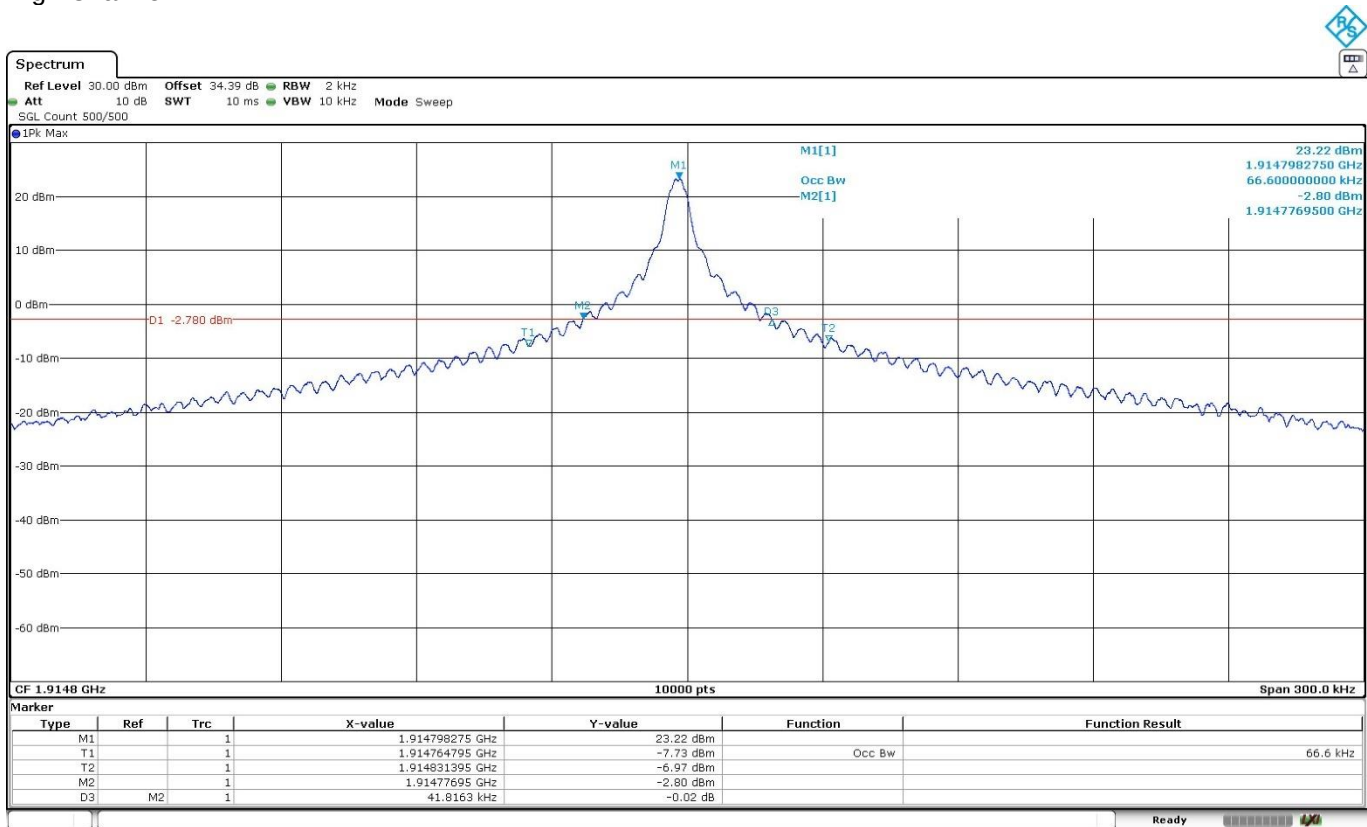


High Channel:



LTE Cat NB1 Band 25. 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)  | 127.71000   | 126.90000      | 125.49000    |
| -26 dBc Bandwidth (kHz)       | 133.34790   | 130.55900      | 113.29420    |
| Measurement uncertainty (kHz) | <±0.25      |                |              |

LTE Cat NB1 Band 25. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=3.

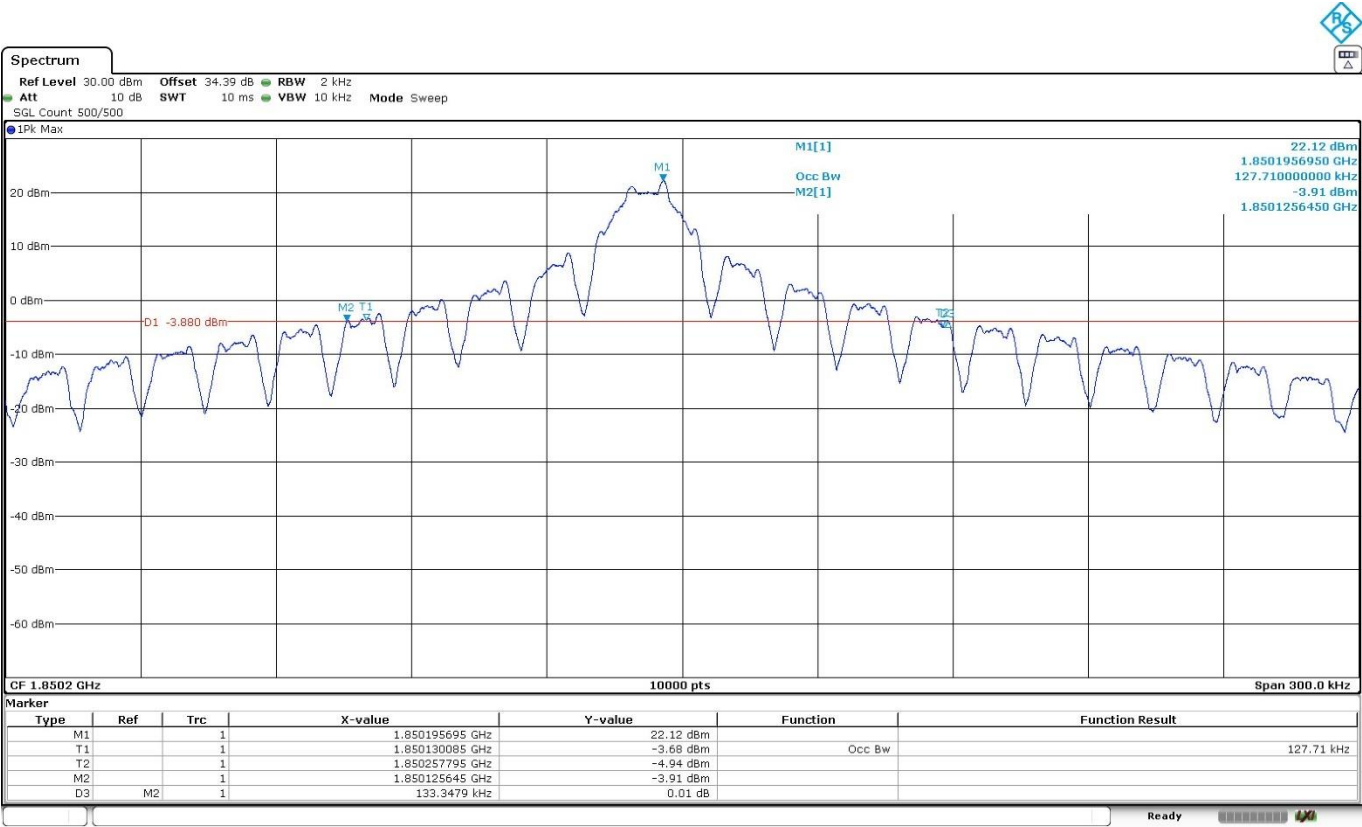
|                               | Low Channel | Middle Channel | High Channel |
|-------------------------------|-------------|----------------|--------------|
| 99% Occupied Bandwidth (kHz)  | 127.56000   | 126.39000      | 126.60000    |
| -26 dBc Bandwidth (kHz)       | 131.72790   | 154.23100      | 158.47140    |
| Measurement uncertainty (kHz) | <±0.25      |                |              |

LTE Cat NB1 Band 25. QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5.

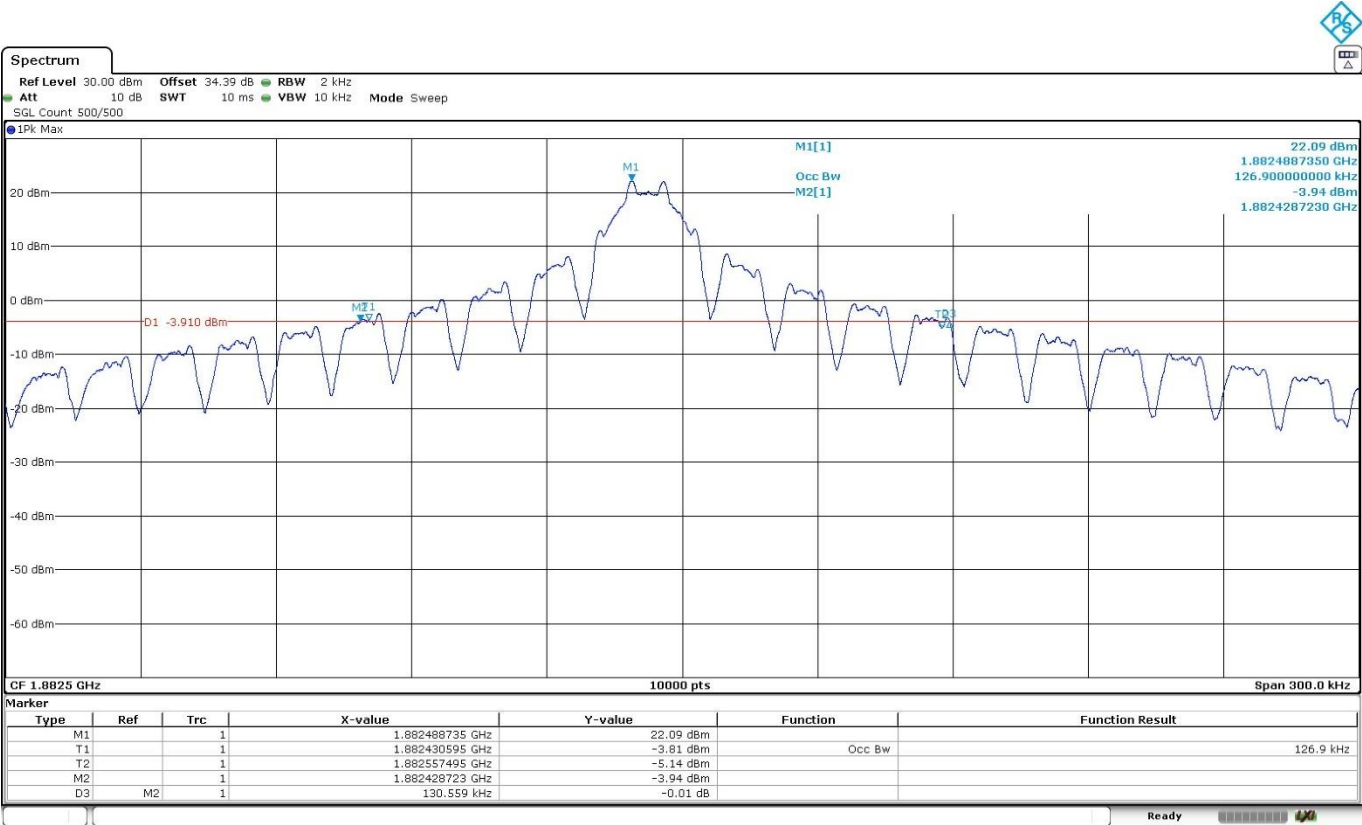
|                               | Low Channel | Middle Channel | High Channel |
|-------------------------------|-------------|----------------|--------------|
| 99% Occupied Bandwidth (kHz)  | 188.40000   | 187.90000      | 188.50000    |
| -26 dBc Bandwidth (kHz)       | 312.45900   | 302.56410      | 321.29000    |
| Measurement uncertainty (kHz) | <±0.25      |                |              |

LTE Cat NB1 Band 25. Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=0.

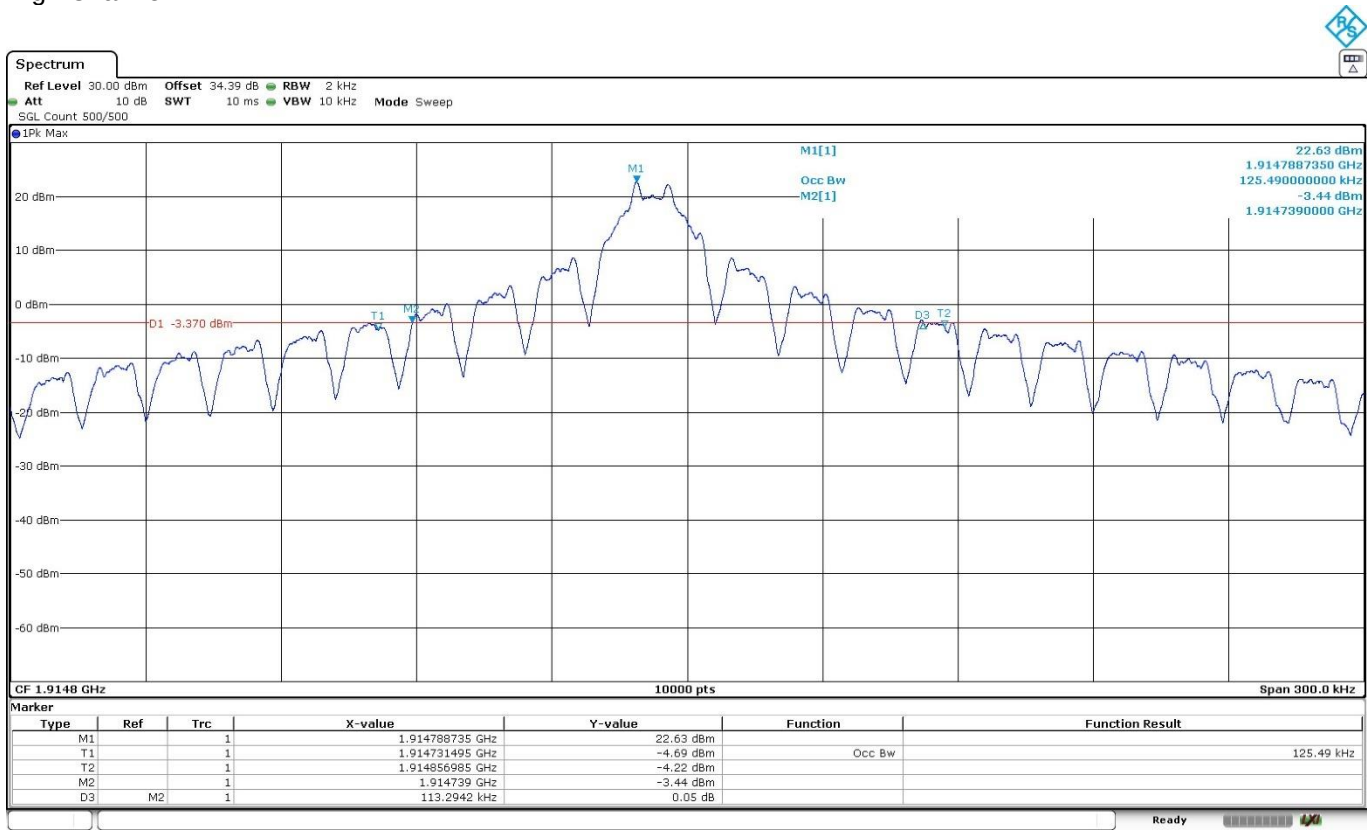
Low Channel:



