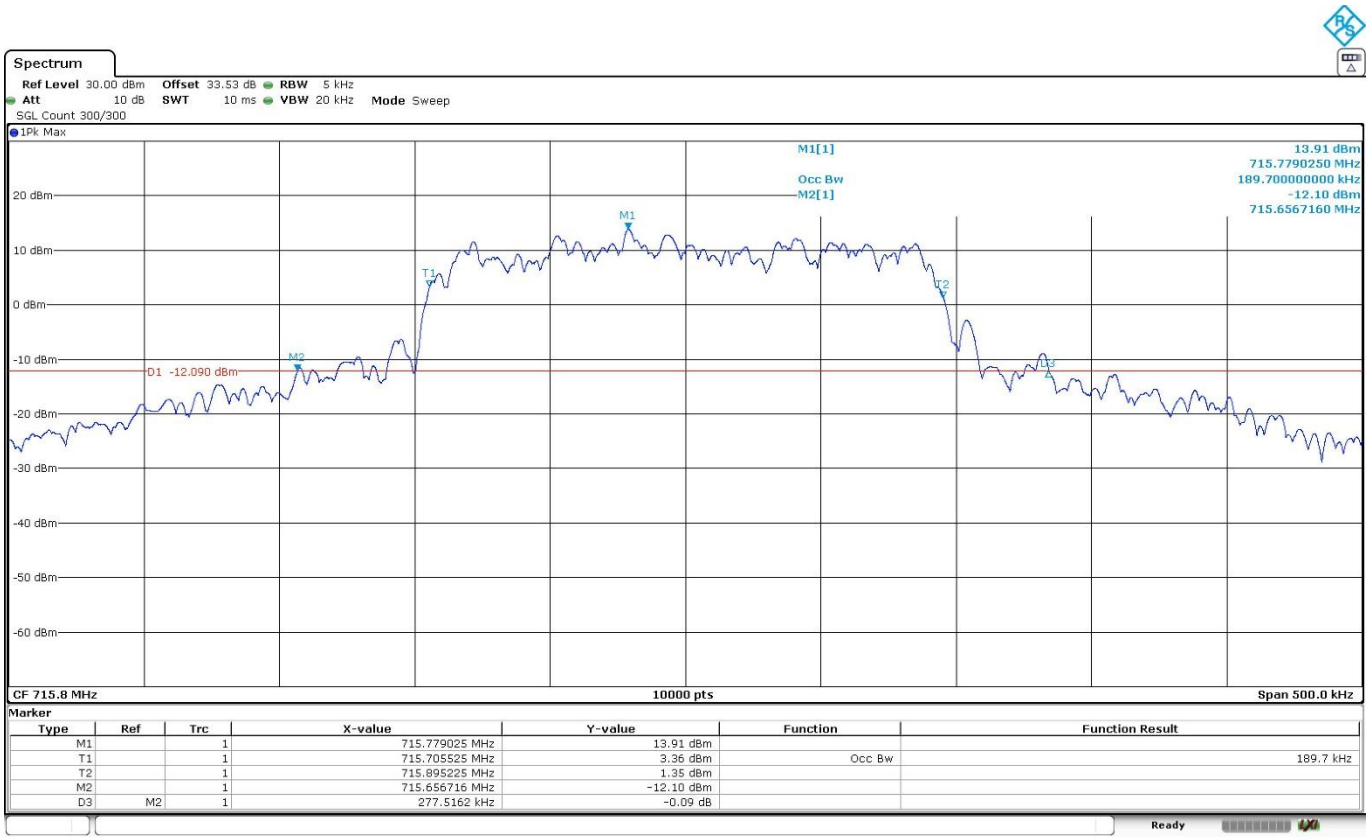
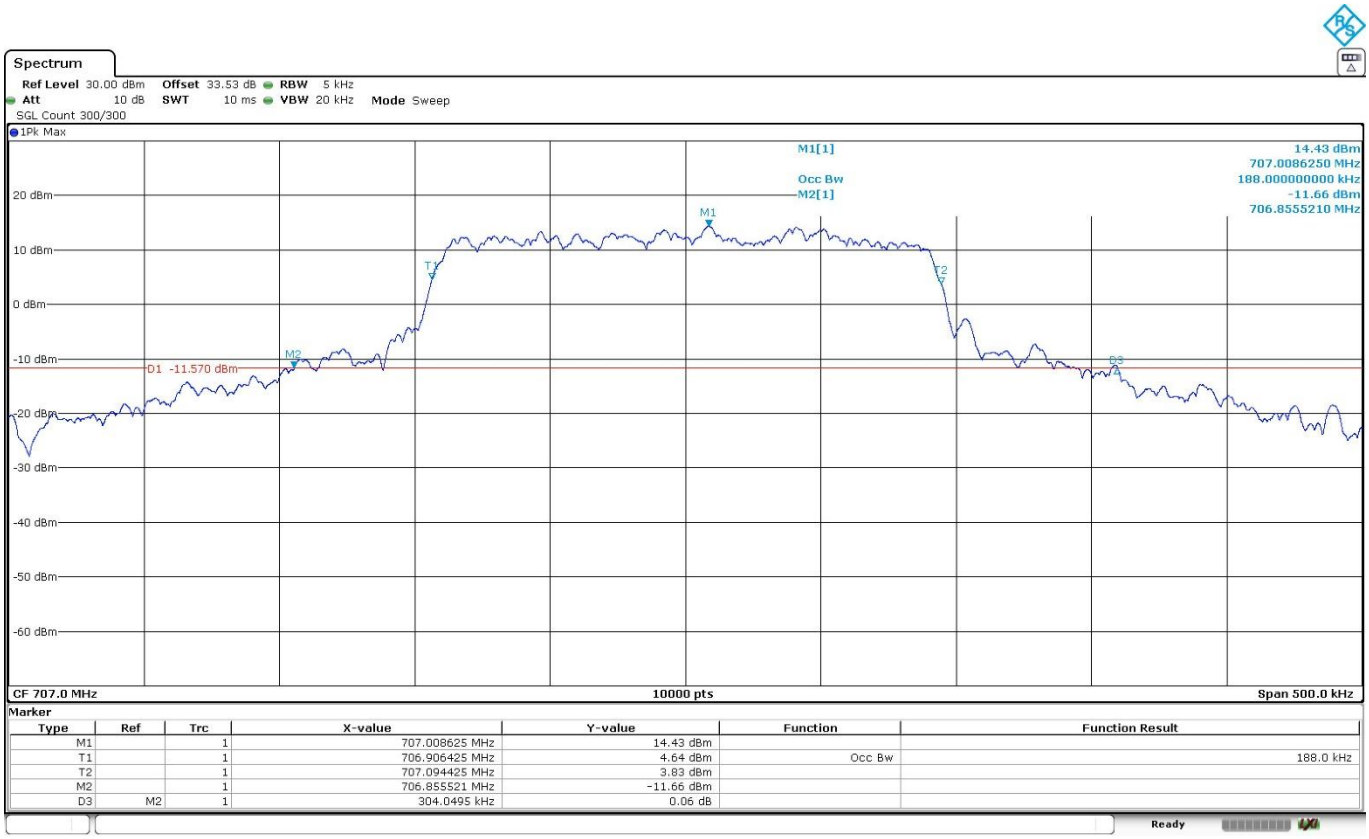
LTE Cat NB2 Band 85. QPSK. BW=15 kHz. Tone Number=12. Tone Offset=0. MSC/TBS=5.

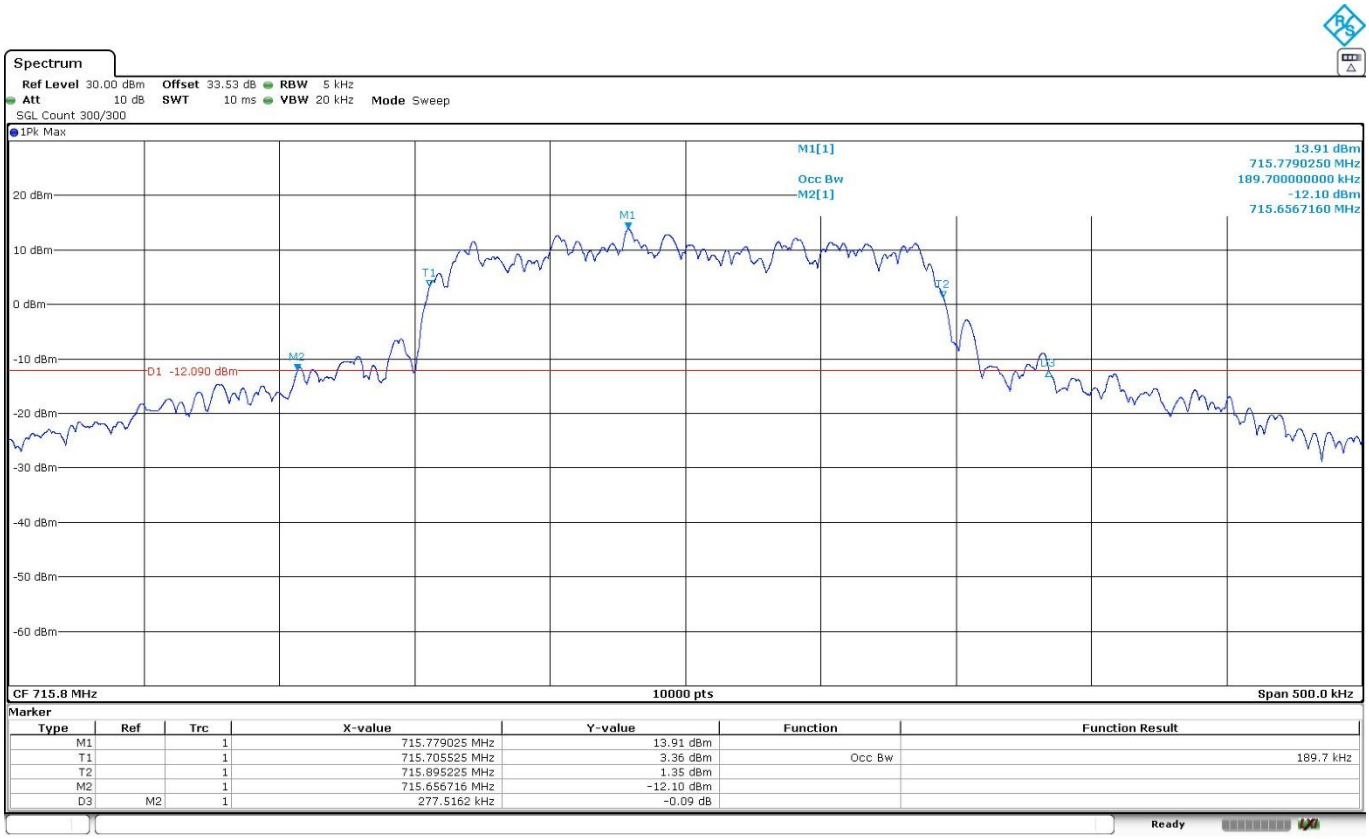
Low Channel:



Middle Channel:



High Channel:



Spurious emissions at antenna terminals

Limits

1. LTE Cat NB2 Band 8. FCC §27.1509 (a).

FCC §27.1509 (a):

The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) in watts by at least the following amounts:

(a) For 900 MHz broadband operations in 897.5–900.5 MHz band by at least 43 + 10 log (P) dB.

2. LTE Cat NB2 Band 13.

FCC §27.53 (c):

On any frequency outside the 776-788 MHz band. the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB. Compliance is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater.

On all frequencies between 763-775 MHz and 793-805 MHz. by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment. for mobile and portable stations. Compliance is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

RSS-130 4.7.1 and 4.7.2:

4.7.1 General unwanted emissions limits:

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 log10 p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

4.7.2 Additional unwanted emissions limits:

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

i. 76 + 10 log10 p (watts), dB, for base and fixed equipment and

ii. 65 + 10 log10 p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

3. LTE Cat NB2 Band 66.

FCC §27.53 (h). RSS-139 5.6:

Unwanted emissions shall be measured in terms of average values.

For all equipment, the TRP or total conducted power (sum of conducted power across all antenna connectors) of the unwanted emissions outside the frequency block or frequency block group shall not exceed the limits shown in table 6.

Table 6: Unwanted emission limits	
Offset from the edge of the frequency block or frequency block group	**Unwanted emission limits**
1 MHz	-13 dBm/(1% of OB*)
>1 MHz	-13 dBm/MHz

*OB is the occupied bandwidth.

In addition to complying with the above limits, equipment operating in the band 2180-2200 MHz may require additional filtering (see SRSP-519).

4. LTE Cat NB2 Band 85.

FCC §27.53 (g):

> For operations in the 600 MHz band and the 698-746 MHz band. the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation. measured in watts. by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater.

RSS-130. Clause 4.7.1:

> The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s). shall be attenuated below the transmitter power. P (dBW). by at least 43 + 10 $\log_{10}$ p (watts). dB.

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

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

At Po transmitting power. the specified minimum attenuation becomes 65+10 log (Po). and the level in dBm relative to Po becomes:

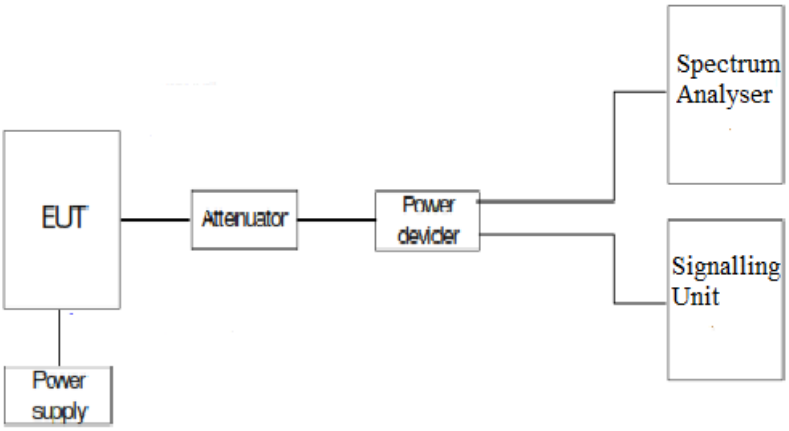
Po (dBm) – [65 + 10 log (Po in mW) - 30] = -35 dBm

Method

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

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

Test Setup


Spectrum Analyser
EUT
Attenuator
Power devicler
Signalling Unit
Power supply

Results

The next results are for the worst-case configuration for each LTE Cat NB2 Band.

LTE Cat NB2 Band 8:

A preliminary scan determined the worst-case:

Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=11. MSC/TBS=3.

Frequency range 9 KHz - 10 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.

LTE Cat NB2 Band 13:

A preliminary scan determined the worst-case:

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

Frequency range 9 KHz - 8 GHz:

- Low Channel: Spurious frequencies at less than 20 dB below the limit:

Frequency (MHz)	Emission limitations conducted (dBm)
774.5362	-43.8
773.0398	-51.4
769.3846	-54.53

- High Channel: Spurious frequencies at less than 20 dB below the limit:

Frequency (MHz)	Emission limitations conducted (dBm)
794.4346	-54.5

LTE Cat NB2 Band 66:

A preliminary scan determined the worst-case:

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

Frequency range 9 KHz - 18 GHz:

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

LTE Cat NB2 Band 85:

A preliminary scan determined the worst-case:

Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=3.

Frequency range 9 KHz - 8 GHz:

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

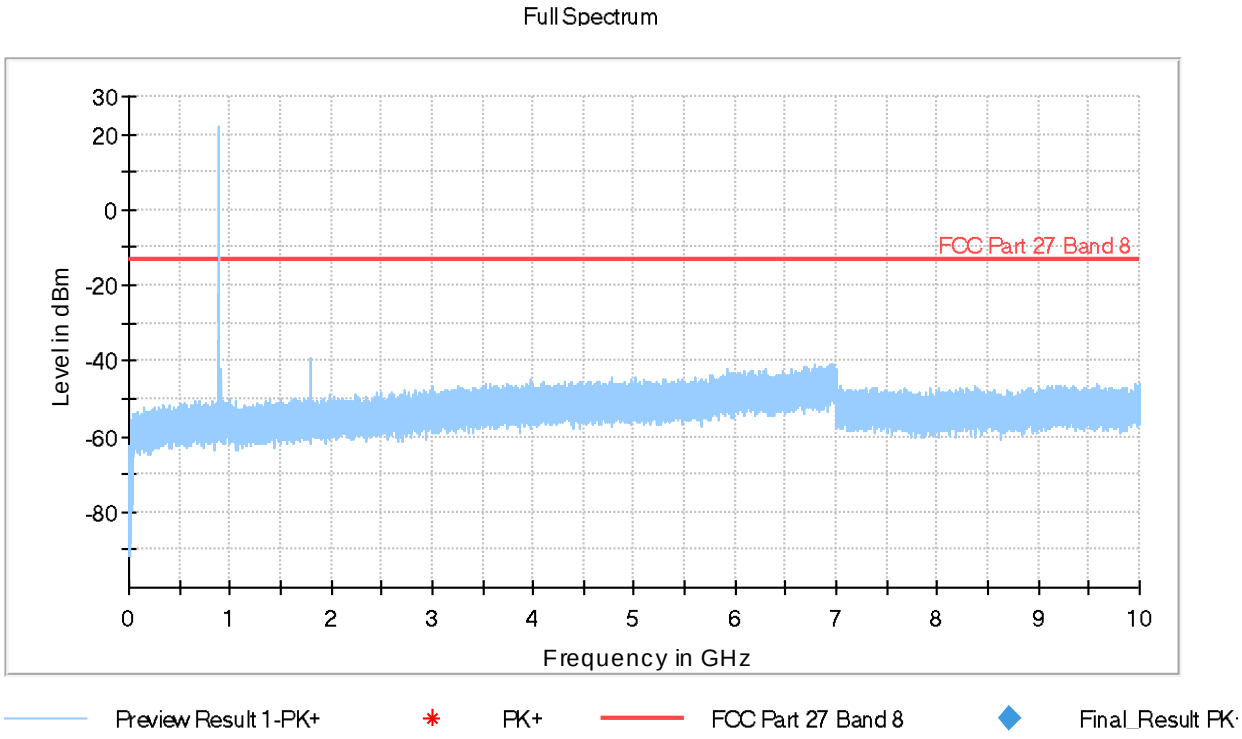
Measurement uncertainty (dB): <±2.76

Verdict: PASS

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

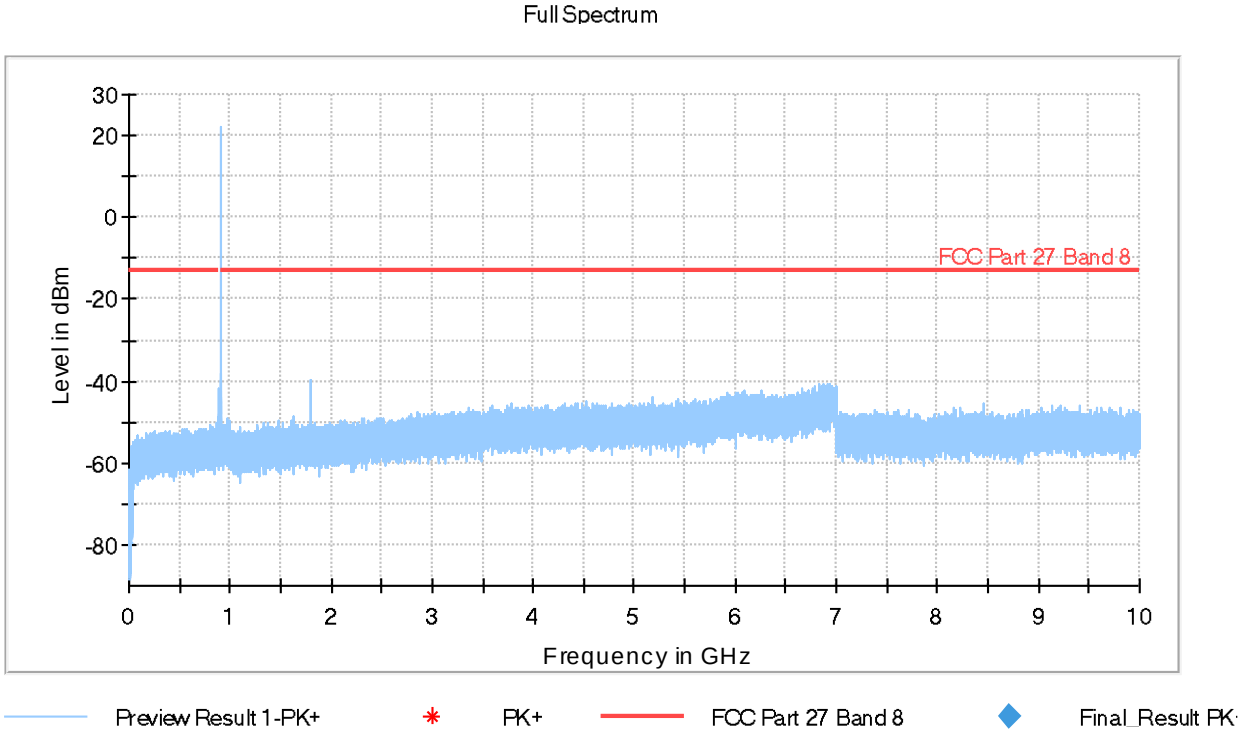
LTE Cat-NB2 Band 8: Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=11. MSC/TBS=3.

Low Channel:



The peak above the limit is the carrier frequency.

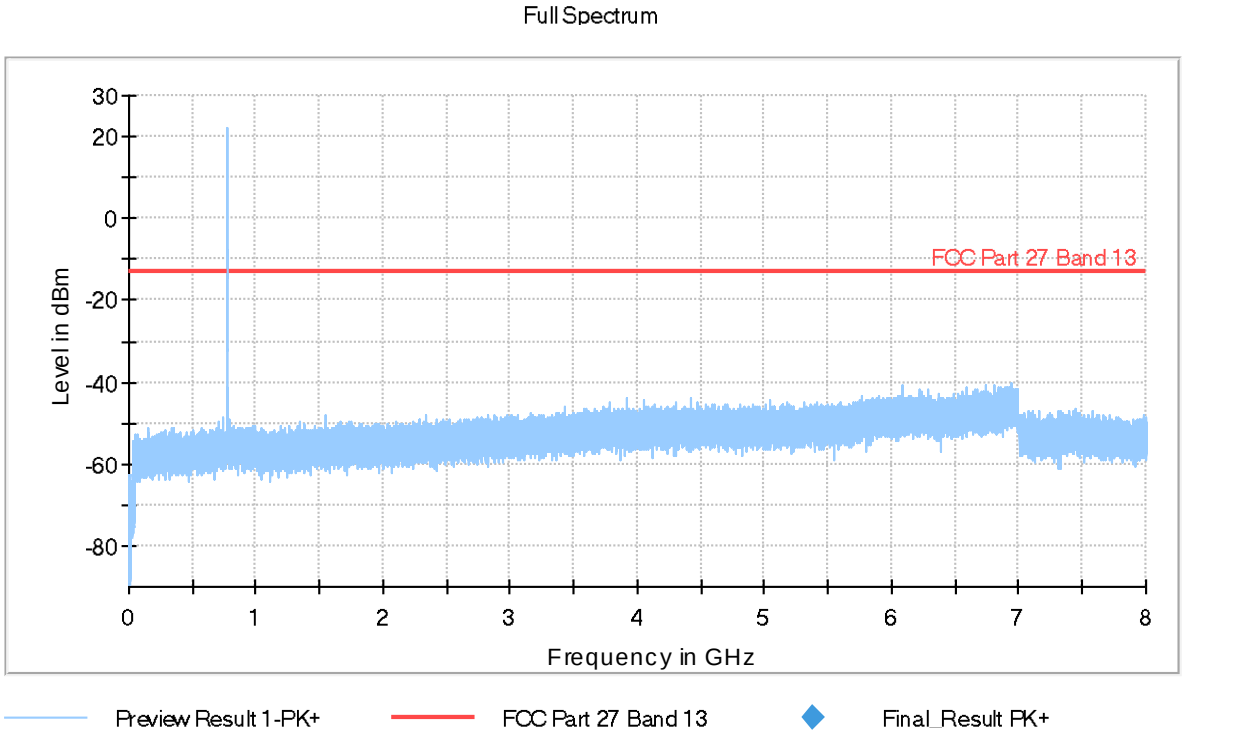
High Channel:



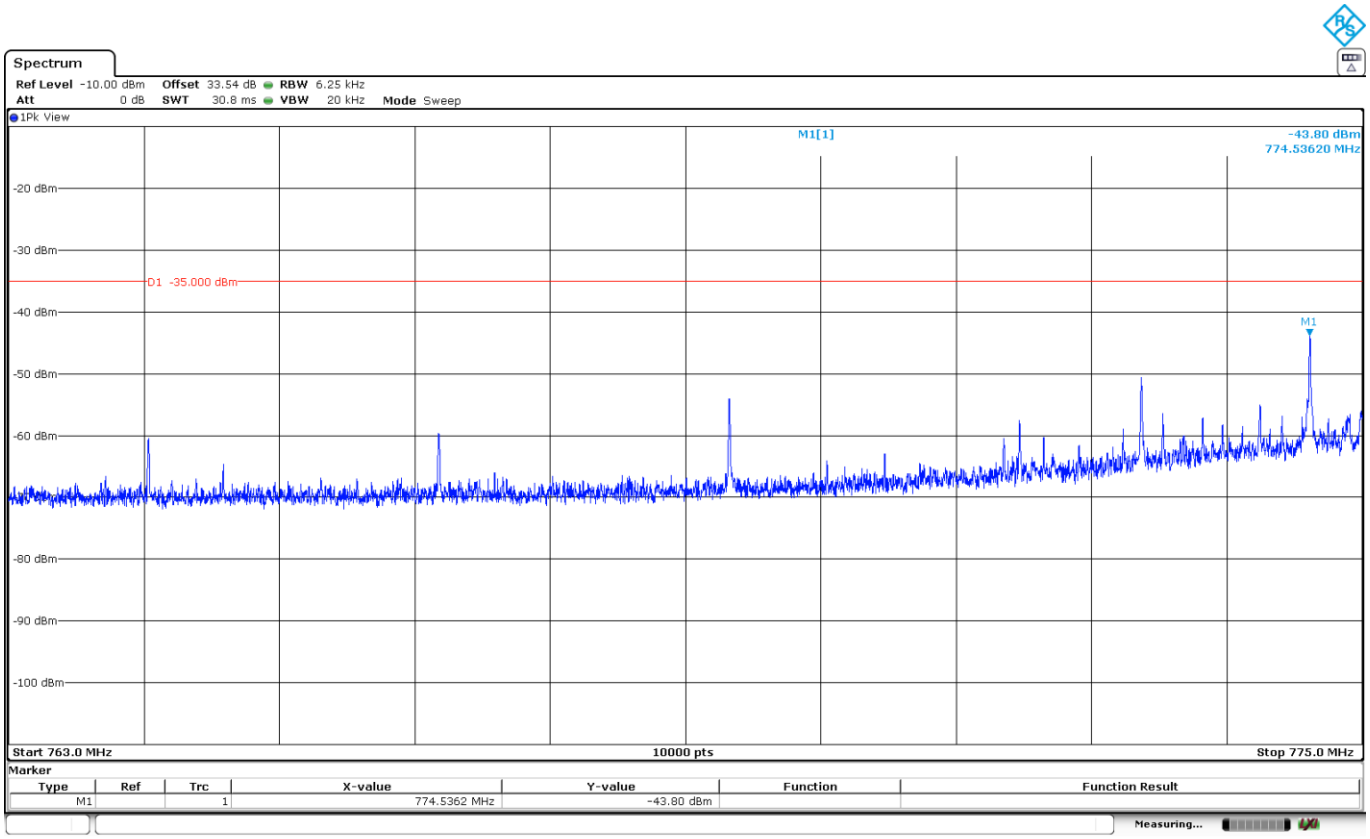
The peak above the limit is the carrier frequency.

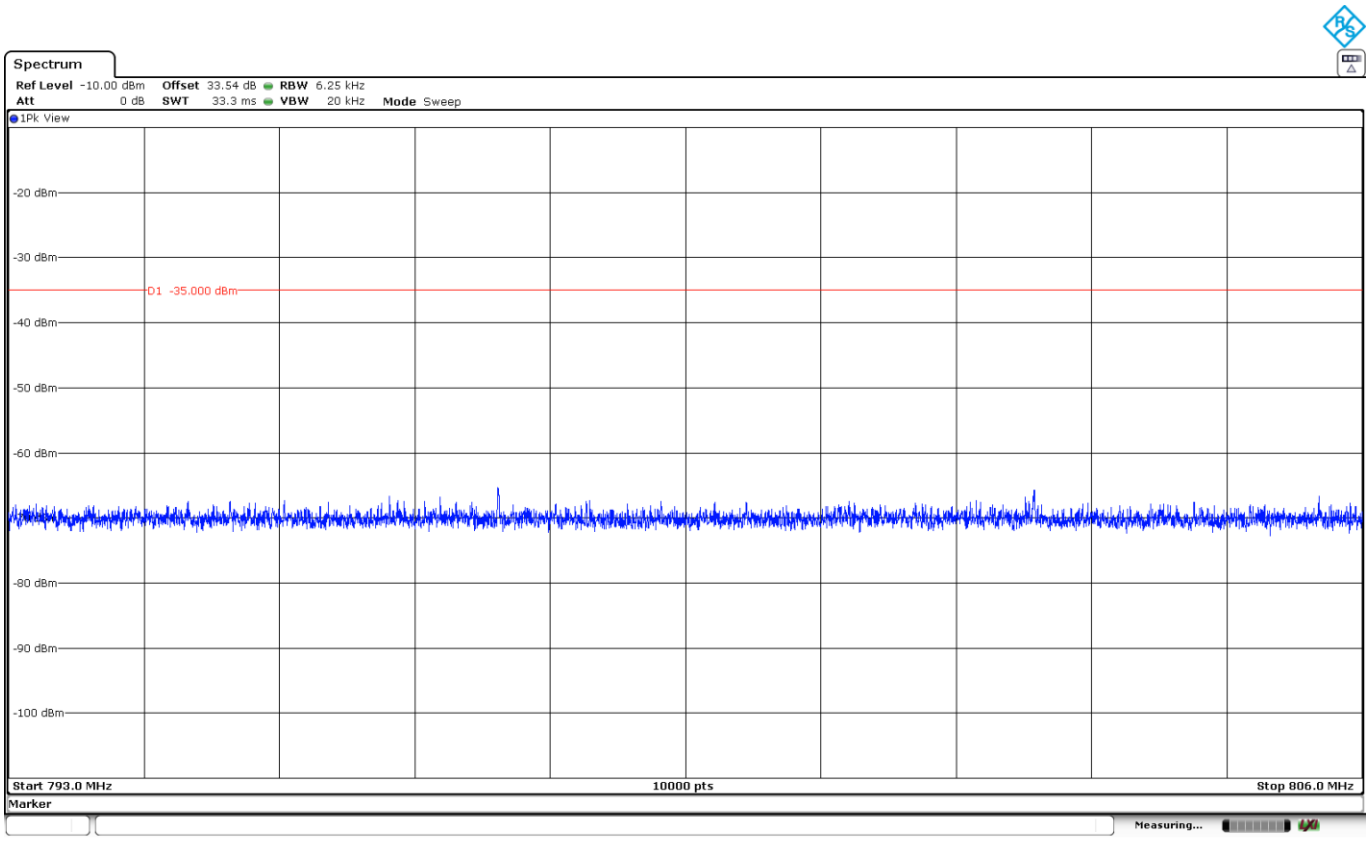
LTE Cat-NB2 Band 13: Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=3.

Low Channel:

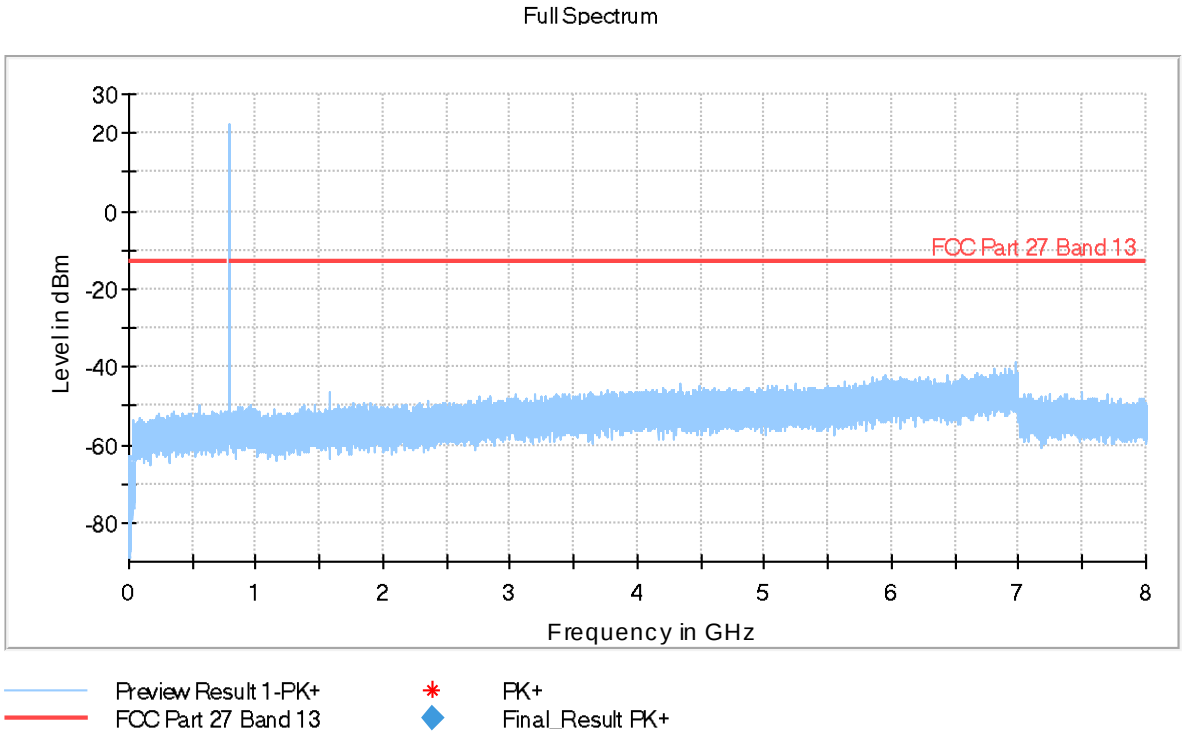


The peak above the limit is the carrier frequency.

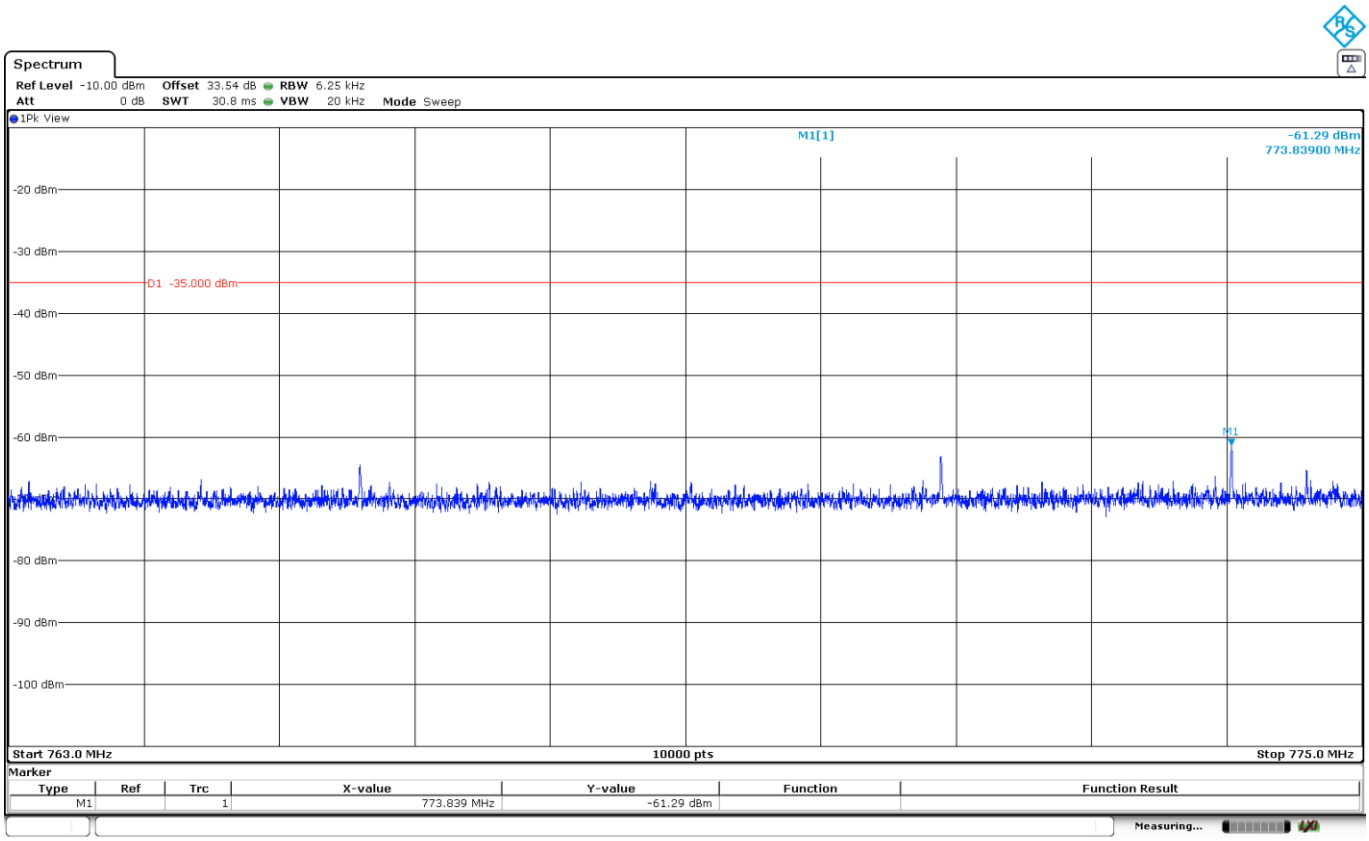

Spectrum
Ref Level -10.00 dBm Offset 33.54 dB RBW 6.25 kHz
Att 0 dB SWT 30.8 ms VBW 20 kHz Mode Sweep
1Pk View
M1[1] -43.80 dBm
774.53620 MHz
D1 -35.000 dBm
M1
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-80 dBm
-90 dBm
-100 dBm
Start 763.0 MHz
10000 pts
Stop 775.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 774.5362 MHz -43.80 dBm
Measuring...

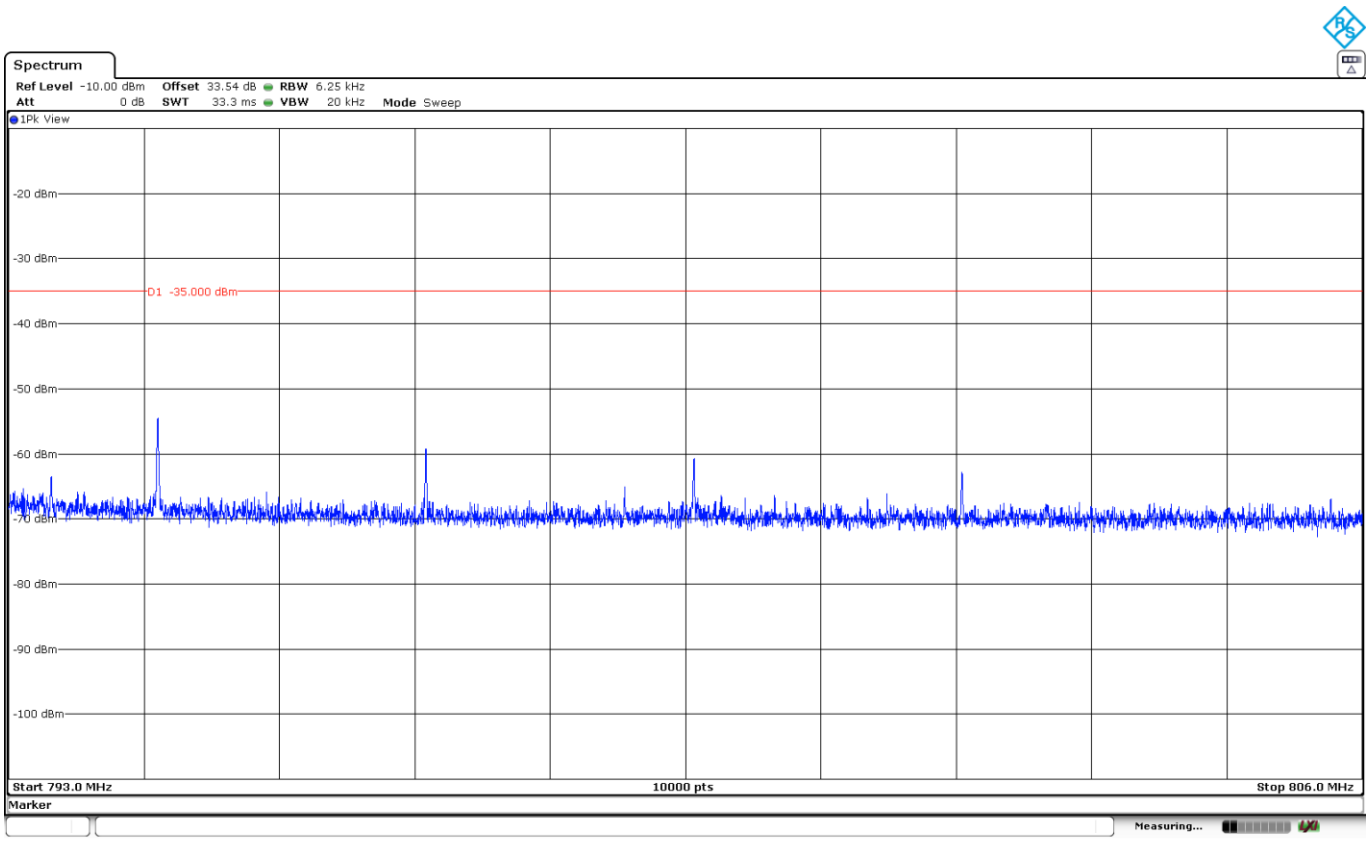

Spectrum
Ref Level -10.00 dBm Offset 33.54 dB RBW 6.25 kHz
Att 0 dB SWT 33.3 ms VBW 20 kHz Mode Sweep
1Pk View
D1 -35.000 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-80 dBm
-90 dBm
-100 dBm
Start 793.0 MHz
10000 pts
Stop 806.0 MHz
Marker
Measuring...

High Channel:



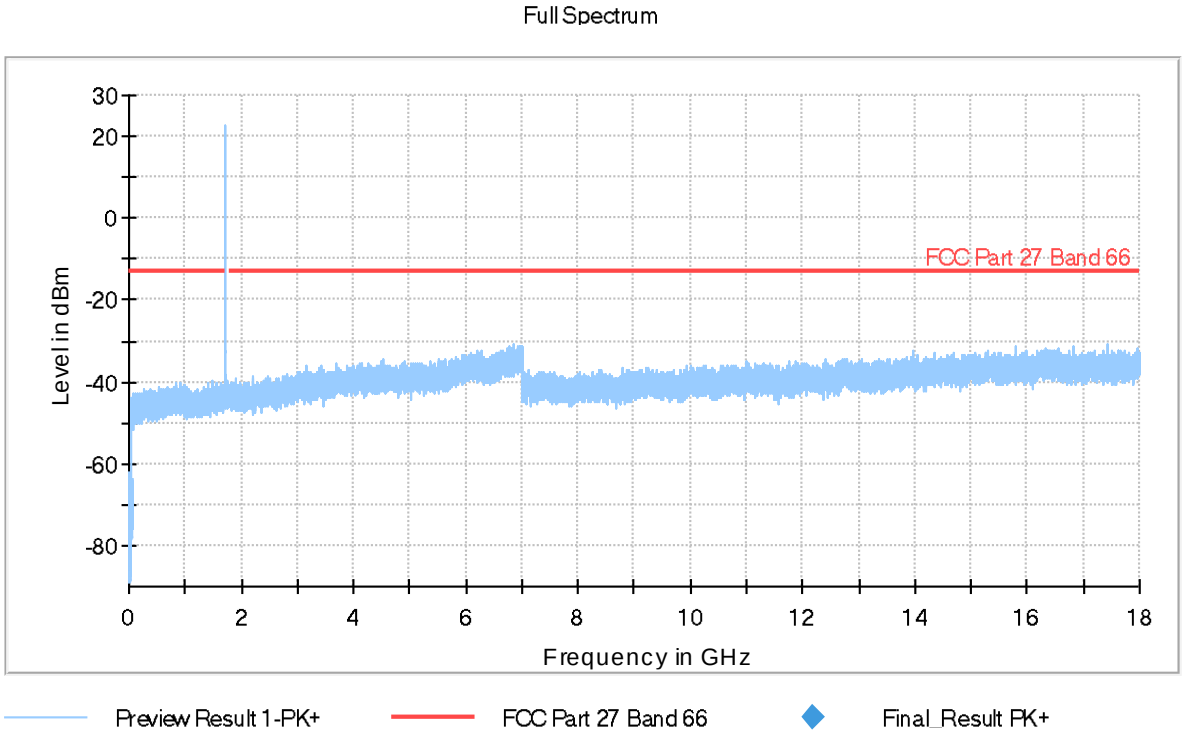
The peak above the limit is the carrier frequency.





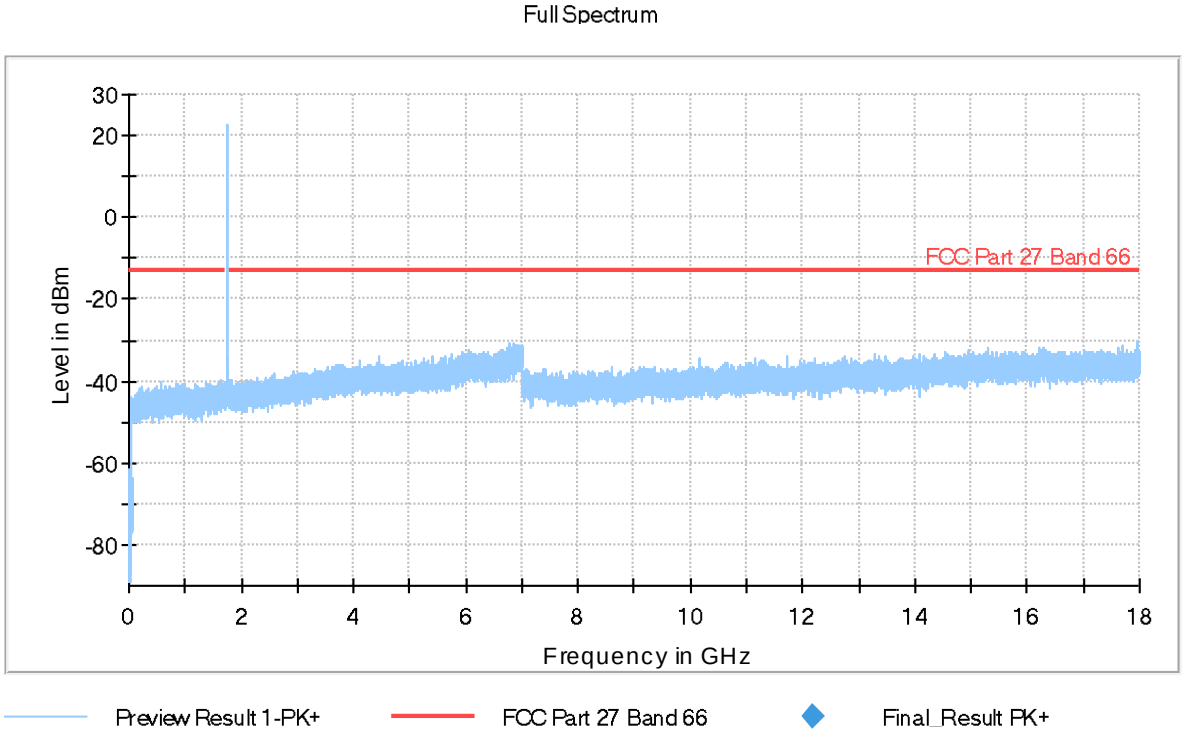
LTE Cat-NB2 Band 66: Pi/2-BPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=0.

Low Channel:



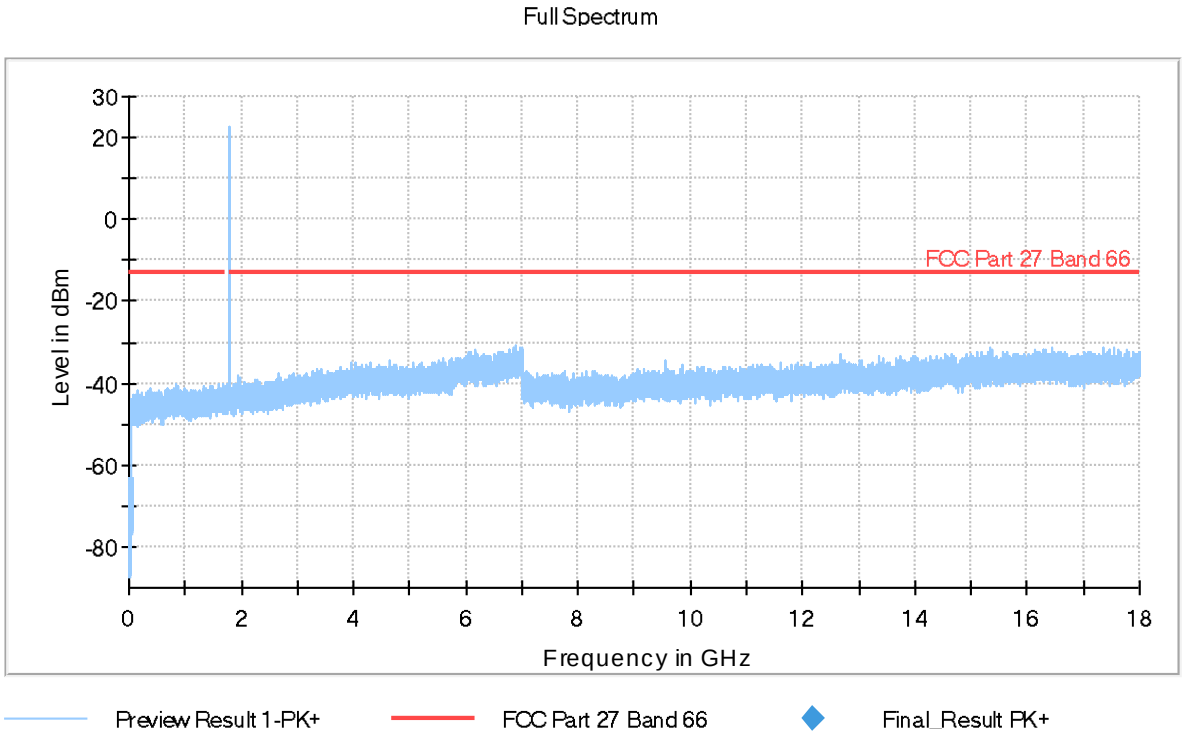
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

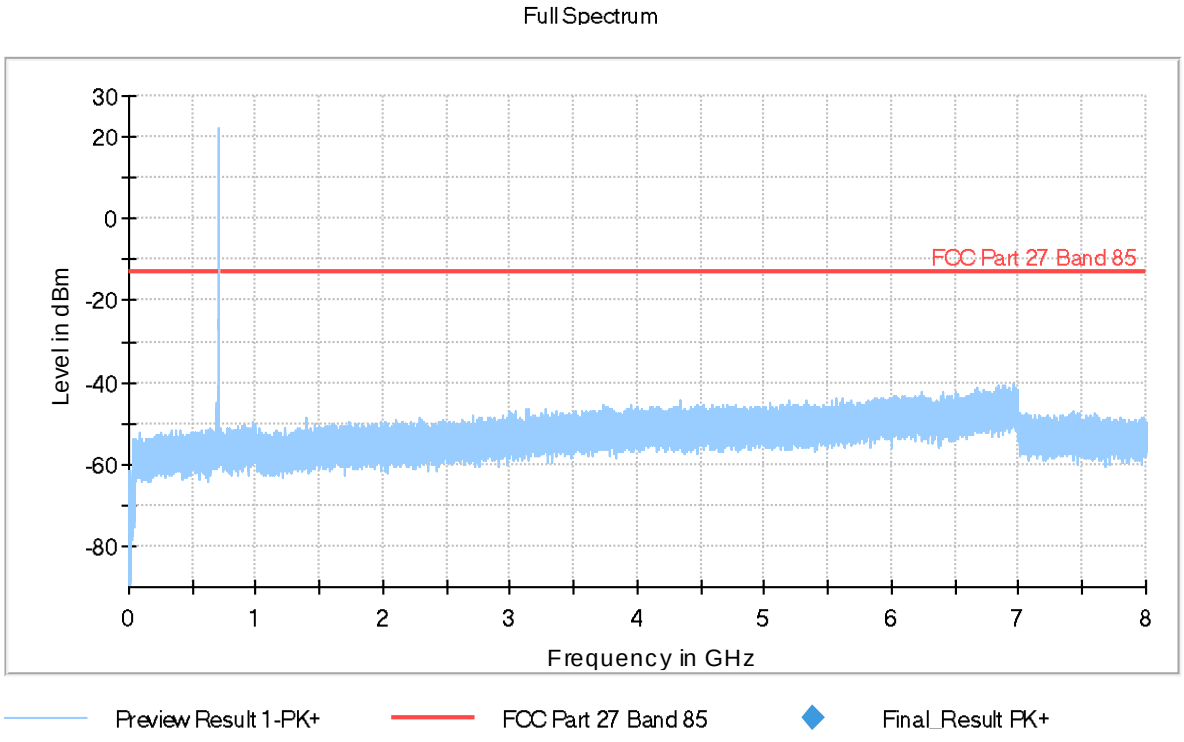
High Channel:



The peak above the limit is the carrier frequency.

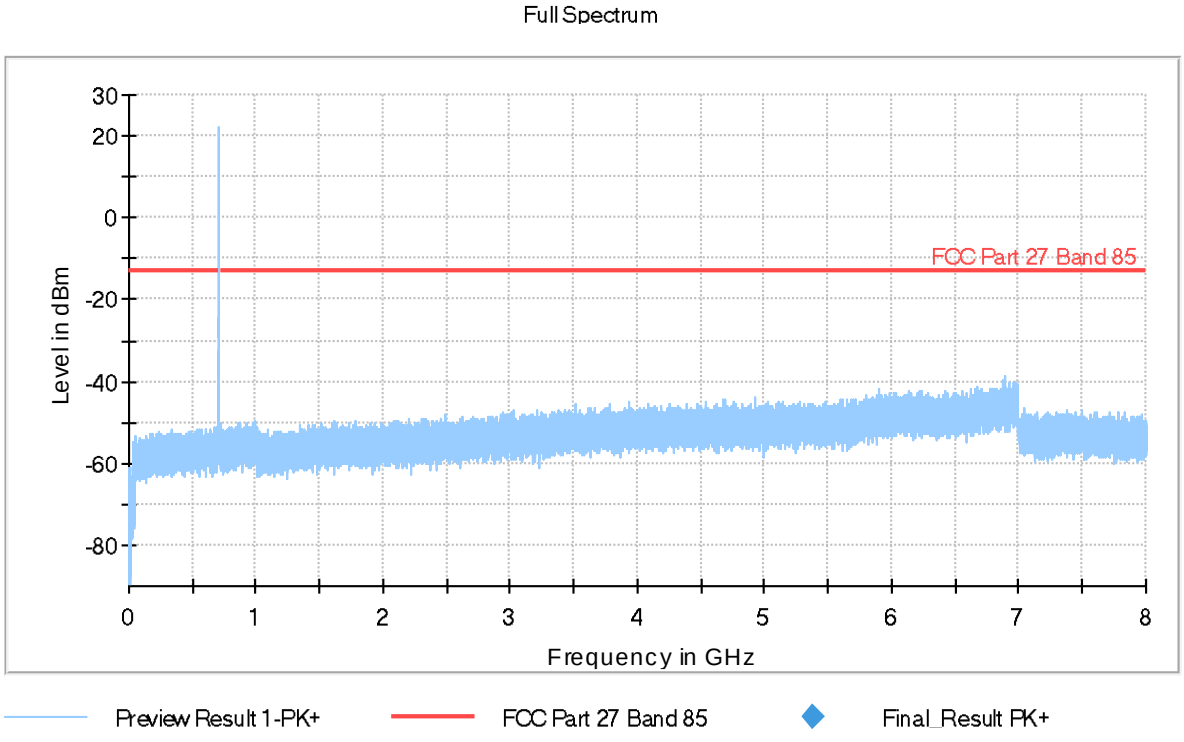
LTE Cat-NB2 Band 85: Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=47. MSC/TBS=0.

Low Channel:



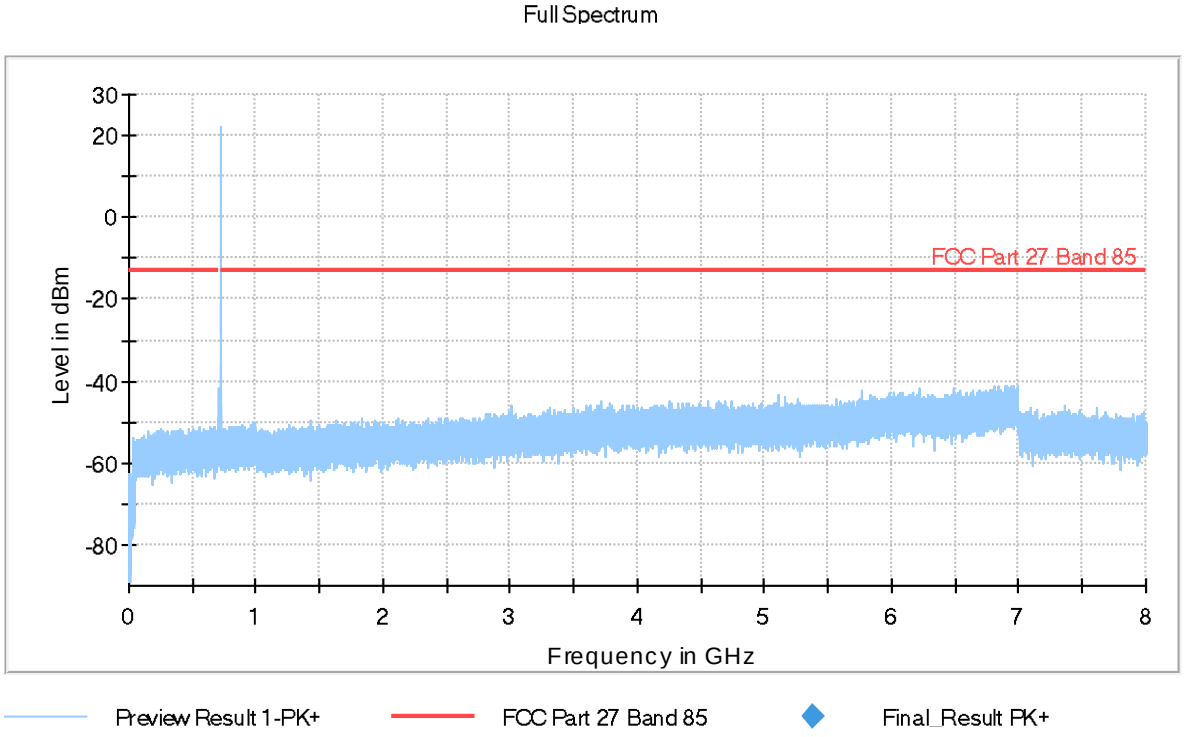
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

High Channel:



The peak above the limit is the carrier frequency.

Spurious emissions at antenna terminals at Block Edges

Limits

1. LTE Cat NB2 Band 8. FCC §27.1509 (a).

FCC §27.1509 (a):

The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) in watts by at least the following amounts:

(a) For 900 MHz broadband operations in 897.5–900.5 MHz band by at least 43 + 10 log (P) dB.

2. LTE Cat NB2 Band 13.

FCC §27.53 (c):

On any frequency outside the 776-788 MHz band. the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB. Compliance is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater.

On all frequencies between 763-775 MHz and 793-805 MHz. by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment. for mobile and portable stations. Compliance is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

RSS-130 4.7.1 and 4.7.2:

4.7.1 General unwanted emissions limits:

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 log10 p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

4.7.2 Additional unwanted emissions limits:

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

i. 76 + 10 log10 p (watts), dB, for base and fixed equipment and

ii. 65 + 10 log10 p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

3. LTE Cat NB2 Band 66.

FCC §27.53 (h). RSS-139 5.6:

Unwanted emissions shall be measured in terms of average values.

For all equipment, the TRP or total conducted power (sum of conducted power across all antenna connectors) of the unwanted emissions outside the frequency block or frequency block group shall not exceed the limits shown in table 6.

Table 6: Unwanted emission limits	
Offset from the edge of the frequency block or frequency block group	**Unwanted emission limits**
1 MHz	-13 dBm/(1% of OB*)
>1 MHz	-13 dBm/MHz

*OB is the occupied bandwidth.

In addition to complying with the above limits, equipment operating in the band 2180-2200 MHz may require additional filtering (see SRSP-519).

4. LTE Cat NB2 Band 85.

FCC §27.53 (g):

> For operations in the 600 MHz band and the 698-746 MHz band. the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation. measured in watts. by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater.

RSS-130. Clause 4.7.1:

> The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s). shall be attenuated below the transmitter power. P (dBW). by at least 43 + 10 $\log_{10}$ p (watts). dB.

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

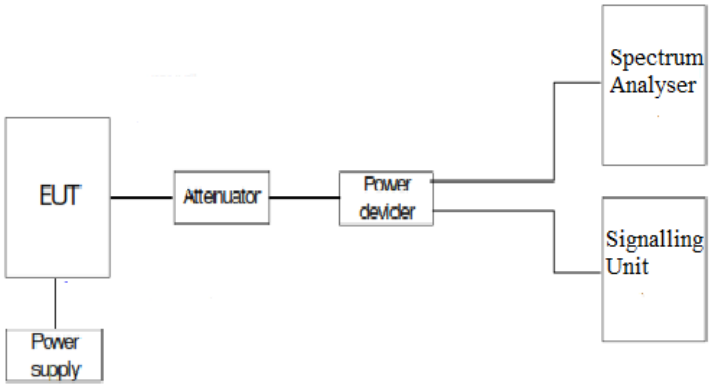
Po (dBm) – [43 + 10 log (Po in mW) - 30] = -13 dBm

Method

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

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

Test Setup



Results

LTE Cat NB2 Band 4:

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

Low Block Edge.

Note: Low Block Edge for LTE Cat NB2 Band 4 is the same as for LTE Cat NB2 Band 66.

High Block Edge.

LTE Cat NB2 Band 4	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)	-23.86	-23.09	-23.18

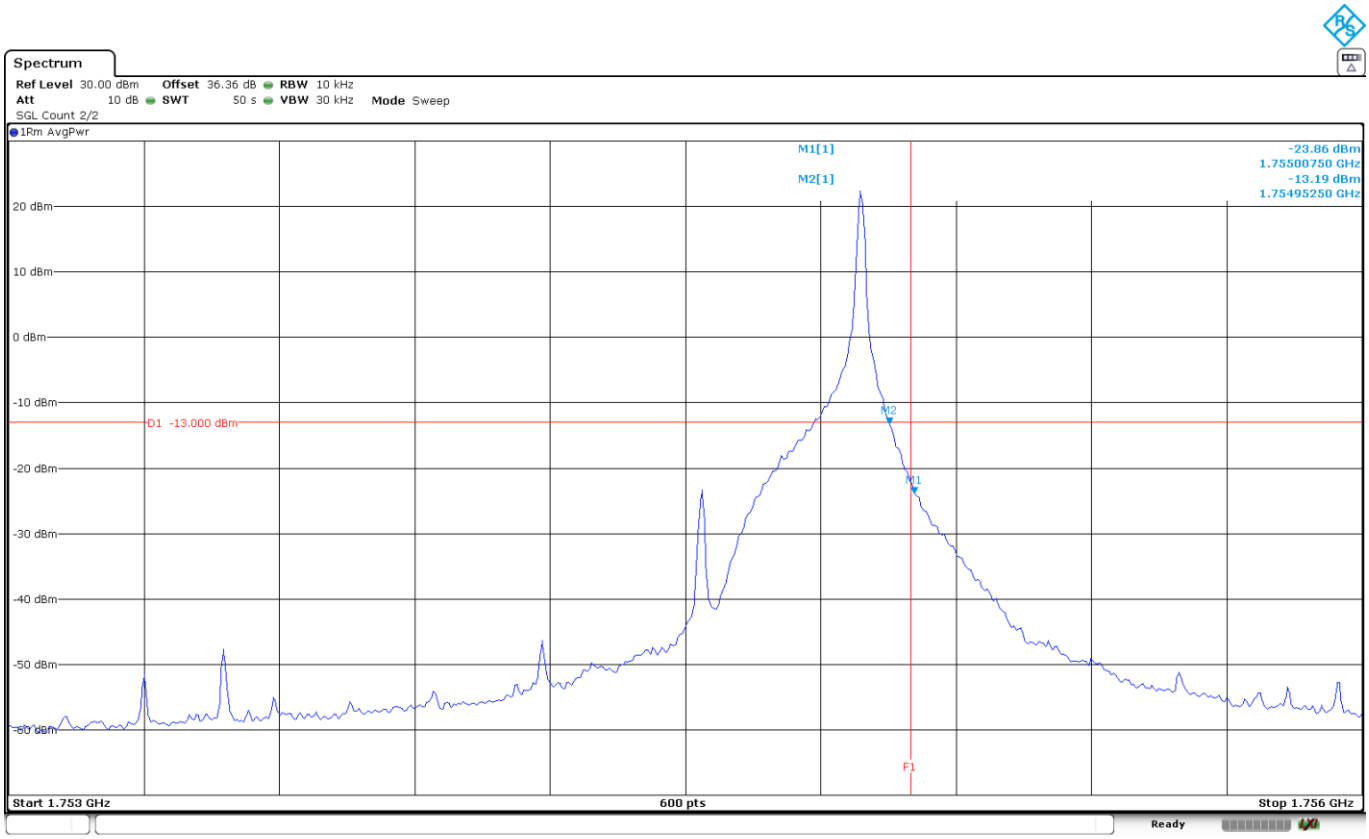
Measurement uncertainty (dB): <±2.76

Verdict

Pass

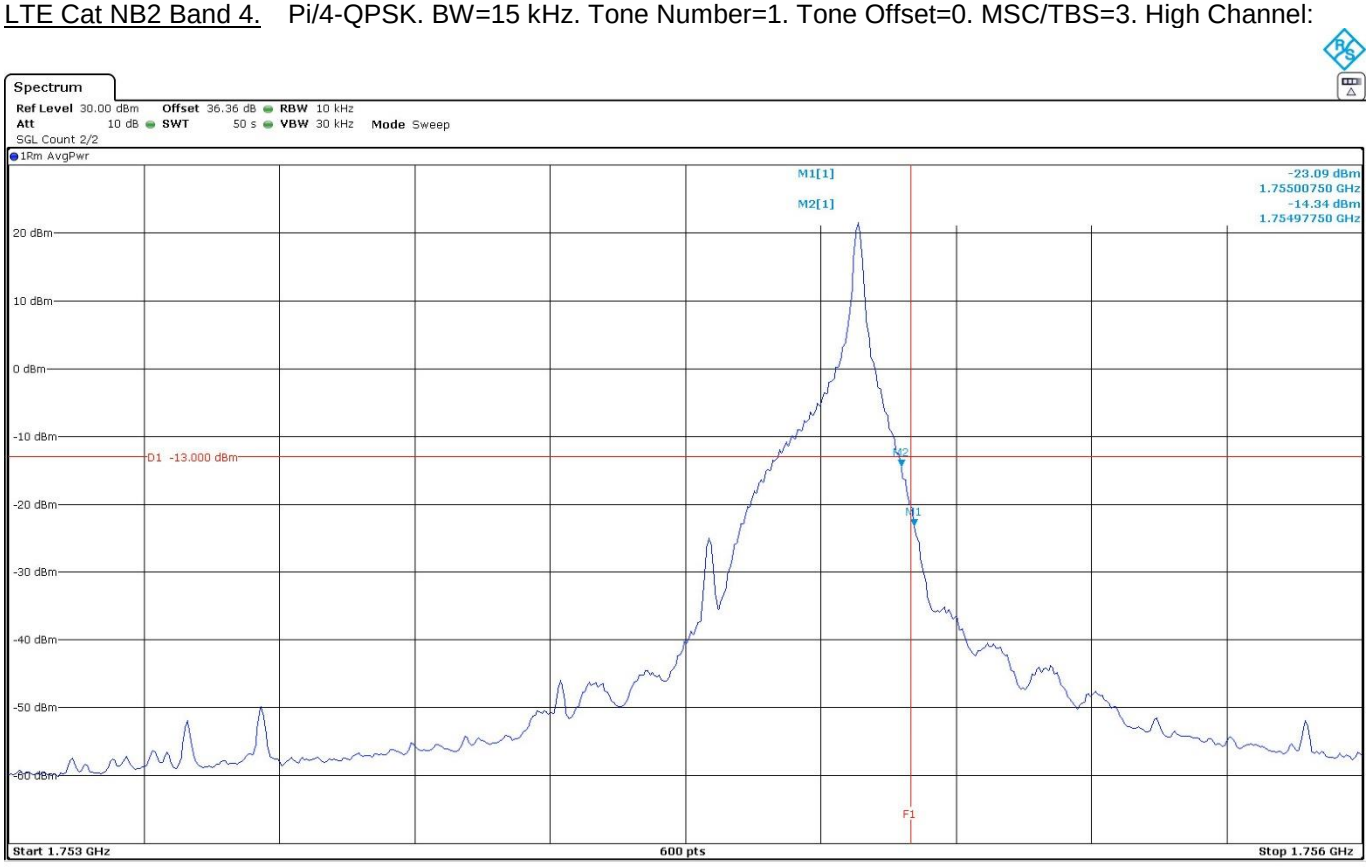
LTE Cat NB2 Band 4:

LTE Cat NB2 Band 4. Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=47. MSC/TBS=0. High Channel:



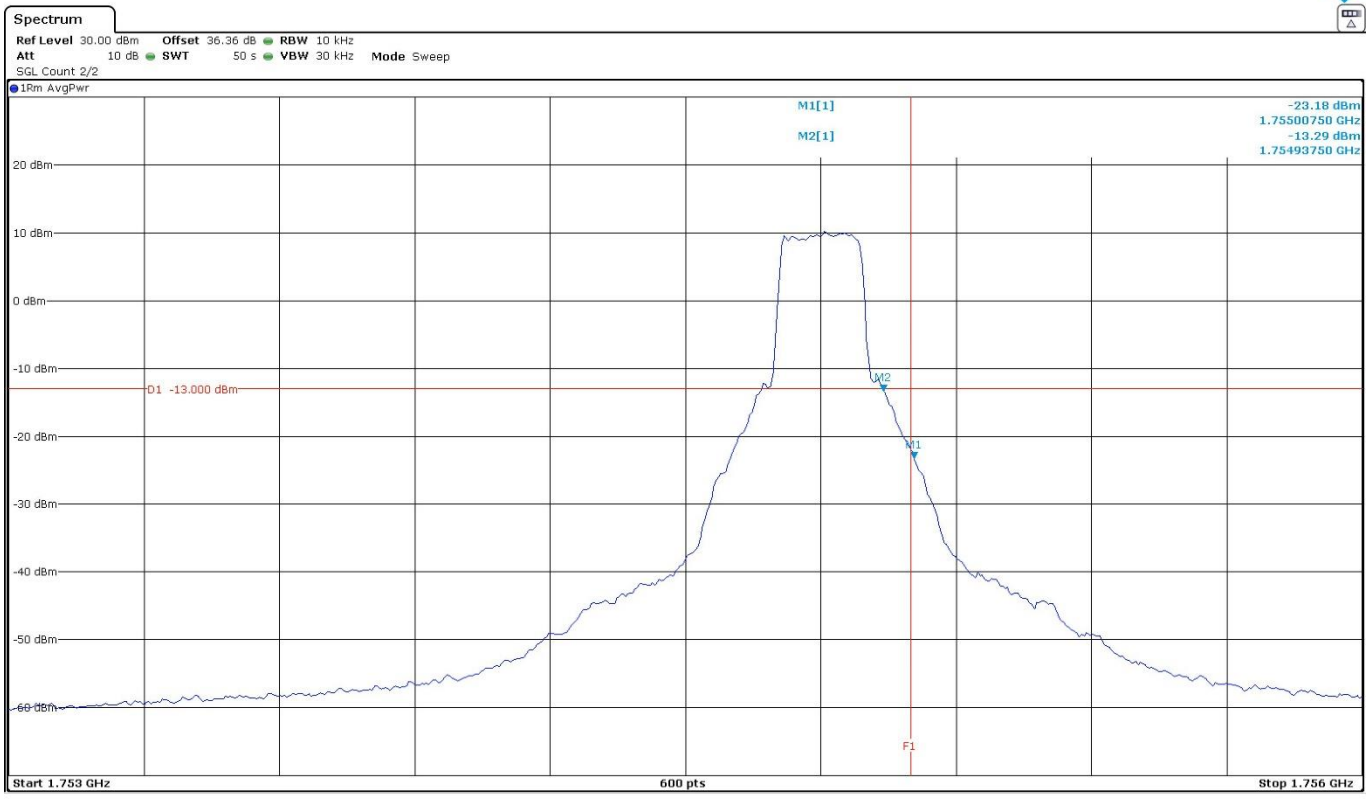
The equipment transmits at the maximum output power.

LTE Cat NB2 Band 4. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=3. High Channel:



The equipment transmits at the maximum output power.

LTE Cat NB2 Band 4. 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 NB2 Band 8:

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

LTE Cat NB2 Band 8	Pi/4-QPSK BW=3.75 kHz Tone Number=1 Tone Offset=0 MSC/TBS=3	Pi/4-QPSK BW=15 kHz Tone Number=1 Tone Offset=0 MSC/TBS=3	QPSK BW=15 kHz Tone Number=12 Tone Offset=0 MSC/TBS=5
Maximum measured level at Low Block Edge at antenna port (dBm)	-21	-22.74	-23.84

LTE Cat NB2 Band 8	Pi/4-QPSK BW=3.75 kHz Tone Number=1 Tone Offset=47 MSC/TBS=3	Pi/4-QPSK BW=15 kHz Tone Number=1 Tone Offset=11 MSC/TBS=3	QPSK BW=15 kHz Tone Number=12 Tone Offset=0 MSC/TBS=5
Maximum measured level at High Block Edge at antenna port (dBm)	-21.88	-22.71	-23.31

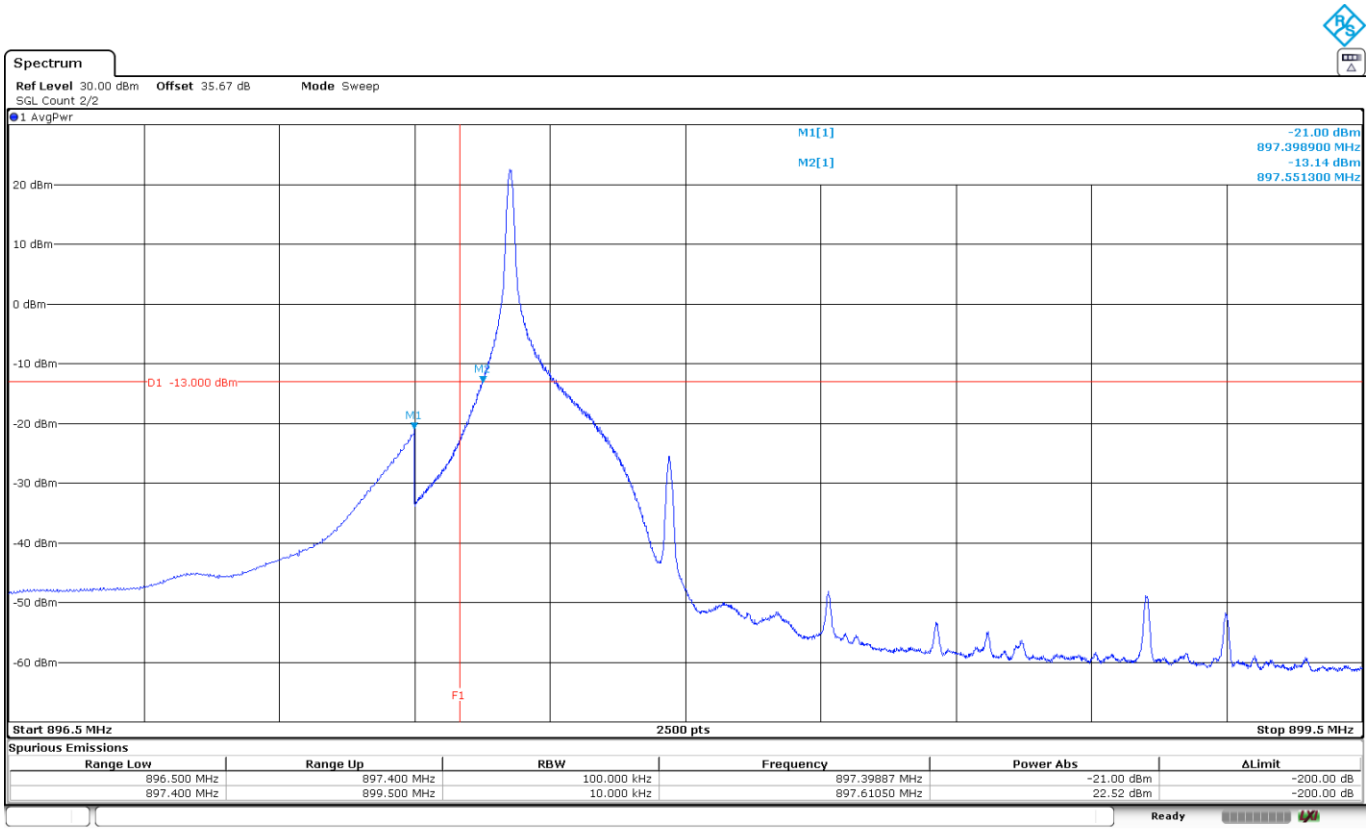
Measurement uncertainty (dB): <±2.76

Verdict

Pass

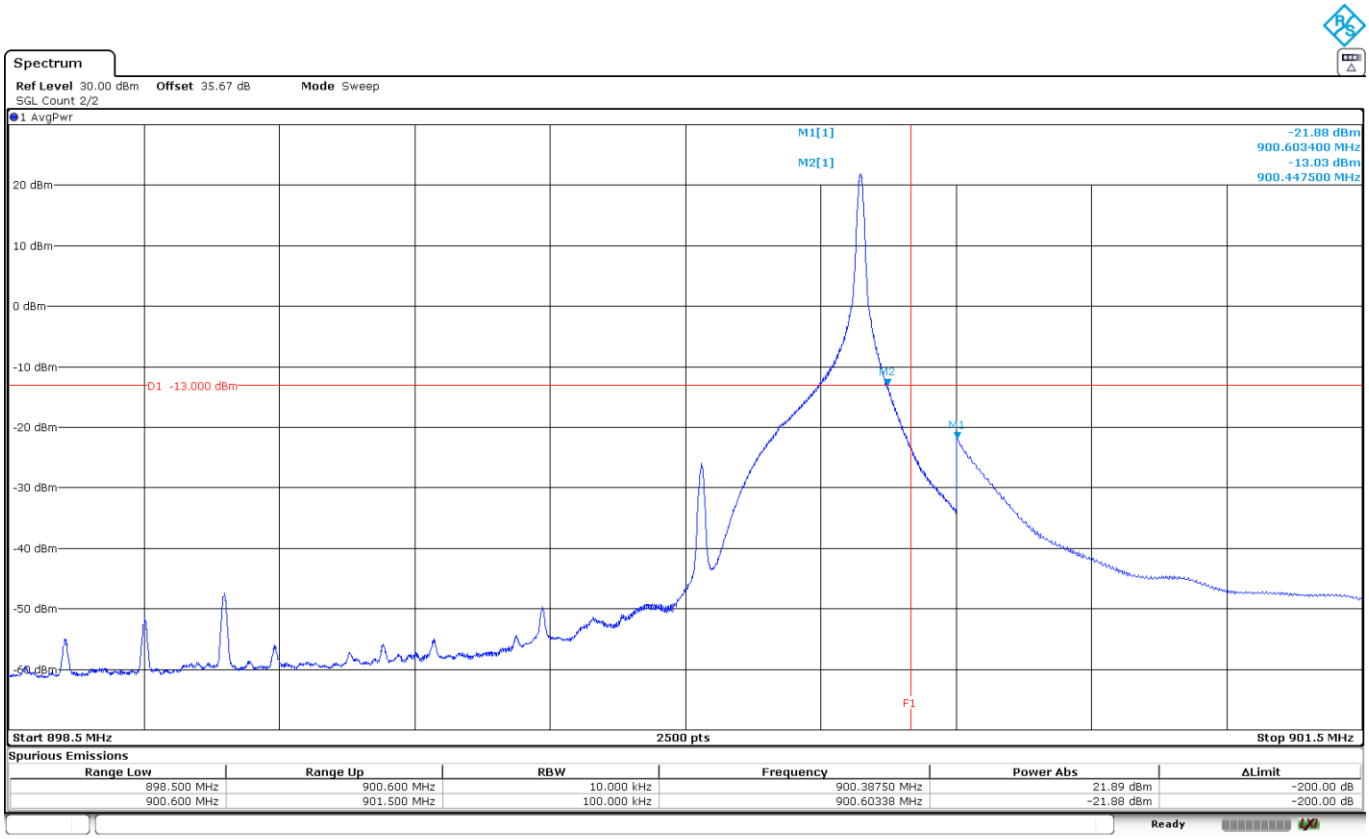
LTE Cat NB2 Band 8:

LTE Cat NB2 Band 8. Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=3. Low Channel:



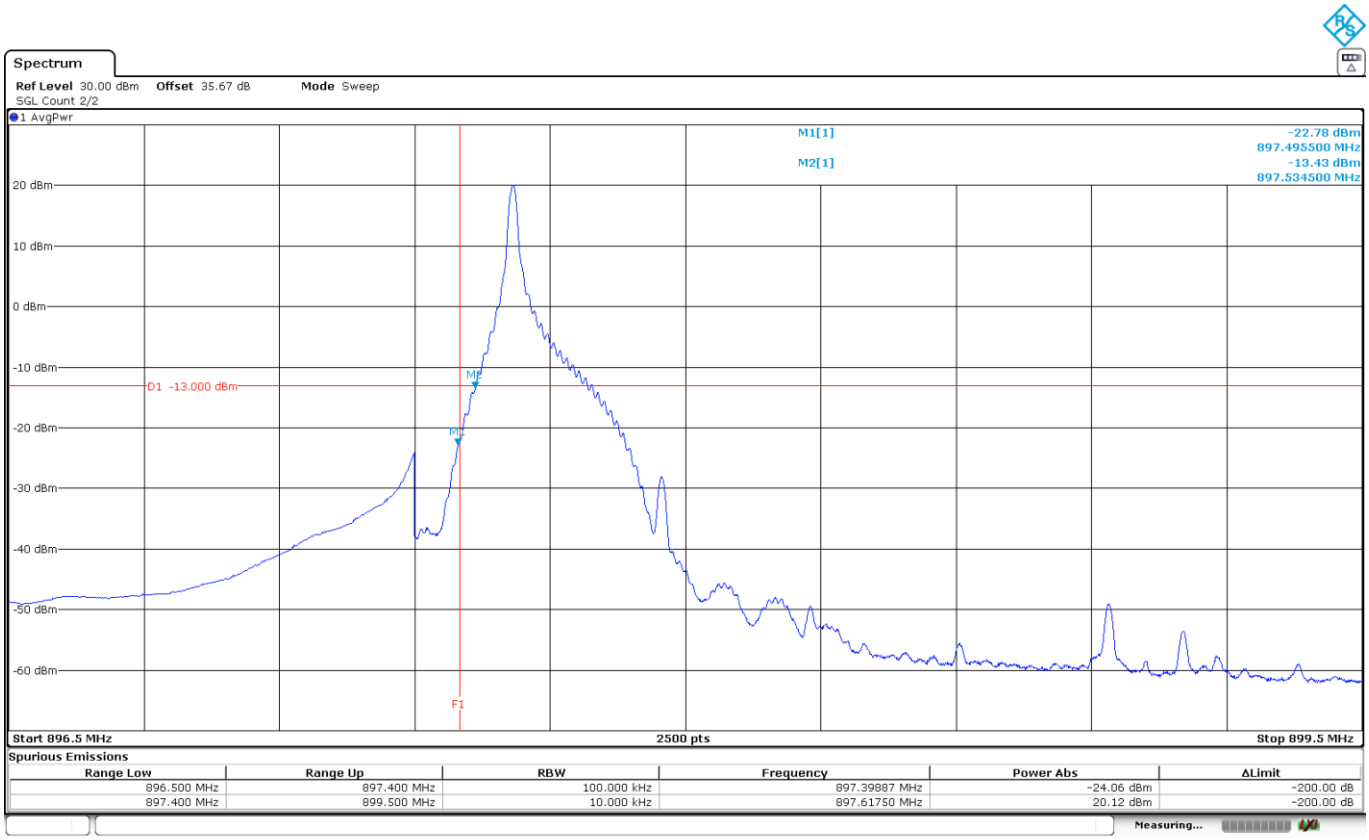
The equipment transmits at the maximum output power.

LTE Cat NB2 Band 8. Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=47. MSC/TBS=3. High Channel:



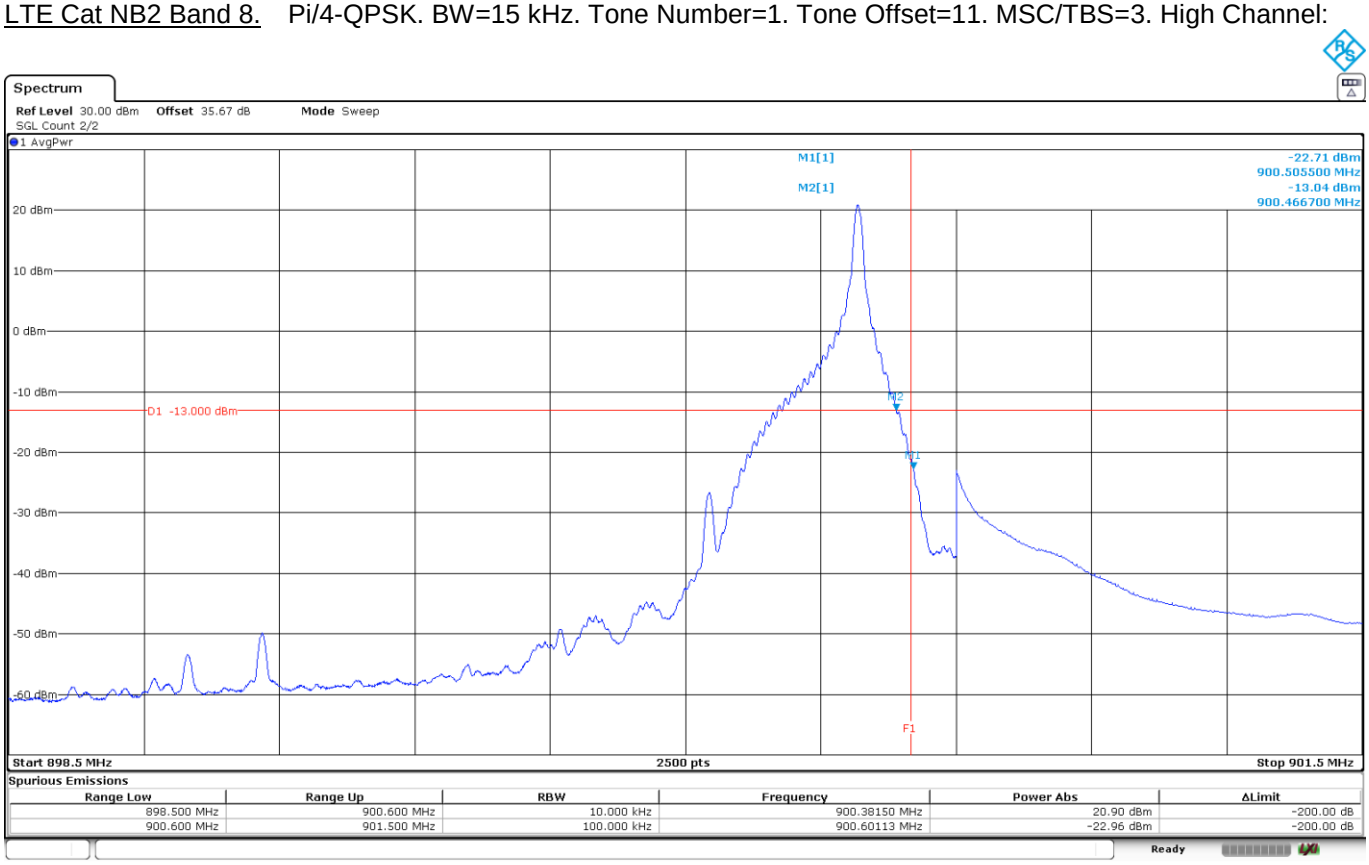
The equipment transmits at the maximum output power.

LTE Cat NB2 Band 8. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=3. Low Channel:



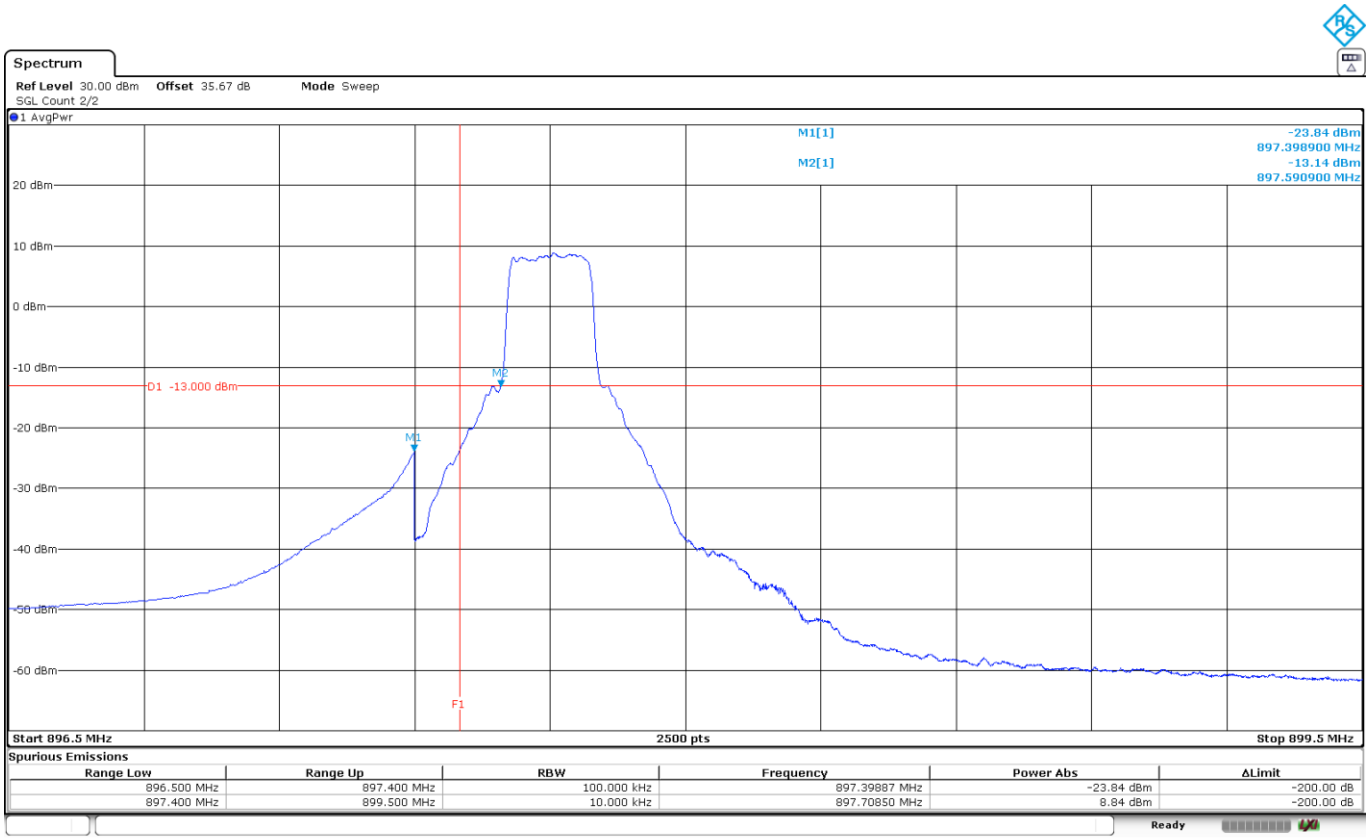
The equipment transmits at the maximum output power.

LTE Cat NB2 Band 8. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=11. MSC/TBS=3. High Channel:



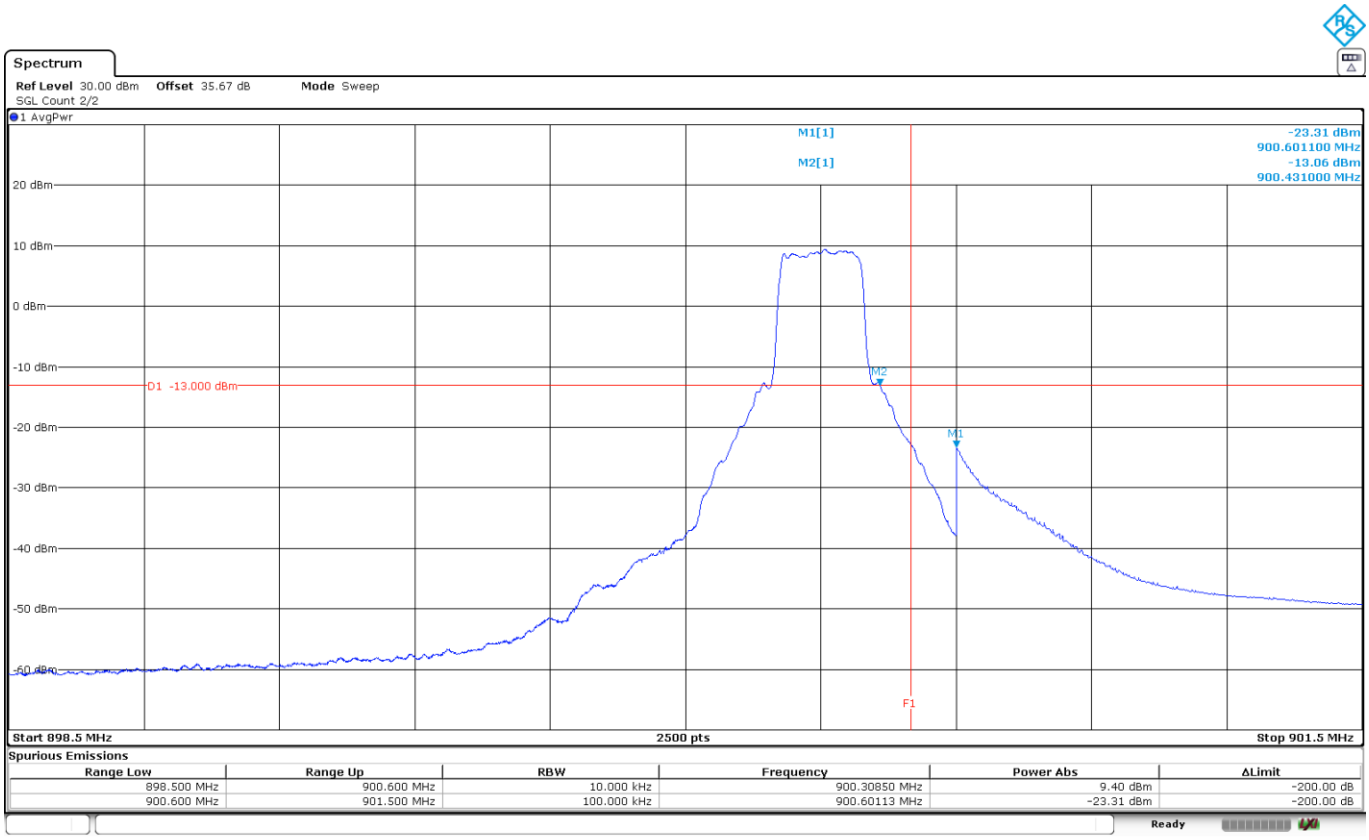
The equipment transmits at the maximum output power.

LTE Cat NB2 Band 8. 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 NB2 Band 8. 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 NB2 Band 12:

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

Low Block Edge.

LTE Cat NB2 Band 12	Pi/2-BPSK BW=3.75 kHz Tone Number=1 Tone Offset=0 MSC/TBS=3	Pi/4-QPSK BW=15 kHz Tone Number=1 Tone Offset=0 MSC/TBS=3	QPSK BW=15 kHz Tone Number=12 Tone Offset=0 MSC/TBS=5
Maximum measured level at Low Block Edge at antenna port (dBm)	-48.24	-49.71	-50.56

High Block Edge.

Note: High Block Edge for LTE Cat NB2 Band 12 is the same as for LTE Cat NB2 Band 85.

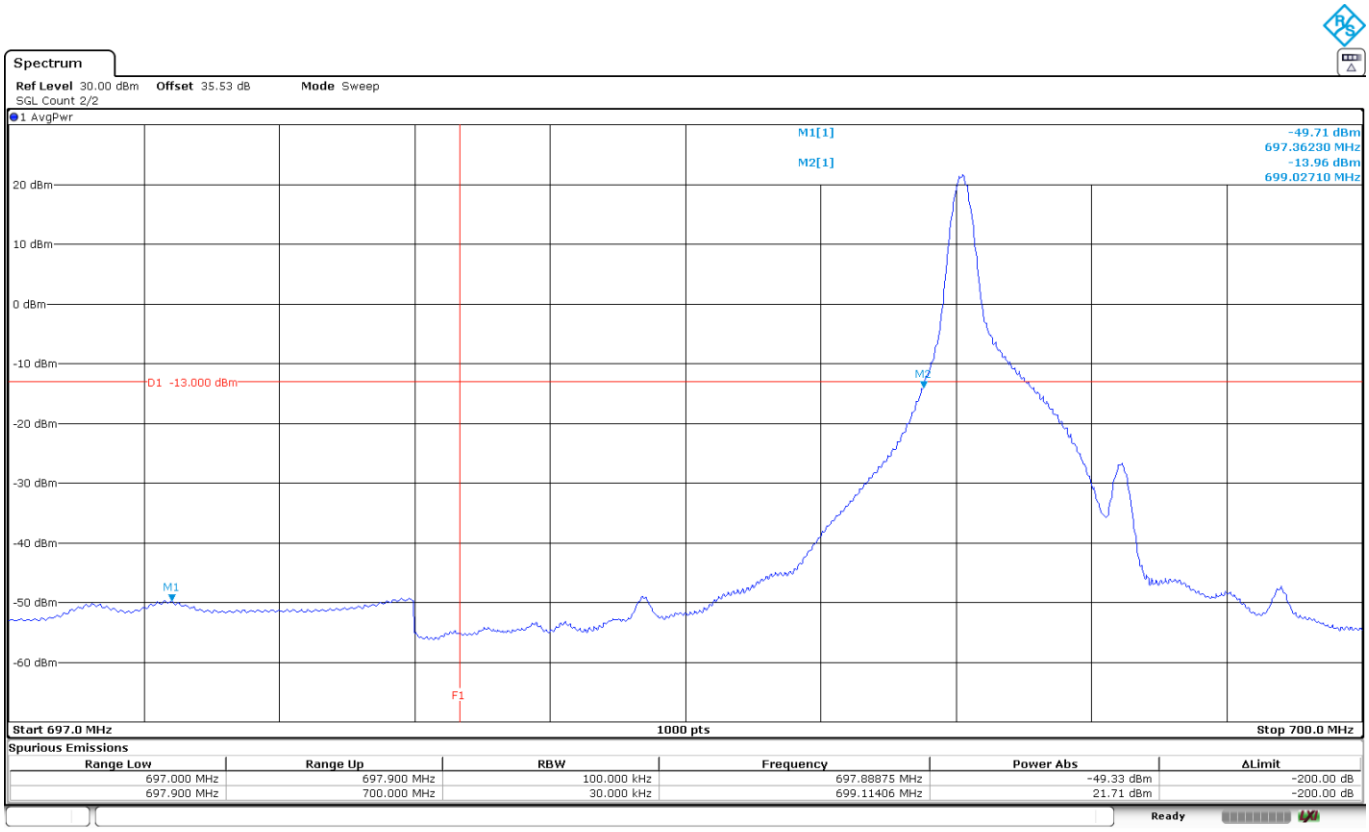
Measurement uncertainty (dB): <±2.76

Verdict

Pass

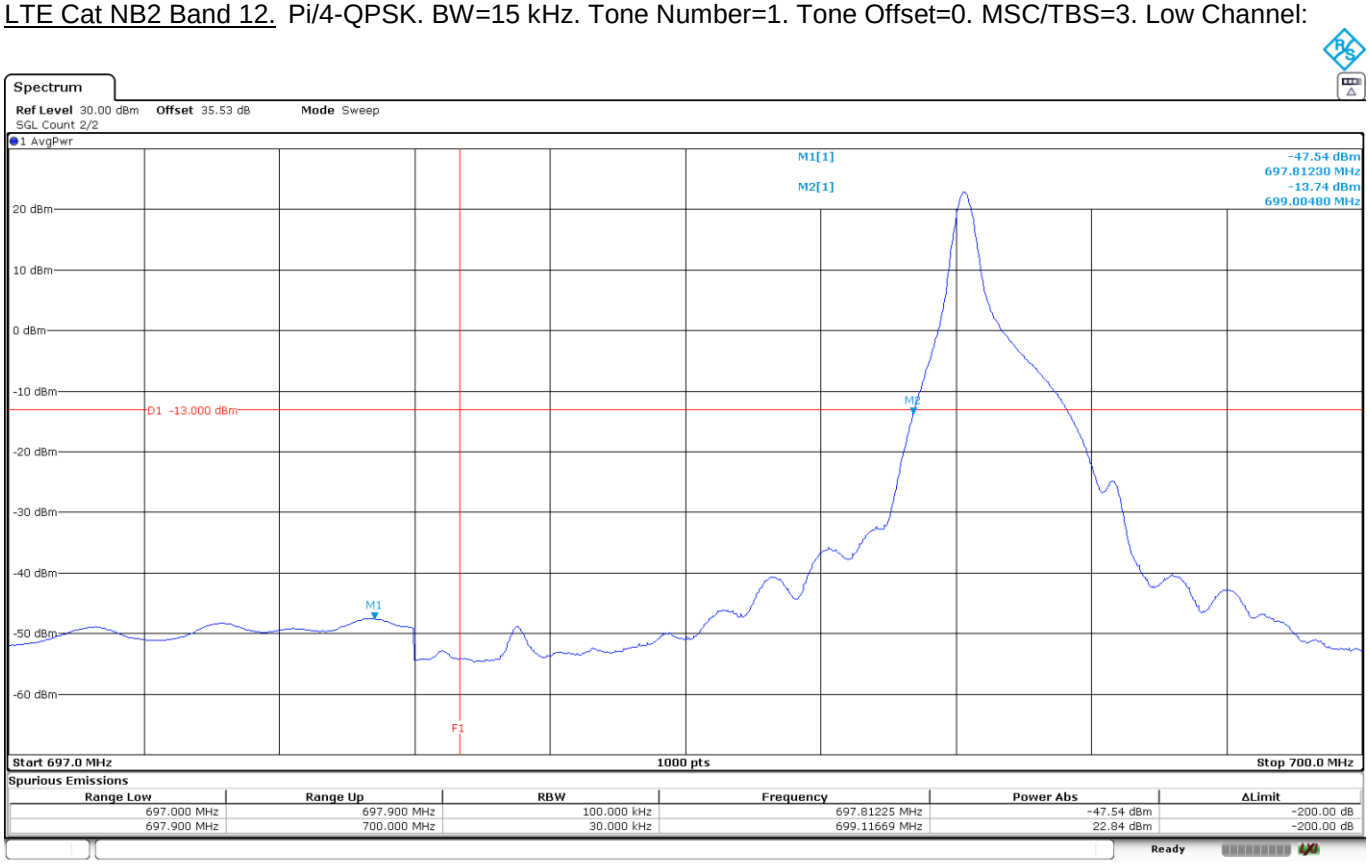
LTE Cat NB2 Band 12:

LTE Cat NB2 Band 12. Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=3. Low Channel:



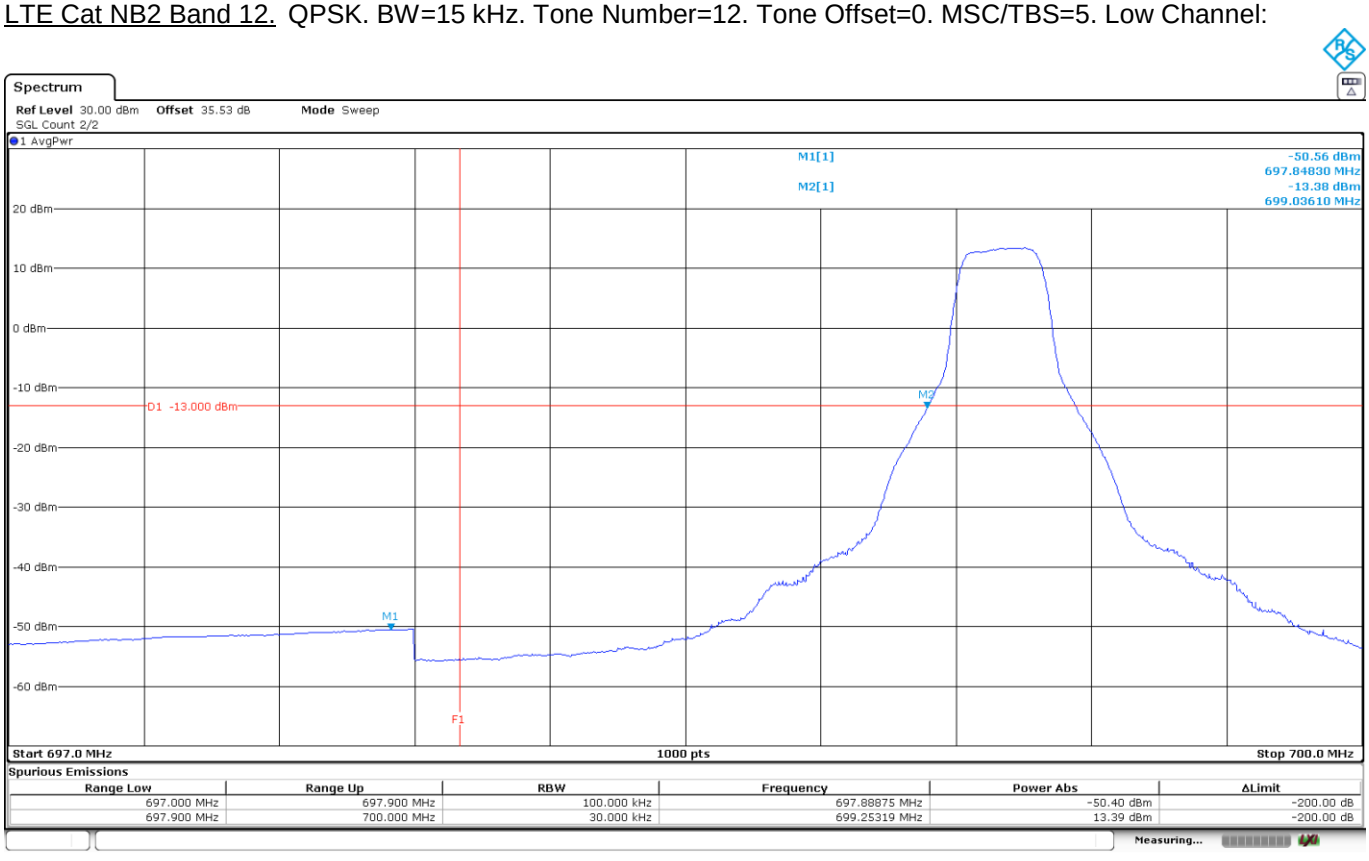
The equipment transmits at the maximum output power.

LTE Cat NB2 Band 12. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=3. Low Channel:



The equipment transmits at the maximum output power.

LTE Cat NB2 Band 12. 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 NB2 Band 13:

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

LTE Cat NB2 Band 13	Pi/4-QPSK BW=3.75 kHz Tone Number=1 Tone Offset=0 MSC/TBS=3	Pi/4-QPSK BW=15 kHz Tone Number=1 Tone Offset=0 MSC/TBS=3	QPSK BW=15 kHz Tone Number=12 Tone Offset=0 MSC/TBS=5
Maximum measured level at Low Block Edge at antenna port (dBm)	-21.07	-20.07	-18.58

LTE Cat NB2 Band 13	Pi/4-QPSK BW=3.75 kHz Tone Number=1 Tone Offset=47 MSC/TBS=3	Pi/4-QPSK BW=15 kHz Tone Number=1 Tone Offset=11 MSC/TBS=3	QPSK BW=15 kHz Tone Number=12 Tone Offset=0 MSC/TBS=5
Maximum measured level at High Block Edge at antenna port (dBm)	-19.96	-19.67	-18.63

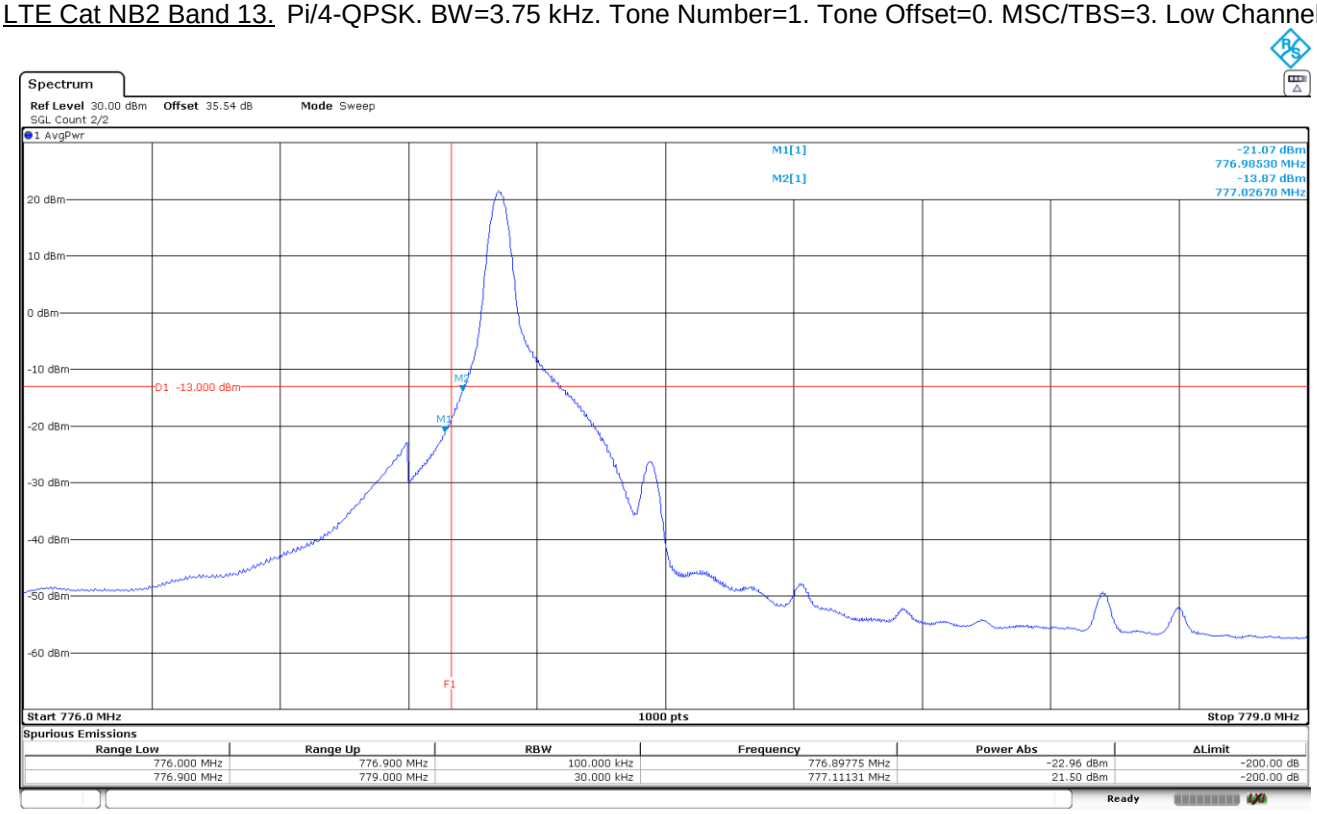
Measurement uncertainty (dB): <±2.76

Verdict

Pass

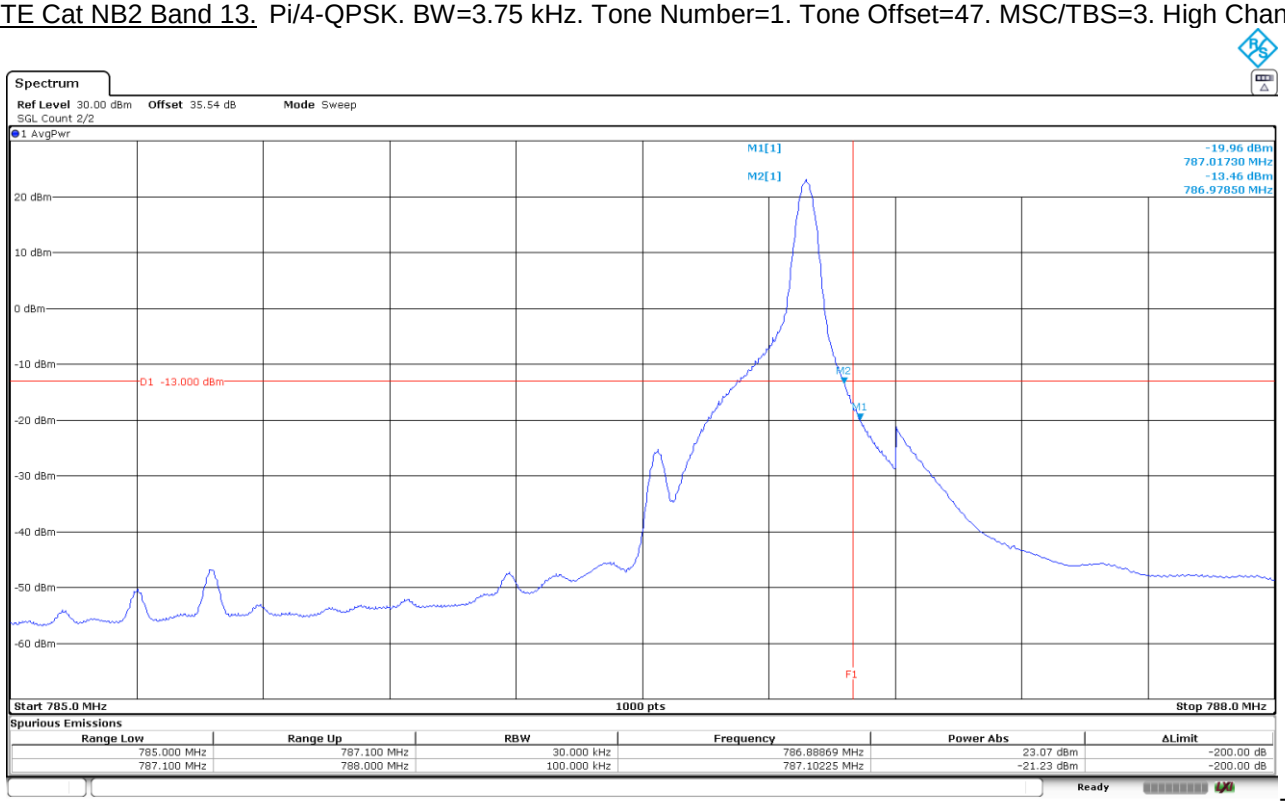
LTE Cat NB2 Band 13:

LTE Cat NB2 Band 13. Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=3. Low Channel:



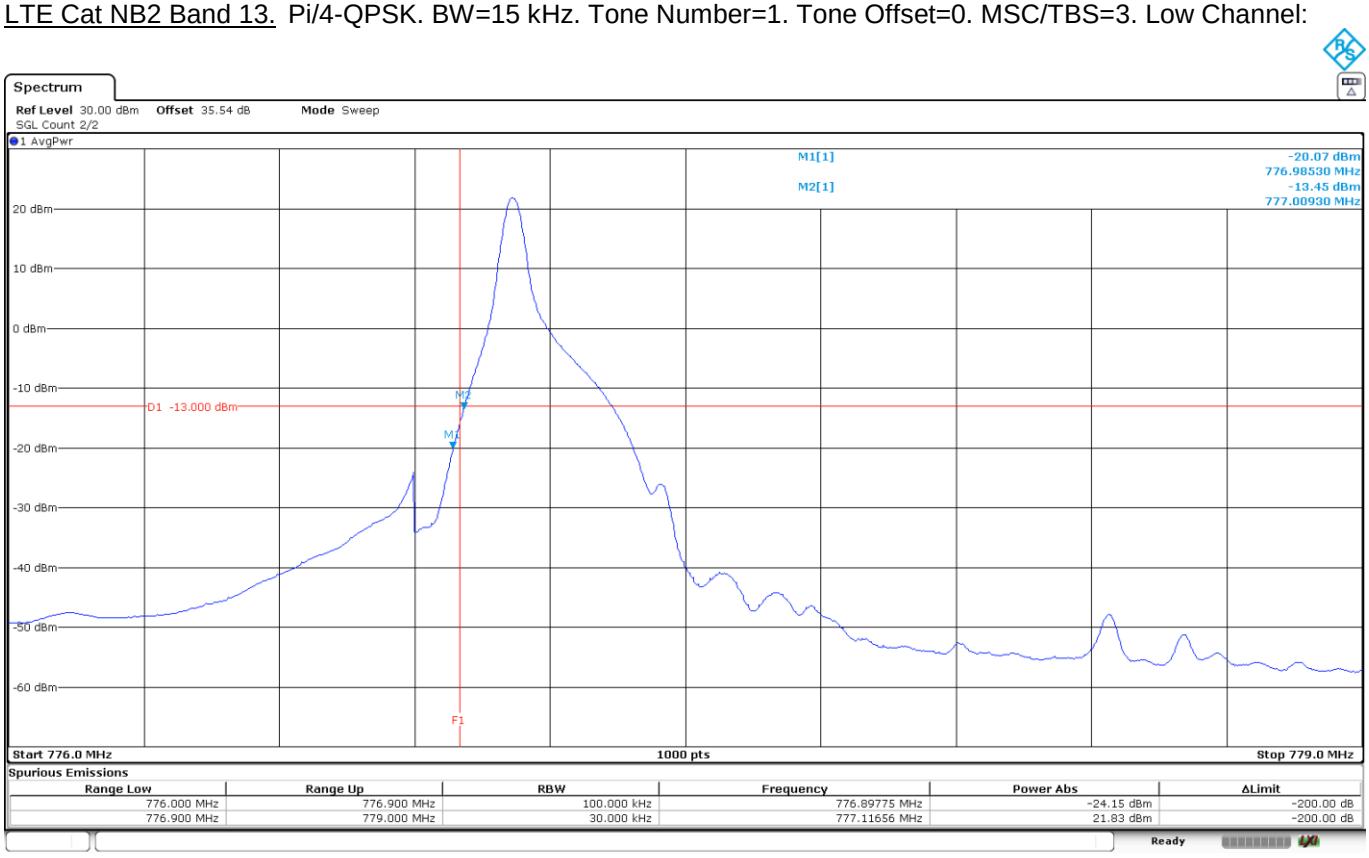
The equipment transmits at the maximum output power.

LTE Cat NB2 Band 13. Pi/4-QPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=47. MSC/TBS=3. High Channel:



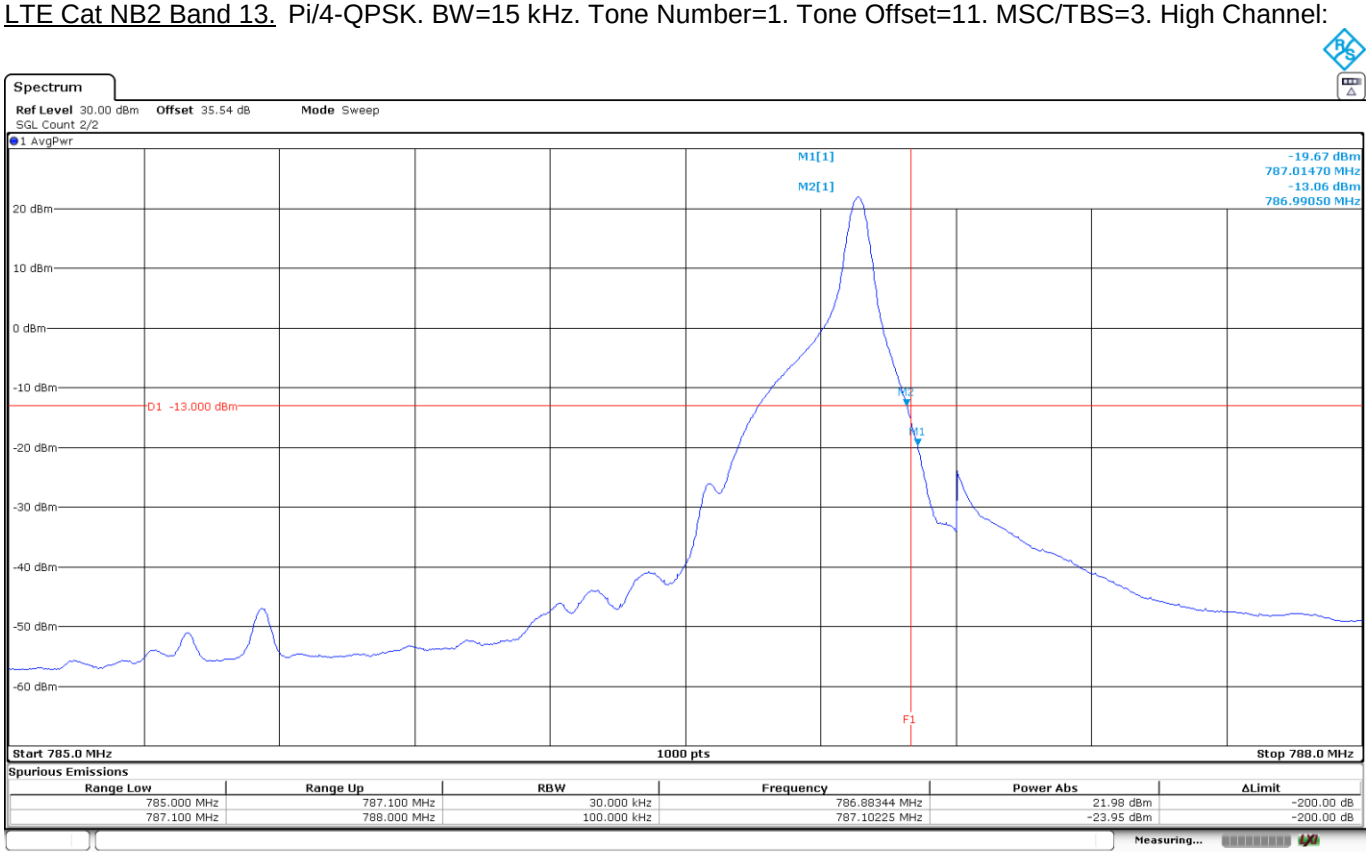
The equipment transmits at the maximum output power.

LTE Cat NB2 Band 13. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=3. Low Channel:



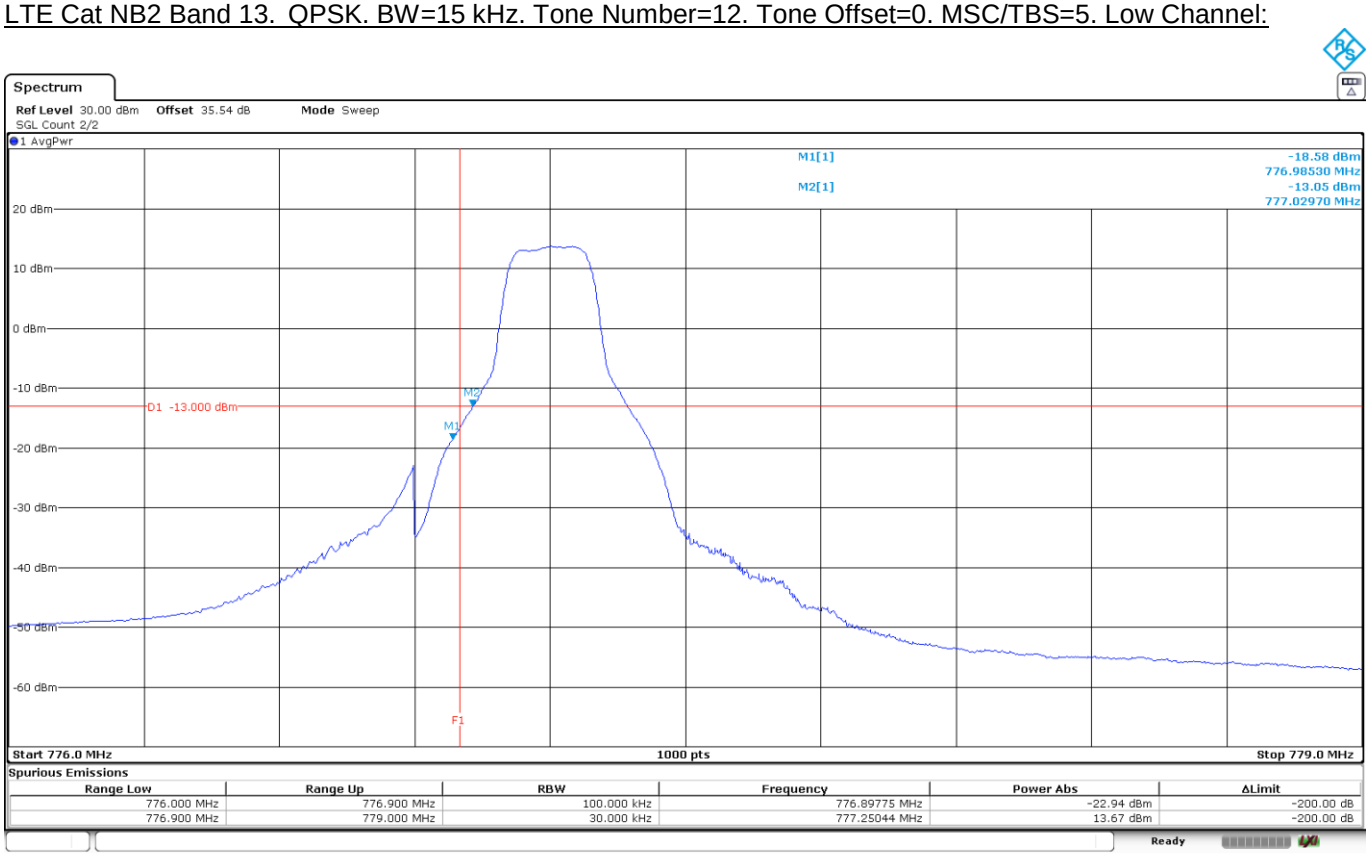
The equipment transmits at the maximum output power.

LTE Cat NB2 Band 13. Pi/4-QPSK. BW=15 kHz. Tone Number=1. Tone Offset=11. MSC/TBS=3. High Channel:



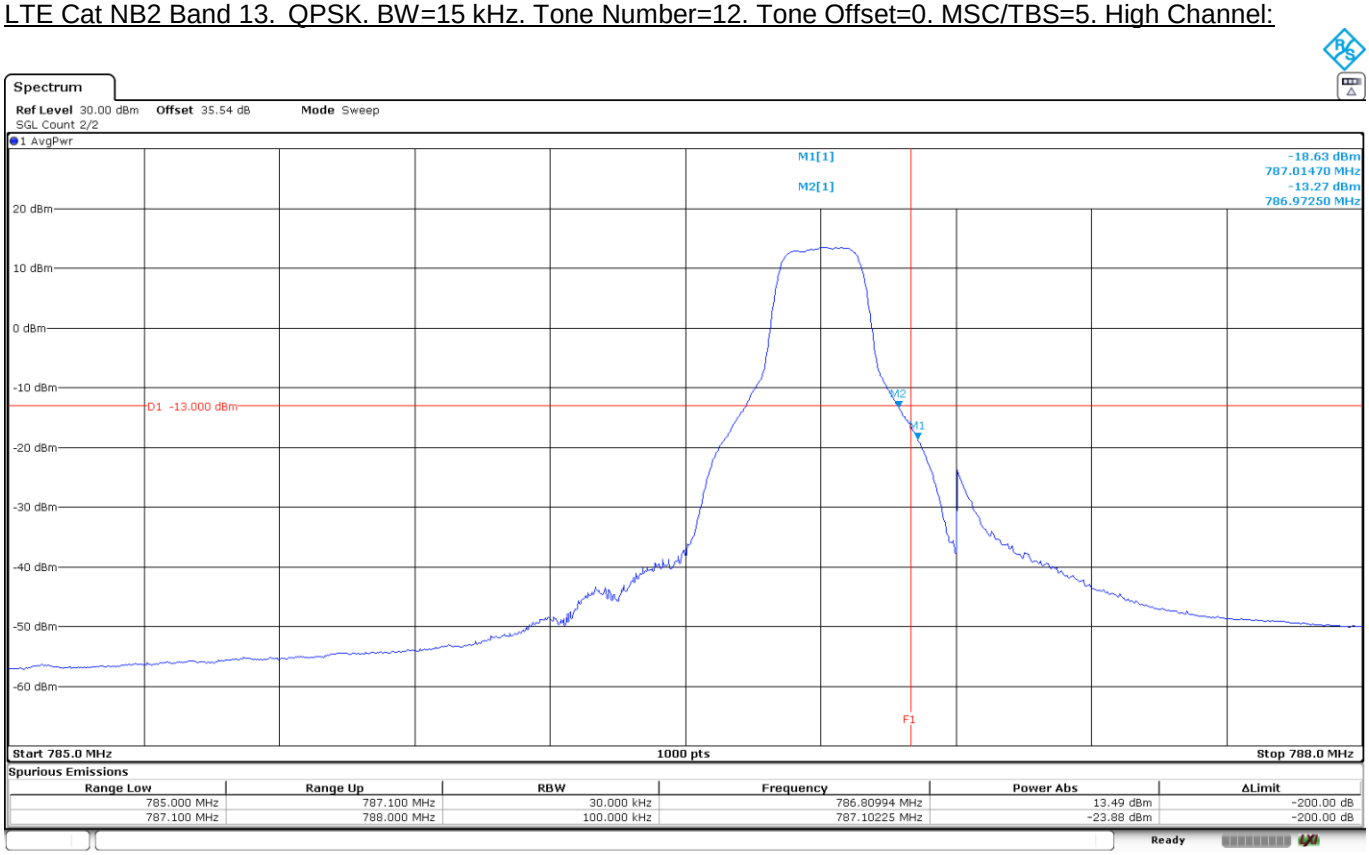
The equipment transmits at the maximum output power.

LTE Cat NB2 Band 13. 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 NB2 Band 13. 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 NB2 Band 17:

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

Low Block Edge.

LTE Cat NB2 Band 17	Pi/2-BPSK BW=3.75 kHz Tone Number=1 Tone Offset=0 MSC/TBS=3	Pi/4-QPSK BW=15 kHz Tone Number=1 Tone Offset=0 MSC/TBS=3	QPSK BW=15 kHz Tone Number=12 Tone Offset=0 MSC/TBS=5
Maximum measured level at Low Block Edge at antenna port (dBm)	-20.22	-19.59	-19.58

High Block Edge.

Note: High Block Edge for LTE Cat NB2 Band 17 is the same as for LTE Cat NB2 Band 85.

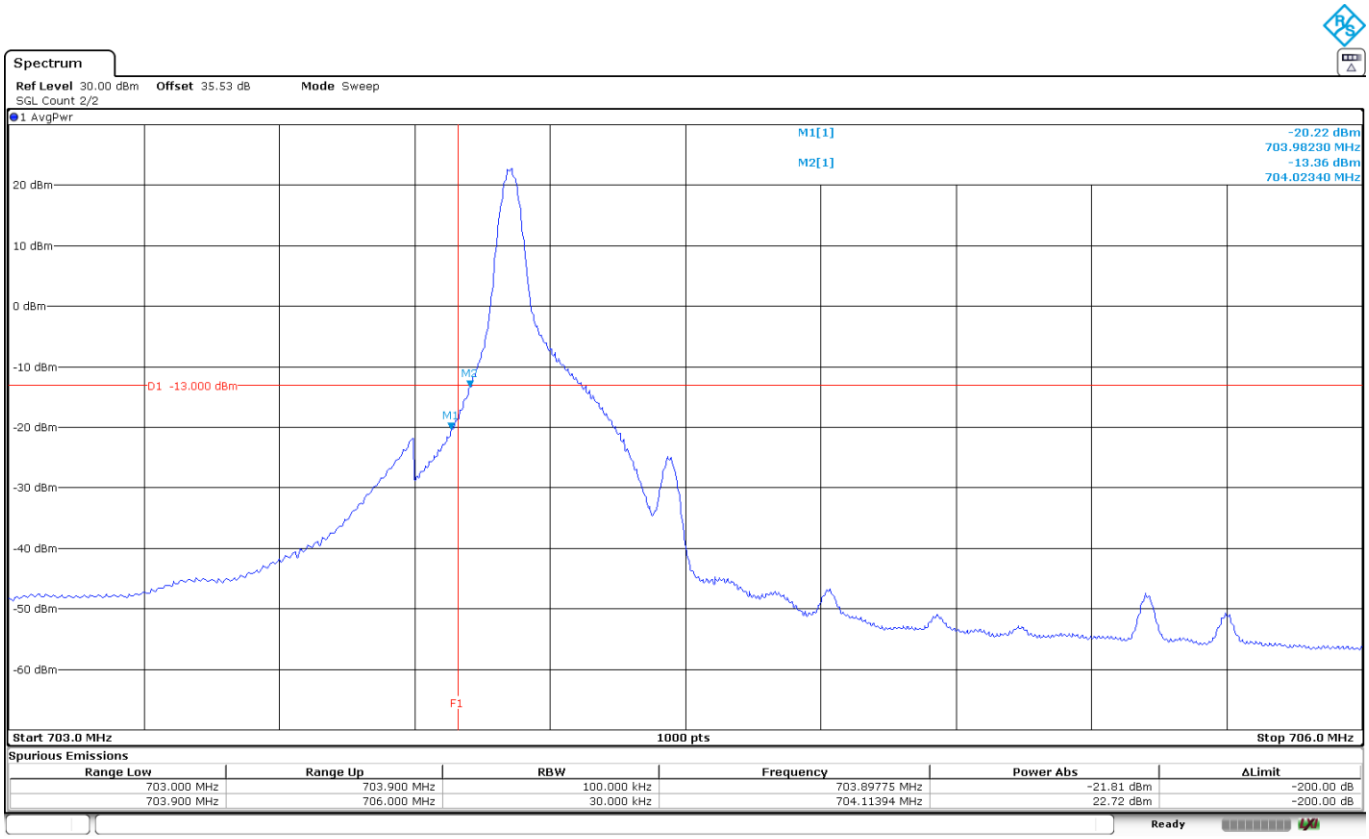
Measurement uncertainty (dB): <±2.76

Verdict

Pass

LTE Cat NB2 Band 17:

LTE Cat NB2 Band 17. Pi/2-BPSK. BW=3.75 kHz. Tone Number=1. Tone Offset=0. MSC/TBS=3. Low Channel:



The equipment transmits at the maximum output power.