

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

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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<br>(814.2)                                                       | 26740<br>(819) | 26788<br>(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<br>(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:

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

### 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<br>(Parts per million (ppm)) | Mobile stations                                        |                                                           |
|-----------------------|------------------------------------------------------|--------------------------------------------------------|-----------------------------------------------------------|
|                       |                                                      | Over 2 watts output power<br>(Parts per million (ppm)) | 2 watts or less output power<br>(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 -40°C to +85°C. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10°C steps from -40°C up to +85°C.

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.

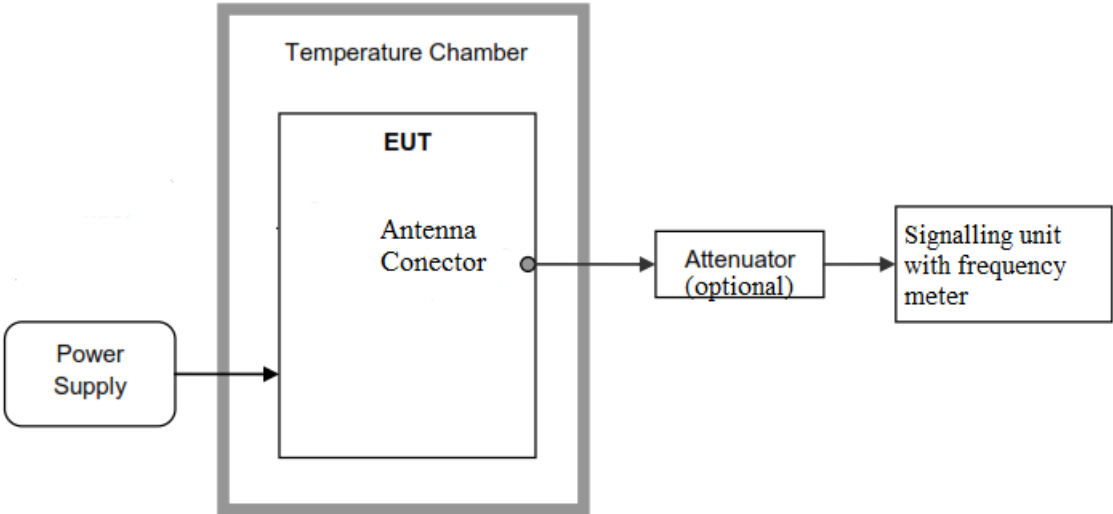
The EUT was set in “Radio Resource Control (RRC) mode” in the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter.

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

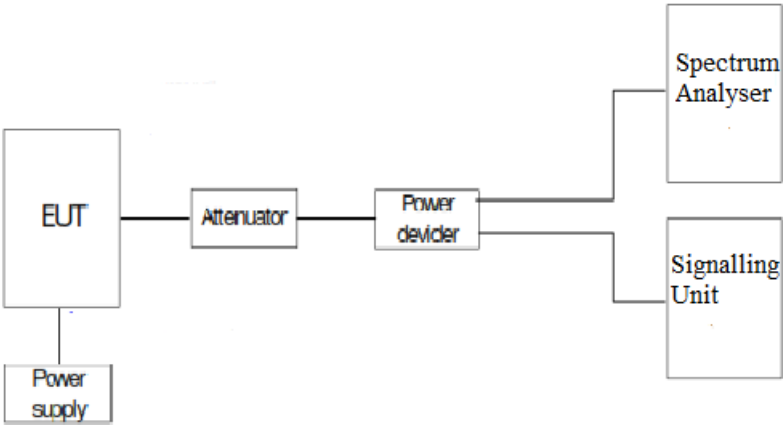
The reference point measurements were made at the RF output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

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 (°C) | 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

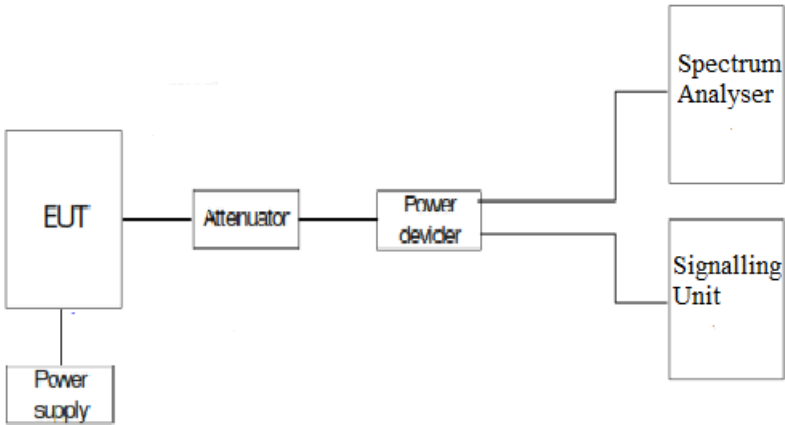
### Limits

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.

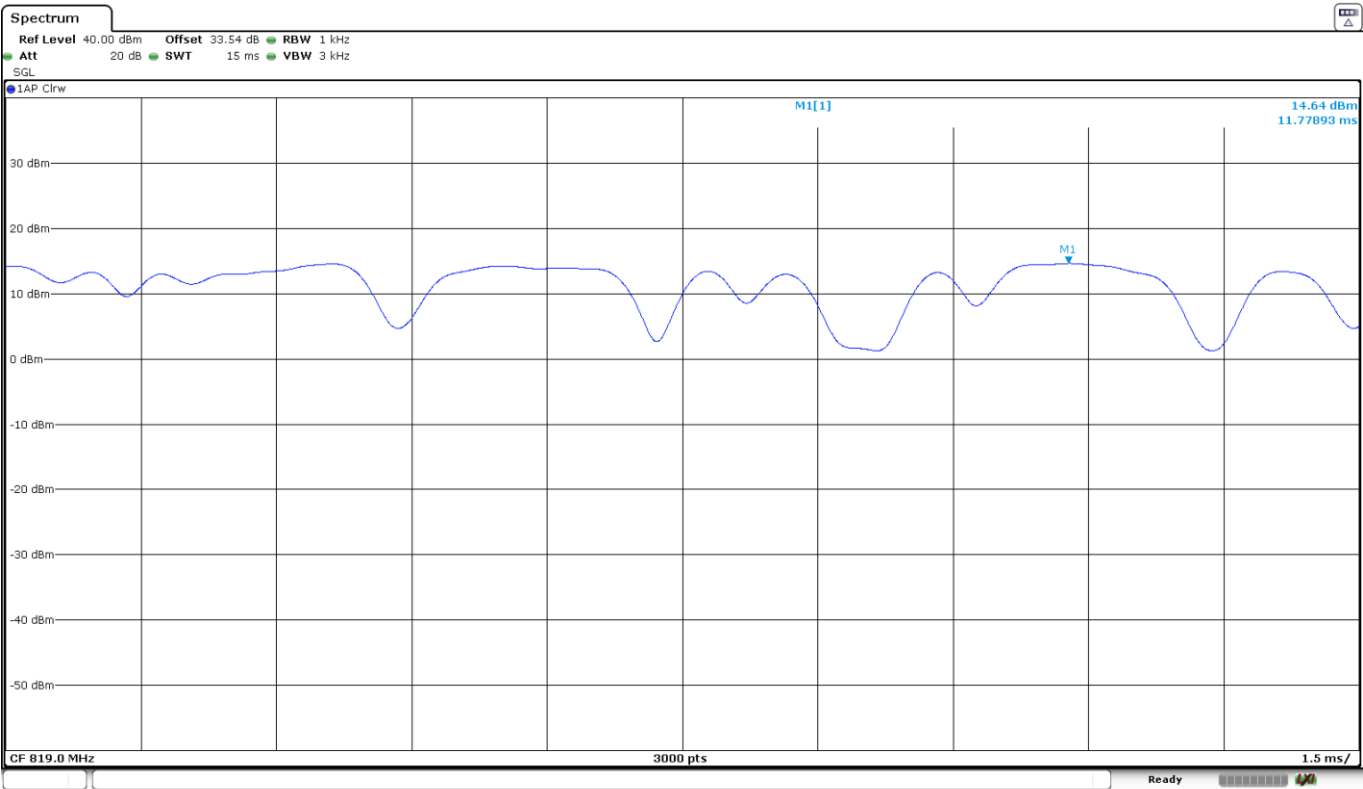
### Test Setup



Results

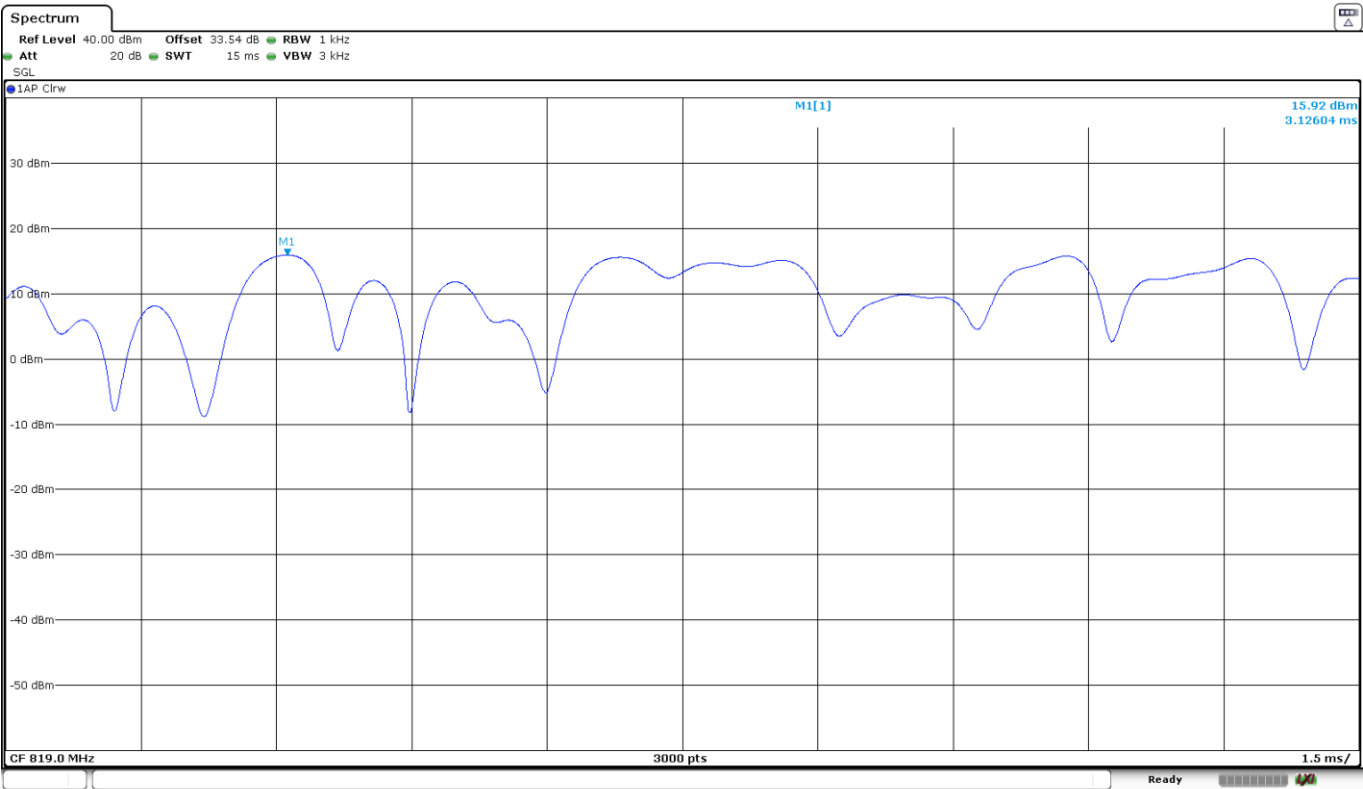
The following plots show the modulation schemes in the EUT.

**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.



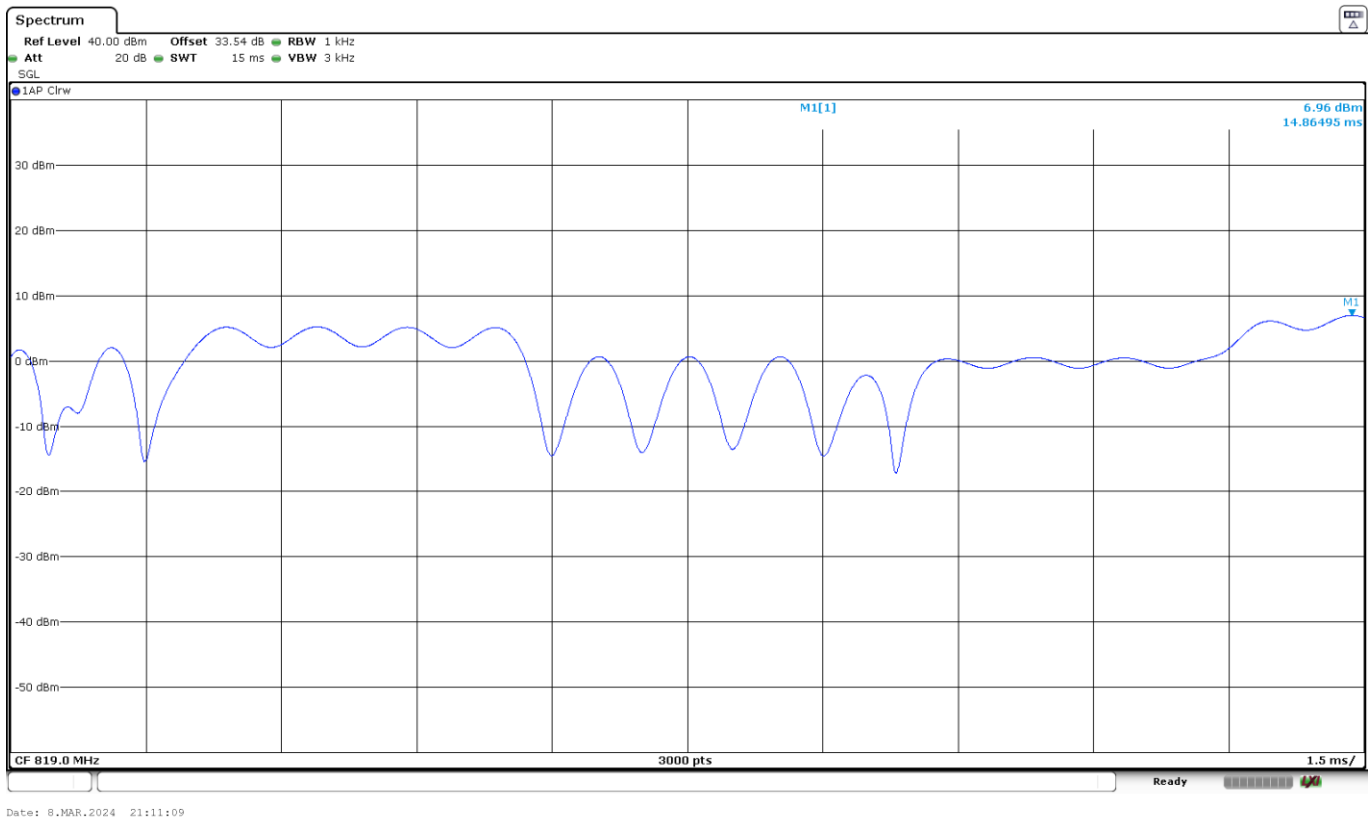
Date: 8.MAR.2024 21:09:29

**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.



Date: 8.MAR.2024 21:08:19

**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

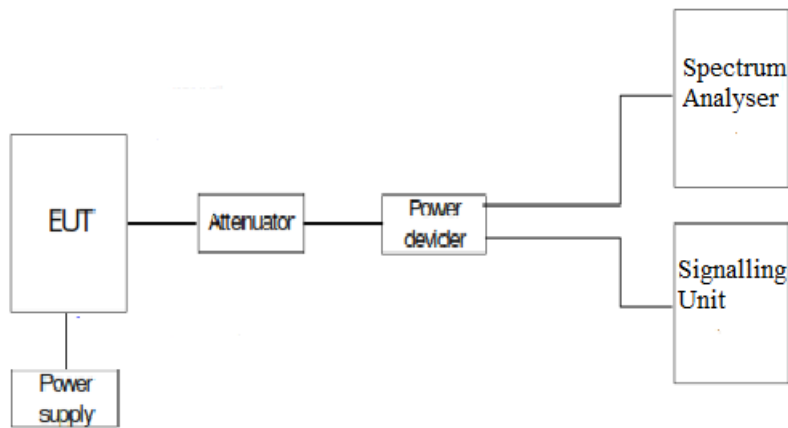
### Limits

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.

