

## Spurious emissions at antenna terminals at Block Edges

### SPECIFICATION

FCC §2.1051 and §22.917  
RSS-132. Clause 5.5.

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.

FCC §90.691. Emission mask requirements for EA-based systems. 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  $116 \text{Log}_{10}(f/6.1)$  decibels or  $50 + 10 \text{Log}_{10}(P)$  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  $43 + 10\text{Log}_{10}(P)$  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 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 22, in the 1 MHz bands immediately outside and adjacent to the frequency block or band a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

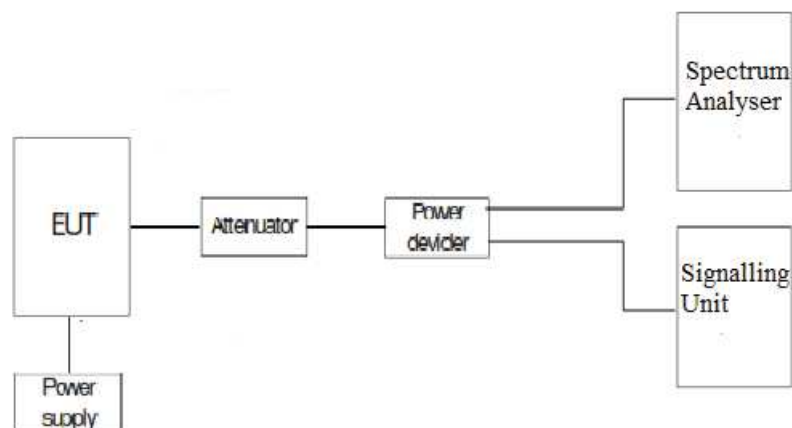
Measurement Limit:

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 (see plots in next pages)

**824-849MHz Band:**

NB IoT	Tone 3.75 kHz. $\pi/4$ - QPSK Offset 0 MCS/TBS=3	Tone 15kHz. $\pi/2$ - BPSK Offset 0 MCS/TBS=0	12 Tone 15kHz. $\pi/2$ - BPSK Offset 0 MCS/TBS=0
Maximum measured level at lowest Block Edge at antenna port (dBm)	-30.28	-31.27	-26.24

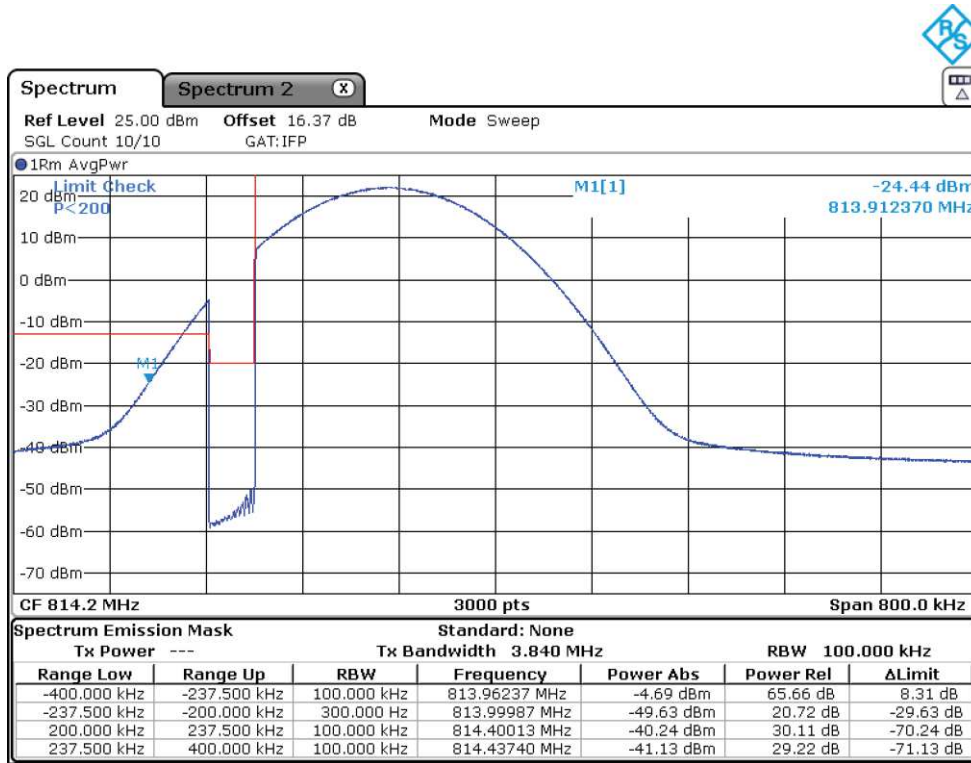
NB IoT	Tone 3.75 kHz. $\pi/4$ - QPSK Offset 0 MCS/TBS=3	Tone 15kHz. $\pi/2$ - BPSK Offset 0 MCS/TBS=0	12 Tone 15kHz. $\pi/2$ - BPSK Offset 0 MCS/TBS=0
Maximum measured level at highest Block Edge at antenna port (dBm)	-31.96	-39	-25.69

Measurement uncertainty =  $\pm 1.57$  dB.

**814-824 MHz Band “EA MASK”.**

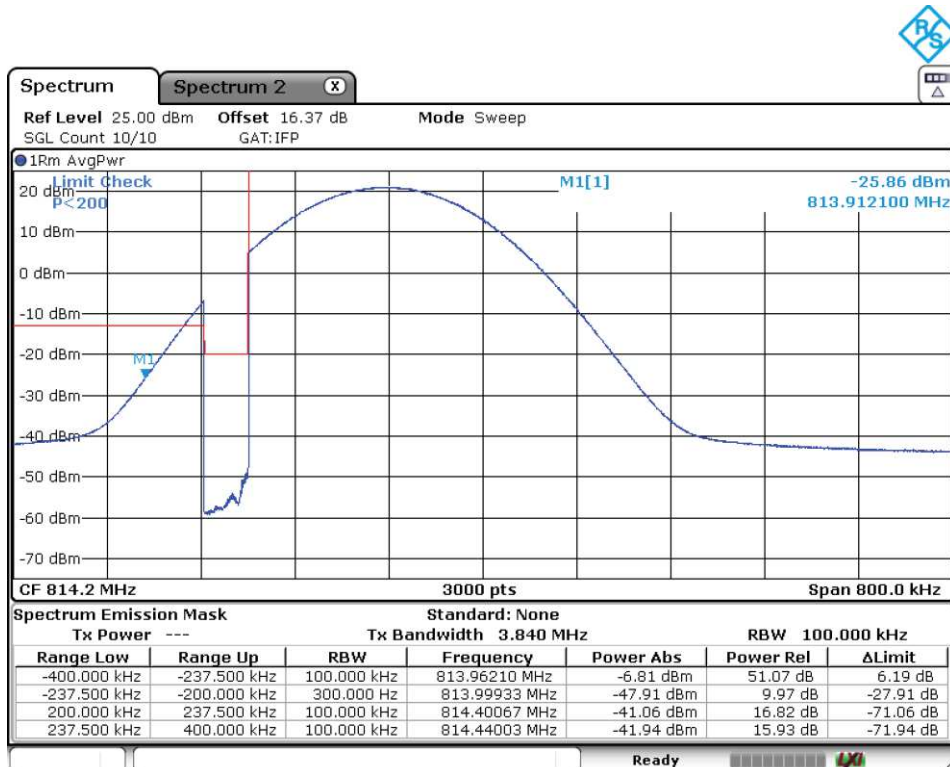
NBiot BAND 26 (Tone 3.75 kHz.  $\pi/4$  - QSK Offset 0)

Lowest Channel:



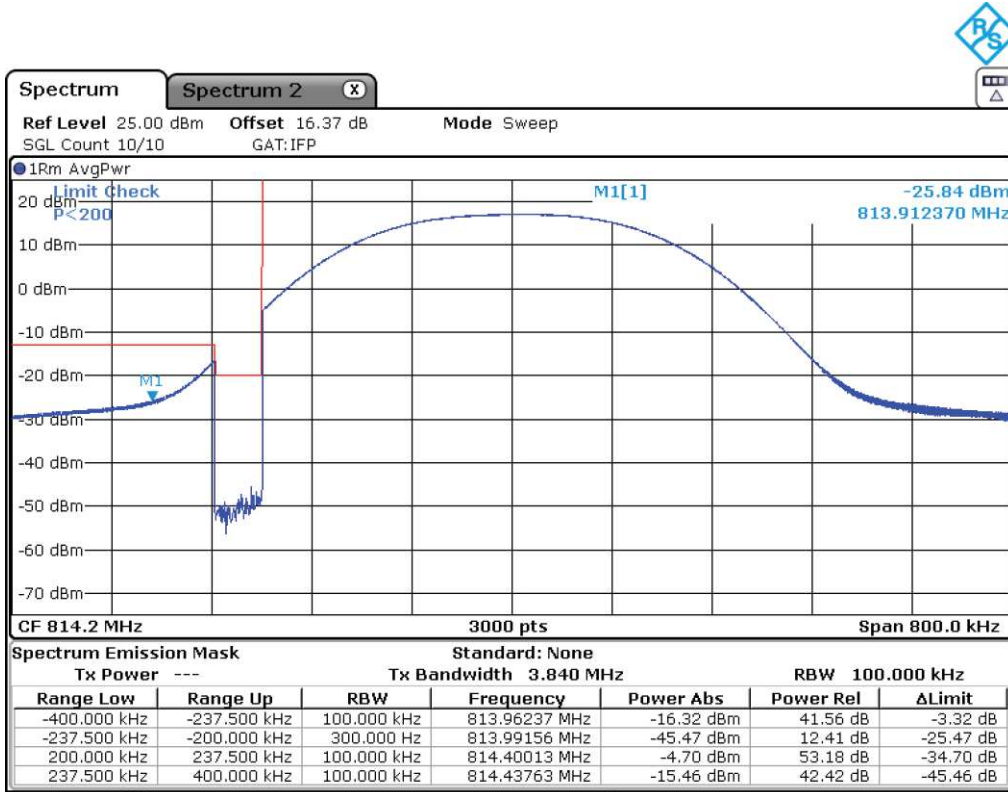
NBiot BAND 26 (Tone 15 kHz.  $\pi/2$  - BPSK Offset 0 MODULATION)

Lowest Channel:



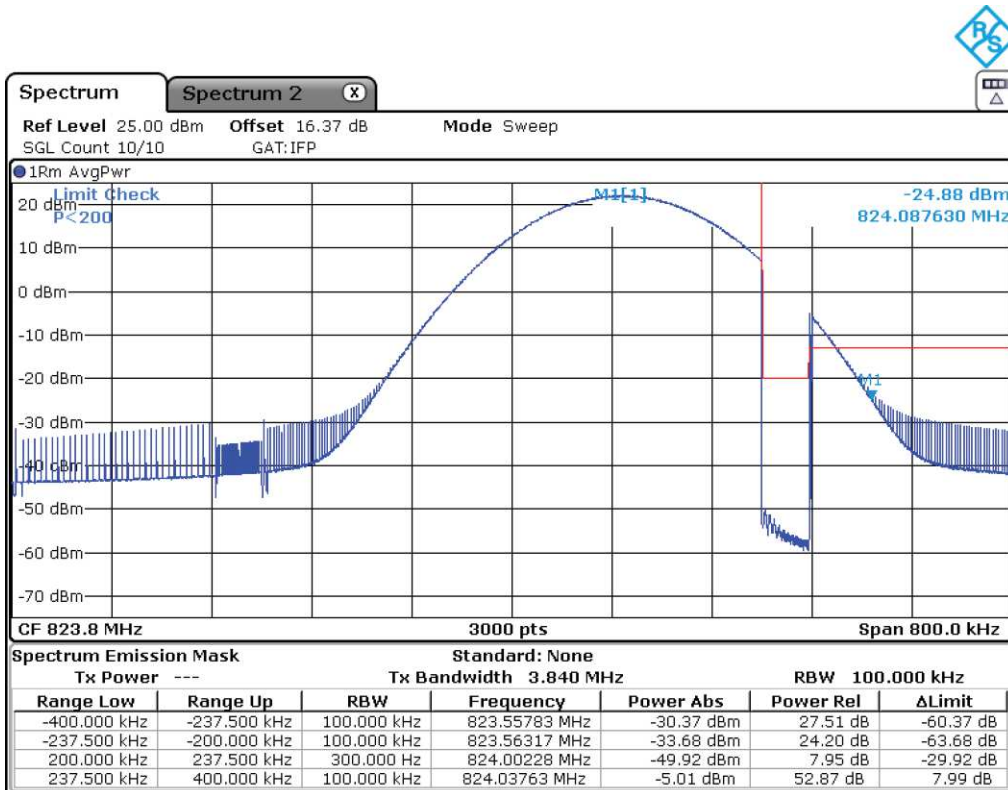
NBLoT BAND 26 (12 Tones 15 kHz.  $\pi/4$  - QPSK Offset 0 MODULATION)

Lowest Channel:



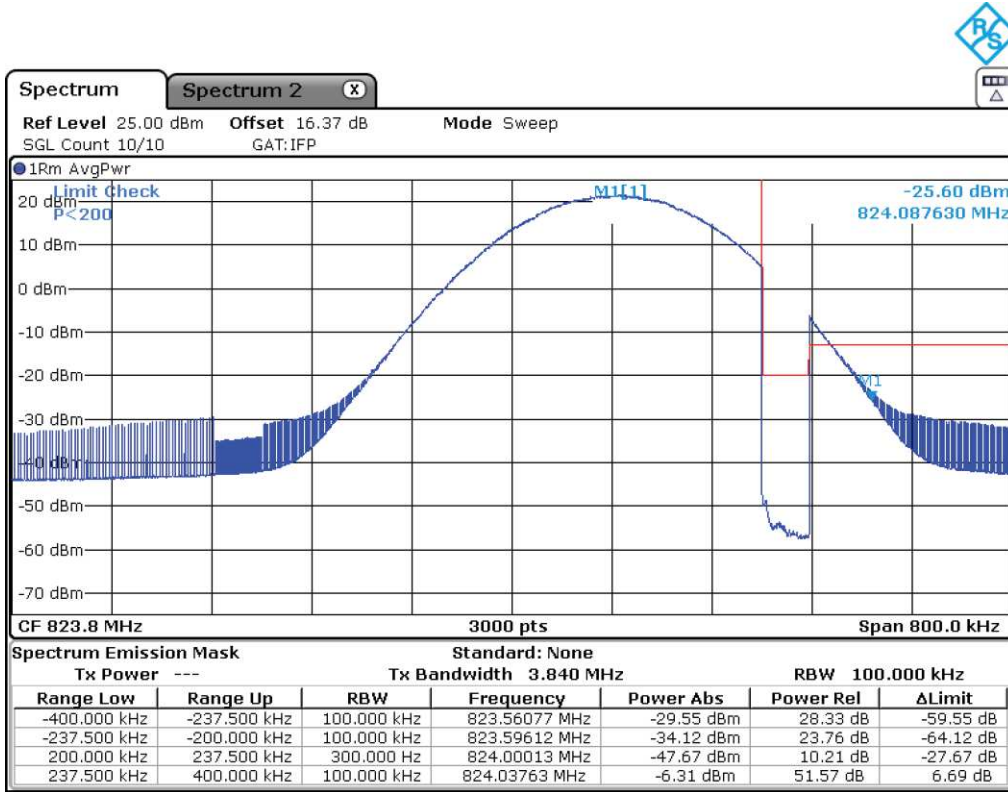
NBLoT BAND 26 (Tone 3.75 kHz.  $\pi/2$  - BPSK Offset 47 MODULATION)

Highest Channel:



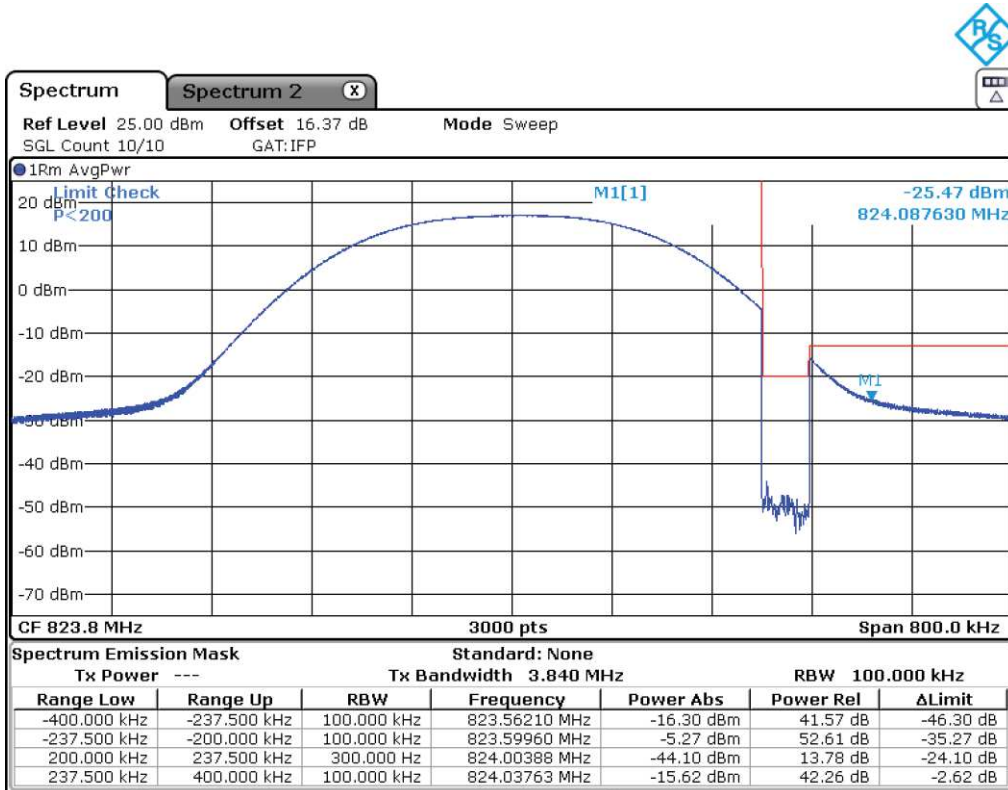
NBLoT BAND 26 (Tone 15 kHz.  $\pi/4$  - QPSK Offset 11 MODULATION)

