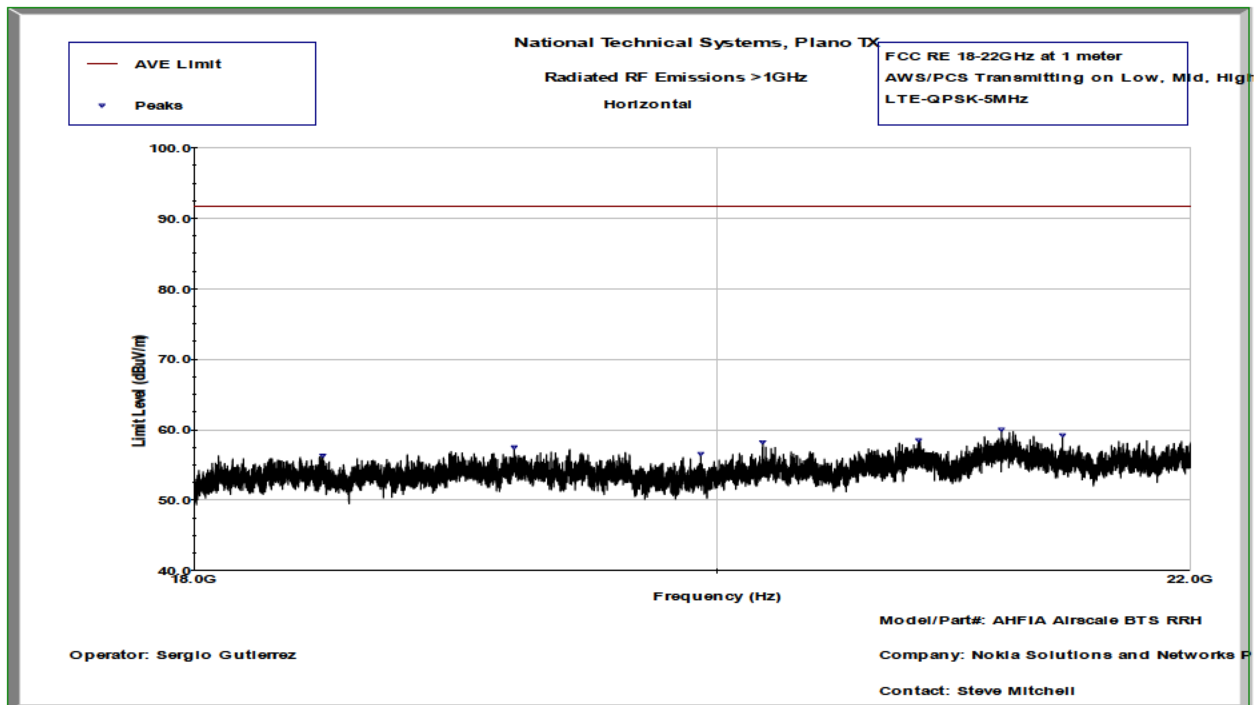
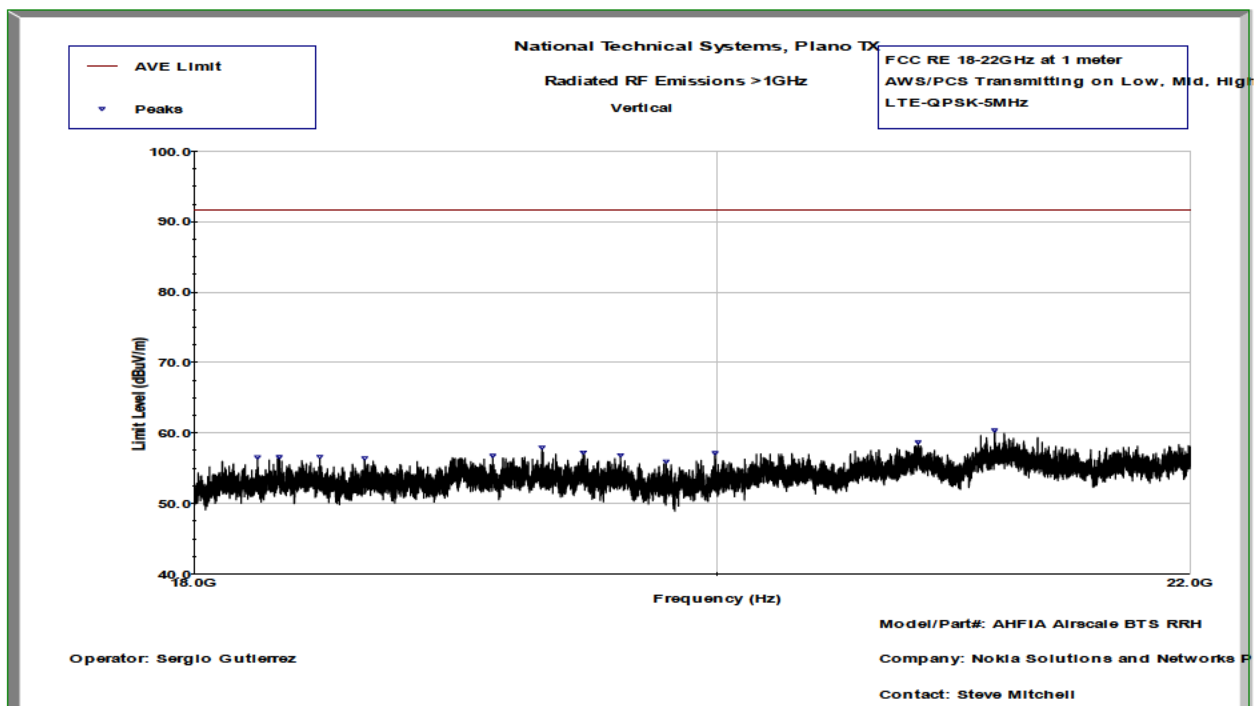




PCS/AWS Carriers 18-22GHz – Horizontal at 1m



PCS/AWS Carriers 18-22GHz – Vertical at 1m

Frequency Stability/Accuracy

Carrier frequency stability of the EUT at extreme temperatures and voltages was measured. The frequency error was measured as follows:

- (1) EUT transmitting in 5MHz-QPSK-LTE mode at center channel (1962.5MHz) on port 4.
- (2) The EUT temperature was stabilized at each temperature step (for a minimum of 30 minutes) prior to frequency accuracy measurement.

Nominal operating voltage of the product is declared as 48VDC.

Frequency error results are listed below for extreme voltages and temperatures.

Extreme Voltages:

Percentage of Rated Supply	DC Voltage (VDC)	Maximum Frequency Error (Hz) at 20°C
85%	40.8	2.23
100%	48.0	1.84
115%	55.2	2.01

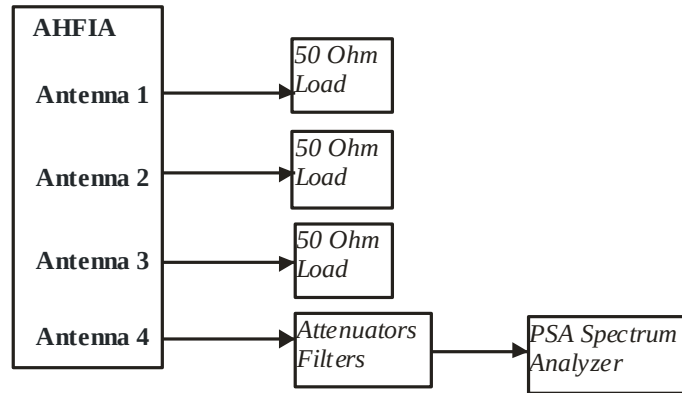
Extreme Temperatures:

Temperature	Maximum Frequency Error (Hz) at 48VDC
-30 °C	2.18
-20 °C	2.19
-10 °C	2.04
0 °C	2.41
10 °C	1.75
20 °C	1.84
30 °C	2.44
40 °C	2.60
50 °C	1.73

Based on the results above, highest recorded frequency error (2.60Hz or ~0.0013 ppm) ensures that the transmitted signal remains in its authorized frequency block at extreme voltages and temperatures. The results above are deemed sufficient to demonstrate carrier frequency stability for all other channel bandwidth modes and modulations since all carriers are controlled by the same frequency stabilization circuitry that was subjected to the extreme conditions under this test.

APPENDIX B: ANTENNA PORT TEST DATA FOR THE AWS BAND

All conducted RF measurements for this test effort in this section were made at AHFIA antenna ports for the AWS band measurements. The test setup used is provided below.



Test Setup Used for Conducted RF Measurements on AHFIA

RF Output Power

RF output power has been measured in both Peak and RMS Average terms for each AWS transmit chain at the middle channel for 256QAM modulation and LTE5 bandwidth. Peak to average power ratio (PAPR) has been calculated as described in Section 5.7.2 of KDB971168 D01 v02r02 and all results are presented in tabular form below.

Antenna	LTE Bandwidth	LTE - 256QAM		
		Peak (dBm)	Average (dBm)	PAPR (dB)
Port 1 Middle Channel	5M	53.90	46.06	7.84
Port 2 Middle Channel	5M	53.93	46.01	7.92
Port 3 Middle Channel	5M	53.99	46.12	7.87
Port 4 Middle Channel	5M	54.27	46.36	7.91

The variation in RMS output power levels between the antenna ports is 0.35 dB per data sample provided above. Pre-compliance testing (and testing of similar EUTs) shows that the output power variation between antenna ports is small (the output ports are essentially electrically identical).

Pre-compliance testing has shown that the output power variation between modulation types is small. Antenna port 4 power output measurements for the LTE5 bandwidth for all modulation types on the middle (center) channel are provided below.

	Modulation Type							
	QPSK		16QAM		64QAM		256QAM	
	Peak (dBm)	Ave (dBm)	Peak (dBm)	Ave (dBm)	Peak (dBm)	Ave (dBm)	Peak (dBm)	Ave (dBm)
Antenna Port 4 Middle Channel LTE5	54.23	46.32	54.17	46.37	54.24	46.32	54.27	46.36

The output power variation between modulation types is small in this measurement snapshot (and from past efforts on similar hardware as well). The variation of average power output versus modulation type is 0.05dB for the data snapshot provided. The variation of peak power output versus modulation type is 0.10dB for the data snapshot provided. All power measurements in this report (except the sample test noted above) were performed with the EUT operating with 256QAM modulation.

Based on the results above, Port 4 had the highest RMS average power for the AWS band (represents the worst case) and therefore it was selected for all the remaining antenna port tests. Port 4 has the highest combined RMS average power for the AWS + PCS bands.

Subsequently output power levels on bottom, middle, and top channels in all 4 LTE channel bandwidths using 256QAM modulation type were tested only at Port 4 and the results presented below. The highest measured values are highlighted.

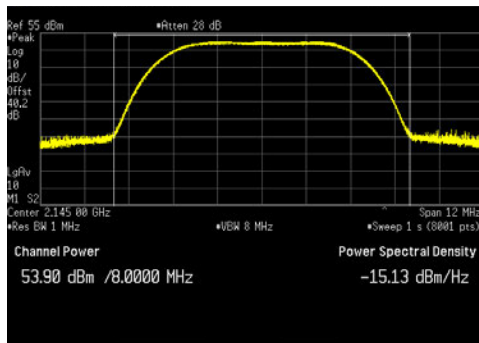
Antenna LTE Channel	LTE Bandwidth	LTE - 256QAM		
		Peak (dBm)	Ave (dBm)	PAPR (dB)
Port 4 Bottom Channel	5M	54.17	46.21	7.96
	10M	54.46	46.38	8.08
	15M	54.41	46.38	8.03
	20M	54.42	46.39	8.03
Port 4 Middle Channel	5M	54.27	46.36	7.91
	10M	54.45	46.41	8.04
	15M	54.40	46.36	8.04
	20M	54.36	46.35	8.01
Port 4 Top Channel	5M	54.16	46.24	7.92
	10M	54.11	46.19	7.92
	15M	54.34	46.33	8.01
	20M	54.09	46.23	7.86

The data provided in the table shows (and testing of similar EUTs) that the output RMS power variation between channel bandwidths at the center frequency channel is small (0.06dB).

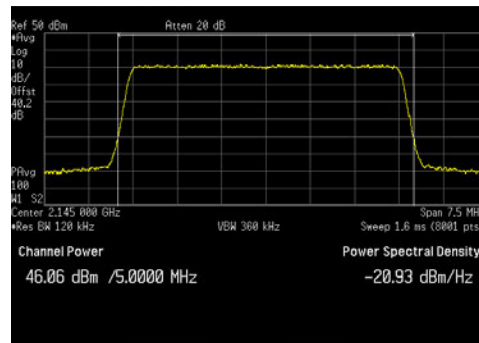
All measurement results are provided in the following pages. The total measurement RF path loss of the test setup (attenuator and test cables) was 40.2 dB and is accounted for by the spectrum analyzer reference level offset.

LTE5 Channel Power Plots at Middle Channel and 256QAM Modulation:

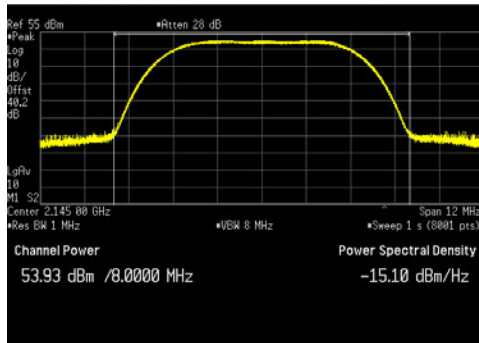
Port 1 - LTE5_ Middle Channel_Peak



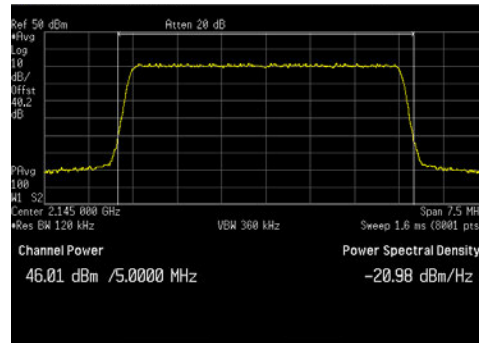
Port 1 - LTE5_ Middle Channel_Average



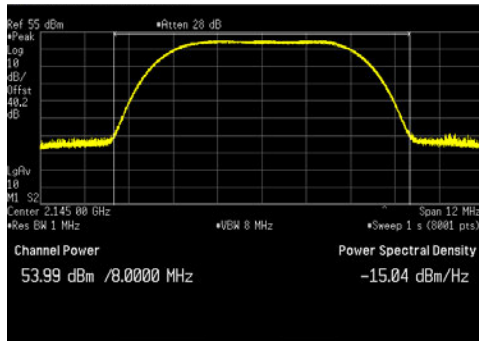
Port 2 - LTE5_ Middle Channel_Peak



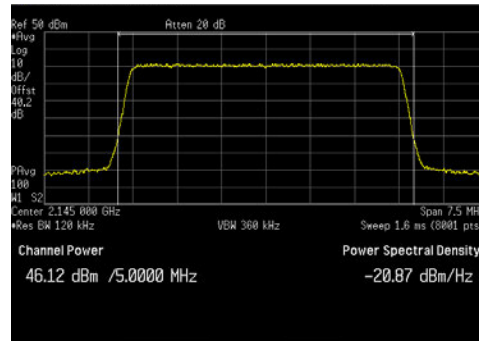
Port 2 - LTE5_ Middle Channel_Average



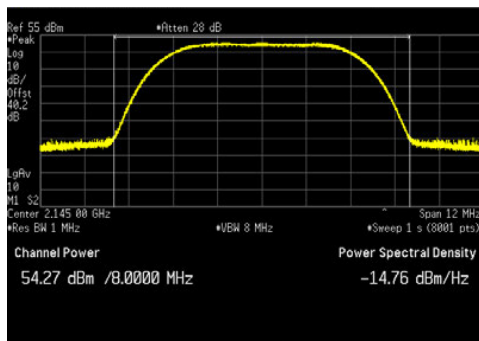
Port 3 - LTE5_ Middle Channel_Peak



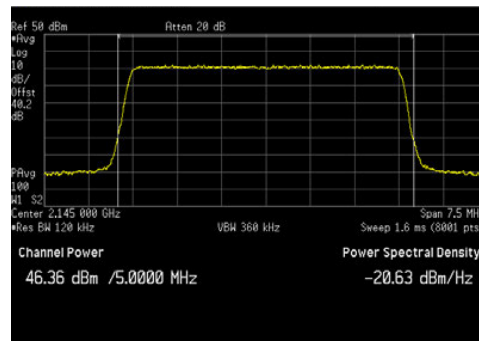
Port 3 - LTE5_ Middle Channel_Average



Port 4 - LTE5_ Middle Channel_Peak

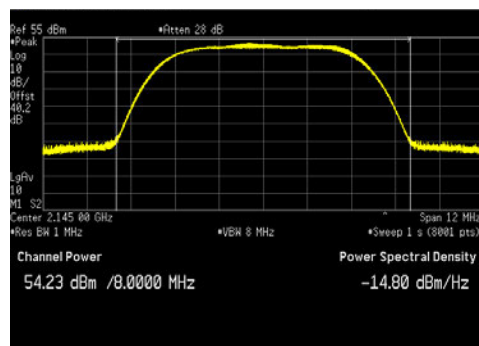


Port 4 - LTE5_ Middle Channel_Average

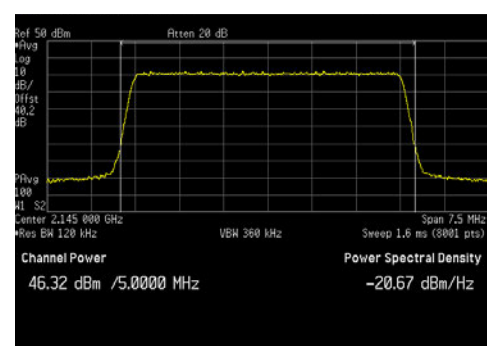


LTE5 Channel Power Plots for Antenna Port 4 at Middle Channel and all Modulation Types:

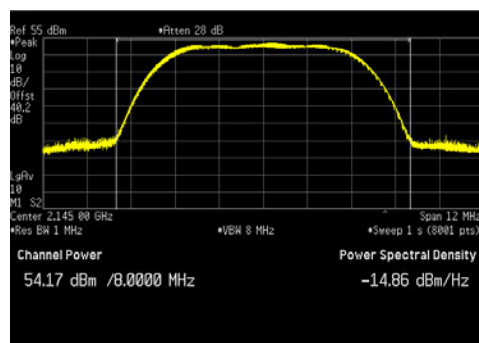
LTE5_ Middle Channel_QPSK_Peak



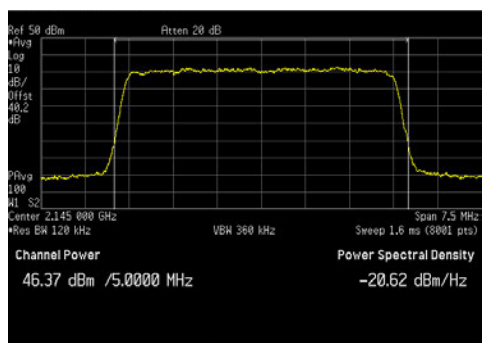
LTE5_ Middle Channel_QPSK_Average



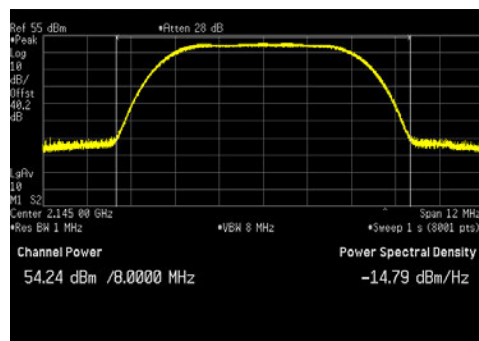
LTE5_ Middle Channel_16QAM_Peak



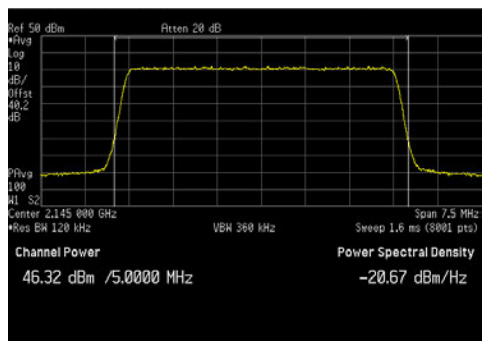
LTE5_ Middle Channel_16QAM_Average



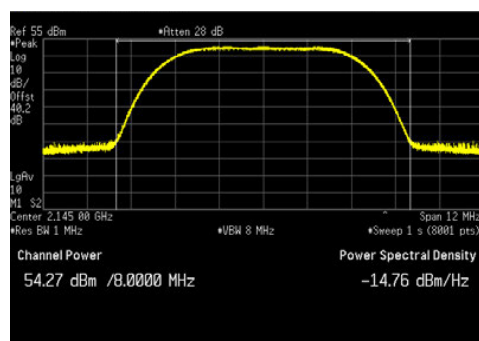
LTE5_ Middle Channel_64QAM_Peak



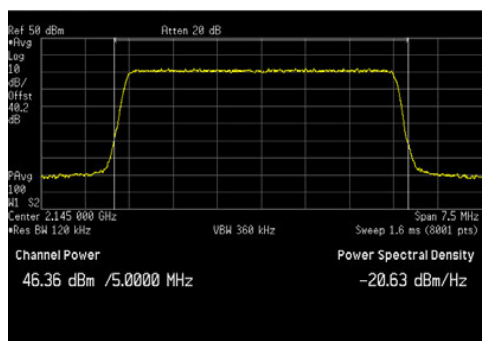
LTE5_ Middle Channel_64QAM_Average



LTE5_ Middle Channel_256QAM_Peak

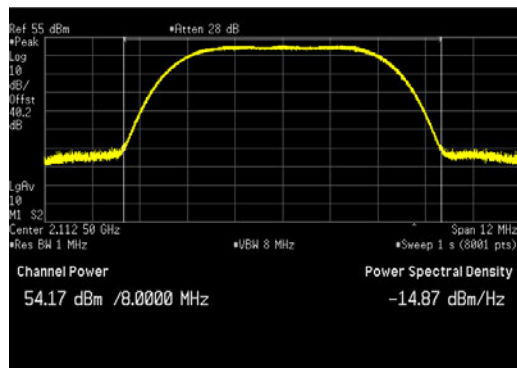


LTE5_ Middle Channel_256QAM_Average

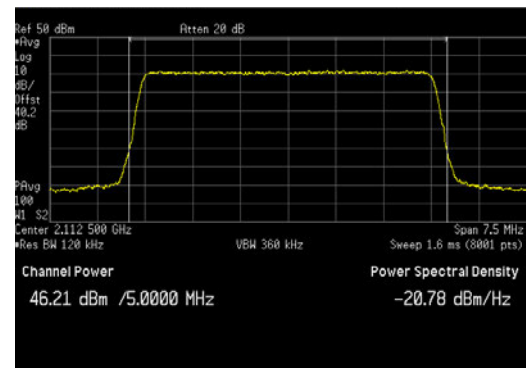


LTE5 Channel Power Plots for Antenna Port 4 and 256QAM Modulation:

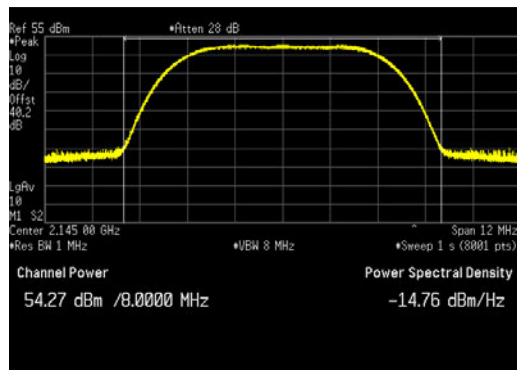
LTE5_Bottom Channel_Peak



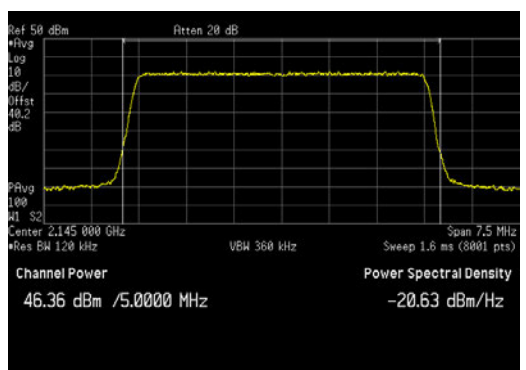
LTE5_Bottom Channel_Average



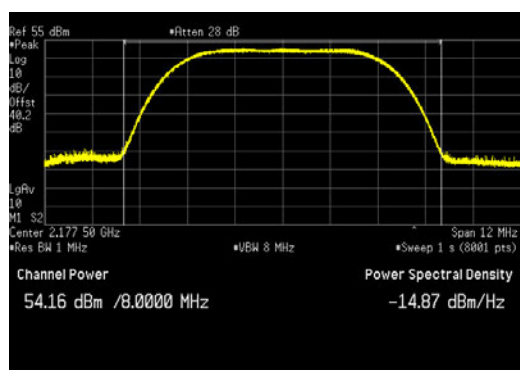
LTE5_Middle Channel_Peak



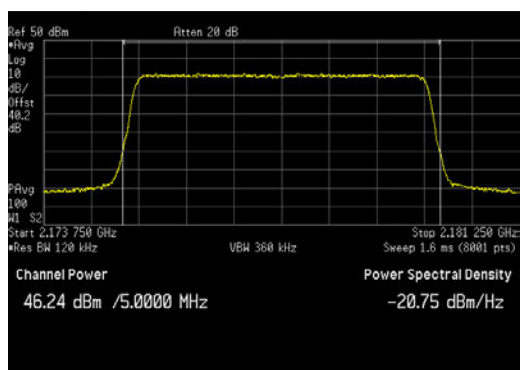
LTE5_Middle Channel_Average



LTE5_Top Channel_Peak

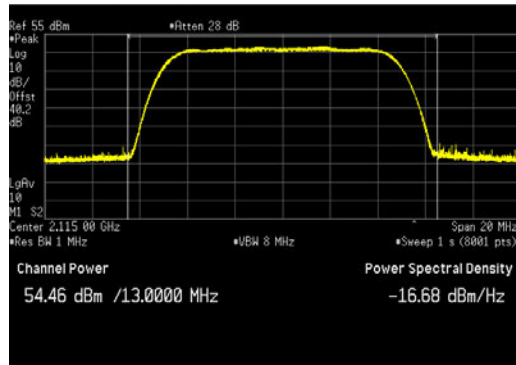


LTE5_Top Channel_Average

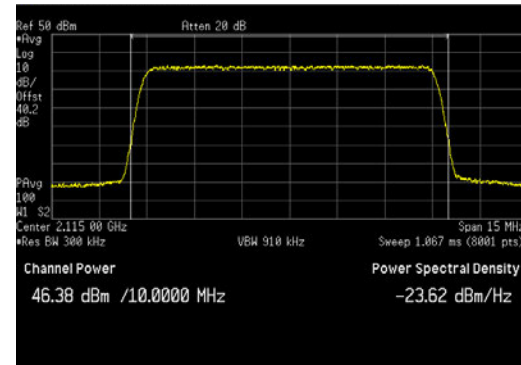


LTE10 Channel Power Plots for Antenna Port 4 and 256QAM Modulation:

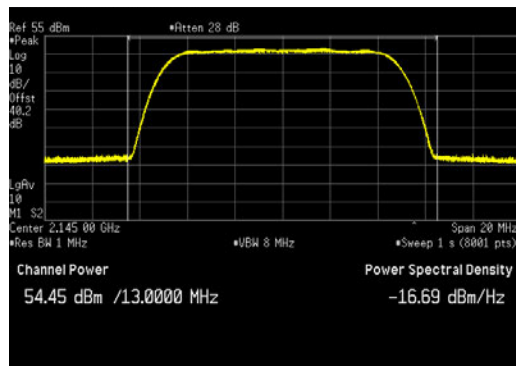
LTE10_Bottom Channel_Peak



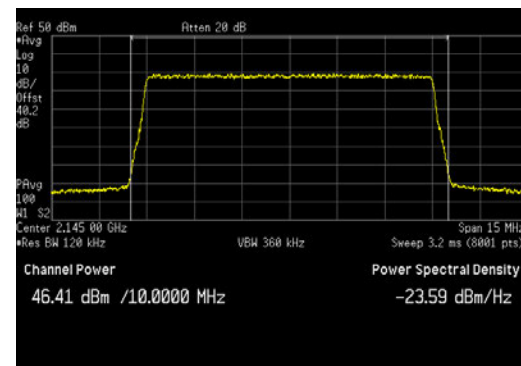
LTE10_Bottom Channel_Average



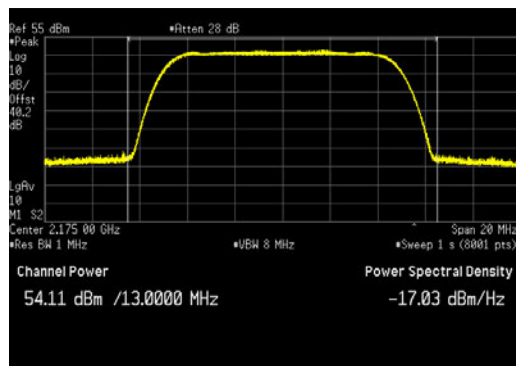
LTE10_Middle Channel_Peak



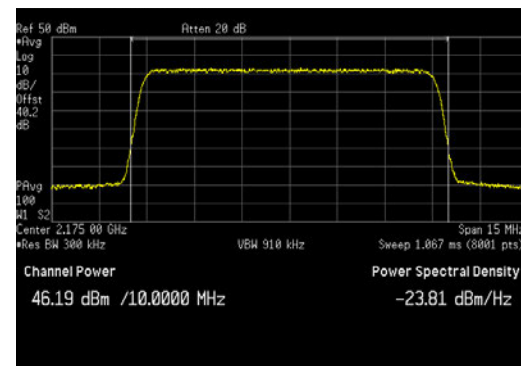
LTE10_Middle Channel_Average



LTE10_Top Channel_Peak

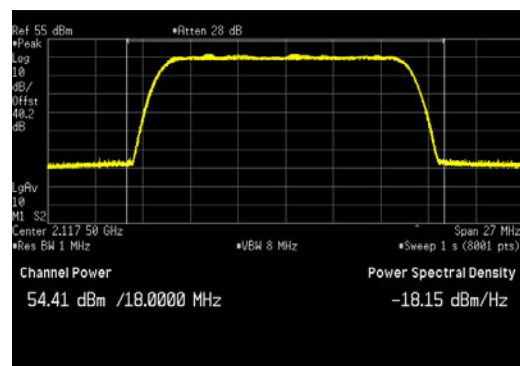


LTE10_Top Channel_Average

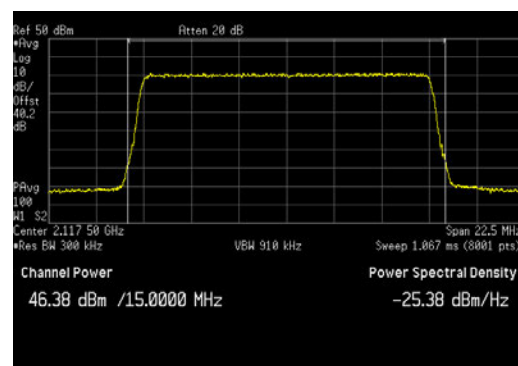


LTE15 Channel Power Plots for Antenna Port 4 and 256QAM Modulation:

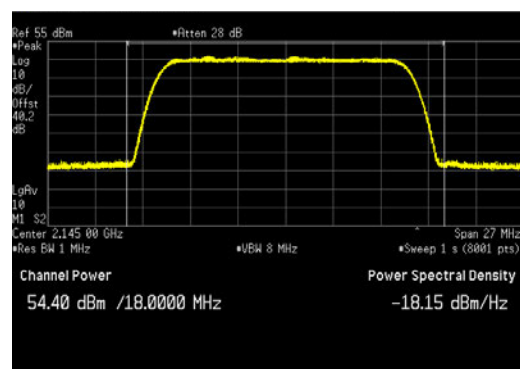
LTE15_Bottom Channel_Peak



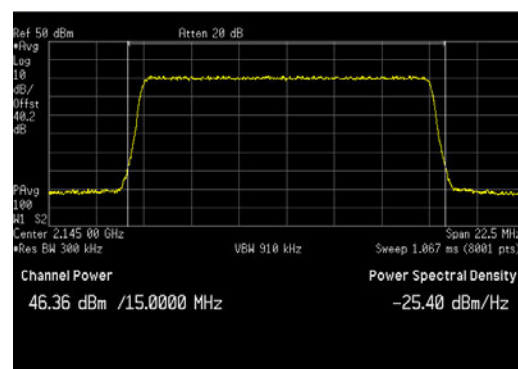
LTE15_Bottom Channel_Average



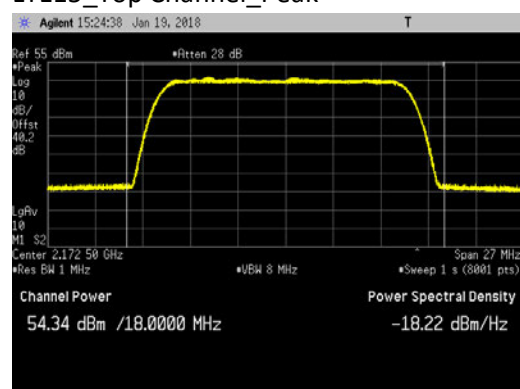
LTE15_Middle Channel_Peak



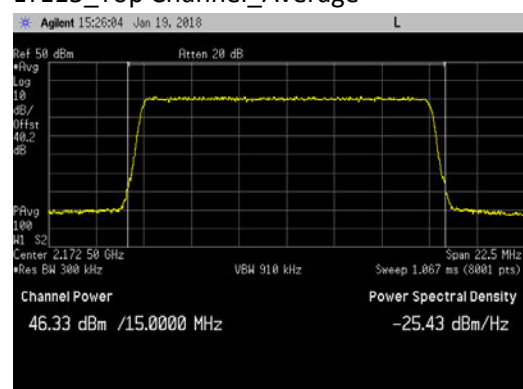
LTE15_Middle Channel_Average



LTE15_Top Channel_Peak

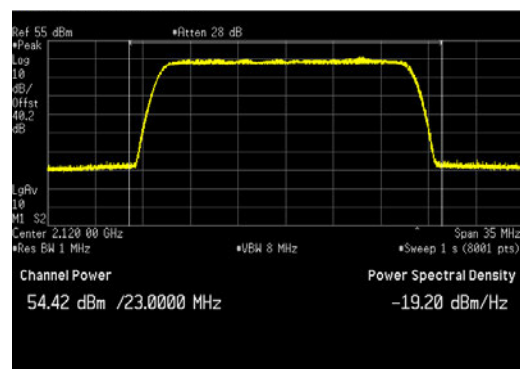


LTE15_Top Channel_Average

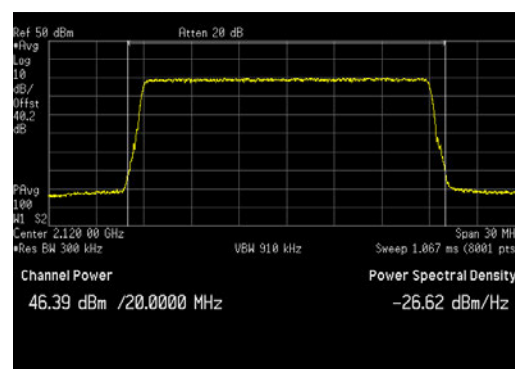


LTE20 Channel Power Plots for Antenna Port 4 and 256QAM Modulation:

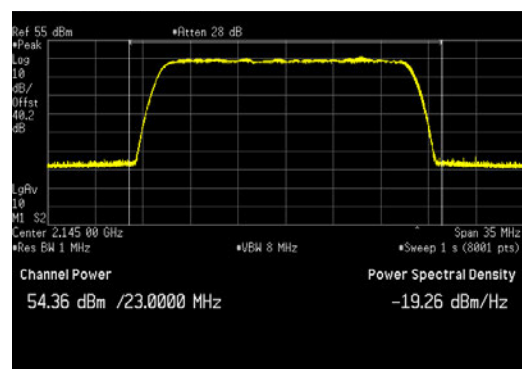
LTE20_Bottom Channel_Peak



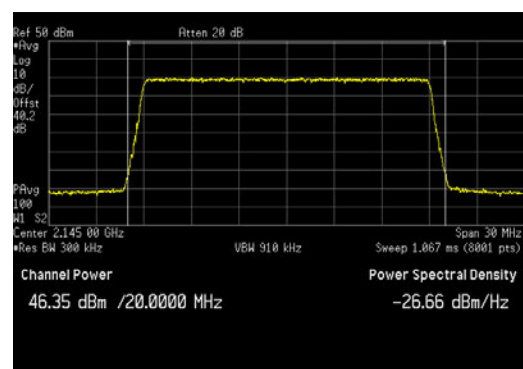
LTE20_Bottom Channel_Average



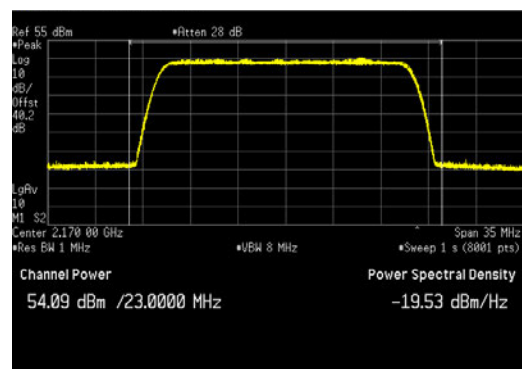
LTE20_Middle Channel_Peak



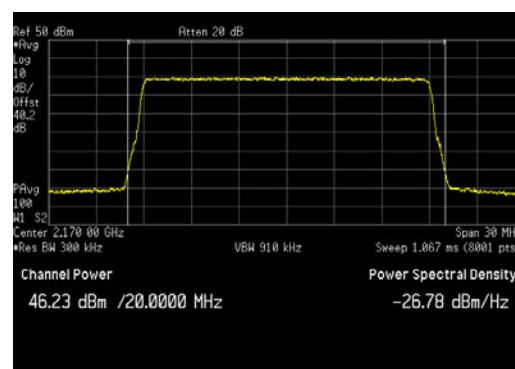
LTE20_Middle Channel_Average



LTE20_Top Channel_Peak



LTE20_Top Channel_Average



Emission Bandwidth (26 dB down and 99%)

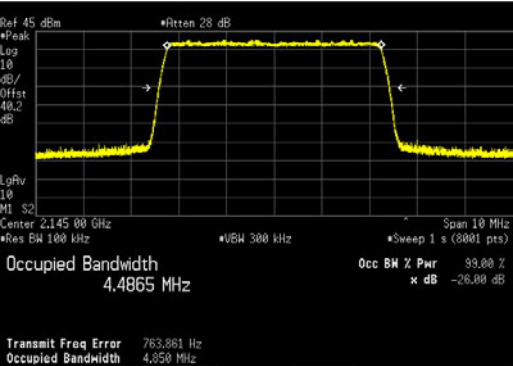
Emission bandwidth measurements were made at antenna port 4 on the middle channel with maximum RF output power. All available LTE modulations (QPSK, 16QAM, 64QAM, 256QAM) were used. All available LTE channel bandwidths (5MHz, 10MHz, 15MHz, and 20MHz) were used. The results are provided in the following table (largest value per modulation are highlighted).