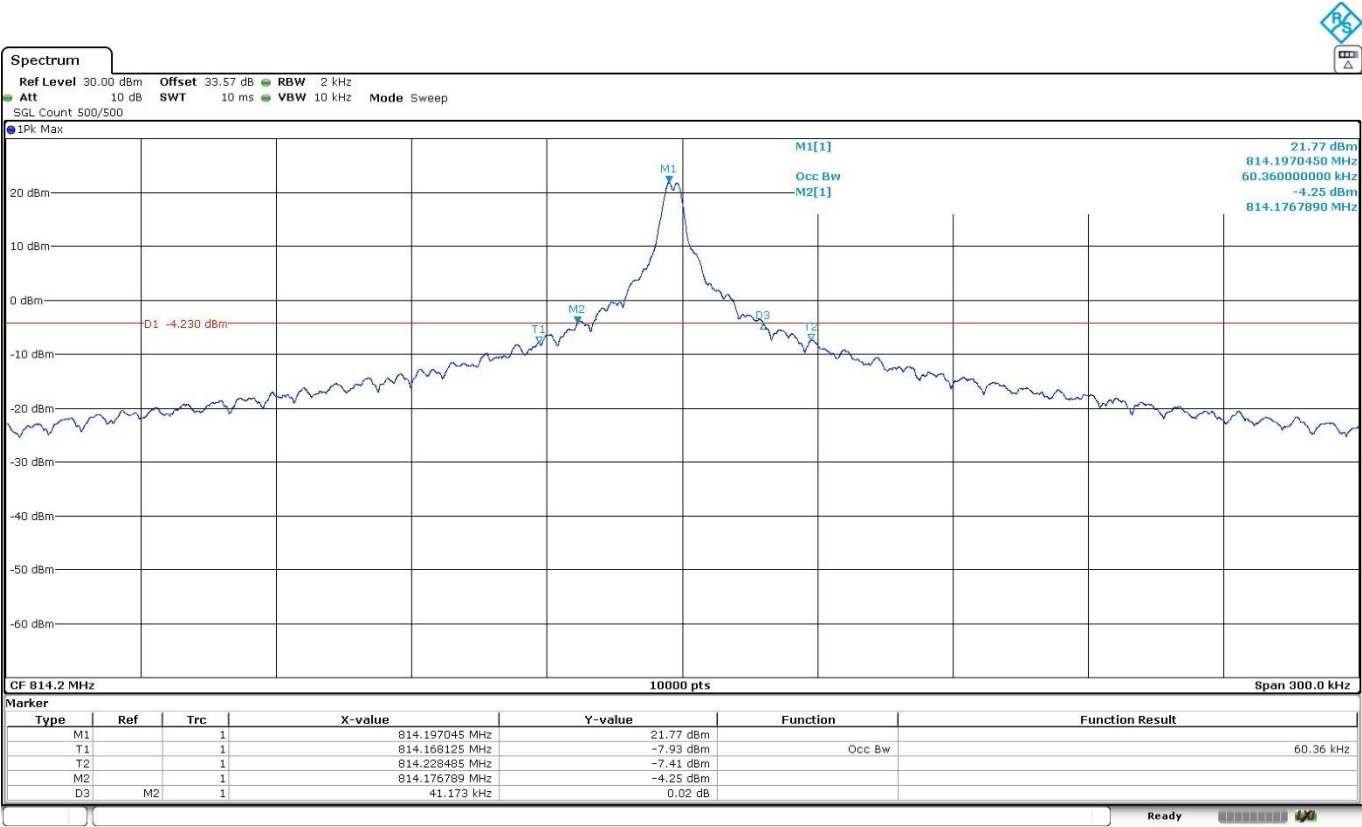
|                               | Low Channel | High Channel |
|-------------------------------|-------------|--------------|
| 99% Occupied Bandwidth (kHz)  | 60.36000    | 60.21000     |
| -26 dBc Bandwidth (kHz)       | 41.17300    | 41.15590     |
| Measurement uncertainty (kHz) | <±4.67      | 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

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.

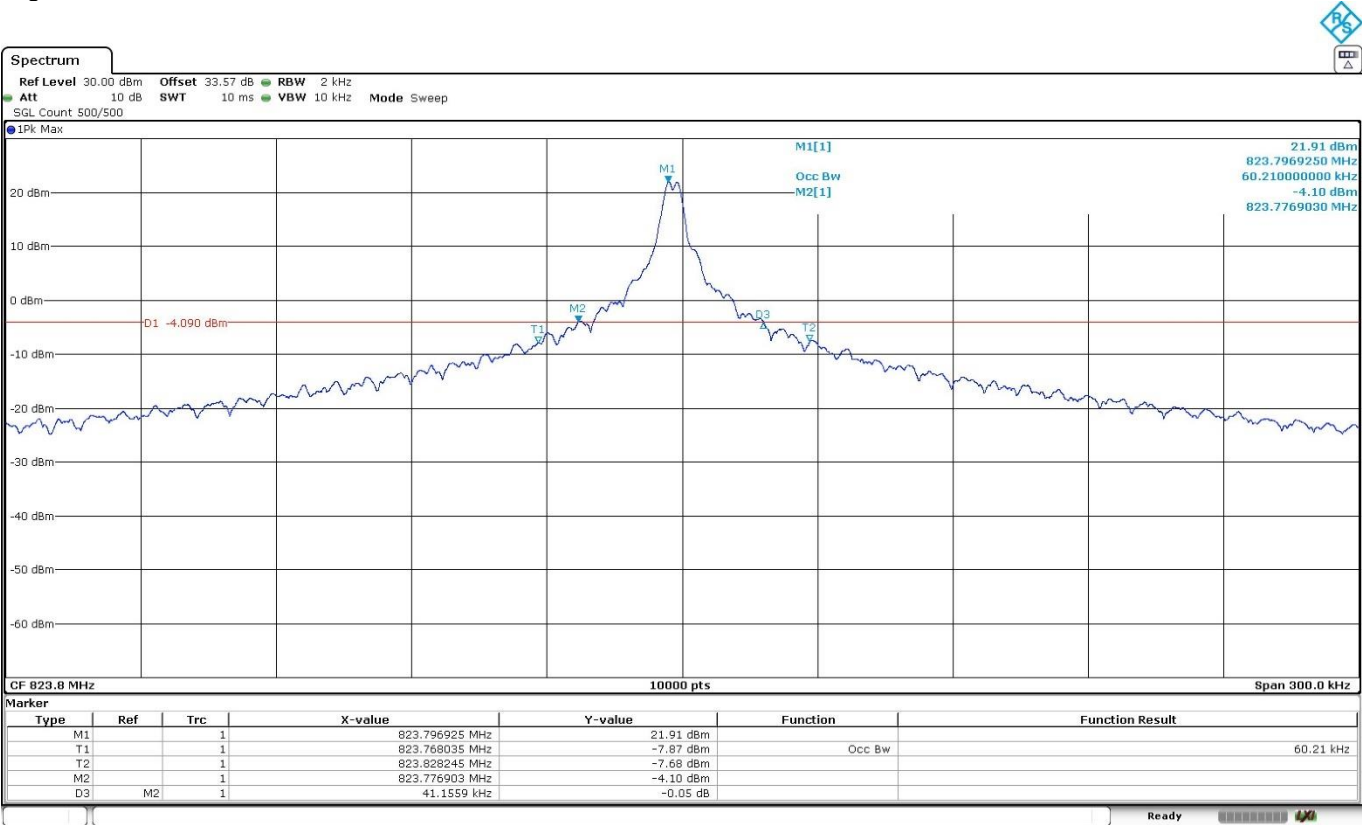
|                               | Low Channel | High Channel |
|-------------------------------|-------------|--------------|
| 99% Occupied Bandwidth (kHz)  | 64.23000    | 64.32000     |
| -26 dBc Bandwidth (kHz)       | 41.68300    | 41.63600     |
| Measurement uncertainty (kHz) | <±4.67      | 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

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:

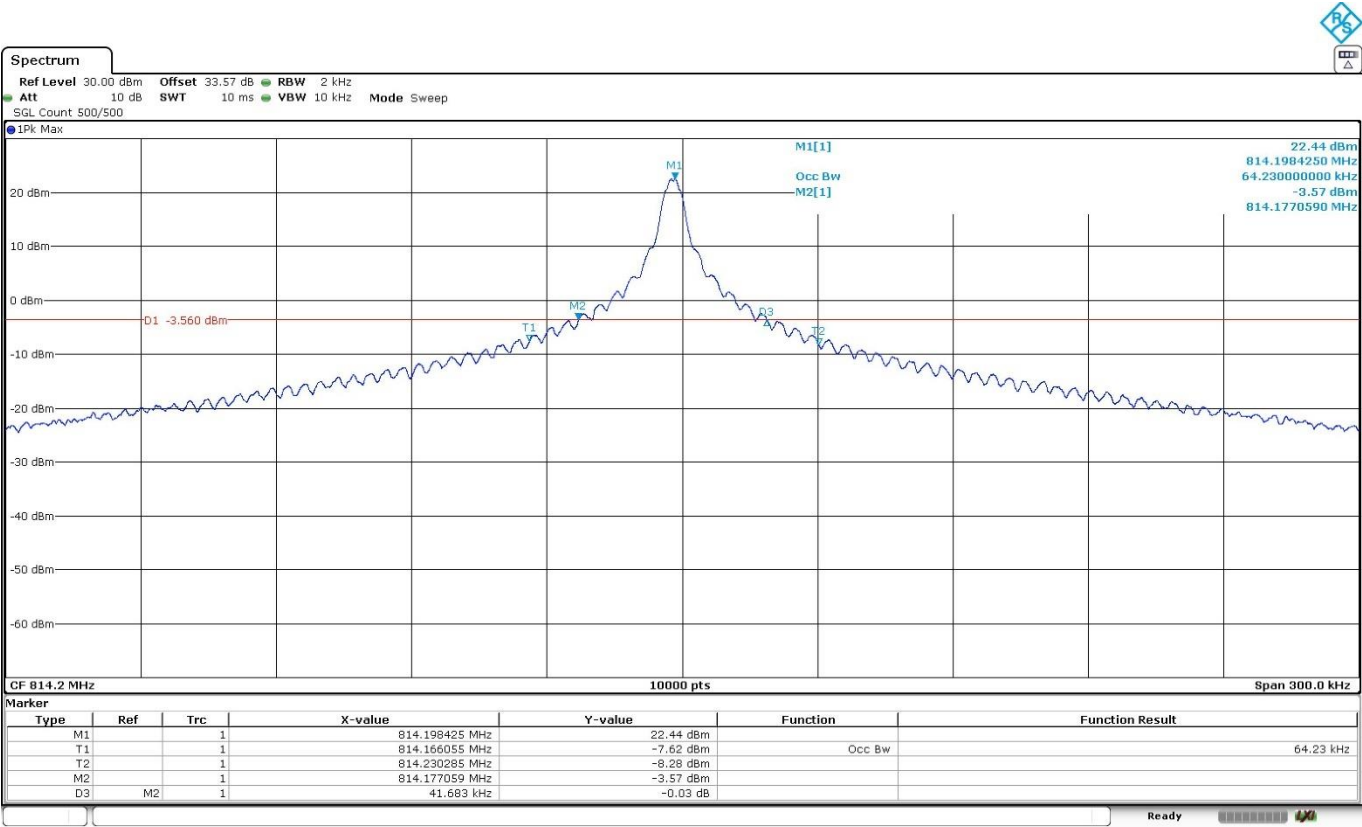


High Channel:

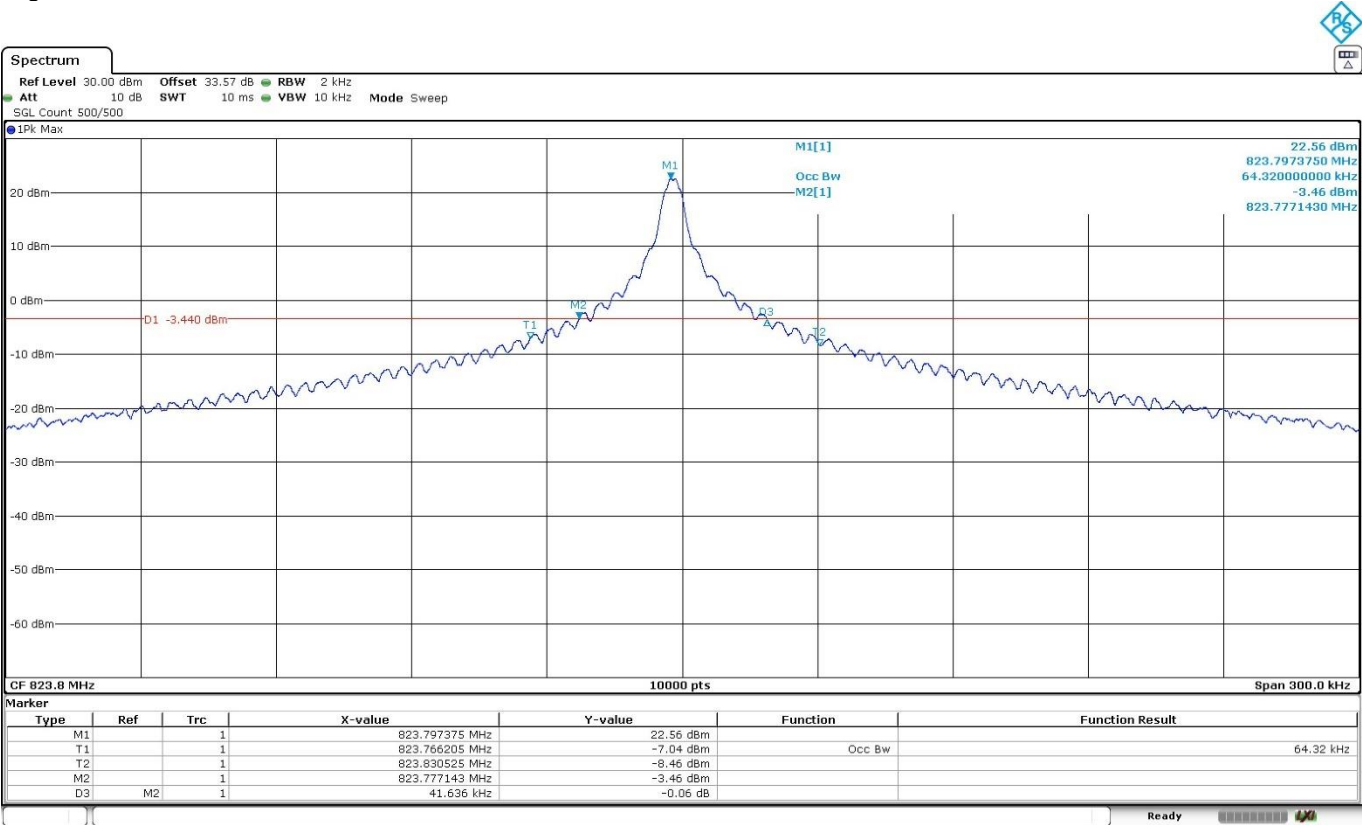


LTE Cat NB2 Band 26. Sub-band 814-824 MHz: Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=23.  
MSC/TBS=3.

