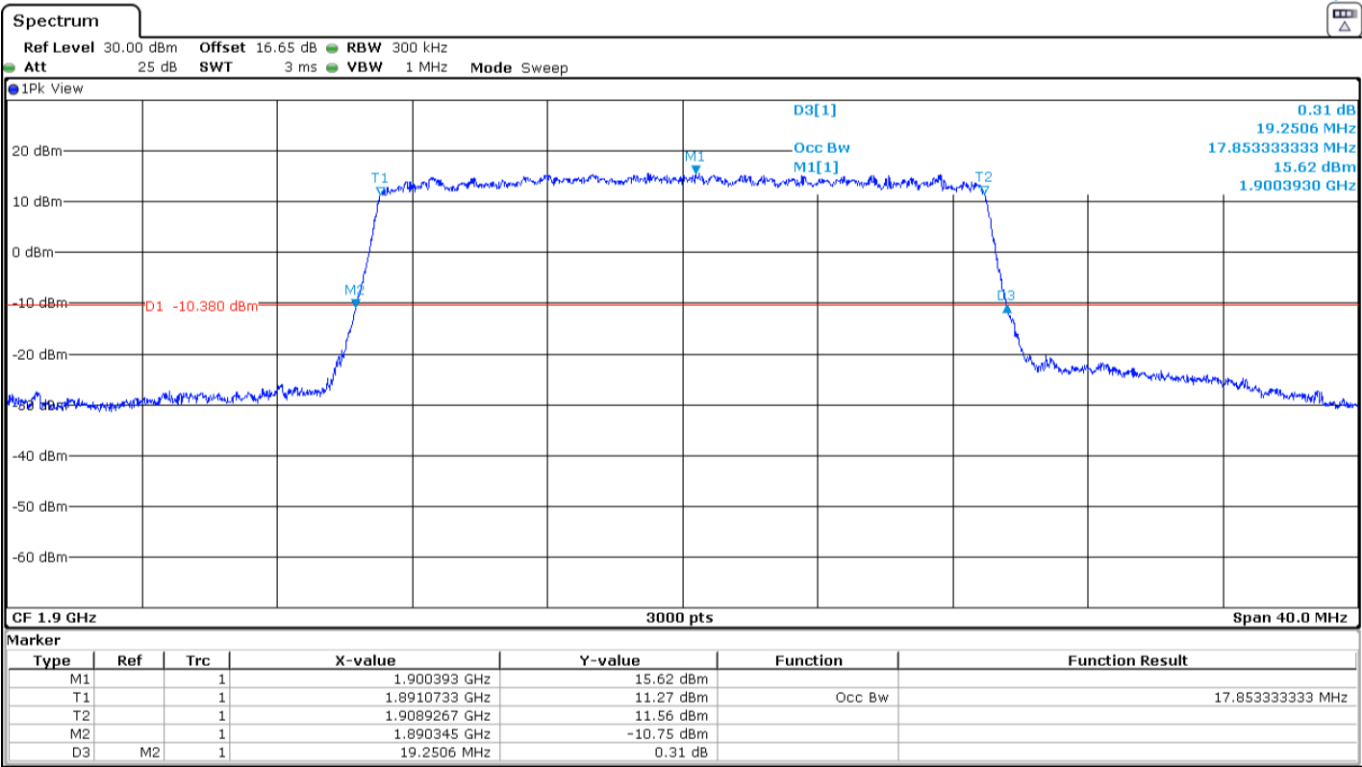
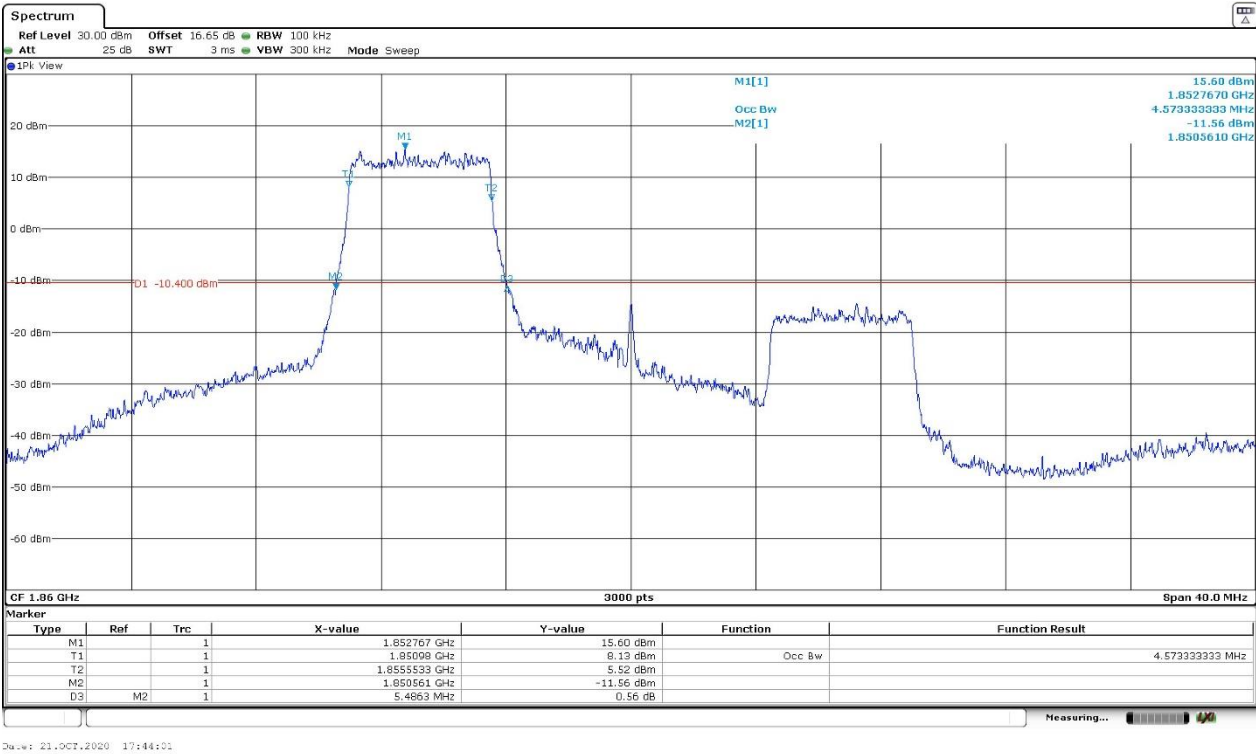


High Channel:

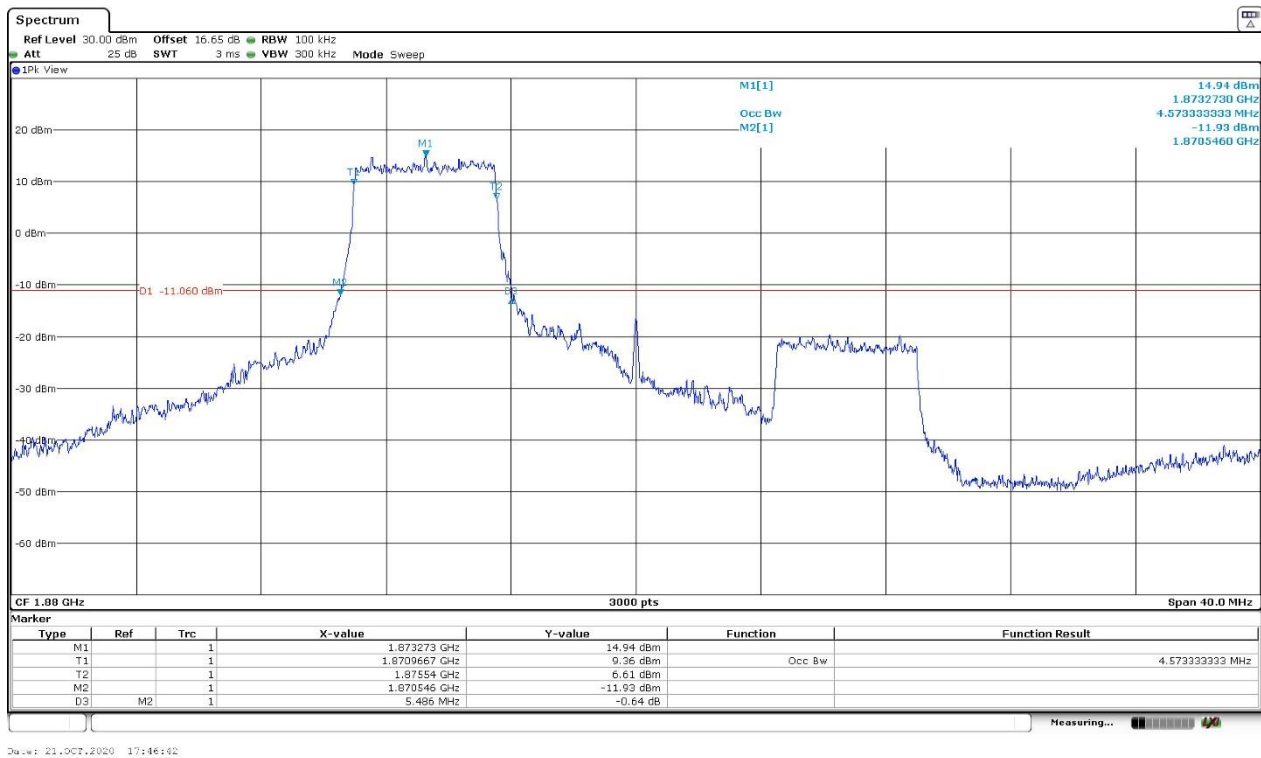


LTE Band 2. 16QAM MODULATION. BW = 20 MHz.

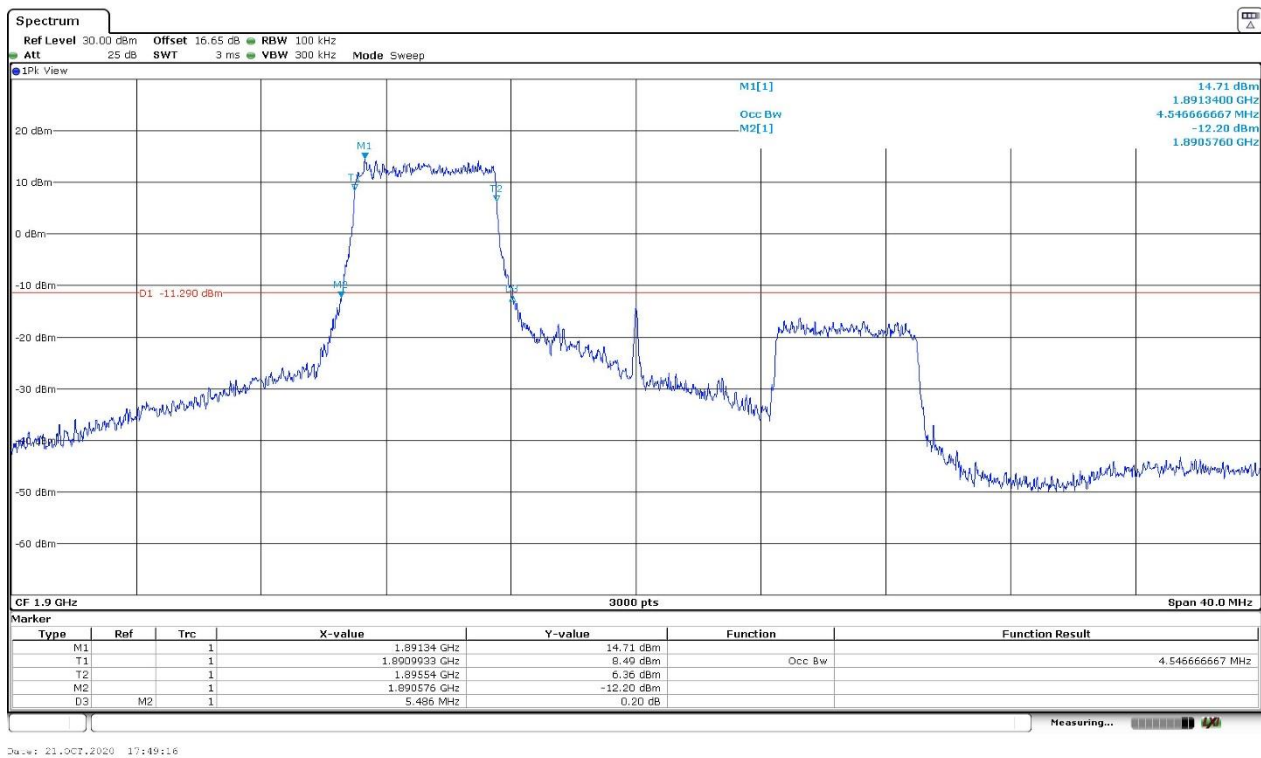
Low Channel:



Middle Channel:



High Channel:



Spurious Emissions at Antenna Terminals

SPECIFICATION:

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.

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 spectrum was investigated from 9 kHz to 20 GHz.

For LTE mode the configuration of Resource Blocks and modulation which is the worst case for conducted power was used.

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.

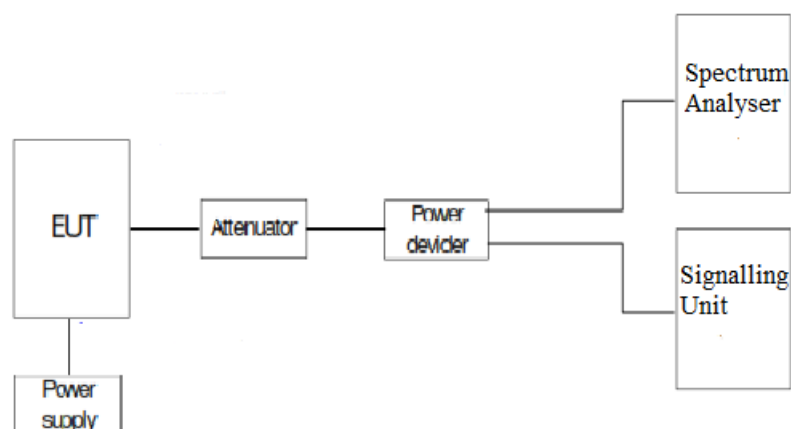
Measurement Limit:

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 Band 2. QPSK MODULATION. BW = 1.4 MHz.

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

LTE Band 2. QPSK MODULATION. BW = 3 MHz.

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

LTE Band 2. QPSK MODULATION. BW = 5 MHz.

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

LTE Band 2. QPSK MODULATION. BW = 10 MHz.

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

LTE Band 2. QPSK MODULATION. BW = 15 MHz.

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

LTE Band 2. QPSK MODULATION. BW = 20 MHz.

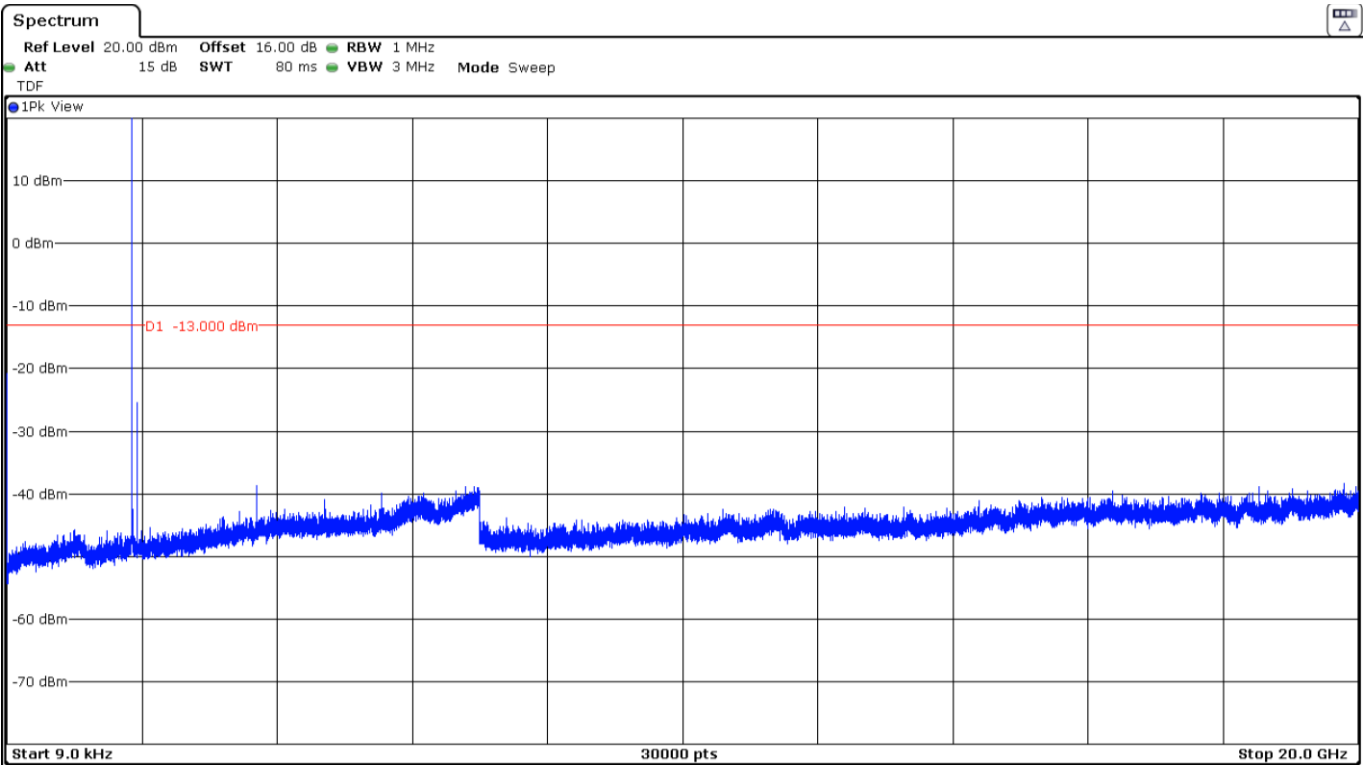
- Low Channel: No spurious frequencies detected at less than 20 dB below the limit
- Middle Channel: No spurious frequencies detected at less than 20 dB below the limit
- High Channel: No spurious frequencies detected at less than 20 dB below the limit

Measurement uncertainty (dB): $< \pm 2.77$

Verdict: PASS

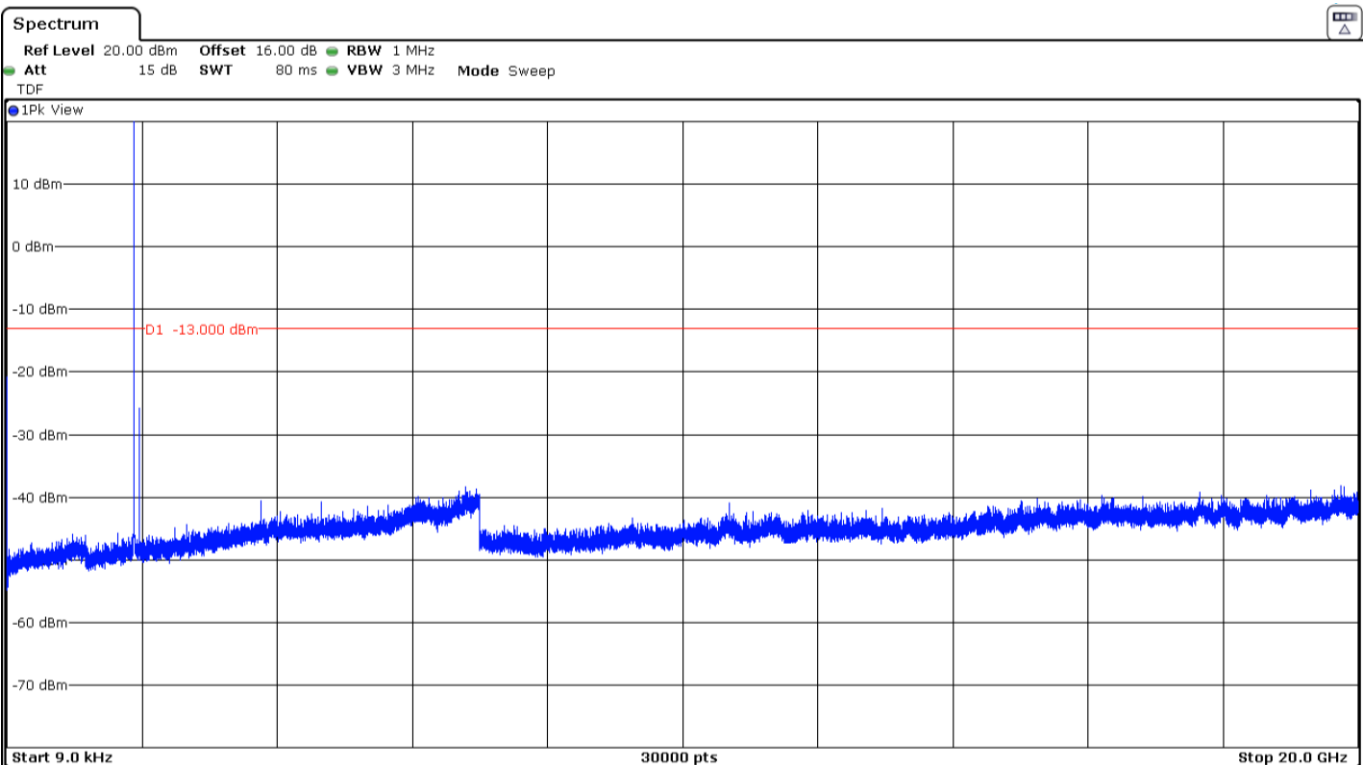
LTE Band 2. QPSK MODULATION. BW = 1.4 MHz.

Low Channel:



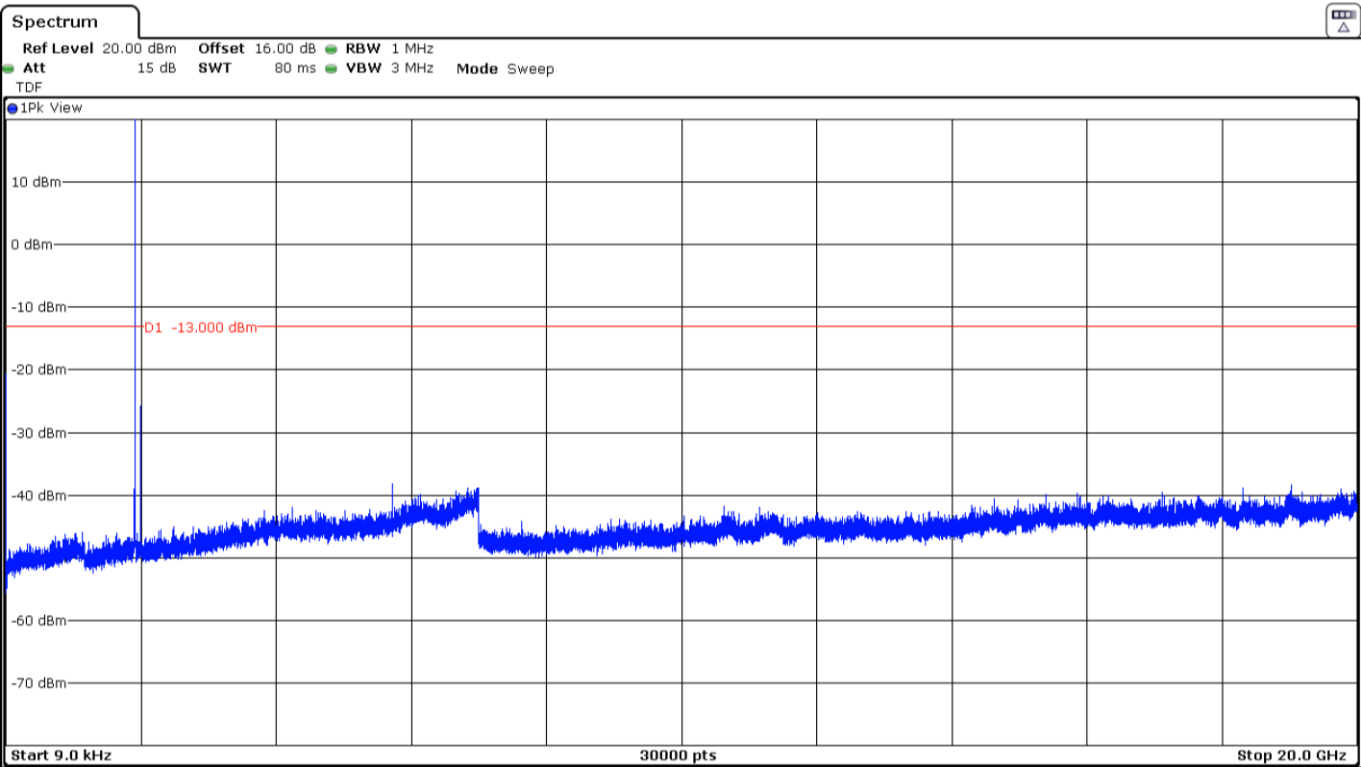
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

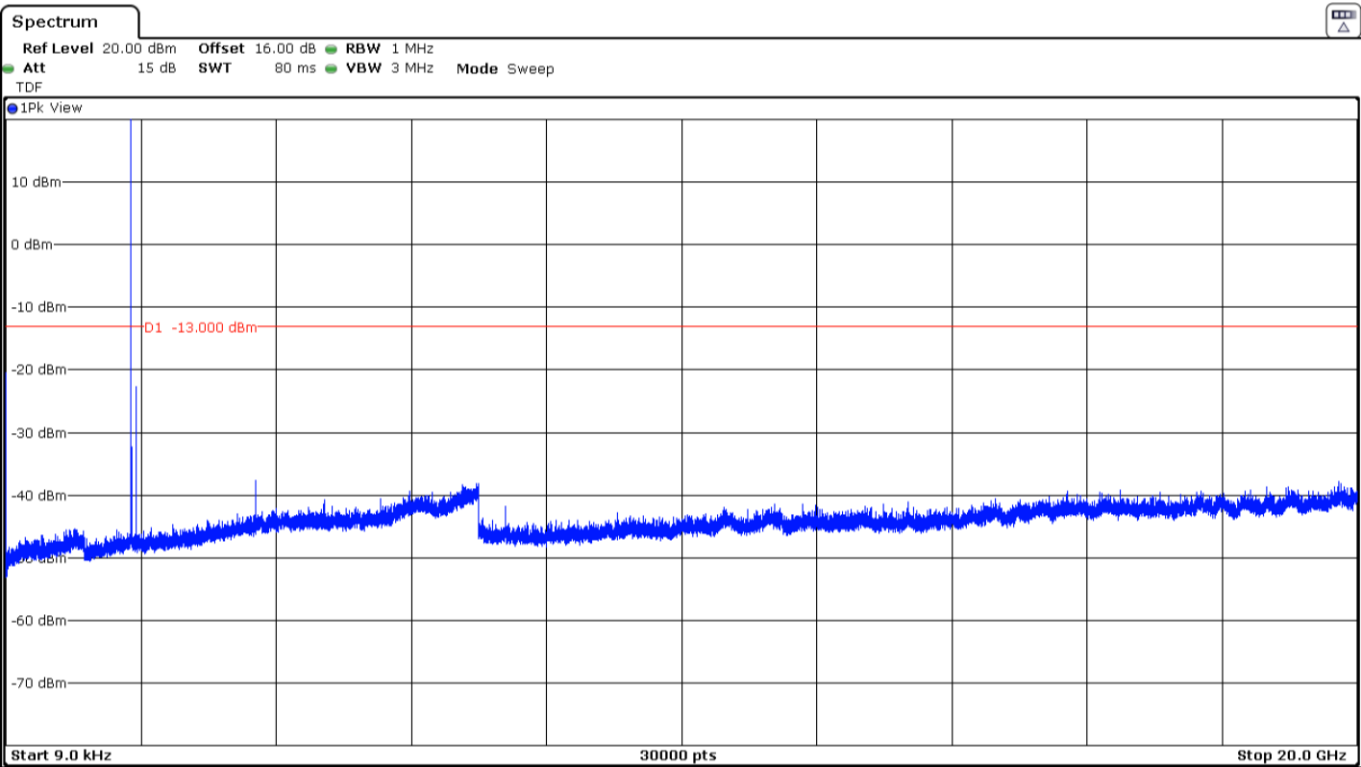
High Channel:



The peak above the limit is the carrier frequency.

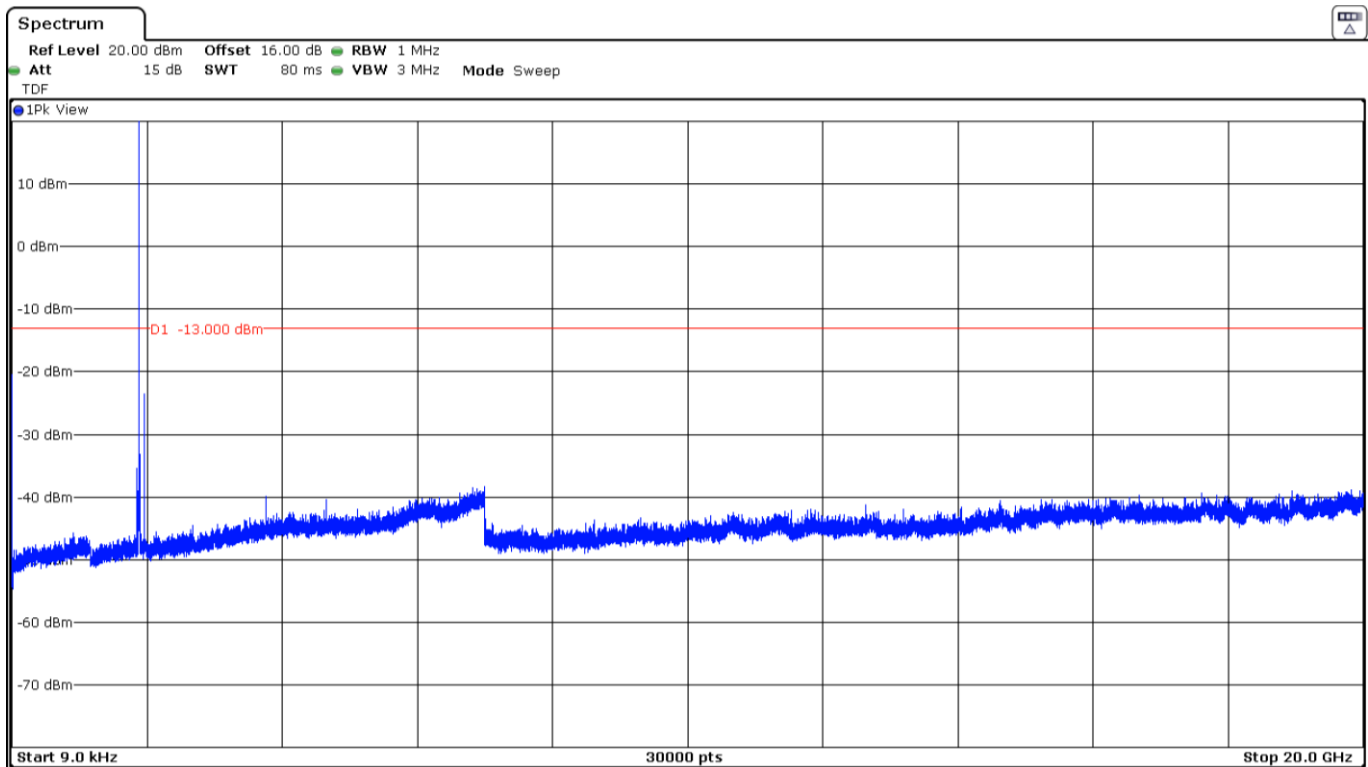
LTE Band 2. QPSK MODULATION. BW = 3 MHz.

Low Channel:



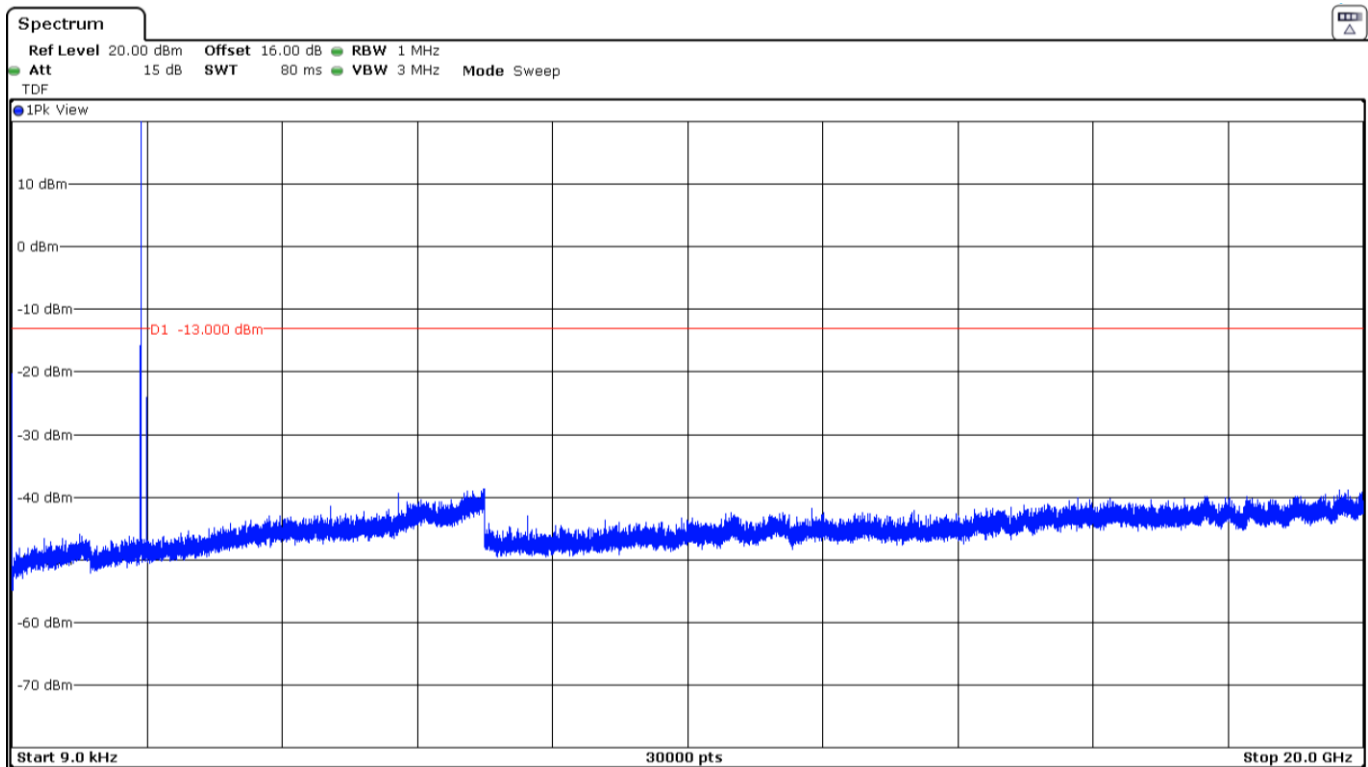
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

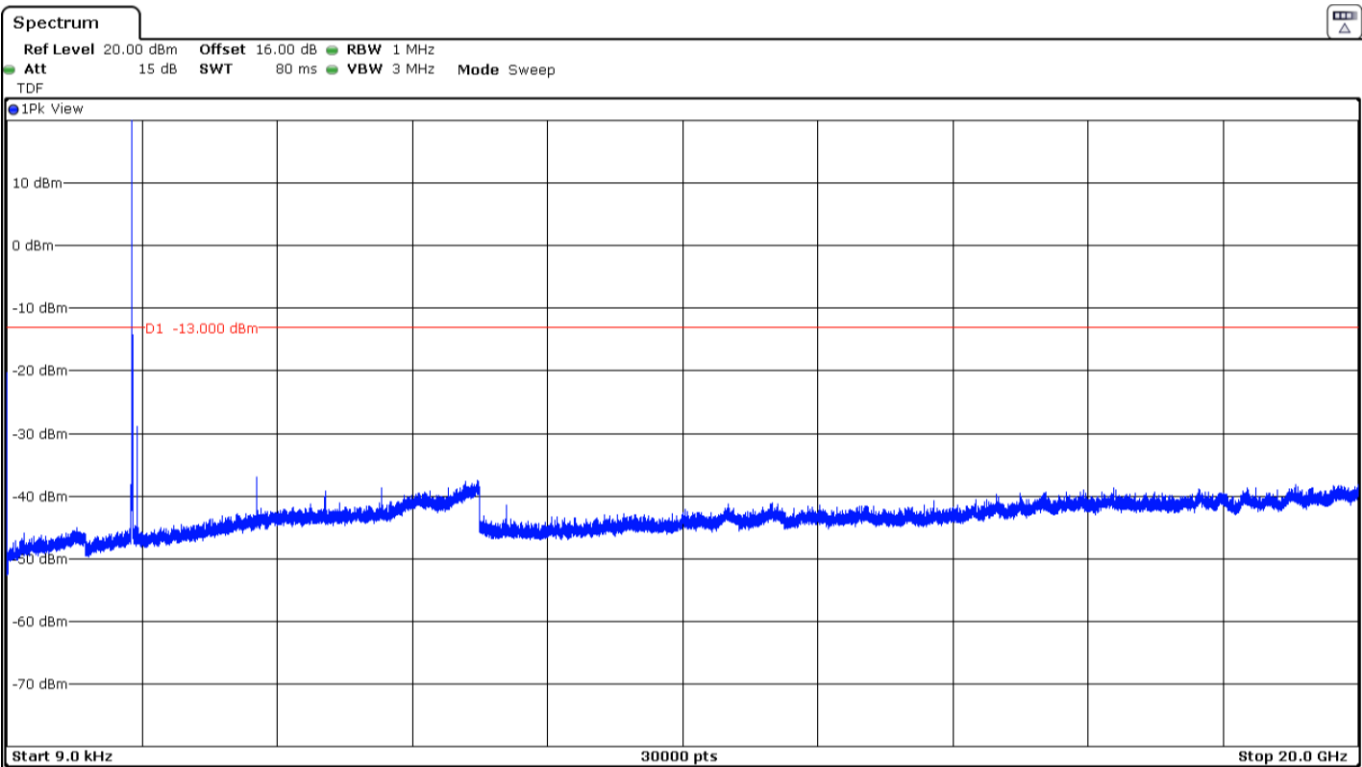
High Channel:



The peak above the limit is the carrier frequency.

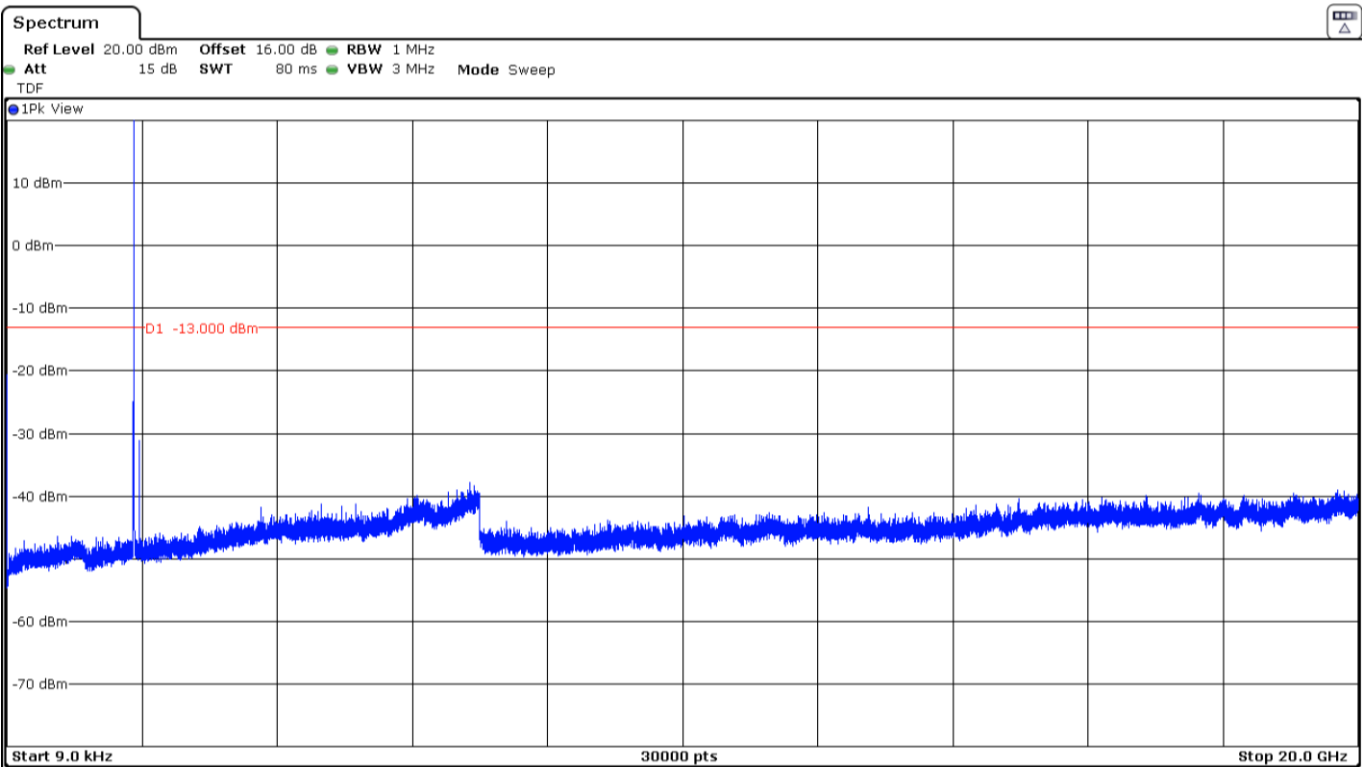
LTE Band 2. QPSK MODULATION. BW = 5 MHz.

Low Channel:



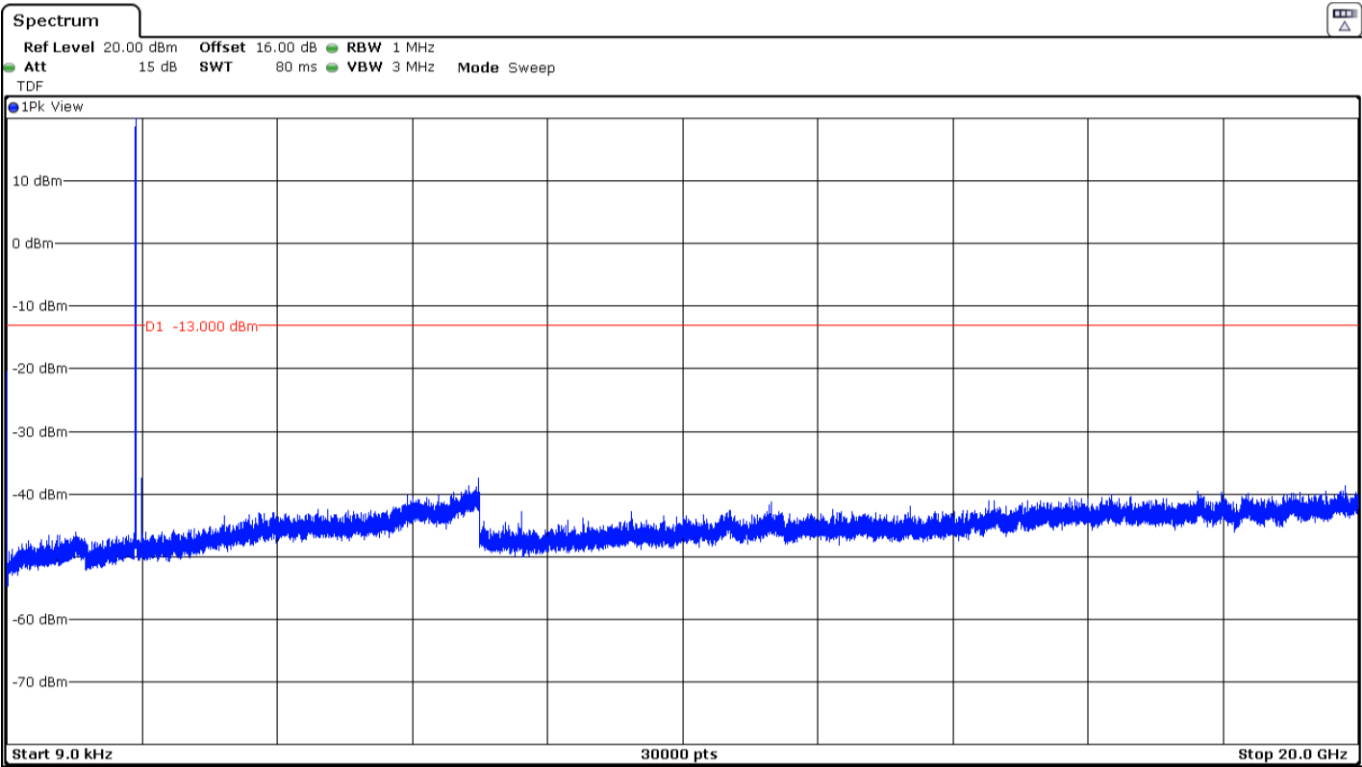
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

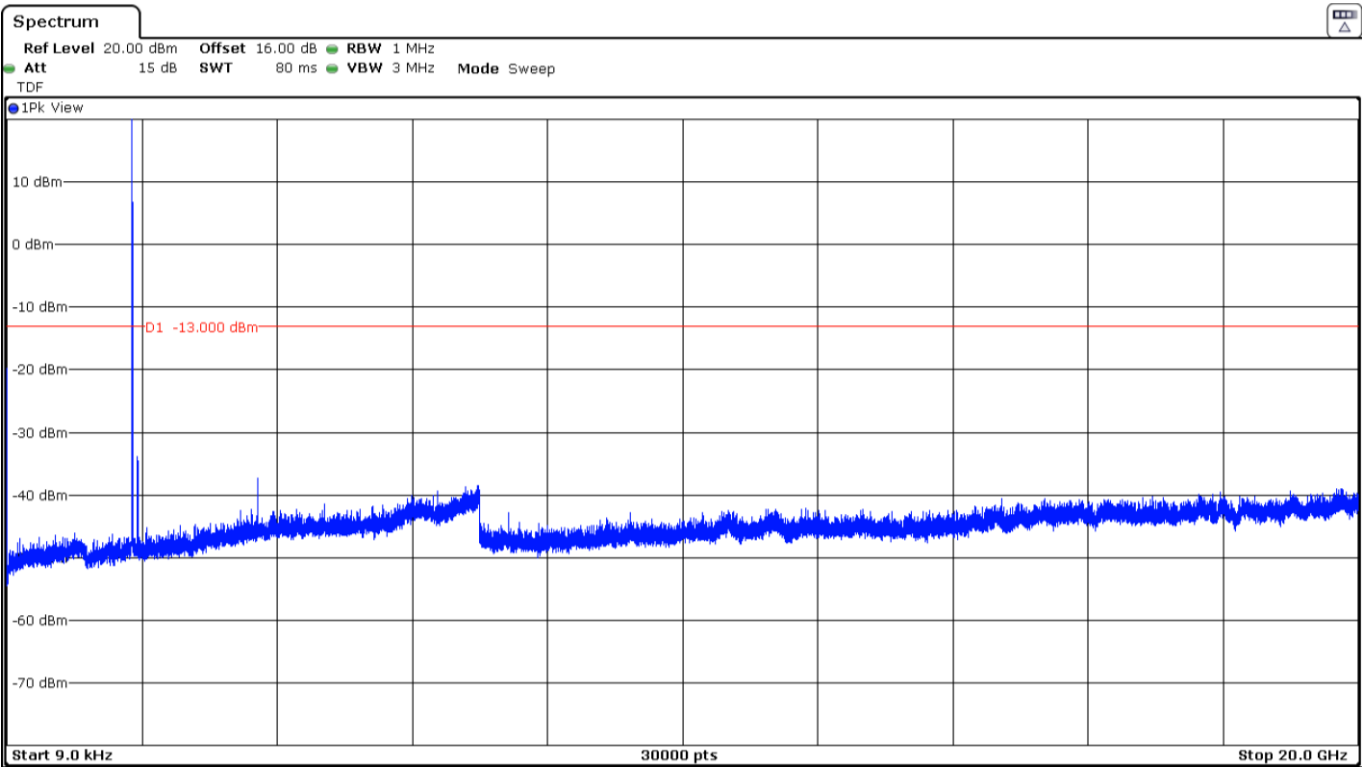
High Channel:



The peak above the limit is the carrier frequency.

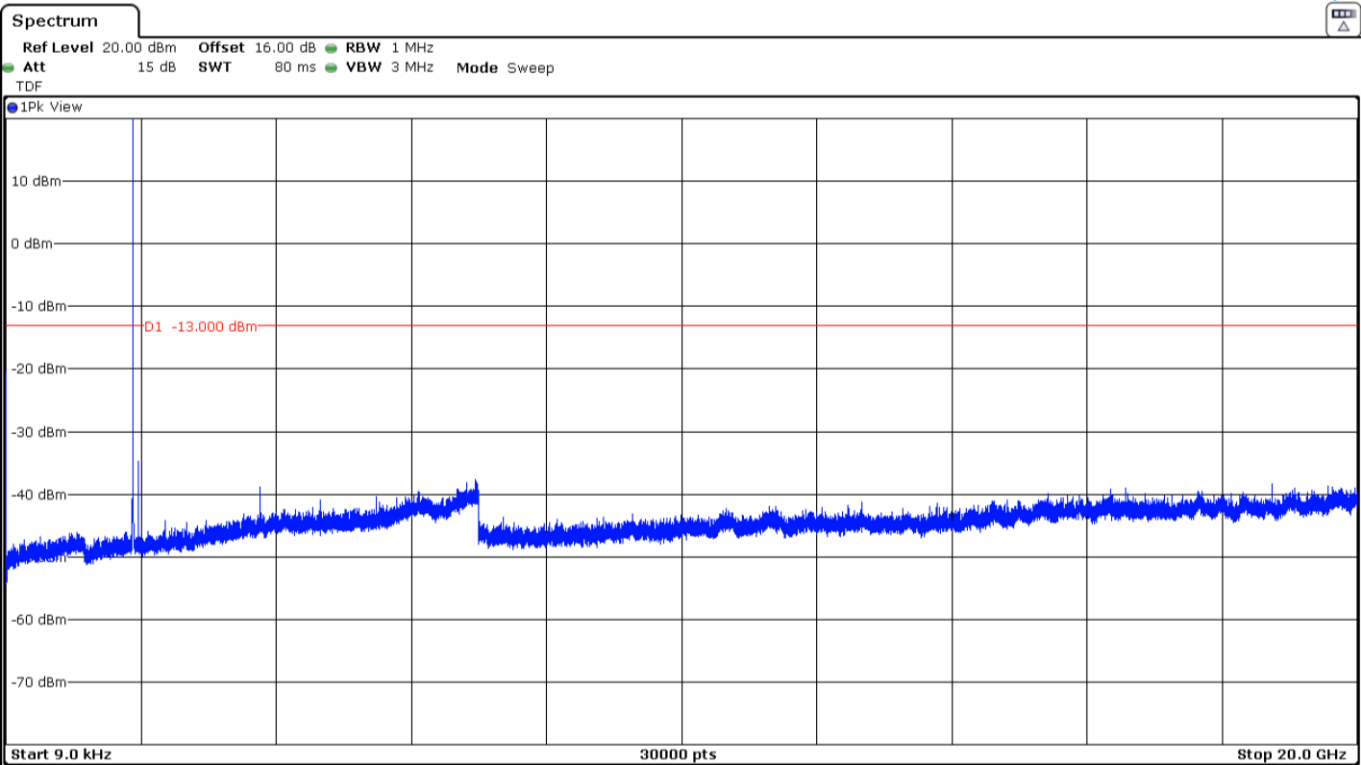
LTE Band 2. QPSK MODULATION. BW = 10 MHz.

Low Channel:



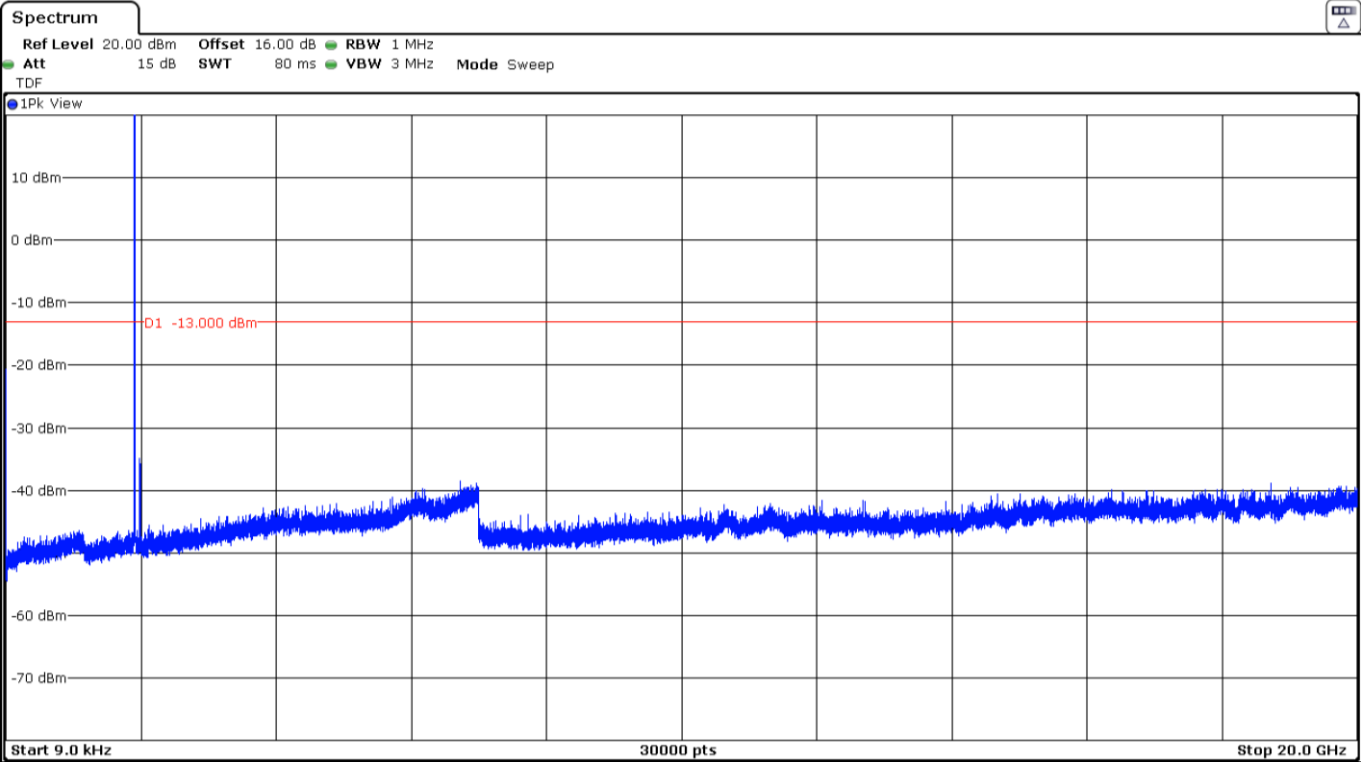
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

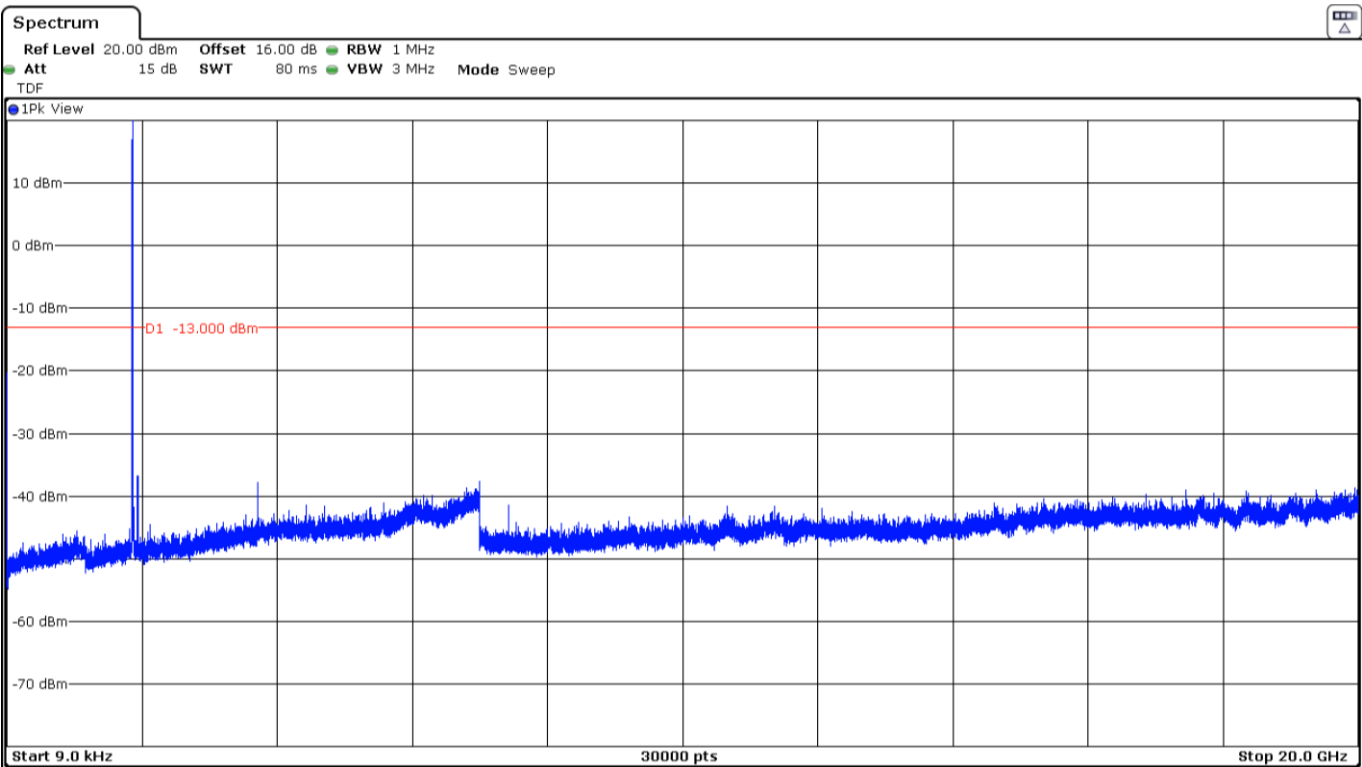
High Channel:



The peak above the limit is the carrier frequency.

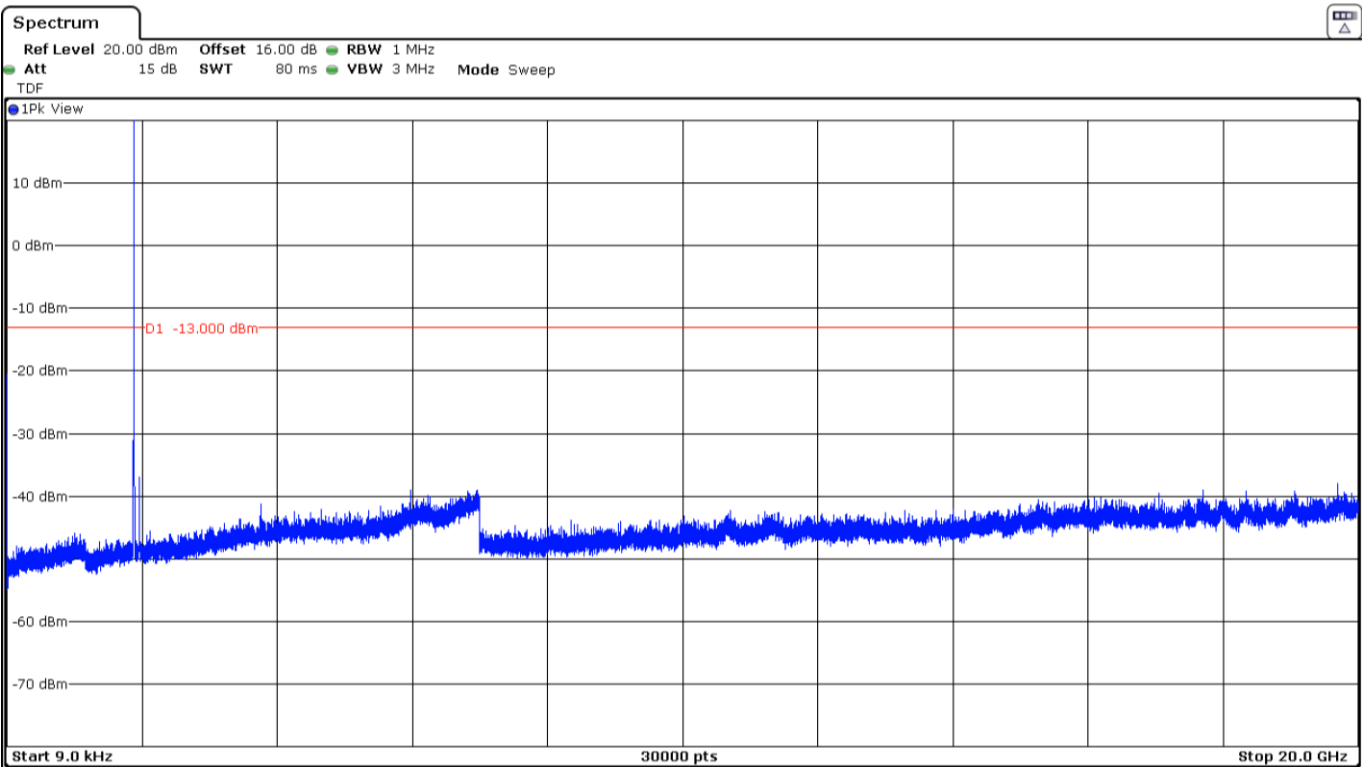
LTE Band 2. QPSK MODULATION. BW = 15 MHz.

Low Channel:



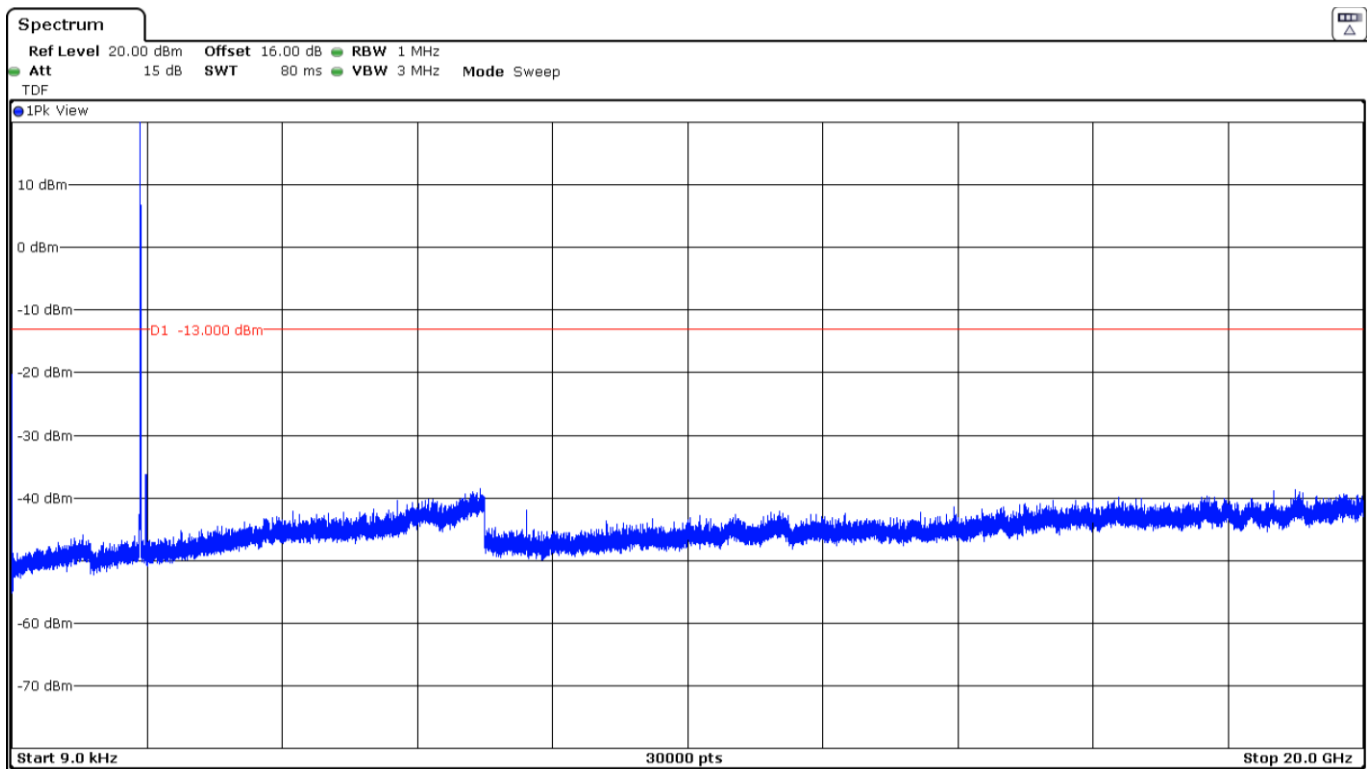
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

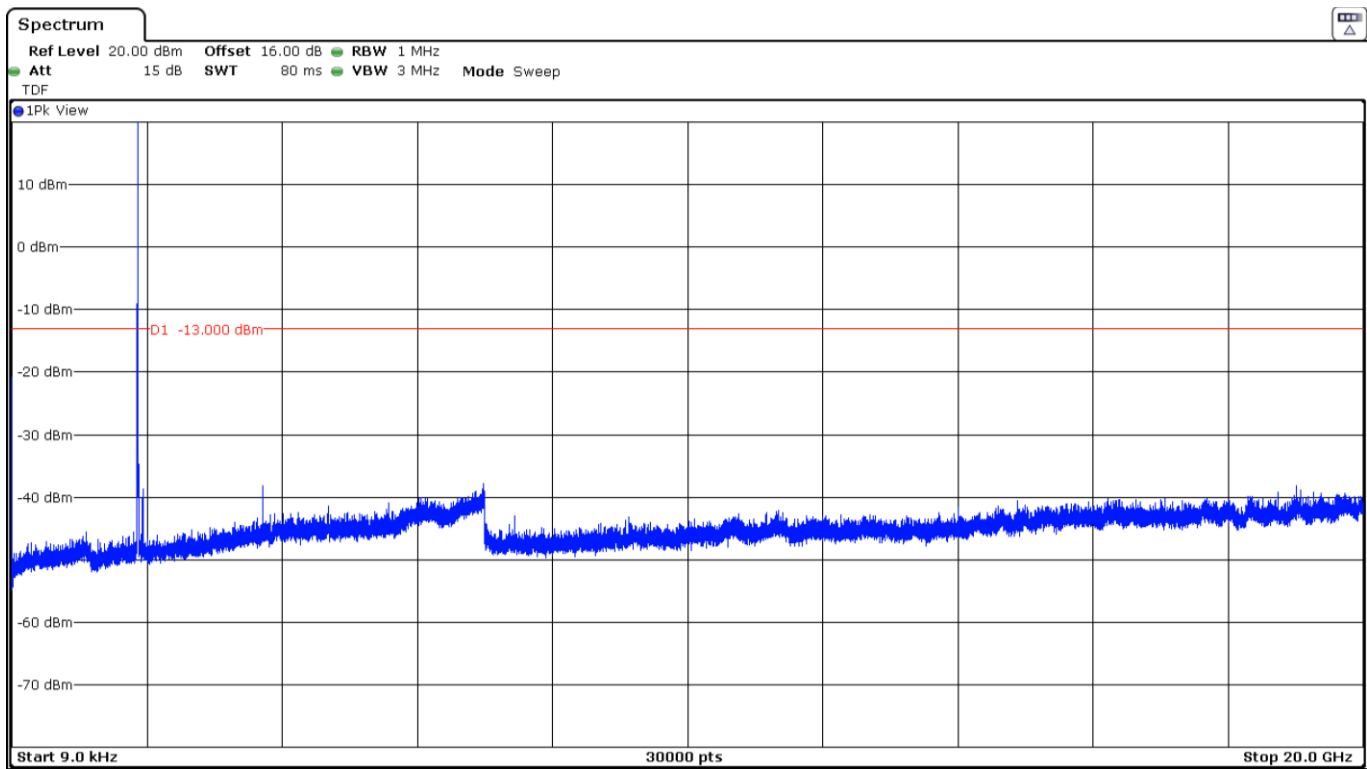
High Channel:



The peak above the limit is the carrier frequency.

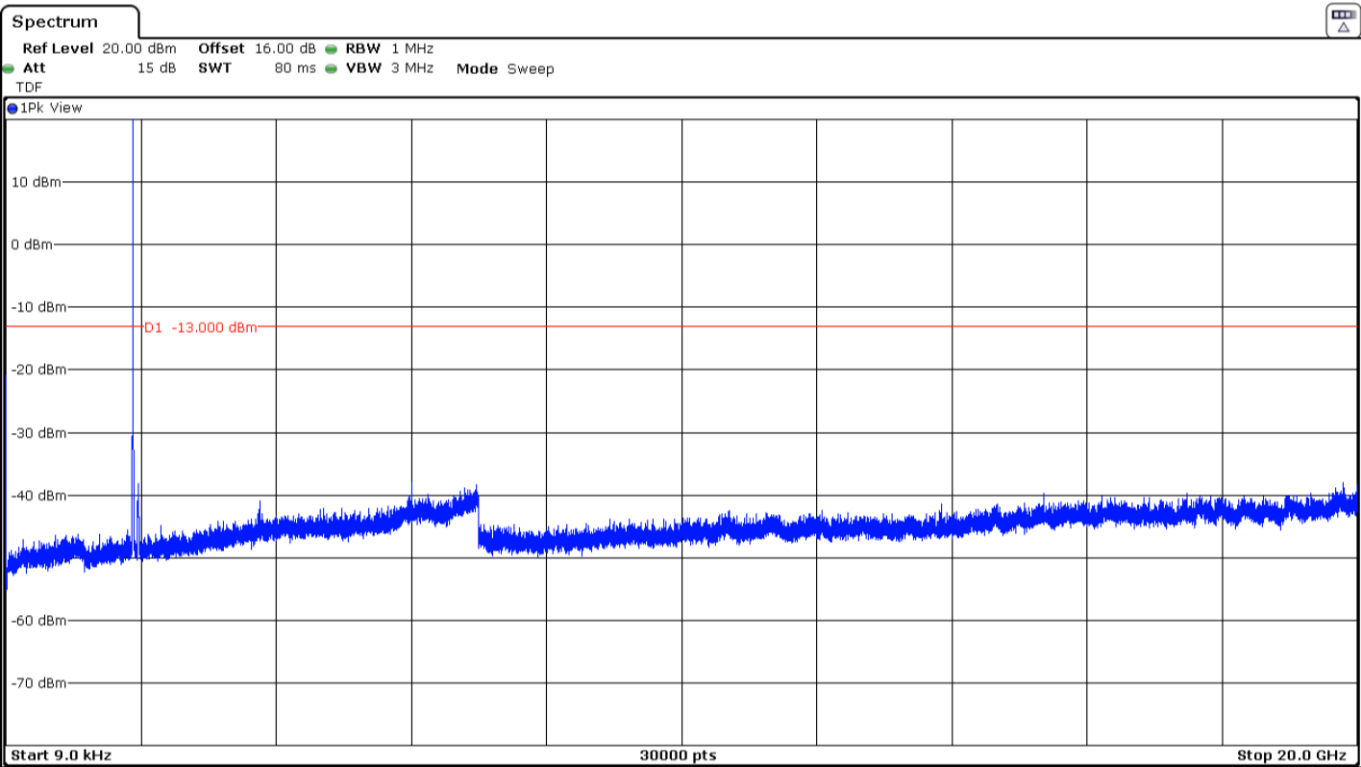
LTE Band 2. QPSK MODULATION. BW = 20 MHz.

Low Channel:



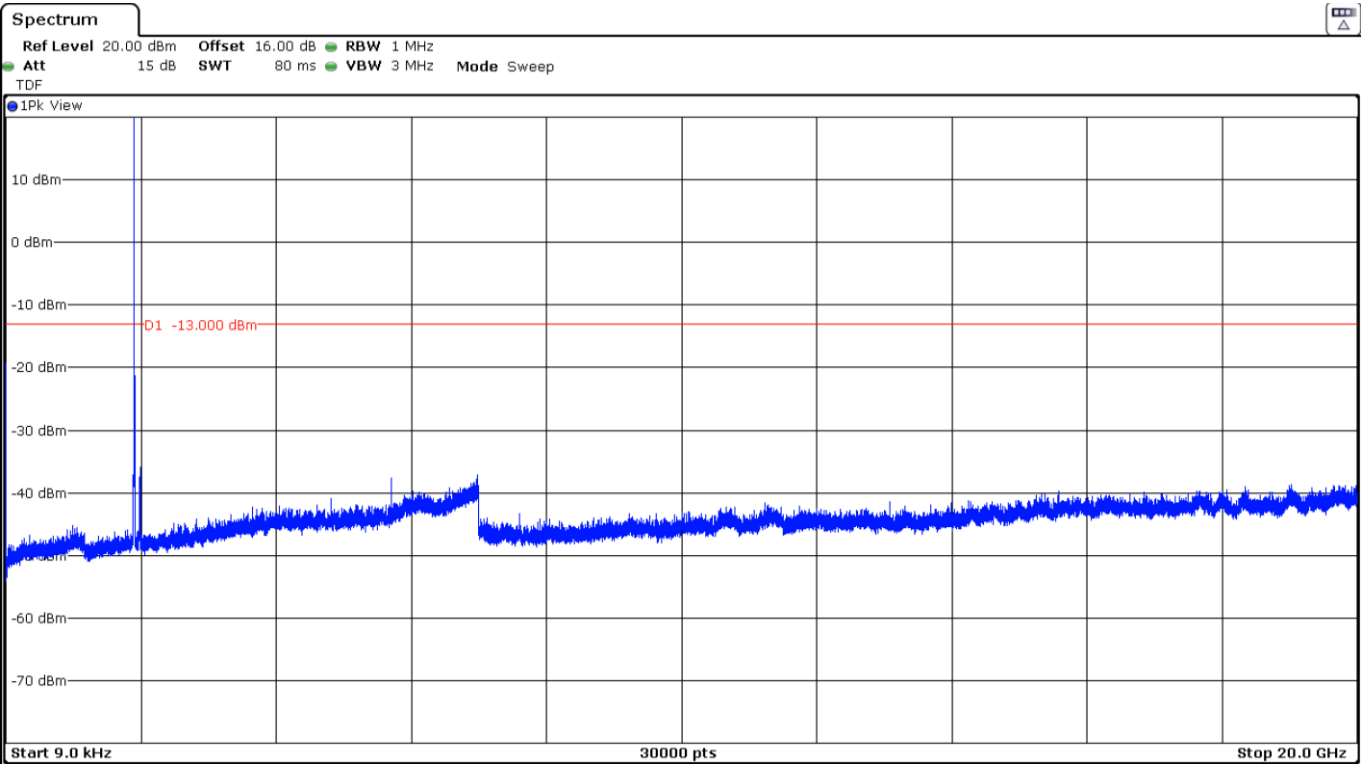
The peak above the limit is the carrier frequency.

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

SPECIFICATION:

FCC §2.1051 and §24.238. RSS-133 Clause 6.5.

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.

As indicated in FCC part 24/RSS-133. 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.

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

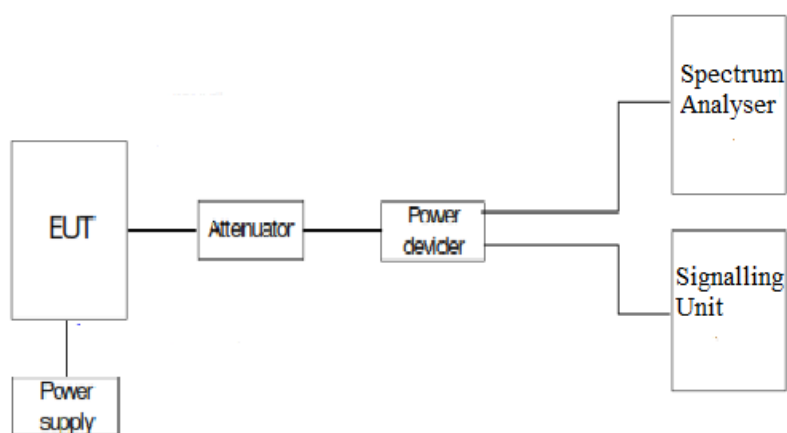
Measurement Limit:

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 Band 2.

LTE QPSK MODULATION:	RB=1. Offset=0. BW=1.4 MHz	RB=1 . Offset =0. BW = 3 MHz	RB=1 . Offset =0. BW = 5 MHz	RB=1 . Offset =0. BW = 10 MHz	RB=1 . Offset =0. BW = 15 MHz	RB=1 . Offset =0. BW = 20 MHz
Maximum measured level at <u>Lowest Block Edge</u> at antenna port (dBm)	-23.57	-21.37	-21.24	-30.24	-30.23	-33.58

LTE QPSK MODULATION:	RB= All. Offset=0. BW=1.4 MHz	RB= All. Offset =0. BW = 3 MHz	RB= All. Offset =0. BW = 5 MHz	RB= All. Offset =0. BW = 10 MHz	RB= All. Offset =0. BW = 15 MHz	RB= All. Offset =0. BW = 20 MHz
Maximum measured level at <u>Lowest Block Edge</u> at antenna port (dBm)	-28.67	-27.78	-28.27	-31.94	-35.31	-36.97

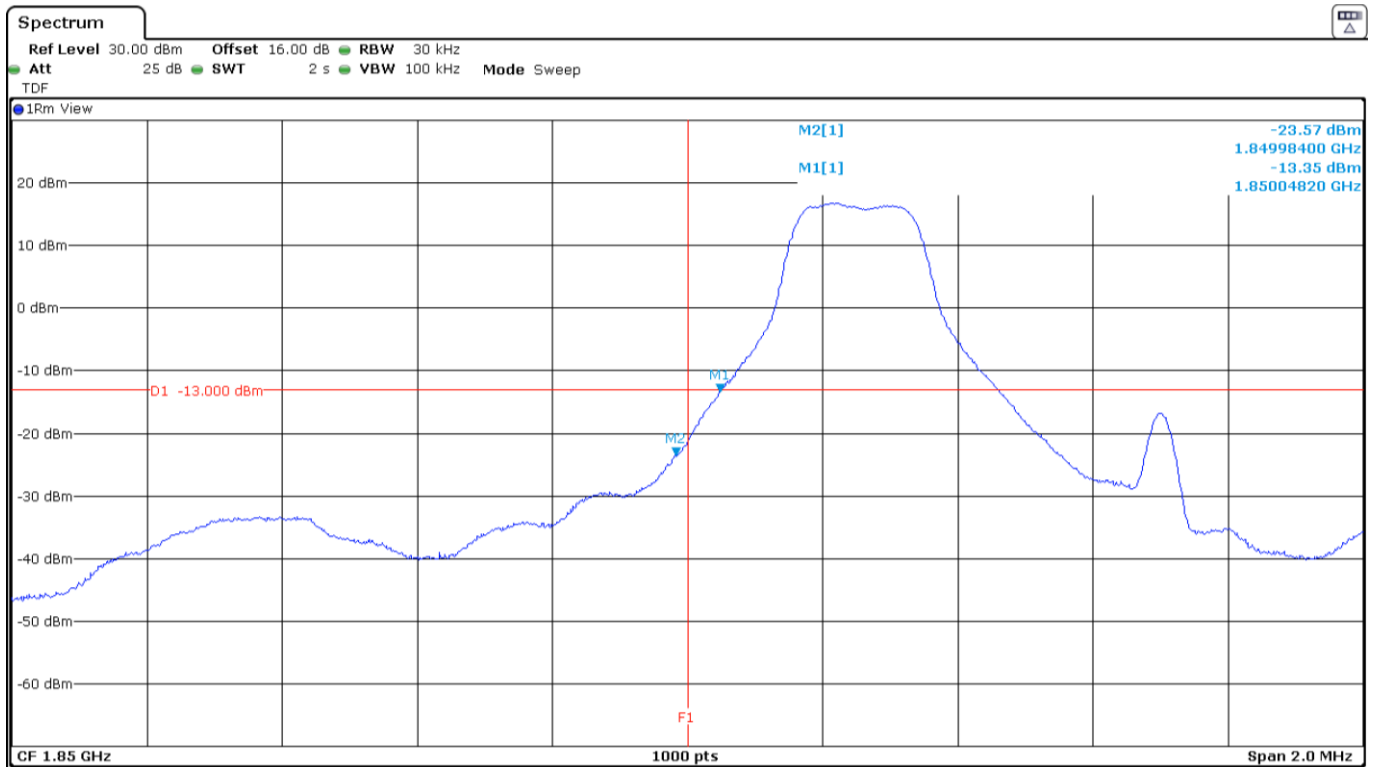
LTE QPSK MODULATION:	RB=1. Offset=Max. BW =1.4 MHz	RB=1. Offset=Max. BW = 3 MHz	RB=1 . Offset=Max. BW = 5 MHz	RB=1 . Offset=Max. BW = 10 MHz	RB=1 . Offset=Max. BW = 15 MHz	RB=1 . Offset=Max. BW = 20 MHz
Maximum measured level at <u>Highest Block Edge</u> at antenna port (dBm)	-22.52	-20.32	-21.17	-30	-31.16	-34.08

LTE QPSK MODULATION:	RB= All. Offset=0. BW=1.4 MHz	RB= All. Offset =0. BW = 3 MHz	RB= All. Offset =0. BW = 5 MHz	RB= All. Offset =0. BW = 10 MHz	RB= All. Offset =0. BW = 15 MHz	RB= All. Offset =0. BW = 20 MHz
Maximum measured level at <u>Highest Block Edge</u> at antenna port (dBm)	-26.16	-26.78	-26.66	-28.83	-29.88	-32.67

Measurement uncertainty: $\leq \pm 1.57$ dB

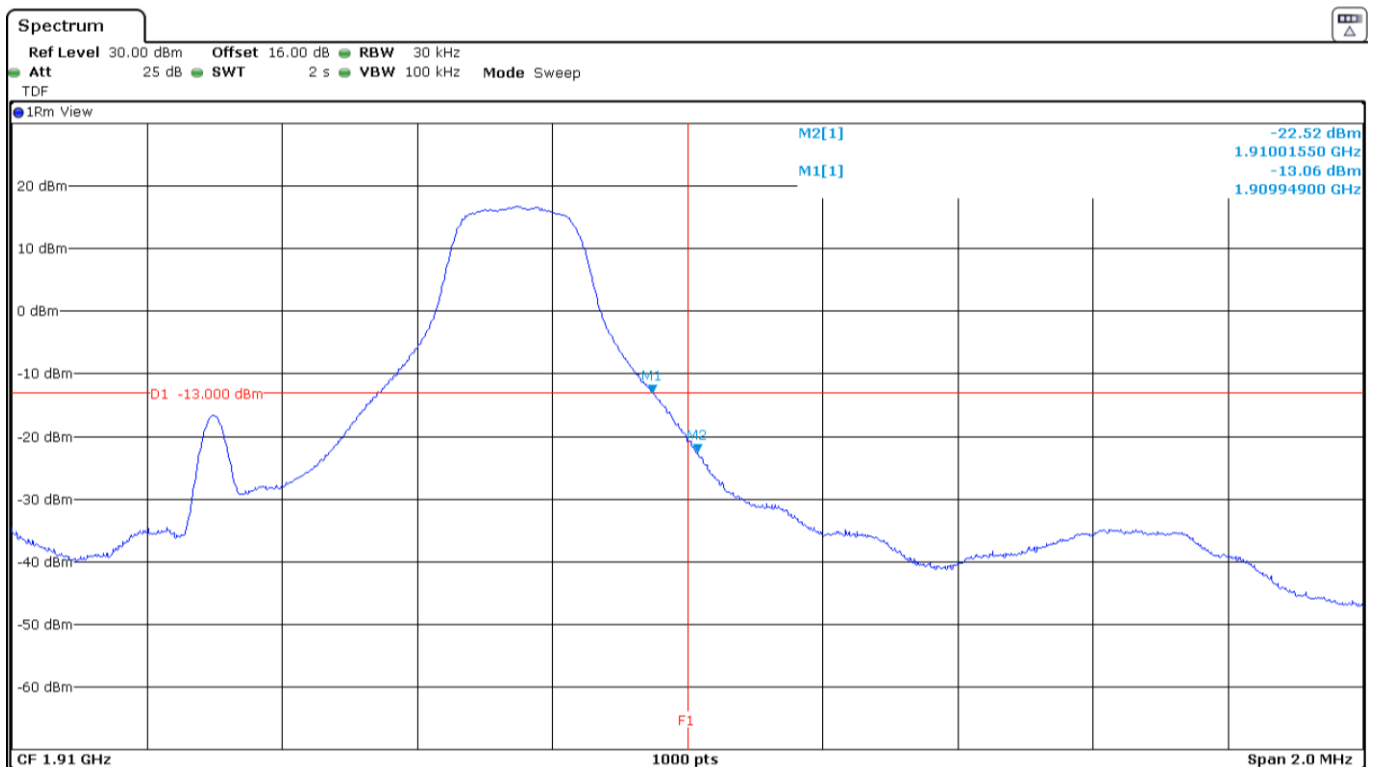
Verdict: PASS

LTE Band 2. QPSK MODULATION. BW=1.4 MHz. RB=1. Offset=0. Lowest Block Edge:



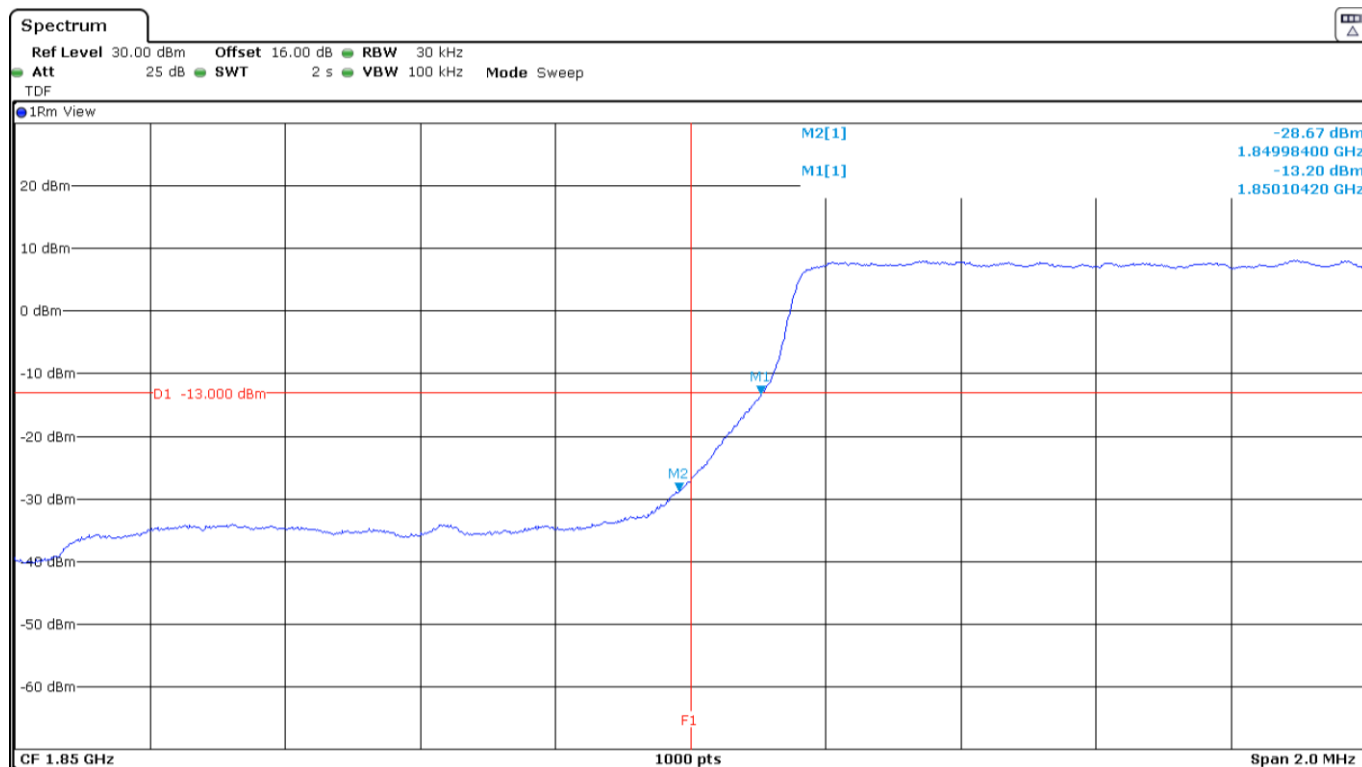
The equipment transmits at the maximum output power

LTE Band 2. QPSK MODULATION. BW=1.4 MHz. RB=1. Offset=Max. Highest Block Edge:

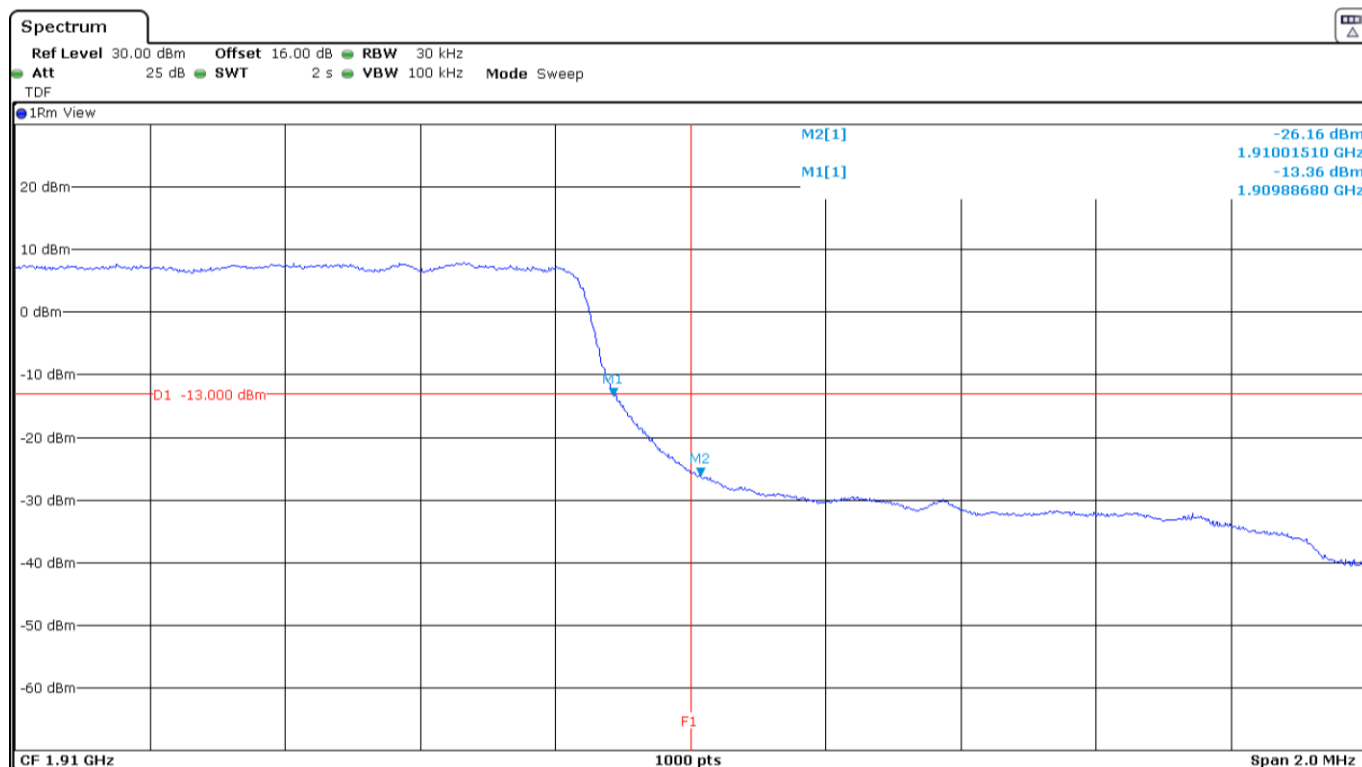


The equipment transmits at the maximum output power

LTE Band 2. QPSK MODULATION. BW=1.4 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:



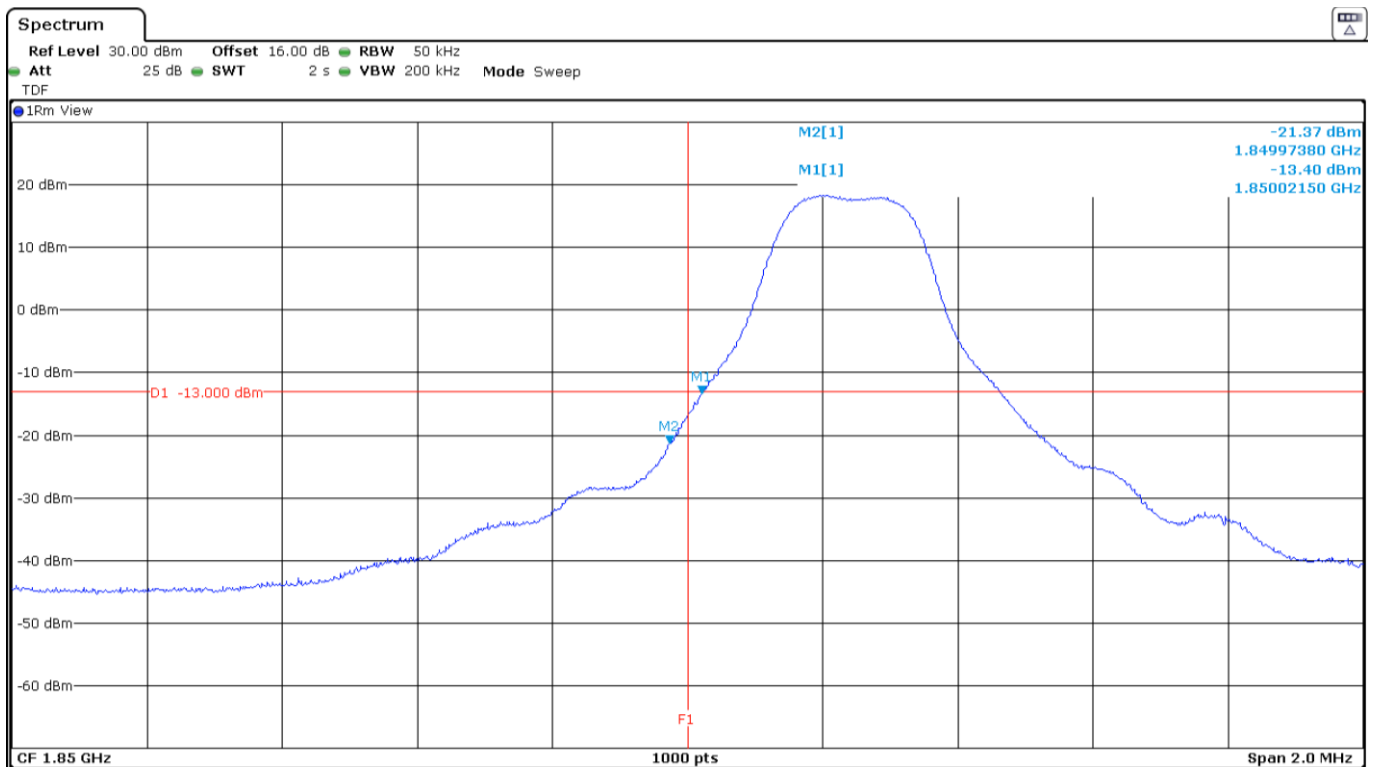
The equipment transmits at the maximum output power



The equipment transmits at the maximum output power

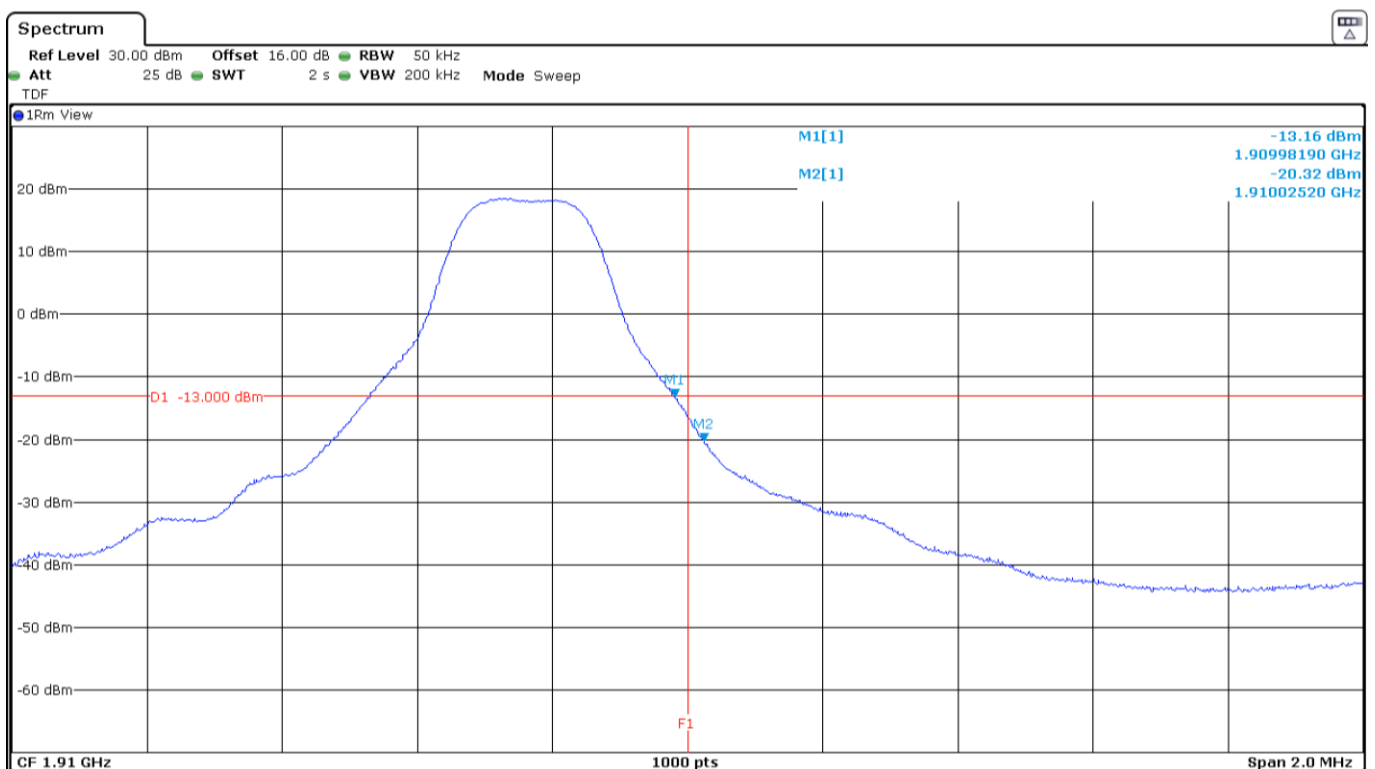
Verdict: PASS

LTE Band 2. QPSK MODULATION. BW=3 MHz. RB=1. Offset=0. Lowest Block Edge:



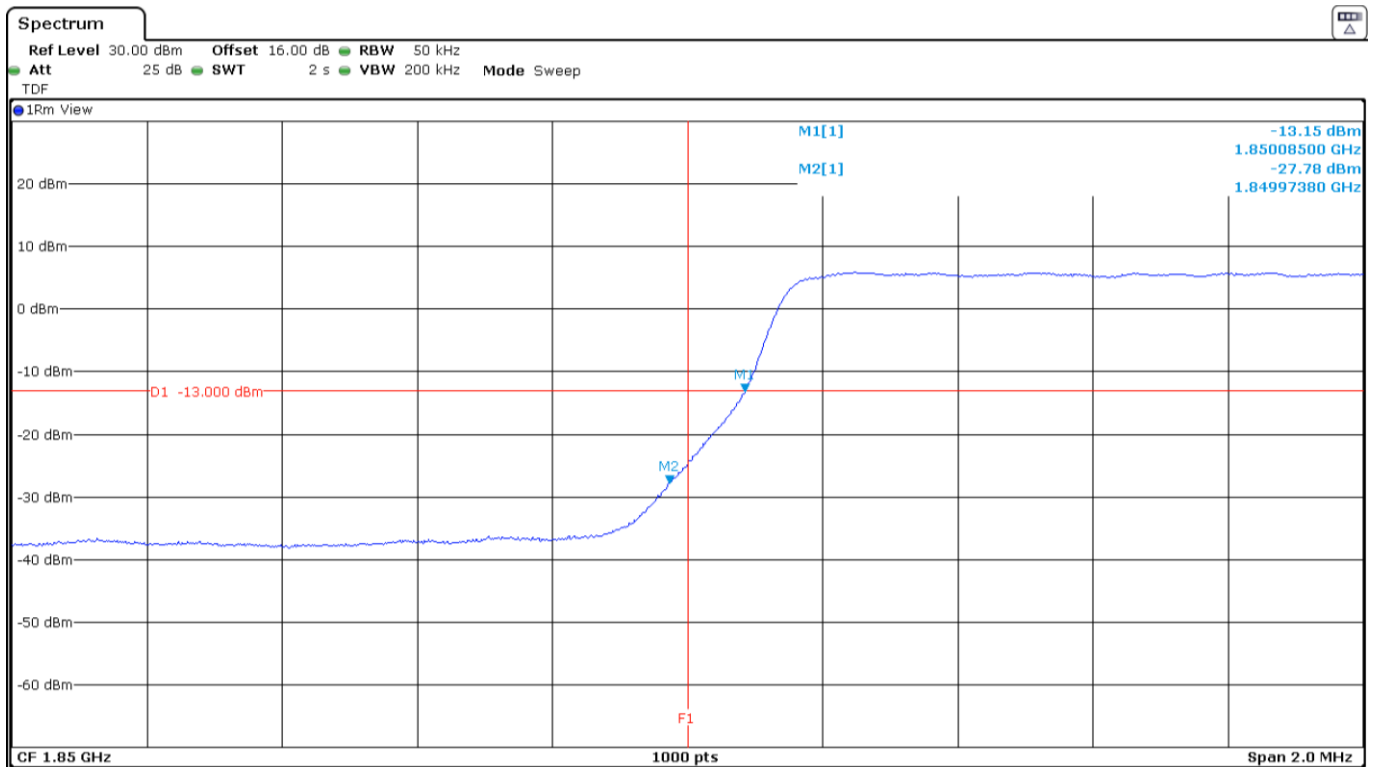
The equipment transmits at the maximum output power

LTE Band 2. QPSK MODULATION. BW=3 MHz. RB=1. Offset=Max. Highest Block Edge:

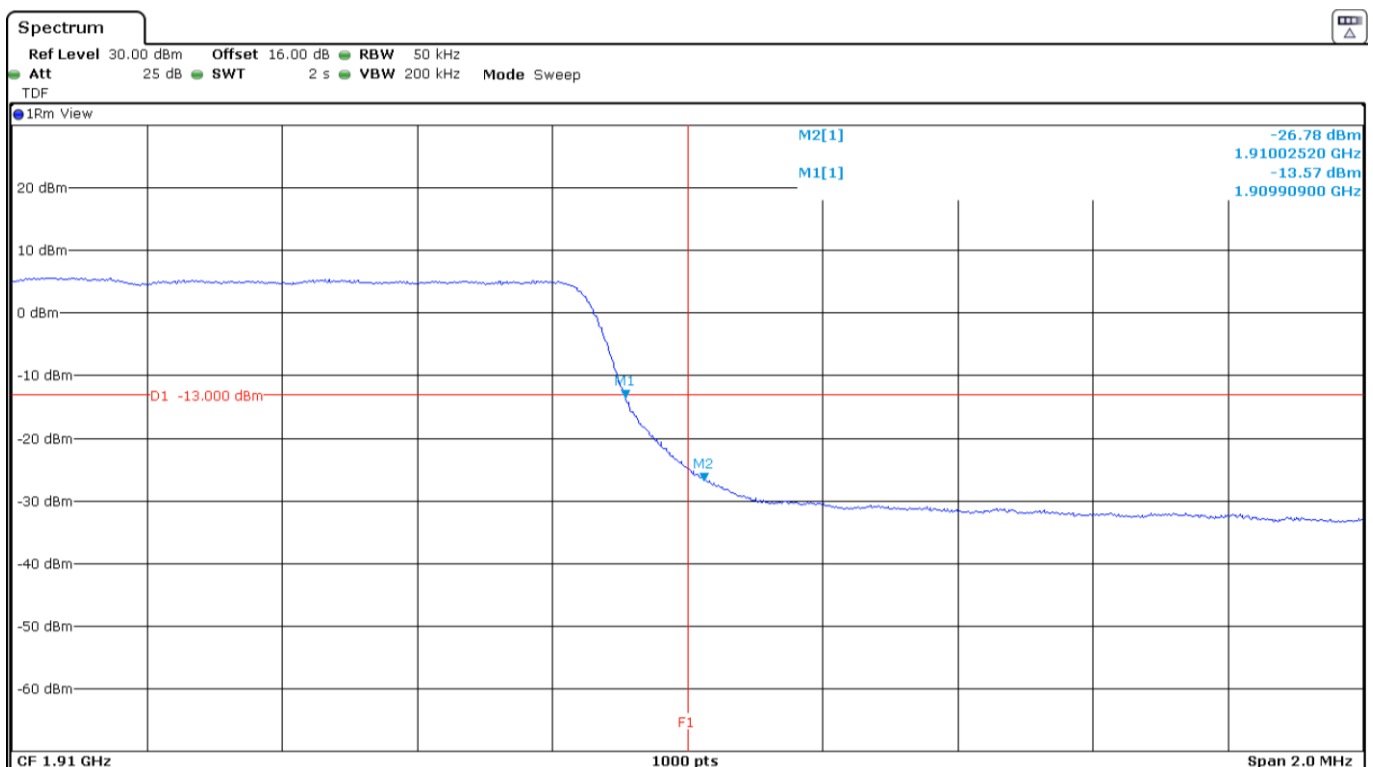


The equipment transmits at the maximum output power

LTE Band 2. QPSK MODULATION. BW=3 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:



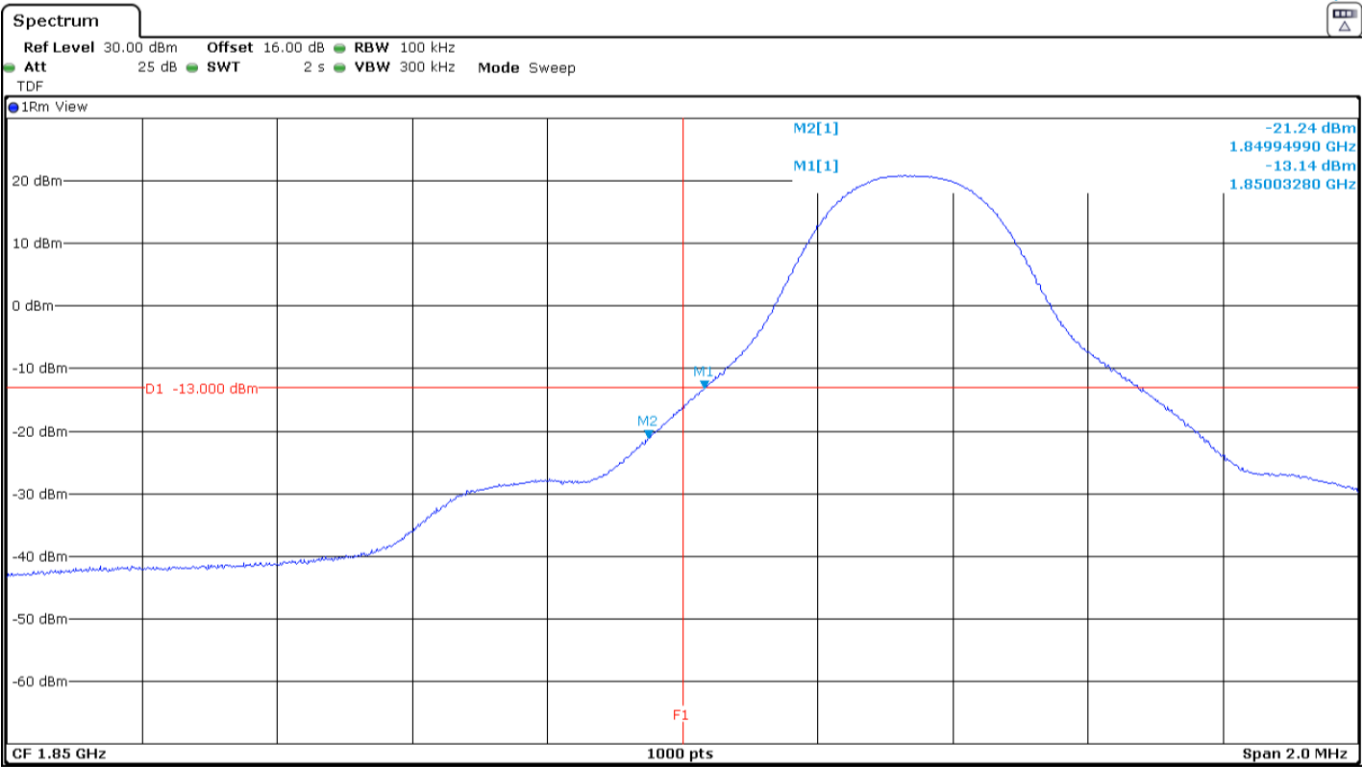
The equipment transmits at the maximum output power



The equipment transmits at the maximum output power

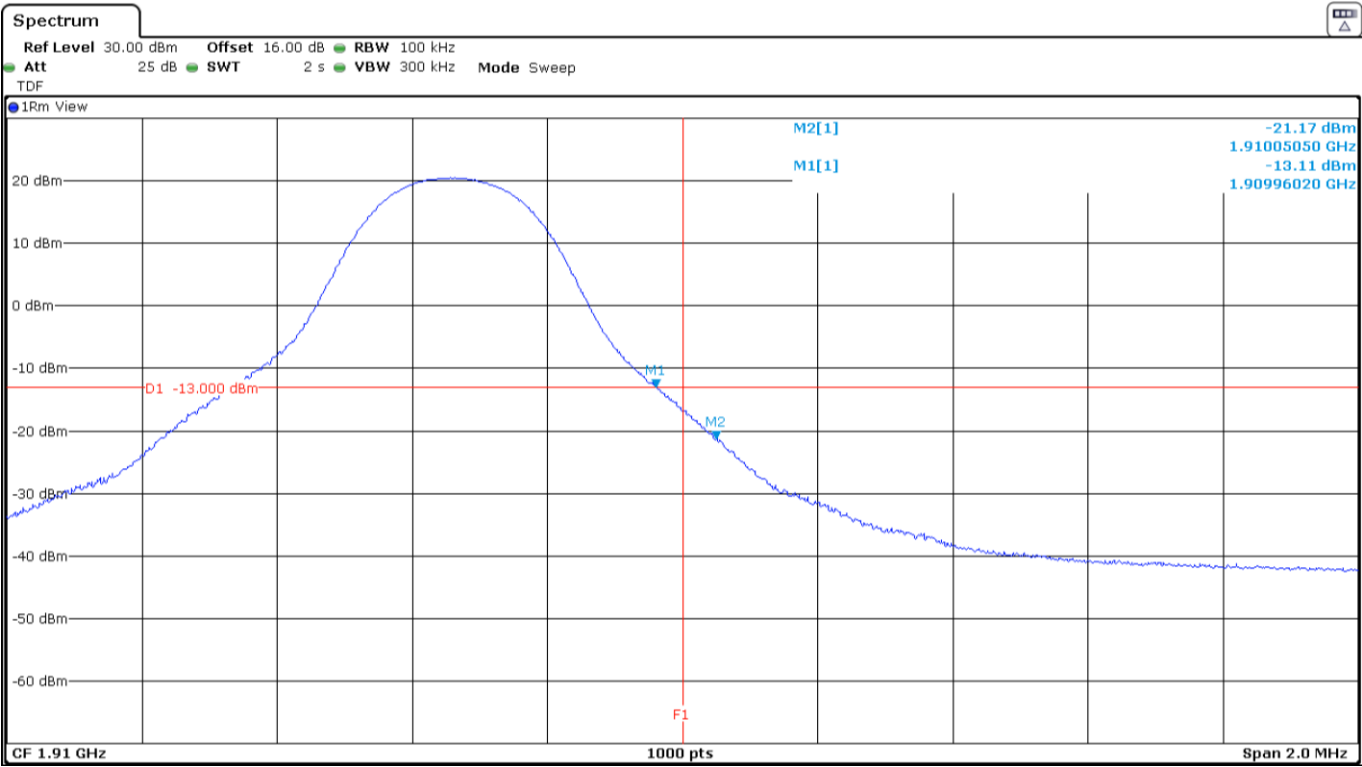
Verdict: PASS

LTE Band 2. QPSK MODULATION. BW=5 MHz. RB=1. Offset=0. Lowest Block Edge:



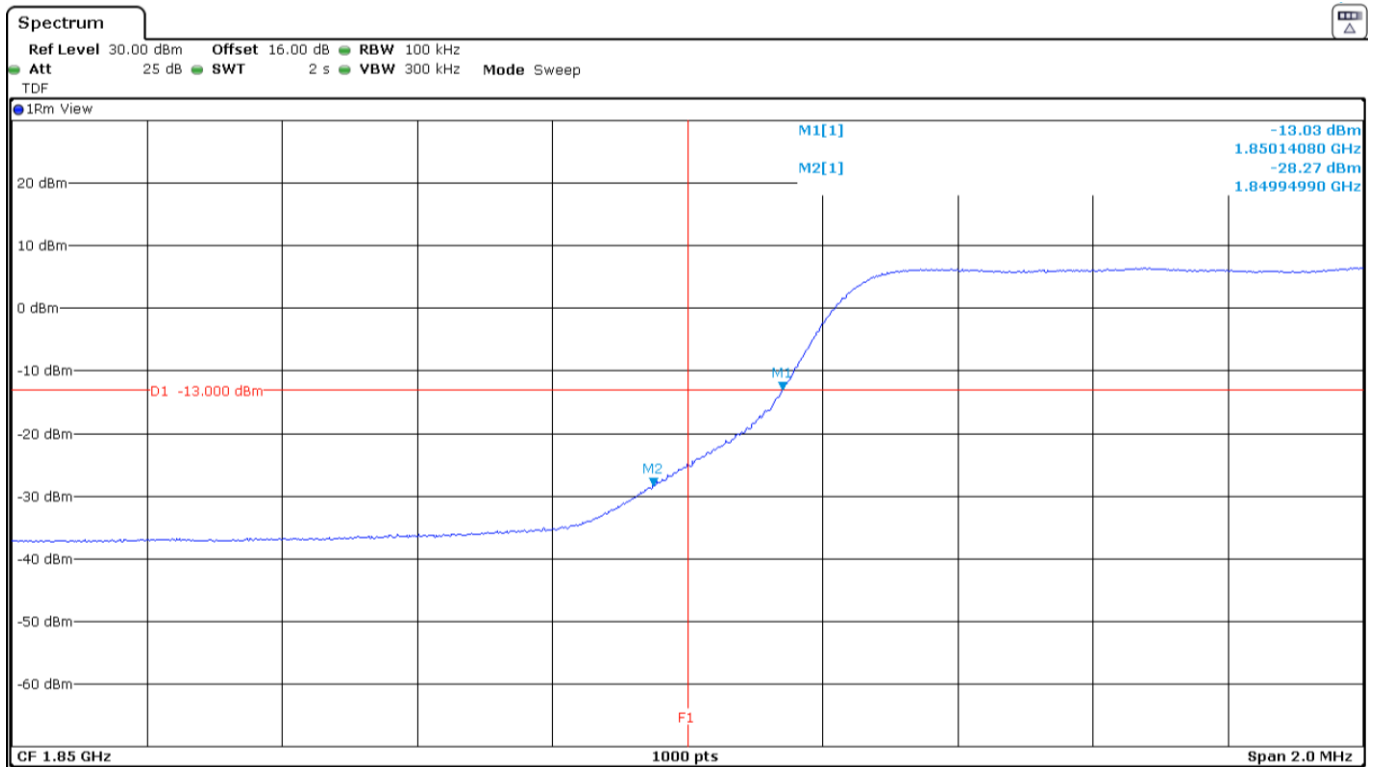
The equipment transmits at the maximum output power

LTE Band 2. QPSK MODULATION. BW=5 MHz. RB=1. Offset=Max. Highest Block Edge:

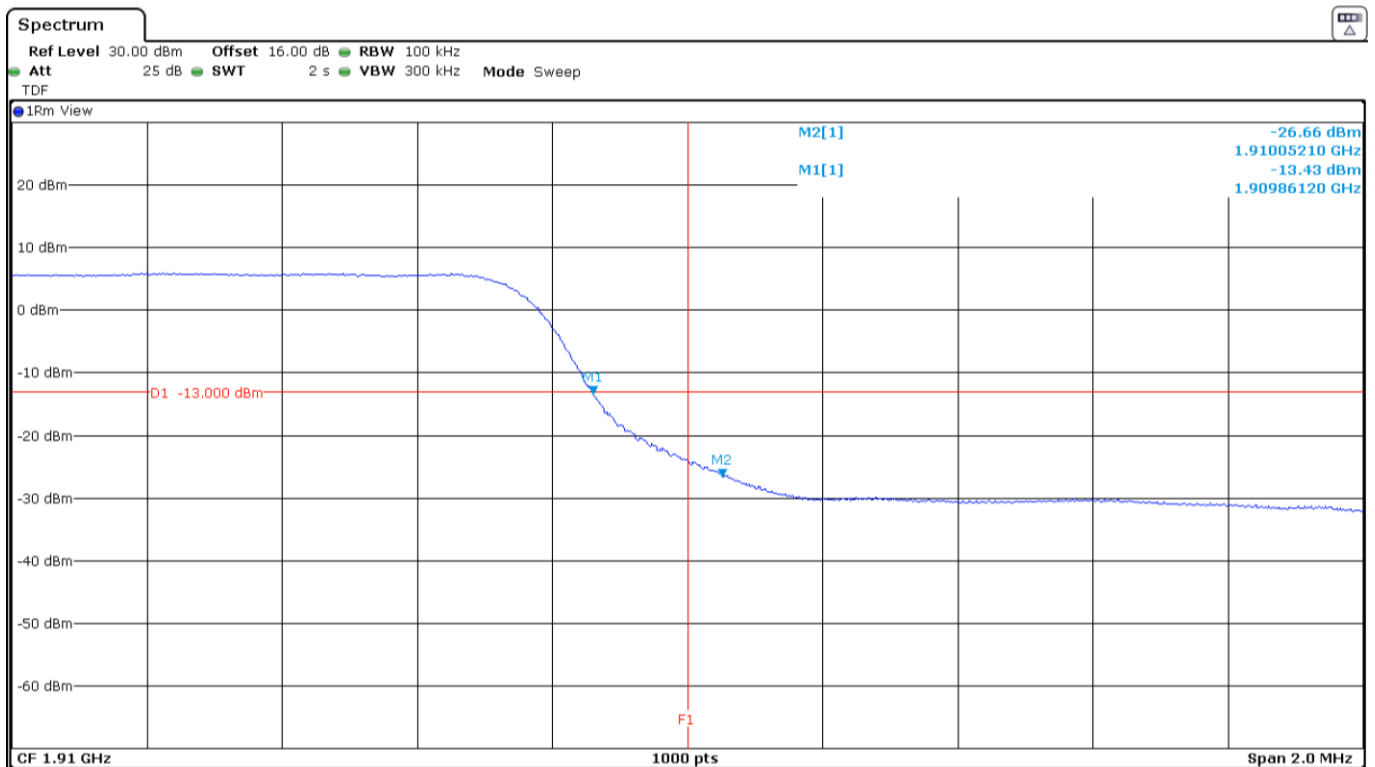


The equipment transmits at the maximum output power

LTE Band 2. QPSK MODULATION. BW=5 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:



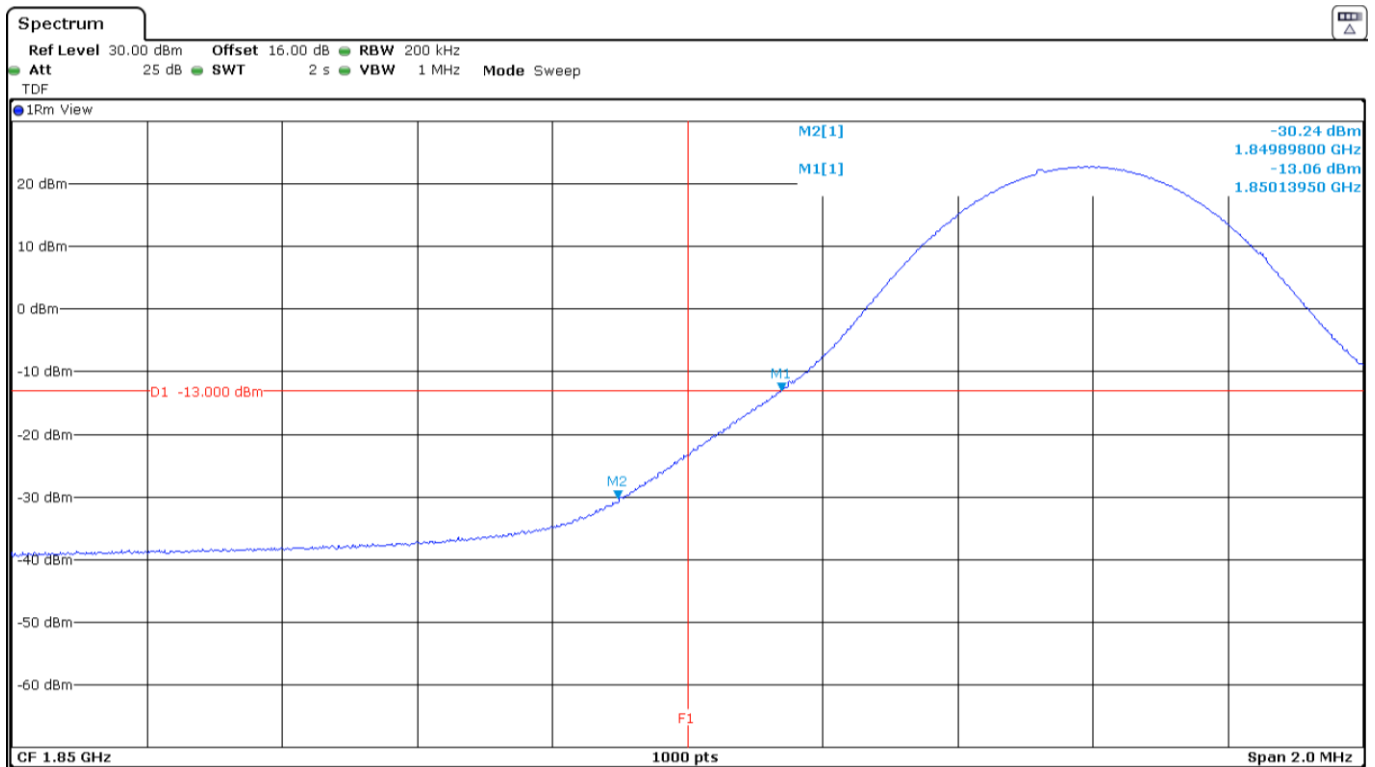
The equipment transmits at the maximum output power



The equipment transmits at the maximum output power

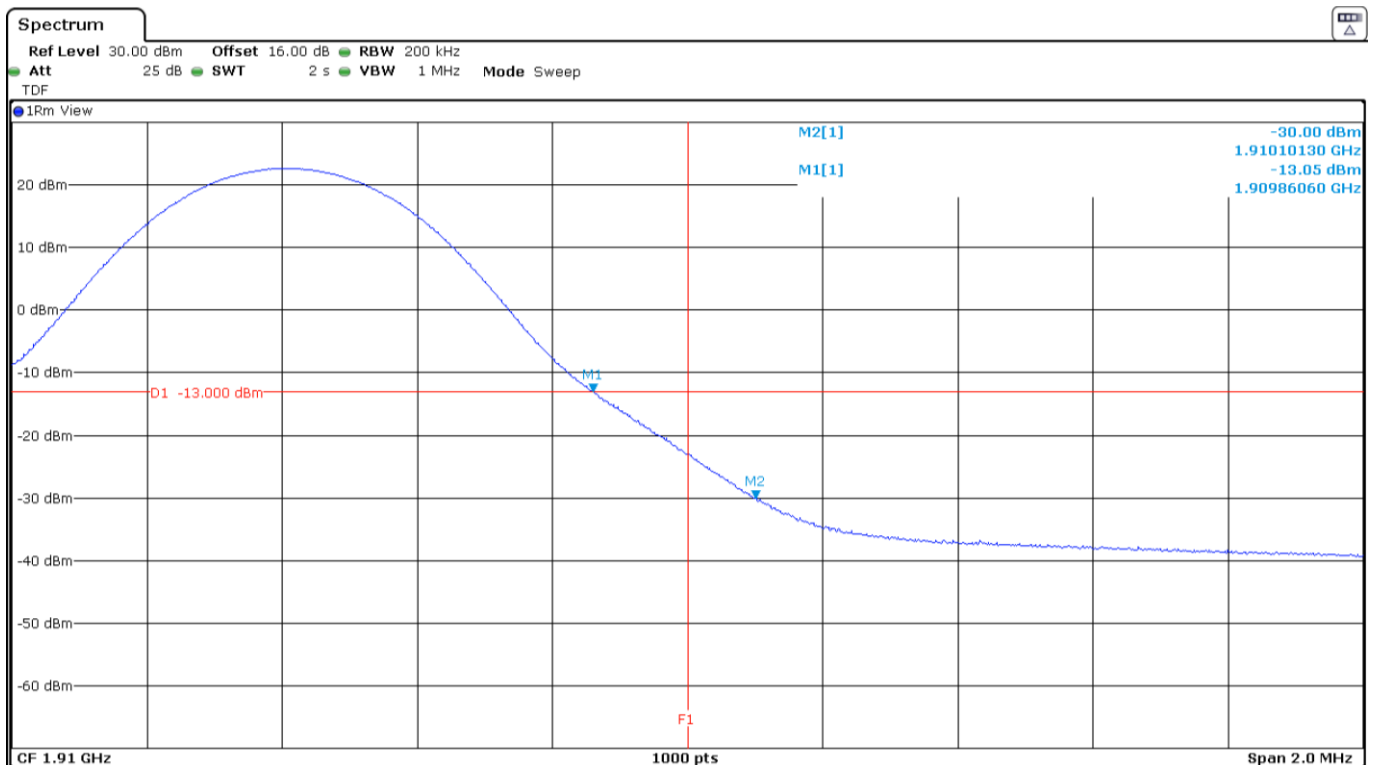
Verdict: PASS

LTE Band 2. QPSK MODULATION. BW=10 MHz. RB=1. Offset=0. Lowest Block Edge:



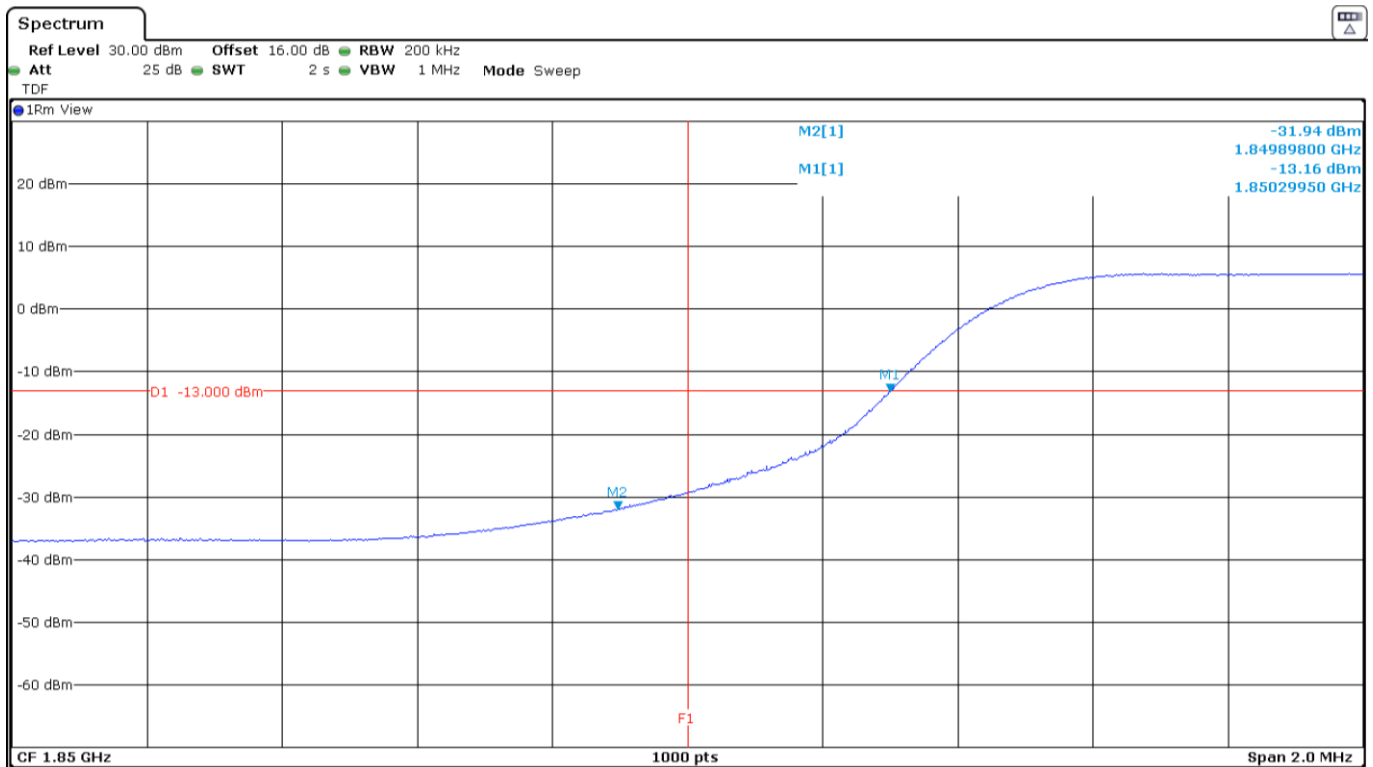
The equipment transmits at the maximum output power

LTE Band 2. QPSK MODULATION. BW=10 MHz. RB=1. Offset=Max. Highest Block Edge:

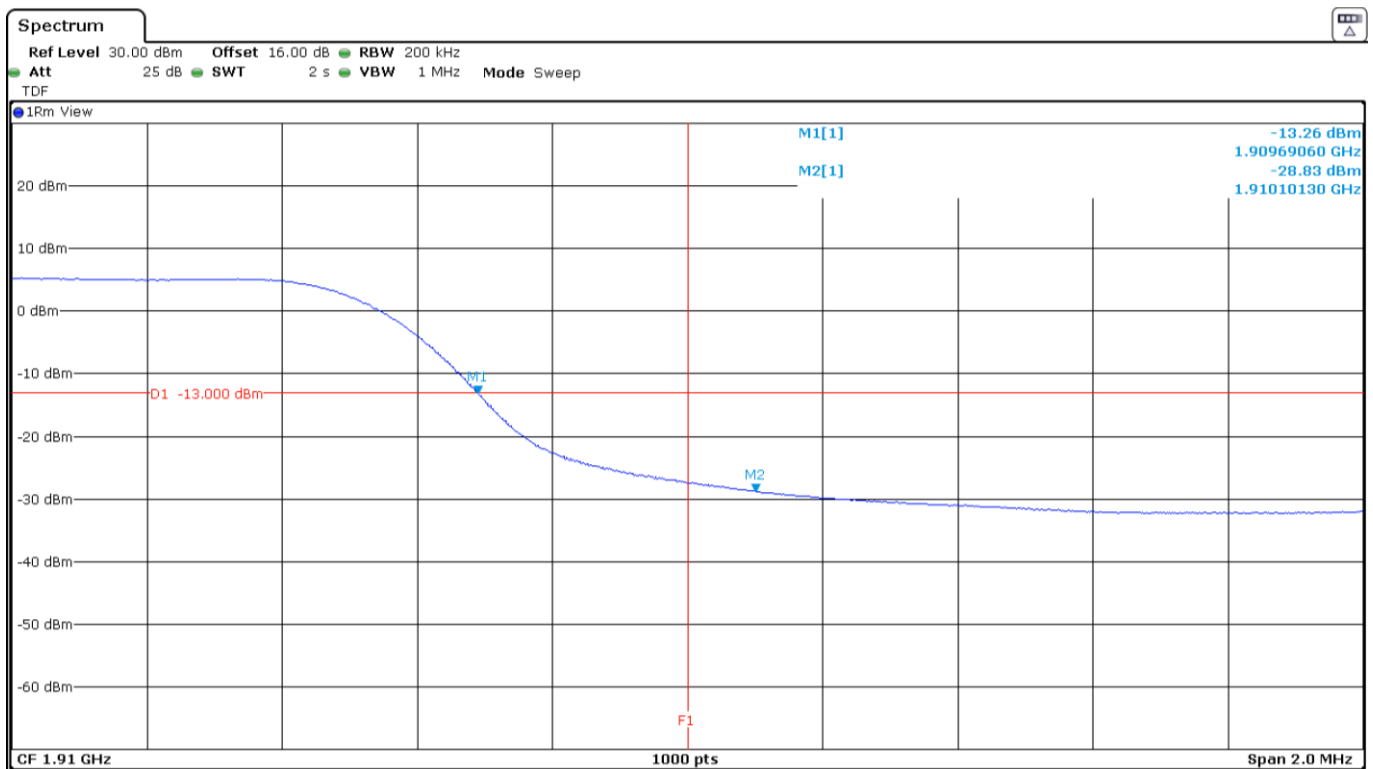


The equipment transmits at the maximum output power

LTE Band 2. QPSK MODULATION. BW=10 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:



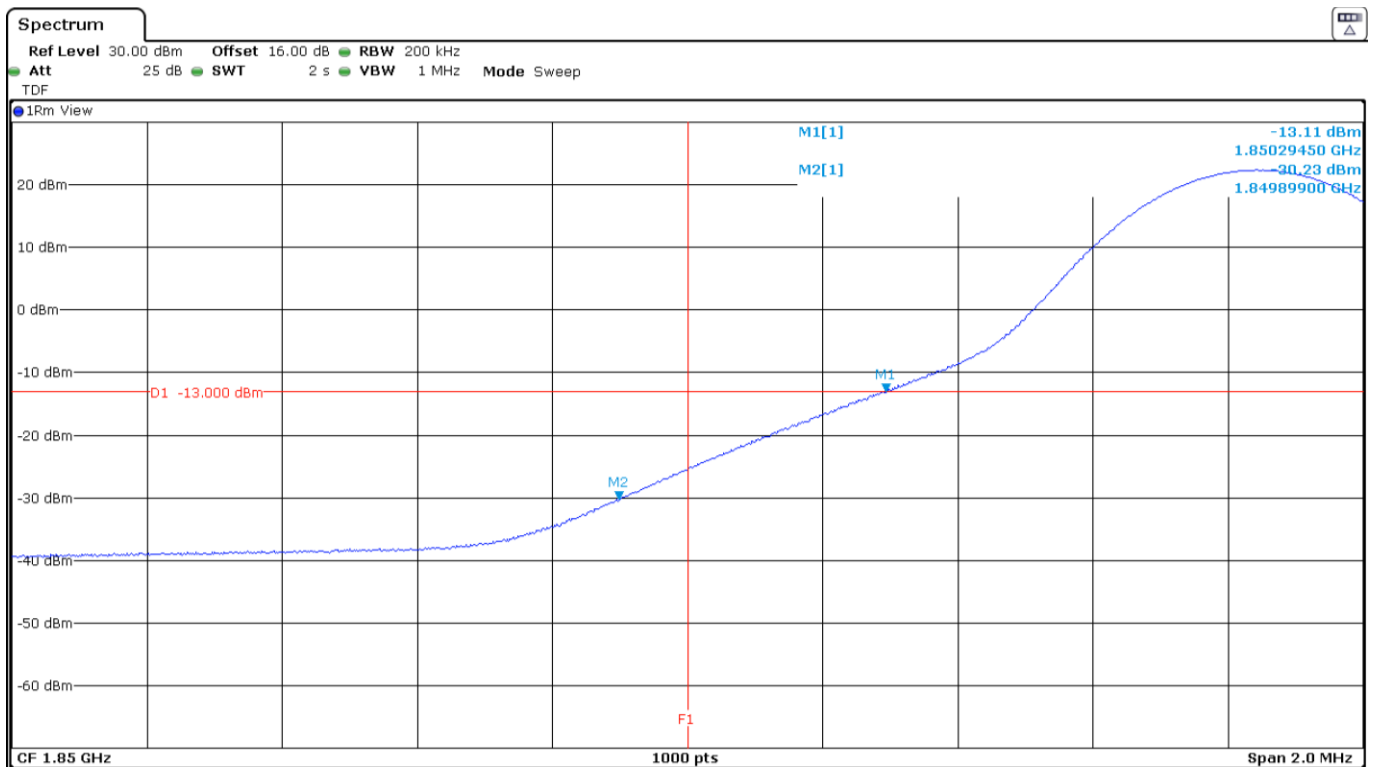
The equipment transmits at the maximum output power



The equipment transmits at the maximum output power

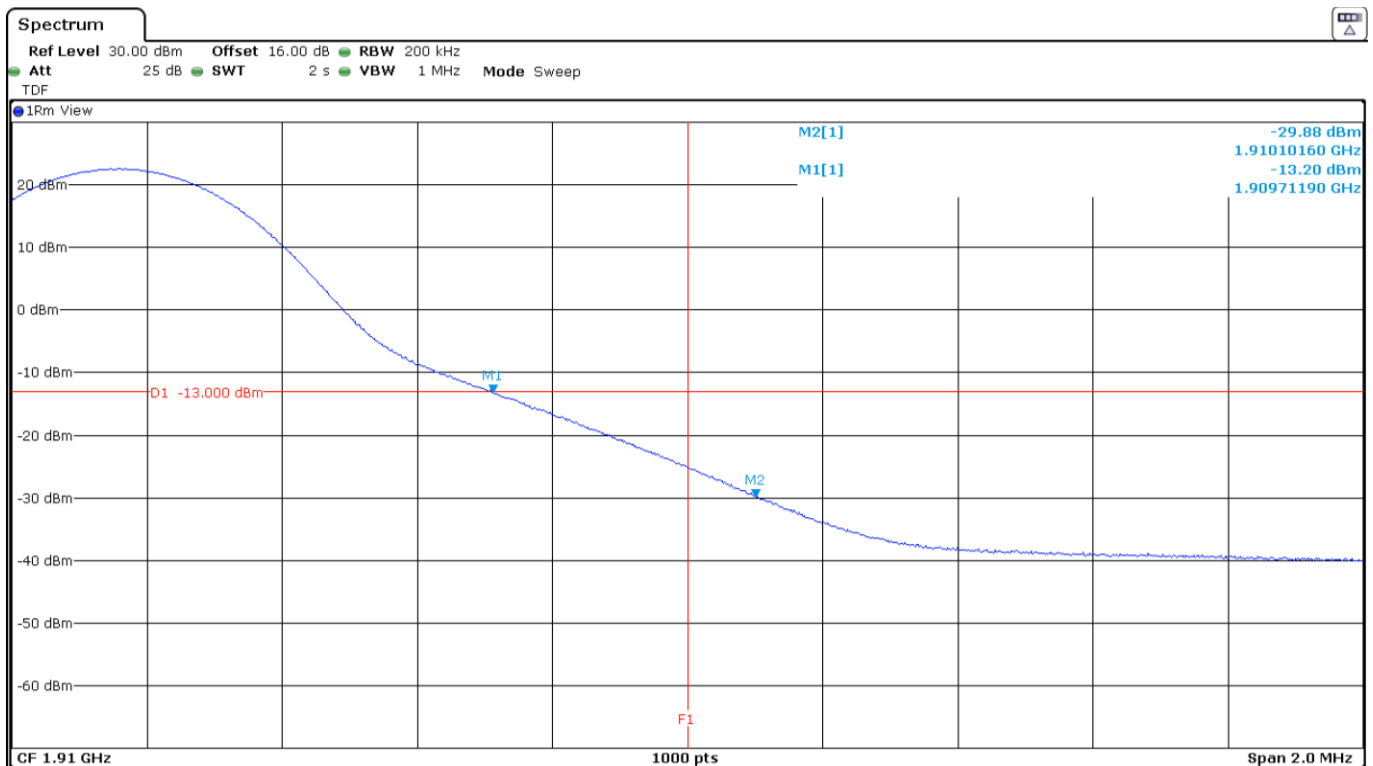
Verdict: PASS

LTE Band 2. QPSK MODULATION. BW=15 MHz. RB=1. Offset=0. Lowest Block Edge:



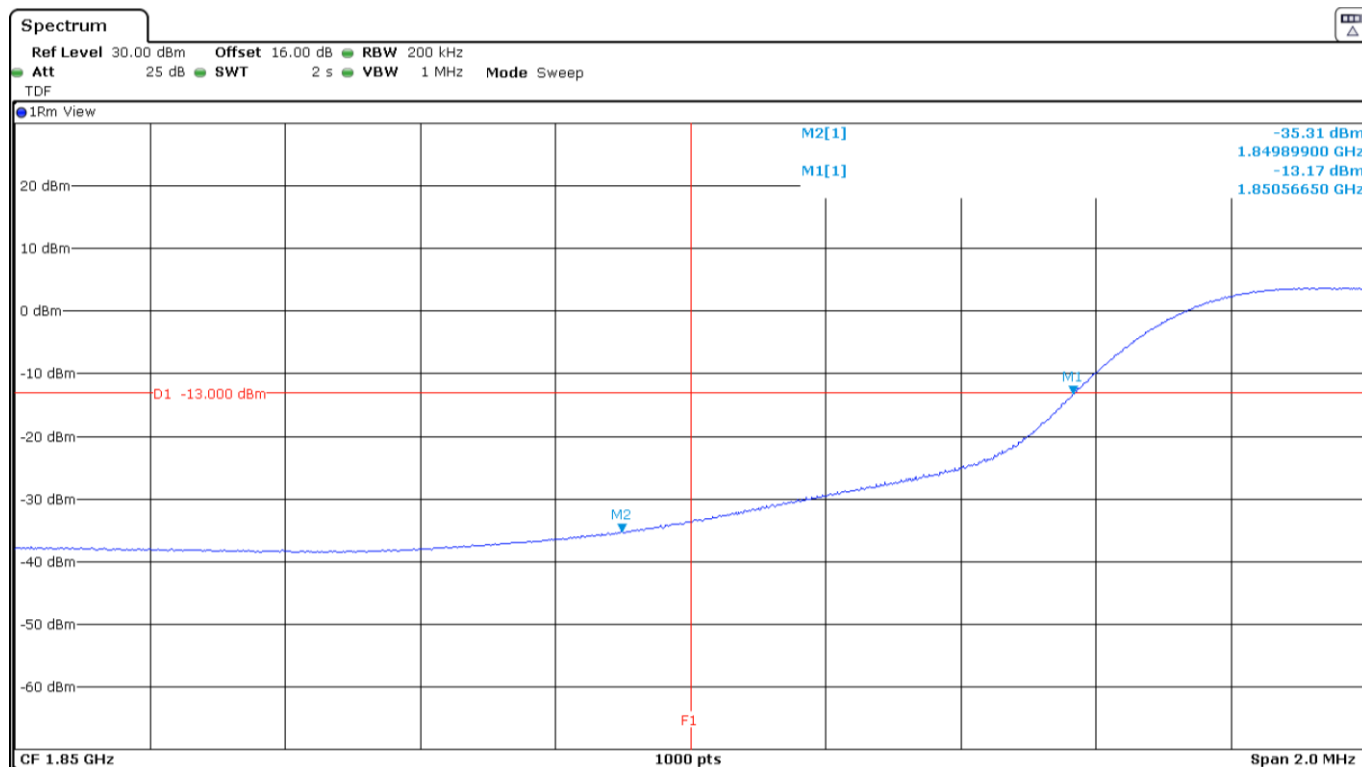
The equipment transmits at the maximum output power

LTE Band 2. QPSK MODULATION. BW=15 MHz. RB=1. Offset=Max. Highest Block Edge:

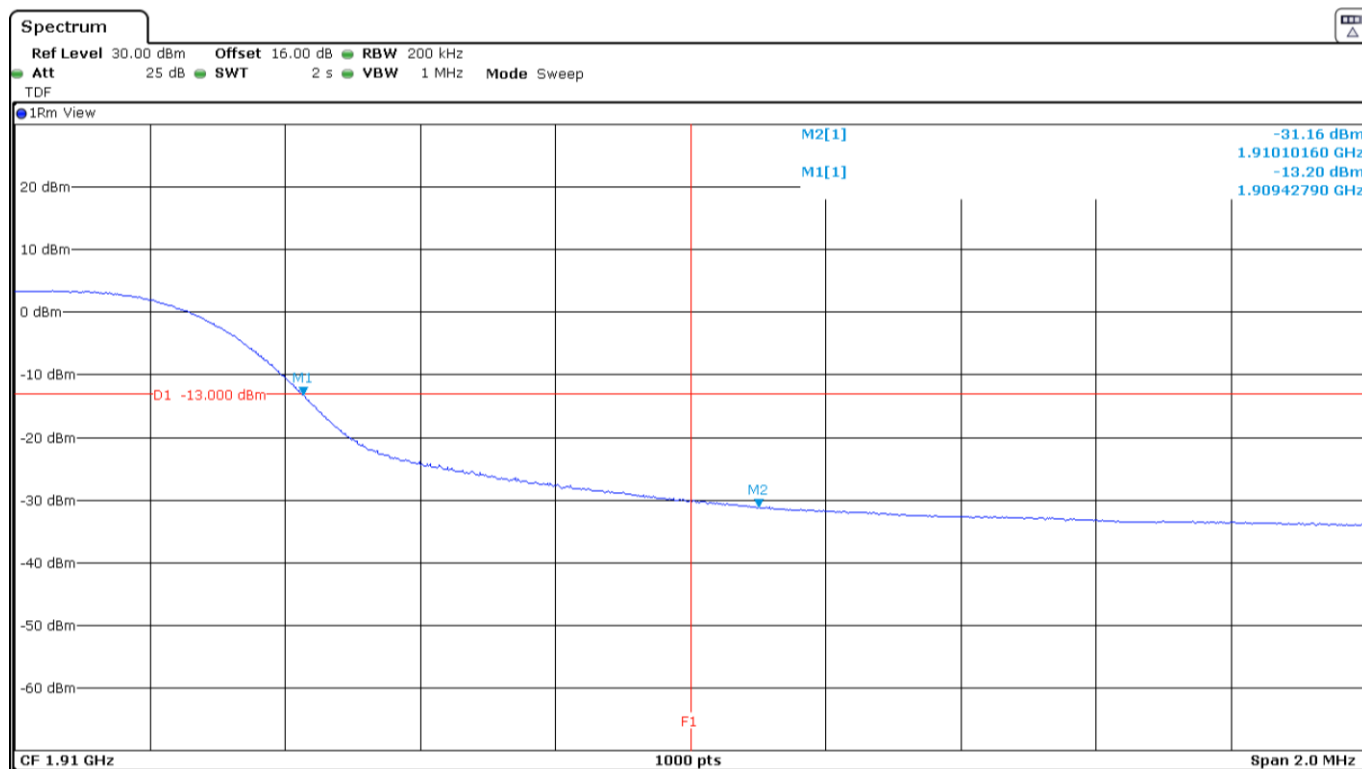


The equipment transmits at the maximum output power

LTE Band 2. QPSK MODULATION. BW=15 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:



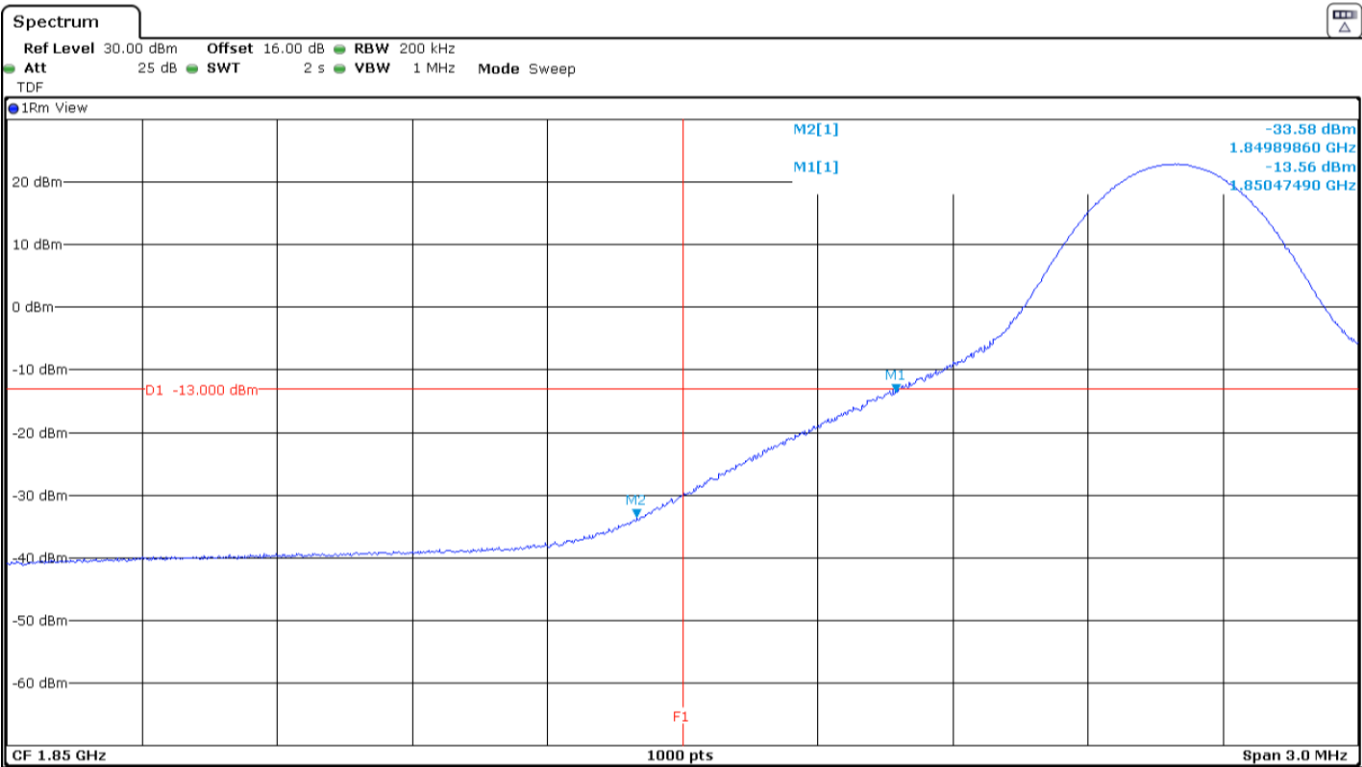
The equipment transmits at the maximum output power



The equipment transmits at the maximum output power

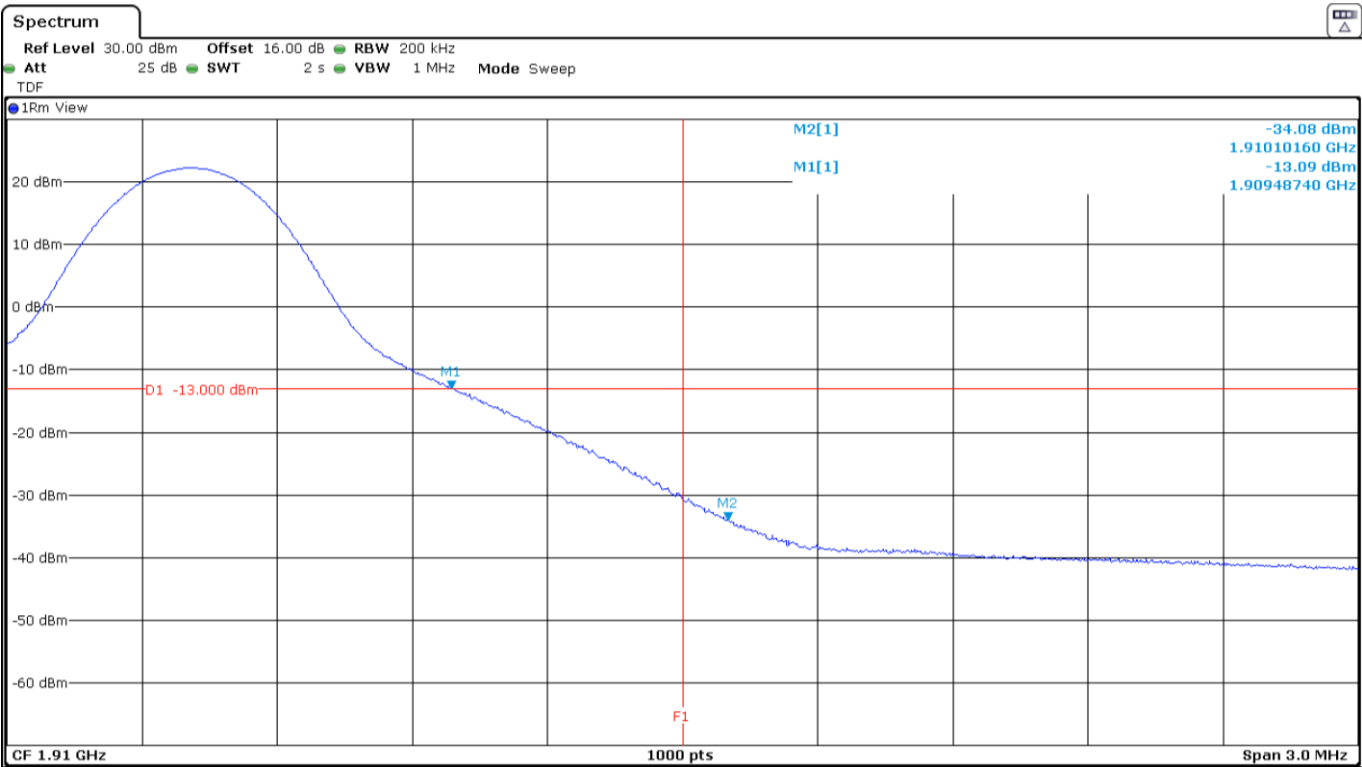
Verdict: PASS

LTE Band 2. QPSK MODULATION. BW=20 MHz. RB=1. Offset=0. Lowest Block Edge:



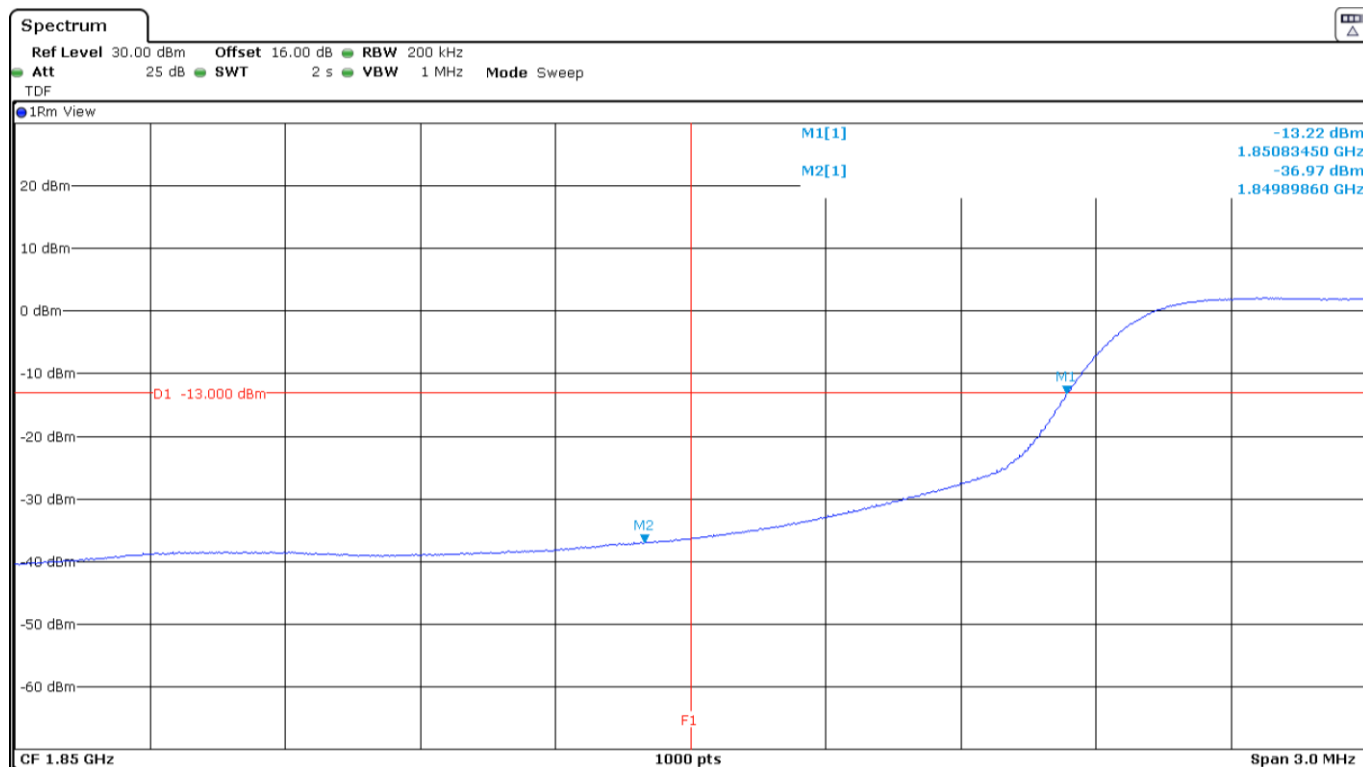
The equipment transmits at the maximum output power

LTE Band 2. QPSK MODULATION. BW=20 MHz. RB=1. Offset=Max. Highest Block Edge:

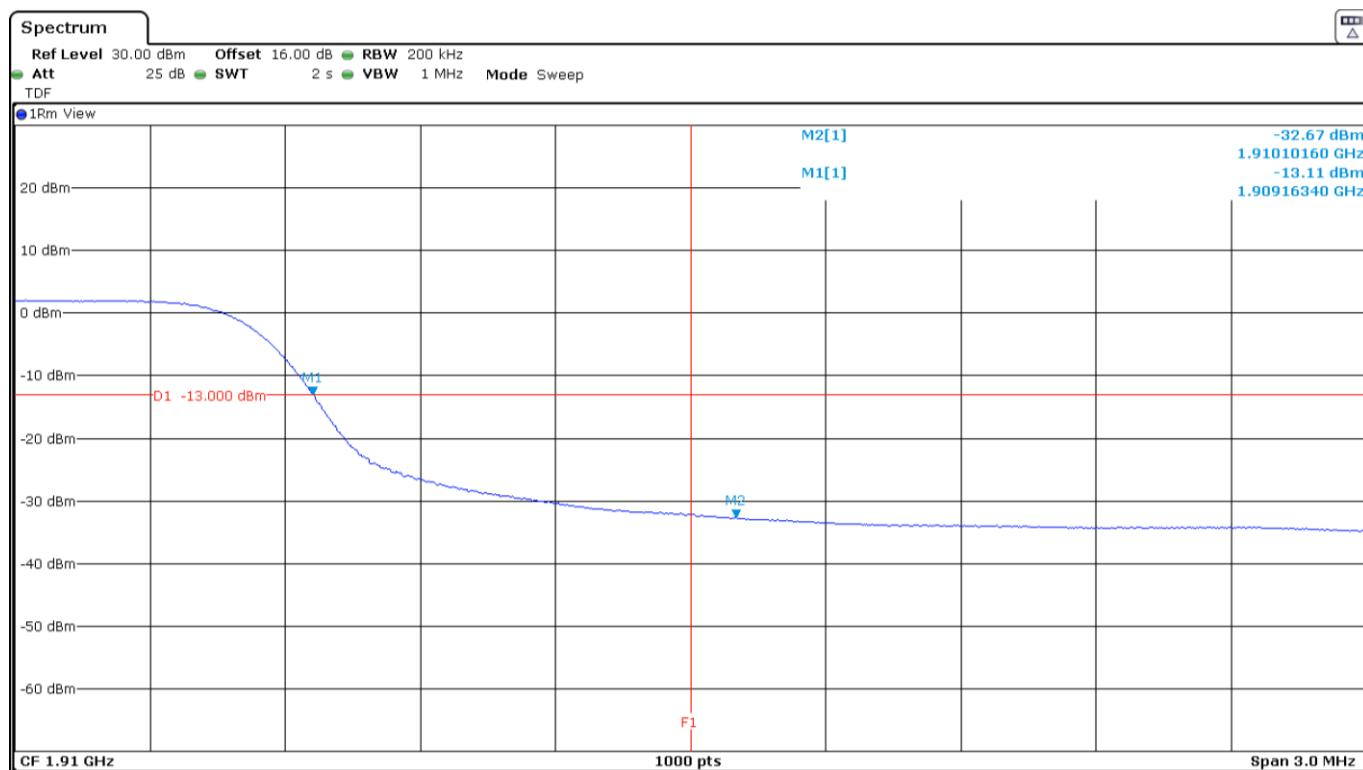


The equipment transmits at the maximum output power

LTE Band 2. QPSK MODULATION. BW=20 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:



The equipment transmits at the maximum output power



The equipment transmits at the maximum output power

Verdict: PASS

Radiated Emissions

SPECIFICATION:

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.

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 non-conductive stand at a 3 meter distance from the measuring antenna for measurements below 18 GHz and at 1 m distance for measurements above 18 GHz.

Detected emissions were maximized at each frequency by rotating the EUT and adjusting the measuring antenna height and polarization. The maximum meter reading was recorded.

The maximum field strength (dB μ 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. $D = 3$ m.

Measurement Limit:

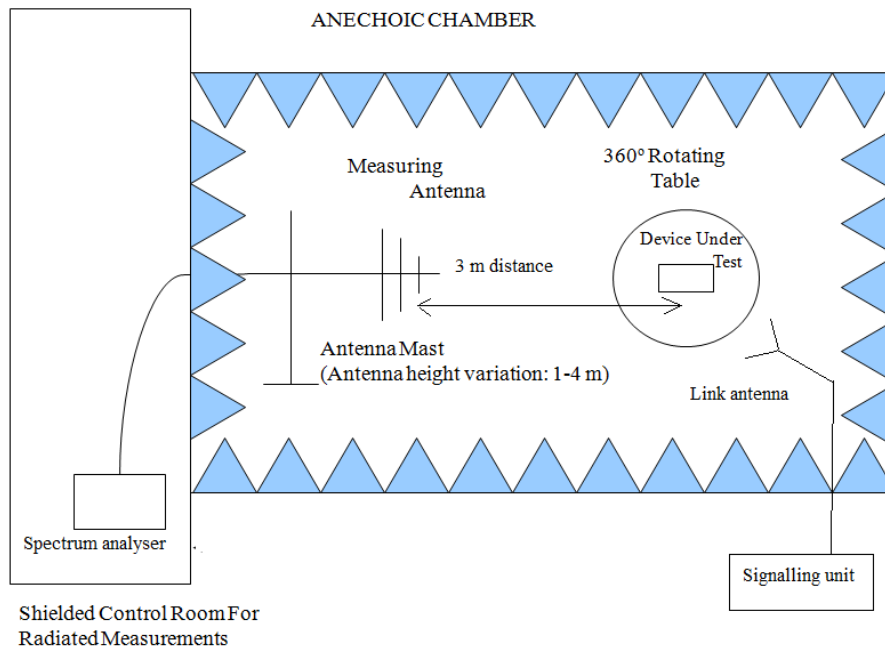
According to specification. the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

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

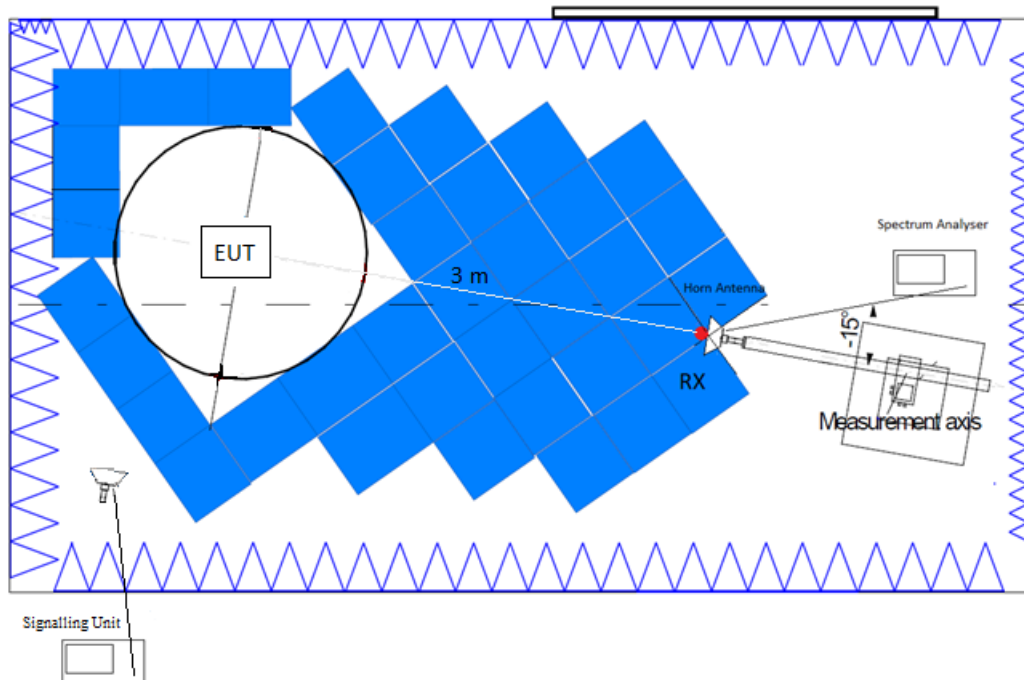
$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = -13 \text{ dBm}$$

TEST SETUP:

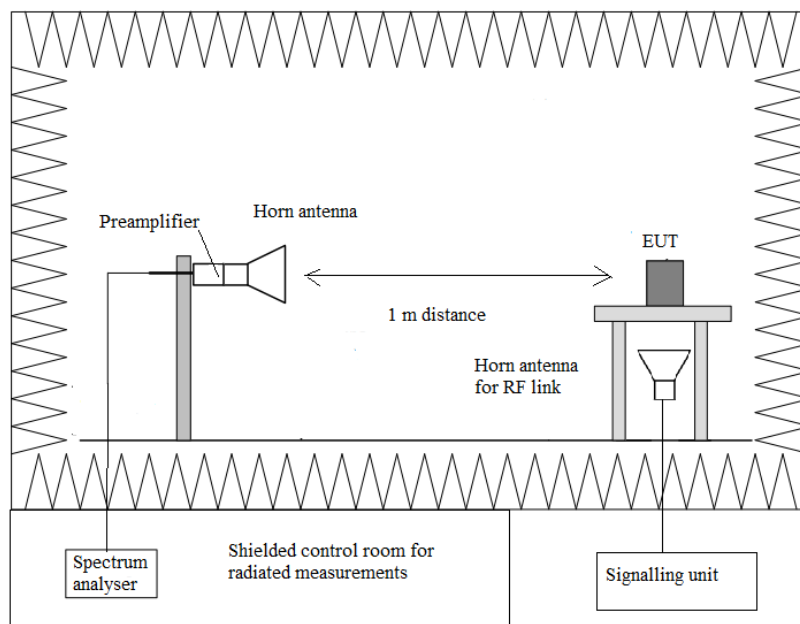
Radiated measurements below 1 GHz.



Radiated measurements between 1 GHz and 18 GHz.



Radiated measurements above 18 GHz.



RESULTS:

LTE Band 2:

QPSK and 16QAM modulations:

A preliminary scan determined the QPSK modulation, BW=10 MHz, RB Size=1, RB Offset=24 as the worst case.

The following tables and plots show the results for this case.

- Low Channel:

Frequency range 30 MHz - 1 GHz

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

Frequency range 1 - 18 GHz

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

Frequency range 18 - 20 GHz

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

- Middle Channel:

Frequency range 30 MHz - 1 GHz

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

Frequency range 1 GHz-18 GHz

Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	E.I.R.P (dBm)	Polarization	Detector
5.63975	-31.26	V	Peak

Frequency range 18 - 20 GHz

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

- High Channel:

Frequency range 30 MHz - 1 GHz

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

Frequency range 1 GHz-18 GHz

Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	E.I.R.P (dBm)	Polarization	Detector
5.71475	-28.96	V	Peak

Frequency range 18 - 20 GHz

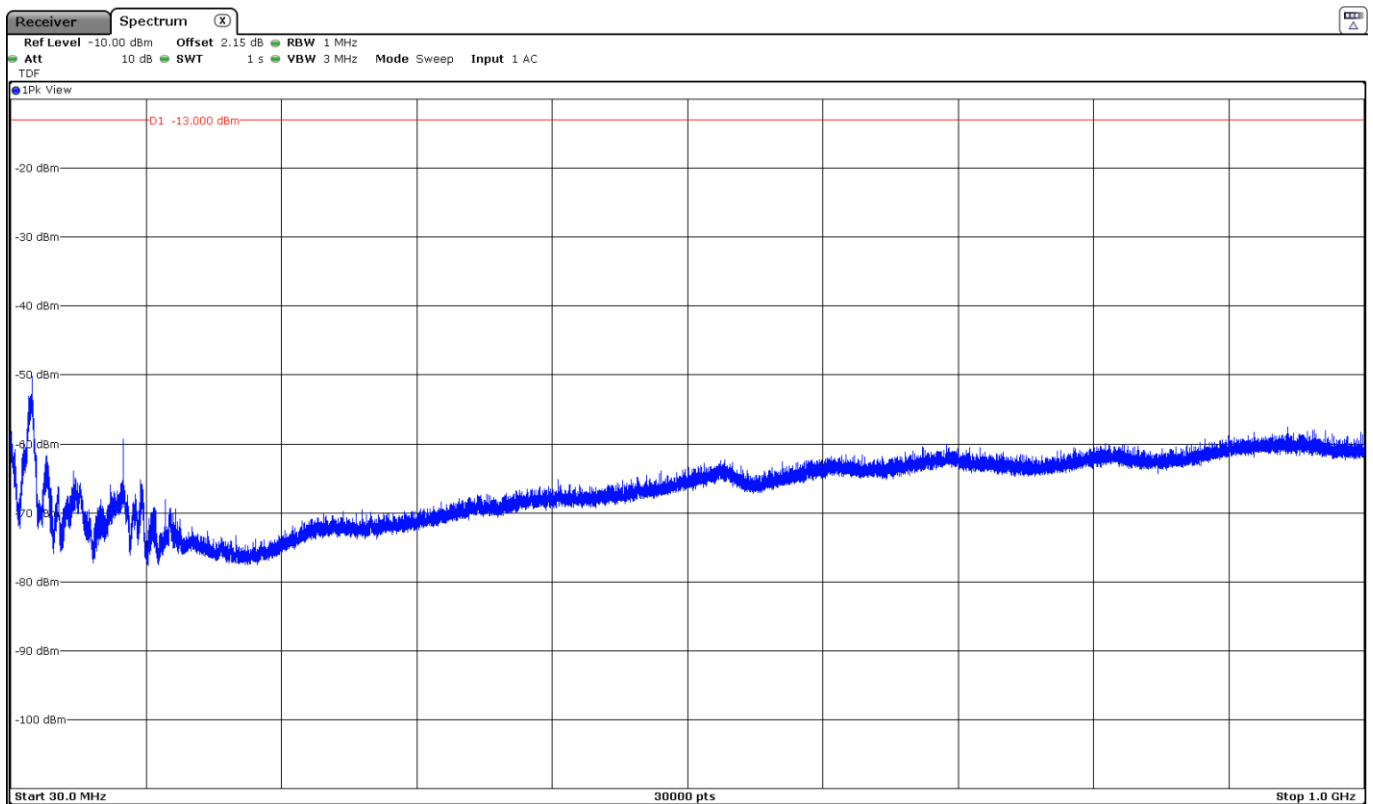
No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB): $<\pm 4.99$ for $f \geq 30$ MHz up to 1 GHz
 $<\pm 4.98$ for $f \geq 1$ GHz up to 18 GHz
 $<\pm 5.08$ for $f \geq 18$ GHz up to 20 GHz

Verdict: PASS

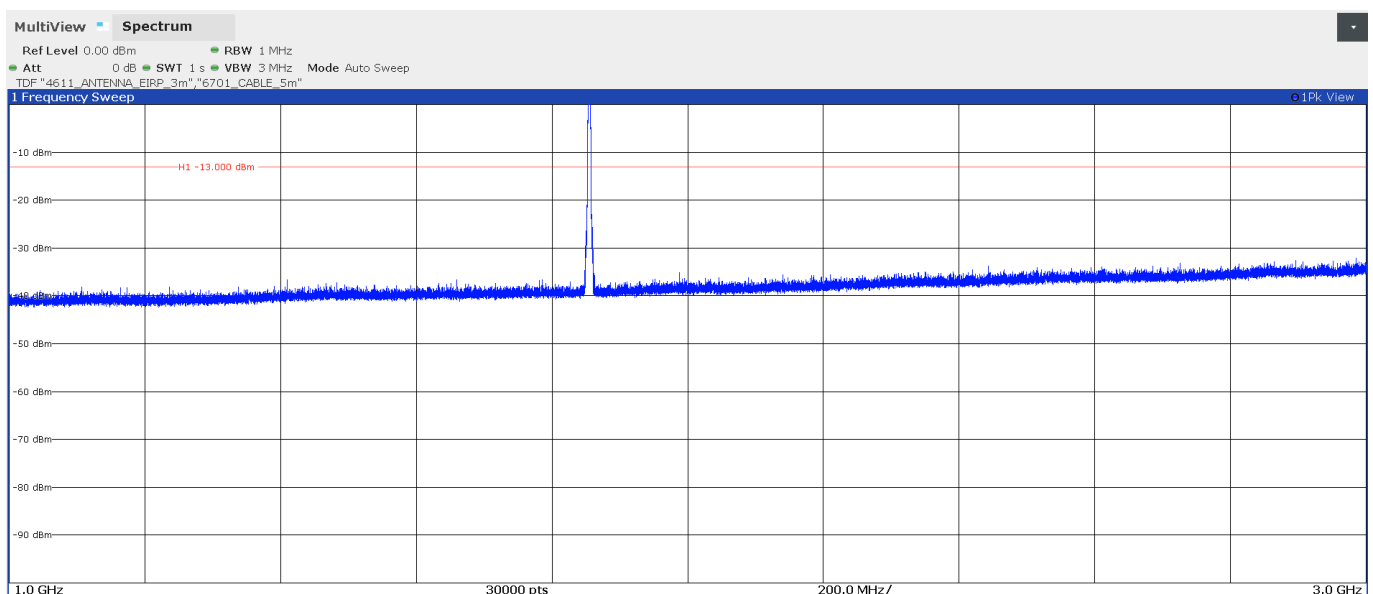
FREQUENCY RANGE 30 MHz - 1 GHz:

This plot is valid for the Low, Middle and High Channels:



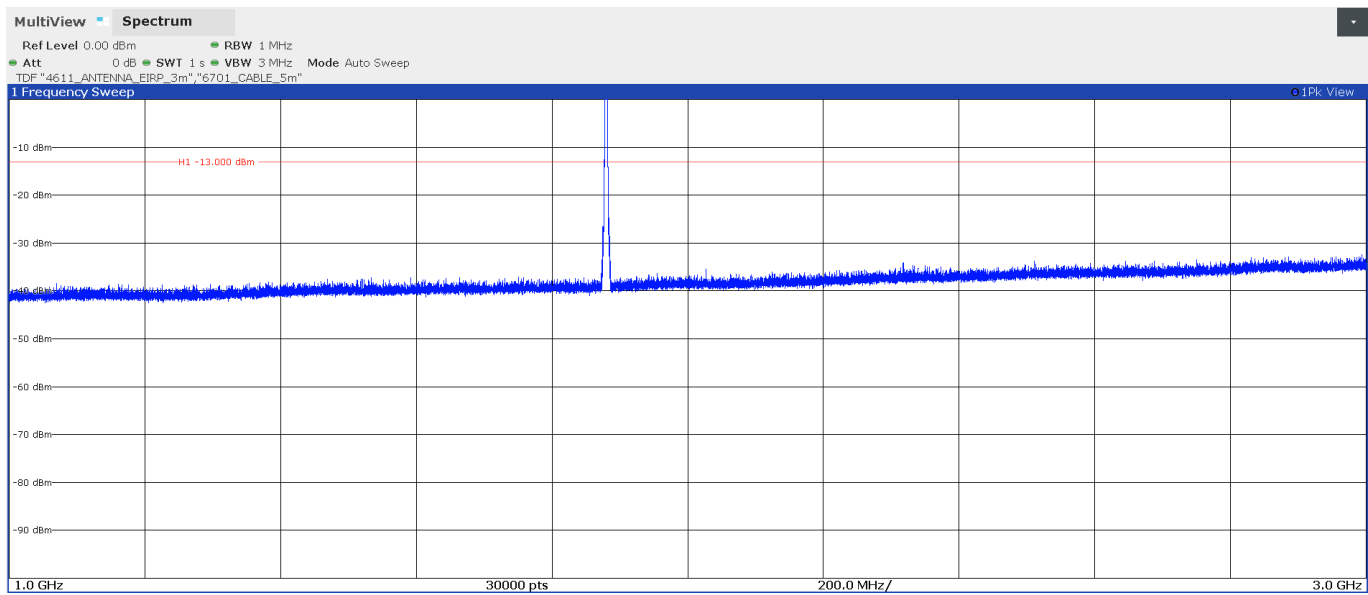
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



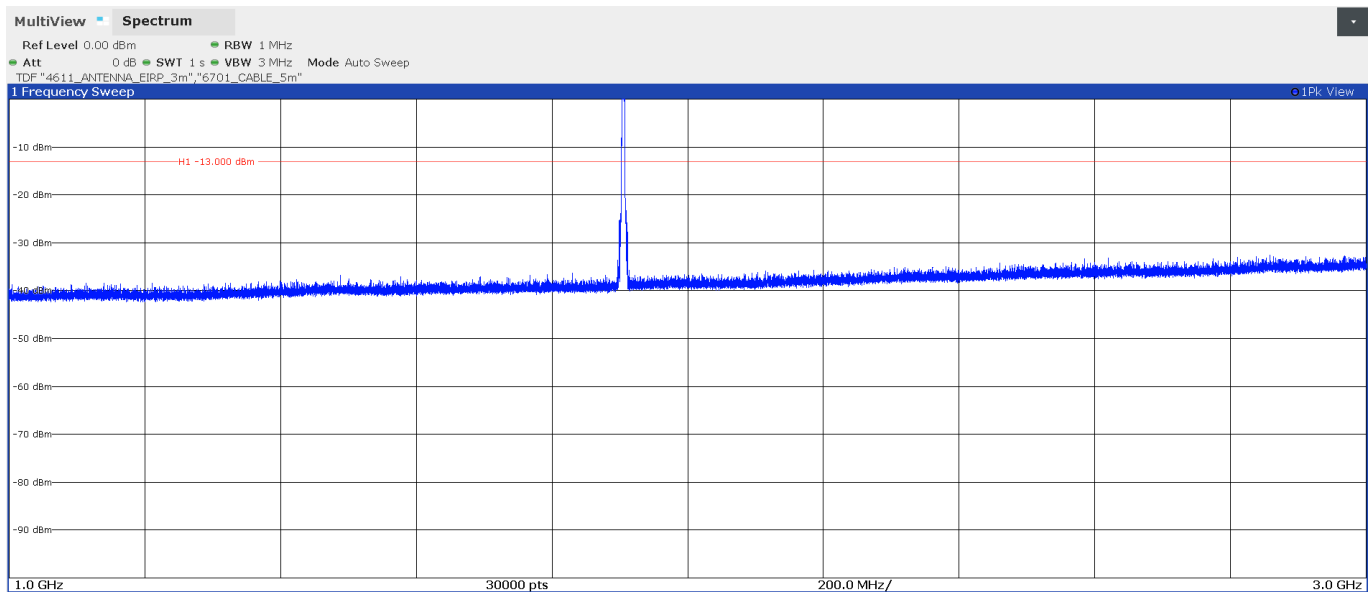
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

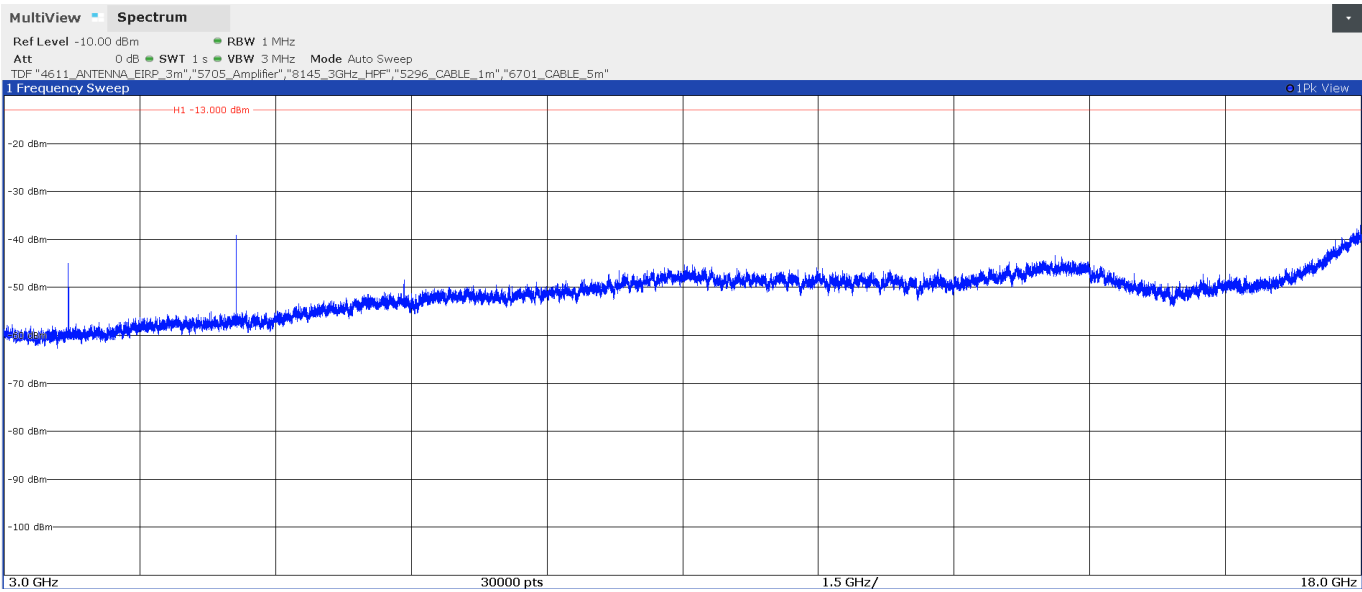
- High Channel:



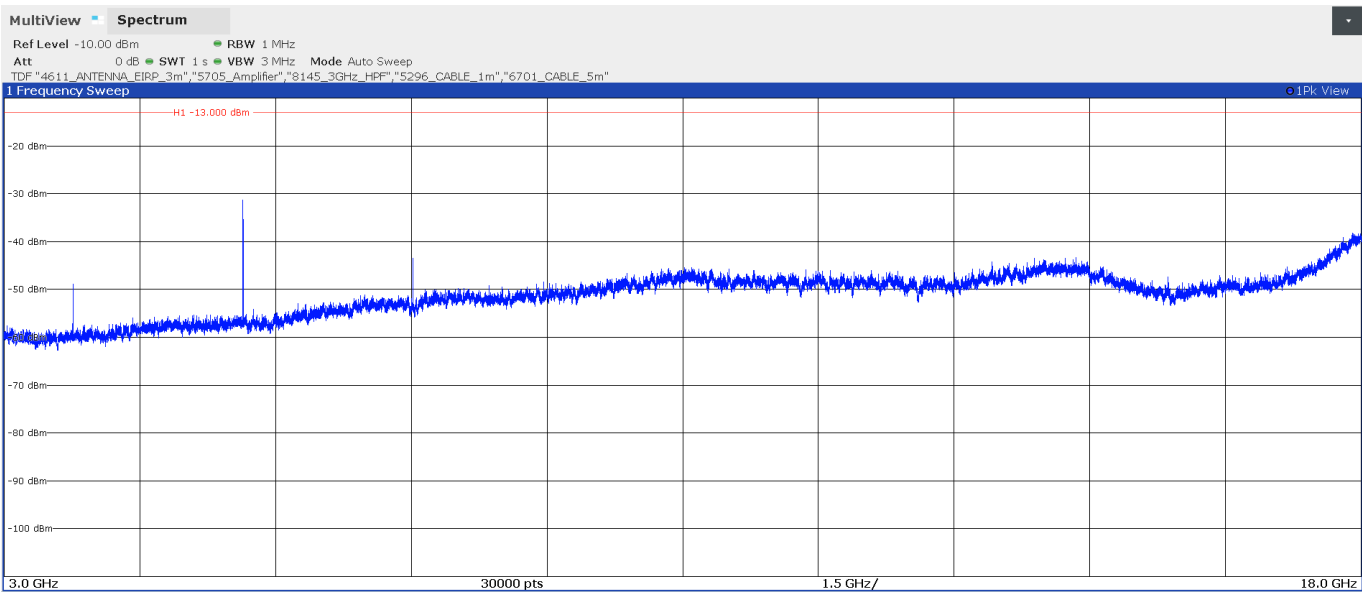
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 18 GHz

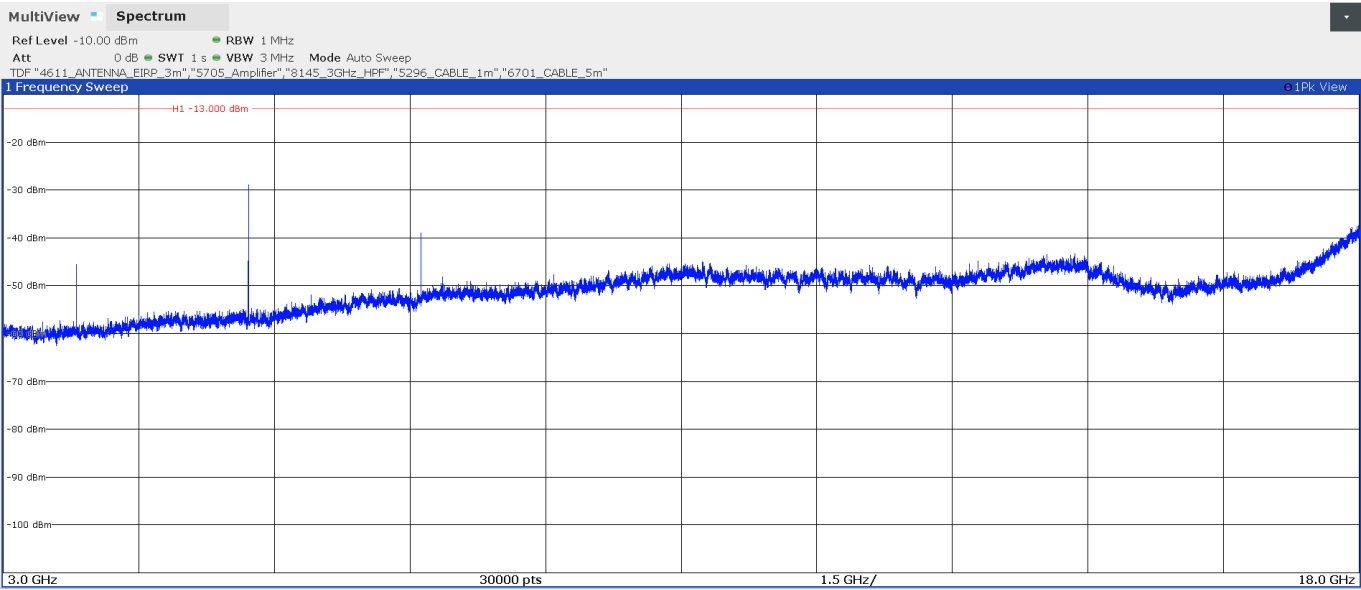
- Low Channel:



- Middle Channel:



- High Channel:



FREQUENCY RANGE 18 - 20 GHz

This plot is valid for the Low, Middle and High Channels:

