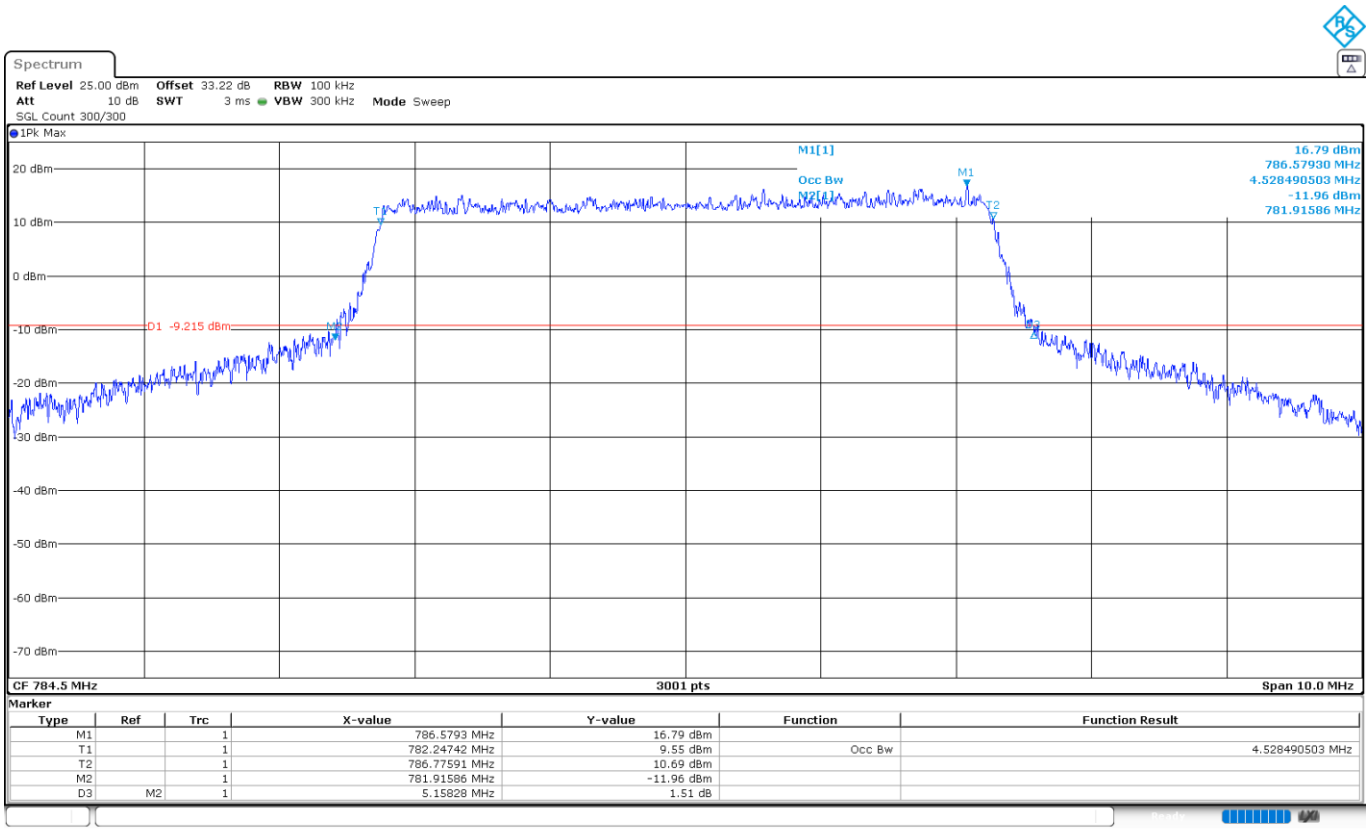
Channel	Low	High
99% Occupied Bandwidth (MHz)	4.468510497	4.521826058
-26 dBc Bandwidth (MHz)	4.718430000	5.221590000
Measurement uncertainty (kHz)	<±3.75	

LTE Cat 1bis Band 13. BW=5 MHz. QPSK. RB Size 6.

Low Channel:

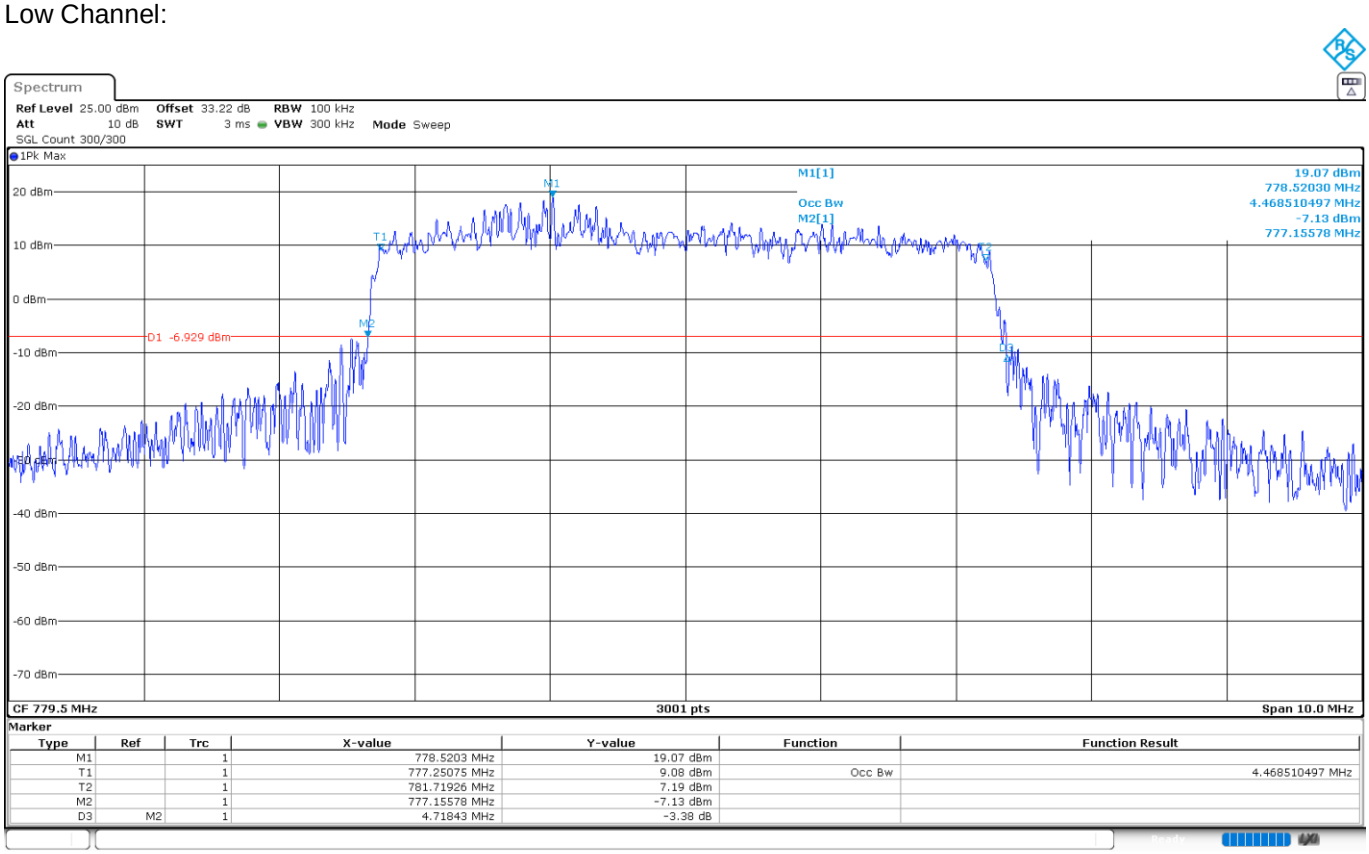


High Channel:

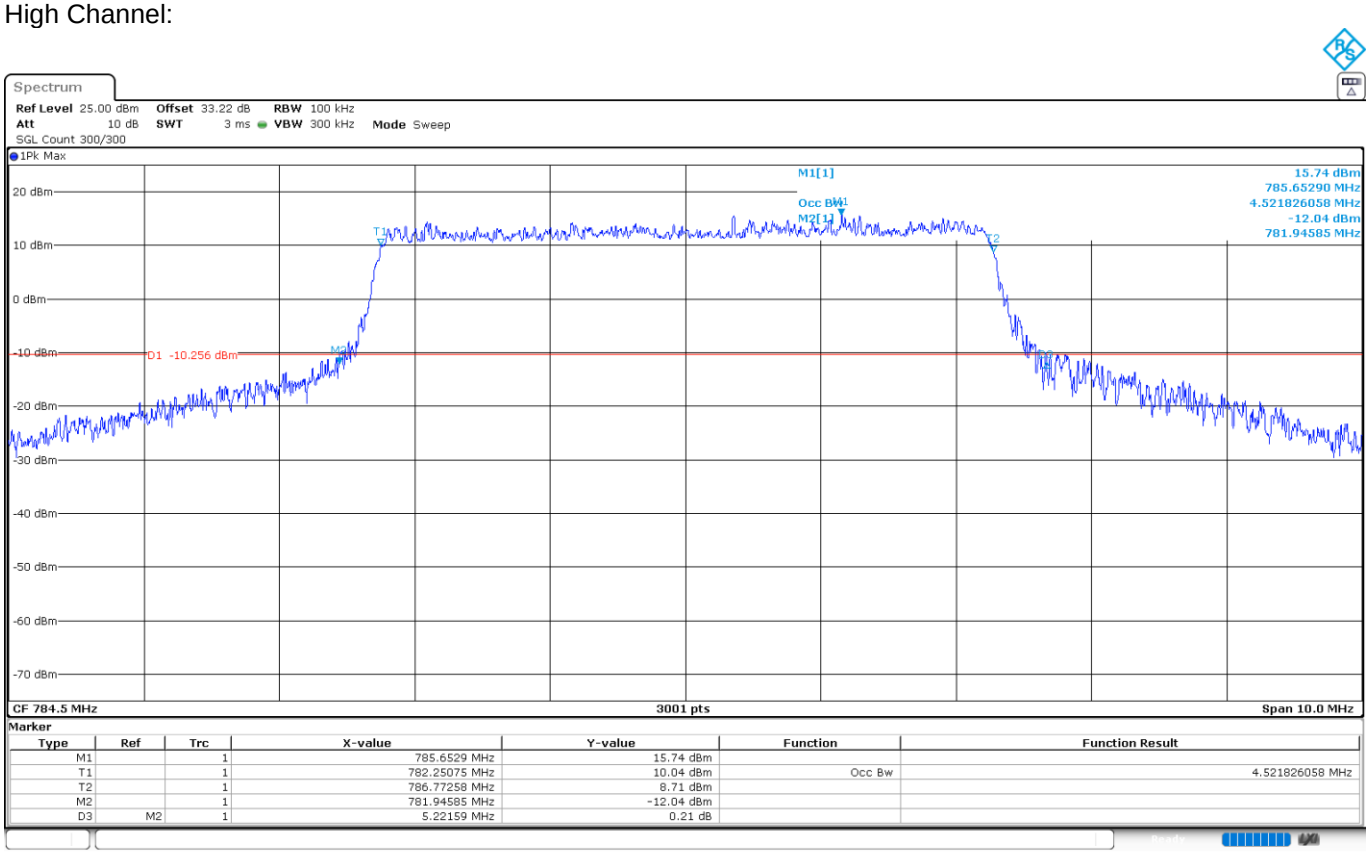


LTE Cat 1bis Band 13. BW=5 MHz. 16QAM. RB Size 5.

Low Channel:



High Channel:



LTE Cat 1bis Band 13. BW=10 MHz. QPSK. RB Size 6.

Channel	Middle
99% Occupied Bandwidth (MHz)	9.0169913350
-26 dBc Bandwidth (MHz)	10.0899700000
Measurement uncertainty (kHz)	<±3.75

LTE Cat 1bis Band 13. BW=10 MHz. 16QAM. RB Size 5.

Channel	Middle
99% Occupied Bandwidth (MHz)	4.5518160610
-26 dBc Bandwidth (MHz)	5.5648100000
Measurement uncertainty (kHz)	<±3.75