Middle Channel:

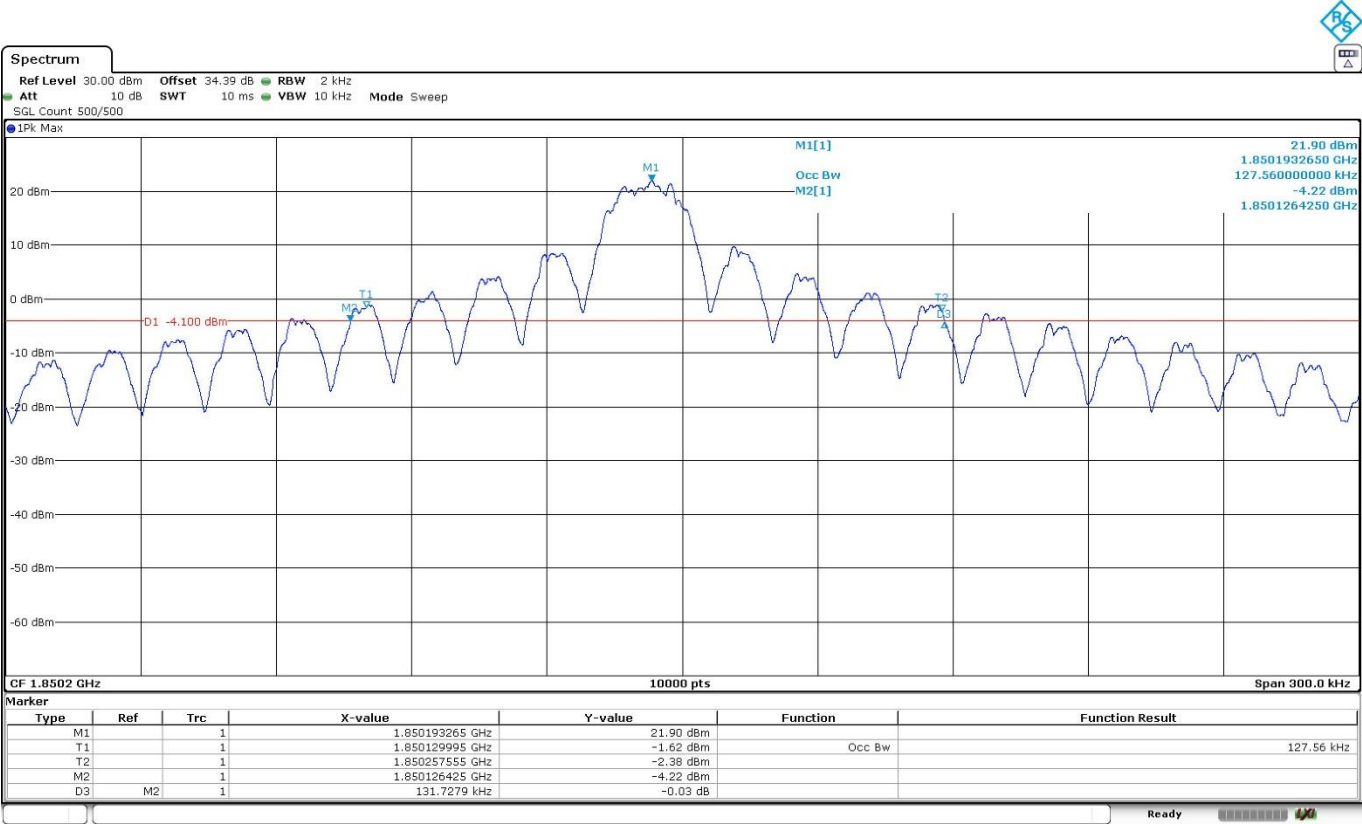


High Channel:

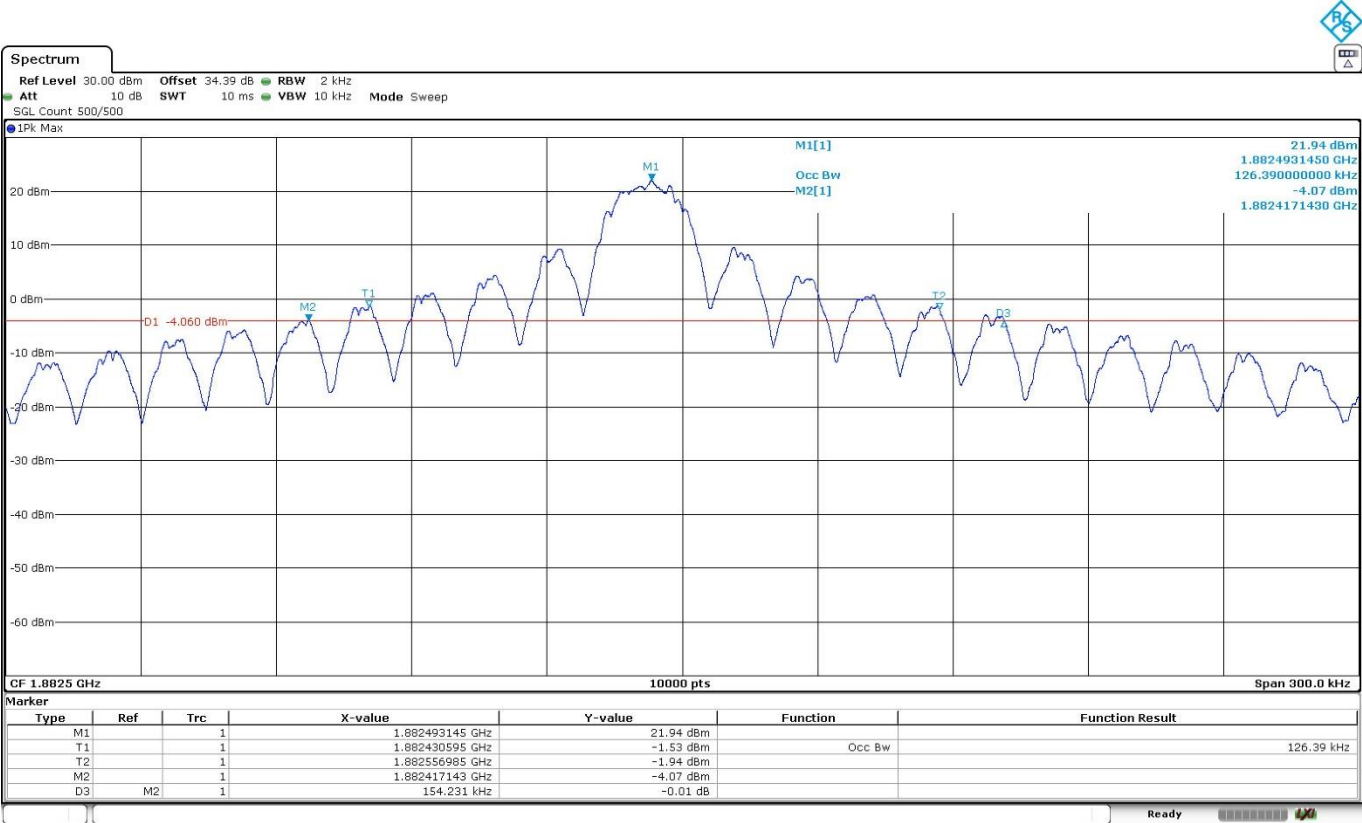


LTE Cat NB1 Band 25. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=5. MSC/TBS=3.

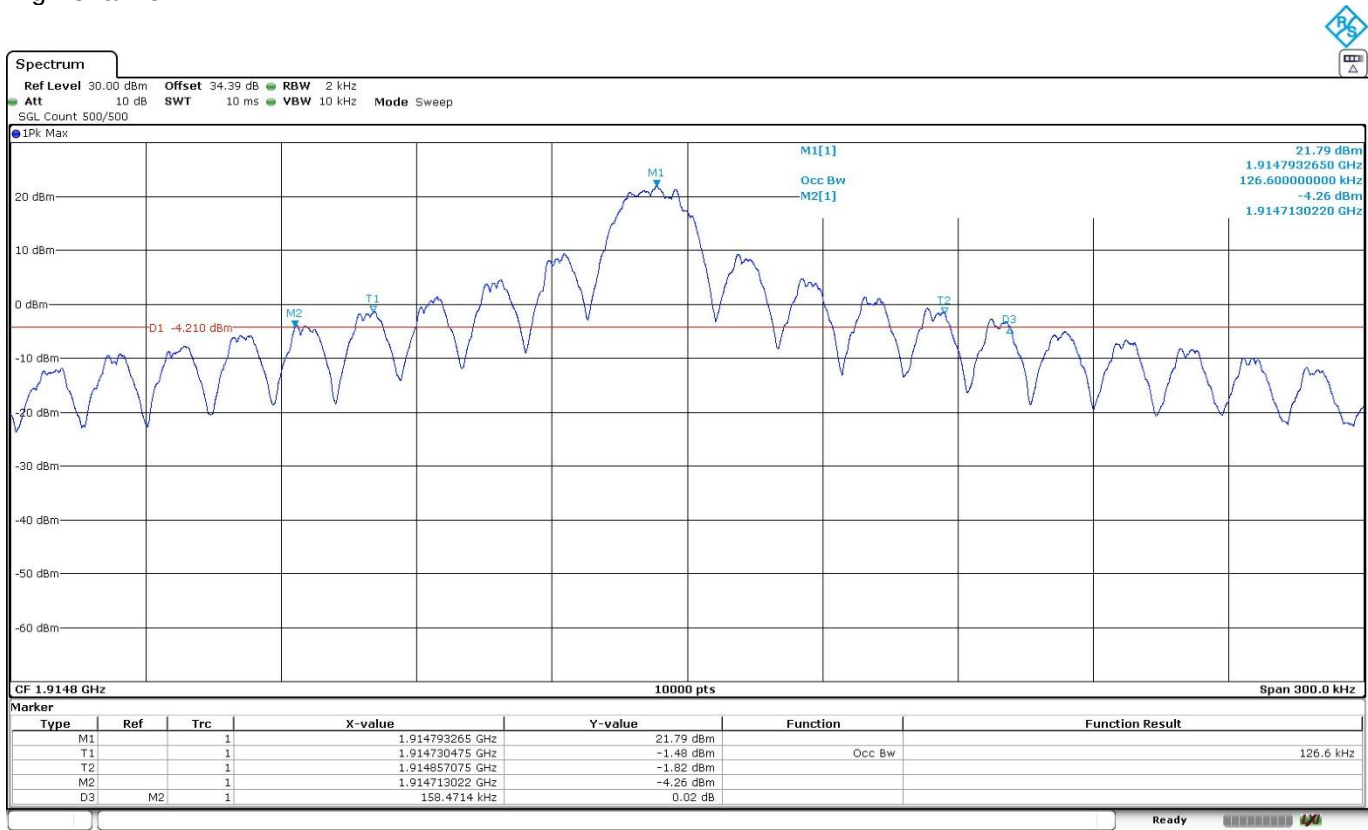
Low Channel:



Middle Channel:

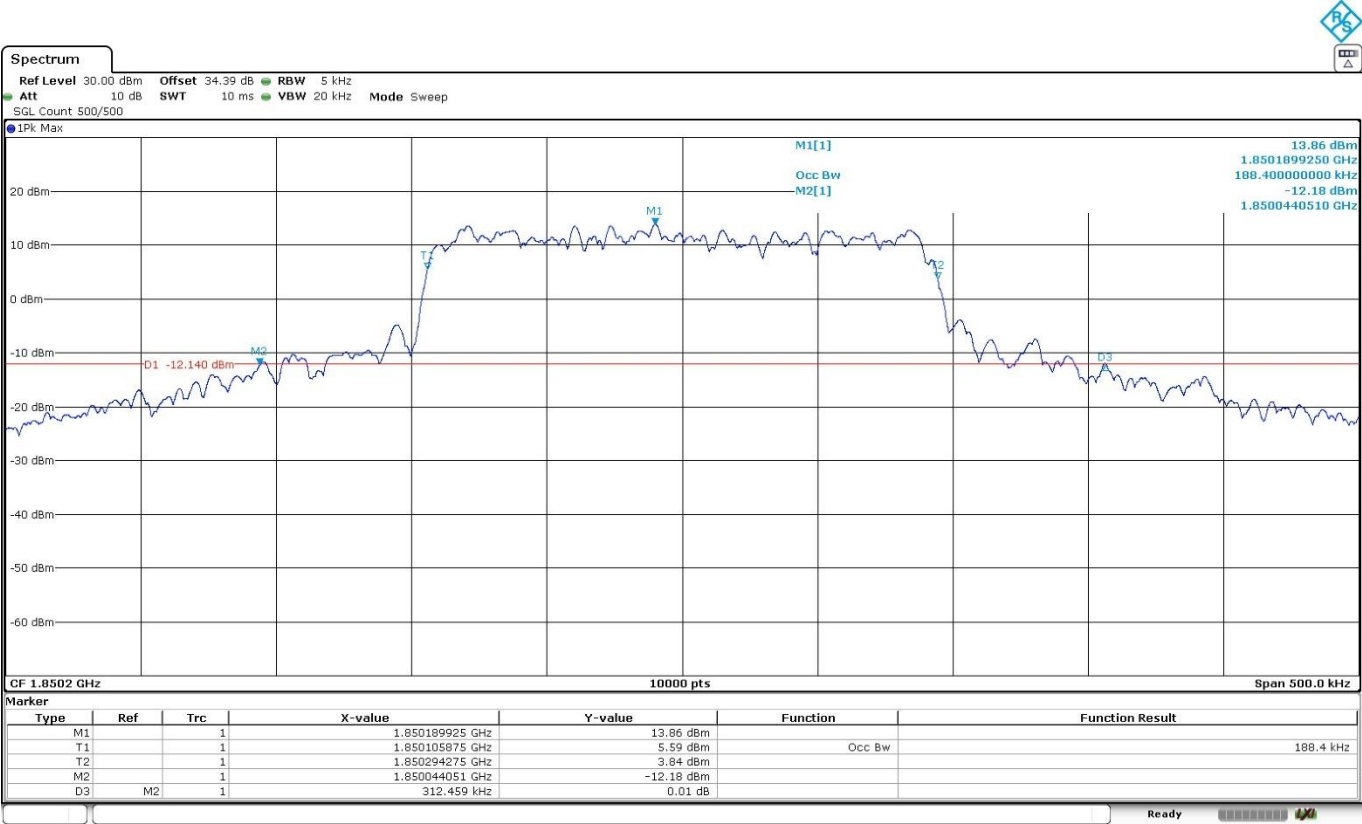


High Channel:

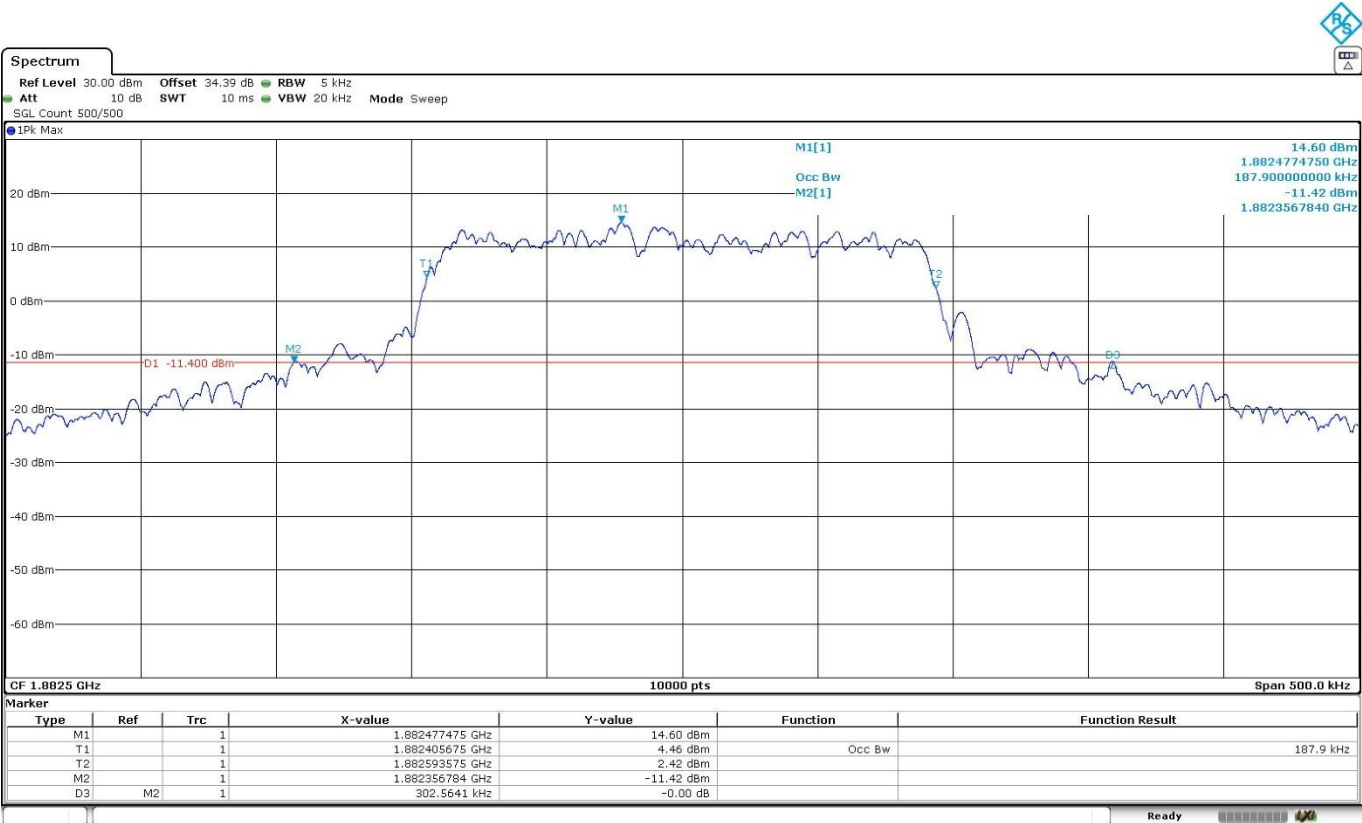


LTE Cat NB1 Band 25. QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5.

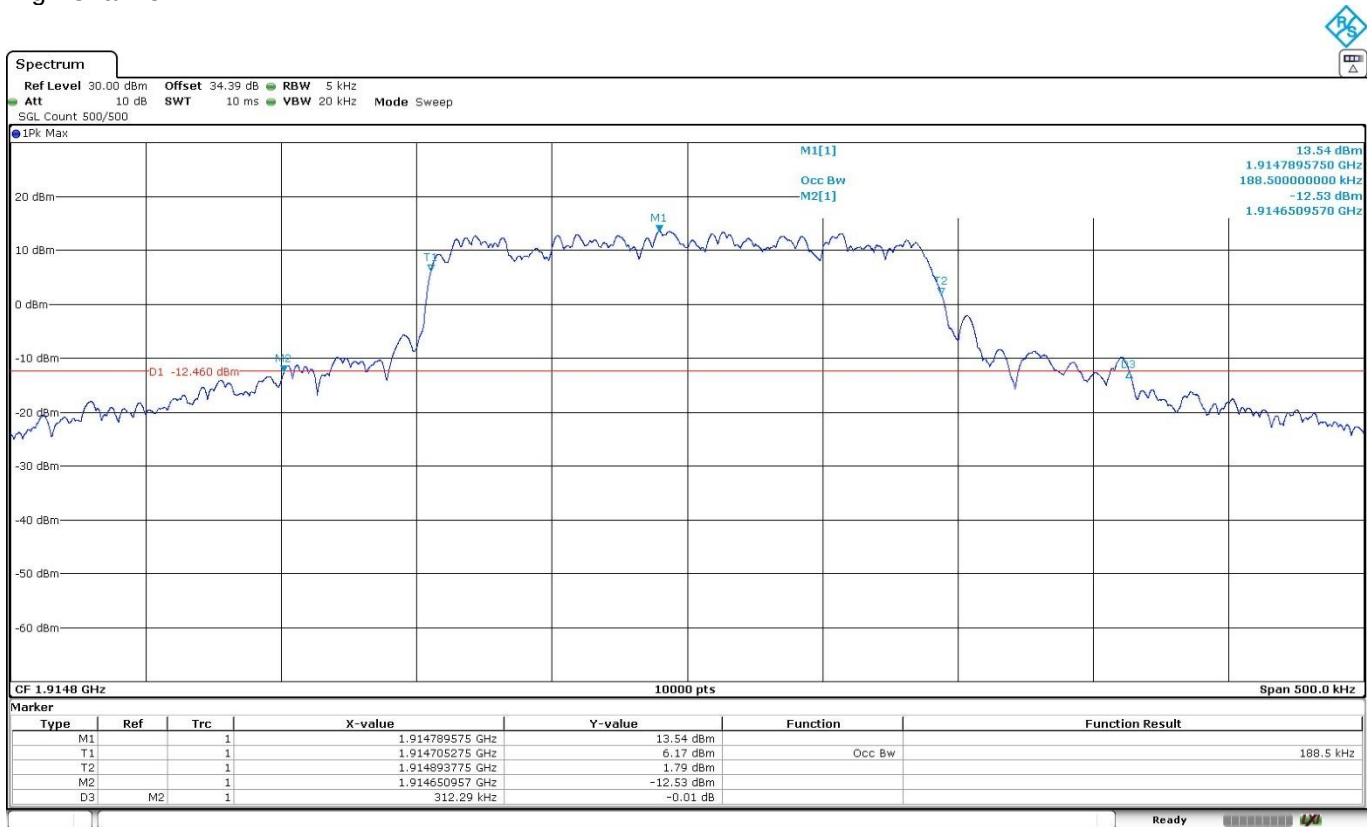
Low Channel:



Middle Channel:



High Channel:



## Spurious emissions at antenna terminals

### 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.

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

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

### 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 spectrum was investigated from 9 kHz to 20 GHz for NB-IoT Band 25.

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.

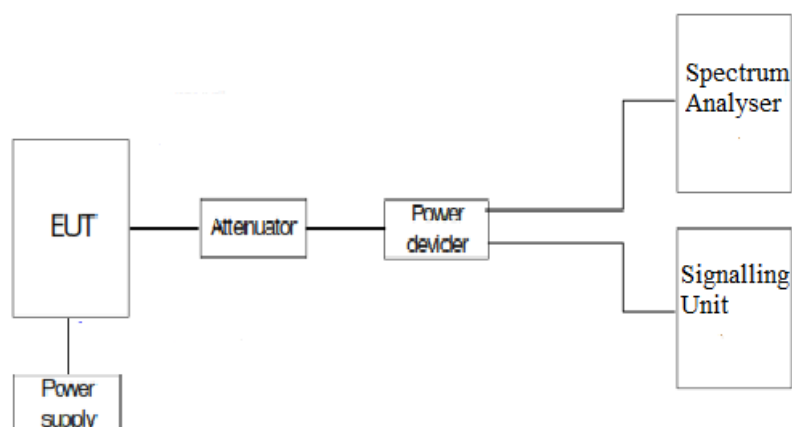
Measurement Limit:

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 NB1 Band 25:

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 - 20 GHz:

- Low Channel: No spurious signals found.
- Middle Channel: No spurious signals found.
- High Channel: No spurious signals found.

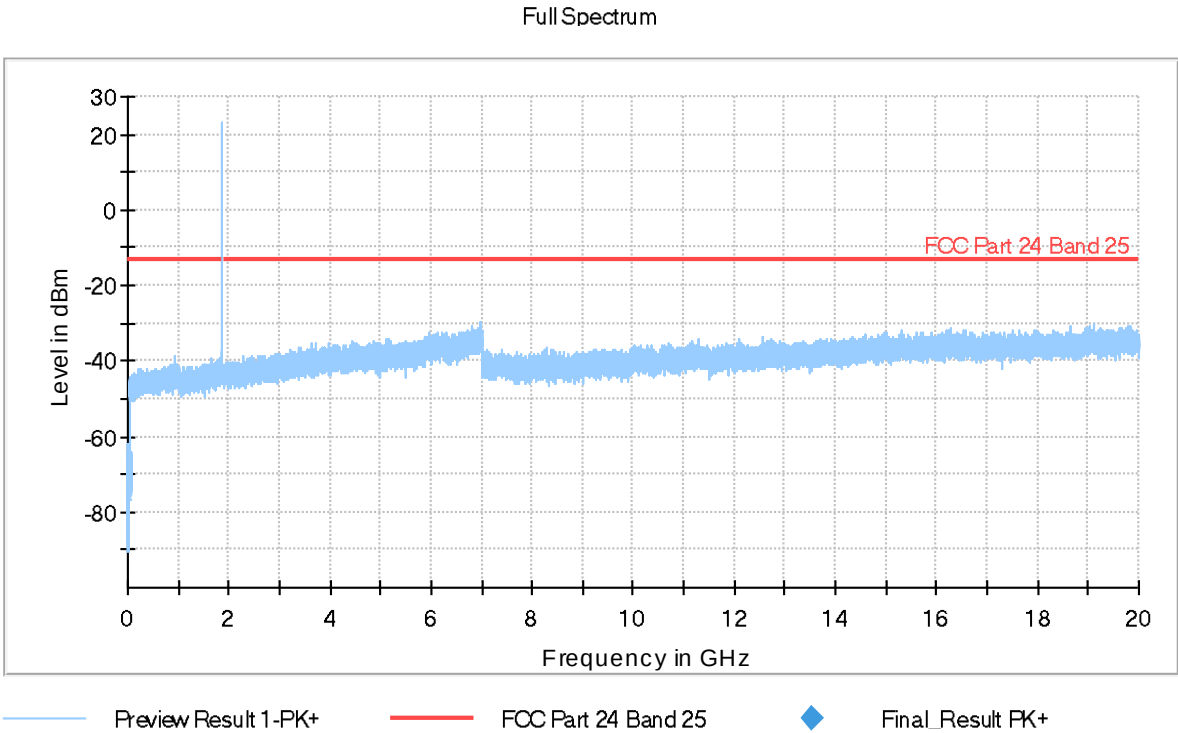
Measurement uncertainty (dB):  $<\pm 2.76$

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   | 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   |

**LTE Cat-NB1 Band 25:** Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=0.

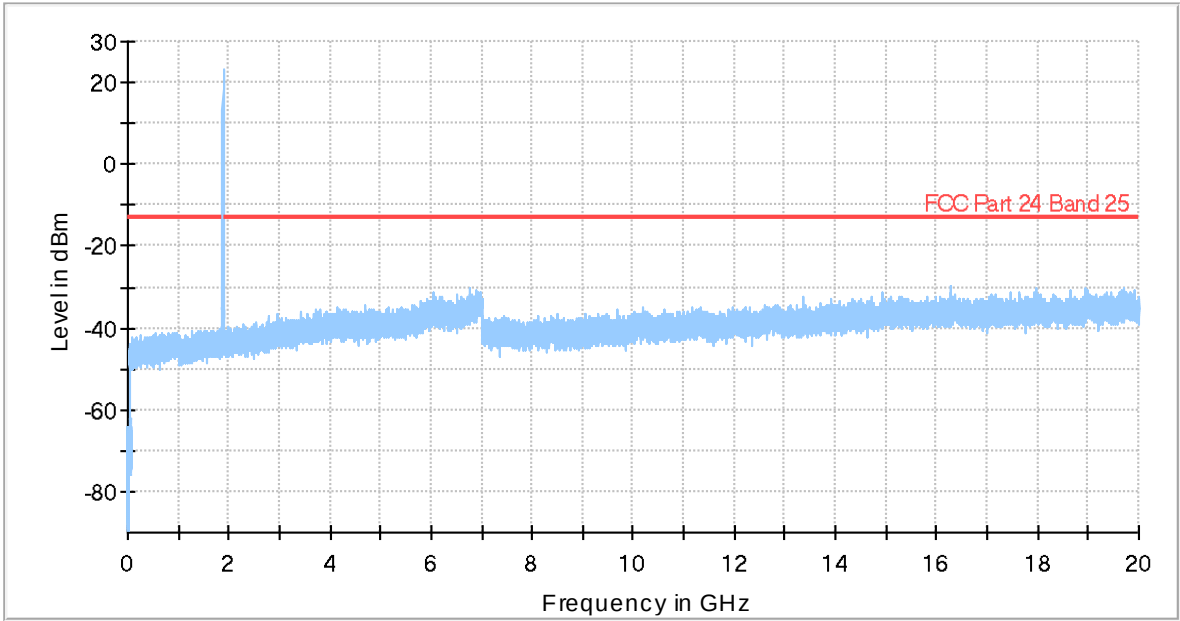
Low Channel:



The peak above the limit is the carrier frequency.