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.

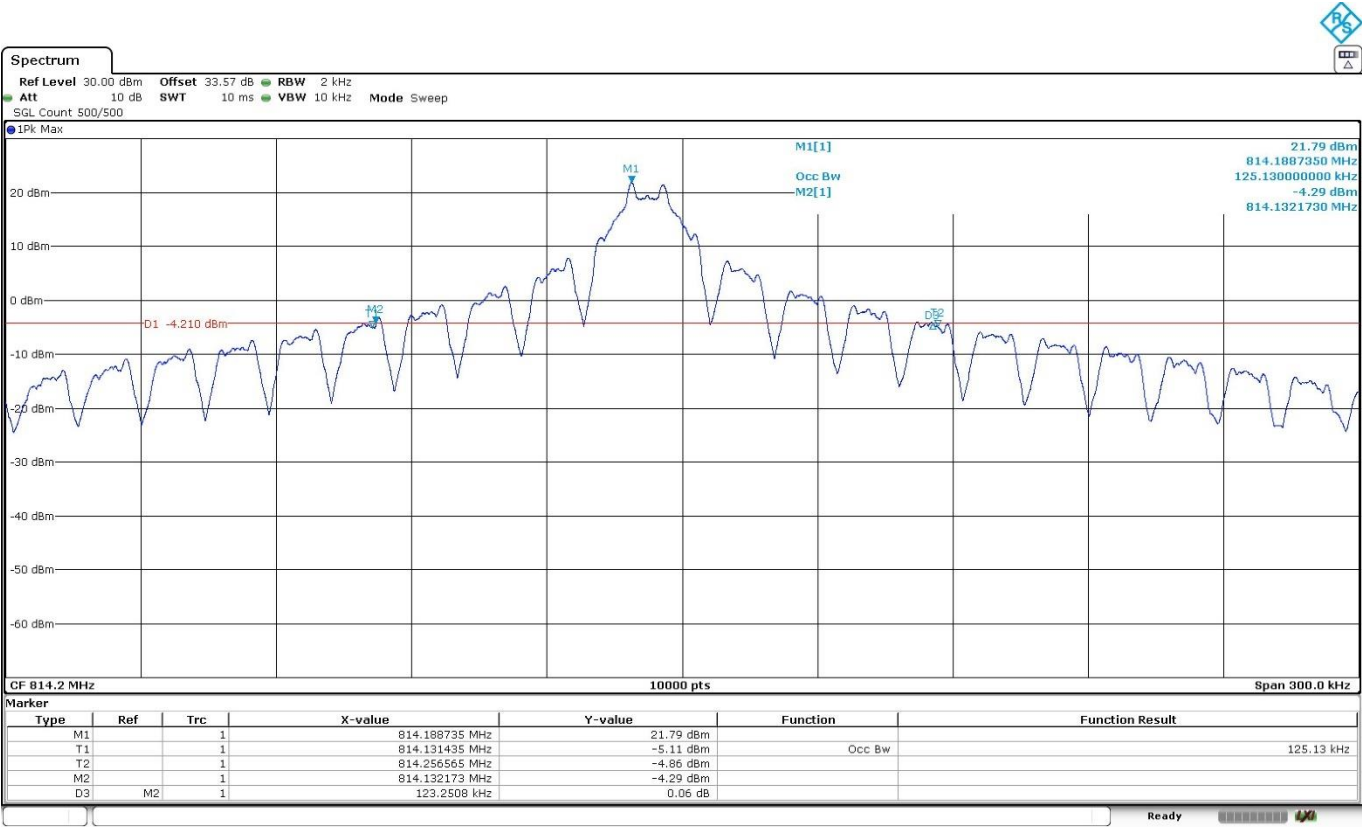
|                               | Low Channel | High Channel |
|-------------------------------|-------------|--------------|
| 99% Occupied Bandwidth (kHz)  | 127.59000   | 126.30000    |
| -26 dBc Bandwidth (kHz)       | 158.60310   | 143.86070    |
| Measurement uncertainty (kHz) | <±4.67      | 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

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

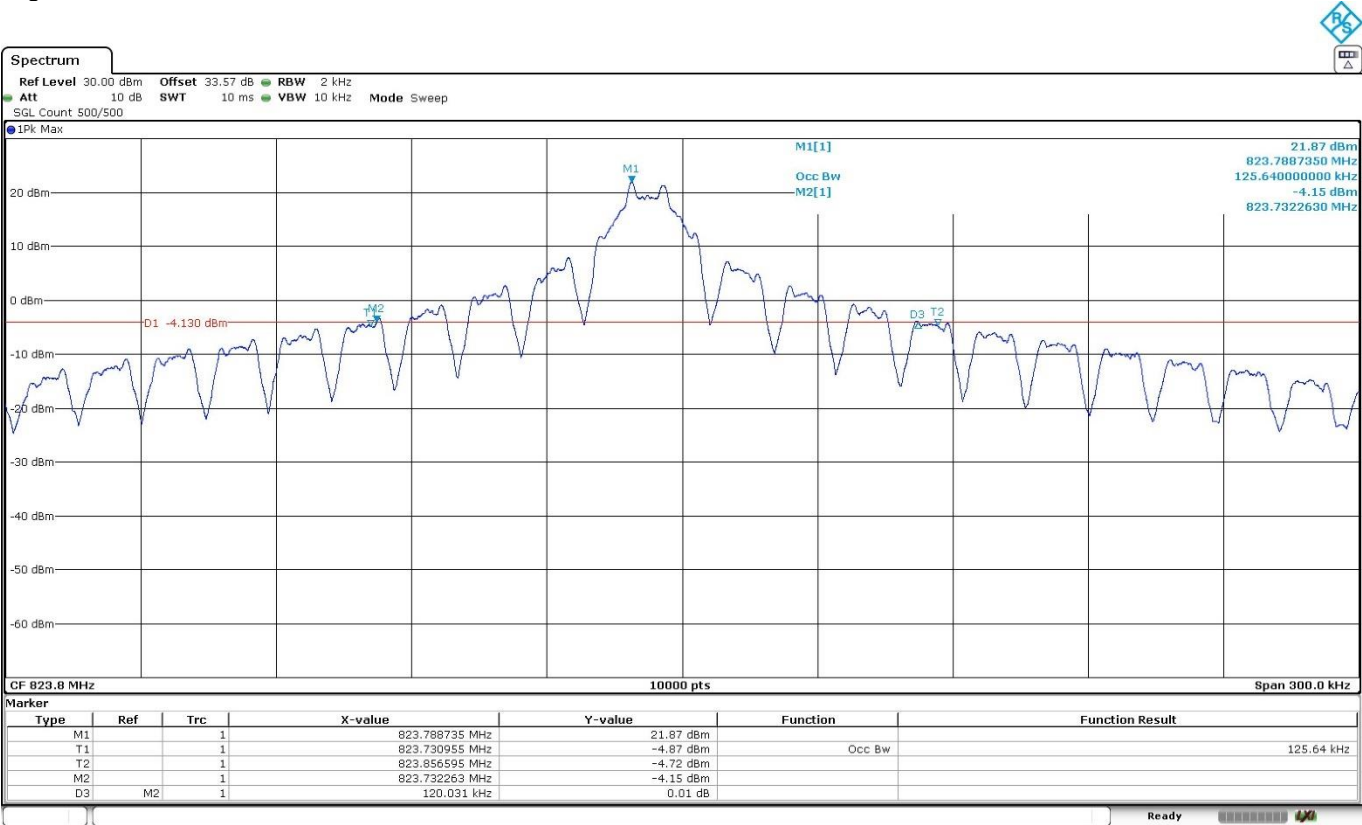
|                               | Low Channel | High Channel |
|-------------------------------|-------------|--------------|
| 99% Occupied Bandwidth (kHz)  | 189.15000   | 188.30000    |
| -26 dBc Bandwidth (kHz)       | 305.55270   | 315.58940    |
| Measurement uncertainty (kHz) | <±4.67      | 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

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:

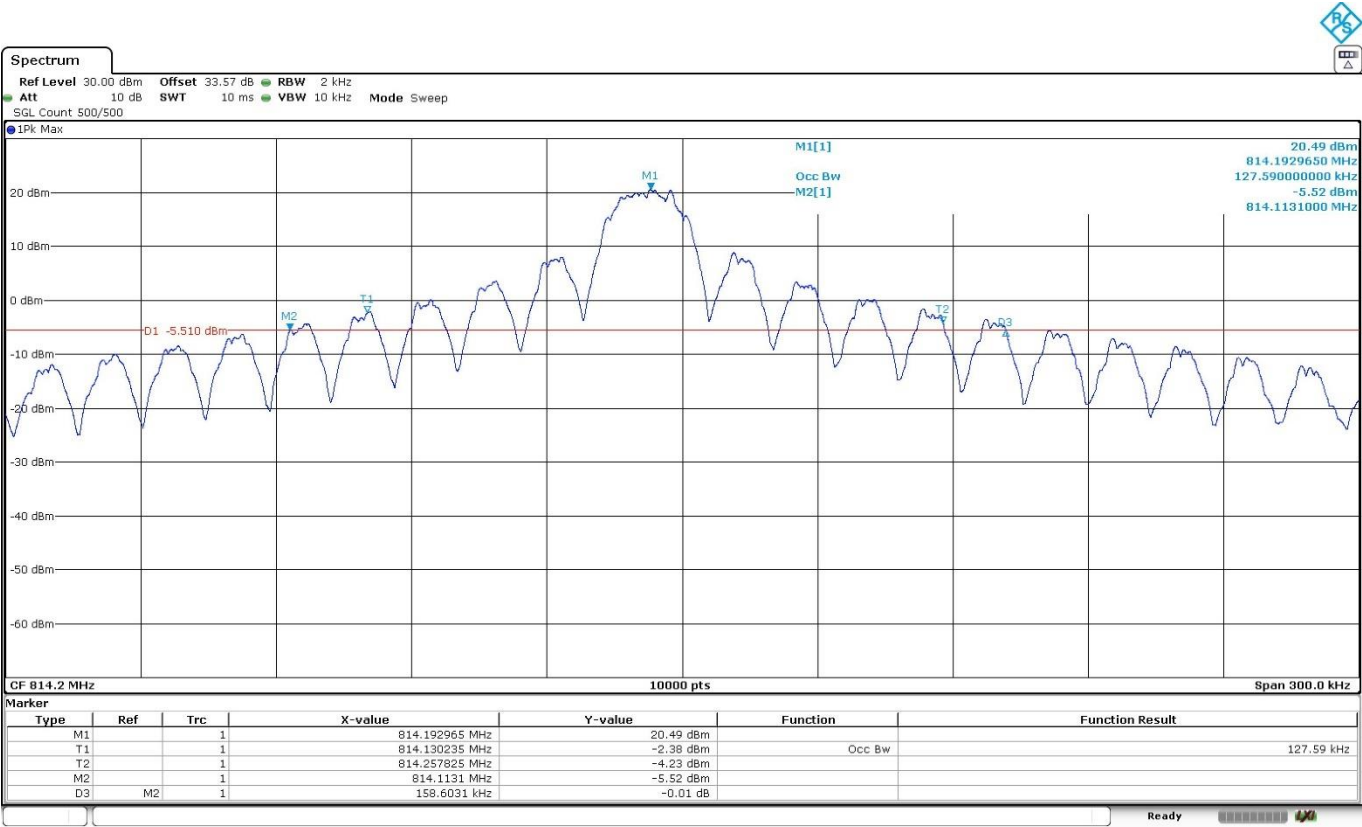


High Channel:

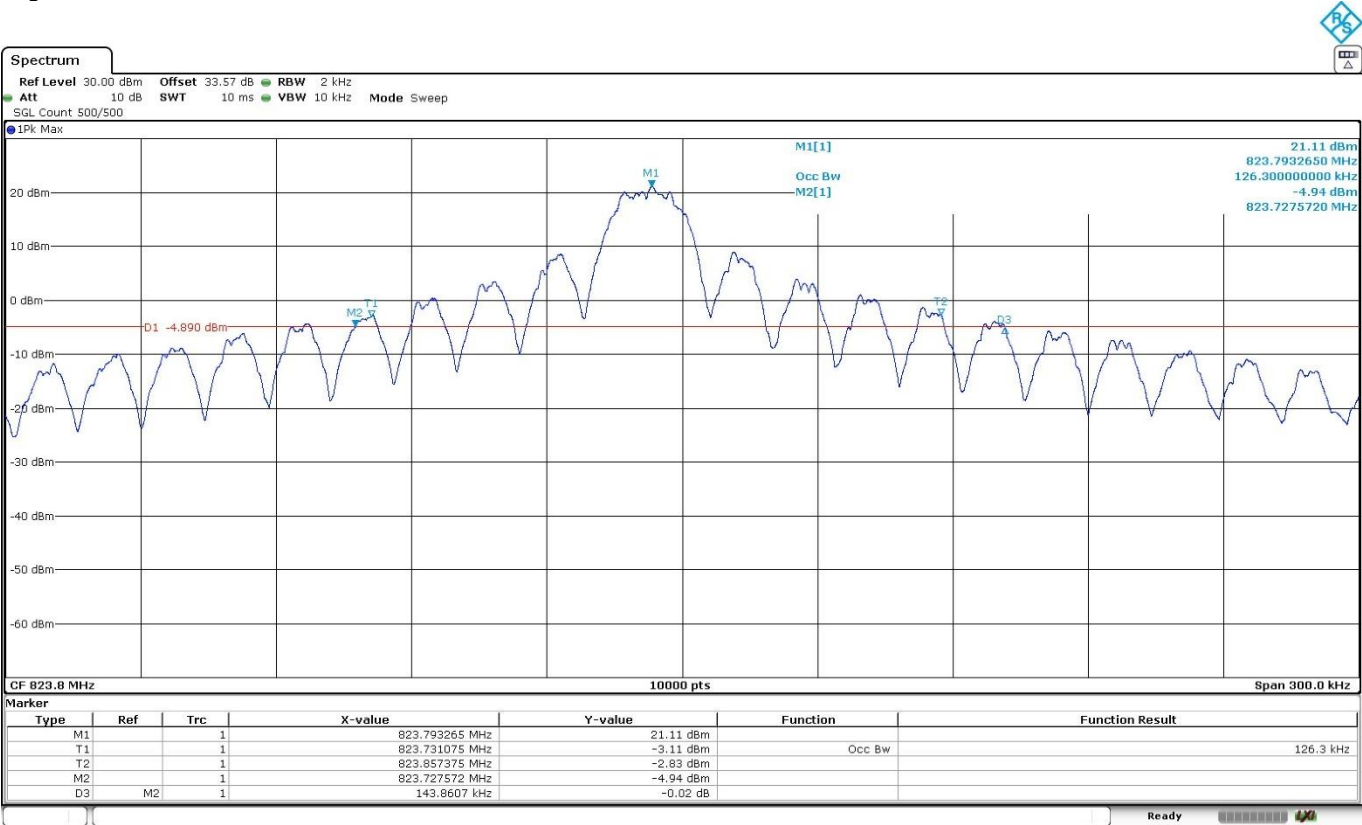


LTE Cat NB2 Band 26. Sub-band 814-824 MHz: Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=5.  
MSC/TBS=3.

Low Channel:

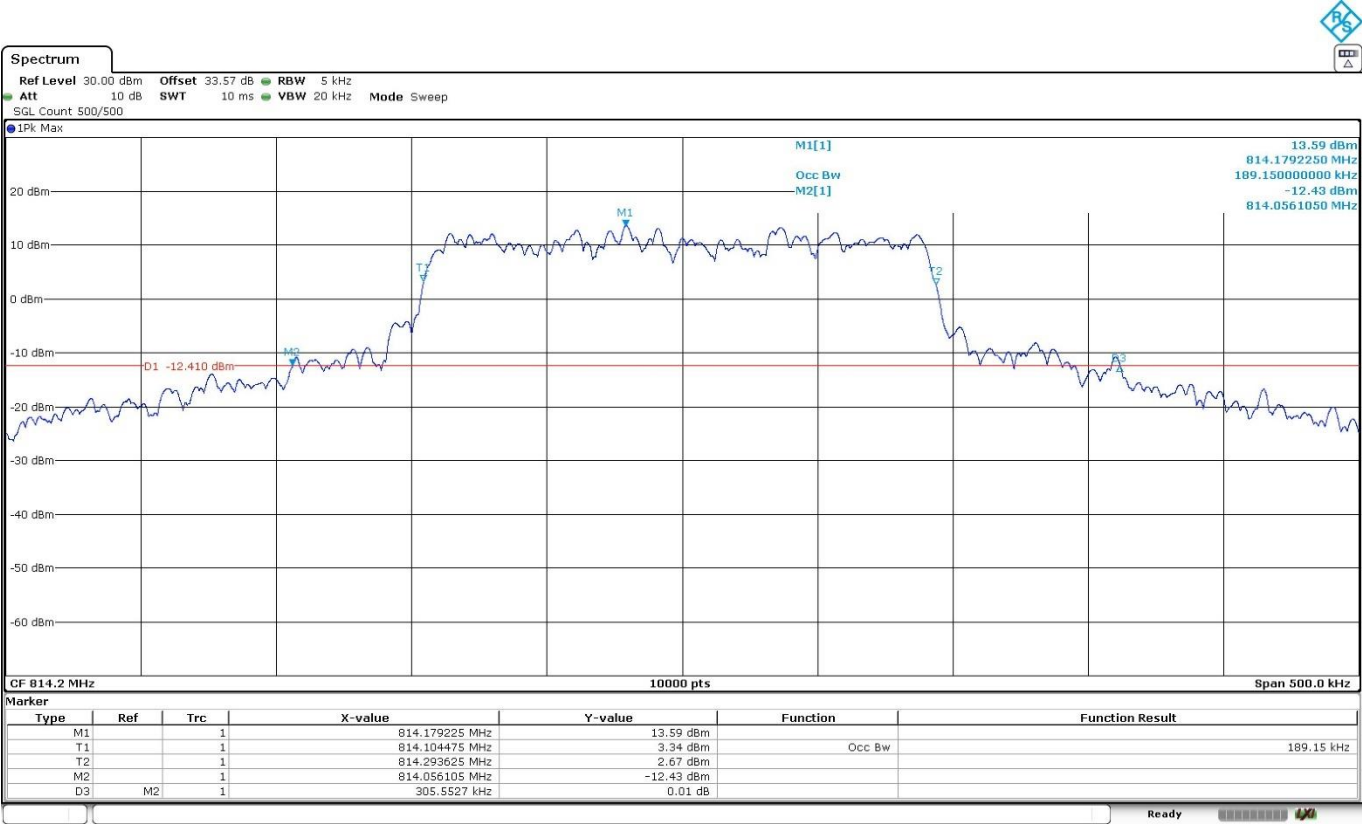


High Channel:

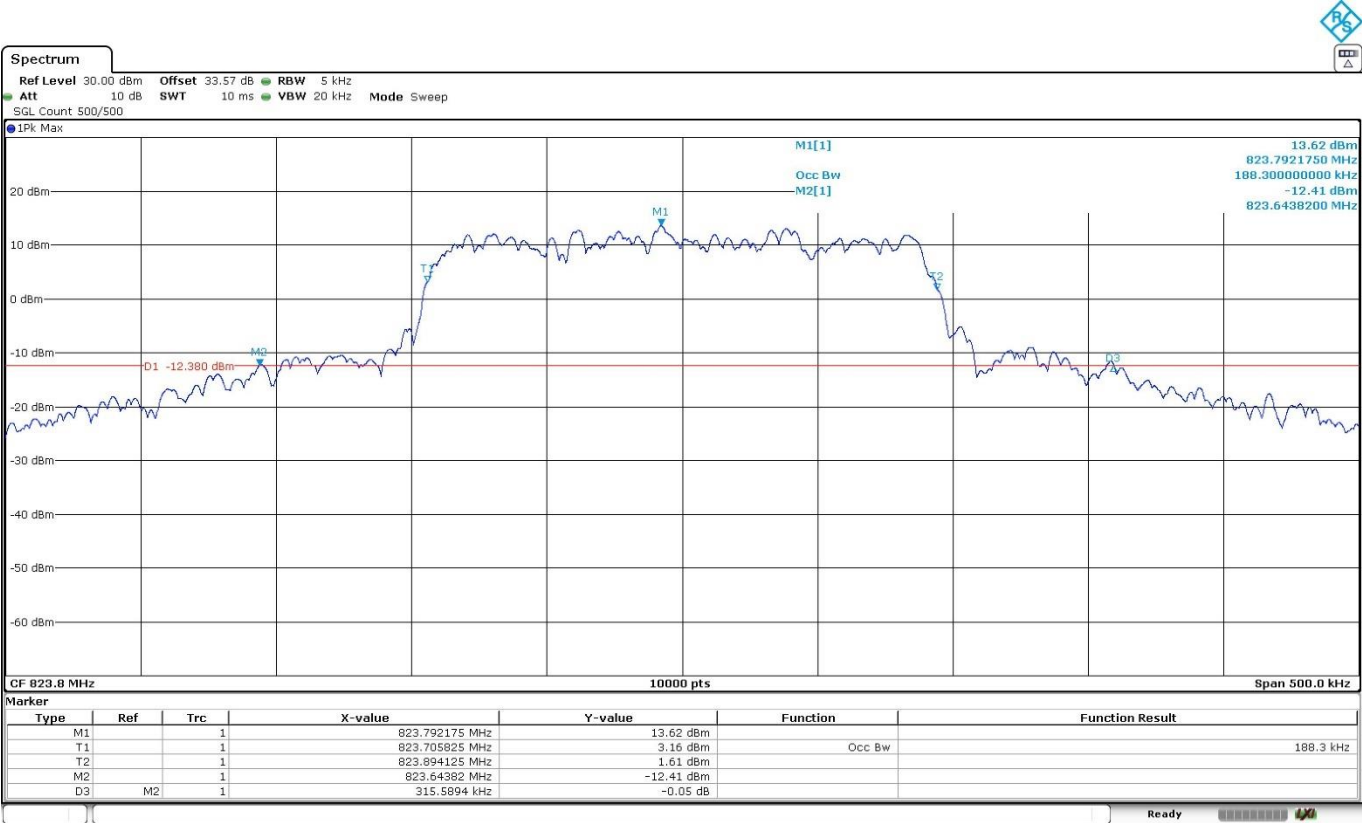


LTE Cat NB2 Band 26. Sub-band 814-824 MHz: QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5.

Low Channel:



High Channel:



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

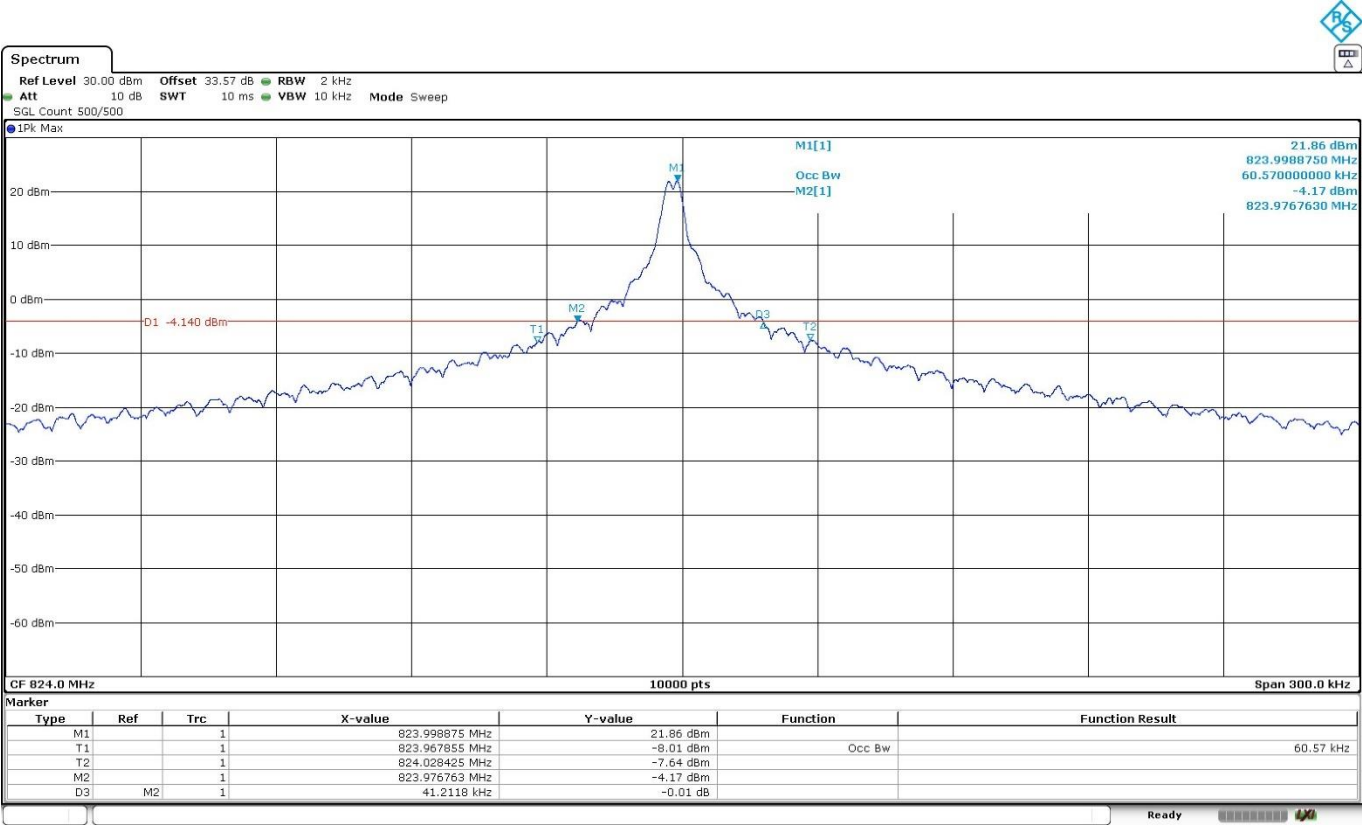
LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz.     $\text{Pi}/2$ -BPSK.    BW=3.75    kHz.    Tone    Number=1.    Tone Offset=23. MSC/TBS=0.

|                               | Single Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (kHz)  | 60.57000       |
| -26 dBc Bandwidth (kHz)       | 41.21180       |
| Measurement uncertainty (kHz) | < $\pm$ 4.67   |

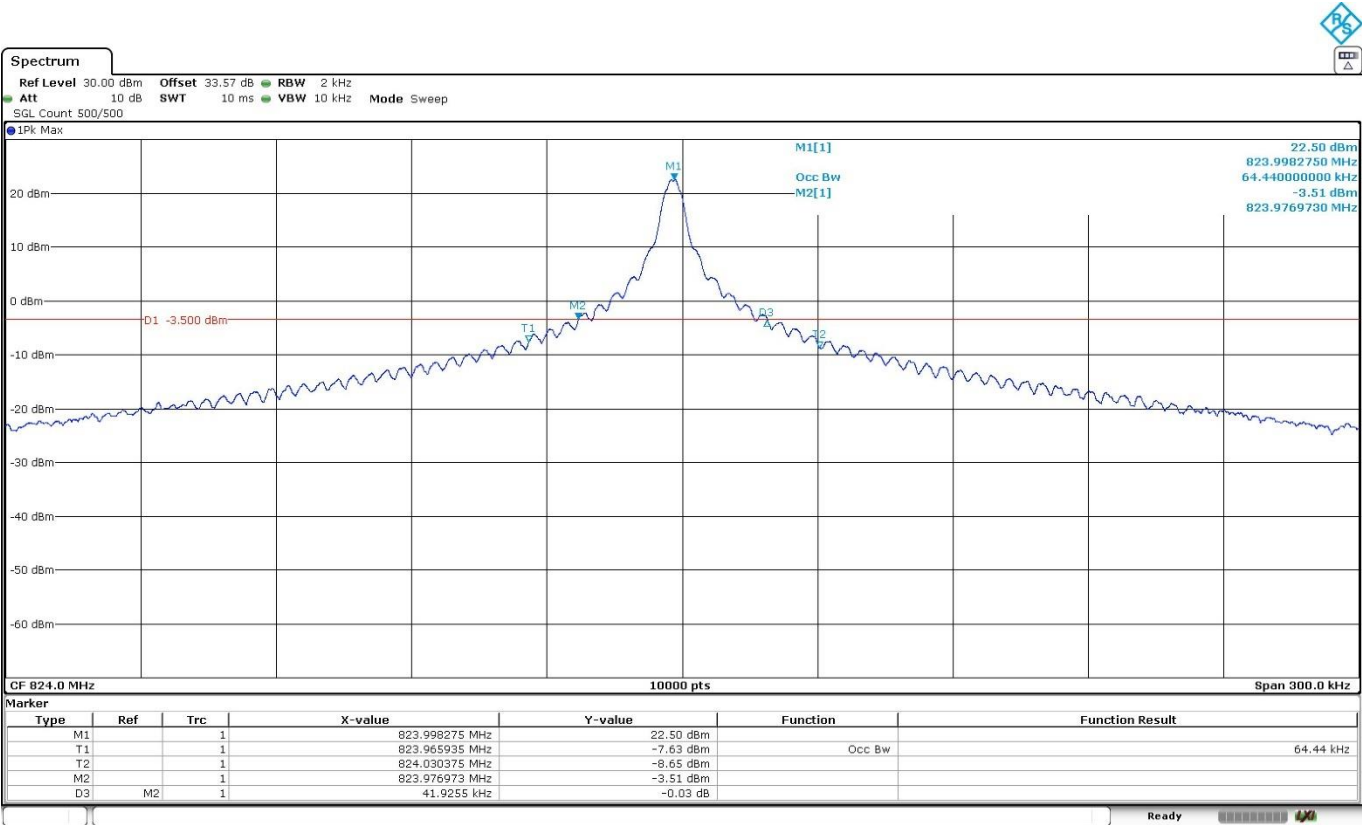
LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz.     $\text{Pi}/4$ -QPSK.    BW=3.75    kHz.    Tone    Number=1.    Tone Offset=23. MSC/TBS=3.

|                               | Single Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (kHz)  | 64.44000       |
| -26 dBc Bandwidth (kHz)       | 41.92550       |
| Measurement uncertainty (kHz) | < $\pm$ 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         |

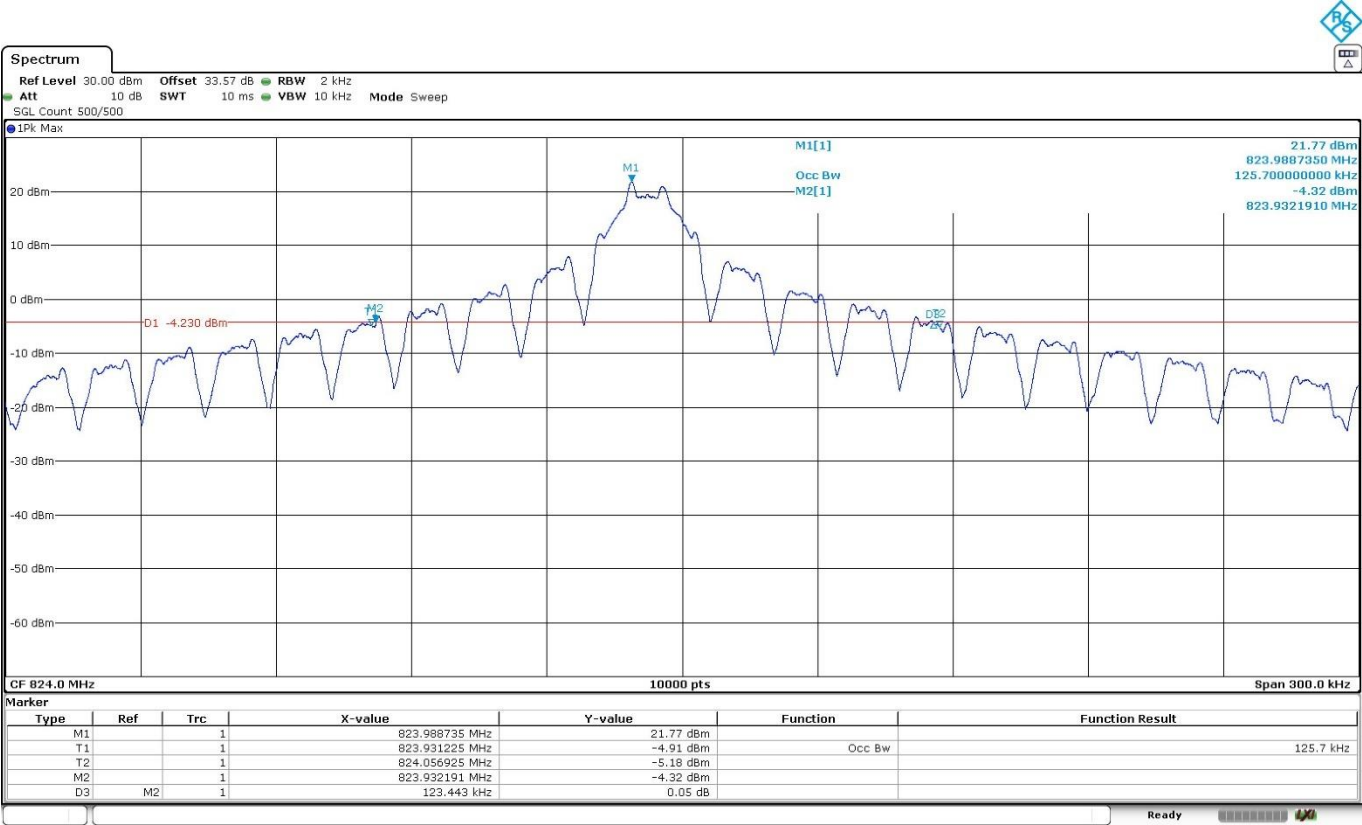
LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=3.

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

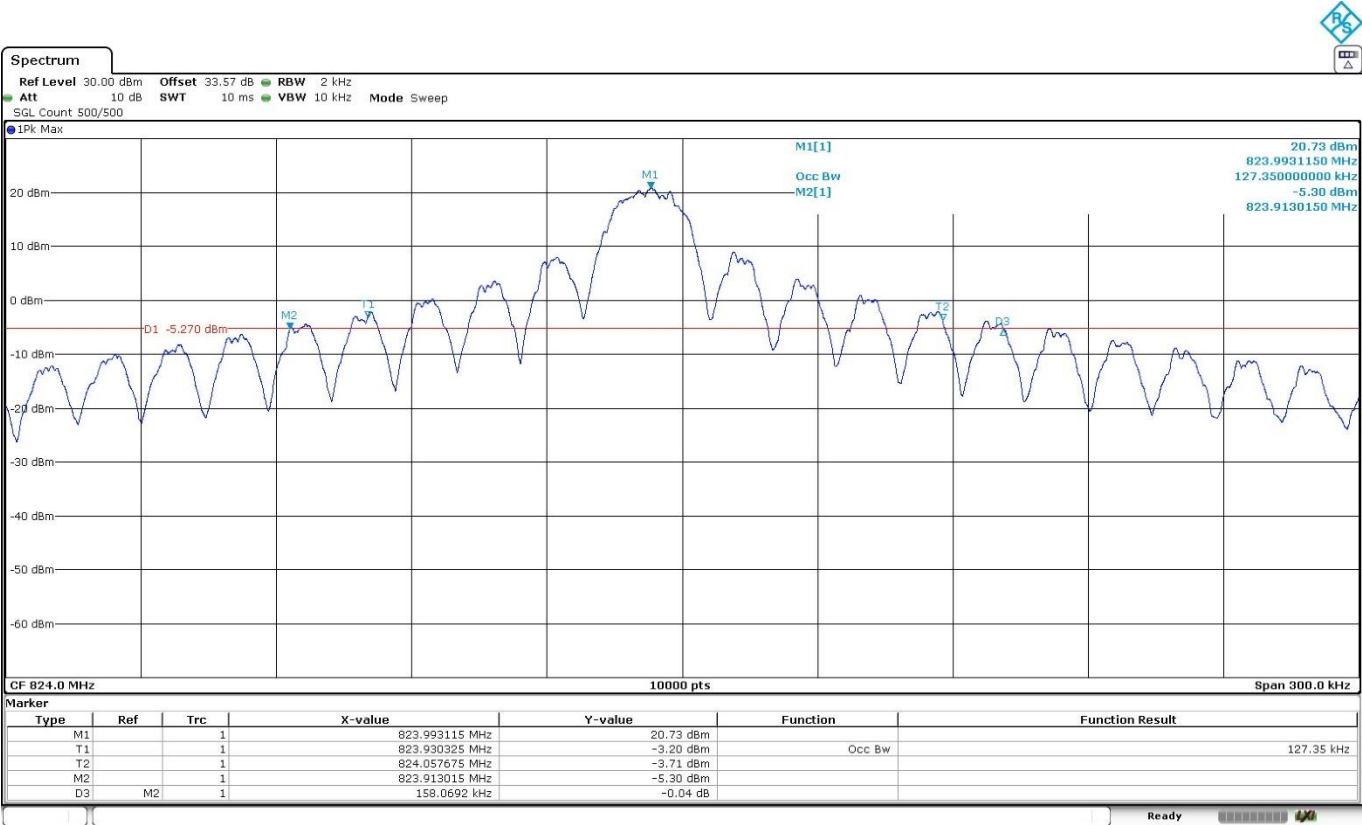
LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz. QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5.

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

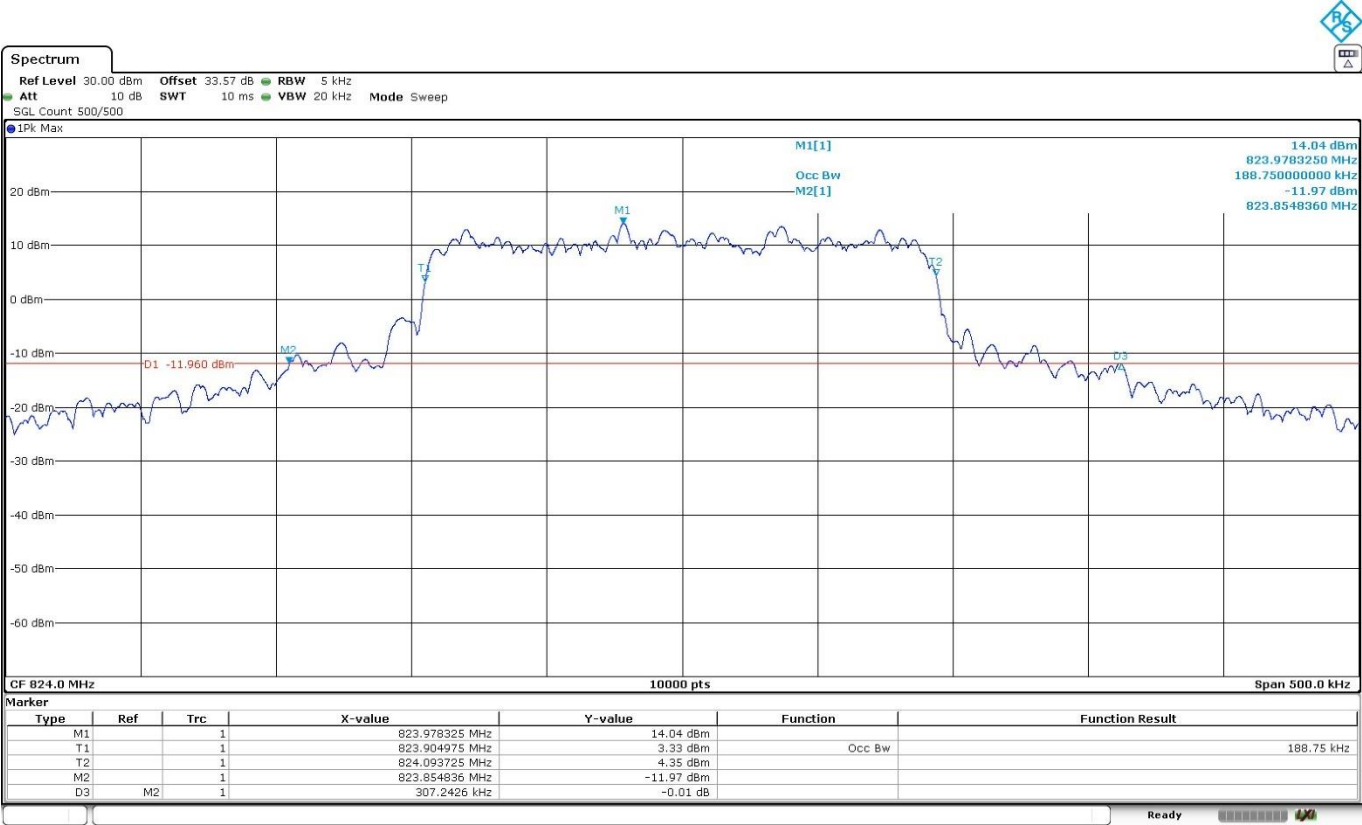
LTE Cat NB2 Band 26. Cross-rule Channel 824 MHz: Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=0.



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  $116 \log_{10}(f/6.1)$  decibels or  $50 + 10 \log_{10}(P)$  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  $43 + 10 \log_{10}(P)$  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.

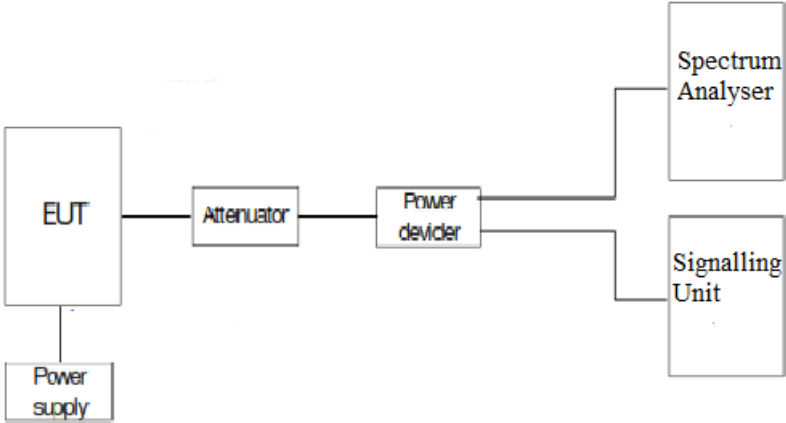
Measurement Limit:

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

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

Test Setup



## 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.

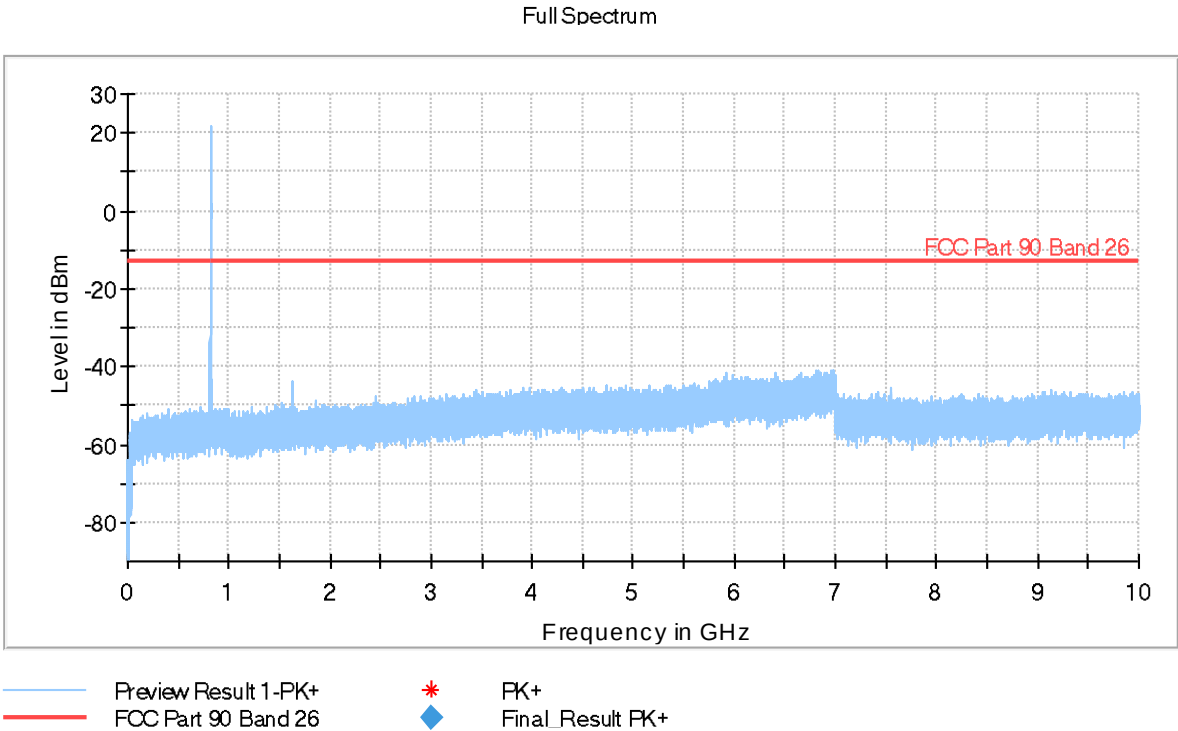
## Verdict

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.

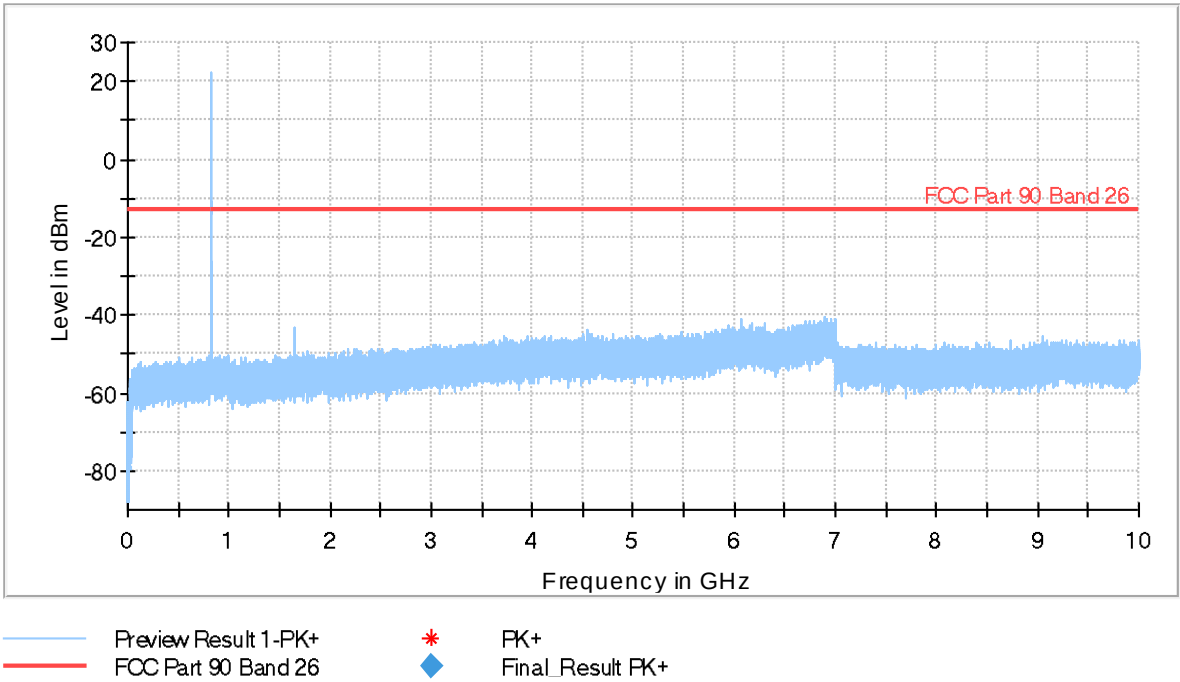
Low Channel:



The peak above the limit is the carrier frequency.

High Channel:

Full Spectrum



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.

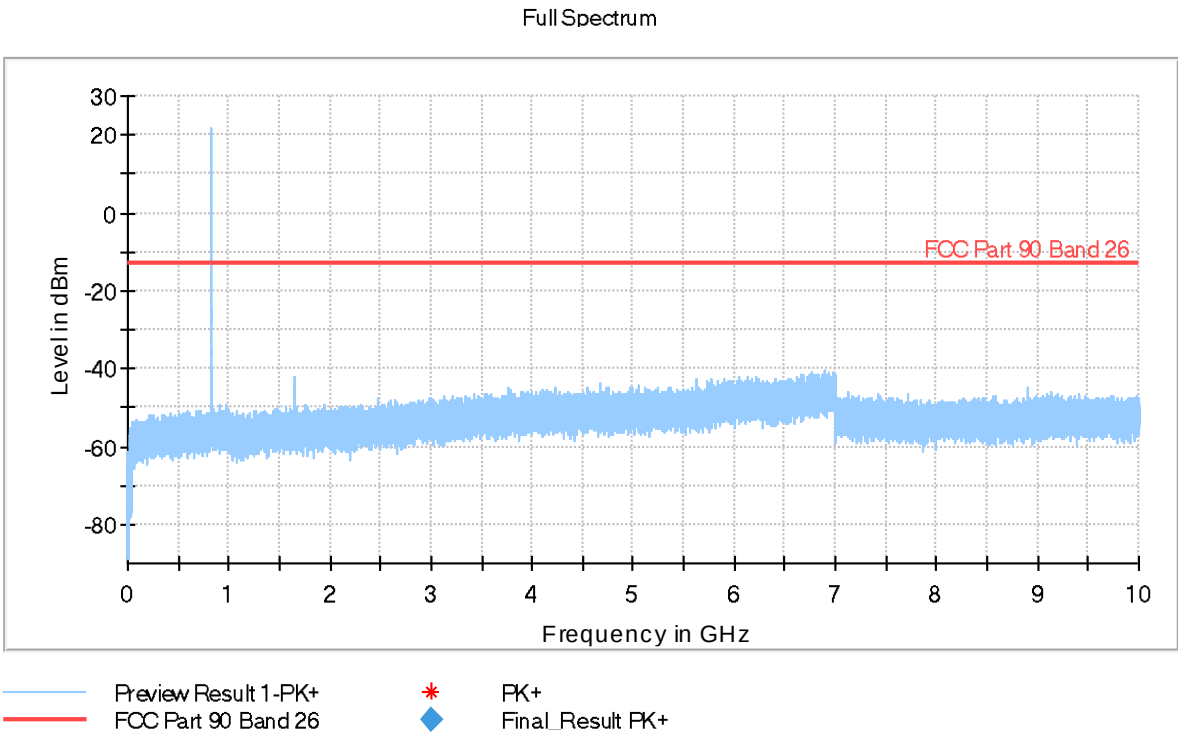
### ***Verdict***

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  $116 \log_{10}(f/6.1)$  decibels or  $50 + 10 \log_{10}(P)$  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  $43 + 10 \log_{10}(P)$  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.

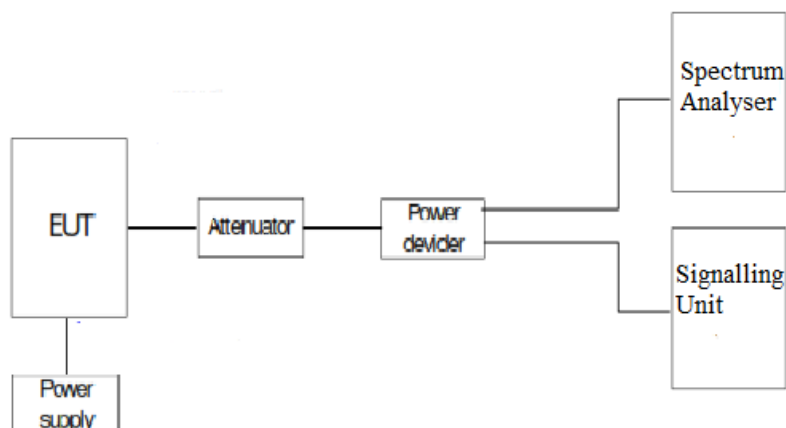
The reading of the spectrum analyser is corrected with the path loss of the connection between the output terminal of the EUT and the input of the spectrum analyzer.

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

At  $P_o$  transmitting power, the specified minimum attenuation  $43 + 10 \log_{10} p$  (watts) for any frequency removed from the EA licensee's frequency block greater than 37.5 kHz becomes:

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

### 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<br>BW=3.75 kHz<br>Tone Number=1<br>Tone Offset=0<br>MSC/TBS=0 | Pi/2-BPSK<br>BW=15 kHz<br>Tone Number=1<br>Tone Offset=0<br>MSC/TBS=0 | QPSK<br>BW=15 kHz<br>Tone Number=12<br>Tone Offset=0<br>MSC/TBS=5 |
| Maximum measured level<br>at <u>Low Block Edge</u> at<br>antenna port (dBm) | -19.14                                                                  | -18.37                                                                | -19.69                                                            |

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

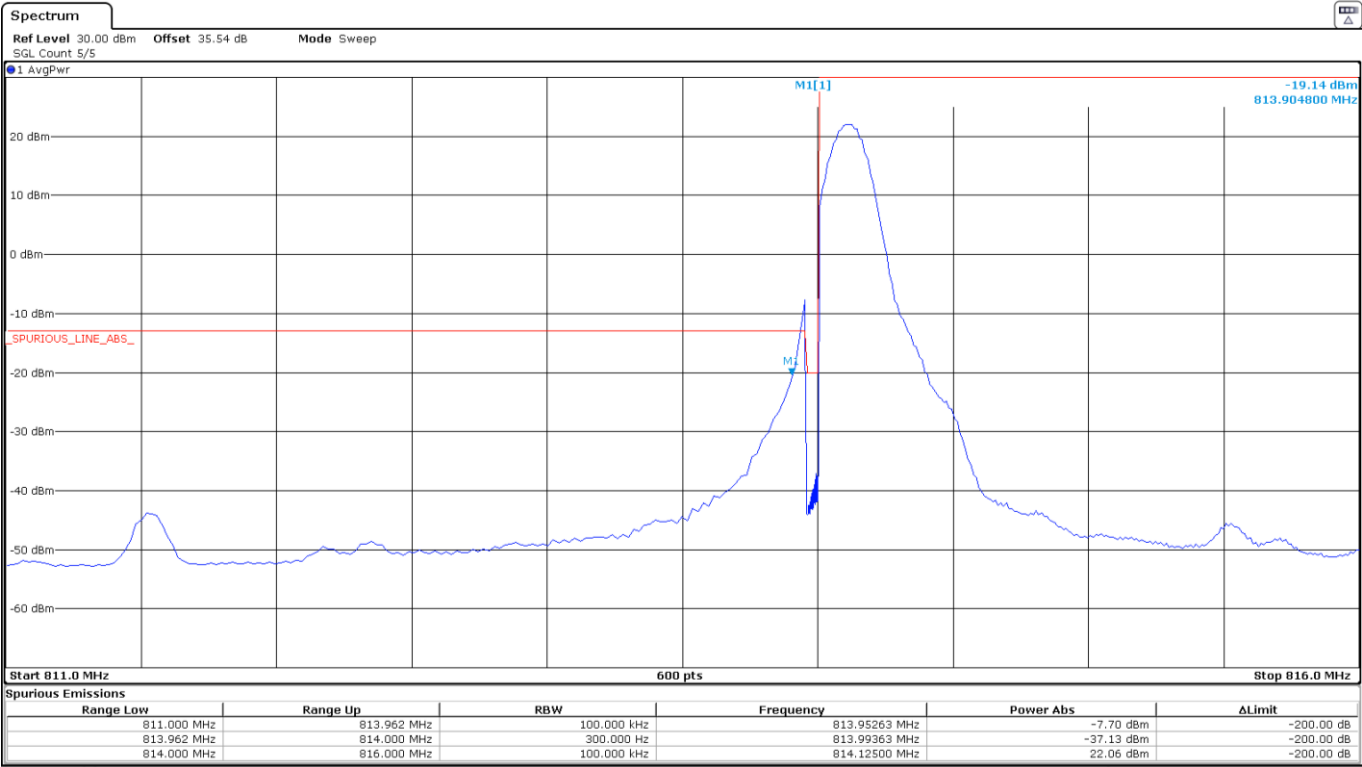
Measurement uncertainty (dB): <±2.76

Verdict

Pass

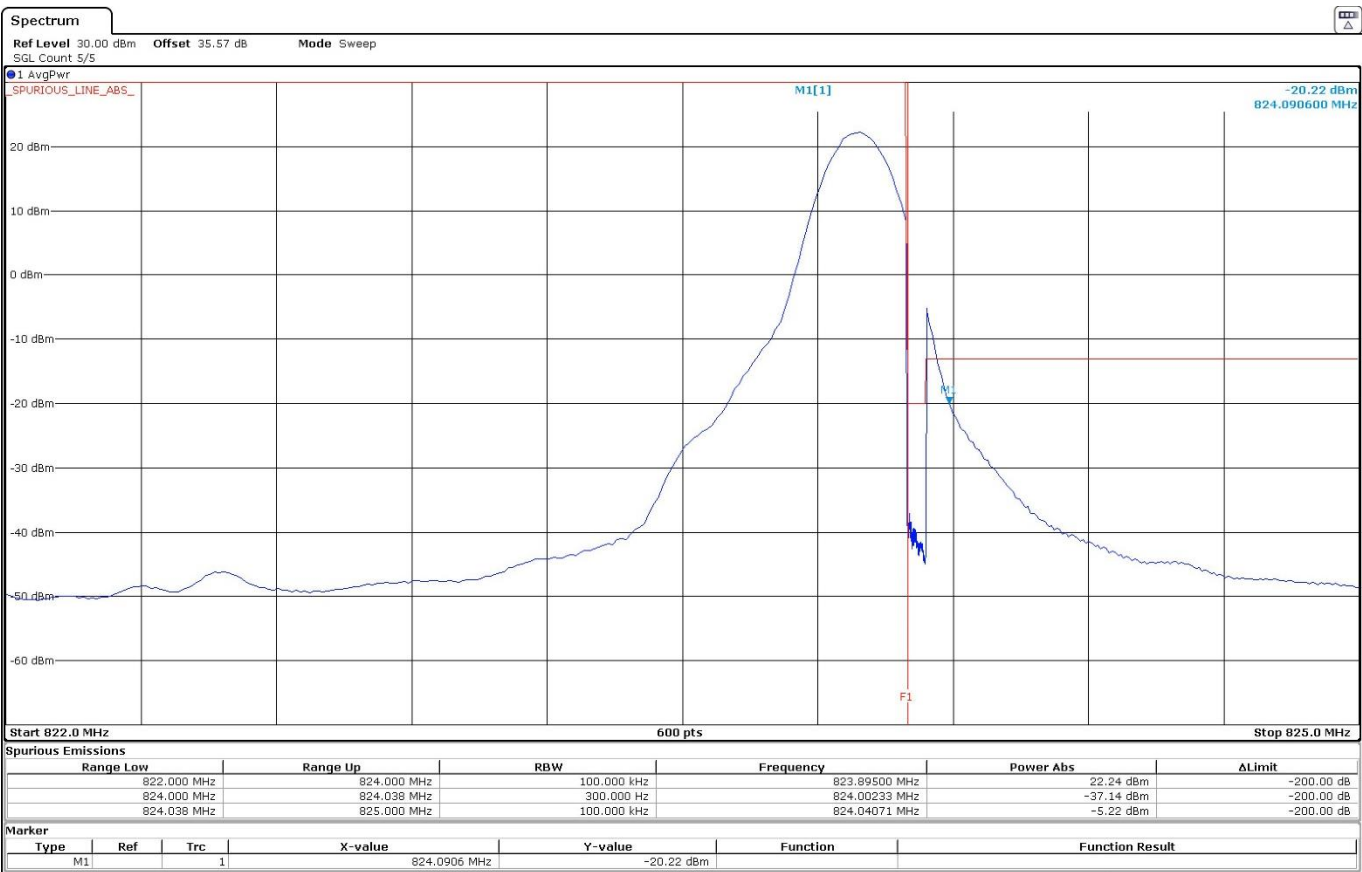
LTE Cat NB2 Band 26. Sub-band 814-824 MHz. EA MASK  
Offset=0. MSC/TBS=0. Low Channel:

Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone

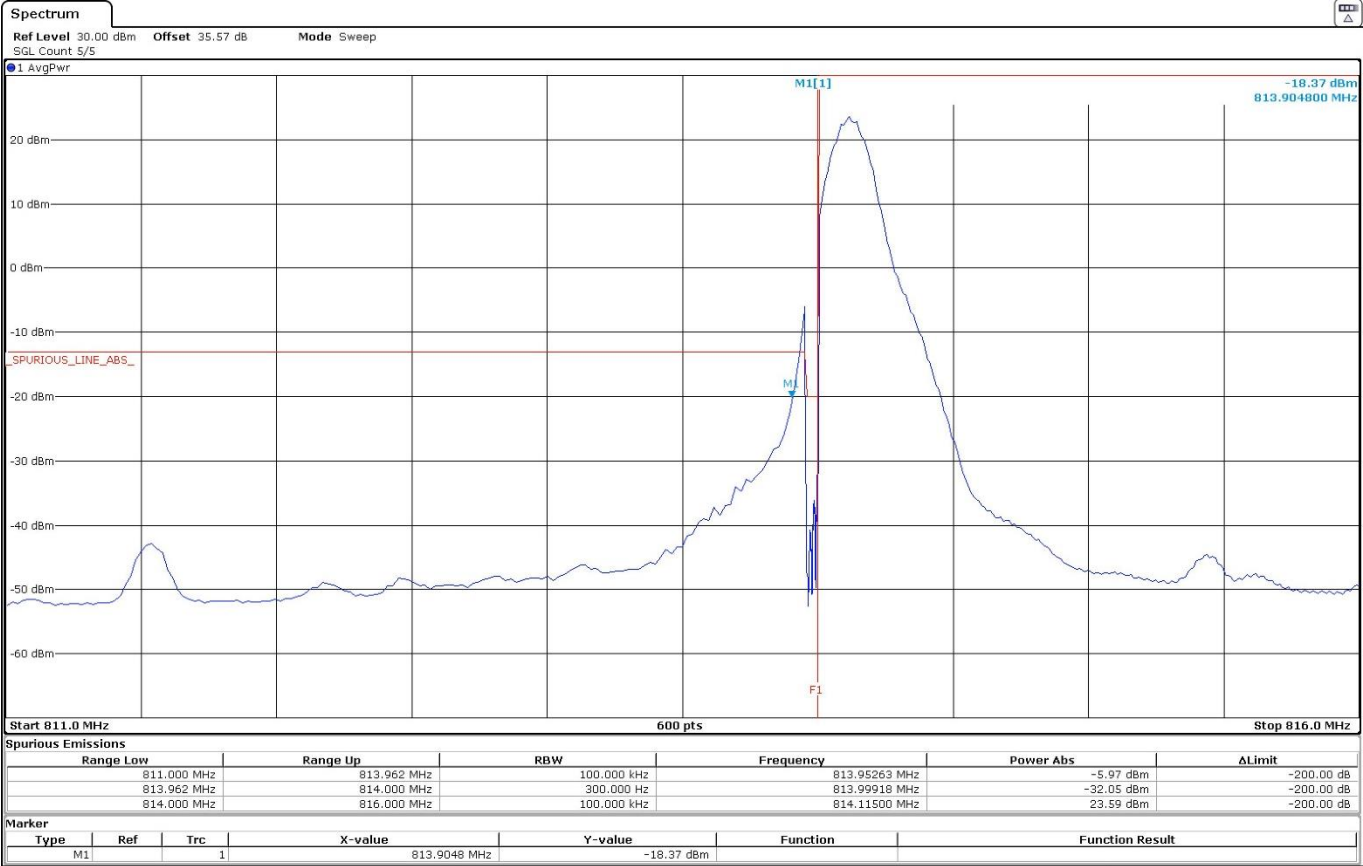


LTE Cat NB2 Band 26. Sub-band 814-824 MHz. EA MASK:  
Offset=47. MSC/TBS=0. High Channel:

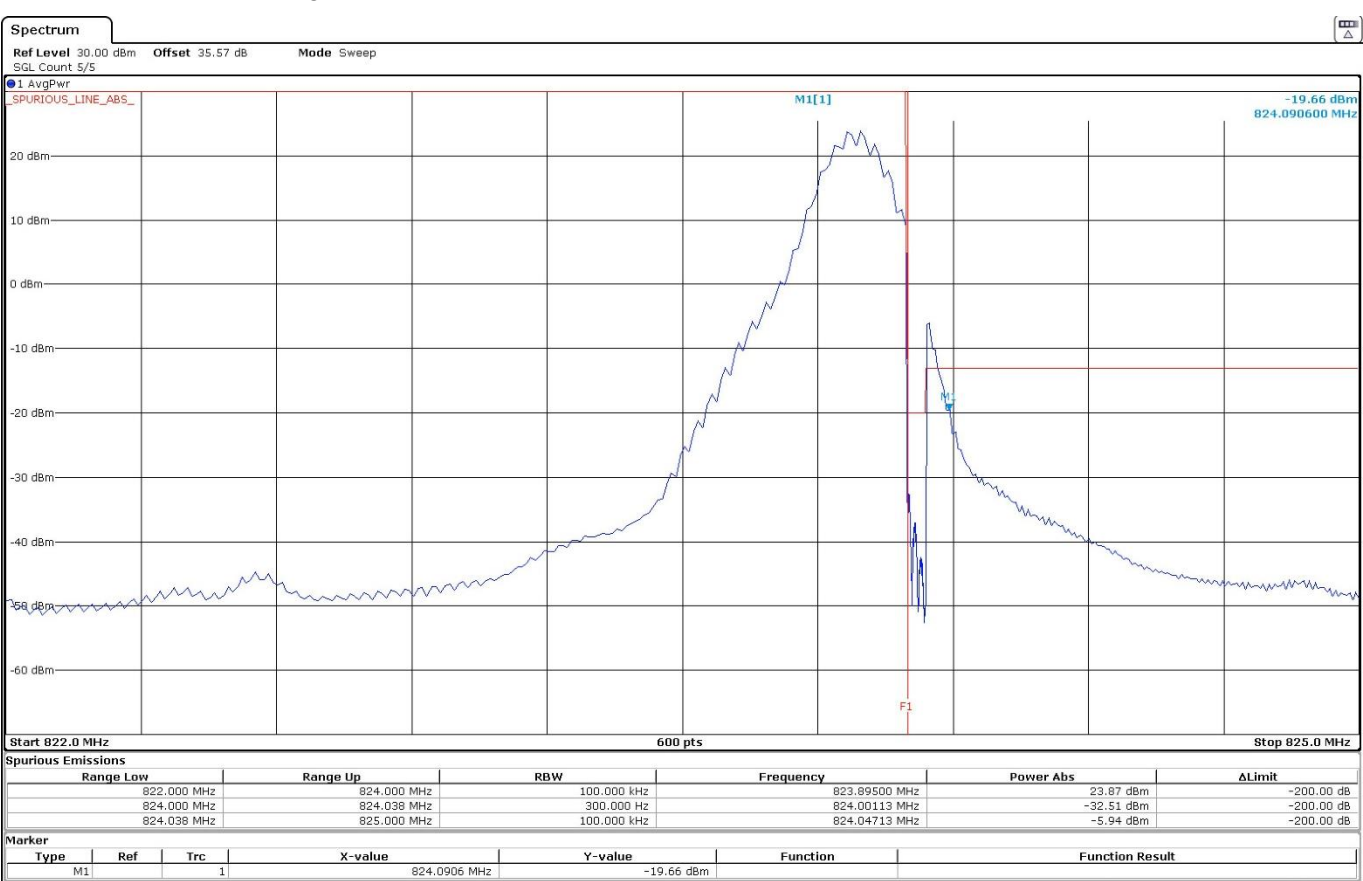
Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone



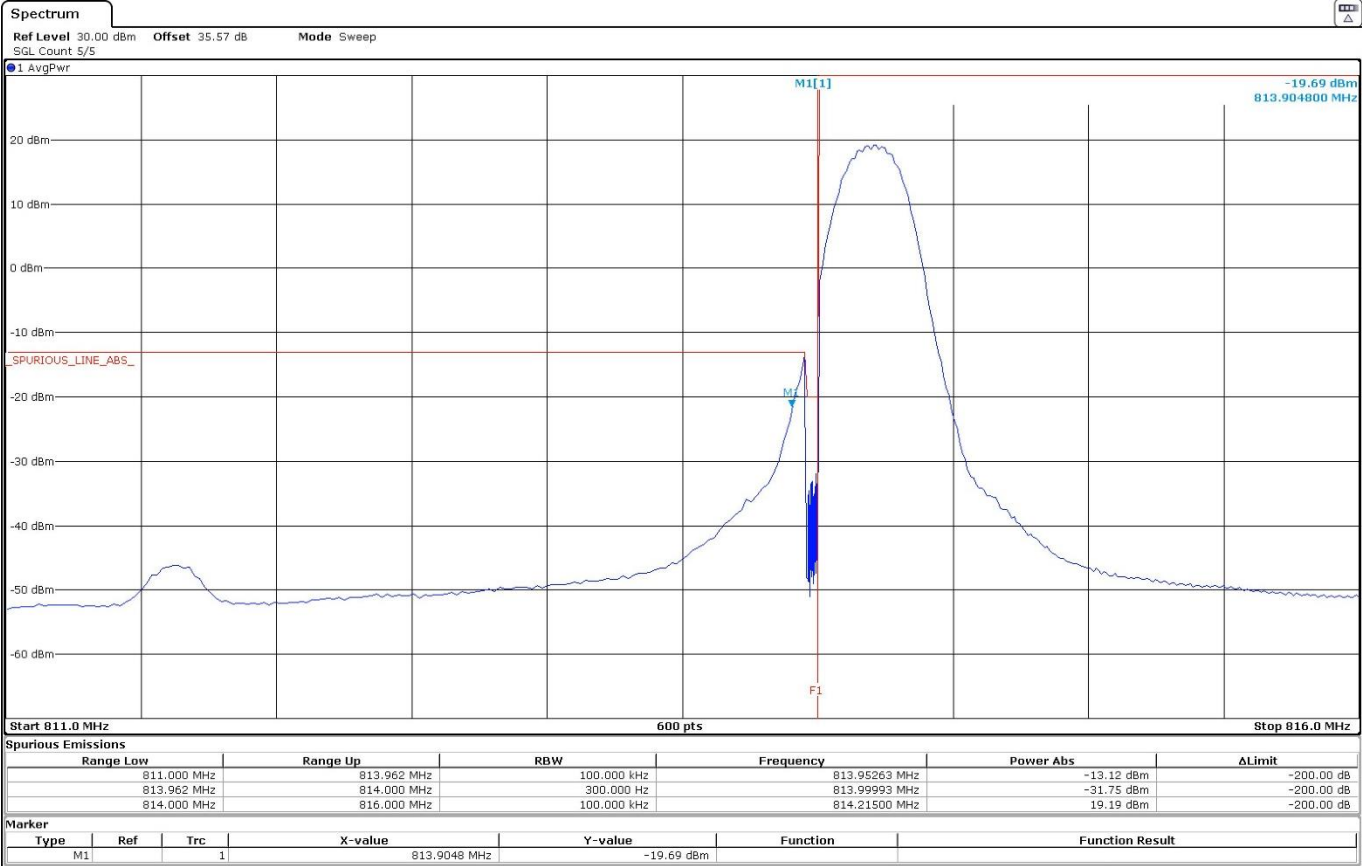
LTE Cat NB2 Band 26. Sub-band 814-824 MHz. EA MASK:      Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=0. Low Channel:



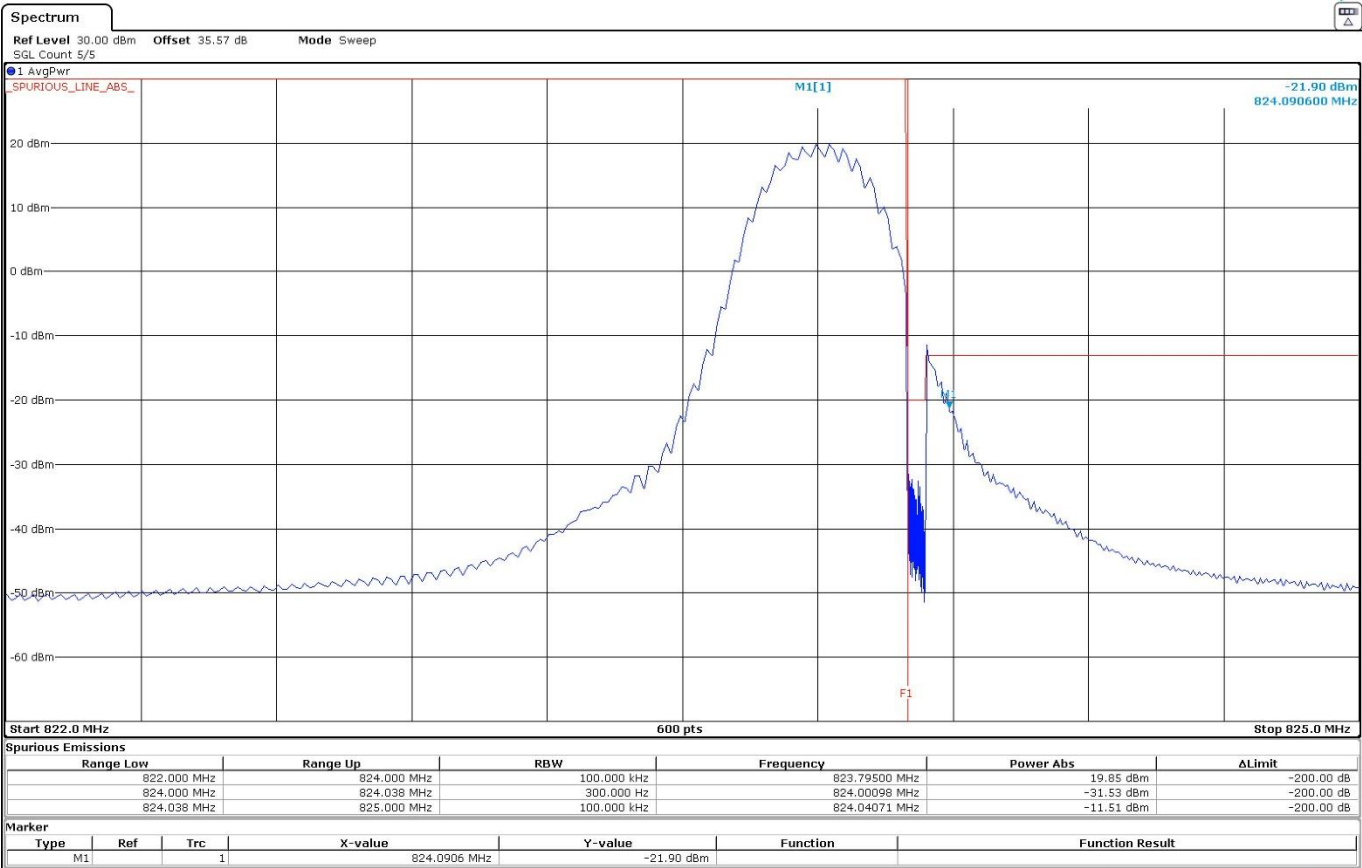
LTE Cat NB2 Band 26. Sub-band 814-824 MHz. EA MASK:      Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=0. High Channel:



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:



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:



## 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  $43 + 10 \log_{10}(P)$  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  $P_o$  transmitting power, the specified minimum attenuation  $43 + 10 \log_{10} p$  (watts) for any frequency removed from the EA licensee's frequency block greater than 37.5 kHz becomes:

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

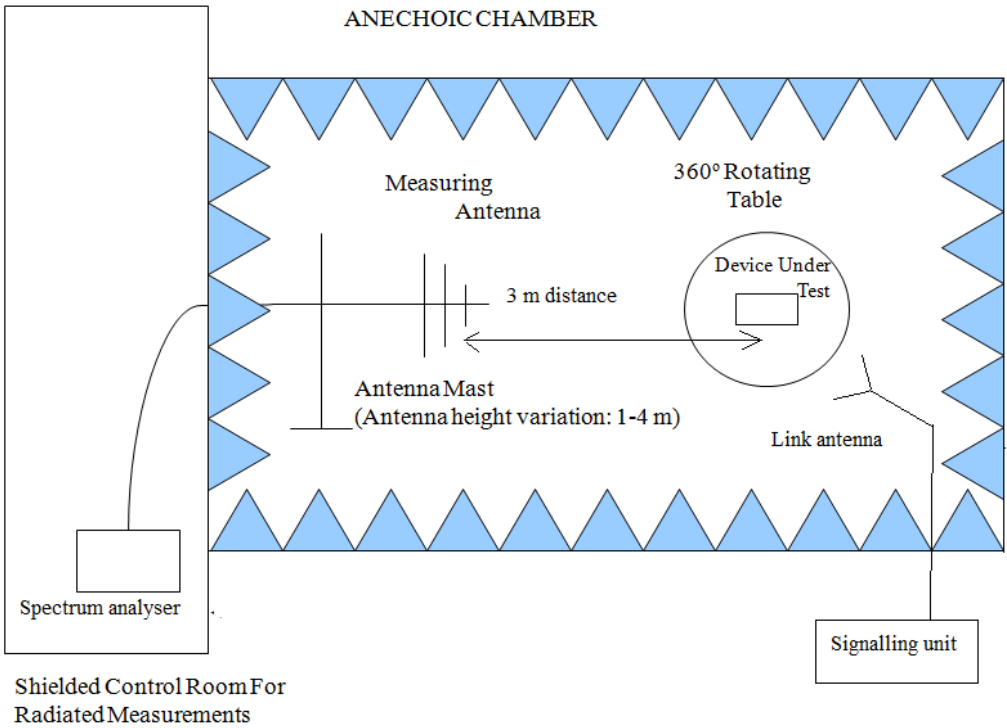
The maximum field strength (dB $\mu$ V/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

$EIRP \text{ (dBm)} = E \text{ (dB}\mu\text{V/m)} + 20 \log(D) - 104.8$ ; where D is the measurement distance (in the far field region) in m.  $D = 3 \text{ m}$

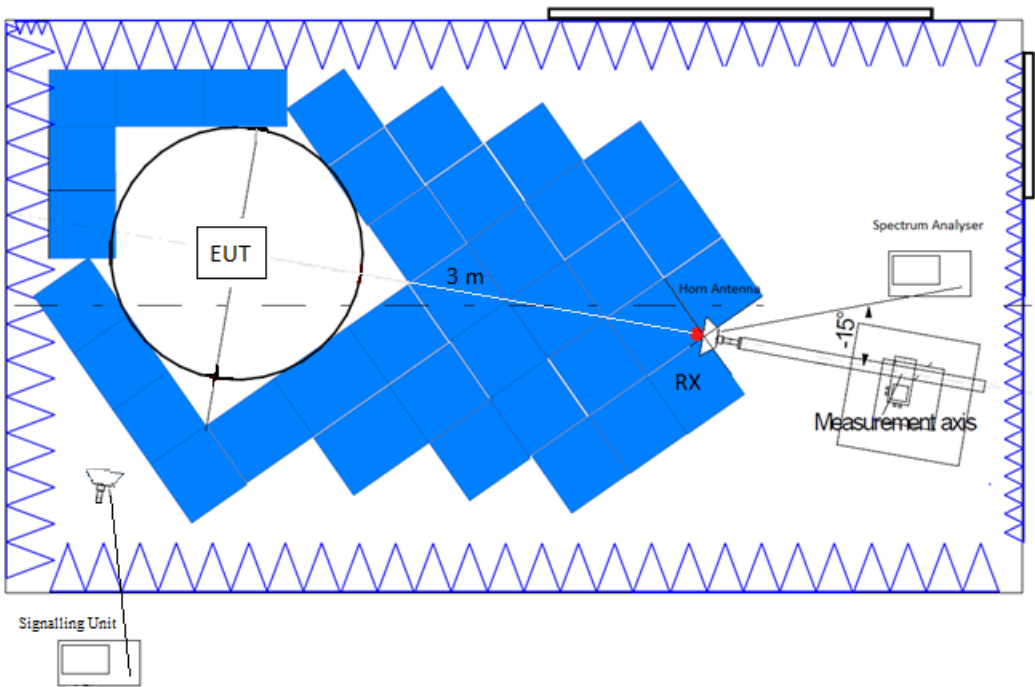
A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

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): <  $\pm 5.35$  for  $f \geq 30$  MHz up to 1 GHz  
<  $\pm 4.32$  for  $f \geq 1$  GHz up to 8.5 GHz

## Verdict

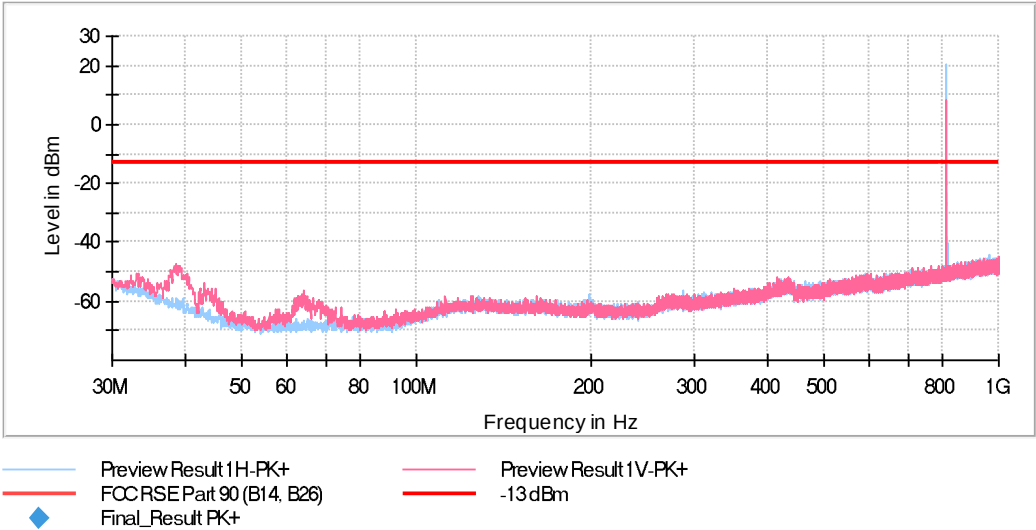
Pass

| 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:

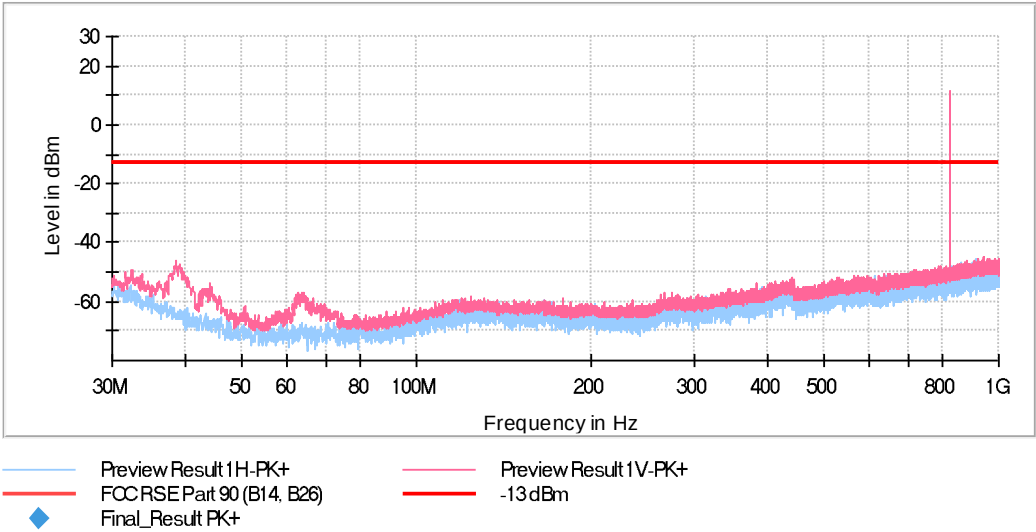
FREQUENCY RANGE 30 MHz - 1 GHz:

- LOW CHANNEL:



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

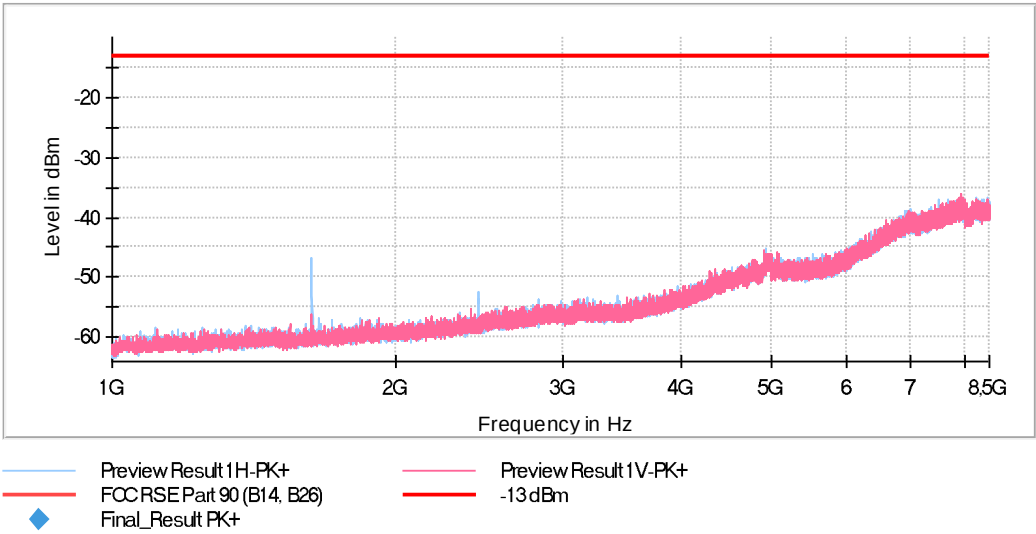
- HIGH CHANNEL:



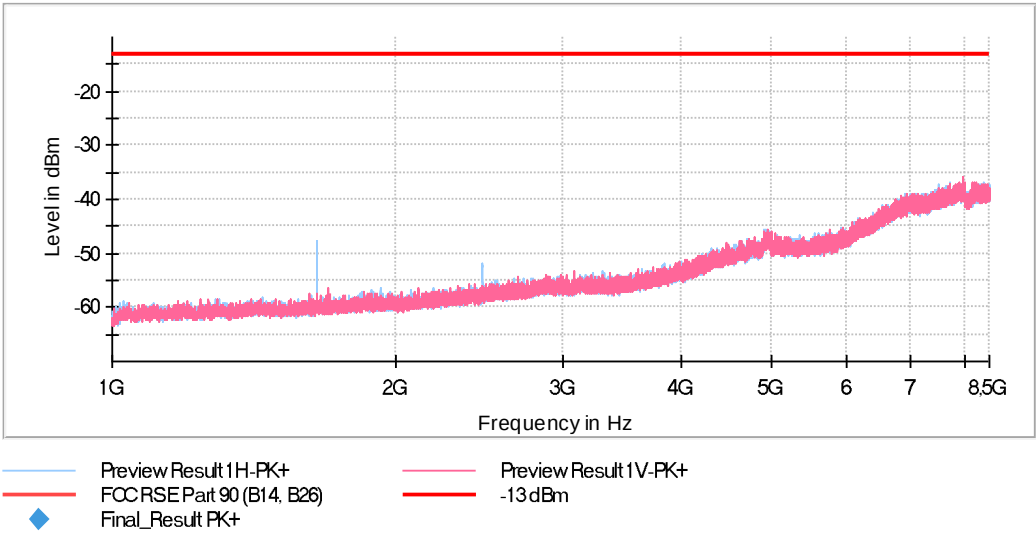
The peak above the limit is the carrier frequency:  
LTE Cat NB2 Band 26. Sub-band 814-824 MHz, 823.8 MHz

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): <  $\pm 5.35$  for  $f \geq 30$  MHz up to 1 GHz  
<  $\pm 4.32$  for  $f \geq 1$  GHz up to 8.5 GHz

#### ***Verdict***

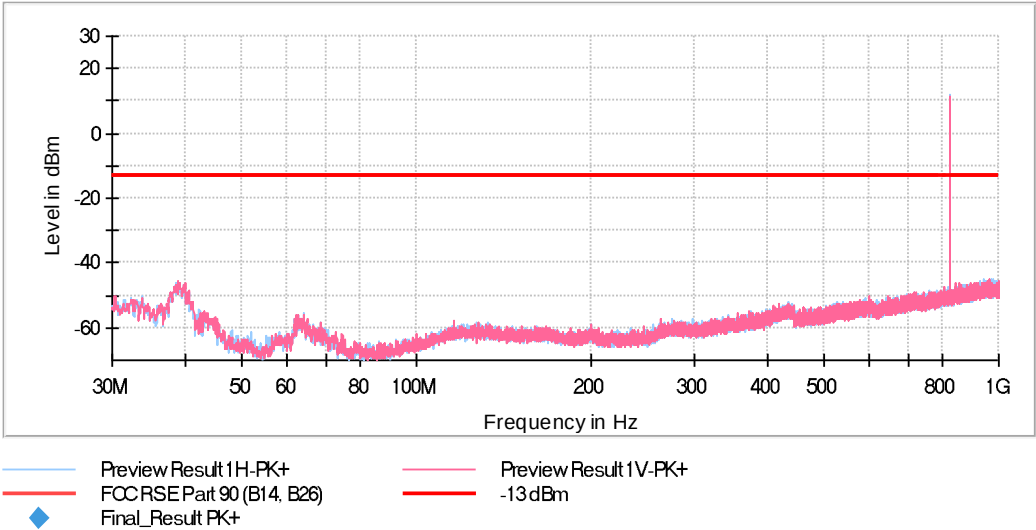
Pass

| 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):