LTE Ch BW	Modulation Type							
	QPSK		16QAM		64QAM		256QAM	
	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)
5M	4.850	4.4865	4.817	4.4785	4.837	4.4939	4.839	4.4966
10M	9.638	8.9755	9.659	8.9922	9.655	8.9799	9.648	8.9735
15M	14.442	13.4711	14.419	13.4883	14.497	13.4554	14.462	13.4631
20M	19.309	17.9259	19.238	17.9740	19.286	17.9399	19.385	17.9522

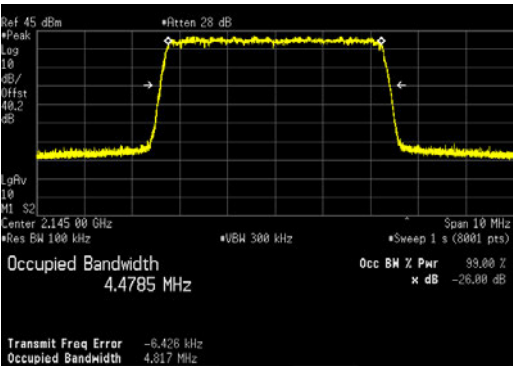
Emission bandwidth measurement data are provided in the following pages.

LTE5 Emission Bandwidth Plots on the Middle Channel for Antenna Port 4:

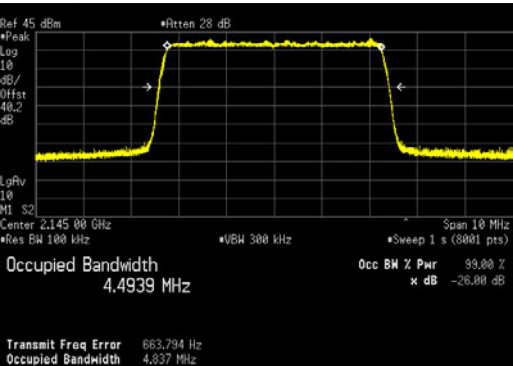
LTE5_QPSK



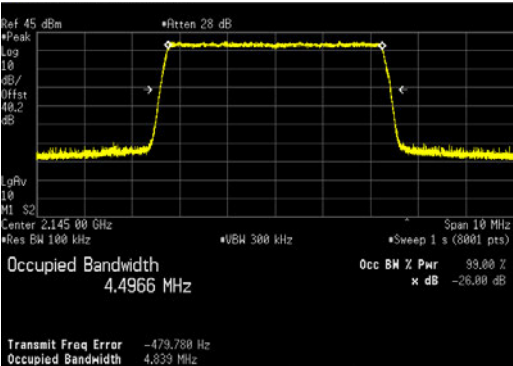
LTE5_16QAM



LTE5_64QAM

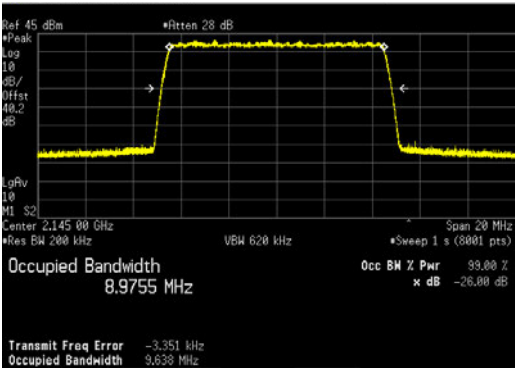


LTE5_256QAM

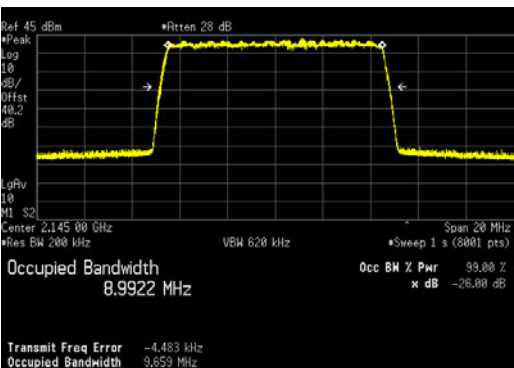


LTE10 Emission Bandwidth Plots on the Middle Channel for Antenna Port 4:

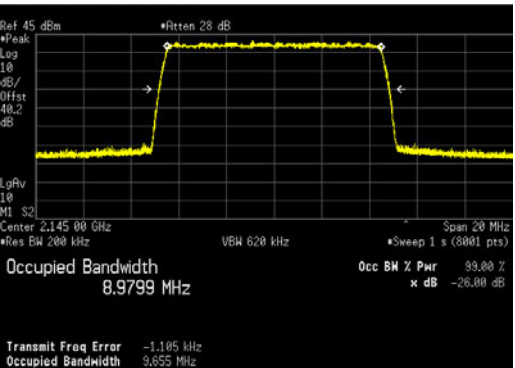
LTE10_QPSK



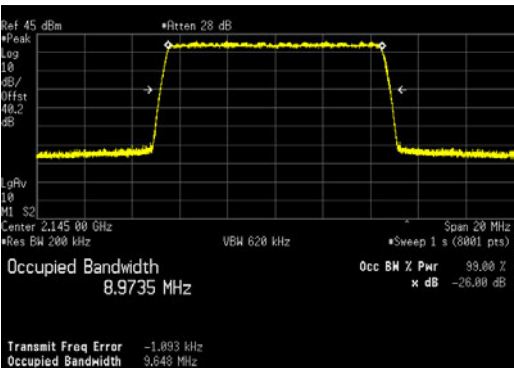
LTE10_16QAM



LTE10_64QAM

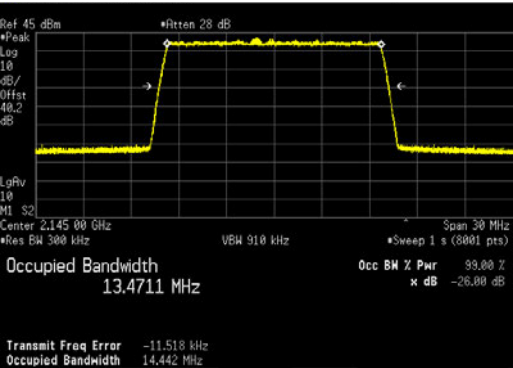


LTE10_256QAM

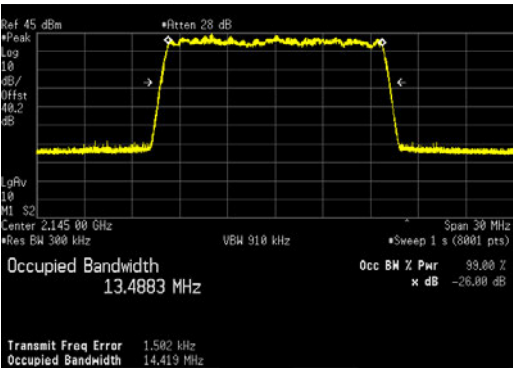


LTE15 Emission Bandwidth Plots on the Middle Channel for Antenna Port 4:

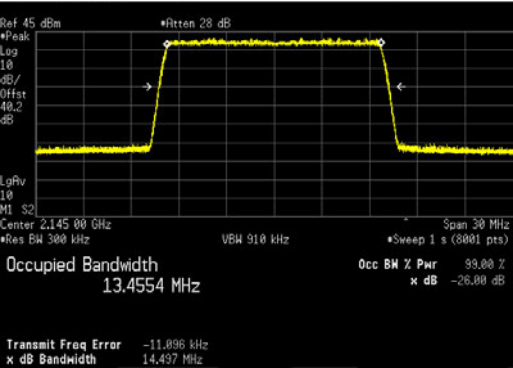
LTE15_QPSK



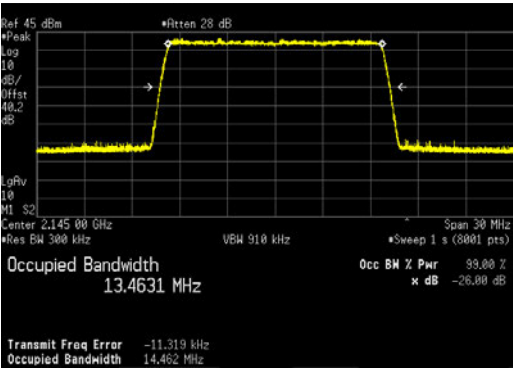
LTE15_16QAM



LTE15_64QAM

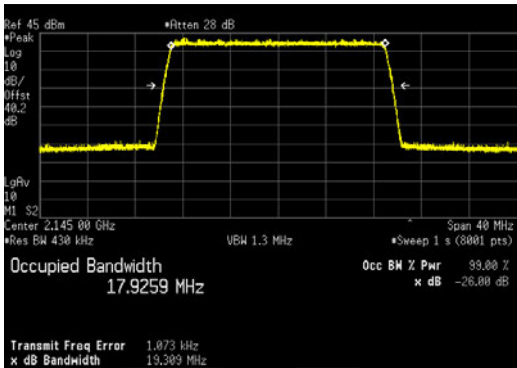


LTE15_256QAM

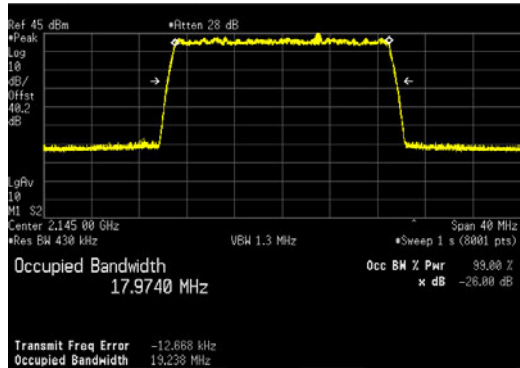


LTE20 Emission Bandwidth Plots on the Middle Channel for Antenna Port 4:

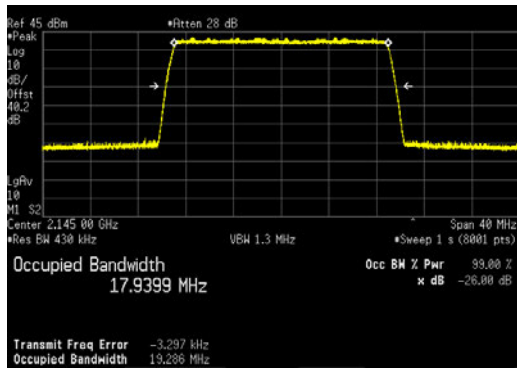
LTE20_QPSK



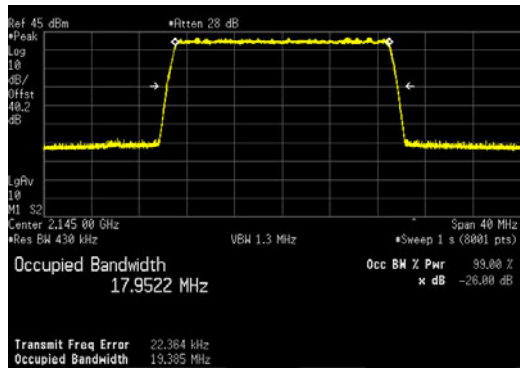
LTE20_16QAM



LTE20_64QAM



LTE20_256QAM



Antenna Port Conducted Band Edge

Conducted band edge measurements were made at RRH antenna port 2. The RRH was operated at the band edge frequencies with all modulation types (QPSK, 16QAM, 64QAM, 256QAM) for 5MHz, 10MHz, 15MHz and 20MHz LTE bandwidths.

The limit of -19dBm was used in the certification testing. The limit is adjusted to -19dBm $[-13\text{dBm} - 10 \log(4)]$ per FCC KDB 662911D01 v02r01 because the BTS may operate as a 4 port MIMO transmitter.

Measurements were performed with the spectrum analyzer in the RMS average mode over 100 traces. In the 1MHz bands outside and adjacent to the frequency block, a resolution bandwidth of 1% of the emission bandwidth was used. In the 1 to 2MHz frequency range outside the band edge (i.e.: 2108 to 2109MHz and 2201 to 2202MHz bands) the RBW was again reduced to 1% of the emission bandwidth and the power integrated over 1MHz. In the 2 to 5MHz frequency range outside the band edge (i.e.: 2105 to 2108MHz and 2202 to 2205MHz bands) a 1MHz RBW and 3MHz VBW was used. An additional measurement was performed for the dual LTE5 cases to show compliance at the upper and lower band edges.

The results are summarized in the following table. The highest (worst case) emissions from the measurement data are provided.

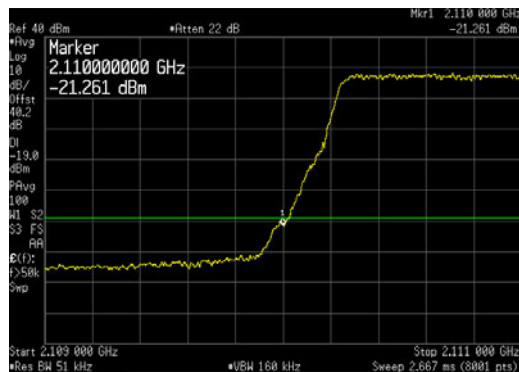
LTE BW	QPSK (dBm)		16QAM (dBm)		64QAM (dBm)		256QAM (dBm)	
	Bottom Channel	Top Channel	Bottom Channel	Top Channel	Bottom Channel	Top Channel	Bottom Channel	Top Channel
5M	-21.261	-20.164	-21.170	-21.151	-21.310	-20.818	-21.460	-19.908
10M	-23.836	-23.234	-24.425	-23.714	-23.449	-24.089	-24.032	-23.912
15M	-24.247	-23.142	-23.789	-23.965	-24.348	-22.057	-23.451	-23.652
20M	-24.827	-24.411	-24.923	-24.534	-24.774	-24.520	-24.938	-24.748
Dual 5M	-23.296	-22.285	-23.752	-23.697	-23.286	-22.195	-23.290	-22.338

The total measurement RF path loss of the test setup (attenuator and test cables) was 40.2 dB and is accounted for by the spectrum analyzer reference level offset.

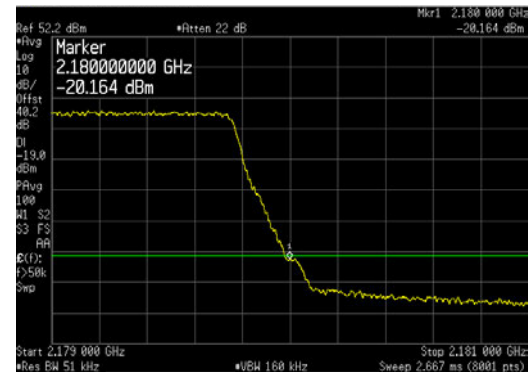
Conducted band edge measurements are provided in the following pages.

LTE5 Band Edge Plots for Antenna Port 4 and QPSK Modulation:

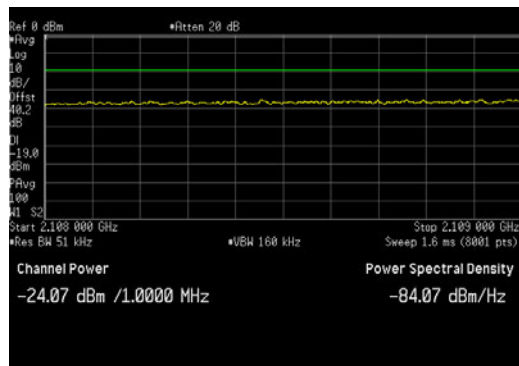
LTE5_Bottom Channel_LBE_2109 to 2111MHz



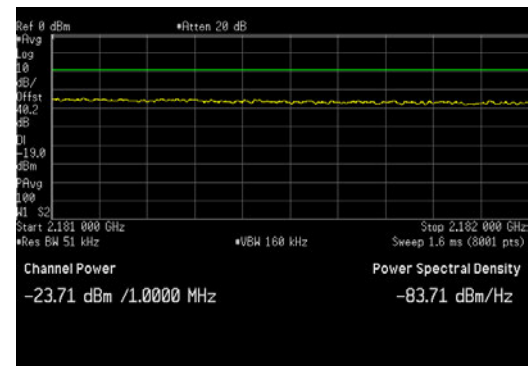
LTE5_Top Channel_UBE_2179 to 2181MHz



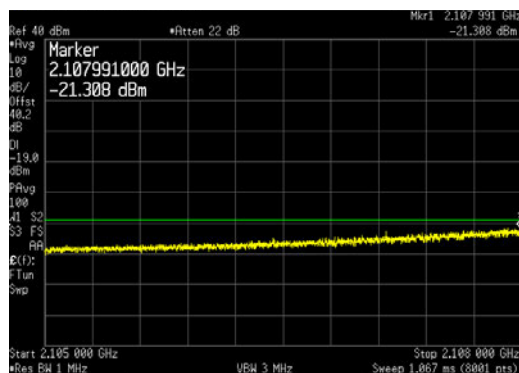
LTE5_Bottom Channel_LBE_2108 to 2109MHz



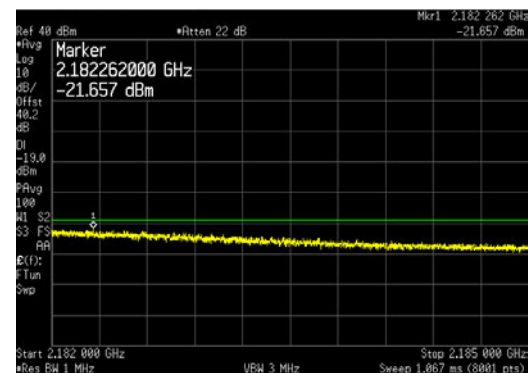
LTE5_Top Channel_UBE_2181 to 2182MHz



LTE5_Bottom Channel_LBE_2105 to 2108MHz

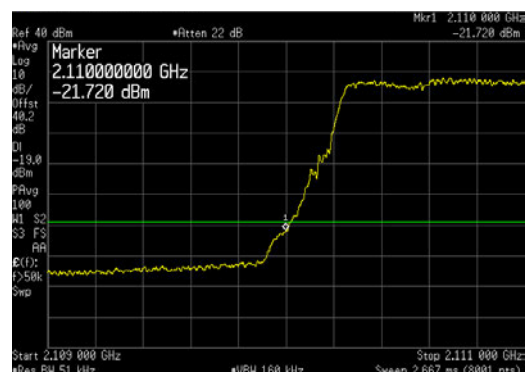


LTE5_Top Channel_UBE_2182 to 2185MHz

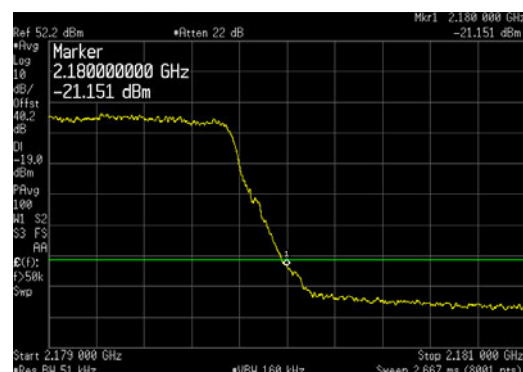


LTE5 Band Edge Plots for Antenna Port 4 and 16QAM Modulation:

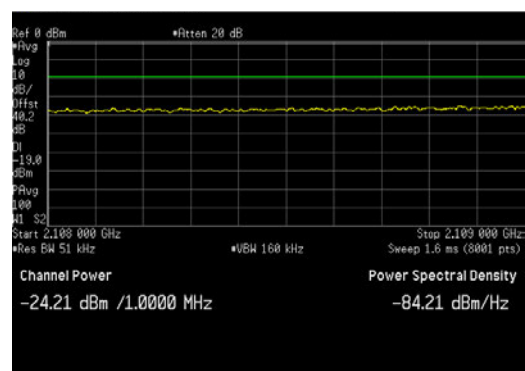
LTE5_Bottom Channel_LBE_2109 to 2111MHz



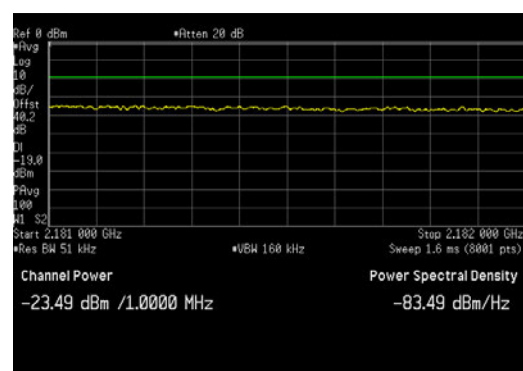
LTE5_Top Channel_UBE_2179 to 2181MHz



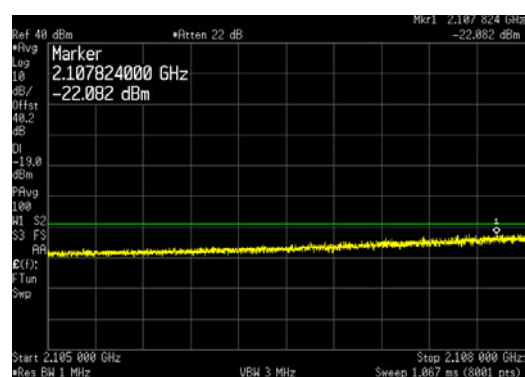
LTE5_Bottom Channel_LBE_2108 to 2109MHz



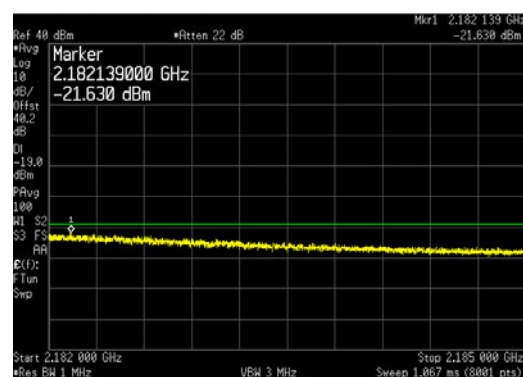
LTE5_Top Channel_UBE_2181 to 2182MHz



LTE5_Bottom Channel_LBE_2105 to 2108MHz

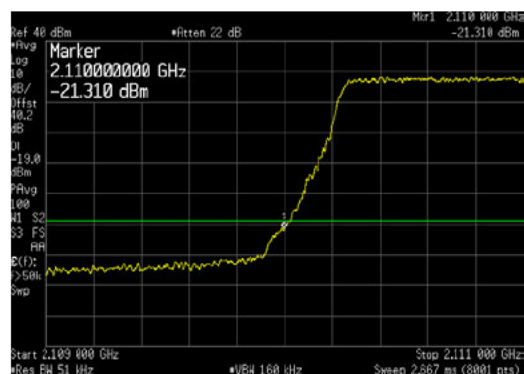


LTE5_Top Channel_UBE_2182 to 2185MHz

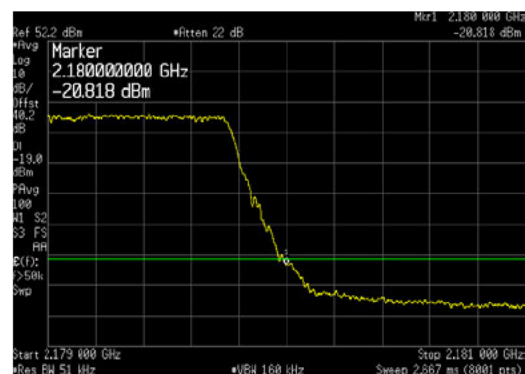


LTE5 Band Edge Plots for Antenna Port 4 and 64QAM Modulation:

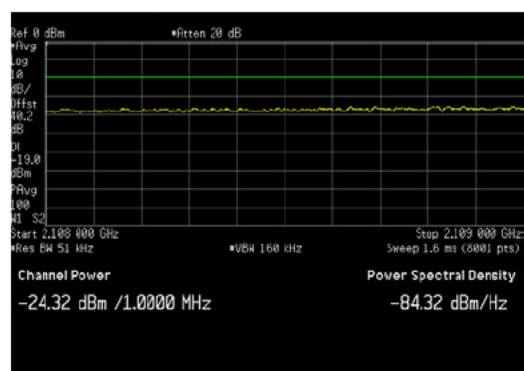
LTE5_Bottom Channel_LBE_2109 to 2111MHz



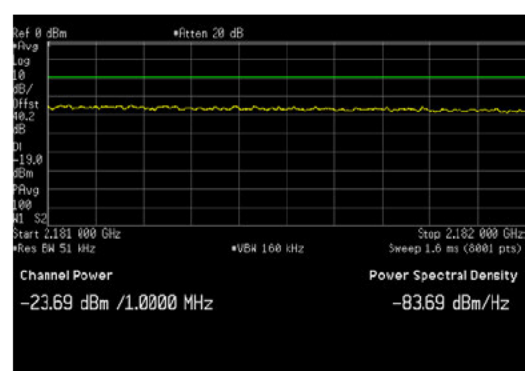
LTE5_Top Channel_UBE_2179 to 2181MHz



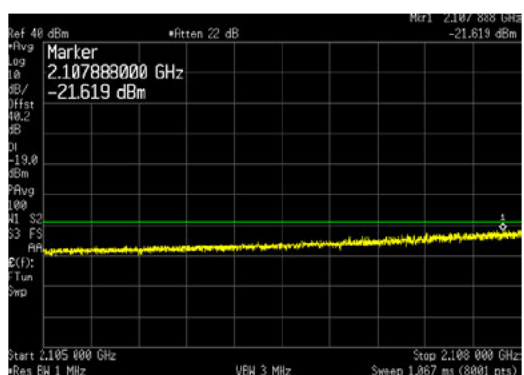
LTE5_Bottom Channel_LBE_2108 to 2109MHz



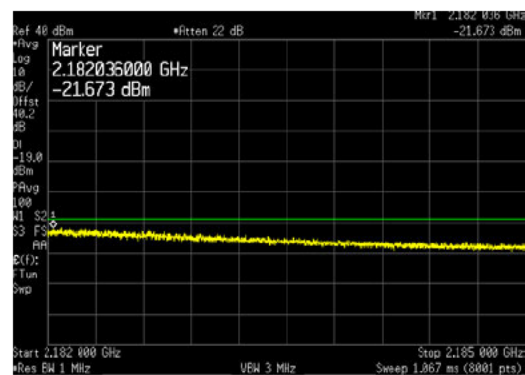
LTE5_Top Channel_UBE_2181 to 2182MHz



LTE5_Bottom Channel_LBE_2105 to 2108MHz

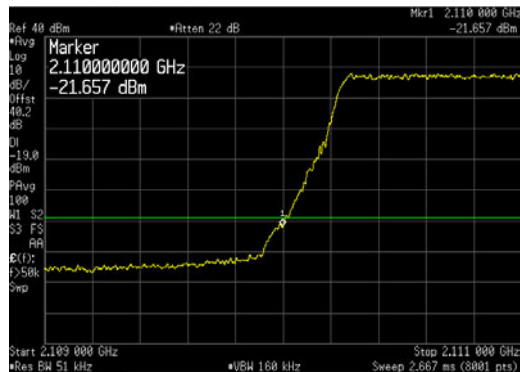


LTE5_Top Channel_UBE_2182 to 2185MHz

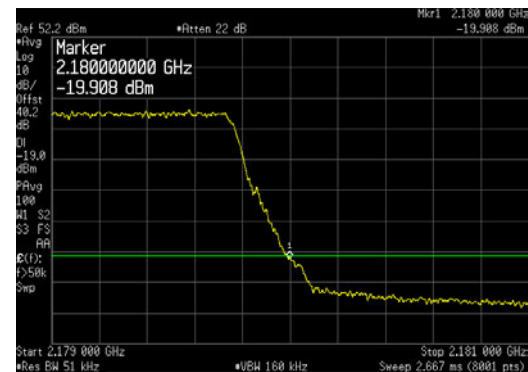


LTE5 Band Edge Plots for Antenna Port 4 and 256QAM Modulation:

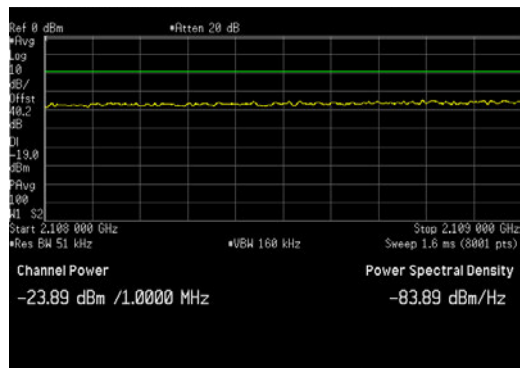
LTE5_Bottom Channel_LBE_2109 to 2111MHz



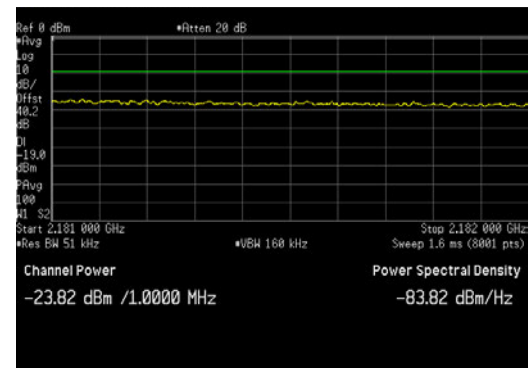
LTE5_Top Channel_UBE_2179 to 2181MHz



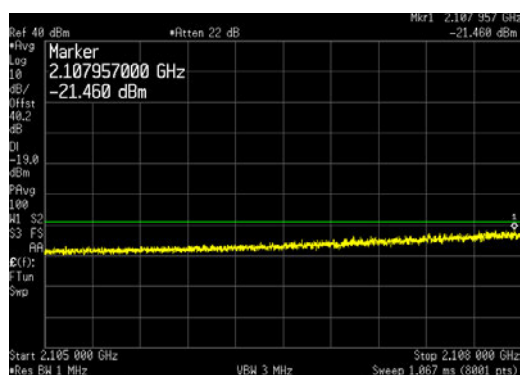
LTE5_Bottom Channel_LBE_2108 to 2109MHz



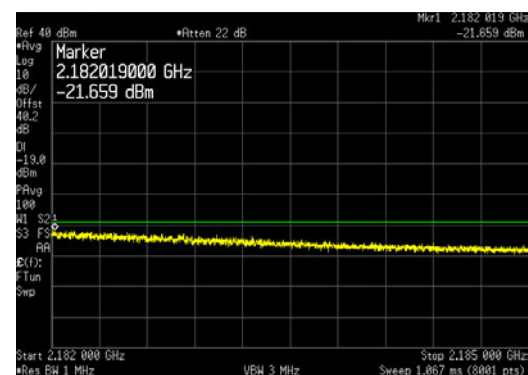
LTE5_Top Channel_UBE_2181 to 2182MHz



LTE5_Bottom Channel_LBE_2105 to 2108MHz

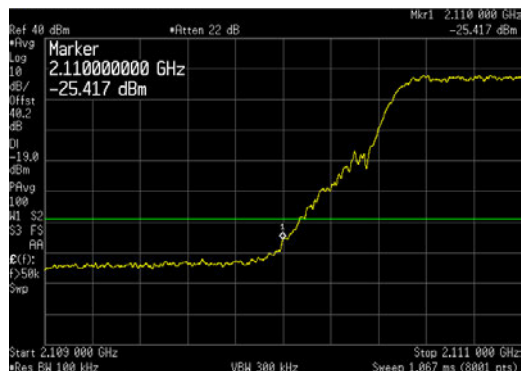


LTE5_Top Channel_UBE_2182 to 2185MHz

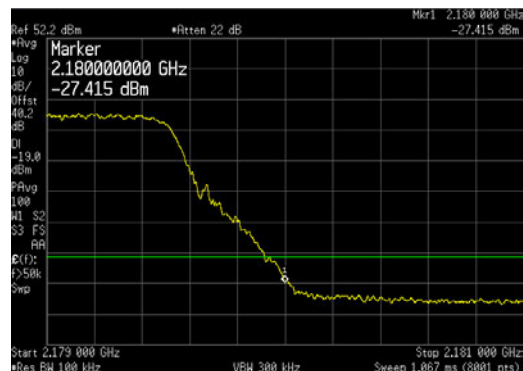


LTE10 Band Edge Plots for Antenna Port 4 and QPSK Modulation:

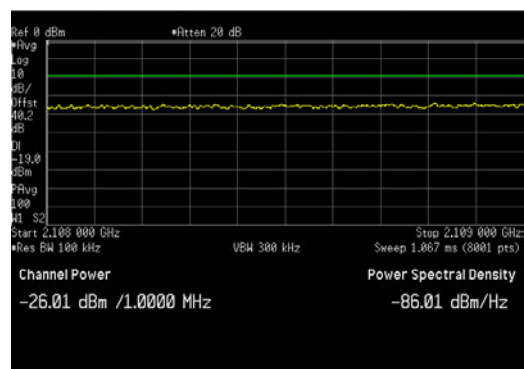
LTE10_Bottom Channel_LBE_2109 to 2111MHz



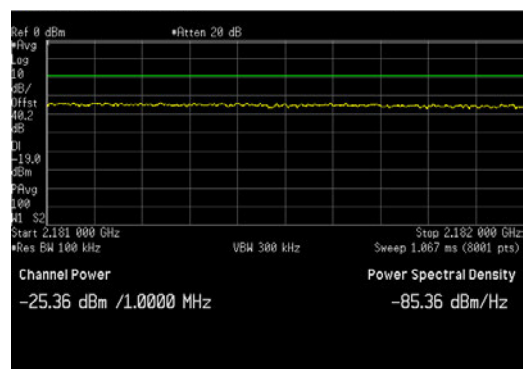
LTE10_Top Channel_UBE_2179 to 2181MHz



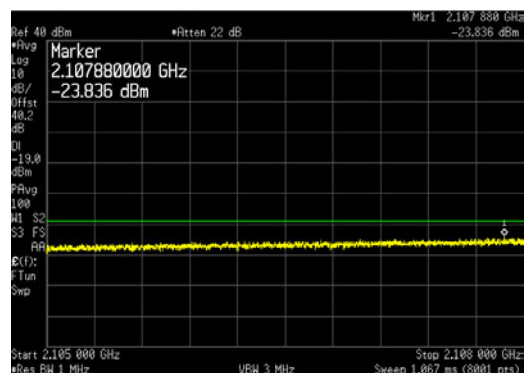
LTE10_Bottom Channel_LBE_2108 to 2109MHz



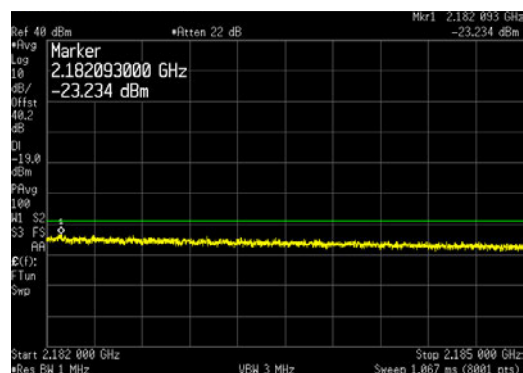
LTE10_Top Channel_UBE_2181 to 2182MHz



LTE10_Bottom Channel_LBE_2105 to 2108MHz



LTE10_Top Channel_UBE_2182 to 2185MHz

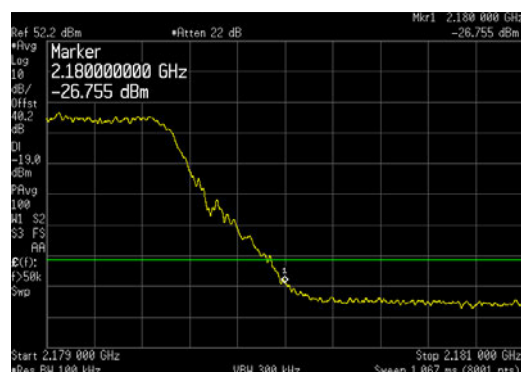


LTE10 Band Edge Plots for Antenna Port 4 and 16QAM Modulation:

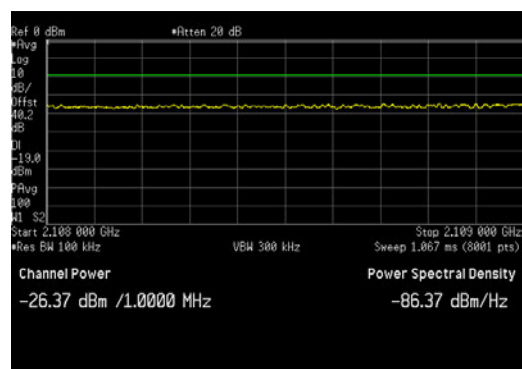
LTE10_Bottom Channel_LBE_2109 to 2111MHz



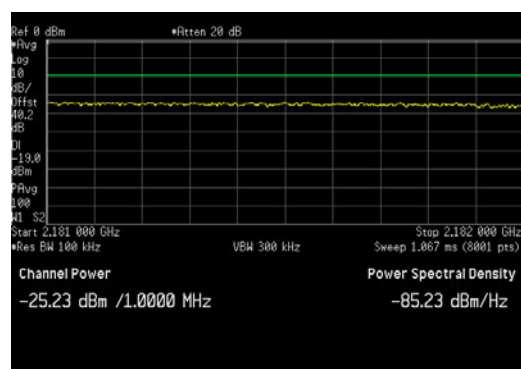
LTE10_Top Channel_UBE_2179 to 2181MHz



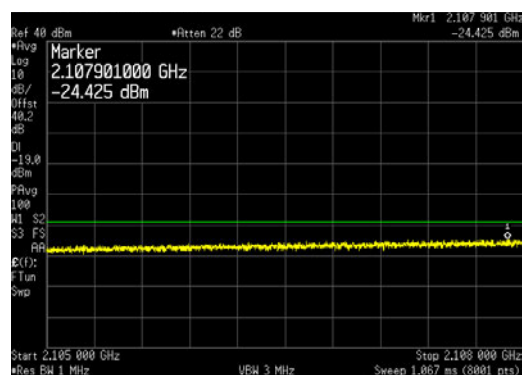
LTE10_Bottom Channel_LBE_2108 to 2109MHz



LTE10_Top Channel_UBE_2181 to 2182MHz



LTE10_Bottom Channel_LBE_2105 to 2108MHz



LTE10_Top Channel_UBE_2182 to 2185MHz

