Appendix B: Test results for FCC 90: LTE Cat NB2 Band 26

INDEX

TEST CONDITIONS

(*): Declared by the Applicant.

POWER SUPPLY (*):

Vnormal: 3.8 Vdc.
Vminimum: 3.0 Vdc
Vmaximum: 5.5 Vdc

Type of Power Supply: Internal DC.

ANTENNA (*):

Band	Gain (dBi)	Type
LTE Cat NB2 26	+2.7	SMD

TEST FREQUENCIES:

LTE Cat NB2 Band 26. Sub-band 814-824 MHz. Pi/2-BPSK, Pi/4-QPSK, QPSK modulations:

Channel. Number (Frequency, MHz)		
Low	Middle	High
26692 (814.2)	26740 (819)	26788 (823.8)
*The outermost channel which is in compliance with Block Edge testing.		

LTE Cat NB2 Band 26. Cross-rule Channel (824 MHz). Pi/2-BPSK, Pi/4-QPSK, QPSK modulations:

Channel. Number (Frequency, MHz)
Low
26790 (824)

RF Output Power

Limits

FCC §90.635 (b): The maximum output power of the transmitter for mobile stations is 100 Watts (20 dBW).

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 R&S CMW500, selecting maximum transmission power of the EUT and different modes of modulation.

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

Results

1. CONDUCTED AVERAGE POWER:

Measurements required on one frequency near top channel and one frequency near bottom channel, according to ANSI C63.26.

LTE Cat NB2 Band 26. Sub-band 814-824 MHz:

Worst-case of RF Power is High Channel, Pi/2-BPSK, BW=15 kHz, Tone Number=1, Tone Offset=11, MSC/TBS=0.

CHANNEL	FREQUENCY (MHz)	MODULATION	BW	Tone Number	Tone Offset (Start SubCarrier)	MCS / TBS	AVERAGE POWER (dBm)
Low 26692	814.2 MHz	Pi/2-BPSK	3.75 kHz	1	0	0	22.27
				1	47	0	22.21
			15 kHz	1	0	0	22.37
				1	11	0	22.27
		Pi/4-QPSK	3.75 kHz	1	0	3	22.3
				1	47	3	22.18
			15 kHz	1	0	3	22.35
				1	11	3	22.34
		QPSK	15 kHz	3	0	5	22.27
				3	6	5	22.29
				6	0	5	21.14
				6	6	5	21.23
				12	0	5	20.39
High 26788	823.8 MHz	Pi/2-BPSK	3.75 kHz	1	0	0	22.26
				1	47	0	22.33
			15 kHz	1	0	0	22.49
				1	11	0	22.48
		Pi/4-QPSK	3.75 kHz	1	0	3	22.42
				1	47	3	22.31
			15 kHz	1	0	3	22.46
				1	11	3	22.46
		QPSK	15 kHz	3	0	5	22.24
				3	6	5	22.25
				6	0	5	21.27
				6	6	5	21.37
				12	0	5	20.42

MAX POWER	COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP (dBm)	RAD. POWER AVG ERP (dBm)
LOW	22.37	2.7	25.07	22.92
HIGH	22.49	2.7	25.19	23.04
MAX:	22.49		25.19	23.04

Measurement uncertainty (dB) <±0.941

Verdict

Pass

LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz:

Worst-case of RF Power is Single Channel, Pi/4-QPSK, BW=3.75 kHz, Tone Number=1, Tone Offset=0, MSC/TBS=3.

CHANNEL	FREQUENCY (MHz)	MODULATION	BW	Tone Number	Tone Offset (Start SubCarrier)	MCS / TBS	AVERAGE POWER (dBm)
26790	824 MHz	Pi/2-BPSK	3.75 kHz	1	0	0	22.29
				1	47	0	22.21
			15 kHz	1	0	0	22.37
				1	11	0	22.39
		Pi/4-QPSK	3.75 kHz	1	0	3	22.42
				1	47	3	22.35
			15 kHz	1	0	3	22.37
				1	11	3	22.39
		QPSK	15 kHz	3	0	5	22.27
				3	6	5	22.28
				6	0	5	21.39
				6	6	5	21.43
				12	0	5	20.35

MAX POWER	COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP (dBm)	RAD. POWER AVG ERP (dBm)
SINGLE	22.42	2.7	25.12	22.97
MAX:	22.42		25.12	22.97

Measurement uncertainty (dB) <±0.941

Verdict

Pass

Frequency Stability

Limits

FCC § 90.213: Frequency stability.

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

Table 1 to § 90.213(a)—Minimum Frequency Stability

Frequency range (MHz)	Fixed and base stations (Parts per million (ppm))	Mobile stations	
		Over 2 watts output power (Parts per million (ppm))	2 watts or less output power (Parts per million (ppm))
809–824	1.5	2.5	2.5

(b) For the purpose of determining the frequency stability limits, the power of a transmitter is considered to be the maximum rated output power as specified by the manufacturer.

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.

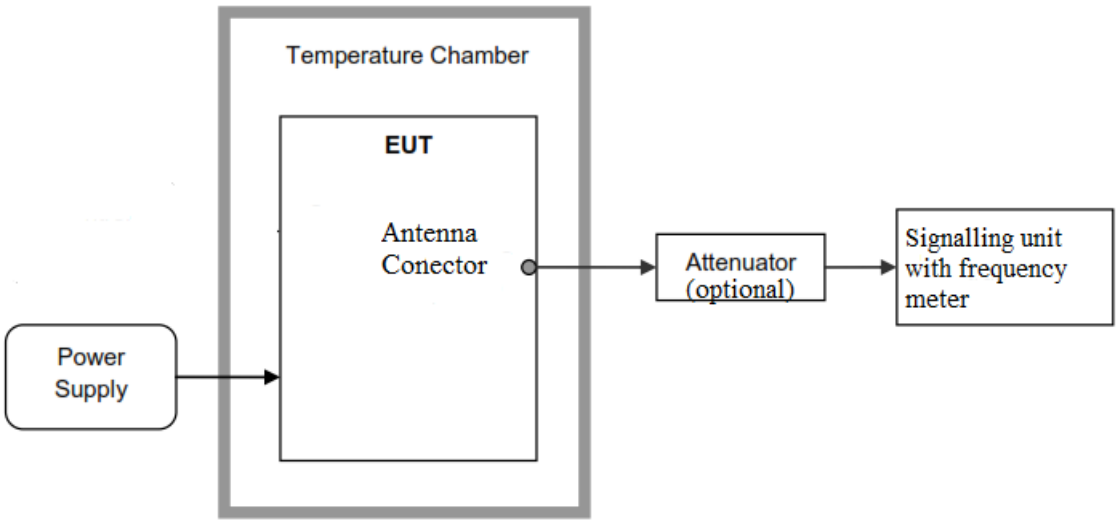
Temperature and voltage range of testing has been extended to the maximum and minimum values declared by customer.

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 LTE mode for conducted power was used for the test.

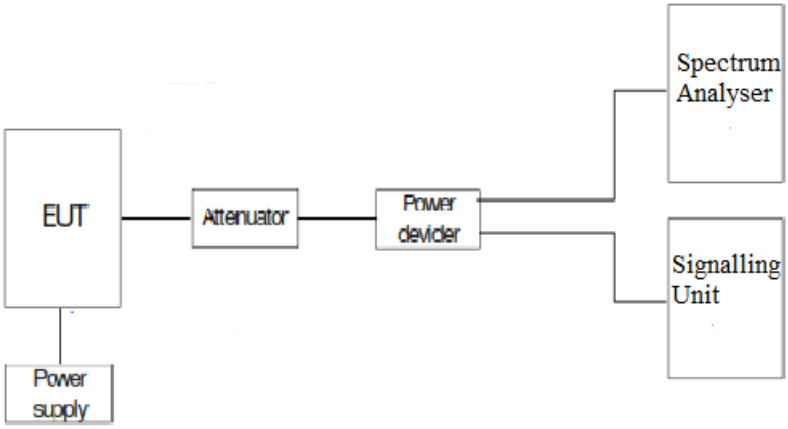
The reference point measurements were made at the RF output terminals of the EUT using an attenuator. power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

Test Setup

1. Frequency Tolerance:



3. Reference Frequency Points fL and fH:



Results

LTE Cat NB2 Band 26. Sub-band 814-824 MHz:

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	-4.88	-0.005958486
+80	-7.82	-0.00954823
+70	-5.34	-0.006520147
+60	15.66	0.019120879
+50	-1.97	-0.002405372
+40	10.67	0.013028083
+30	-5.62	-0.006862027
+20	-16.77	-0.02047619
+10	4.89	0.005970696
0	-13.09	-0.015982906
-10	-9.8	-0.011965812
-20	2.1	0.002564103
-30	-12.32	-0.015042735
-40	25.98	0.031721612

- **Frequency Stability over Voltage Variations.**

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	5.5	-5.79	-0.007069597
Vmin	3	-0.97	-0.001184371

Measurement uncertainty (Hz) <± 249.55

Results

PASS

Modulation Characteristics

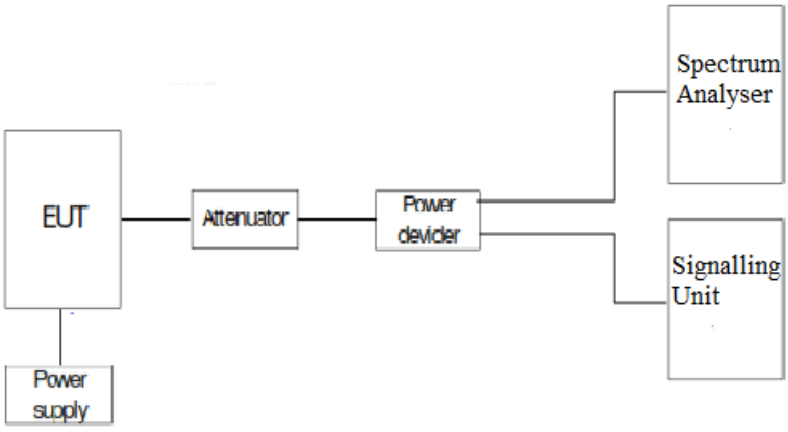
Limits

FCC §2.1047 Measurements required: Modulation characteristics.

Method

For LTE NB2 the EUT operates with PI/2-BPSK, Pi/4-QPSK and QPSK modulations in which the information is digitized and coded into a bit stream.

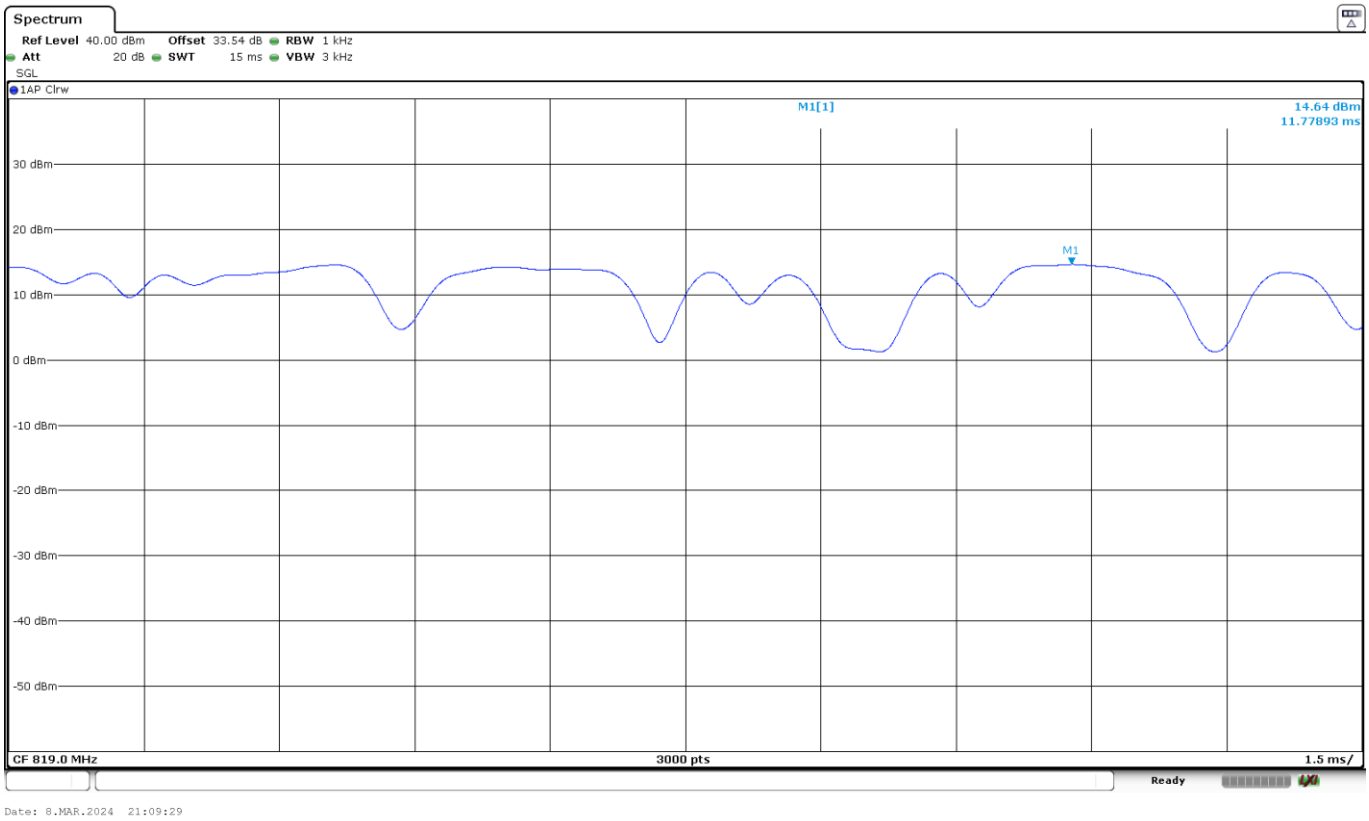
Test Setup



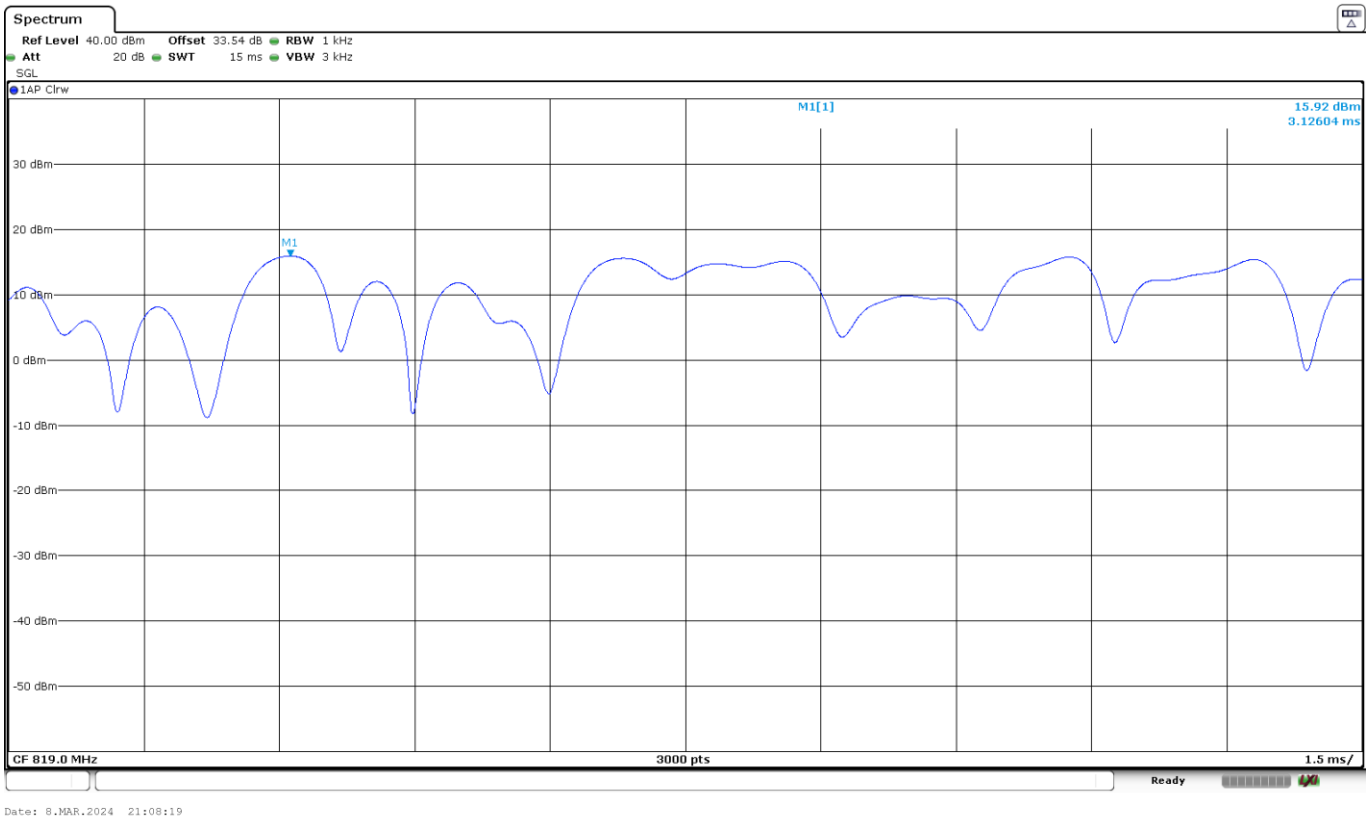
Results

The following plots show the modulation schemes in the EUT.

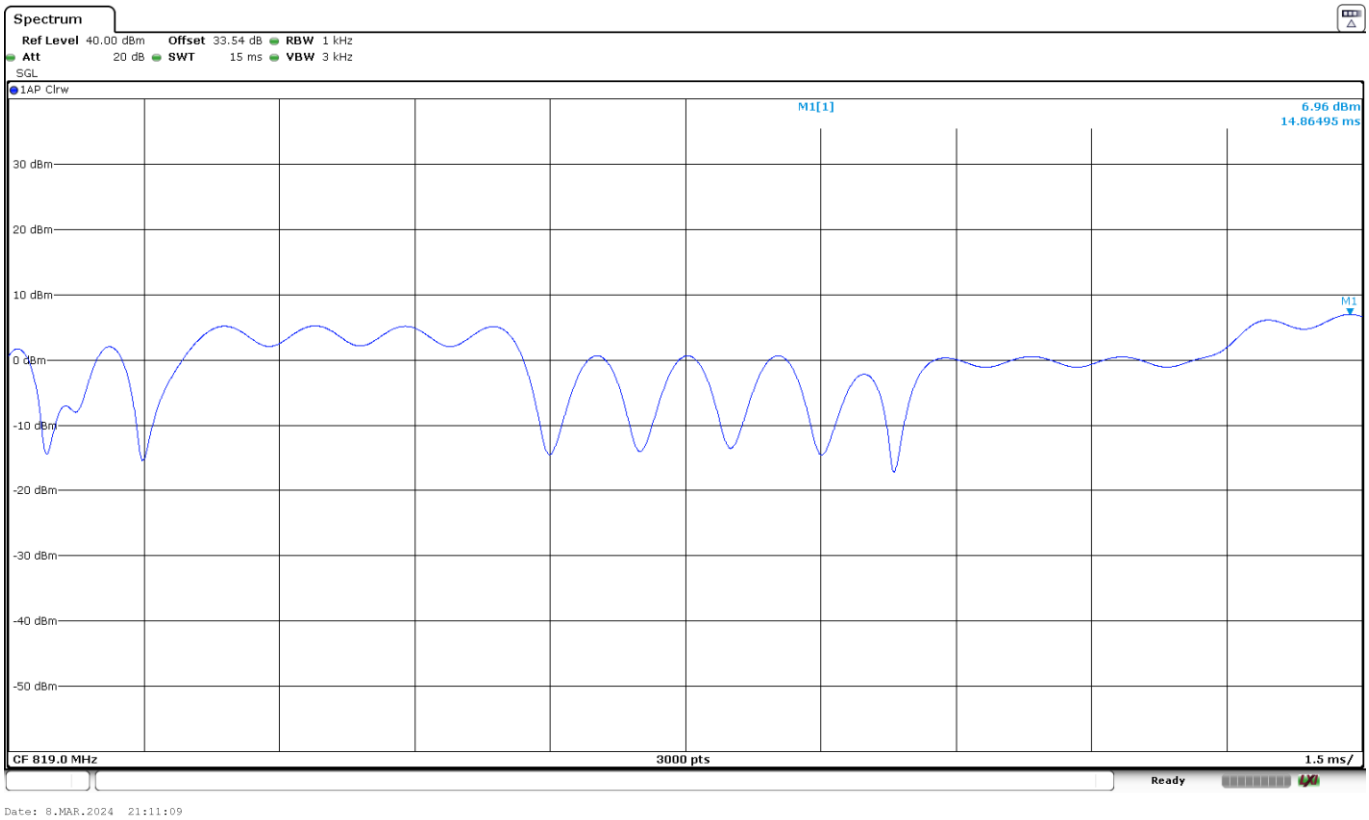
LTE Cat NB2 Band 26. Sub-band 814-824 MHz: Pi/2-BPSK. Middle Channel. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=0.



LTE Cat NB2 Band 26. Sub-band 814-824 MHz: Pi/4-QPSK. Middle Channel. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=3.



LTE Cat NB2 Band 26. Sub-band 814-824 MHz: QPSK. Middle Channel. BW=15 kHz. Tone Number=3. Tone Offset=5. MSC/TBS=5.



Occupied Bandwidth

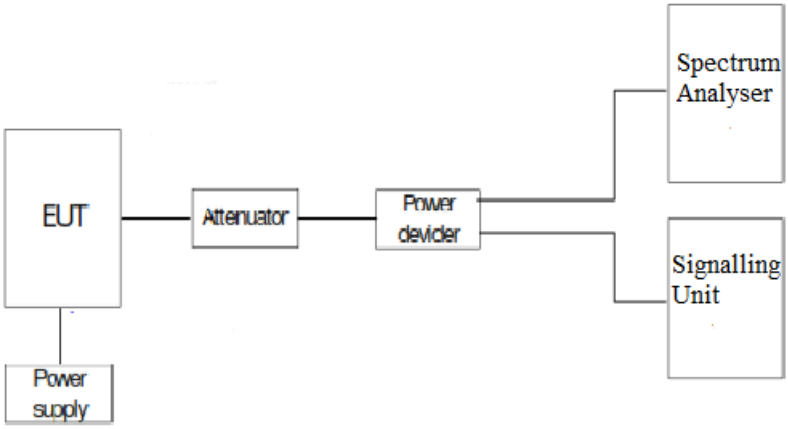
Limits

FCC §2.1049. Measurements required: Occupied bandwidth.

Method

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

Test Setup



Results

LTE Cat NB2 Band 26. Sub-band 814-824 MHz:

LTE Cat NB2 Band 26. Sub-band 814-824 MHz. Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=0.

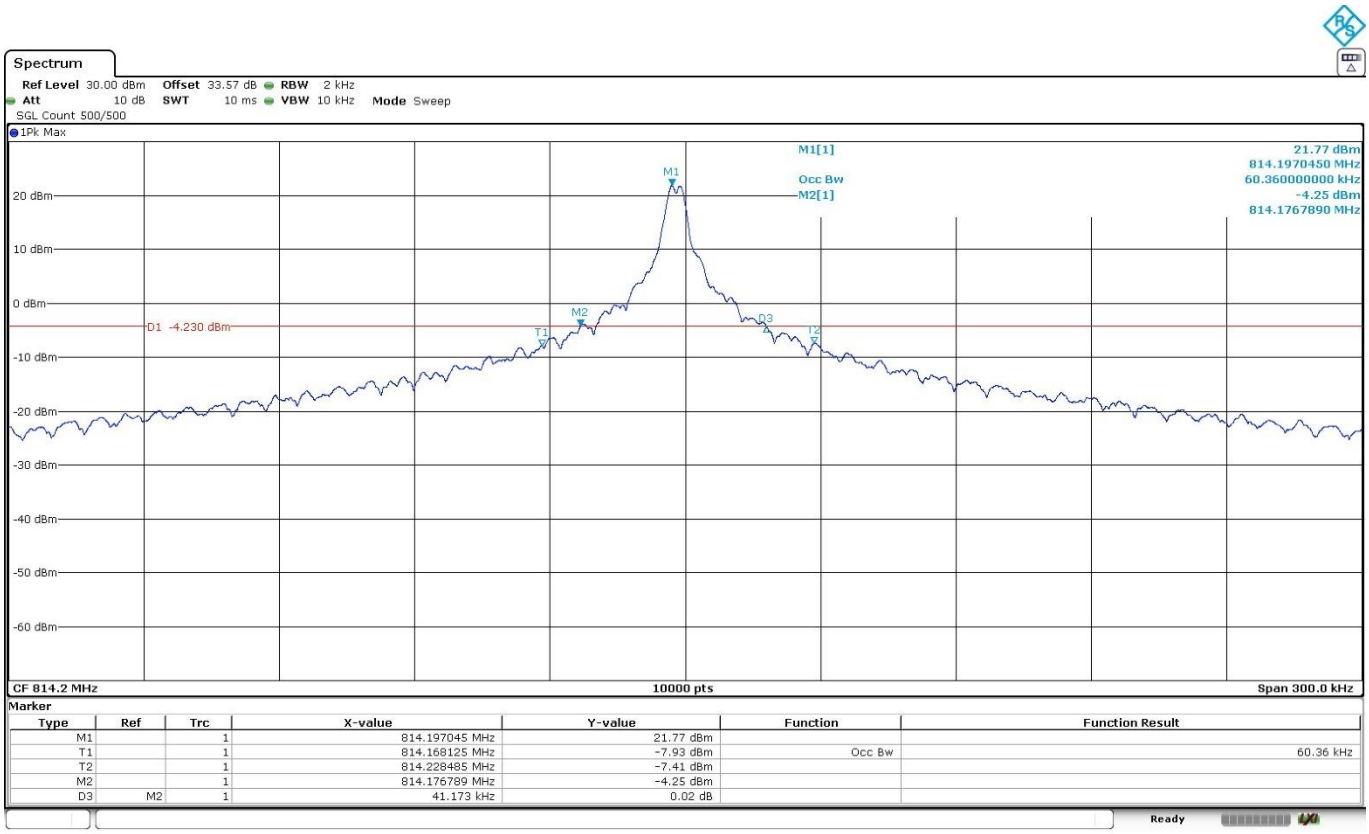
	Low Channel	High Channel
99% Occupied Bandwidth (kHz)	60.36000	60.21000
-26 dBc Bandwidth (kHz)	41.17300	41.15590
Measurement uncertainty (kHz)	<±4.67	

LTE Cat NB2 Band 26. Sub-band 814-824 MHz. Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=3.

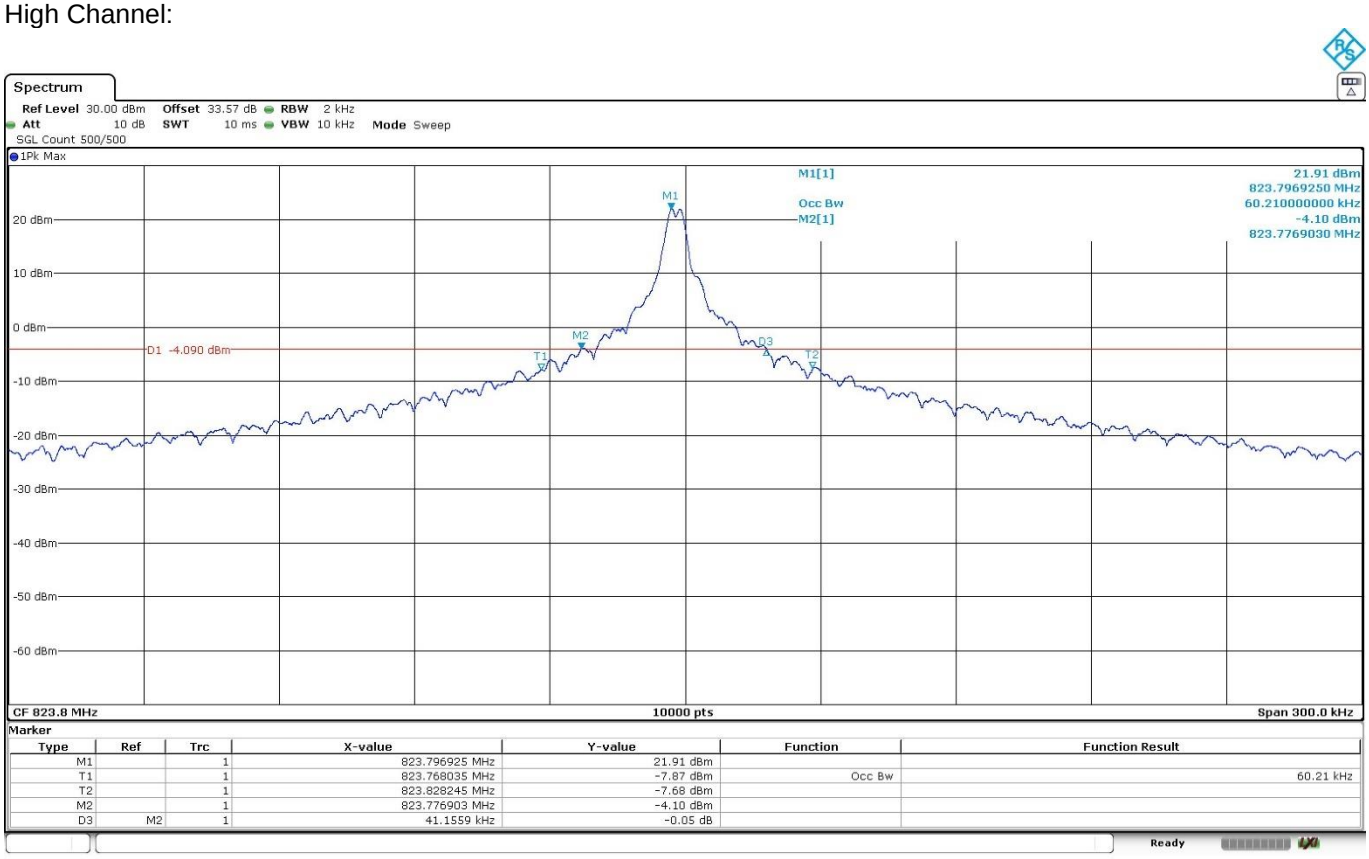
	Low Channel	High Channel
99% Occupied Bandwidth (kHz)	64.23000	64.32000
-26 dBc Bandwidth (kHz)	41.68300	41.63600
Measurement uncertainty (kHz)	<±4.67	

LTE Cat NB2 Band 26. Sub-band 814-824 MHz: Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=0.

Low Channel:

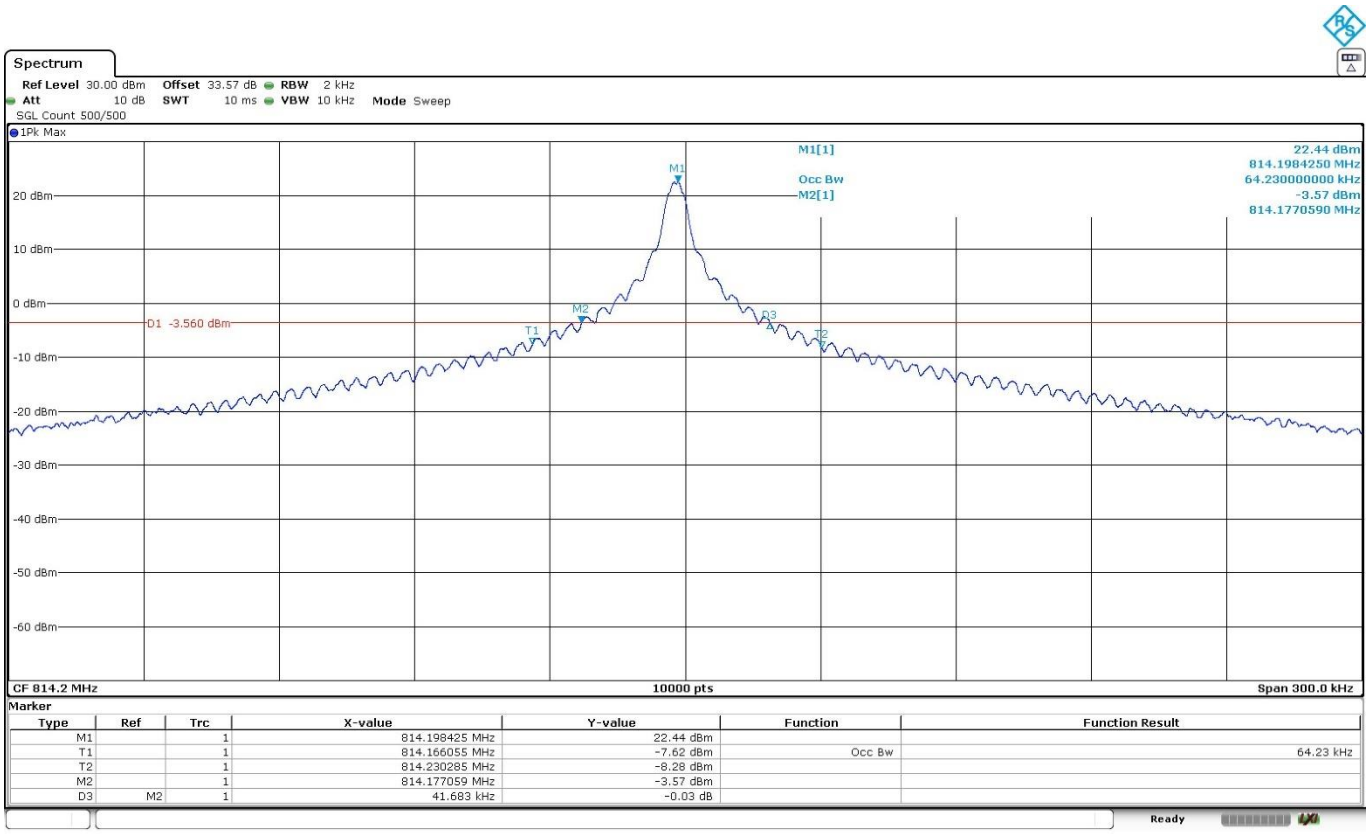


High Channel:

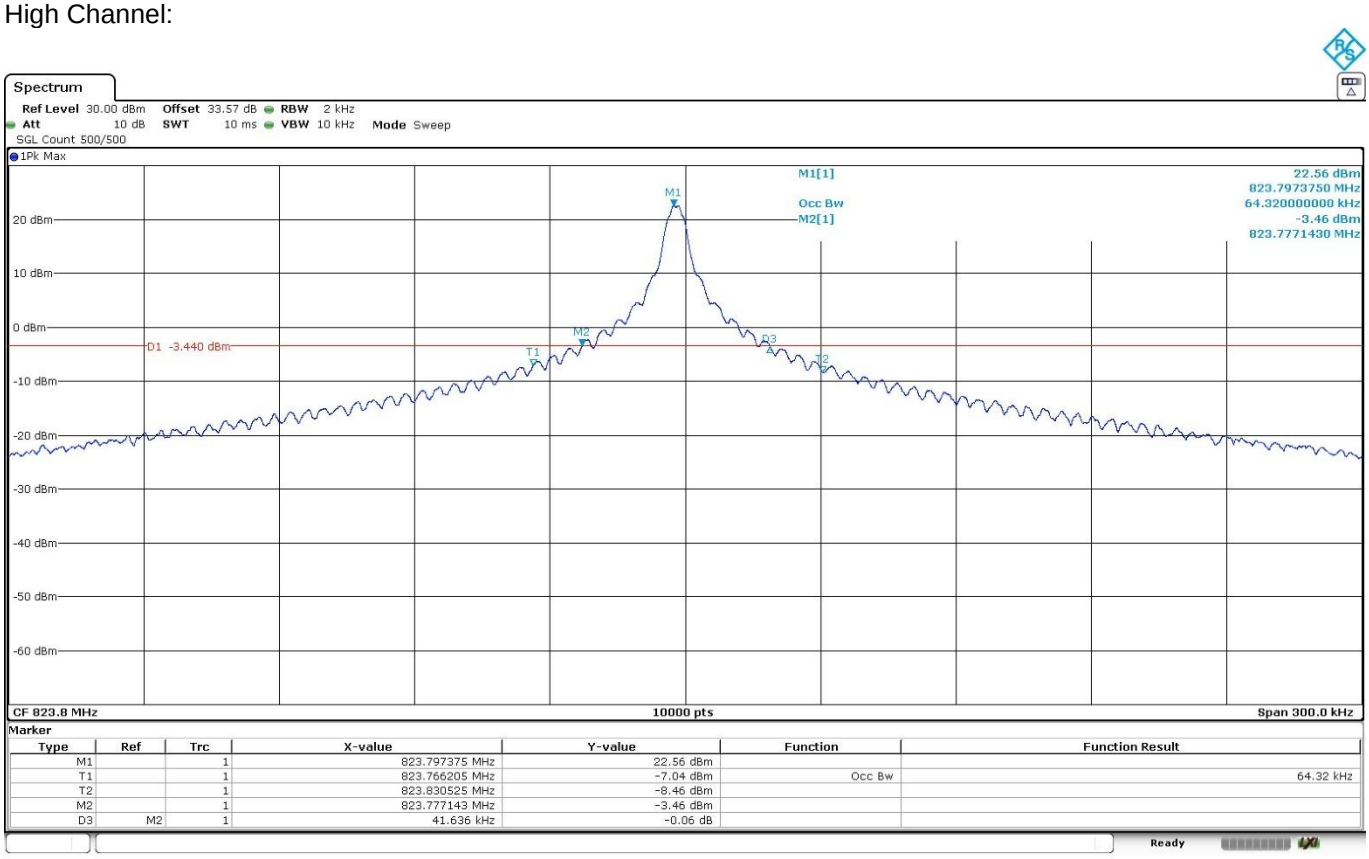


LTE Cat NB2 Band 26. Sub-band 814-824 MHz: Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=3.

Low Channel:



High Channel:



LTE Cat NB2 Band 26. Sub-band 814-824 MHz. Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=0.

	Low Channel	High Channel
99% Occupied Bandwidth (kHz)	125.13000	125.64000
-26 dBc Bandwidth (kHz)	123.25080	120.03100
Measurement uncertainty (kHz)	<±4.67	

LTE Cat NB2 Band 26. Sub-band 814-824 MHz. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=3.

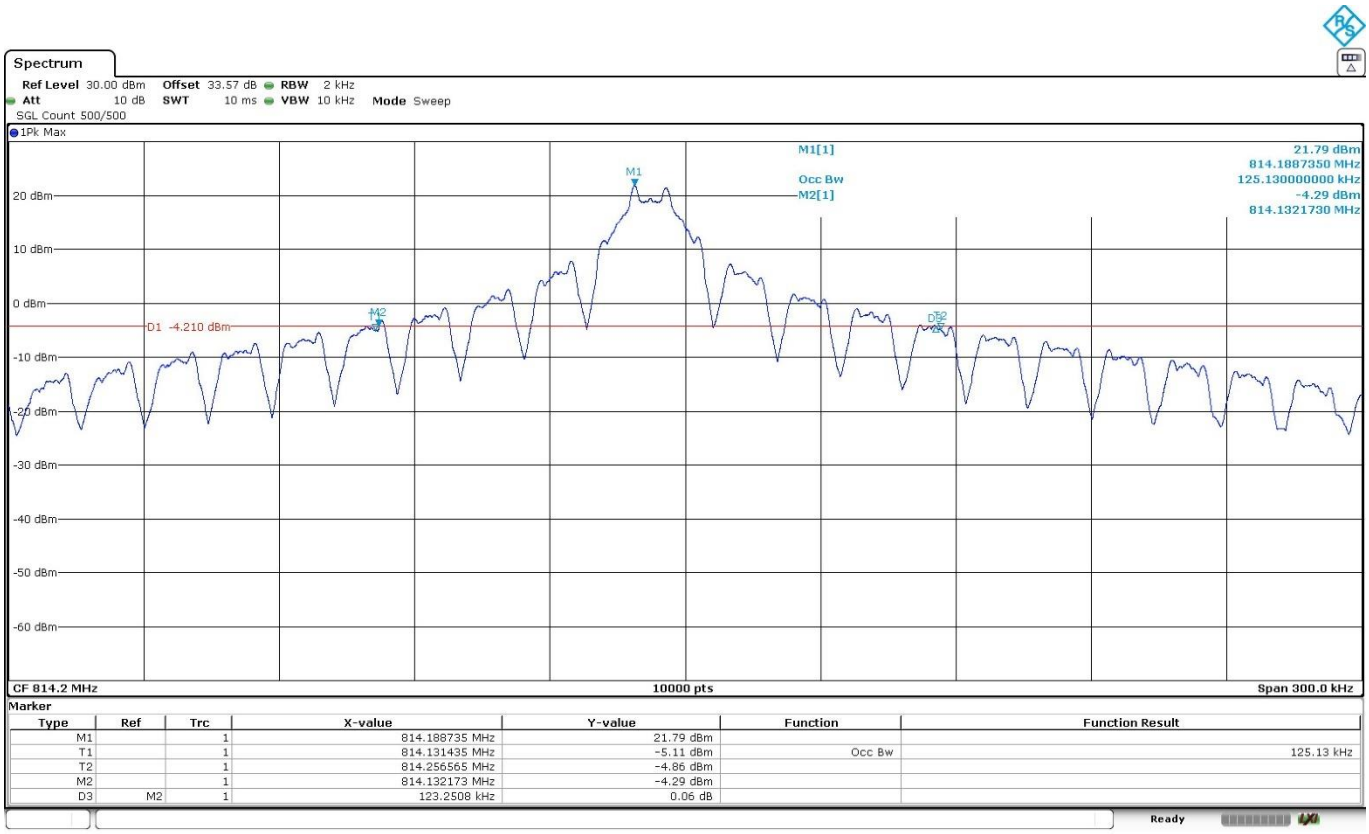
	Low Channel	High Channel
99% Occupied Bandwidth (kHz)	127.59000	126.30000
-26 dBc Bandwidth (kHz)	158.60310	143.86070
Measurement uncertainty (kHz)	<±4.67	

LTE Cat NB2 Band 26. Sub-band 814-824 MHz. QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5.

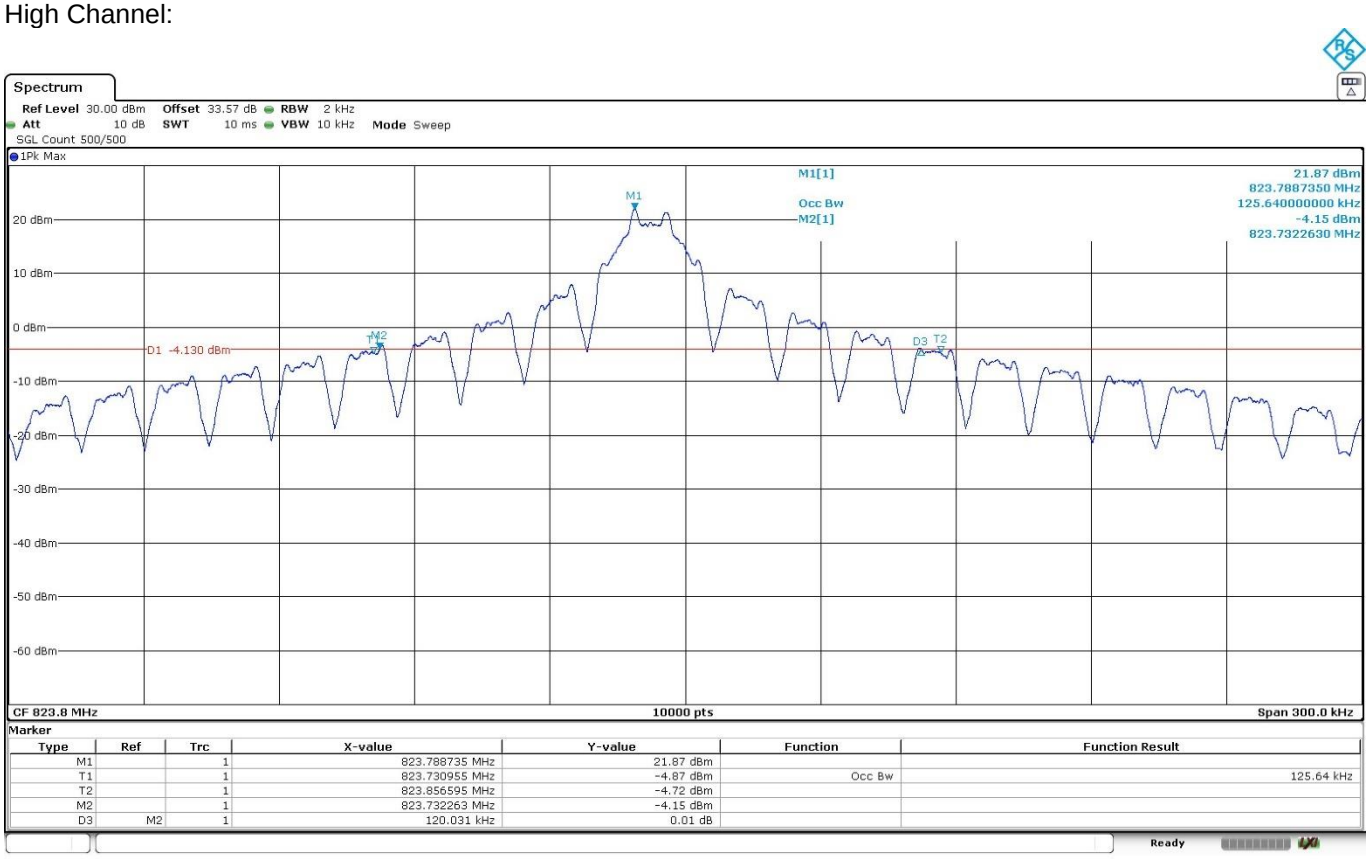
	Low Channel	High Channel
99% Occupied Bandwidth (kHz)	189.15000	188.30000
-26 dBc Bandwidth (kHz)	305.55270	315.58940
Measurement uncertainty (kHz)	<±4.67	

LTE Cat NB2 Band 26. Sub-band 814-824 MHz: Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=0.

Low Channel:

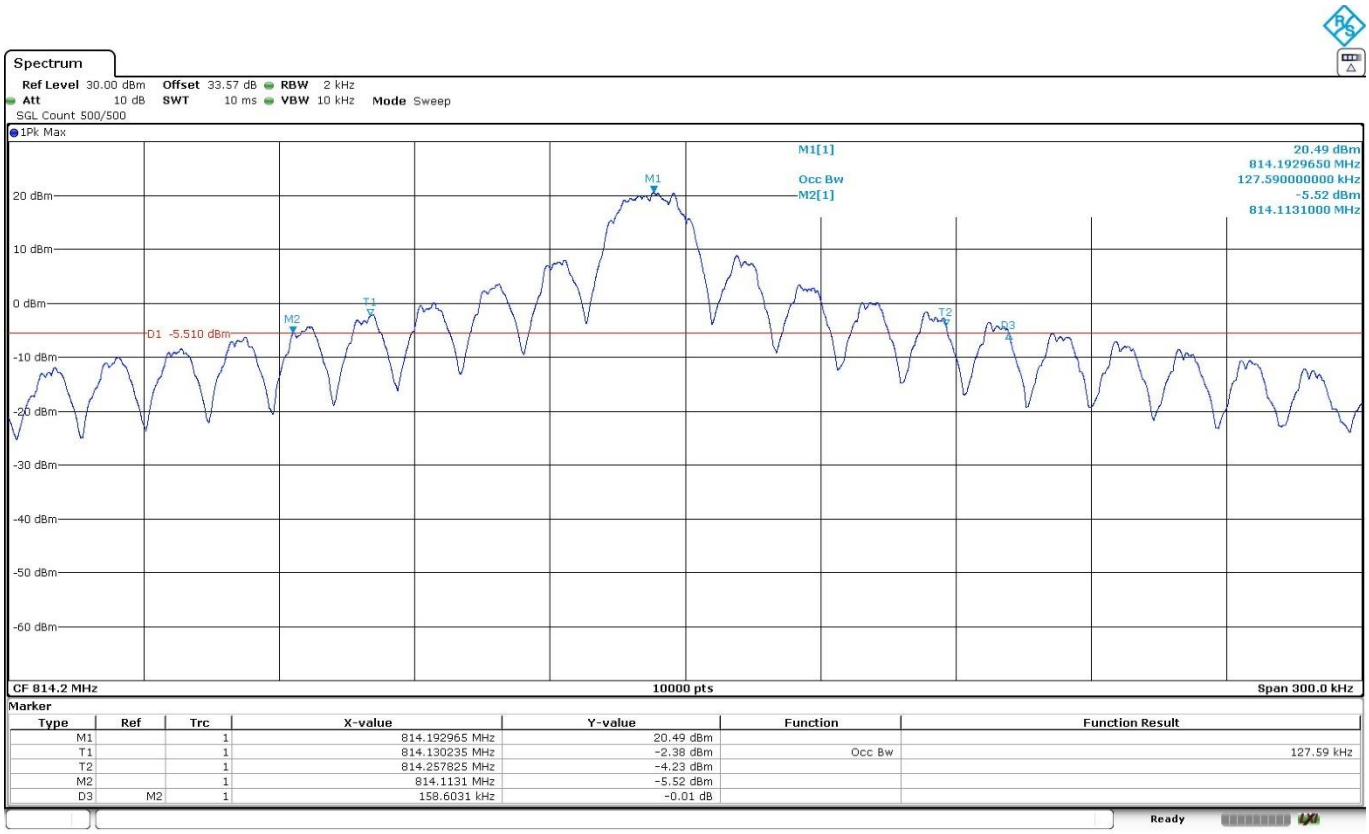


High Channel:

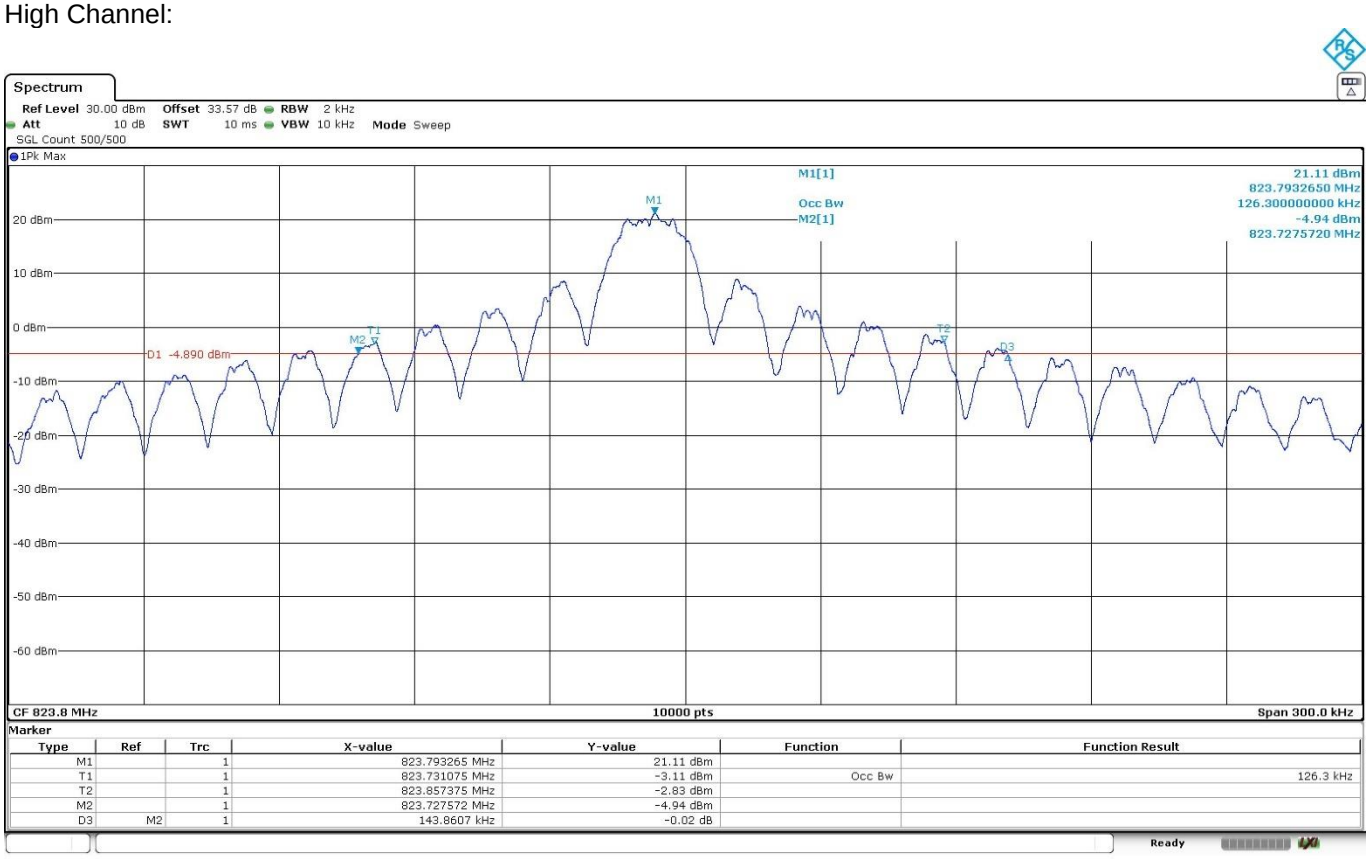


LTE Cat NB2 Band 26. Sub-band 814-824 MHz: Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=3.

Low Channel:

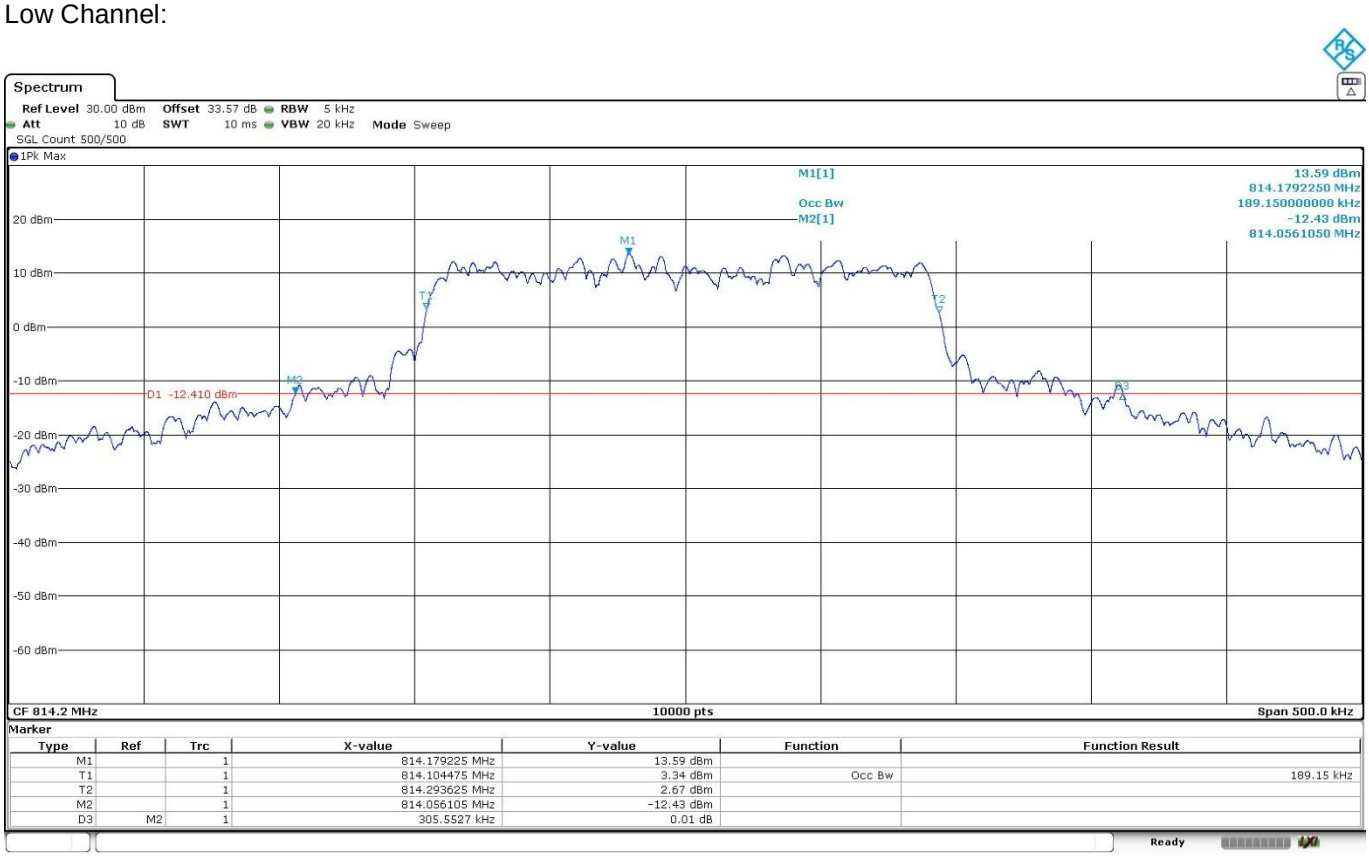


High Channel:

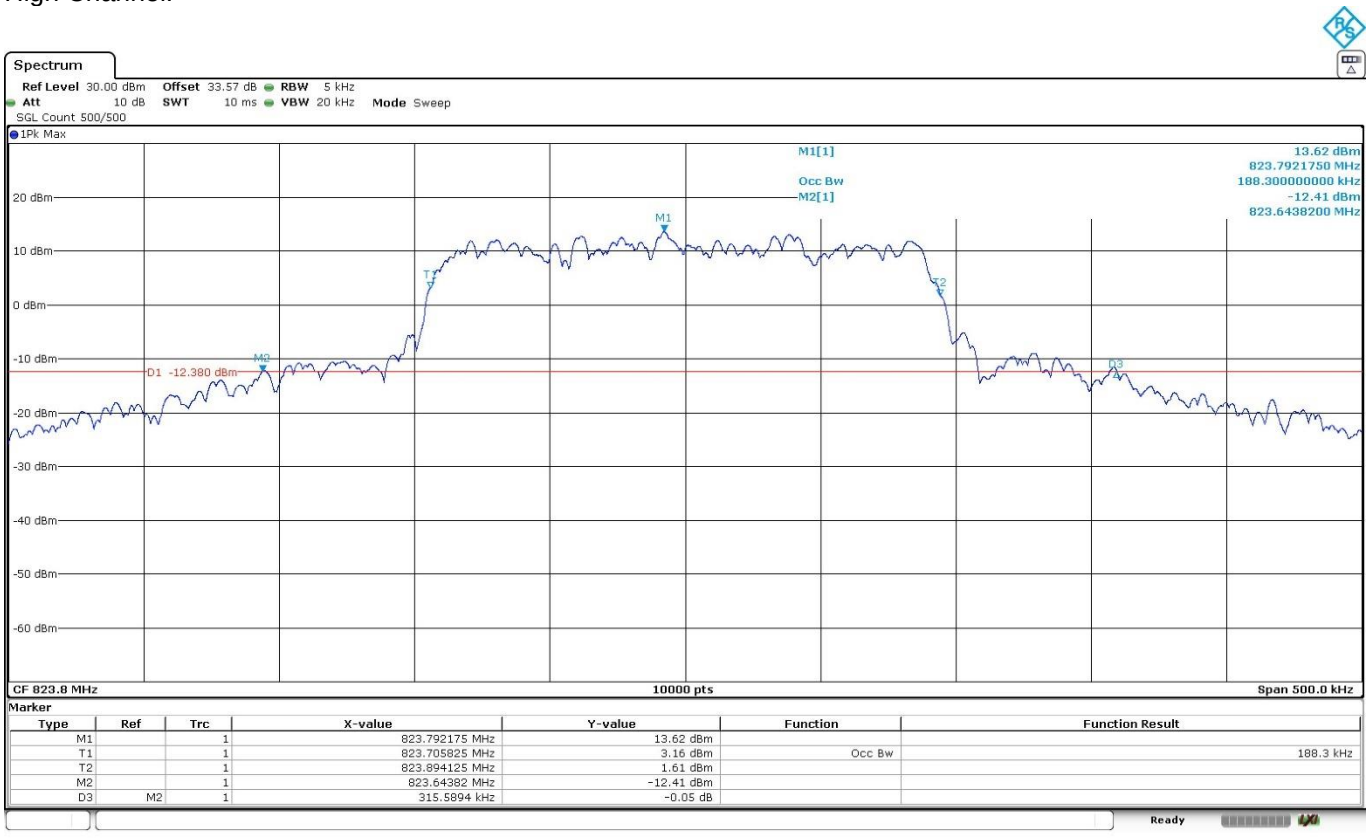


LTE Cat NB2 Band 26. Sub-band 814-824 MHz: QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5.

Low Channel:



High Channel:



LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz:

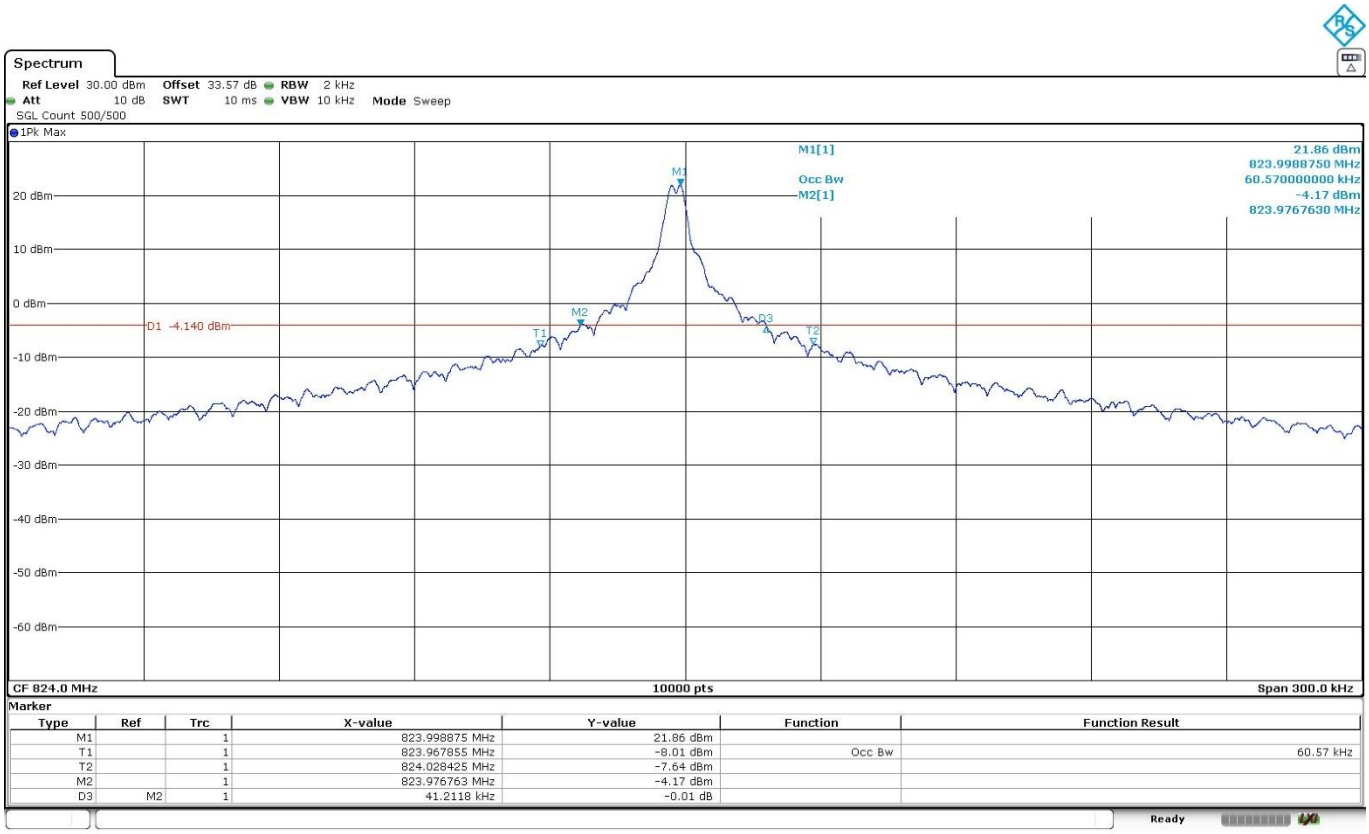
LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz. Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=0.

	Single Channel
99% Occupied Bandwidth (kHz)	60.57000
-26 dBc Bandwidth (kHz)	41.21180
Measurement uncertainty (kHz)	<±4.67

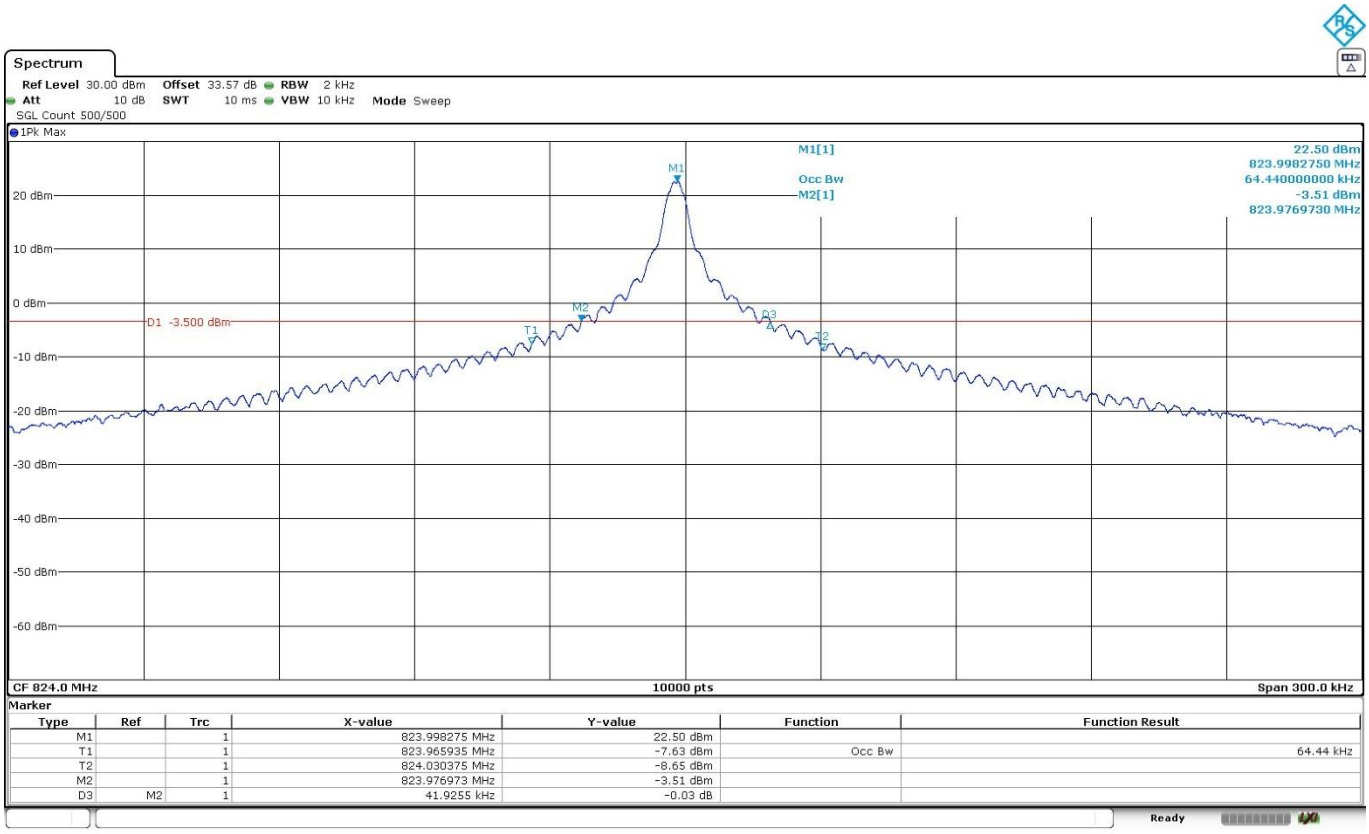
LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz. Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=3.

	Single Channel
99% Occupied Bandwidth (kHz)	64.44000
-26 dBc Bandwidth (kHz)	41.92550
Measurement uncertainty (kHz)	<±4.67

LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz: Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=0.



LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz: Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=23. MSC/TBS=3.



LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz. Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=0.

	Single Channel
99% Occupied Bandwidth (MHz)	125.70000
-26 dBc Bandwidth (MHz)	123.44300
Measurement uncertainty (kHz)	<±4.67

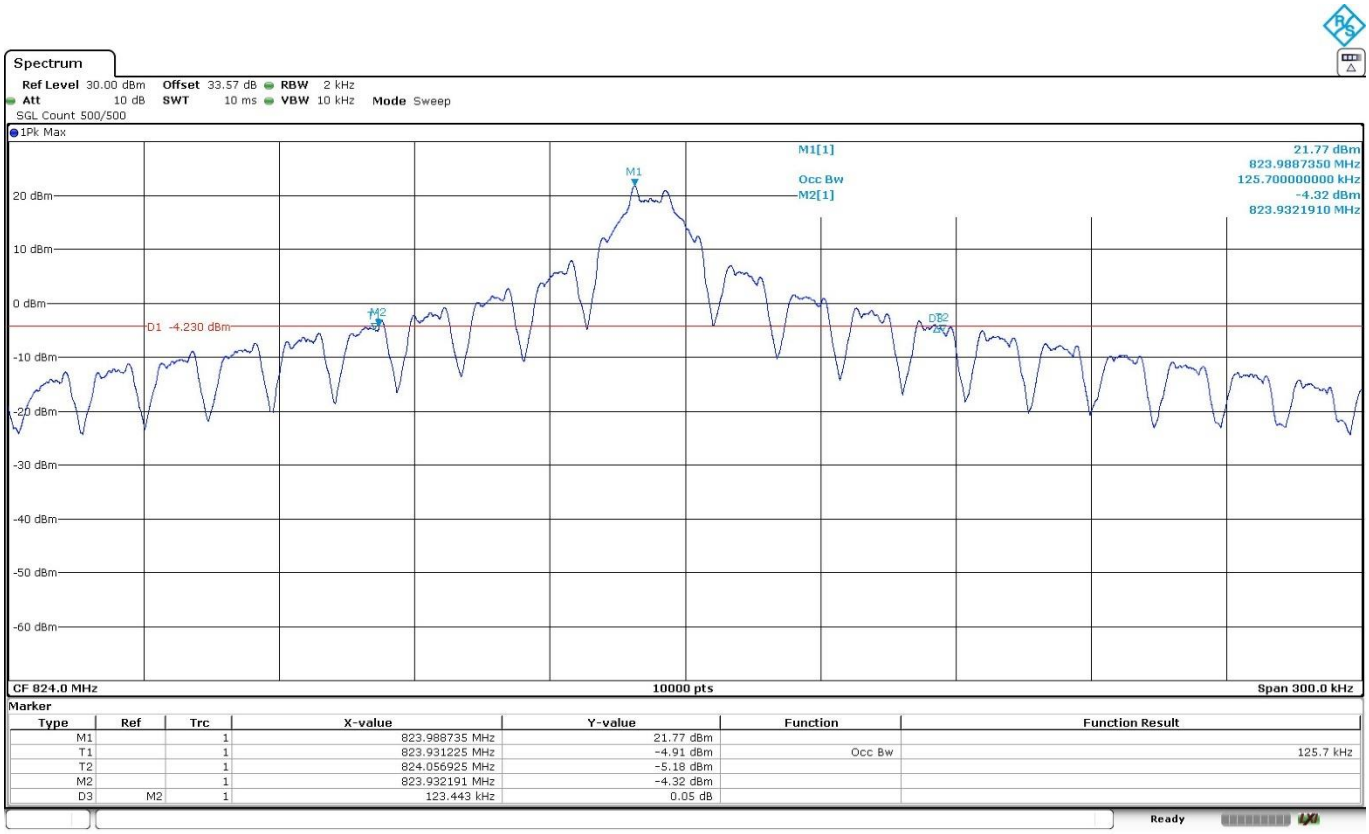
LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=3.

	Single Channel
99% Occupied Bandwidth (MHz)	127.35000
-26 dBc Bandwidth (MHz)	158.06920
Measurement uncertainty (kHz)	<±4.67

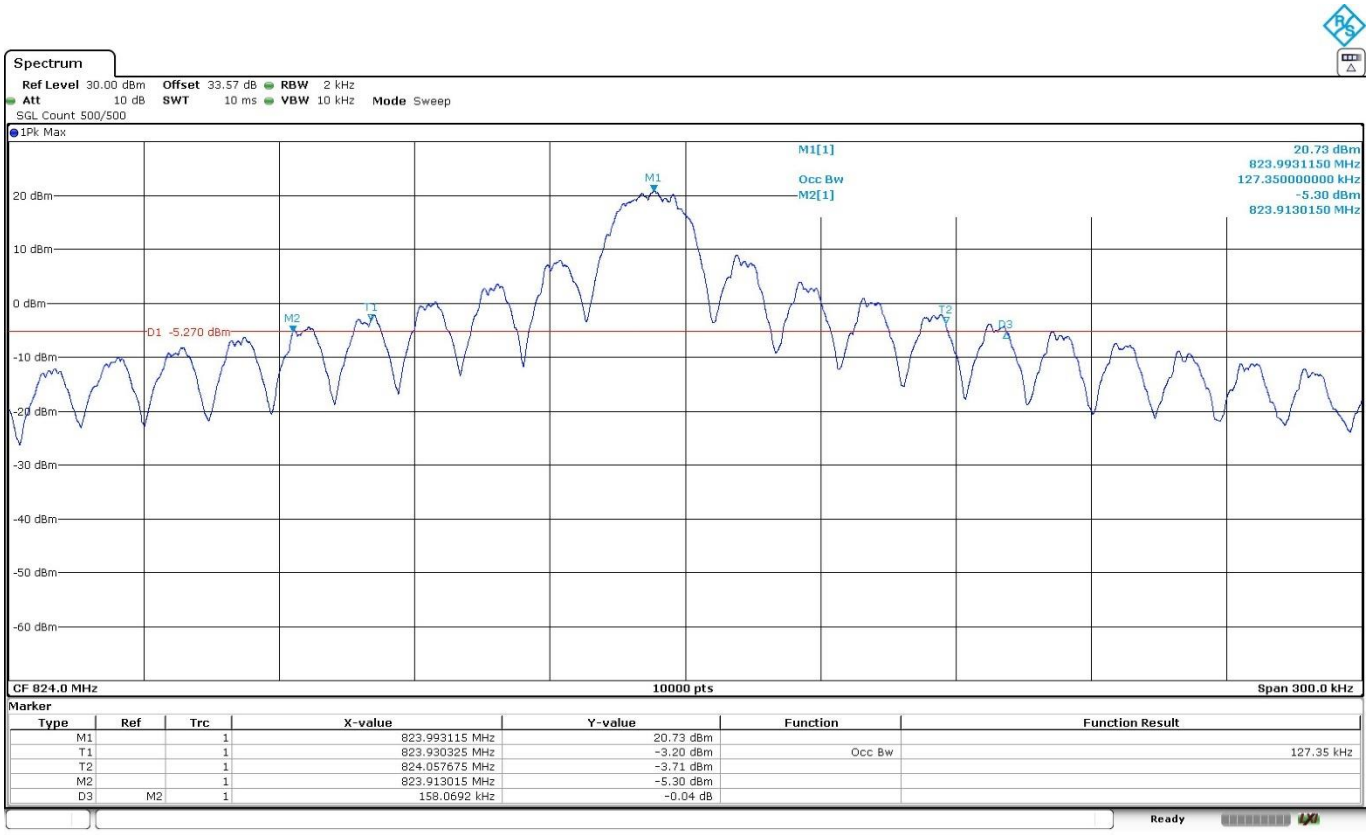
LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz. QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5.

	Single Channel
99% Occupied Bandwidth (MHz)	188.75000
-26 dBc Bandwidth (MHz)	307.24260
Measurement uncertainty (kHz)	<±4.67

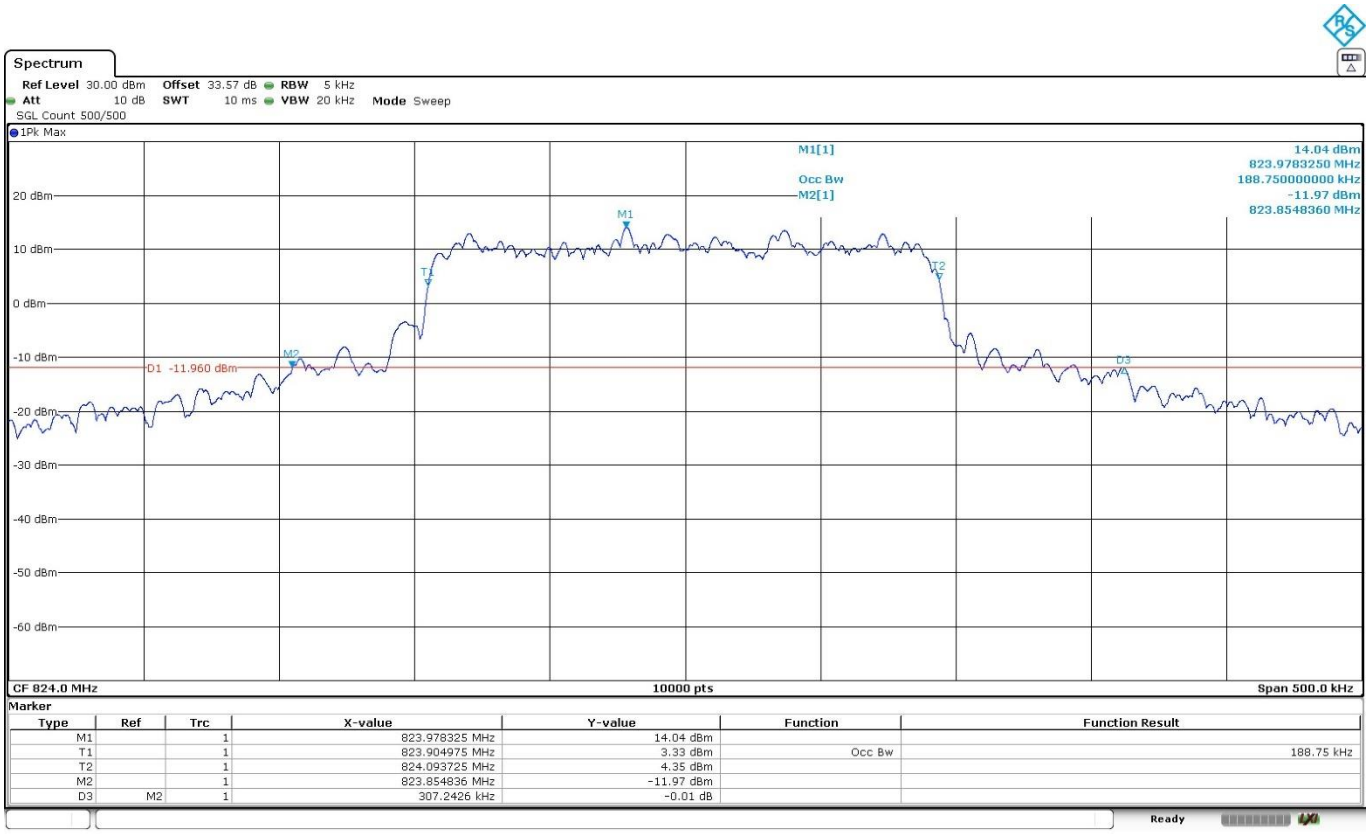
LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz: Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=0.



LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz: Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=3.



LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz: QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5.



Spurious emissions at antenna terminals

Limits

FCC §2.1051. Measurements required: Spurious emissions at antenna terminals.

FCC §90.691:

(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 Log10(f/6.1) decibels or 50 + 10 Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

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

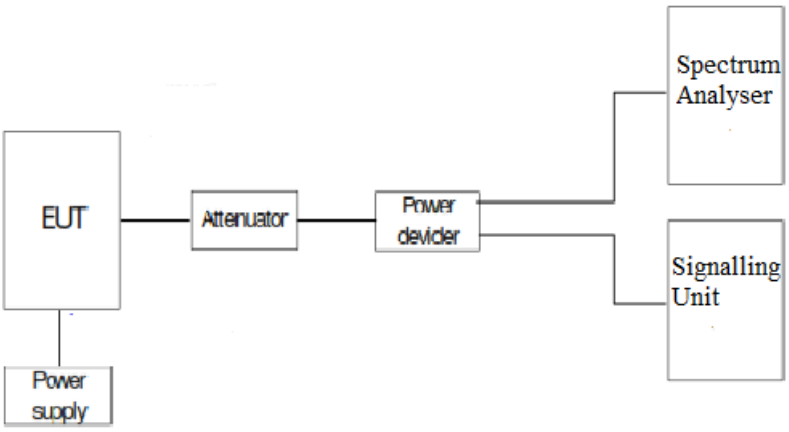
Method

The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50 Ohm attenuator and a power divider.
The reading of the spectrum analyser is corrected with the attenuation loss of connection between output terminal of EUT and input of the spectrum analyser.

Measurement Limit:
According to specification. 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.
At Po transmitting power. the specified minimum attenuation becomes 43+10log (Po). and the level in dBm relative Po becomes:

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

Test Setup


EUT
Attenuator
Power devicler
Spectrum Analyser
Signalling Unit
Power supply

Results

LTE Cat NB2 Band 26. Sub-band 814-824 MHz:

A preliminary scan determined the worst-case:

Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=0.

The next results are for this worst-case configuration,

Frequency range 9 KHz - 10 GHz:

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

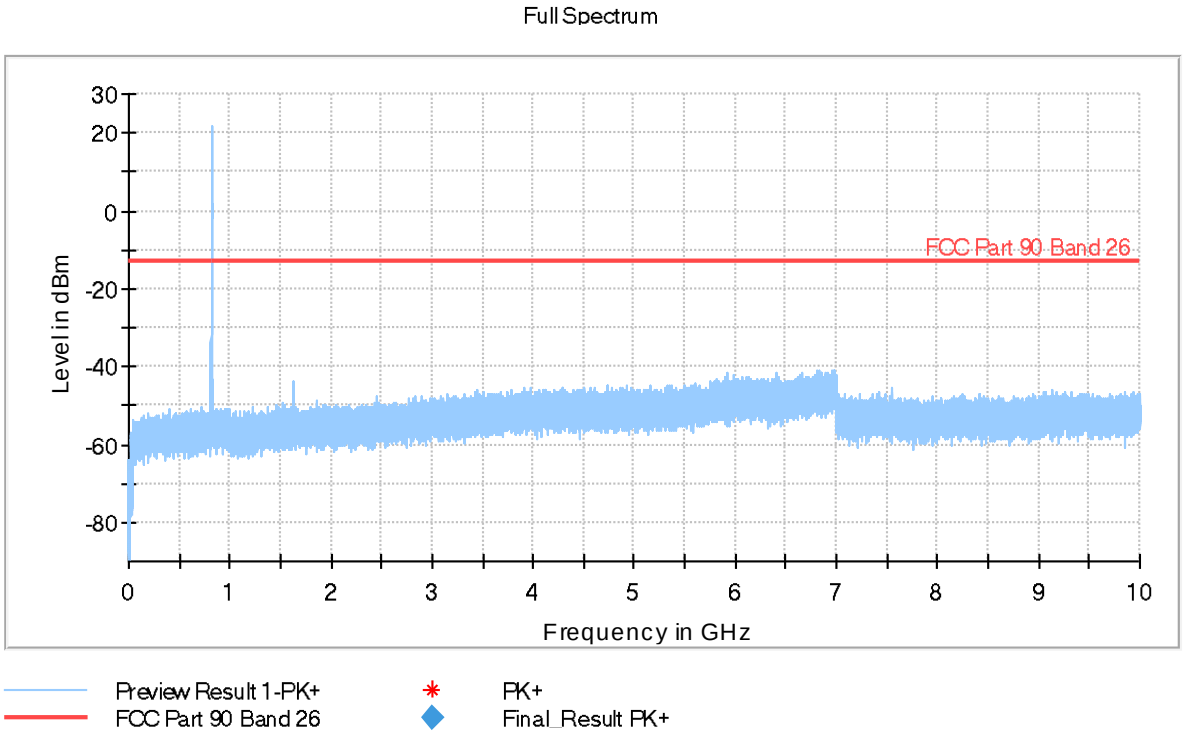
Verdict

PASS

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
9 kHz - 150 kHz	14.1 Hz	PK+	300 Hz	Coupled	0 dB
150 kHz - 30 MHz	932.812 Hz	PK+	10 kHz	Coupled	0 dB
30 MHz - 1 GHz	30.312 kHz	PK+	100 kHz	Coupled	0 dB
1 GHz - 2 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
2 GHz - 3 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
3 GHz - 4 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
4 GHz - 5 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
5 GHz - 6 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
6 GHz - 7 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
7 GHz - 8 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
8 GHz - 9 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
9 GHz - 10 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB

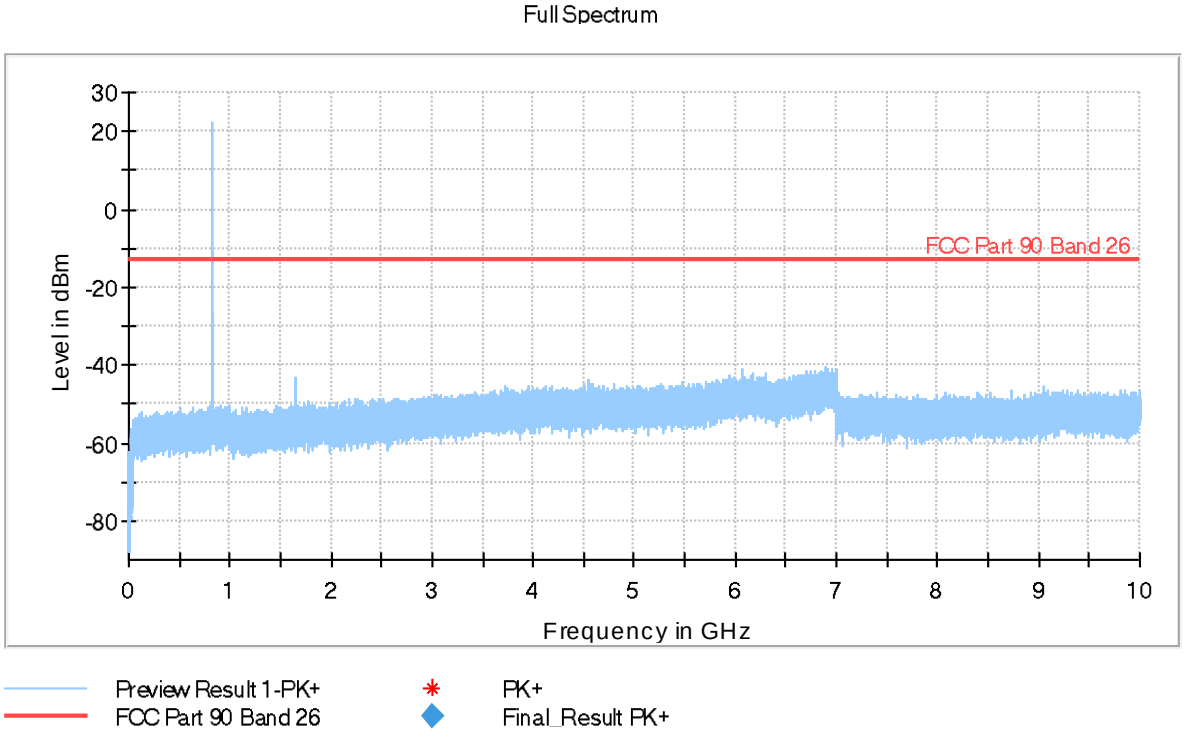
LTE Cat NB2 Band 26. Sub-band 814-824 MHz:
Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=0.

Low Channel:



The peak above the limit is the carrier frequency.

High Channel:



The peak above the limit is the carrier frequency.

LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz:

A preliminary scan determined the worst-case:

Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=3.

The next results are for this worst-case configuration,

Frequency range 9 KHz - 10 GHz:

- Single Channel: No spurious frequencies detected at less than 20 dB below the limit.

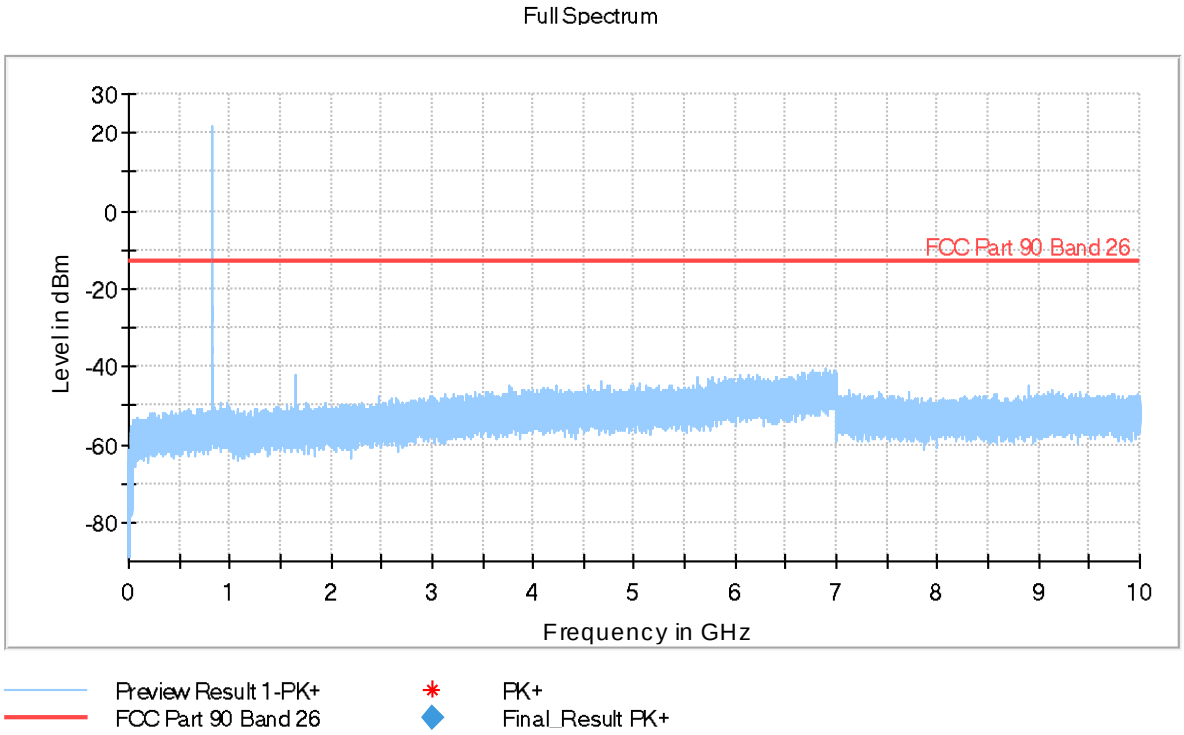
Verdict

PASS

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
9 kHz - 150 kHz	14.1 Hz	PK+	300 Hz	Coupled	0 dB
150 kHz - 30 MHz	932.812 Hz	PK+	10 kHz	Coupled	0 dB
30 MHz - 1 GHz	30.312 kHz	PK+	100 kHz	Coupled	0 dB
1 GHz - 2 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
2 GHz - 3 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
3 GHz - 4 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
4 GHz - 5 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
5 GHz - 6 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
6 GHz - 7 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
7 GHz - 8 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
8 GHz - 9 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB
9 GHz - 10 GHz	31.25 kHz	PK+	100 kHz	Coupled	0 dB

LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz:
Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=3.

Single Channel:



The peak above the limit is the carrier frequency.

Spurious Emissions at Antenna Terminals at Block Edges

Limits

FCC §2.1051. Measurements required: Spurious emissions at antenna terminals.

FCC §90.691:

(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 Log10(f/6.1) decibels or 50 + 10 Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

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

Method

The EUT RF output connector was connected to a spectrum analyzer 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.

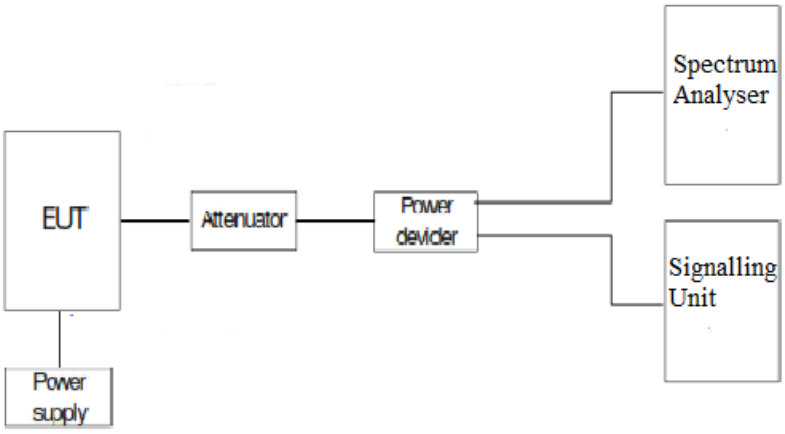
The reading of the spectrum analyser is corrected with the path loss of the connection between the output terminal of the EUT and the input of the spectrum analyzer.

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

At Po transmitting power, the specified minimum attenuation 43 + 10 log10 p (watts) for any frequency removed from the EA licensee's frequency block greater than 37.5 kHz becomes:

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

Test Setup



Results

LTE Cat NB2 Band 26. Sub-band 814-824 MHz:

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

LTE Cat NB2 Band 26	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	QPSK BW=15 kHz Tone Number=12 Tone Offset=0 MSC/TBS=5
Maximum measured level at Low Block Edge at antenna port (dBm)	-19.14	-18.37	-19.69

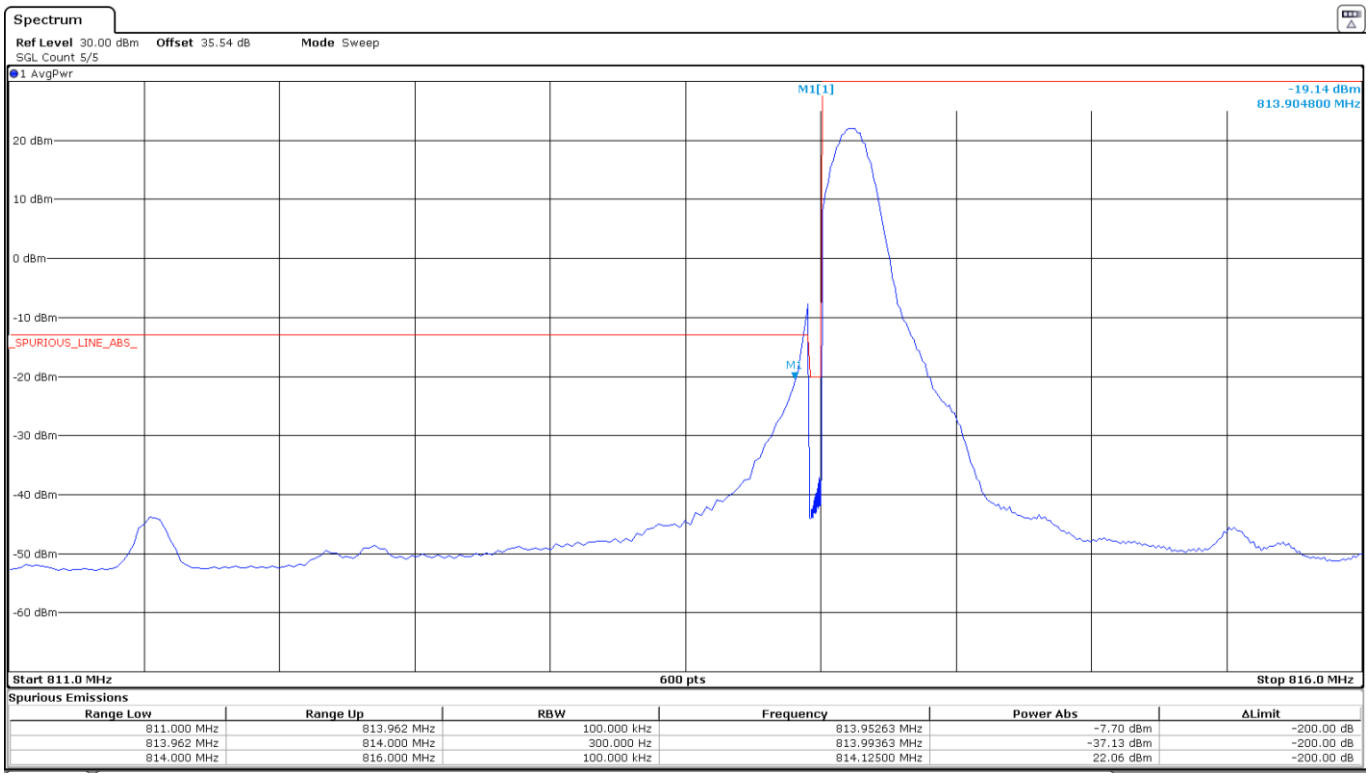
LTE Cat NB2 Band 26	Pi/2-BPSK BW=3.75 kHz Tone Number=1 Tone Offset=47 MSC/TBS=0	Pi/2-BPSK BW=15 kHz Tone Number=1 Tone Offset=11 MSC/TBS=0	QPSK BW=15 kHz Tone Number=12 Tone Offset=0 MSC/TBS=5
Maximum measured level at High Block Edge at antenna port (dBm)	-20.22	-19.66	-21.9

Measurement uncertainty (dB): <±2.76

Verdict

Pass

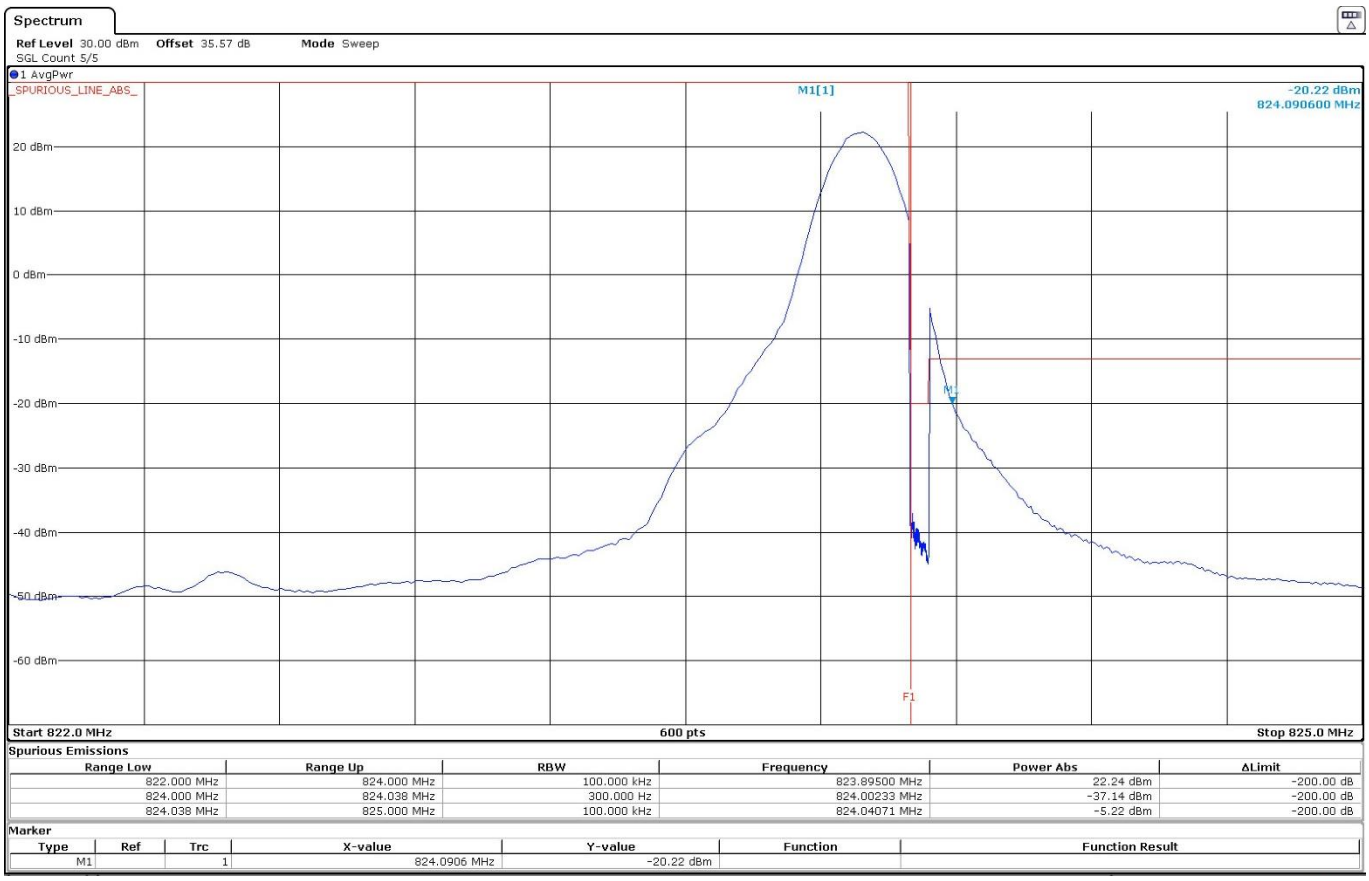
LTE Cat NB2 Band 26. Sub-band 814-824 MHz. EA MASK Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=0. Low Channel:



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
811.000 MHz	813.962 MHz	100.000 kHz	813.95263 MHz	-7.70 dBm	-200.00 dB
813.962 MHz	814.000 MHz	300.000 Hz	813.99363 MHz	-37.13 dBm	-200.00 dB
814.000 MHz	816.000 MHz	100.000 kHz	814.12500 MHz	22.06 dBm	-200.00 dB

LTE Cat NB2 Band 26. Sub-band 814-824 MHz. EA MASK: Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=47. MSC/TBS=0. High Channel:



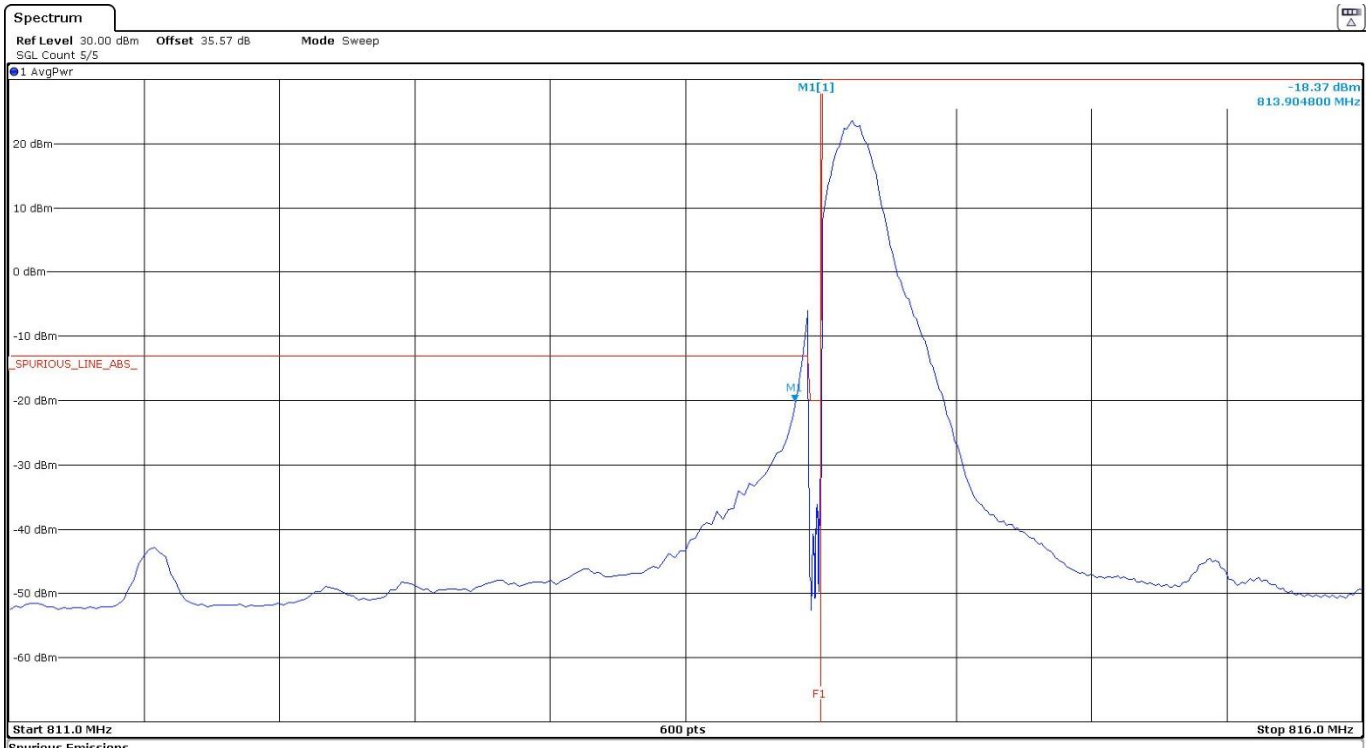
Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
822.000 MHz	824.000 MHz	100.000 kHz	823.89500 MHz	22.24 dBm	-200.00 dB
824.000 MHz	824.038 MHz	300.000 Hz	824.00233 MHz	-37.14 dBm	-200.00 dB
824.038 MHz	825.000 MHz	100.000 kHz	824.04071 MHz	-5.22 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	824.0906 MHz	-20.22 dBm		

LTE Cat NB2 Band 26. Sub-band 814-824 MHz. EA MASK: Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=0. Low Channel:



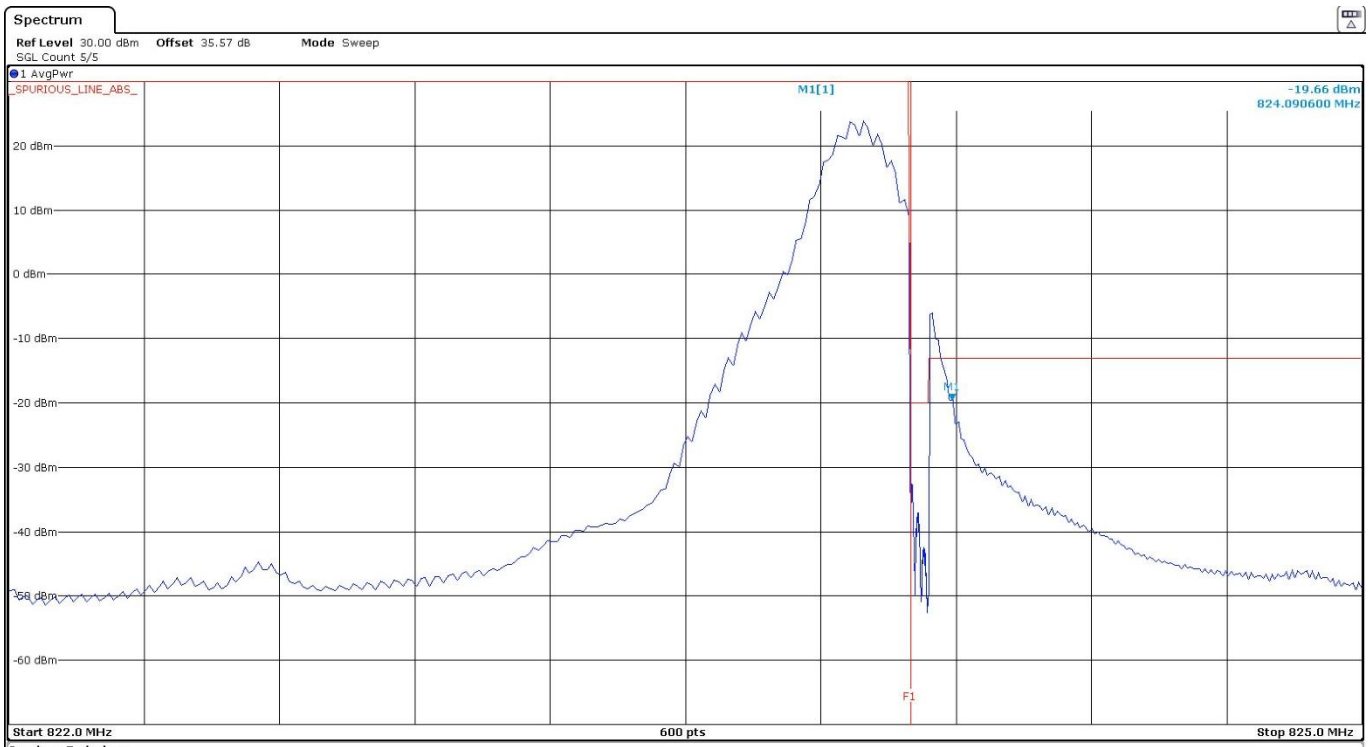
Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
811.000 MHz	813.962 MHz	100.000 kHz	813.95263 MHz	-5.97 dBm	-200.00 dB
813.962 MHz	814.000 MHz	300.000 Hz	813.99918 MHz	-32.05 dBm	-200.00 dB
814.000 MHz	816.000 MHz	100.000 kHz	814.11500 MHz	23.59 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	813.9048 MHz	-18.37 dBm		

LTE Cat NB2 Band 26. Sub-band 814-824 MHz. EA MASK: Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=0. High Channel:



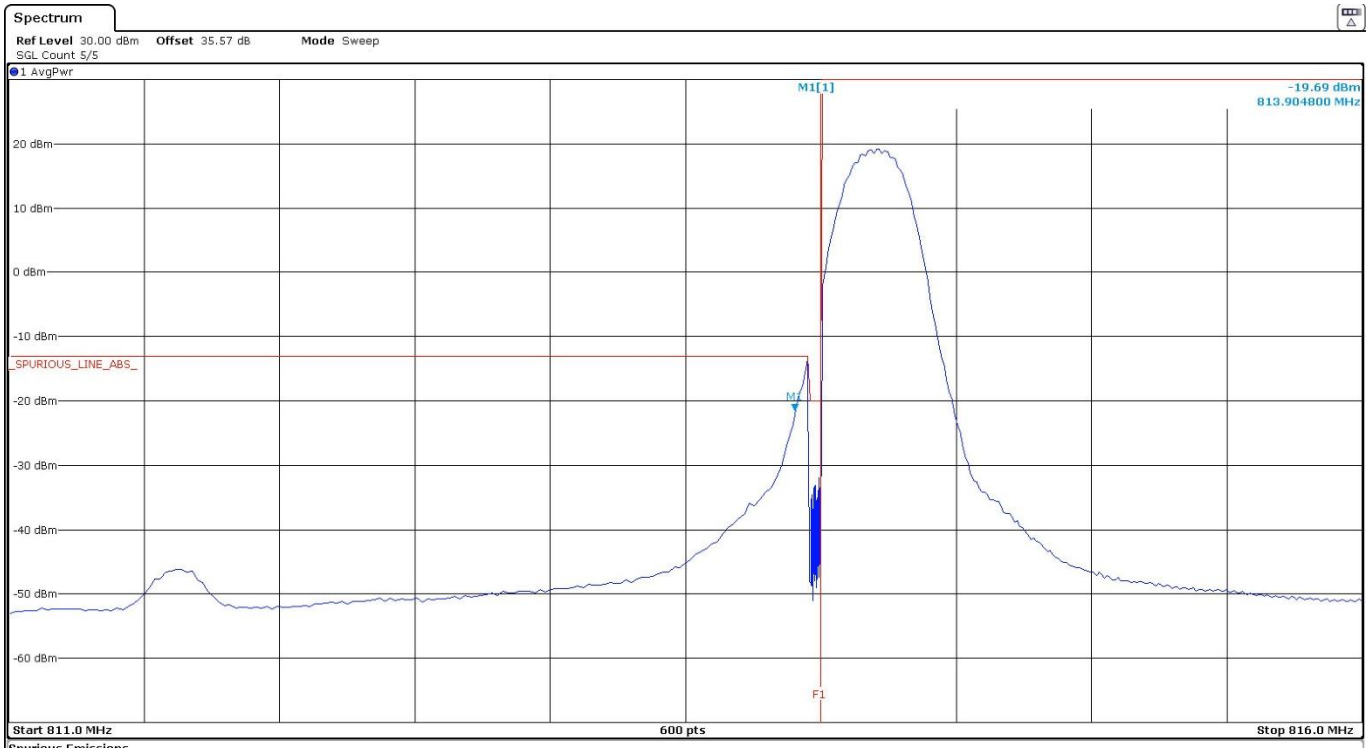
Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
822.000 MHz	824.000 MHz	100.000 kHz	823.89500 MHz	23.87 dBm	-200.00 dB
824.000 MHz	824.038 MHz	300.000 Hz	824.00113 MHz	-32.51 dBm	-200.00 dB
824.038 MHz	825.000 MHz	100.000 kHz	824.04713 MHz	-5.94 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	824.0906 MHz	-19.66 dBm		

LTE Cat NB2 Band 26. Sub-band 814-824 MHz. EA MASK: QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5. Low Channel:



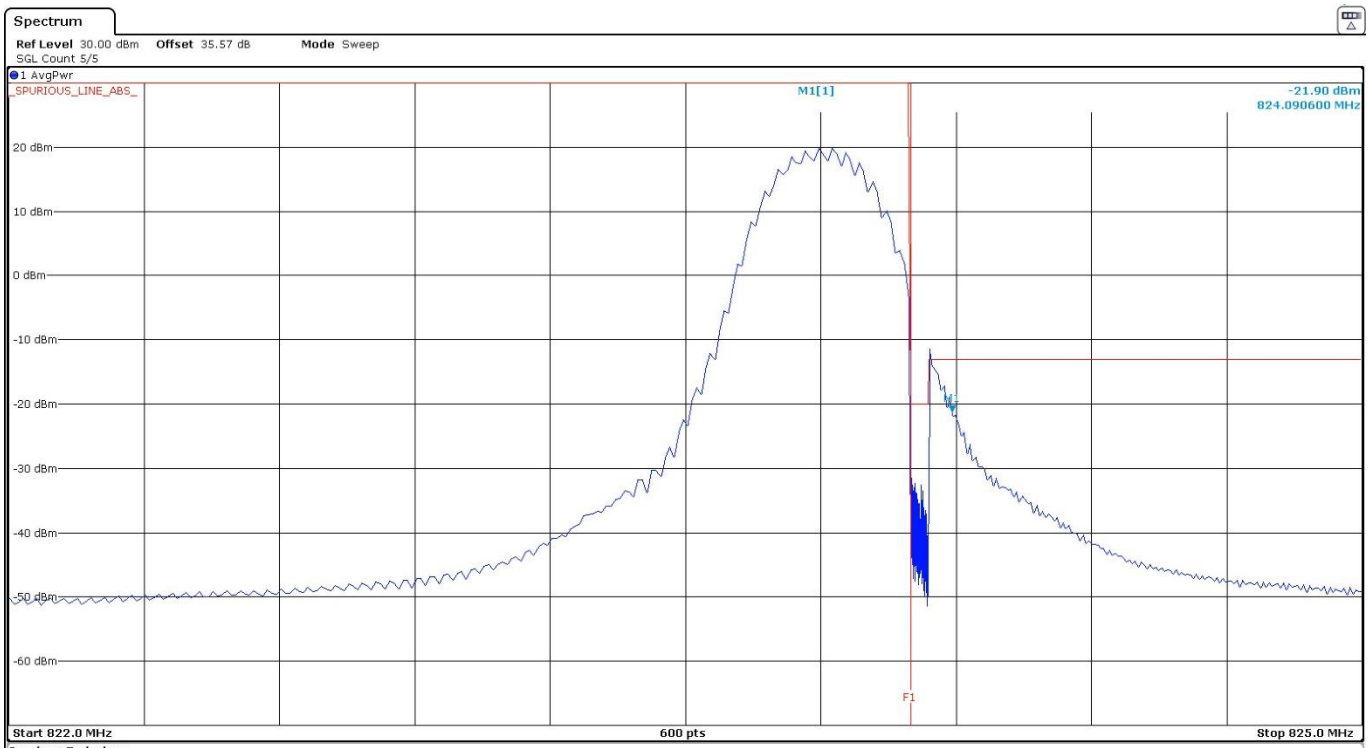
Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
811.000 MHz	813.962 MHz	100.000 kHz	813.95263 MHz	-13.12 dBm	-200.00 dB
813.962 MHz	814.000 MHz	300.000 Hz	813.99993 MHz	-31.75 dBm	-200.00 dB
814.000 MHz	816.000 MHz	100.000 kHz	814.21500 MHz	19.19 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	813.9048 MHz	-19.69 dBm		

LTE Cat NB2 Band 26. Sub-band 814-824 MHz. EA MASK: QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5. High Channel:



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
822.000 MHz	824.000 MHz	100.000 kHz	823.79500 MHz	19.85 dBm	-200.00 dB
824.000 MHz	824.038 MHz	300.000 Hz	824.00098 MHz	-31.53 dBm	-200.00 dB
824.038 MHz	825.000 MHz	100.000 kHz	824.04071 MHz	-11.51 dBm	-200.00 dB

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	824.0906 MHz	-21.90 dBm		

Radiated Emissions

Limits

FCC §90.691:

For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

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 a 3 meter distance from the measuring antenna.
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 43 + 10 log10 p (watts) for any frequency removed from the EA licensee's frequency block greater than 37.5 kHz becomes:

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

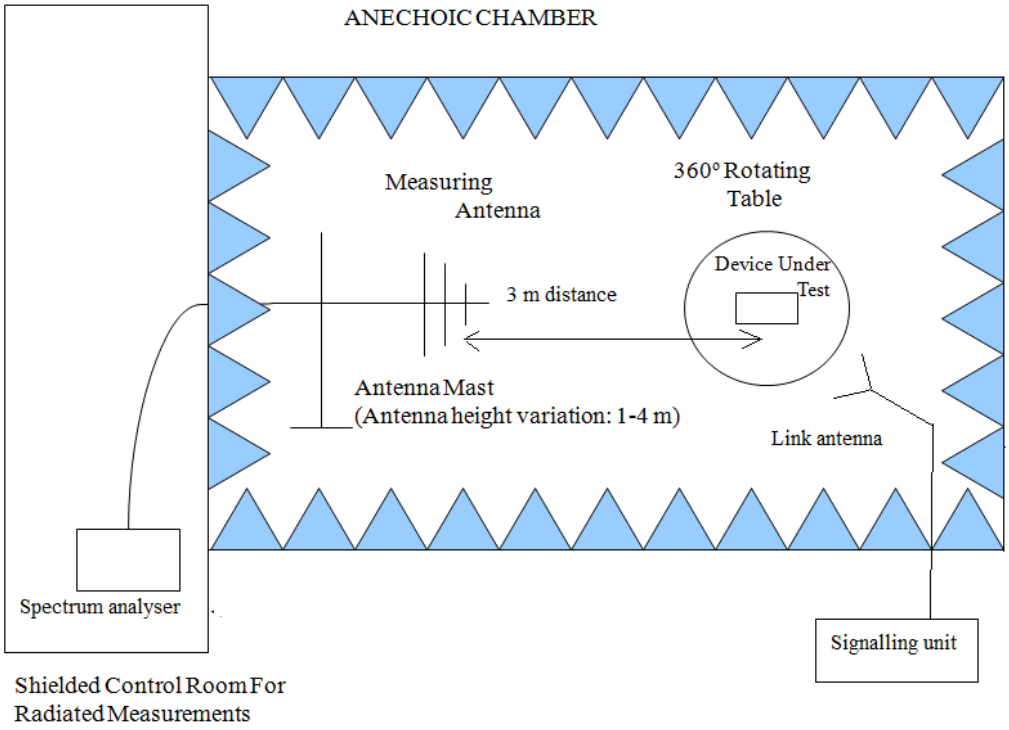
The maximum field strength (dBµV/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

EIRP (dBm) = E (dBµV/m) + 20 log(D) - 104.8; where D is the measurement distance (in the far field region) in m. D = 3 m

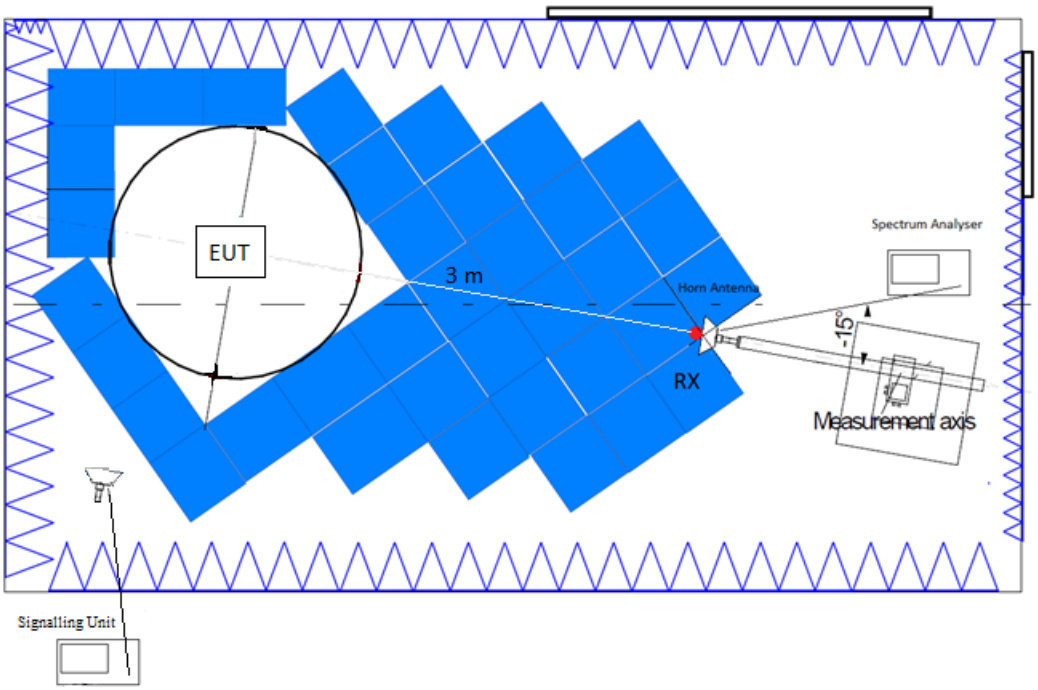
A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

Test Setup

Radiated measurements below 1 GHz:



Radiated measurements above 1 GHz:



Results

Measurements required on one frequency near top channel and one frequency near bottom channel, according to ANSI C63.26.

LTE Cat NB2 Band 26. Sub-band 814-824 MHz:

A preliminary scan determined the Pi/2-BPSK, BW=15 kHz, Tone Number=1, Tone Offset=0, MSC/TBS=0 as the worst case. The following results are for this worst-case configuration.

Frequency range 30 MHz - 1 GHz

- LOW 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.

Frequency range 1 - 8.5 GHz

- LOW 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): < ±5.35 for f ≥ 30 MHz up to 1 GHz
< ±4.32 for f ≥ 1 GHz up to 8.5 GHz

Verdict

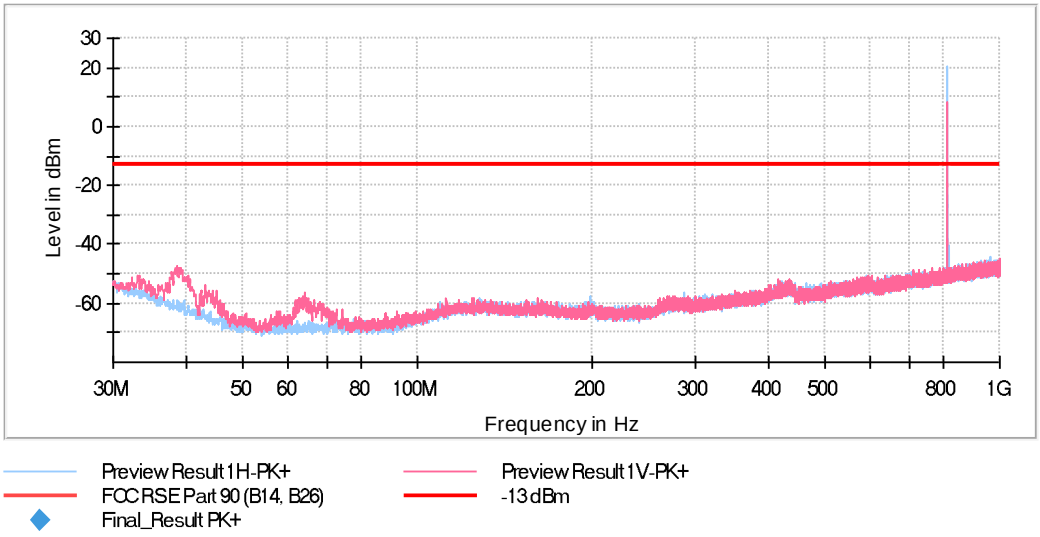
Pass

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	30.312 kHz	PK+	100 kHz	Coupled	0 dB
1 GHz - 8.5 GHz	234.375 kHz	PK+	1 MHz	1 s	0 dB

LTE Cat NB2 Band 26. Sub-band 814-824 MHz:

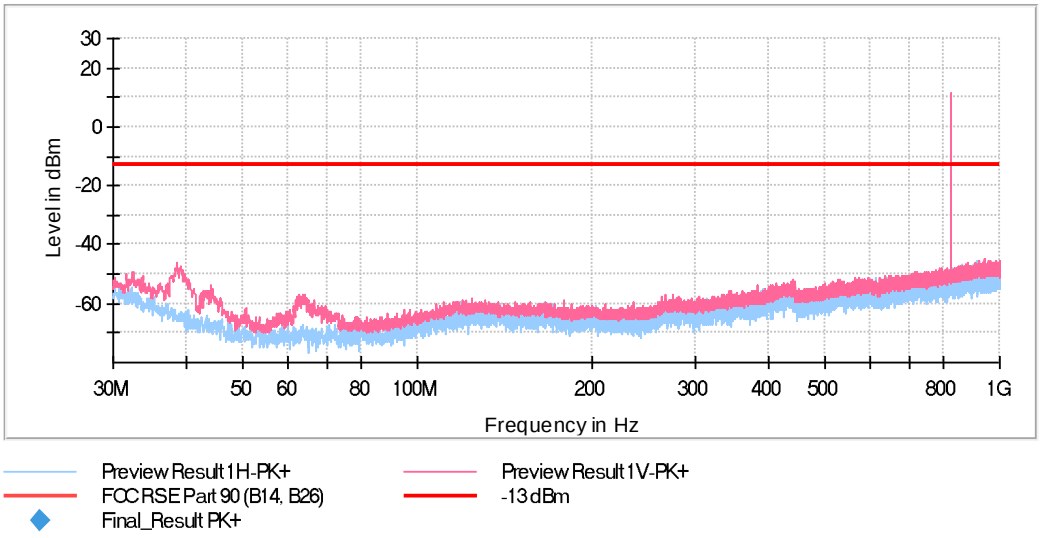
FREQUENCY RANGE 30 MHz - 1 GHz:

- LOW CHANNEL:



The peak above the limit is the carrier frequency:
LTE Cat NB2 Band 26. Sub-band 814-824 MHz, 814.2 MHz

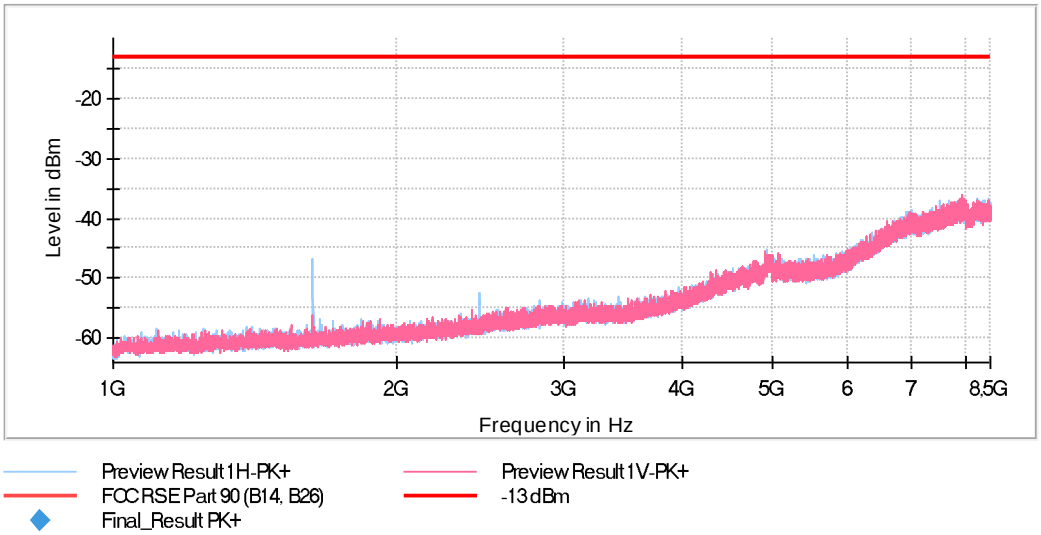
- HIGH CHANNEL:



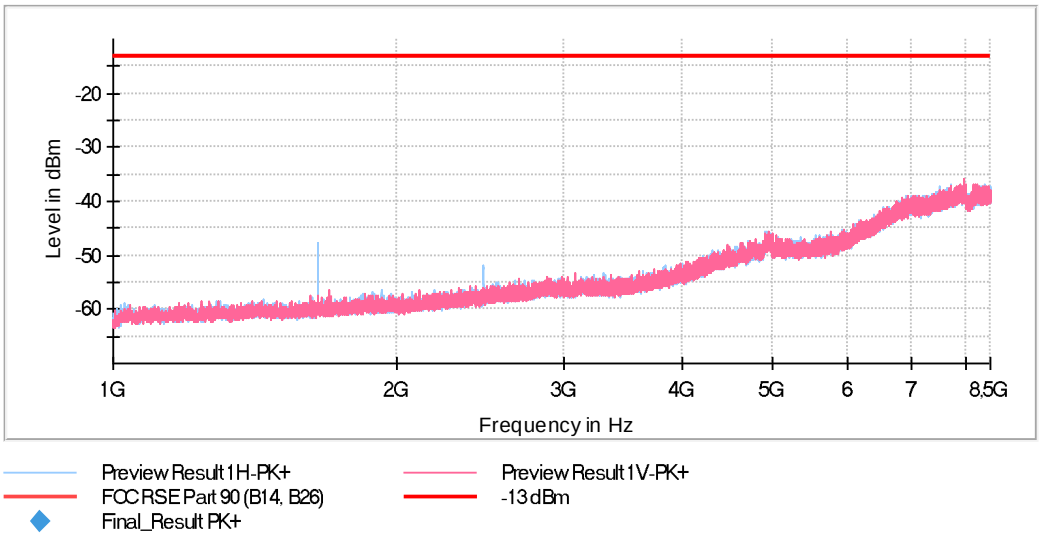
The peak above the limit is the carrier frequency:
LTE Cat NB2 Band 26. Sub-band 814-824 MHz, 823.8 MHz

FREQUENCY RANGE 1 - 8.5 GHz:

- LOW CHANNEL:



- HIGH CHANNEL:



LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz:

A preliminary scan determined the Pi/4-QPSK, BW=3.75 kHz, Tone Number=1, Tone Offset=0, MSC/TBS=3 as the worst case. The following results are for this worst-case configuration.

- CROSS-RULE CHANNEL 824 MHz:

Frequency range 30 MHz - 1 GHz:

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

Frequency range 1 - 8.5 GHz:

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

Measurement uncertainty (dB): < ±5.35 for f ≥ 30 MHz up to 1 GHz
< ±4.32 for f ≥ 1 GHz up to 8.5 GHz

Verdict

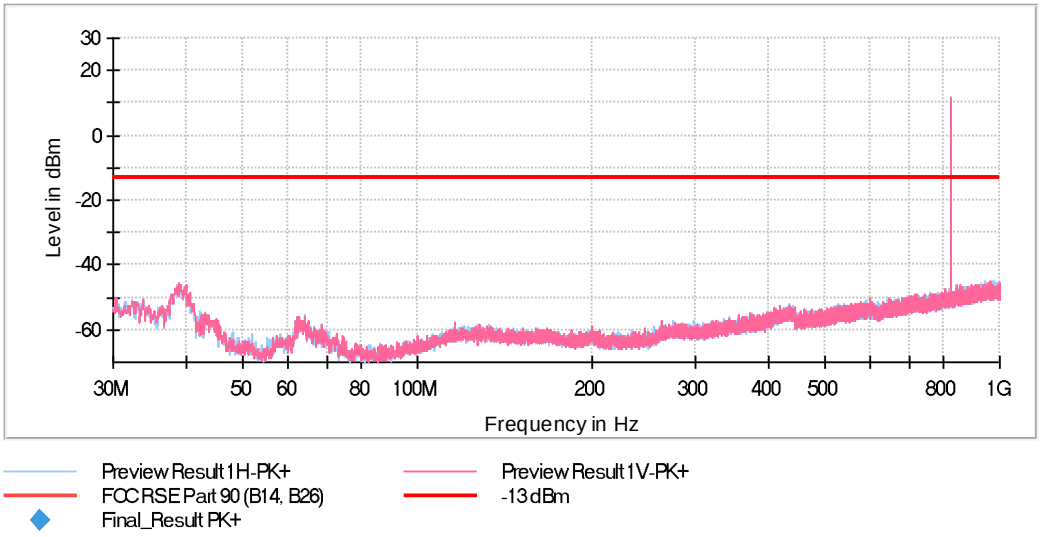
Pass

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	30.312 kHz	PK+	100 kHz	Coupled	0 dB
1 GHz - 8.5 GHz	234.375 kHz	PK+	1 MHz	1 s	0 dB

LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz:

FREQUENCY RANGE 30 MHz - 1 GHz:

- SINGLE CHANNEL (Cross-rule Channel 824 MHz):



The peak above the limit is the carrier frequency:
LTE Cat NB2 Band 26 Sub-band 814-824 MHz, 824 MHz

FREQUENCY RANGE 1 - 8.5 GHz:

- SINGLE CHANNEL (Cross-rule Channel 824 MHz):