5. Peak-Average Ratio

5.1. Limit

- §22.913(d) Measurement of the ERP of Cellular base transmitters and repeaters must be made using an average power measurement technique. The peak-to-average ratio (PAR) of the transmission must not exceed 13 ㎧.

- §24.232(d), power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 ㎧.

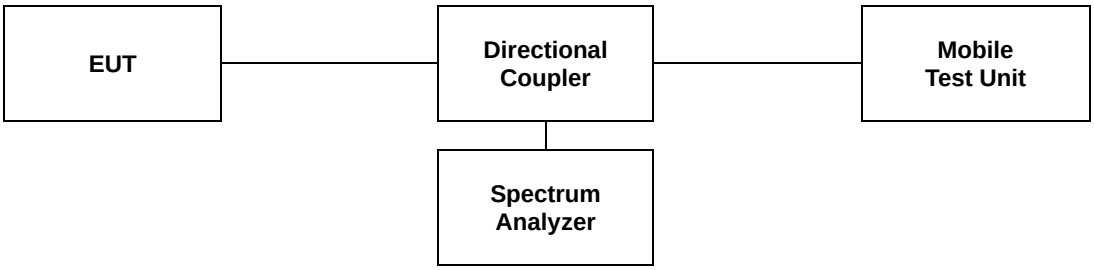
- §27.50(d)(5), power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 ㎧.

5.2. Test Procedure

The test follows section 5.7.2 of FCC KDB Publication 971168 D01 v03r01.

See instrumentation-specific application literature for further guidance regarding use of the CCDF capability. The following guidelines are offered for performing a CCDF measurement.

a. Set resolution/measurement bandwidth ≥ OBW or specified reference bandwidth.
b. Set the number of counts to a value that stabilizes the measured CCDF curve.
c. Set the measurement interval as follows:
  1) For continuous transmissions, set to greater of [10 x (number of points in sweep) x (transmission symbol period)] or 1 ㎳.
  2) For burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize. Set the measurement interval to a time that is less than or equal to the burst duration.
  3) If there are several carriers in a single antenna port, the peak power shall be determined for each individual carrier (by disabling the other carriers while measuring the required carrier) and the total peak power calculated from the sum of the individual carrier peak powers.
d. Record the maximum PAPR level associated with a probability of 0.1 %.
e. The peak power level is calculated form the sum of the PAPR value from step d) to the measured average power.



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5.3 Test Results

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Band	Mode	Frequency (㎒)	PAR (㏈)
2 (1.4 ㎒)	QPSK	1 850.7	4.81
		1 880.0	5.16
		1 909.3	4.81
2 (3 ㎒)	QPSK	1 851.5	4.81
		1 880.0	4.93
		1 908.5	4.87
2 (5 ㎒)	QPSK	1 852.5	4.90
		1 880.0	4.90
		1 907.5	4.84
2 (10 ㎒)	QPSK	1 855.0	5.01
		1 880.0	4.87
		1 905.0	4.84
2 (15 ㎒)	QPSK	1 857.5	5.28
		1 880.0	5.16
		1 902.5	5.04
2 (20 ㎒)	QPSK	1 860.0	4.87
		1 880.0	4.90
		1 900.0	4.81

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Band	Mode	Frequency (㎒)	PAR (㏈)
4 (1.4 ㎒)	QPSK	1 710.7	5.10
		1 732.5	4.96
		1 754.3	5.16
4 (3 ㎒)	QPSK	1 711.5	5.13
		1 732.5	4.81
		1 753.5	5.04
4 (5 ㎒)	QPSK	1 712.5	5.07
		1 732.5	4.84
		1 752.5	5.07
4 (10 ㎒)	QPSK	1 715.0	5.01
		1 732.5	4.84
		1 750.0	5.01
4 (15 ㎒)	QPSK	1 717.5	5.25
		1 732.5	5.01
		1 747.5	5.30
4 (20 ㎒)	QPSK	1 720.0	4.87
		1 732.5	4.78
		1 745.0	5.07

Band	Mode	Frequency (㎒)	PAR (㏈)
5 (1.4 ㎒)	QPSK	824.7	4.72
		836.5	4.93
		848.3	5.19
5 (3 ㎒)	QPSK	825.5	4.70
		836.5	4.84
		847.5	5.01
5 (5 ㎒)	QPSK	826.5	4.78
		836.5	4.90
		846.5	4.90
5 (10 ㎒)	QPSK	829.0	4.87
		836.5	4.90
		844.0	4.78

Band	Mode	Frequency (㎒)	PAR (㏈)
13 (5 ㎒)	QPSK	779.5	4.38
		782.0	4.49
		784.5	4.64
13 (10 ㎒)	QPSK	-	-
		782.0	4.55
		-	-

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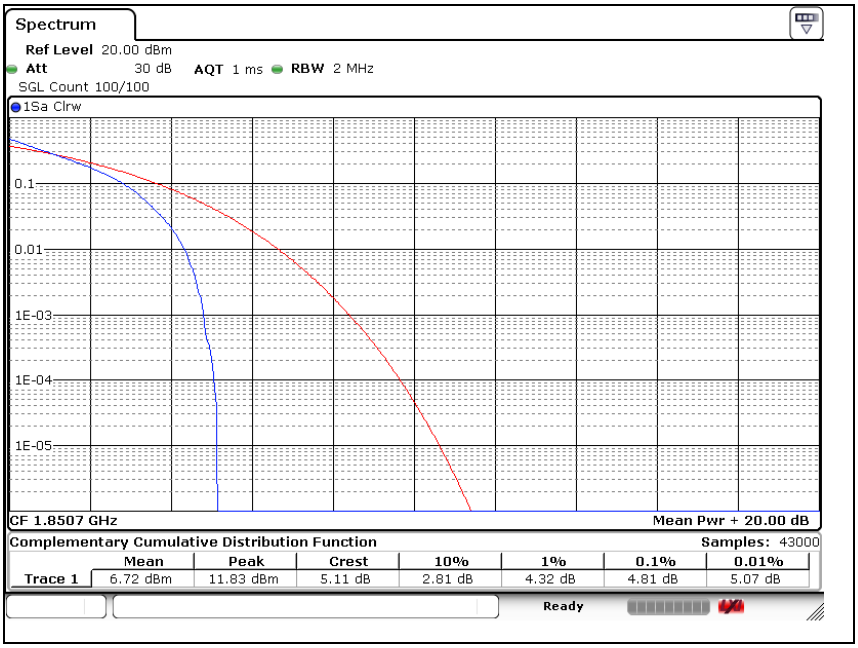
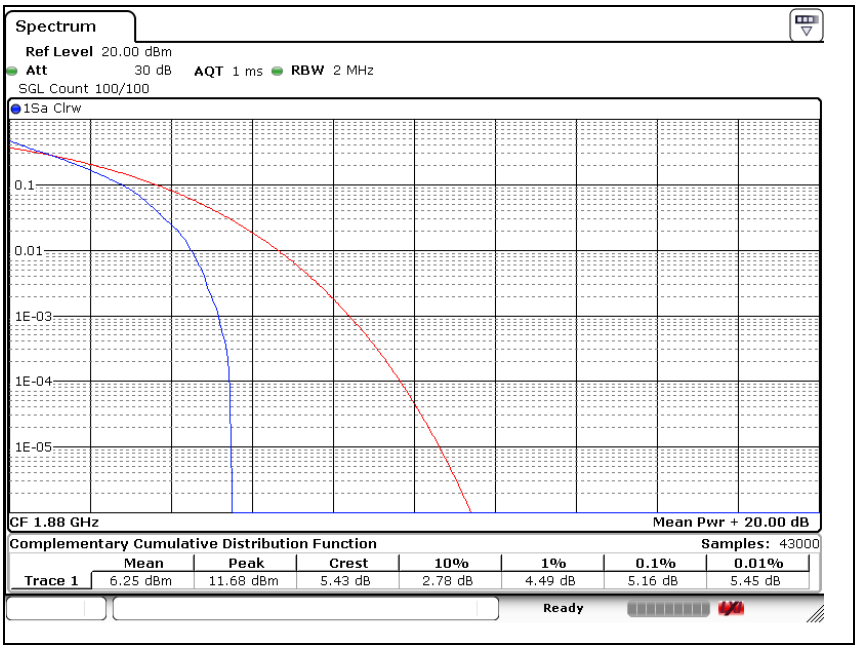
LTE band 2 (1.4 ㎒ - QPSK)

Low Channel



Middle Channel



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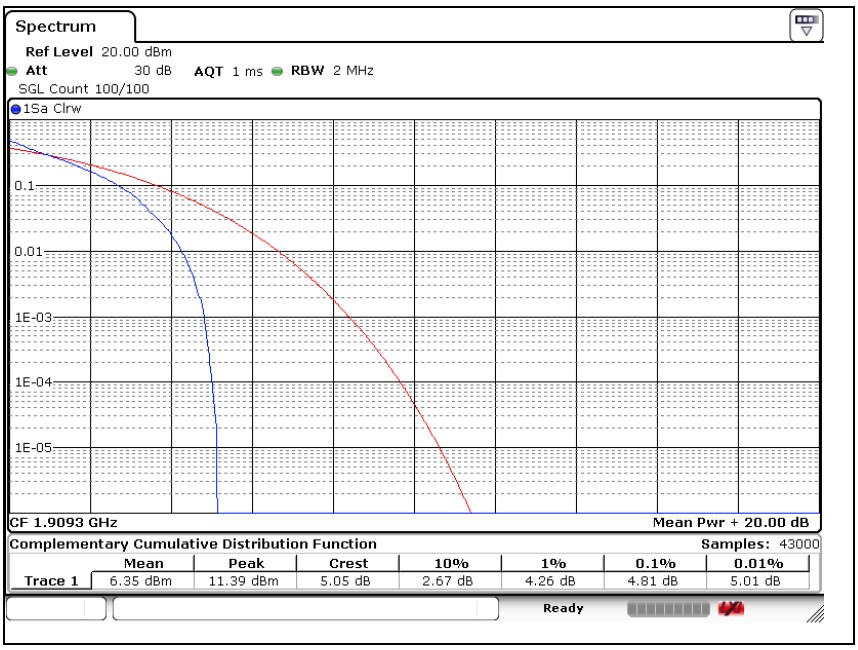
High Channel



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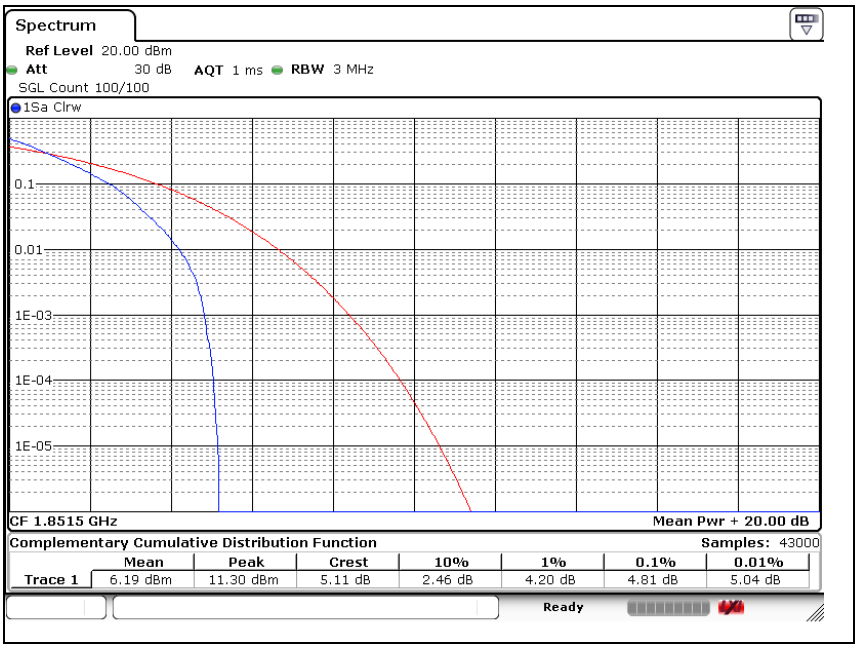
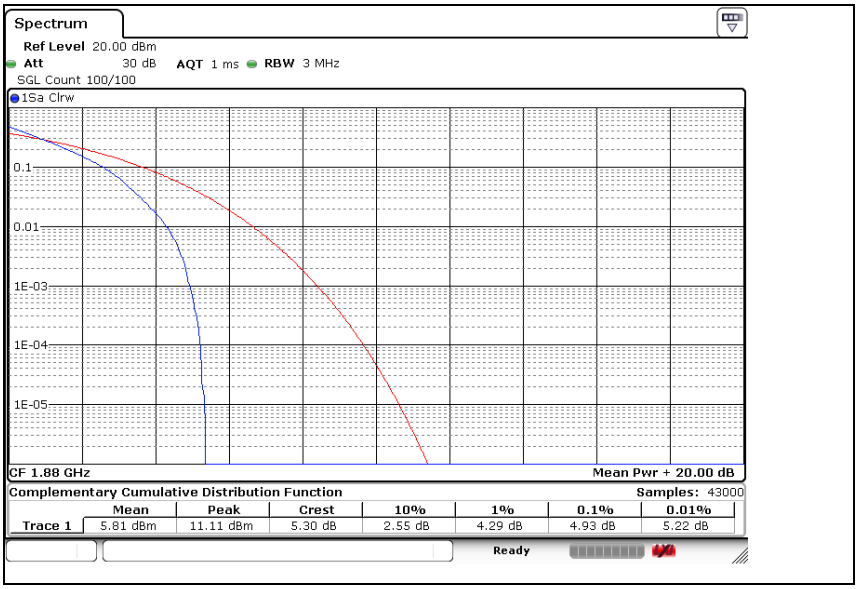
LTE band 2 (3 ㎒ - QPSK)

Low Channel



Middle Channel



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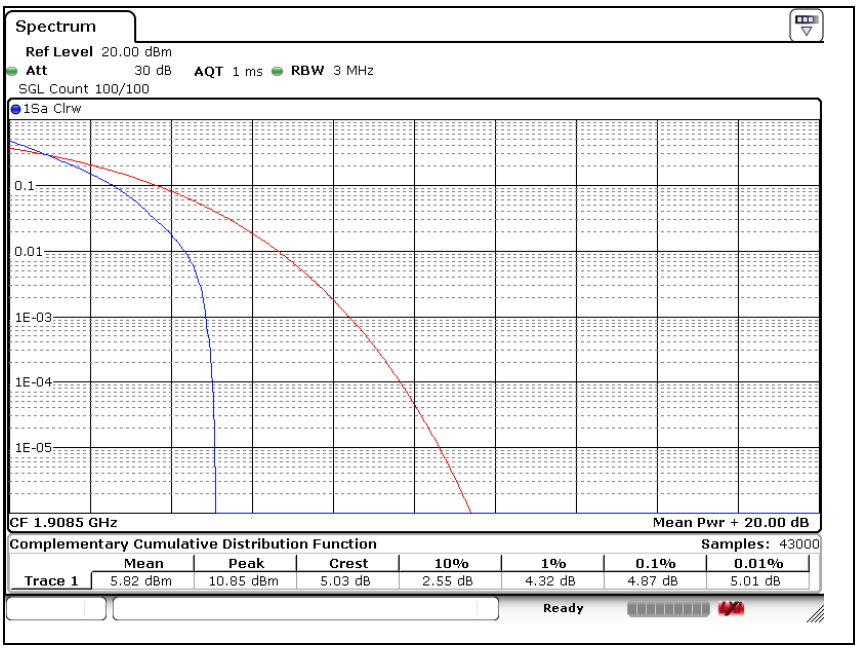
High Channel



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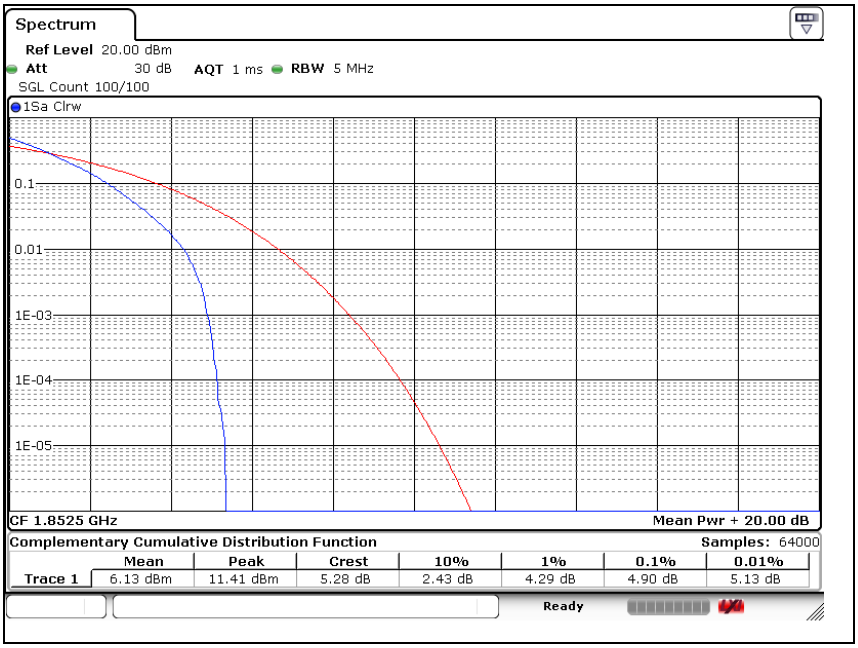
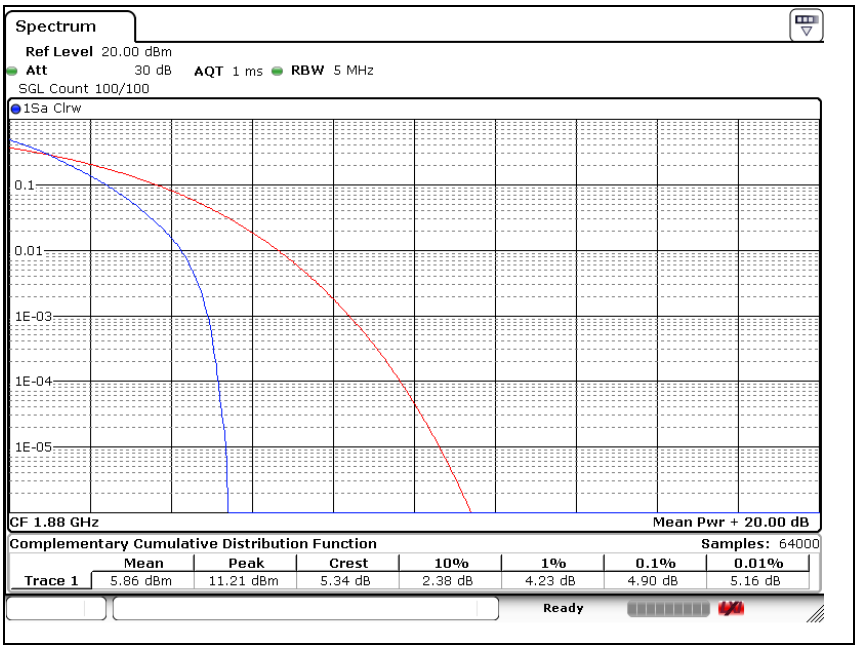
LTE band 2 (5 ㎒ - QPSK)

Low Channel



Middle Channel



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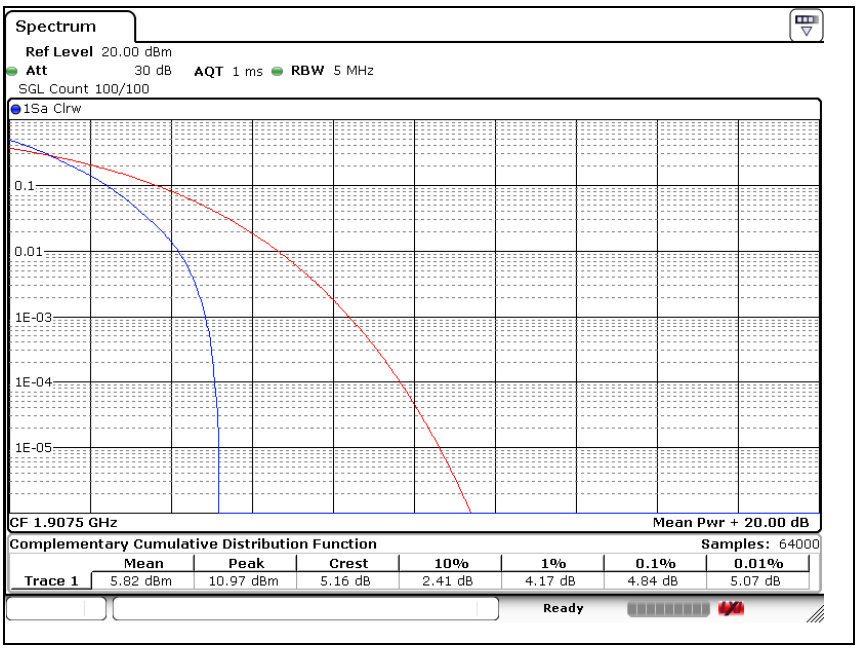
High Channel



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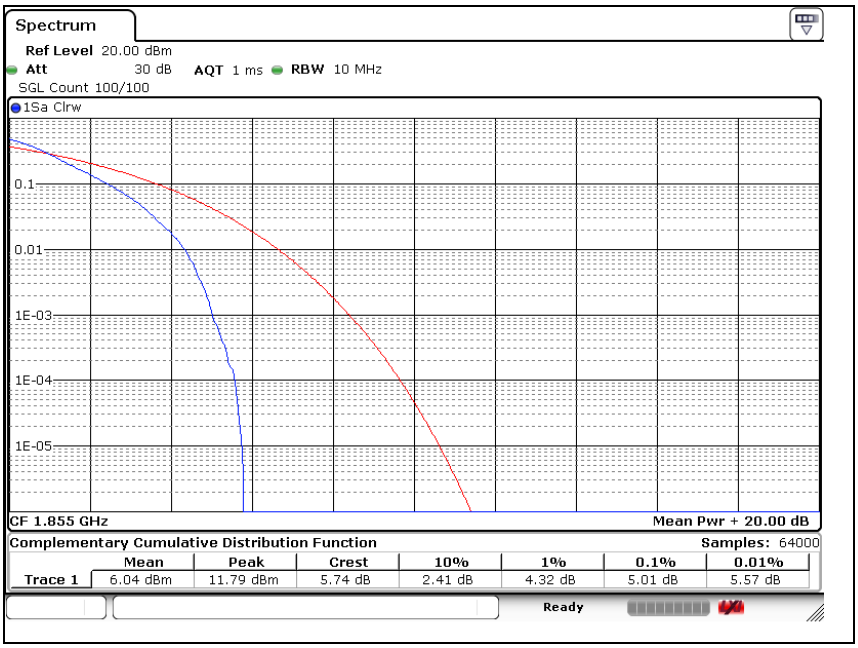
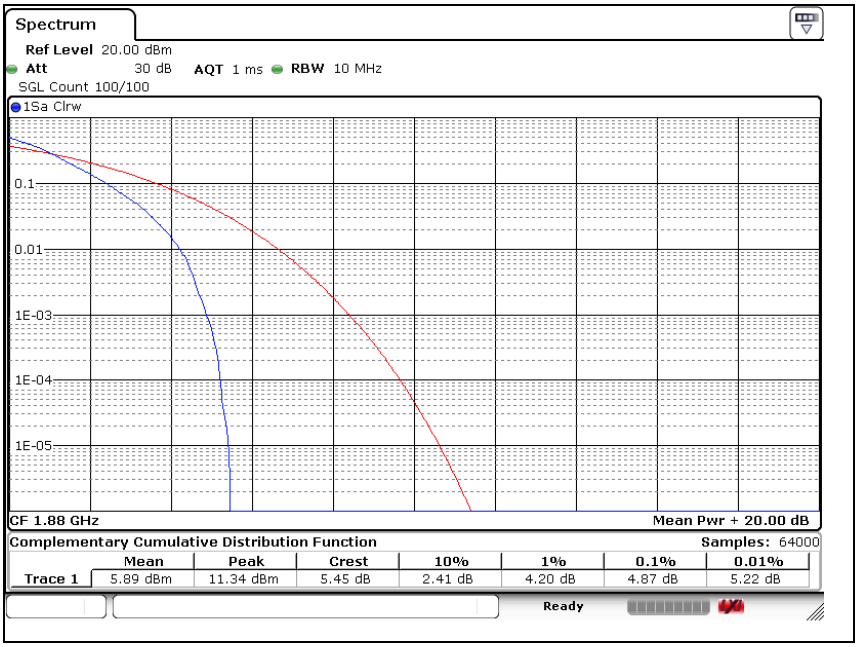
LTE band 2 (10 ㎒ - QPSK)

Low Channel



Middle Channel



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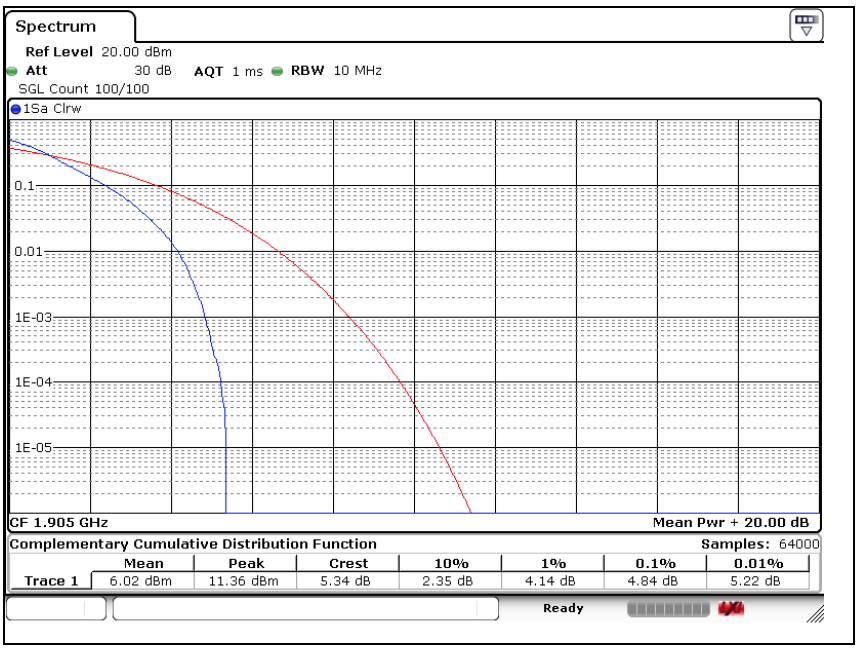
High Channel



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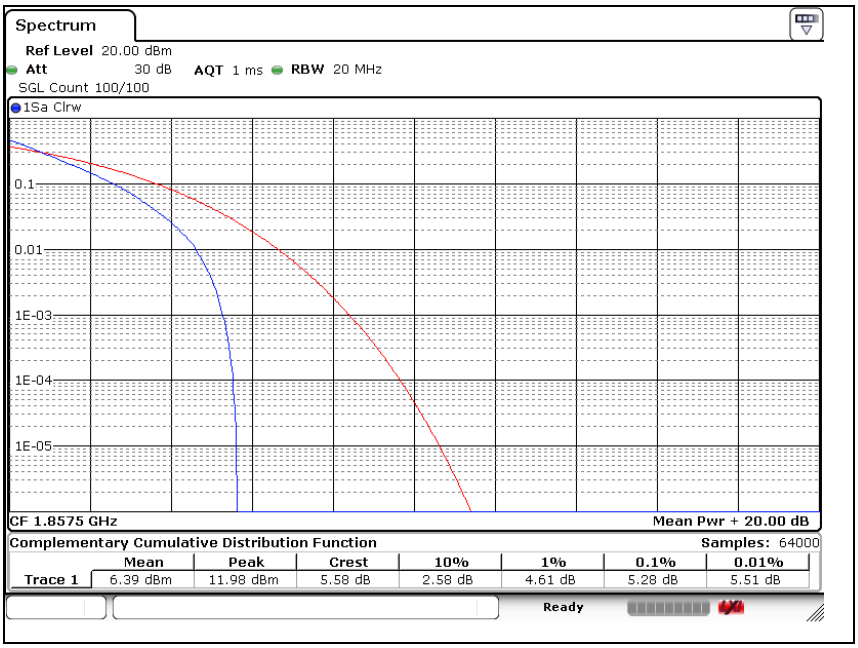
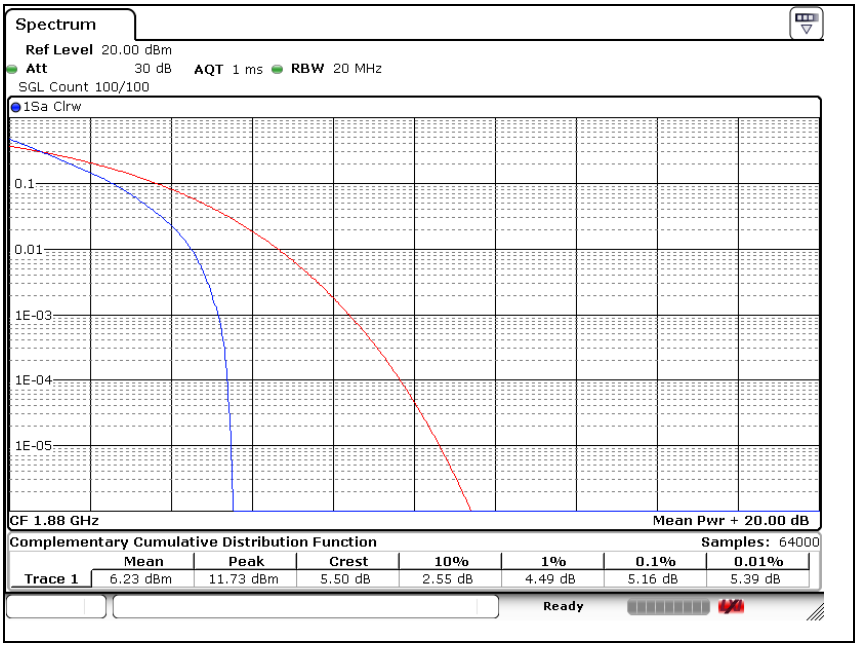
LTE band 2 (15 ㎒ - QPSK)

Low Channel



Middle Channel



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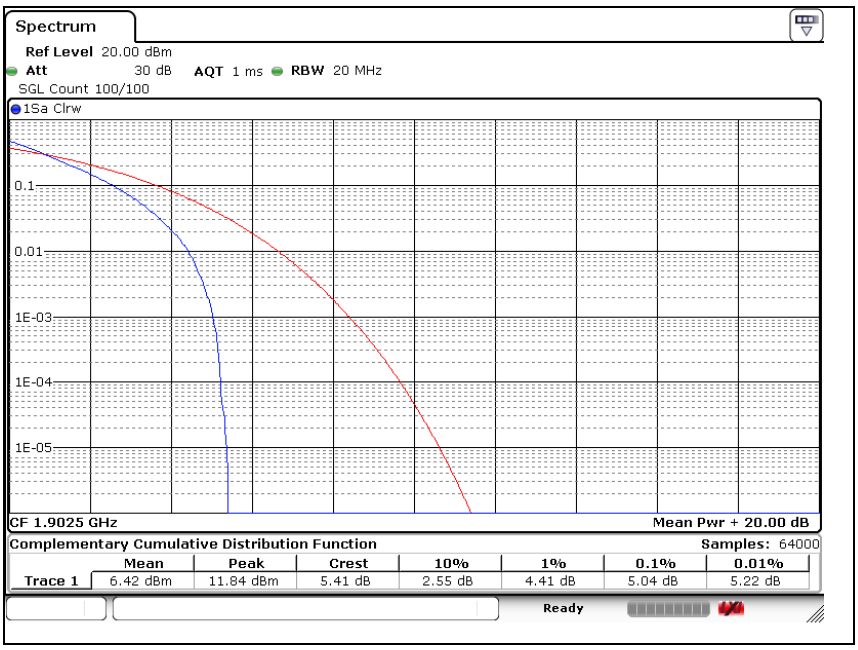
High Channel



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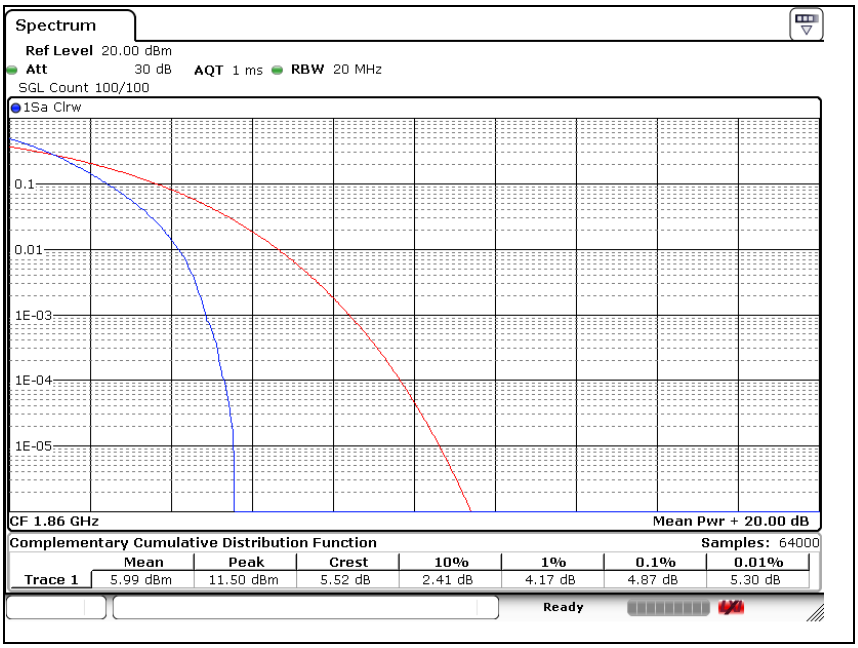
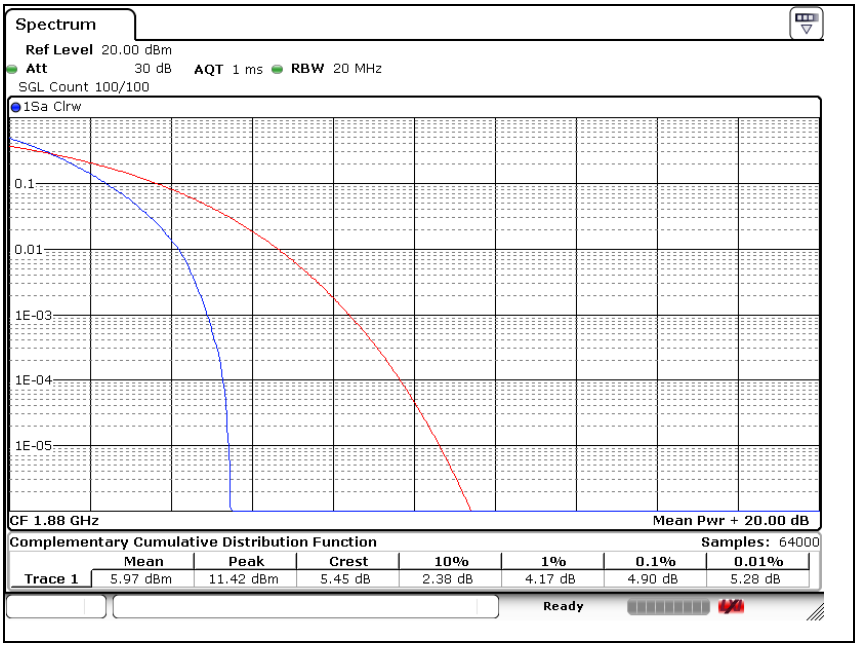
LTE band 2 (20 ㎒ - QPSK)

Low Channel



Middle Channel



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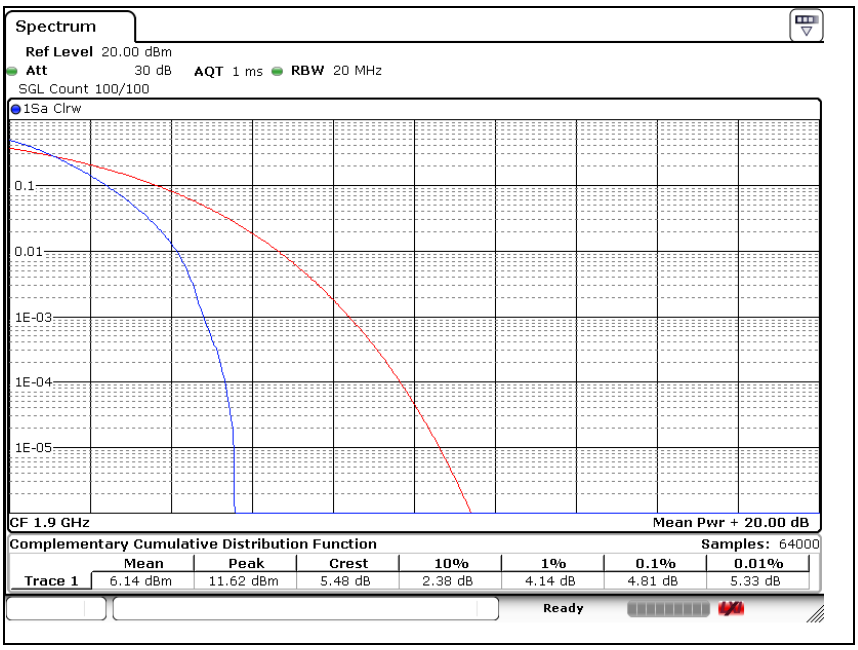
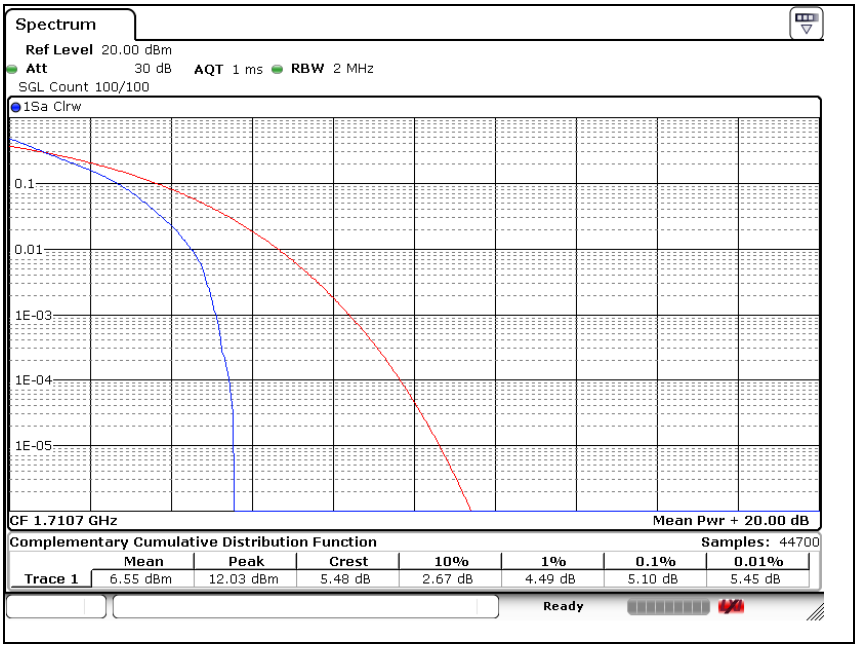
High Channel

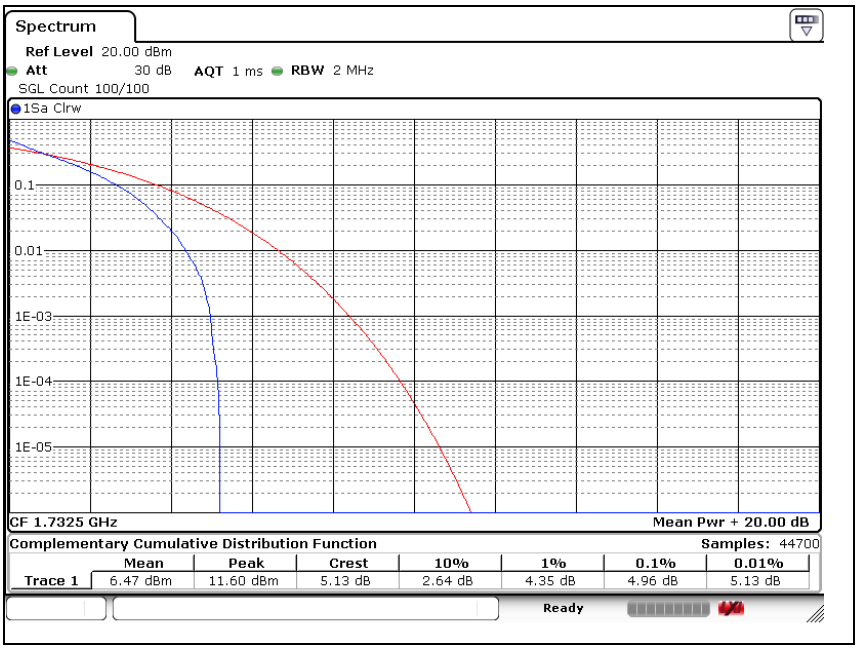


LTE band 4 (1.4 ㎒ - QPSK)

Low Channel



Middle Channel



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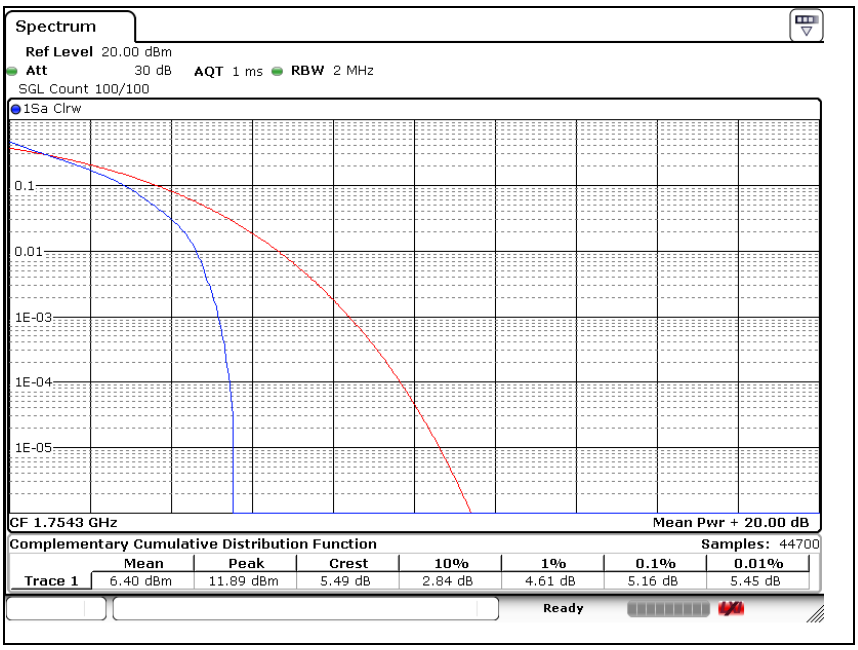
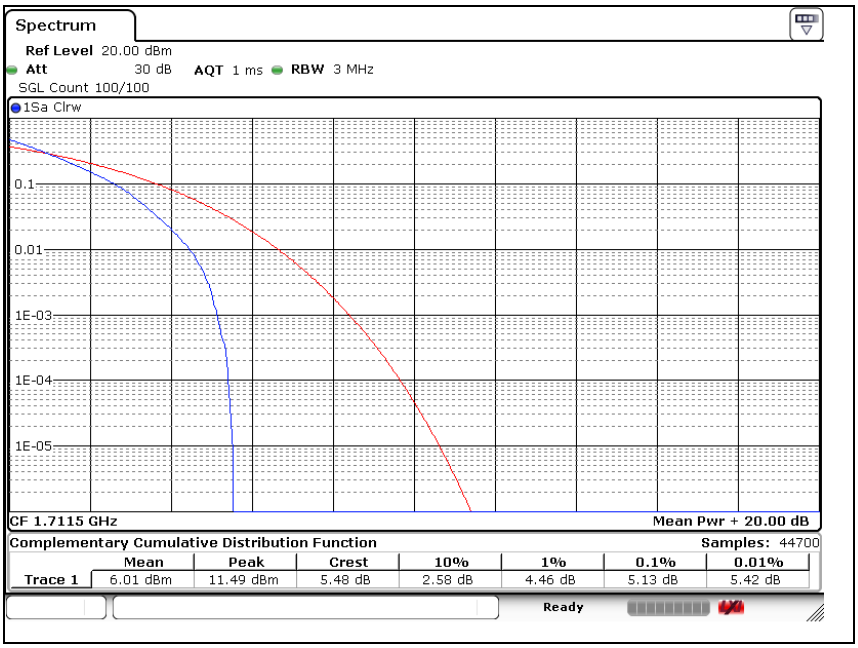
High Channel

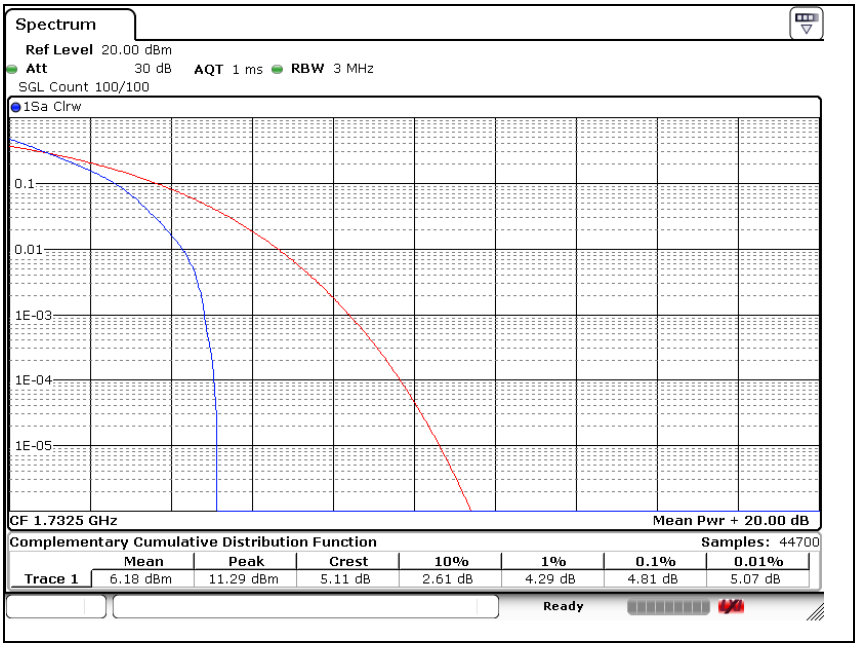


LTE band 4 (3 ㎒ - QPSK)

Low Channel



Middle Channel



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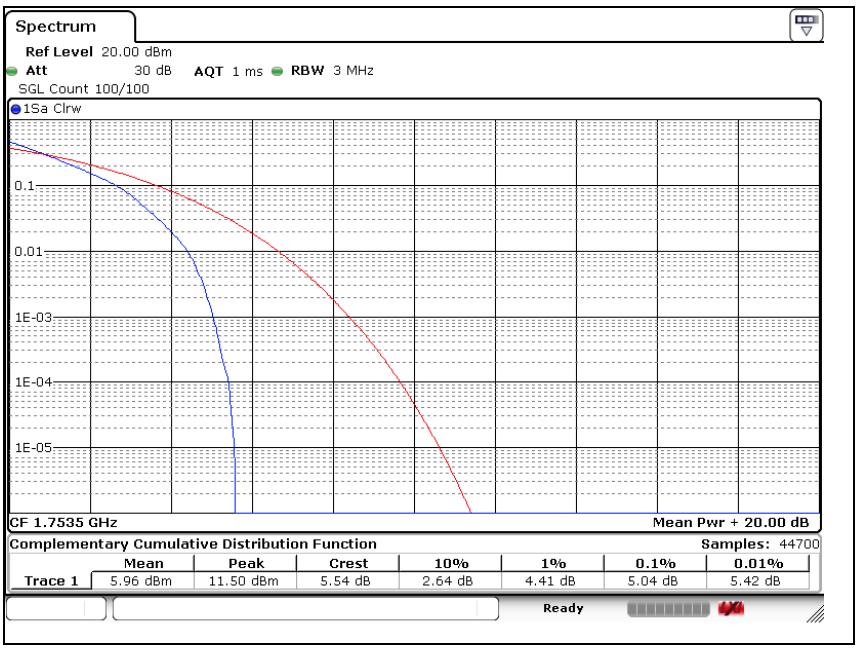
High Channel



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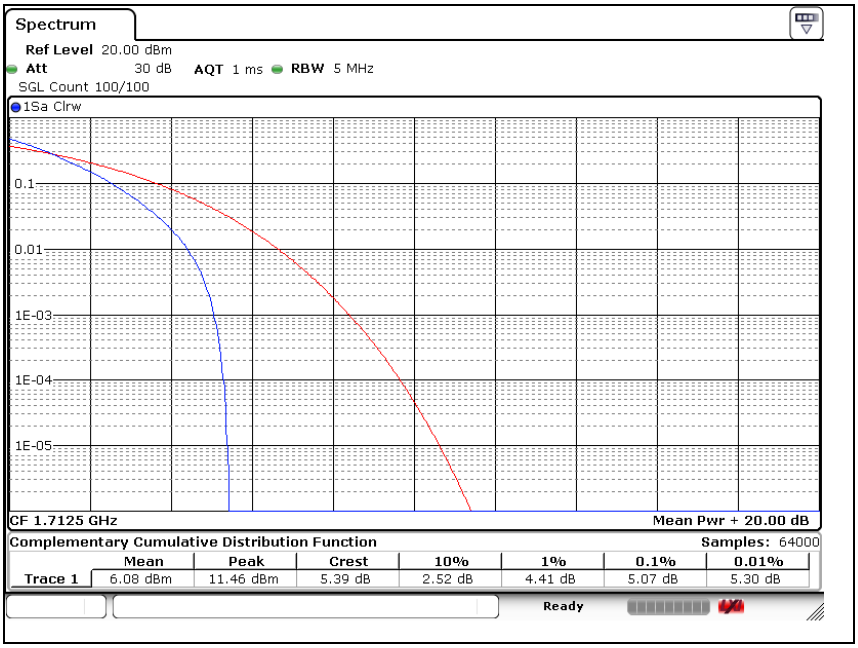
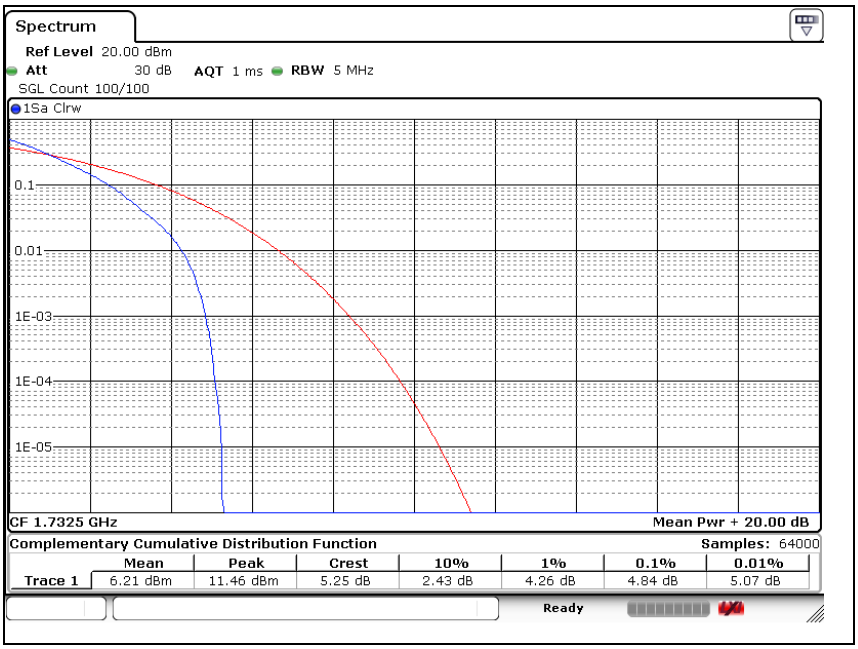
LTE band 4 (5 ㎒ - QPSK)

Low Channel



Middle Channel



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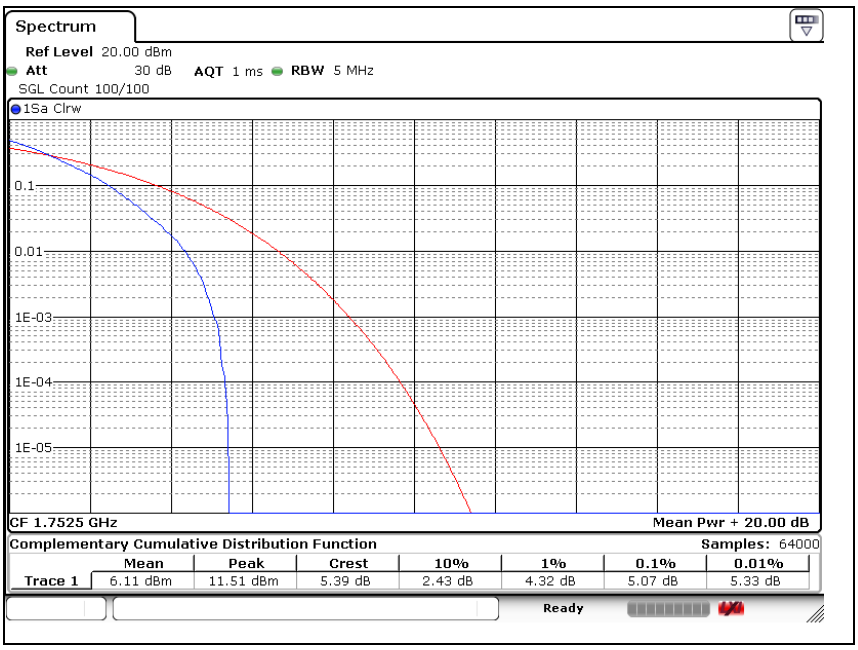
High Channel



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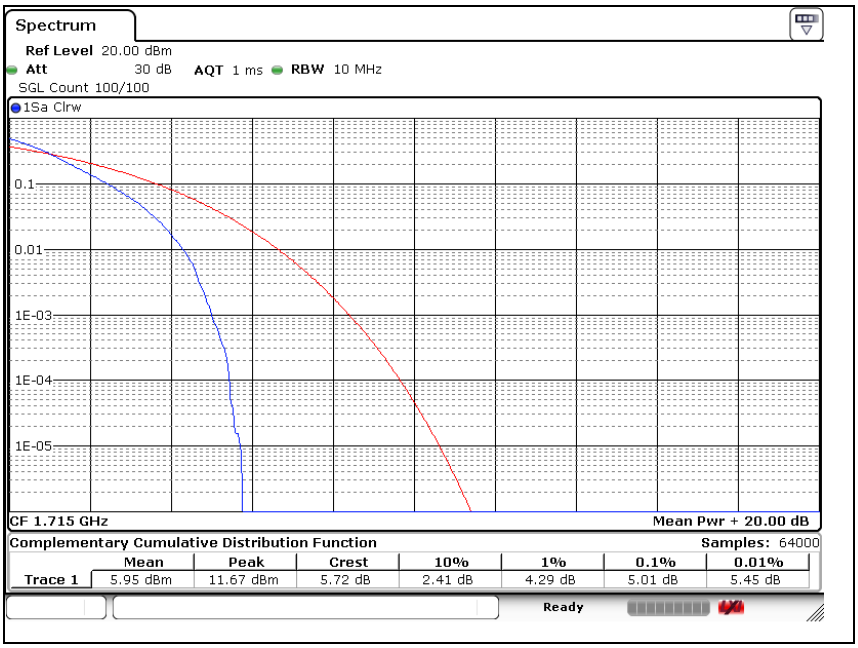
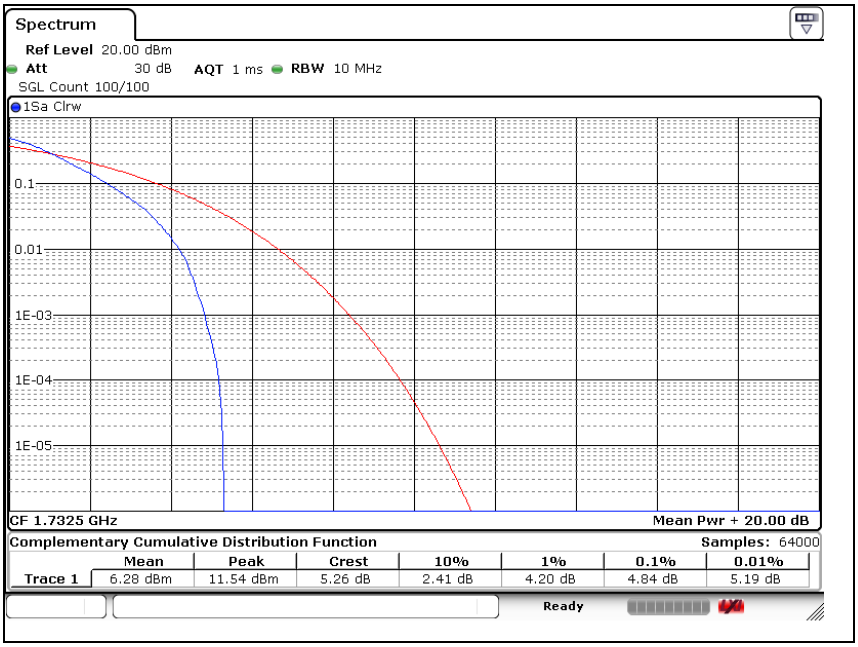
LTE band 4 (10 ㎒ - QPSK)

Low Channel



Middle Channel



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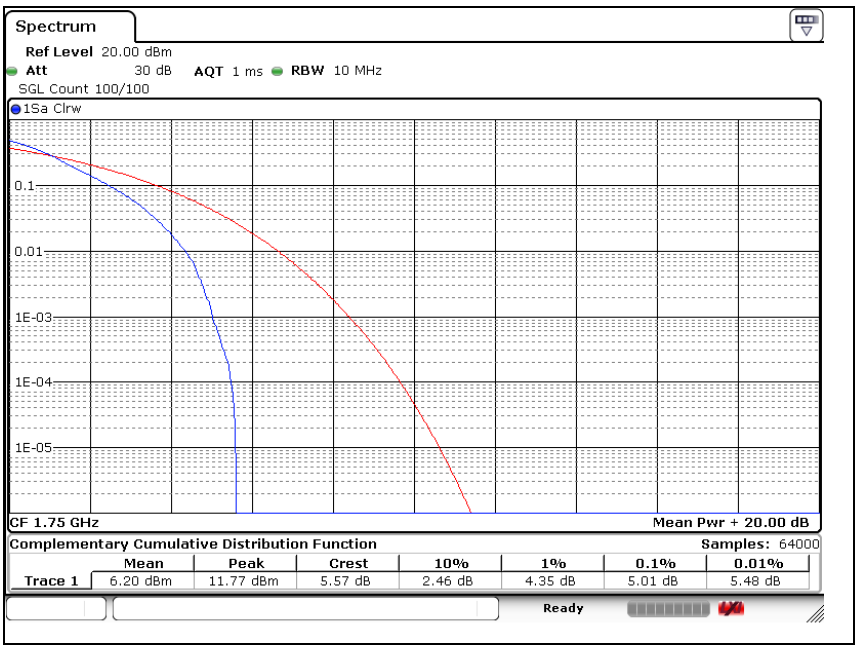
High Channel



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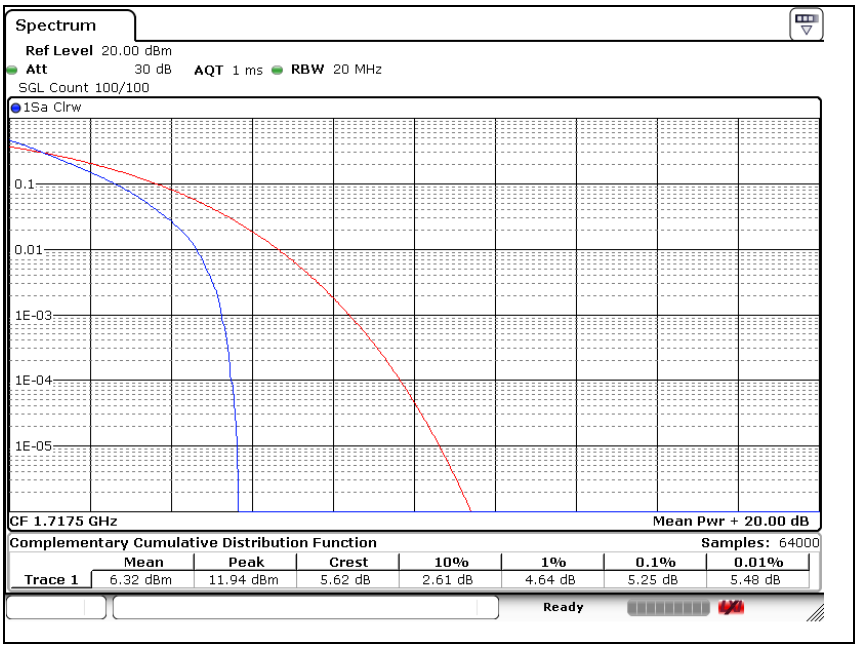
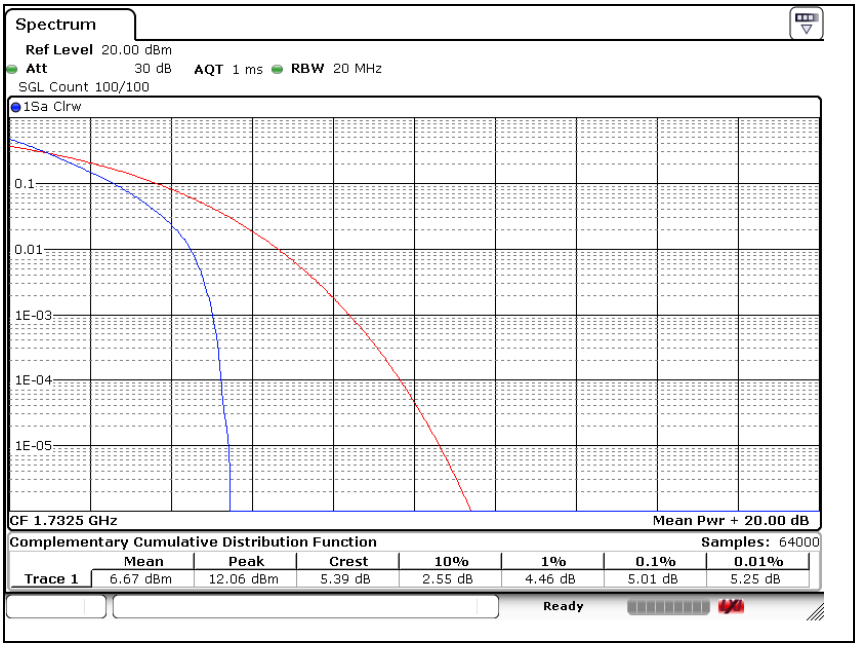
LTE band 4 (15 ㎒ - QPSK)

Low Channel



Middle Channel



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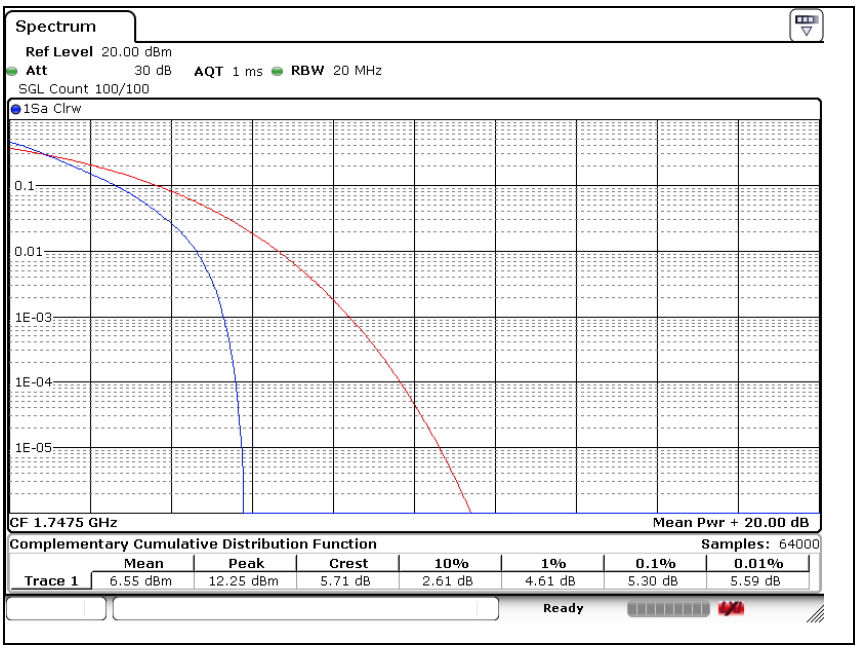
High Channel



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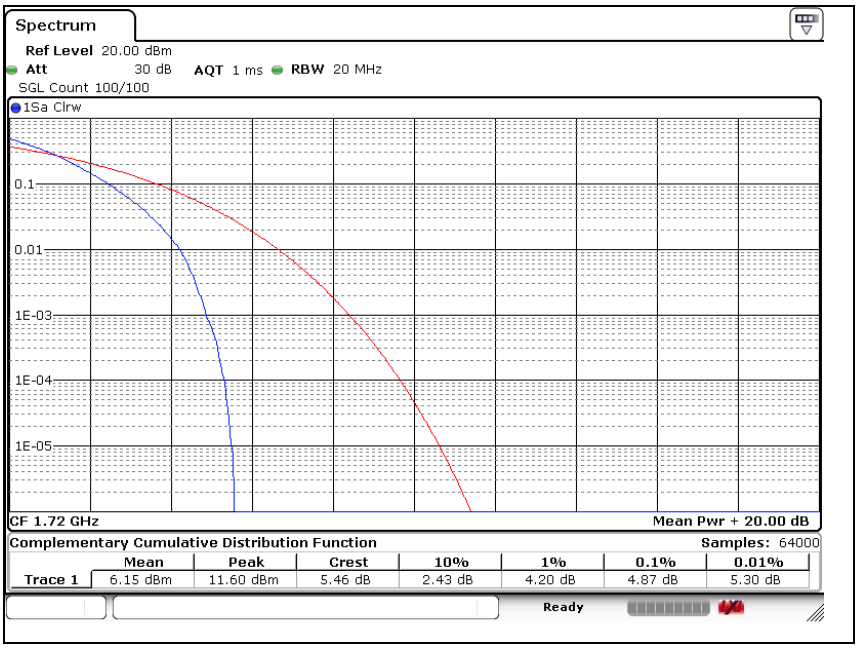
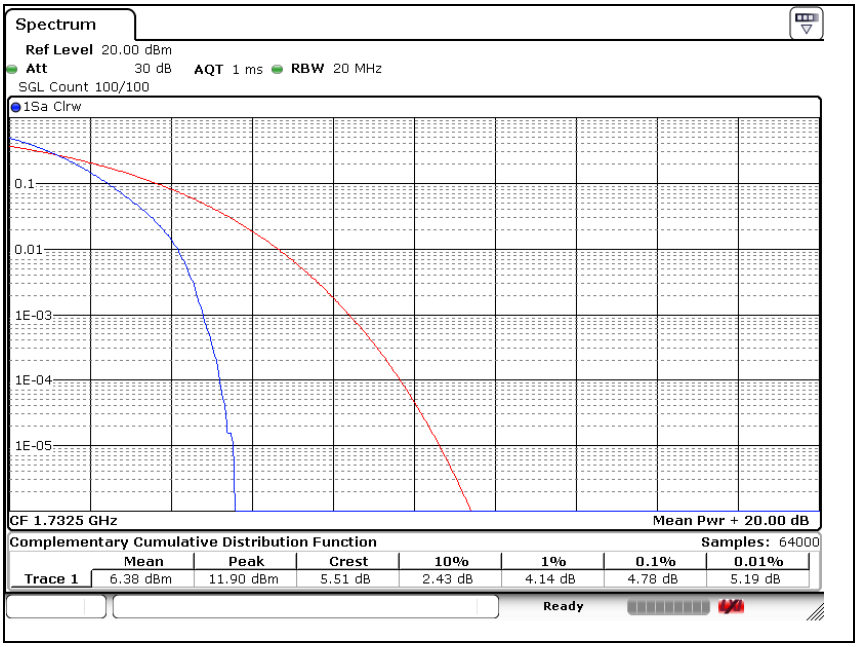
LTE band 4 (20 ㎒ - QPSK)

Low Channel



Middle Channel



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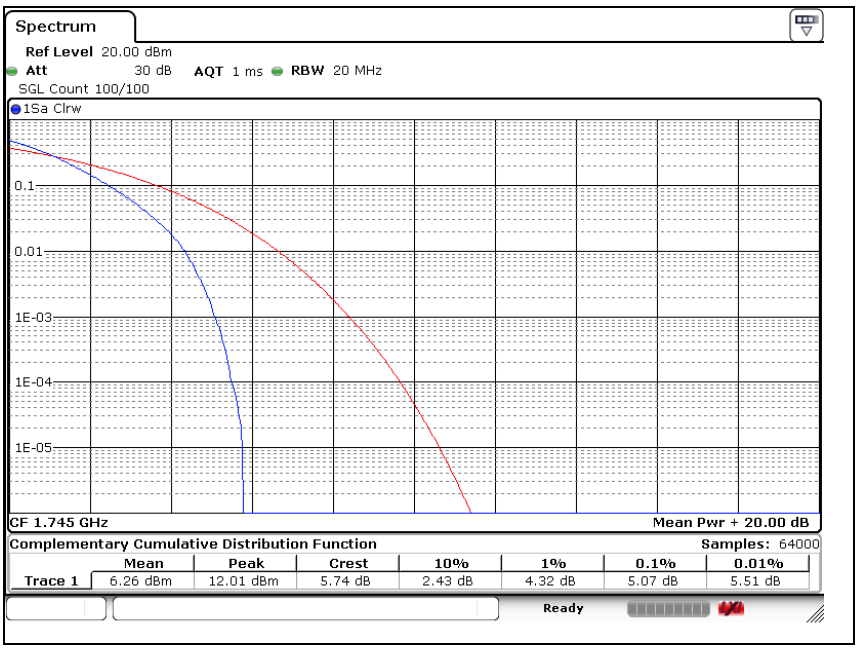
High Channel



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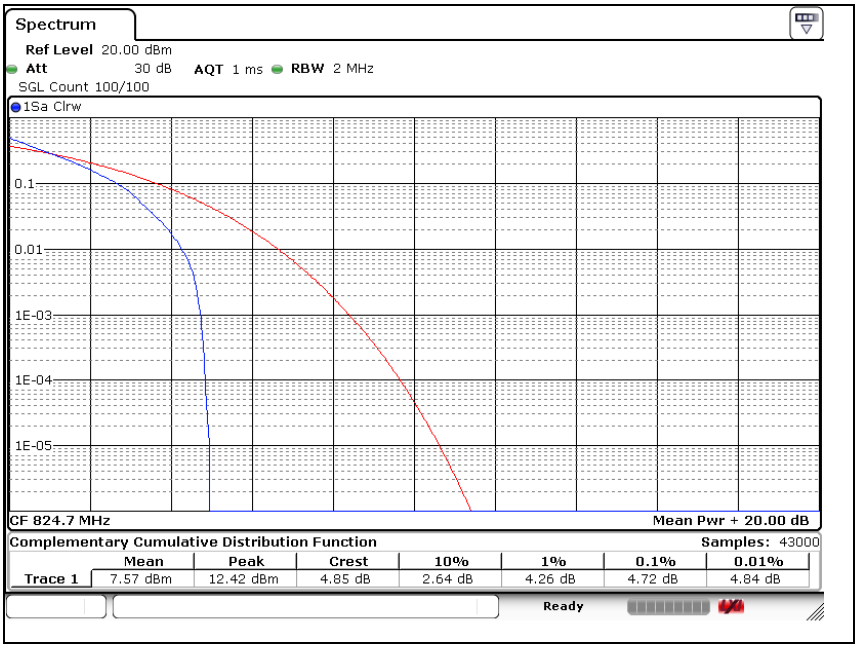
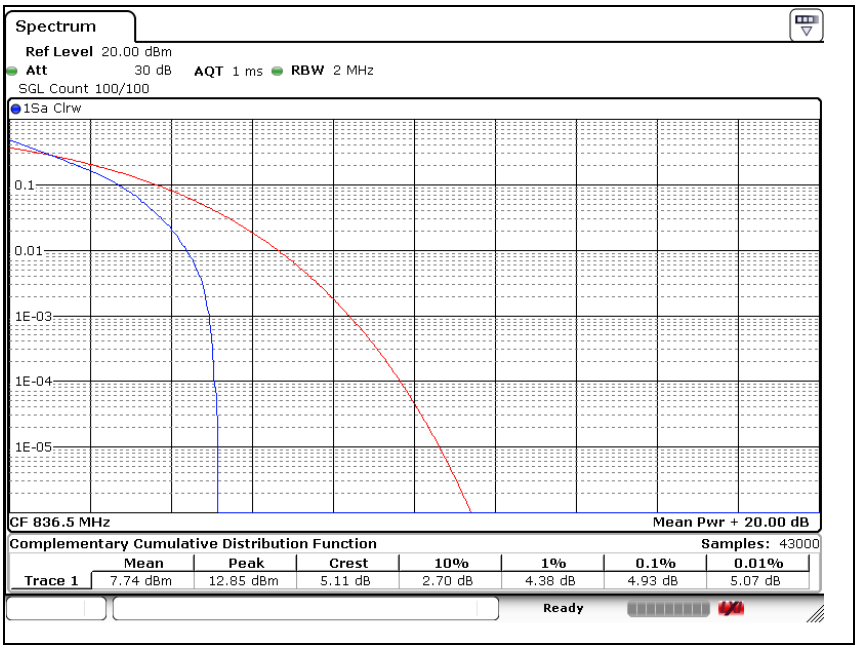
LTE band 5 (1.4 ㎒ - QPSK)

Low Channel



Middle Channel



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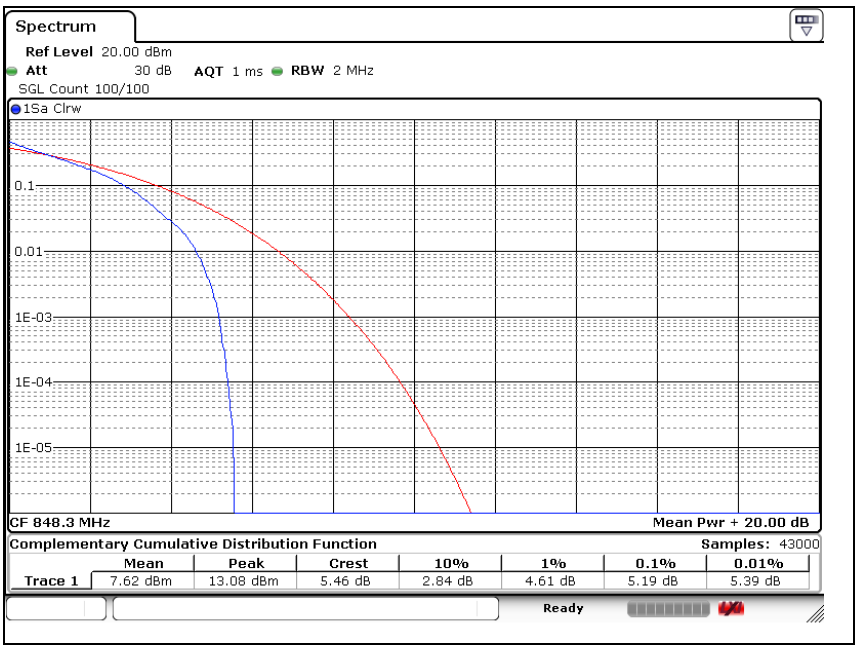
High Channel



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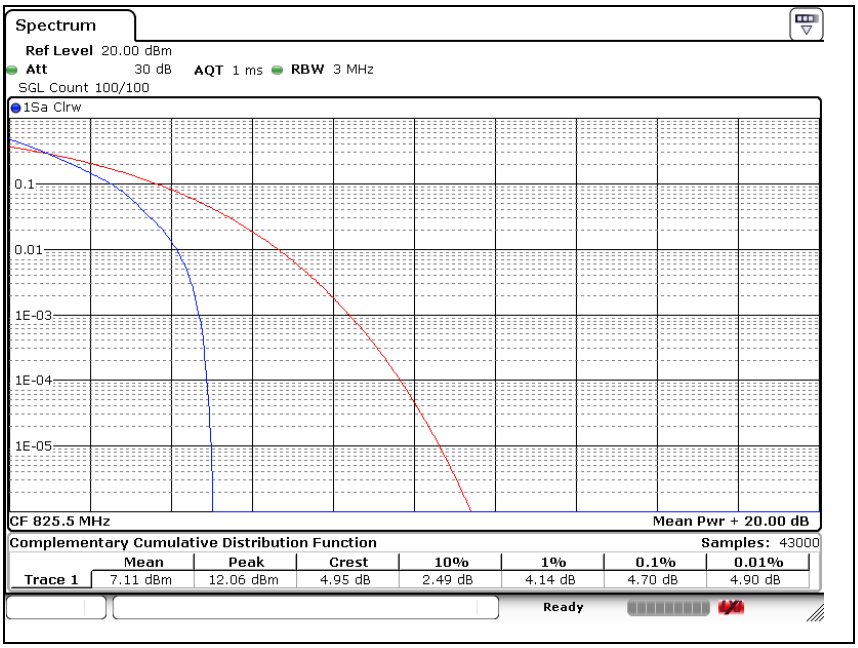
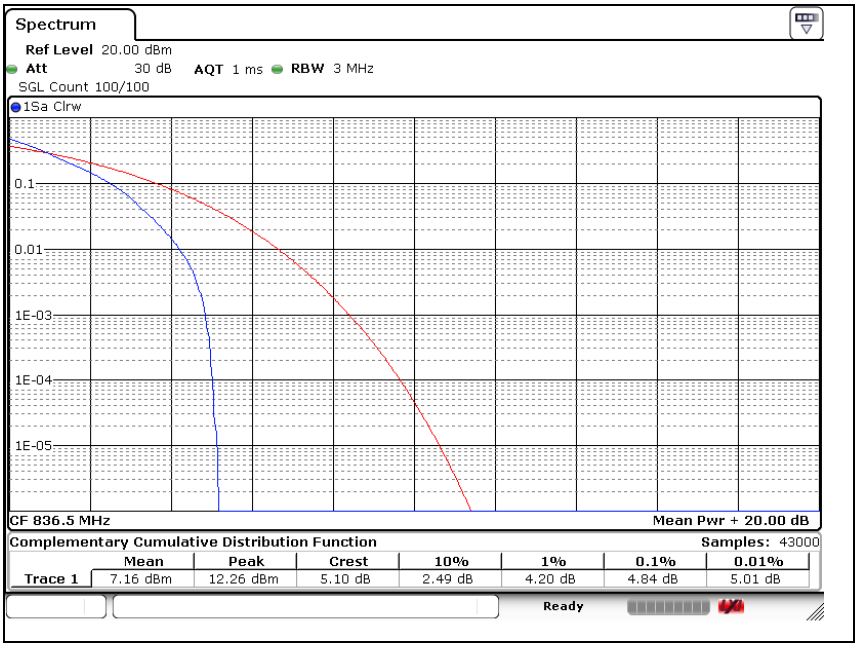
LTE band 5 (3 ㎒ - QPSK)

Low Channel



Middle Channel



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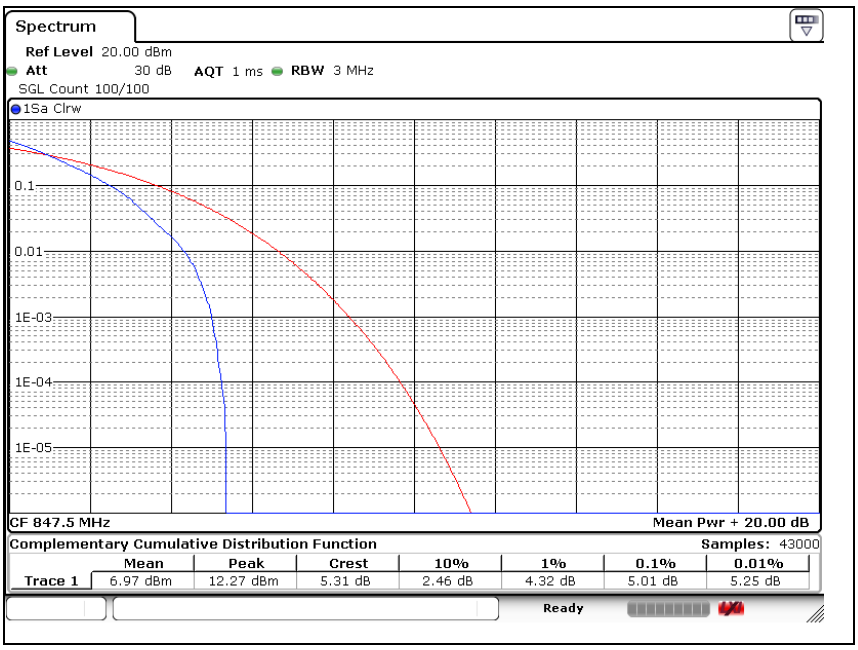
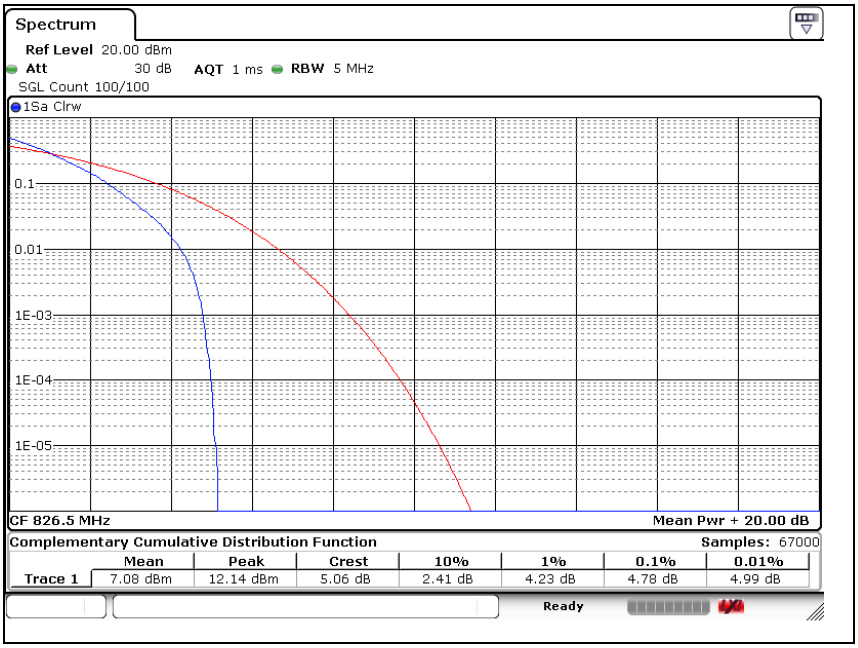
High Channel

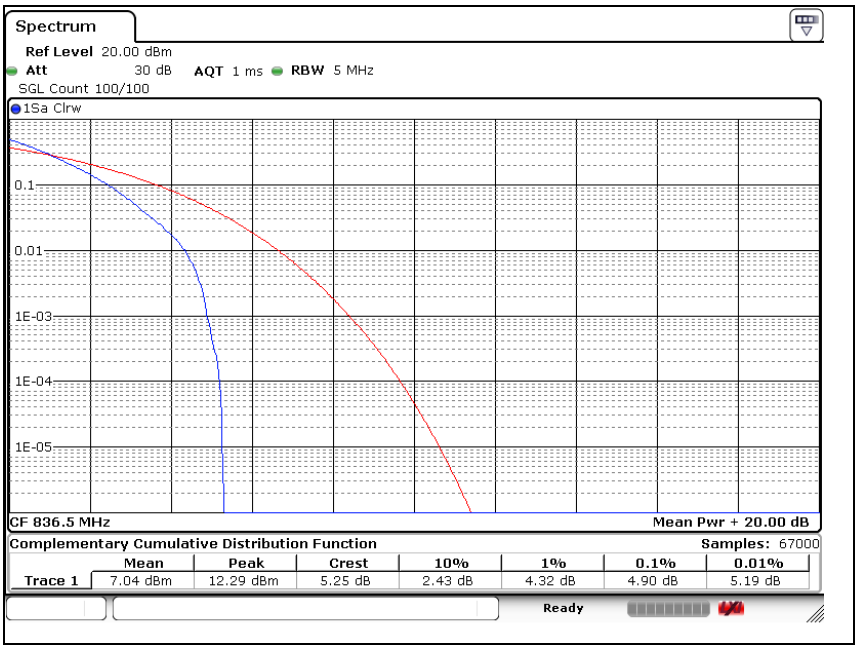


LTE band 5 (5 ㎒ - QPSK)

Low Channel



Middle Channel



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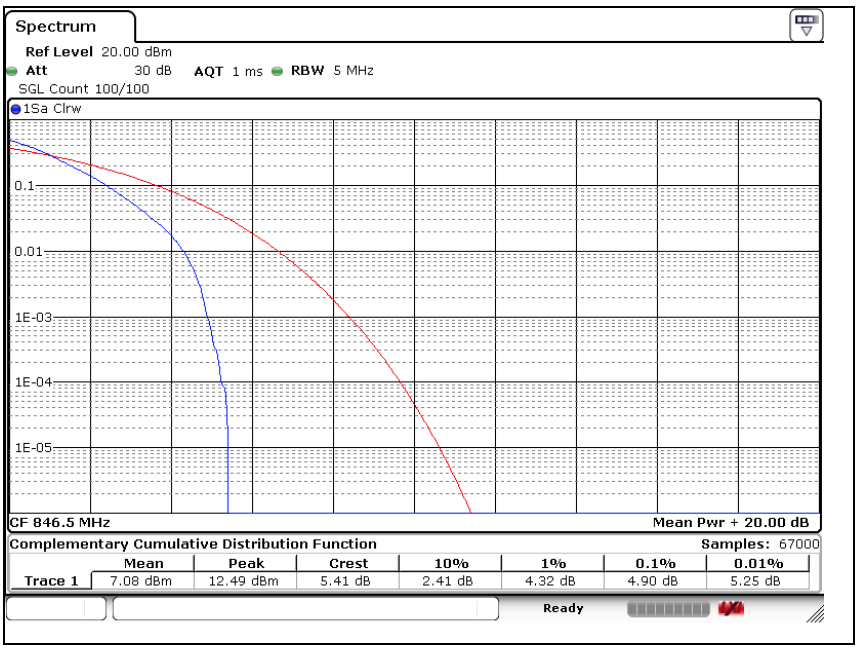
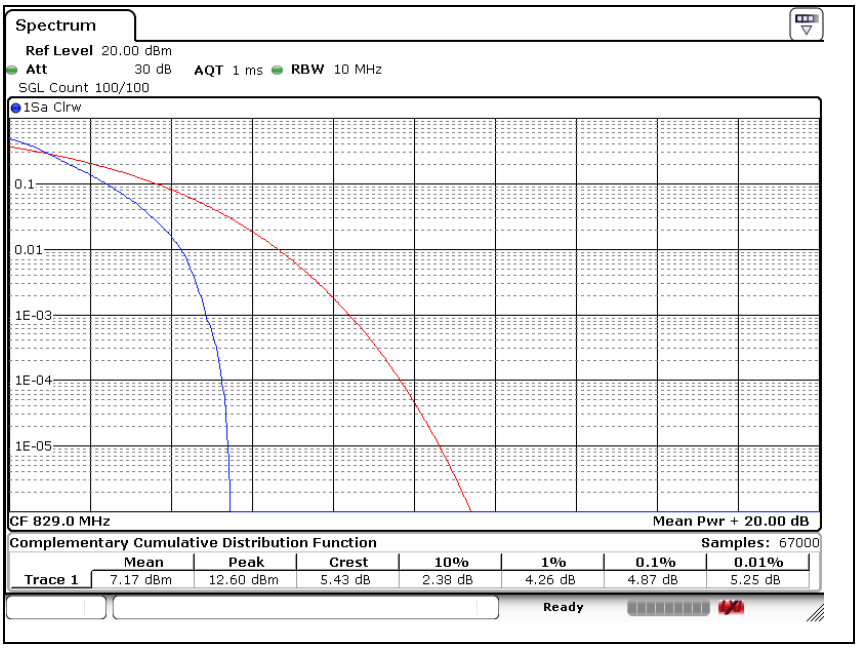
High Channel

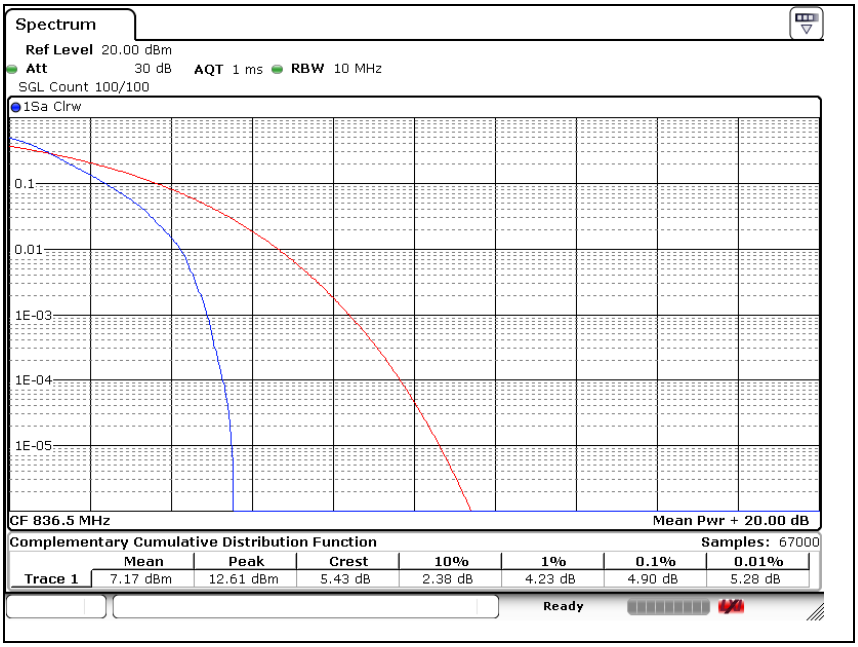


LTE band 5 (10 ㎒ - QPSK)

Low Channel



Middle Channel



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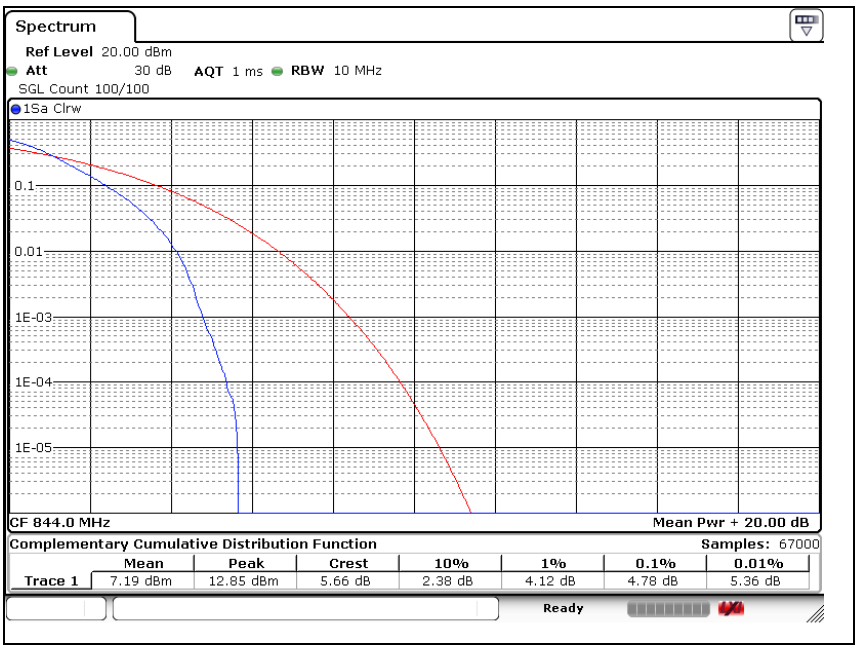
High Channel



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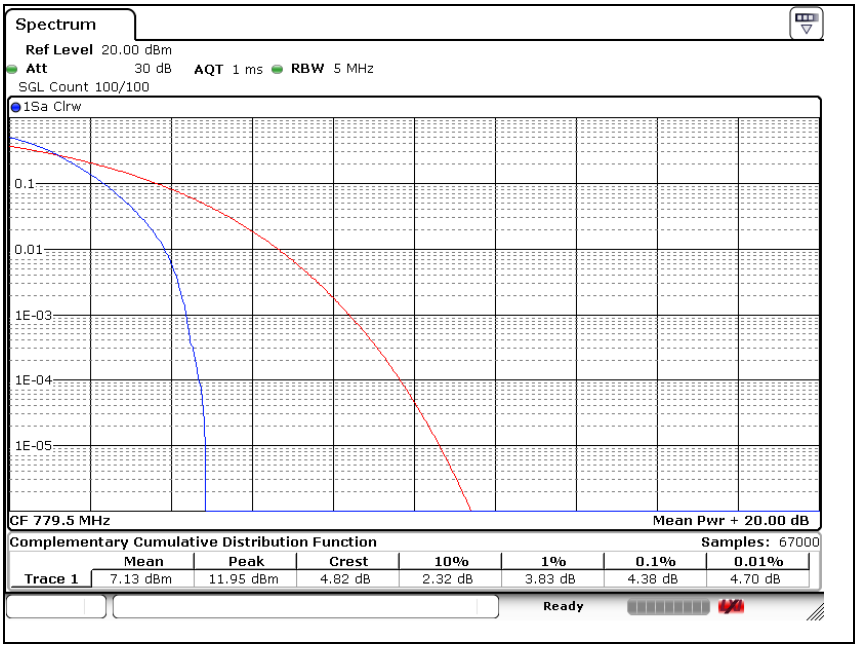
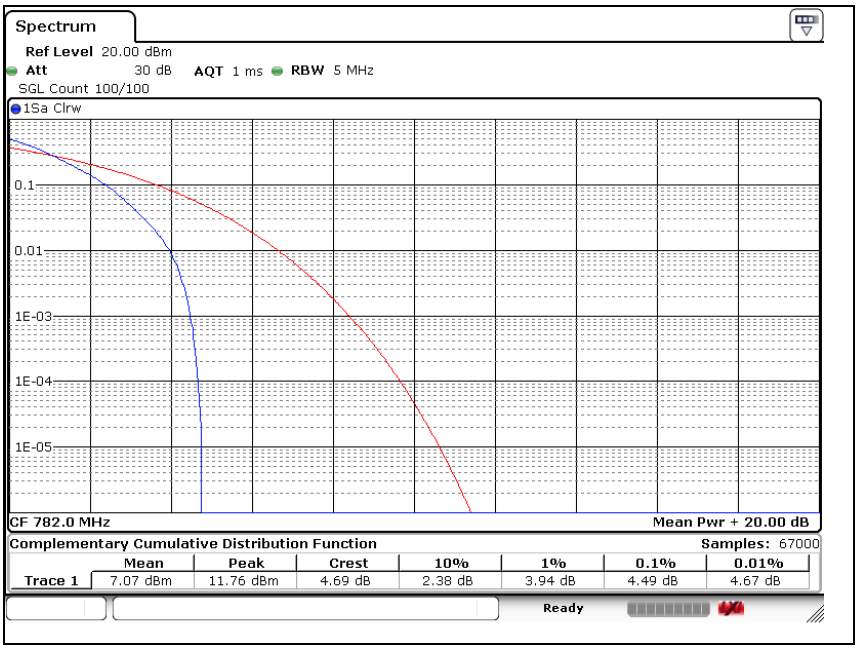
LTE band 13 (5 ㎒ - QPSK)

Low Channel



Middle Channel



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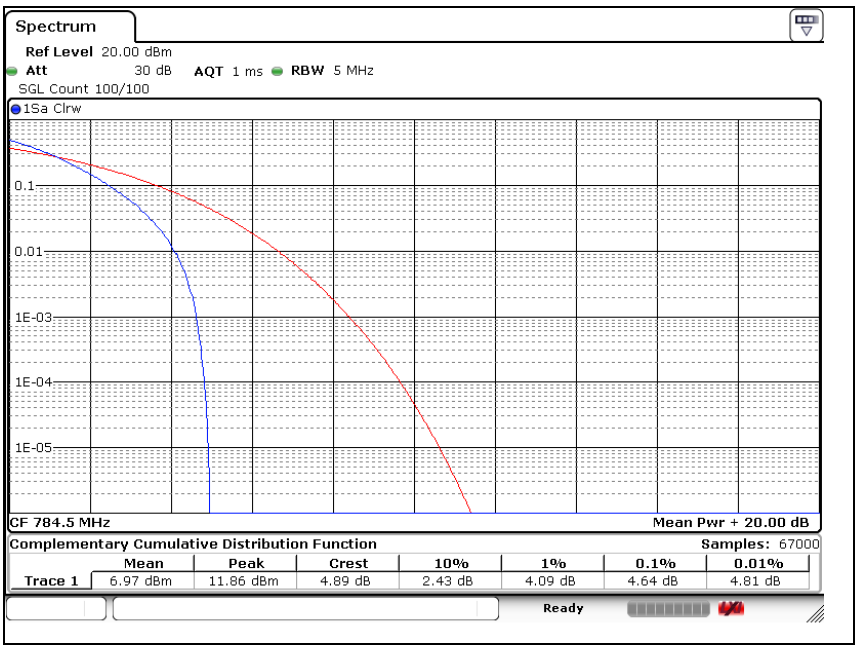
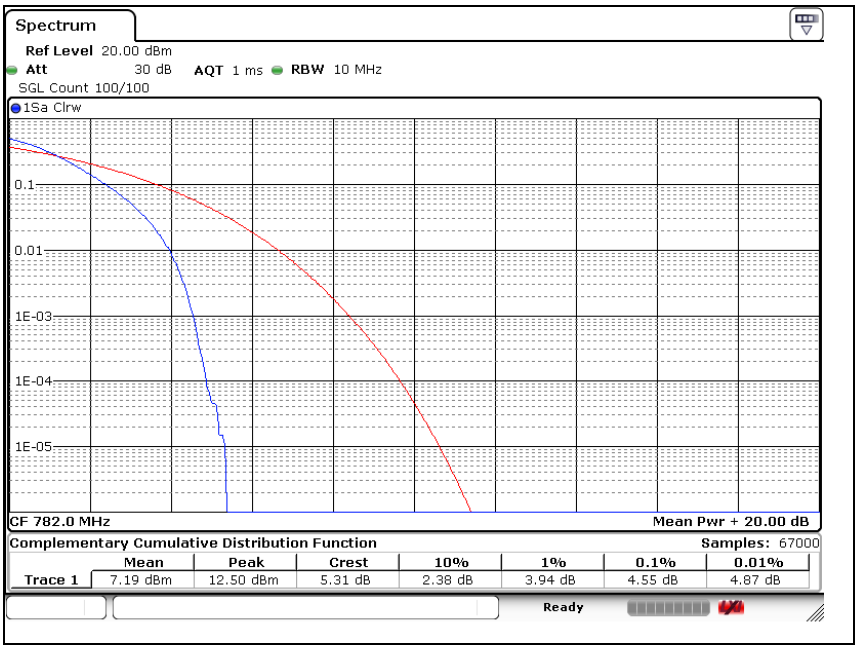
High Channel



LTE band 13 (10 ㎒ - QPSK)

Middle Channel



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6. Spurious Emissions at Antenna Terminal

6.1. Limit

- §22.917(a), 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 + 10log(P) ㎧.

- §24.238(a), 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) ㎧.

- §27.53(c)(2), on any frequency outside the 776-788 ㎒ band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) ㎧.

- §27.53(h)(1), for operations in the 1 695-1 710 ㎒, 1 710-1 755 ㎒, 1 755-1 780 ㎒, 1 915-1 920 ㎒, 1 995-2 000 ㎒, 2 000-2 020 ㎒, 2 110-2 155 ㎒, 2 155-2 180 ㎒, and 2 180-2 200 ㎒ bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 $\log_{10}$ (P) ㎧.

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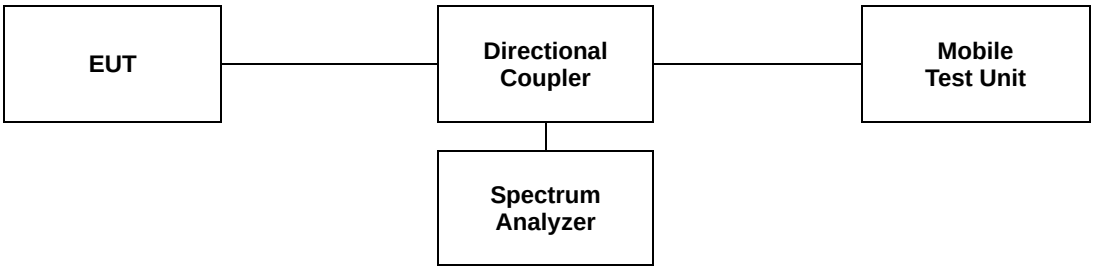
6.2. Test Procedure

The test follows section 6.1 of FCC KDB Publication 971168 D01 v03r01.

a. Start frequency was set to 30 ㎒ and stop frequency was set to at least 10* the fundamental frequency.
b. Detector = Peak.
c. Trace mode = Max hold.
d. Sweep time = Auto couple.
e. The trace was allowed to stabilize.
f. Please see notes below for RBW and VBW settings.
g. For plots showing conducted spurious emissions from 30 ㎒ to 20 ㎓, all path loss of wide frequency range was investigated and compensated to spectrum analyzer as TDF function.



Notes;

Compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 100 ㎑ or greater for frequencies less than 1 ㎓ and frequencies greater than 1 ㎓. However, in the 1 ㎒ bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two point, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 ㏈ below the transmitter power.

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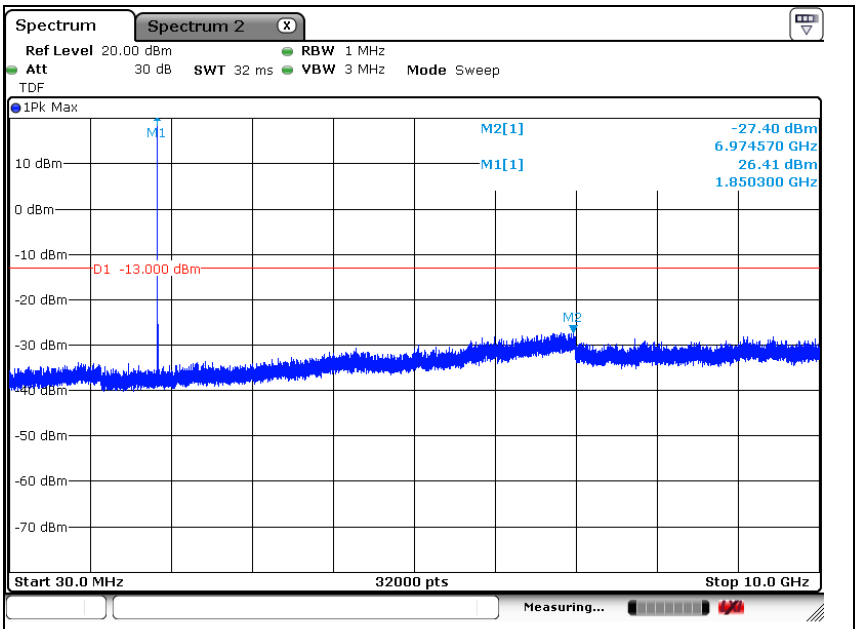
6.3. Test Results

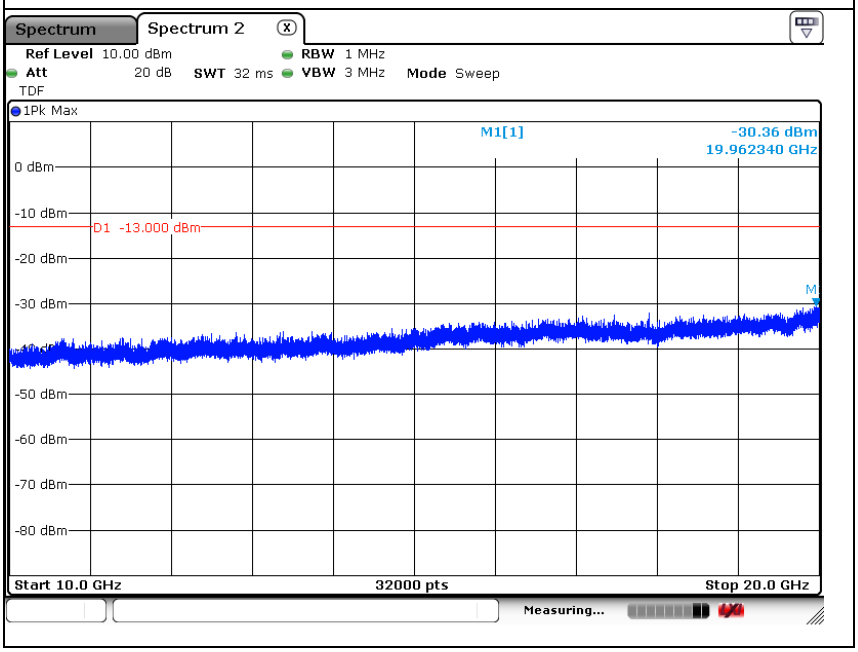
Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Please refer to the following plots.

LTE band 2 (1.4 ㎒ - QPSK)

Low Channel





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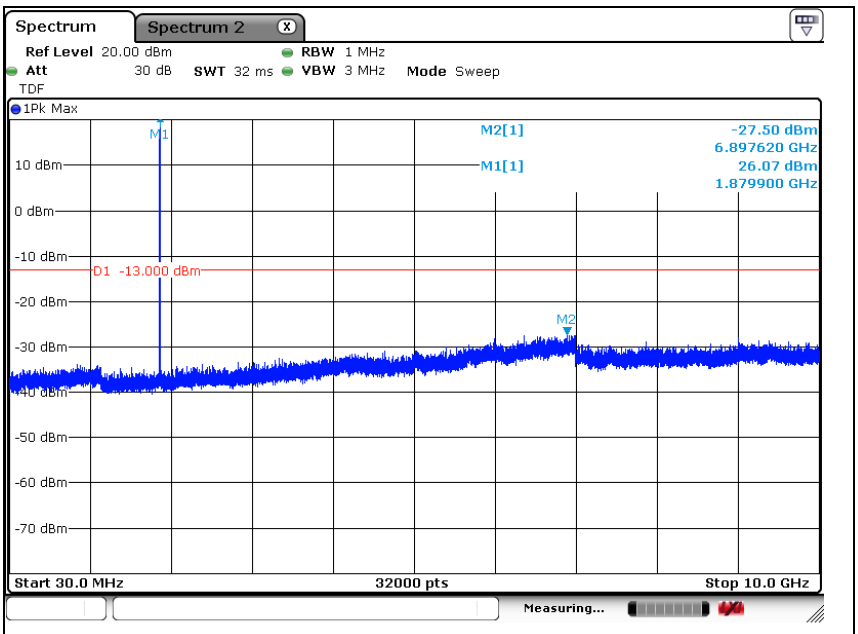
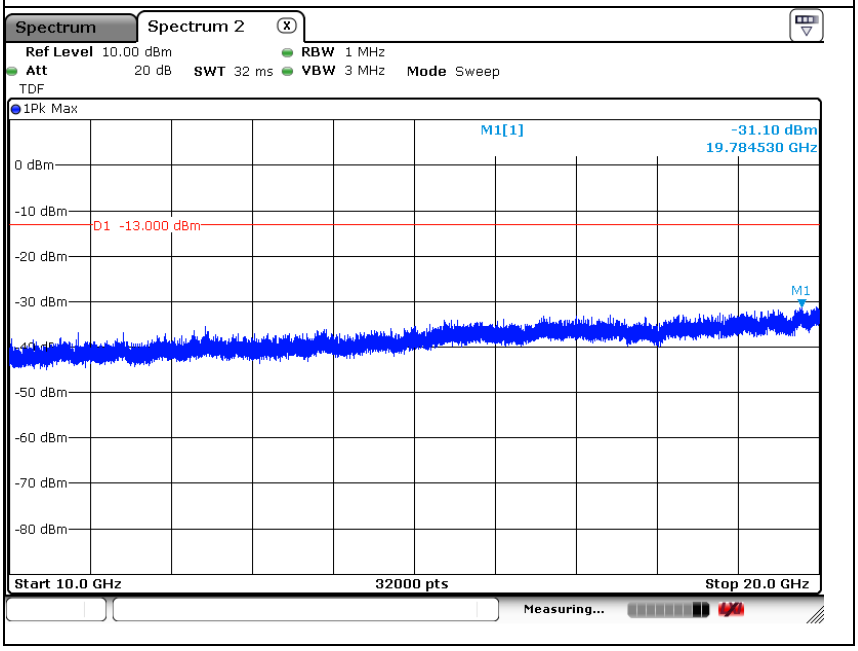
Middle Channel





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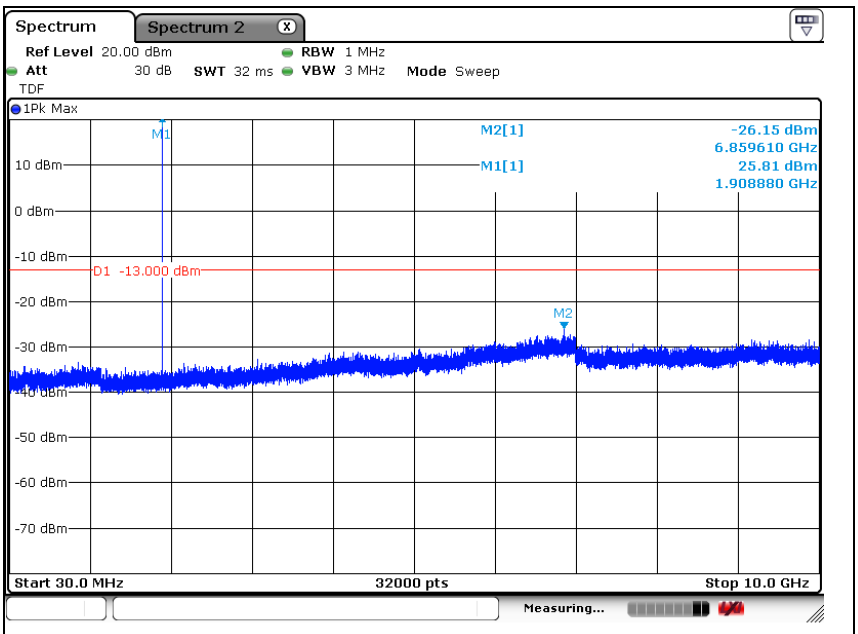
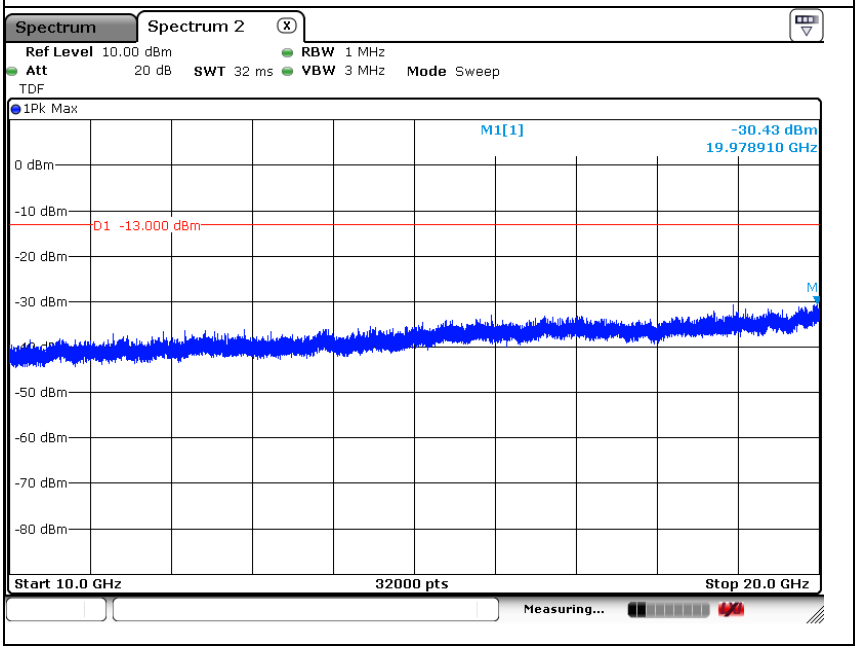
High Channel





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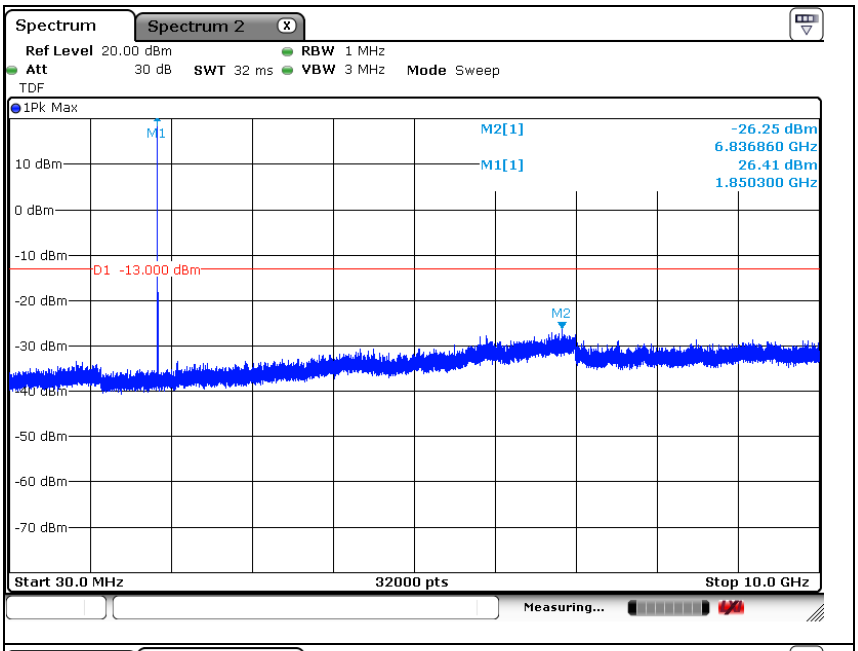
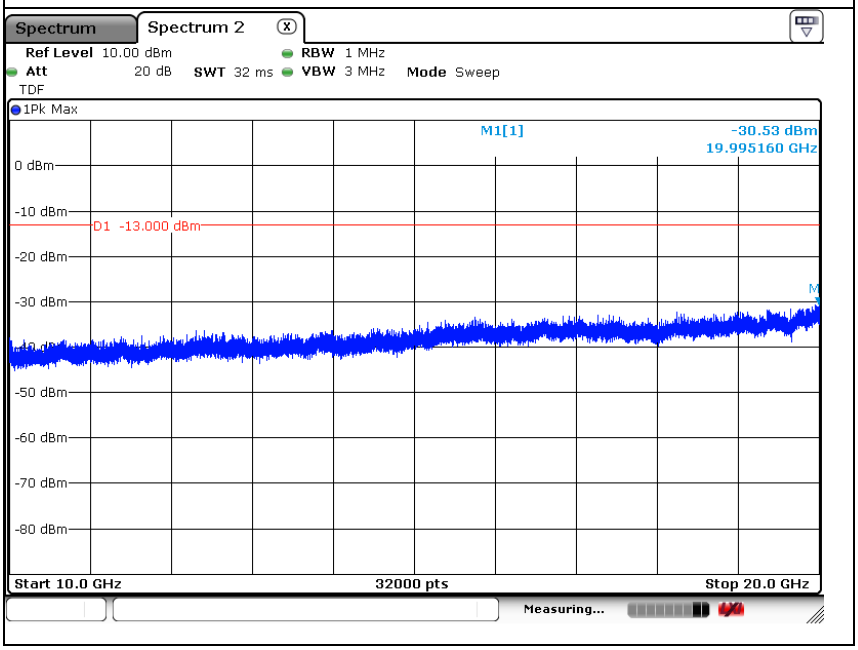
LTE band 2 (3 ㎒ - QPSK)

Low Channel





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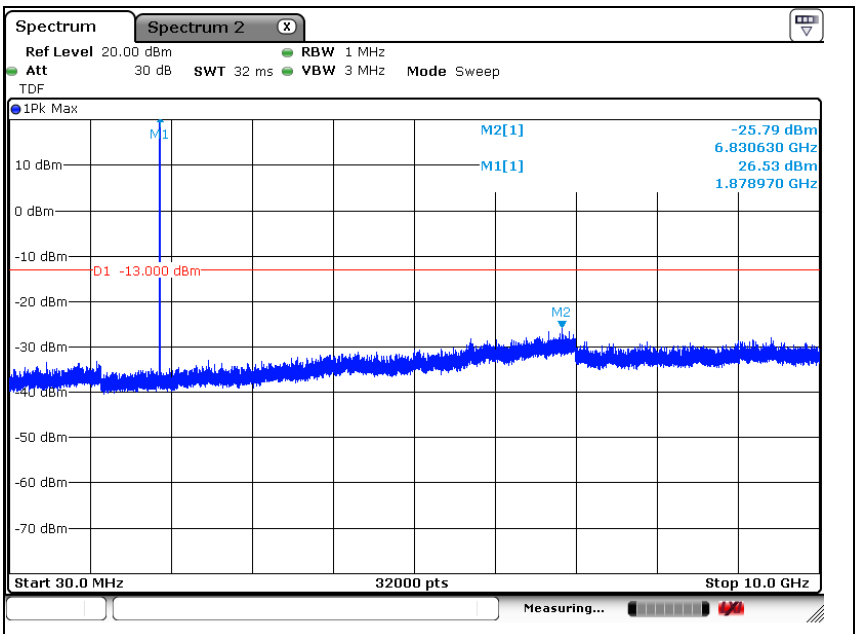
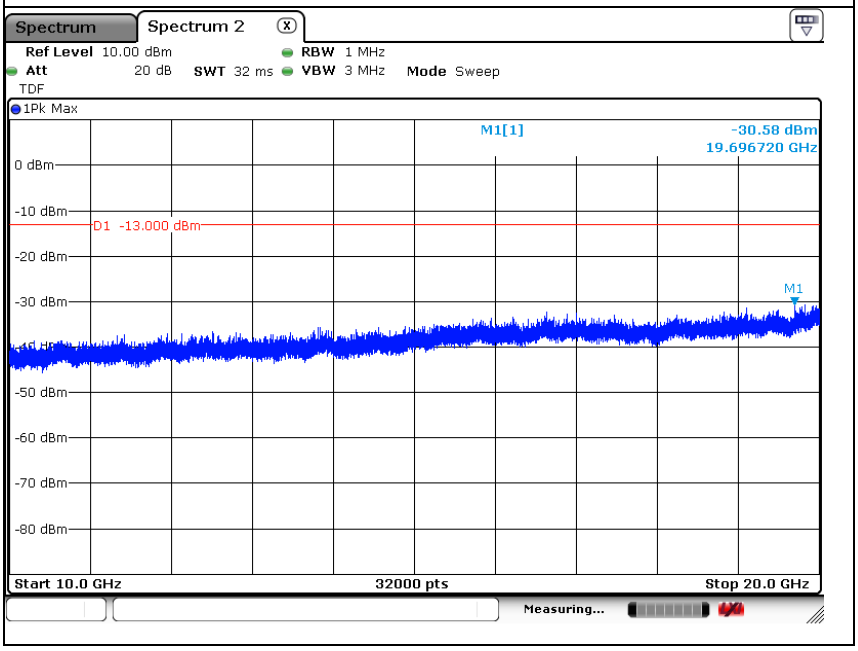
Middle Channel





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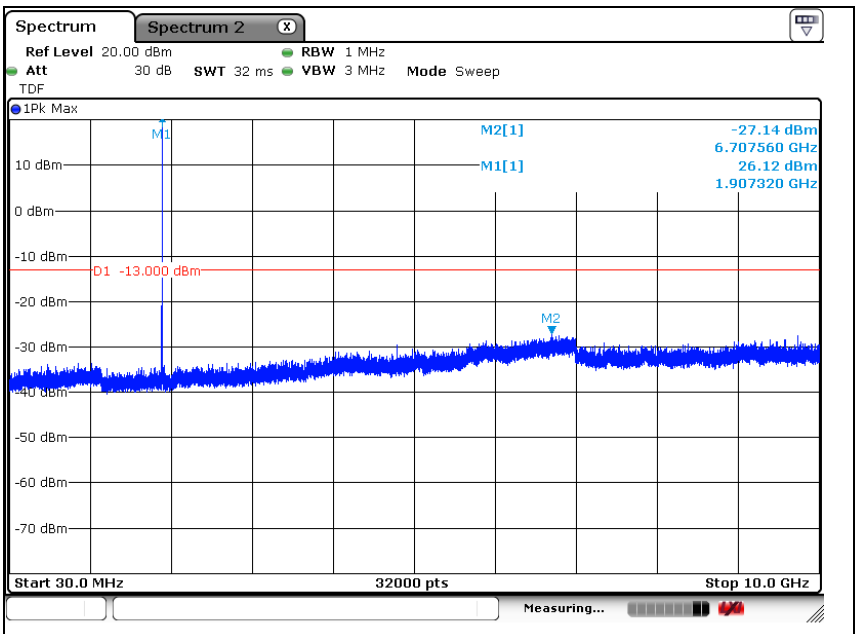
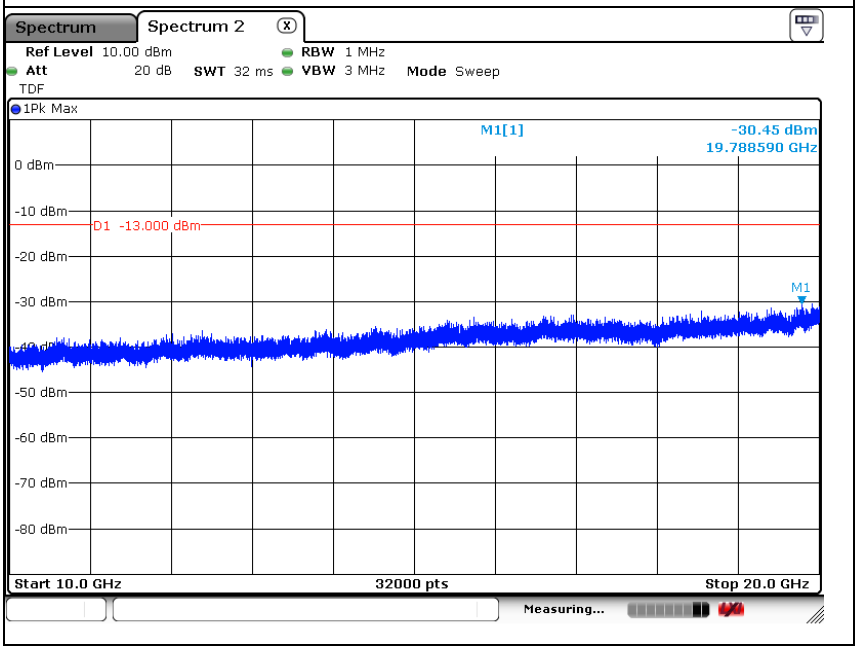
High Channel





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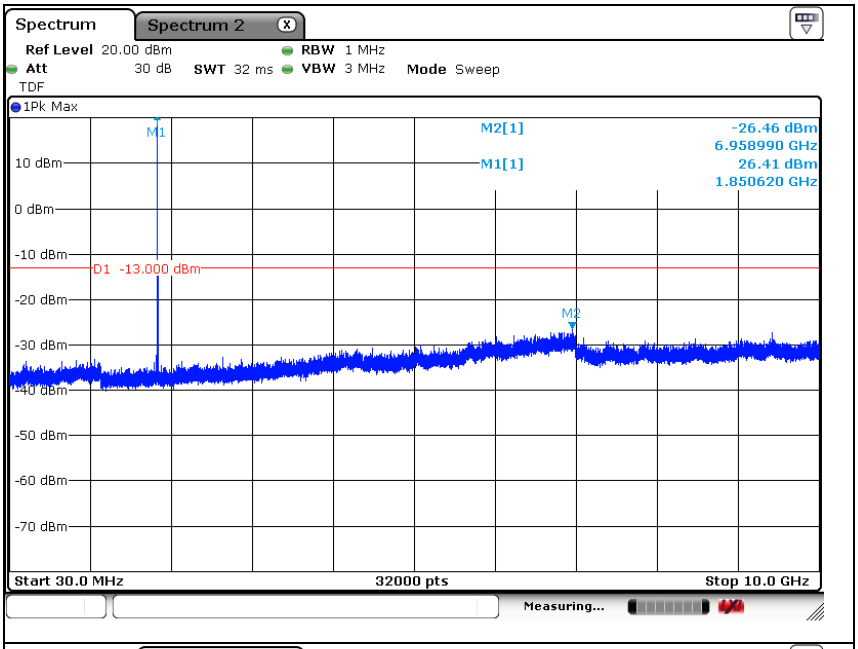
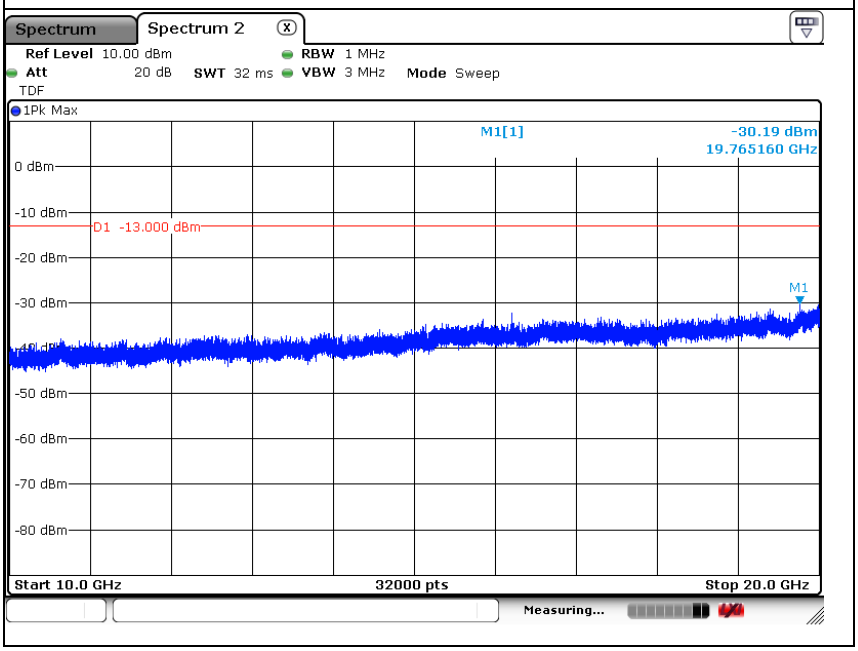
LTE band 2 (5 ㎒ - QPSK)

Low Channel





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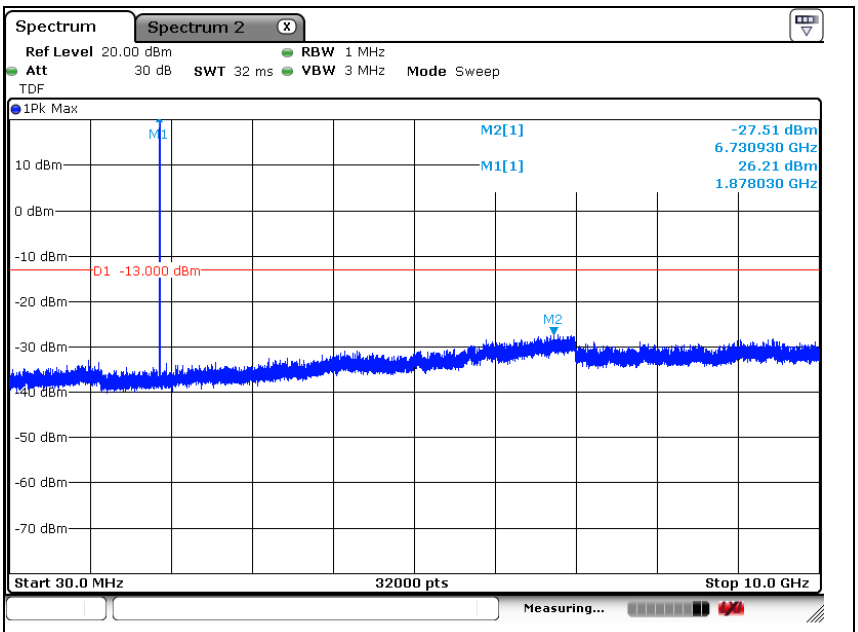
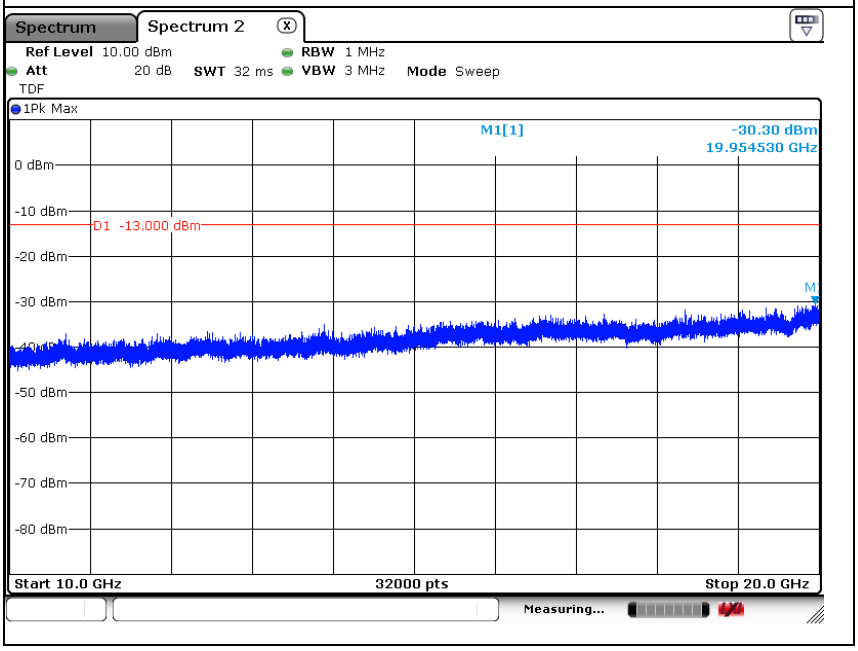
Middle Channel





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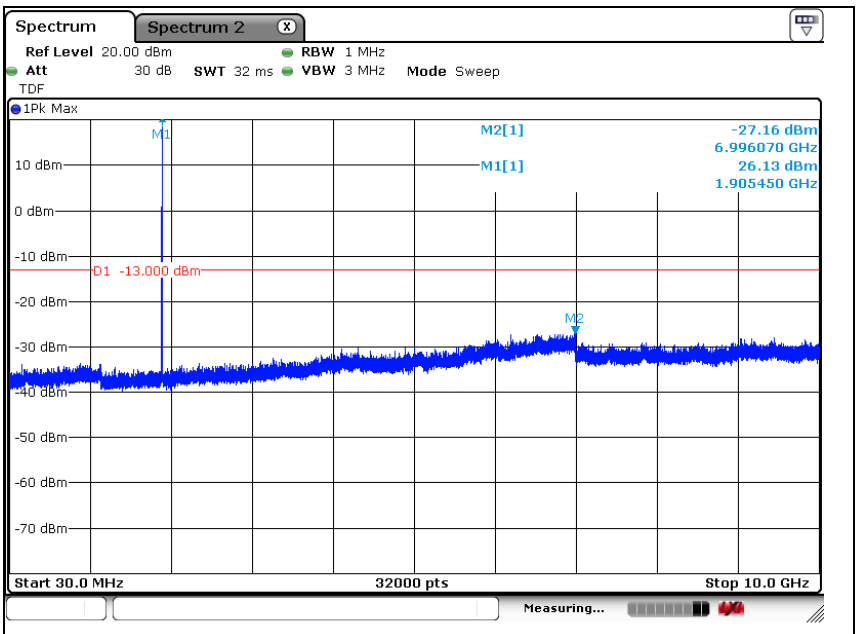
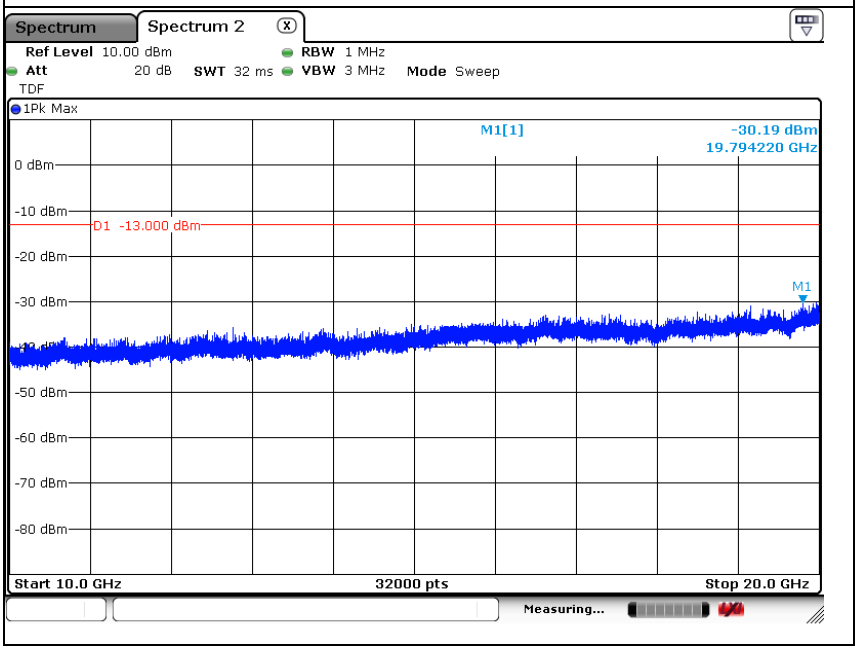
High Channel





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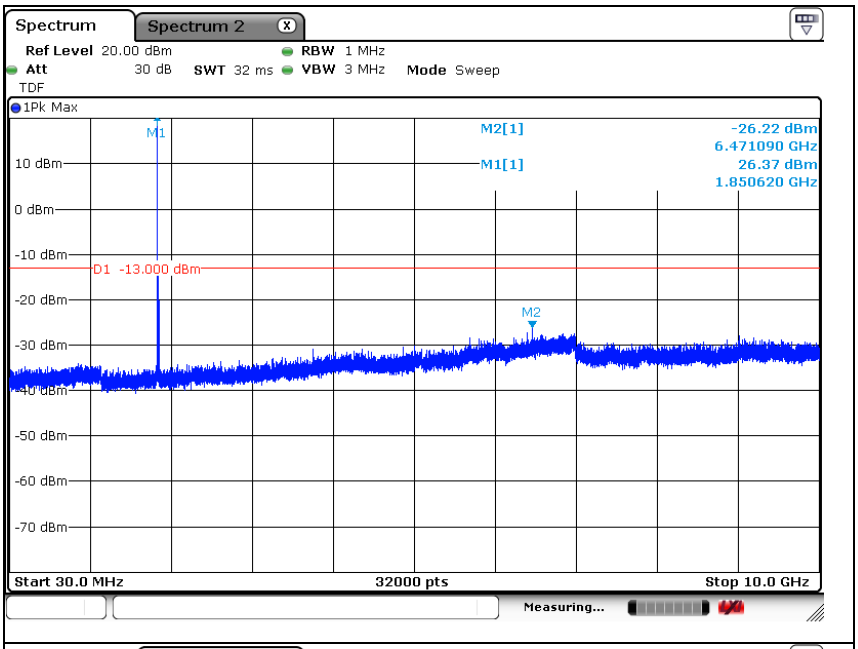
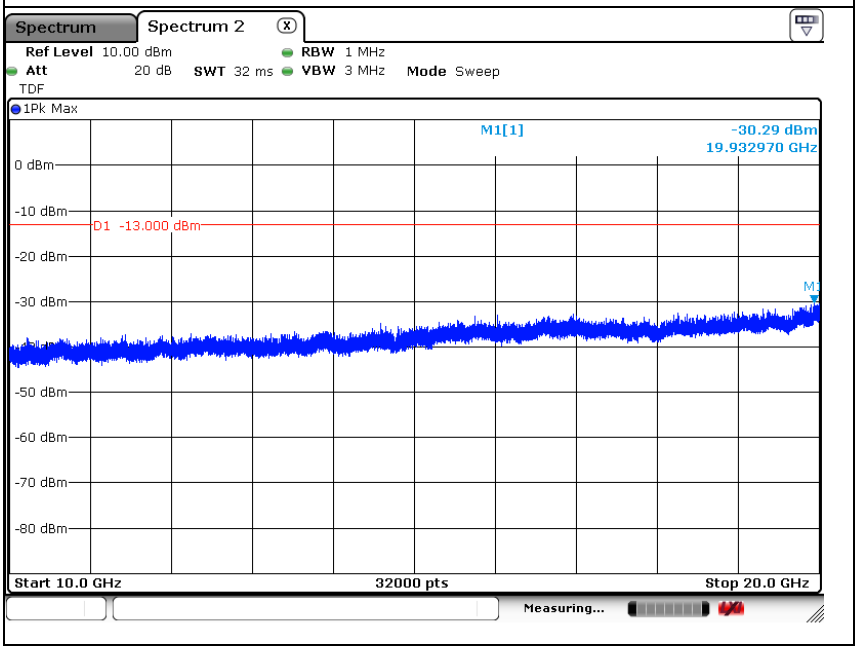
LTE band 2 (10 ㎒ - QPSK)

Low Channel





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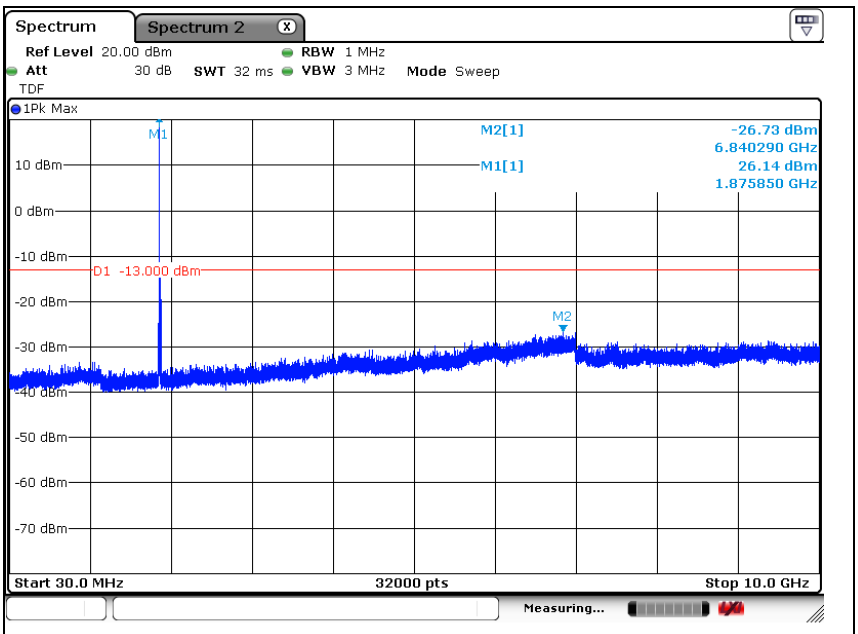
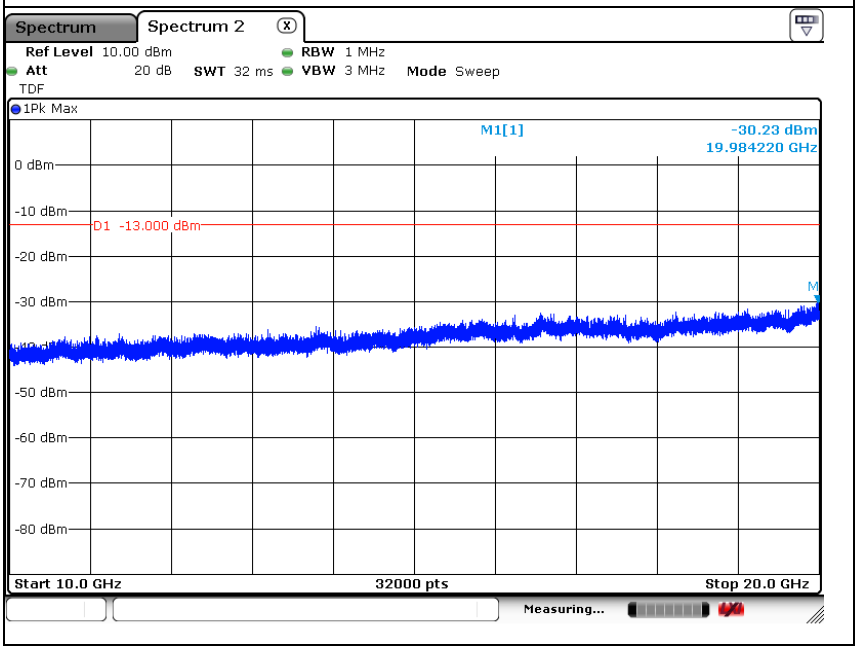
Middle Channel





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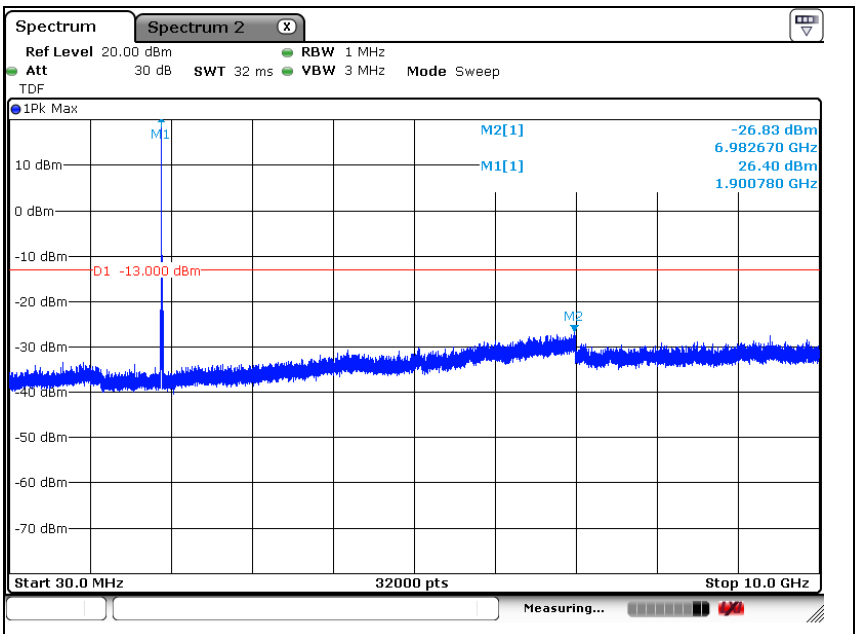
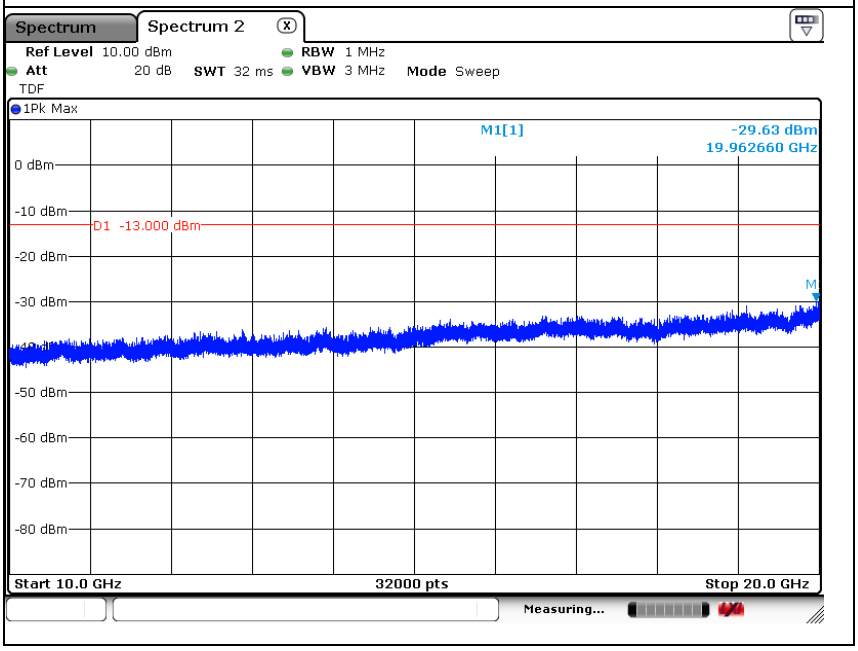
High Channel





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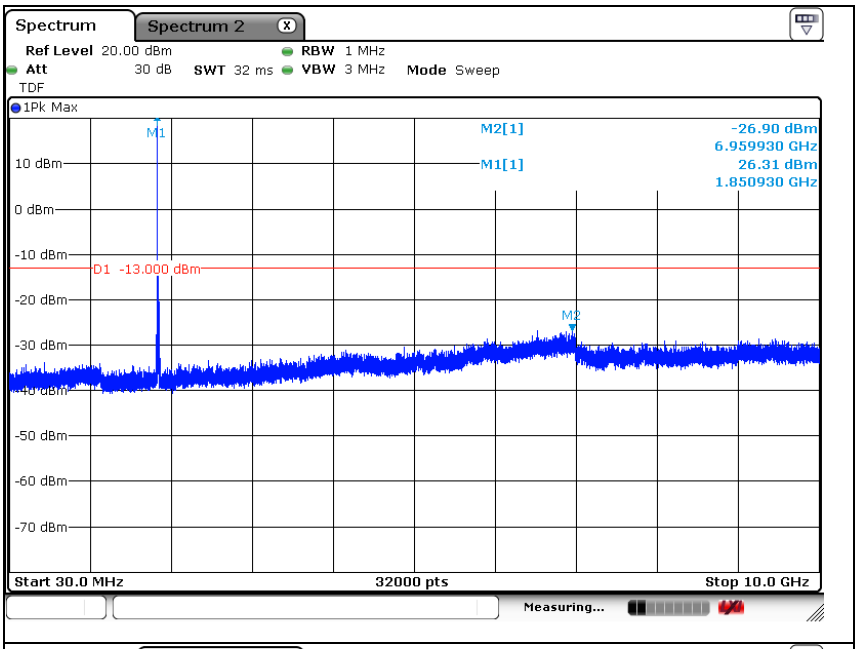
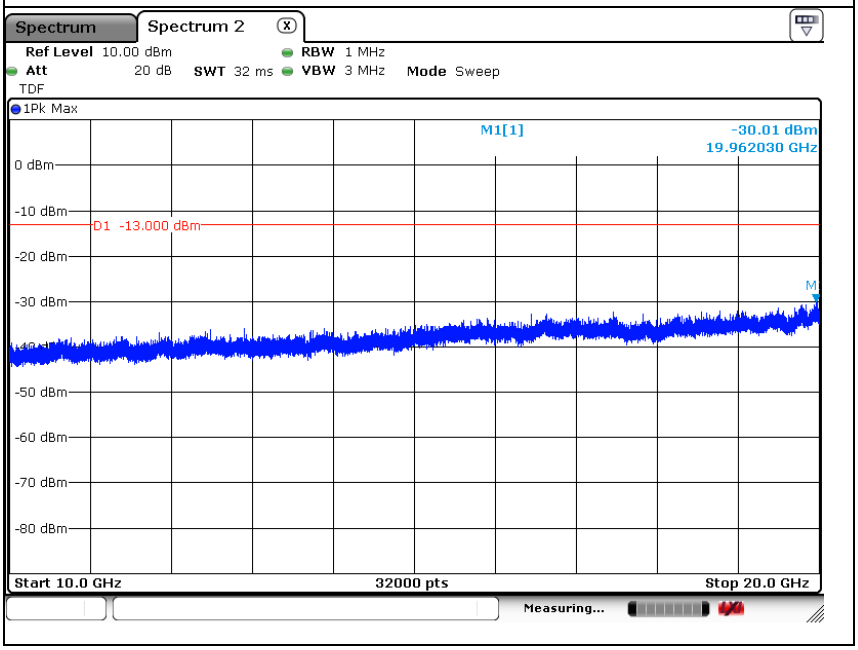
LTE band 2 (15 ㎒ - QPSK)

Low Channel





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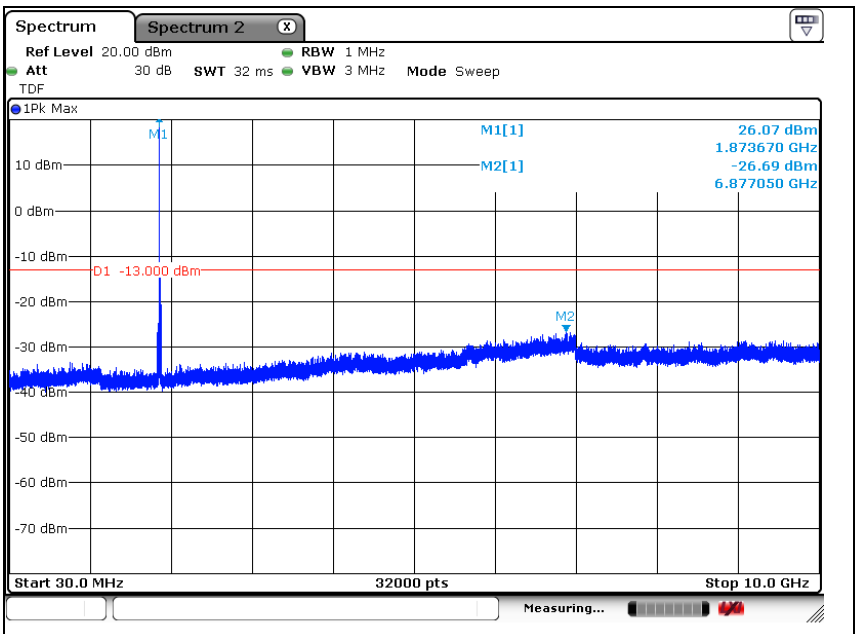
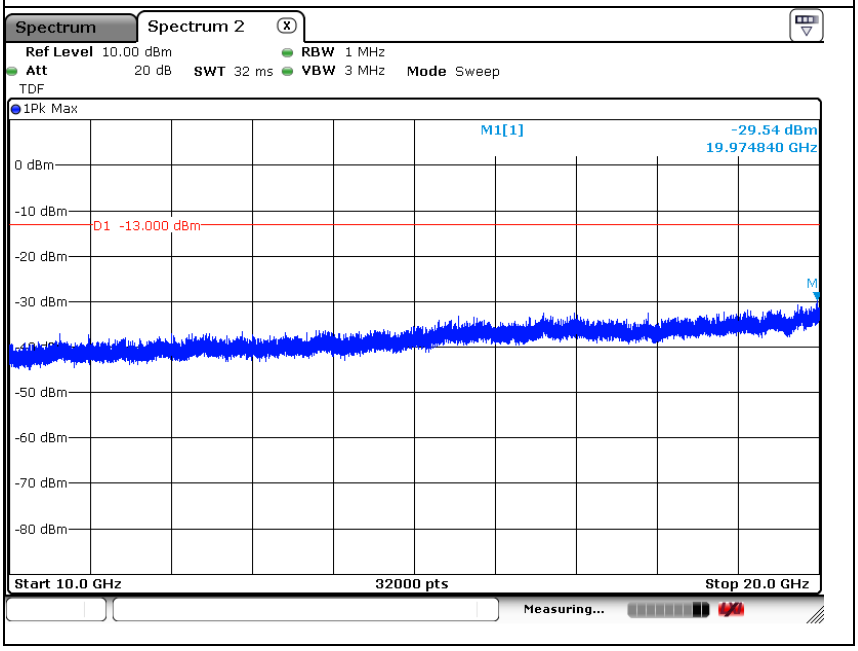
Middle Channel





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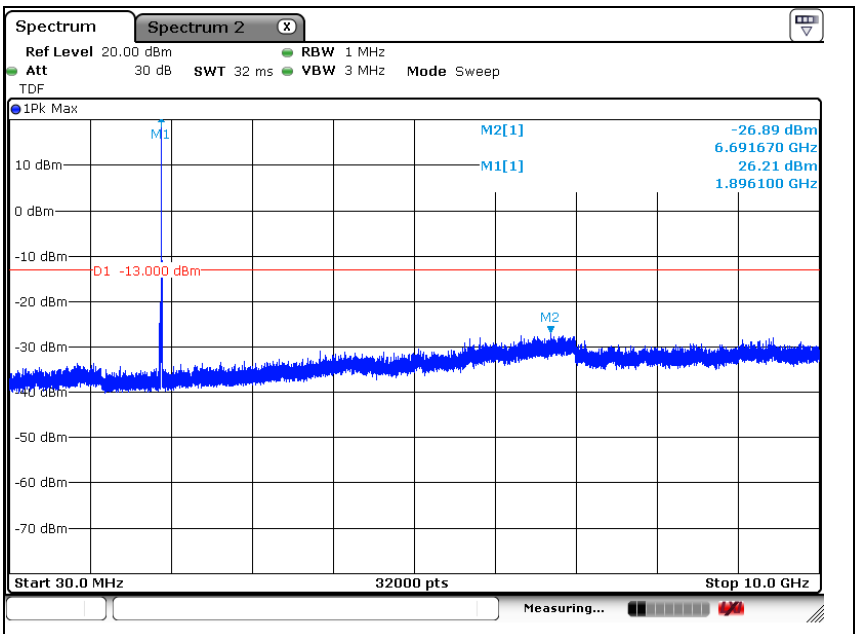
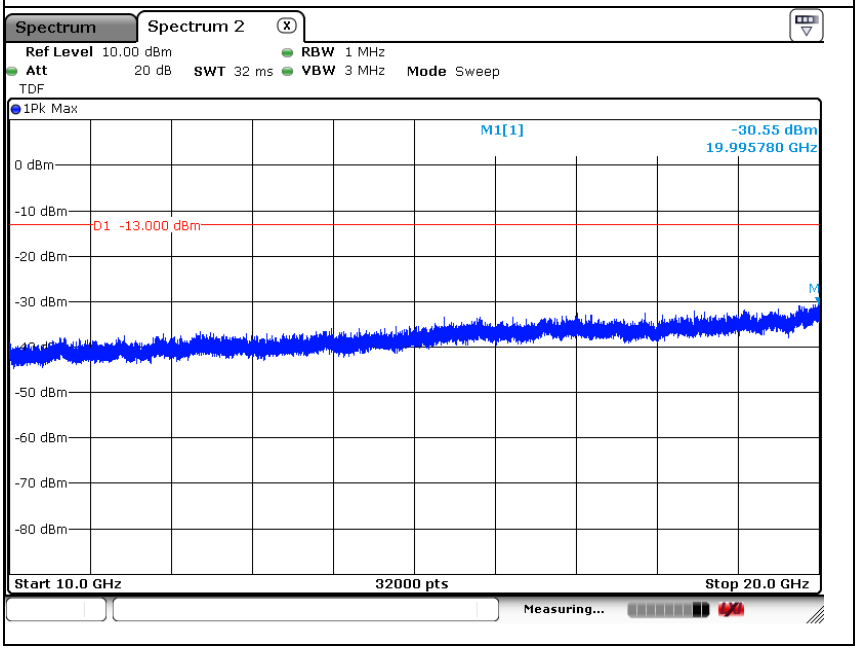
High Channel





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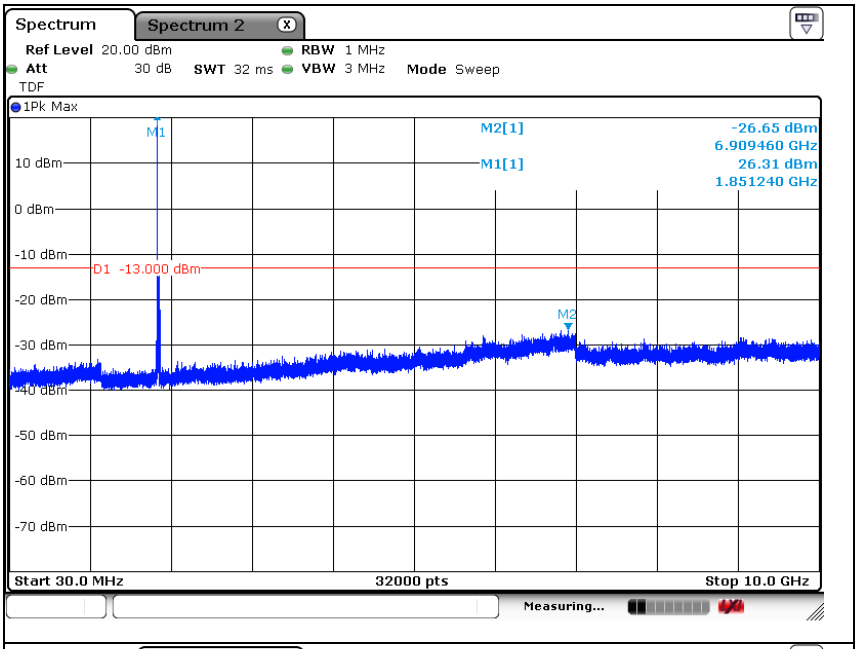
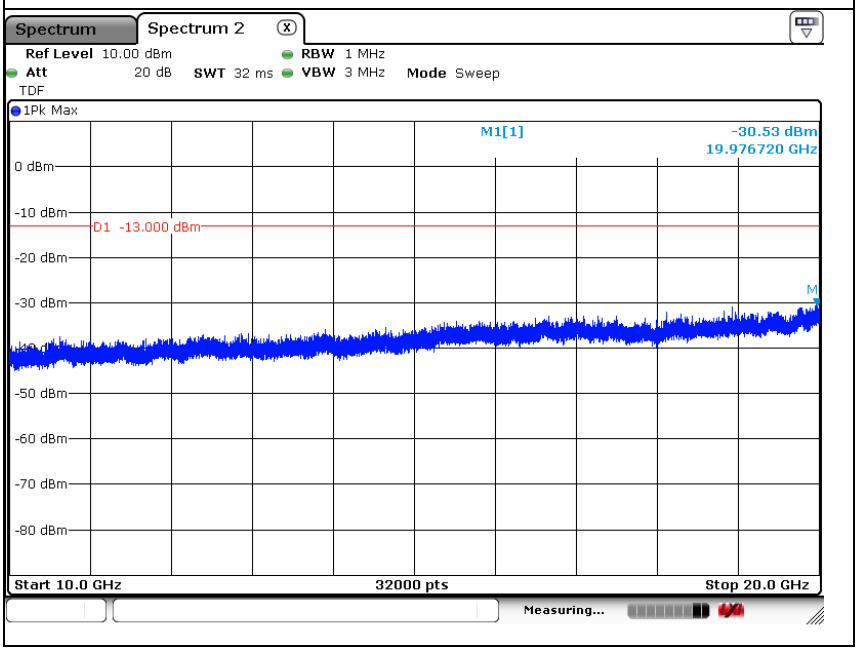
LTE band 2 (20 ㎒ - QPSK)

Low Channel





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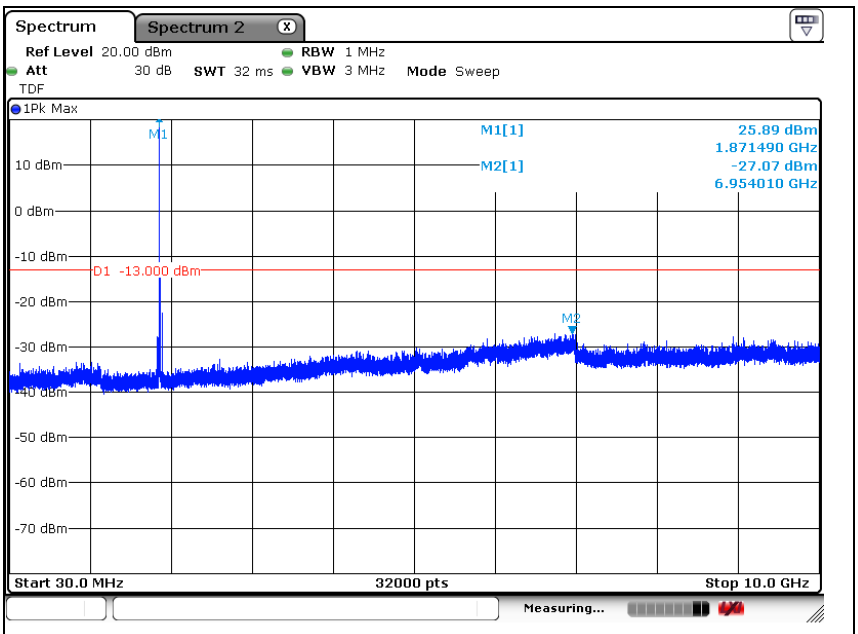
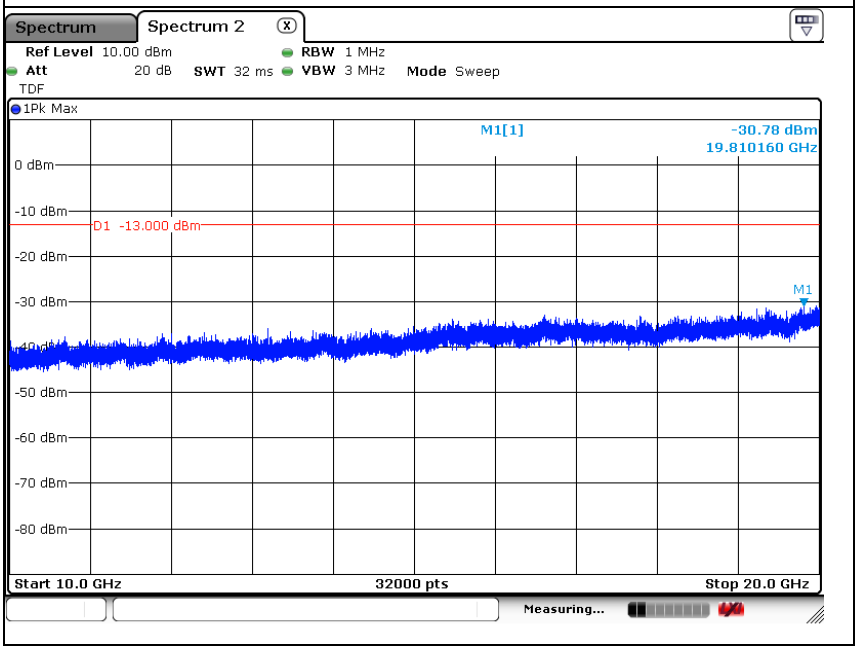
Middle Channel





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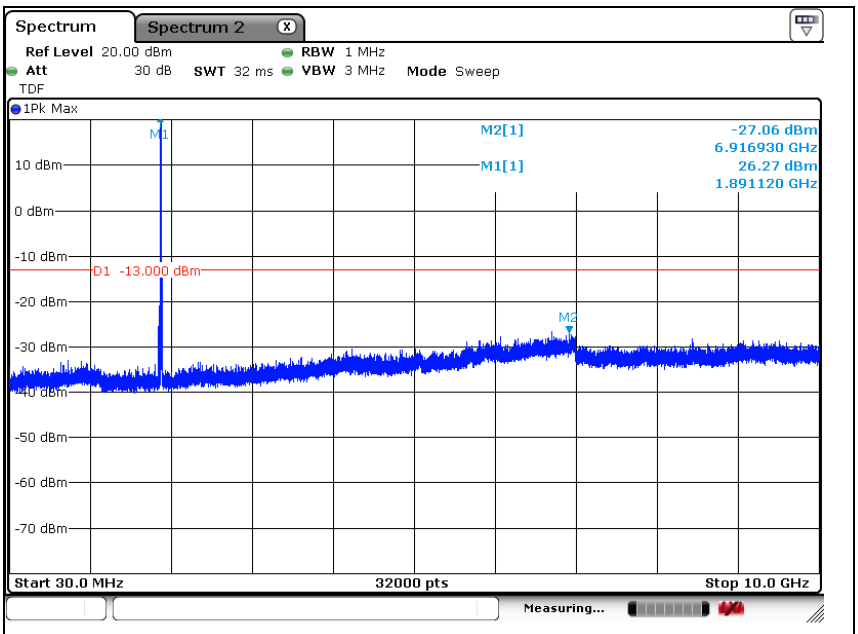
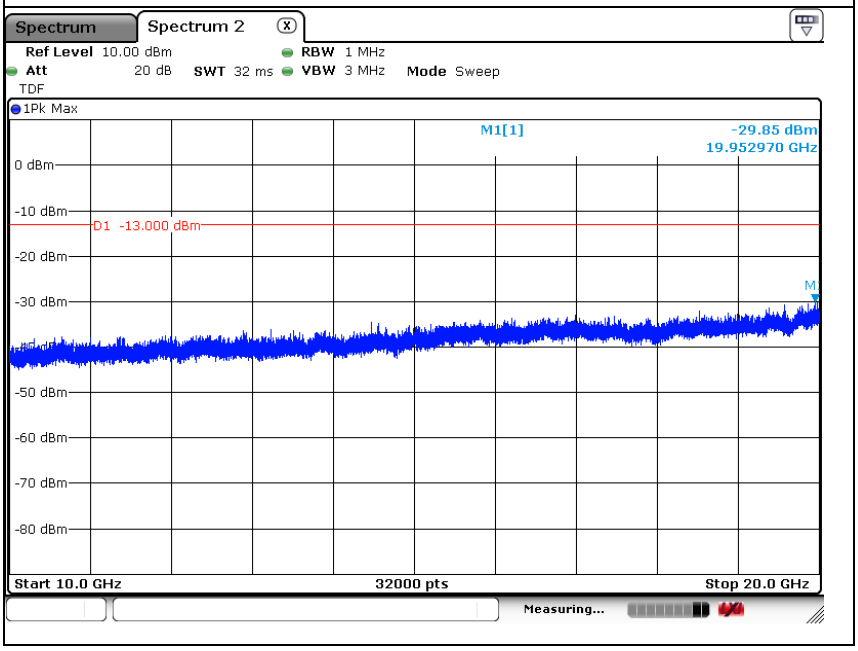
High Channel





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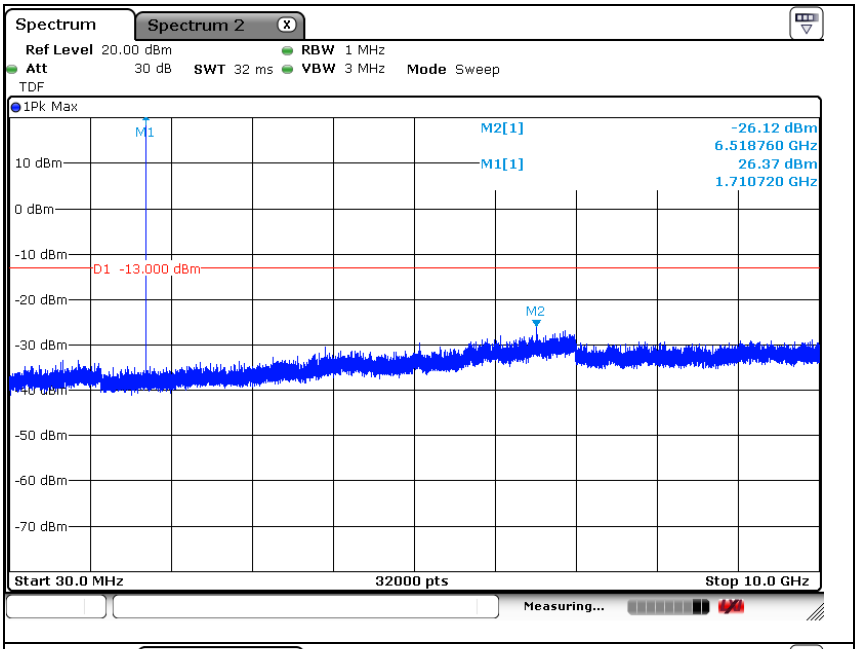
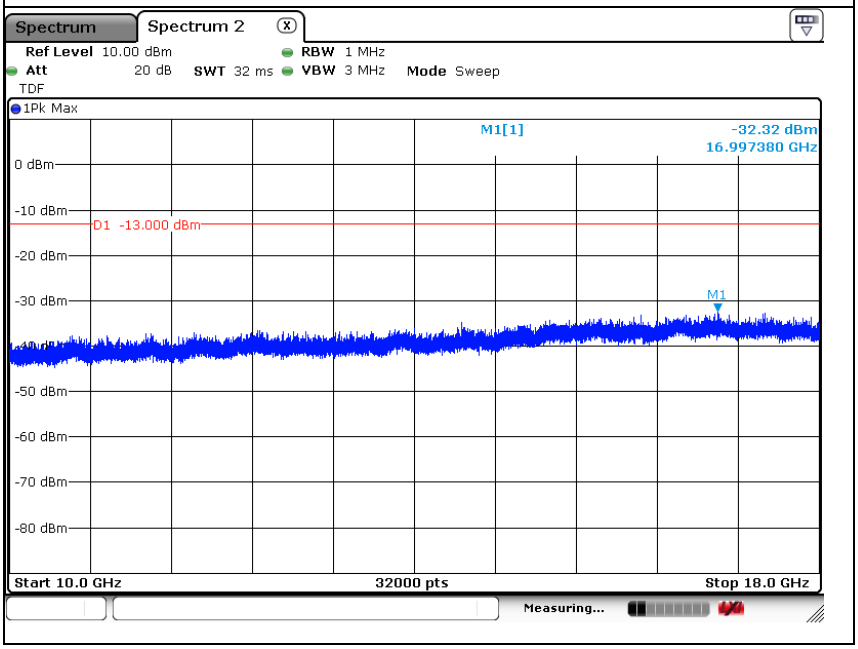
LTE band 4 (1.4 ㎒ - QPSK)

Low Channel





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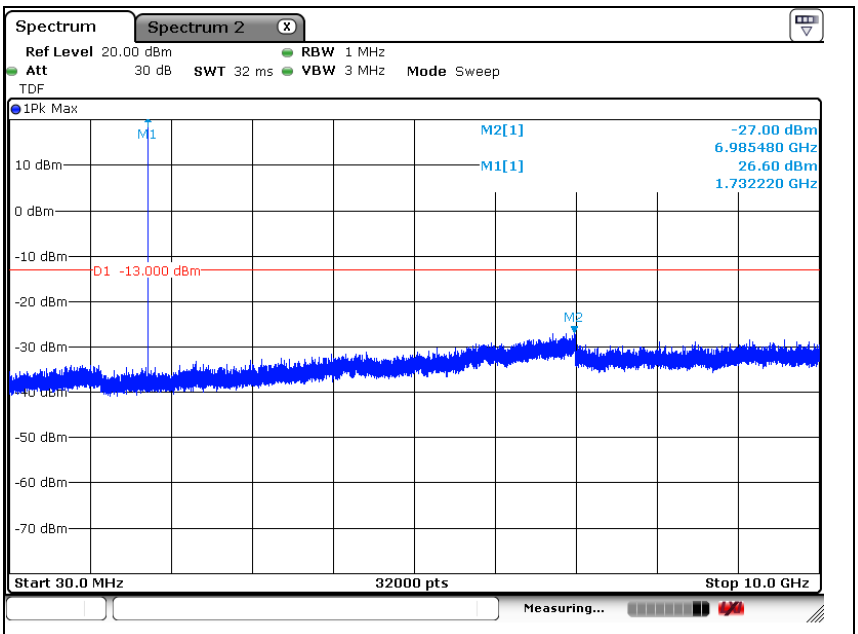
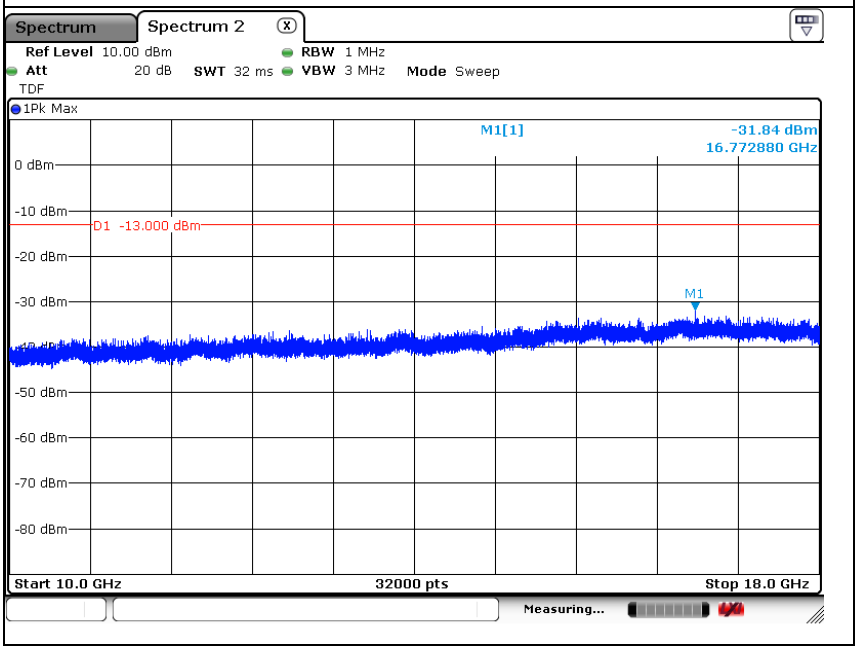
Middle Channel





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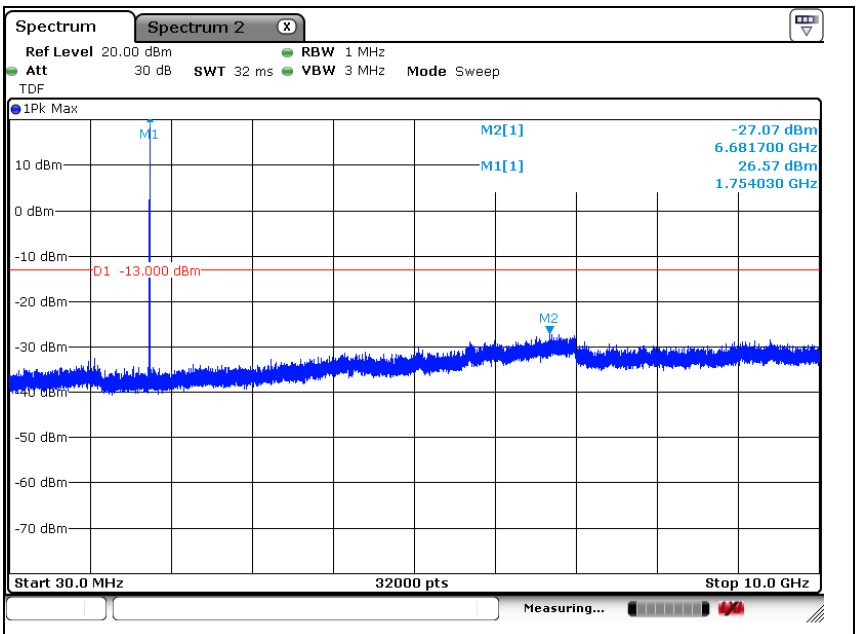
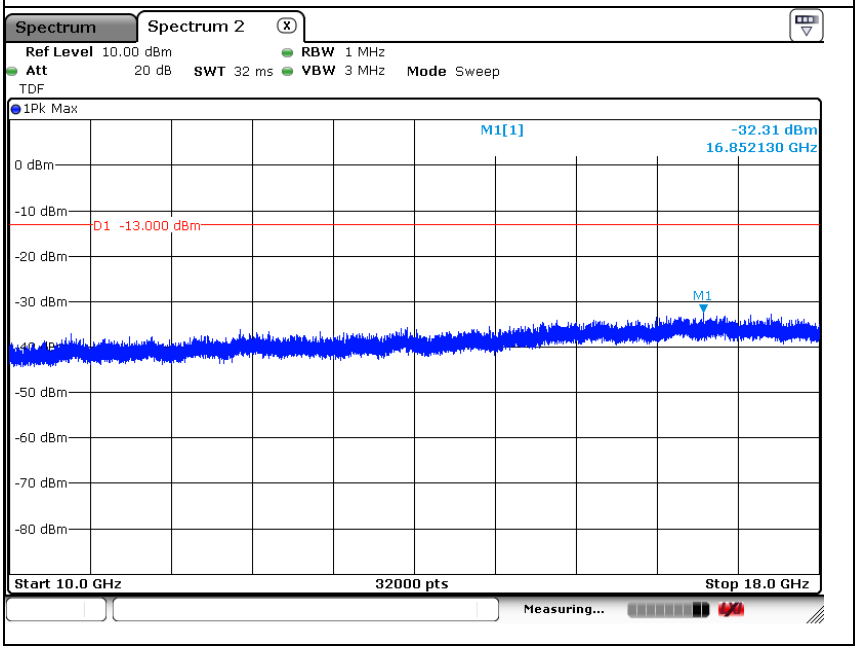
High Channel





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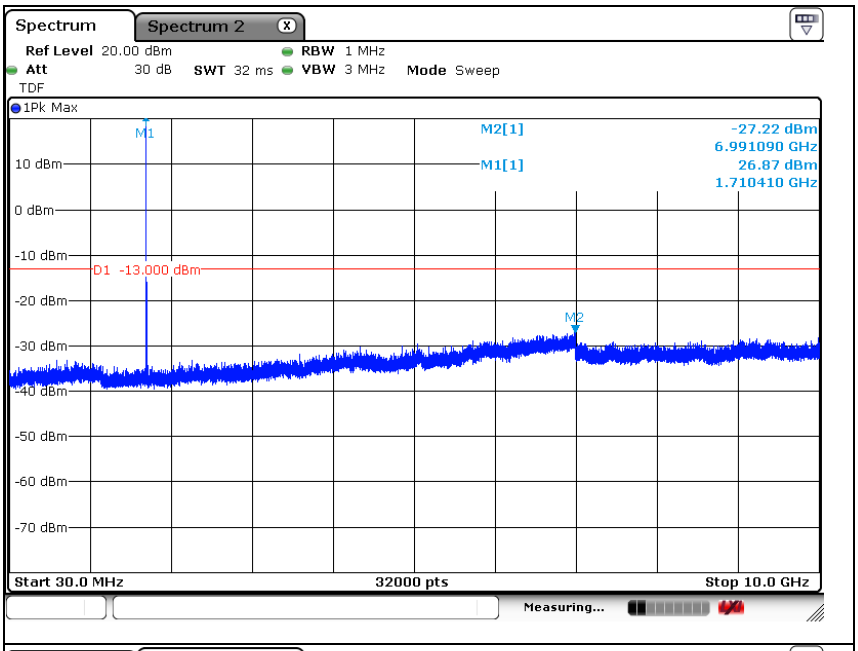
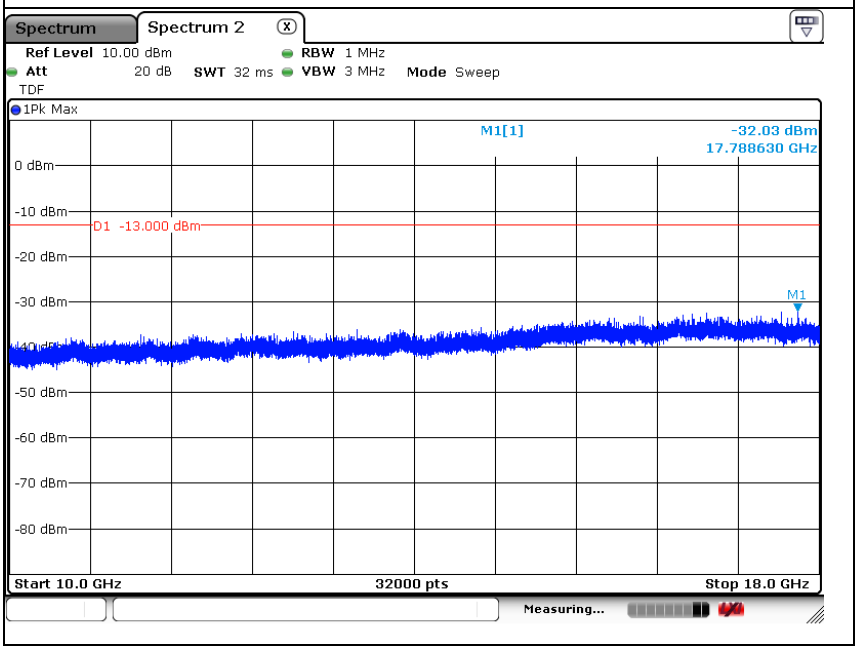
LTE band 4 (3 ㎒ - QPSK)

Low Channel





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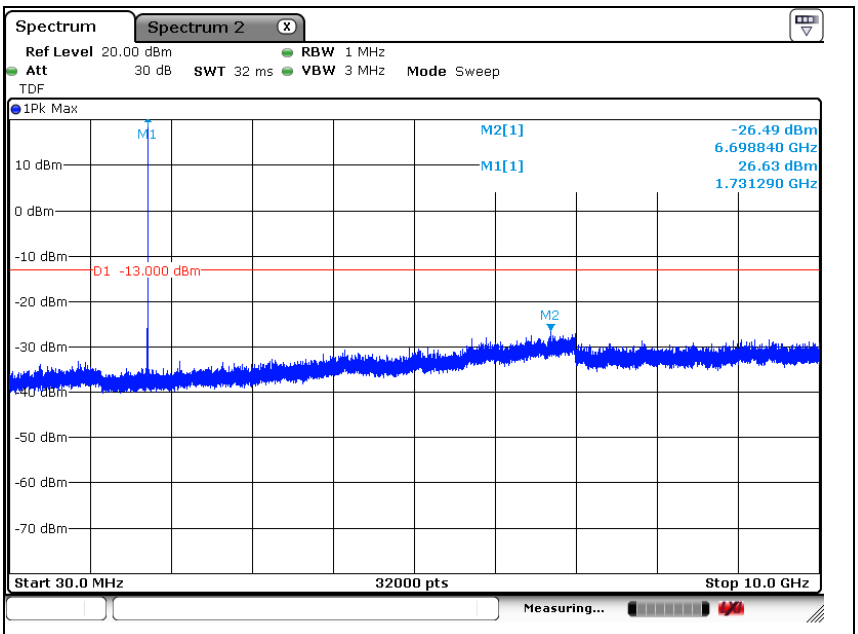
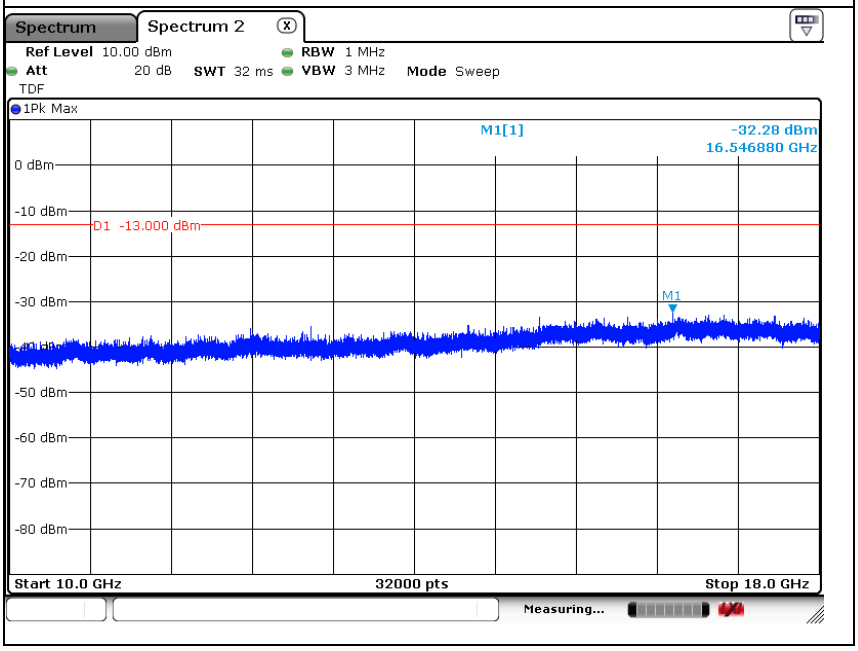
Middle Channel





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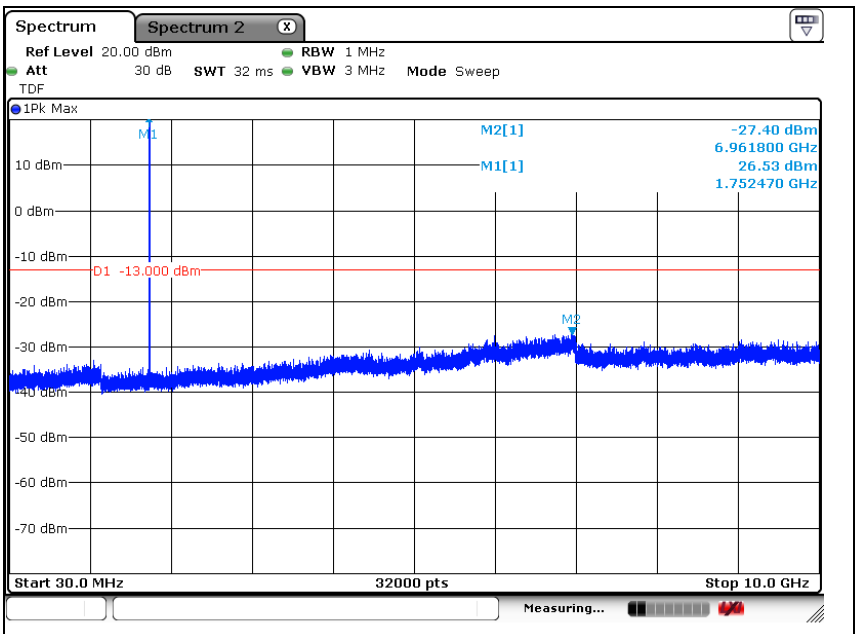
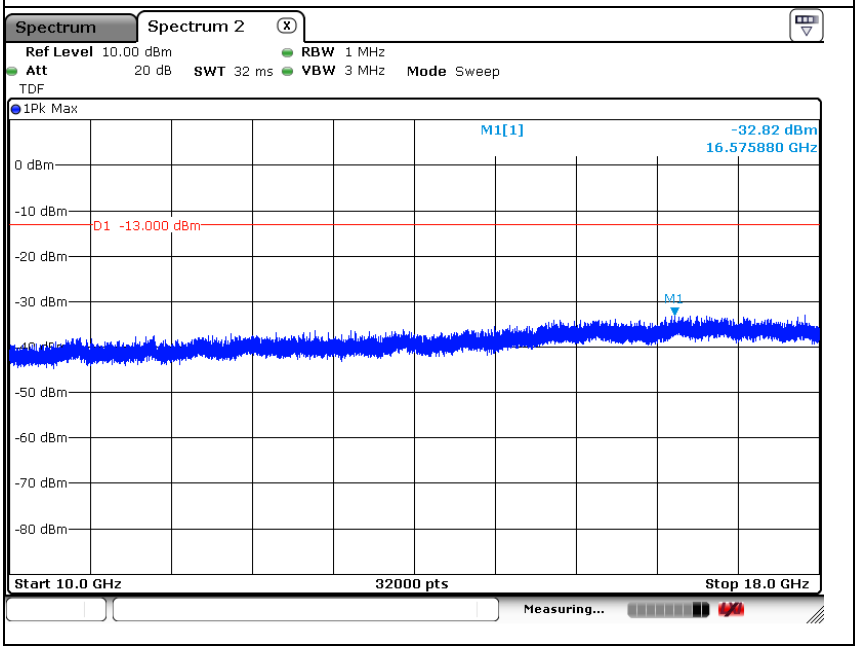
High Channel





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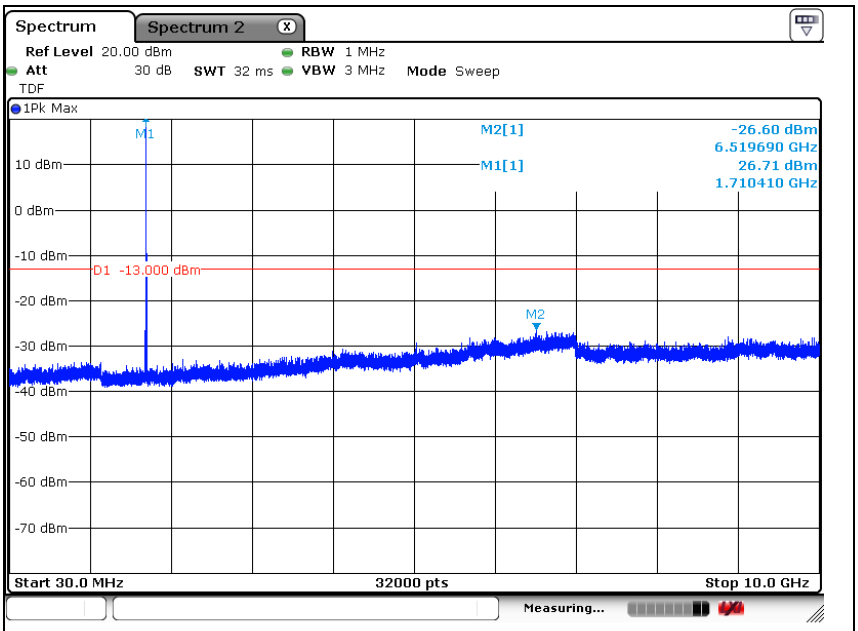
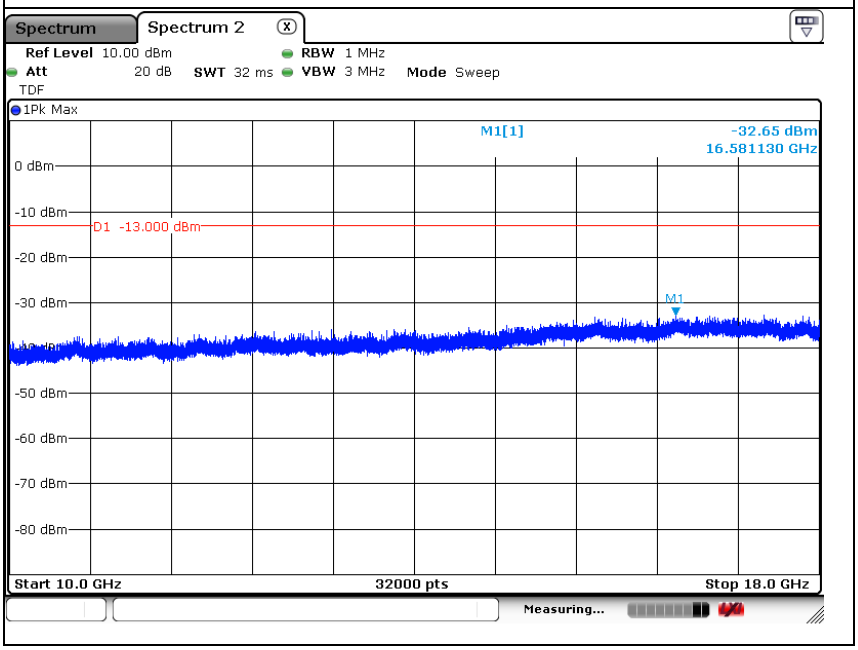
LTE band 4 (5 ㎒ - QPSK)

Low Channel





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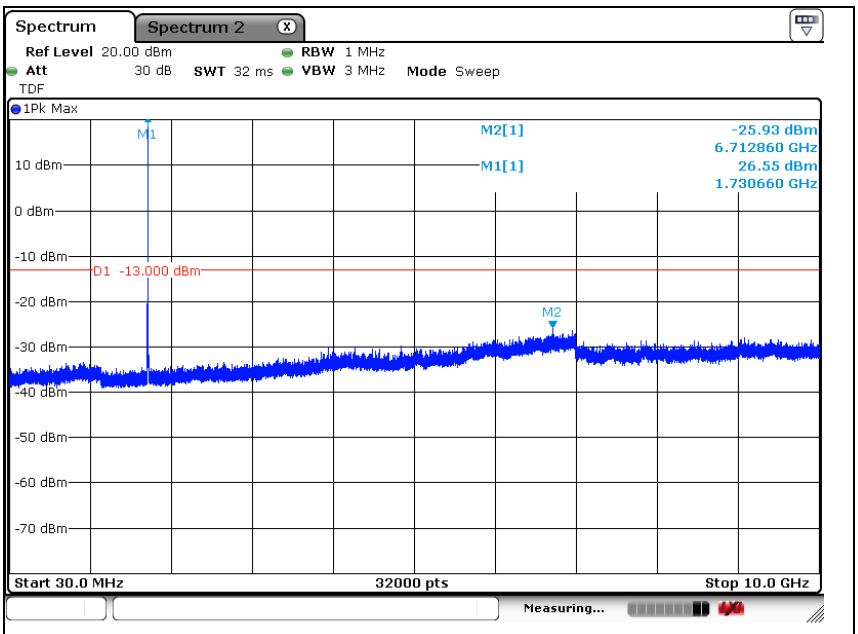
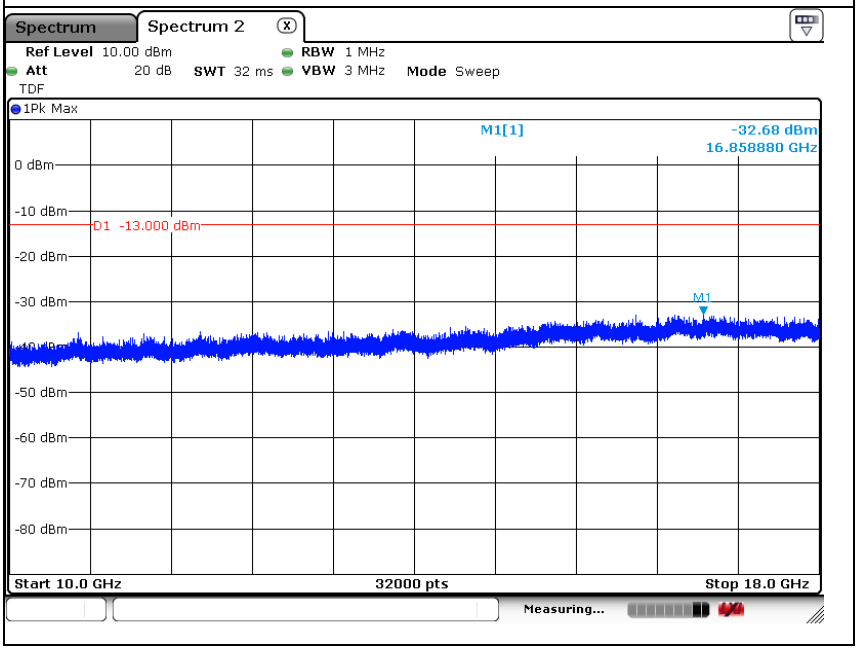
Middle Channel





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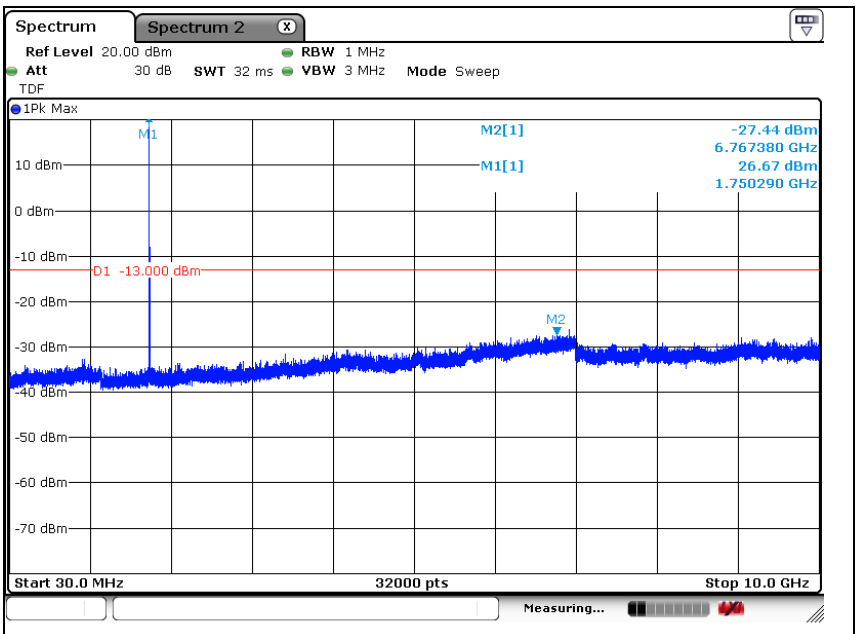
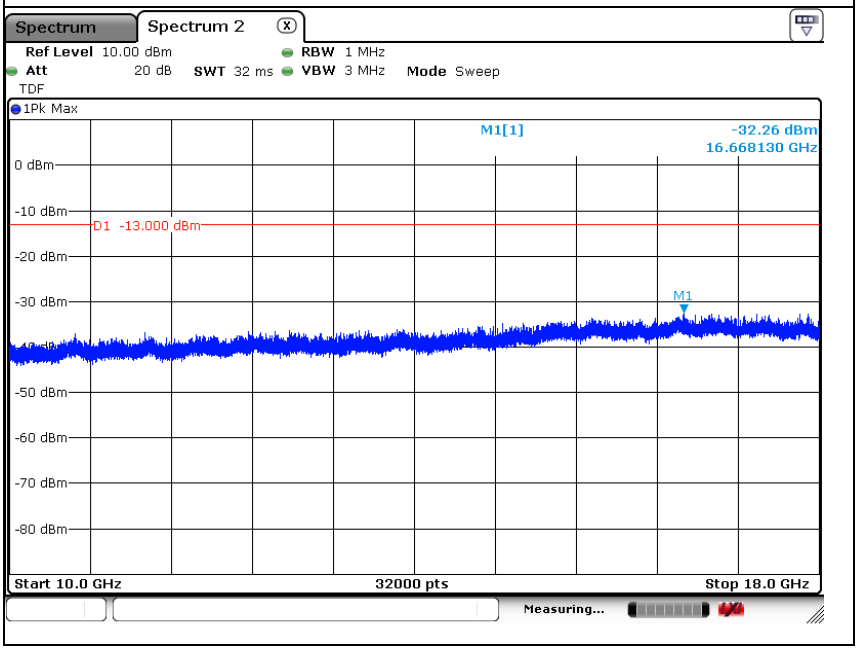
High Channel





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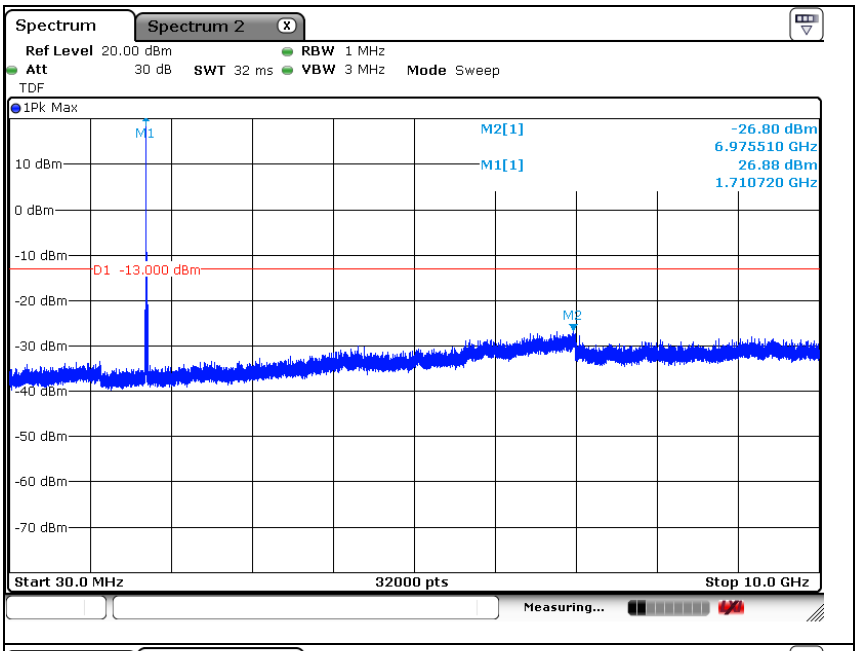
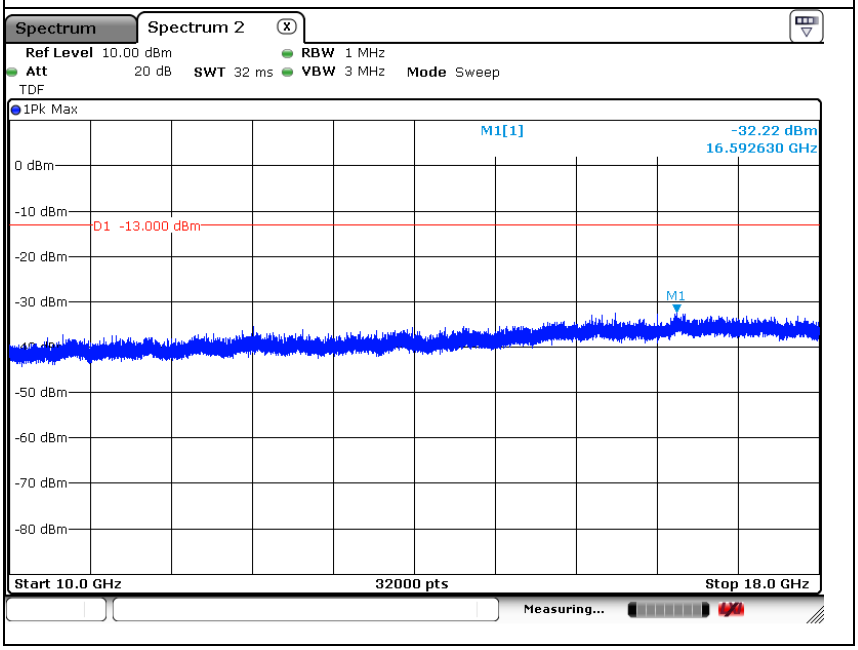
LTE band 4 (10 ㎒ - QPSK)

Low Channel





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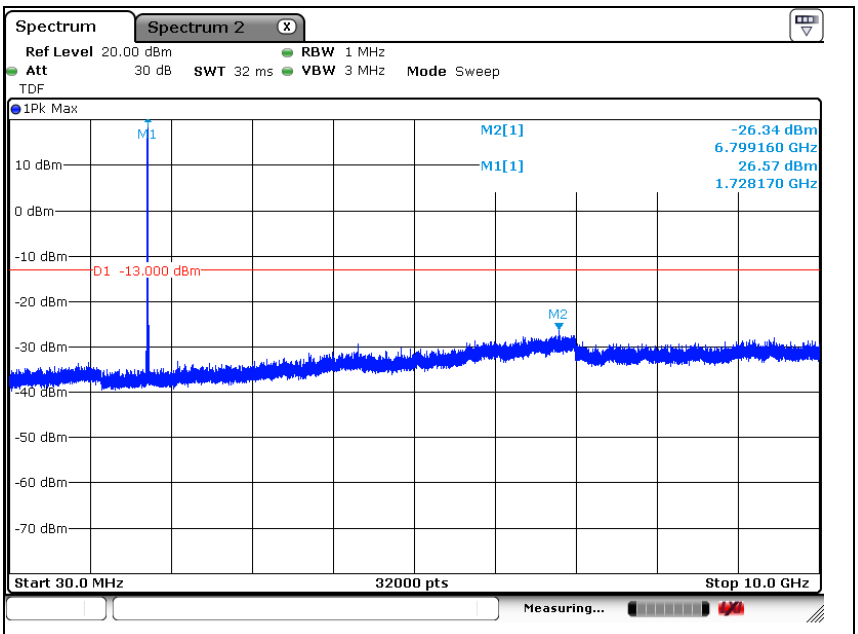
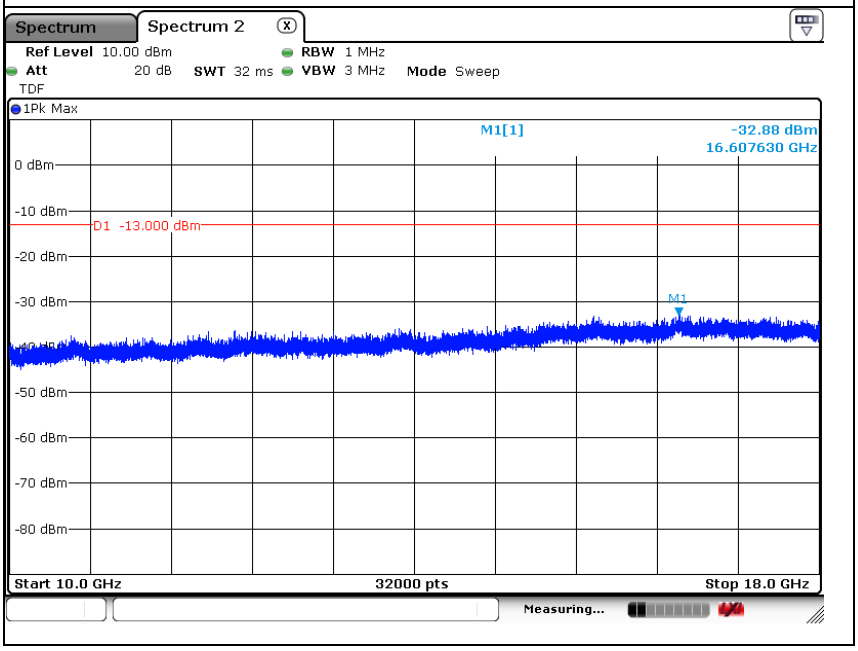
Middle Channel





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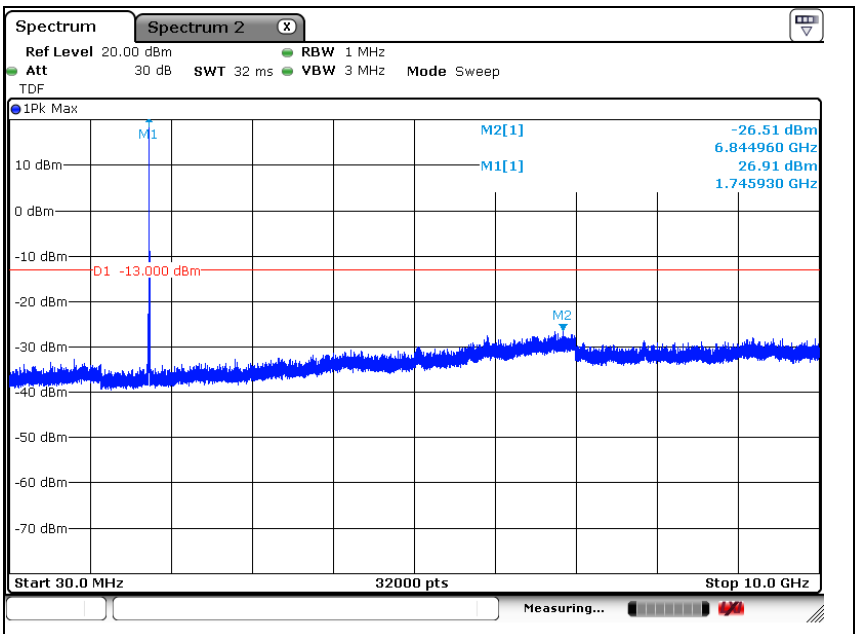
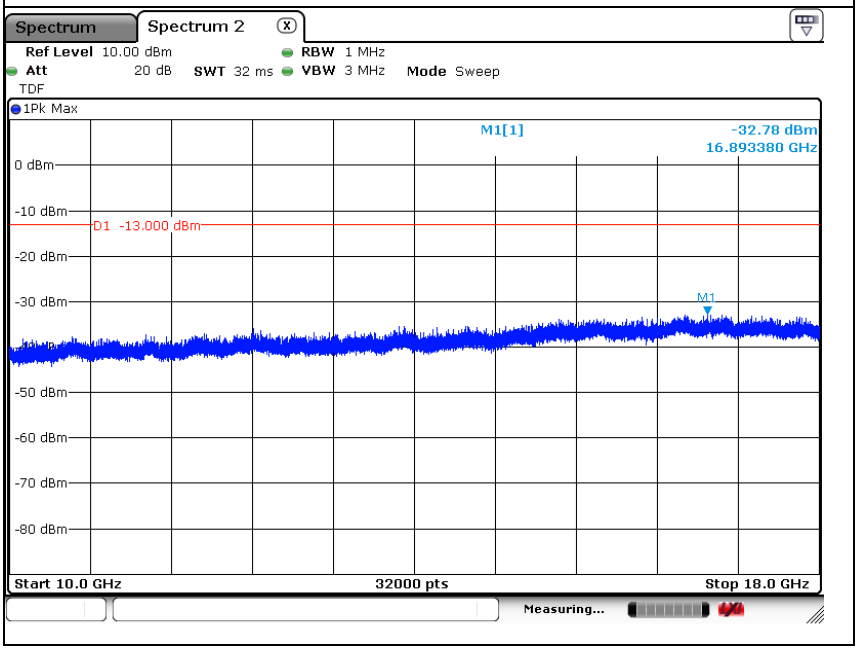
High Channel





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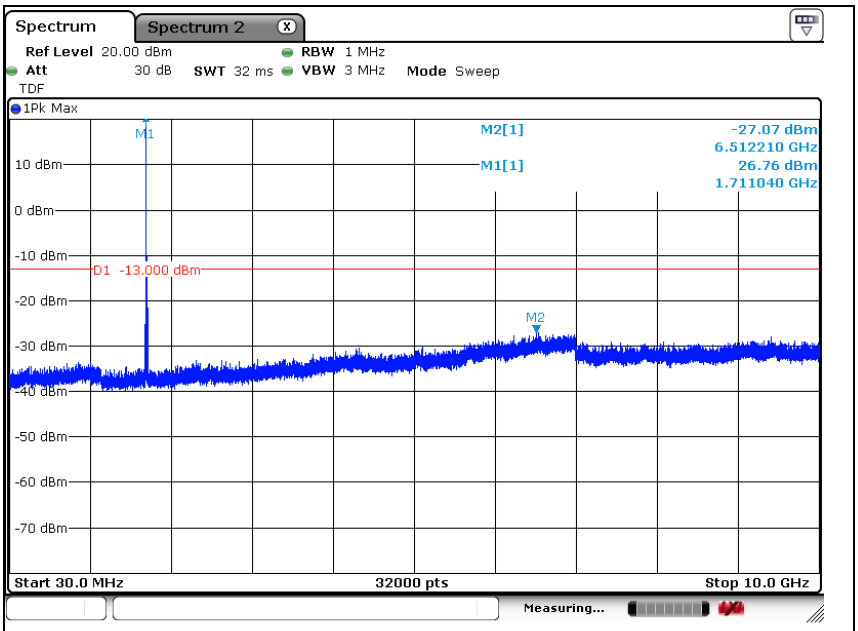
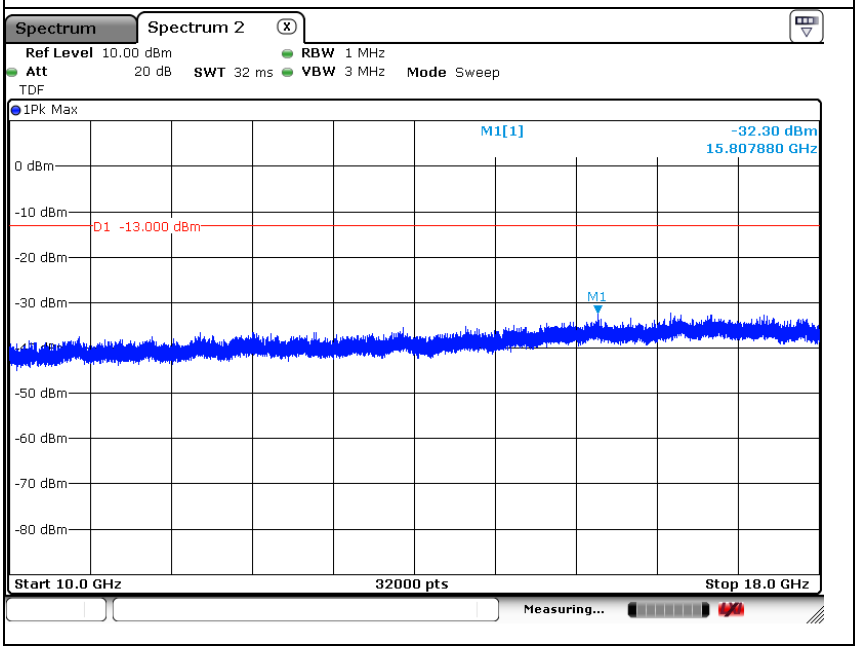
LTE band 4 (15 ㎒ - QPSK)

Low Channel





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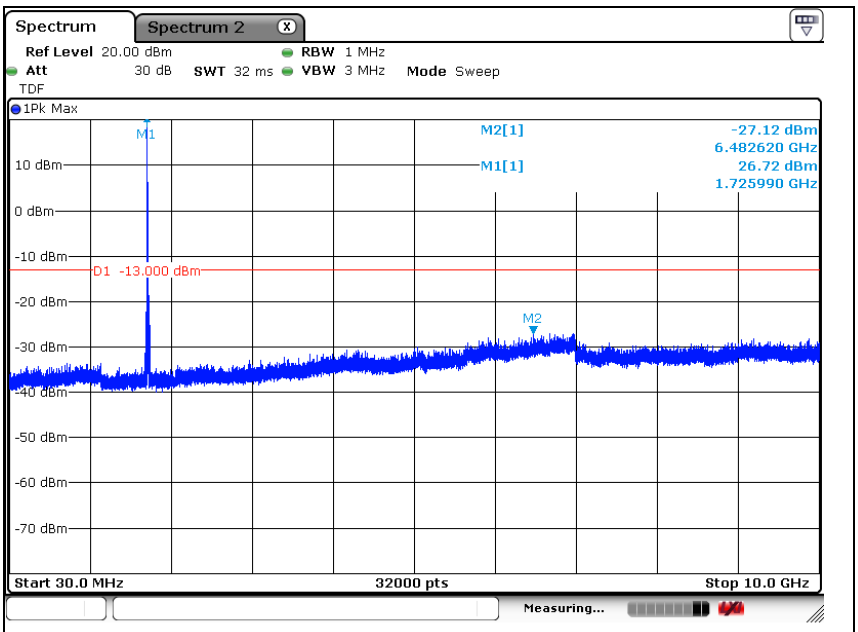
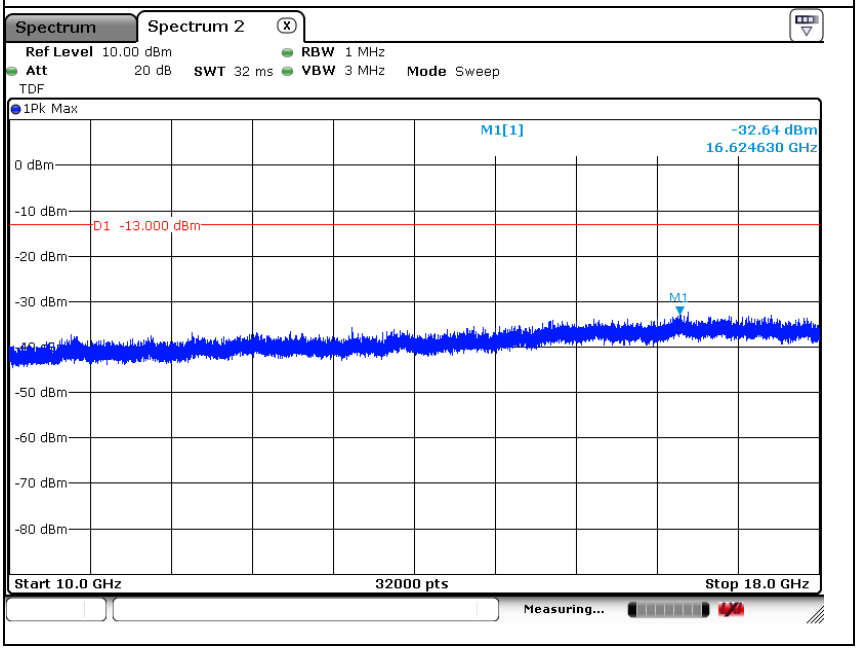
Middle Channel





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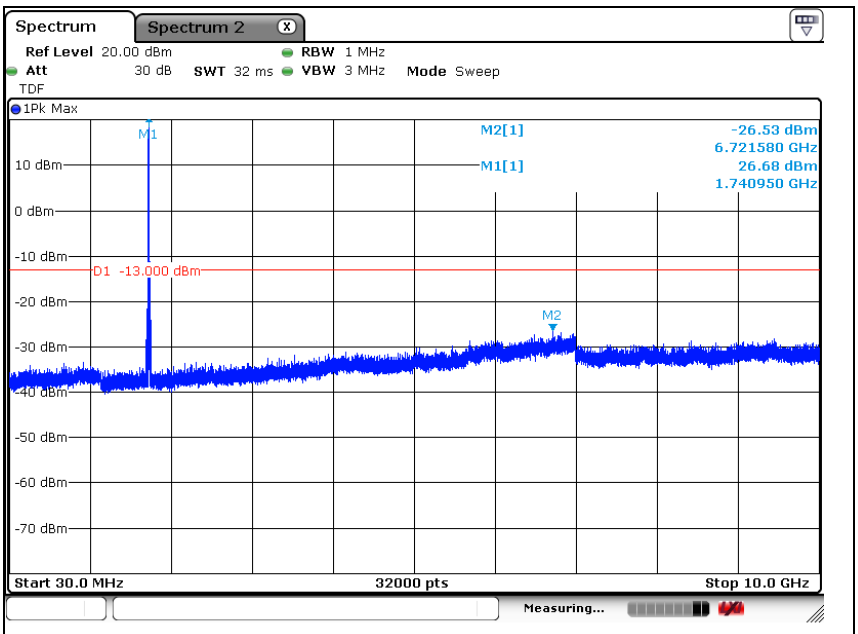
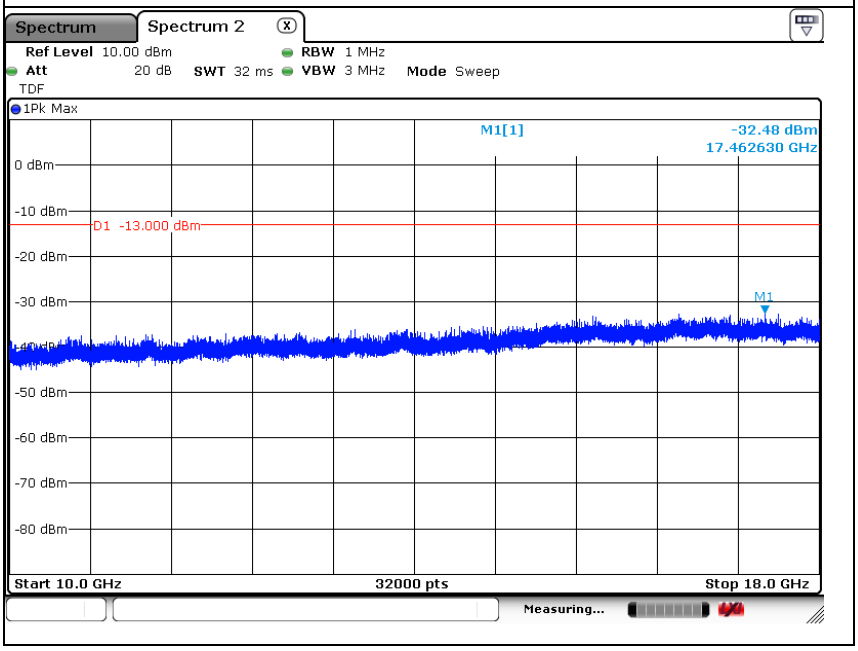
High Channel





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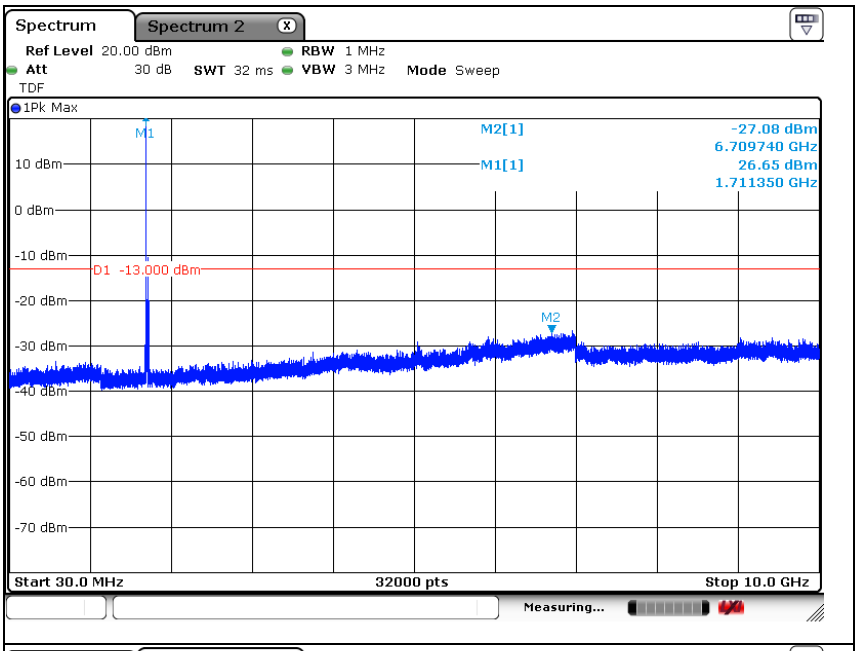
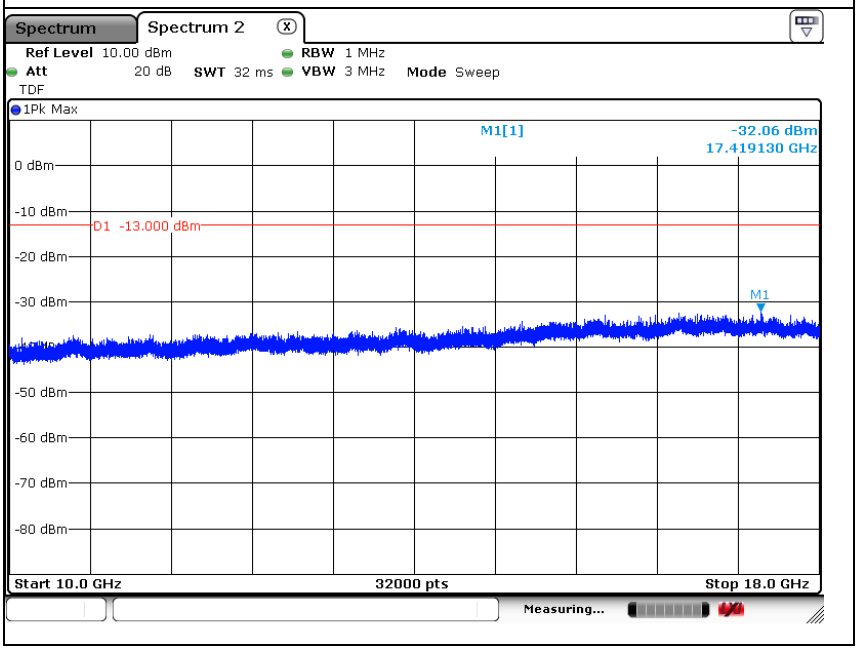
LTE band 4 (20 ㎒ - QPSK)

Low Channel





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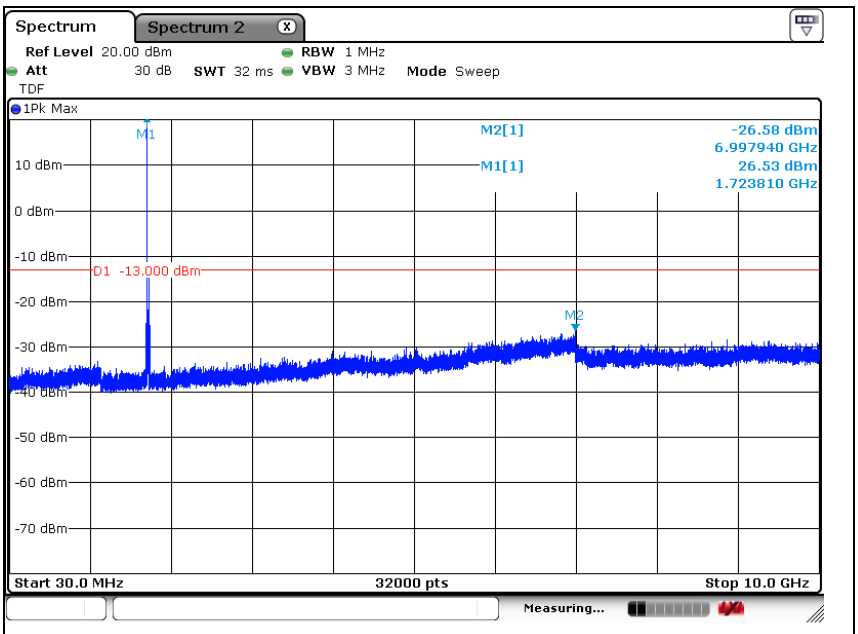
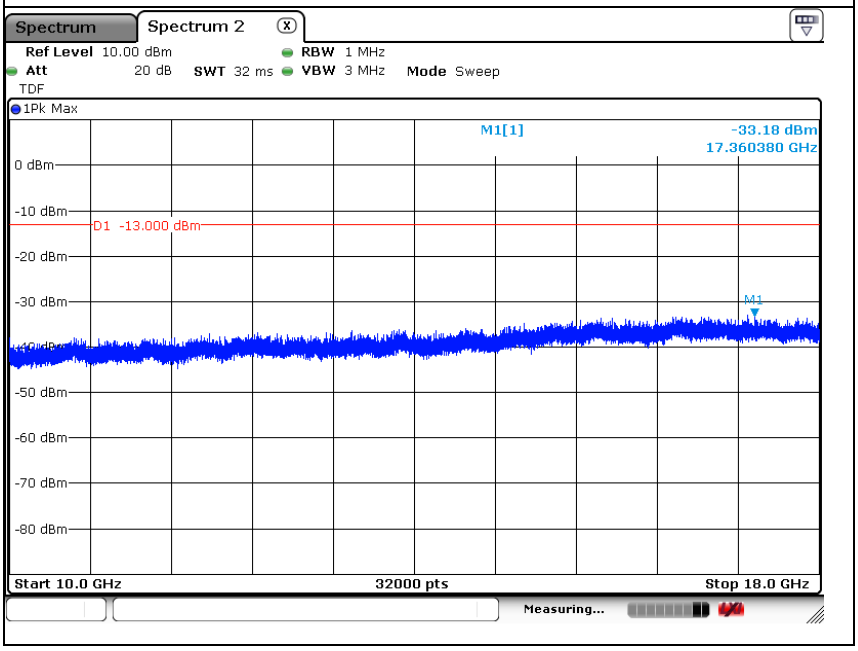
Middle Channel





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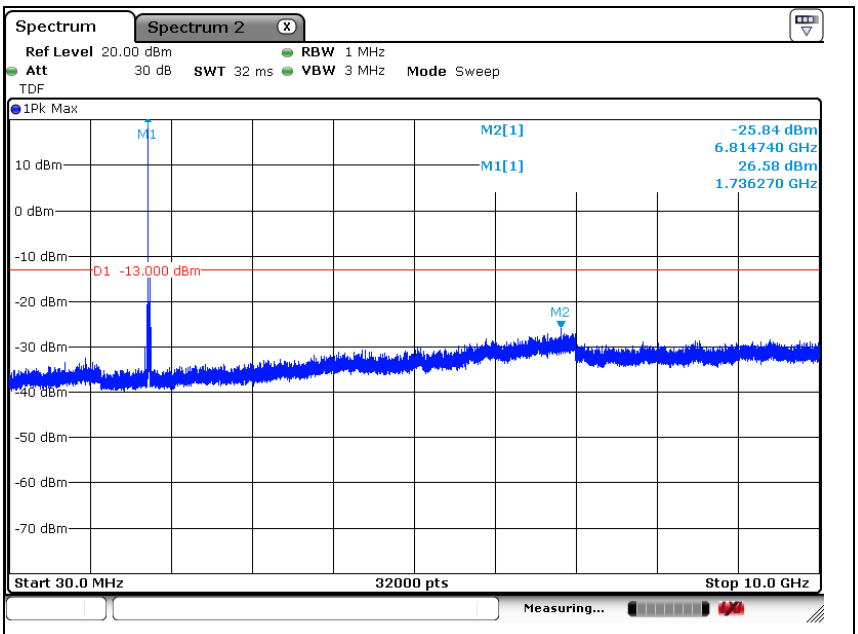
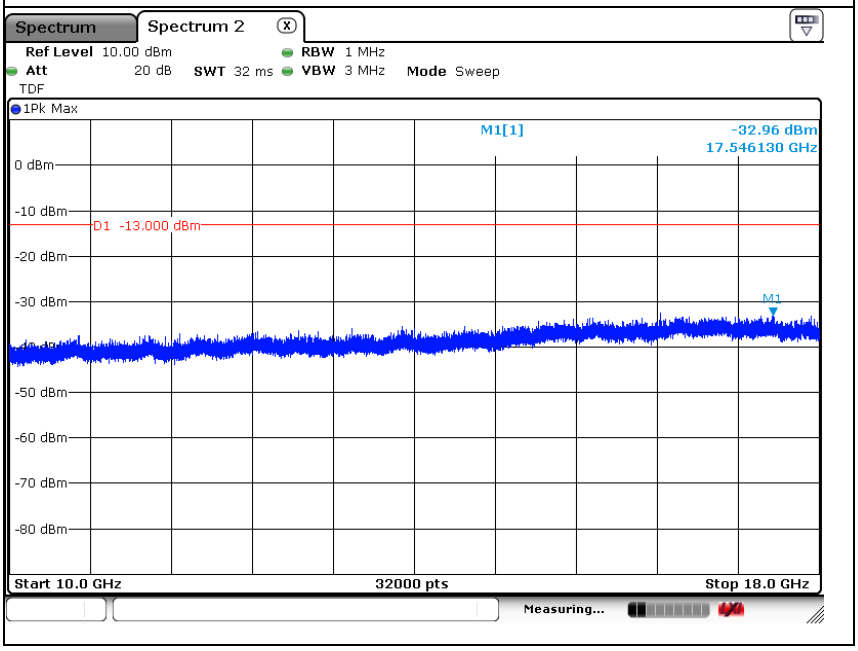
High Channel





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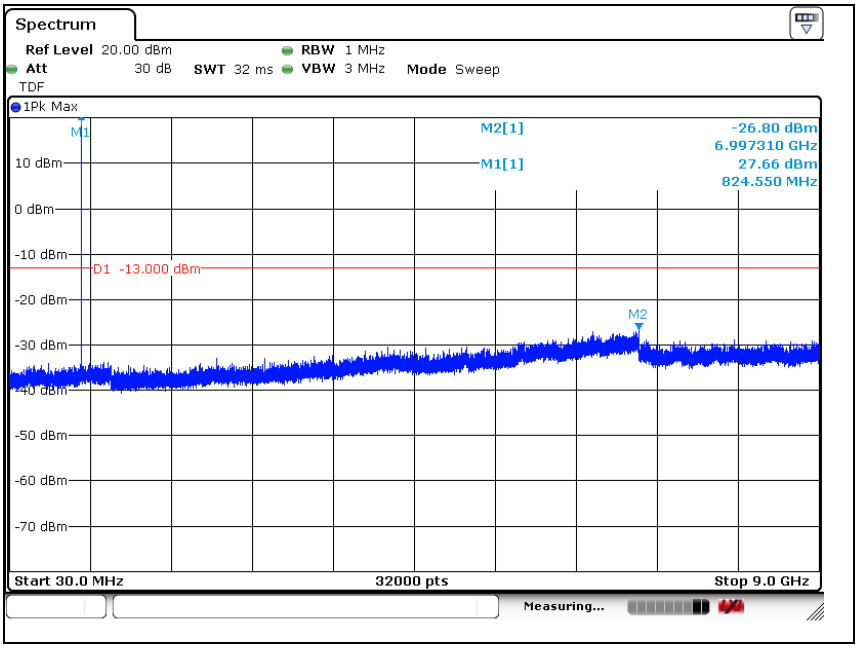
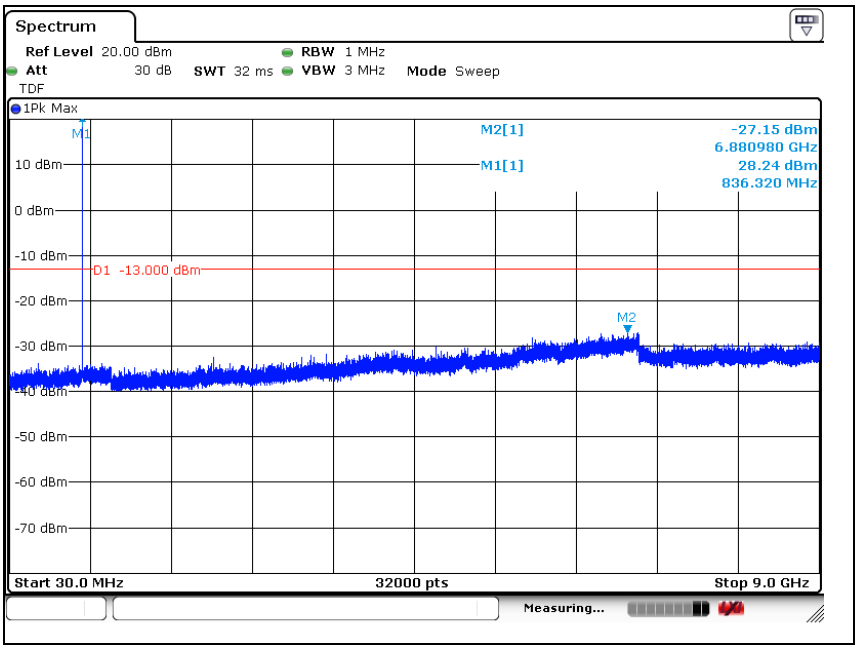
LTE band 5 (1.4 ㎒ - QPSK)

Low Channel



Middle Channel



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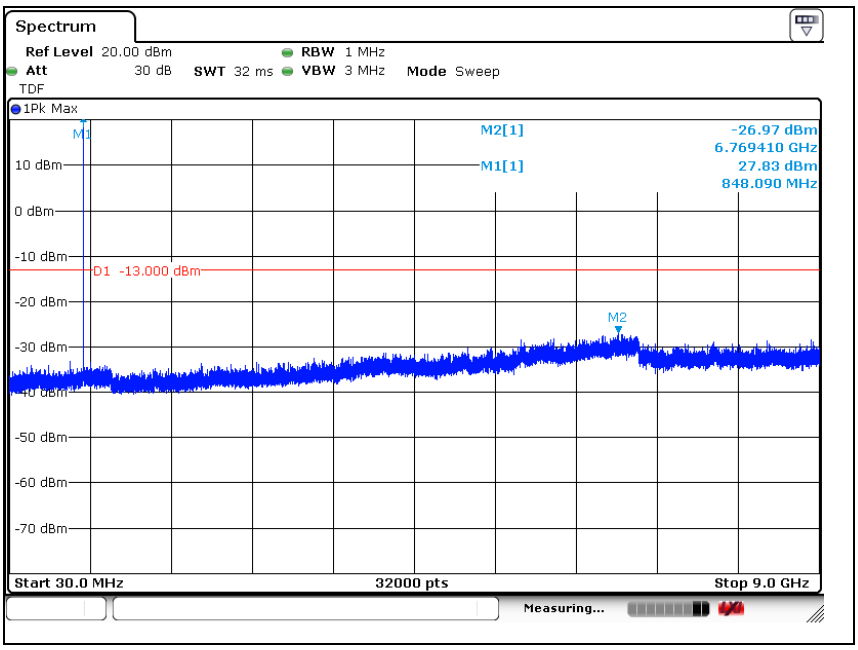
High Channel



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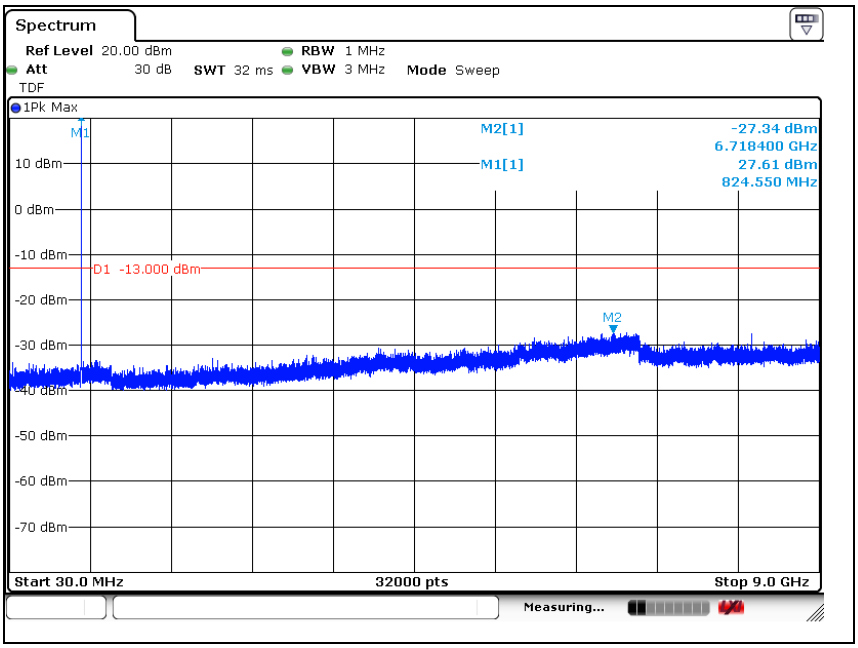
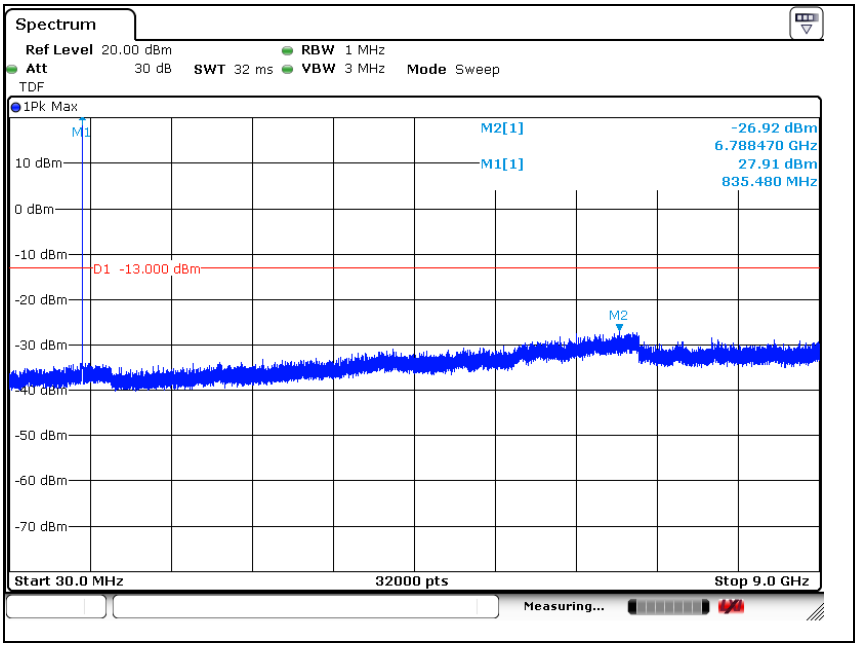
LTE band 5 (3 ㎒ - QPSK)

Low Channel



Middle Channel



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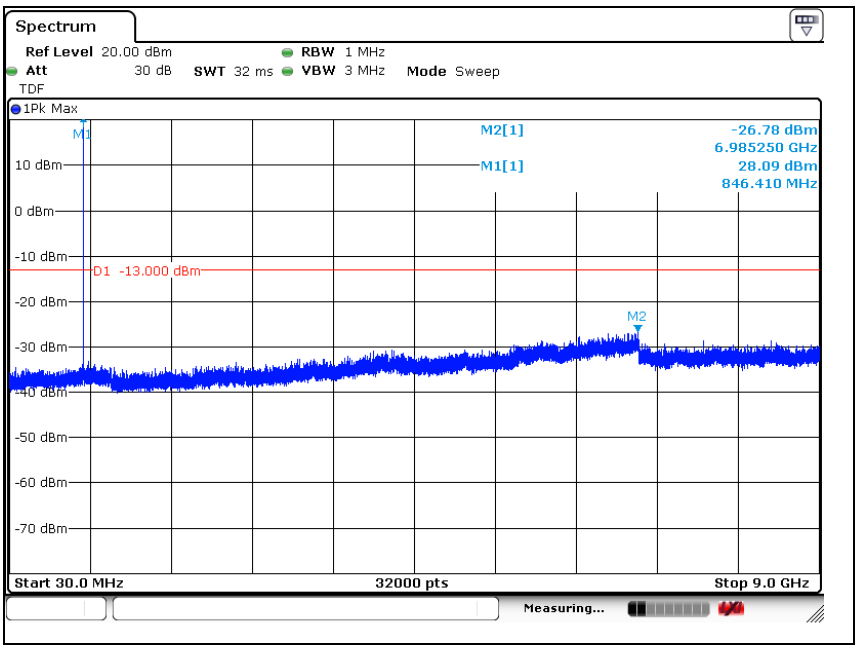
High Channel



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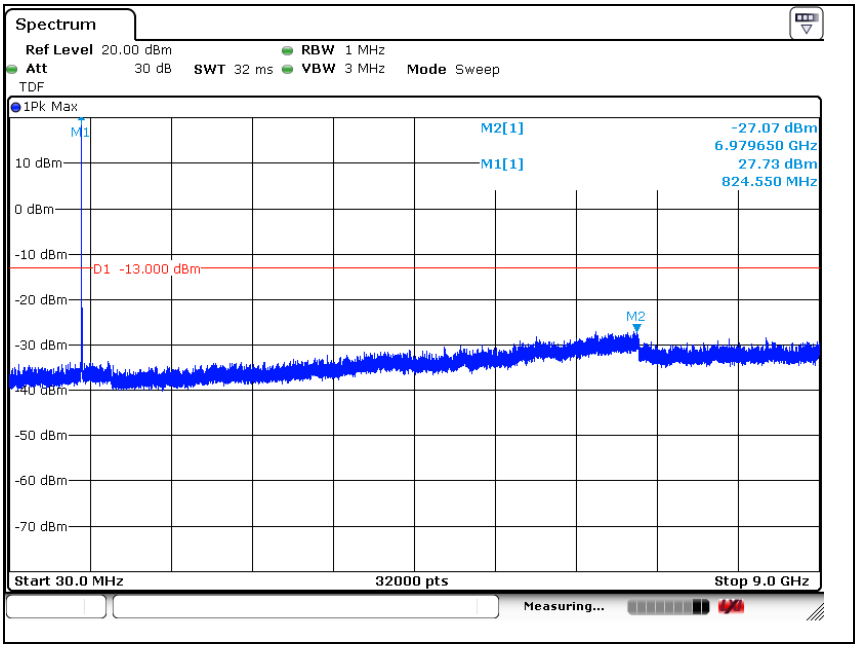
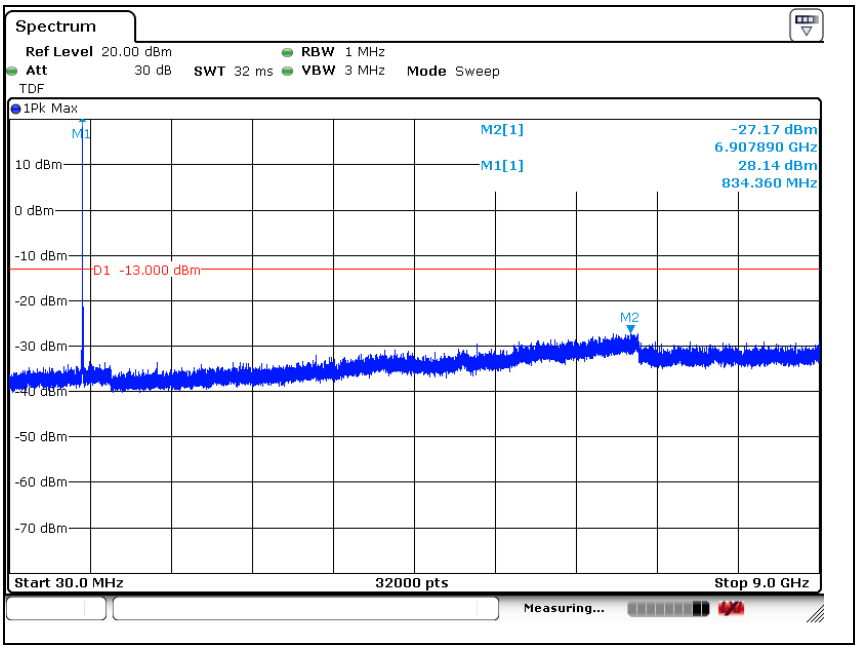
LTE band 5 (5 ㎒ - QPSK)

Low Channel



Middle Channel



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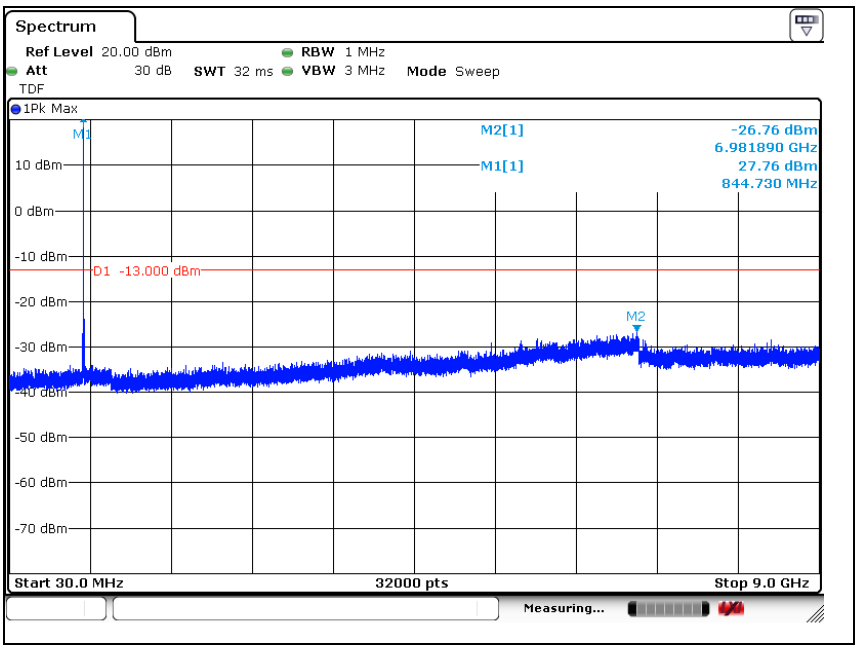
High Channel



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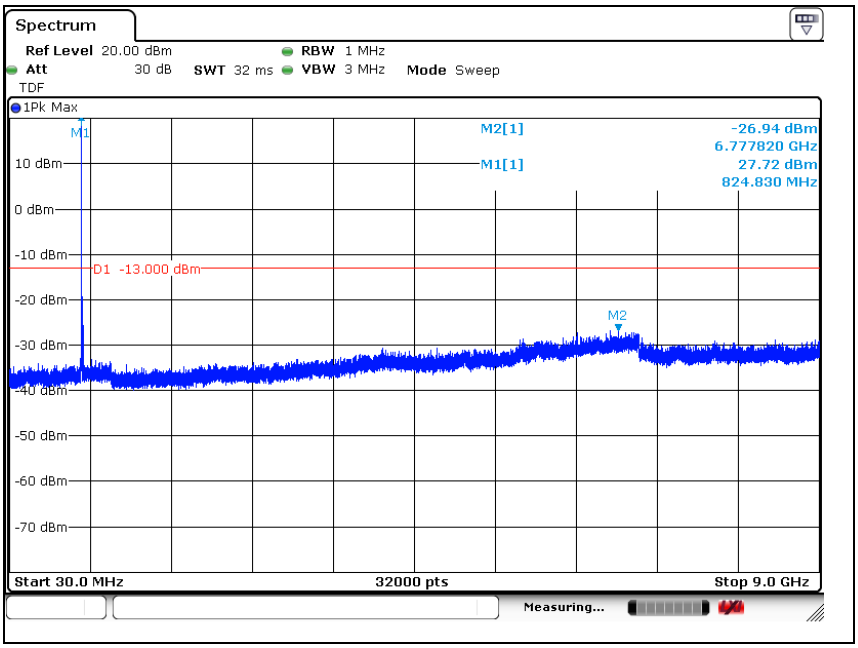
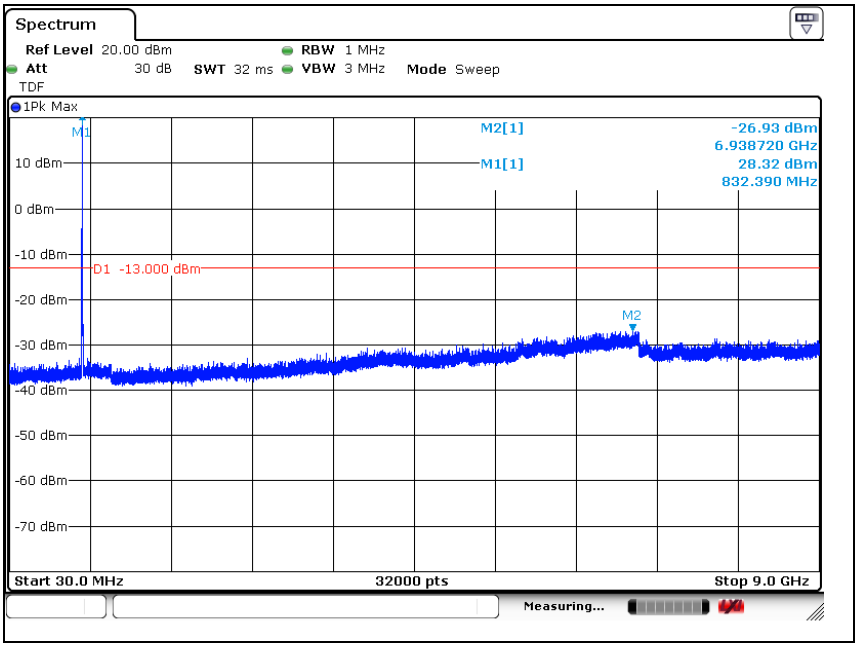
LTE band 5 (10 ㎒ - QPSK)

Low Channel



Middle Channel



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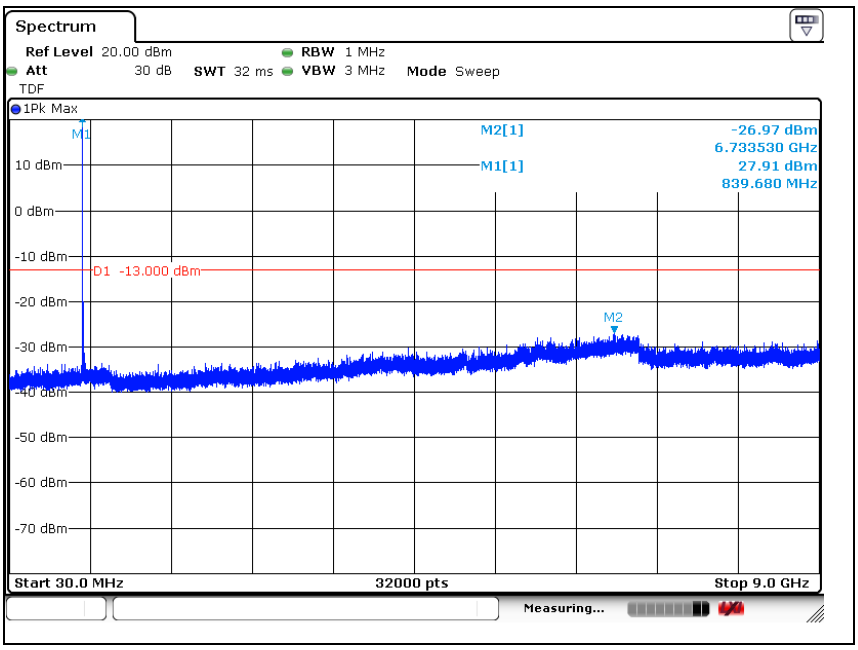
High Channel



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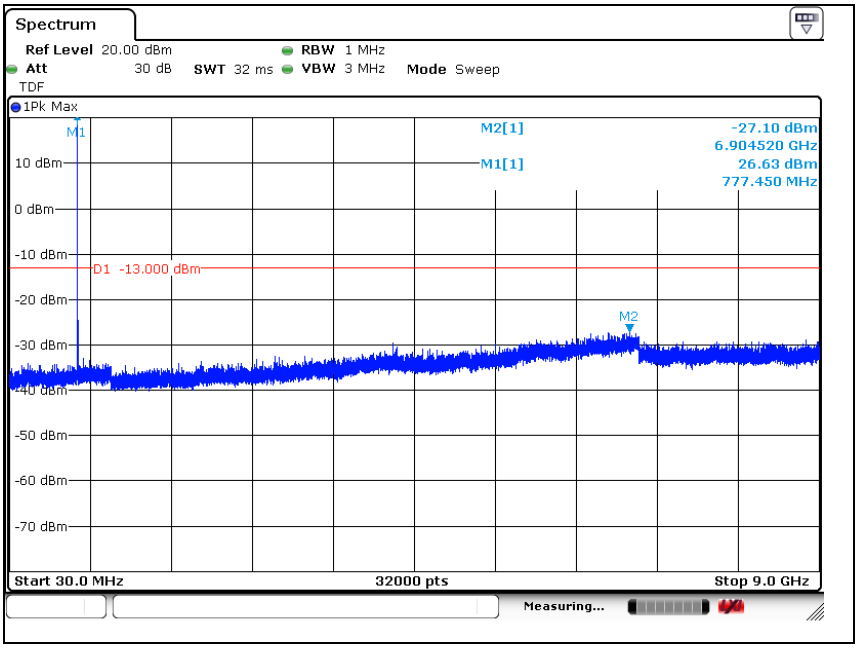
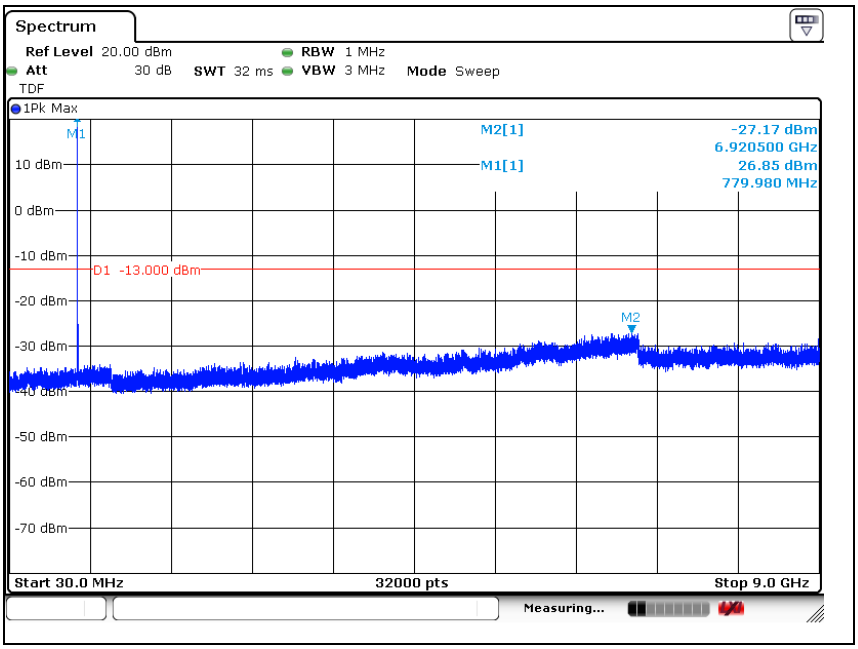
LTE band 13 (5 ㎒ - QPSK)

Low Channel



Middle Channel



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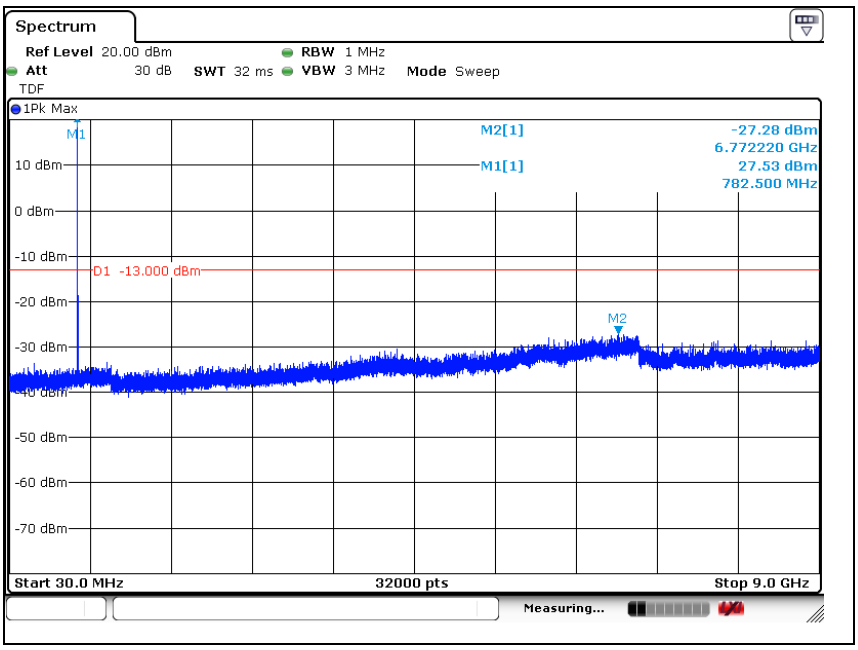
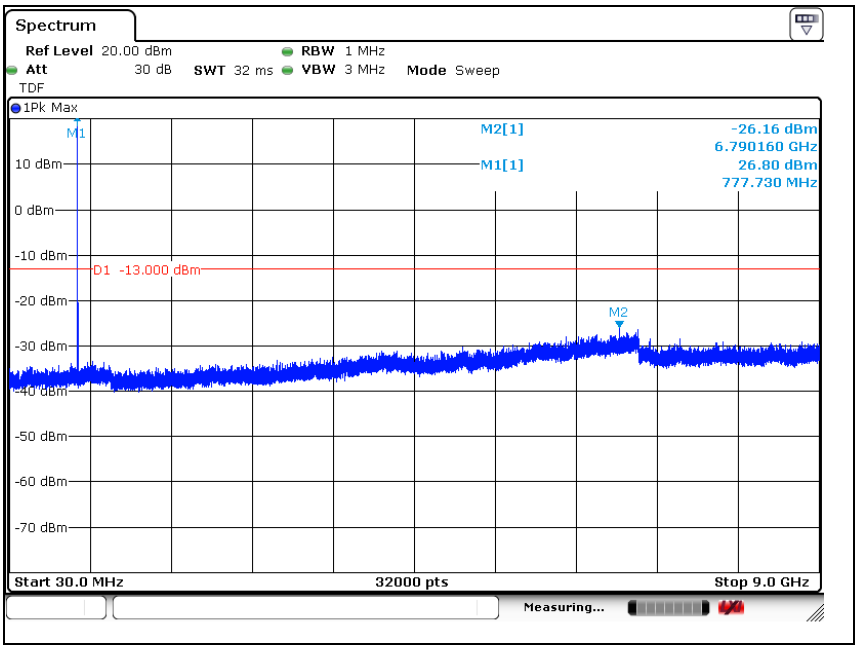
High Channel



LTE band 13 (10 ㎒ - QPSK)

Middle Channel



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7. Band Edge

7.1. Limit

- §22.917(a), 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 + 10log(P) ㏈.

- §24.238(a), 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) ㏈.

- §27.53(c)(2), on any frequency outside the 776-788 ㎒ band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) ㏈.

- §27.53(h)(1), for operations in the 1 695-1 710 ㎒, 1 710-1 755 ㎒, 1 755-1 780 ㎒, 1 915-1 920 ㎒, 1 995-2 000 ㎒, 2 000-2 020 ㎒, 2 110-2 155 ㎒, 2 155-2 180 ㎒, and 2 180-2 200 ㎒ bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 $\log_{10}$ (P) ㏈.

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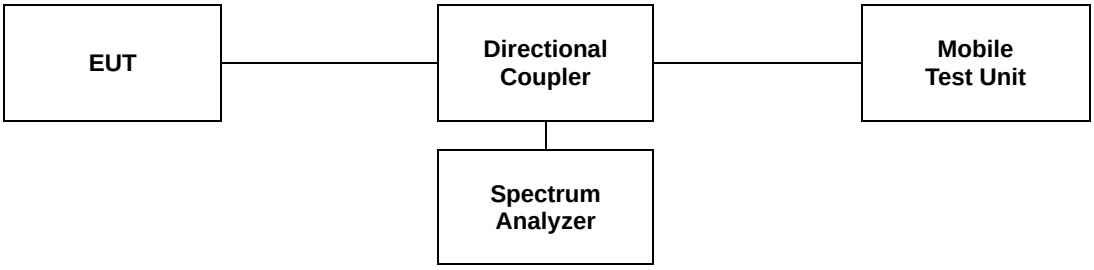
7.2. Test Procedure

The test follows section 6.0 of FCC KDB Publication 971168 D01 v03r01.

a. Span was set large enough so as to capture all out of band emissions near the band edge.
b. RBW ≥ 1 % of OBW
c. VBW ≥ 3 x RBW.
d. Detector = RMS.
e. Trace mode = Average.
f. Sweep time = Auto.
g. The trace was allowed to stabilize.
h. All path loss of frequency range was investigated and compensated to spectrum analyzer as TDF function.



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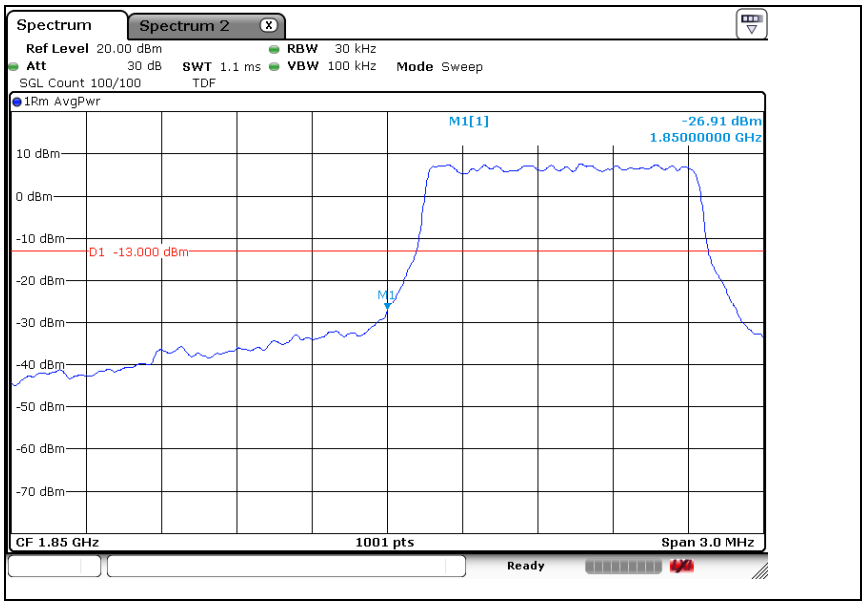
7.3. Test Results

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

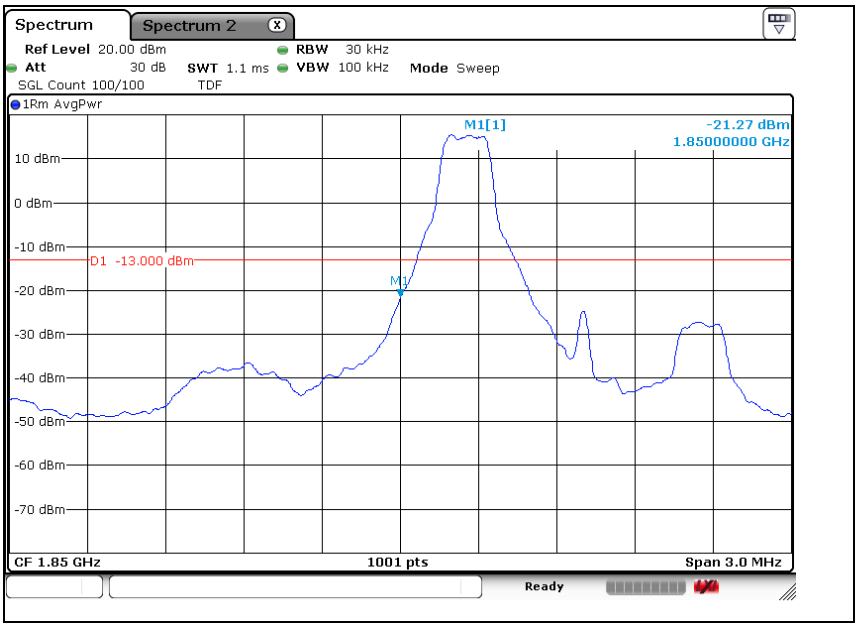
LTE band 2 (1.4 ㎒ - QPSK_RB 6)

Low Channel



LTE band 2 (1.4 ㎒ - QPSK_RB 1)

Low Channel



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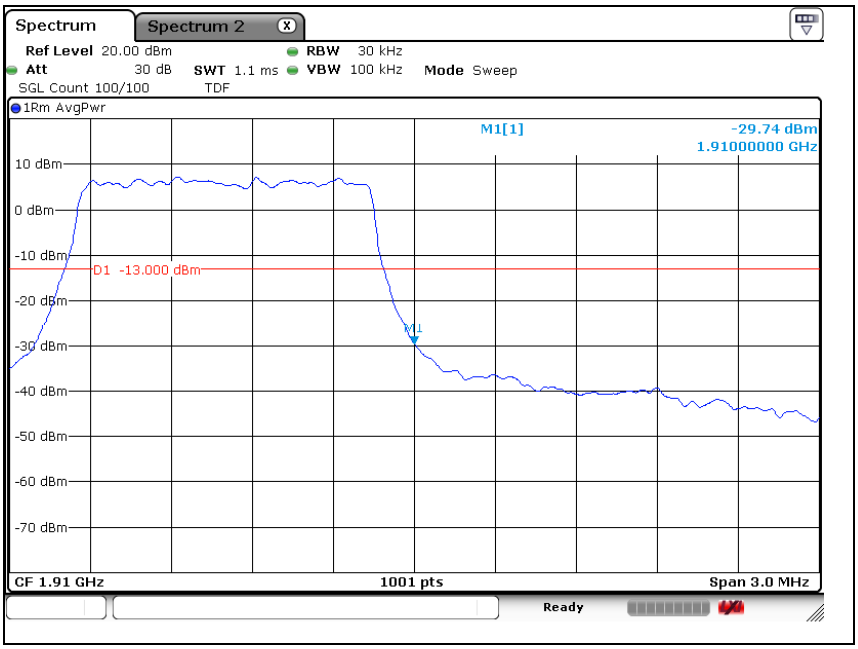
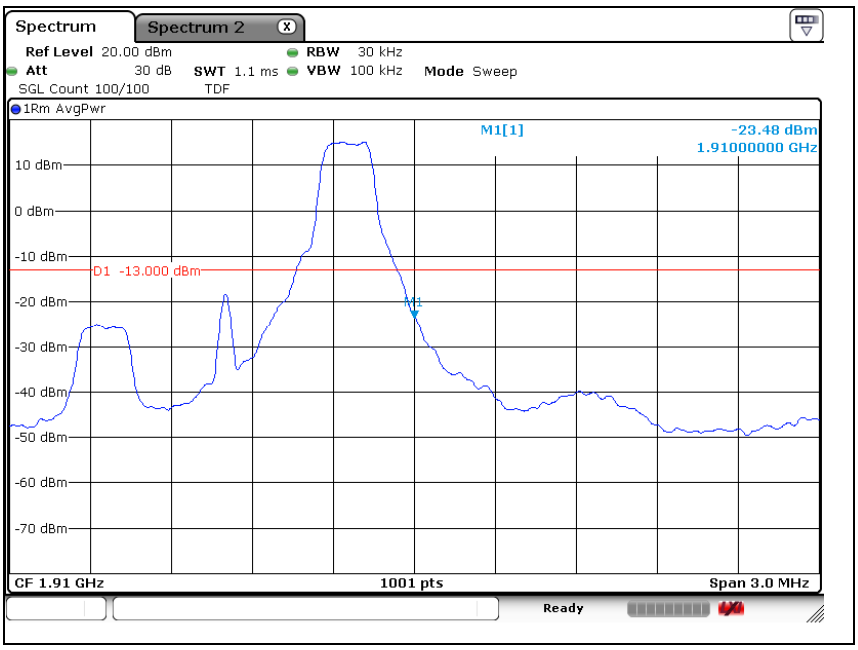
LTE band 2 (1.4 ㎒ - QPSK_RB 6)

High Channel



LTE band 2 (1.4 ㎒ - QPSK_RB 1)

High Channel



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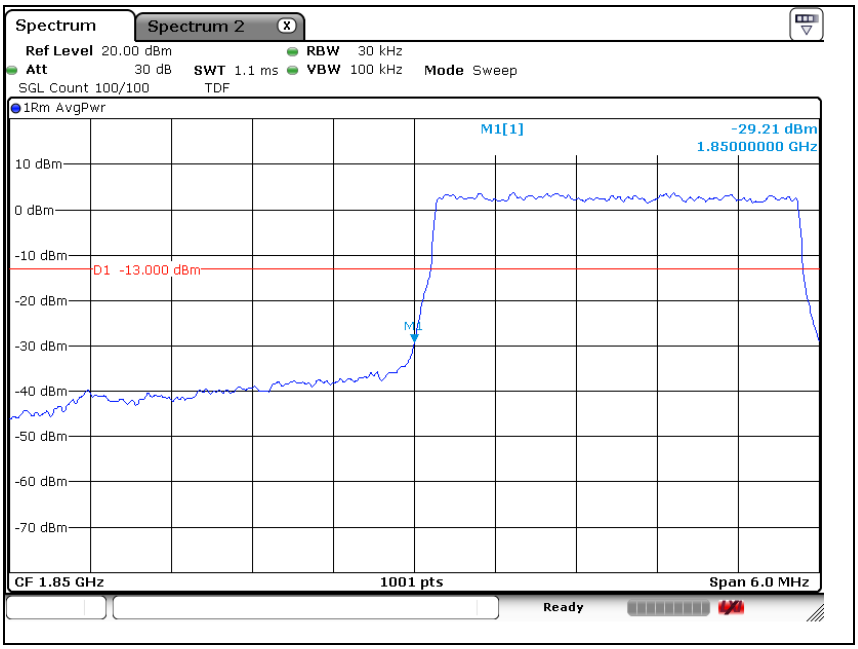
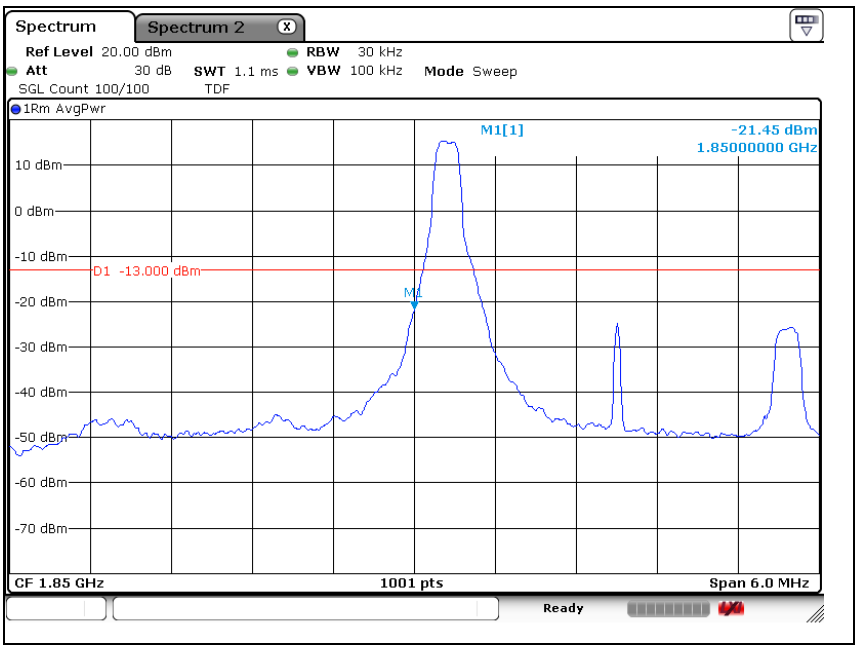
LTE band 2 (3 ㎒ - QPSK_RB 15)

Low Channel



LTE band 2 (3 ㎒ - QPSK_RB 1)

Low Channel



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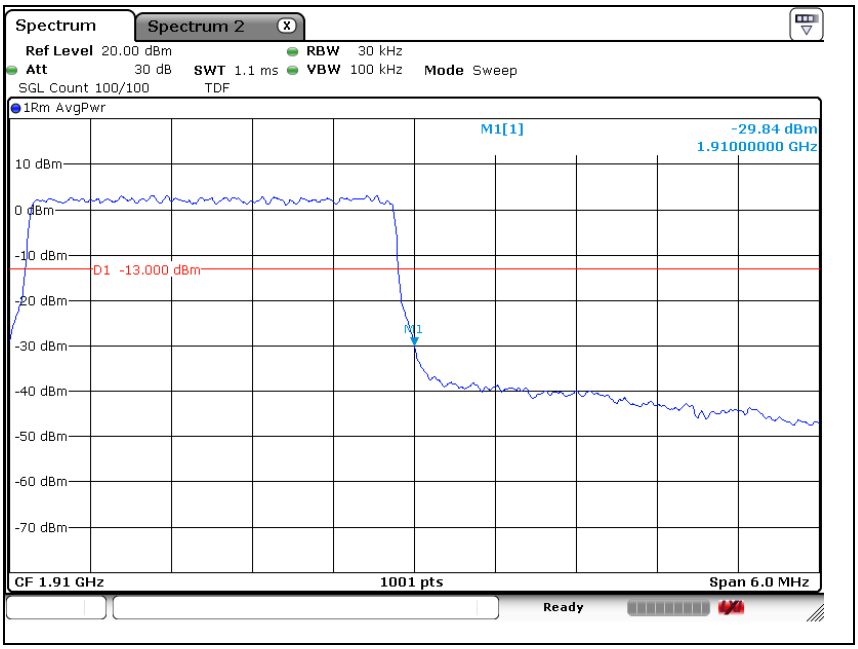
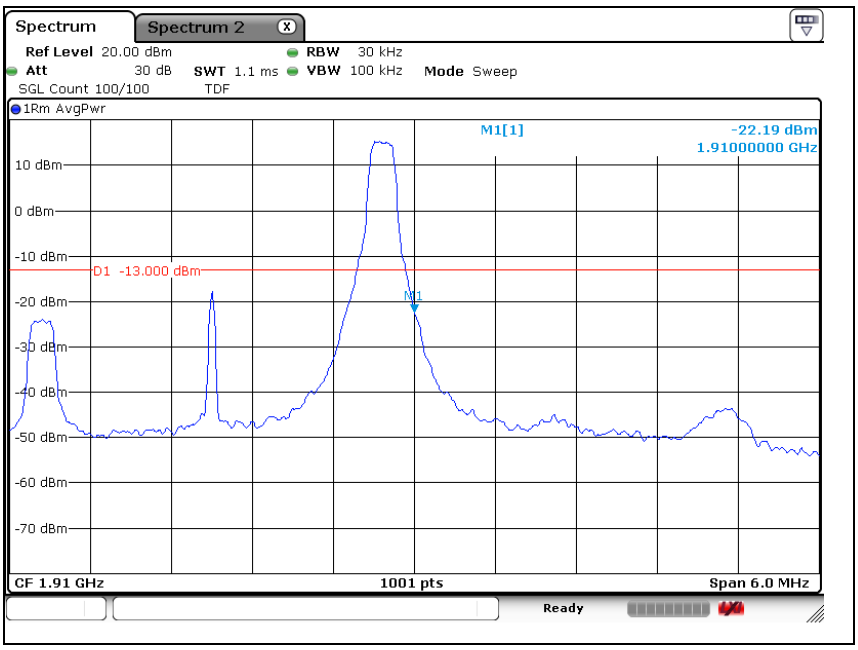
LTE band 2 (3 ㎒ - QPSK_RB 15)

High Channel



LTE band 2 (3 ㎒ - QPSK_RB 1)

High Channel



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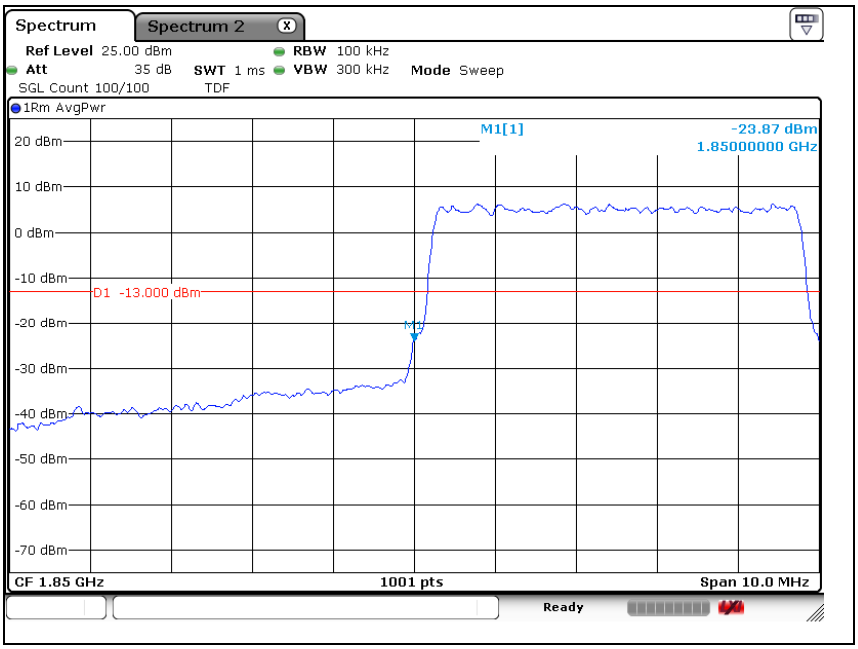
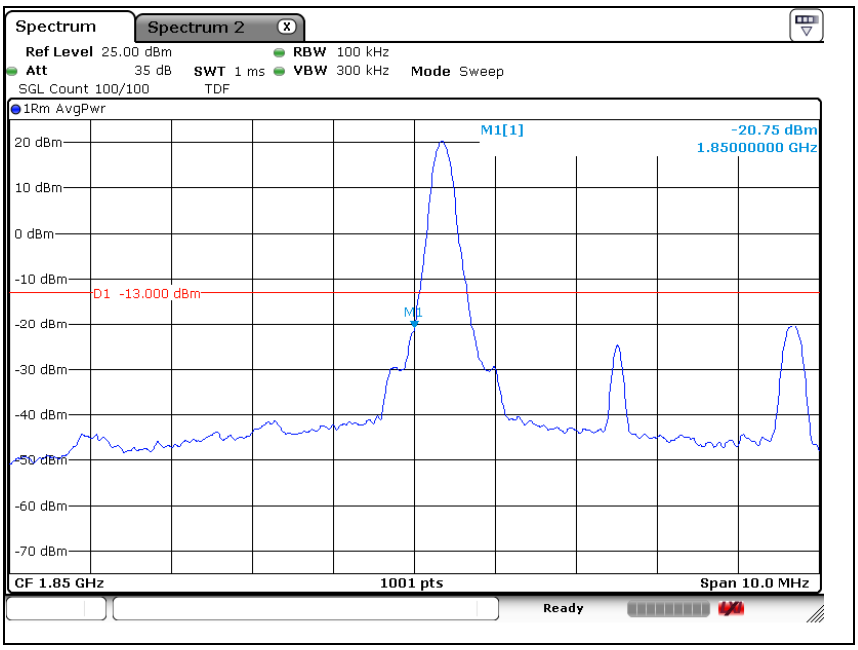
LTE band 2 (5 ㎒ - QPSK_RB 25)

Low Channel



LTE band 2 (5 ㎒ - QPSK_RB 1)

Low Channel



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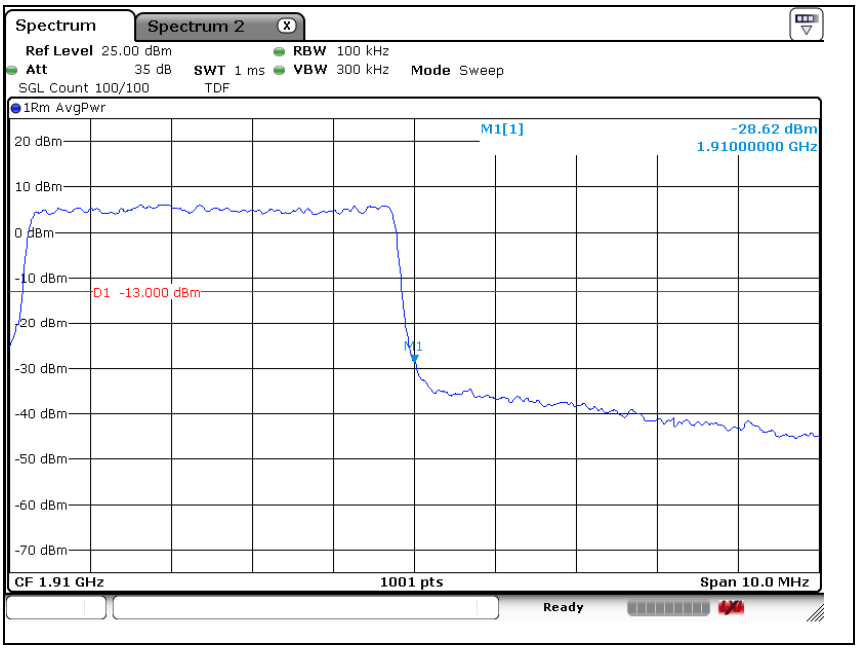
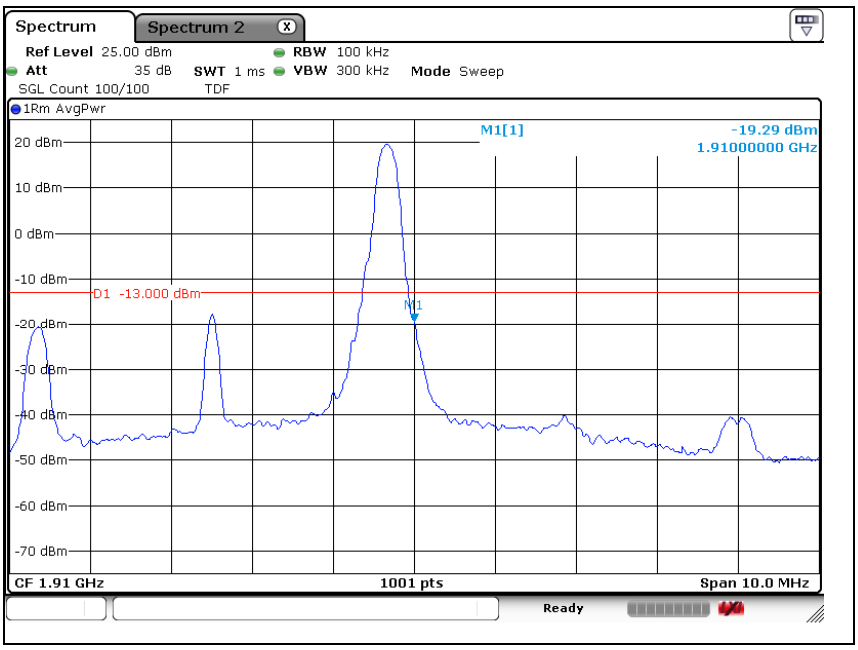
LTE band 2 (5 ㎒ - QPSK_RB 25)

High Channel



LTE band 2 (5 ㎒ - QPSK_RB 1)

High Channel



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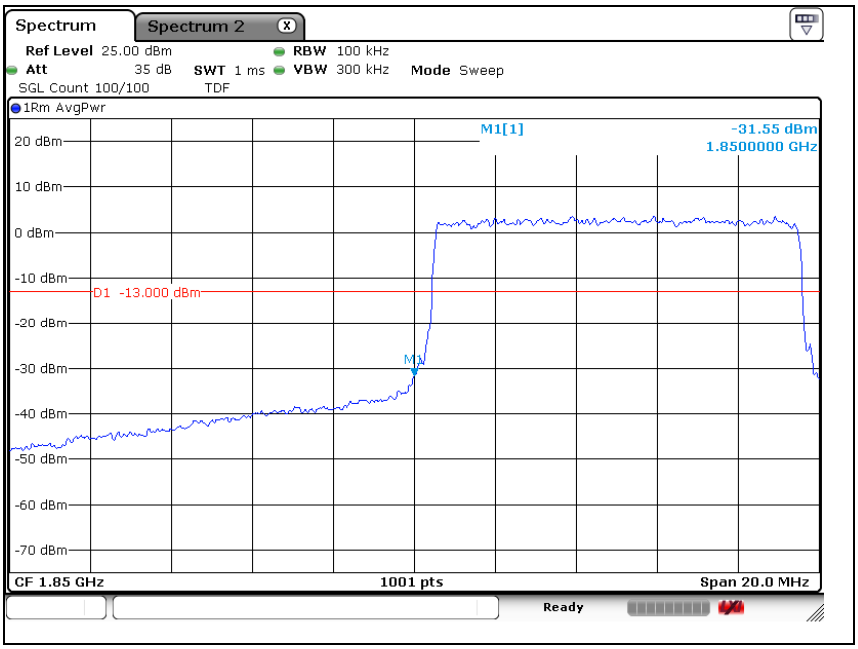
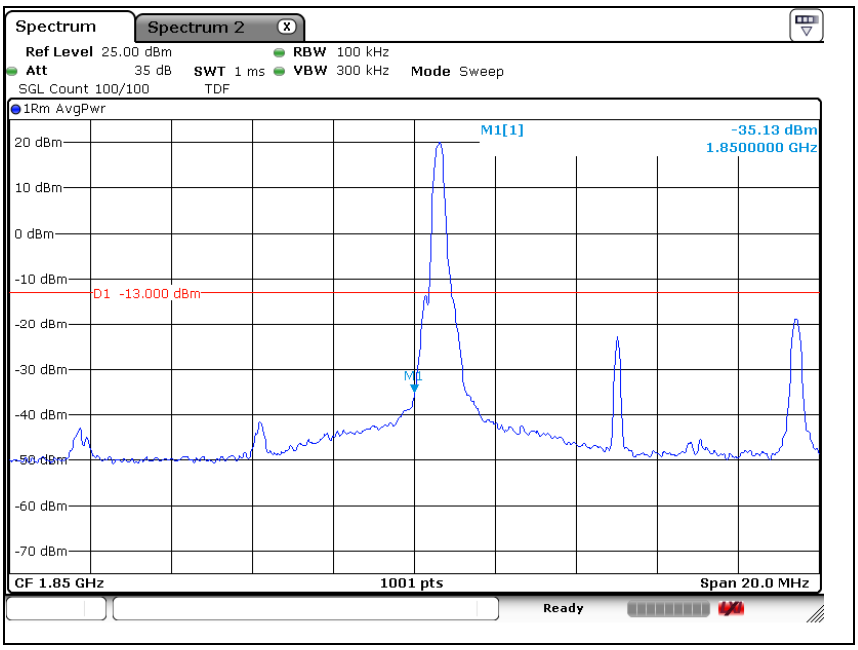
LTE band 2 (10 ㎒ - QPSK_RB 50)

Low Channel



LTE band 2 (10 ㎒ - QPSK_RB 1)

Low Channel



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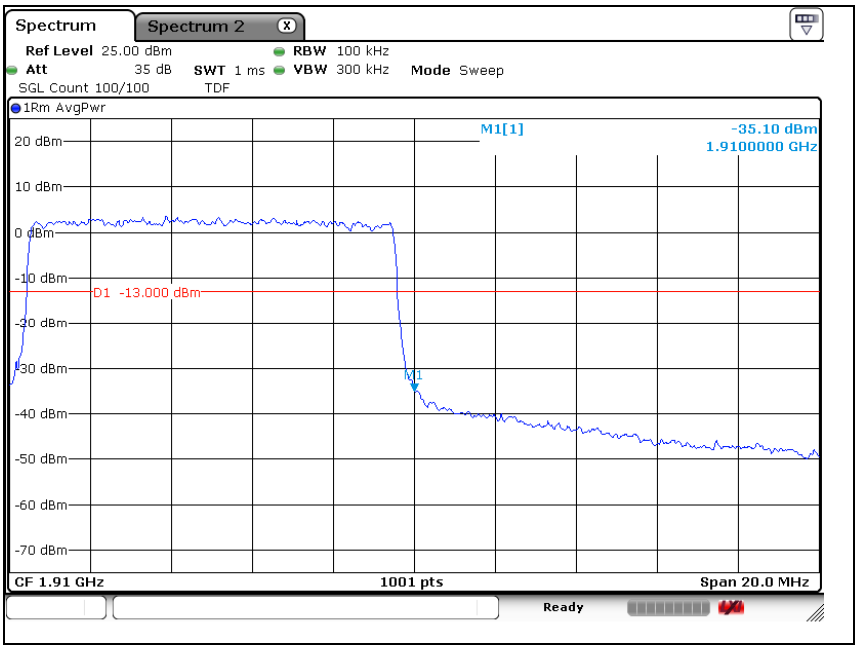
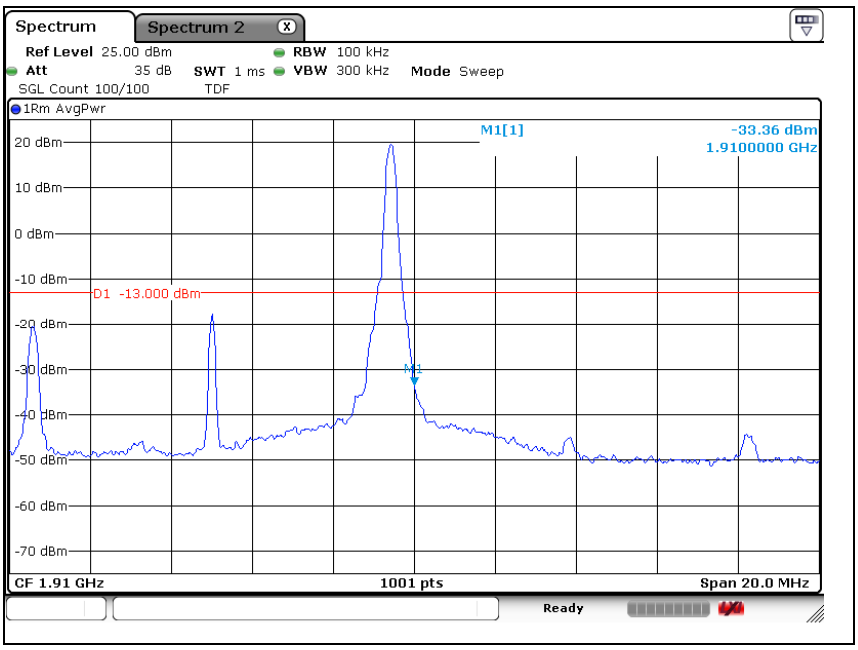
LTE band 2 (10 ㎒ - QPSK_RB 50)

High Channel



LTE band 2 (10 ㎒ - QPSK_RB 1)

High Channel



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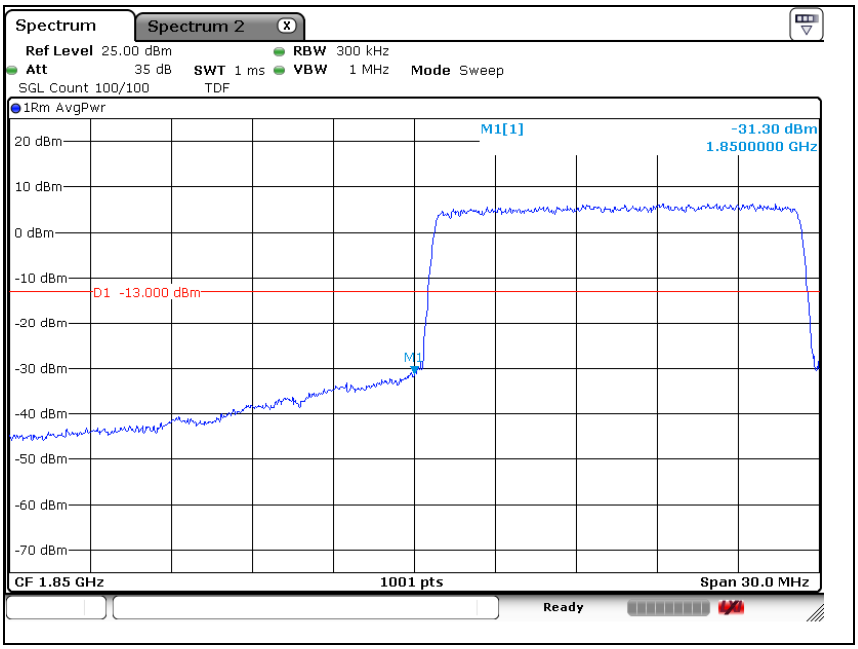
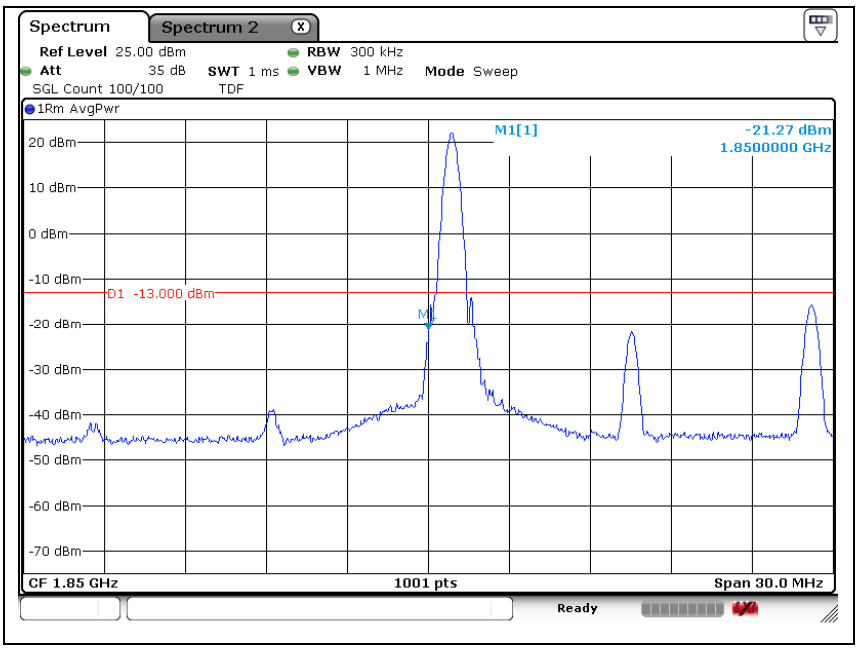
LTE band 2 (15 ㎒ - QPSK_RB 75)

Low Channel



LTE band 2 (15 ㎒ - QPSK_RB 1)

Low Channel



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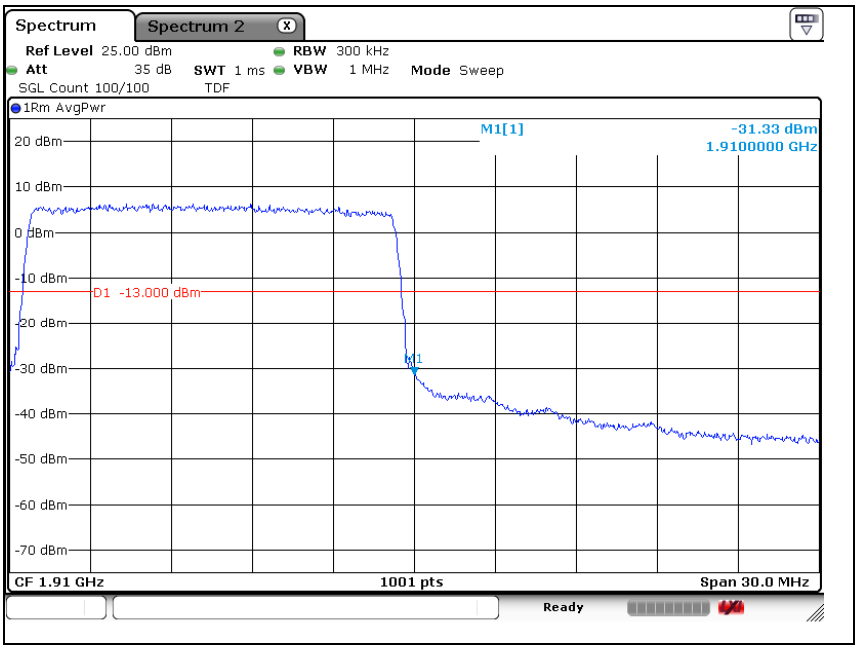
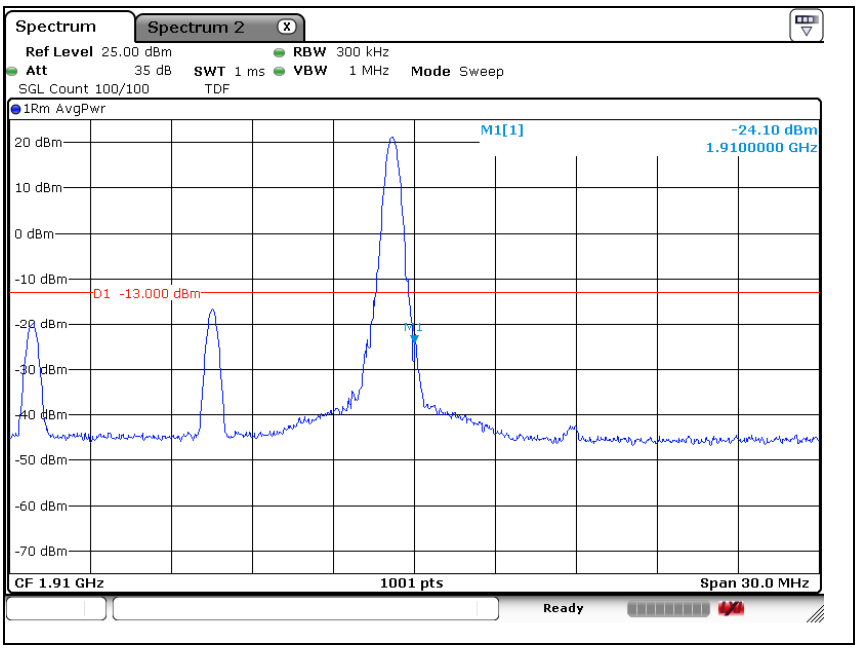
LTE band 2 (15 ㎒ - QPSK_RB 75)

High Channel



LTE band 2 (15 ㎒ - QPSK_RB 1)

High Channel



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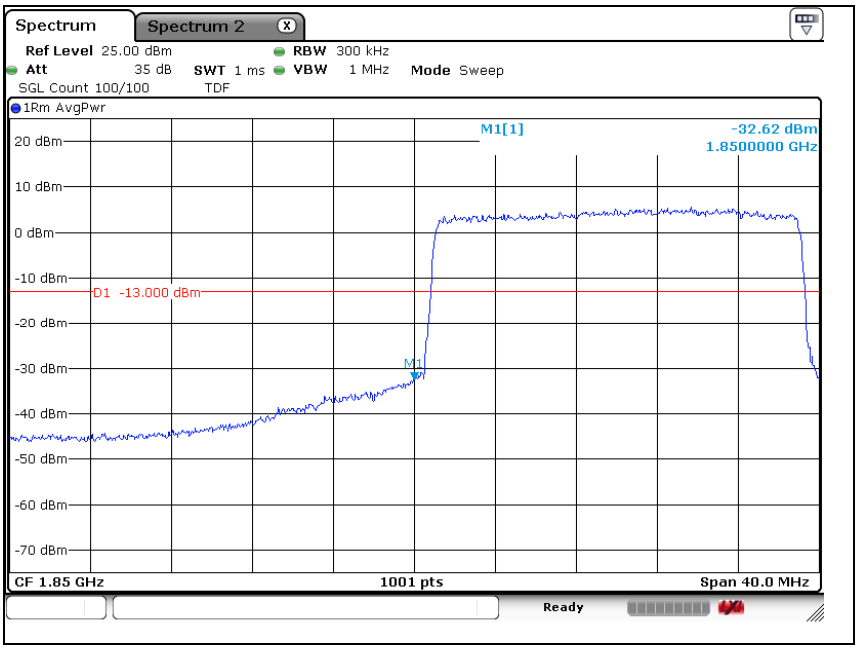
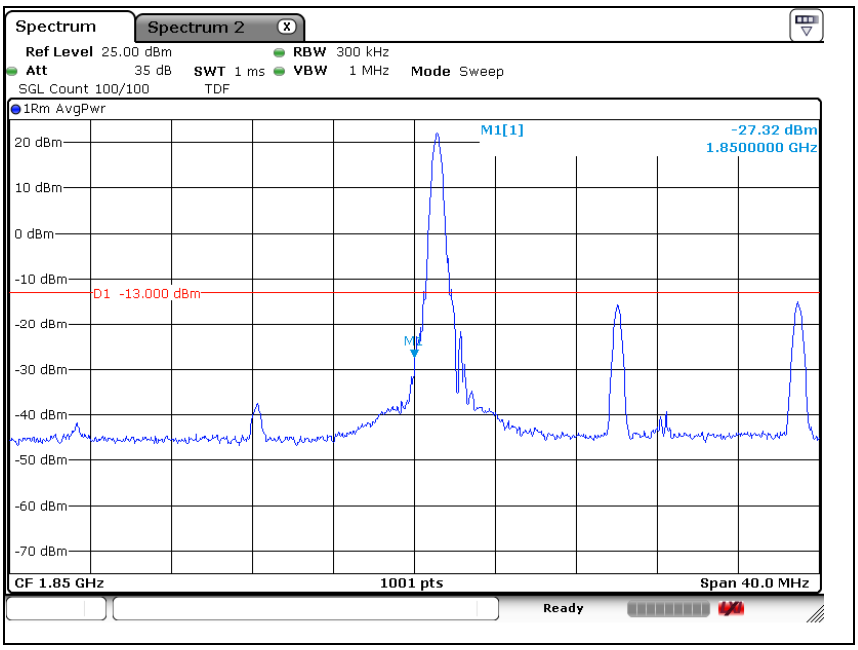
LTE band 2 (20 ㎒ - QPSK_RB 100)

Low Channel



LTE band 2 (20 ㎒ - QPSK_RB 1)

Low Channel



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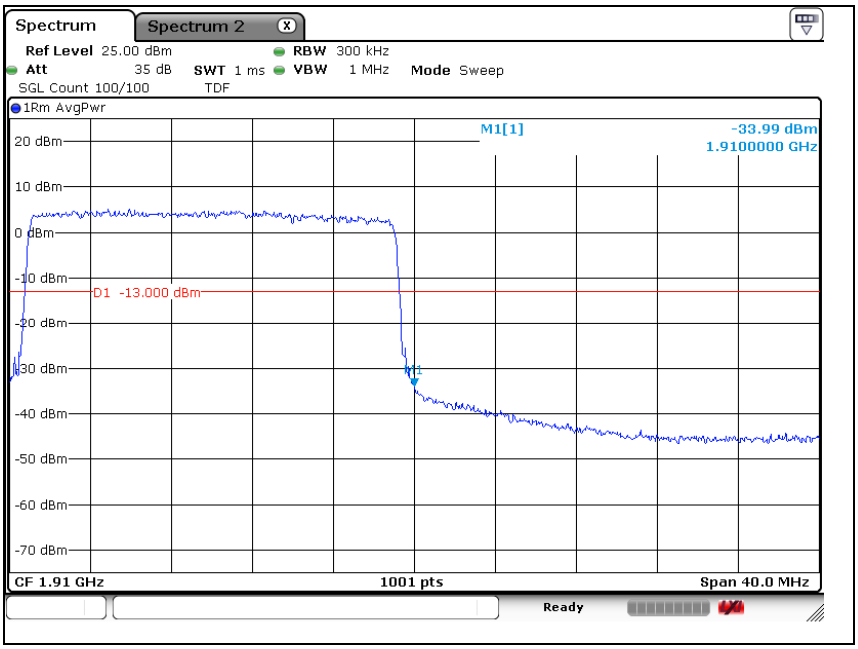
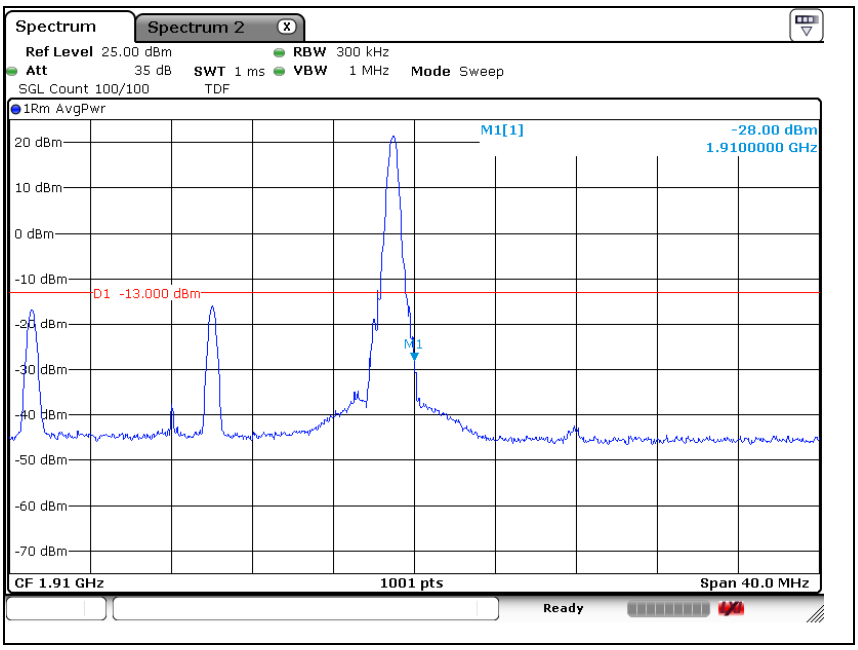
LTE band 2 (20 ㎒ - QPSK_RB 100)

High Channel



LTE band 2 (20 ㎒ - QPSK_RB 1)

High Channel



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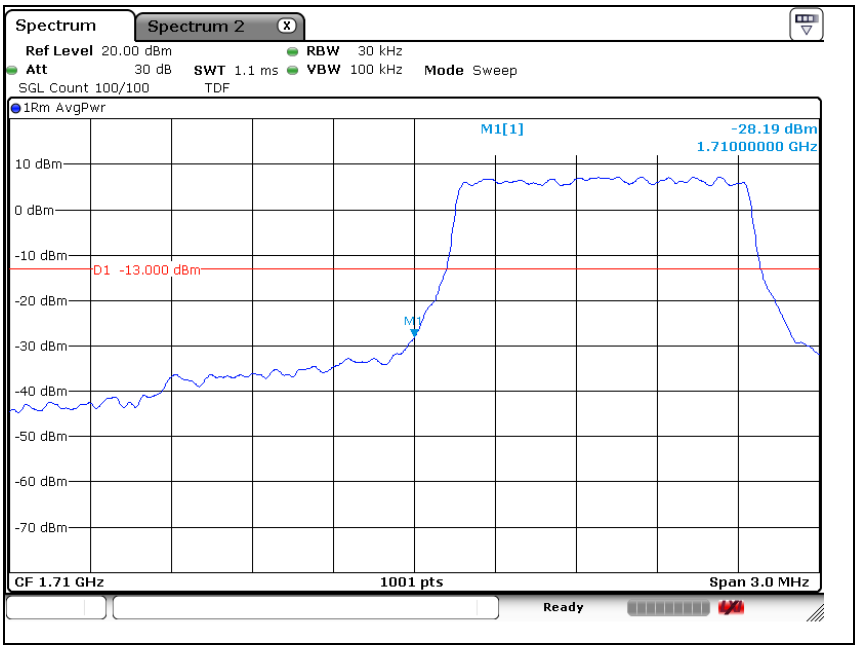
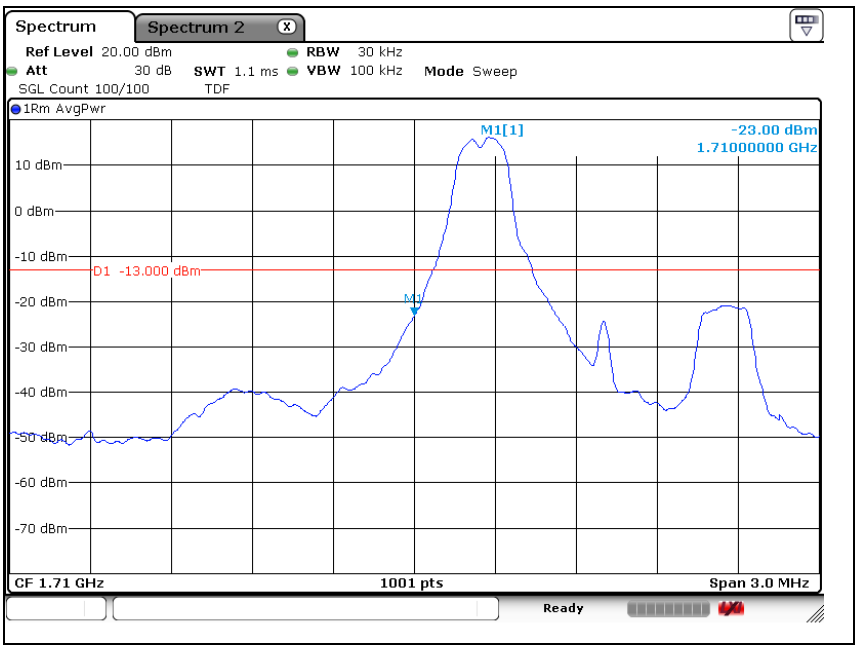
LTE band 4 (1.4 ㎒ - QPSK_RB 6)

Low Channel



LTE band 4 (1.4 ㎒ - QPSK_RB 1)

Low Channel



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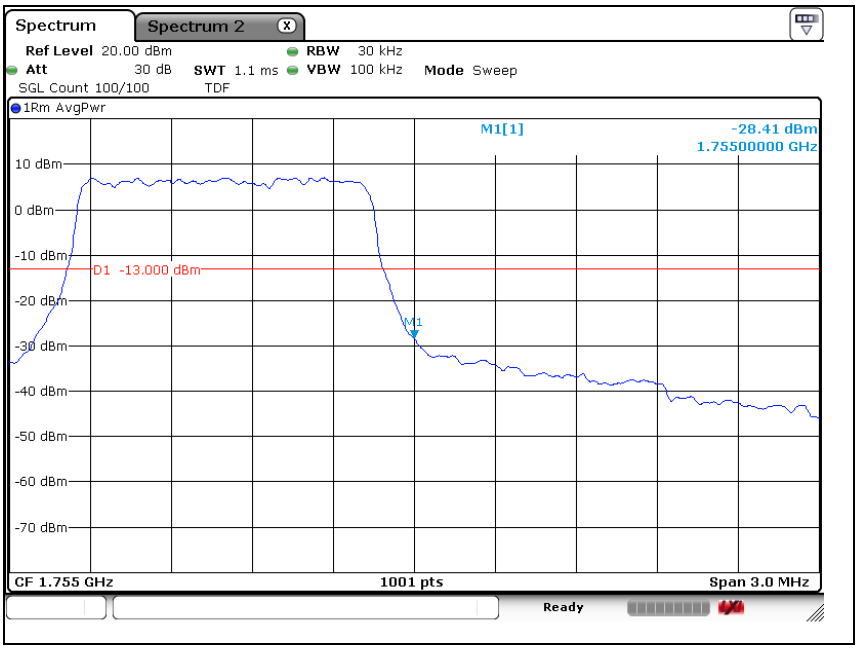
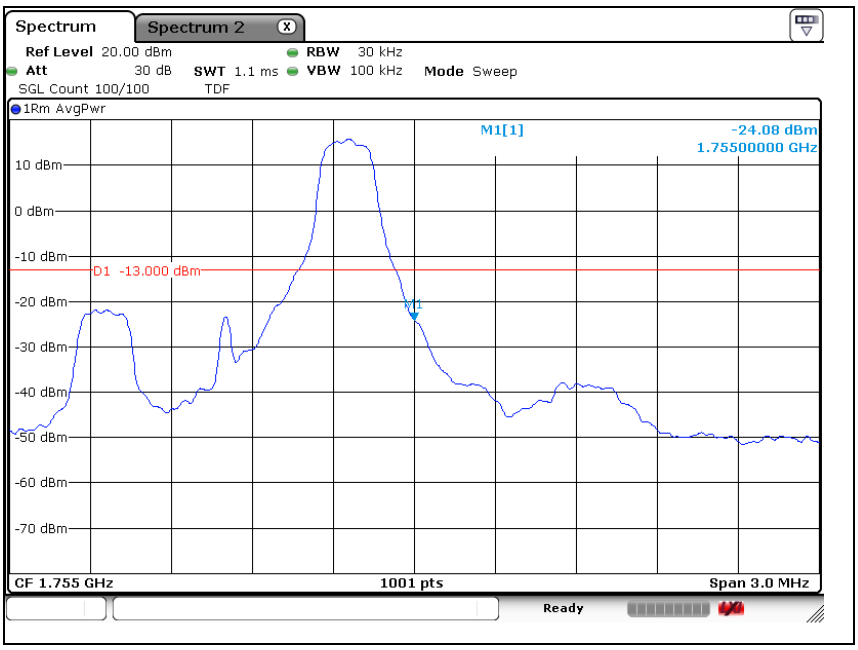
LTE band 4 (1.4 ㎒ - QPSK_RB 6)

High Channel



LTE band 4 (1.4 ㎒ - QPSK_RB 1)

High Channel



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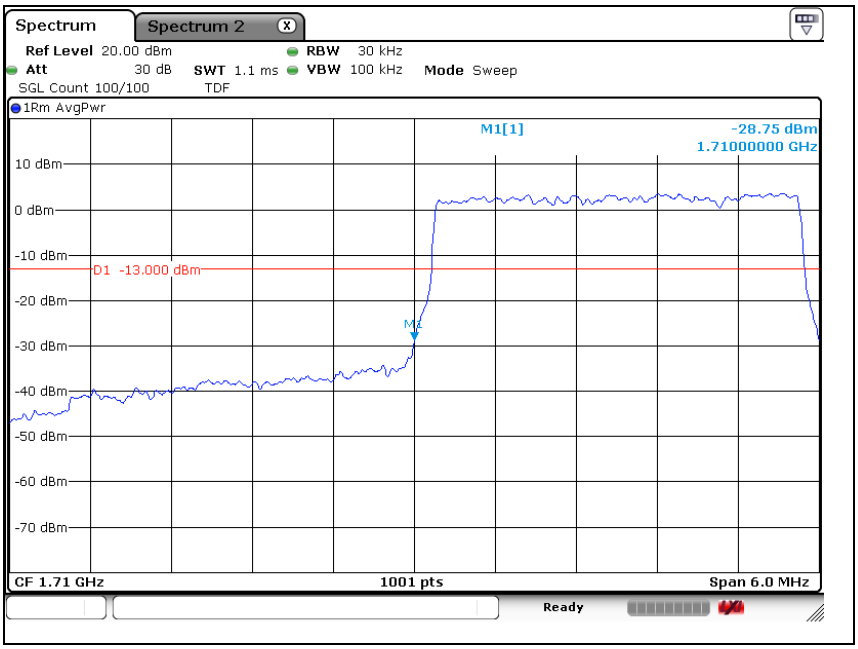
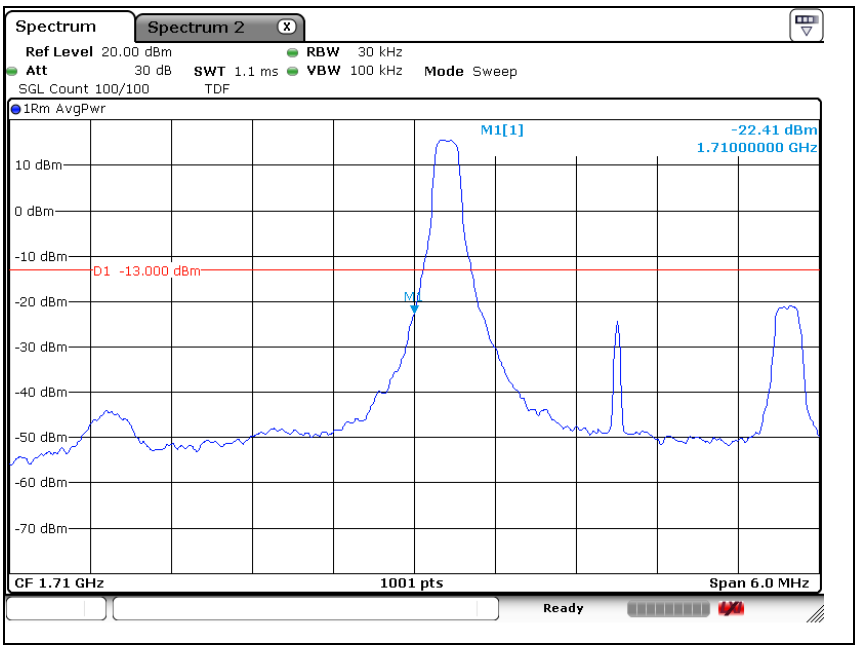
LTE band 4 (3 ㎒ - QPSK_RB 15)

Low Channel



LTE band 4 (3 ㎒ - QPSK_RB 1)

Low Channel



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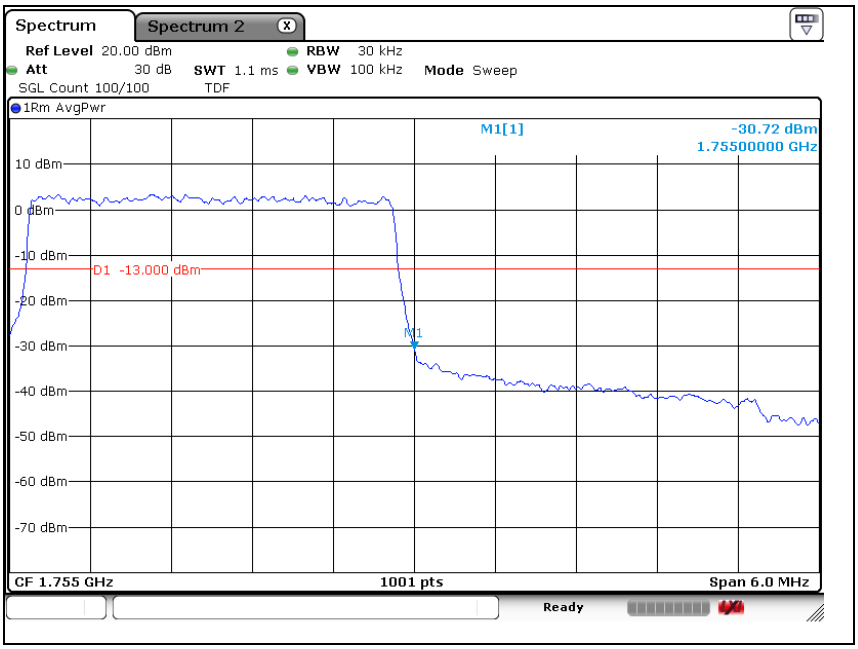
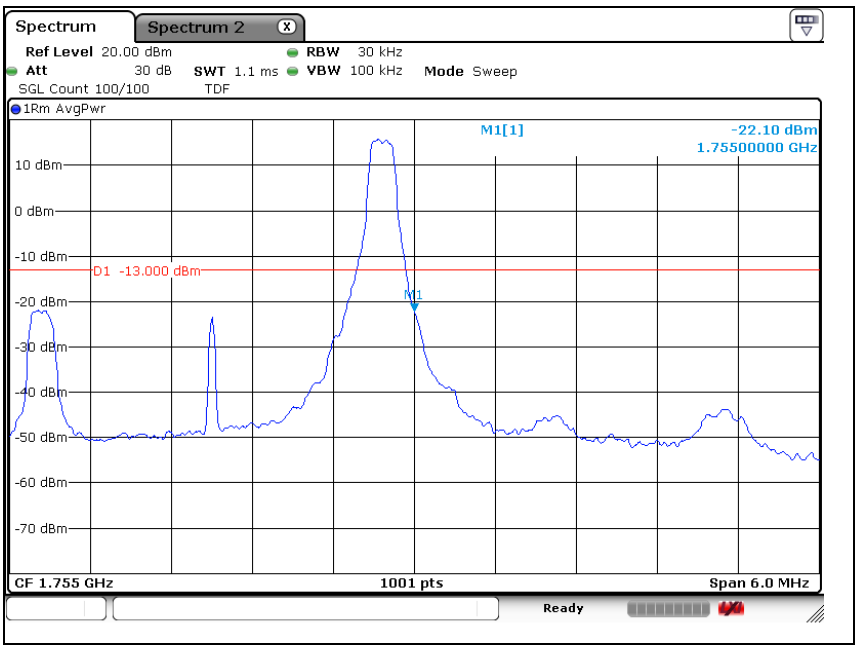
LTE band 4 (3 ㎒ - QPSK_RB 15)

High Channel



LTE band 4 (3 ㎒ - QPSK_RB 1)

High Channel



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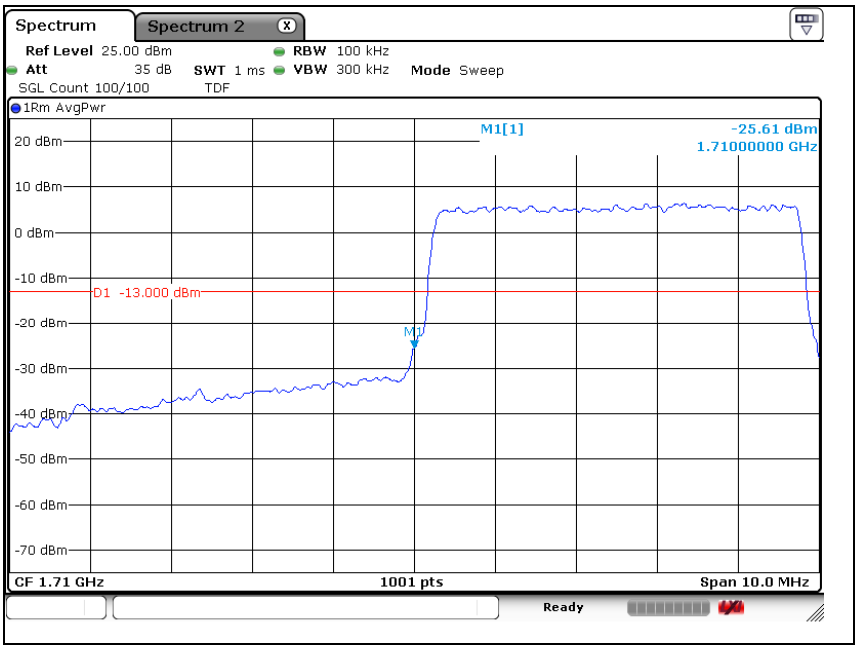
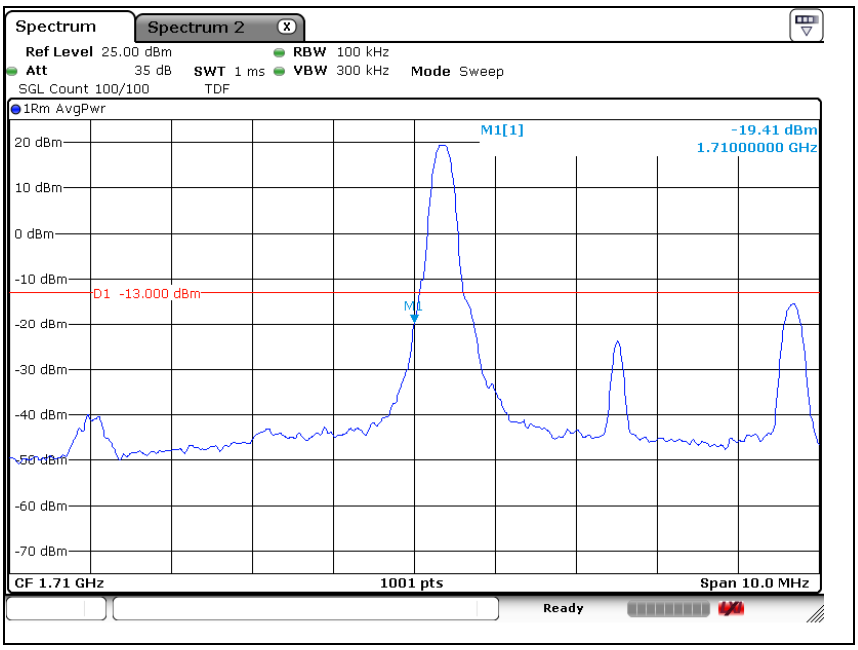
LTE band 4 (5 ㎒ - QPSK_RB 25)

Low Channel



LTE band 4 (5 ㎒ - QPSK_RB 1)

Low Channel



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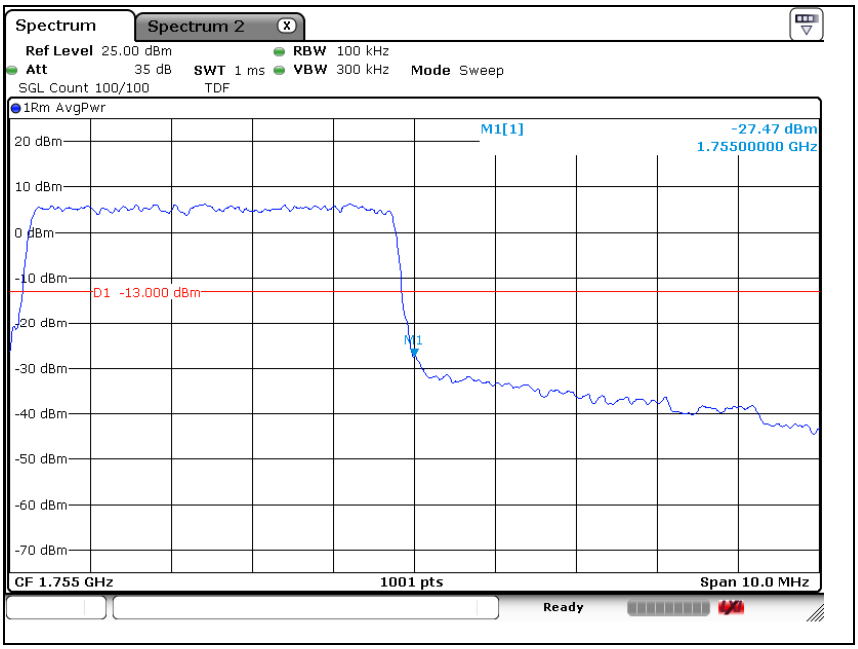
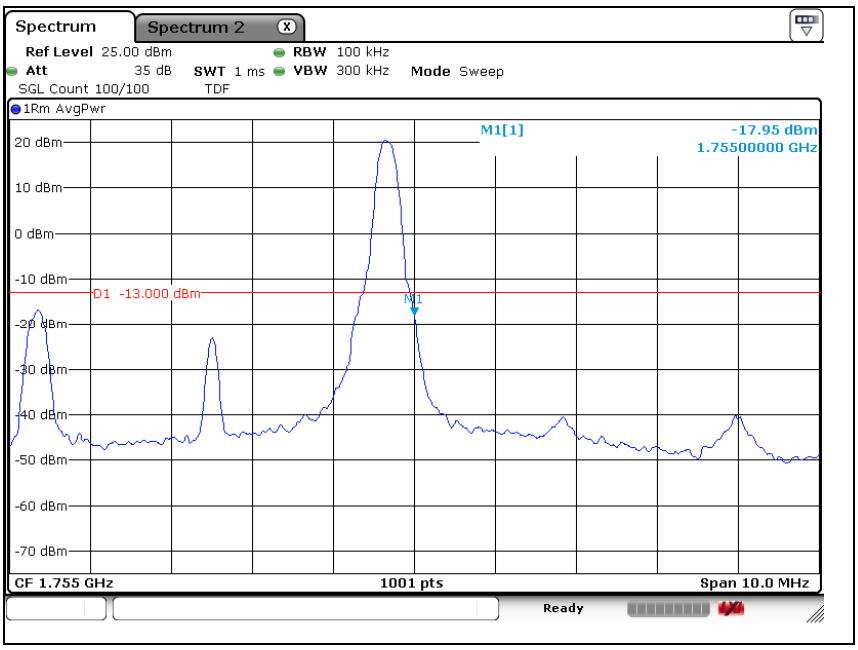
LTE band 4 (5 ㎒ - QPSK_RB 25)

High Channel



LTE band 4 (5 ㎒ - QPSK_RB 1)

High Channel



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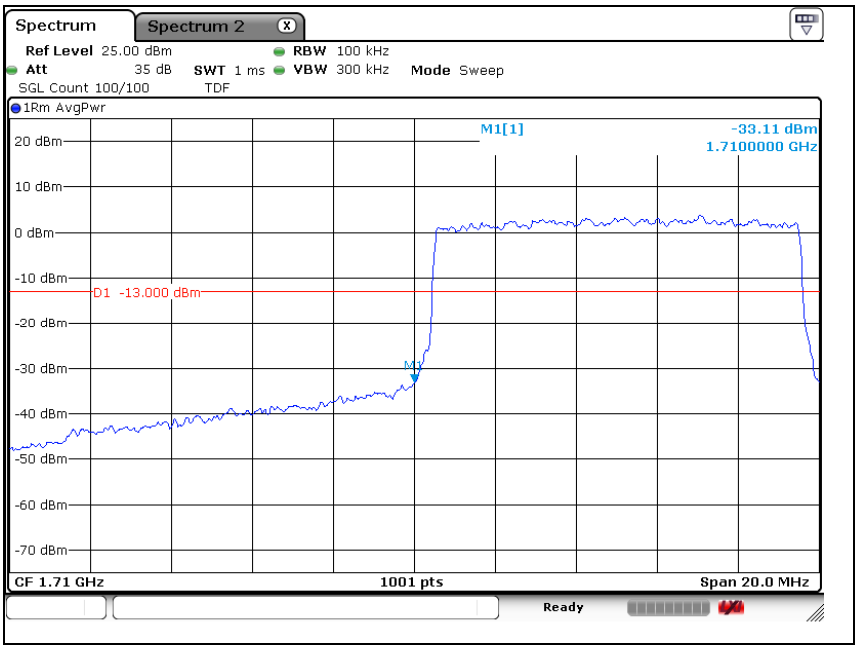
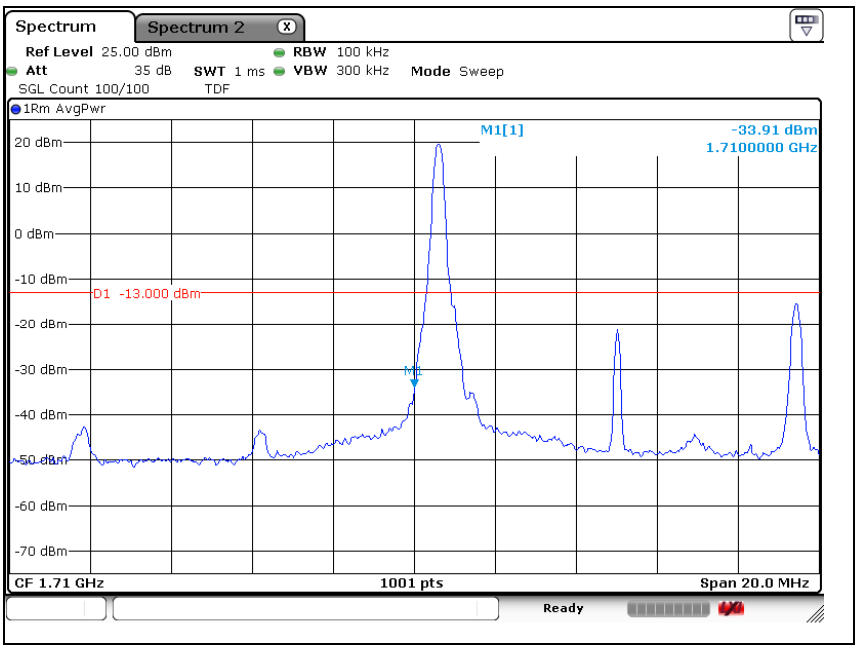
LTE band 4 (10 ㎒ - QPSK_RB 50)

Low Channel



LTE band 4 (10 ㎒ - QPSK_RB 1)

Low Channel



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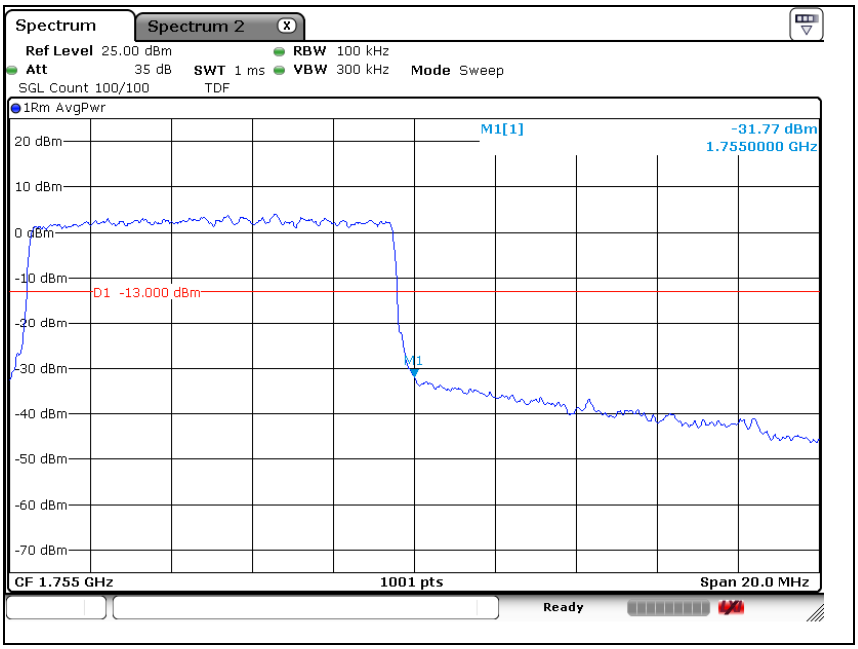
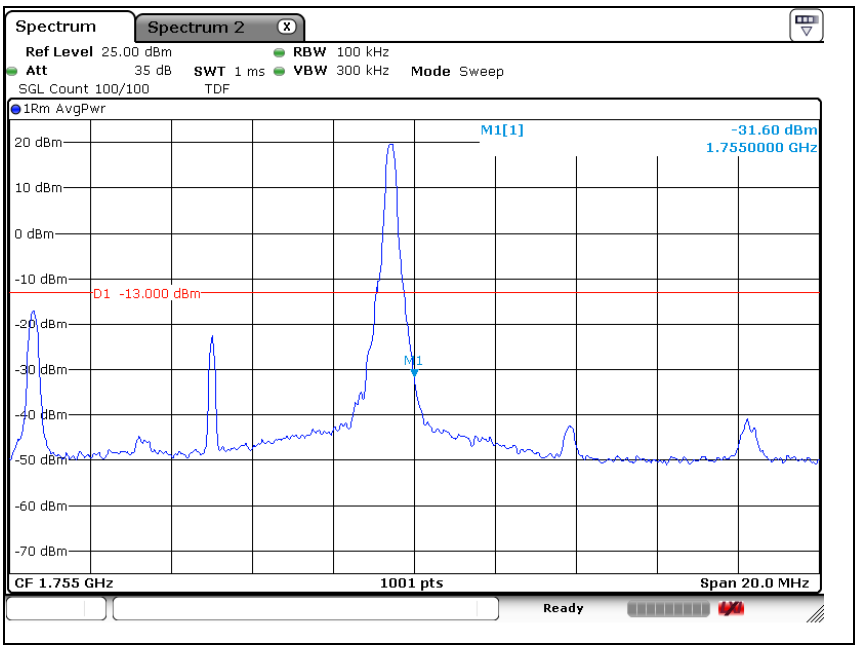
LTE band 4 (10 ㎒ - QPSK_RB 50)

High Channel



LTE band 4 (10 ㎒ - QPSK_RB 1)

High Channel



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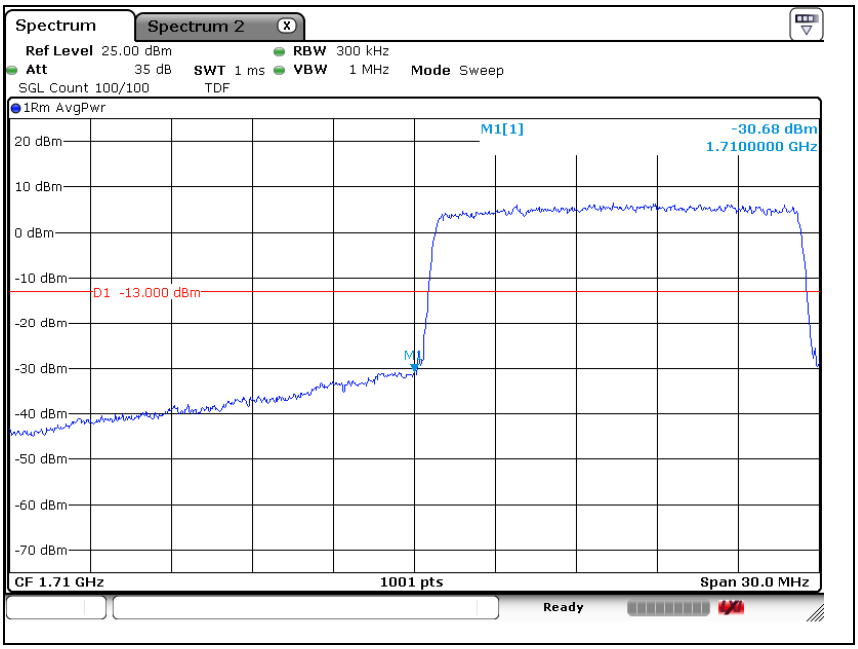
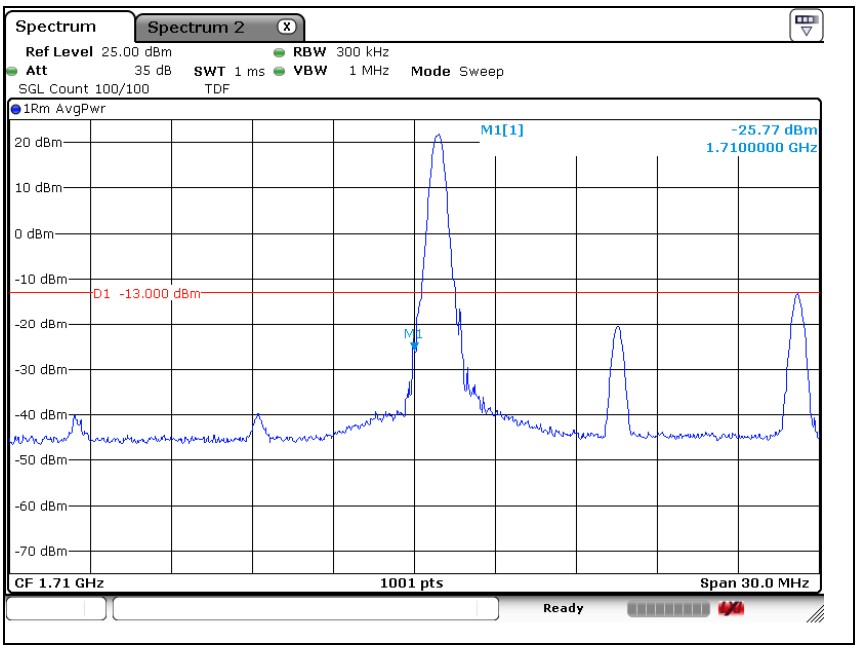
LTE band 4 (15 ㎒ - QPSK_RB 75)

Low Channel



LTE band 4 (15 ㎒ - QPSK_RB 1)

Low Channel



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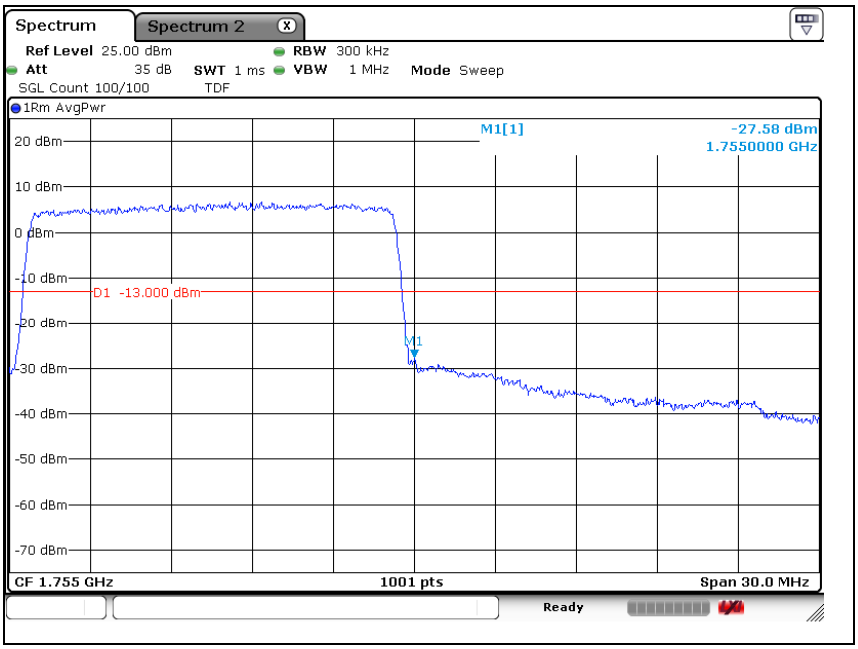
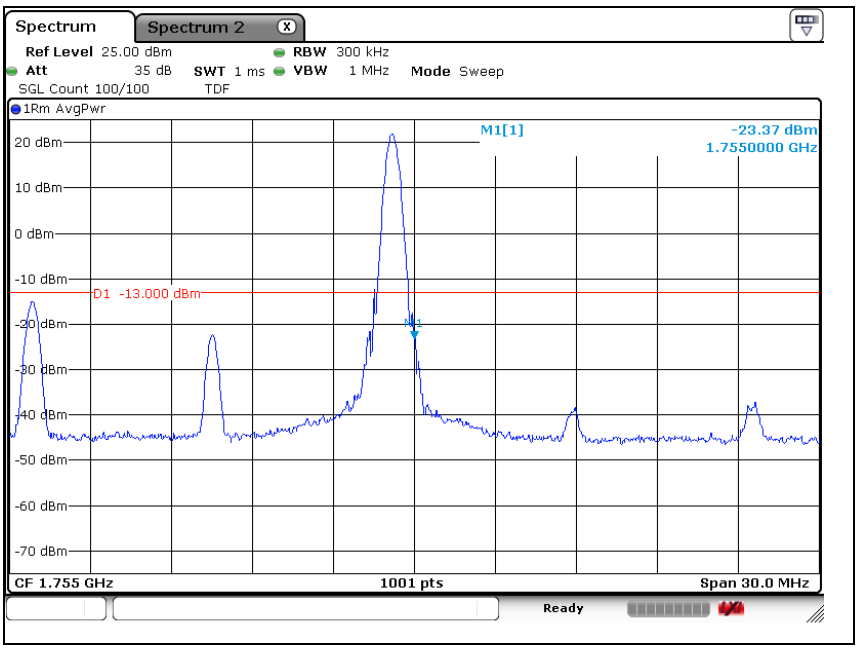
LTE band 4 (15 ㎒ - QPSK_RB 75)

High Channel



LTE band 4 (15 ㎒ - QPSK_RB 1)

High Channel



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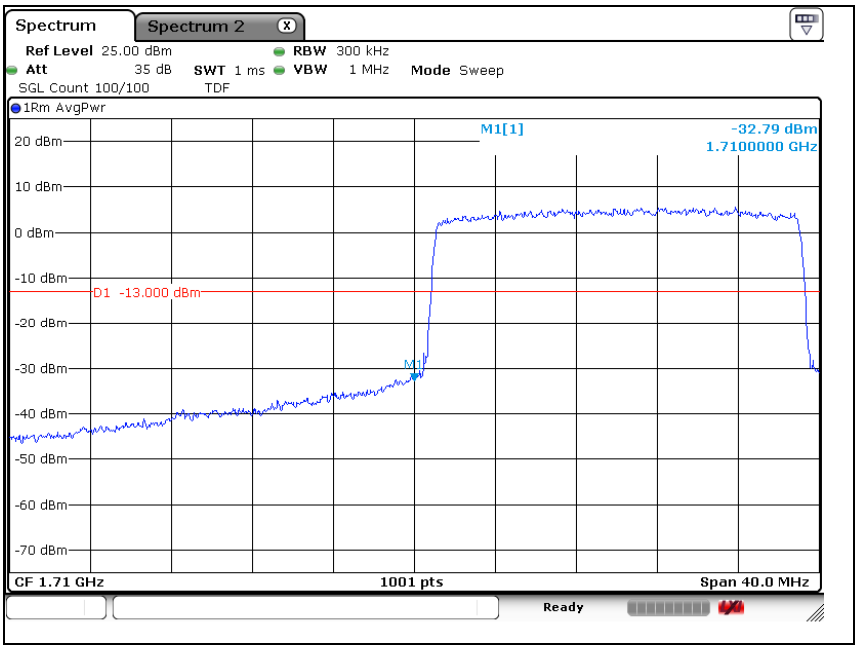
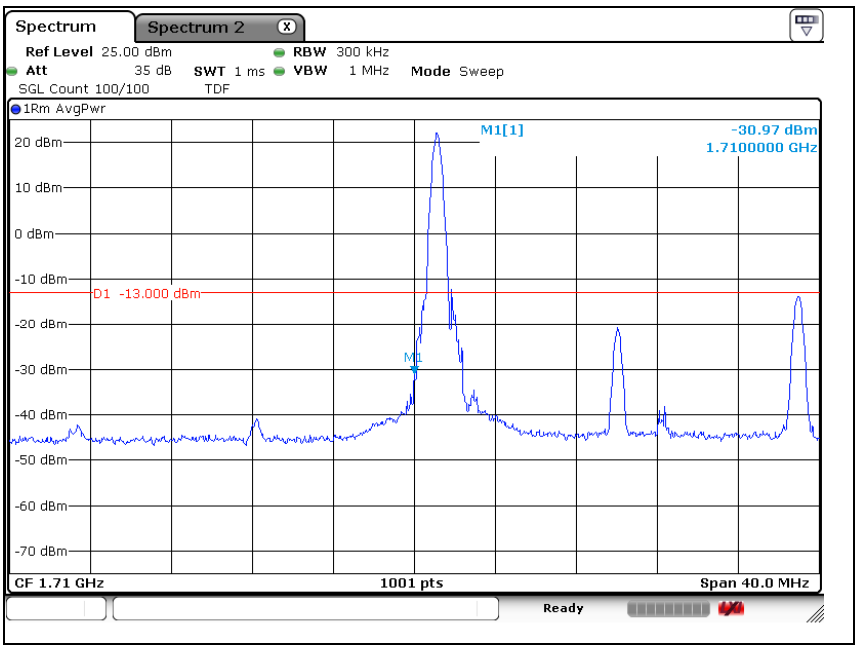
LTE band 4 (20 ㎒ - QPSK_RB 100)

Low Channel



LTE band 4 (20 ㎒ - QPSK_RB 1)

Low Channel



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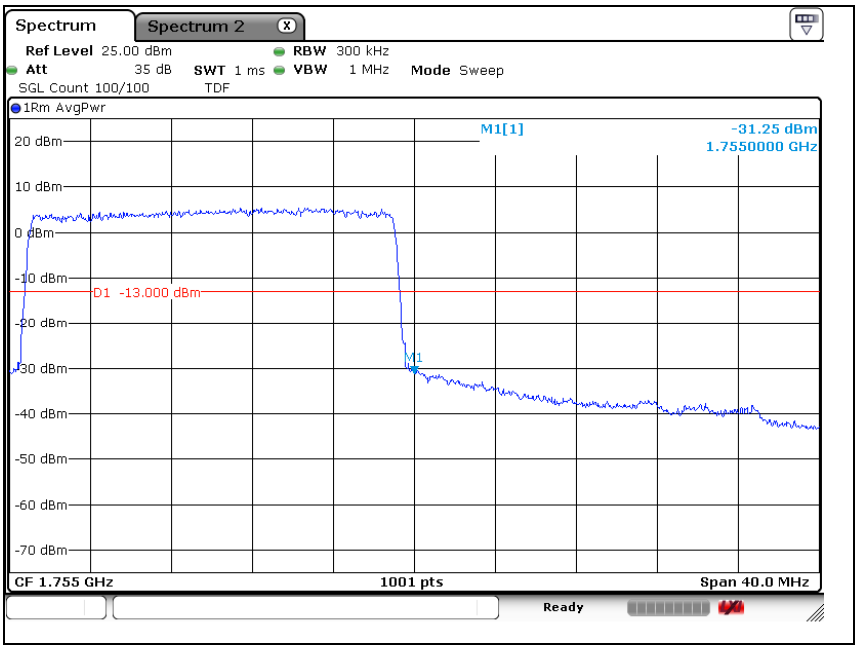
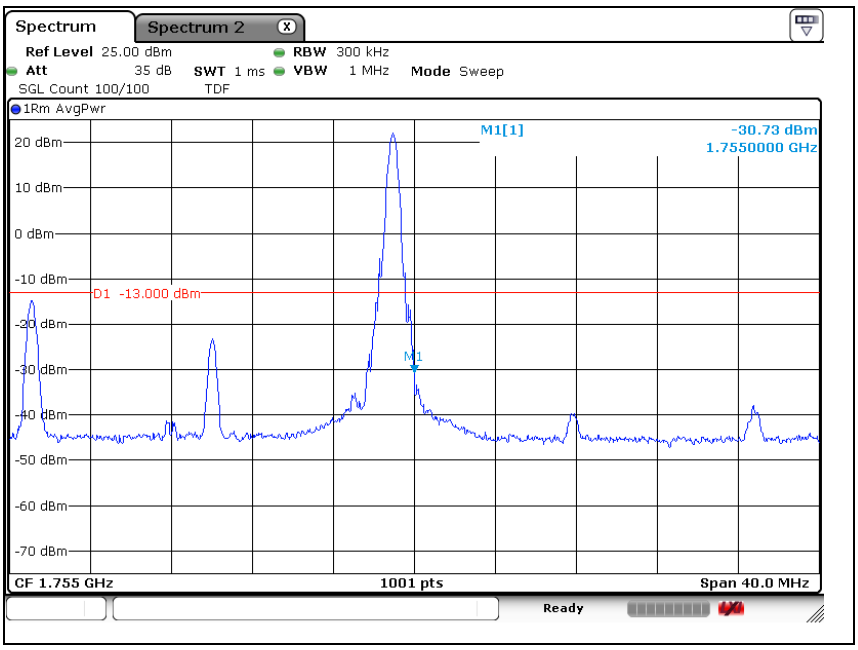
LTE band 4 (20 ㎒ - QPSK_RB 100)

High Channel



LTE band 4 (20 ㎒ - QPSK_RB 1)

High Channel



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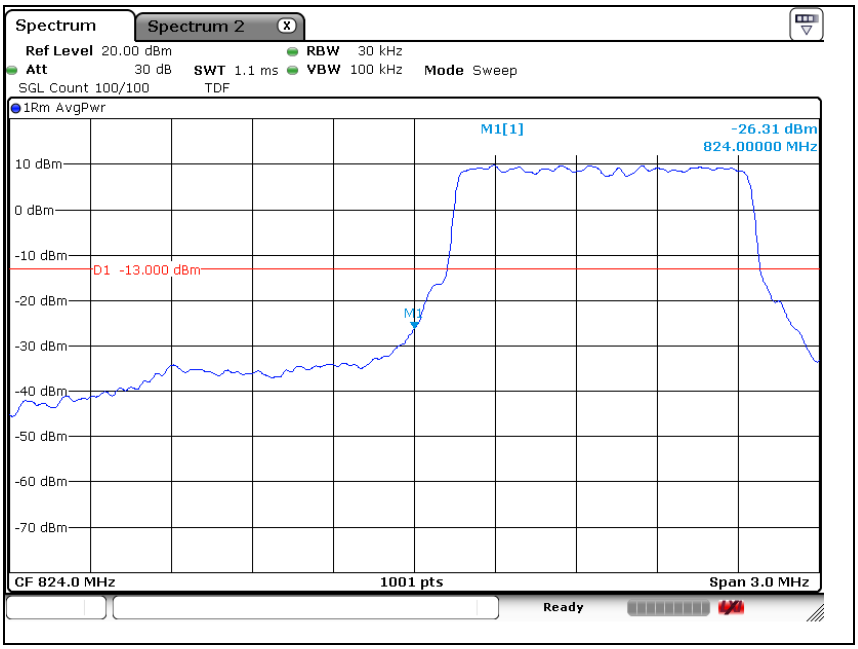
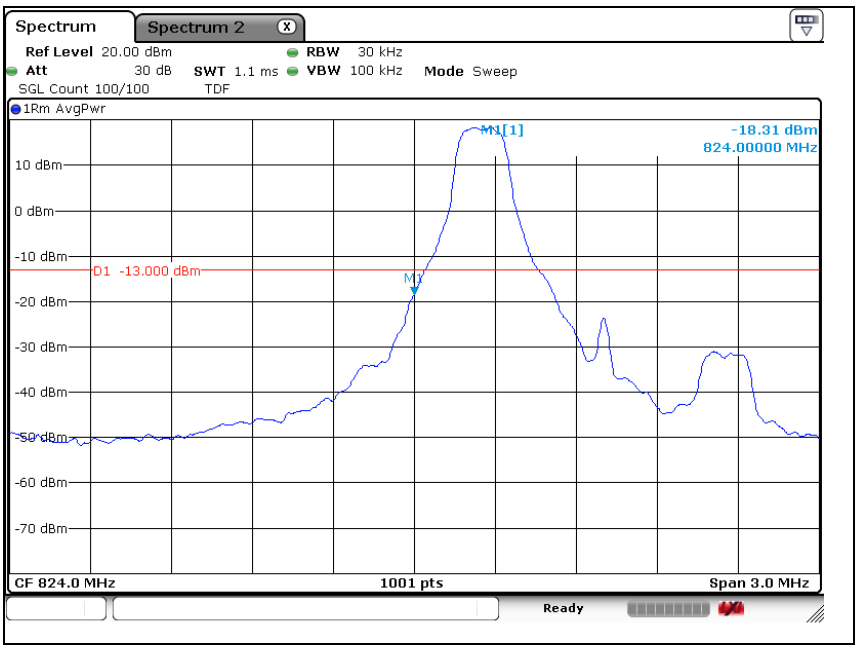
LTE band 5 (1.4 ㎒ - QPSK_RB 6)

Low Channel



LTE band 5 (1.4 ㎒ - QPSK_RB 1)

Low Channel



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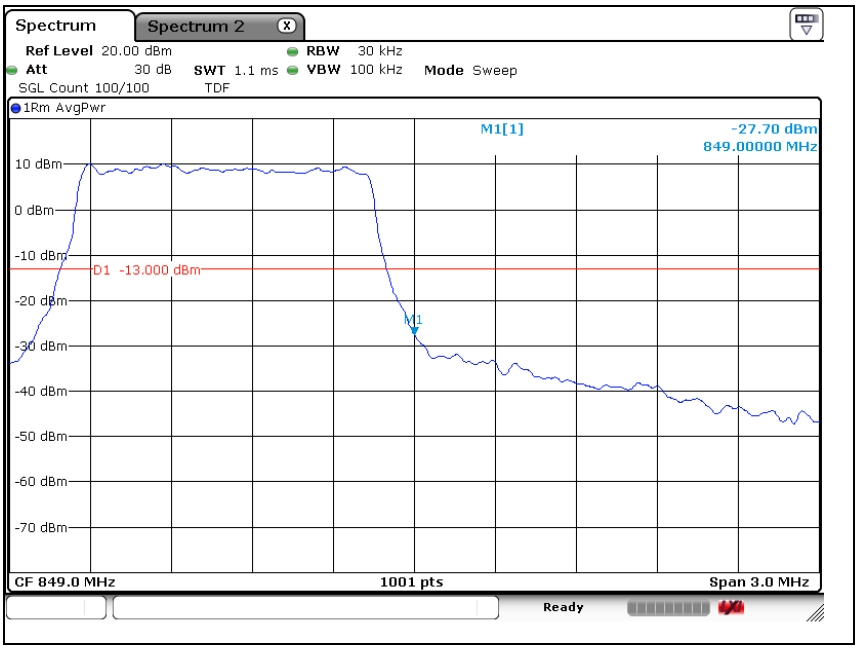
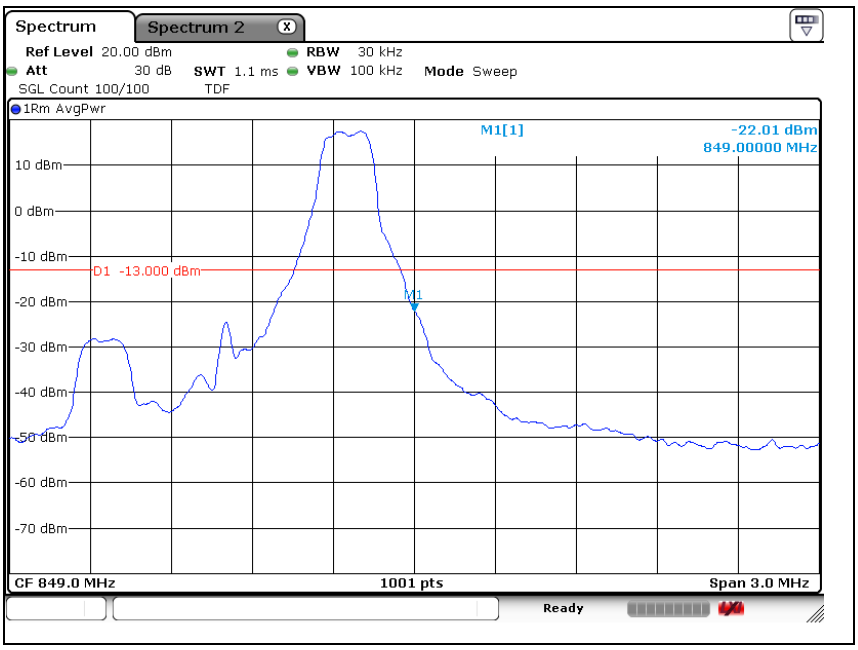
LTE band 5 (1.4 ㎒ - QPSK_RB 6)

High Channel



LTE band 5 (1.4 ㎒ - QPSK_RB 1)

High Channel



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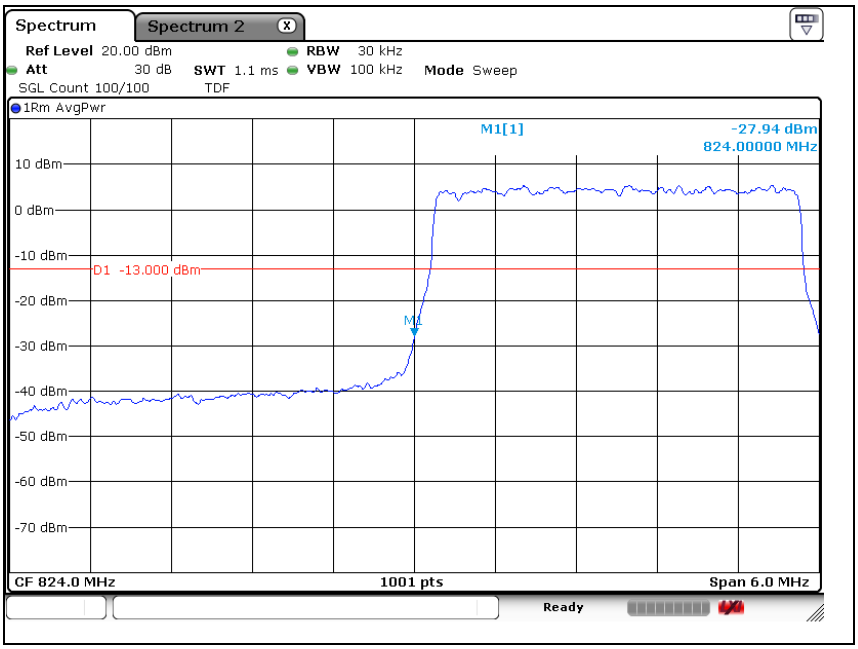
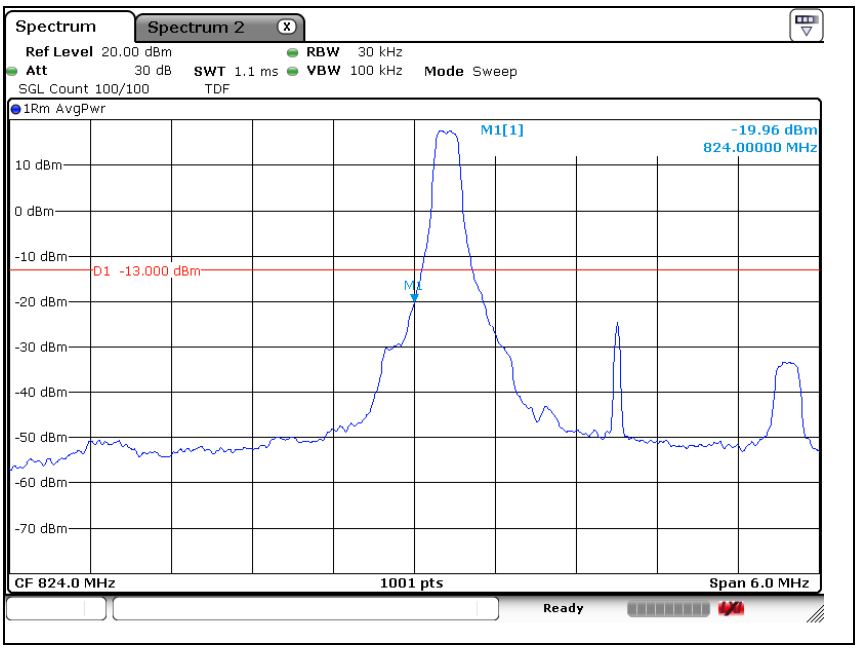
LTE band 5 (3 ㎒ - QPSK_RB 15)

Low Channel



LTE band 5 (3 ㎒ - QPSK_RB 1)

Low Channel



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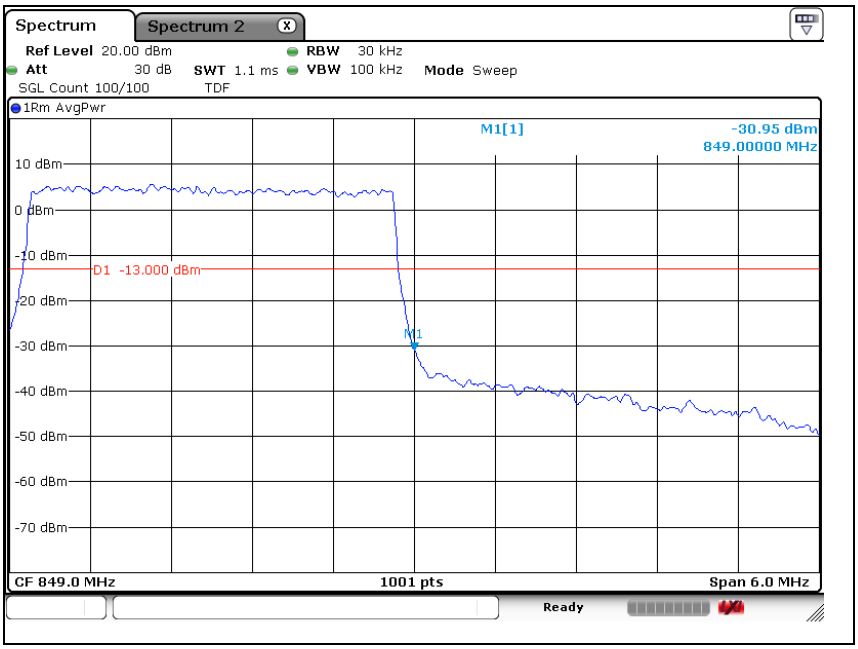
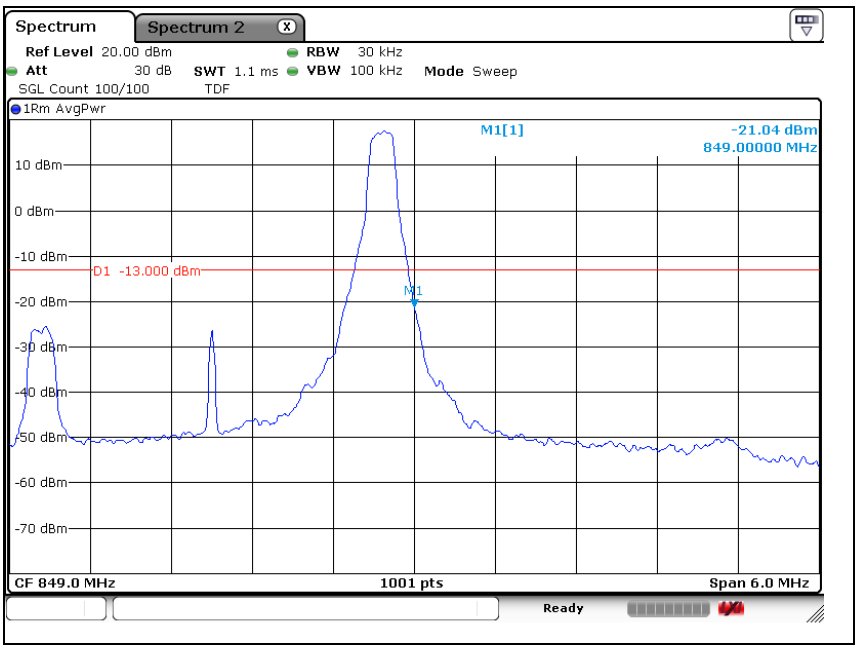
LTE band 5 (3 ㎒ - QPSK_RB 15)

High Channel



LTE band 5 (3 ㎒ - QPSK_RB 1)

High Channel



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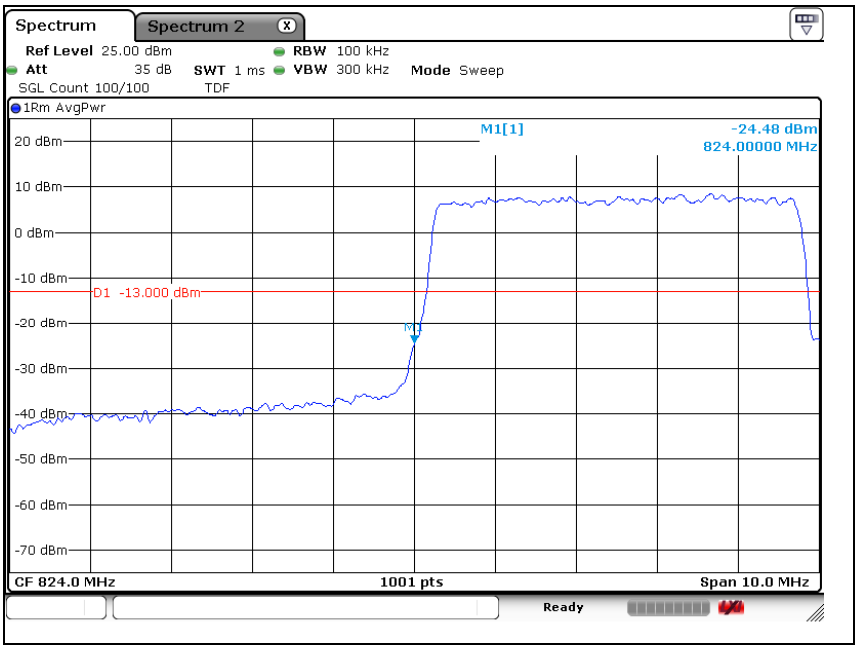
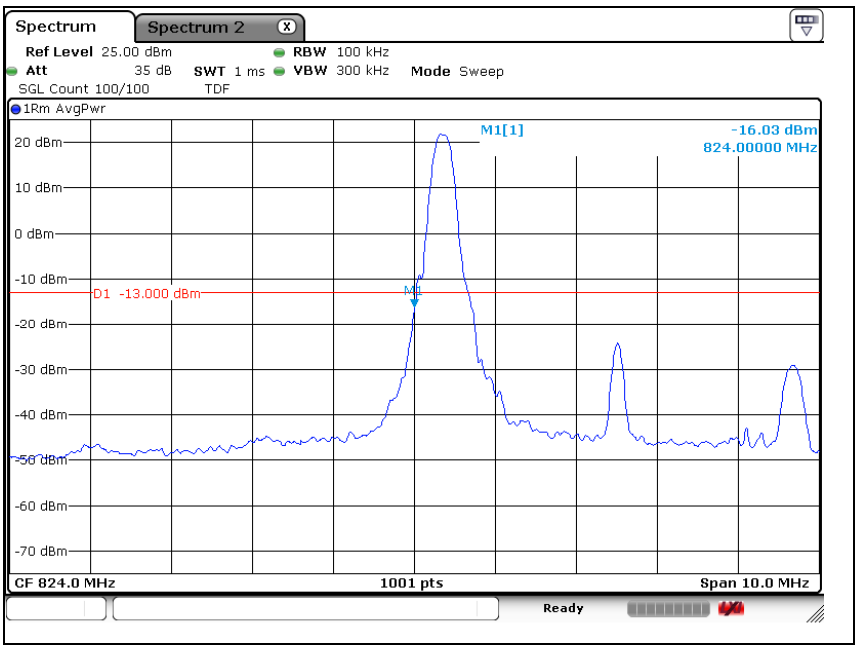
LTE band 5 (5 ㎒ - QPSK_RB 25)

Low Channel



LTE band 5 (5 ㎒ - QPSK_RB 1)

Low Channel



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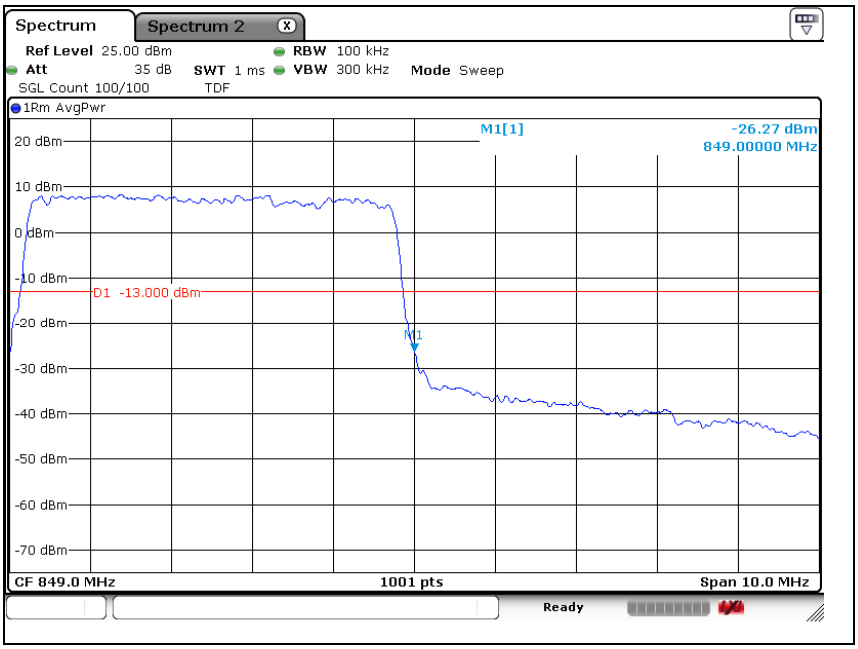
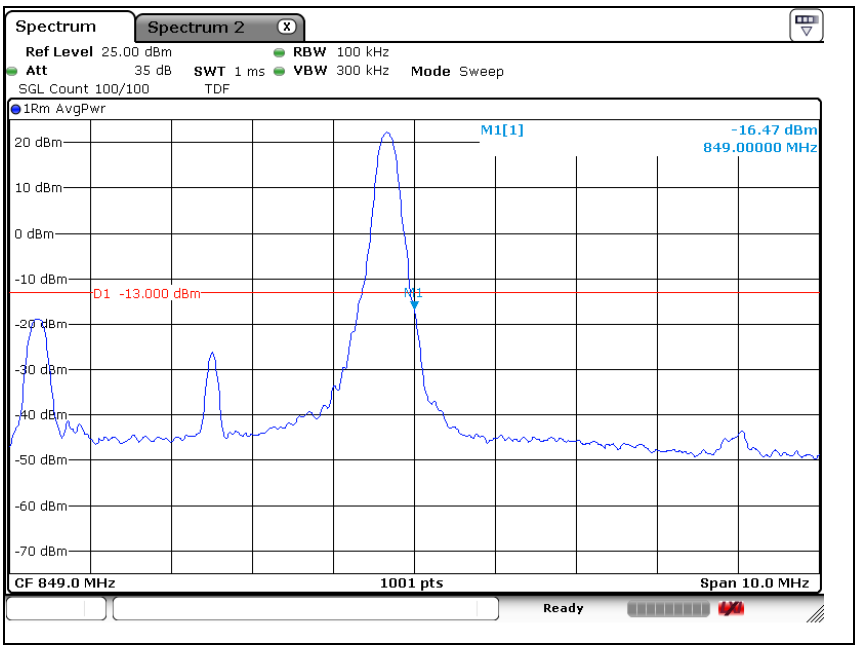
LTE band 5 (5 ㎒ - QPSK_RB 25)

High Channel



LTE band 5 (5 ㎒ - QPSK_RB 1)

High Channel



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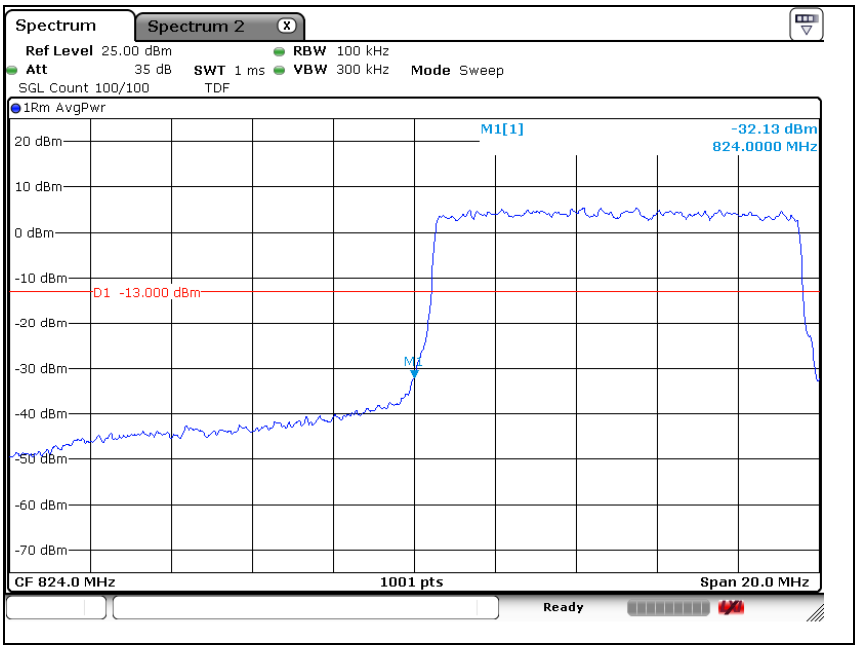
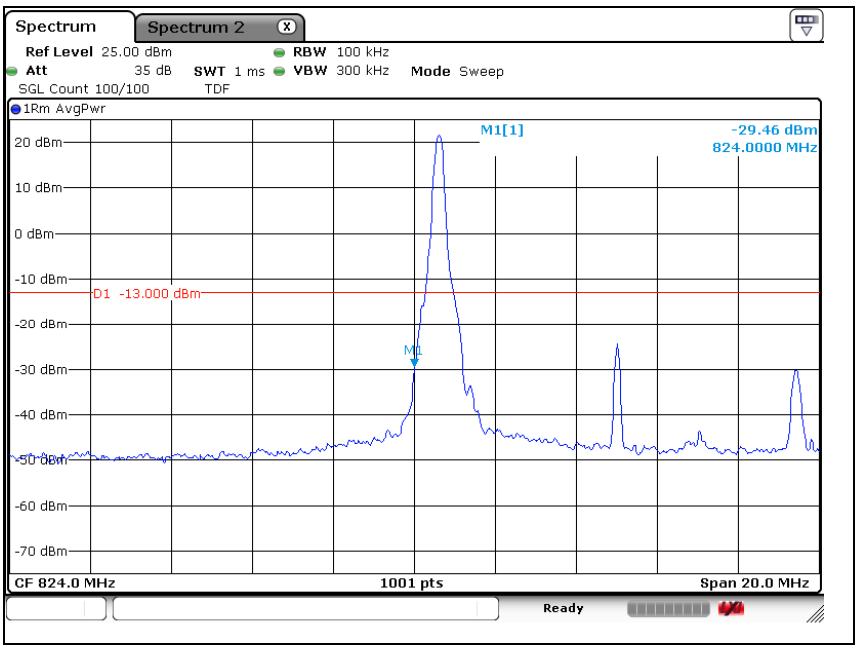
LTE band 5 (10 ㎒ - QPSK_RB 50)

Low Channel



LTE band 5 (10 ㎒ - QPSK_RB 1)

Low Channel



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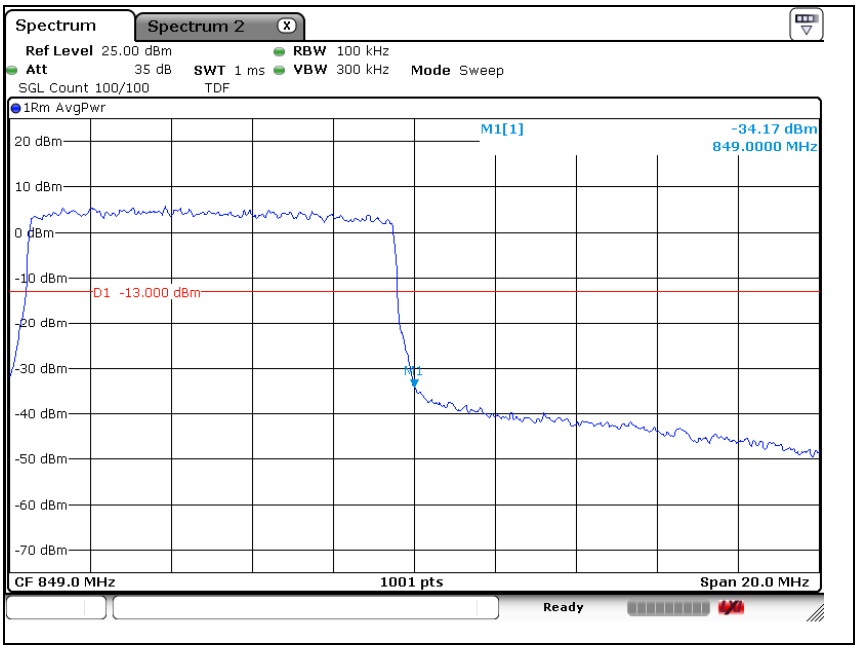
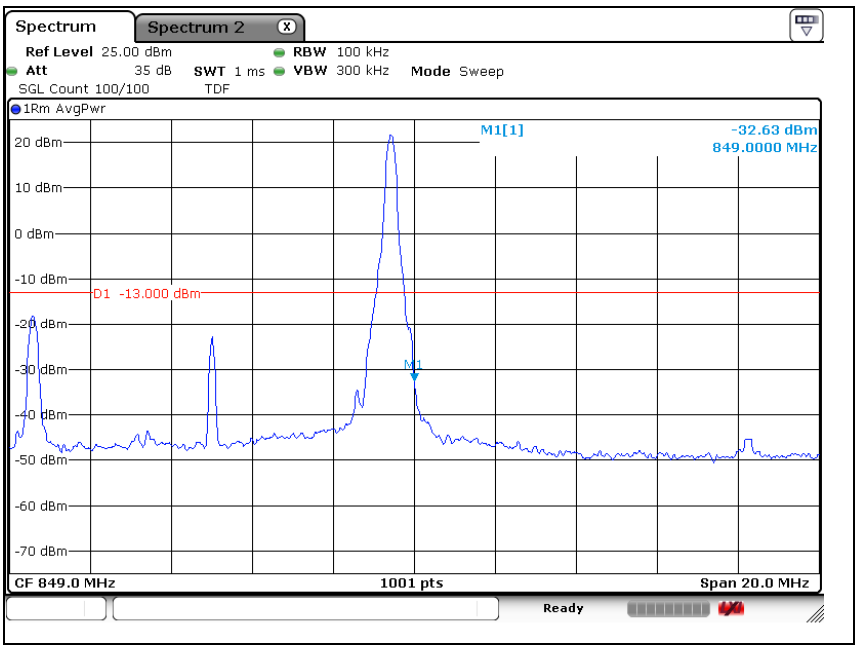
LTE band 5 (10 ㎒ - QPSK_RB 50)

High Channel



LTE band 5 (10 ㎒ - QPSK_RB 1)

High Channel



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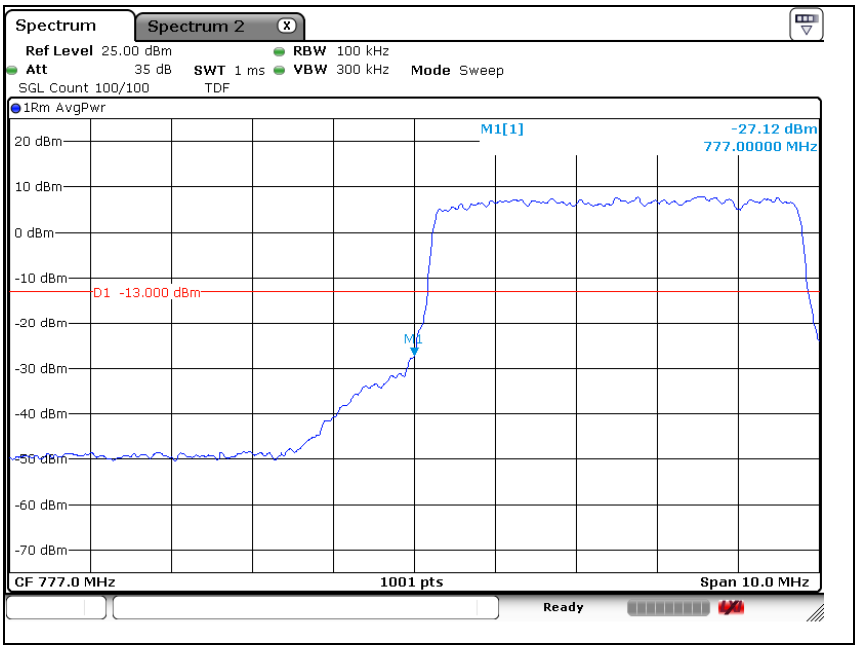
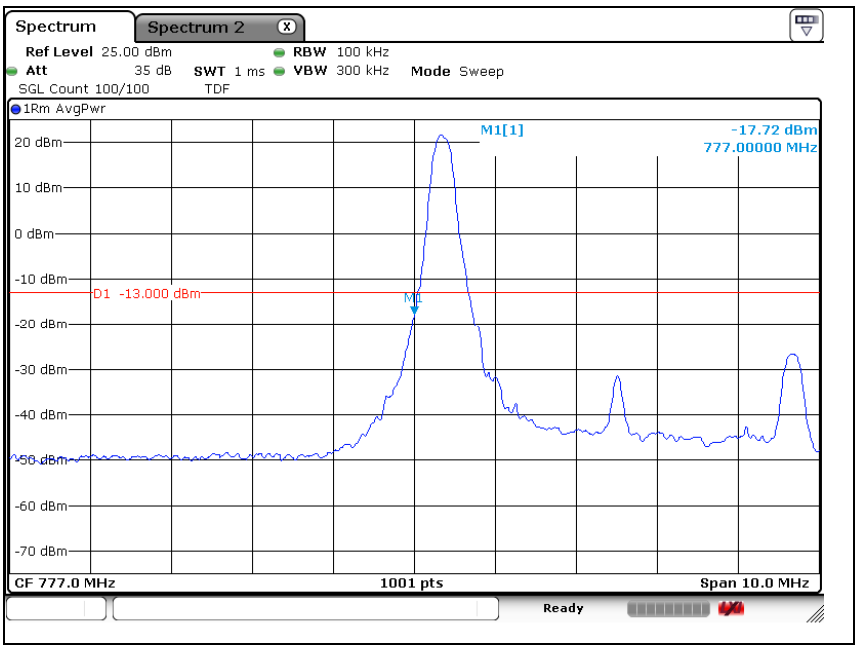
LTE band 13 (5 ㎒ - QPSK_RB 25)

Low Channel



LTE band 13 (5 ㎒ - QPSK_RB 1)

Low Channel



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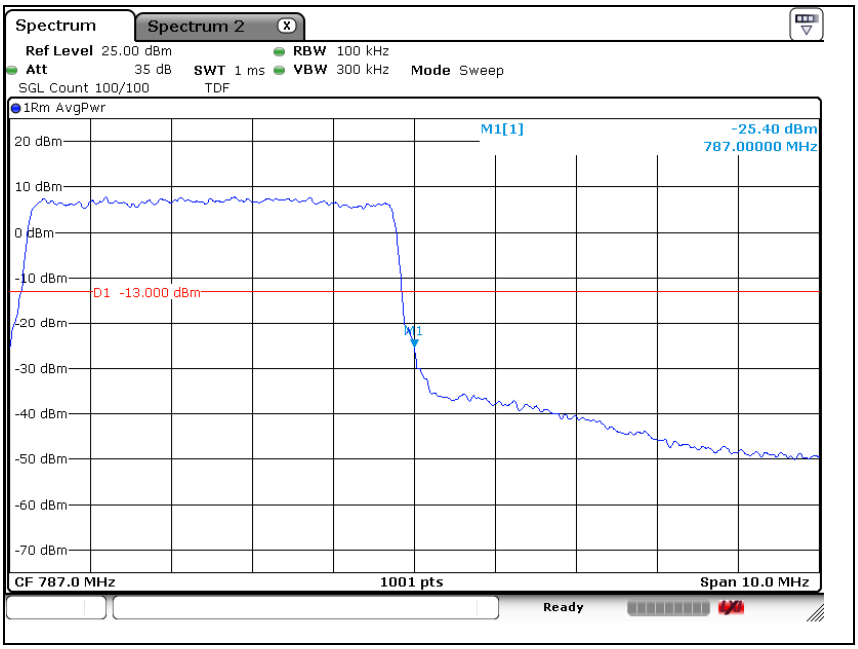
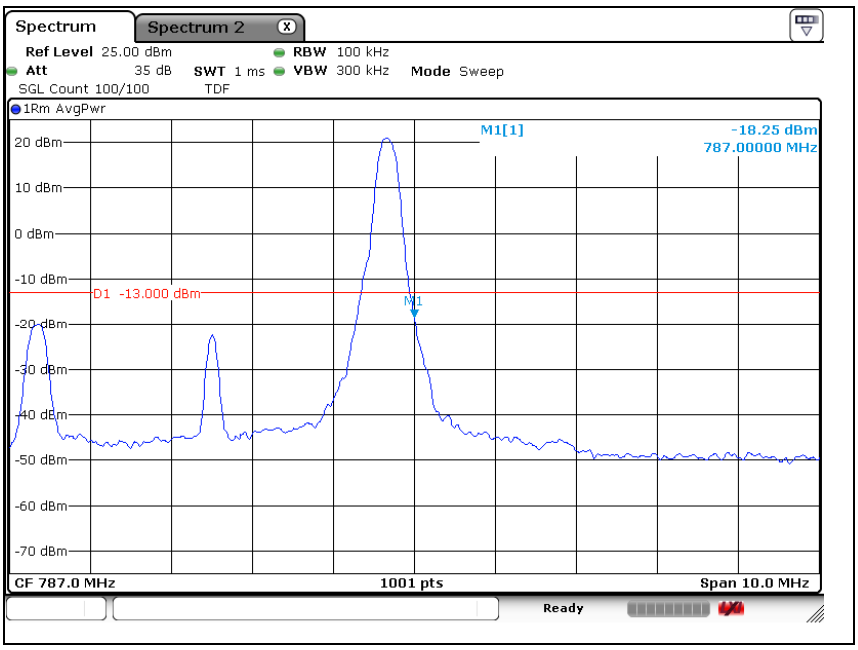
LTE band 13 (5 ㎒ - QPSK_RB 25)

High Channel



LTE band 13 (5 ㎒ - QPSK_RB 1)

High Channel



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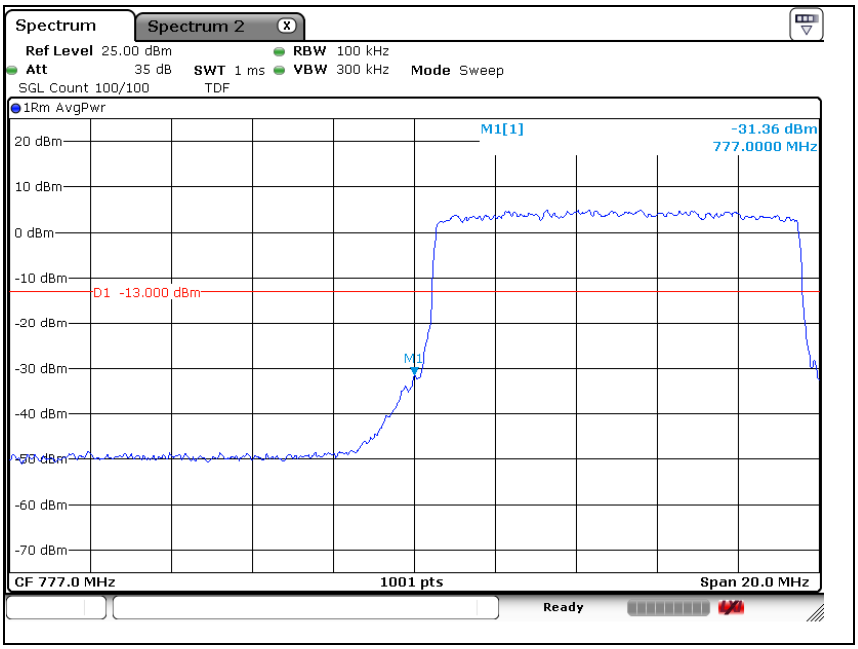
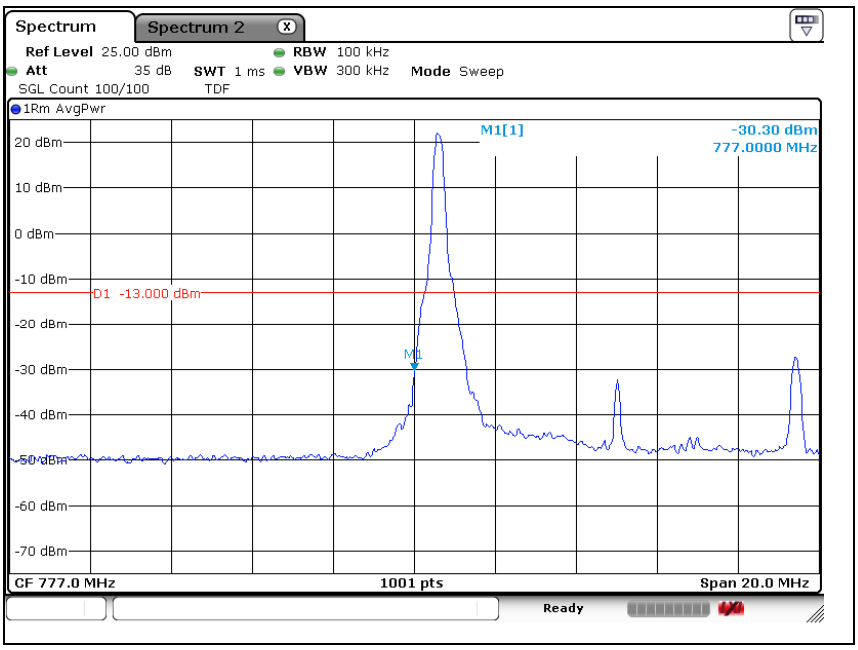
LTE band 13 (10 ㎒ - QPSK_RB 50)

Low Channel



LTE band 13 (10 ㎒ - QPSK_RB 1)

Low Channel



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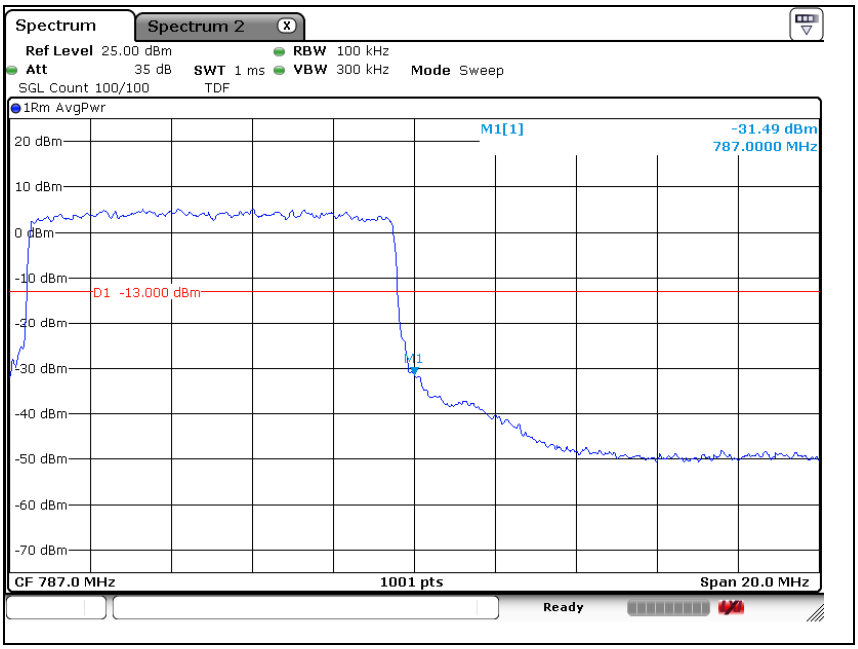
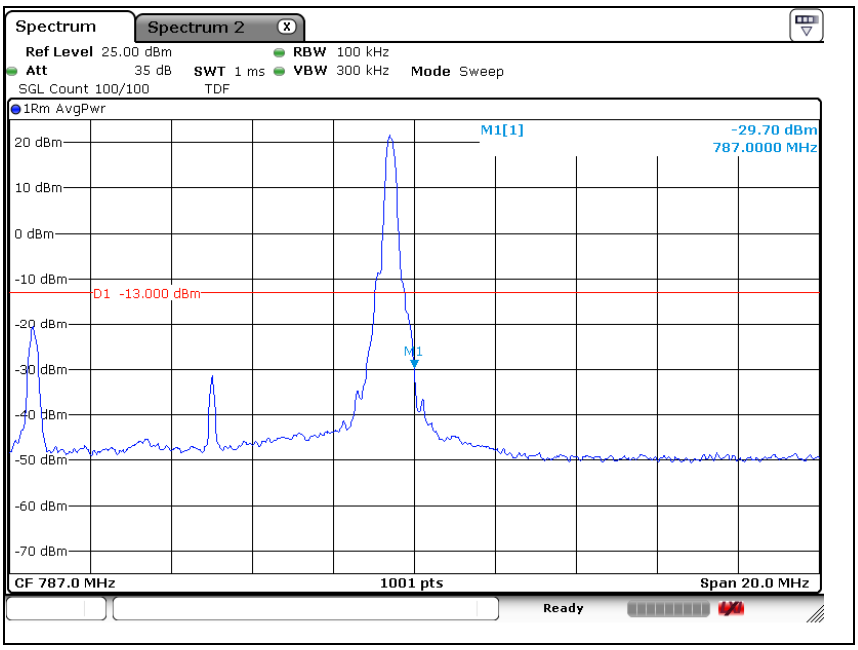
LTE band 13 (10 ㎒ - QPSK_RB 50)

High Channel



LTE band 13 (10 ㎒ - QPSK_RB 1)

High Channel



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8. Frequency Stability

8.1. Limit

- §2.1055 (a), §2.1055 (d) & following:

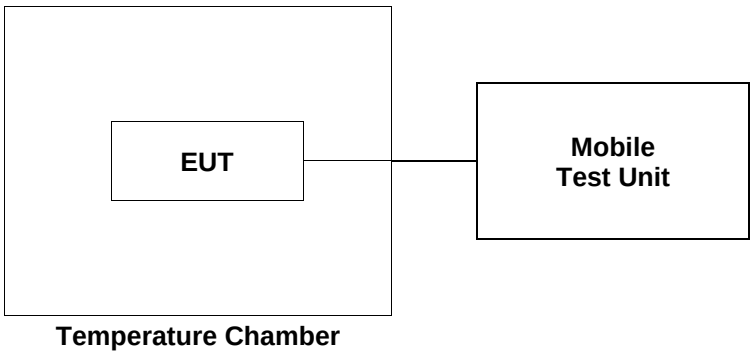
- §22.355, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table of this section.
For Mobile devices operating in the 824 to 849 ㎒ band at a power level less than or equal to 3 Watts, the limit specified in Table C-1 is +/- 2.5 ppm.

- §24.235, the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

- §27.54, the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

8.2. Test Procedure

1. Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to a Mobile Test Unit via feed-through attenuators.
2. The EUT was placed inside the temperature chamber.
3. After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from Mobile Test Unit.



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8.3. Test Results

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

LTE band 2 at middle channel

Reference Frequency: 1 880.0 ㎒			
Frequency Stability versus Temperature			
Environment Temperature (℃)	**Power Supplied (V_{dc})**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
50	4.0	-4	-0.002 1
40		-1	-0.000 5
30		2	0.001 1
23		-6	-0.003 2
10		1	0.000 5
0		2	0.001 1
-10		-3	-0.001 6
-20		2	0.001 1
-30		-4	-0.002 1
Frequency Stability versus Power Supply			
Environment Temperature (℃)	**Power Supplied (V_{dc})**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
23	4.6	-5	-0.002 7
	3.4	-3	-0.001 6

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LTE band 4 at middle channel

Reference Frequency: 1 732.5 ㎒			
Frequency Stability versus Temperature			
Environment Temperature (℃)	**Power Supplied (V_{dc})**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
50	4.0	5	0.002 9
40		1	0.000 6
30		-3	-0.001 7
23		-1	-0.000 6
10		2	0.001 2
0		4	0.002 3
-10		-5	-0.002 9
-20		2	0.001 2
-30		-3	-0.001 7
Frequency Stability versus Power Supply			
Environment Temperature (℃)	**Power Supplied (V_{dc})**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
23	4.6	2	0.001 2
	3.4	-1	-0.000 6

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LTE band 5 at middle channel

Reference Frequency: 836.5 ㎒			
Frequency Stability versus Temperature			
Environment Temperature (℃)	**Power Supplied (V_{dc})**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
50	4	-3	-0.003 6
40		1	0.001 2
30		2	0.002 4
23		2	0.002 4
10		2	0.002 4
0		-1	-0.001 2
-10		-3	-0.003 6
-20		1	0.001 2
-30		-3	-0.003 6
Frequency Stability versus Power Supply			
Environment Temperature (℃)	**Power Supplied (V_{dc})**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
23	4.6	-2	-0.002 4
	3.4	1	0.001 2

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LTE band 13 at middle channel

Reference Frequency: 782.0 ㎒			
Frequency Stability versus Temperature			
Environment Temperature (℃)	**Power Supplied (V_{dc})**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
50	4	-3	-0.003 8
40		-2	-0.002 6
30		2	0.002 6
23		-4	-0.005 1
10		-1	-0.001 3
0		1	0.001 3
-10		-2	-0.002 6
-20		4	0.005 1
-30		2	0.002 6
Frequency Stability versus Power Supply			
Environment Temperature (℃)	**Power Supplied (V_{dc})**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
23	4.6	-2	-0.002 6
	3.4	-3	-0.003 8

- End of the Test Report -

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