Middle Channel:

Full Spectrum

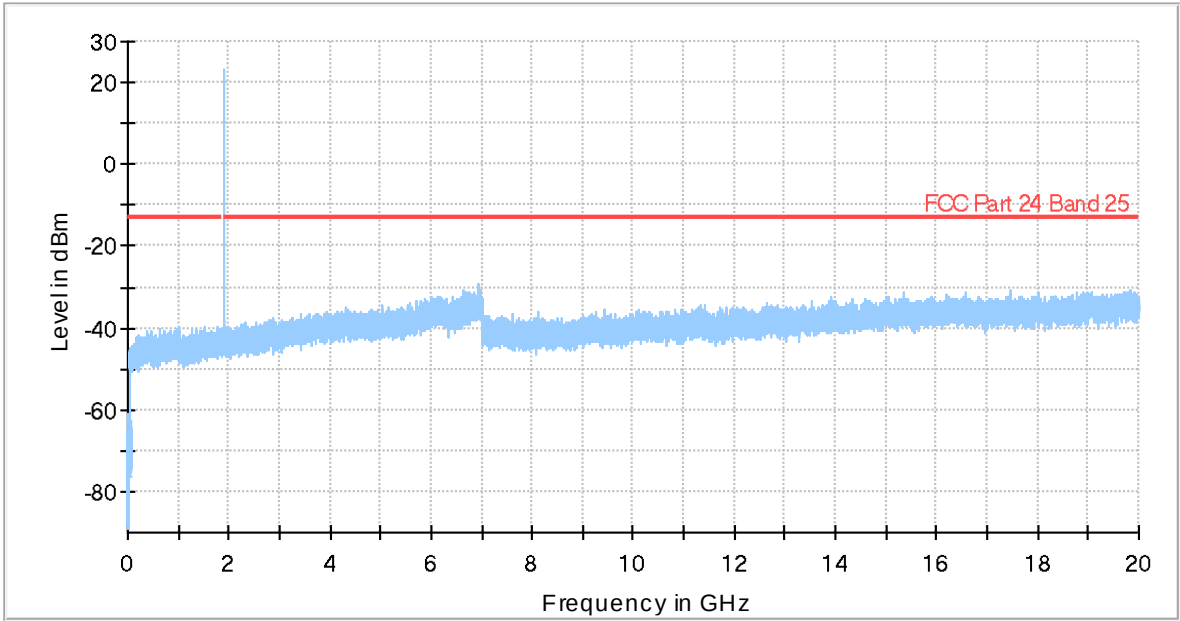


Preview Result 1-PK+      FCC Part 24 Band 25      Final Result PK+

The peak above the limit is the carrier frequency.

High Channel:

Full Spectrum



Preview Result 1-PK+      FCC Part 24 Band 25      Final Result PK+

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 Clause 6.5.:

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

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

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

### Method

The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50 ohm attenuator and a power splitter.

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

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

As indicated in FCC part 24. in the 1 MHz bands immediately outside and adjacent to the licensee's frequency block. a resolution bandwidth of at least one percent of the emission bandwidth/occupied bandwidth of the fundamental emission of the transmitter may be employed.

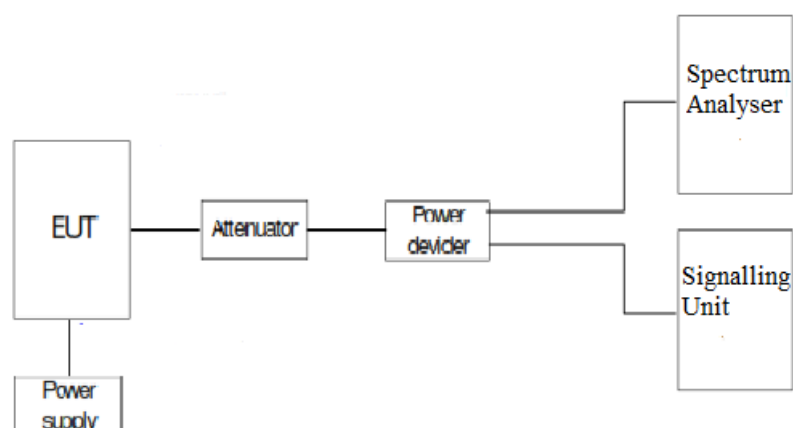
Measurement Limit:

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 NB1 Band 2:

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

Low Block Edge.

Note: Low Block Edge for LTE Cat NB1 Band 2 is the same as for LTE Cat NB1 Band 25.

High Block Edge.

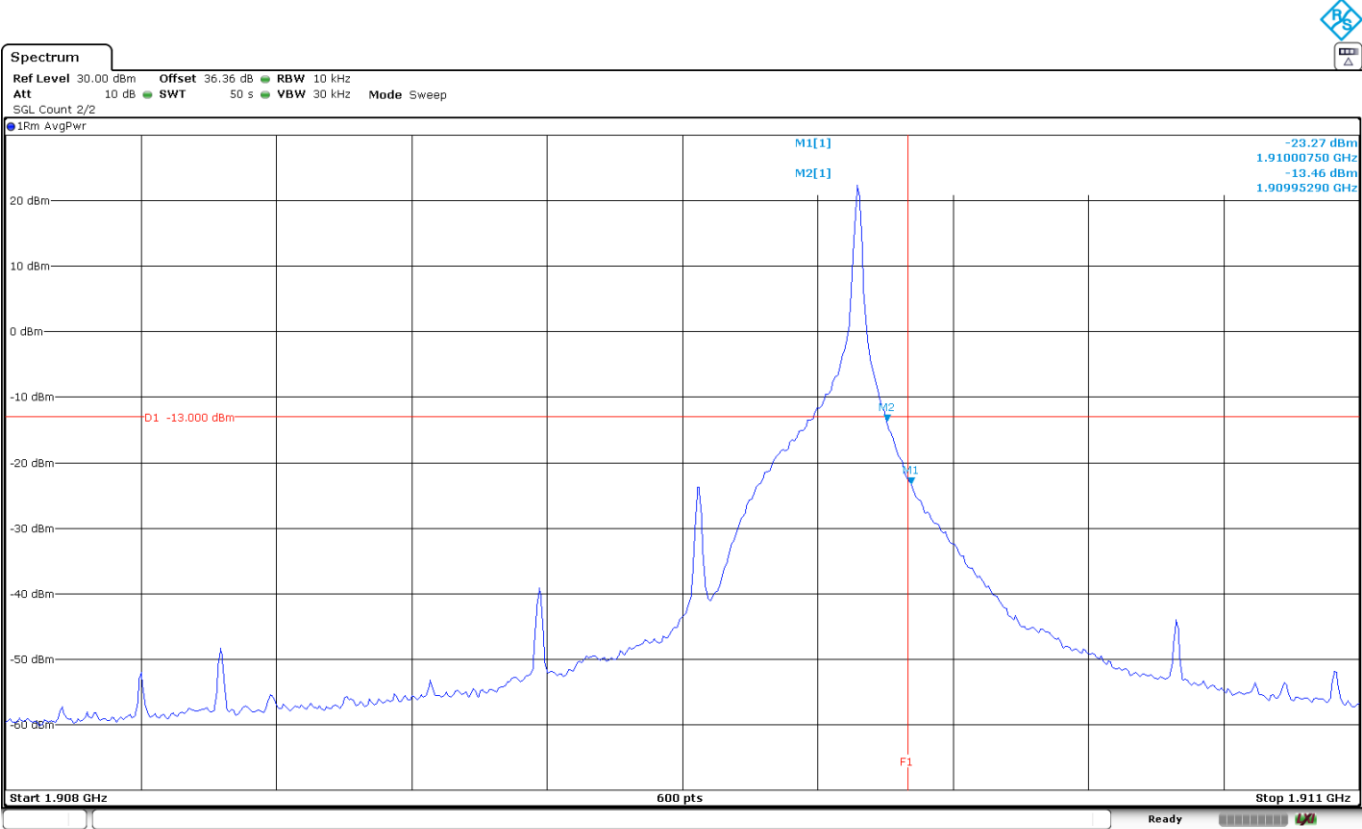
| LTE Cat NB1 Band 2                                                           | Pi/2-BPSK<br>BW=3.75 kHz<br>Tone Number=1<br>Tone Offset=47<br>MSC/TBS=0 | Pi/2-BPSK<br>BW=15 kHz<br>Tone Number=1<br>Tone Offset=11<br>MSC/TBS=0 | QPSK<br>BW=15 kHz<br>Tone Number=12<br>Tone Offset=0<br>MSC/TBS=5 |
|------------------------------------------------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------|
| Maximum measured level<br>at <u>High Block Edge</u> at<br>antenna port (dBm) | -23.27                                                                   | -22.88                                                                 | -22.57                                                            |

Measurement uncertainty (dB): <±2.76

Verdict

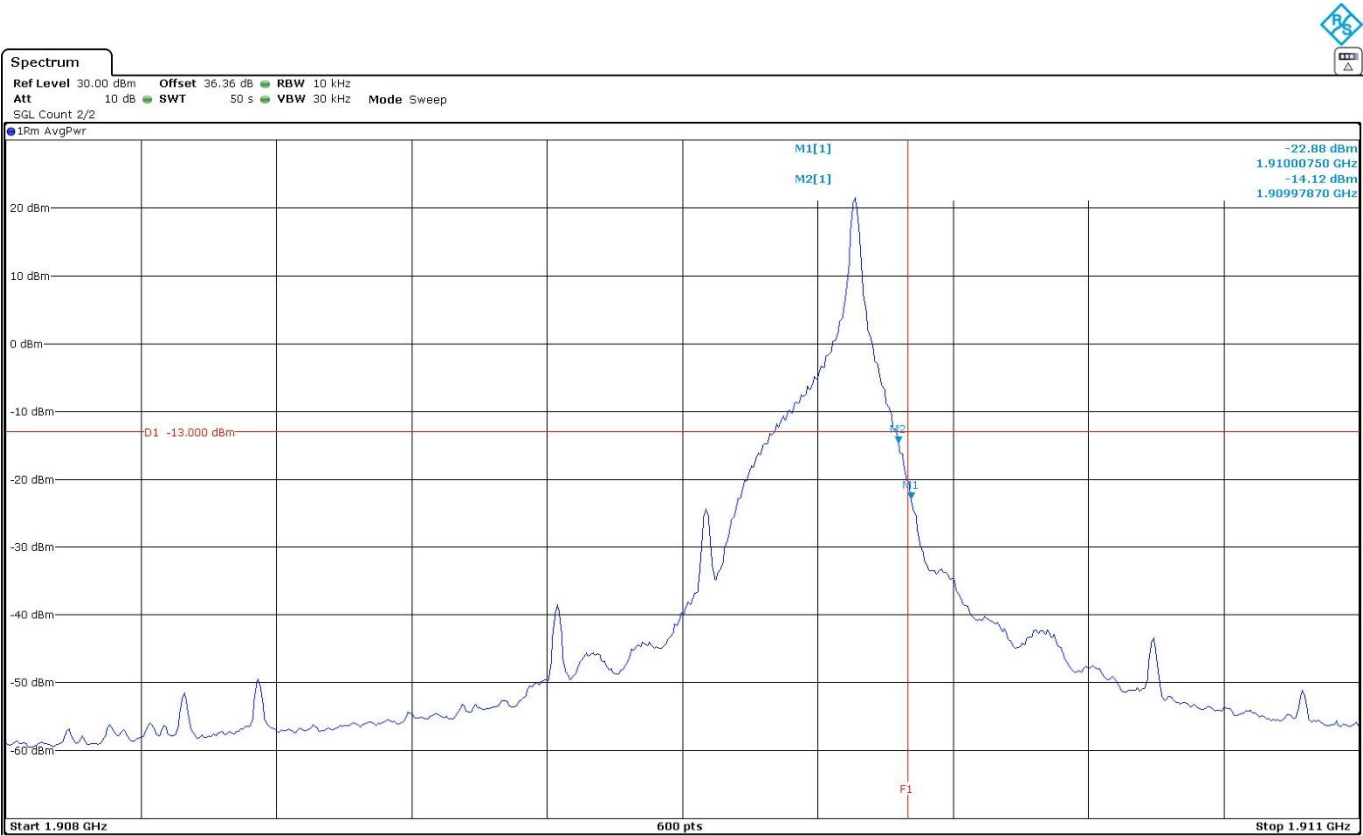
Pass

LTE Cat NB1 Band 2. Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=47. MSC/TBS=0. High Channel:



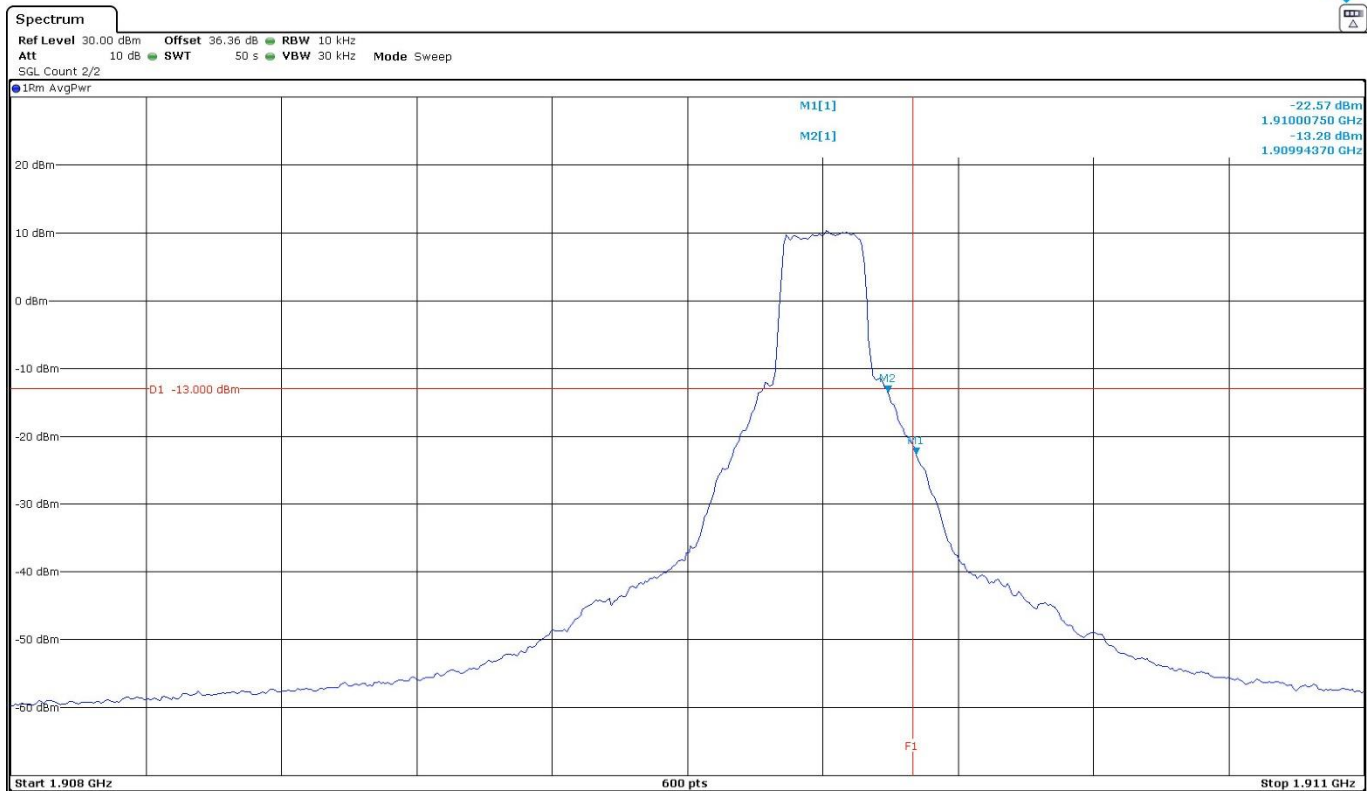
The equipment transmits at the maximum output power

LTE Cat NB1 Band 2. Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=11. MSC/TBS=0. High Channel:



The equipment transmits at the maximum output power

LTE Cat NB1 Band 2. QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5. High Channel:



The equipment transmits at the maximum output power

**LTE Cat NB1 Band 25:**

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

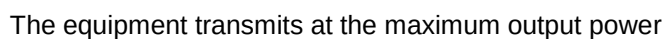
|                                                                             |                                                                         |                                                                       |                                                                   |
|-----------------------------------------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------------|
| LTE Cat NB1 Band 25                                                         | Pi/4-QPSK<br>BW=3.75 kHz<br>Tone Number=1<br>Tone Offset=0<br>MSC/TBS=0 | Pi/4-QPSK<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) | -23.32                                                                  | -23.13                                                                | -22.74                                                            |

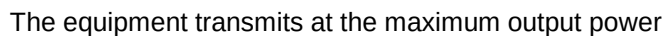
|                                                                              |                                                                          |                                                                        |                                                                   |
|------------------------------------------------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------|
| LTE Cat NB1 Band 25                                                          | Pi/4-QPSK<br>BW=3.75 kHz<br>Tone Number=1<br>Tone Offset=47<br>MSC/TBS=0 | Pi/4-QPSK<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) | -23.85                                                                   | -23.01                                                                 | -22.88                                                            |

Measurement uncertainty (dB): <±2.76

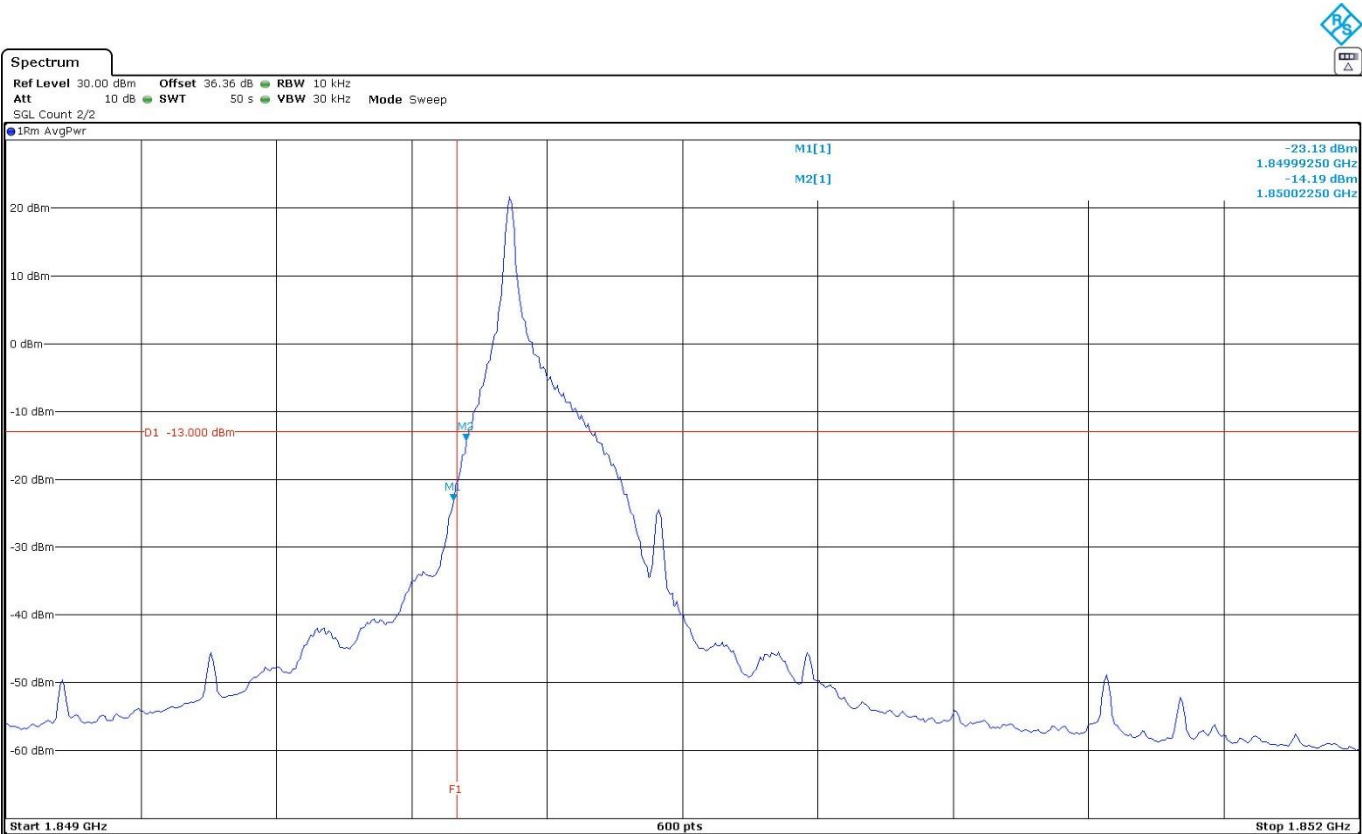
**Verdict**

Pass



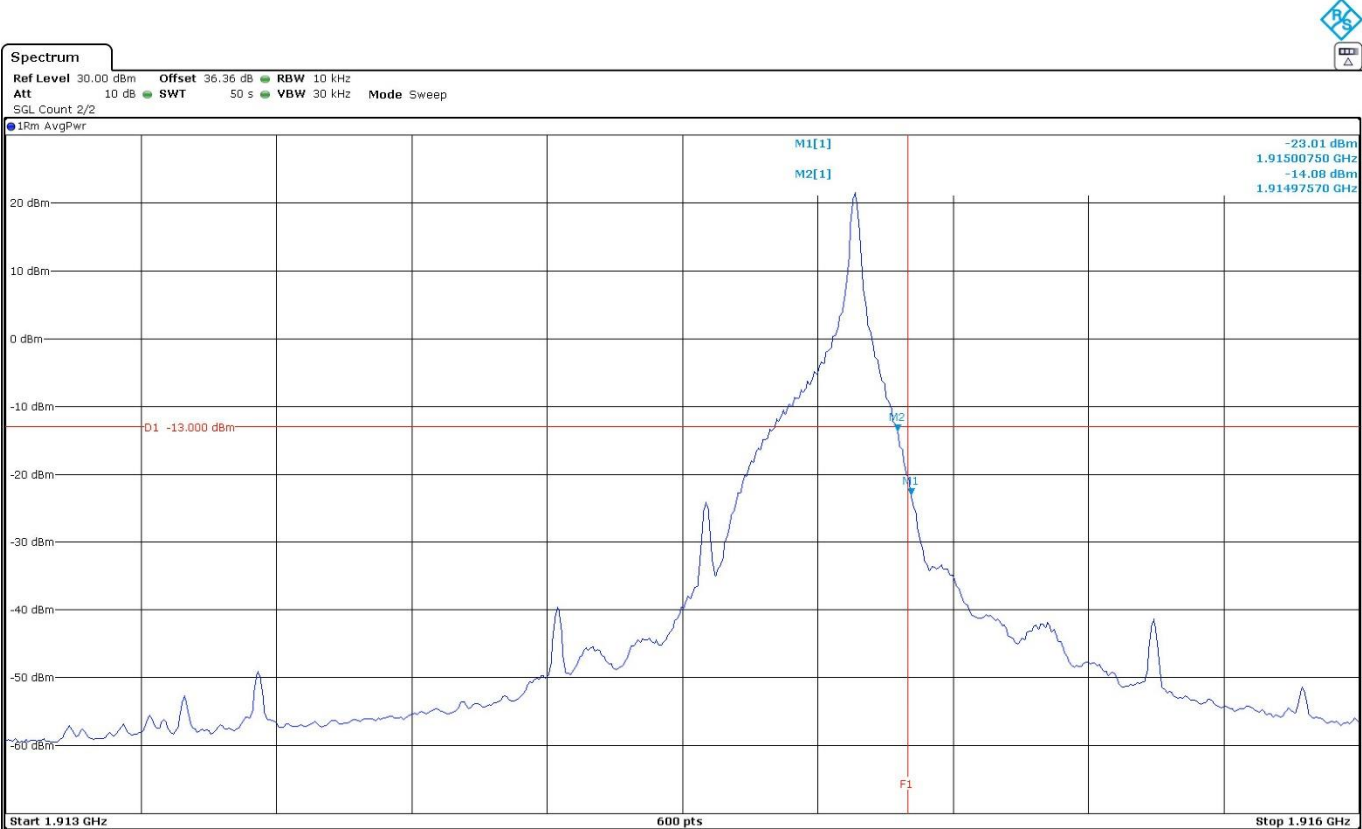


LTE Cat NB1 Band 25. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=0. Low Channel:



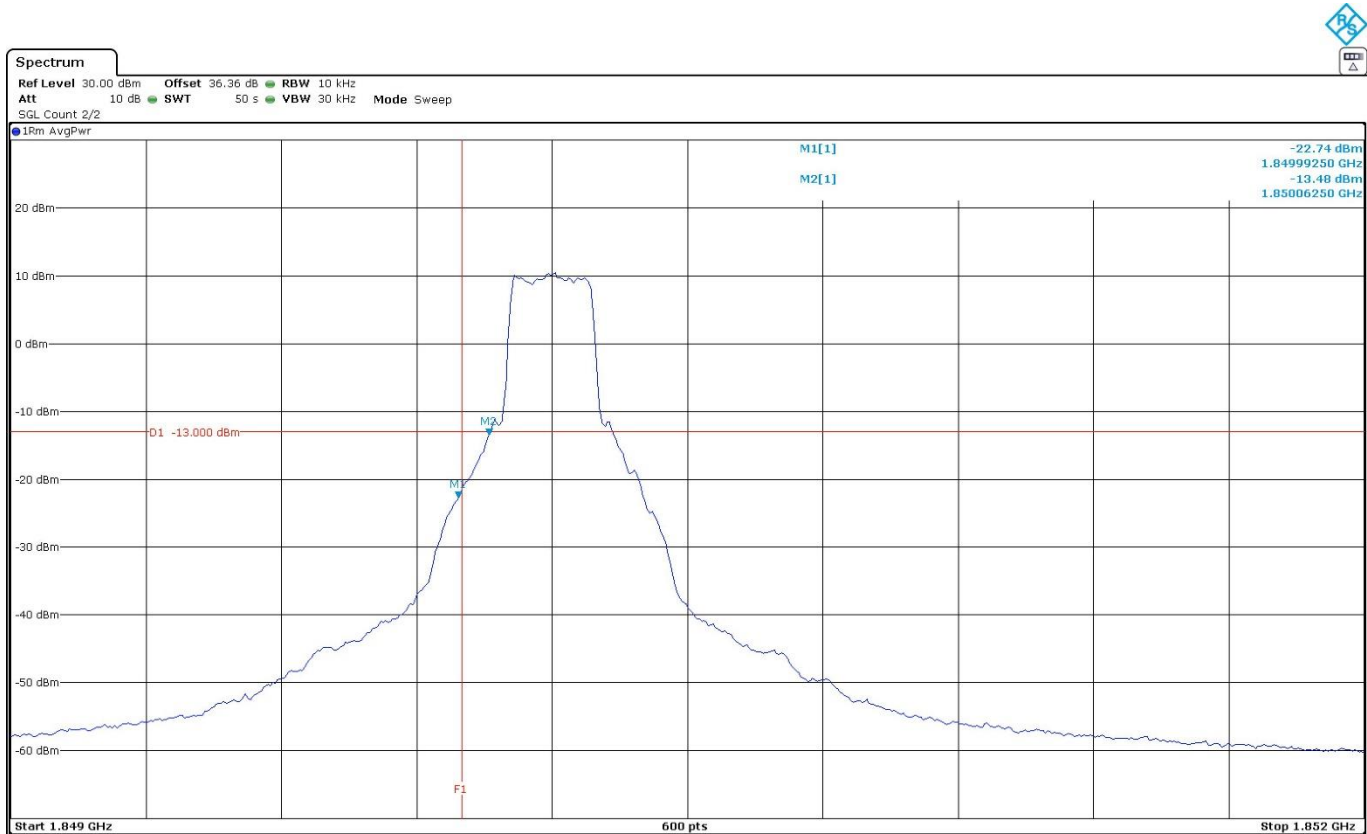
The equipment transmits at the maximum output power

LTE Cat NB1 Band 25. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=11. MSC/TBS=0. High Channel:



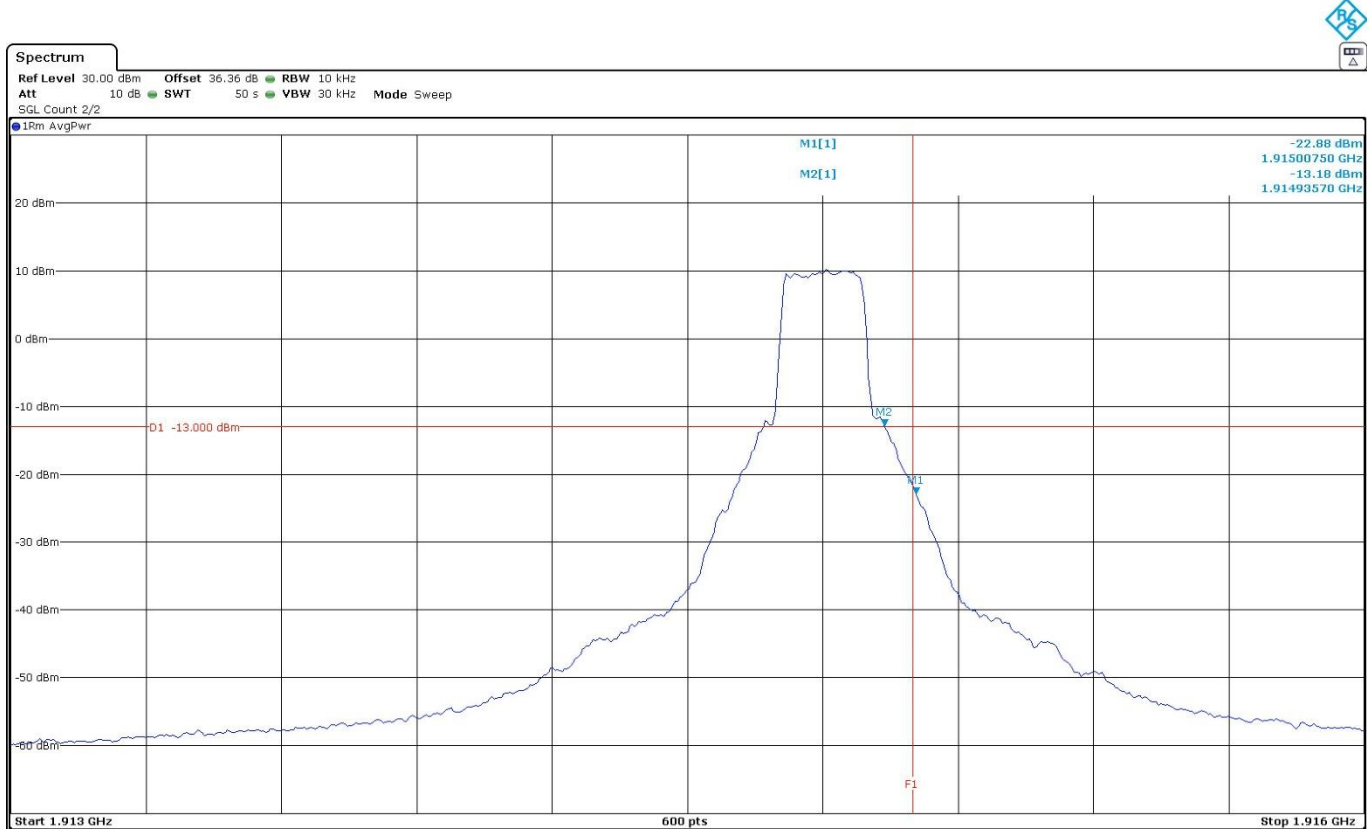
The equipment transmits at the maximum output power

LTE Cat NB1 Band 25. QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5. Low Channel:



The equipment transmits at the maximum output power

LTE Cat NB1 Band 25. QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5. High Channel:



The equipment transmits at the maximum output power

## Radiated emissions

### Limits

FCC § 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.

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

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

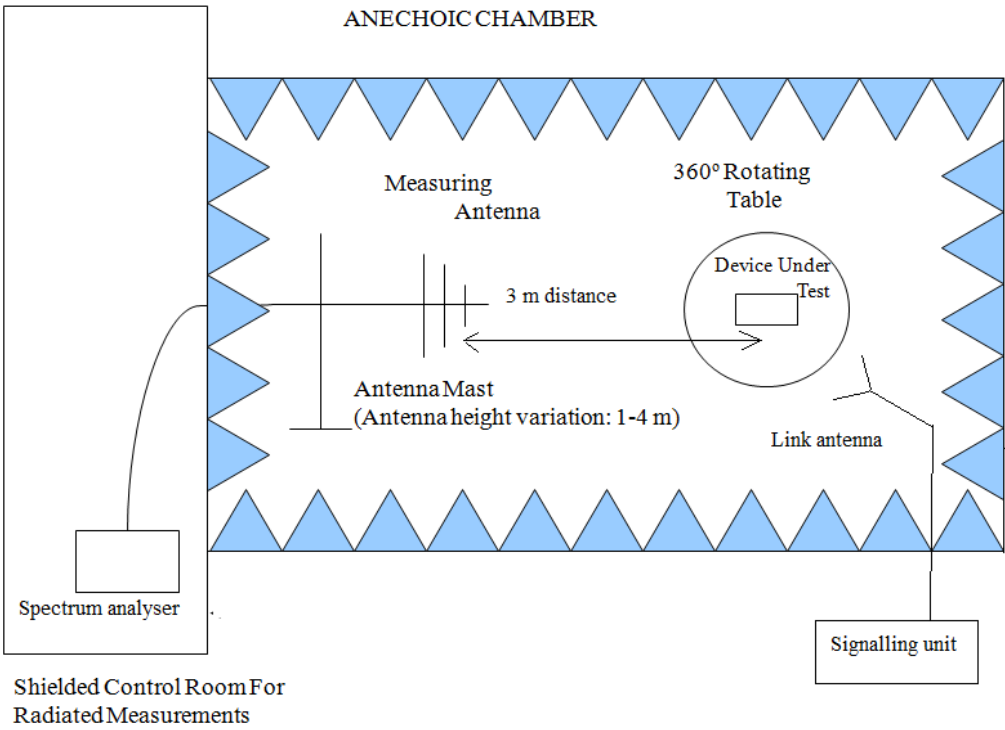
The maximum field strength (dB $\mu$ V/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

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

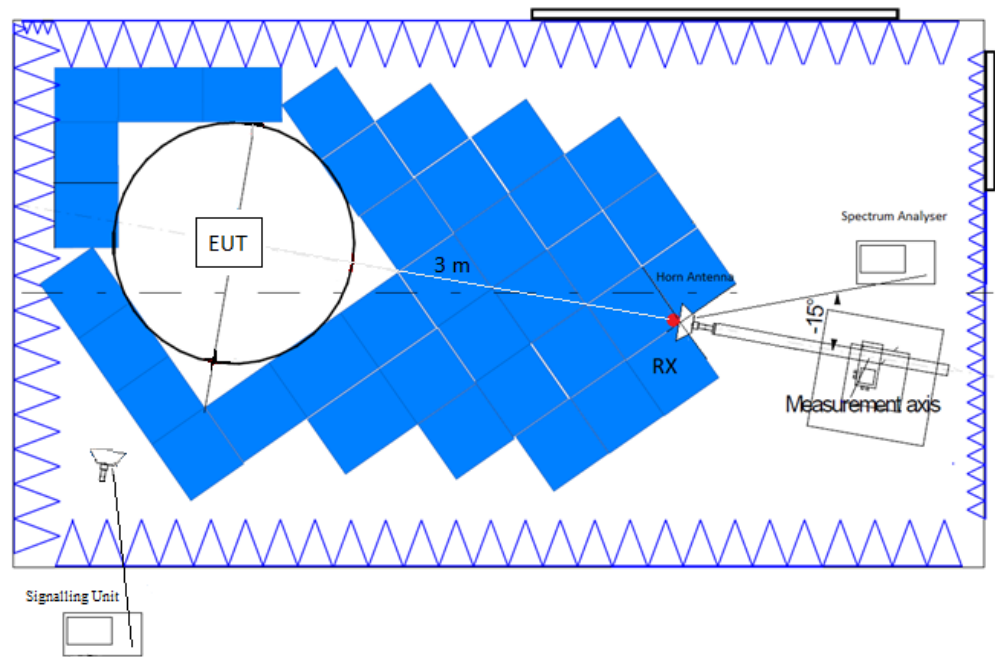
where D is the measurement distance (in the far field region) in m.

Test Setup

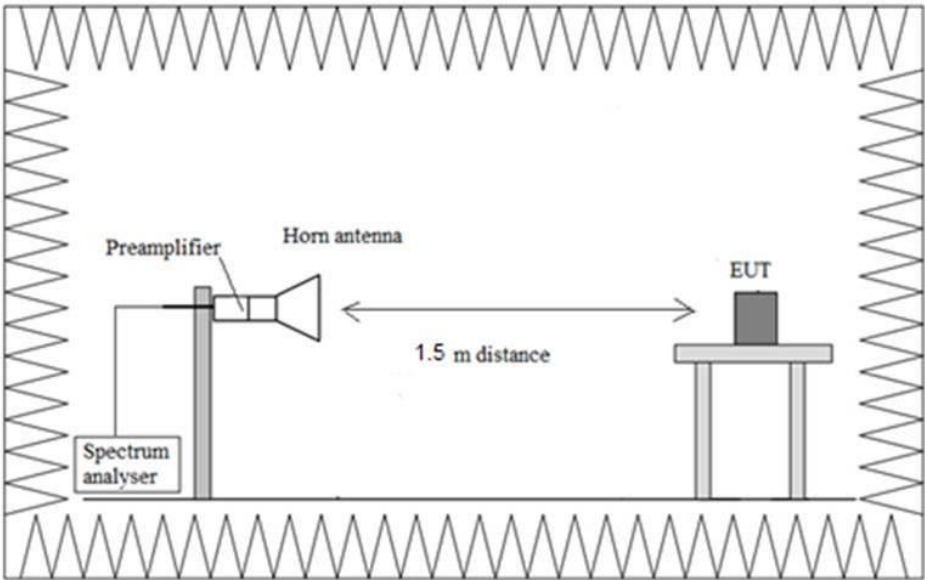
Radiated measurements below 1 GHz:



Radiated measurements above 1 GHz up to 17 GHz:



Radiated measurements above 17 GHz:



Results

LTE Cat NB1 Band 25:

NOTE: testing performed on S/02

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.

- LOW CHANNEL:

- Frequency range 30 MHz - 1 GHz:  
No spurious signals were found at less than 20 dB below the limit.
- Frequency range 1 - 17 GHz:  
No spurious signals were found at less than 20 dB below the limit.
- Frequency range 17 - 20 GHz:  
No spurious signals were found at less than 20 dB below the limit.

- MIDDLE CHANNEL:

- Frequency range 30 MHz - 1 GHz:  
Spurious signals were found at less than 20 dB below the limit:

| Spurious frequency (MHz) | E.I.R.P (dBm) | Polarization | Detector |
|--------------------------|---------------|--------------|----------|
| 38.942188                | -31.33        | V            | Peak     |

- Frequency range 1 - 17 GHz:  
No spurious signals were found at less than 20 dB below the limit.
- Frequency range 17 - 20 GHz:  
No spurious signals were found at less than 20 dB below the limit.

- HIGH CHANNEL:

- Frequency range 30 MHz - 1 GHz:  
Spurious signals were found at less than 20 dB below the limit:

| Spurious frequency (MHz) | E.I.R.P (dBm) | Polarization | Detector |
|--------------------------|---------------|--------------|----------|
| 38.881563                | -31.75        | V            | Peak     |

- Frequency range 1 - 17 GHz:  
No spurious signals were found at less than 20 dB below the limit.
- Frequency range 17 - 20 GHz:  
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

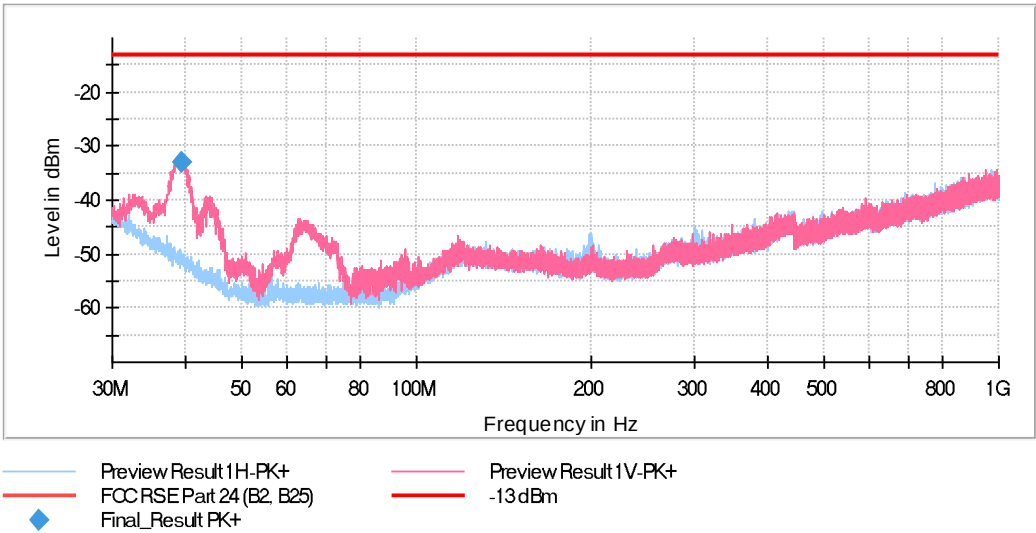
Verdict

Pass

| Subrange        | Step Size  | Detectors | Bandwidth | Sweep Time | Preamp |
|-----------------|------------|-----------|-----------|------------|--------|
| 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   |
| 17 GHz - 20 GHz | 93.75 kHz  | PK+       | 1 MHz     | 1 s        | 0 dB   |

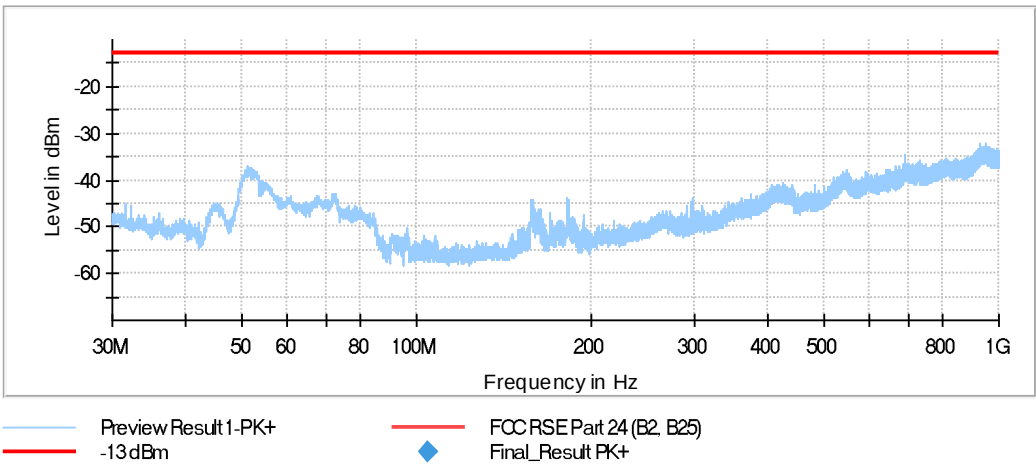
FREQUENCY RANGE 30 MHz - 1 GHz:

- Low Channel:

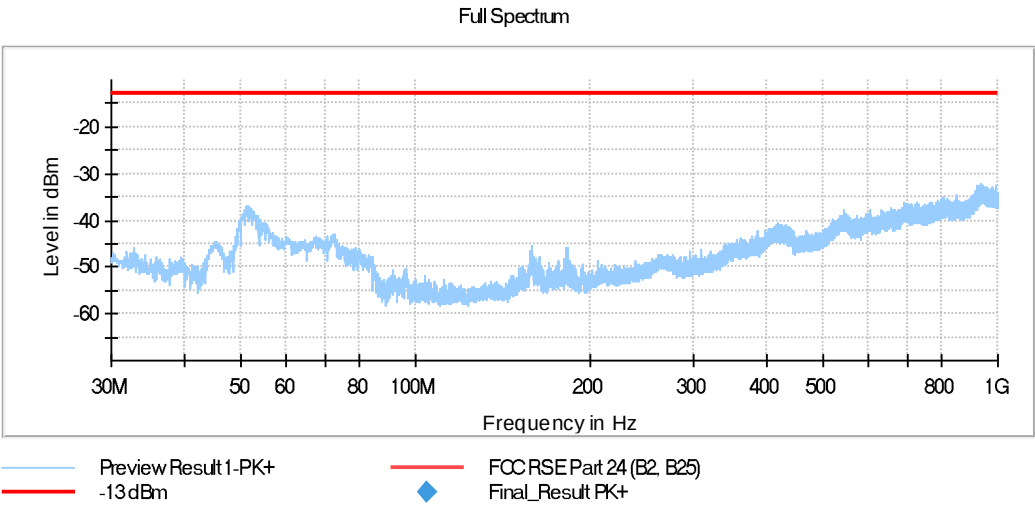


- Middle Channel:

Full Spectrum

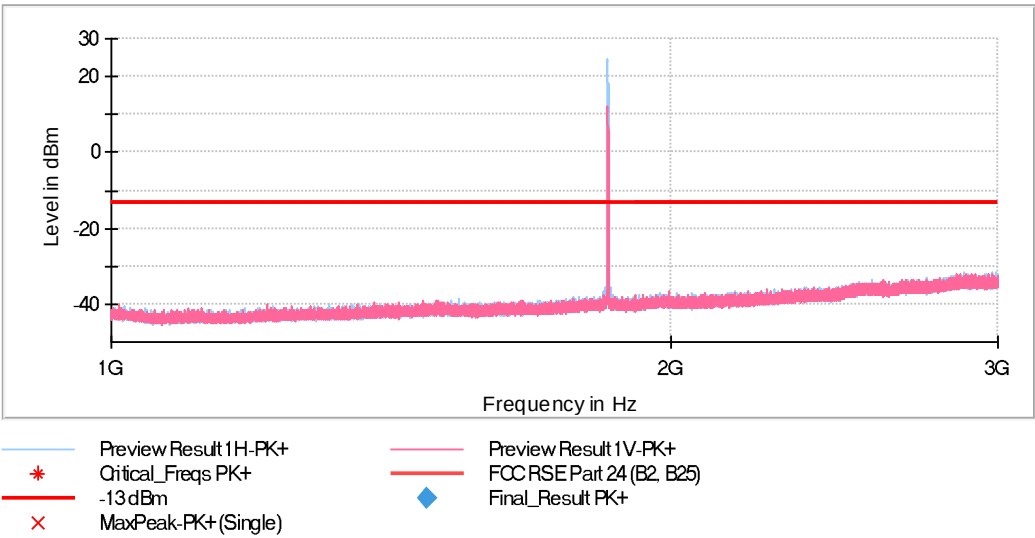


- High Channel:



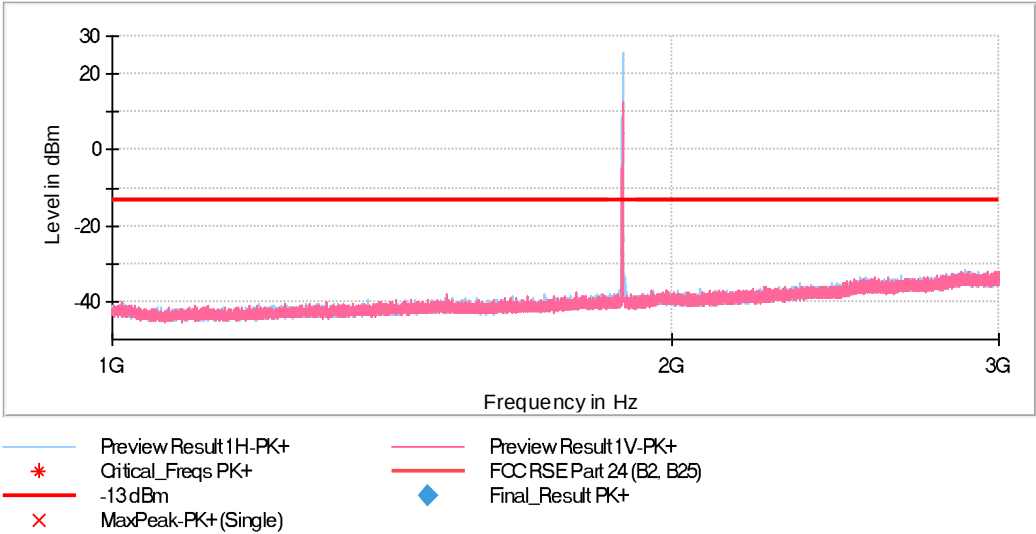
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



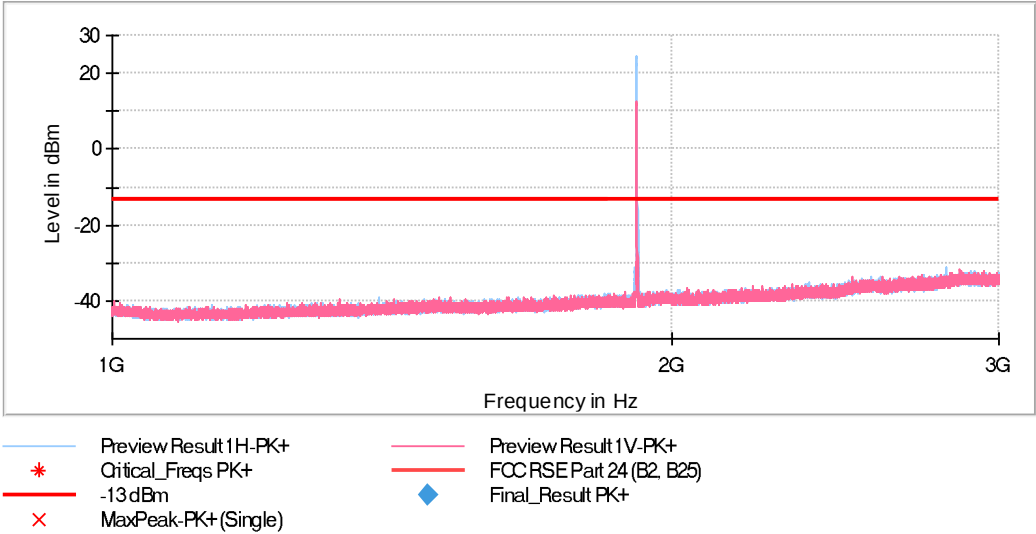
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

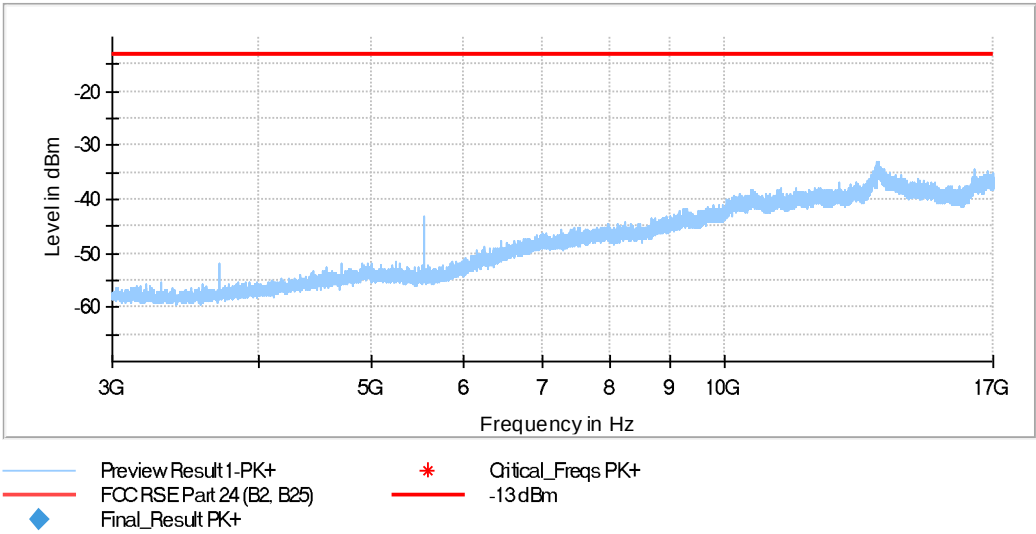
- High Channel:



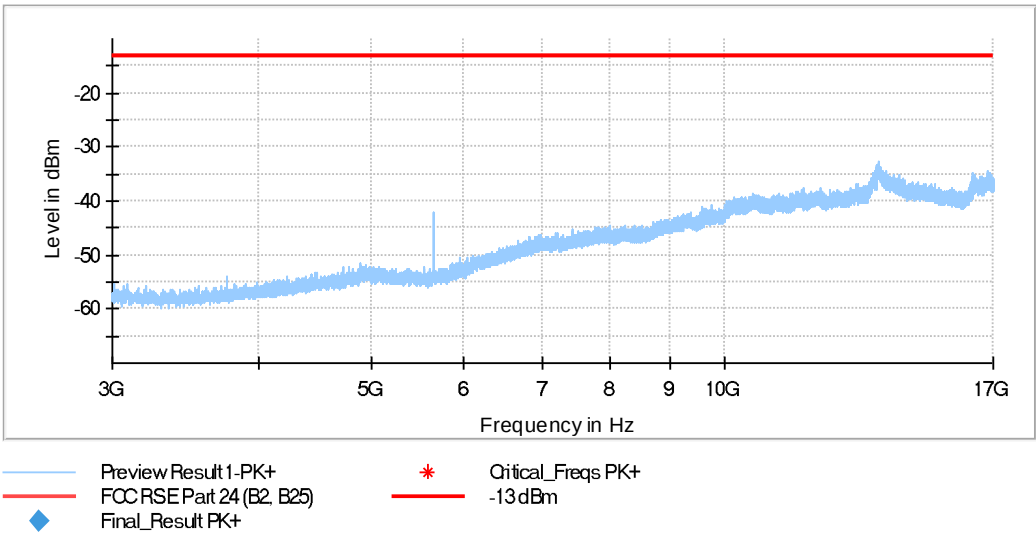
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

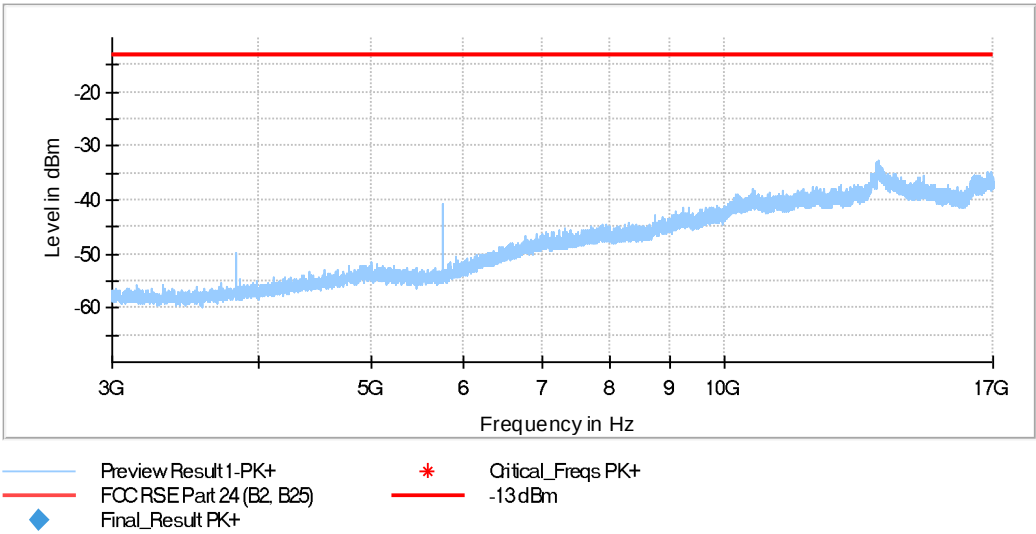
- Low Channel:



- Middle Channel:

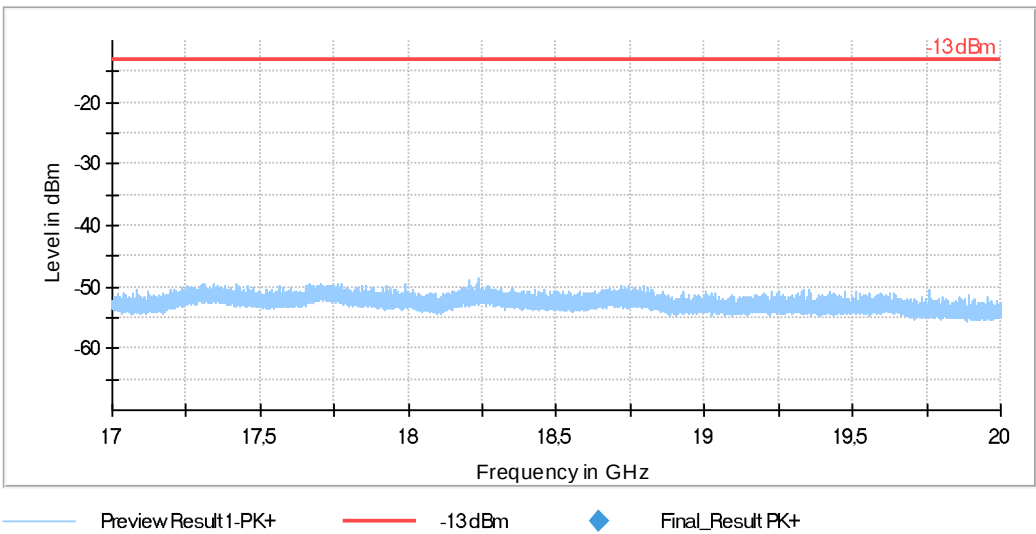


- High Channel:

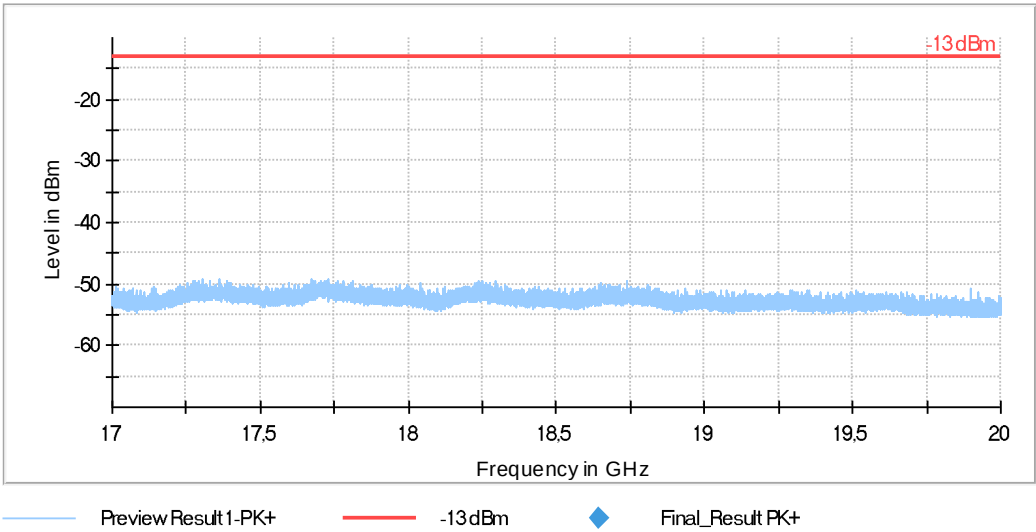


**FREQUENCY RANGE 17 - 20 GHz:**

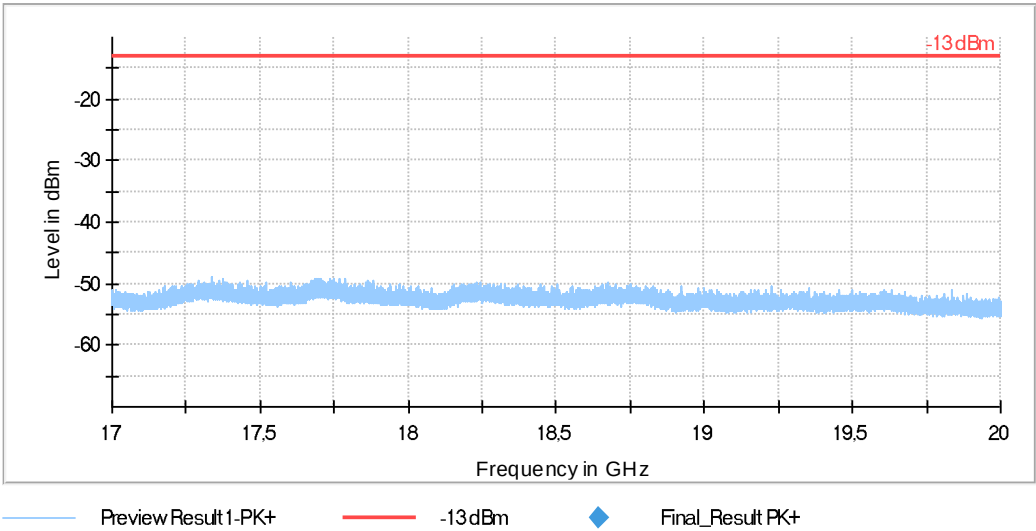
- Low Channel:



- Middle Channel:



- High Channel:



LTE Cat NB1 Band 25:

**NOTE:** testing performed on S/04

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.

**- LOW CHANNEL:**

**Frequency range 30 MHz - 1 GHz:**

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

| Spurious frequency (MHz) | E.I.R.P (dBm) | Polarization | Detector |
|--------------------------|---------------|--------------|----------|
| 38.699688                | -27.68        | V            | Peak     |

**Frequency range 1 - 17 GHz:**

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

| Spurious frequency (MHz) | E.I.R.P (dBm) | Polarization | Detector |
|--------------------------|---------------|--------------|----------|
| 13537.625000             | -31.93        | V            | Peak     |

**Frequency range 17 - 20 GHz:**

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

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

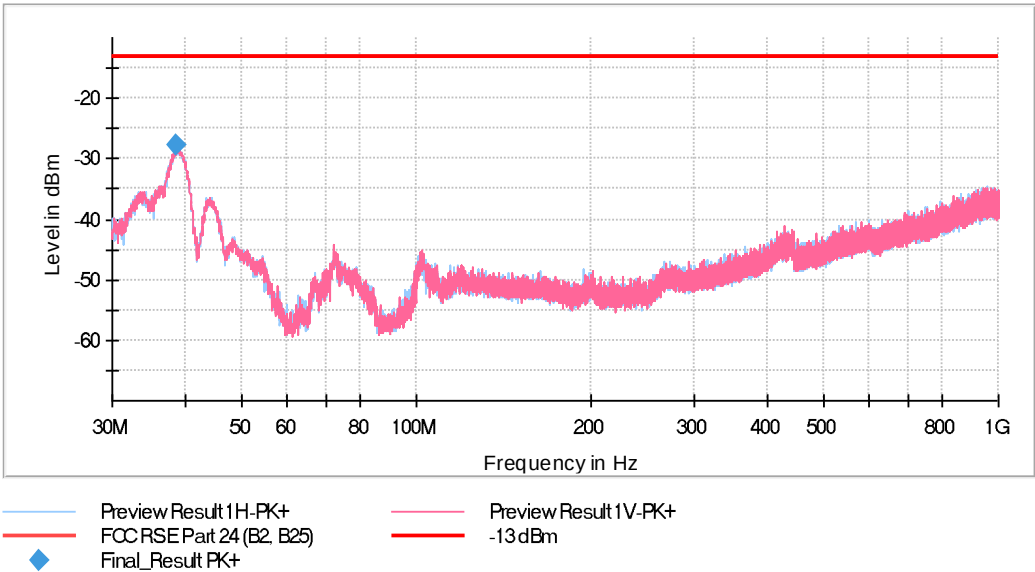
**Verdict**

Pass

| Subrange        | Step Size  | Detectors | Bandwidth | Sweep Time | Preamp |
|-----------------|------------|-----------|-----------|------------|--------|
| 30 MHz - 1 GHz  | 30.312 kHz | PK+       | 1 MHz     | 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   |
| 17 GHz - 20 GHz | 93.75 kHz  | PK+       | 1 MHz     | 1 s        | 0 dB   |

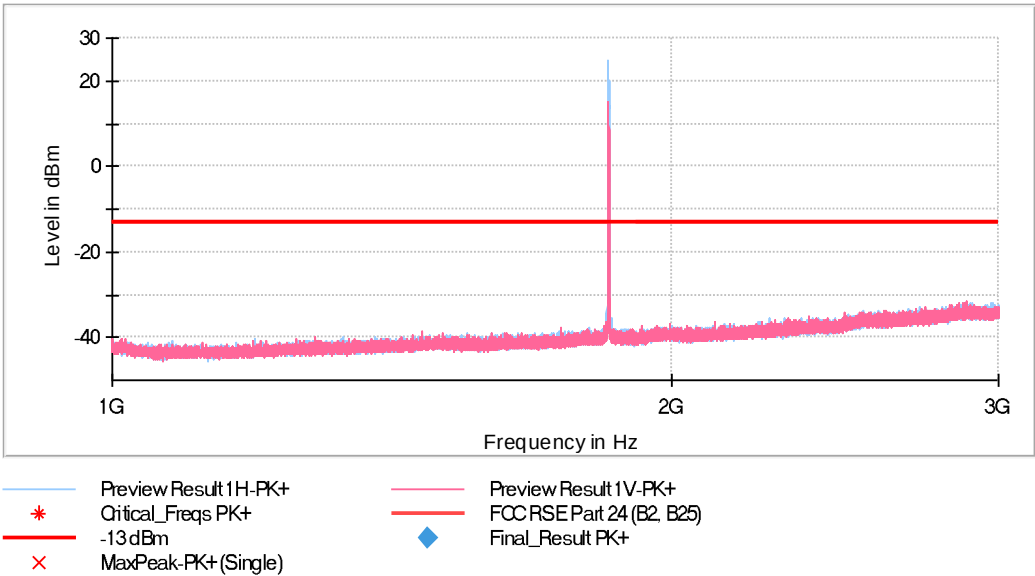
FREQUENCY RANGE 30 MHz - 1 GHz:

- Low Channel:



FREQUENCY RANGE 1 - 3 GHz:

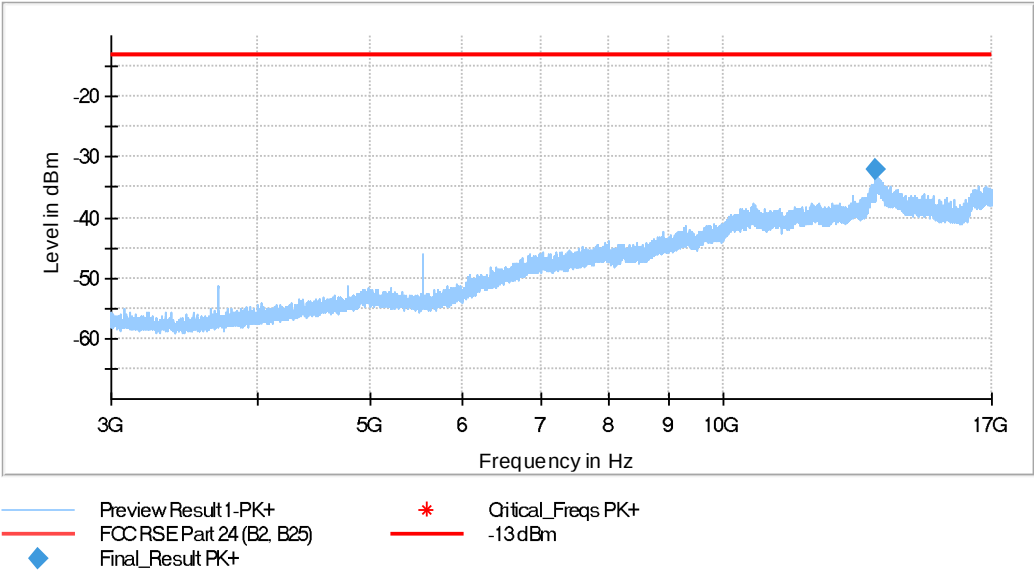
- Low Channel:



The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

- Low Channel:



FREQUENCY RANGE 17 - 20 GHz:

- Low Channel:

