DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
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C.I.F. A29507456

ISED CABid: ES1909
Lab. Company Number: 4621A

Test Report No:
82302RRF.002

Partial Test Report
USA FCC Part 24
CANADA RSS-133

(*) Identification of item tested	LTE NB2 module
(*) Trademark	ST87M01
(*) Model and /or type reference	ST87M01
Other identification of the product	FCC ID: S9N-ST87M01 IC: 8976C-ST87M01
(*) Features	LTE NB2, GNSS HW version: MA_641 SW version: M:2.6.0
Applicant	ST Microelectronics SRL Via Camillo Olivetti n. 2 - 20864 Agrate Brianza (MB) - Italy
Test method requested, standard	USA FCC Part 24 (10-1-24 Edition). CANADA RSS-133 Issue 7 (2024). ANSI C63.26-2015. KDB 971168 D01 Power Meas License Digital Systems v03r01, April. 2018.
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	2025-09-29
Report template No.	FDT08_25 (*) "Data provided by the client"

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

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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.

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 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.

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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 ST87M01 is a Module for NB-IOT NB2 and GNSS.

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.

Id	Control Number	Description	Model	Serial Nº	Date of Reception	Application
S/01	82302_1	Module Circuit Board	ST87M01	-	2025-03-03	Element Under Test
S/01	81088_2	Evaluation board	TEKIT 600-PTCRB0	-	2024-11-12	Auxiliary Element
S/02	82302_2	Module Circuit Board	ST87M01	-	2025-03-03	Element Under Test
S/02	78078_6	Antenna GPS	-	-	2024-02-16	Auxiliary Element
S/02	78078_8	Antenna	-	-	2024-02-16	Auxiliary Element

Id	Type
S/01	Conducted tests.
S/02	Radiated tests.

Test sample description

Ports……:	Port name and description	Cable			
		Specified max length [m]	Attached during test	Shielded	
	MAIN Antenna		☒	☒	
	GNSS Antenna		☐	☐	
Supplementary information to the ports……:	-				
Rated power supply..... :	Voltage and Frequency				
	☒	DC: Min: 2.2V - Nom: 2.5 V - Max: 3V			
Rated Power ..... :	-				
Clock frequencies..... :	Reference clocks: 38.4MHz - 32 kHz				
Other parameters..... :	Temperature: -40/+25/+85°C				
Software version ..... :	M: 2.6.0				
Hardware version..... :	EVKITST87M01-1 - Version: LA_711				
Dimensions in cm (W x H x D)... :	6 * 2* 8				
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	
	MA_633_EV_LA_711_#591/IMEI:352825350057562		Module	STMicroelectronic	

	MA_633_EV_LA_711_#593/IMEI:352825350057885	Module	STMicroelectronic
	MA_633_EV_LA_711_#600/IMEI:352825350057893	Module	STMicroelectronic
	MA_633_EV_LA_711_#601/IMEI:352825350057653	Module	STMicroelectronic
	MA_633_EV_LA_711_#602/IMEI:352825350057729	Module	STMicroelectronic
Accessories (not part of the test item)..... :	Description	Type	Manufacturer
	-	-	-
Documents as provided by the applicant ..... :	Description	File name	Issue date
	EVKITST87M01-1 User Manual	EVKITST87M01	2024-06-18
	ST87MXX UM AT commands description	ST87MXX_UM_	2025-02-18
	DataSheet ST87M01		

Identification of the client

ST Microelectronics

10 Rue de Jouanet. 35700 RENNES. FRANCE

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2024-12-12
Date (finish)	2025-02-22

Document history

Report number	Date	Description
82302RRF.002	2025-09-29	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: Pablo Redondo, Carmen Vázquez.

Used instrumentation:

Control No.	Equipment	Model	Manufacturer	Next Calibration
7760	Digital Multimeter	175	FLUKE	2025-11-07
7445	DC POWER Supply 30V/5A	U8002A	KEYSIGHT TECHNOLOGIES	N/A
7794	SIGNAL AND SPECTRUM ANALYZER 10 Hz - 40 GHz	FSV40	ROHDE AND SCHWARZ	2025-04-21
6157	Signal and Spectrum Analyzer 10 Hz - 40 GHz	FSV40	ROHDE AND SCHWARZ	2027-03-17
9227	Wideband Radio Communication Tester	CMW500	ROHDE AND SCHWARZ	2025-10-29
6254	Attenuator 6 dB 2W DC-26.5 GHz	TWSMAG2	TECHNIWAVE	2025-03-30
6794	Shielded Room	S101	ETS LINDGREN	N/A
6791	SEMIANECHOIC ABSORBER LINED	FACT 3 200 STP	ETS LINDGREN	N/A
6792	SHIELDED ROOM	S101	ETS LINDGREN	N/A
6614	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2025-04-22
6666	EMI TEST RECEIVER 2Hz-44GHz	ESW44	ROHDE AND SCHWARZ	2026-07-12
3783	PRE-AMPLIFIER G>30dB 1GHz-18GHz	BLMA 0118-3A	BONN ELEKTRONIK	2026-03-17
6496	HORN ANTENNA 1-18GHz	BBHA 9120 D	SCHWARZBECK	2026-12-01
6143	Biconical/Log Antenna 30 MHz - 6 GHz	3142E	ETS LINDGREN	2027-01-22
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 NB2 Band 2.

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	
Supplementary information and remarks: None		

Appendix A: Test results for FCC 24 / RSS-133: LTE Cat NB2 Band 2

INDEX

TEST CONDITIONS

(*): Data provided by the Applicant.

POWER SUPPLY (*):

Vnominal: 2.5 Vdc.
Vminimum: 2.2 Vdc
Vmaximum: 3 Vdc

Type of Power Supply: Internal DC.

ANTENNA (*):

Bands	Gain (dBi)	Type
LTE Cat NB2 2	4.5	External

TEST FREQUENCIES:

LTE Cat NB2 Band 2. Pi/2-BPSK, Pi/4-QPSK, QPSK modulations:

Channel. Number (Frequency, MHz)		
Low	Middle	High
18602 (1850.2)*	18900 (1880)	19198 (1909.8)*
*The outermost channel which is in compliance with Block edge testing.		

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).

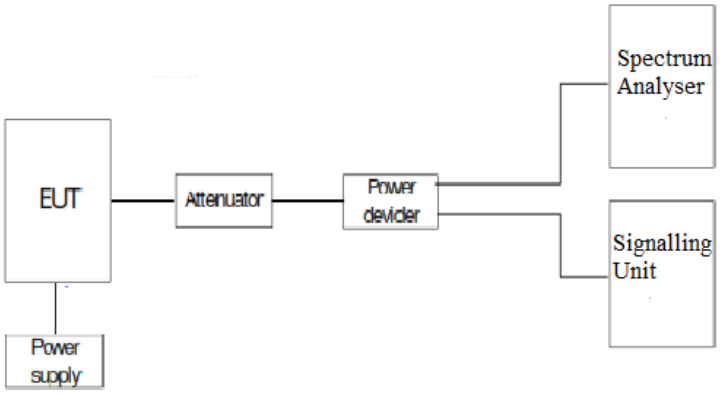
The maximum effective radiated power e.r.p. is calculated from the maximum equivalent isotropically radiated power (e.i.r.p.) by subtracting 2.15 dB:

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

Test Setup

1. CONDUCTED AVERAGE POWER:

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



Results

1. CONDUCTED AVERAGE POWER:

LTE Cat NB2 Band

CHANNEL	FREQUENCY (MHz)	MODULATION	BW Tono	Number of Tone	Offset Tone (Start SubCarrier)	MCS / TBS	AVERAGE POWER (dBm)
Low 18602	1850,20 MHz	pi/2 - BPSK	3,75 kHz	1	0	0	22,61
				1	47	0	22,59
			15 kHz	1	0	0	22,65
				1	11	0	22,75
		pi/4 - QPSK	3,75 kHz	1	0	3	22,64
				1	47	3	22,53
			15 kHz	1	0	3	22,78
				1	11	3	22,9
		QPSK	15 kHz	3	0	5	22,8
				3	6	5	22,92
				6	0	5	22,17
				6	6	5	22,21
				12	0	5	20,97
Middle 18900	1880 MHz	pi/2 - BPSK	3,75 kHz	1	0	0	22,41
				1	47	0	22,45
			15 kHz	1	0	0	22,64
				1	11	0	22,85
		pi/4 - QPSK	3,75 kHz	1	0	3	22,47
				1	47	3	22,48
			15 kHz	1	0	3	22,71
				1	11	3	22,83
		QPSK	15 kHz	3	0	5	22,75
				3	6	5	22,88
				6	0	5	22,15
				6	6	5	22,12
				12	0	5	21,06
High 19198	1909,8 MHz	pi/2 - BPSK	3,75 kHz	1	0	0	22,52
				1	47	0	22,49
			15 kHz	1	0	0	22,65
				1	11	0	22,81
		pi/4 - QPSK	3,75 kHz	1	0	3	22,57
				1	47	3	22,57
			15 kHz	1	0	3	22,79
				1	11	3	22,92
		QPSK	15 kHz	3	0	5	22,82
				3	6	5	**22,95**
				6	0	5	22,16
				6	6	5	22,17
				12	0	5	21,03

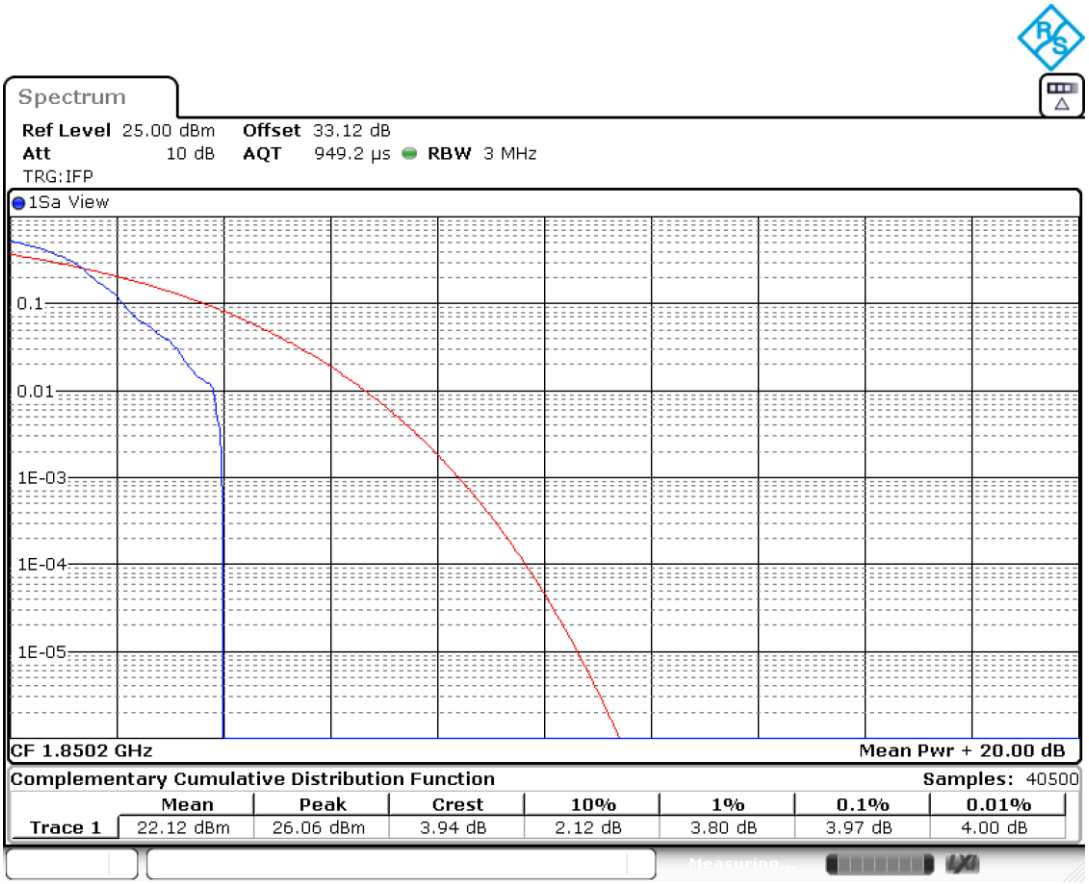
MAX POWER	COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG (dBm)
LOWEST	22,92	4,5	27,42
MIDDLE	22,88	4,5	27,38
HIGHEST	22,95	4,5	27,45
MAX:	**22,95**		**27,45**

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

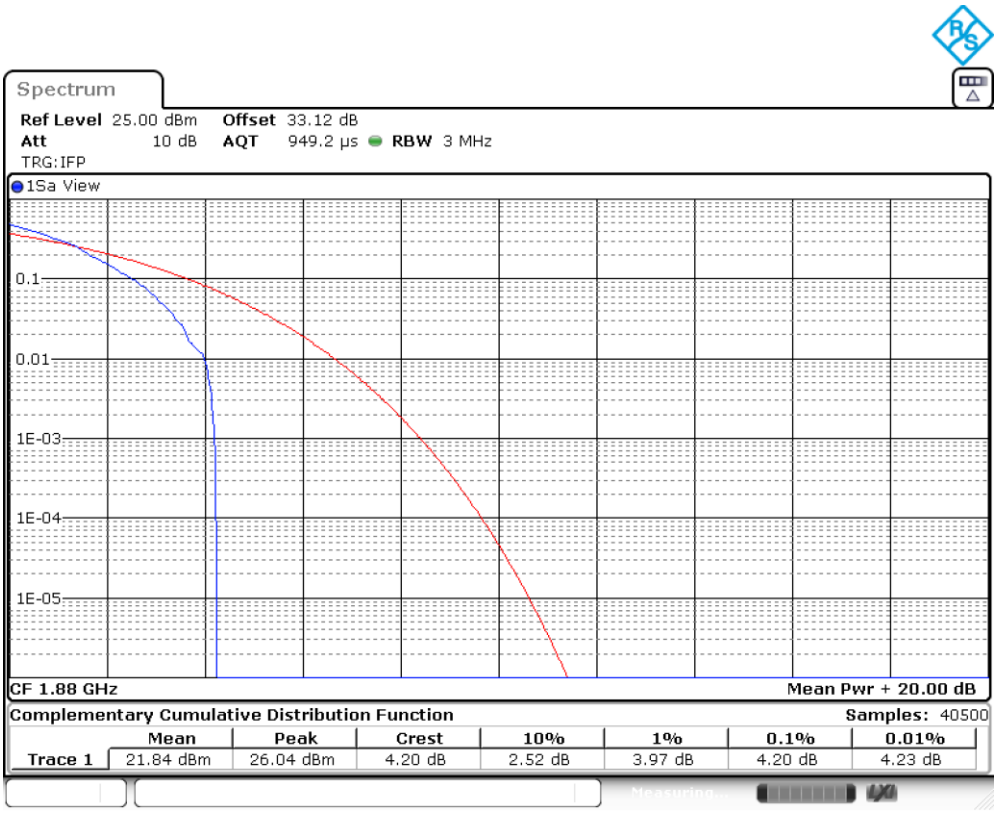
LTE Cat NB2 Band 2:

Preliminary measurements determined the worst-case of PAPR is Middle Channel, QPSK, BW=15 kHz, Tone Number=6, Tone Offset=6, MSC/TBS=5.

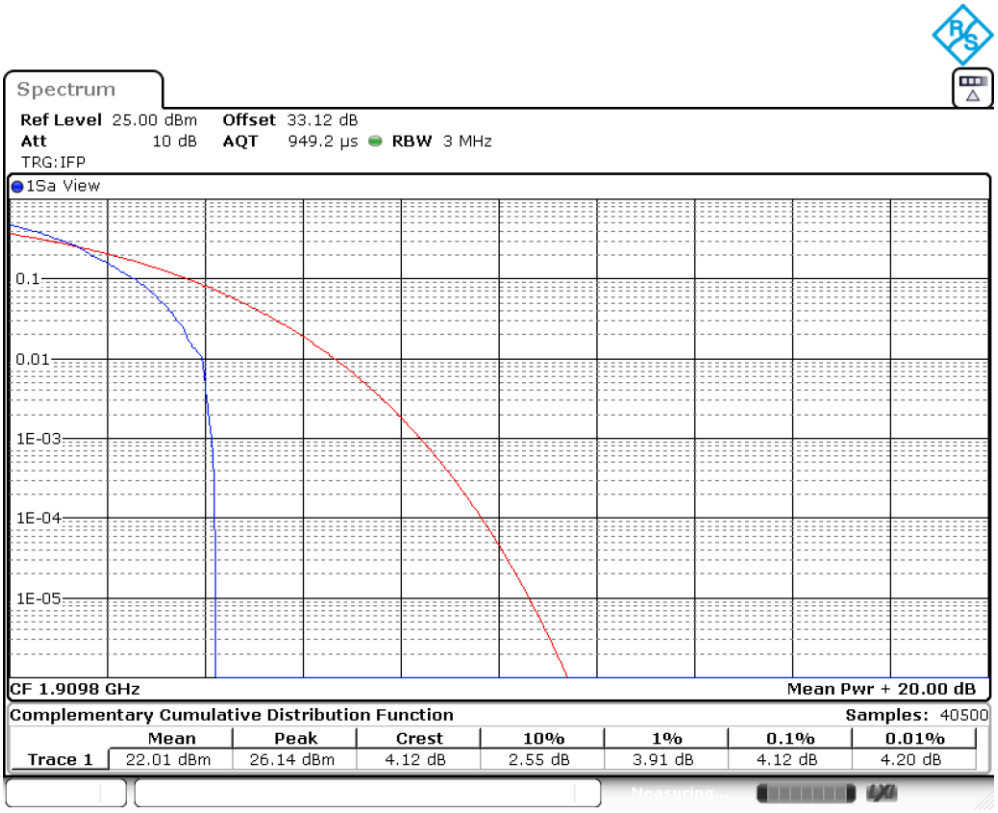
Low Channel:



Middle Channel:



High Channel:



QPSK	Low	Middle	High
PAPR (dB)	3.97	4.20	4.12

Measurement uncertainty (dB) <±1.11

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 -40ºC to +85ºC. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10ºC steps from -40ºC up to +85ºC.
The supply voltage was varied between 85% and 115% of nominal voltage or the value declared by the customer, the one considered as worst case.

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

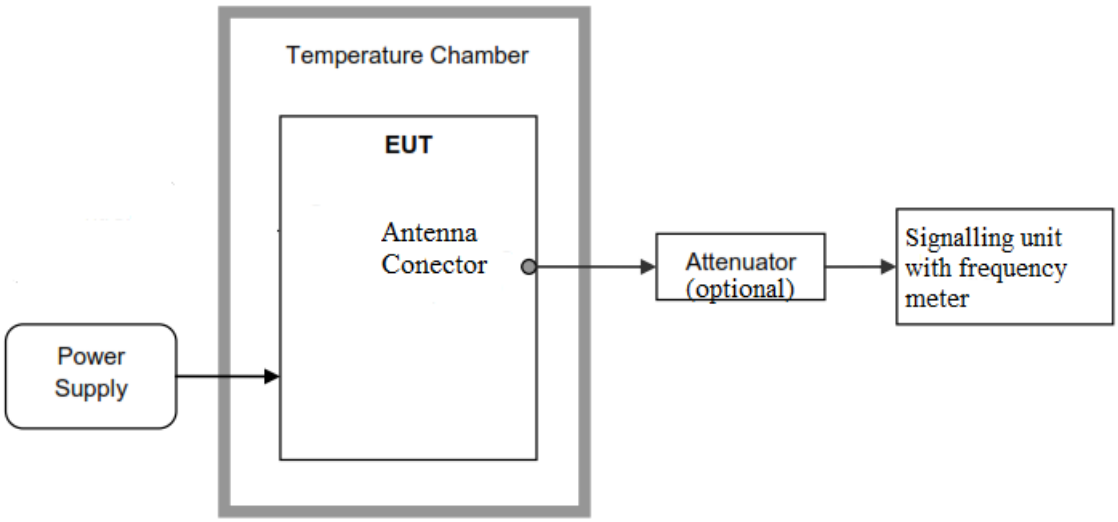
The EUT was set in “Radio Resource Control (RRC) mode” in the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter.
The worst case NBIoT mode for conducted power was used for the test.

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 Low and High 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.

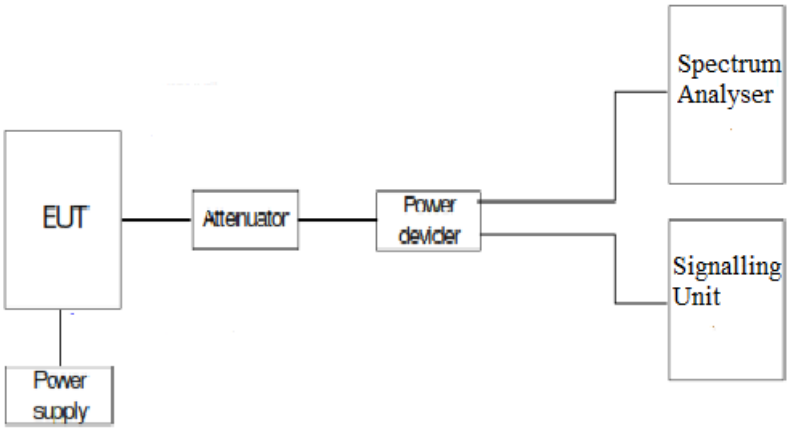
The reference point measurements were made at the RF output terminals of the EUT using an attenuator. power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

Test Setup

Frequency tolerance.



Reference points *f*L and *fH.*



Results

LTE Cat NB2 Band 2:

The worst case modulation in terms of Frequency Stability is QPSK, BW=15 kHz, Tone Number=3, Tone Offset=6, MSC/TBS=5.

1. Frequency Tolerance:

- **Frequency Stability over Temperature Variations:**

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)
+85 [#]	26.66	0.014180851
+80 [#]	21.77	0.011579787
+70 [#]	34.2	0.018191489
+60 [#]	35.98	0.019138298
+50	36.79	0.019569149
+40	31.49	0.01675
+30	38.45	0.020452128
+20	31.03	0.016505319
+10	21.74	0.01156383
0	23.52	0.012510638
-10	19.8	0.010531915
-20	27.8	0.014787234
-30	33.55	0.017845745
-40 [#]	29.78	0.015840426

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- **Frequency Stability over Voltage Variations.**

Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	3	24.4	0.012978723
Vmin	2.2	33.89	0.018026596

2. Reference Frequency Points fL and fH:

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

*f*L (MHz)	1850.048500
*f*H (MHz)	1909.953600

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

Measurement uncertainty (Hz) <± 249.55

Verdict: PASS

Modulation Characteristics

Limits

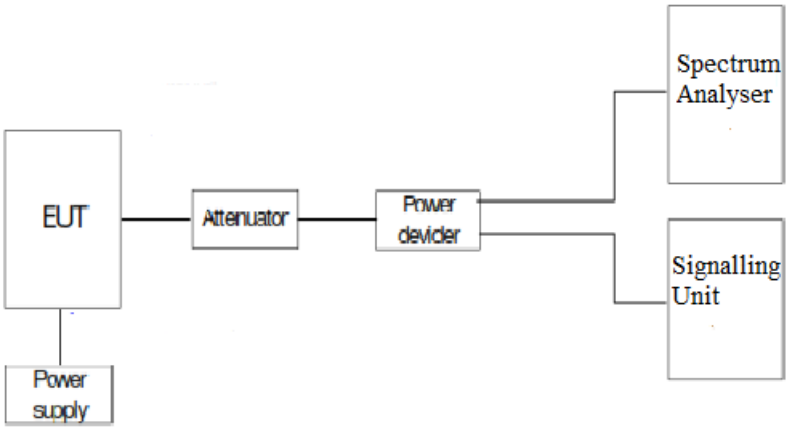
* FCC §2.1047.

* 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).

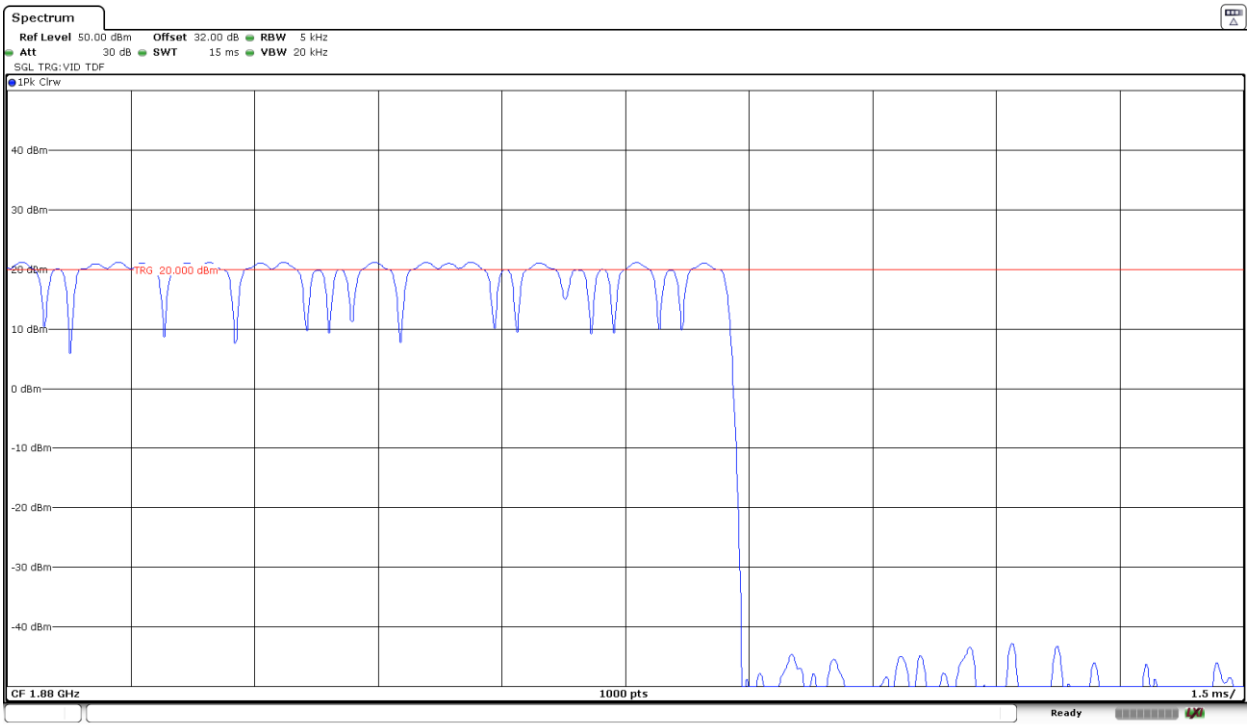
Test Setup

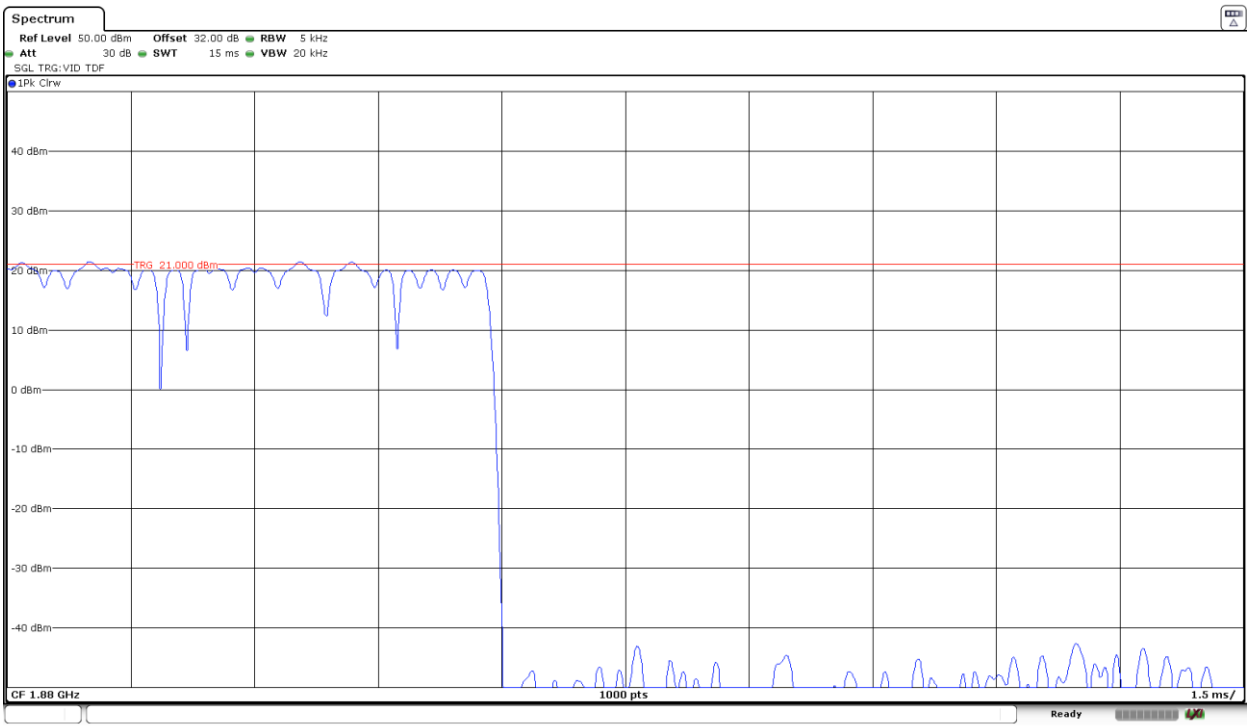


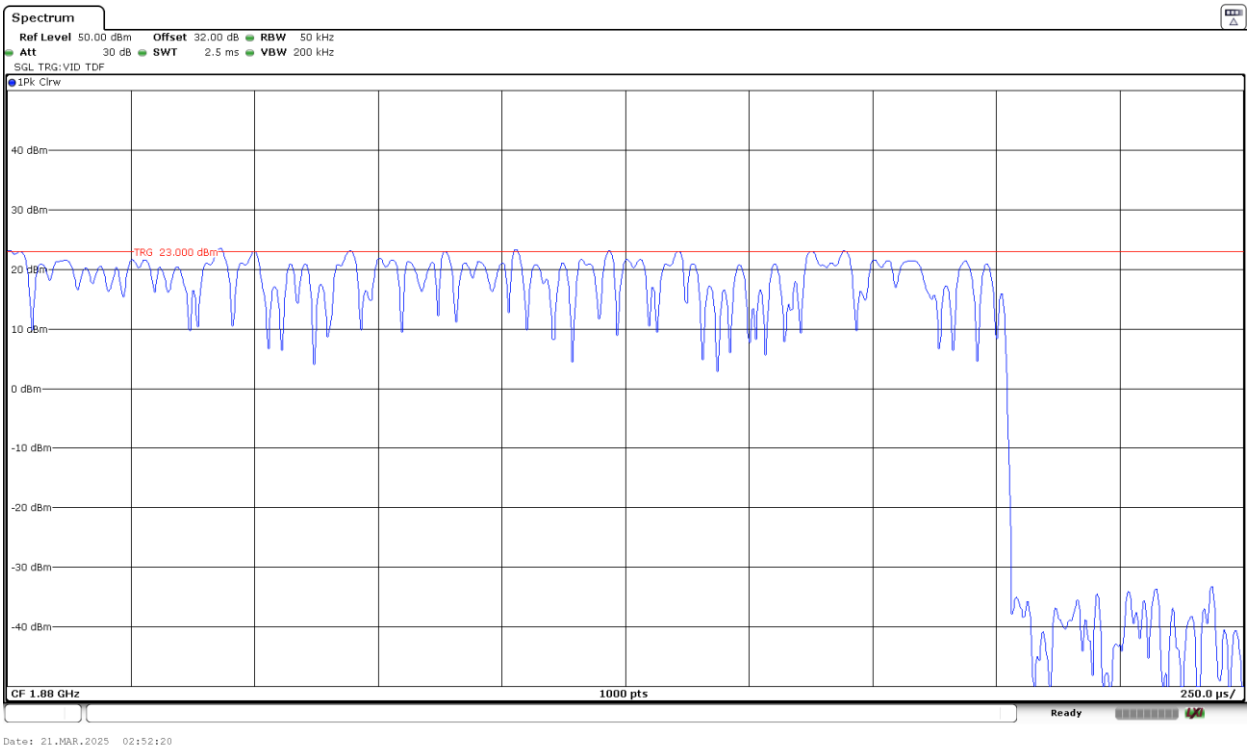
Results

The following plots show the modulation schemes in the EUT.

LTE NBIoT Band 2: BW=3.75 KHz. QPSK. RB Size=1. RB Offset=24. Middle Channel. MCS = 0






Spectrum
Ref Level 50.00 dBm Offset 32.00 dB RBW 50 kHz
Att 30 dB SWT 2.5 ms VBW 200 kHz
SGL TRG:VID TDF
1Pk Clrw
40 dBm
30 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
TRG 23.000 dBm
CF 1.88 GHz
1000 pts
250.0 µs/
Ready
Date: 21.MAR.2025 02:52:20

Occupied Bandwidth

Limits

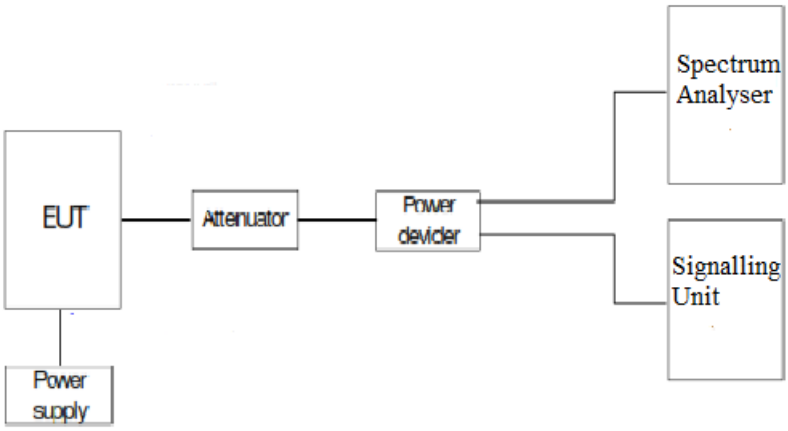
FCC §2.1049. Measurements required: Occupied bandwidth.

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 per modulation is:

<u>LTE Cat NB2 Band 2</u>:

LTE Cat NB2 Band 2. Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=0.

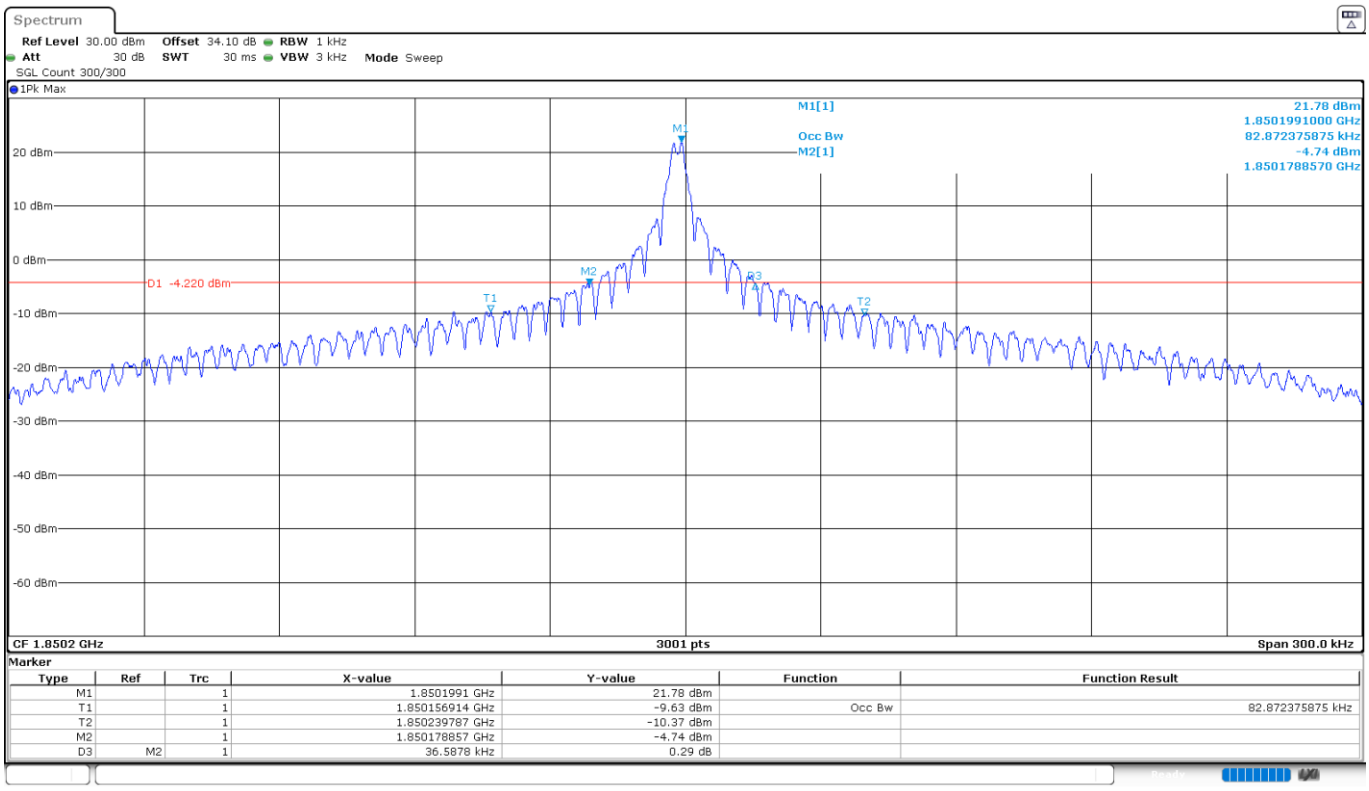
	Low Channel	Middle Channel	High Channel
99% Occupied Bandwidth (kHz)	82.87238	84.47184	85.67144
-26 dBc Bandwidth (kHz)	36.58780	35.08830	37.18760
Measurement uncertainty (kHz)	<±0.25		

LTE Cat NB2 Band 2. Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=3.

