

TEST REPORT

MEASUREMENT PER SECTION 2.1033 (C) (14) OF THE RULES

SECTION 2.1033 (c) (14)

The data required by Section 2.1046 through 2.1057, inclusive, measured in accordance with the procedures set out in Section 2.1041.

RESPONSE:

The following pages include the data required for the **AS5BBTRX-15A**, measured in accordance with the procedures set out in Section 2. 1033(c)(14) of the Rules.

Each required measurement and its corresponding exhibit number are:

Measurement: 1	Section 2.1046	RF Power Output - See Measurement 3
Measurement: 2	Section 2.1047 Section 27.50(d)(5)	Modulation Characteristics Peak-to-Average ratio (PAR)
Measurement: 3	Section 2.1049	(a) Emissions Bandwidth (b) Occupied Bandwidth/Band Edge spurious Emissions
Measurement: 4	Section 2.1051	Spurious Emissions at Antenna Terminals
Measurement: 5	Section 2.1053	Field Strength of Spurious Radiation
Measurement: 6	Section 2.1055	Measurement of Frequency Stability
	Section 2.1057	Frequency Spectrum to be Investigated

Measurement 1

FCC Section 2.1046 RF Power output

Refer to **Measurement 3** Occupied Bandwidth/Band Edge Measurement during that measurement RF Output was continuously monitored.

Measurement 2

FCC Section 2.1047 Modulation Characteristics & Section 27.50(d)(5) Measurement of Peak-to-Average ratio (PAR)

Section 2.1047

Modulation Characteristics

The modulation techniques used are explained in the submission as part section 2.1033 (c) (13). The RF signal at the antenna port was demodulated and verified for correctness of modulation signal used before each test was performed. The attached plots of graphs show the modulation components: In phase (I) and Quadrature (Q) components.

- (1) Quadrature Phase Shift Keying (QPSK) modulation scheme uses 2 bits are transmitted simultaneously (one per channel) and a symbol can be represented by 2 bits. Therefore there are $2^2 = 4$ states (Binary 00 to 11). The theoretical bandwidth is 2bits/second/Hz.
- (2) 16 Quadrature amplitude modulation (QAM): In 16QAM, there 16-states. There are four I values and four Q values, therefore 4 bits are available for represent a symbol. Therefore there are $2^4 = 16$ states (Binary 0000 to 1111). The theoretical bandwidth is 4bits/second/Hz.
- (3) 64 Quadrature amplitude modulation (QAM): In 64QAM: The 64QAM is similar to 16QAM and there will be 64 states and 6 bits are available to represent a symbol.

Time domain LTE (TD-LTE) Modulation is similar to Frequency domain LTE. However TD-LTE uses a single carrier frequency for both uplink and downlink. The TD-RRH transceiver divides the communication time into transmission and reception periods depending on user needs.

Therefore gating technique is used for measuring transmit power and occupied BW. Reference signal derived from GPS and frame trigger from the RRH were input into analyzer. This enables analyzer to measure power and occupied BW only during the transmit cycle.

Occupied Bandwidth Measurement:

Spectrum Analyzer was used for Gated spectrum measurements. In addition to RF input from TD-RRH, this analyzer uses following additional inputs:

- (1) A 10MHz signal from GPS receiver as reference input signal (Plot 1)
- (2) A 100Hz 50% duty cycle square wave (frame trigger) from the TD-RRH as trigger input (Plot 2)
- (3) Using signals (1) and (2) Spectrum Analyzer produces a trigger pulse having 10ms period and 66.98% duty cycle square wave). Spectrum Analyzer uses this trigger pulse for performing gated measurement.

Gated Power Measurements:

Similarly Signals provided in plot 1&2 were used as inputs to power meters for measuring RF power and Peak to average accurately.

Blocks	Bandwidth (MHz)	Frequency (MHz)	Power (Watts)
Lower	20	2496-2516	20
Middle	20	2568-2588	20
Higher	20	2660-2680	20

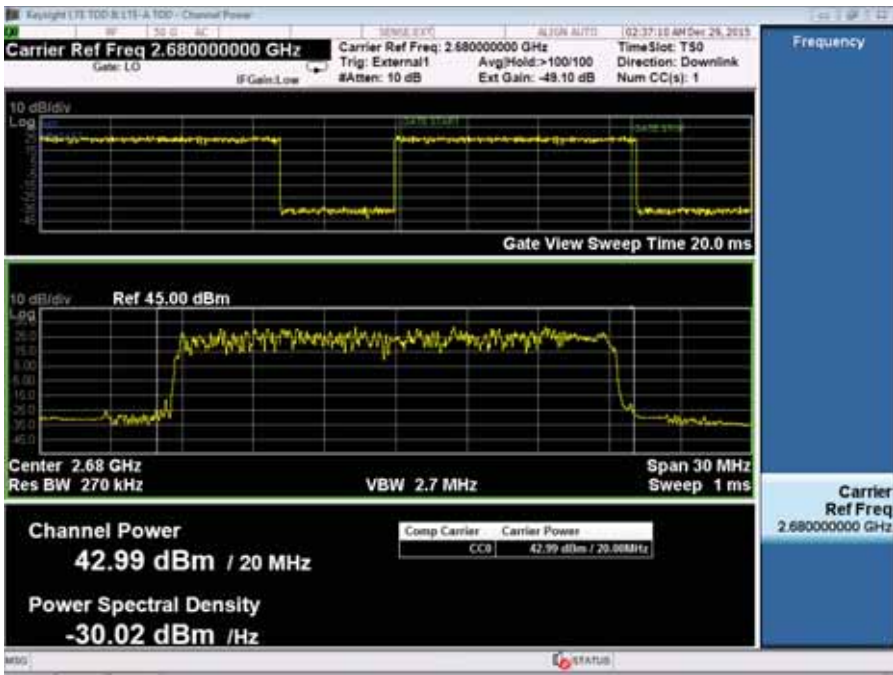
Blocks	Bandwidth Contiguous (MHz)	Frequency (MHz)	Power (Watts)
Lower	20+20	2496-2516 and 2516-2536	20
Middle	20+20	2558-2578 and 2578-2598	20
Higher	20+20	2650-2670 and 270-2690	20

Blocks	Bandwidth Contiguous (MHz)	Frequency (MHz)	Power (Watts)
Lower	20+20+20	2496-2516, 2516-2536 and 2536-2546	20
Middle	20+20+20	2563-2583, 2583-2603 and 2603-2623	20
Higher	20+20+20	2630-2650, 2650-2670 and 2670-2690	20

Blocks	Bandwidth Non-contiguous (MHz)	Frequency (MHz)	Power (Watts)
Lower	20+10	2496-2516 and 2528-2538	20
Middle	20+10	2562-2582 and 2604-2614	20
Higher	20+10	2648-2668 and 2680-2690	20

Blocks	Bandwidth Non-contiguous (MHz)	Frequency (MHz)	Power (Watts)
Lower	20+20	2496-2516 and 2536-2556	20
Middle	20+20	2563-2583 and 2603-2623	20
Higher	20+20	2630-2650 and 2670-2690	20

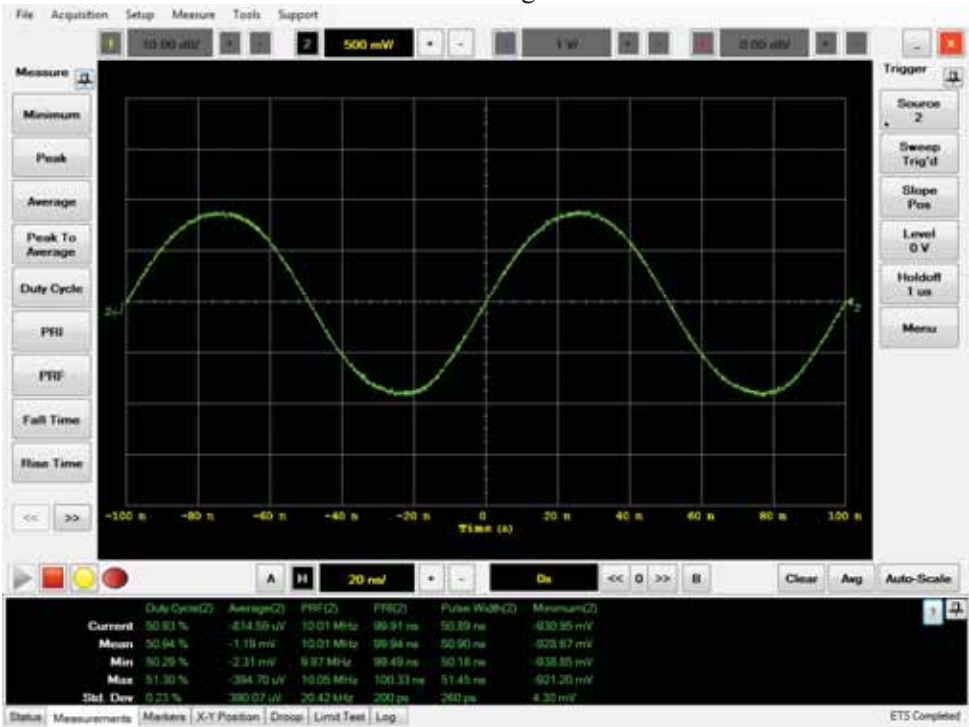
Gate View 20MHz



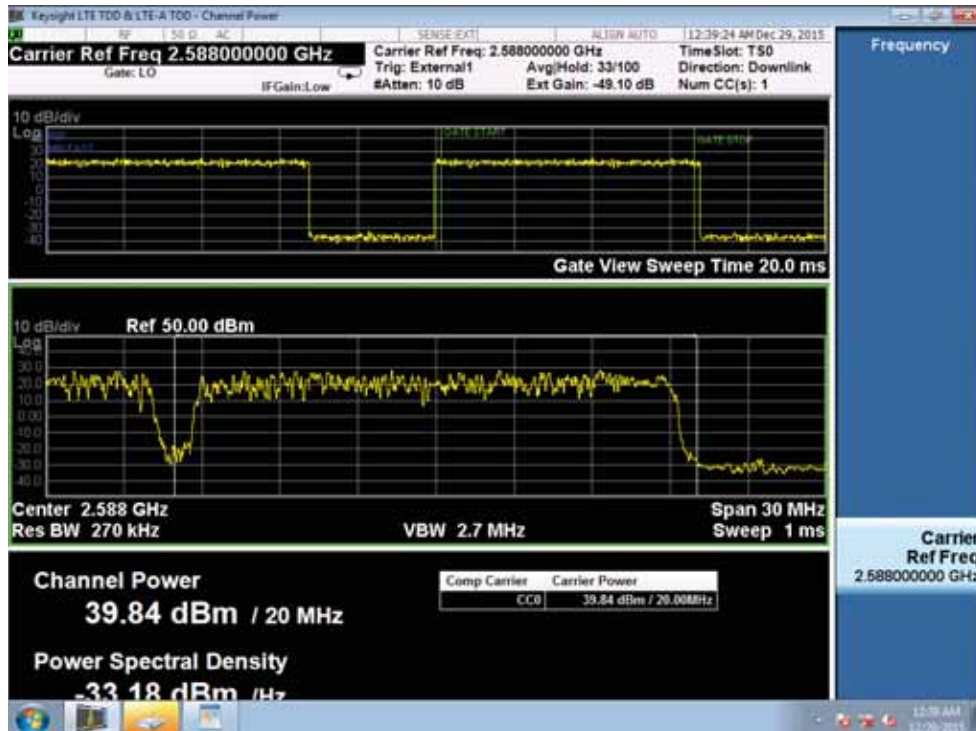
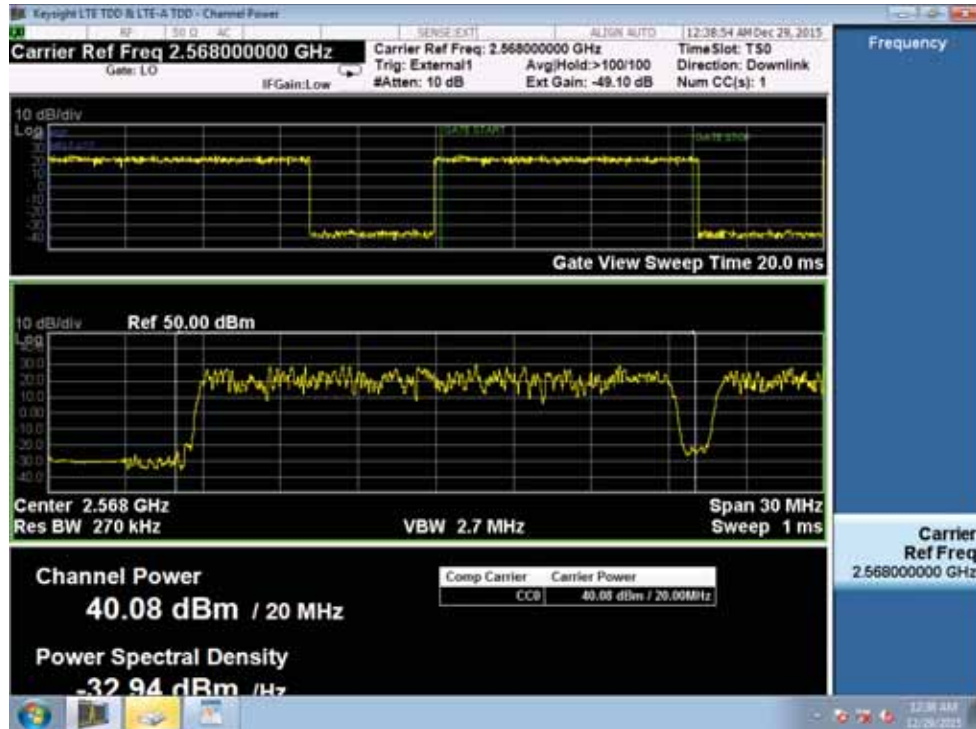
Trigger Signal



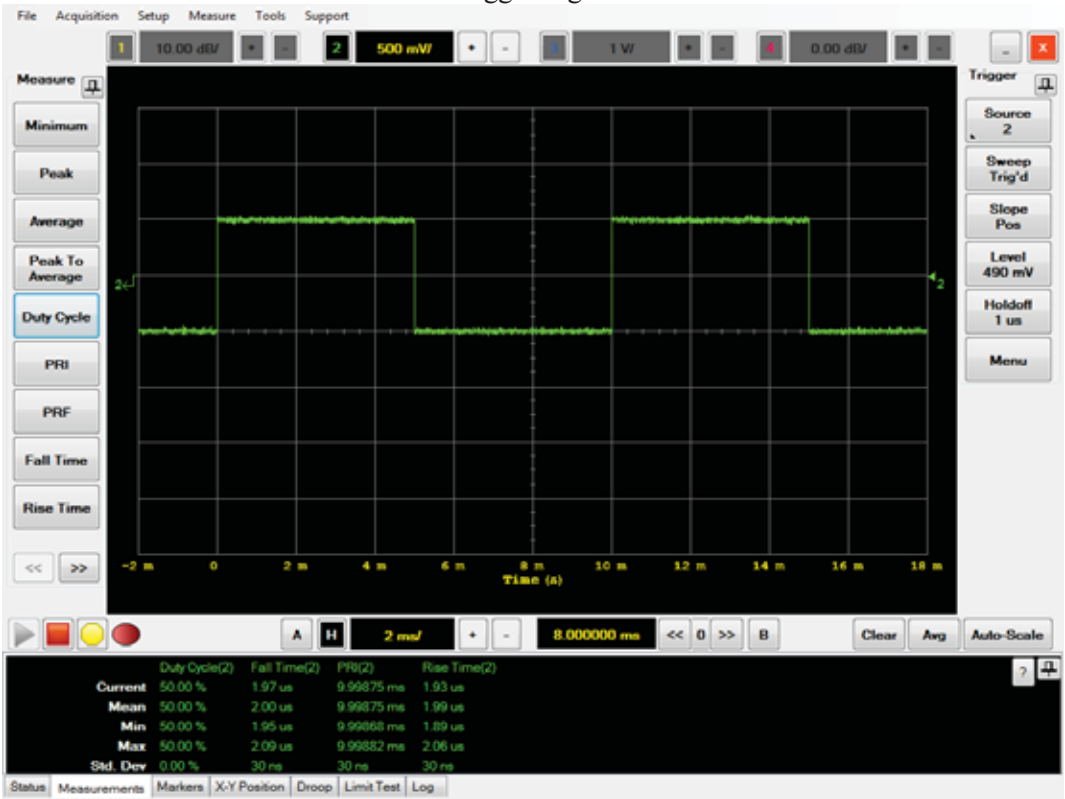
10MHz Signal



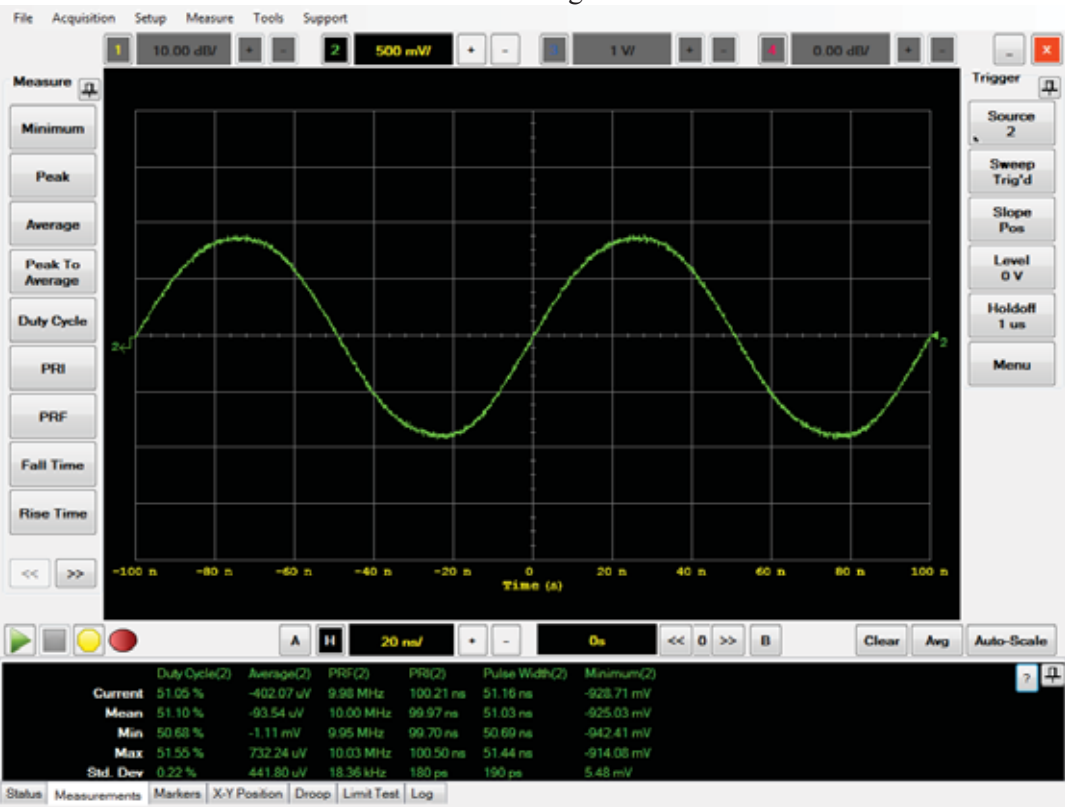
Gate View 20+20MHz



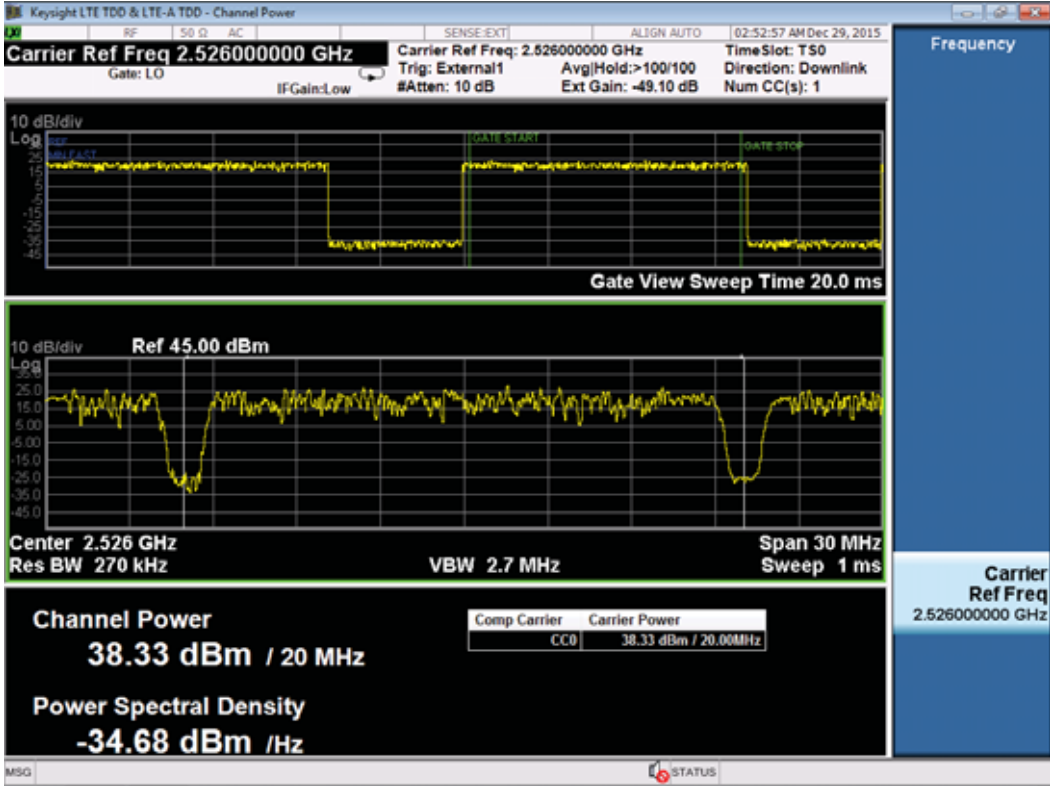
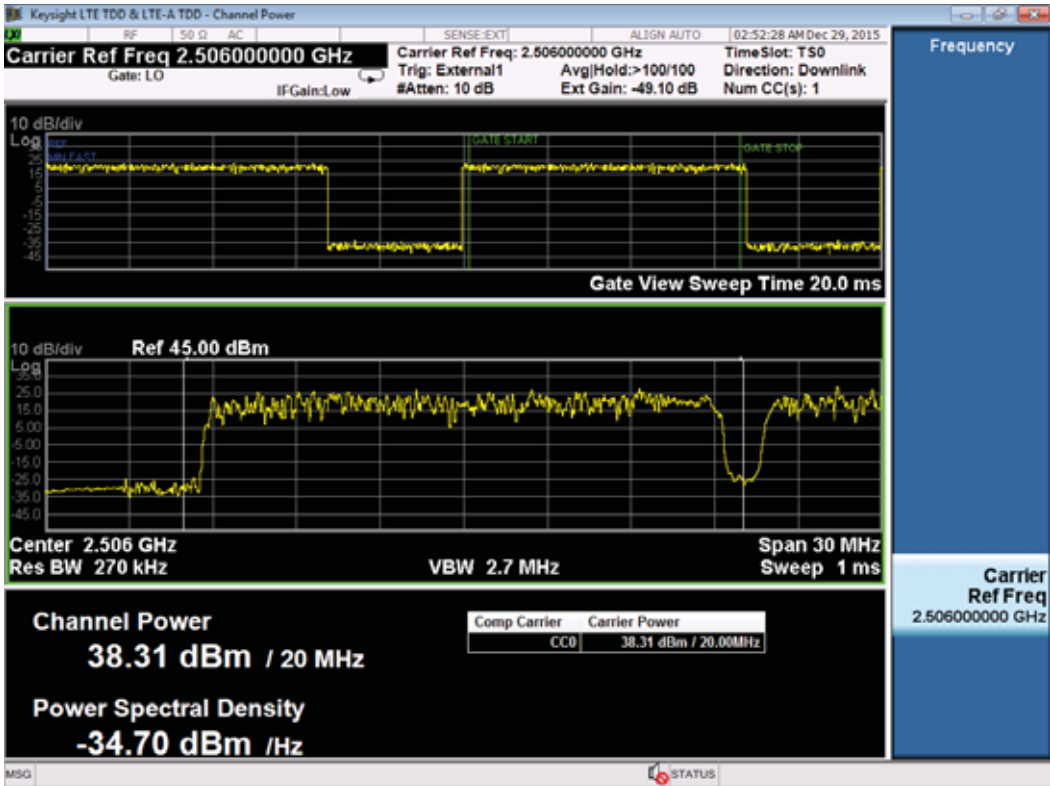
Trigger Signal

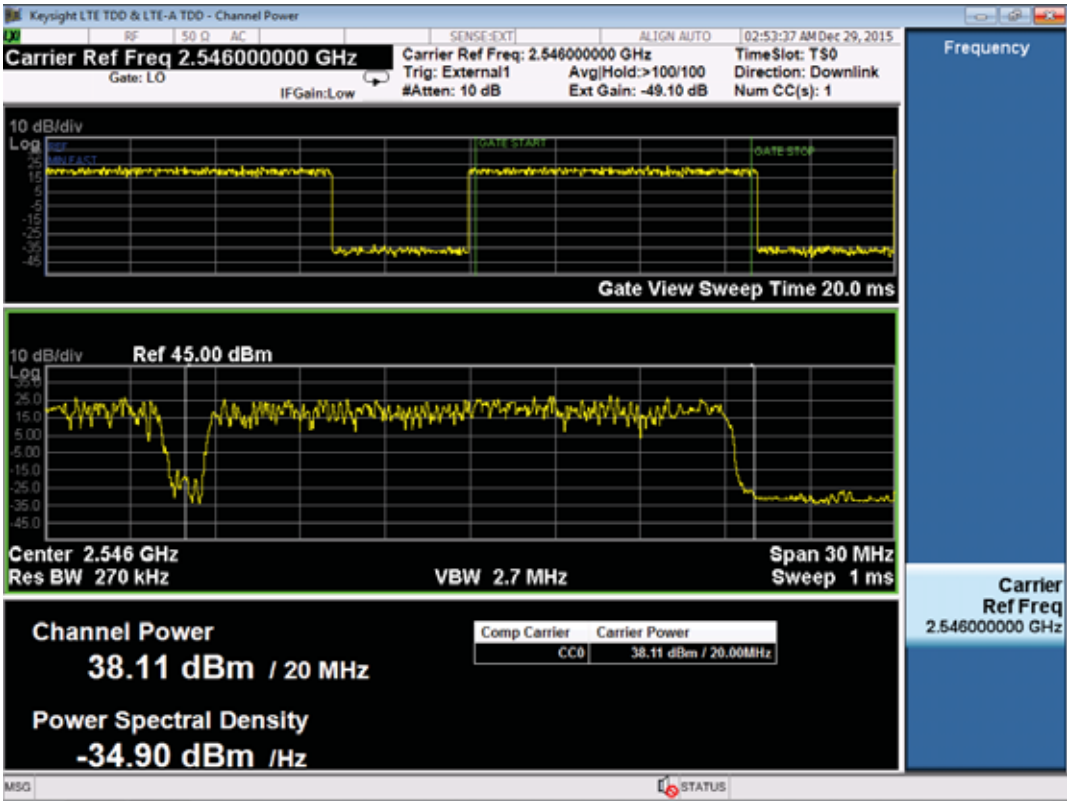


10MHz Signal

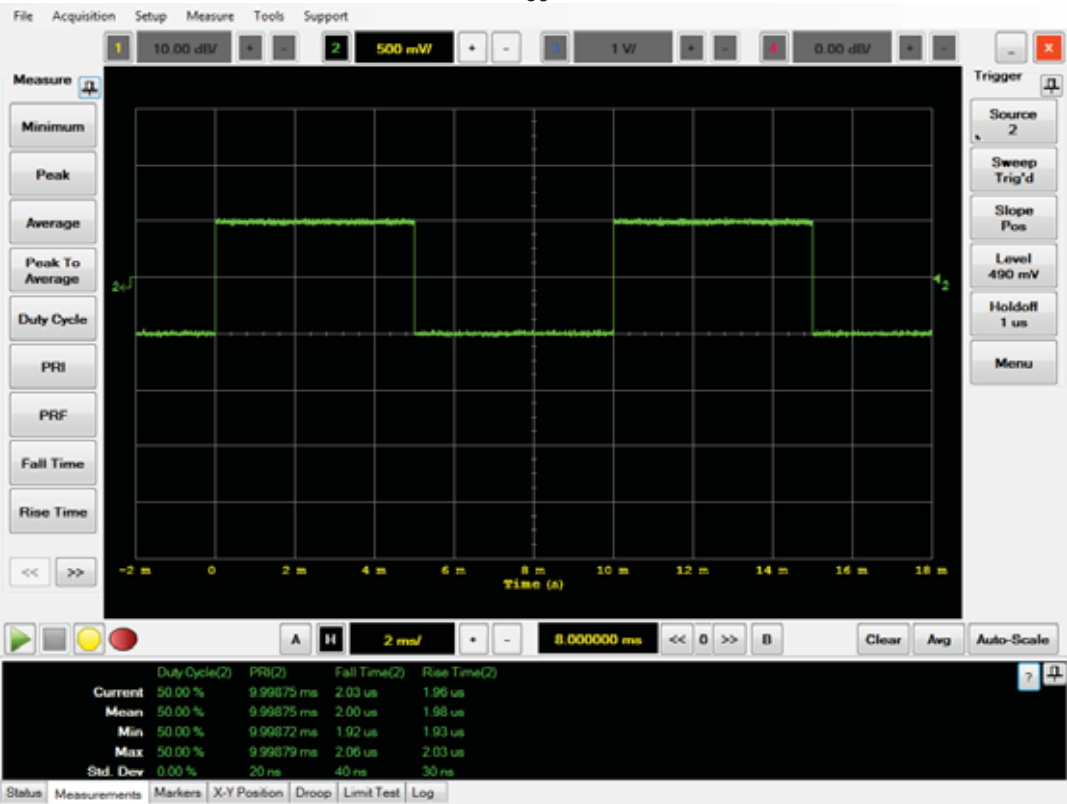


Gate View 20+20+20 MHz

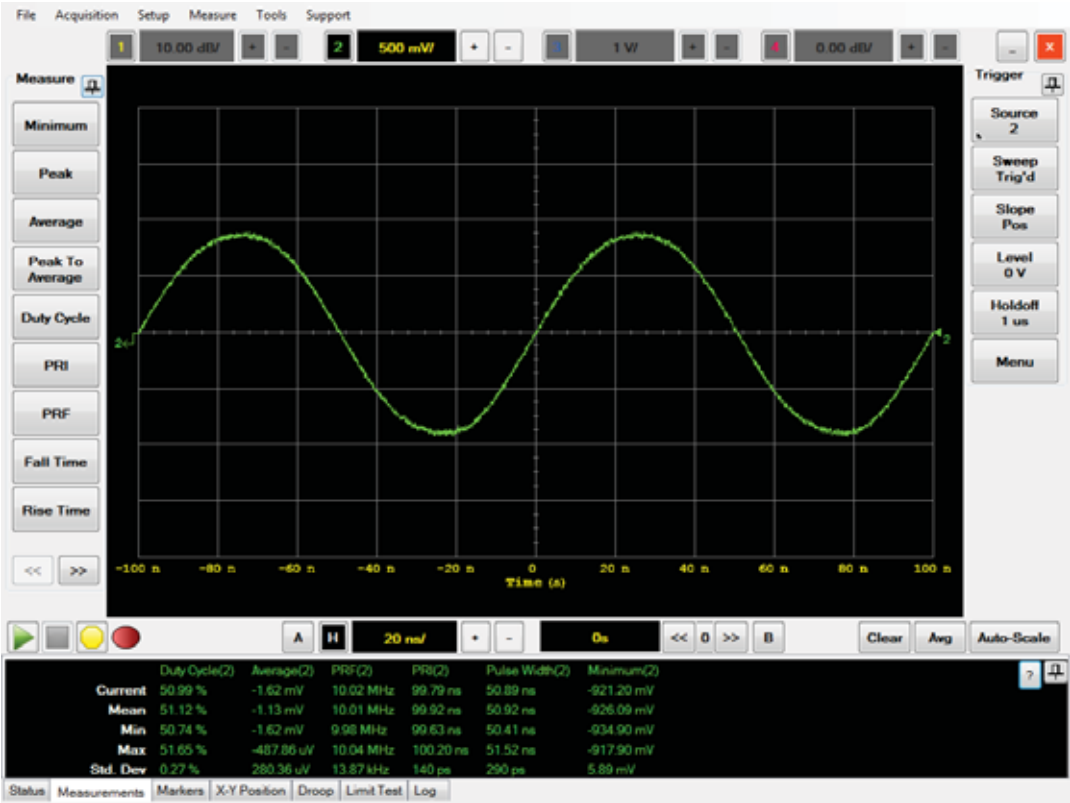




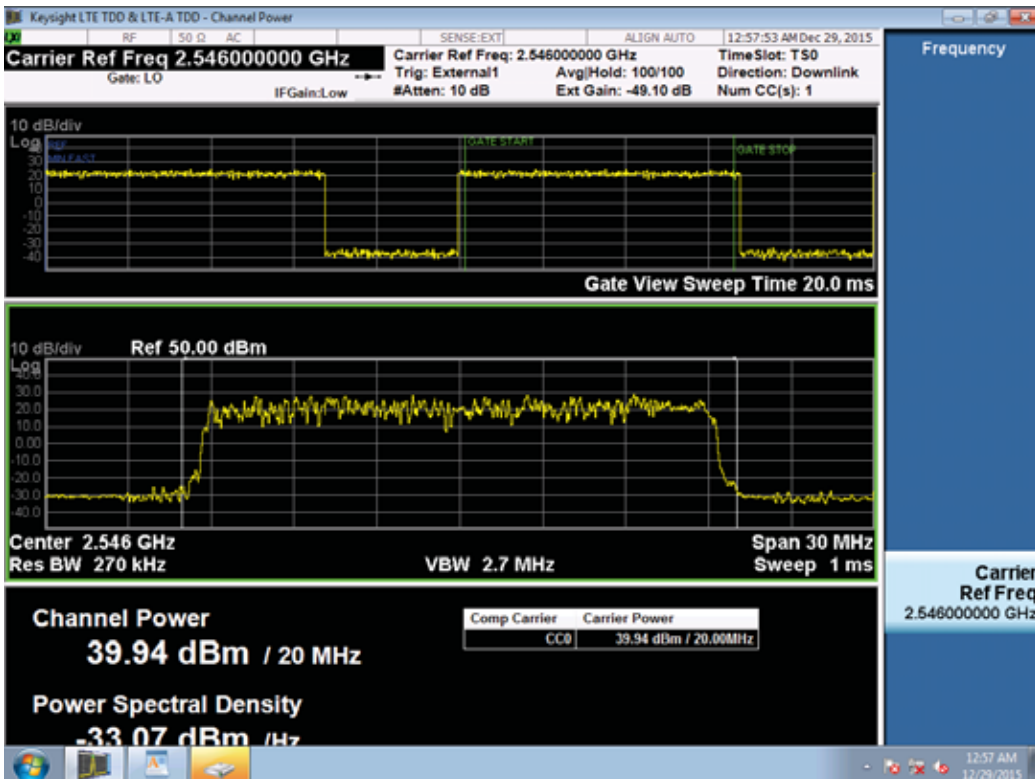
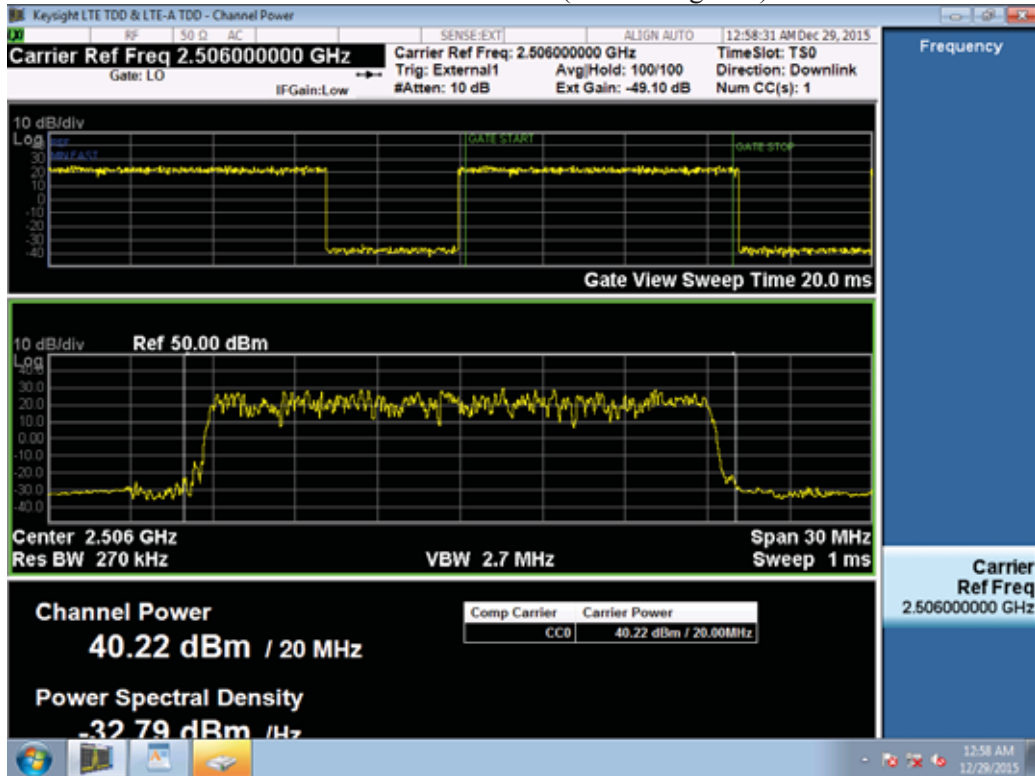
Trigger



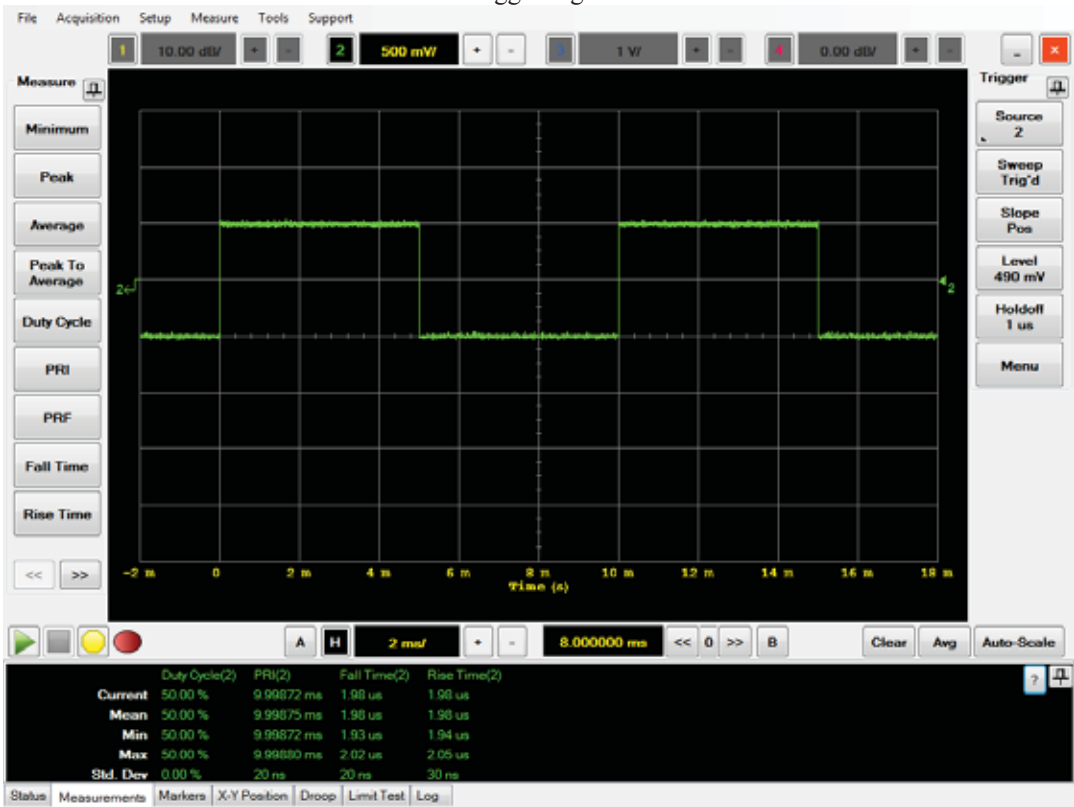
10 MHz



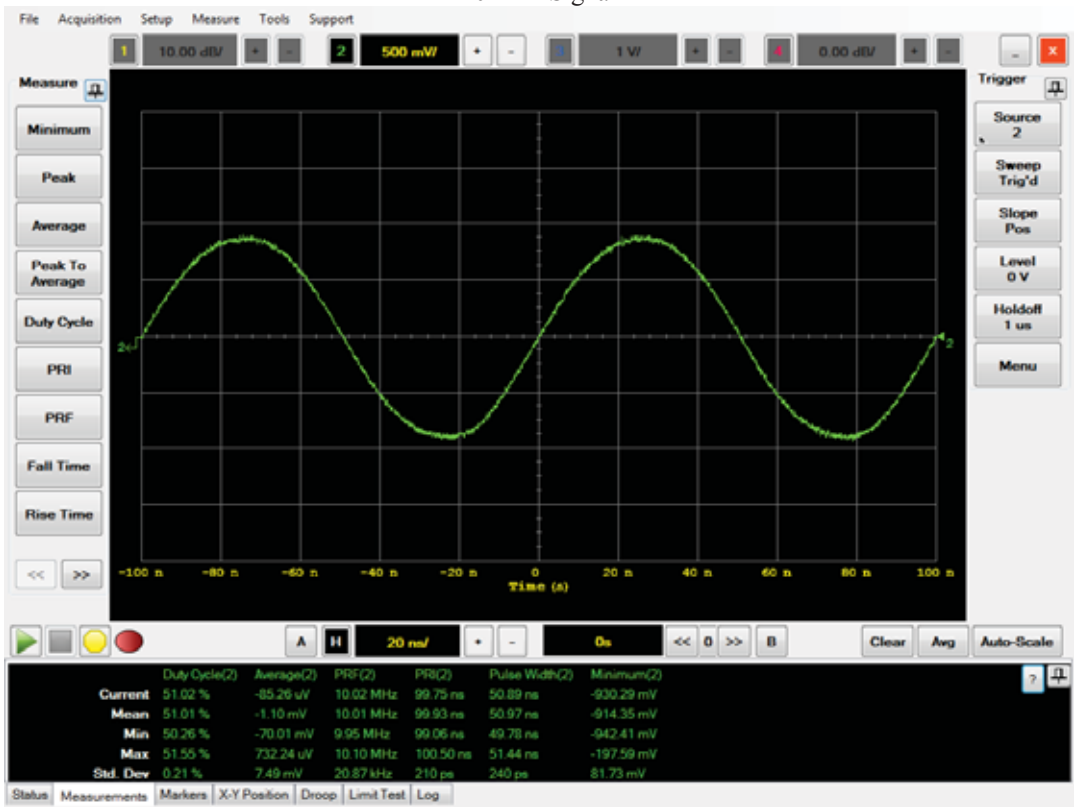
Gate View 20+20 MHz (Non-contiguous)



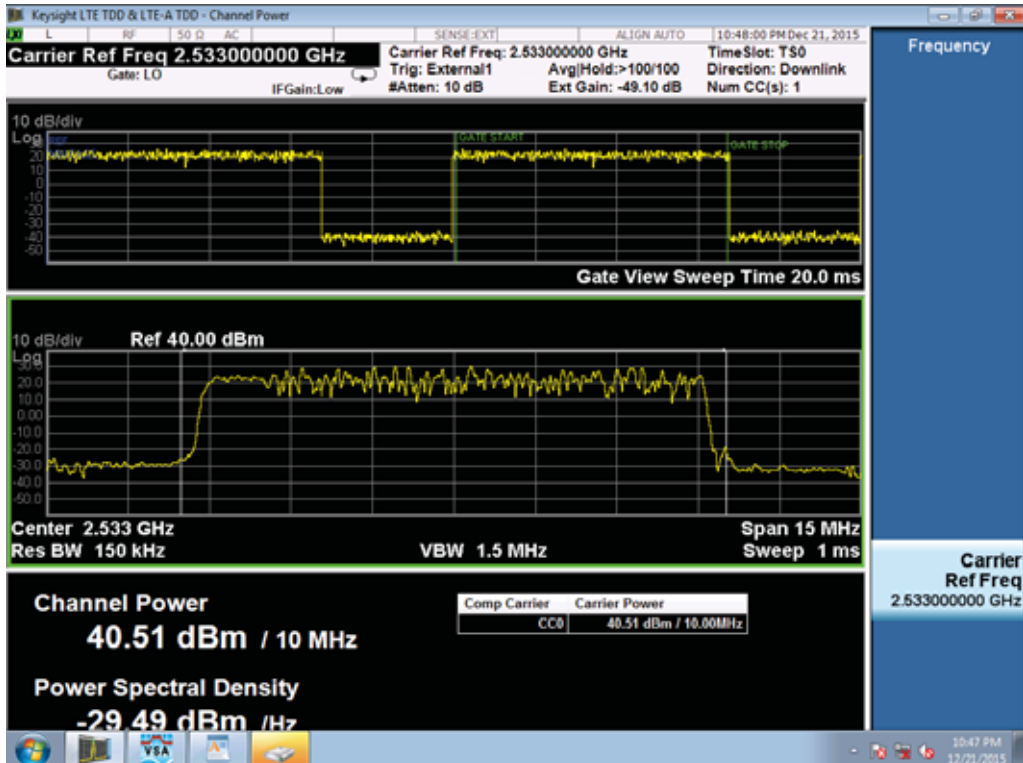
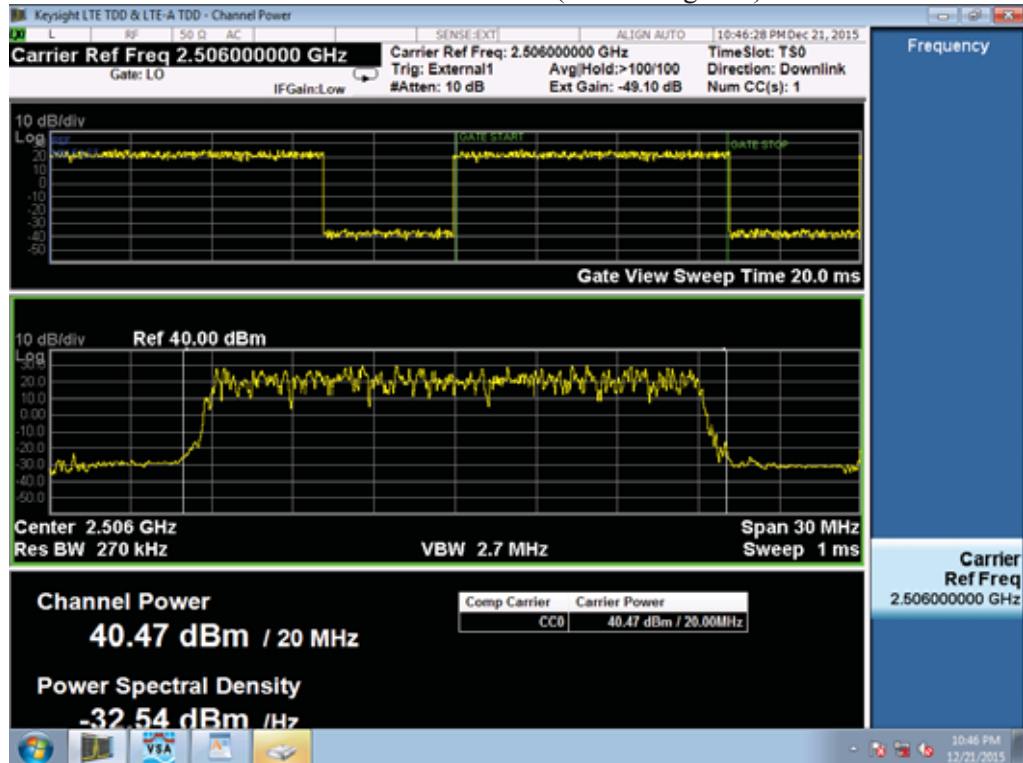
Trigger Signal



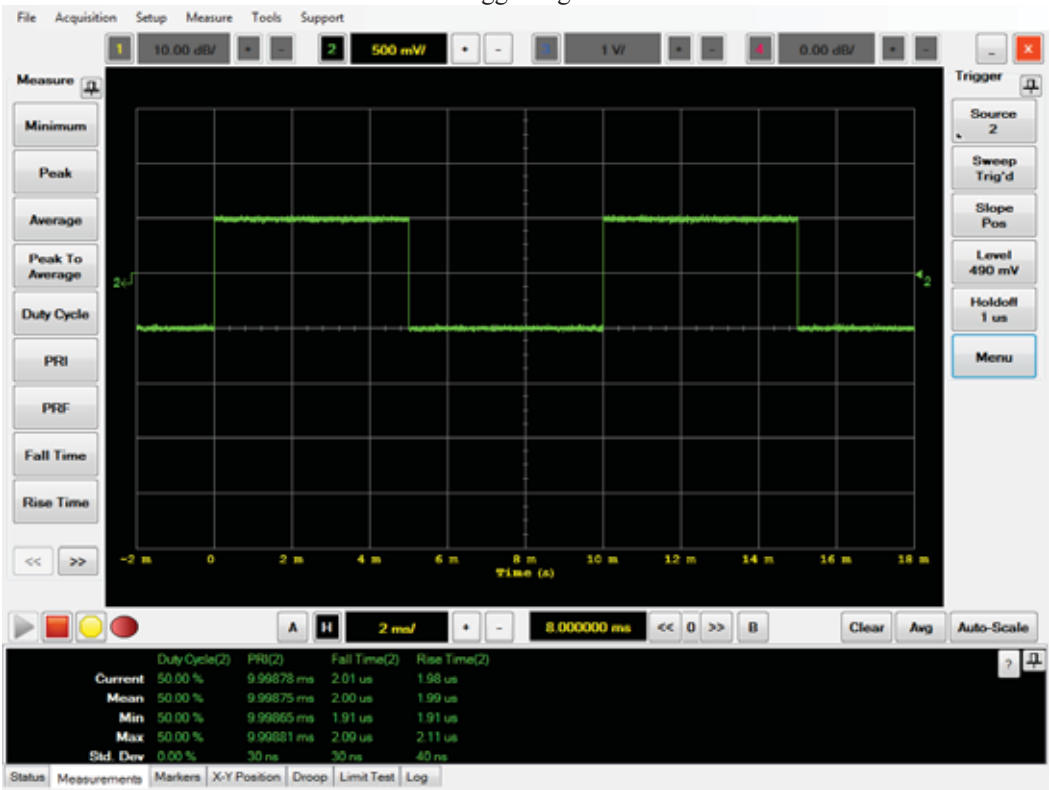
10MHz Signal



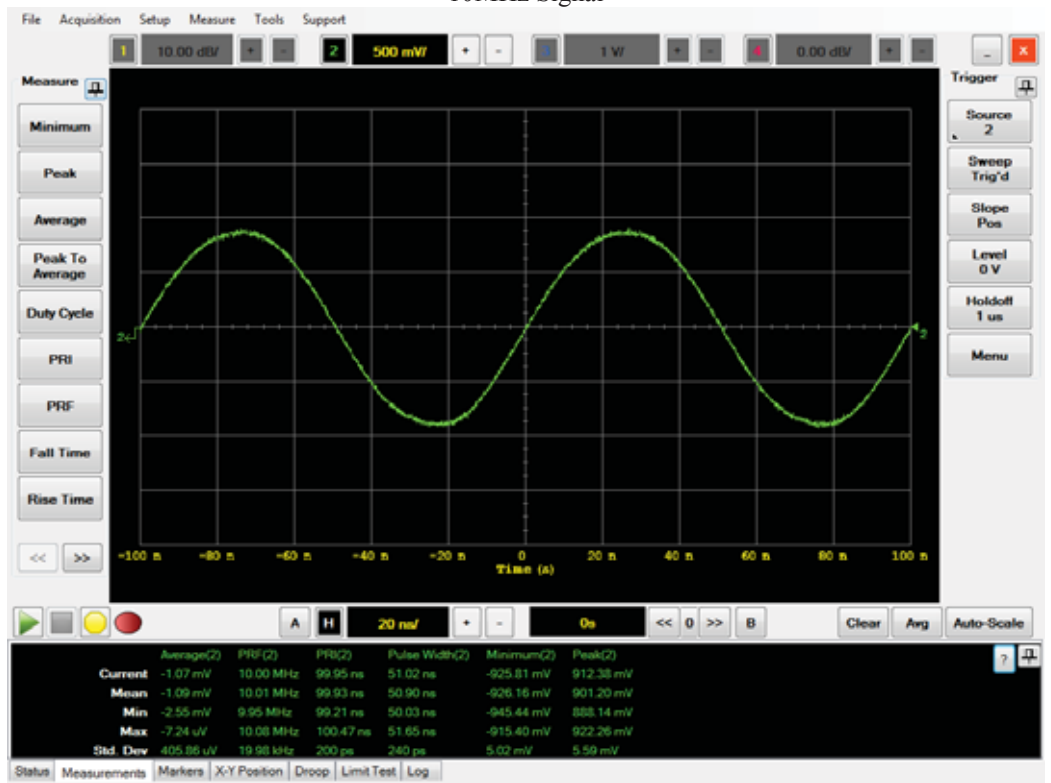
Gate View 20+10 MHz (Non-contiguous)



Trigger Signal



10MHz Signal



DEMODULATED CONSTELLATIONS (FCC Section 2.1047)

&
Measurement of Peak-to-Average ratio (PAR) Section 27.50(d)(5)

The peak-to-average (PAR) is plotted along with demodulated constellation plots. The plots show that average and peak values in dBm. The difference of peak-to-averages ratio does not exceed 13 dB as required in section 27.50(d) (5).

The list of blocks and bands, tested for QPSK, 16QAM and 64QAM are listed below:

Blocks	Bandwidth (MHz)	Frequency (MHz)	Power (Watts)
Lower	20	2496-2516	20
Middle	20	2568-2588	20
Higher	20	2660-2680	20

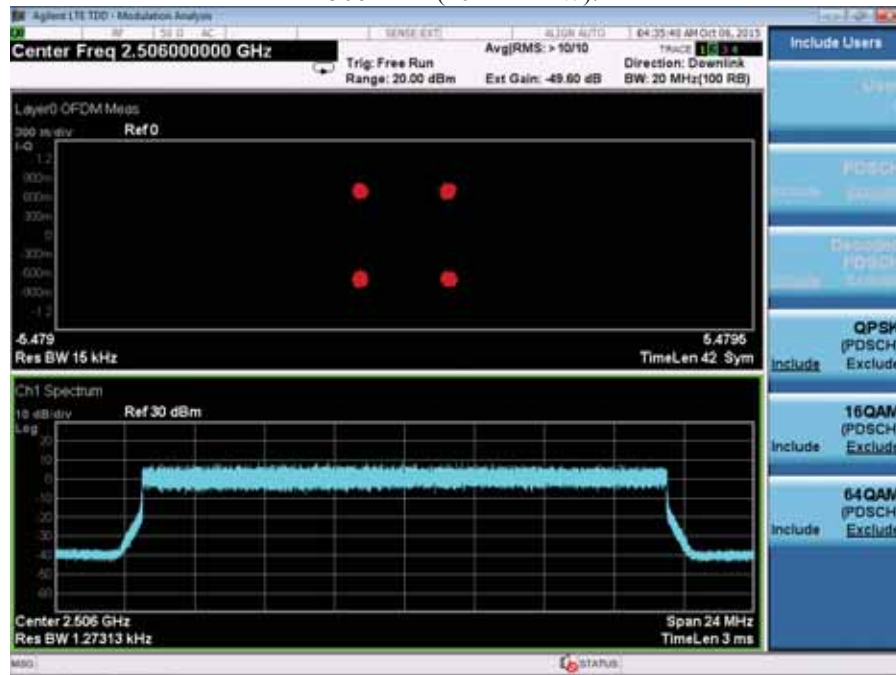
Blocks	Bandwidth Contiguous (MHz)	Frequency (MHz)	Power (Watts)
Lower	20+20	2496-2516 and 2516-2536	20
Middle	20+20	2558-2578 and 2578-2598	20
Higher	20+20	2650-2670 and 270-2690	20

Blocks	Bandwidth Contiguous (MHz)	Frequency (MHz)	Power (Watts)
Lower	20+20+20	2496-2516, 2516-2536 and 2536-2546	20
Middle	20+20+20	2563-2583, 2583-2603 and 2603-2623	20
Higher	20+20+20	2630-2650, 2650-2670 and 2670-2690	20

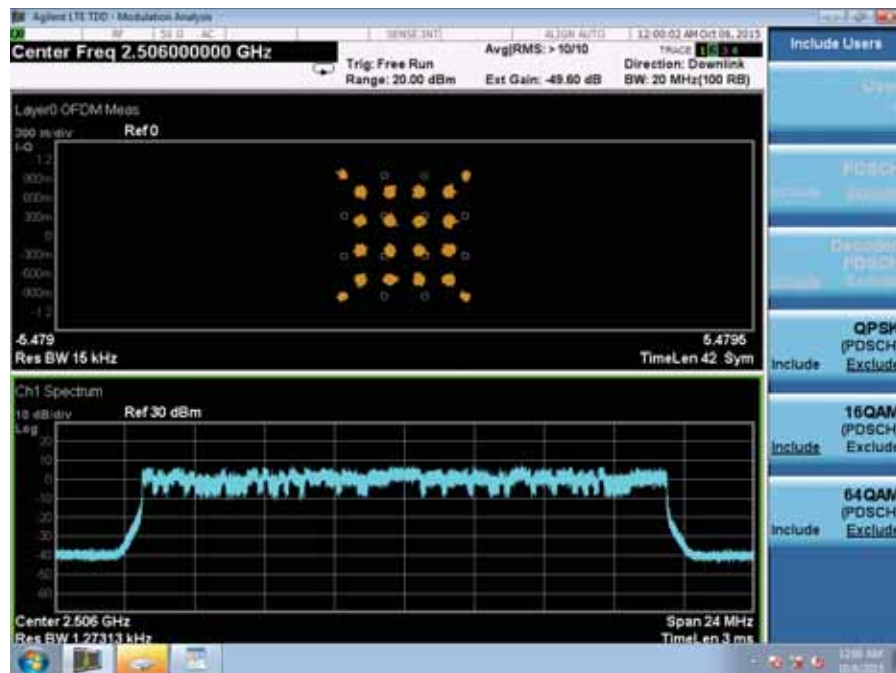
Blocks	Bandwidth Non-contiguous (MHz)	Frequency (MHz)	Power (Watts)
Lower	20+10	2496-2516 and 2528-2538	20
Middle	20+10	2562-2582 and 2604-2614	20
Higher	20+10	2648-2668 and 2680-2690	20

Blocks	Bandwidth Non-contiguous (MHz)	Frequency (MHz)	Power (Watts)
Lower	20+20	2496-2516 and 2536-2556	20
Middle	20+20	2563-2583 and 2603-2623	20
Higher	20+20	2630-2650 and 2670-2690	20

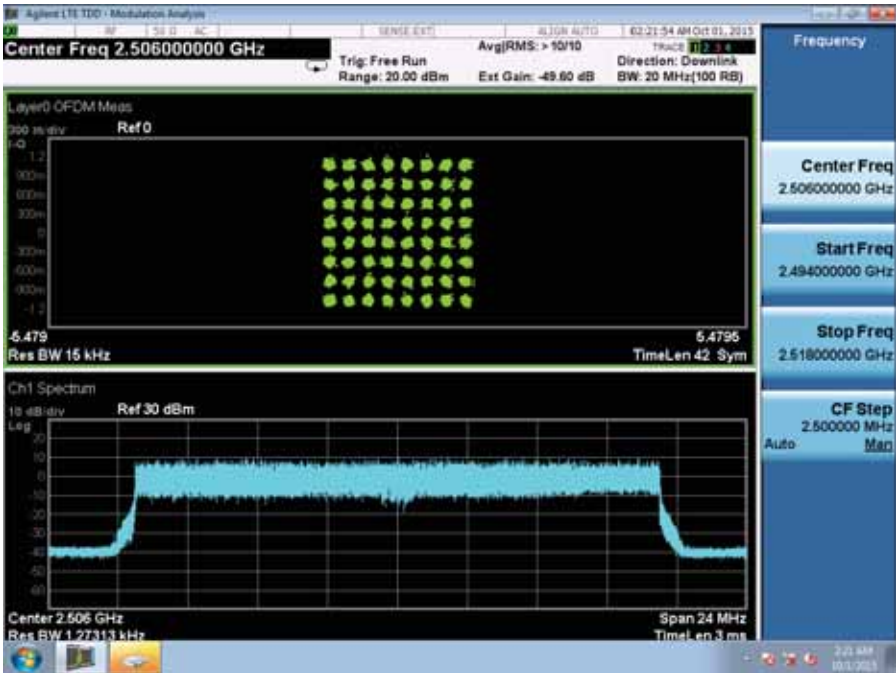
QPSK Modulation
2506 MHz (20 MHz BW).



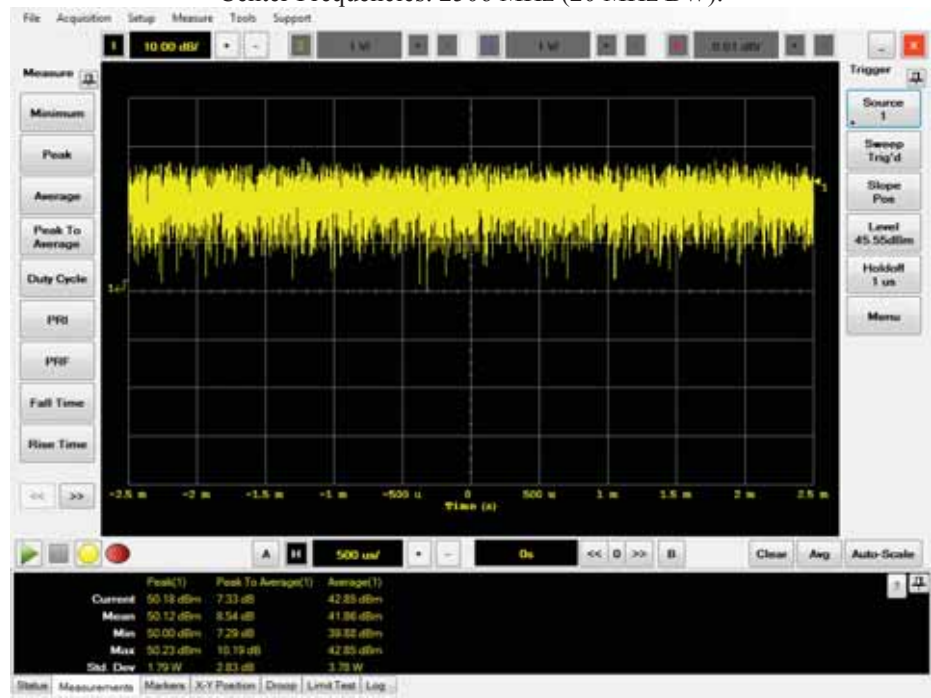
QPSK Modulation
2526 MHz (20 MHz BW).



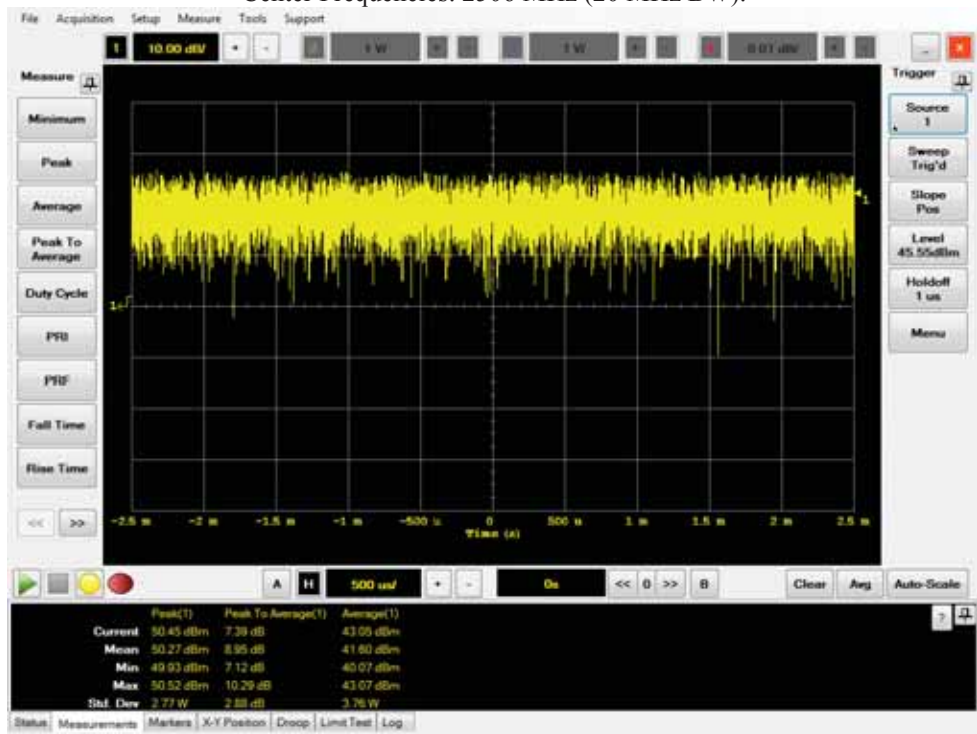
QPSK Modulation
2546 MHz (20 MHz BW).



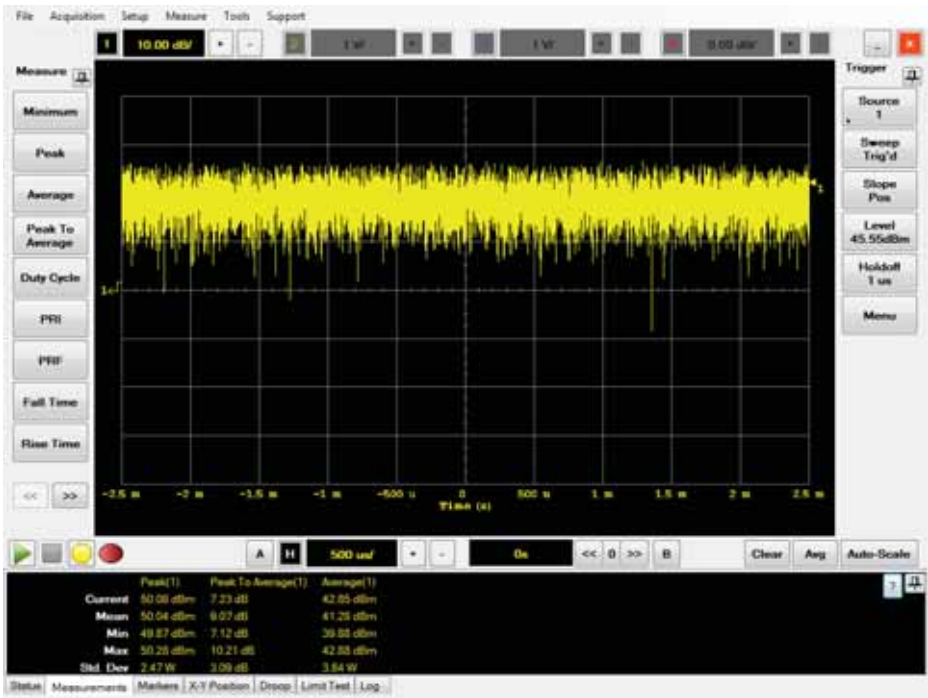
Peak to Average
QPSK Modulation
Center Frequencies: 2506 MHz (20 MHz BW).



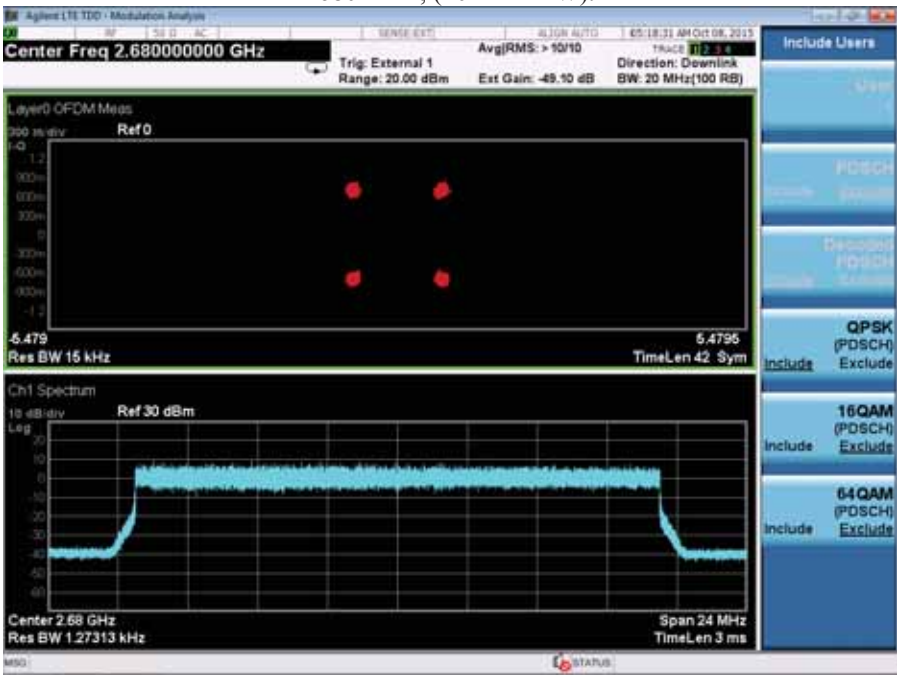
Peak to Average
16QAM Modulation
Center Frequencies: 2506 MHz (20 MHz BW).



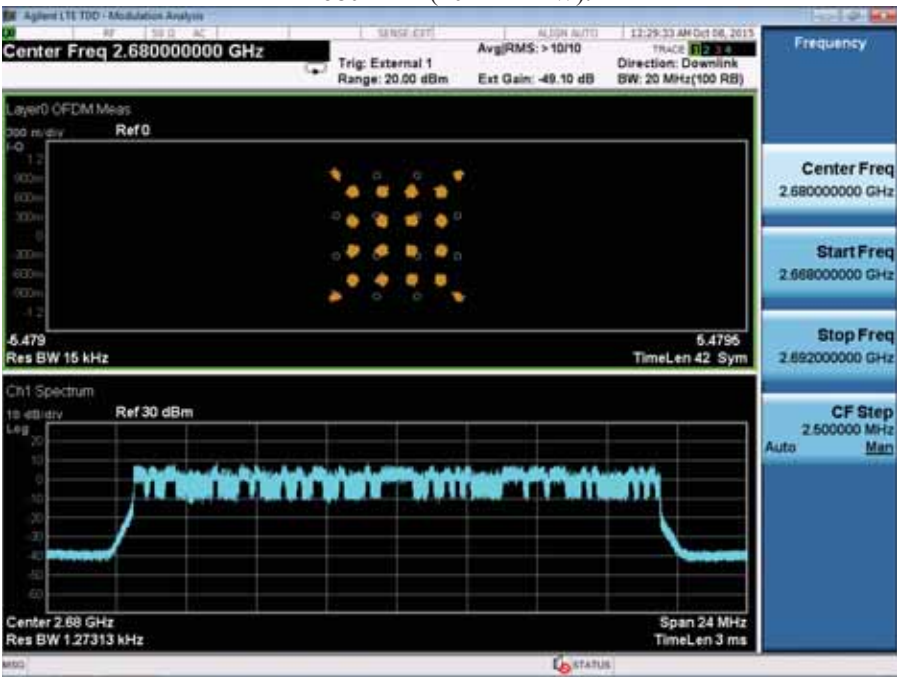
Peak to Average
64QAM Modulation
Center Frequencies: 2506 MHz (20 MHz BW).



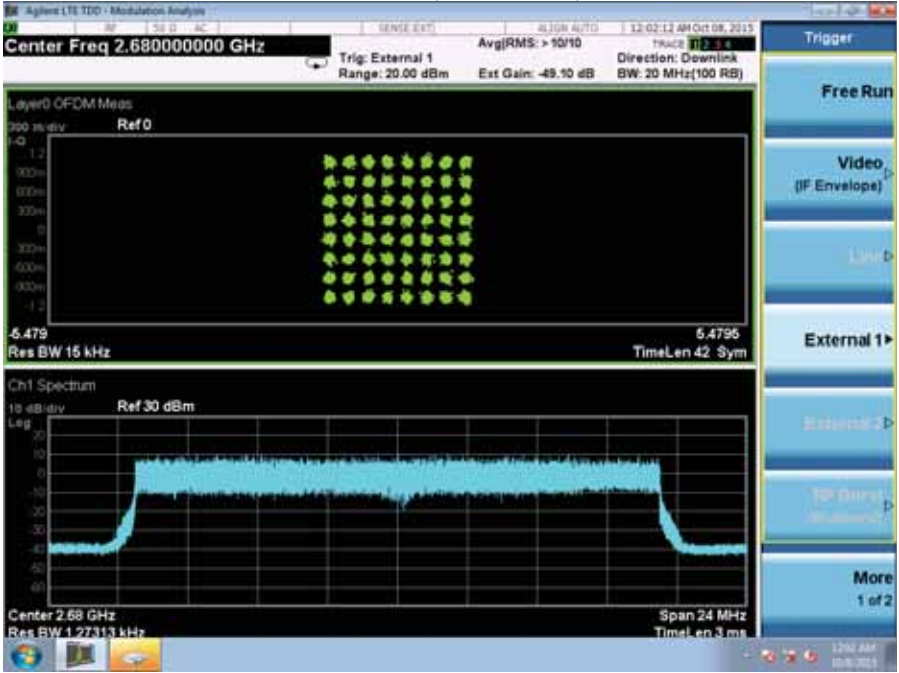
QPSK Modulation
2680 MHz, (20 MHz BW).



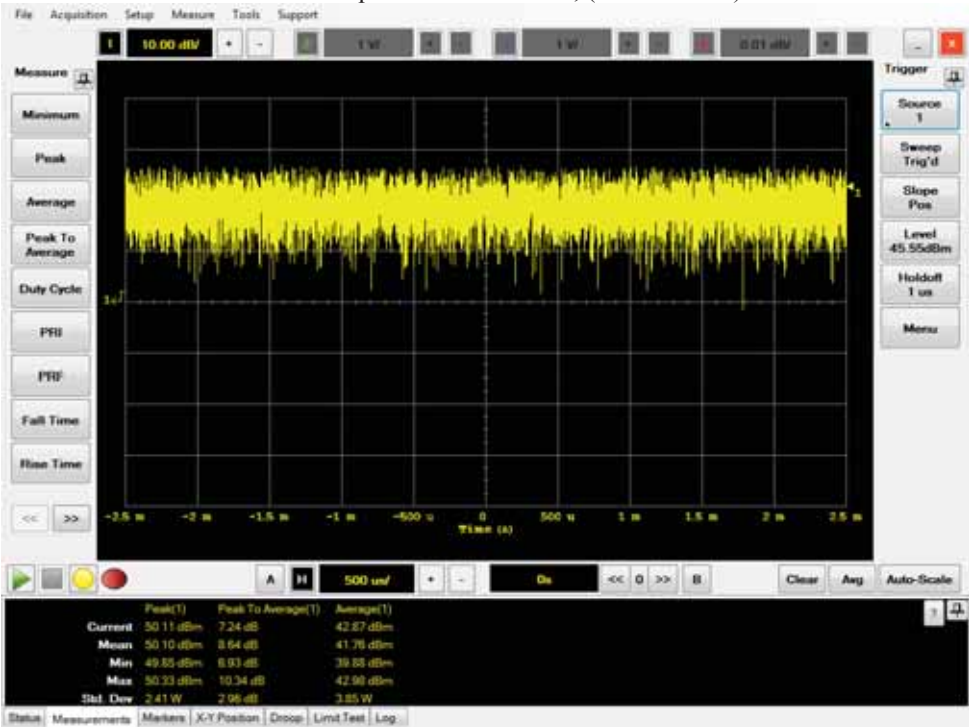
16QAM Modulation
2680 MHz (20 MHz BW).



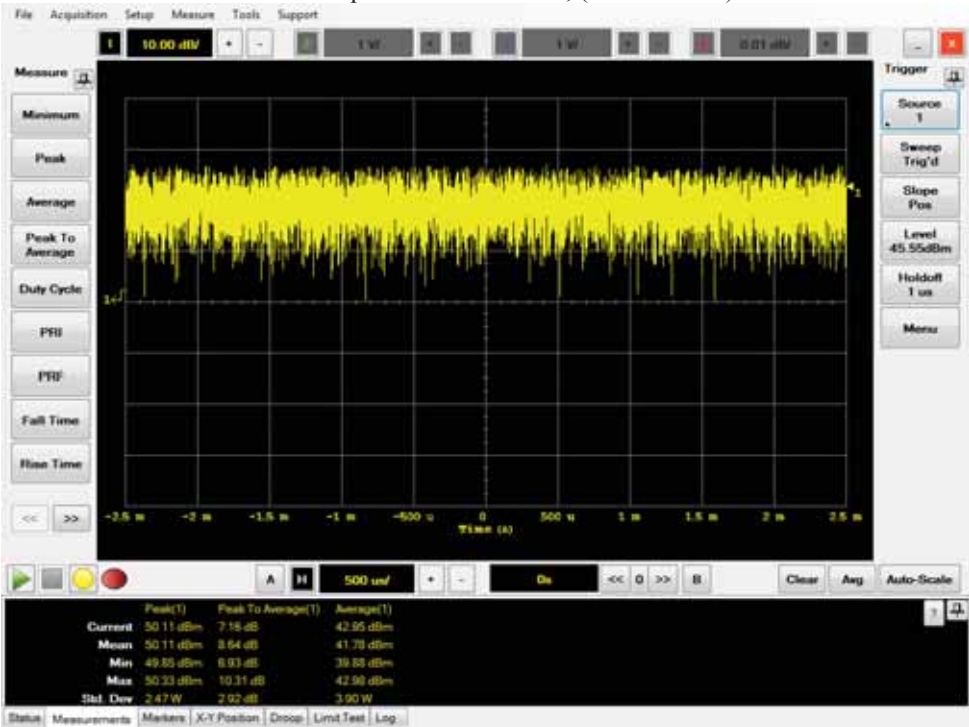
64QAM Modulation
2680 MHz (20 MHz BW).



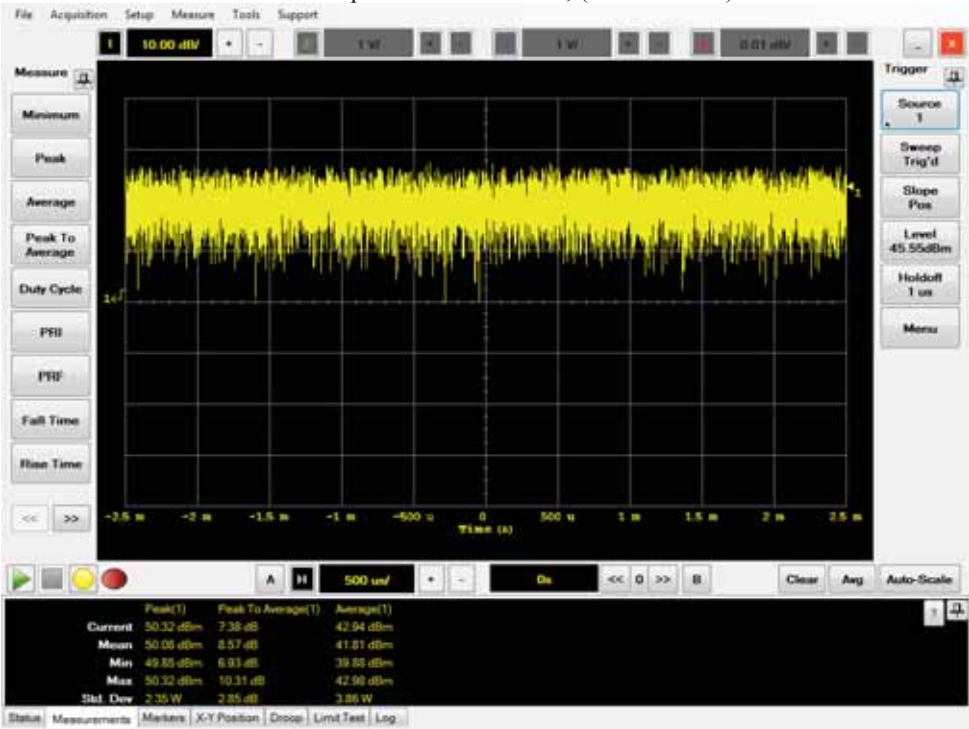
Peak to Average
QPSK Modulation
Center Frequencies: 2680 MHz, (20 MHz BW).



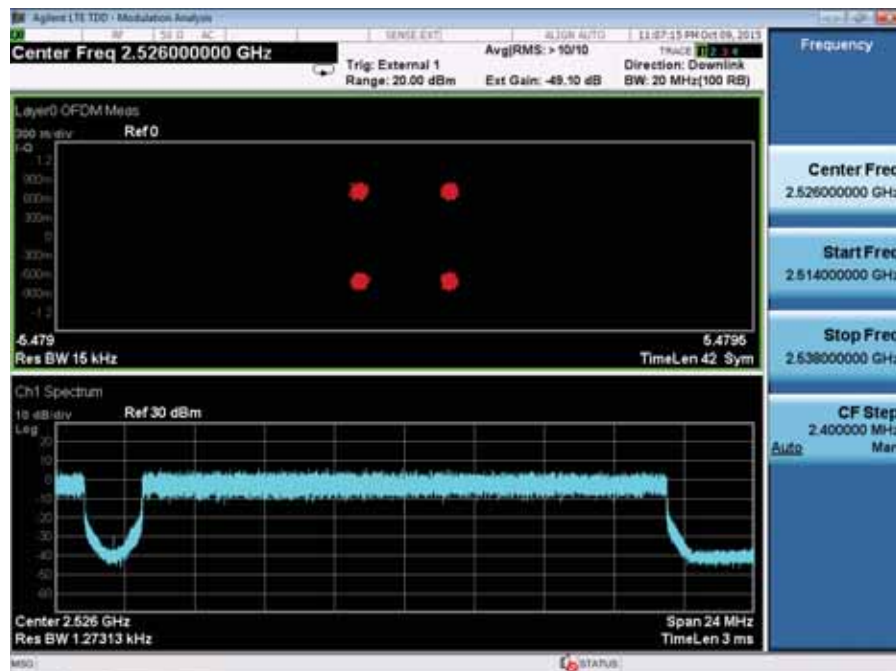
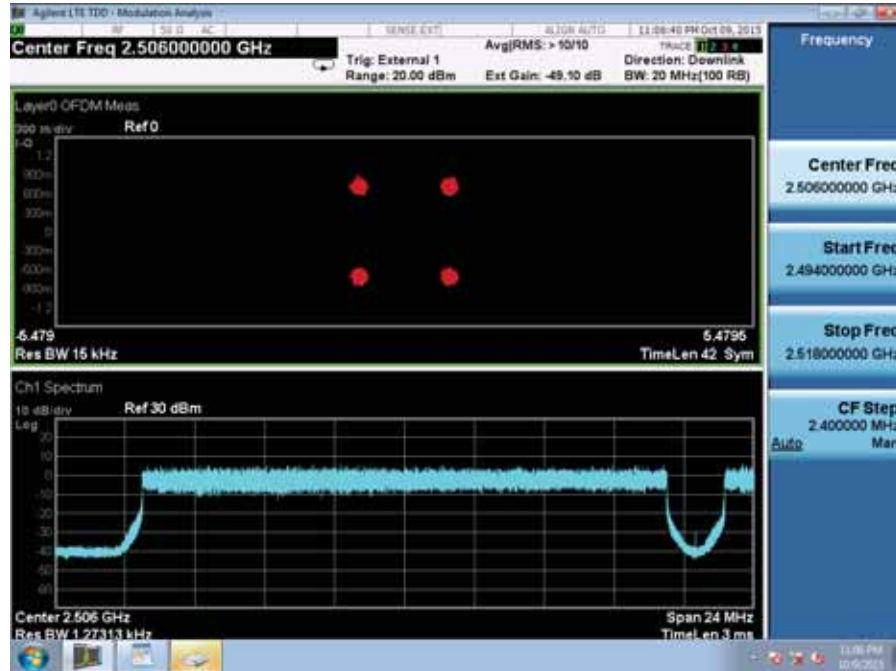
Peak to Average
16 QAM Modulation
Center Frequencies: 2680 MHz, (20 MHz BW).



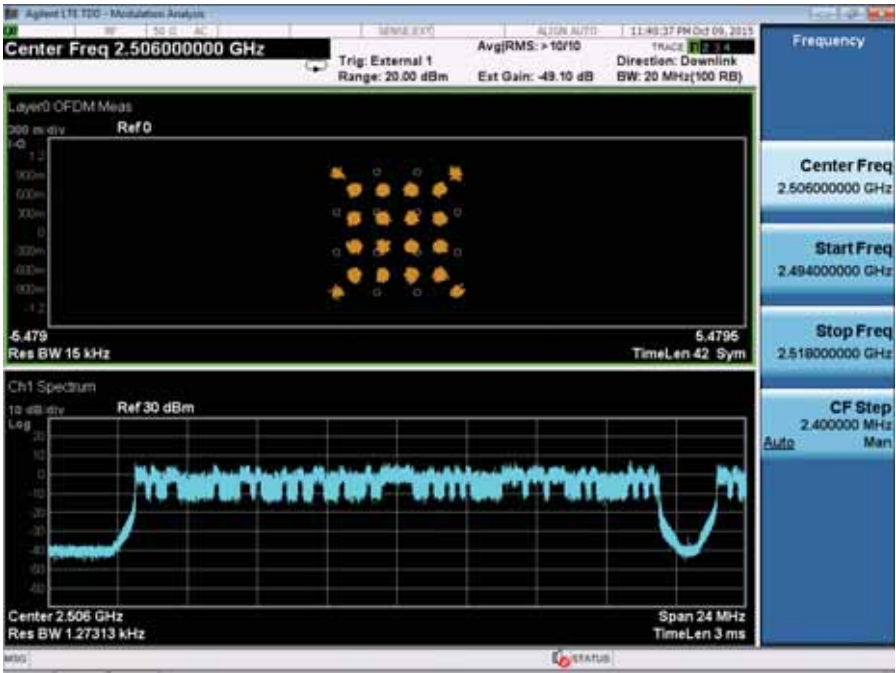
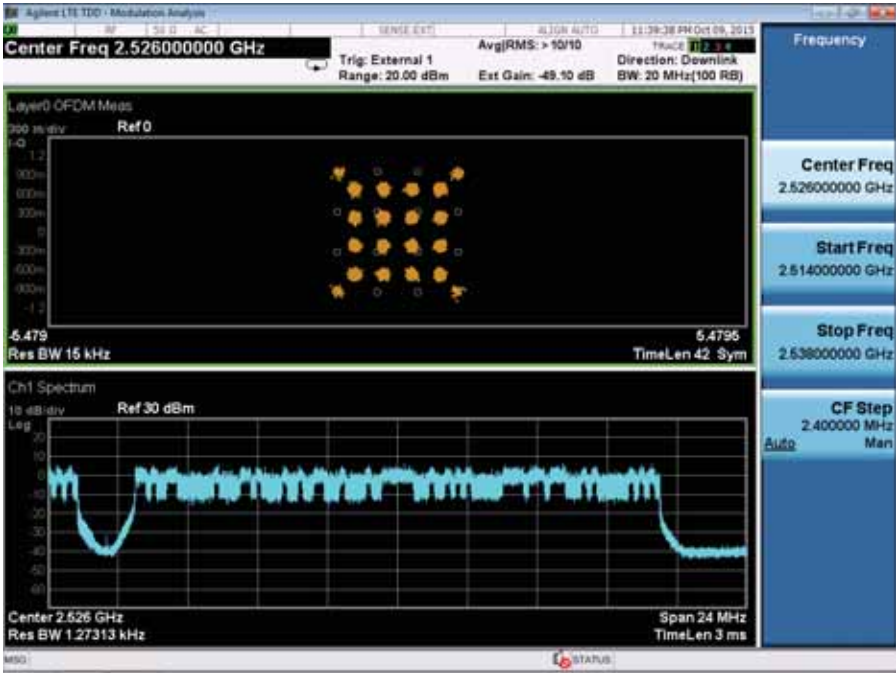
Peak to Average
64 QAM Modulation
Center Frequencies: 2680 MHz, (20 MHz BW).



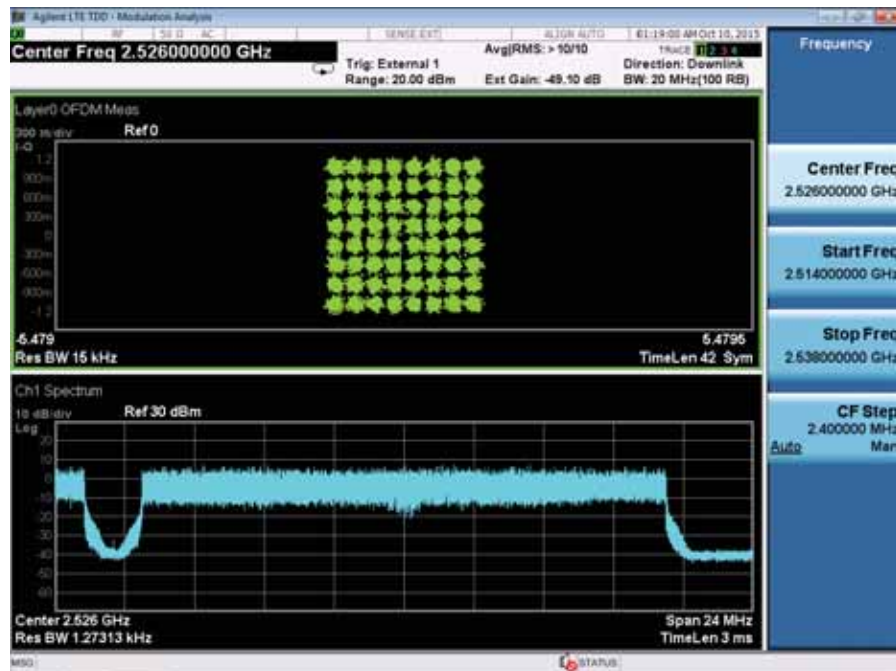
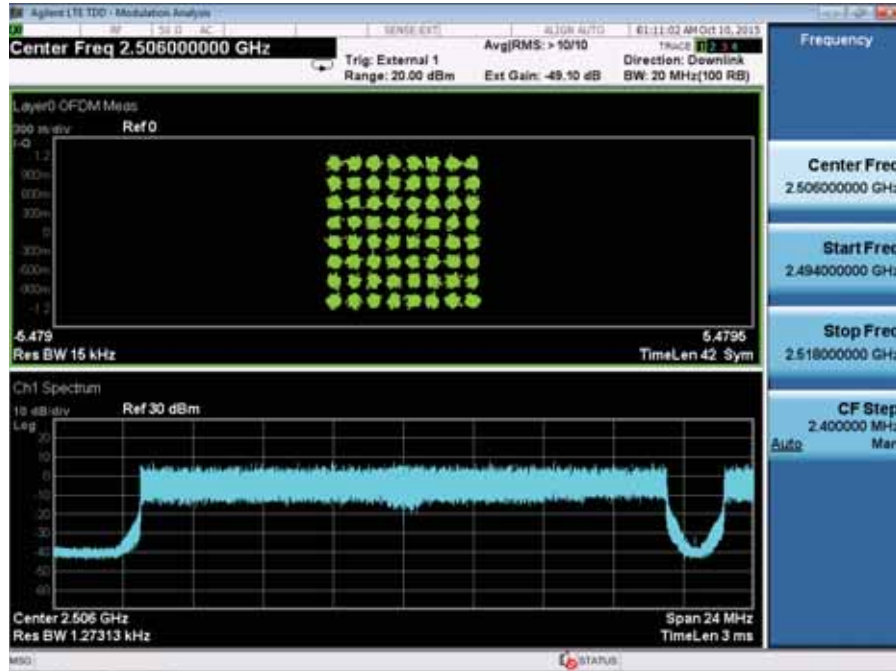
QPSK Modulation
2506 and 2526 MHz, (20+20 MHz BW).



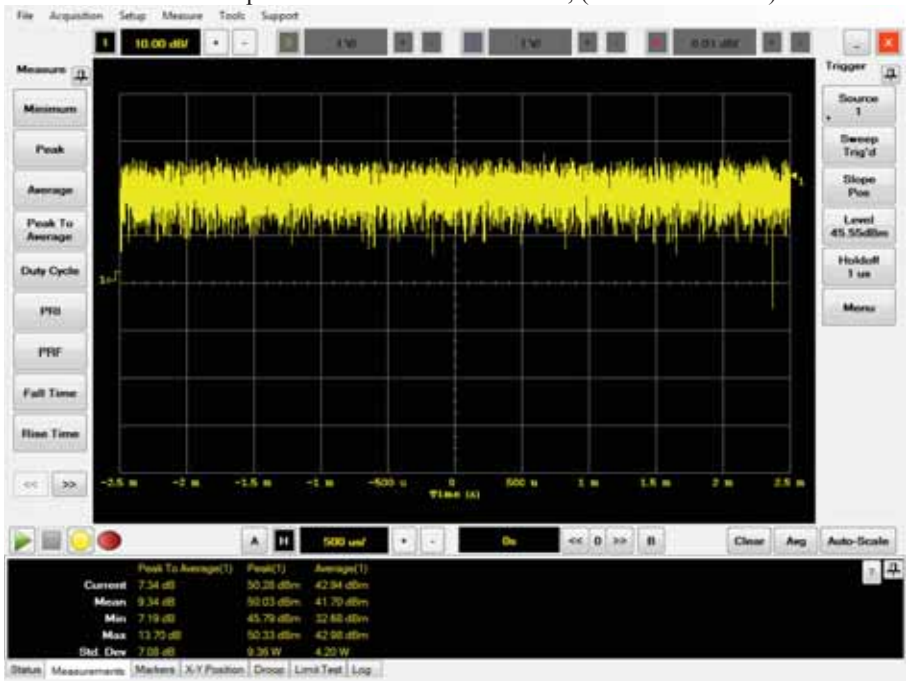
16QAM Modulation
2506 and 2526 MHz, (20+20 MHz BW).



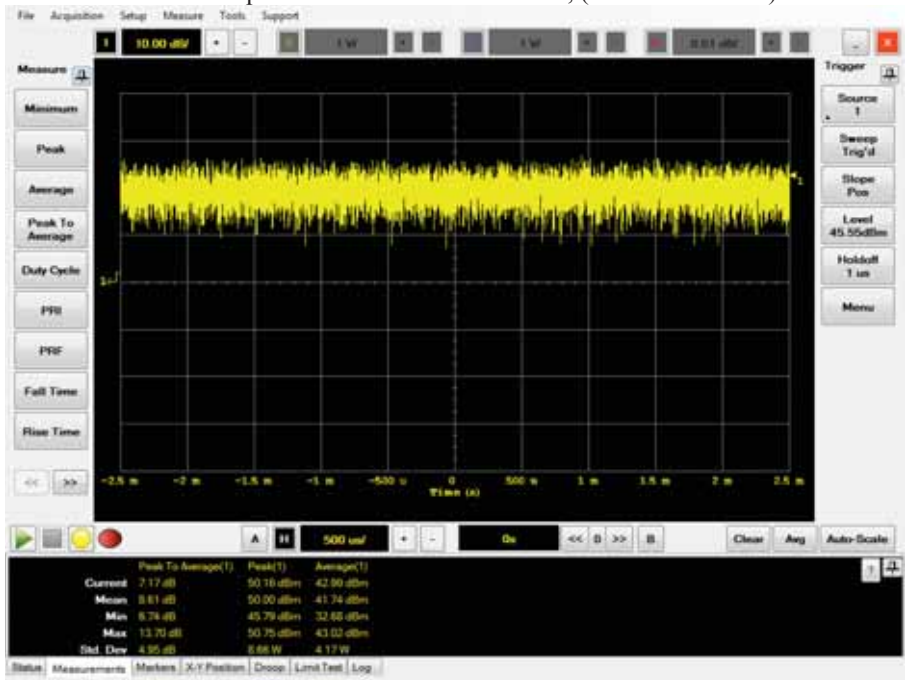
64QAM Modulation
2506 and 2526 MHz, (20+20 MHz BW).



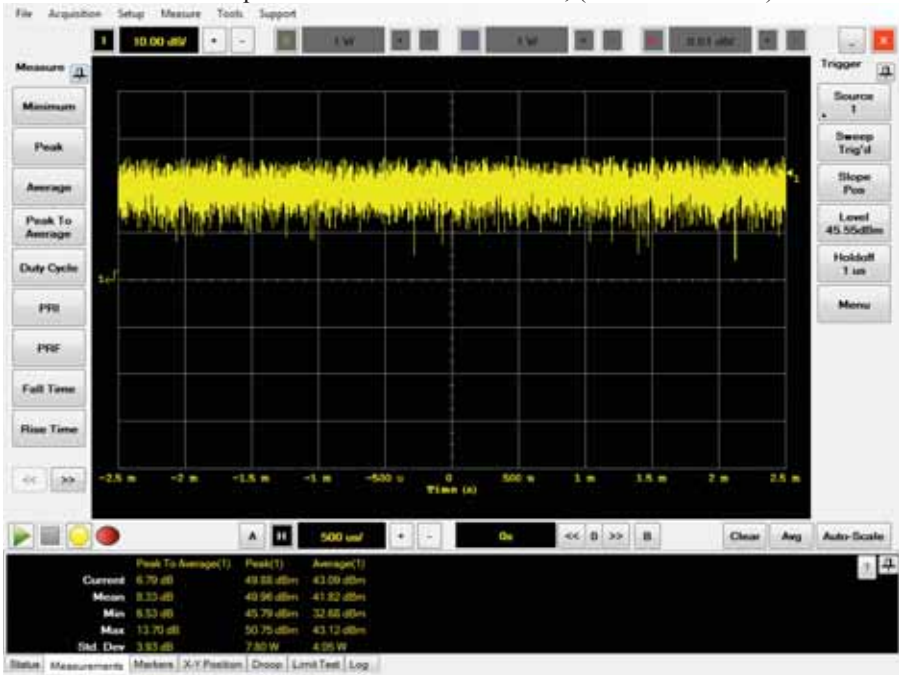
Peak to Average
QPSK QAM Modulation
Center Frequencies: 2506 and 2526 MHz, (20+20 MHz BW).



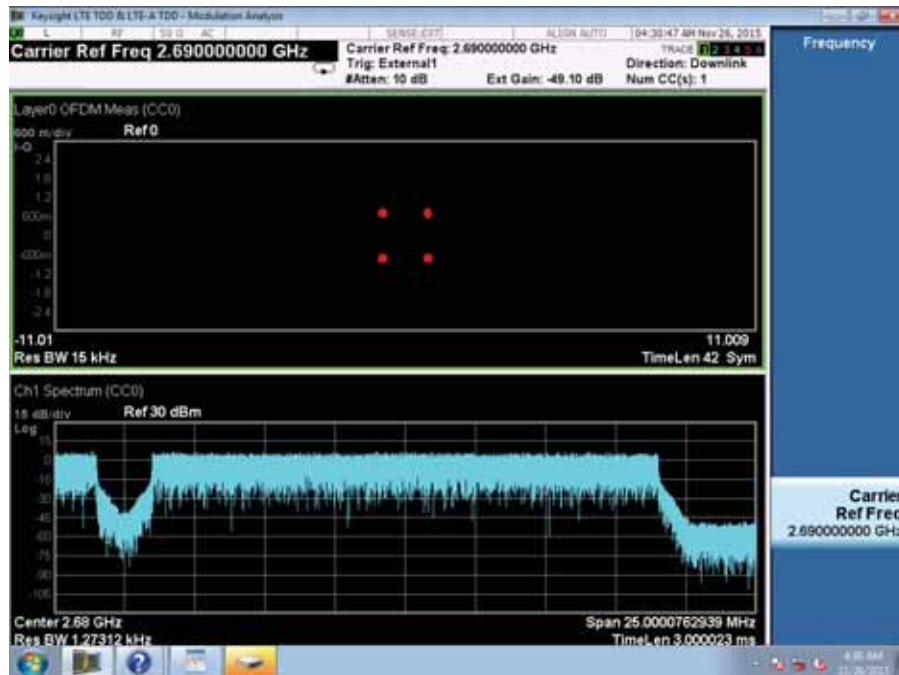
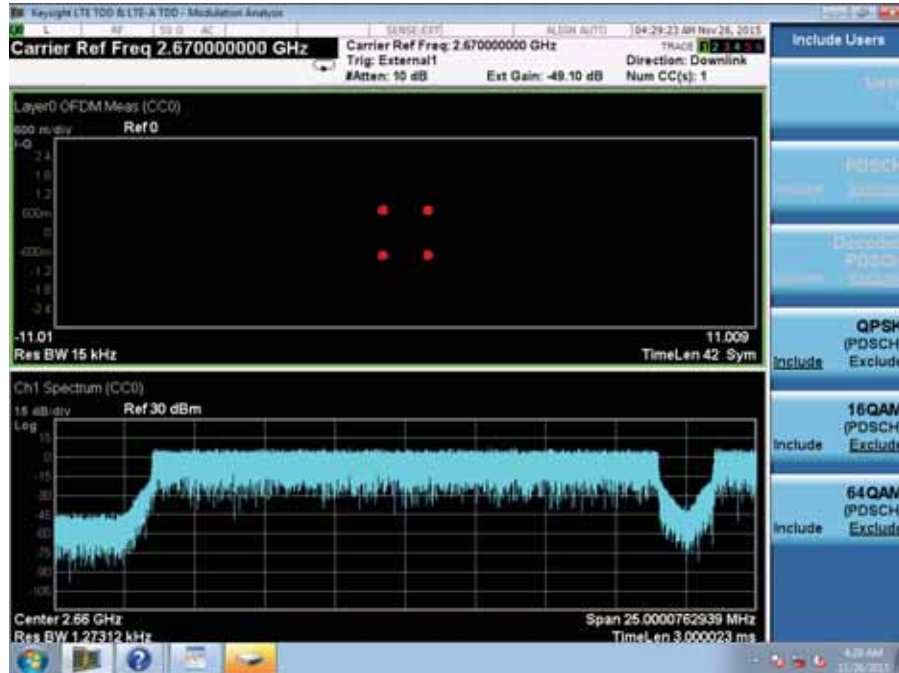
Peak to Average
16 QAM Modulation
Center Frequencies: 2506 and 2526 MHz, (20+20 MHz BW).



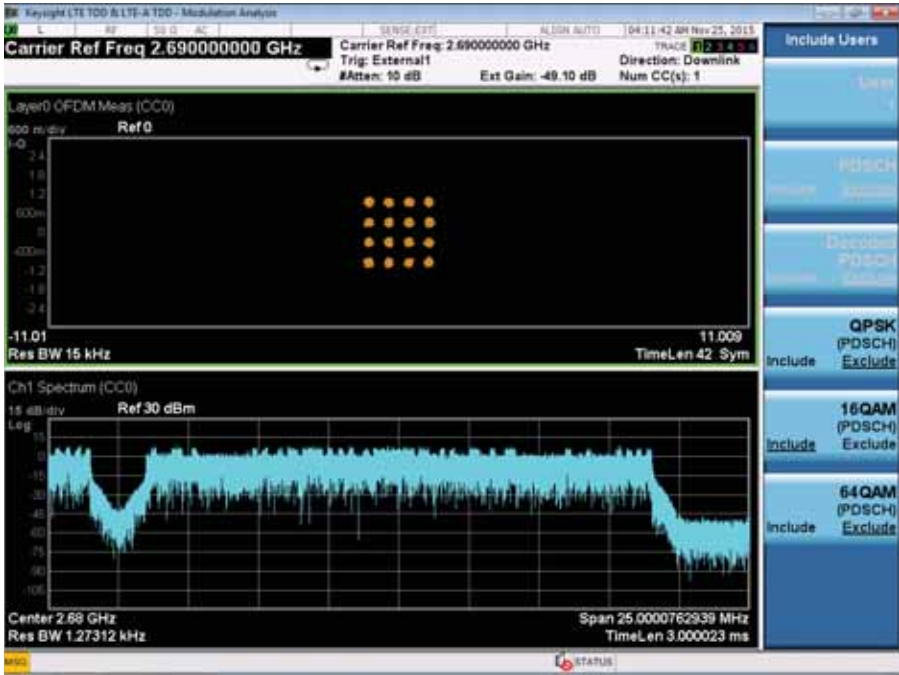
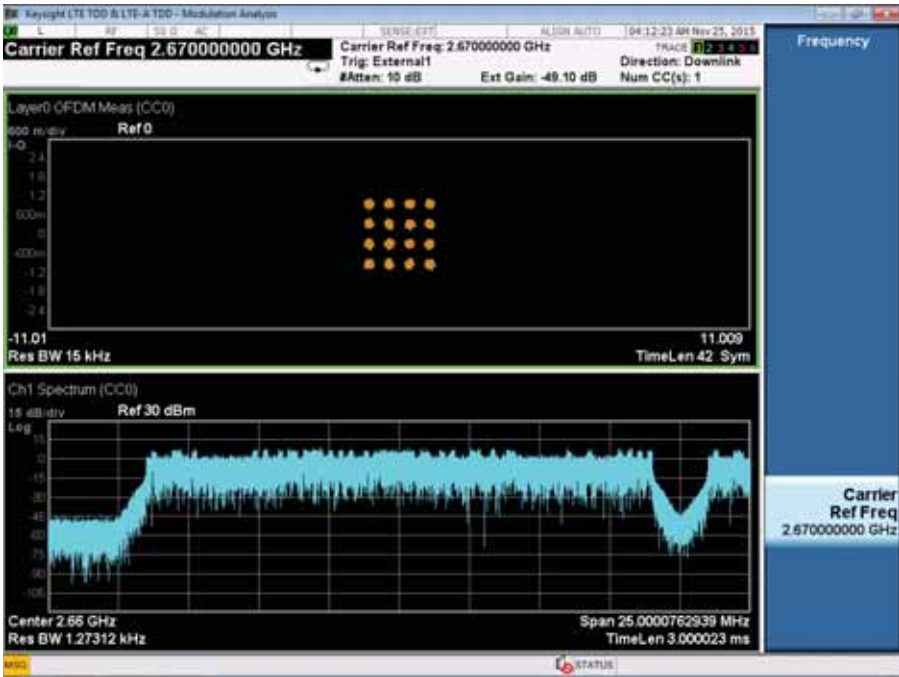
Peak to Average
64 QAM Modulation
Center Frequencies: 2506 and 2526 MHz, (20+20 MHz BW).



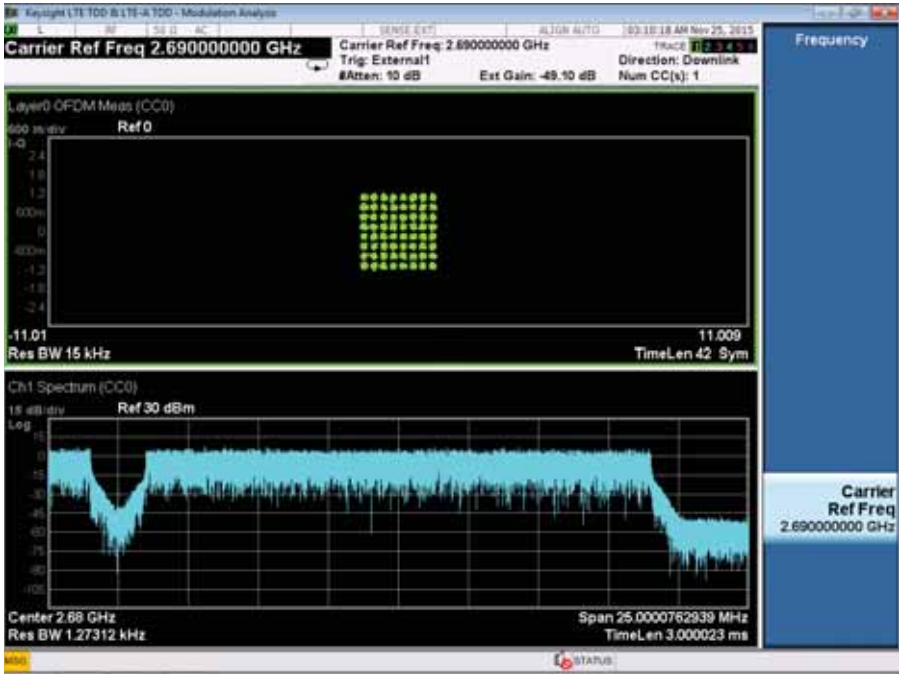
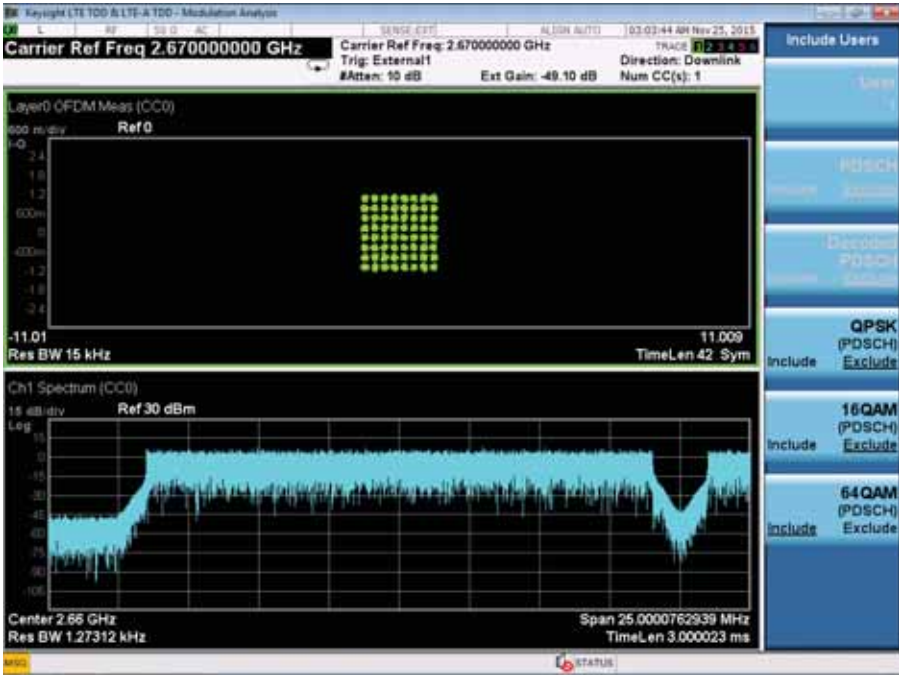
QPSK Modulation
2660 and 2680 MHz, (20+20 MHz BW).



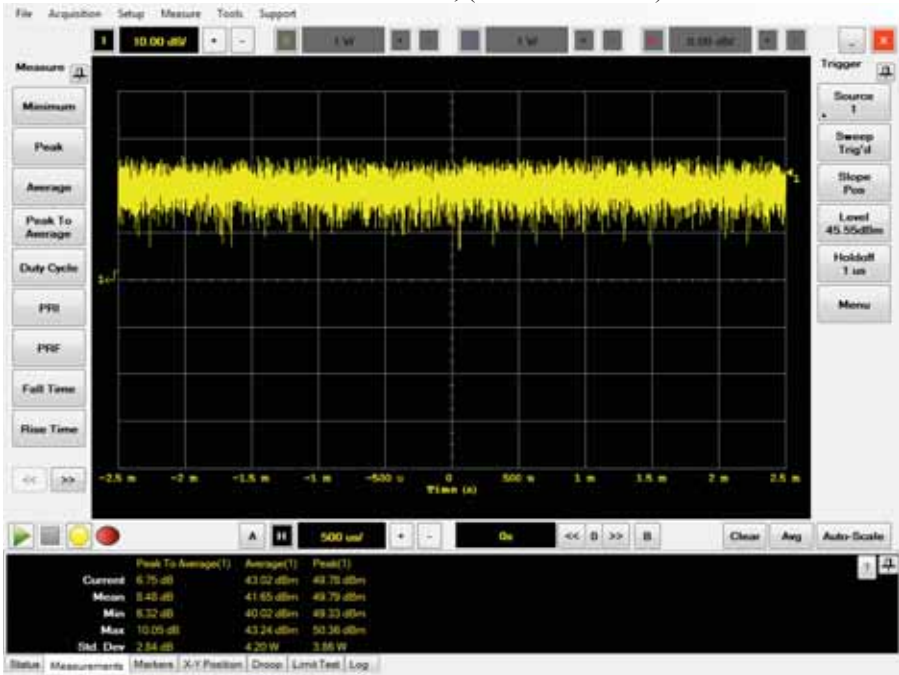
16QAM Modulation
2660 and 2680 MHz, (20+20 MHz BW).



64QAM Modulation
2660 and 2680 MHz, (20+20 MHz BW).



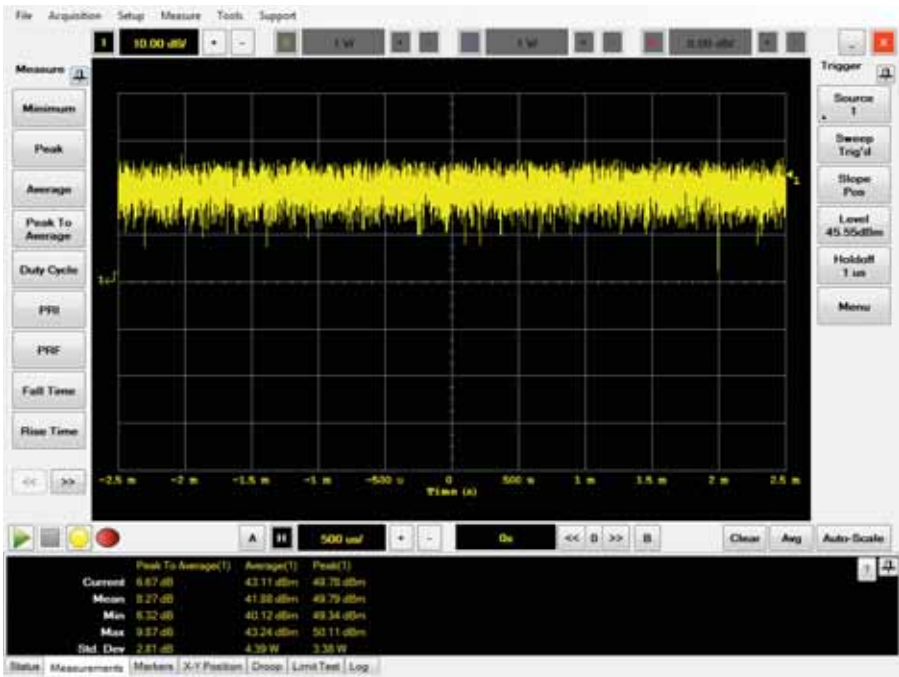
Peak to Average
QPSK Modulation
2660 and 2680 MHz, (20+20 MHz BW).



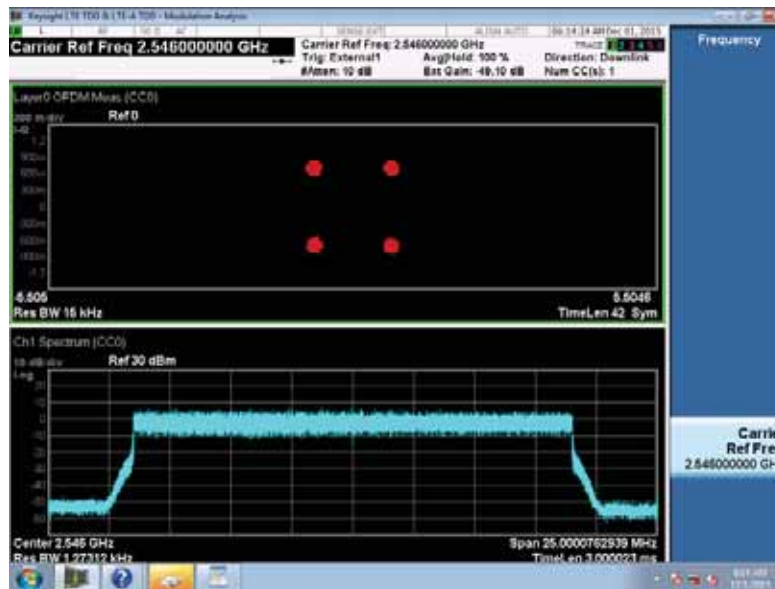
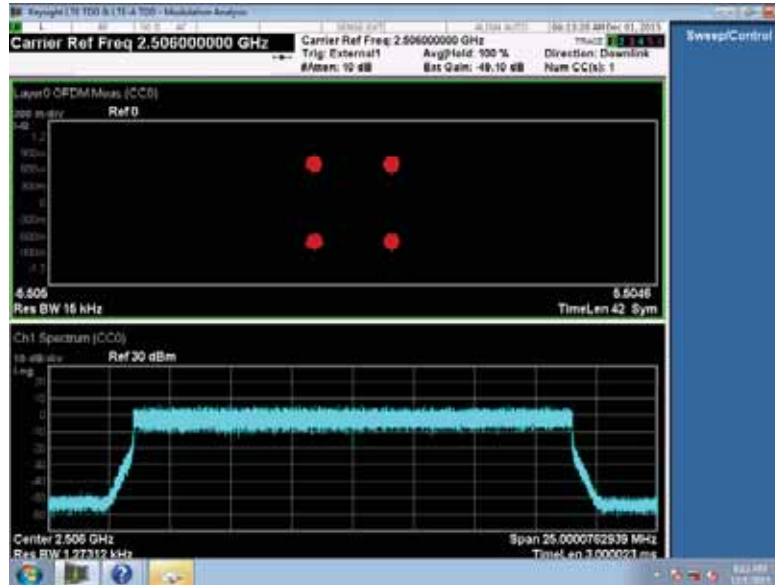
Peak to Average
16QAM Modulation
2660 and 2680 MHz, (20+20 MHz BW).



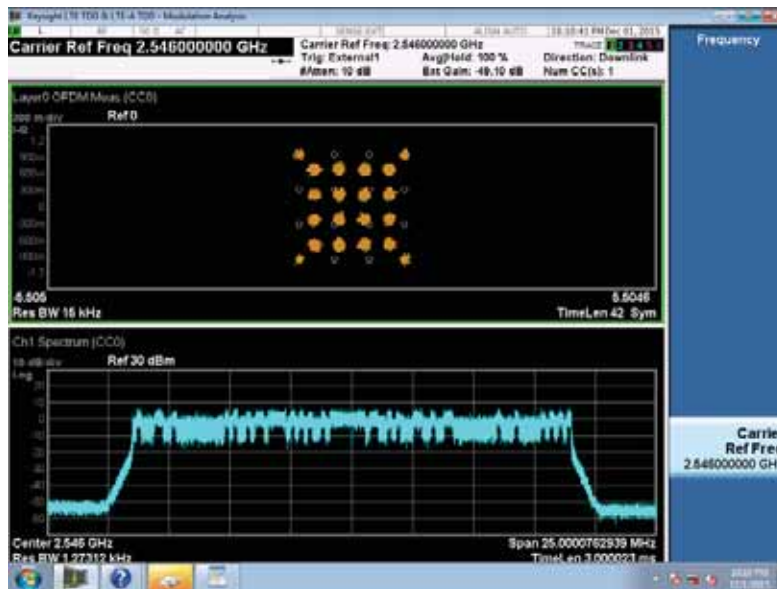
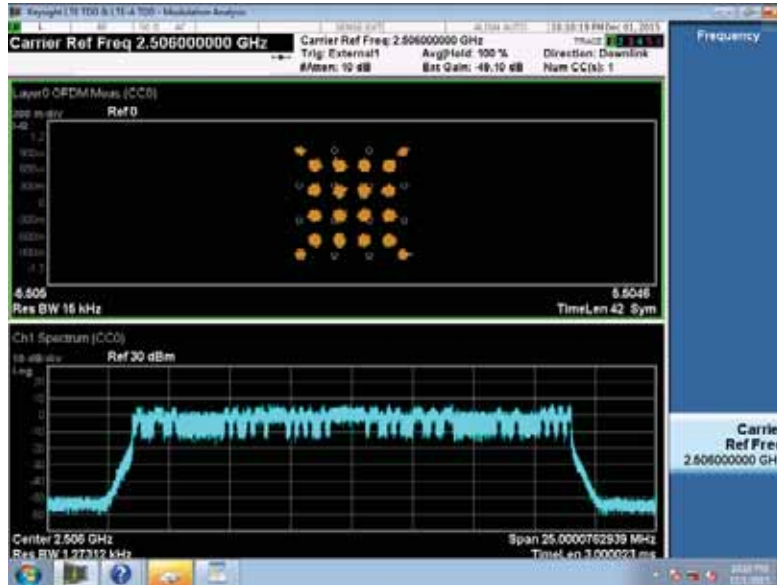
Peak to Average
64QAM Modulation
2660 and 2680 MHz, (20+20 MHz BW).



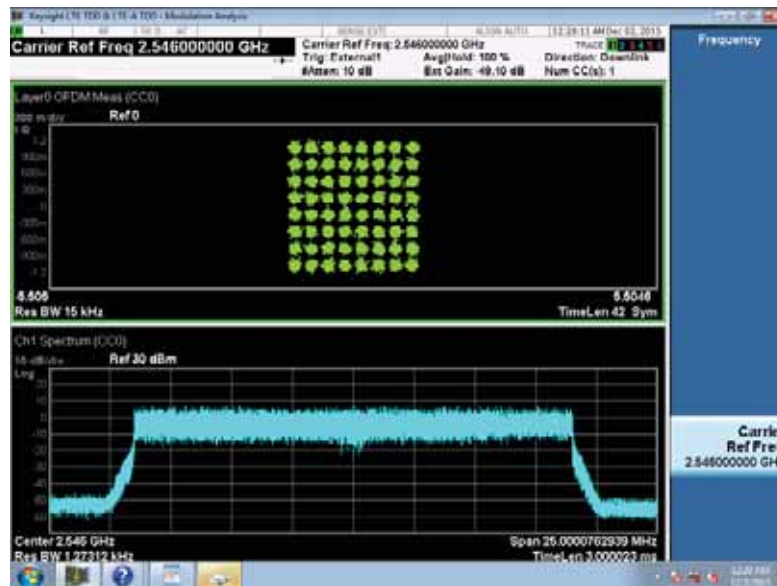
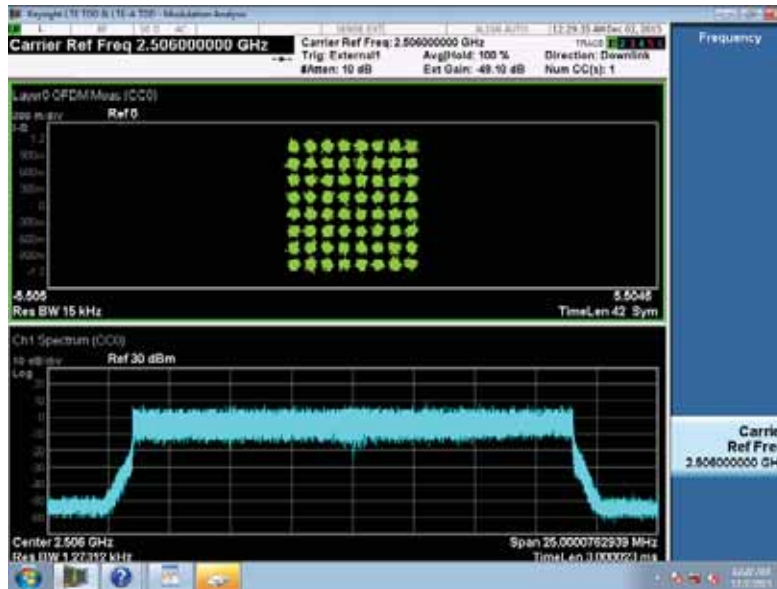
QPSK Modulation
2506 and 2546 MHz, Non-contiguous (20+20 MHz BW).



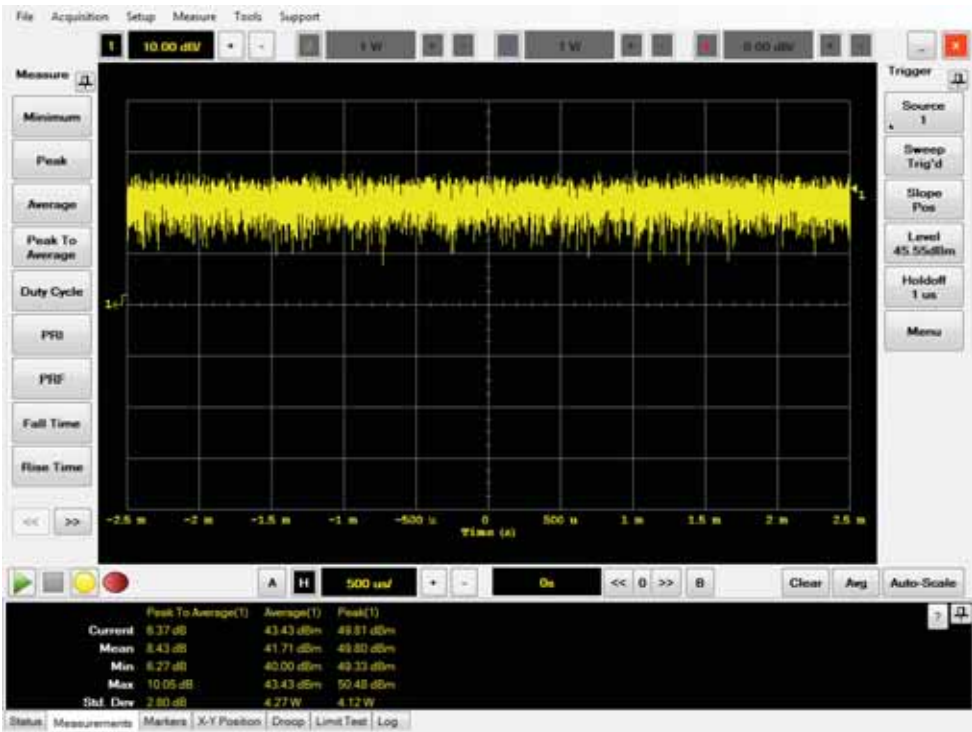
16QAM Modulation
2506 and 2546 MHz, Non-contiguous (20+20 MHz BW).



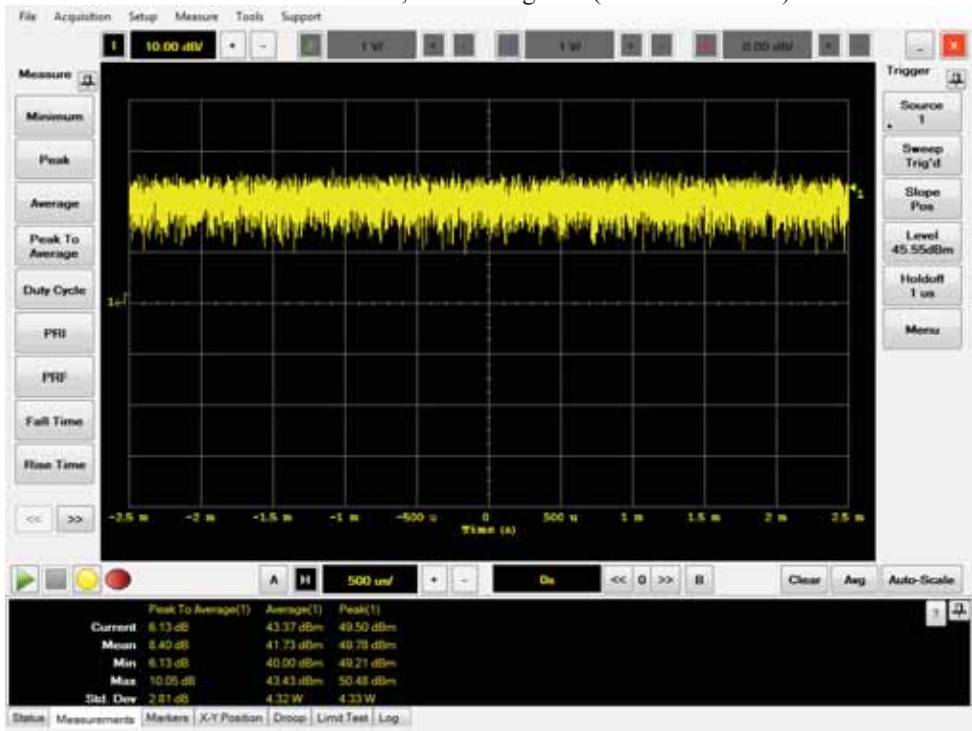
64QAM Modulation
2506 and 2546 MHz, Non-contiguous (20+20 MHz BW).



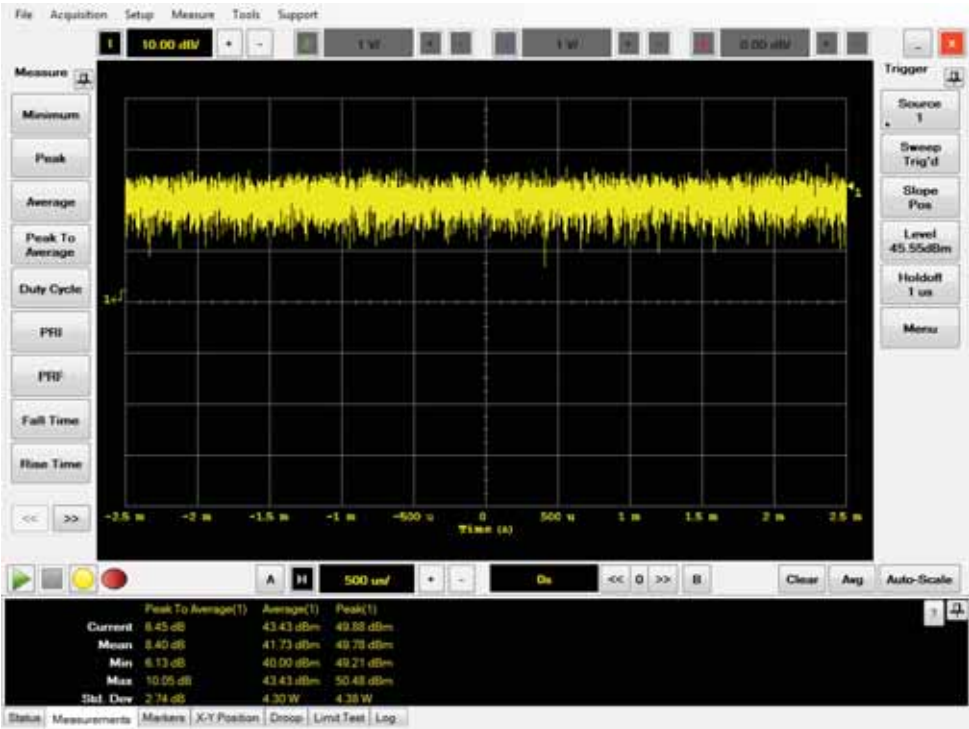
Peak to Average
QPSK Modulation
2506 and 2546 MHz, Non-contiguous (20+20 MHz BW).



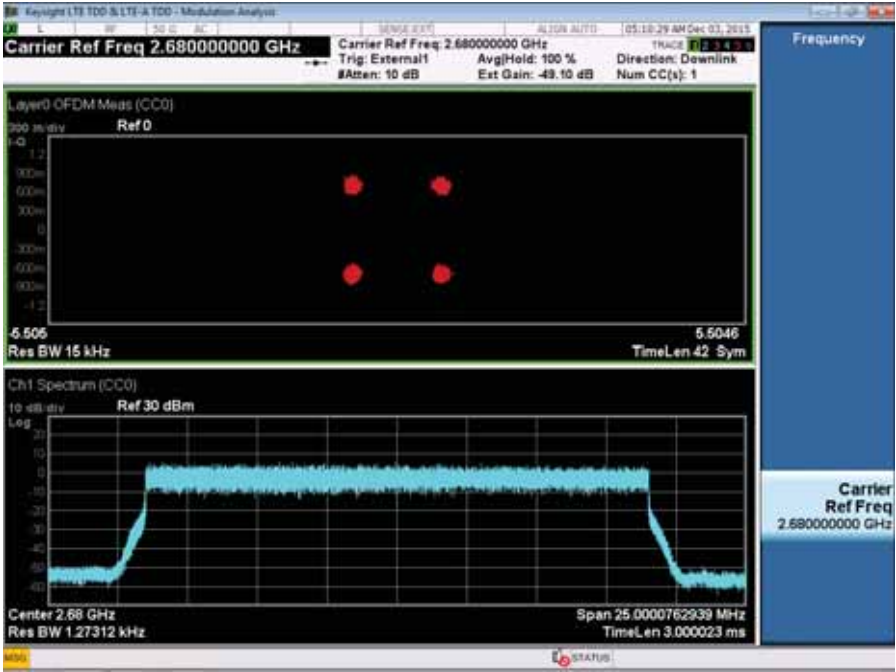
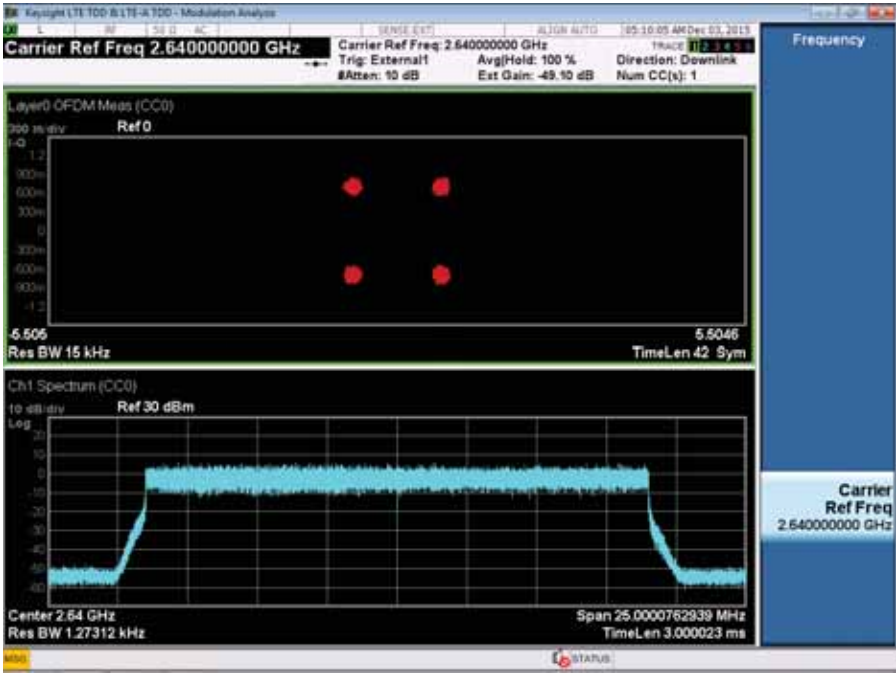
Peak to Average
16QAM Modulation
2506 and 2546 MHz, Non-contiguous (20+20 MHz BW).



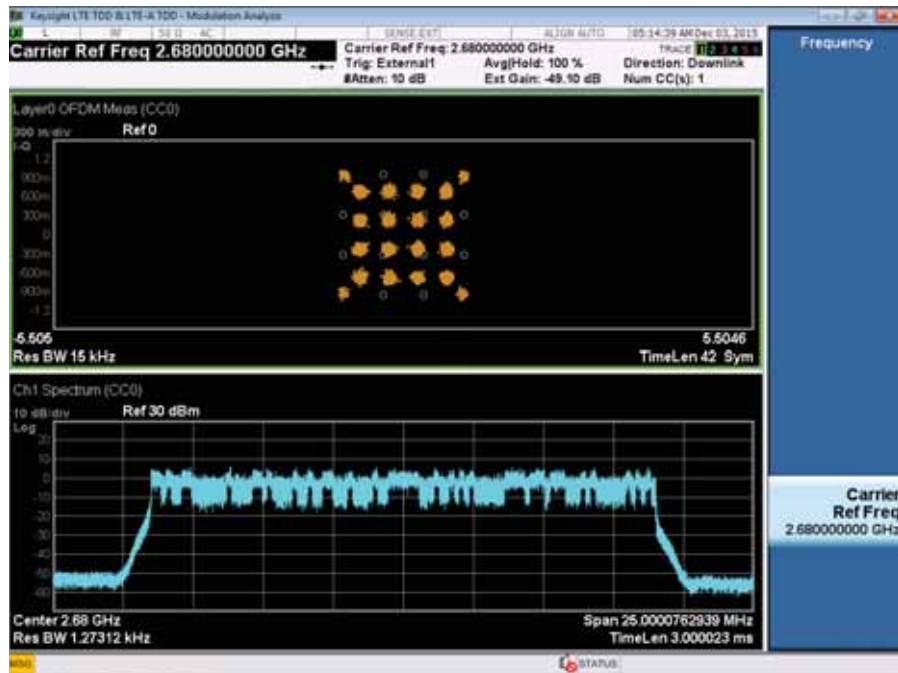
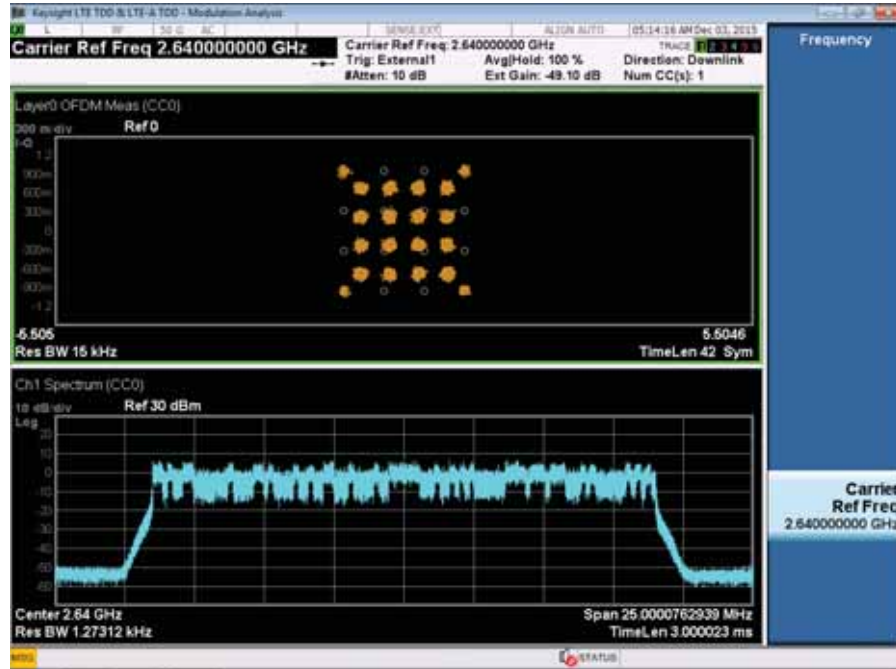
Peak to Average
64QAM Modulation
2506 and 2546 MHz, Non-contiguous (20+20 MHz BW).



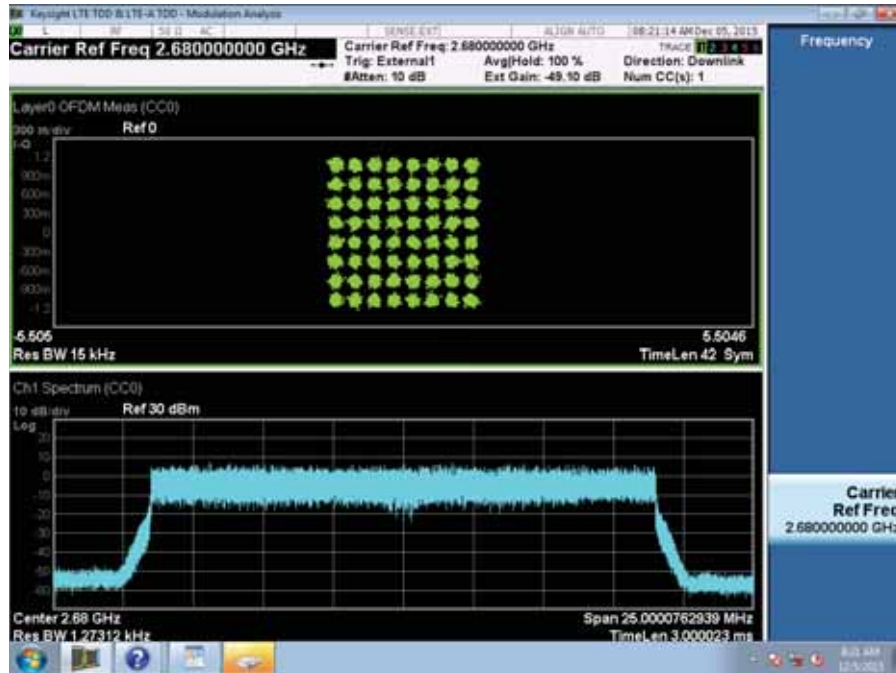
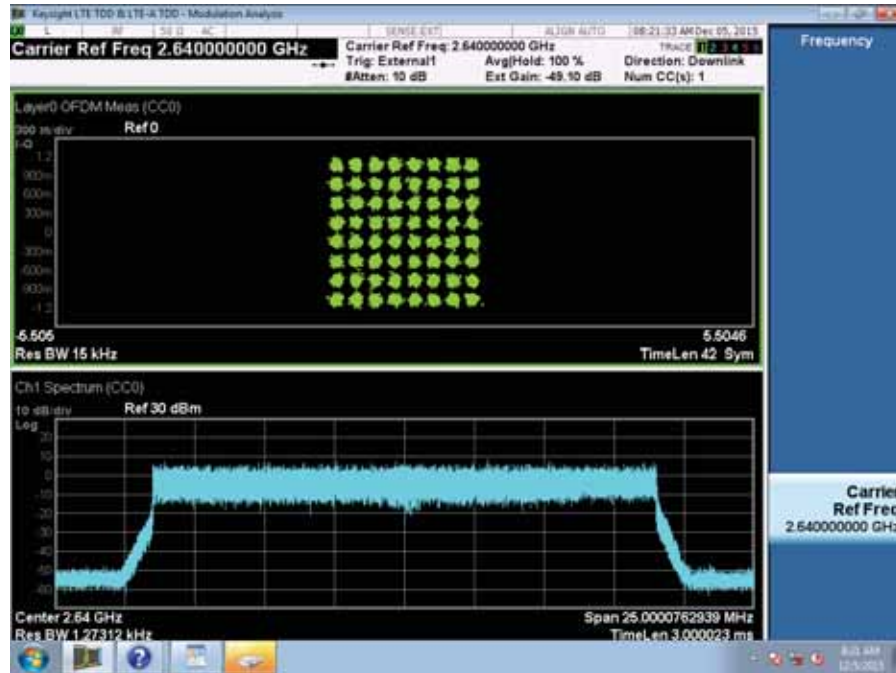
QPSK Modulation
2640 and 2680 MHz, Non-contiguous (20+20 MHz BW).



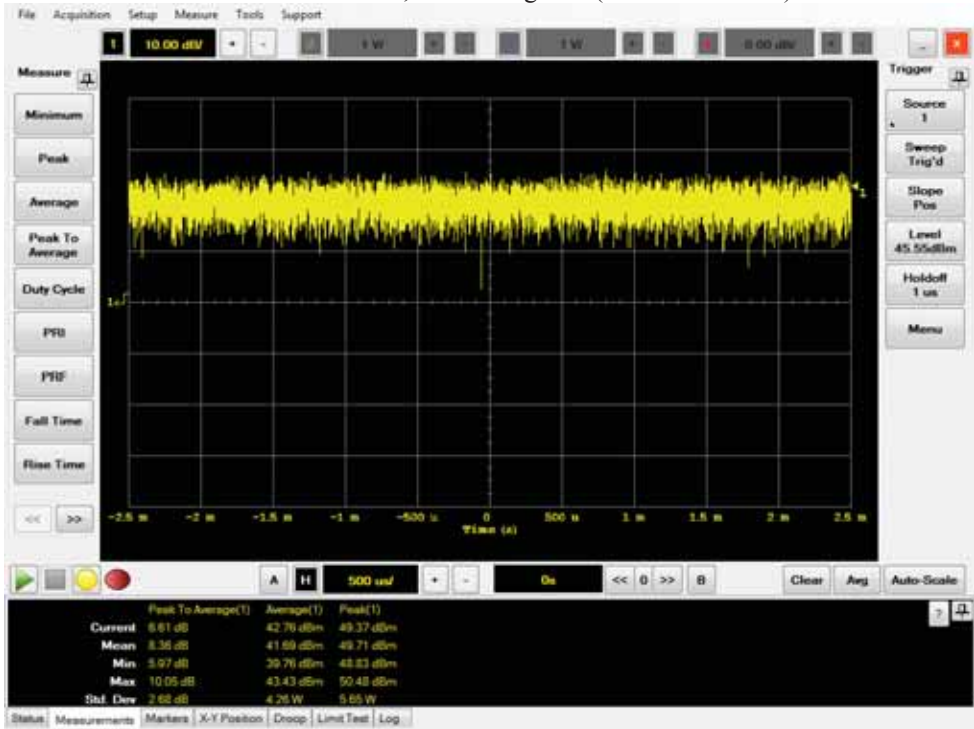
16QAM Modulation
2640 and 2680 MHz, Non-contiguous (20+20 MHz BW).



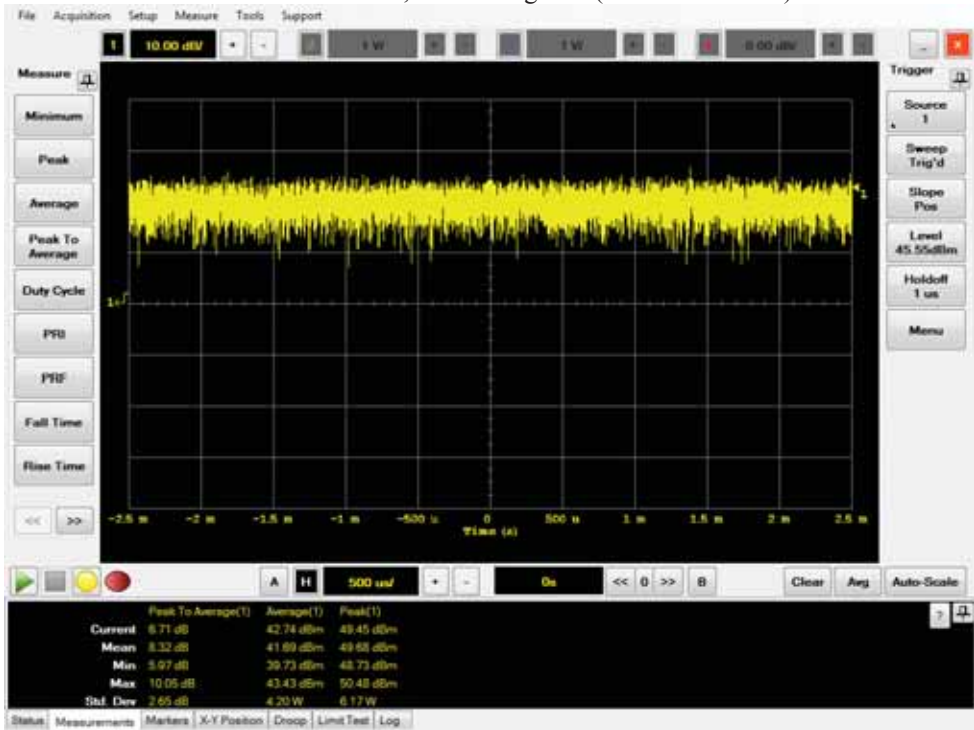
64QAM Modulation
2640 and 2680 MHz, Non-contiguous (20+20 MHz BW).



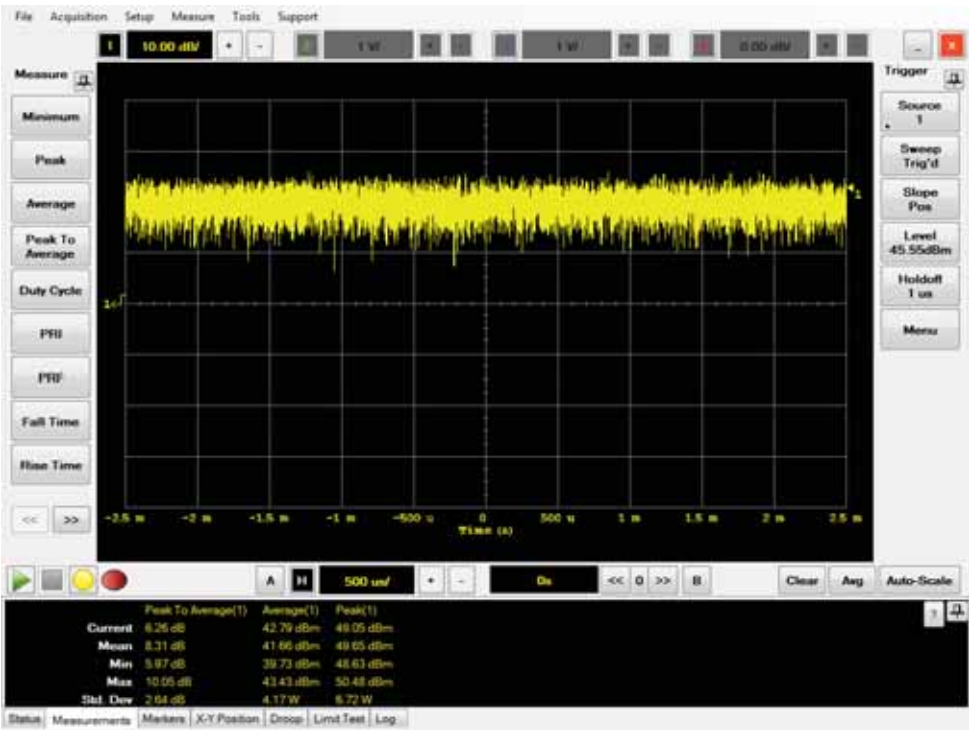
Peak to Average
QPSK Modulation
2640 and 2680 MHz, Non-contiguous (20+20 MHz BW).



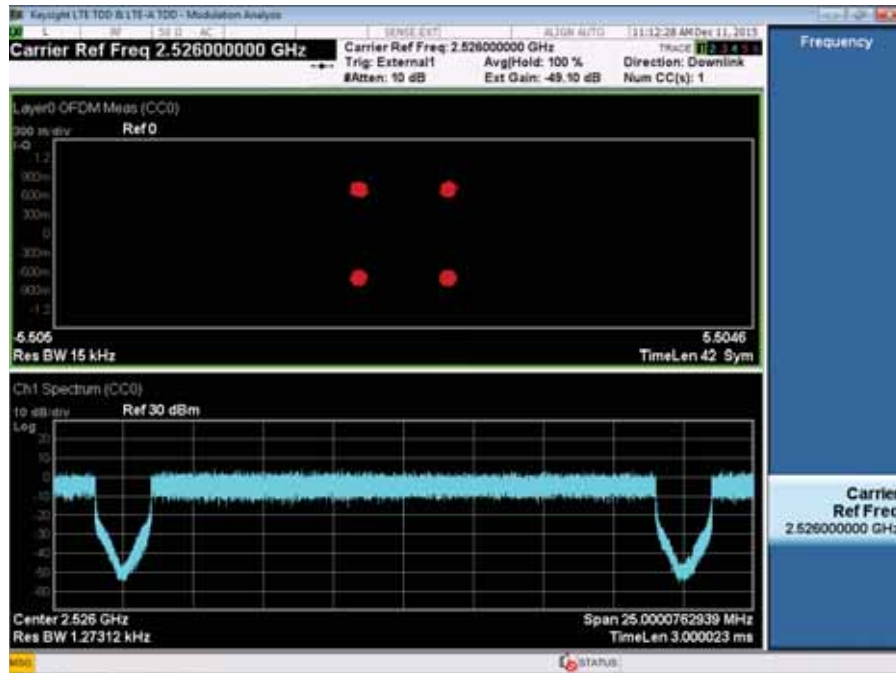
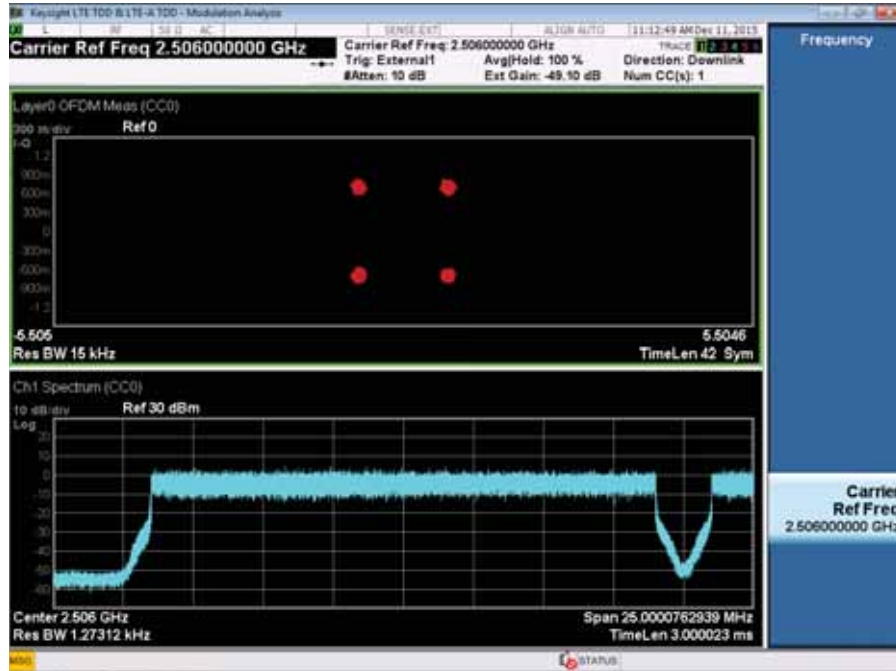
Peak to Average
16QAM Modulation
2640 and 2680 MHz, Non-contiguous (20+20 MHz BW).

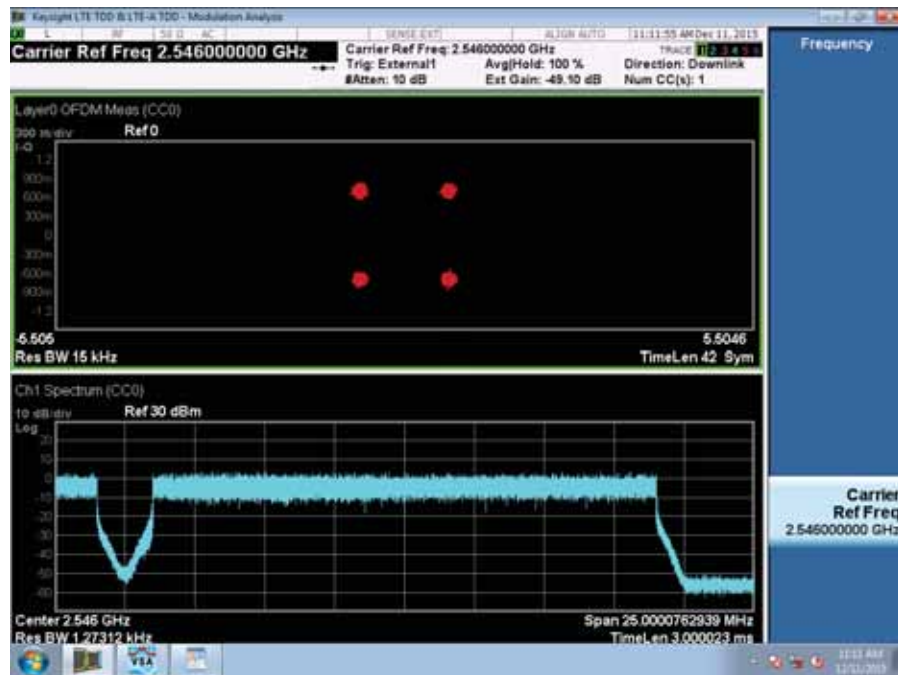


Peak to Average
64QAM Modulation
2640 and 2680 MHz, Non-contiguous (20+20 MHz BW).

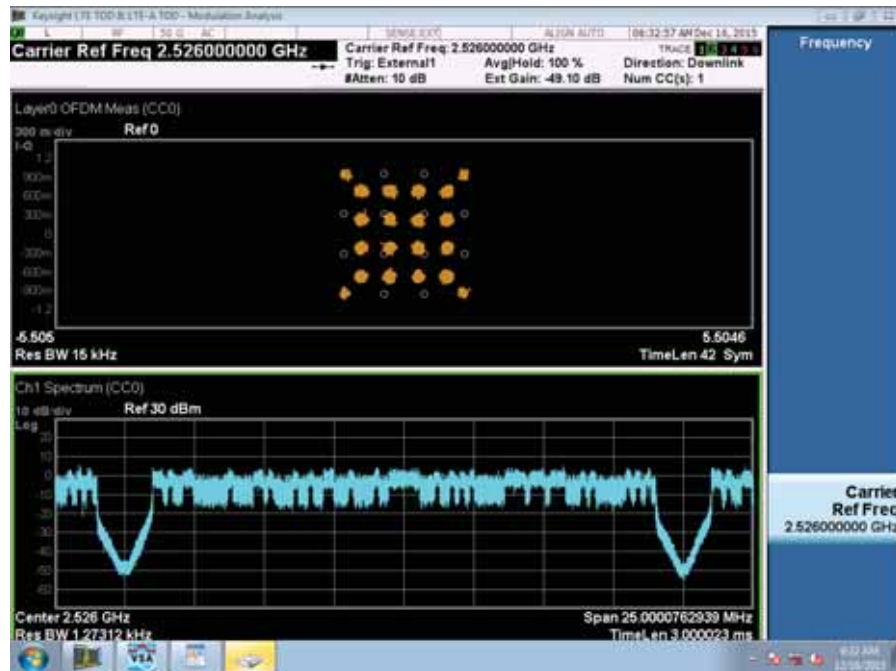
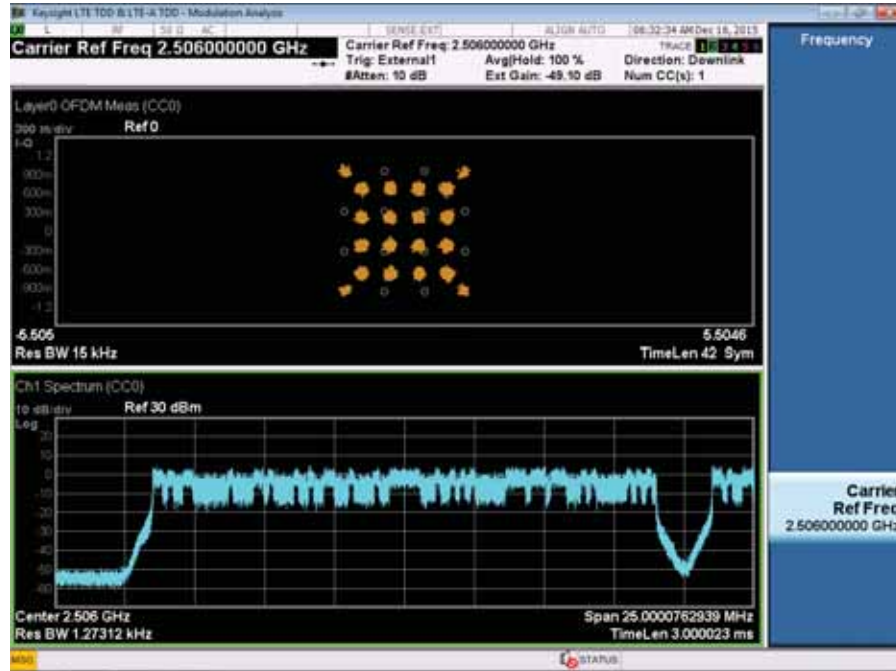


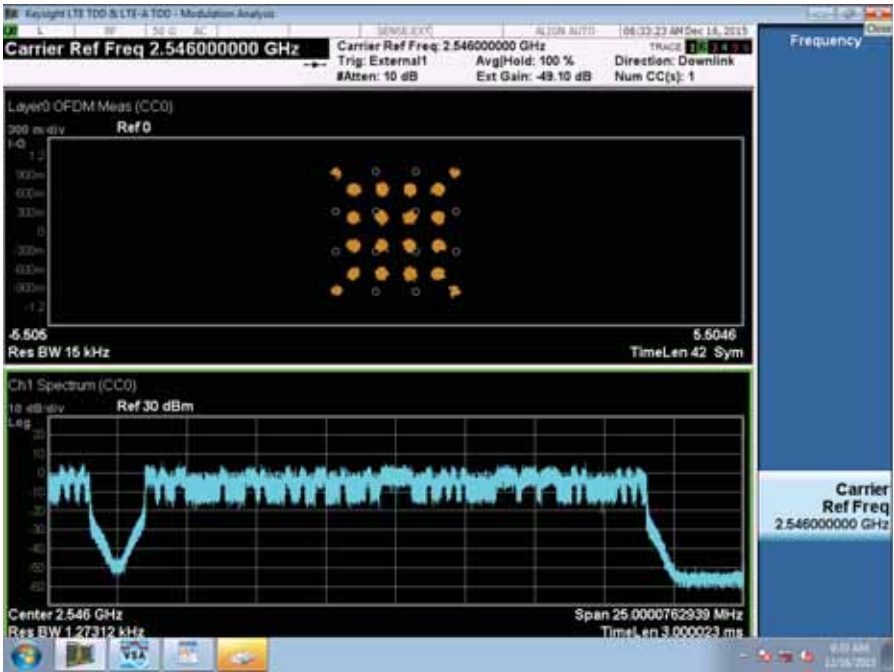
QPSK Modulation
Center Frequencies: 2506, 2526&2546 MHz, (20+20+20MHz BW).



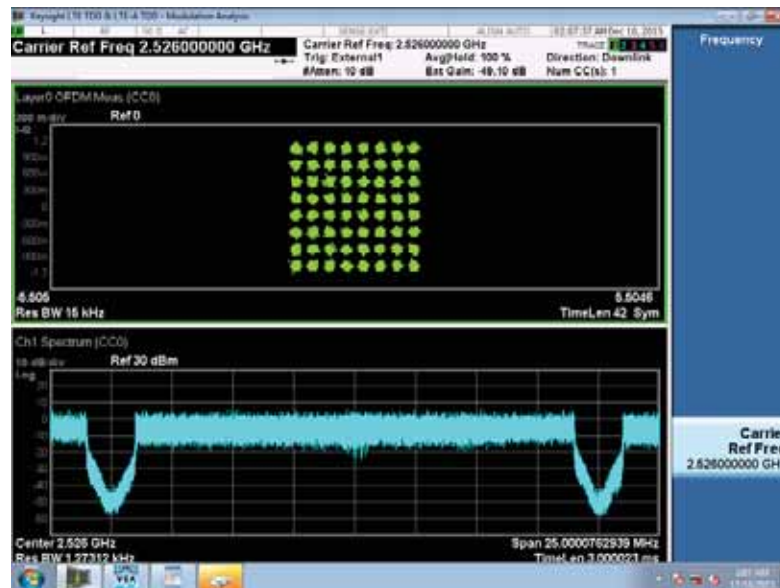
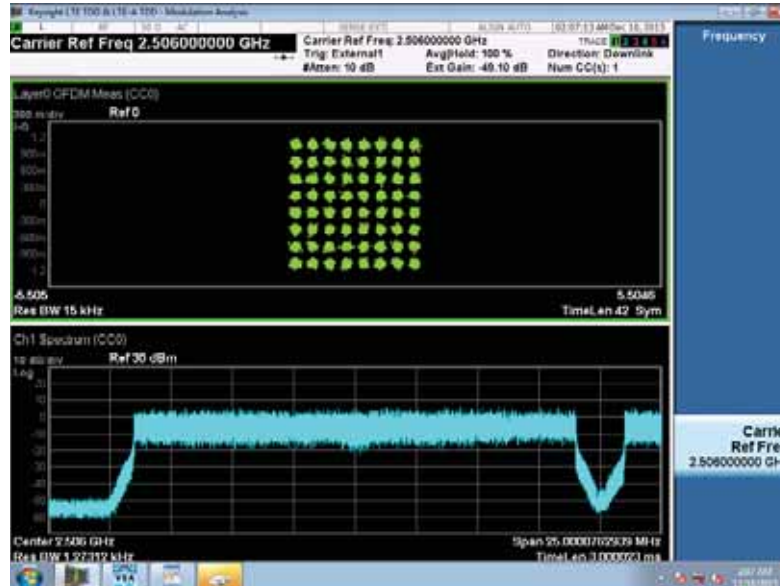


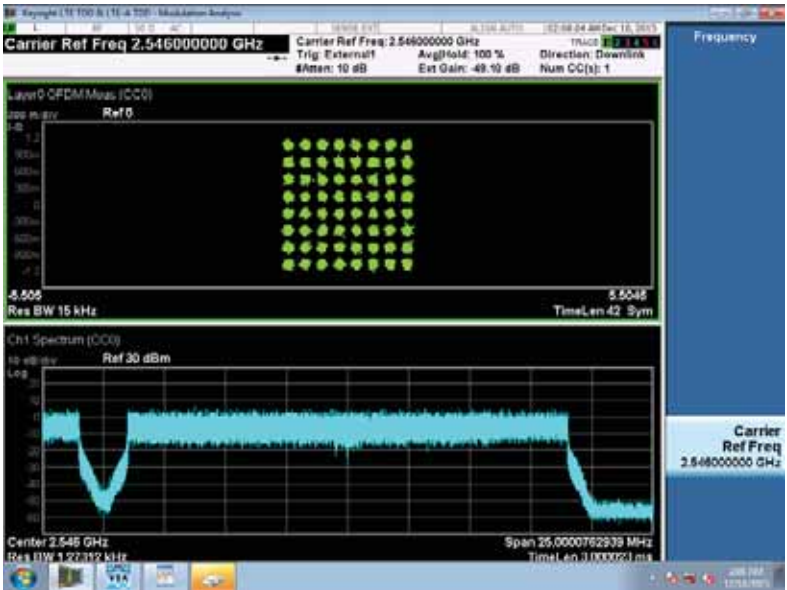
16QAM Modulation
Center Frequencies: 2506, 2526&2546 MHz, (20+20+20MHz BW).



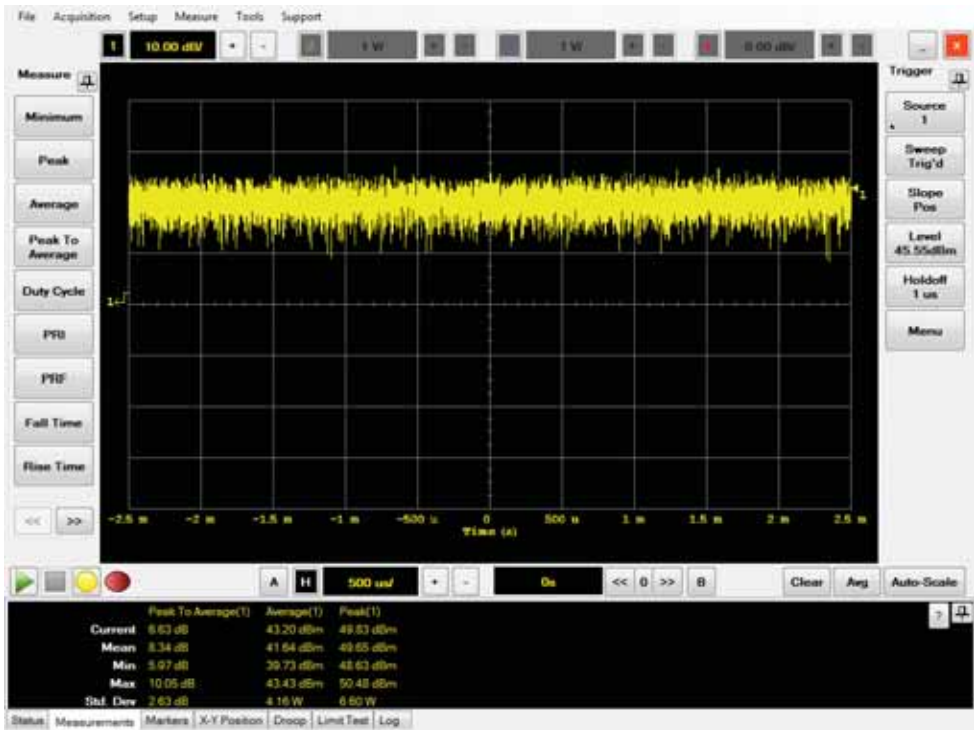


64QAM Modulation
Center Frequencies: 2506, 2526&2546 MHz, (20+20+20MHz BW).





Peak to Average
QPSK Modulation
Center Frequencies: 2506, 2526&2546 MHz, (20+20+20MHz BW).



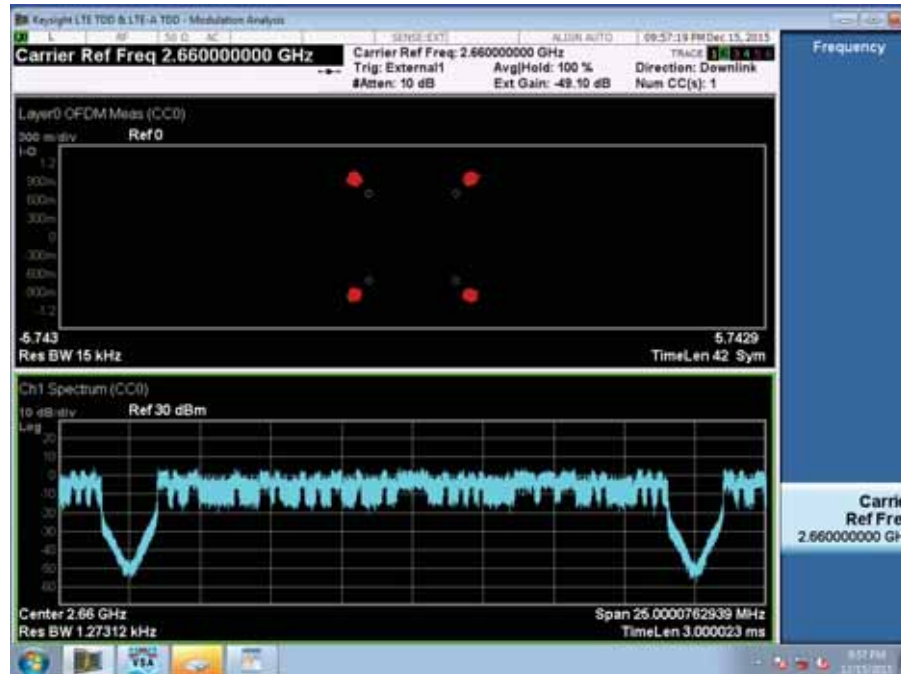
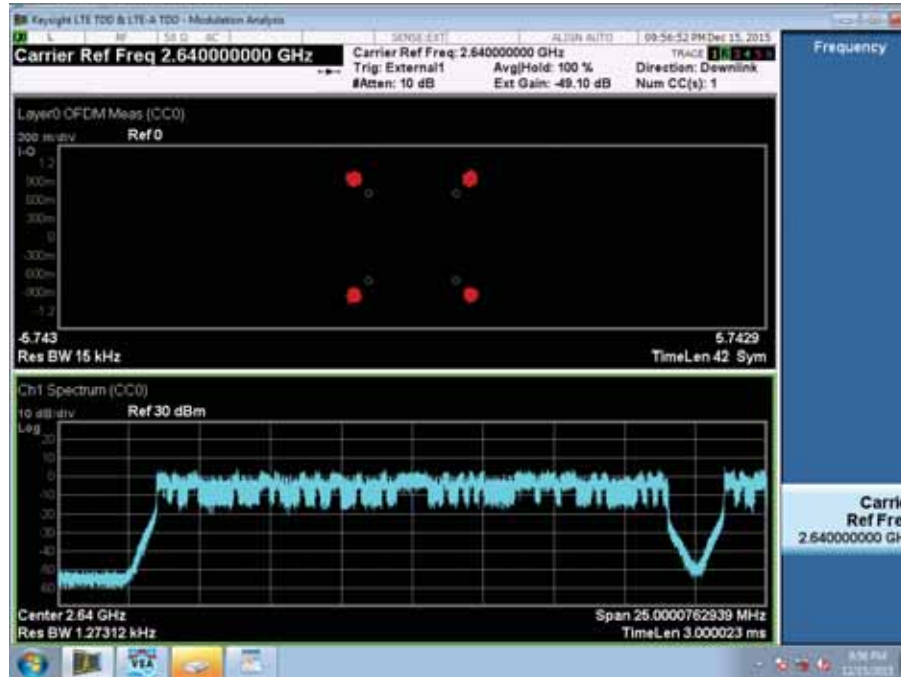
Peak to Average
16QAM Modulation
Center Frequencies: 2506, 2526&2546 MHz, (20+20+20MHz BW).

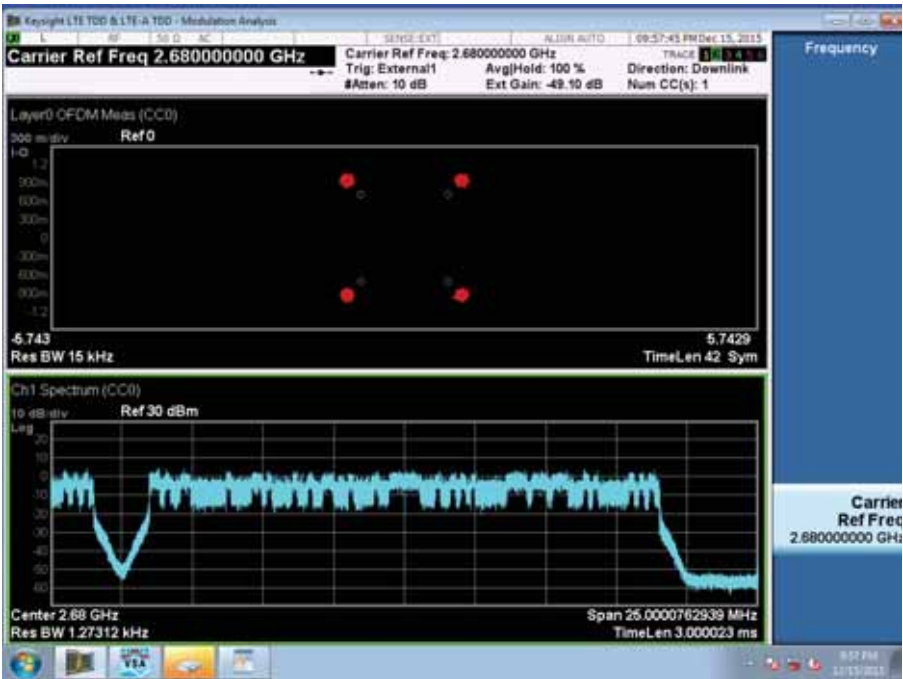


Center Frequencies: 2506, 2526&2546 MHz, (20+20+20MHz BW).

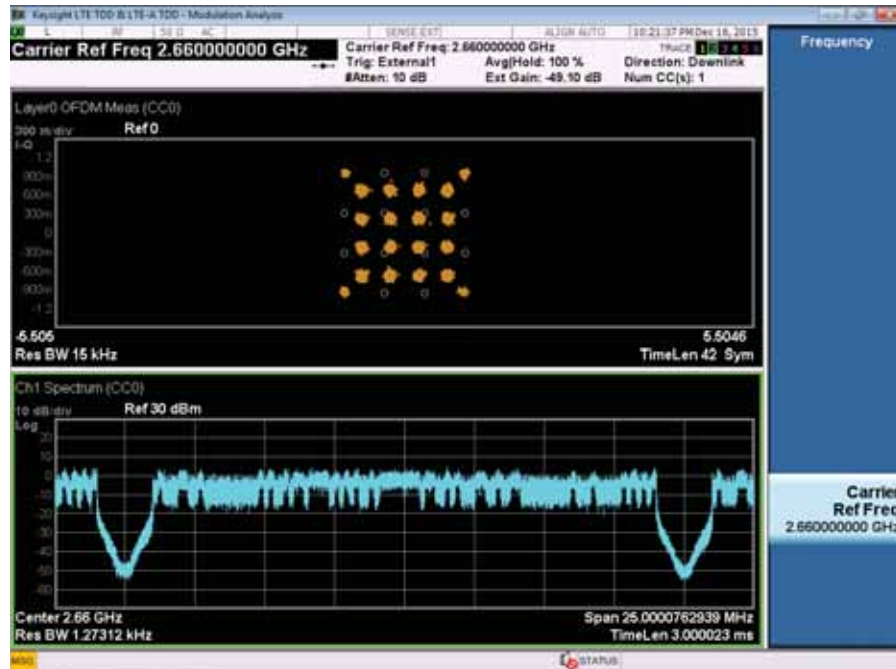
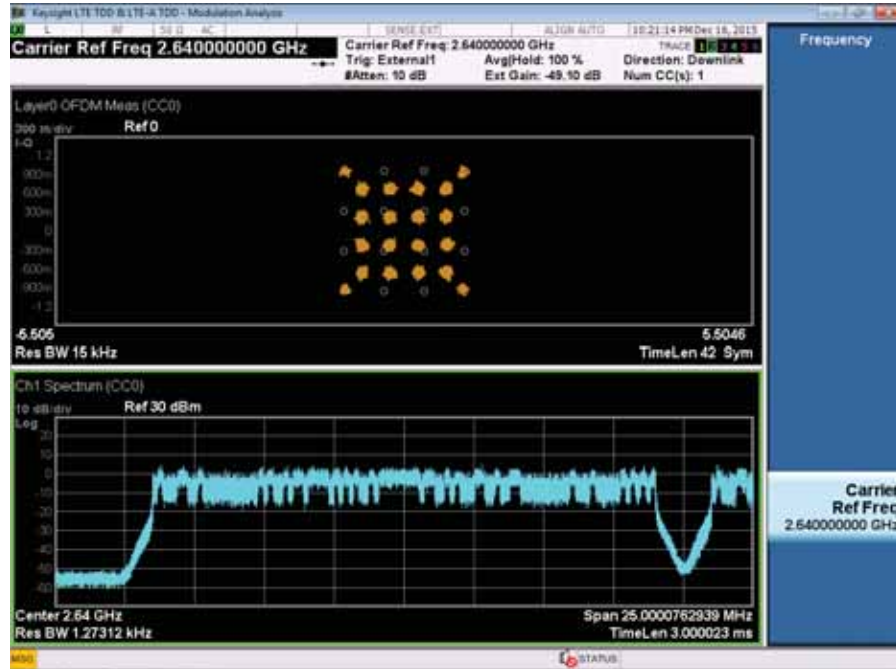


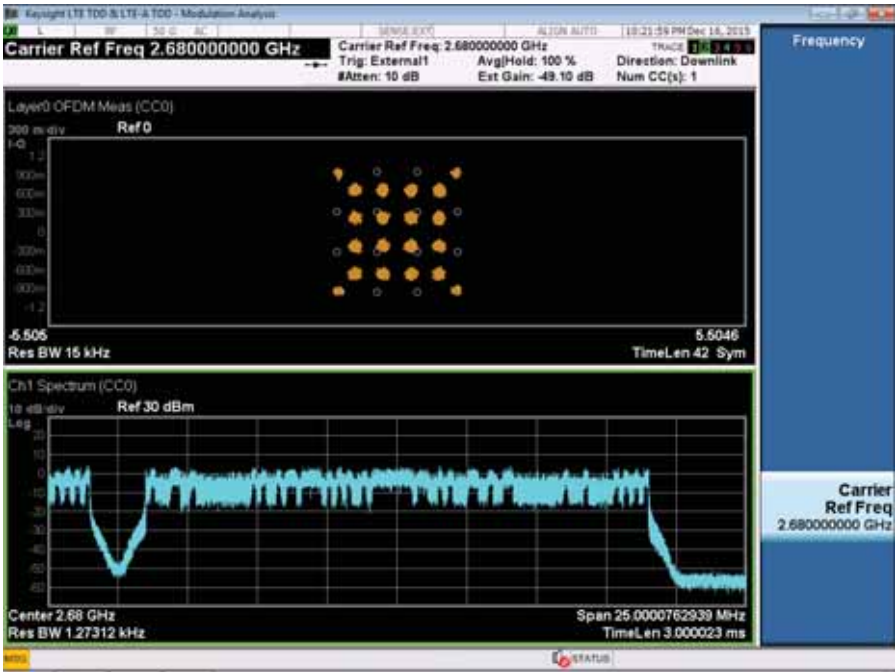
QPSK Modulation
Center Frequencies: 2640, 2660&2680 MHz, (20+20+20MHz BW).



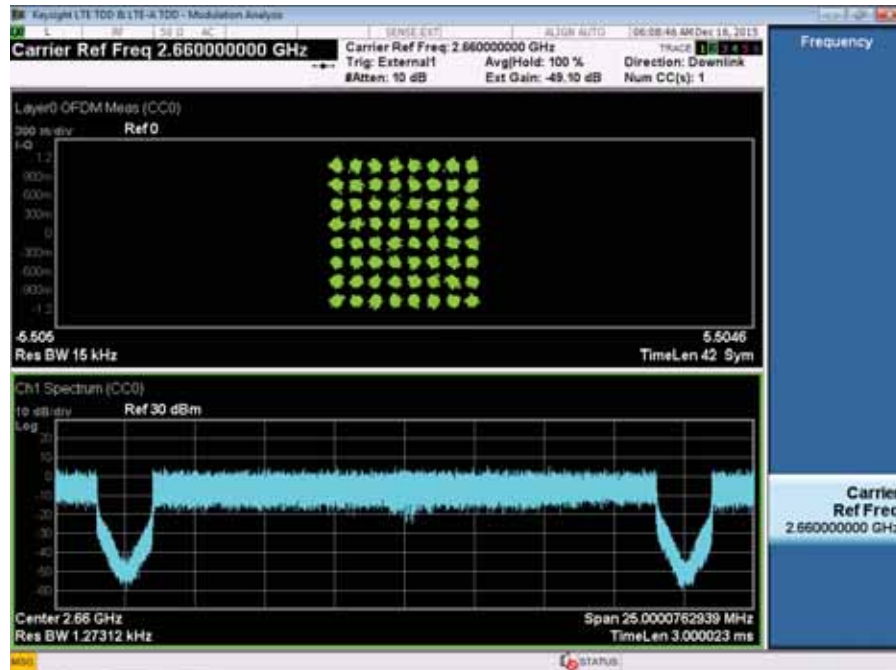
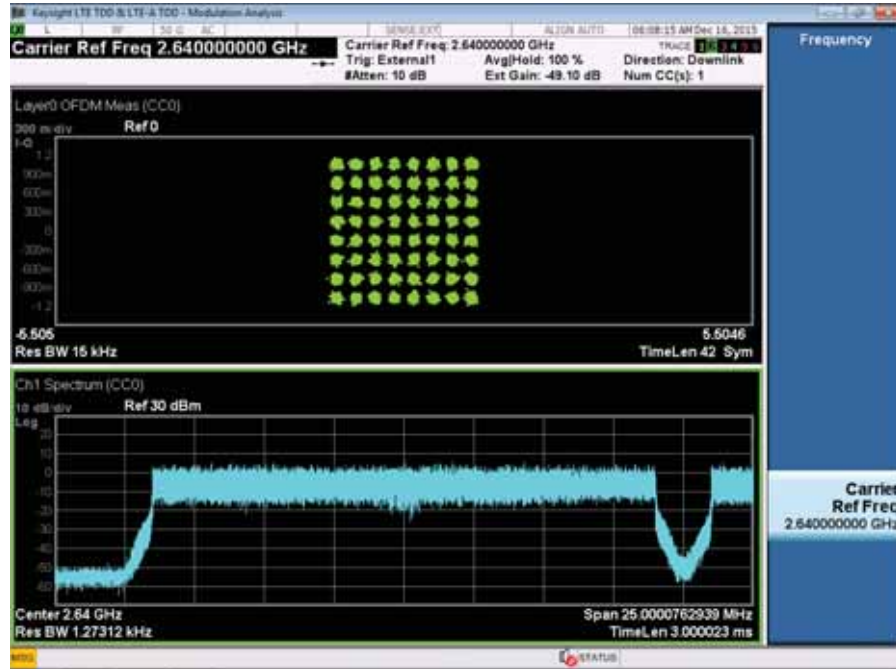


16QAM Modulation
Center Frequencies: 2640, 2660&2680 MHz, (20+20+20MHz BW).





64QAM Modulation
Center Frequencies: 2640, 2660&2680 MHz, (20+20+20MHz BW).





Peak to Average
QPSK Modulation
Center Frequencies: 2640, 2660&2680 MHz, (20+20+20MHz BW).



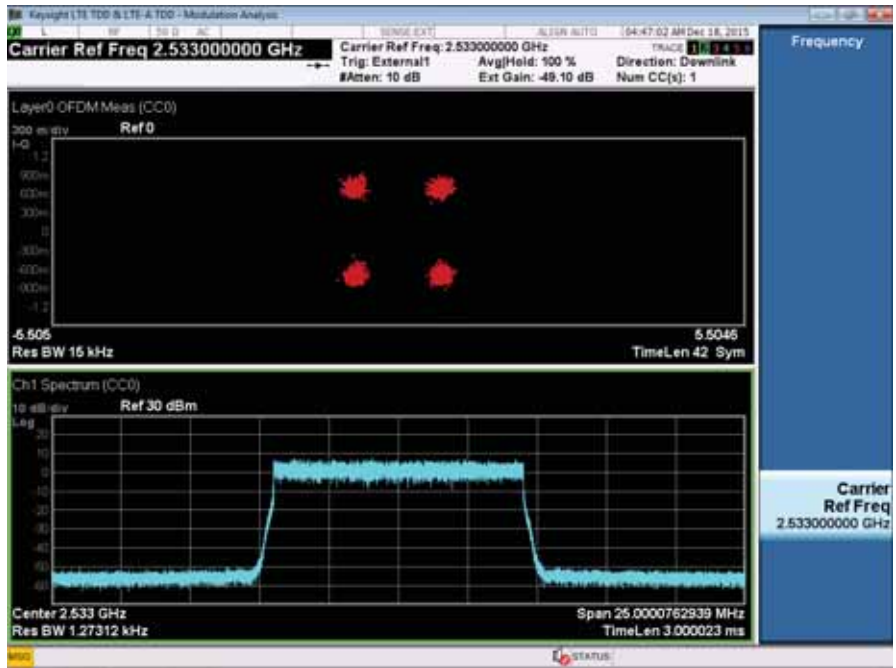
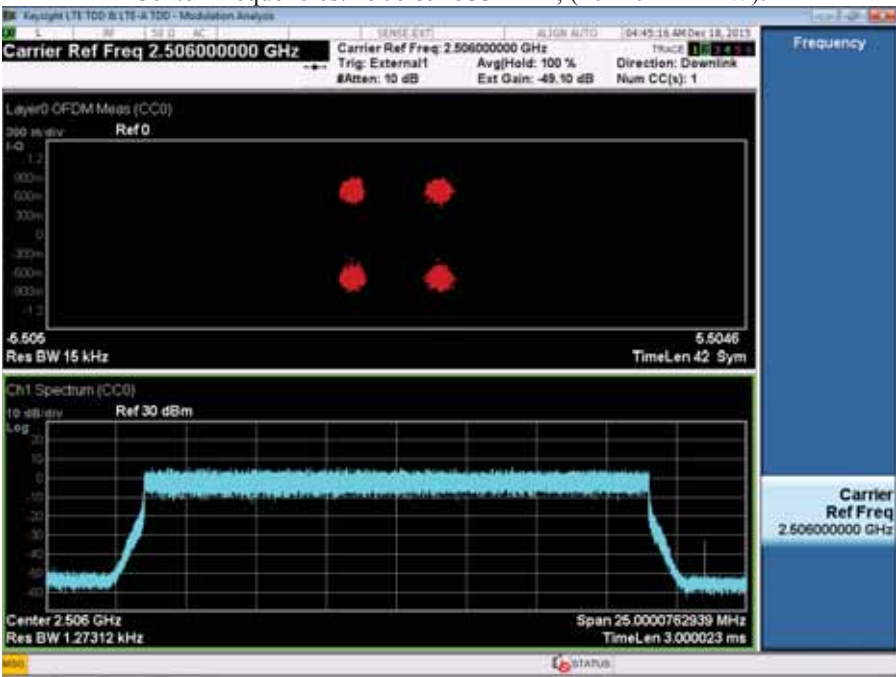
Peak to Average
16QAM Modulation
Center Frequencies: 2640, 2660&2680 MHz, (20+20+20MHz BW).



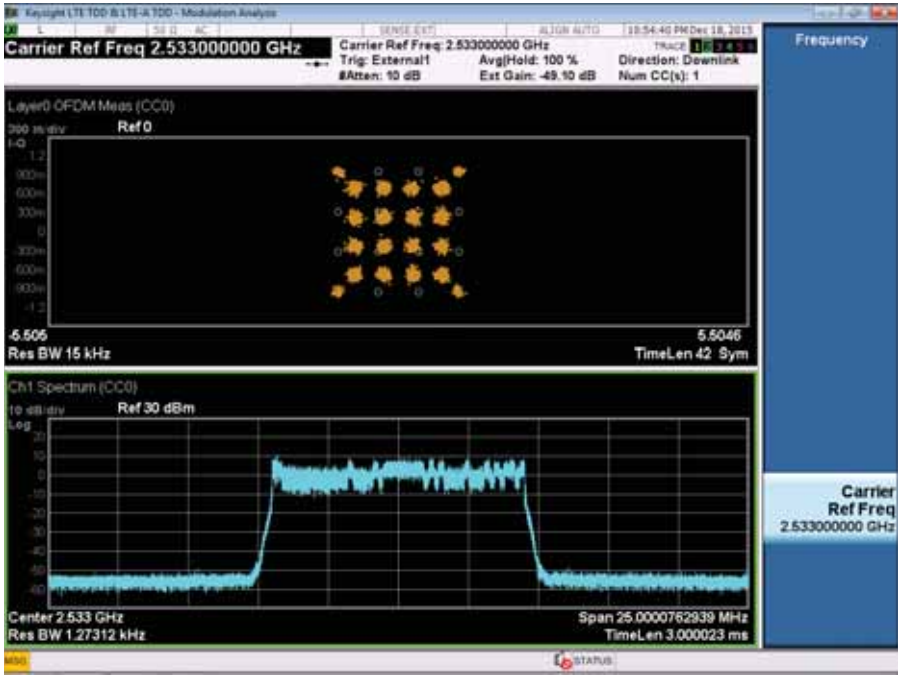
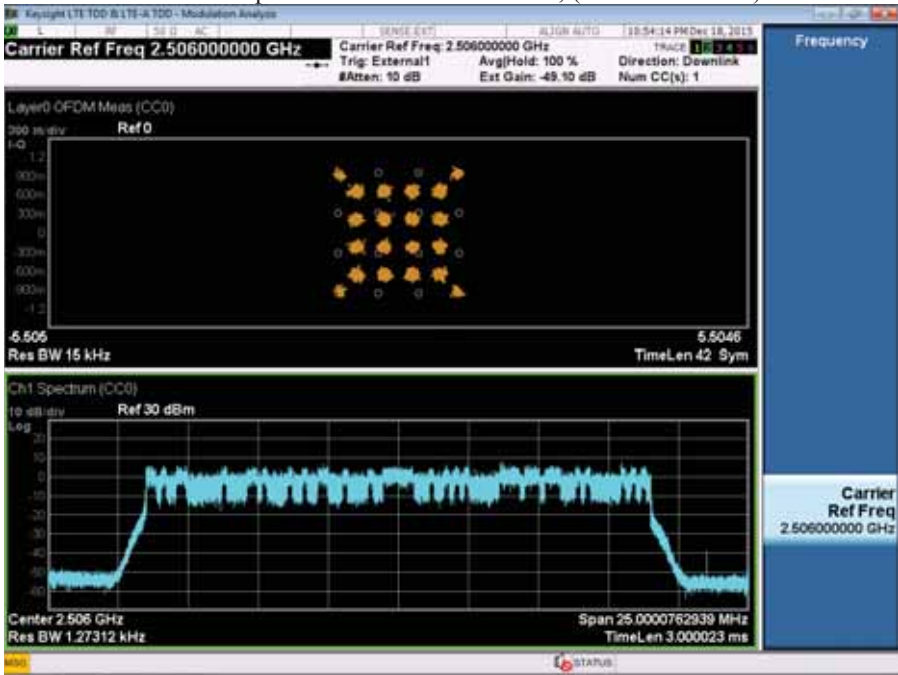
Peak to Average
64QAM Modulation
Center Frequencies: 2640, 2660&2680 MHz, (20+20+20MHz BW).



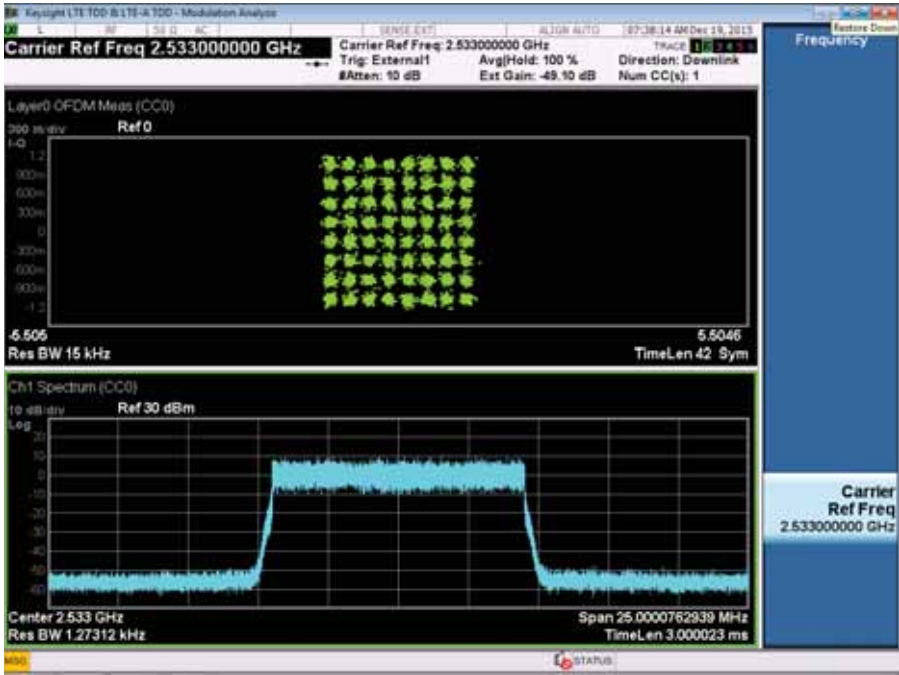
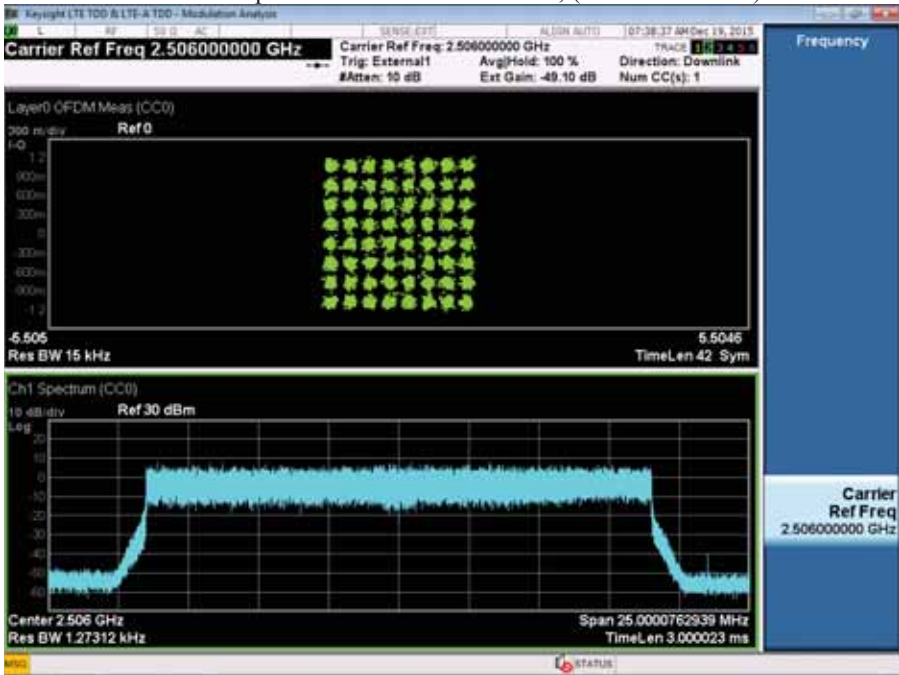
QPSK Modulation
Center Frequencies: 2506 & 2533 MHz, (20+10MHz BW).



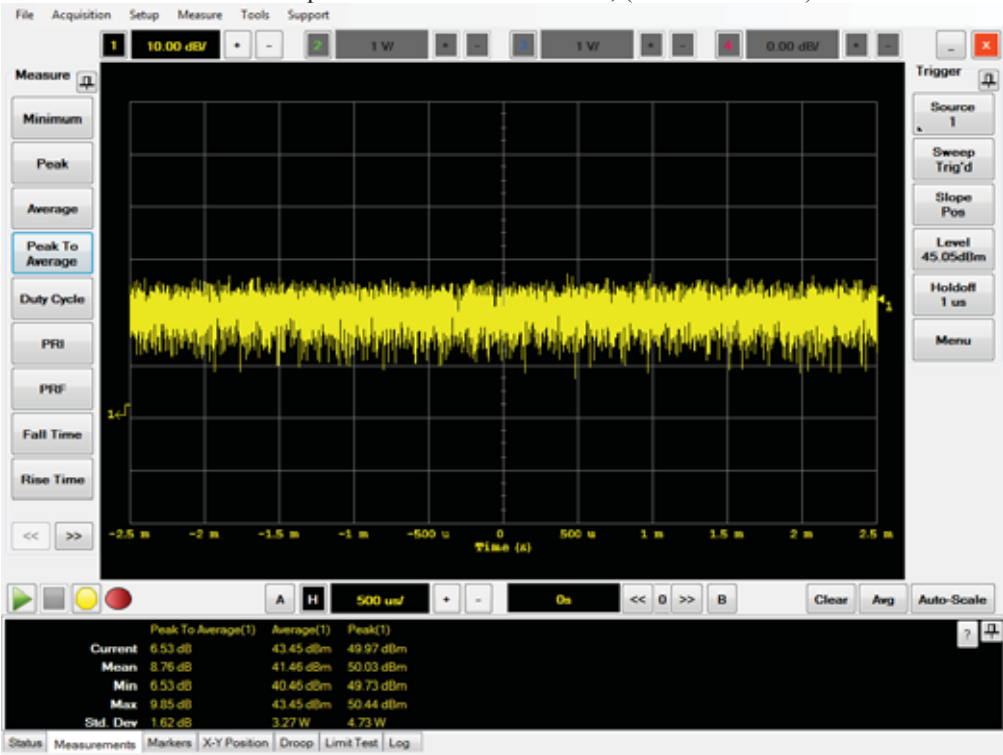
16QAM Modulation
Center Frequencies: 2506 & 2533 MHz, (20+10MHz BW).



64QAM Modulation
Center Frequencies: 2506 & 2533 MHz, (20+10MHz BW).



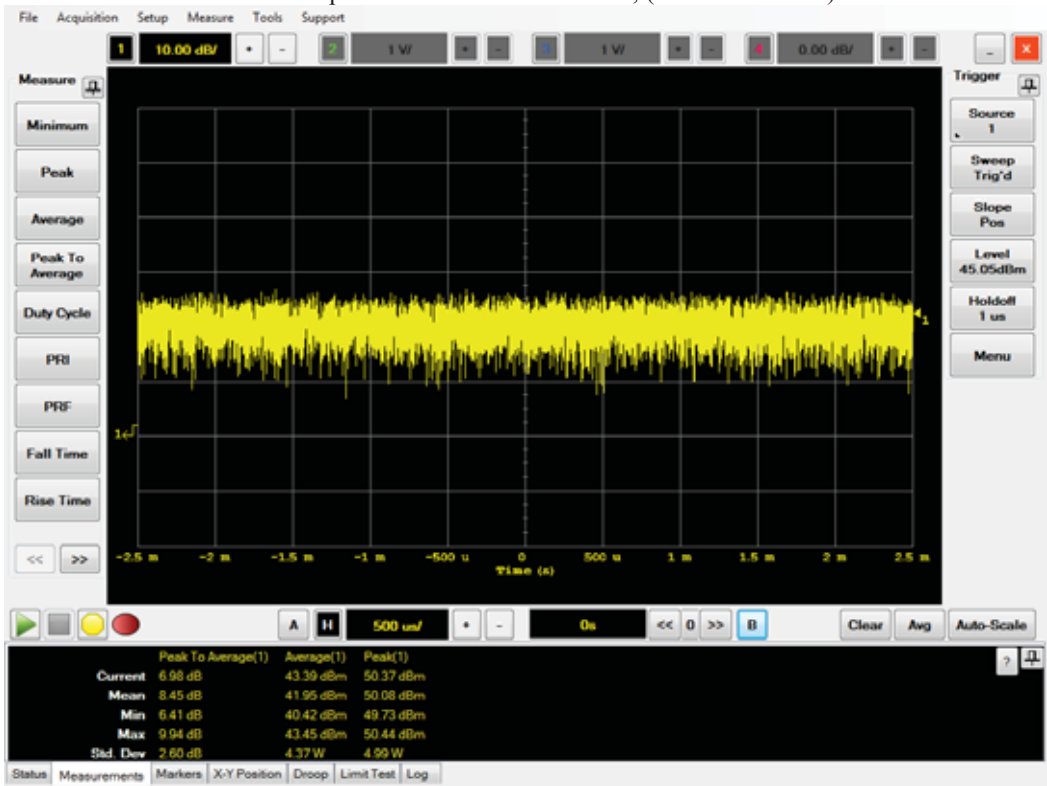
Peak to Average
QPSK Modulation
Center Frequencies: 2506 & 2533 MHz, (20+10MHz BW).



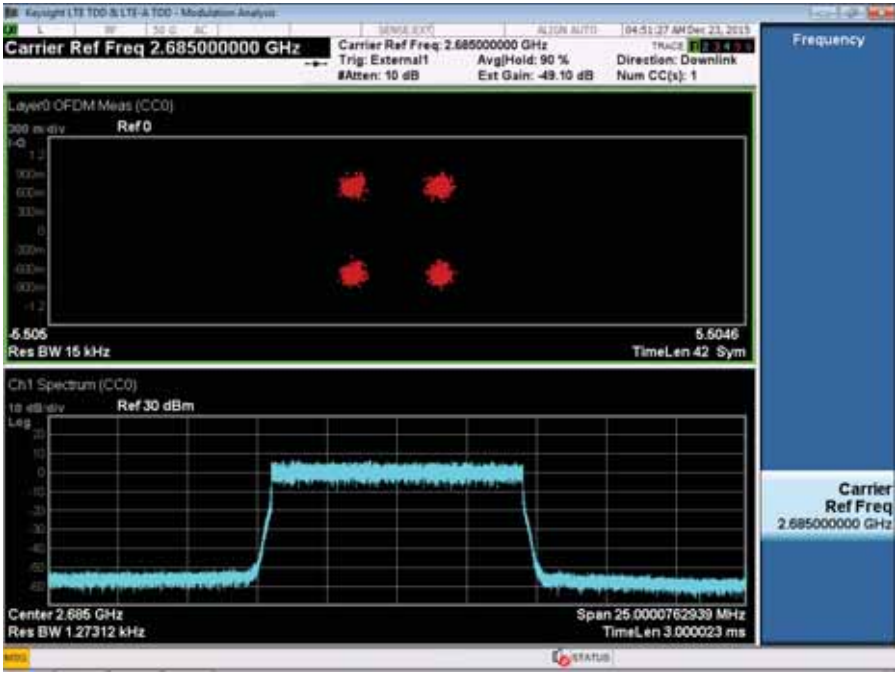
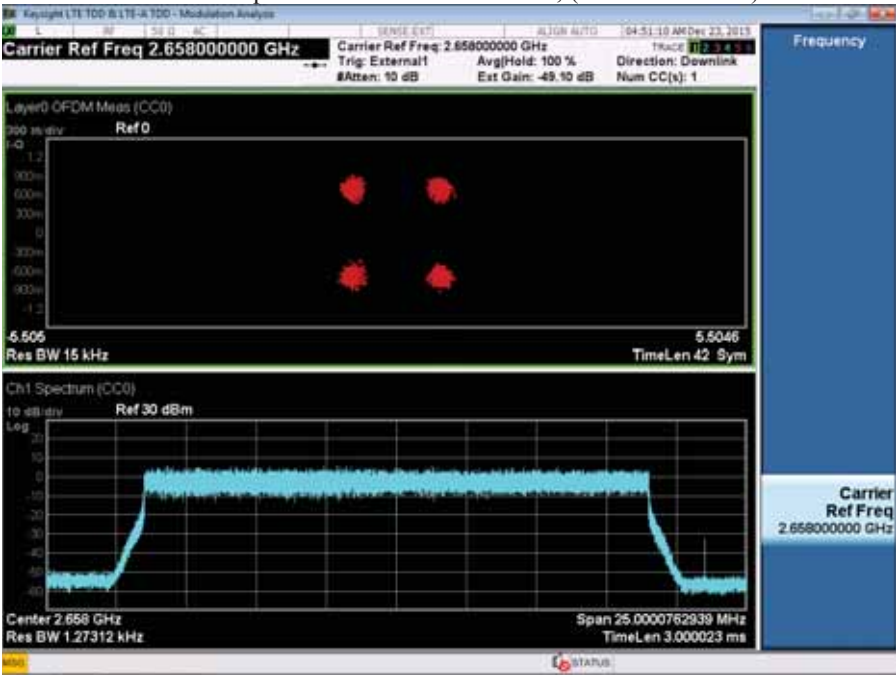
Peak to Average
16QAM Modulation
Center Frequencies: 2506 & 2533 MHz, (20+10MHz BW).



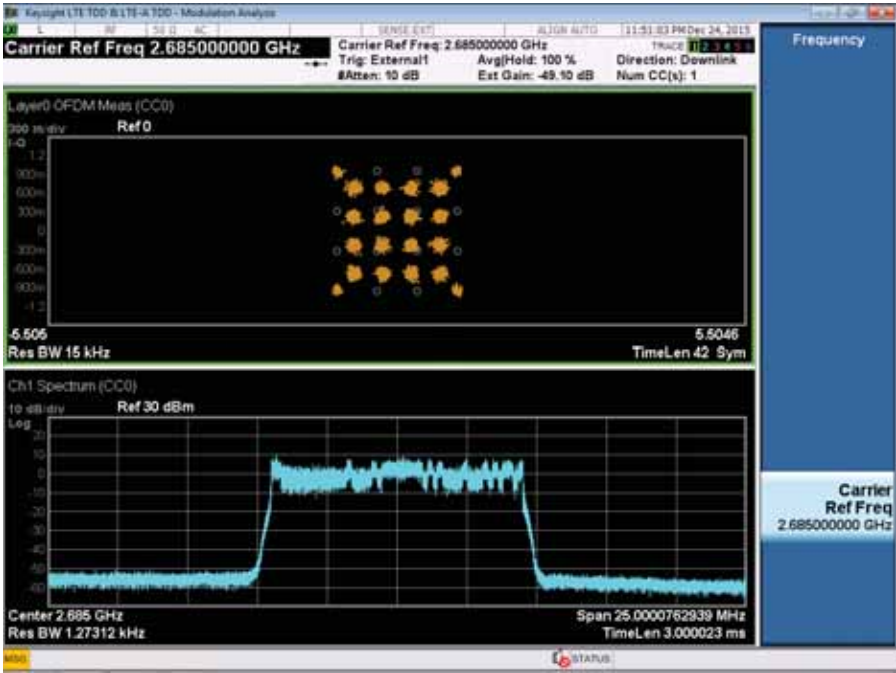
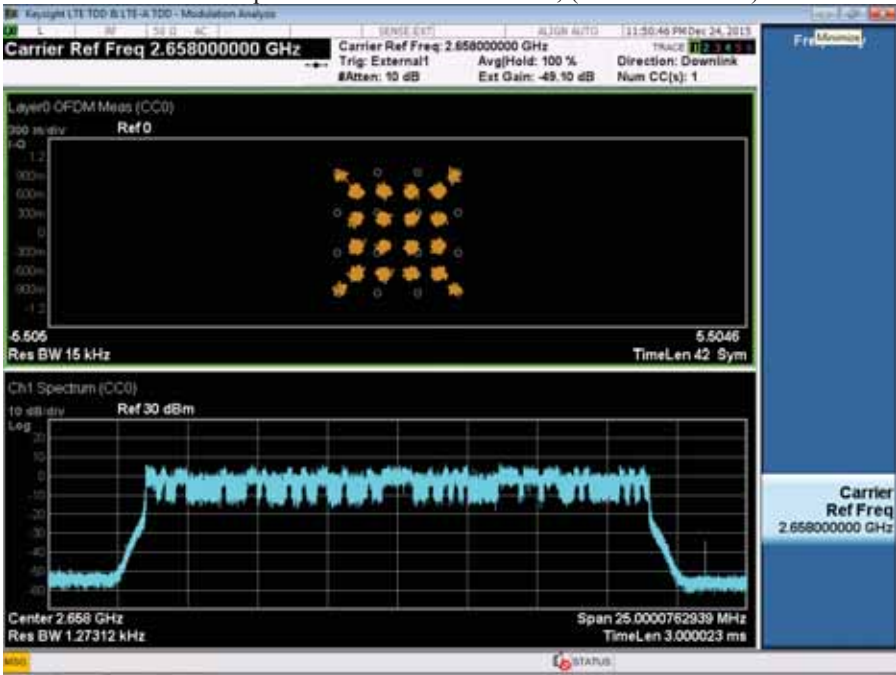
Peak to Average
64QAM Modulation
Center Frequencies: 2506 & 2533 MHz, (20+10MHz BW).



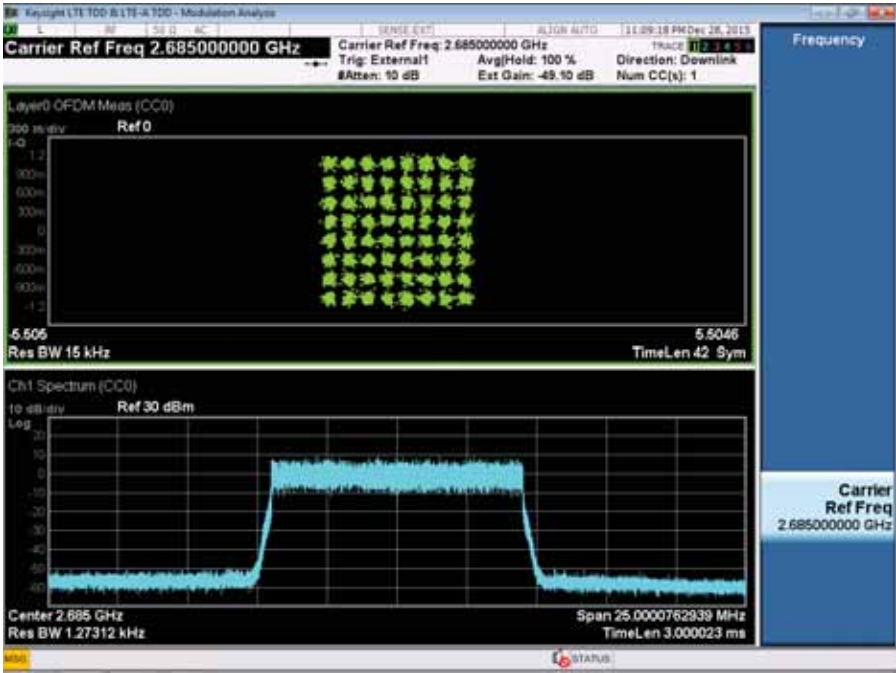
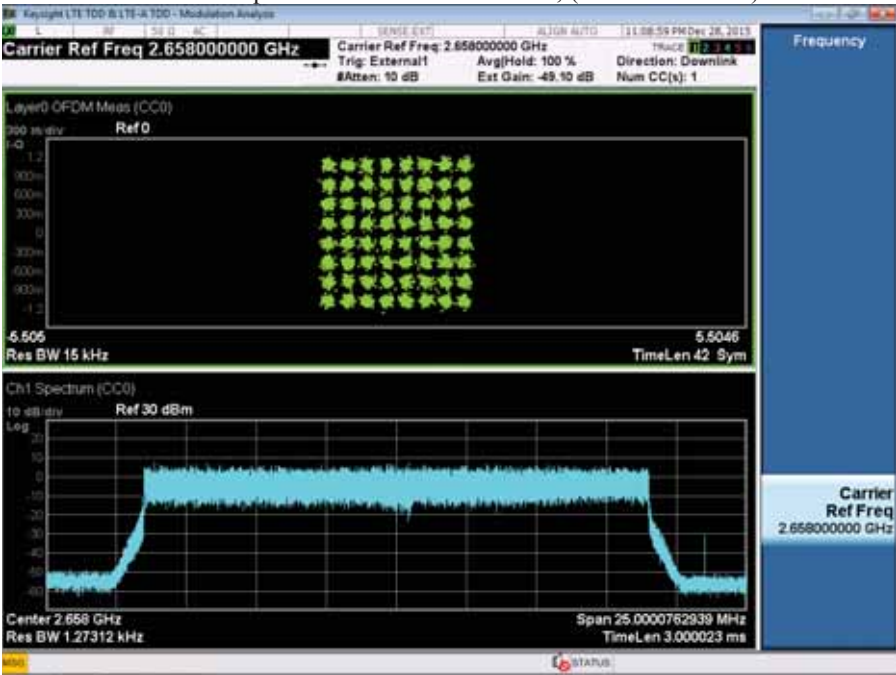
QPSK Modulation
Center Frequencies: 2658 & 2685 MHz, (20+10MHz BW).



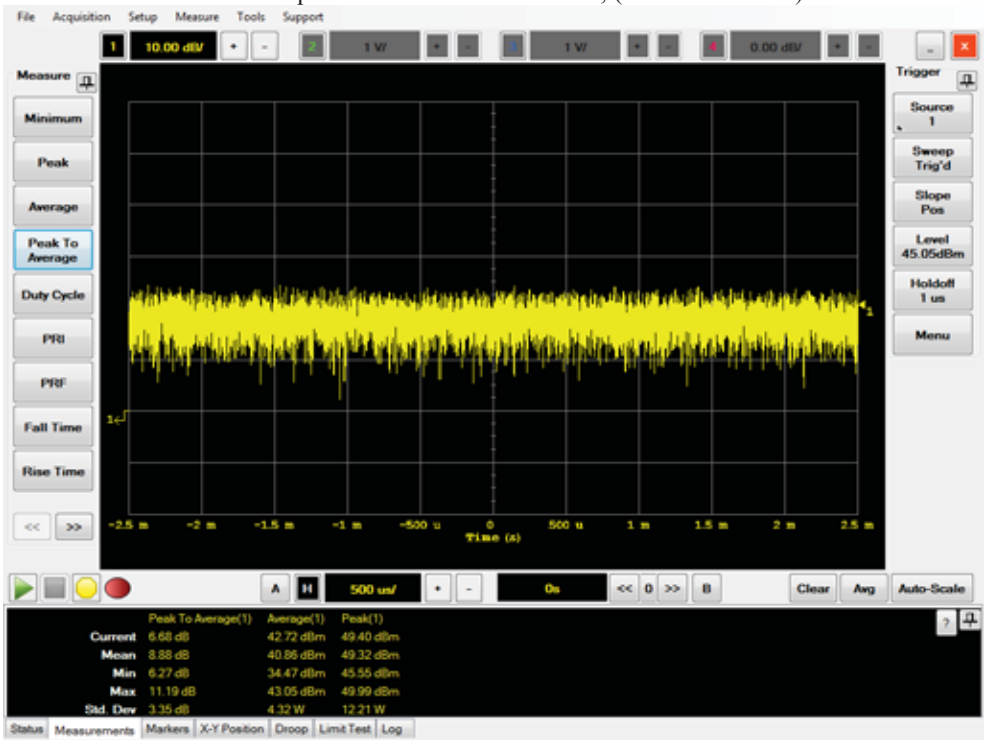
16QAM Modulation
Center Frequencies: 2658 & 2685 MHz, (20+10MHz BW).



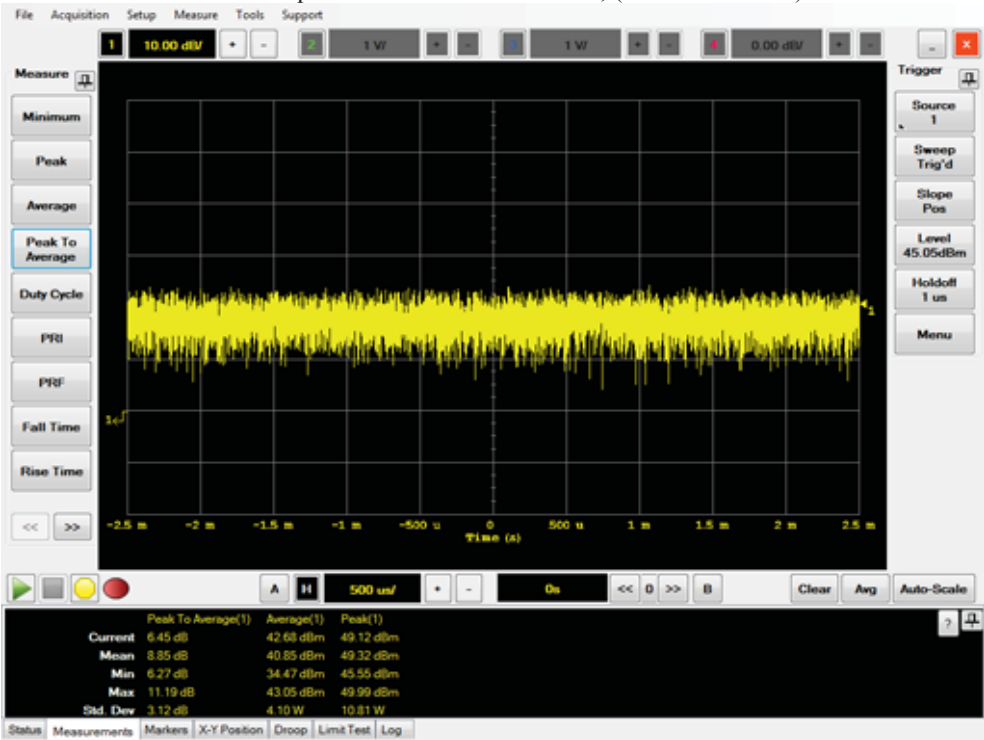
64QAM Modulation
Center Frequencies: 2658 & 2685 MHz, (20+10MHz BW).



Peak to Average
QPSK Modulation
Center Frequencies: 2658 & 2685 MHz, (20+10MHz BW).



Peak to Average
16QAM Modulation
Center Frequencies: 2658 & 2685 MHz, (20+10MHz BW).



Peak to Average
64QAM Modulation
Center Frequencies: 2658 & 2685 MHz, (20+10MHz BW).



2. FCC Section 2.1049

- (a) Emissions Bandwidth Measurement
- (b) Occupied Bandwidth Measurement showing spurious Emissions **1MHz close to Block edges.**

Spectrum Bandwidth Measurement For Emissions Type

FCC approved measurement method for Spectrum Bandwidth.

(A) 26 dB Band width.

This method was used to measure the bandwidth at modulations and highest is recorded. The modulations used are:

- 1. QPSK
- 2. 16 QAM
- 3. 64 QAM

Highest Bandwidth is used for Emissions type designation: 18.50 MHz for 20 MHz Bandwidth, and 9.42MHz for 10 MHz Bandwidth.

Therefore:

Measured Emission type: 18M9F9W (10W) for 20 MHz Bandwidth.

Measured Emission type: **9M47F9W** (10W) for 10 MHz Bandwidth.

The list of blocks and bands, tested for QPSK, 16QAM and 64QAM are listed below:

Blocks	Bandwidth (MHz)	Frequency (MHz)	Power (Watts)
Lower	20	2496-2516	20
Middle	20	2568-2588	20
Higher	20	2660-2680	20

Blocks	Bandwidth Contiguous (MHz)	Frequency (MHz)	Power (Watts)
Lower	20+20	2496-2516 and 2516-2536	20
Middle	20+20	2558-2578 and 2578-2598	20
Higher	20+20	2650-2670 and 270-2690	20

Blocks	Bandwidth Contiguous (MHz)	Frequency (MHz)	Power (Watts)
Lower	20+20+20	2496-2516, 2516-2536 and 2536-2546	20
Middle	20+20+20	2563-2583, 2583-2603 and 2603-2623	20
Higher	20+20+20	2630-2650, 2650-2670 and 2670-2690	20

Blocks	Bandwidth Non-contiguous (MHz)	Frequency (MHz)	Power (Watts)
Lower	20+10	2496-2516 and 2528-2538	20
Middle	20+10	2562-2582 and 2604-2614	20
Higher	20+10	2648-2668 and 2680-2690	20

Blocks	Bandwidth Non-contiguous (MHz)	Frequency (MHz)	Power (Watts)
Lower	20+20	2496-2516 and 2536-2556	20
Middle	20+20	2563-2583 and 2603-2623	20
Higher	20+20	2630-2650 and 2670-2690	20

MEASUREMENT OF EMISSIONS BANDWIDTH 26 dB POWER BANDWIDTH

(b) MEASUREMENT OF SPECTRUM BANDWIDTH For Emissions Type

The occupied bandwidth of the Long Term Evolution (LTE) is measured using a Rohde & Schwarz ESU 40 Spectrum Analyzer/Receiver. The emissions bandwidth is described in section 27.53 (m) (v) (6) is used. Accordingly “The emissions bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26dB below the transmitter power.”

The measurements were made on a “TD-RRH8X20” enclosure in the following configurations:

1. QPSK
2. 16 QAM
3. 64 QAM

Results:

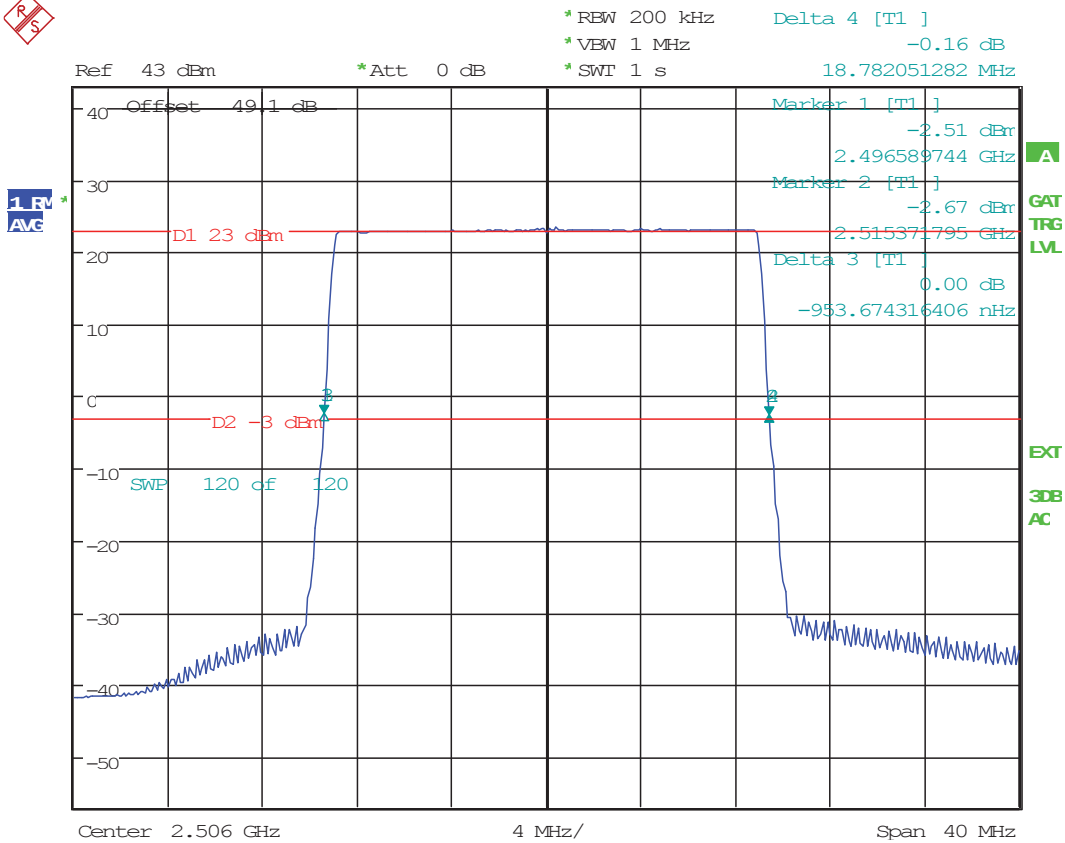
The plots are provided for QPSK, 16QAM and 64QAM modulations for 20 MHz, 20+20MHz, 20+20+20MHz, 20+20MHz (Non-contiguous), 20+10MHz (Non-contiguous).

The Measured 26dB emissions bandwidth is 18.91 MHz for 20 MHz (20W) bandwidth and 9.47MHz for 10MHz bandwidth.

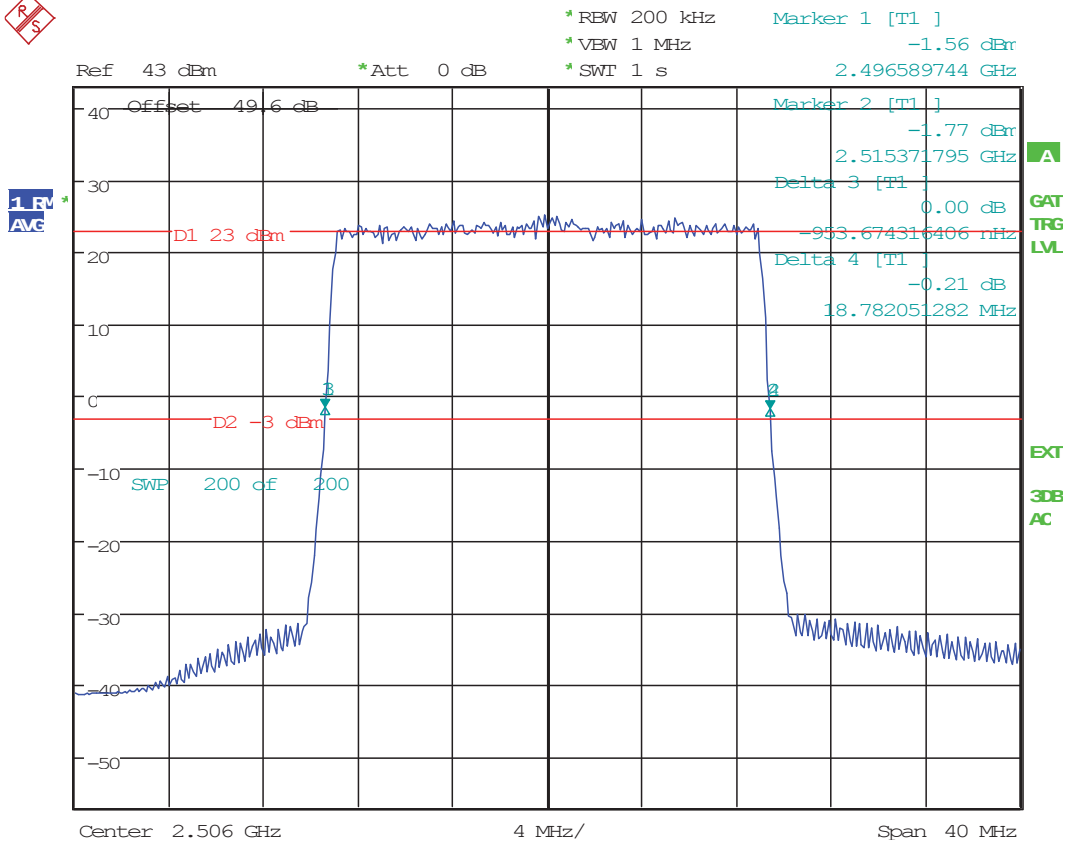
**20 MHz Bandwidth 2496 – 2516 MHz
(Lower)**

8x20 watts (MIMO)

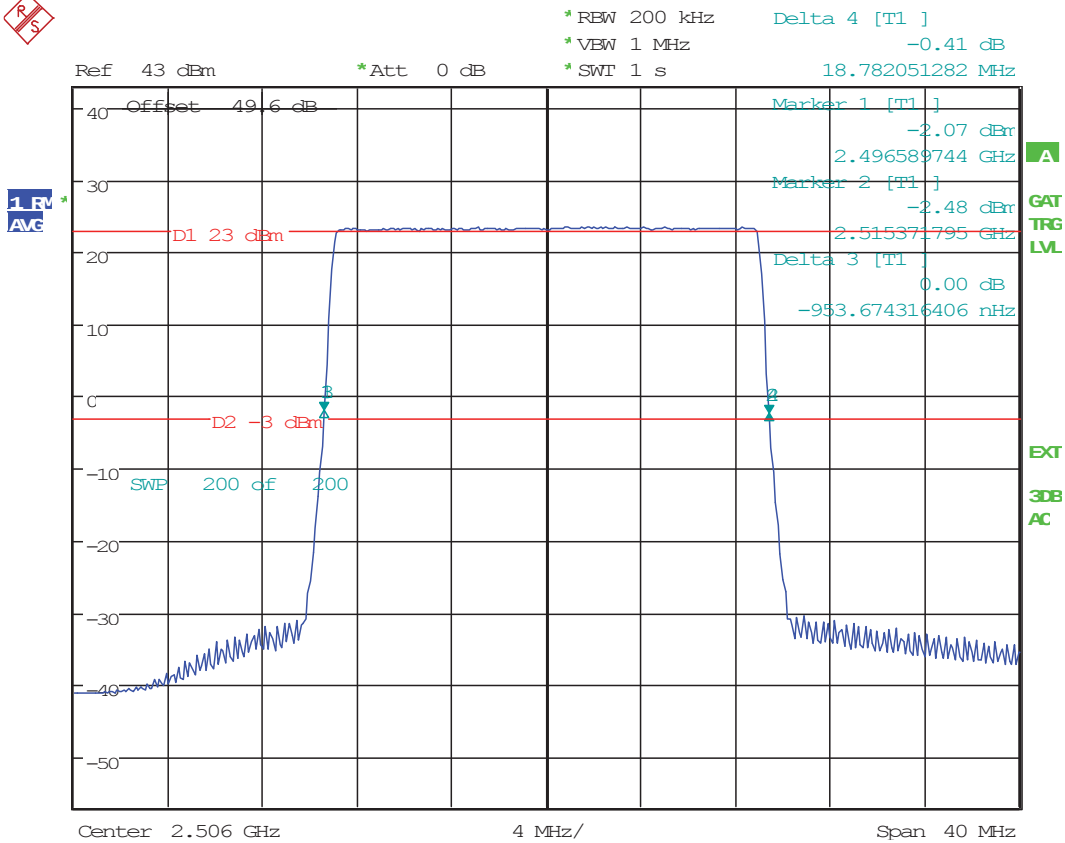
(26dB Bandwidth)



26dB BANDWIDTH; Test Eng:JY TDD B41 RRH Cast Fingu Fltr;20M
BW;20W;2496-2516M;-48VDC;QPSK; FCCID-AS5BBTRX-15A.
Date: 5.OCT.2015 14:26:42



26dB BANDWIDTH; Test Eng:JY TDD B41 RRH Cast Fingu Fltr;20M
BW;20W;2496-2516M;-48VDC;16QAM; FCCID-AS5BBTRX-15A.
Date: 5.OCT.2015 10:17:36

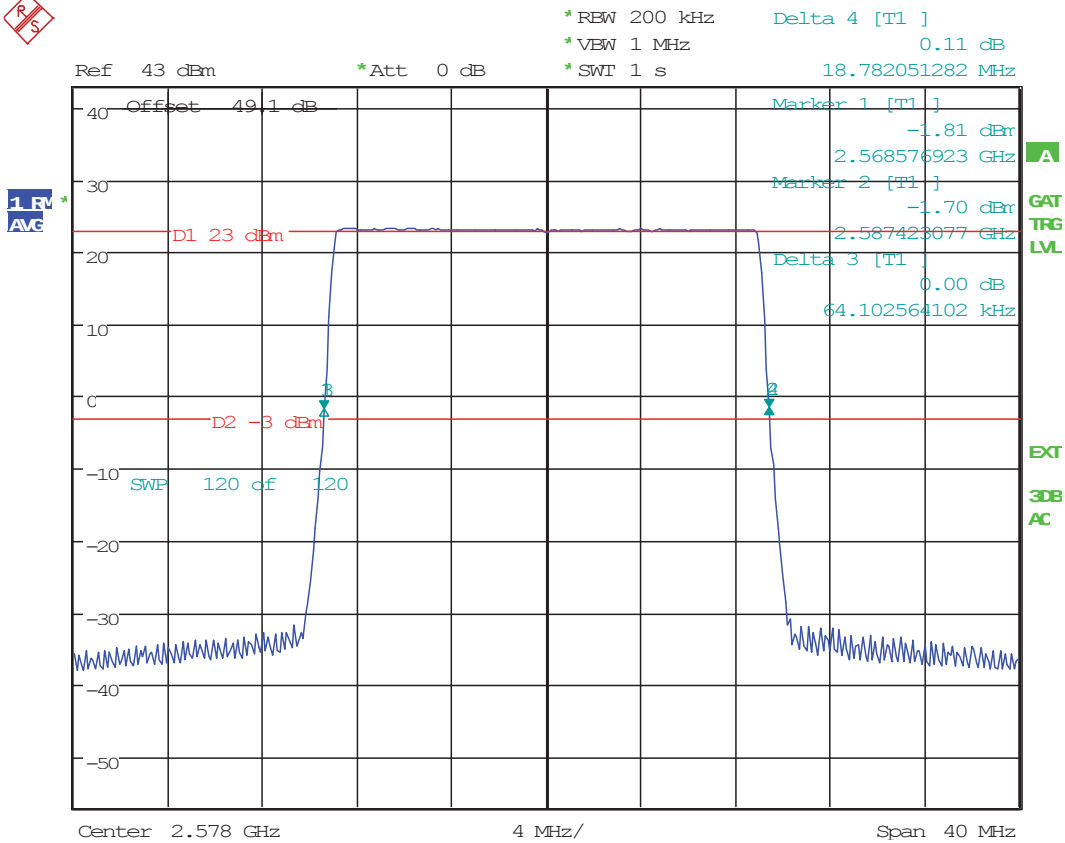


26dB BANDWIDTH; Test Eng:JY TDD B41 RRH Cast Fingu Fltr;20M
BW;20W;2496-2516M;-48VDC;64QAM; FCCID-AS5BBTRX-15A.
Date: 29.SEP.2015 15:41:39

**20 MHz Bandwidth 2568 – 2588 MHz
(Middle)**

8x20 watts (MIMO)

(26dB Bandwidth)



26dB BANDWIDTH; Test Eng:JY TDD B41 RRH Cast Fingu Fltr;20M
BW;20W;2568-2588M;-48VDC;QPSK; FCCID-AS5BBTRX-15A.
Date: 6.OCT.2015 12:14:51