Highest Channel:



NBLoT BAND 26 (12 Tones 15 kHz.  $\pi/4$  - QPSK Offset 0 MODULATION)

Highest Channel:

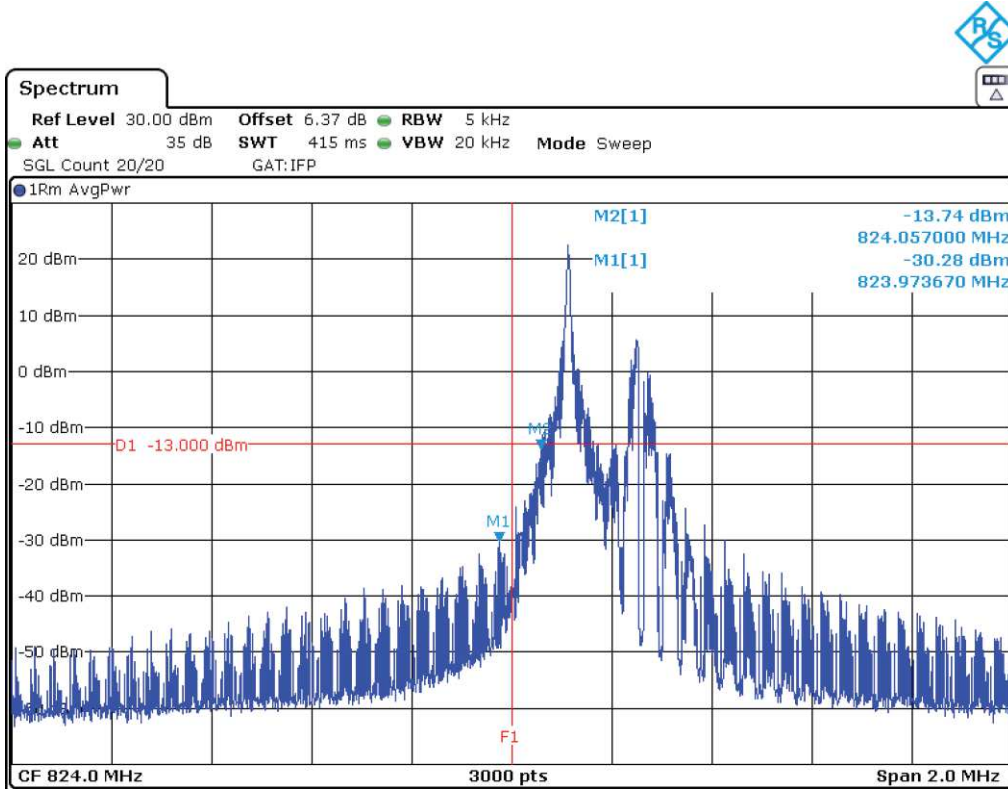


Verdict: PASS

**824-849 MHz:**

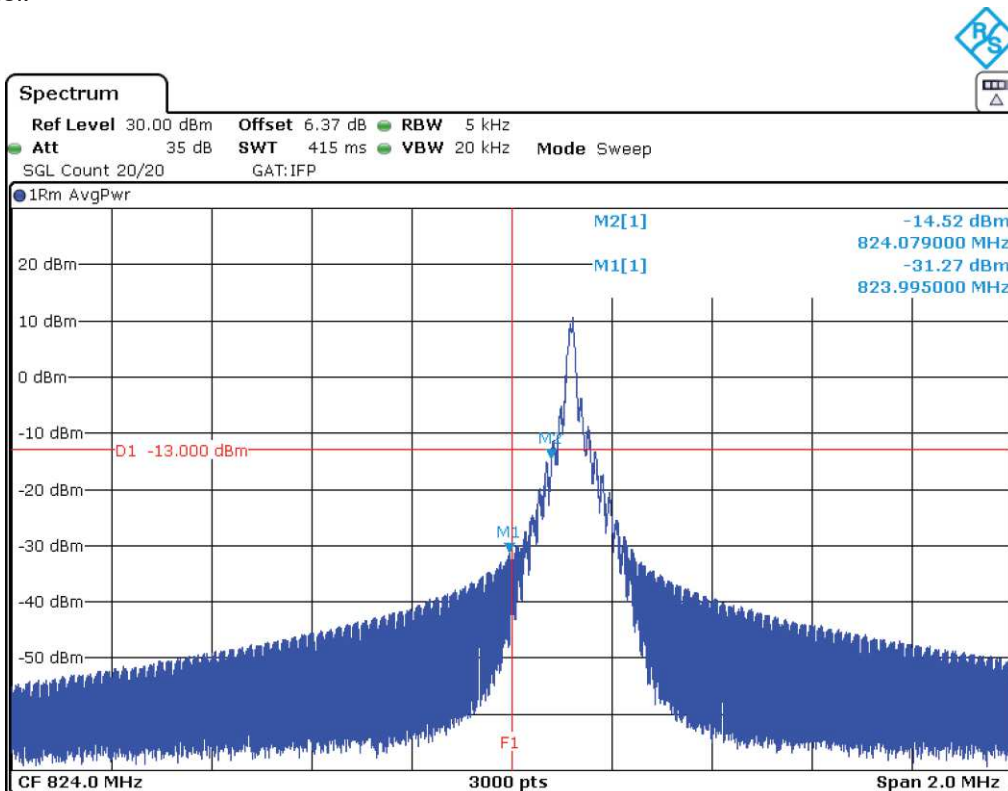
NBLoT BAND 5 (Tone 3.75 kHz.  $\pi/2$  - BPSK Offset 0 MODULATION)

Lowest Channel:



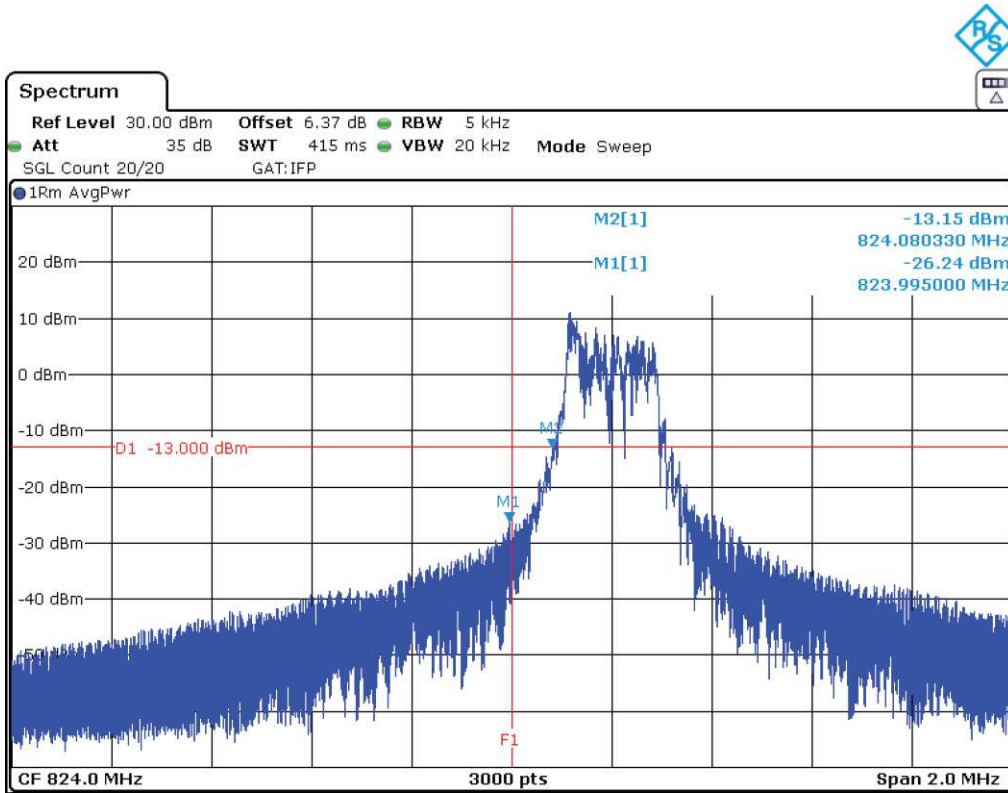
NBLoT BAND 5 (Tone 15 kHz.  $\pi/4$  - QPSK Offset 0 MODULATION)

Lowest Channel:



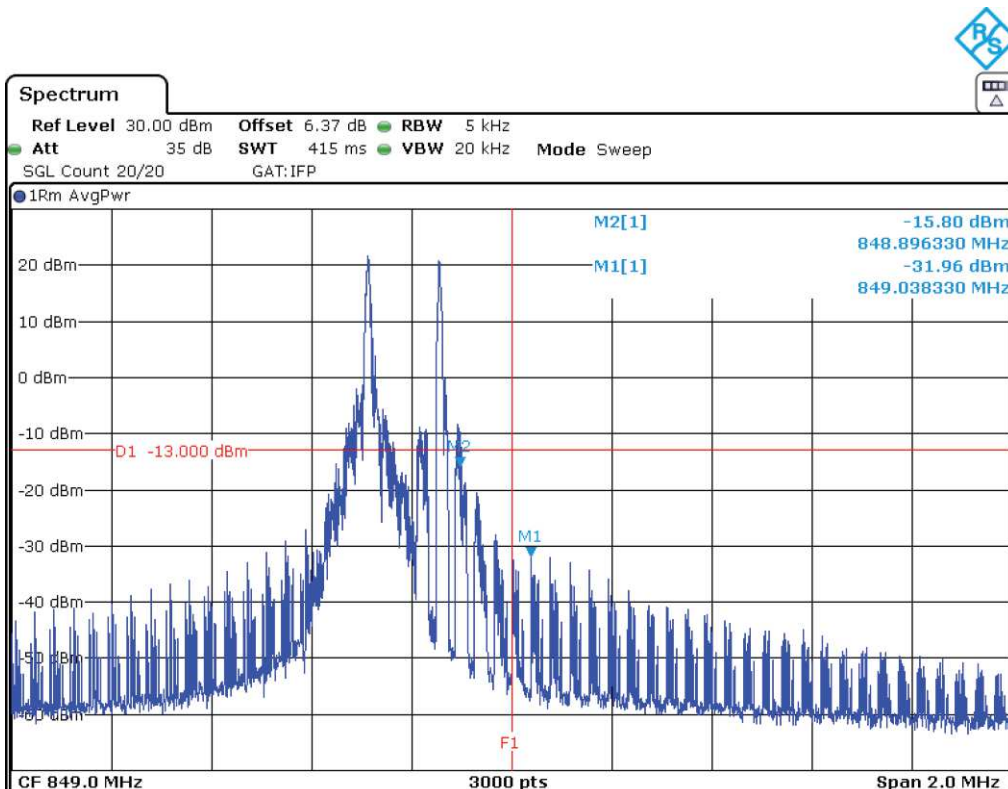
NBLoT BAND 5 (12 Tones 15 kHz.  $\pi/4$  - QPSK Offset 0 MODULATION)

Lowest Channel:



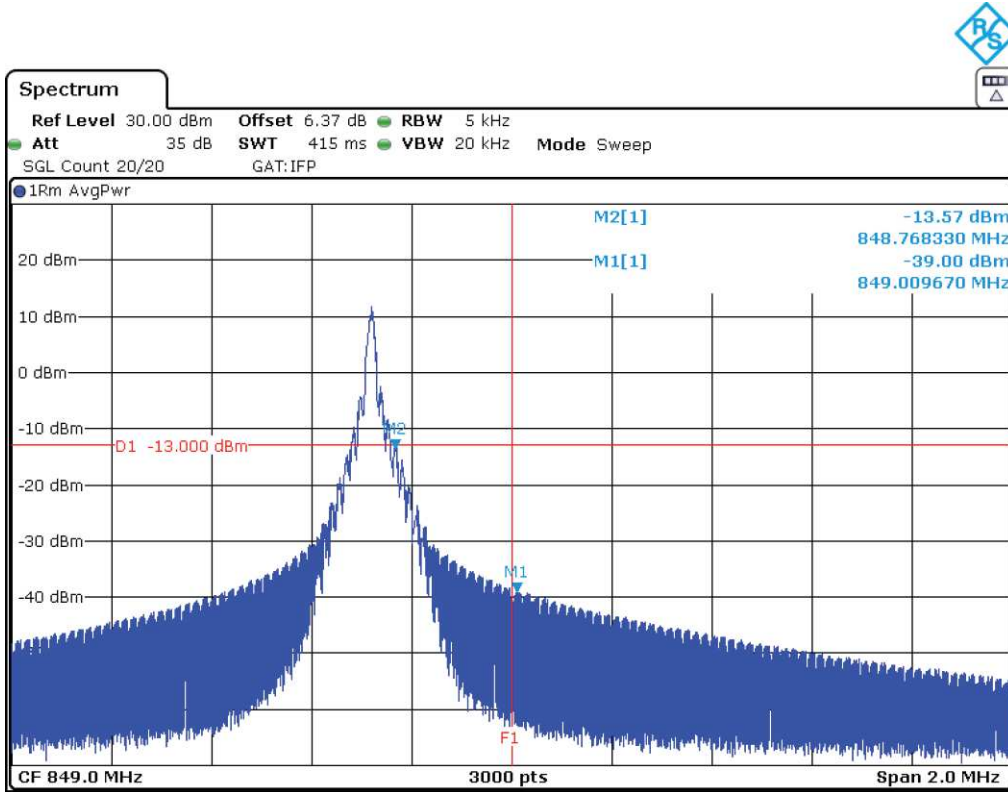
NBLoT BAND 5 (Tone 3.75 kHz.  $\pi/2$  - BPSK Offset 47 MODULATION)

Highest Channel:



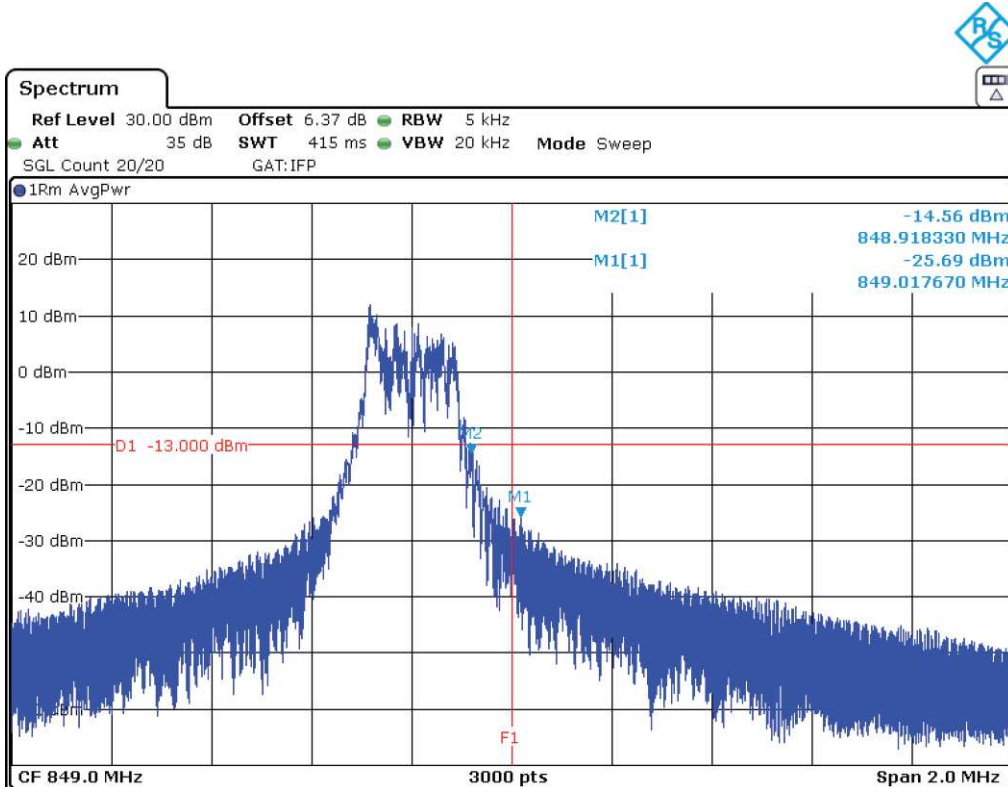
NB-IoT BAND 5 (Tone 15 kHz.  $\pi/4$  - QPSK Offset 11 MODULATION)

Highest Channel:



NB-IoT BAND 5 (12 Tones 15 kHz.  $\pi/4$  - QPSK Offset 0 MODULATION)

Highest Channel:





## Radiated emissions

### SPECIFICATION

FCC § 22.917

RSS-132. Clause 5.5.

FCC §2.1051, §90.691

Emission mask requirements for EA-based systems.

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 highest frequency generated within the equipment.

The EUT was placed on a 1 meter high 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 measuring antenna height and polarization. The maximum field strength (dB $\mu$ V/m) is measured and recorded.

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:

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

Measurement Limit:

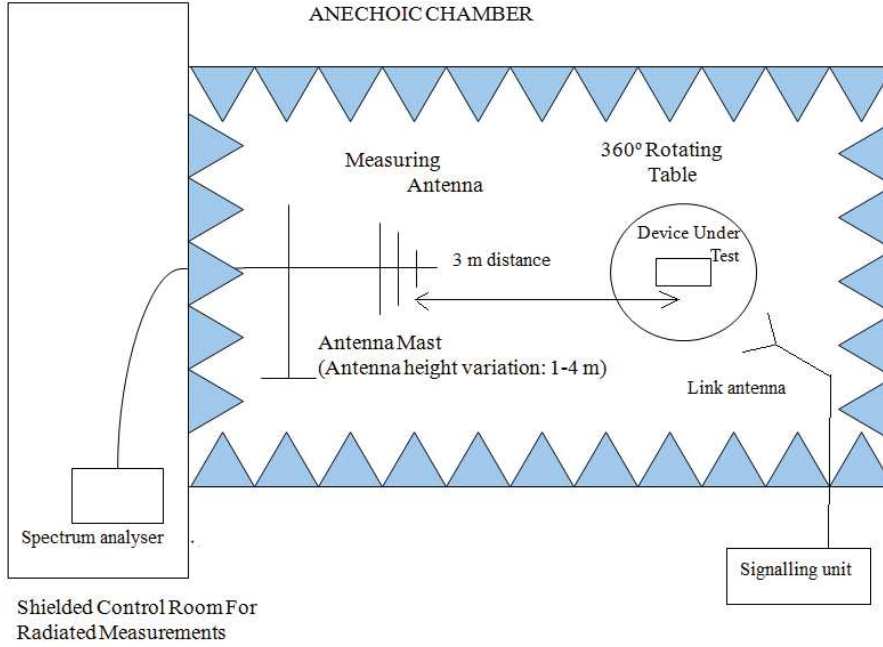
According to specification. the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least  $43 + 10 \log (P)$  dB. P in watts.

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

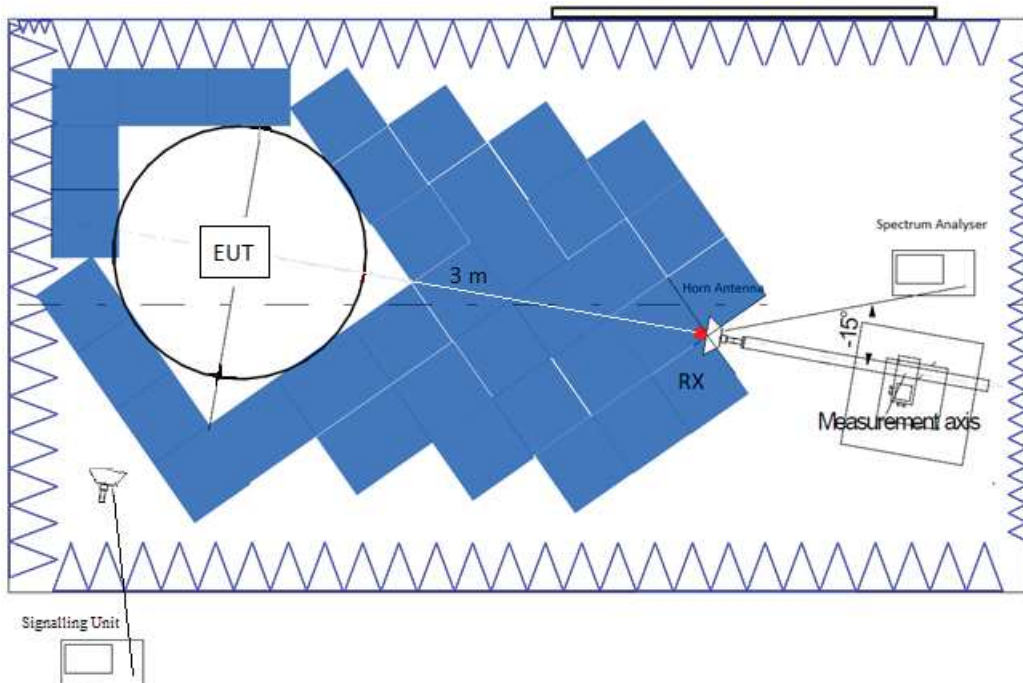
$P_o (dBm) - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = - 13 \text{ dBm}$

## TEST SETUP

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



## RESULTS

### **814-824MHz Band:**

Preliminary measurements determined that 1 tone of 3.75kHz (QPSK) as the worst case. The results in the next tables shows the results for this configuration.

#### 1. CHANNEL: LOWEST

##### **Frequency range 30 MHz-1000 MHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

##### **Frequency range 1 GHz-8.5 GHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

#### 2. CHANNEL: MIDDLE

##### **Frequency range 30 MHz-1000 MHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

##### **Frequency range 1 GHz-8.5 GHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

#### 3. CHANNEL: HIGHEST

##### **Frequency range 30 MHz-1000 MHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

##### **Frequency range 1 GHz-8.5 GHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

Measurement uncertainty (dB)	<±4.65 for f < 1GHz <±4.98 for f ≥ 1 GHz up to 10 GHz
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Verdict: PASS

**824-849MHz Band:**

Preliminary measurements determined that 1 tones of 3.75kHz (QPSK) as the worst case. The results in the next tables shows the results for this configuration.

1. CHANNEL: LOWEST

**Frequency range 30 MHz-1000 MHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

**Frequency range 1 GHz-8.5 GHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

2. CHANNEL: MIDDLE

**Frequency range 30 MHz-1000 MHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

**Frequency range 1 GHz-8.5 GHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

3. CHANNEL: HIGHEST

**Frequency range 30 MHz-1000 MHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

**Frequency range 1 GHz-8.5 GHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

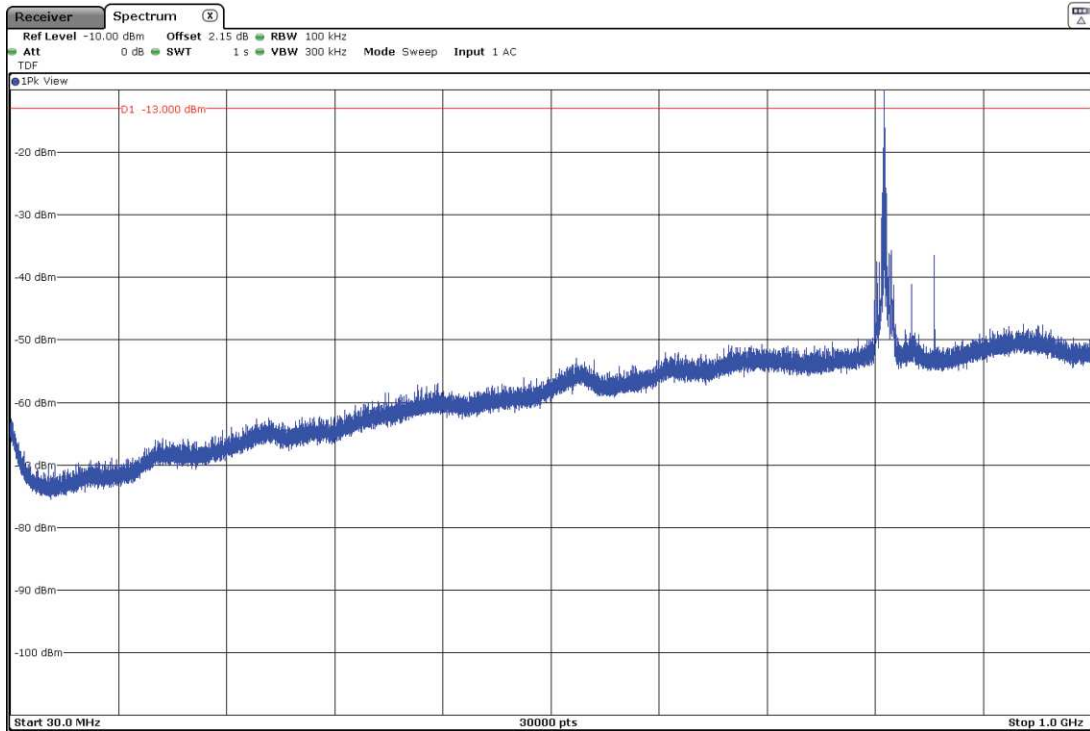
Measurement uncertainty (dB)	<±4.65 for f < 1GHz <±4.98 for f ≥ 1 GHz up to 10 GHz
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Verdict: PASS

**814-824MHz Band:**

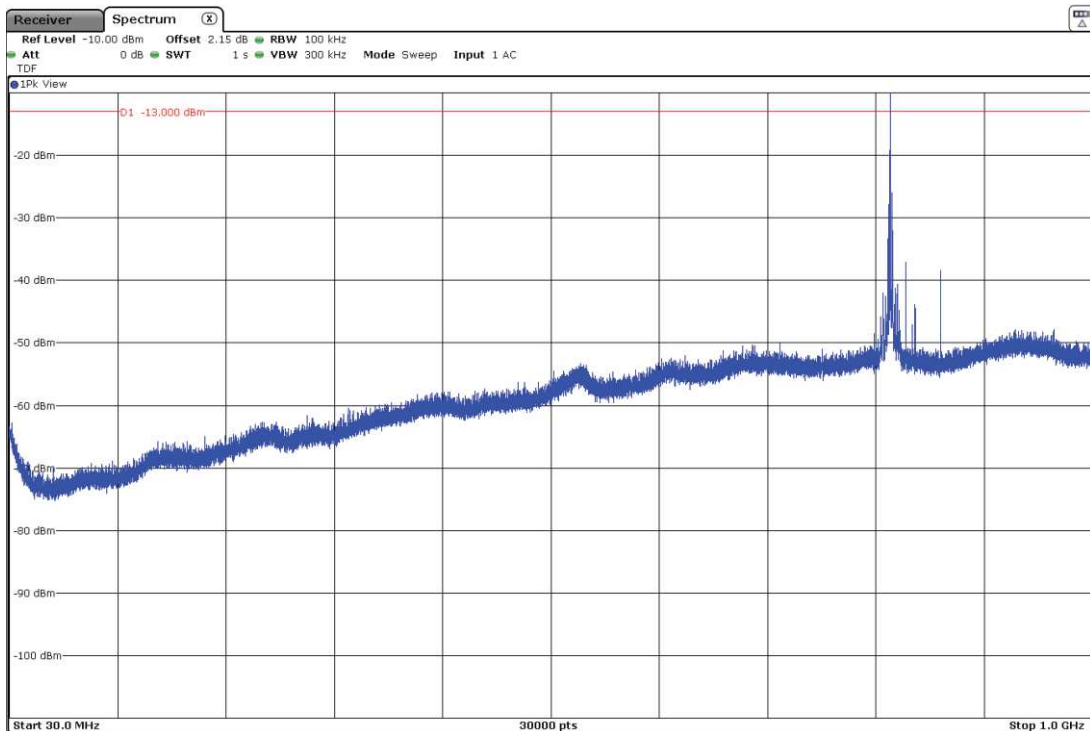
FREQUENCY RANGE 30 MHz-1000 MHz.

CHANNEL: LOWEST



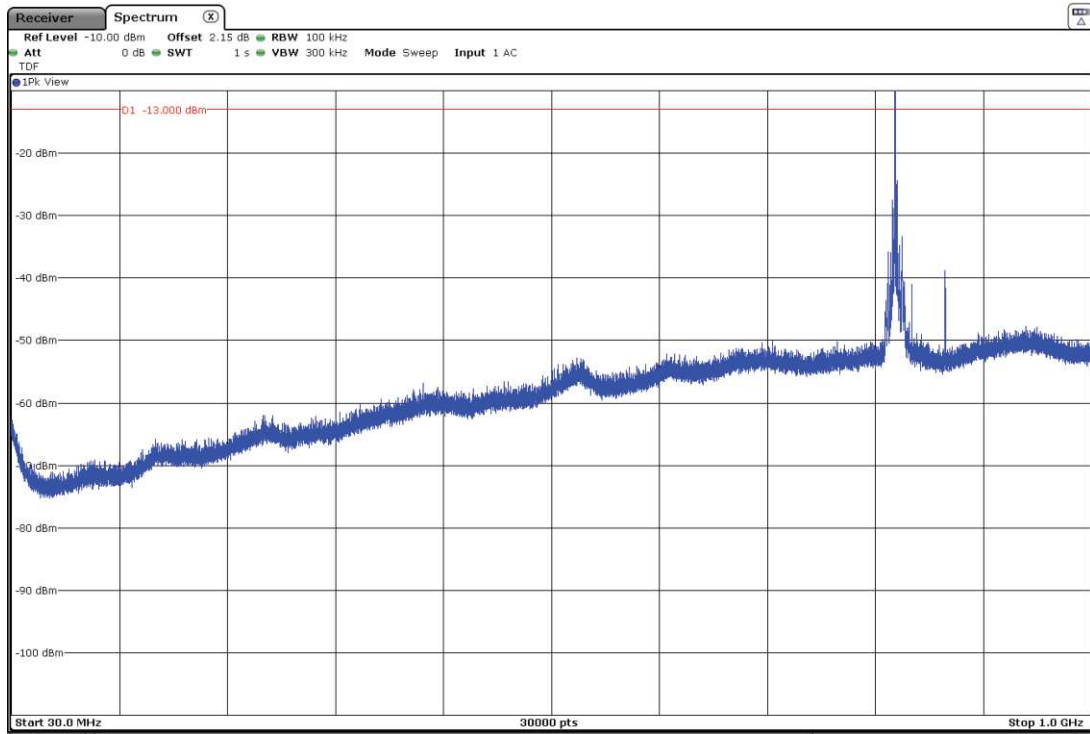
Note: The peak above the limit is the carrier frequency. The peak at 859MHz corresponds to the downlink signal

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency. The peak at 864MHz corresponds to the downlink signal

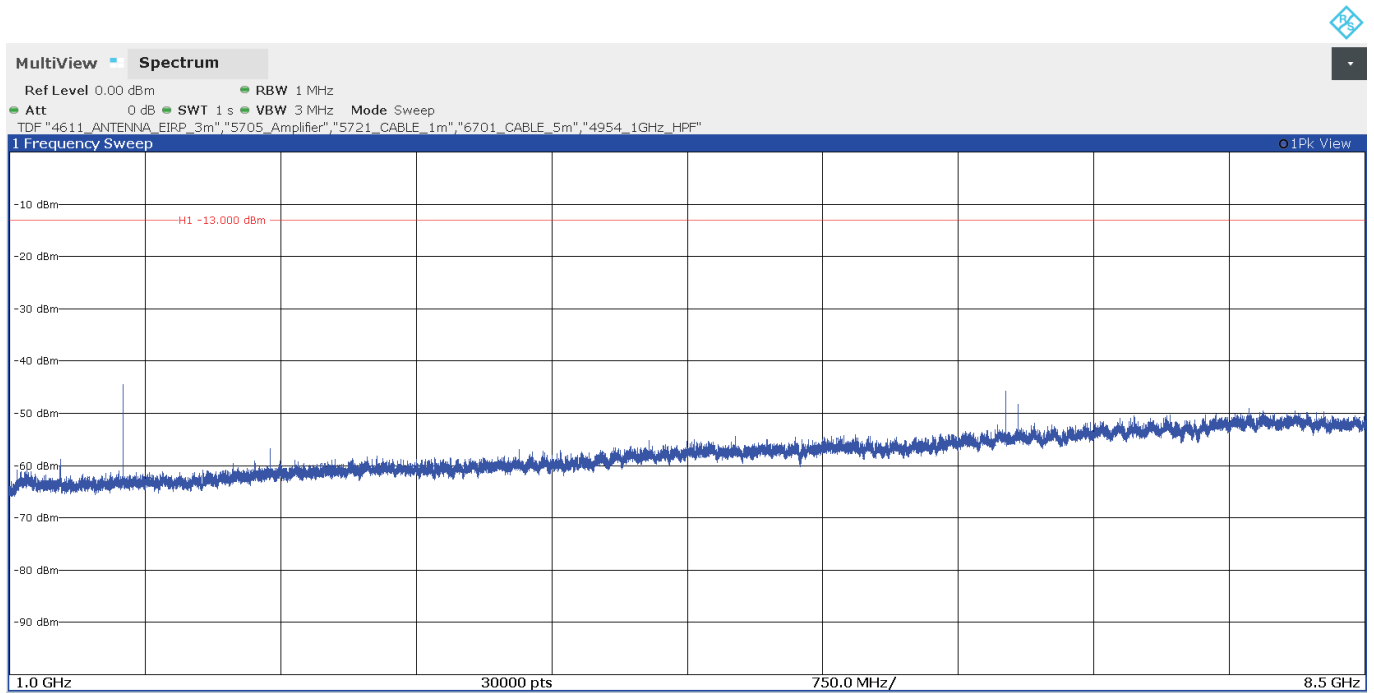
CHANNEL: HIGHEST



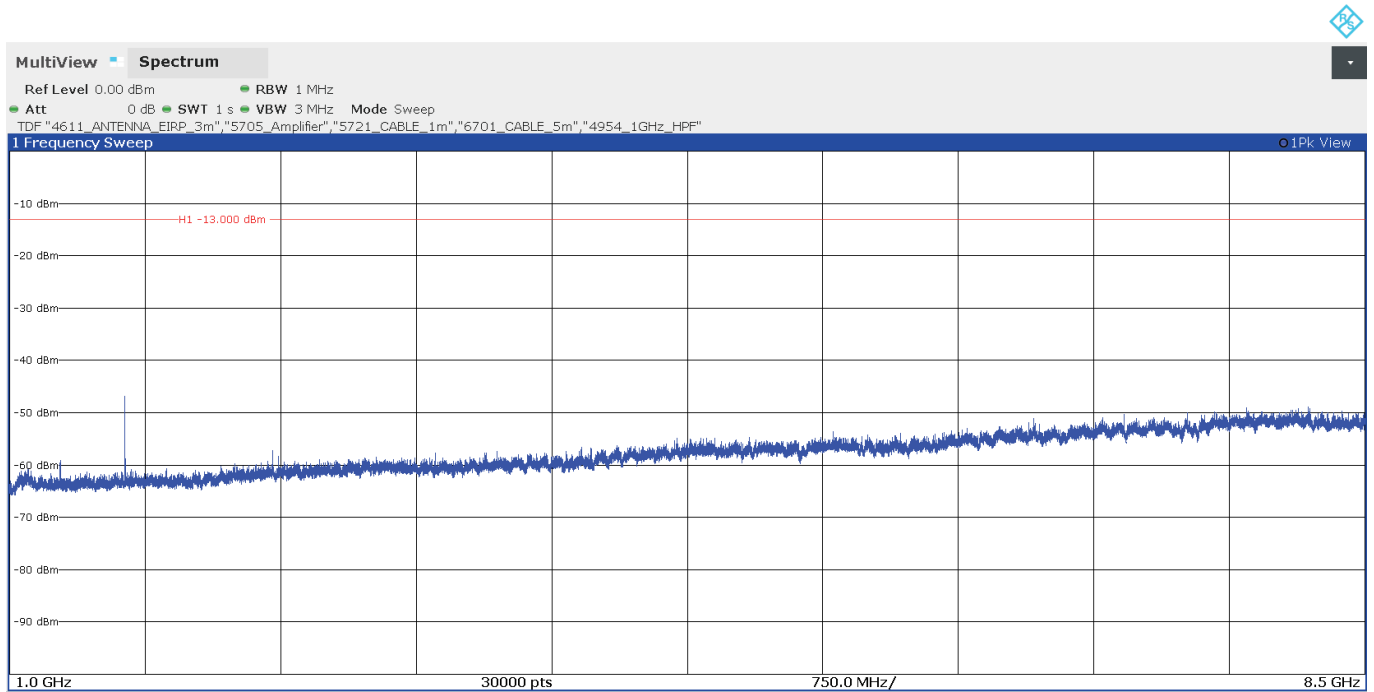
Note: The peak above the limit is the carrier frequency. The peak at 869MHz corresponds to the downlink signal

FREQUENCY RANGE 1 GHz to 8.5 GHz.

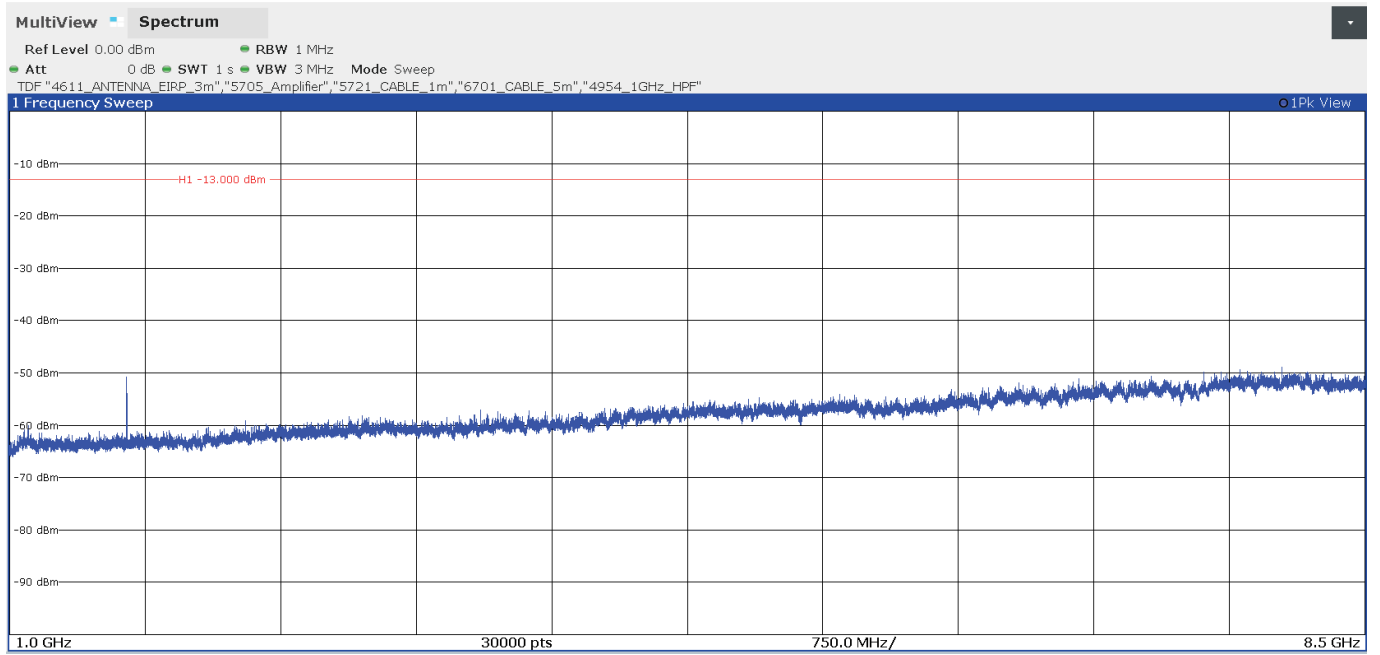
CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST

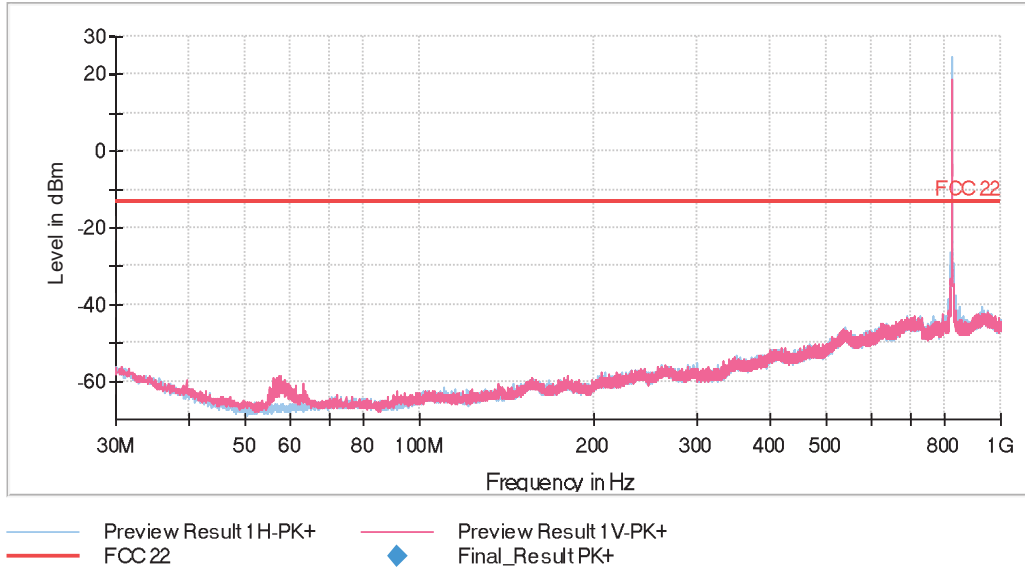




**824-849MHz Band:**

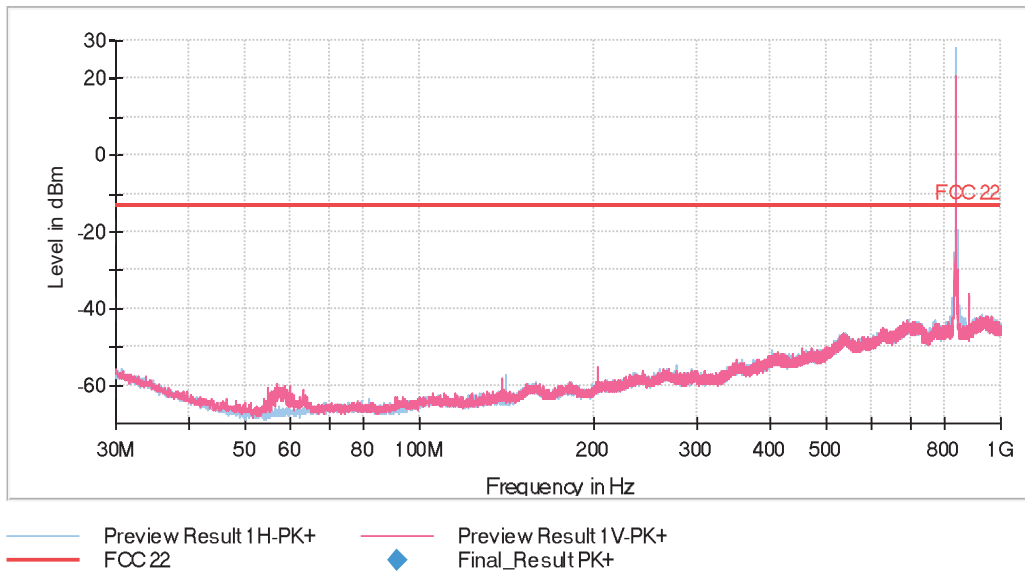
FREQUENCY RANGE 30 MHz-1000 MHz.

CHANNEL: LOWEST



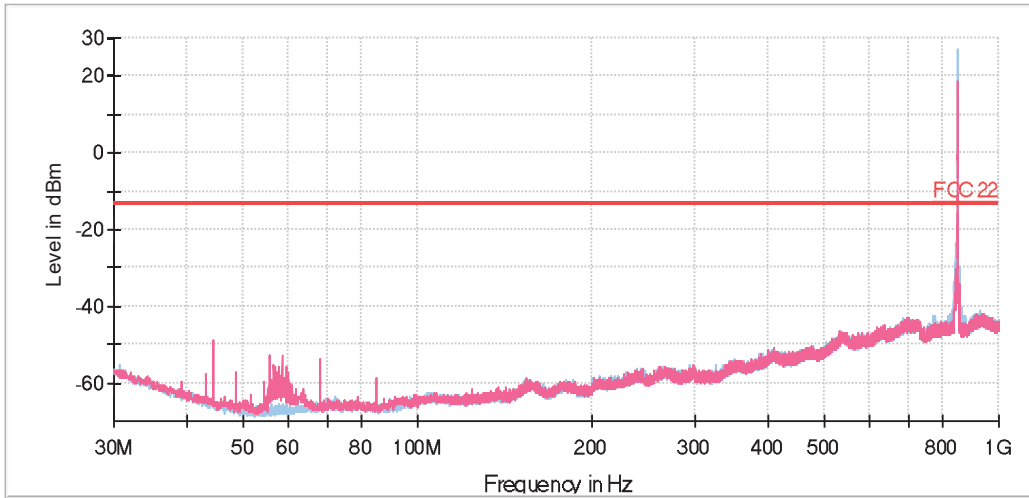
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency. The peak at 882MHz corresponds to the downlink signal

CHANNEL: HIGHEST

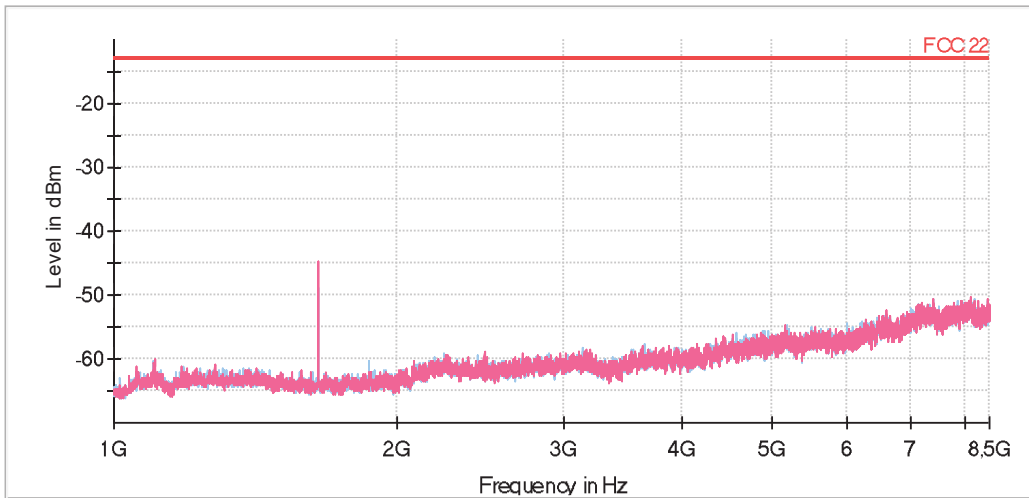


— Preview Result 1H-PK+     — Preview Result 1V-PK+  
— FCC 22                             ◆ Final\_Result PK+

Note: The peak above the limit is the carrier frequency.

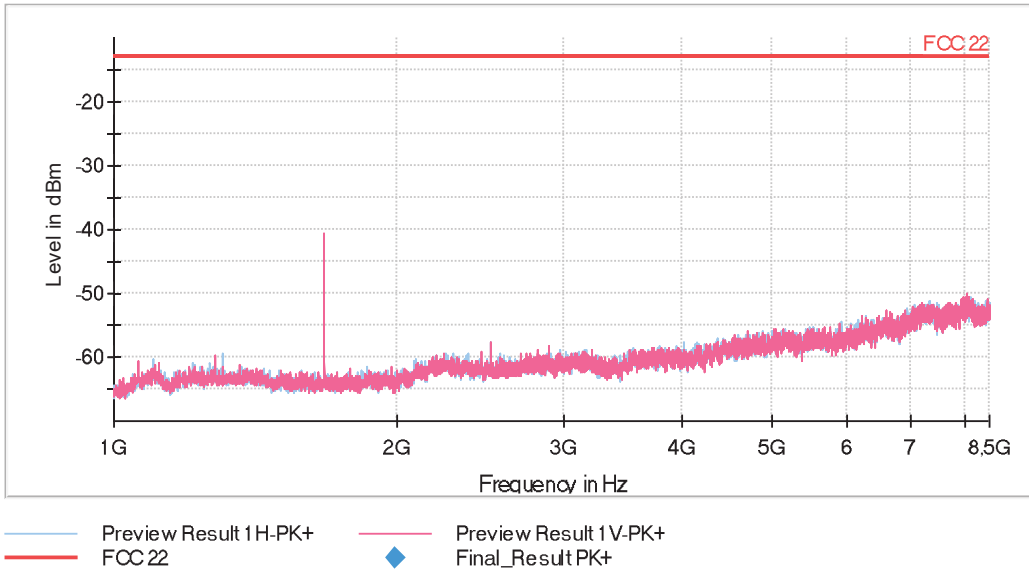
FREQUENCY RANGE 1 GHz to 8.5 GHz.

CHANNEL: LOWEST



— Preview Result 1H-PK+     — Preview Result 1V-PK+  
— FCC 22                             ◆ Final\_Result PK+

CHANNEL: MIDDLE



CHANNEL: HIGHEST