	Low Channel	Middle Channel	High Channel
99% Occupied Bandwidth (kHz)	73.27557	77.07431	78.57381
-26 dBc Bandwidth (kHz)	41.48620	41.28620	40.98630
Measurement uncertainty (kHz)	<±0.25		

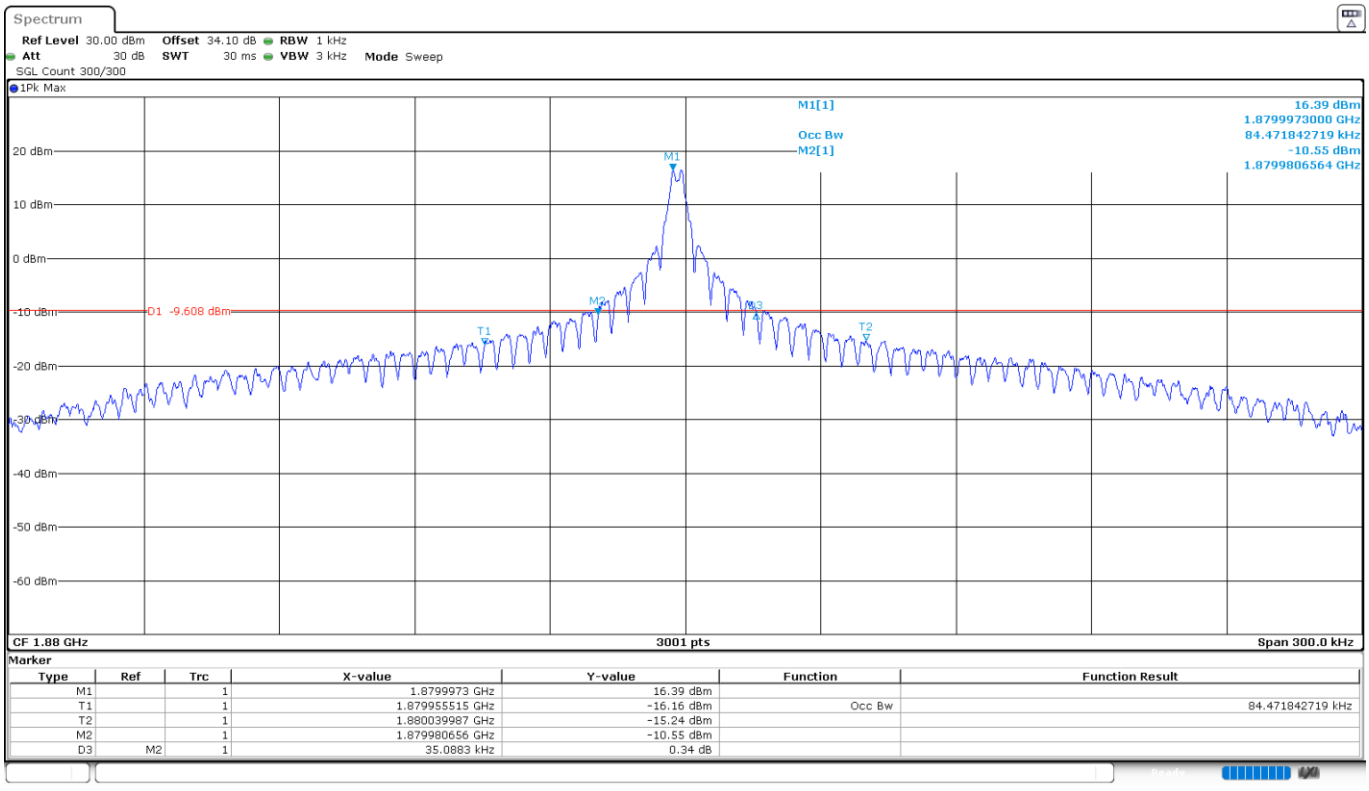
LTE Cat NB2 Band 2. Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=0.

Low Channel:



Date: 12.DEC.2024 22:42:19

Middle Channel:



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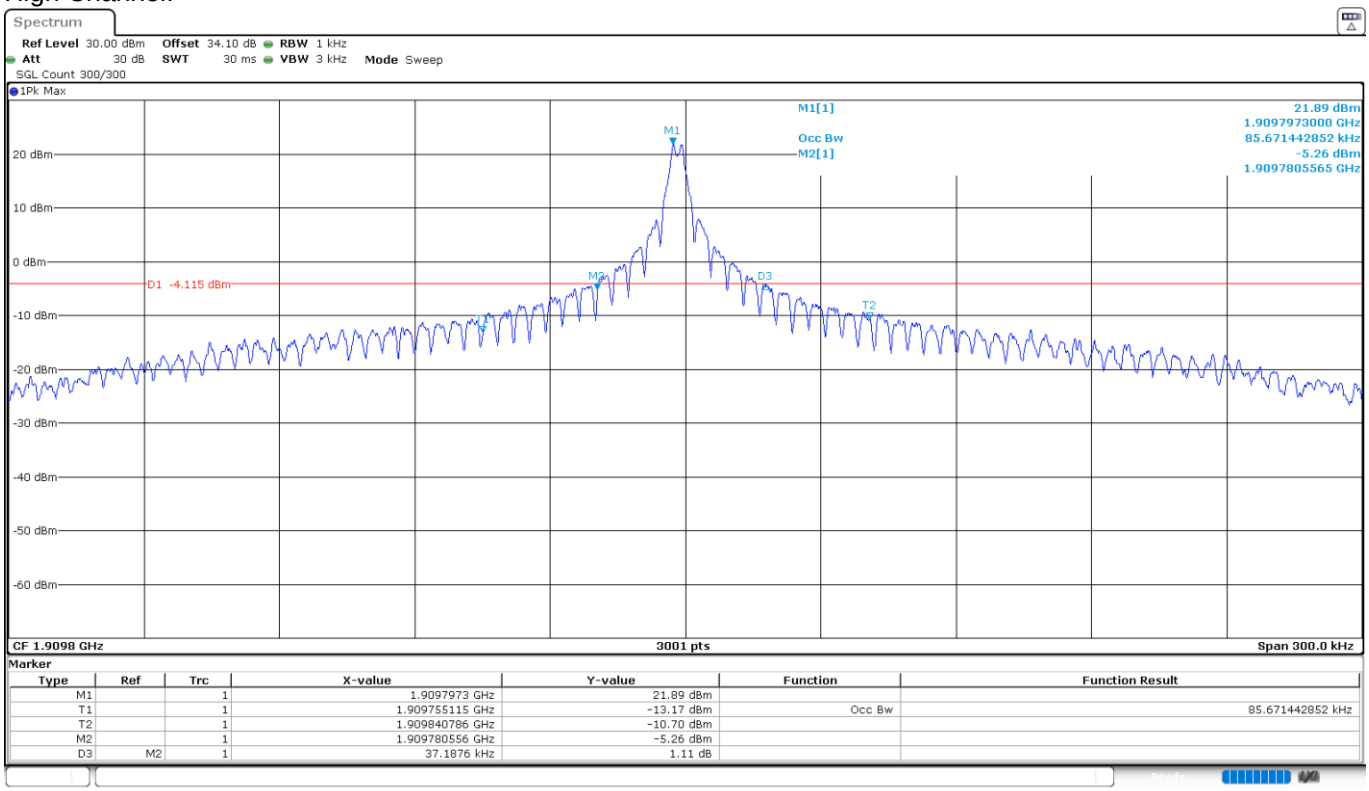
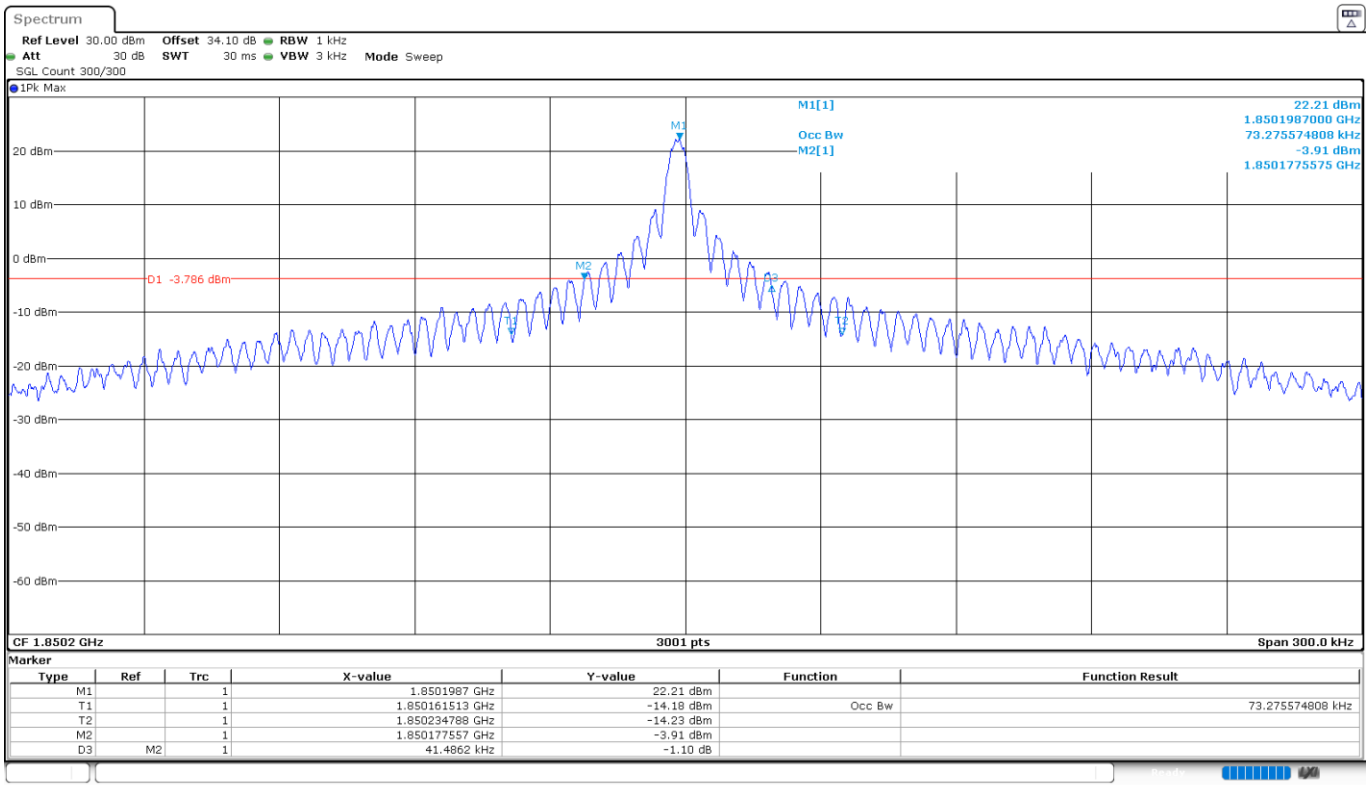
High Channel:



Date: 12.DEC.2024 22:51:32

LTE Cat NB2 Band 2. Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=3.

Low Channel:

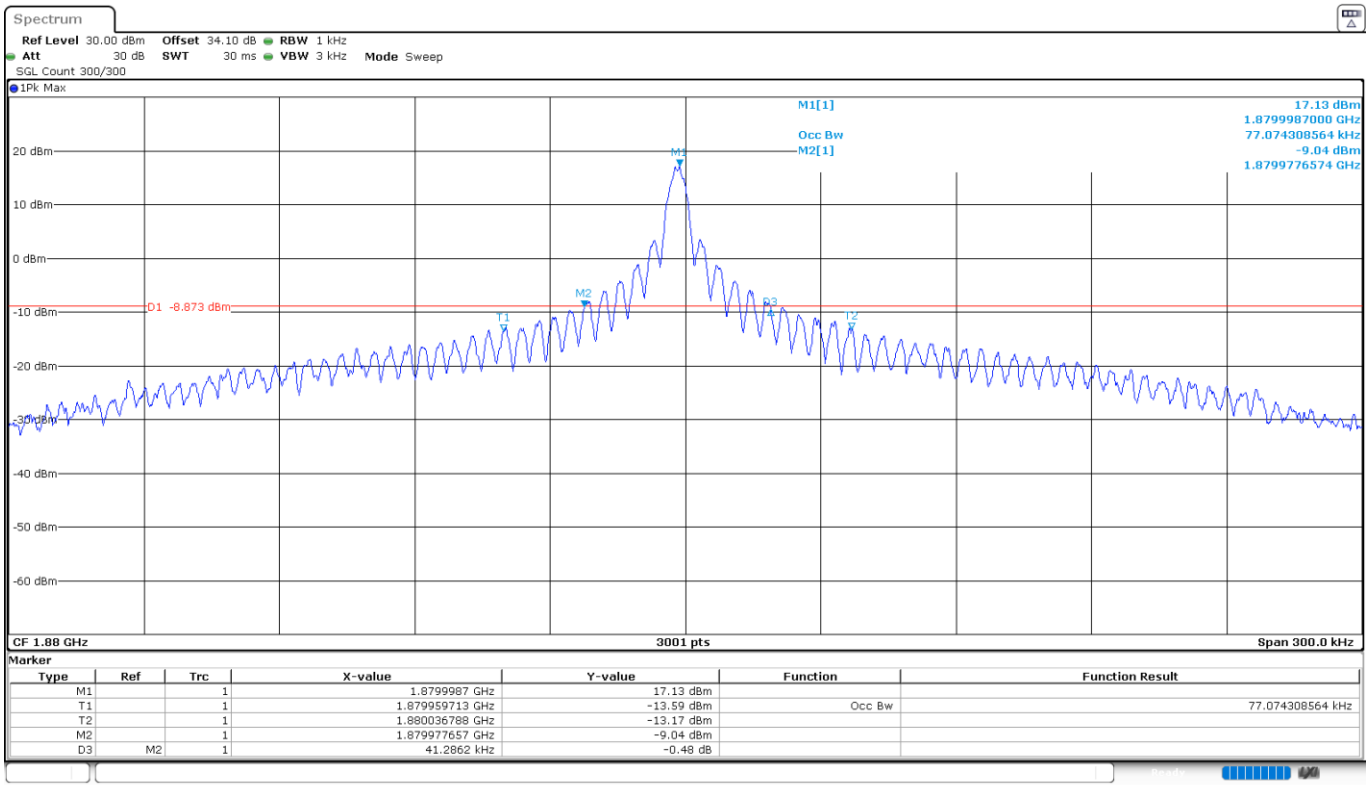


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.8501987 GHz	22.21 dBm		
T1		1	1.850161513 GHz	-14.18 dBm	Occ Bw	73.275574808 kHz
T2		1	1.850234788 GHz	-14.23 dBm		
M2		1	1.850177557 GHz	-3.91 dBm		
D3	M2	1	41.4862 kHz	-1.10 dB		

Date: 12.DEC.2024 22:42:45

Middle Channel:

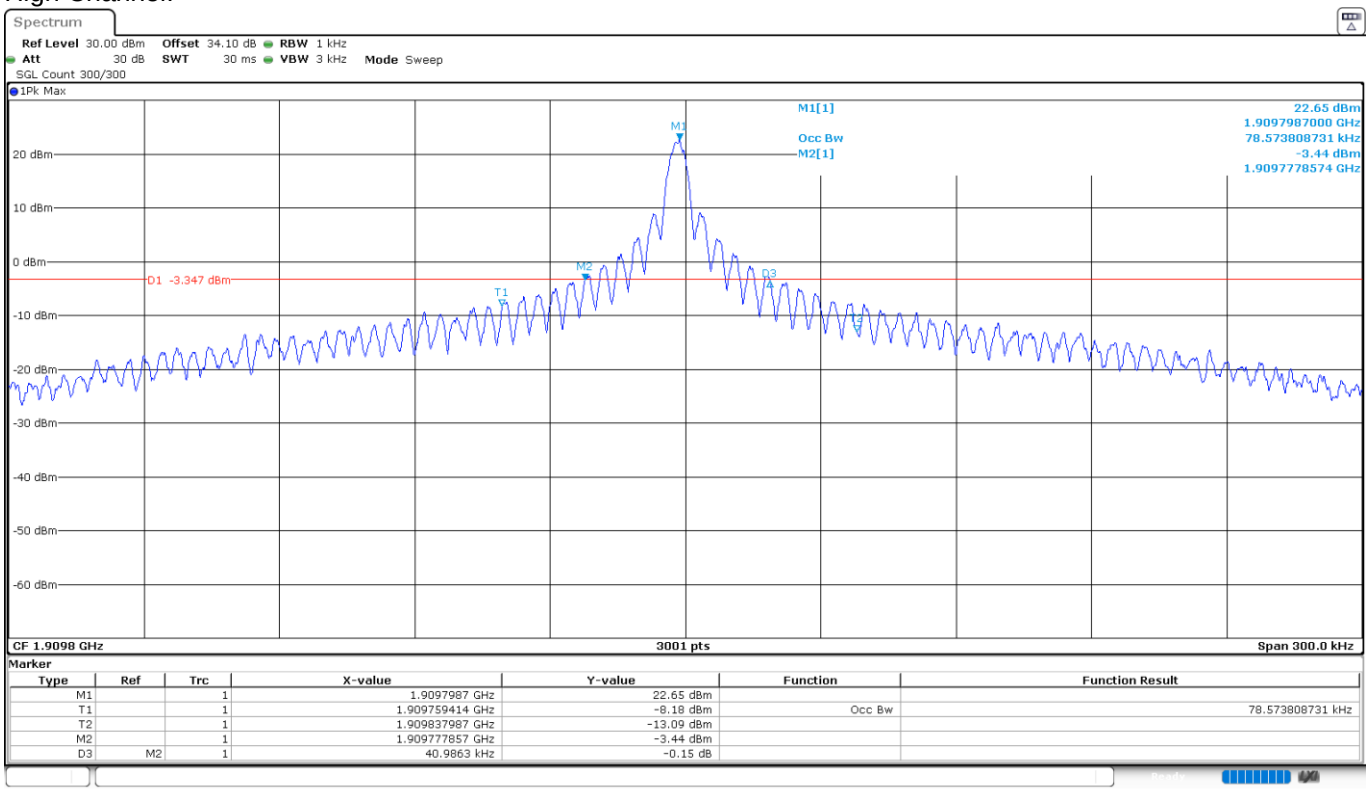


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.8799987 GHz	17.13 dBm		
T1		1	1.879959713 GHz	-13.59 dBm	Occ Bw	77.074308564 kHz
T2		1	1.880036788 GHz	-13.17 dBm		
M2		1	1.879977657 GHz	-9.04 dBm		
D3	M2	1	41.2862 kHz	-0.48 dB		

Date: 12.DEC.2024 22:45:09

High Channel:



LTE Cat NB2 Band 2. Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=0.

	Low Channel	Middle Channel	High Channel
99% Occupied Bandwidth (kHz)	140.95302	139.35355	142.85238
-26 dBc Bandwidth (kHz)	128.95700	129.45680	155.34820
Measurement uncertainty (kHz)	<±0.25		

LTE Cat NB2 Band 2. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=3.

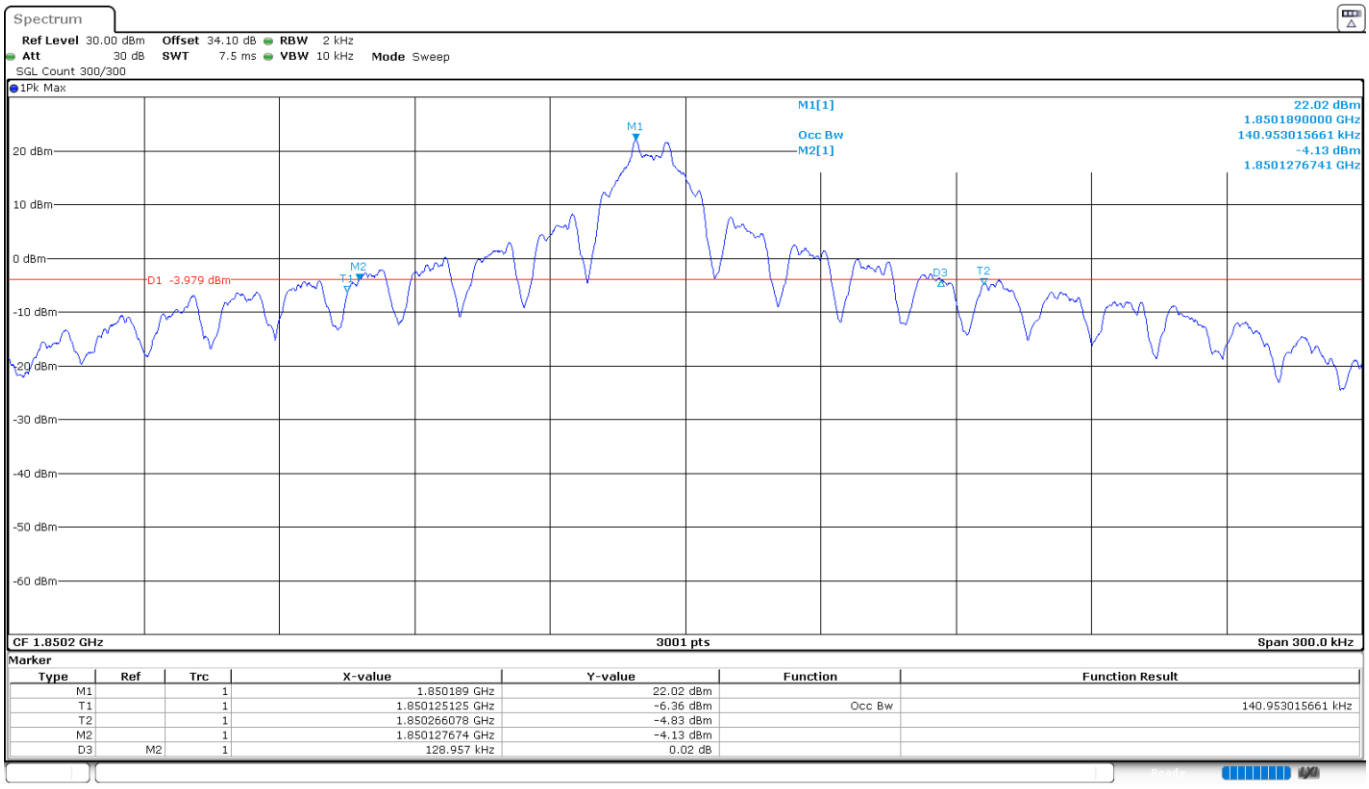
	Low Channel	Middle Channel	High Channel
99% Occupied Bandwidth (kHz)	153.61546	152.28257	151.94935
-26 dBc Bandwidth (kHz)	171.94300	194.43500	158.94700
Measurement uncertainty (kHz)	<±0.25		

LTE Cat NB2 Band 2. QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5.

	Low Channel	Middle Channel	High Channel
99% Occupied Bandwidth (kHz)	188.93702	183.77208	182.93902
-26 dBc Bandwidth (kHz)	263.07600	247.91700	254.41500
Measurement uncertainty (kHz)	<±0.25		

LTE Cat NB2 Band 2. Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=0.

Low Channel:

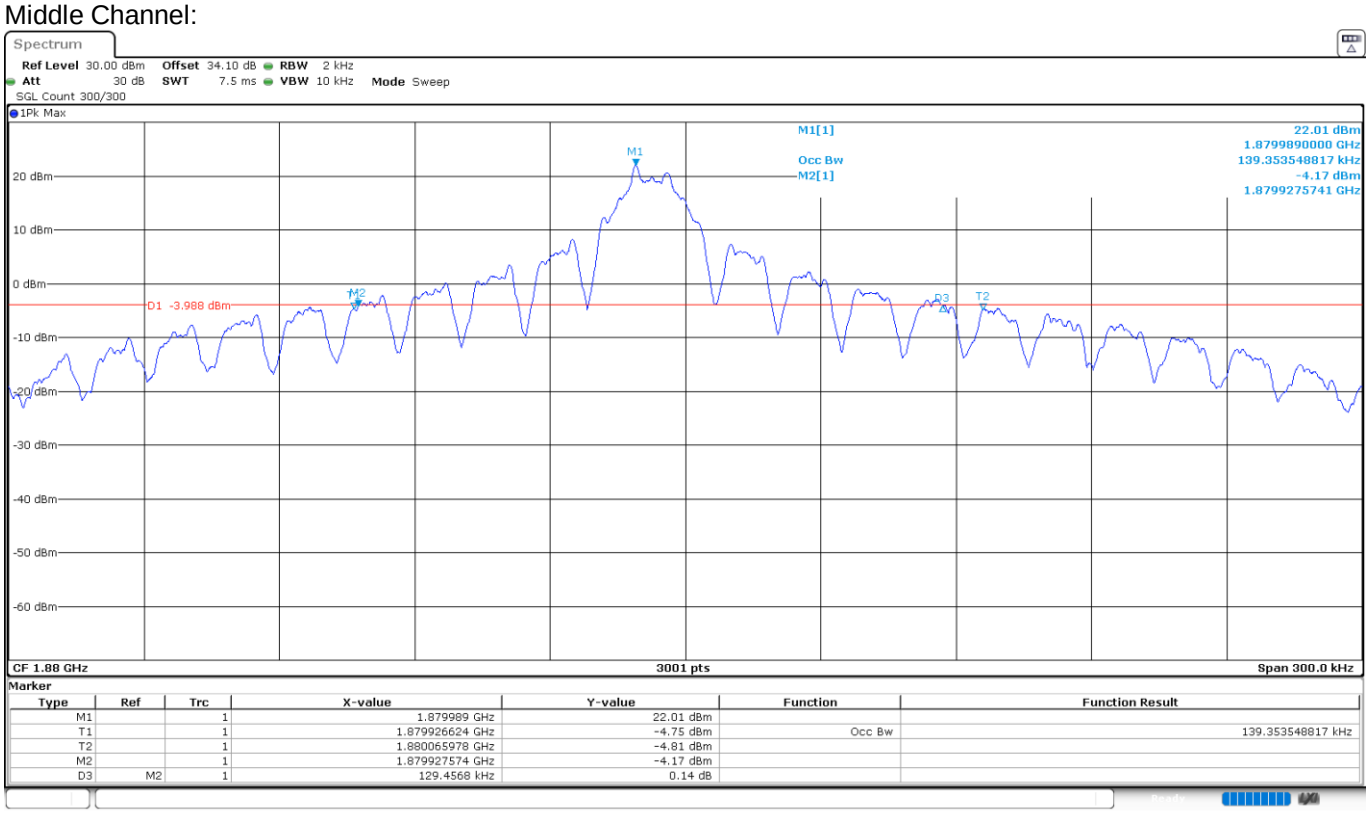


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.850189 GHz	22.02 dBm		
T1		1	1.850125125 GHz	-6.36 dBm	Occ Bw	140.953015661 kHz
T2		1	1.850266078 GHz	-4.83 dBm		
M2		1	1.850127674 GHz	-4.13 dBm		
D3	M2	1	128.957 kHz	0.02 dB		

Date: 12.DEC.2024 22:43:13

Middle Channel:

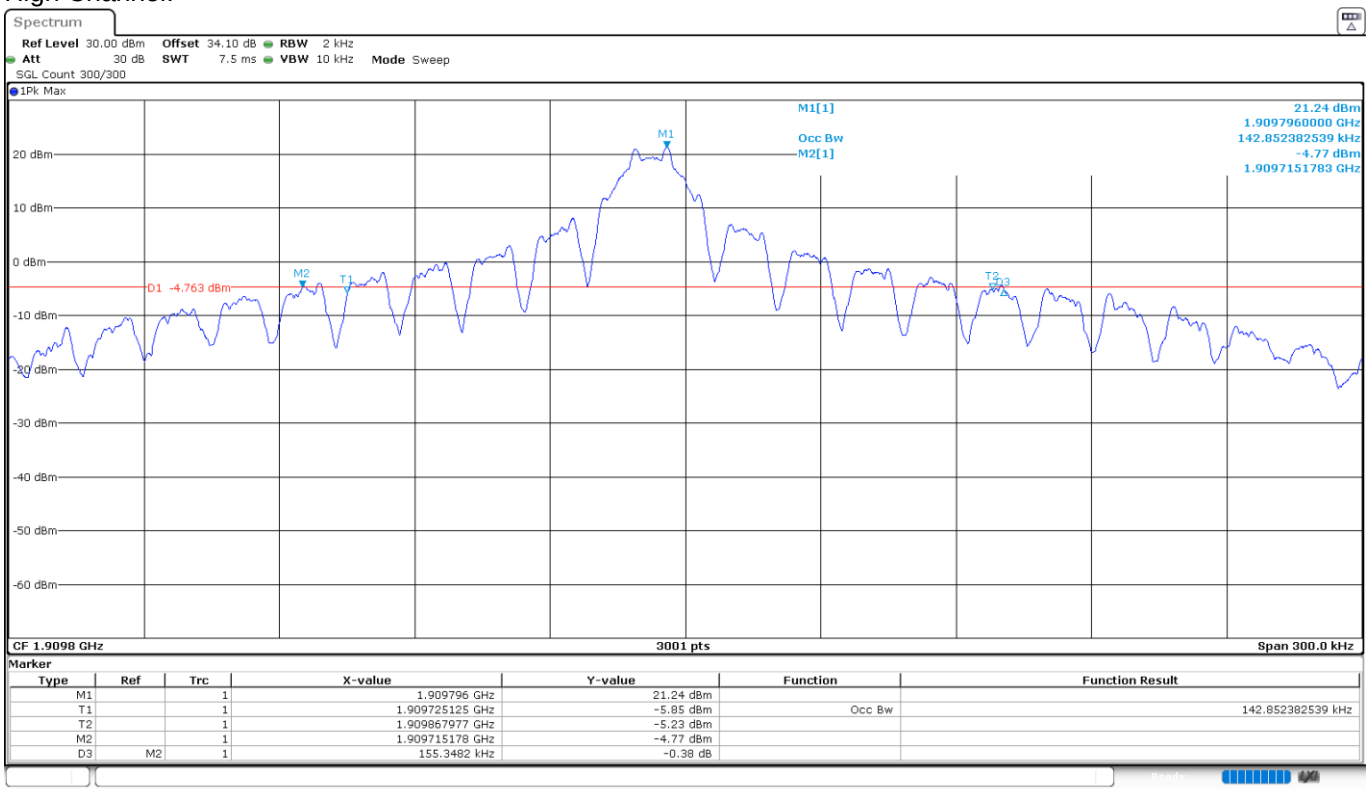


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.879989 GHz	22.01 dBm		
T1		1	1.879926624 GHz	-4.75 dBm	Occ Bw	139.353548817 kHz
T2		1	1.880065978 GHz	-4.81 dBm		
M2		1	1.879927574 GHz	-4.17 dBm		
D3	M2	1	129.4568 kHz	0.14 dB		

Date: 12.DEC.2024 22:45:56

High Channel:



Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.909796 GHz	21.24 dBm		
T1		1	1.909725125 GHz	-5.85 dBm	Occ Bw	142.852382539 kHz
T2		1	1.909867977 GHz	-5.23 dBm		
M2		1	1.909715178 GHz	-4.77 dBm		
D3	M2	1	155.3482 kHz	-0.38 dB		

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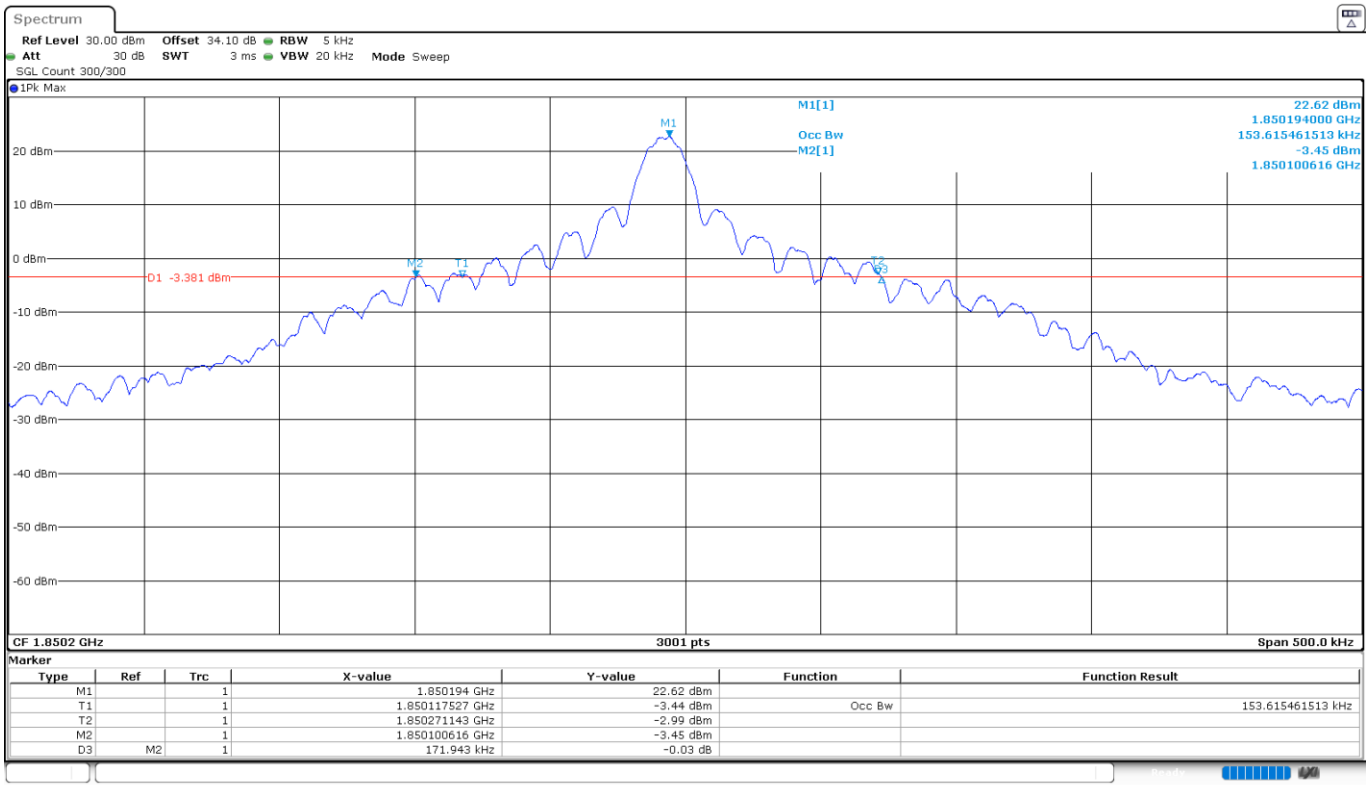
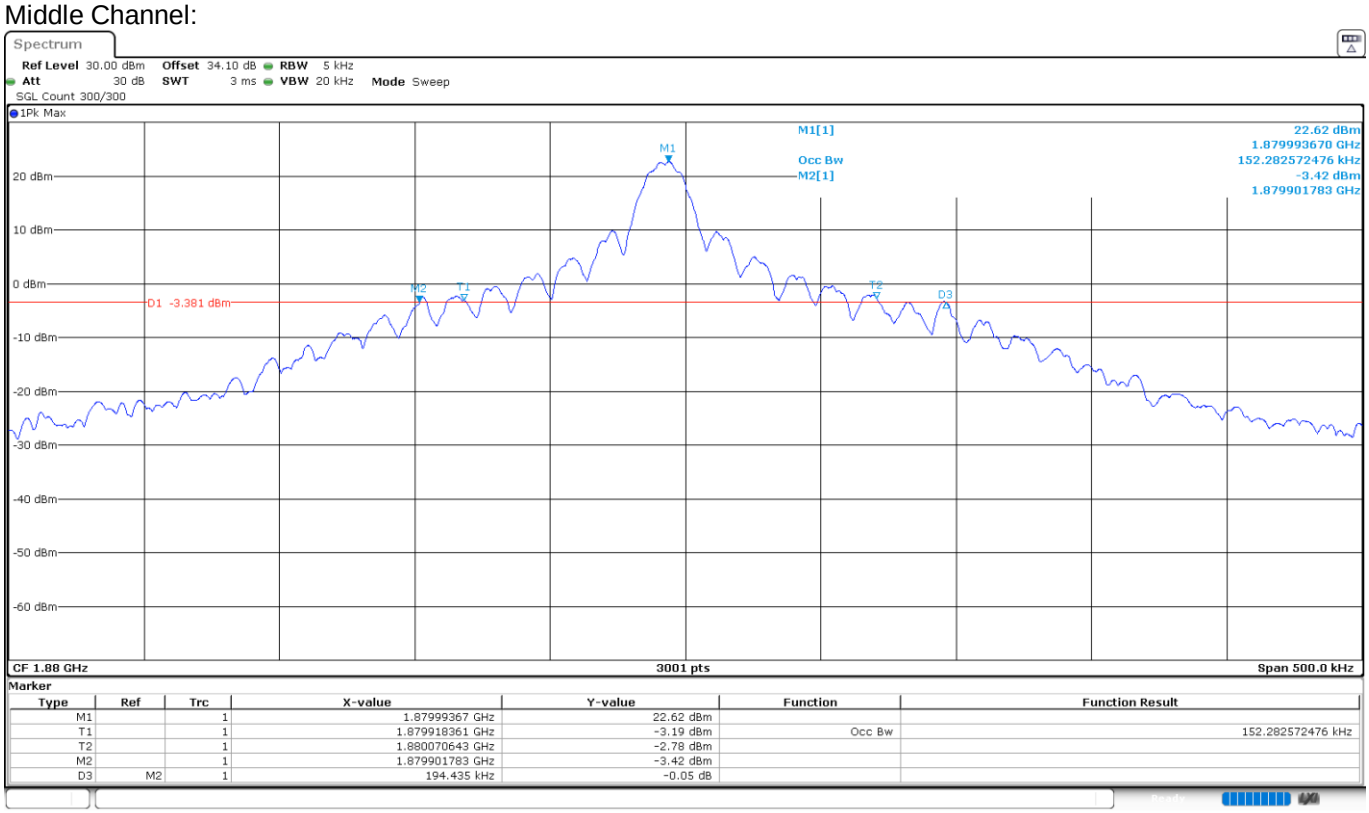
LTE Cat NB2 Band 2. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=3.

Low Channel:



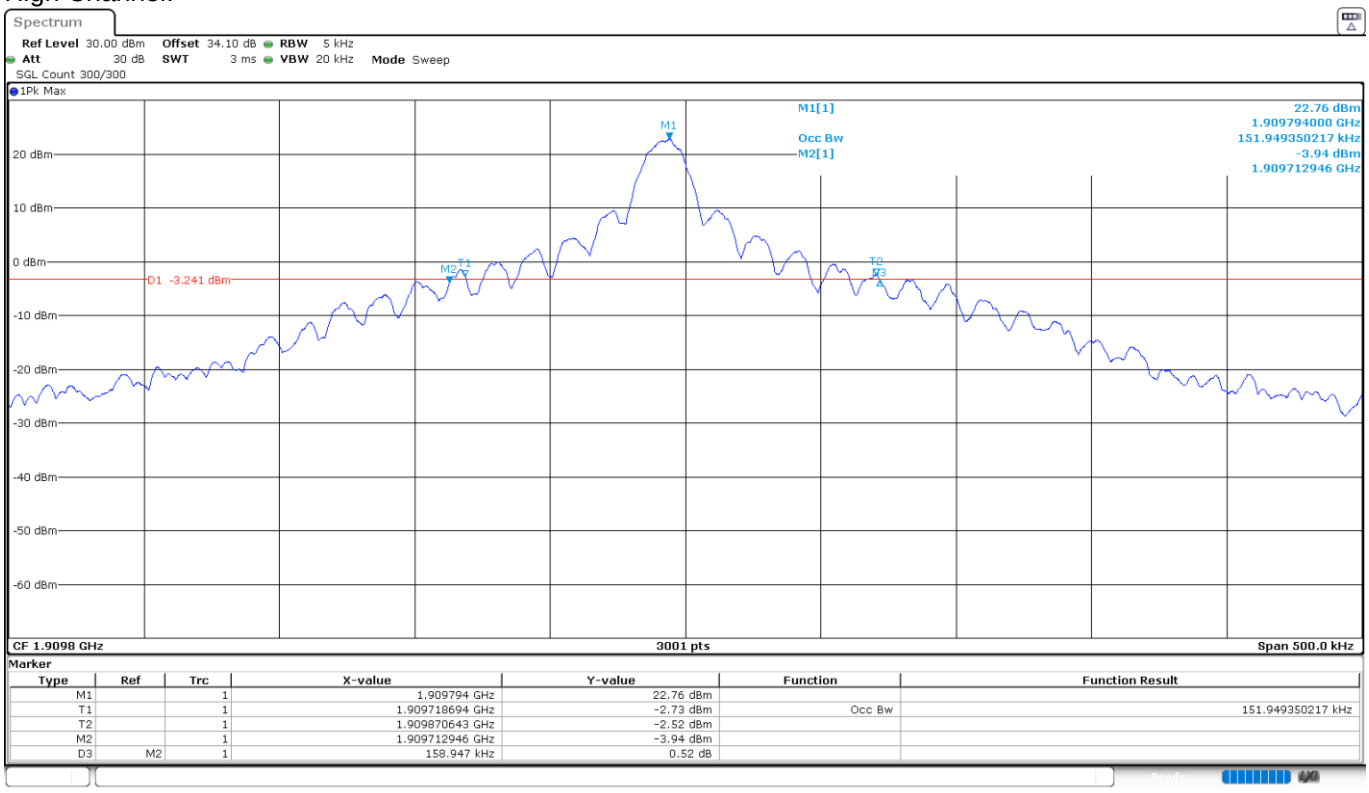
Date: 12.DEC.2024 22:43:29

Middle Channel:



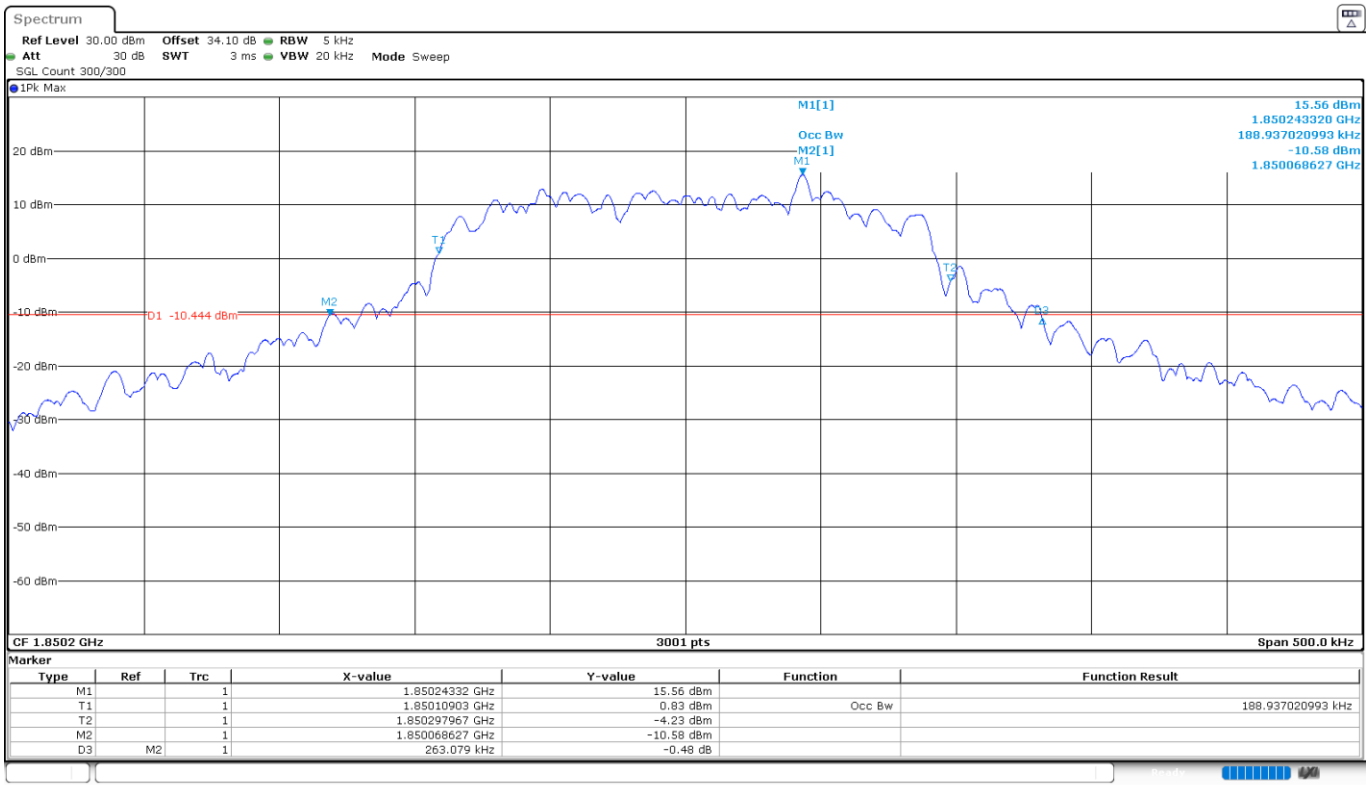
Date: 12.DEC.2024 22:46:13

High Channel:



LTE Cat NB2 Band 2. QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5.

Low Channel:

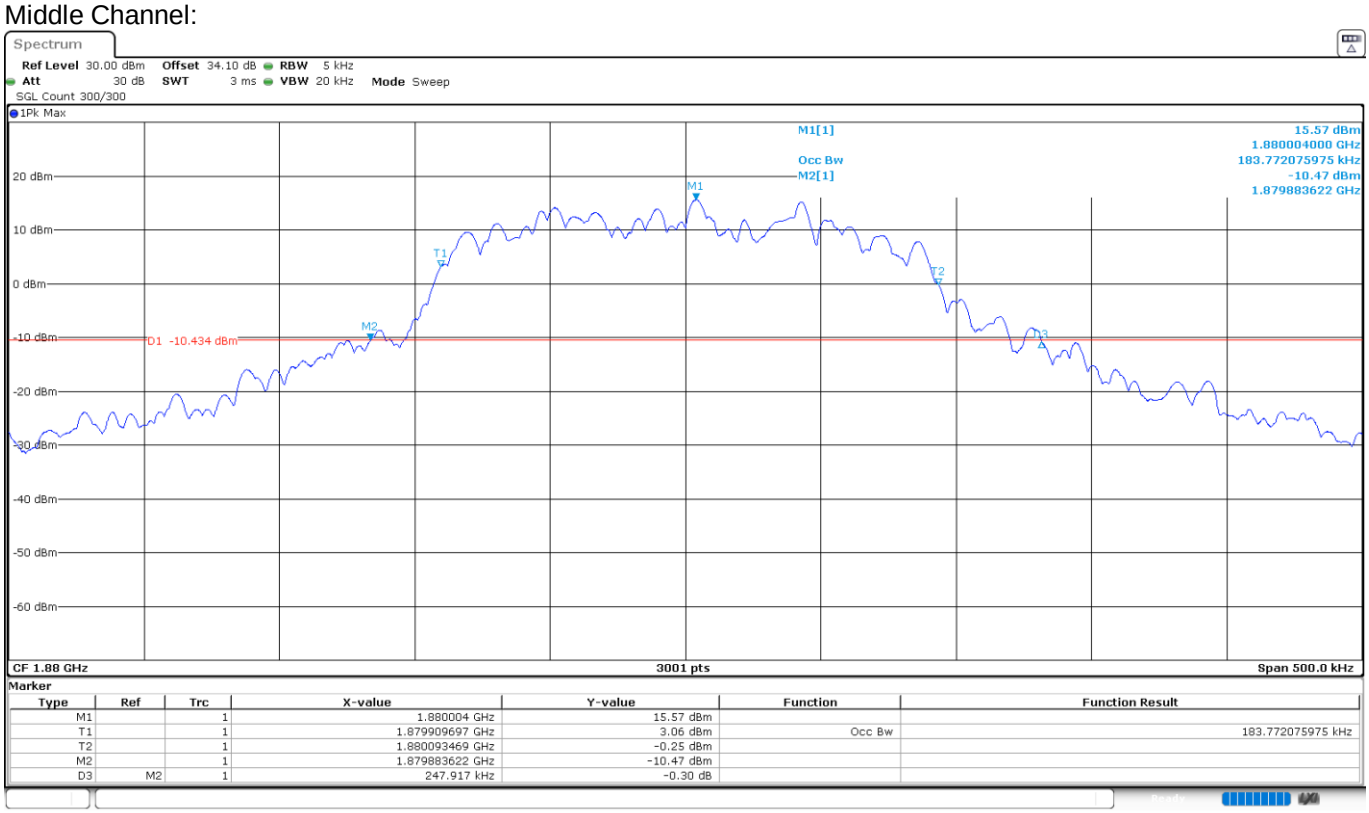


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.85024332 GHz	15.56 dBm		
T1		1	1.85010903 GHz	0.83 dBm	Occ Bw	188.937020993 kHz
T2		1	1.850297967 GHz	-4.23 dBm		
M2		1	1.850068627 GHz	-10.58 dBm		
D3	M2	1	263.079 kHz	-0.48 dB		

Date: 12.DEC.2024 22:43:45

Middle Channel:

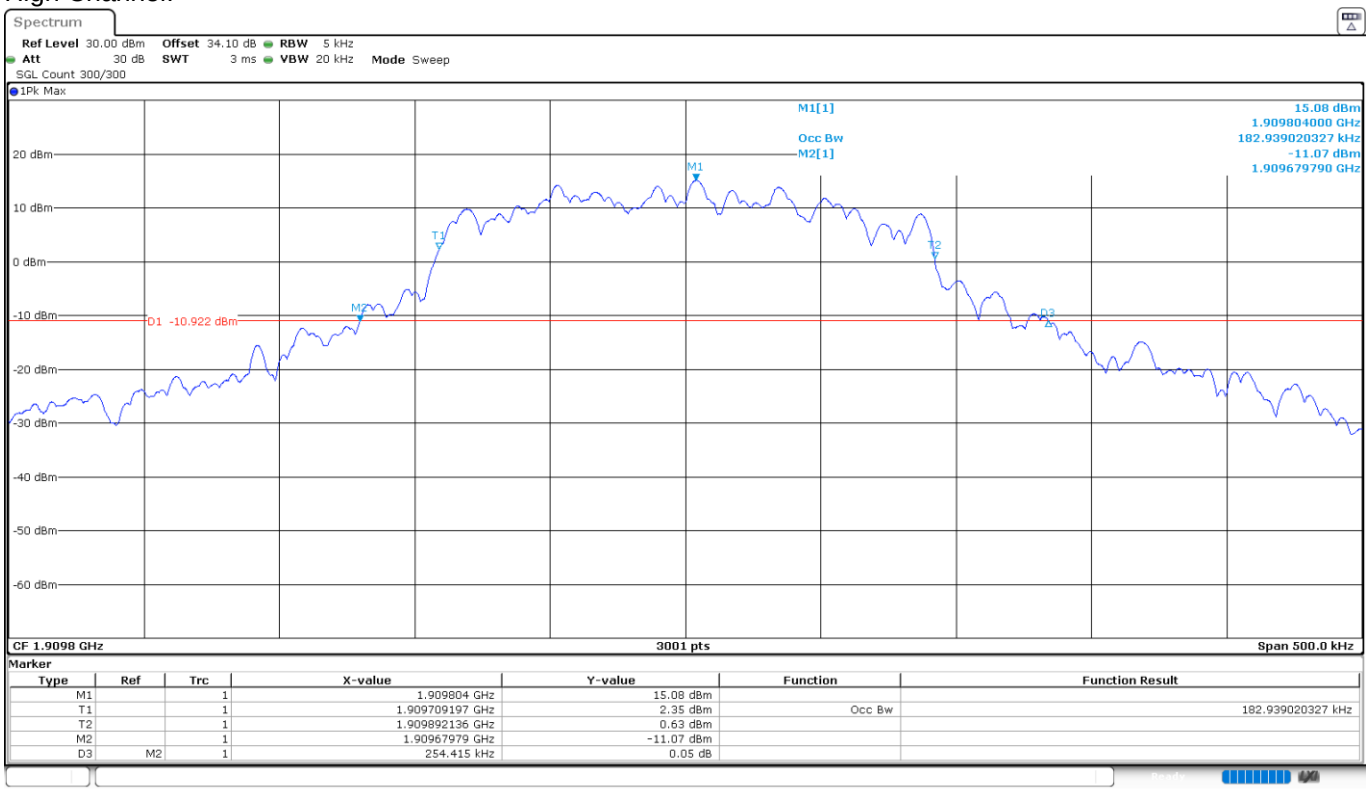


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.880004 GHz	15.57 dBm		
T1		1	1.879909697 GHz	3.06 dBm	Occ Bw	183.772075975 kHz
T2		1	1.880093469 GHz	-0.25 dBm		
M2		1	1.879883622 GHz	-10.47 dBm		
D3	M2	1	247.917 kHz	-0.30 dB		

Date: 12.DEC.2024 22:46:29

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 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

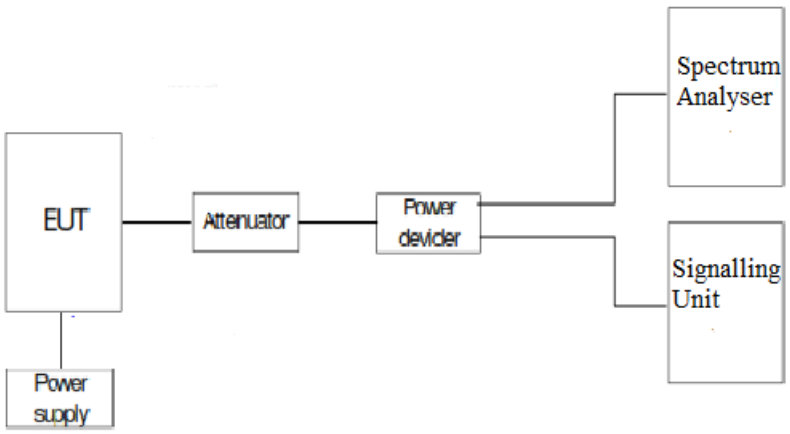
Method

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 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 NB2 Band 2.

A preliminary scan determined the worst-case:

QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5.

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.

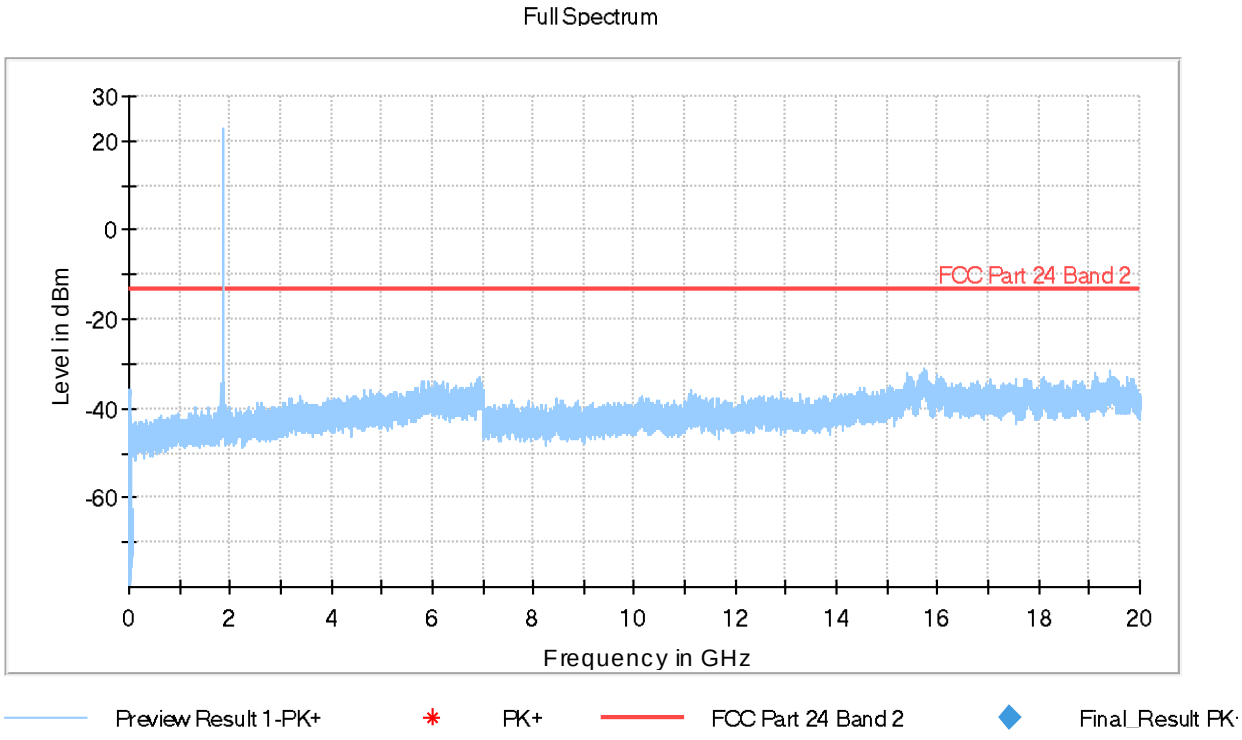
Measurement uncertainty (dB): <±2.76

Verdict: PASS

LTE Cat NB2 Band 2. QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5.

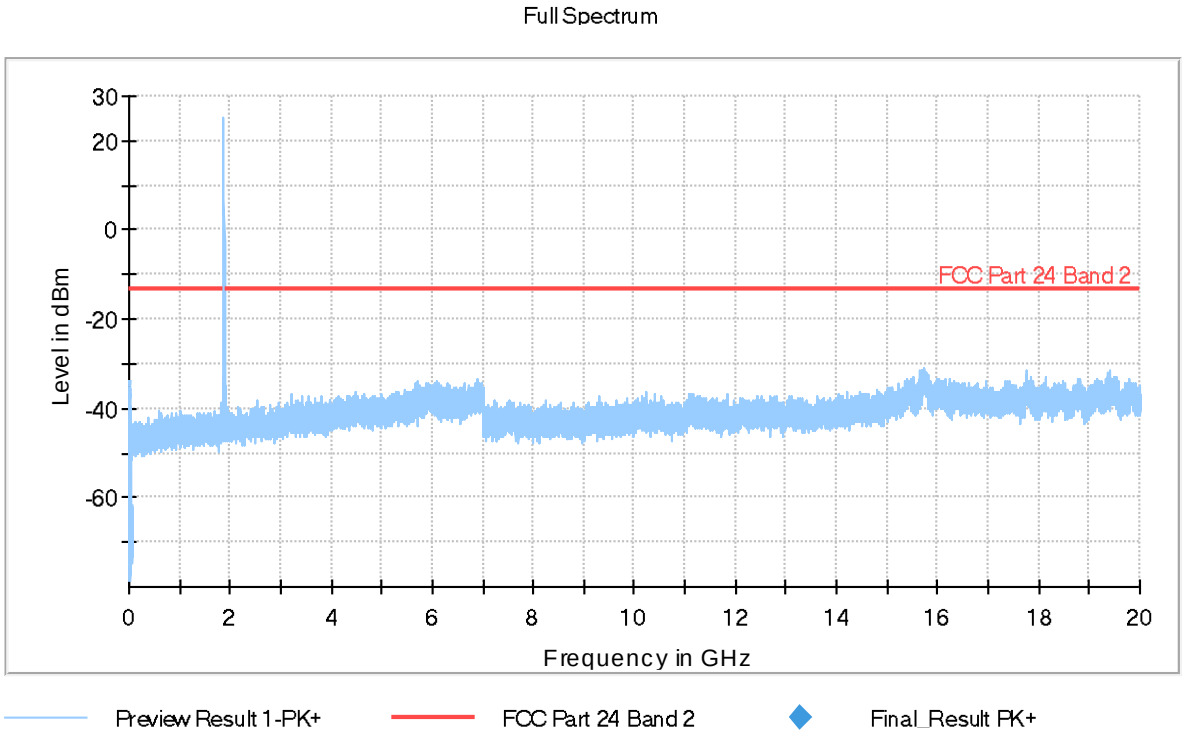
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40]					
9 kHz - 150 kHz	14,1 Hz	PK+	300 Hz	Coupled	0 dB
150 kHz - 30 MHz	932,812 Hz	PK+	10 kHz	Coupled	0 dB
30 MHz - 1 GHz	303,125 kHz	PK+	1 MHz	Coupled	0 dB
1 GHz - 10 GHz	281,25 kHz	PK+	1 MHz	Coupled	0 dB
10 GHz - 20 GHz	312,5 kHz	PK+	1 MHz	Coupled	0 dB

Low Channel:



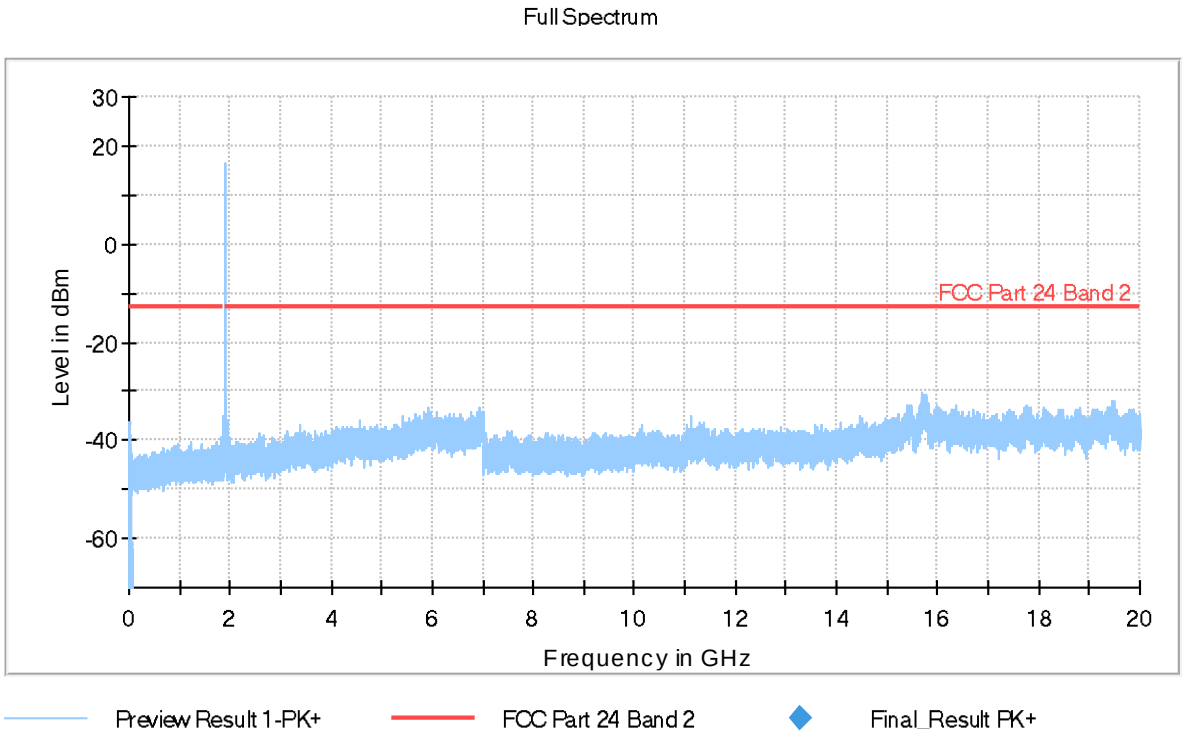
The peak above the limit is the carrier frequency.

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

* 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 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

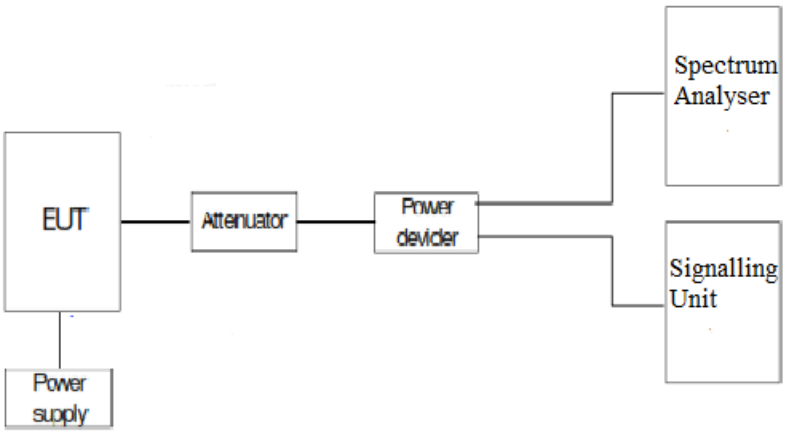
Method

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.

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 NB2 Band 2:

Preliminary measurements determined the worst-case. Results attached are for this worst-case configuration.

LTE Cat NB2 Band 2	Pi/2-BPSK BW=3.75 kHz Tone Number=1 Tone Offset=0 MSC/TBS=0	Pi/2-BPSK BW=15 kHz Tone Number=1 Tone Offset=0 MSC/TBS=0	Pi/2-BPSK BW=15 kHz Tone Number=12 Tone Offset=0 MSC/TBS=5
Maximum measured level at Low Block Edge at antenna port (dBm)	-21,92	-22,25	-27,05

LTE Cat NB2 Band 2	Pi/2-BPSK BW=3.75 kHz Tone Number=1 Tone Offset=47 MSC/TBS=0	Pi/2-BPSK BW=15 kHz Tone Number=1 Tone Offset=11 MSC/TBS=0	Pi/2-BPSK BW=15 kHz Tone Number=12 Tone Offset=0 MSC/TBS=5
Maximum measured level at High Block Edge at antenna port (dBm)	-23,38	-20,38	-26,78

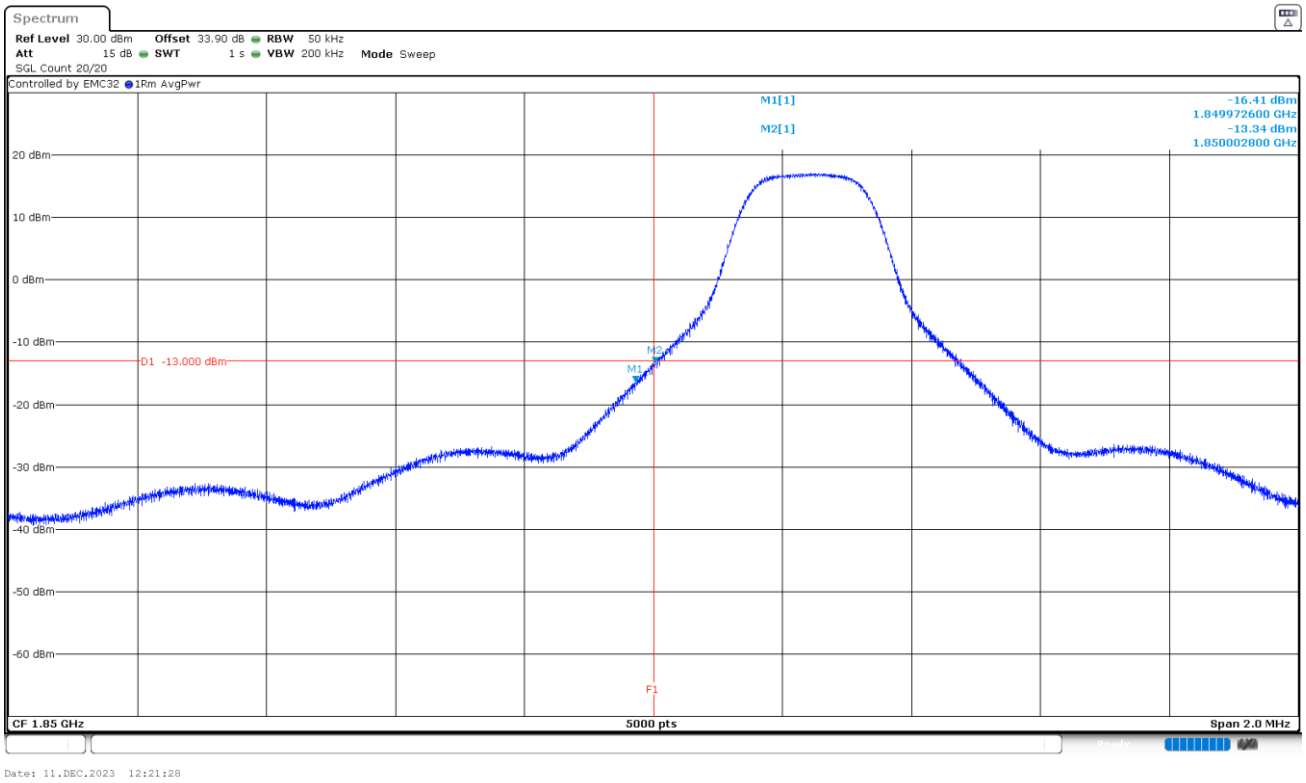
Measurement uncertainty (dB): <±2.76

Verdict

PASS

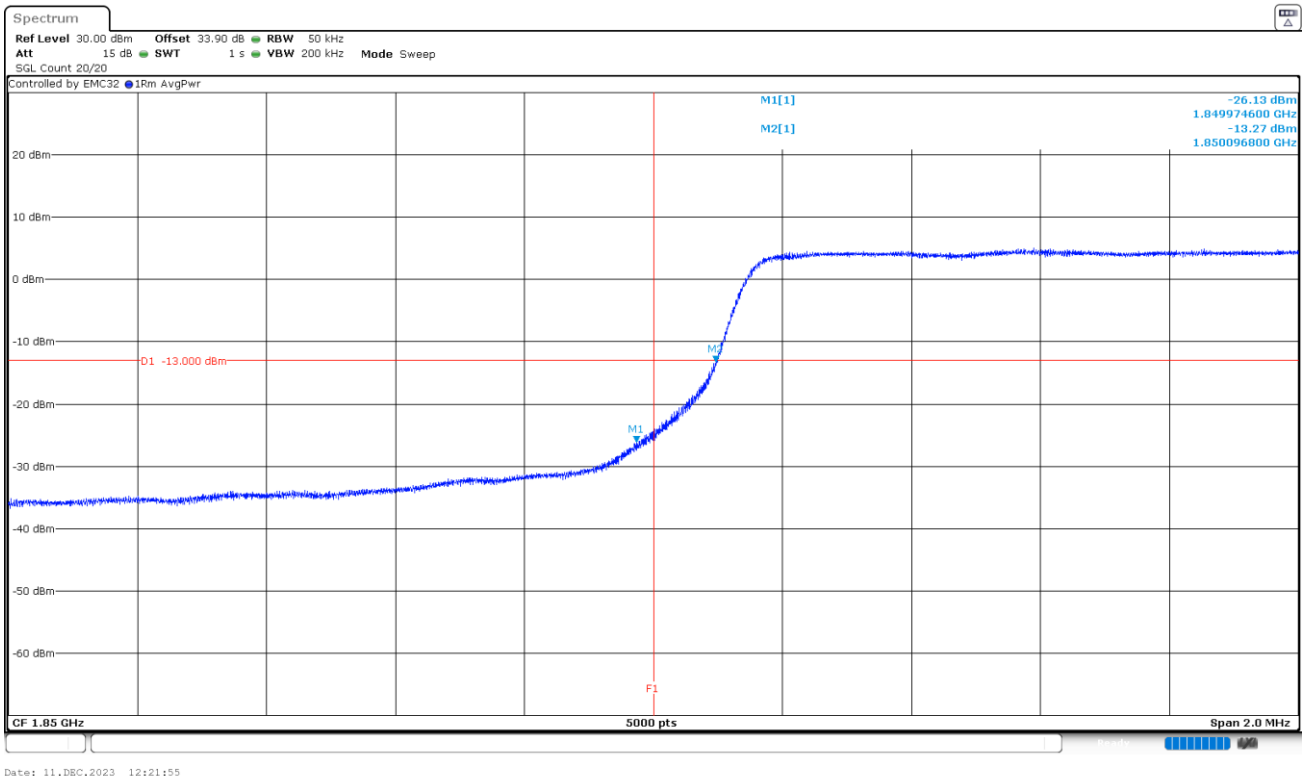
The plots below are for the worst case configuration specified before.

LTE NB2 Band 2. BW=3 MHz. QPSK. RB Size=1. RB Offset=0. Low Block Edge:



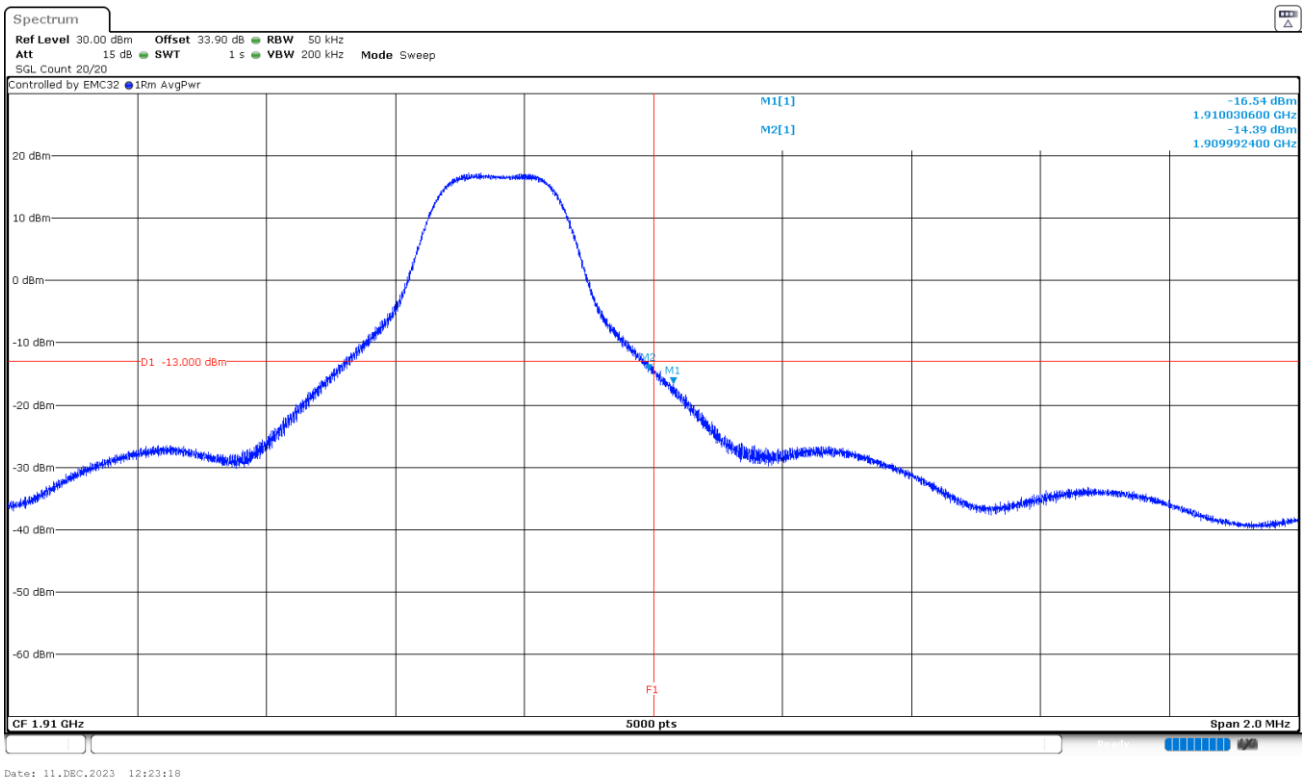
The equipment transmits at the maximum output power.

LTE NB2 Band 2. BW=3 MHz. QPSK. RB Size=All. RB Offset=0. Low Block Edge:



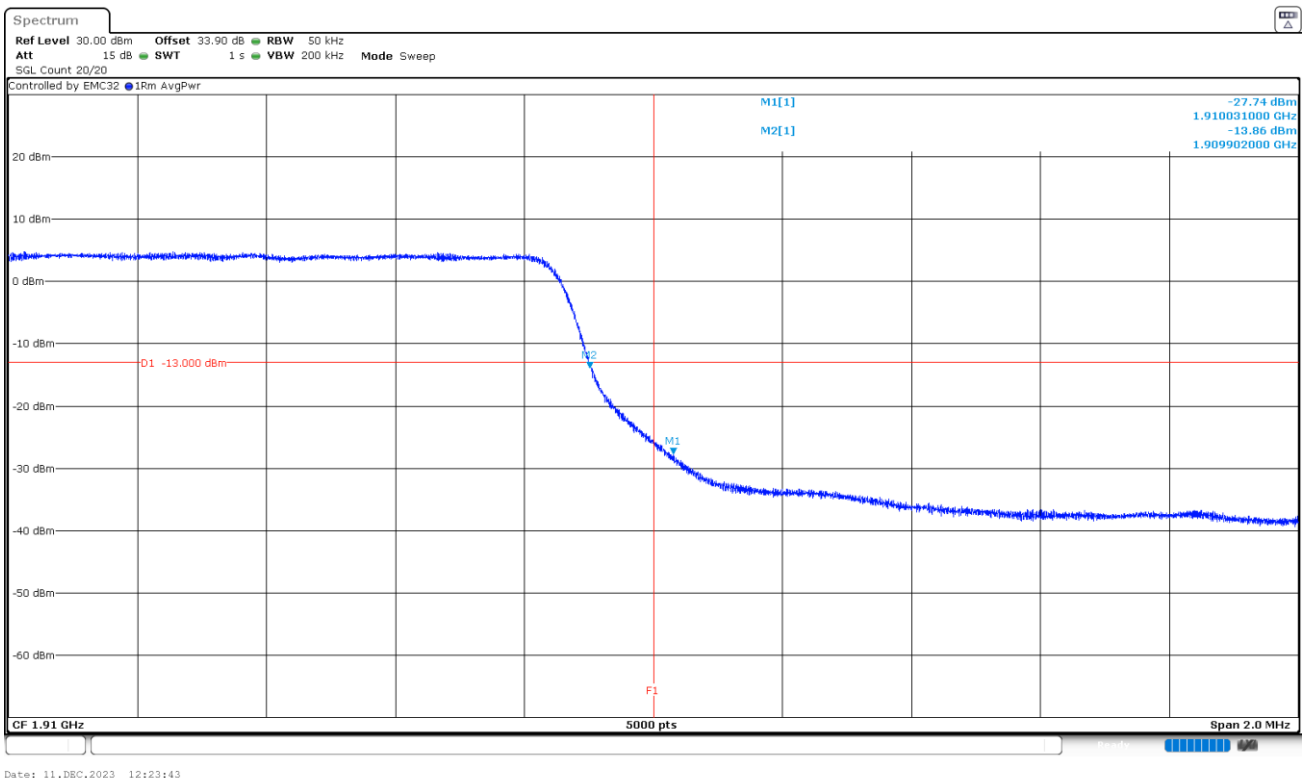
The equipment transmits at the maximum output power.

LTE NB2 Band 2. BW=3 MHz. QPSK. RB Size=1. RB Offset=Max. High Block Edge:



The equipment transmits at the maximum output power.

LTE NB2 Band 2. BW=3 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 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 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 17 GHz. Measurements above 17 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 Po transmitting power. the specified minimum attenuation becomes 43+10log (Po) and the level in dBm relative Po becomes:

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

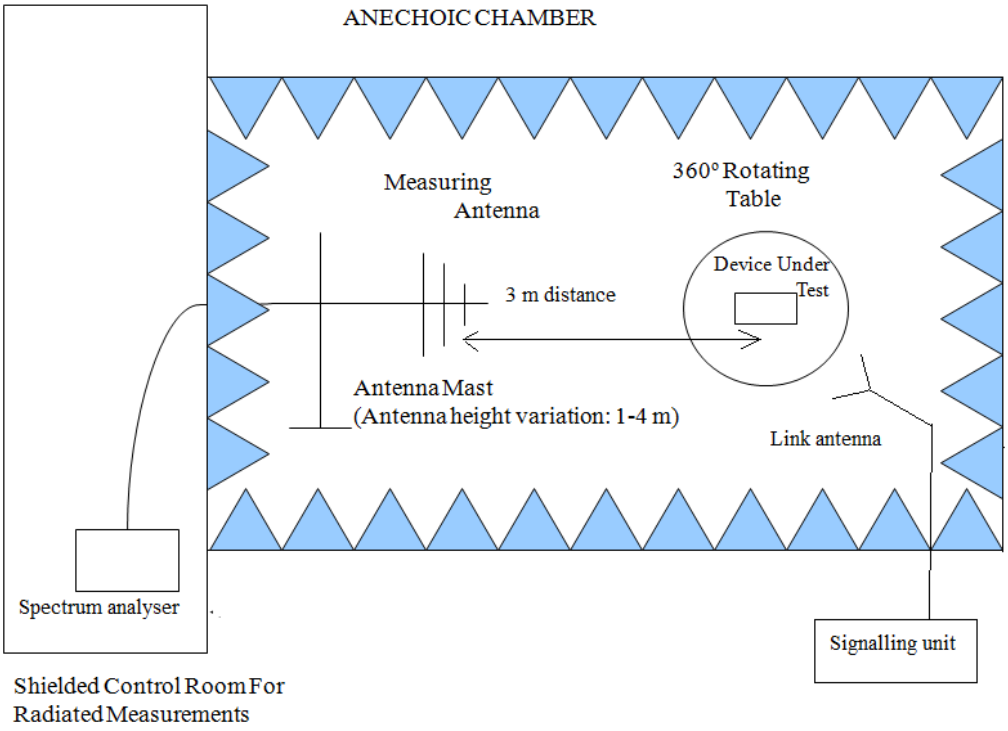
The maximum field strength (dBµV/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

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

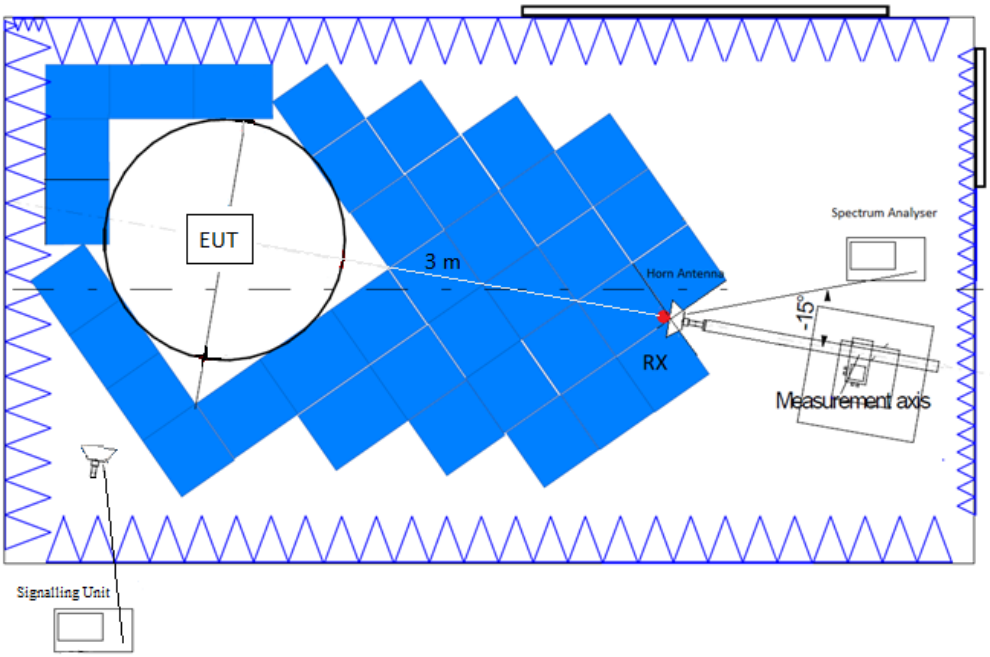
where D is the measurement distance (in the far field region) in m.

Test Setup

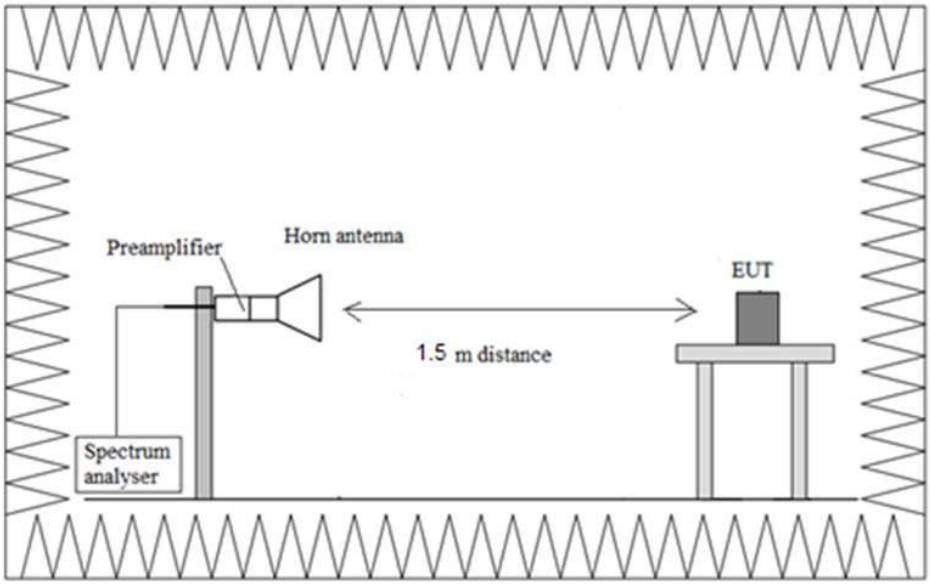
Radiated measurements below 1 GHz:



Radiated measurements above 1 GHz up to 17 GHz:



Radiated measurements above 17 GHz:



Results

LTE Cat NB2 Band 2.

A preliminary scan determined the QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5. as the worst case. The following results are for this worst-case configuration.

Frequency range 9 kHz – 30 MHz:

No radiofrequency signal generated in the device found below 10º sub-armonic, no further investigation required

Frequency range 30 MHz - 1 GHz:

- LOW CHANNEL:

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

- MIDDLE CHANNEL:

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

- HIGH CHANNEL:

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

Frequency range 1 - 17 GHz:

- LOW CHANNEL:

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

- MIDDLE CHANNEL:

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

- HIGH CHANNEL:

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

Frequency range 17 - 20 GHz:

- LOW CHANNEL:

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

- MIDDLE CHANNEL:

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

- HIGH CHANNEL:

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

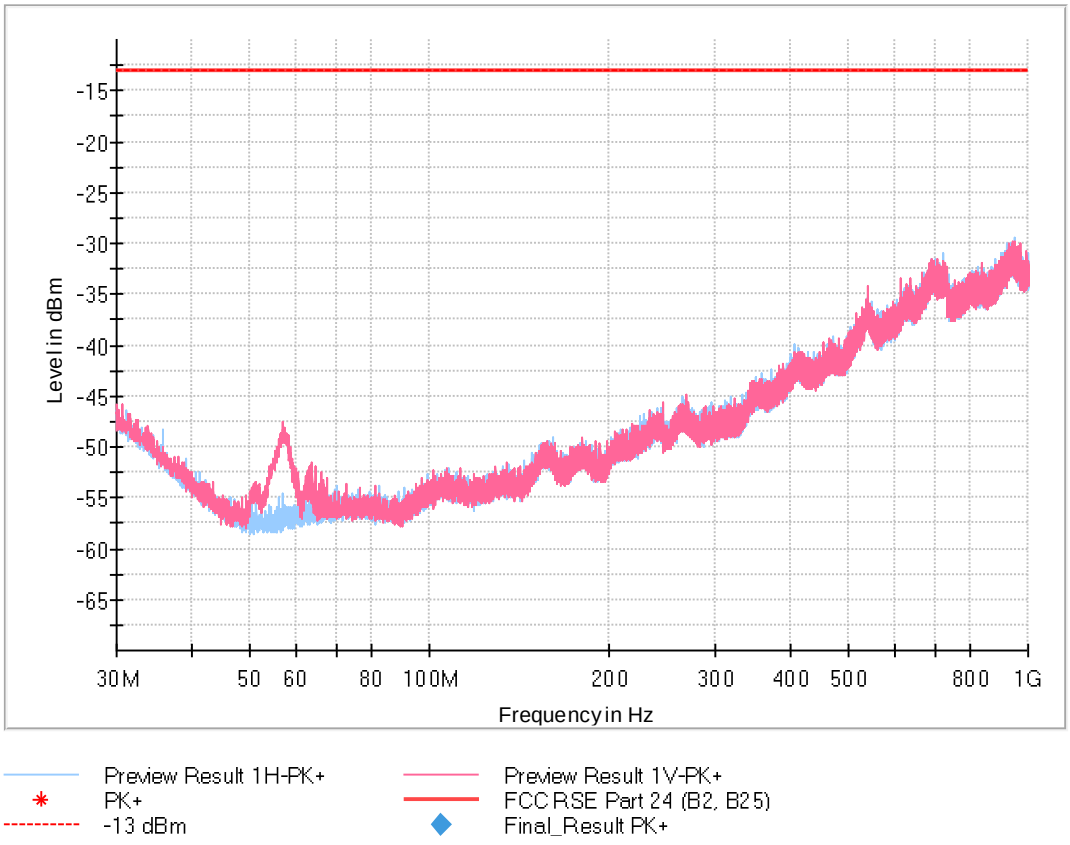
Measurement uncertainty (dB)	<± 5.03 for f < 1 GHz <± 4.32 for f ≥ 1 GHz up to 17 GHz <± 4.58 for f ≥ 17 GHz up to 20 GHz

Verdict: *Pass*

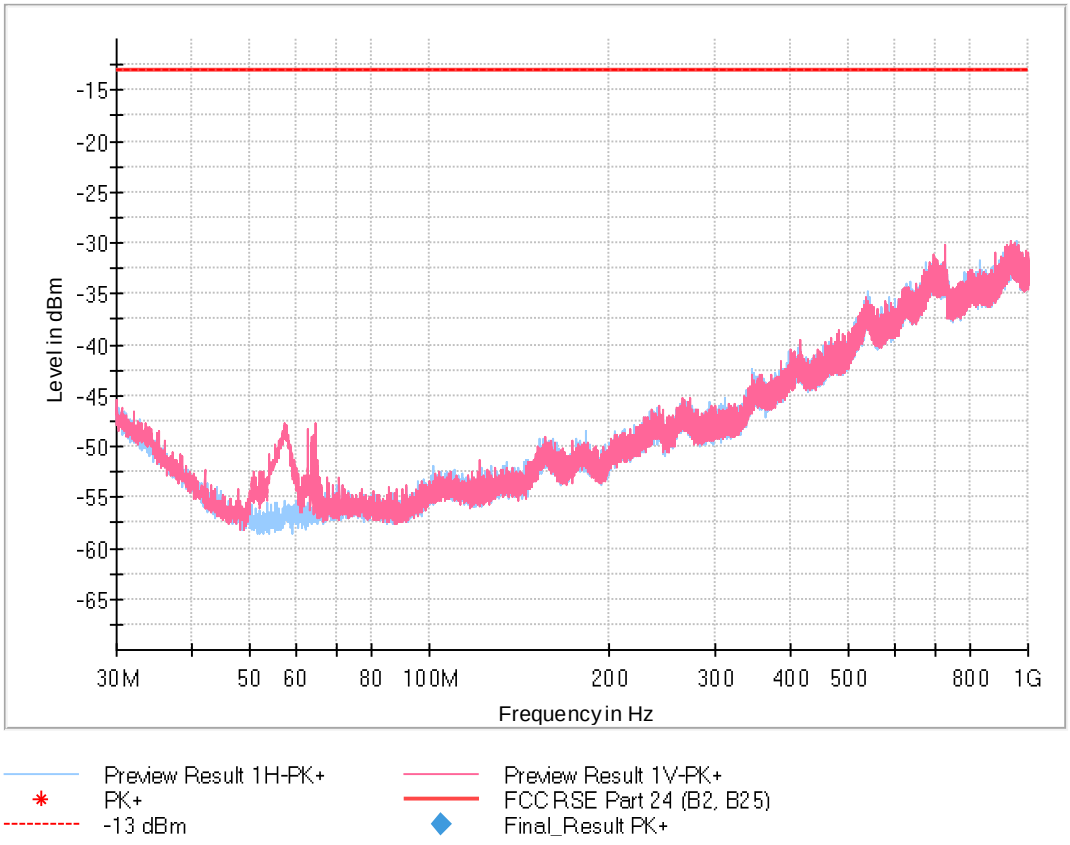
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
30 MHz - 1 GHz	30,312 kHz	PK+	1 MHz	Coupled	0 dB
1 GHz - 3 GHz	62,5 kHz	PK+	1 MHz	1 s	0 dB
3 GHz - 17 GHz	437,5 kHz	PK+	1 MHz	1 s	0 dB

FREQUENCY RANGE 30 MHz - 1 GHz:

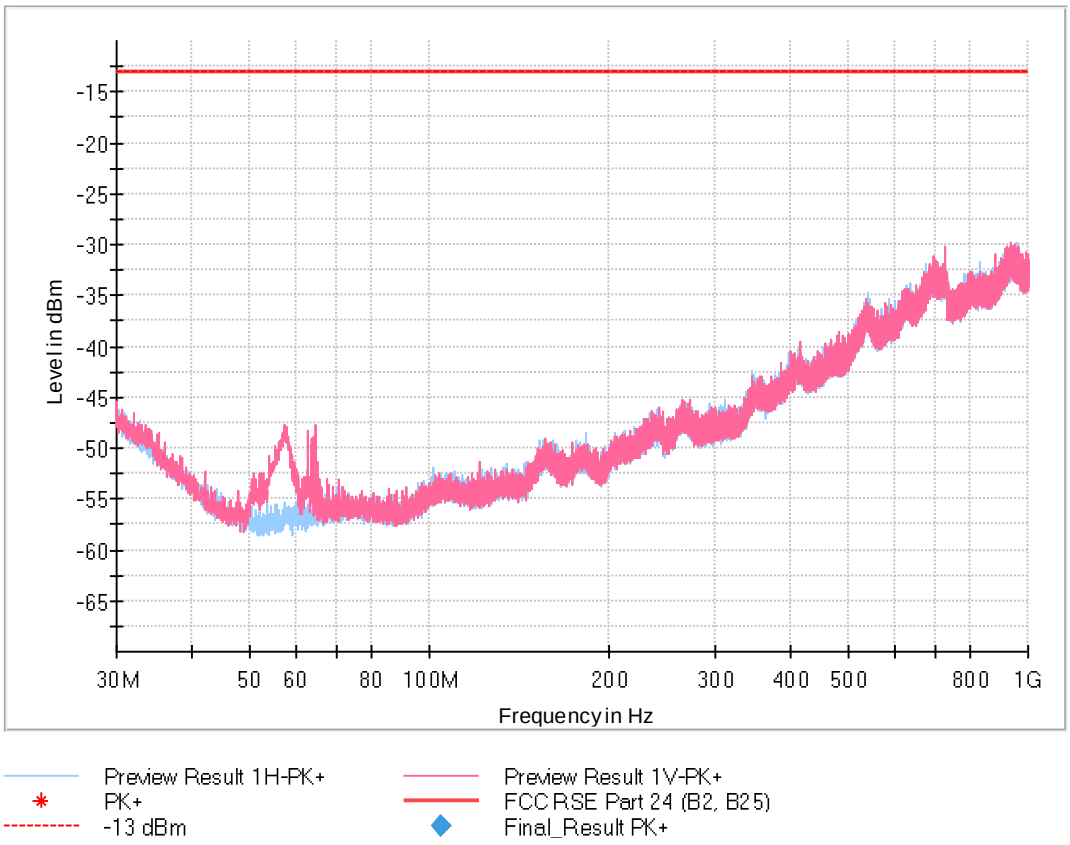
- Low Channel:



- Middle Channel:

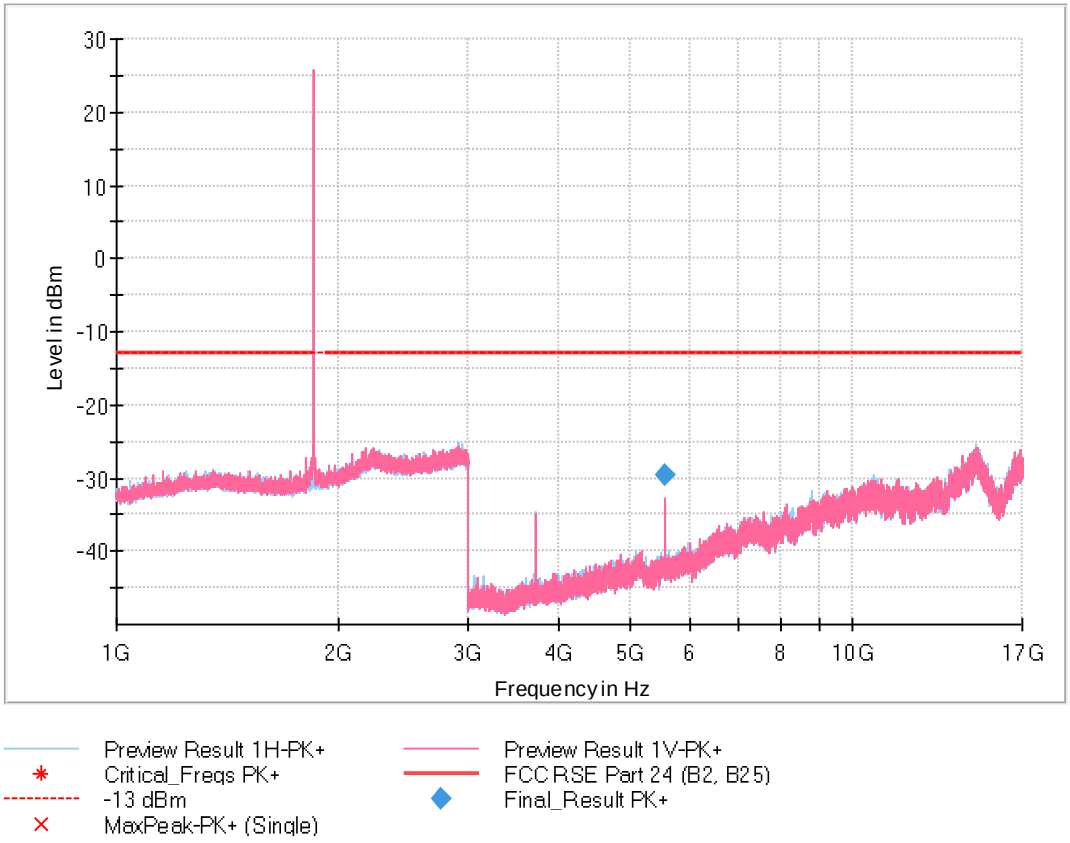


- High Channel:



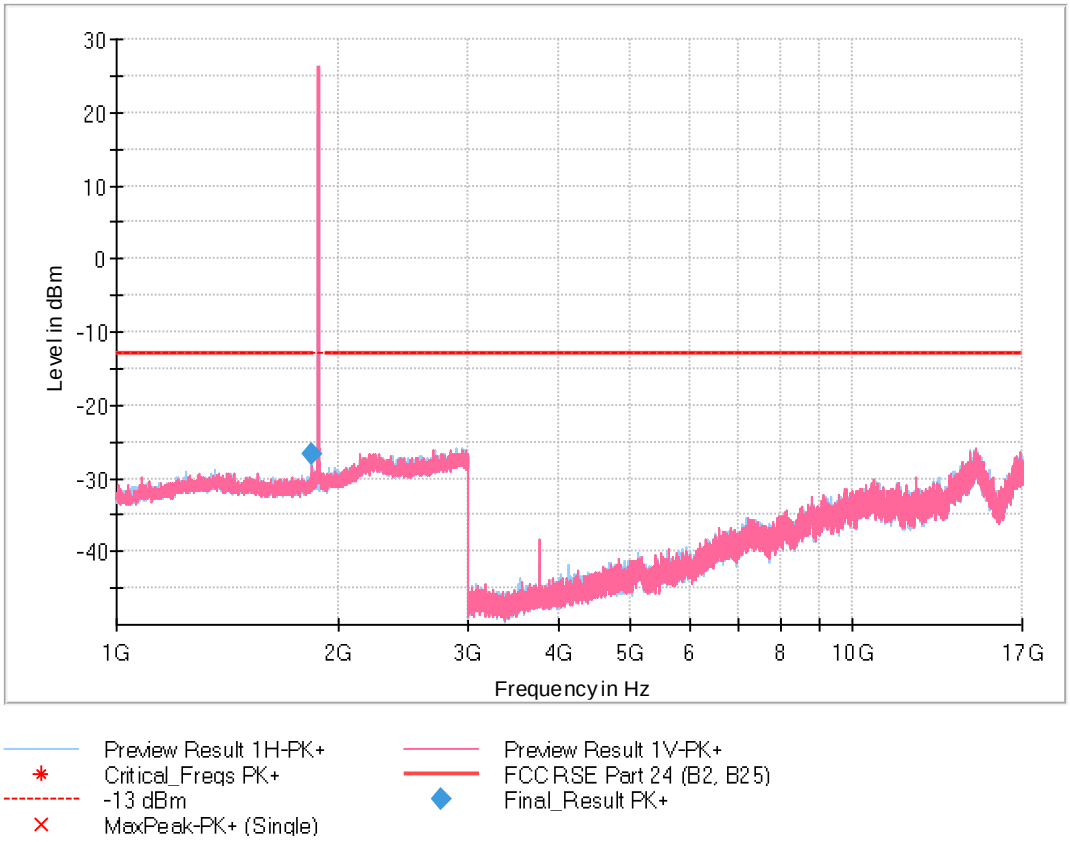
FREQUENCY RANGE 1 - 17 GHz:

- Low Channel:



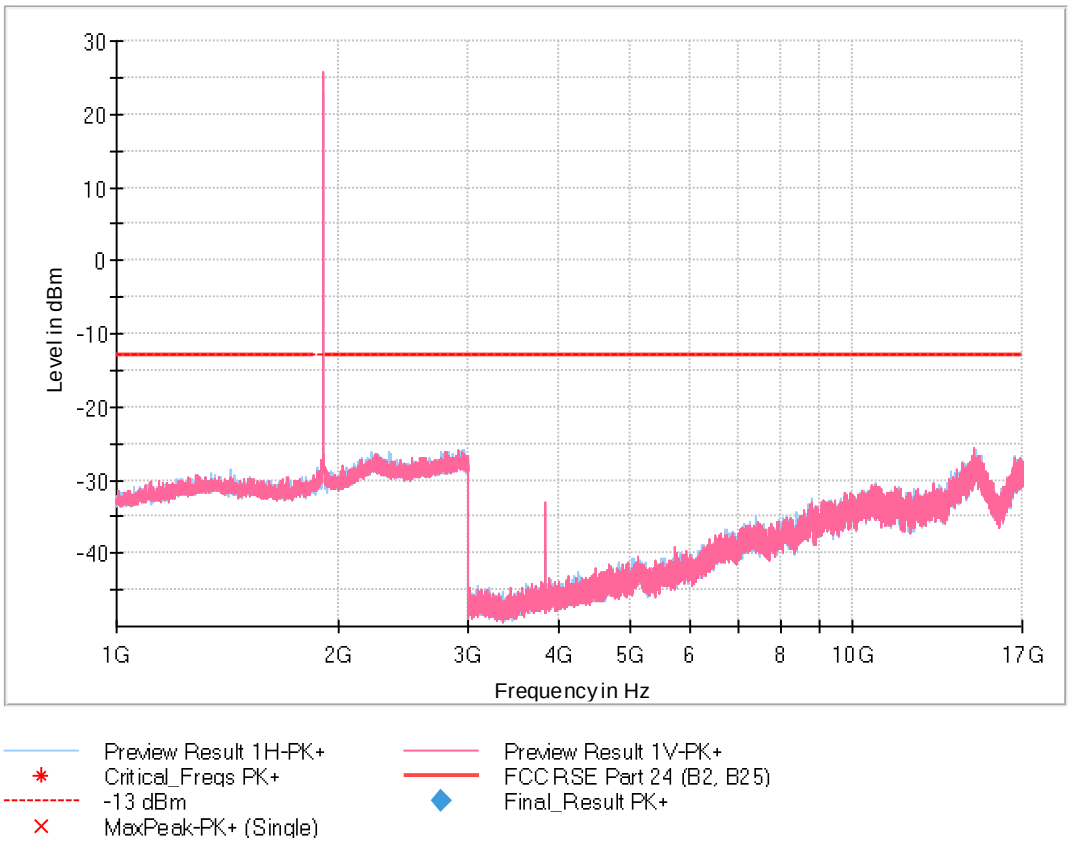
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

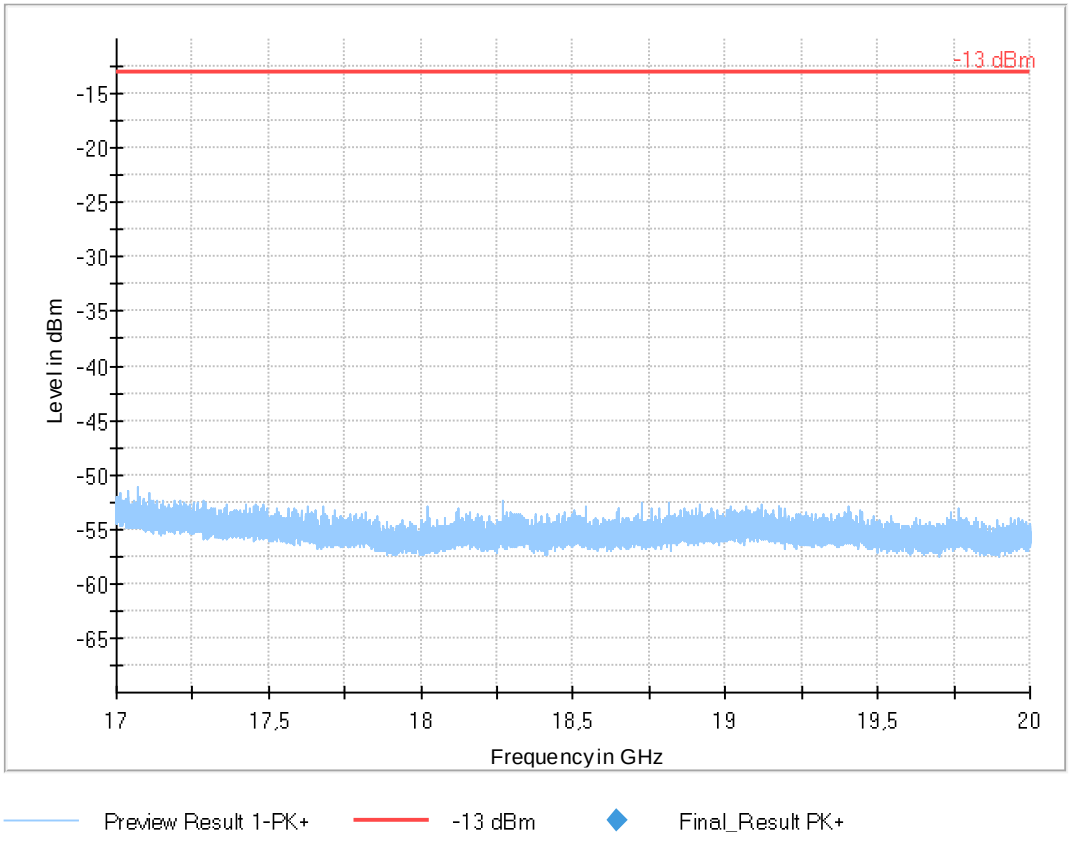
- High Channel:



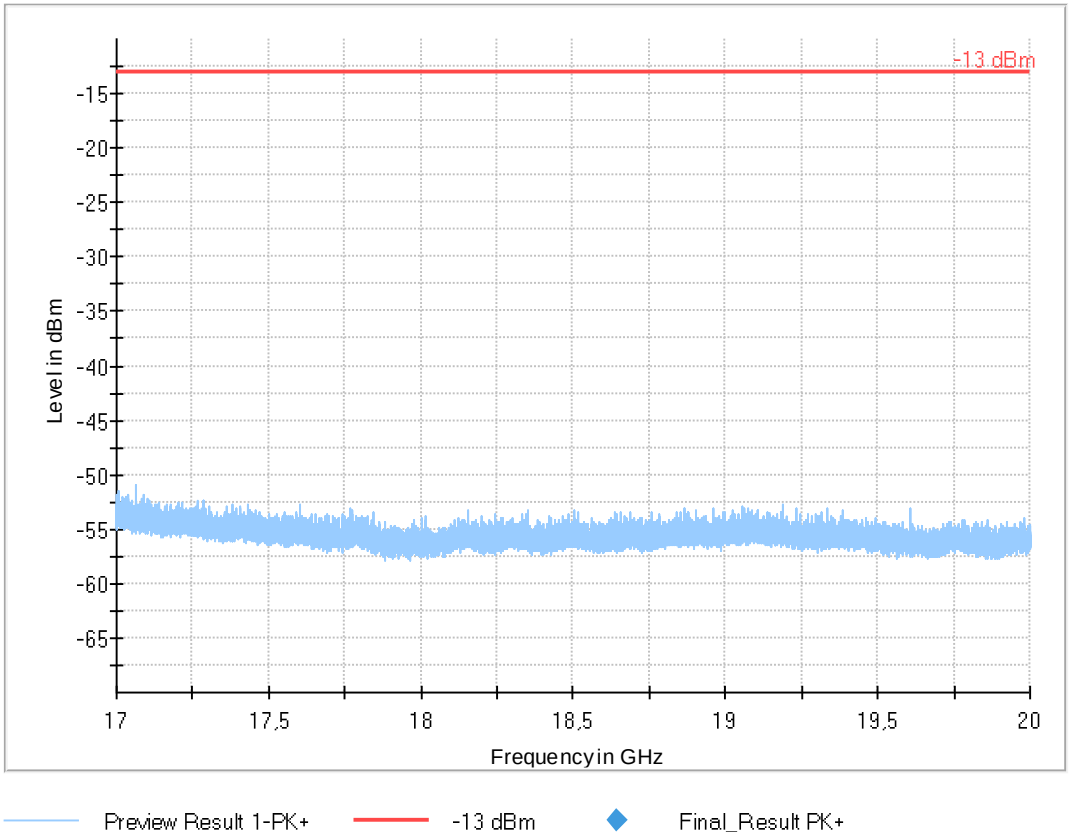
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 17 - 20 GHz:

- Low Channel:



- Middle Channel:



- High Channel: