- **Frequency Stability over Voltage Variations.**

2G Band 1900 MHz. GPRS AND EDGE MODULATIONS.

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	13.8	-5.55	-0.002952128
Vmin	10.2	-6.78	-0.003606383

3G Band II. WCDMA AND HSUPA MODULATIONS.

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	13.8	0.04	0.000021276
Vmin	10.2	-2.21	-0.001175532

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

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	13.8	-0.3	-0.000159574
Vmin	10.2	-2.1	-0.001117021

2. Reference Frequency Points fL and fH:

The worst-case frequency offsets added or subtracted per band and bandwidth:

2G Band 1900 MHz:

	GPRS MODULATION
*f*L (MHz)	1850.0549920300
fH (MHz)	1909.9510047500

3G Band II:

	WCDMA MODULATION
*f*L (MHz)	1850.1279977900
fH (MHz)	1909.8713012900

LTE Band 2:

	LTE QPSK MODULATION. BW = 3 MHz
*f*L (MHz)	1850.0341952200
fH (MHz)	1909.9650009000

Measurement uncertainty (kHz)	<±11.17

The reference frequency points fL and fH stay within the authorized blocks for all the bands above.

Verdict: PASS

Modulation Characteristics

SPECIFICATION:

FCC §2.1047

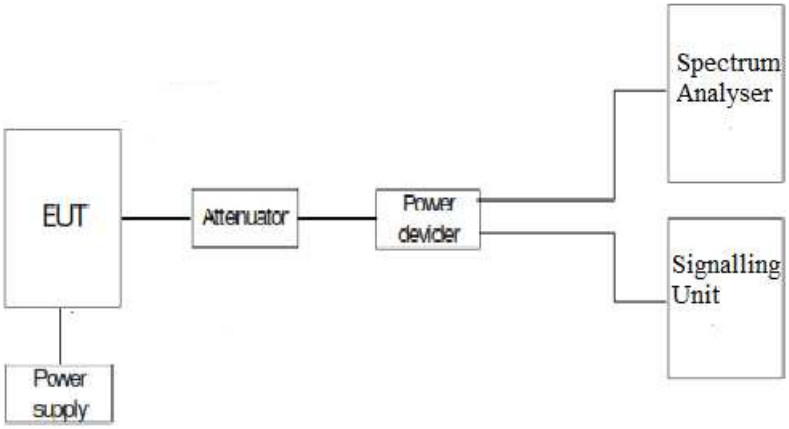
RSS-133. Clause 6.2. Equipment certified under this standard shall use digital modulation.

METHOD:

For 2G/3G, the EUT operates with GPRS (GMSK), EDGE (8PSK), WCDMA (QPSK) and HSUPA (QPSK) modulation modes, in which the information is digitized and coded into a bit stream.

For LTE the EUT operates with QPSK and 16QAM modulation modes in which the information is digitised and coded into a bit stream. The RF transmission is multiplexed using *Orthogonal Frequency Division Multiplexing (OFDM)* using different possible arrangement of subcarriers (Resource Blocks RB).

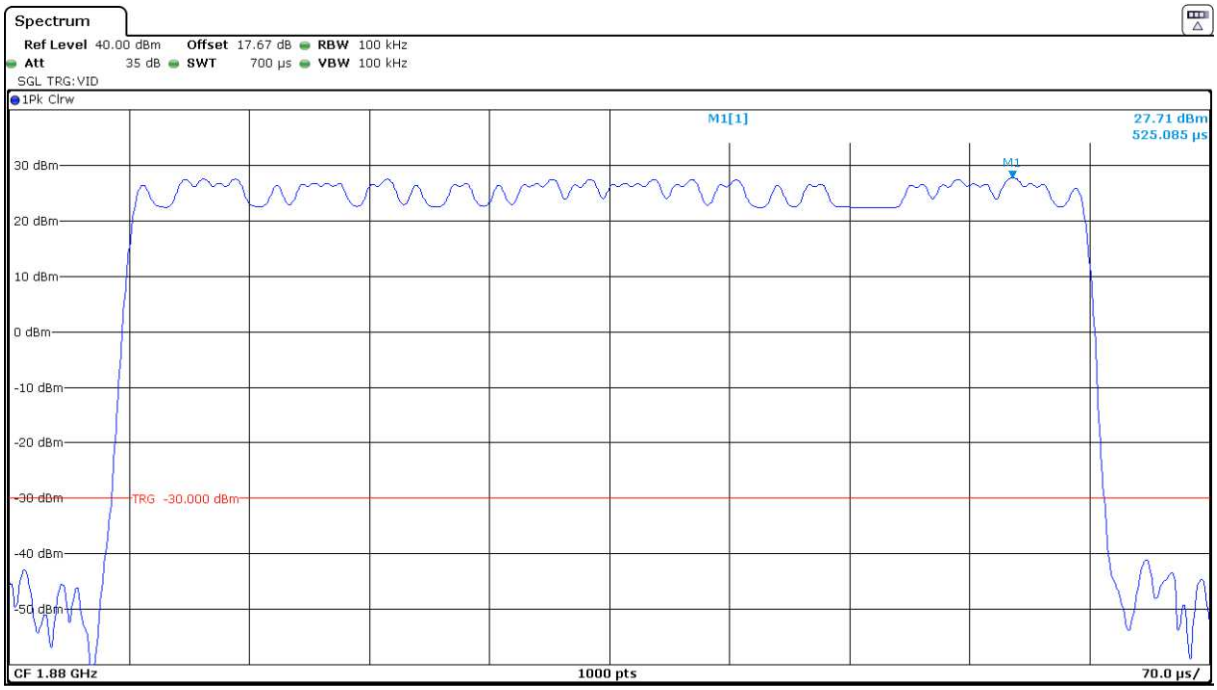
TEST SETUP:



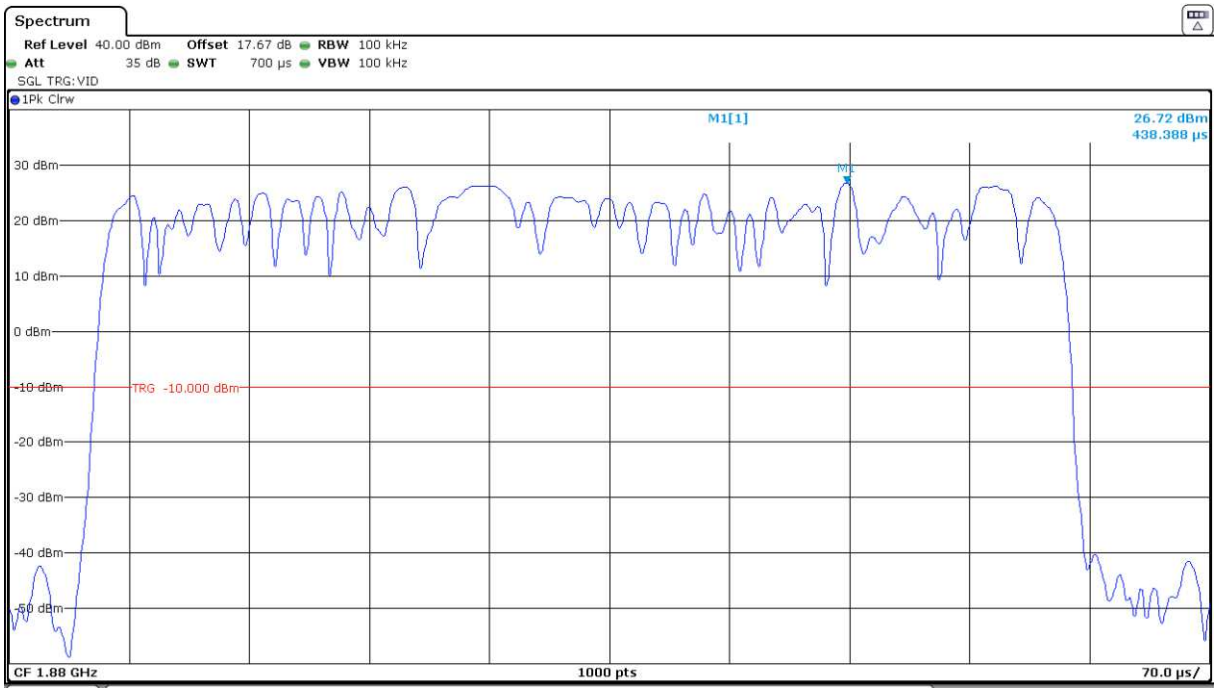
RESULTS:

The following plots show the modulation schemes in the EUT.

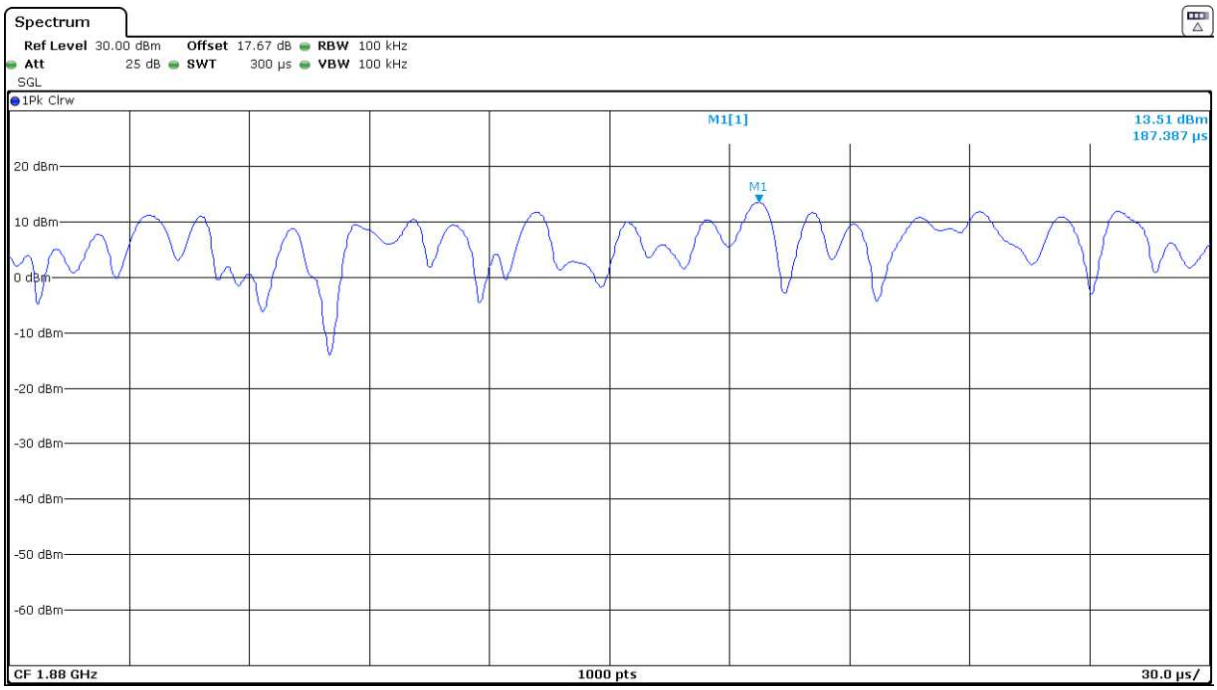
2G Band 1900 MHz. GPRS MODULATION.



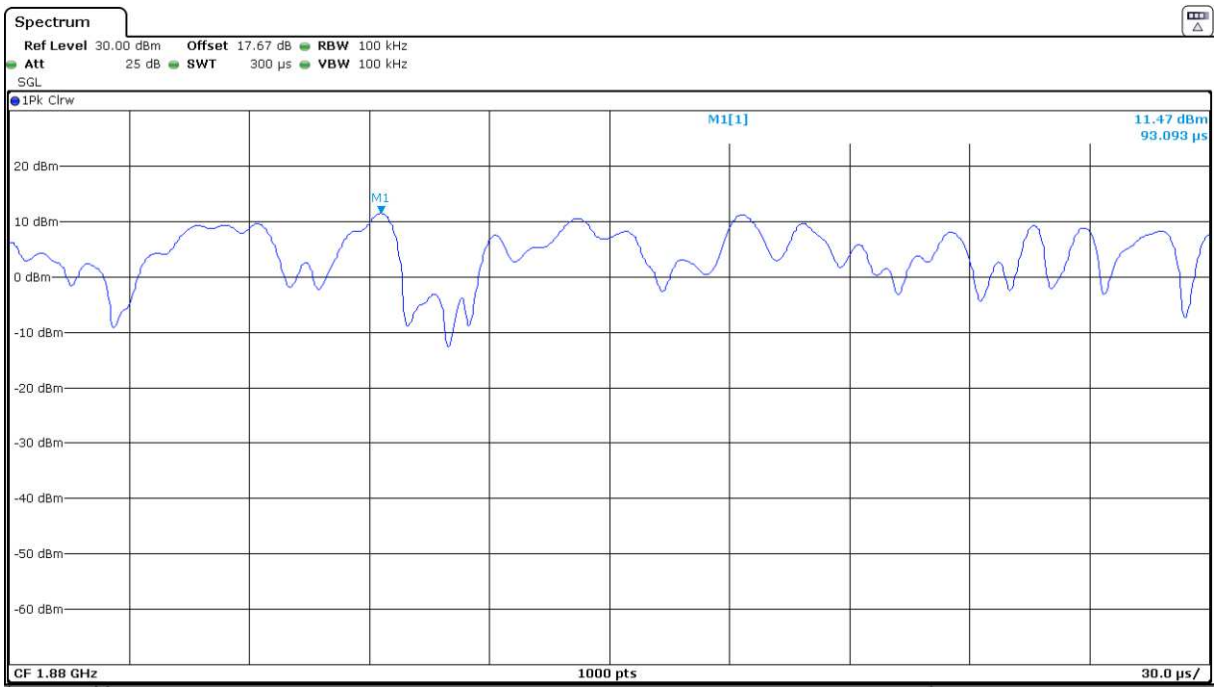
2G Band 1900 MHz. EDGE MODULATION.



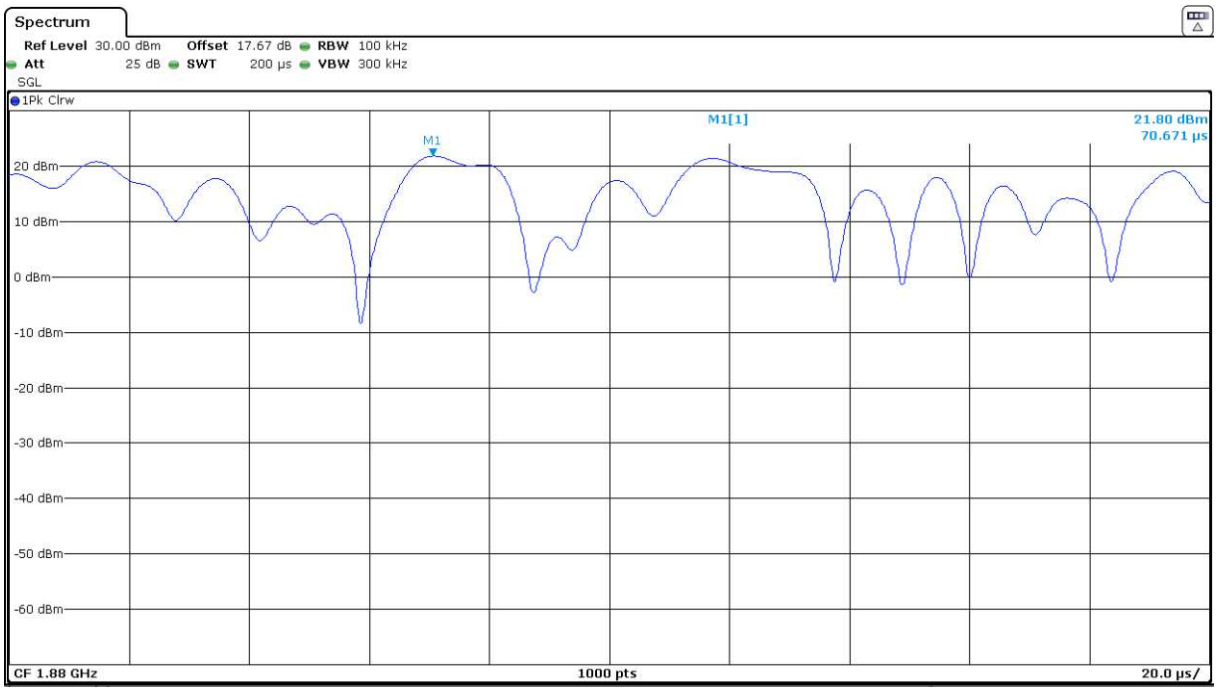
3G Band II. WCDMA MODULATION.



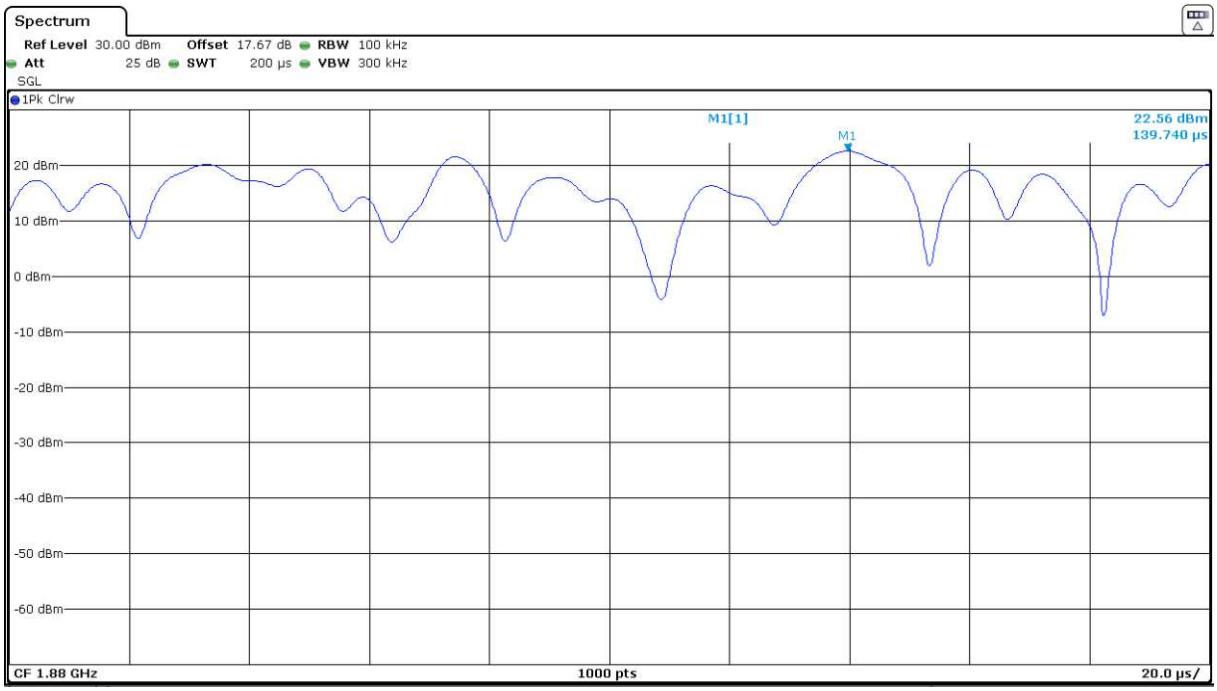
3G Band II. HSUPA MODULATION.



LTE Band 2 QPSK MODULATION. BW = 10 MHz.



LTE Band 2. 16QAM MODULATION. BW = 10 MHz.



Occupied Bandwidth

SPECIFICATION:

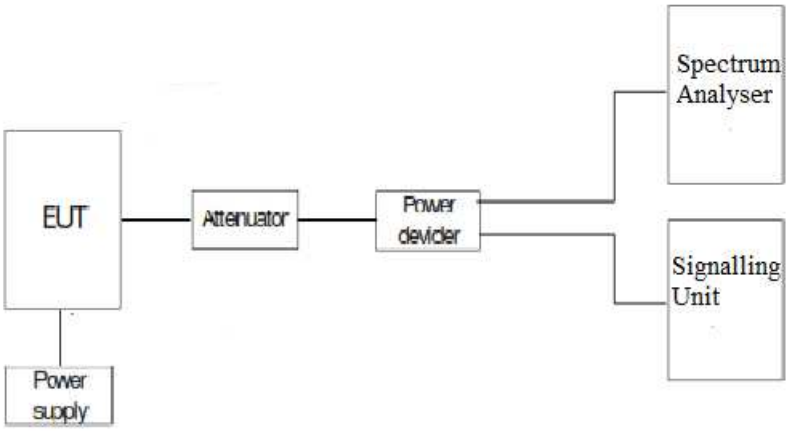
FCC §2.1049. Measurements required: Occupied bandwidth.

RSS-Gen Clause 6.7.

METHOD:

The occupied bandwidth measurement was performed at the output terminals of the EUT using an attenuator. power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The 99% occupied bandwidth and the -26 dBc bandwidth were measured directly using the built-in bandwidth measuring option of spectrum analyser.

TEST SETUP:



RESULTS:

2G Band 1900 MHz:

2G Band 1900 MHz. GPRS MODULATION.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	243	243	243
-26 dBc bandwidth (kHz)	309.19	301.70	310.54
Measurement uncertainty (kHz)	<±1.39		

2G Band 1900 MHz. EDGE MODULATION.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	240	240	240
-26 dBc bandwidth (kHz)	317.30	316.10	319.50
Measurement uncertainty (kHz)	<±1.39		

3G Band II:

3G Band II. WCDMA MODULATION.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4110	4110	4120
-26 dBc bandwidth (kHz)	4697.10	4695.80	4693
Measurement uncertainty (kHz)	<±11.58		

3G Band II. HSUPA MODULATION.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4160	4150	4150
-26 dBc bandwidth (kHz)	4757.70	4757.00	4752.80
Measurement uncertainty (kHz)	<±11.58		

LTE Bands: The worst case of Occupied Bandwidth corresponds to all Resource Blocks (RB) with Offset 0, regardless the nominal bandwidth selected.

LTE Band 2:

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	1.098	1.098	1.098
-26 dBc bandwidth (MHz)	1.320	1.316	1.311
Measurement uncertainty (kHz)	<±5.25		

LTE Band 2. 16QAM MODULATION. BW = 1.4 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	1.101	1.101	1.101
-26 dBc bandwidth (MHz)	1.326	1.322	1.326
Measurement uncertainty (kHz)	<±5.25		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	2.736	2.754	2.742
-26 dBc bandwidth (MHz)	3.058	3.082	3.063
Measurement uncertainty (kHz)	<±15.03		

LTE Band 2. 16QAM MODULATION. BW = 3 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	2.742	2.736	2.742
-26 dBc bandwidth (MHz)	3.070	3.064	3.075
Measurement uncertainty (kHz)	<±15.03		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	4.51	4.53	4.51
-26 dBc bandwidth (MHz)	5.024	5.035	4.993
Measurement uncertainty (kHz)	<±17.34		

LTE Band 2. 16QAM MODULATION. BW = 5 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	4.52	4.51	4.51
-26 dBc bandwidth (MHz)	4.994	5.025	5.003
Measurement uncertainty (kHz)	<±17.34		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	9.06	9.06	9.04
-26 dBc bandwidth (MHz)	10.198	10.068	10.167
Measurement uncertainty (kHz)	<±46.21		

LTE Band 2. 16QAM MODULATION. BW = 10 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	9.04	9.04	9.04
-26 dBc bandwidth (MHz)	10.098	10.125	10.047
Measurement uncertainty (kHz)	<±46.21		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	13.50	13.47	13.50
-26 dBc bandwidth (MHz)	14.876	14.724	14.850
Measurement uncertainty (kHz)	<±51.99		

LTE Band 2. 16QAM MODULATION. BW = 15 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	13.47	13.47	13.47
-26 dBc bandwidth (MHz)	14.756	14.814	14.850
Measurement uncertainty (kHz)	<±51.99		

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

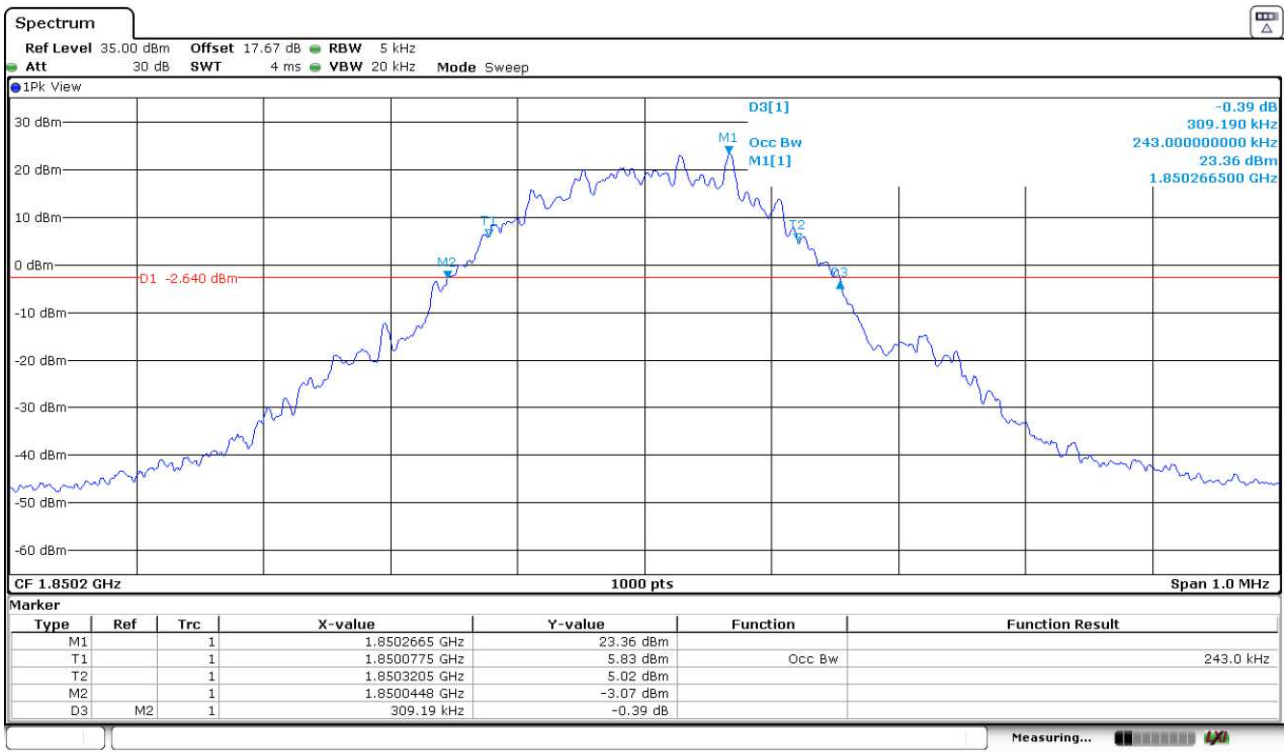
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	17.88	17.88	17.88
-26 dBc bandwidth (MHz)	19.354	19.425	19.402
Measurement uncertainty (kHz)	<±57.76		

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

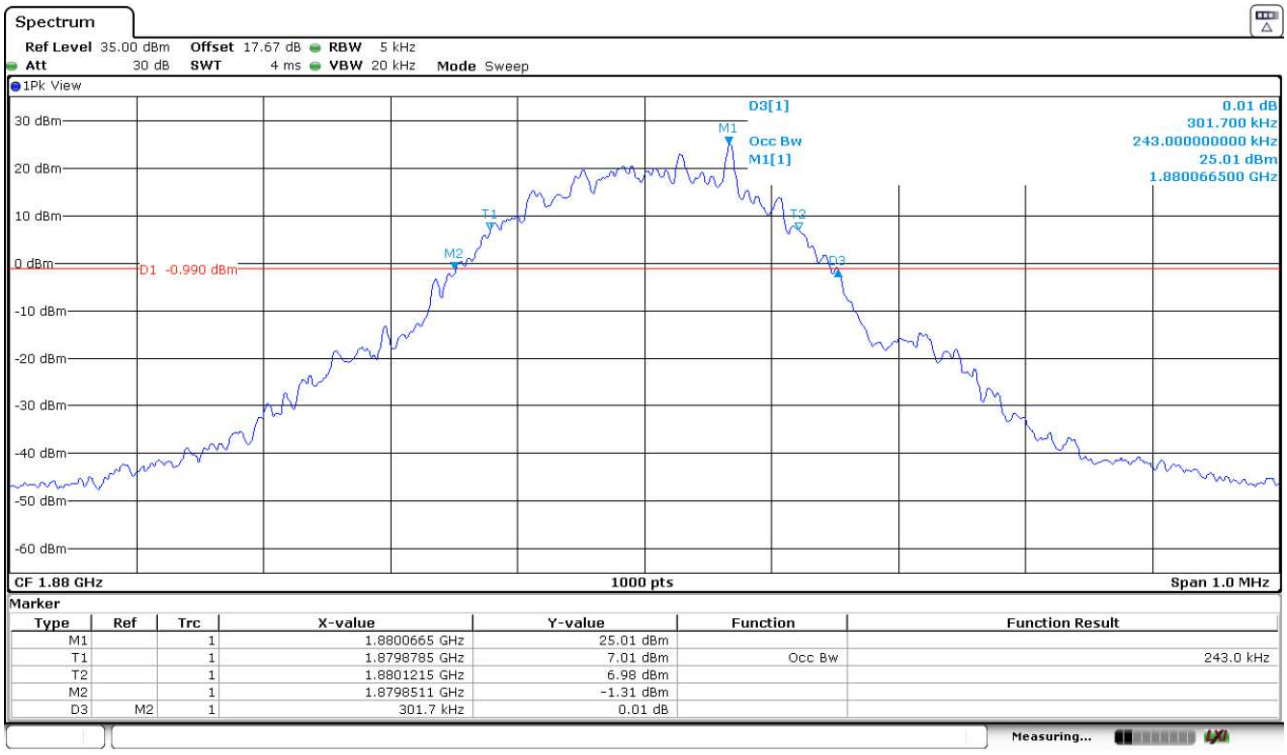
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	17.92	17.84	17.92
-26 dBc bandwidth (MHz)	19.514	19.385	19.562
Measurement uncertainty (kHz)	<±57.76		

2G Band 1900 MHz. GPRS MODULATION.

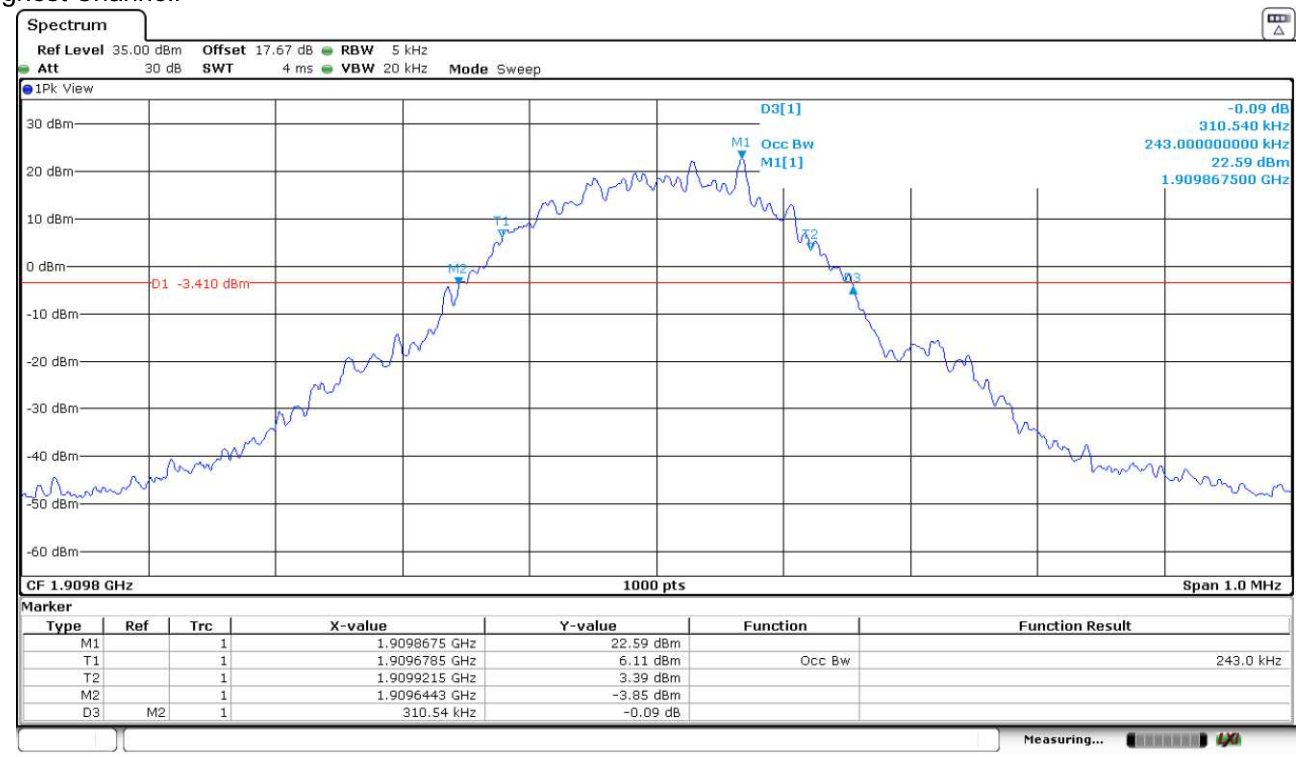
Lowest Channel:



Middle Channel:

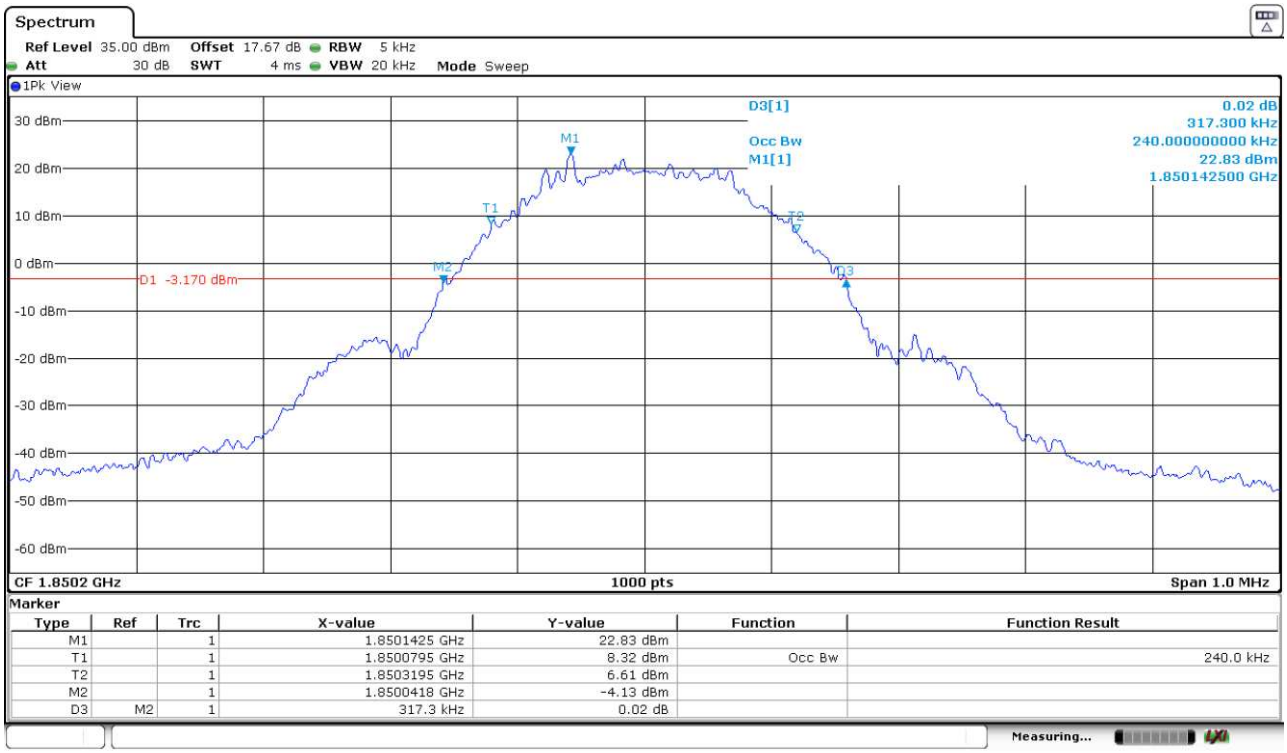


Highest Channel:

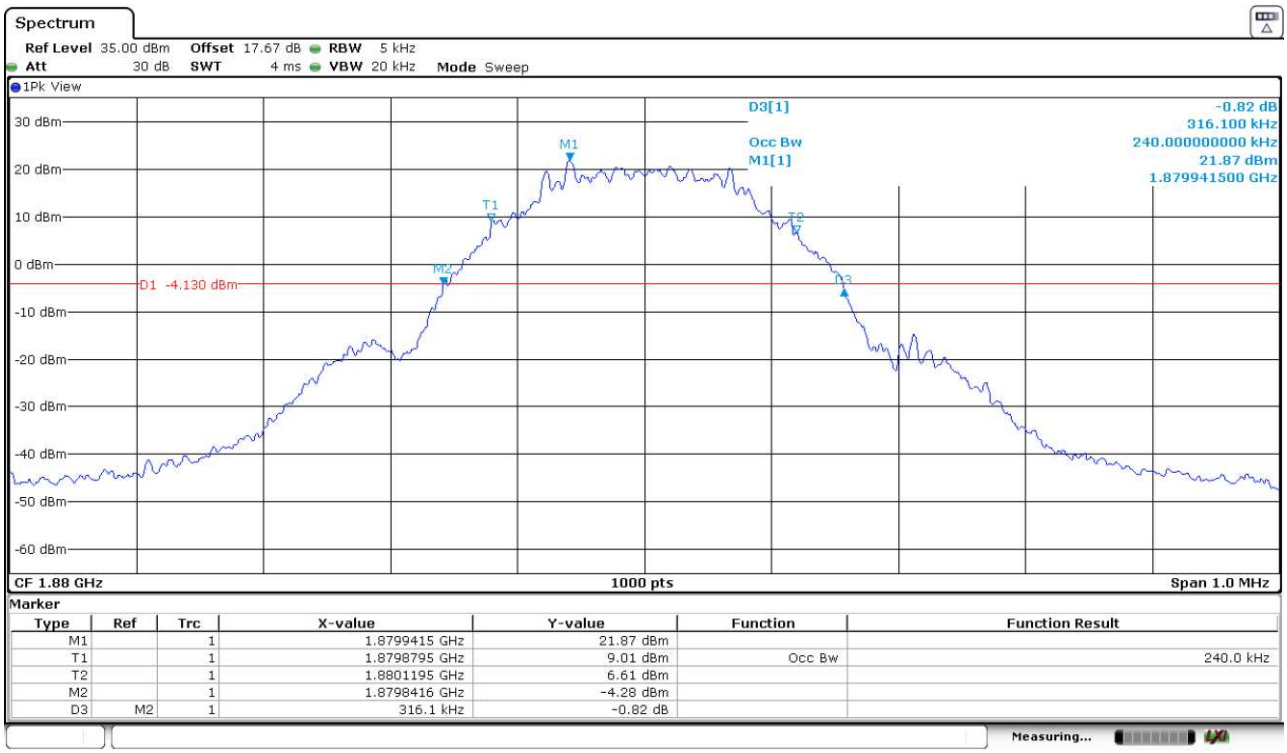


2G Band 1900 MHz. EDGE MODULATION.

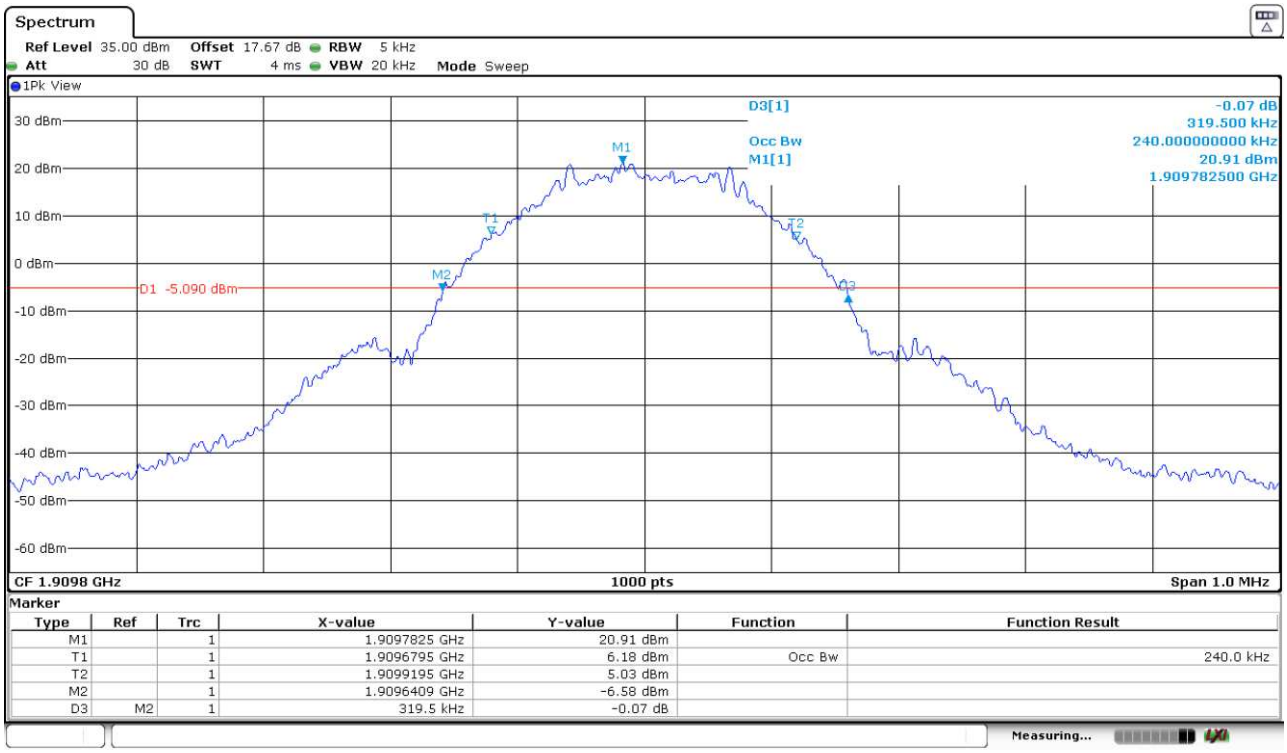
Lowest Channel:



Middle Channel:

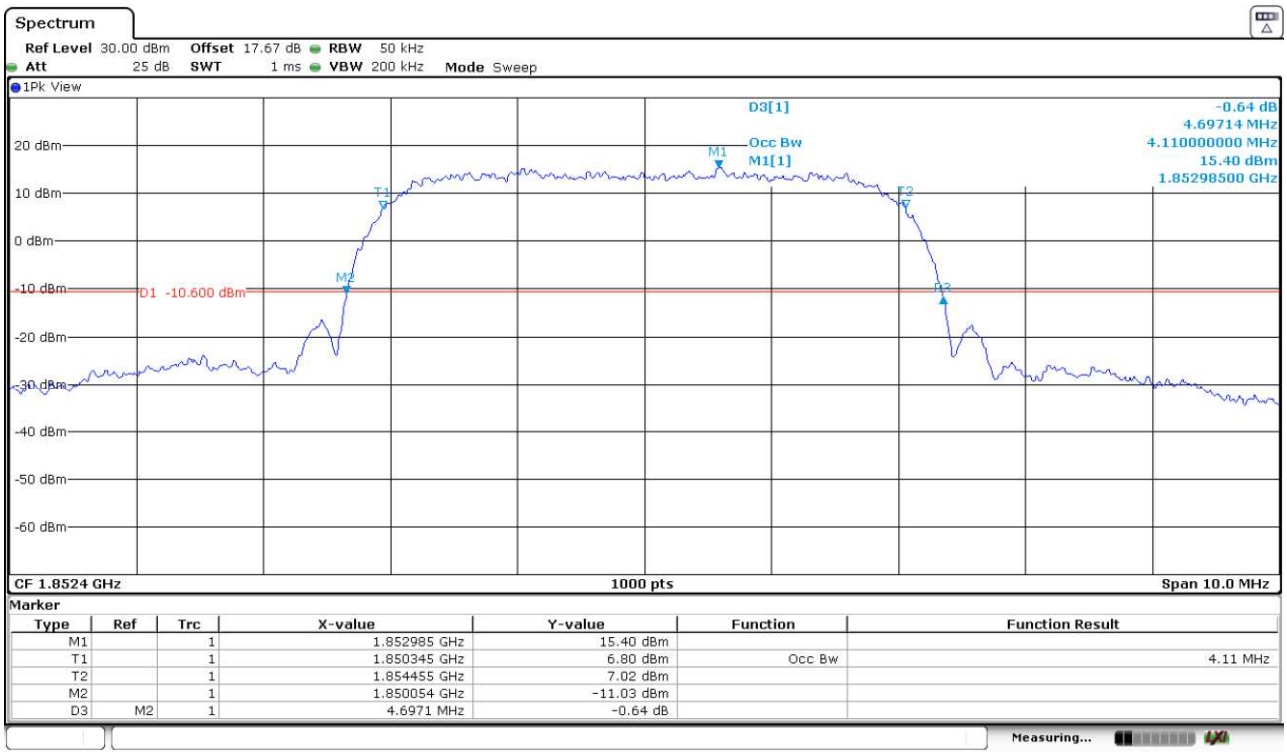


Highest Channel:

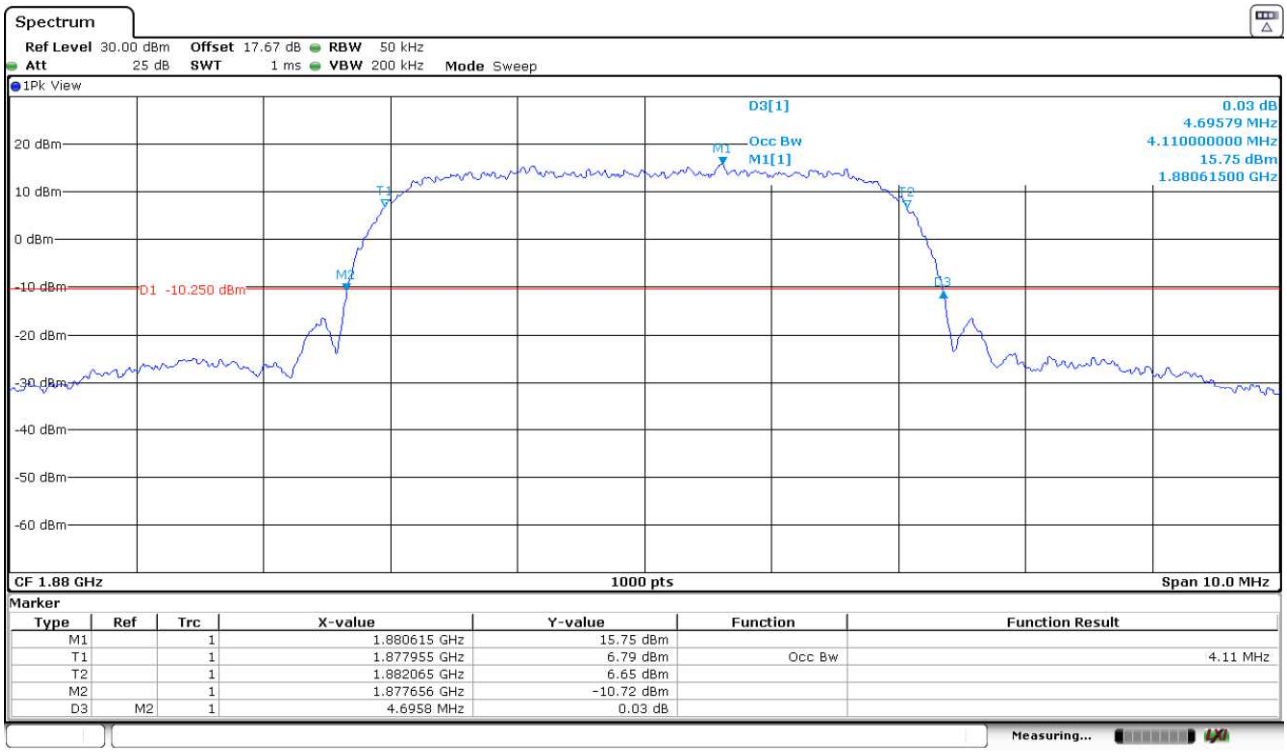


3G Band II. WCDMA MODULATION.

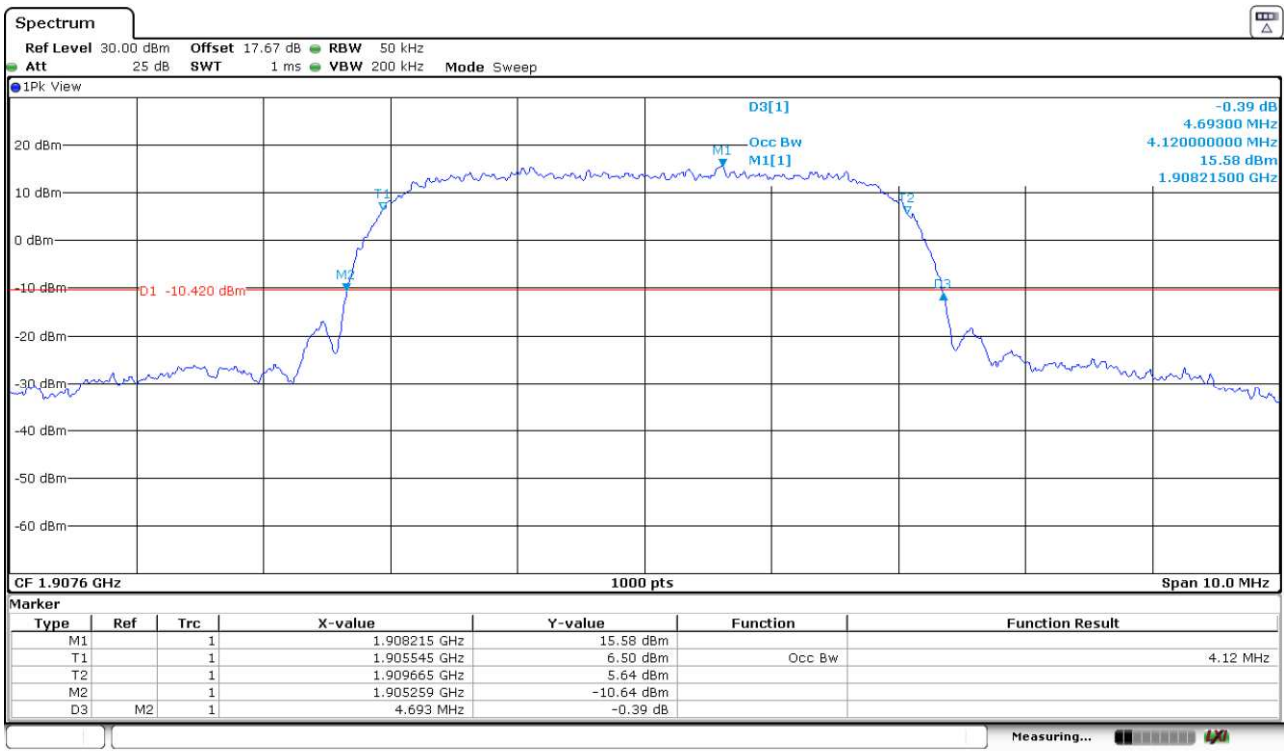
Lowest Channel:



Middle Channel:

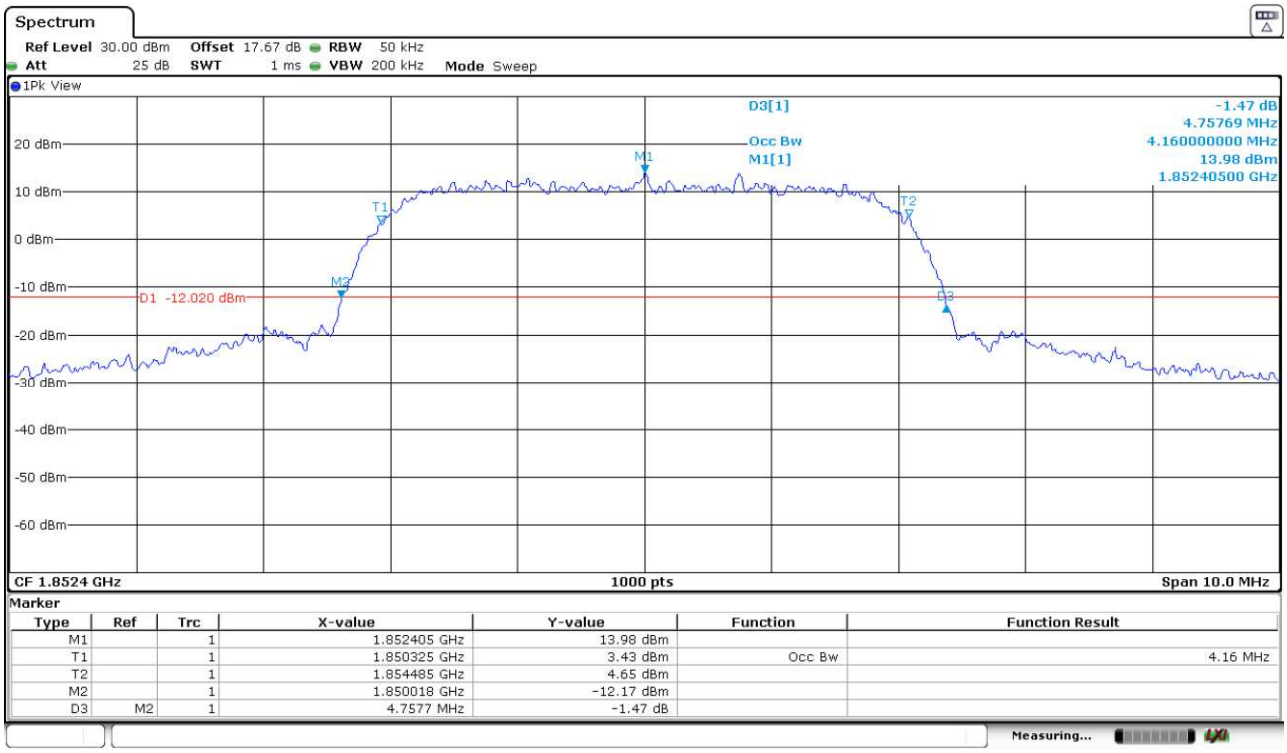


Highest Channel:

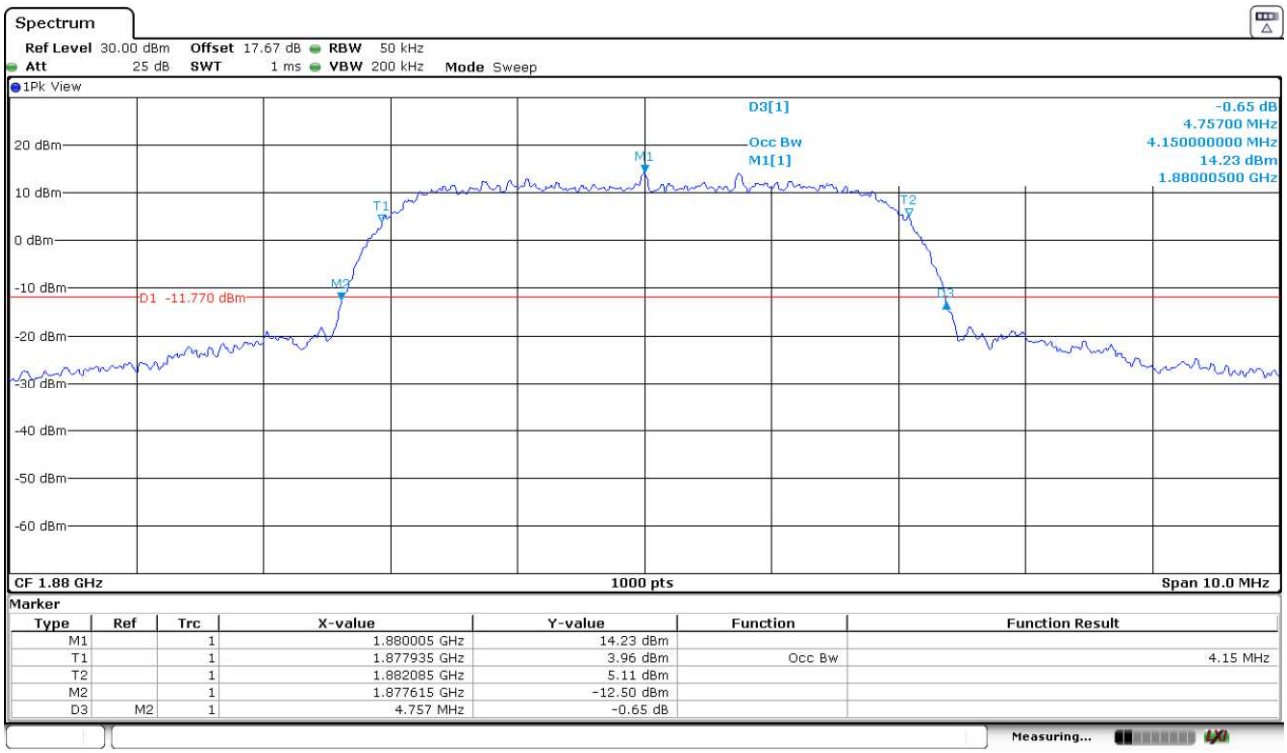


3G Band II. HSUPA MODULATION.

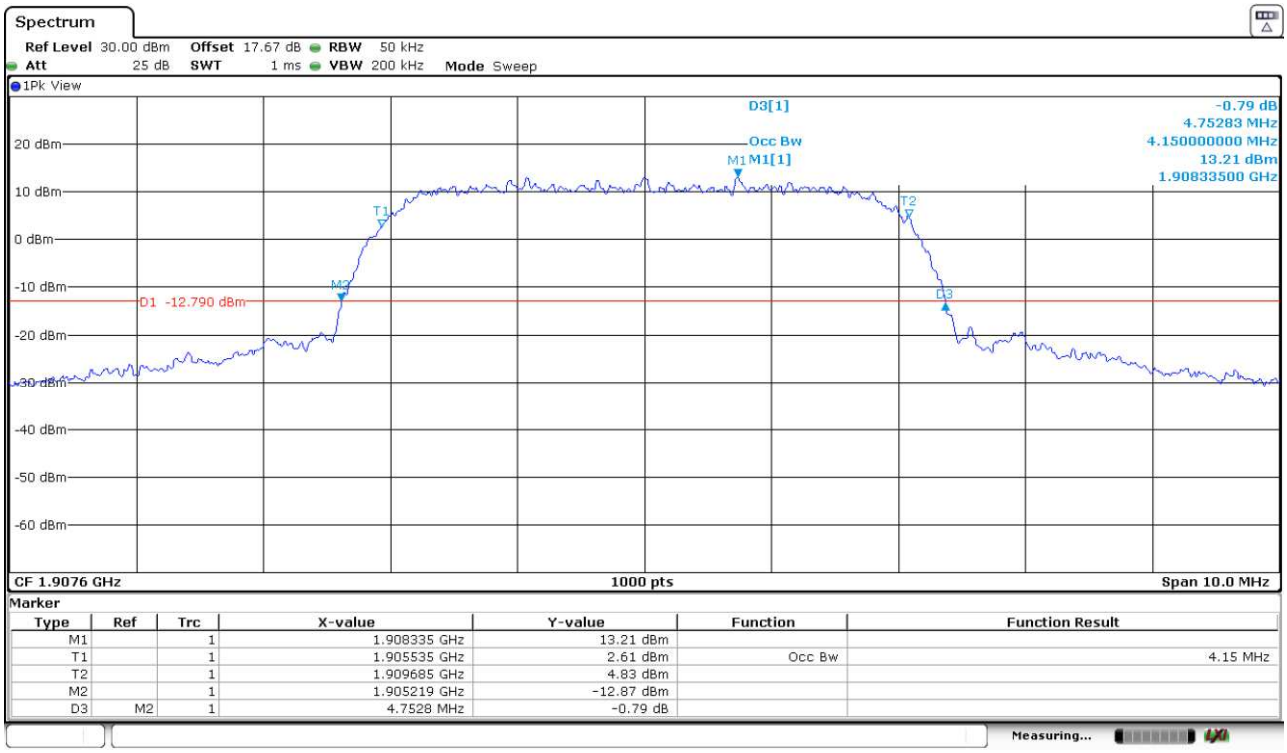
Lowest Channel:



Middle Channel:

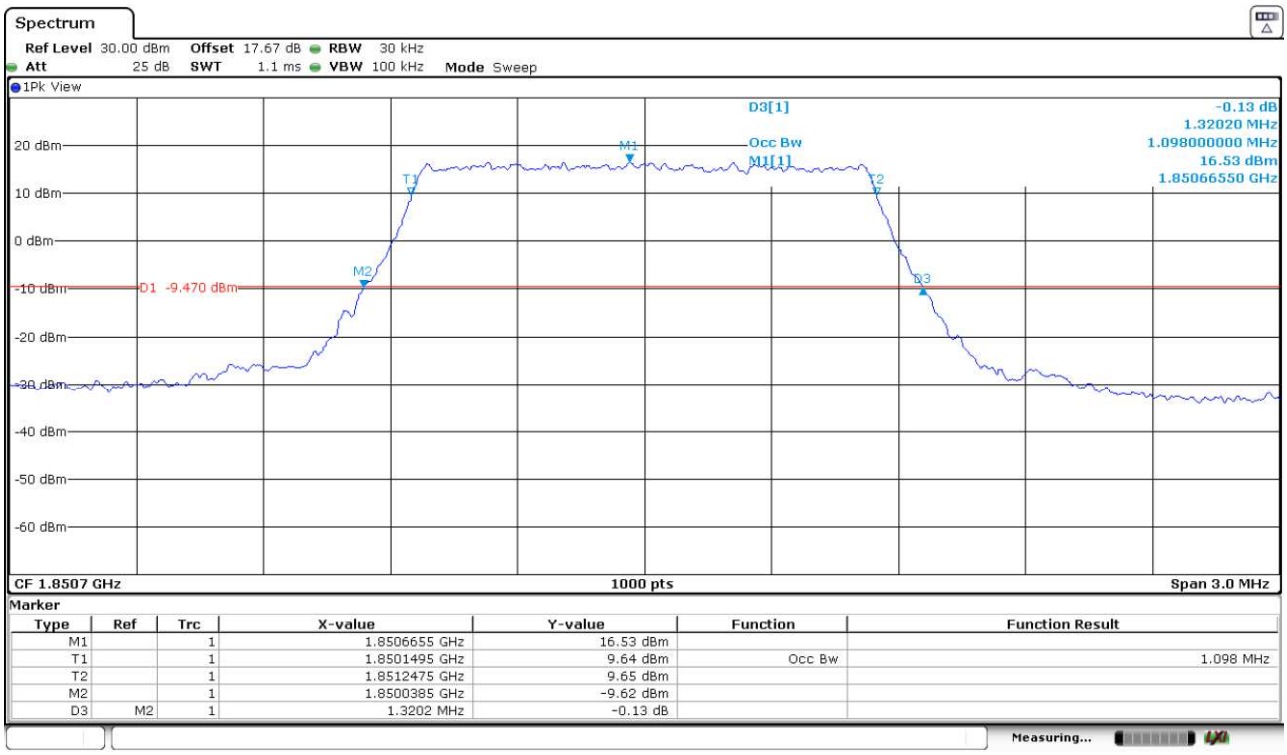


Highest Channel:

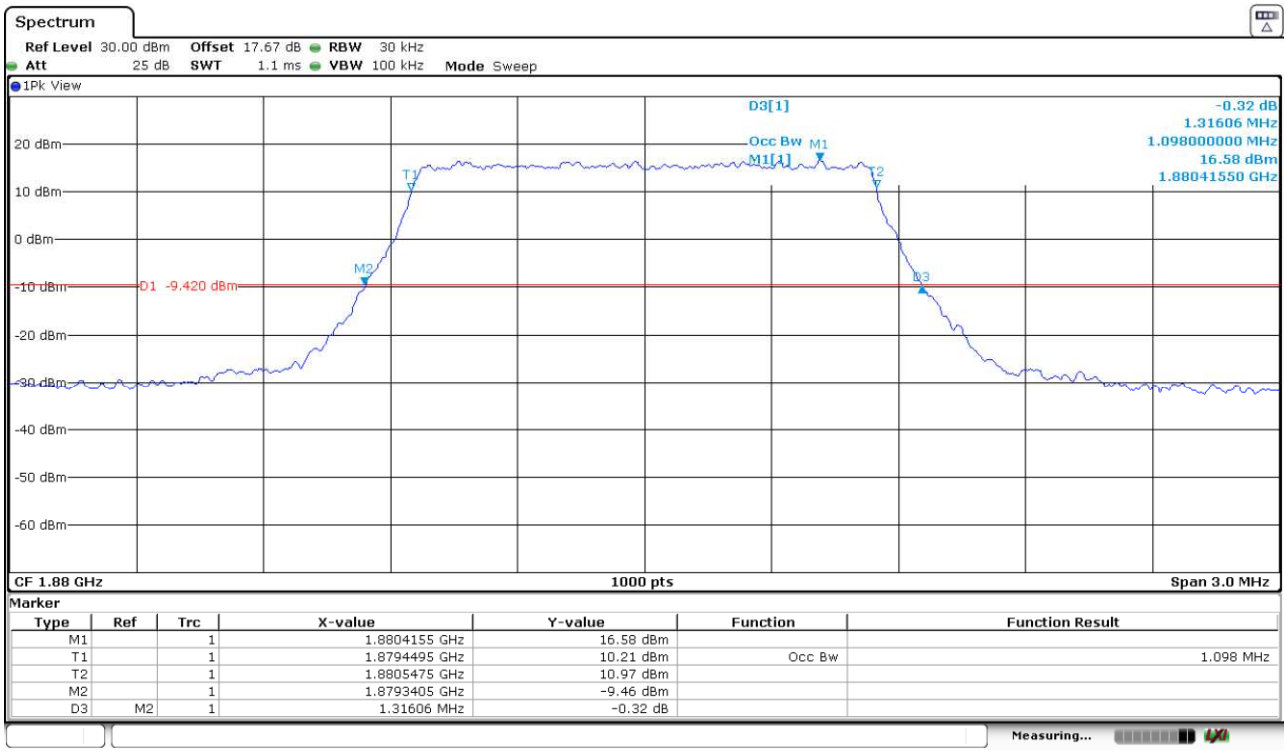


LTE Band 2. QPSK MODULATION. BW = 1.4 MHz.

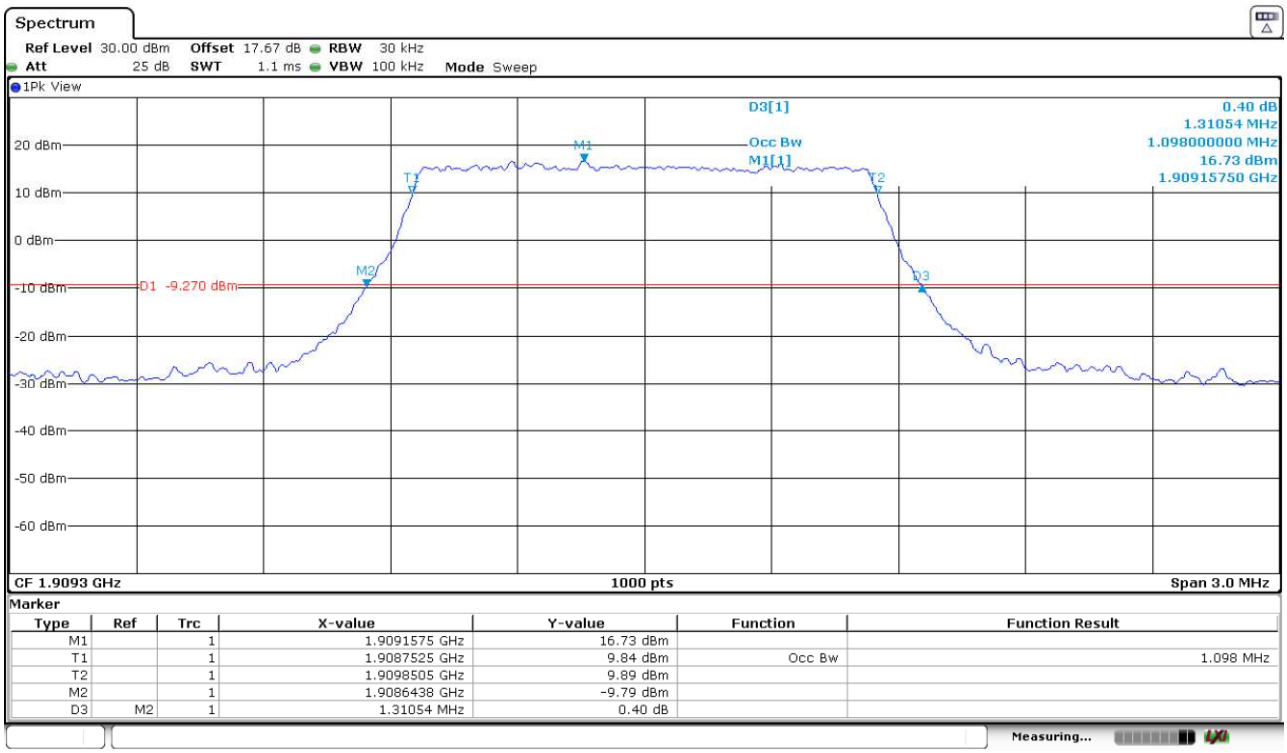
Lowest Channel:



Middle Channel:

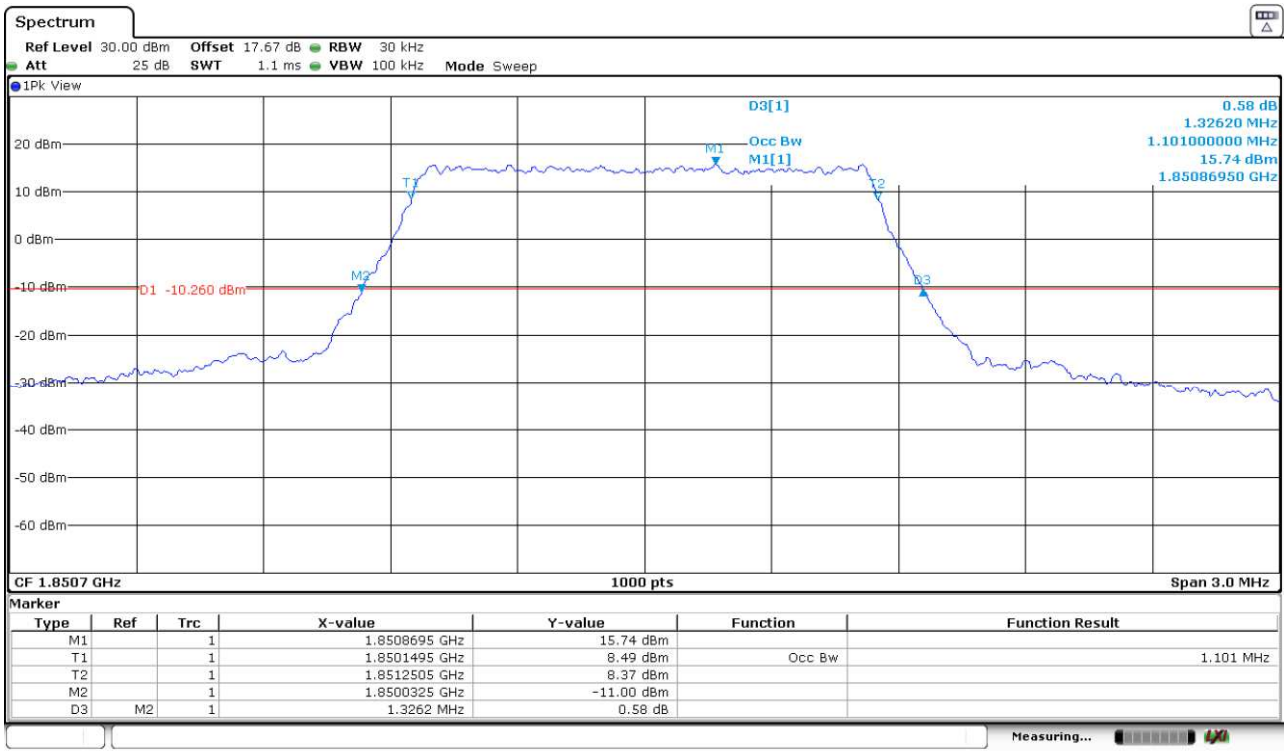


Highest Channel:

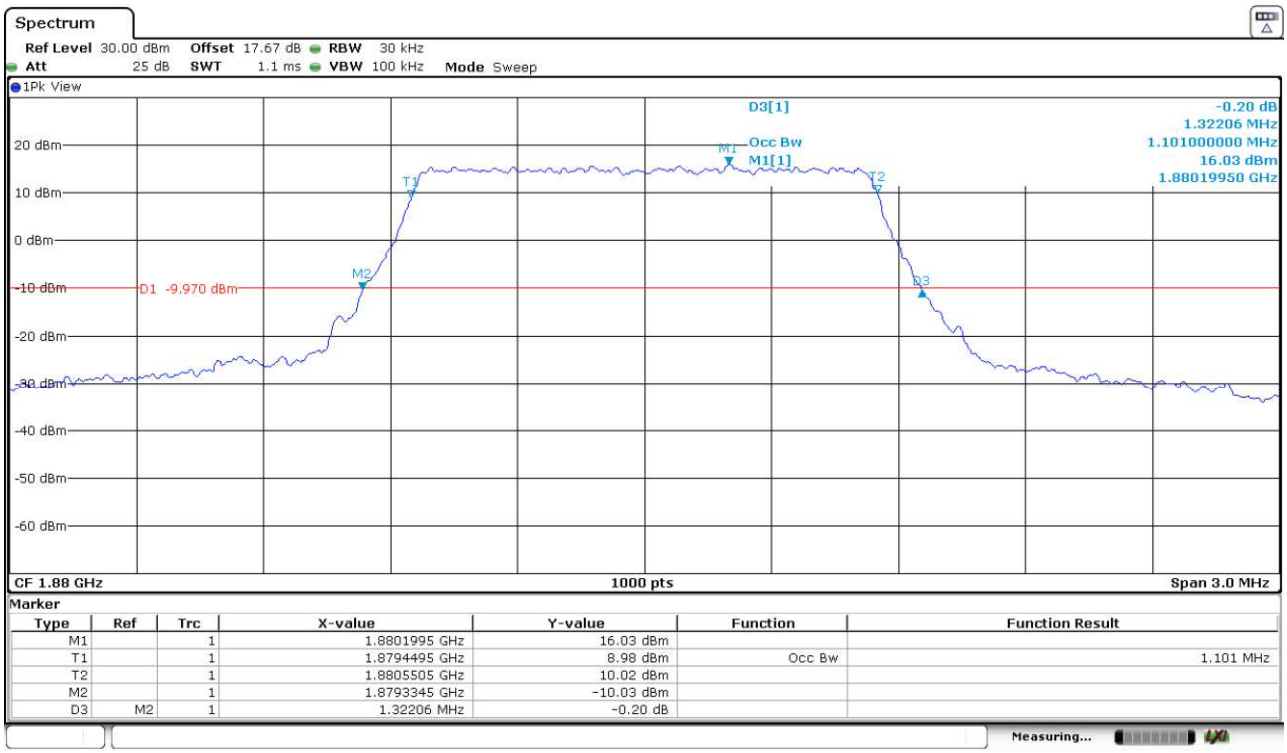


LTE Band 2. 16QAM MODULATION. BW = 1.4 MHz.

Lowest Channel:



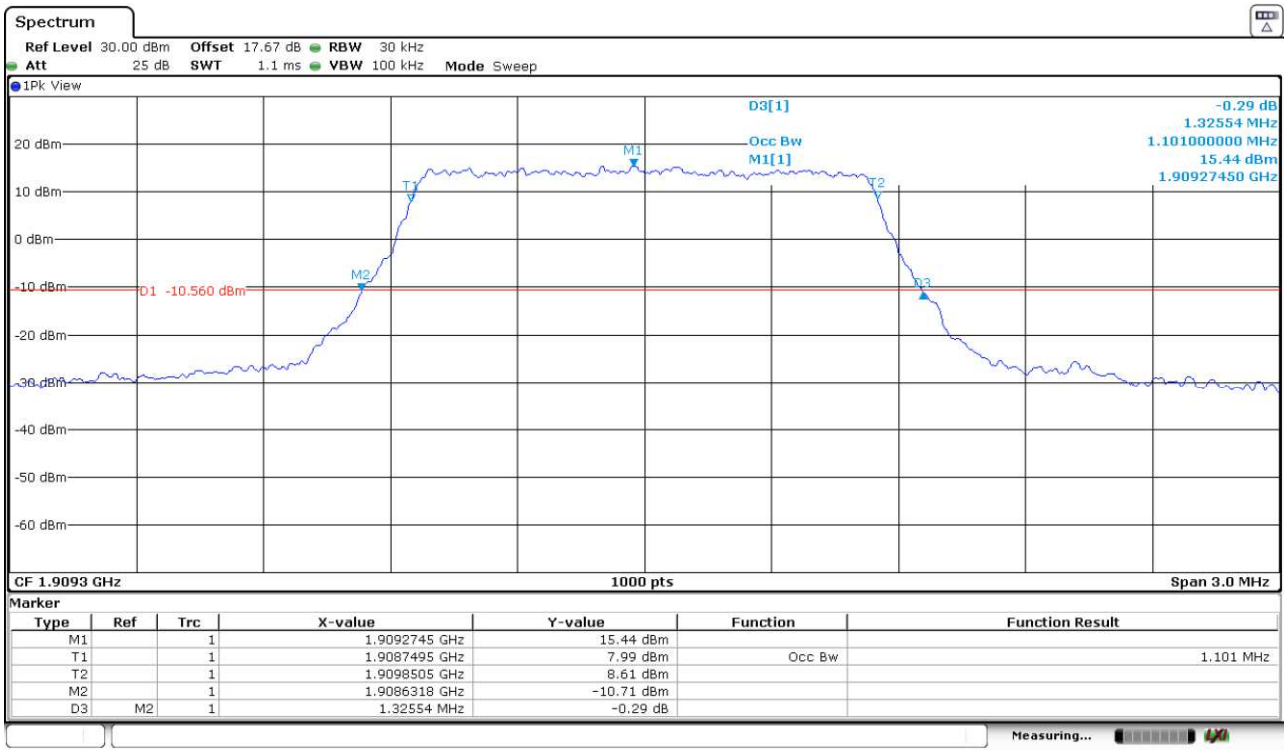
Middle Channel:



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.8801995 GHz	16.03 dBm		
T1		1	1.8794495 GHz	8.98 dBm	Occ Bw	1.101 MHz
T2		1	1.8805505 GHz	10.02 dBm		
M2		1	1.8793345 GHz	-10.03 dBm		
D3	M2	1	1.32206 MHz	-0.20 dB		

Highest Channel:

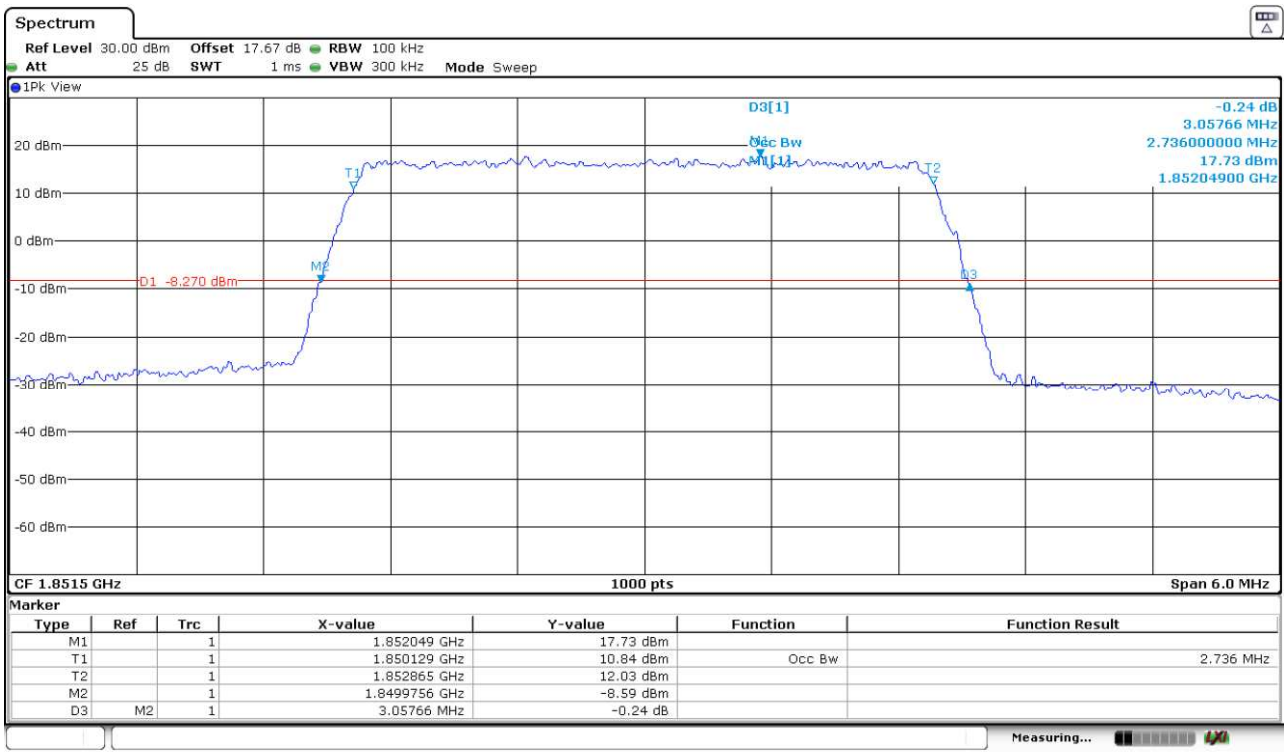


Marker

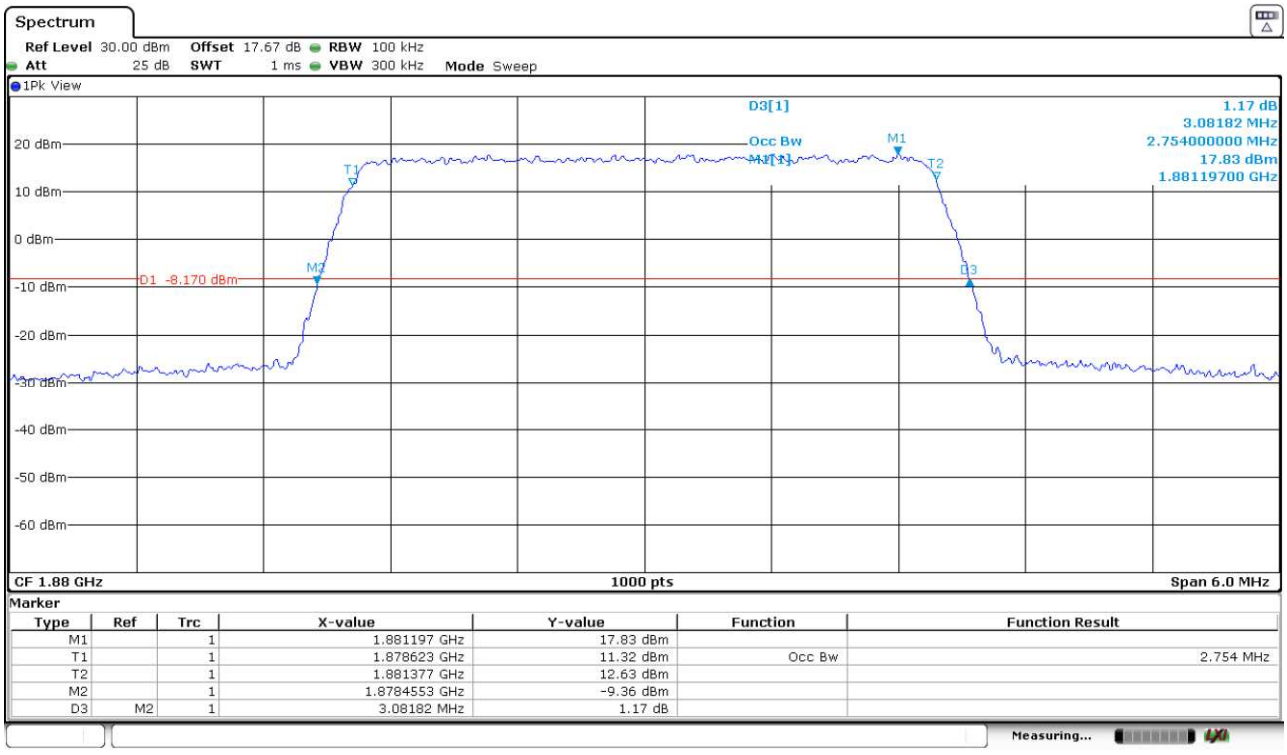
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.9092745 GHz	15.44 dBm		
T1		1	1.9087495 GHz	7.99 dBm	Occ Bw	1.101 MHz
T2		1	1.9098505 GHz	8.61 dBm		
M2		1	1.9086318 GHz	-10.71 dBm		
D3	M2	1	1.32554 MHz	-0.29 dB		

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

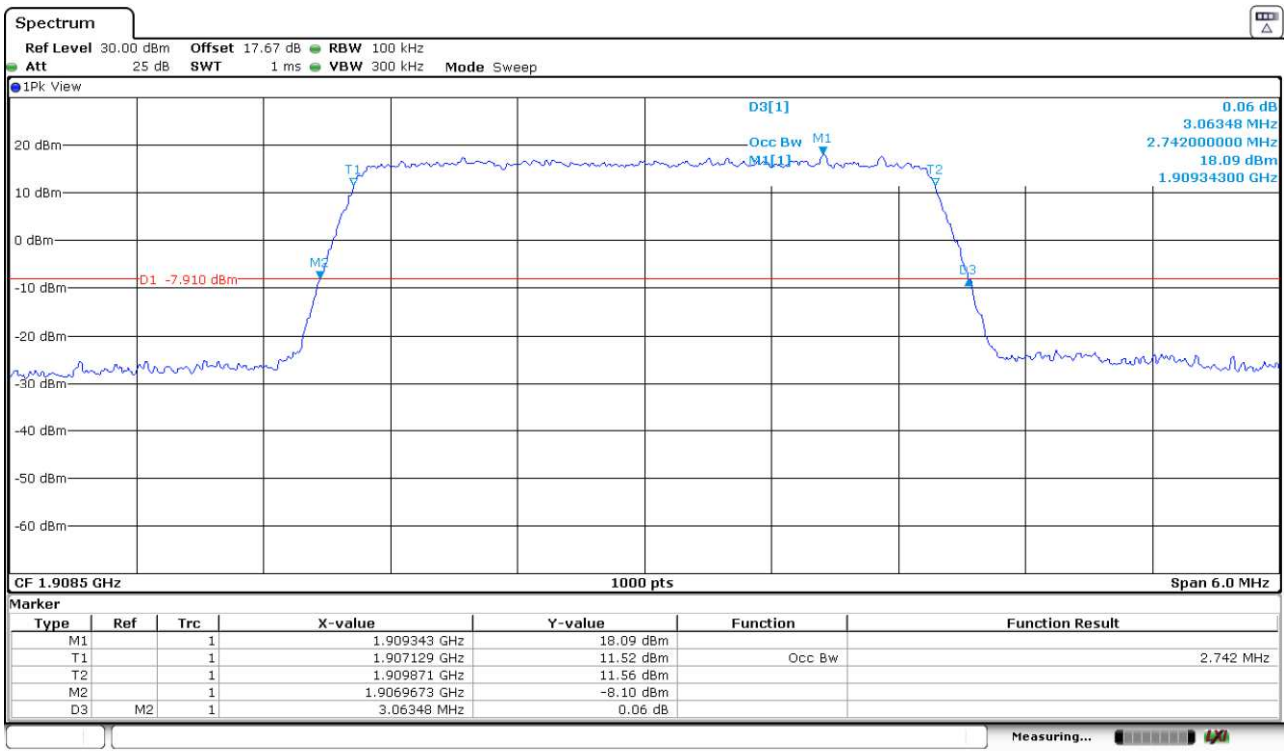
Lowest Channel:



Middle Channel:

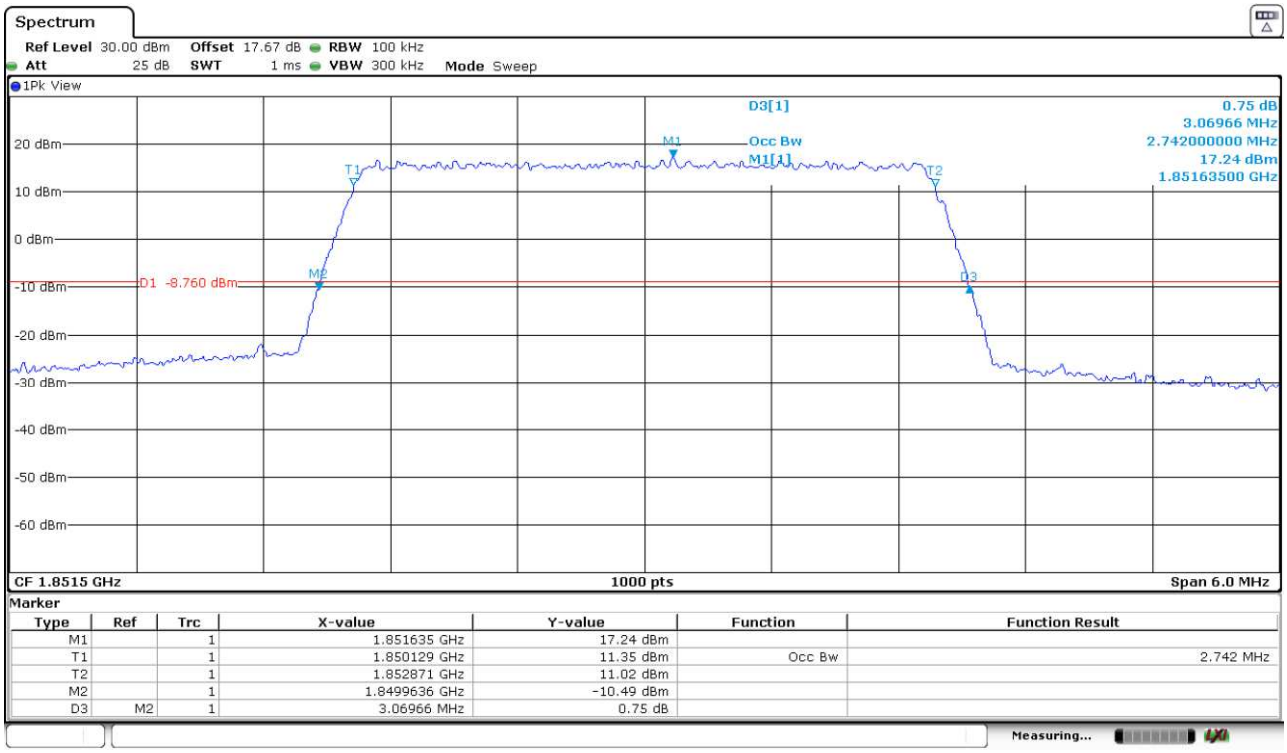


Highest Channel:

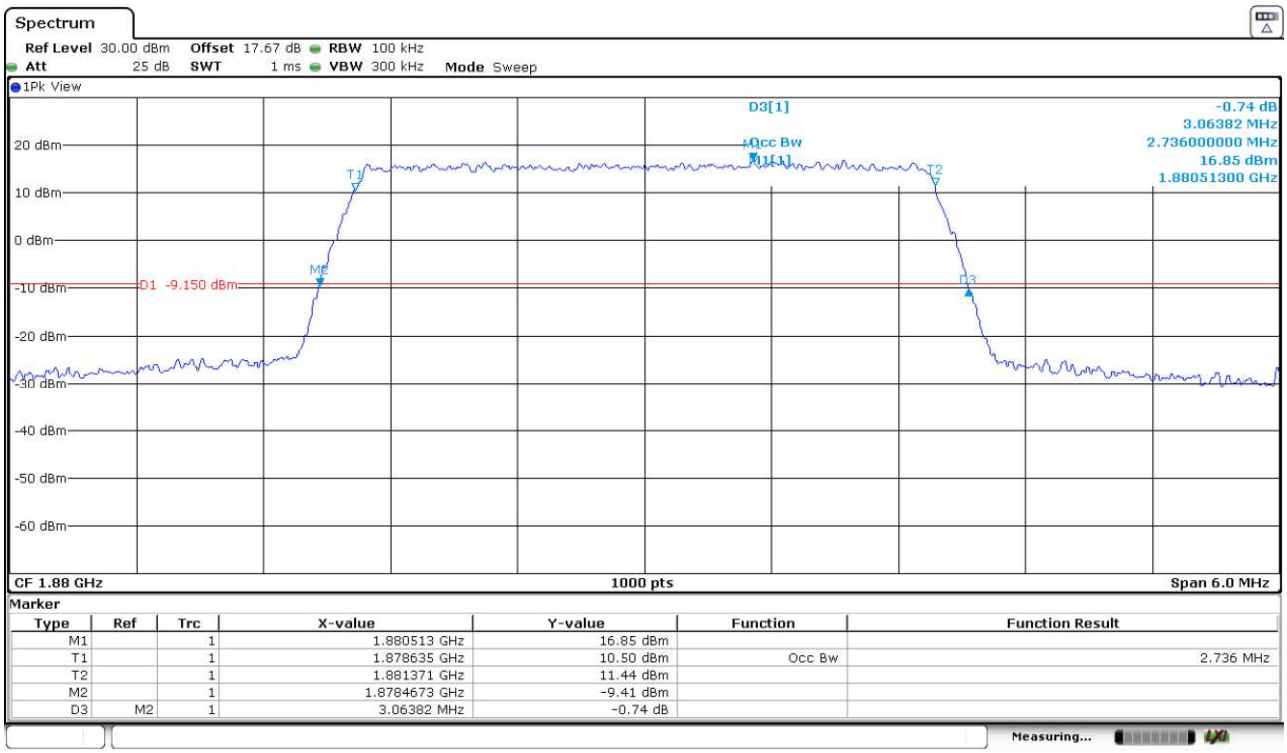


LTE Band 2. 16QAM MODULATION. BW = 3 MHz.

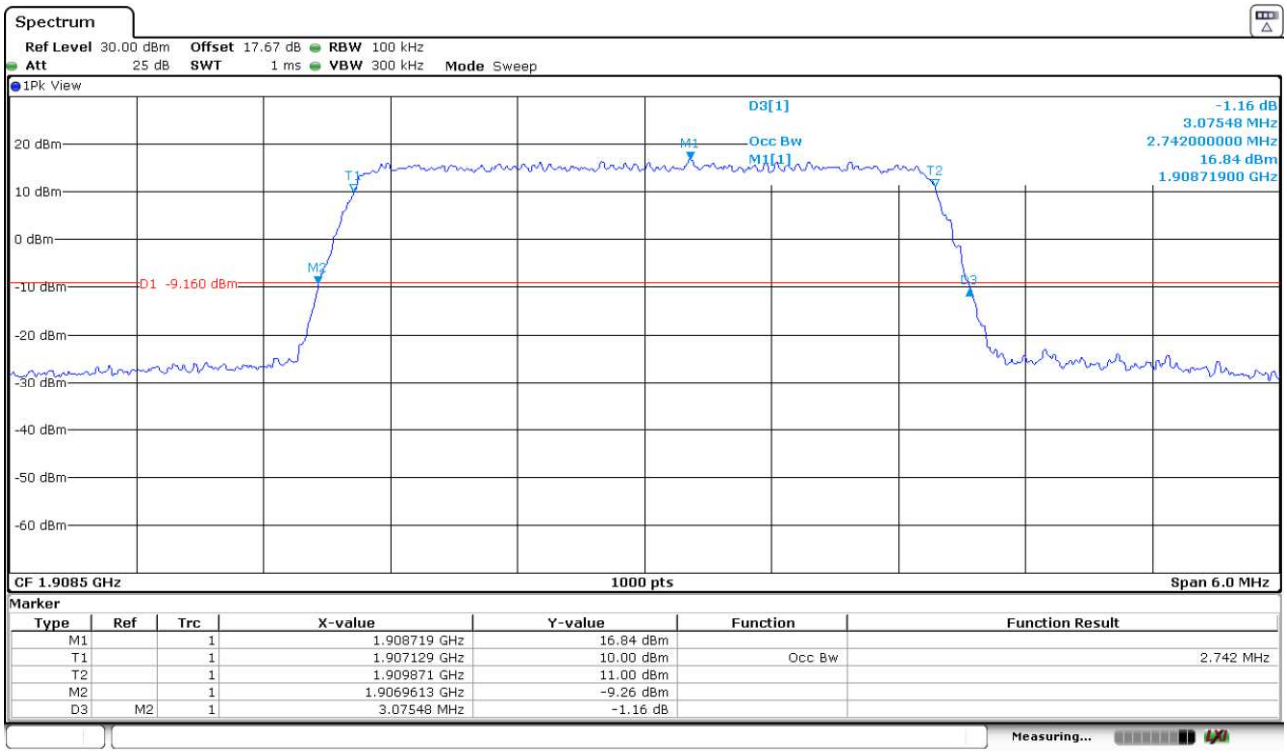
Lowest Channel:



Middle Channel:

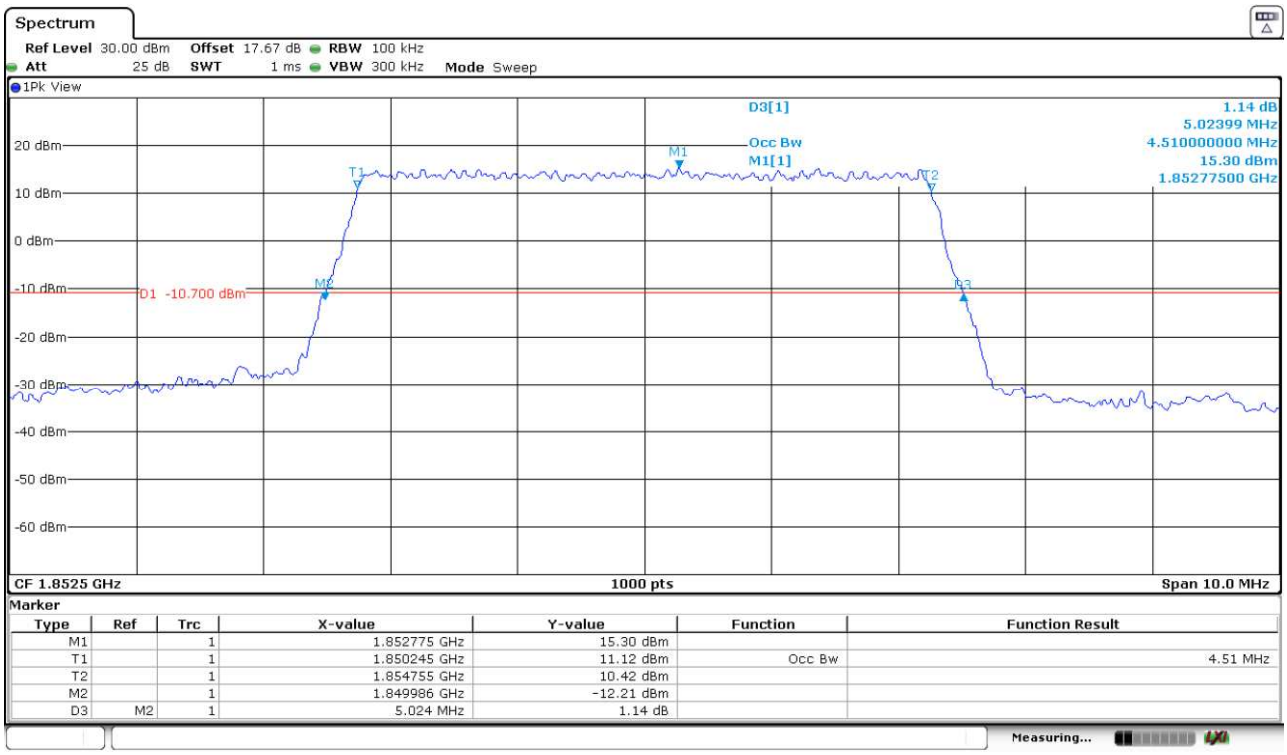


Highest Channel:

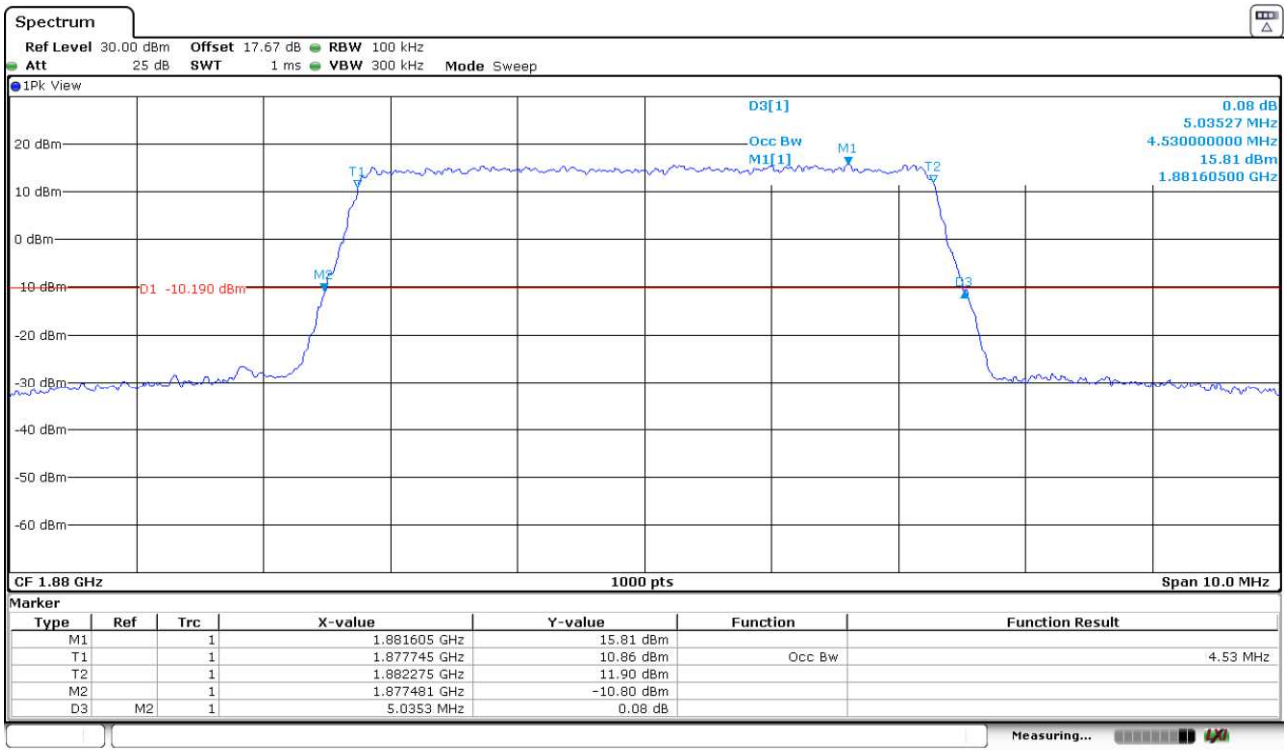


LTE Band 2. QPSK MODULATION. BW = 5 MHz.

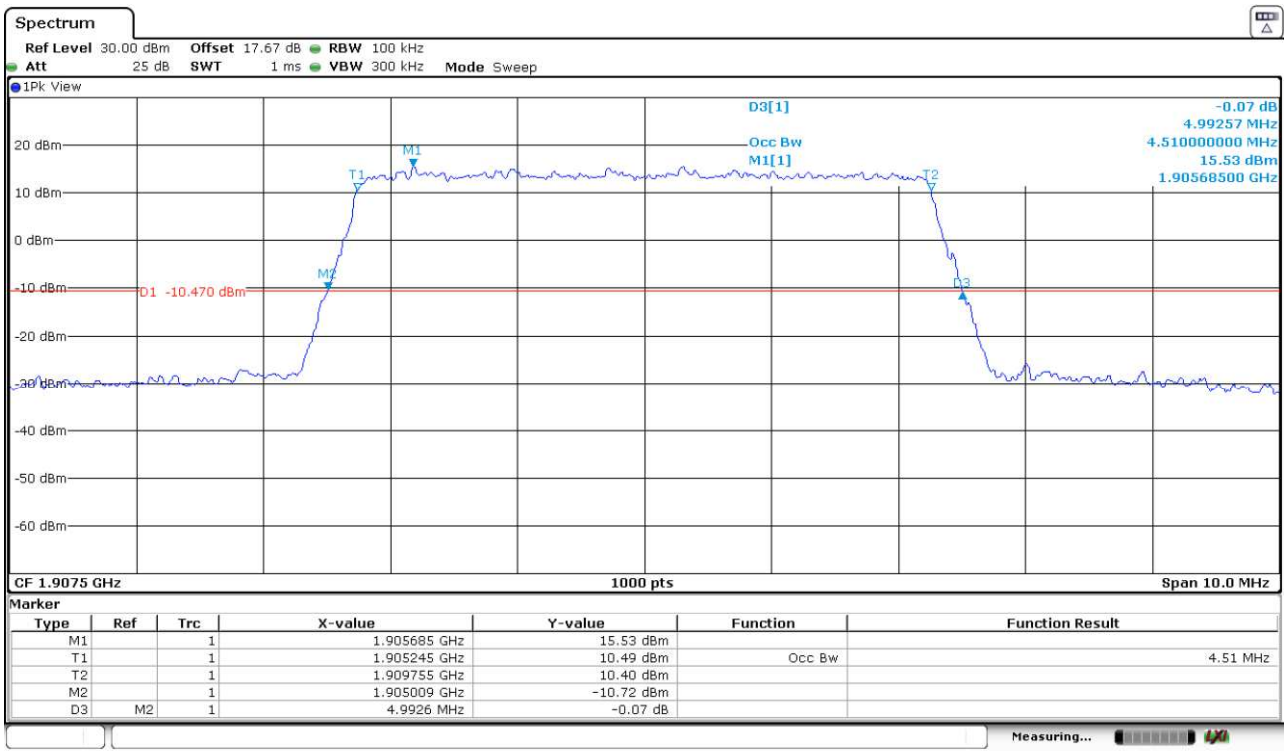
Lowest Channel:



Middle Channel:

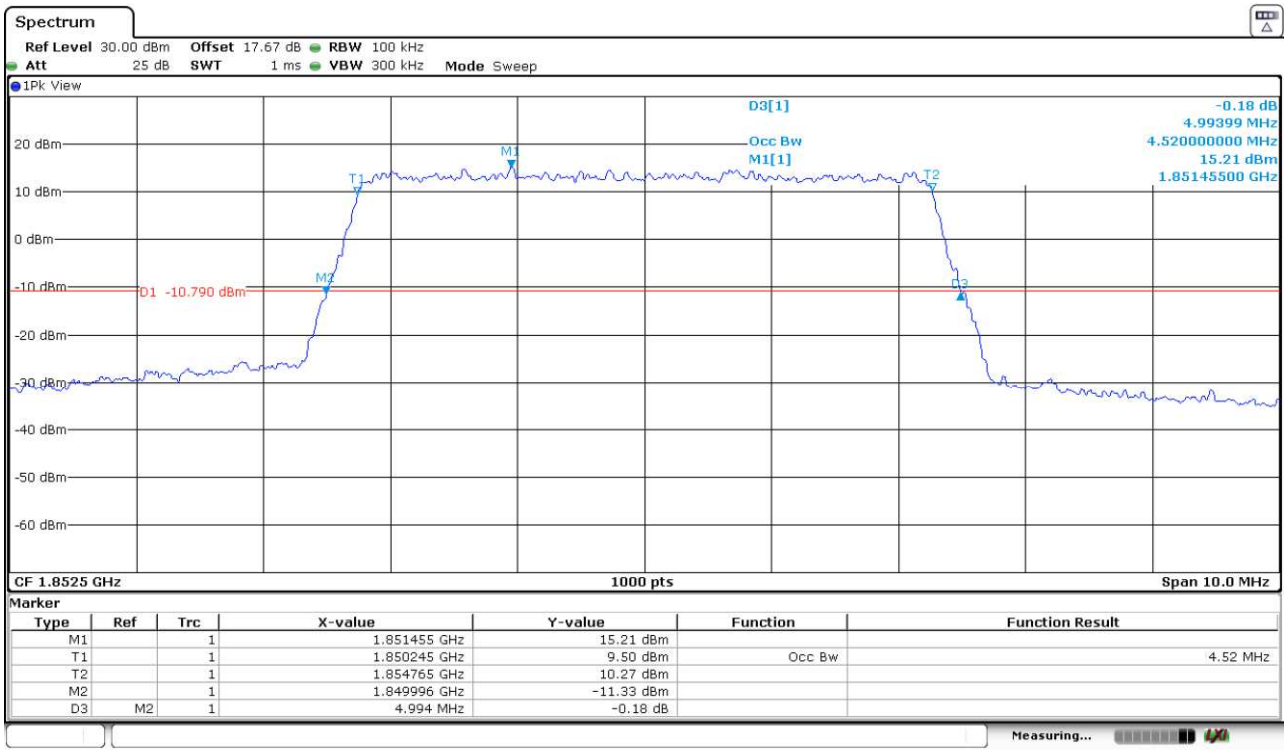


Highest Channel:

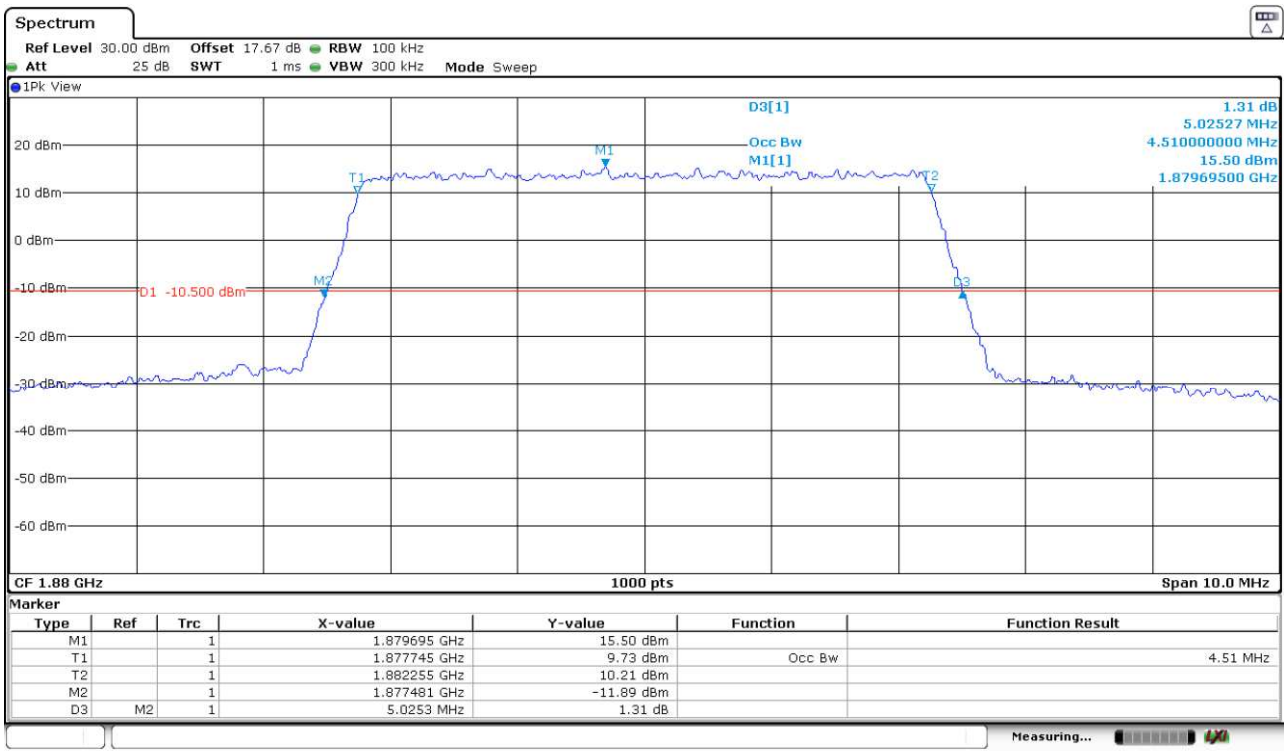


LTE Band 2. 16QAM MODULATION. BW = 5 MHz.

Lowest Channel:



Middle Channel:



Highest Channel: