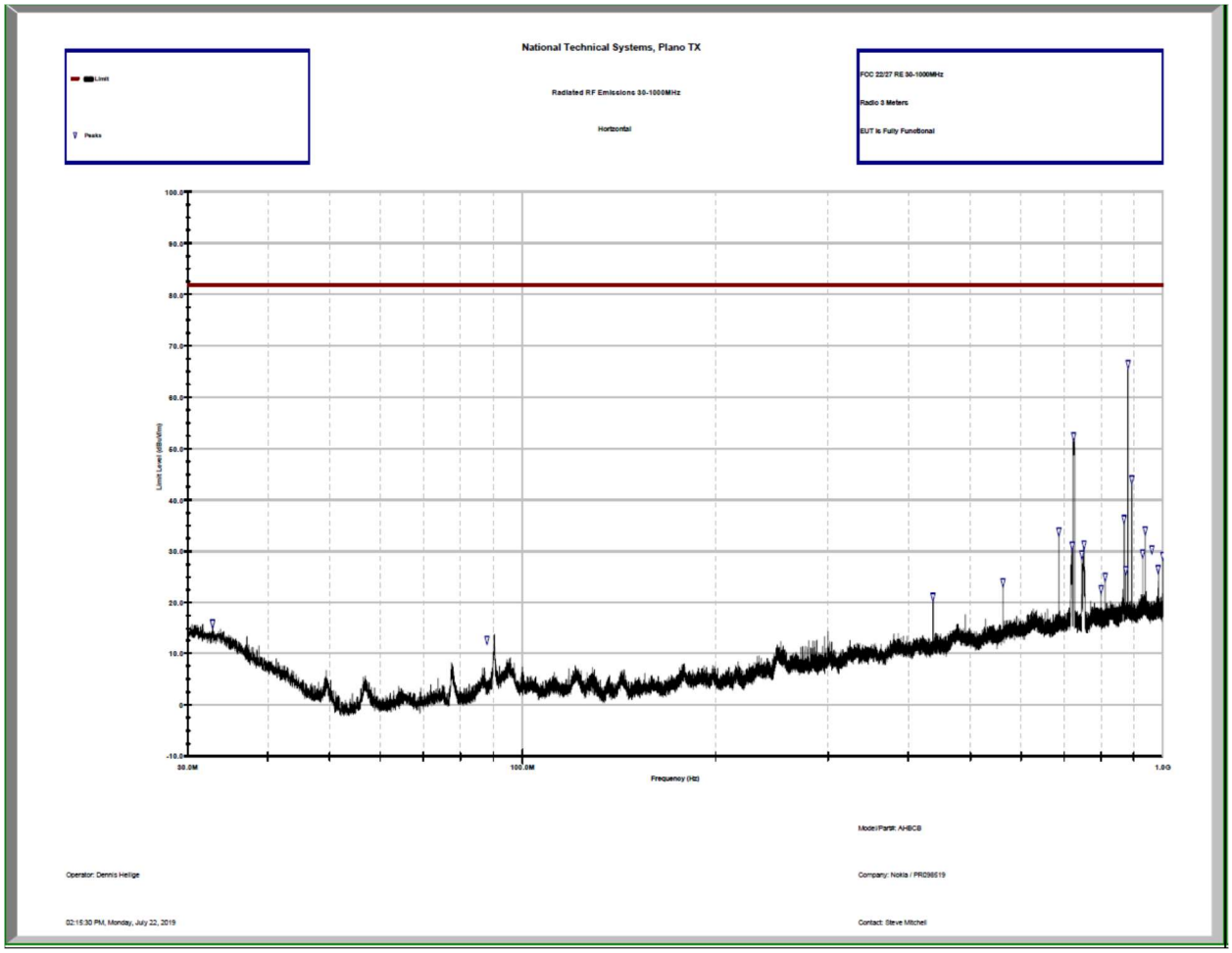
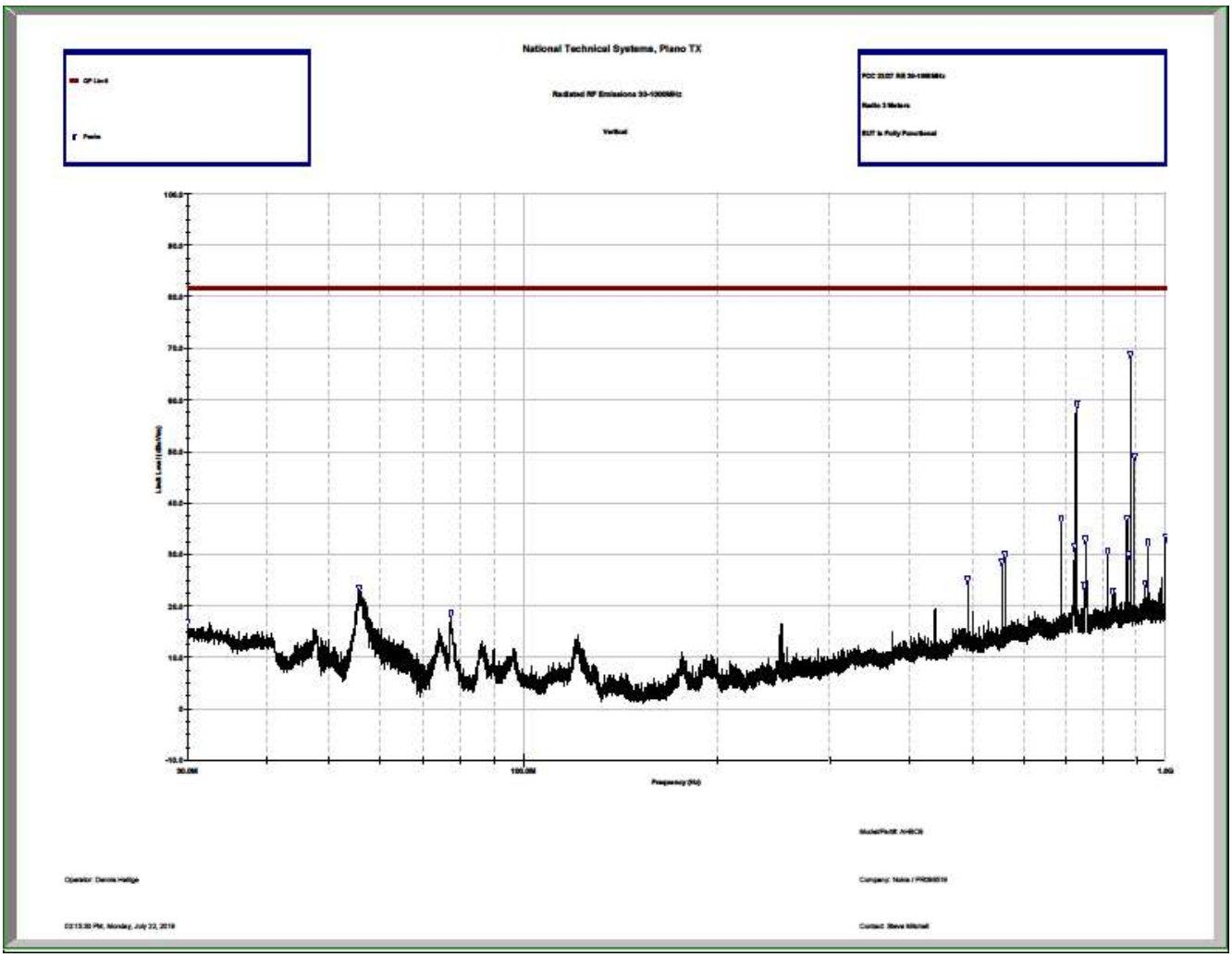
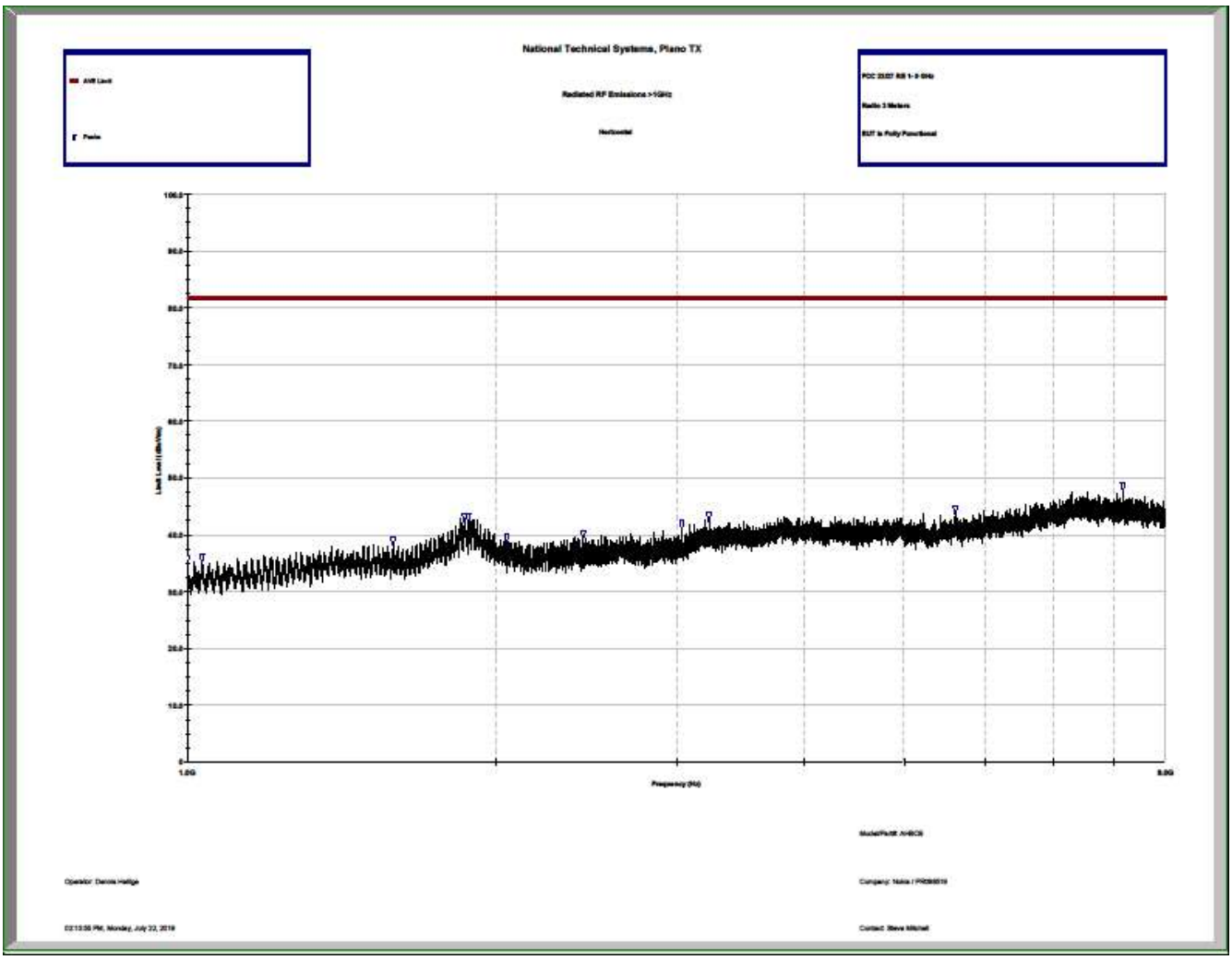


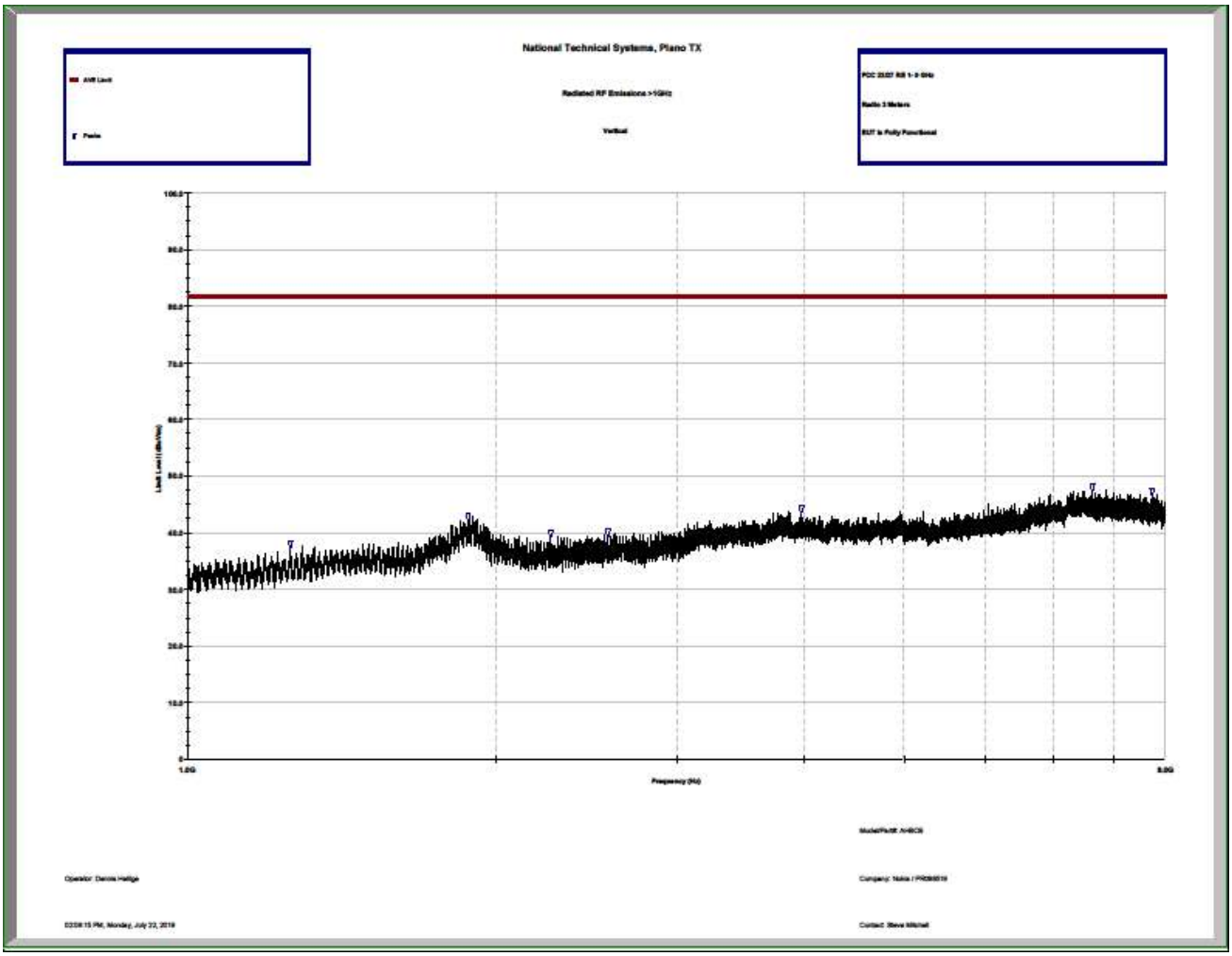
RE 30-1000MHz Radio Test Horizontal Graph (3 meter test distance)



RE 30-1000MHz Radio Test Vertical Graph (3-meter test distance)



RE 1-9 GHz Radio Test Horizontal Graph (3-meter test distance)



RE 1-9 GHz Radio Test Vertical Graph (3-meter test distance)

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 the Band 5 center channel (881.5MHz) and at the Band 29 center channel (722.5MHz) port 2.
(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)	Frequency Error (Hz) at 20°C	
		Band 5 881.5MHz LTE5	Band 29 722.5MHz LTE5
85%	40.8	0.699	0.515
100%	48.0	1.06	0.633
115%	55.2	0.887	0.748

Extreme Temperatures:

Temperature	Maximum Frequency Error (Hz) at 48VDC	
	Band 5 881.5MHz LTE5	Band 29 722.5MHz LTE5
-30 °C	**1.58**	1.08
-20 °C	0.820	0.738
-10 °C	0.940	0.797
0 °C	0.843	0.627
10 °C	0.731	0.570
20 °C	1.06	0.633
30 °C	1.08	**1.52**
40 °C	1.40	0.620
50 °C	1.56	1.06

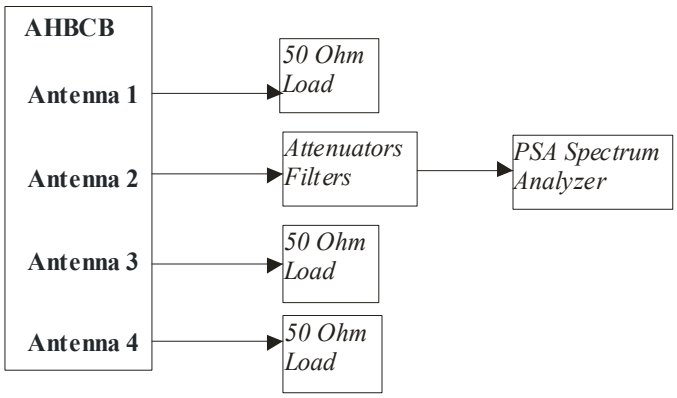
The highest recorded frequency error for Band 5 is 1.58Hz or ~0.0018 ppm. The Band 5 deviation limit is defined as ± 1.5 ppm in FCC 22.355 and RSS 132 5.3. The allowable deviation is ± 1322.3 Hz at the center channel (EARFCN 2525: 881.5 MHz).

The highest recorded frequency error for Band 29 is 1.52Hz or ~0.0021 ppm. The Band 29 frequency stability must be sufficient to show carrier stays in authorized band as defined in FCC 27.54 and RSS 130.

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 LTE TEST DATA FOR BAND 29 (717-728MHZ)

All conducted RF measurements in this section were made at AHBCB antenna ports. All available LTE channel bandwidths (5 & 10MHz) with all available modulation types (QPSK, 16QAM, 64QAM & 256QAM) were measured. The LTE modulation types are setup according to 3GPP TS 36.141 E-UTRA Test Models (E-TM) as follows E-TM 1.1: QPSK, E-TM 3.1: 64QAM, E-TM3.1a: 256QAM and E-TM 3.2: 16QAM. The test setup used is provided below.



Test Setup Used for Conducted RF Measurements on AHBCB

RF Output Power

RF output power has been measured in RMS Average terms for each Band 29 transmit chain at the middle channel (722.5MHz) for 256QAM modulation and LTE5 bandwidth as described in section 5.2 of KDB 971168 D01v03r01 and ANSI C63.26-2015 section 5.2.4.4. The RRH was operated at maximum RF output power. The peak to average power ratio (PAPR) has been measured using the signal analyzer complementary cumulative distribution function (CCDF) for a probability of 0.1% as described in section 5.7.2 of KDB971168 D01v03r01 and ANSI C63.26-2015 section 5.2.3.4. All results are presented in tabular form below. The highest measured values are highlighted.

Antenna	LTE Bandwidth	LTE - 256QAM	
		PAPR (dB)	Average (dBm)
Port 1 Middle Channel	**5M**	6.75	46.11
Port 2 Middle Channel	**5M**	**6.76**	**46.12**

The variation in RMS output power levels between the antenna ports is 0.01 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). The highest power port was selected as the worst case.

Pre-compliance testing has shown that the output power variation between modulation types is small. Antenna port 2 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	
	PAPR (dB)	Ave (dBm)	PAPR (dB)	Ave (dBm)	PAPR (dB)	Ave (dBm)	PAPR (dB)	Ave (dBm)
Antenna Port 2 Middle Channel LTE5	6.75	46.11	6.74	46.12	6.75	46.11	6.76	46.12

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 0.01dB for the data snapshot provided. The variation of PAPR versus modulation type is 0.02dB 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 2 had the highest RMS average power for Band 29 (represents the worst case) and therefore it was selected for all the remaining antenna port tests. Port 2 has the highest combined RMS average power for Band 5 + Band 29.
Subsequently output power levels on bottom, middle, and top channels in all Band 29 LTE channel bandwidths using 256QAM modulation type were tested only at Port 2 and the results presented below. The highest measured values are highlighted.

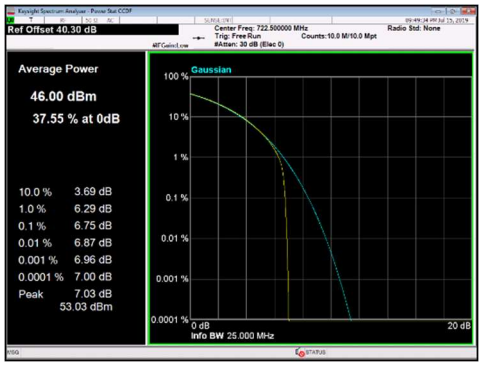
Antenna LTE Channel	LTE Bandwidth	LTE - 256QAM	
		PAPR (dB)	Average (dBm)
Port 2 Bottom Channel	**5M**	7.30	46.10
	10M	**7.44**	45.92
Port 2 Middle Channel	**5M**	6.76	**46.12**
	10M	7.22	45.94
Port 2 Top Channel	**5M**	6.83	46.01
	10M	7.05	45.97

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 (0.18dB).

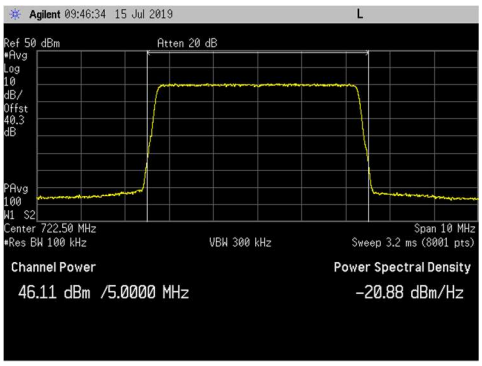
All measurement results are provided in the following pages. The total measurement RF path loss of the test setup (attenuator and test cables) was 40.3 dB and is accounted for by the spectrum analyzer reference level offset.

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

Port 1_ Middle Channel_ CCDF

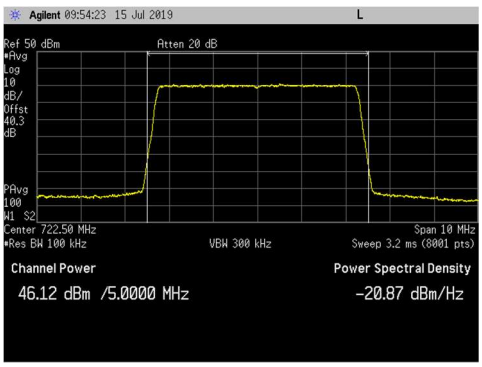


Port 1_ Middle Channel_ Average



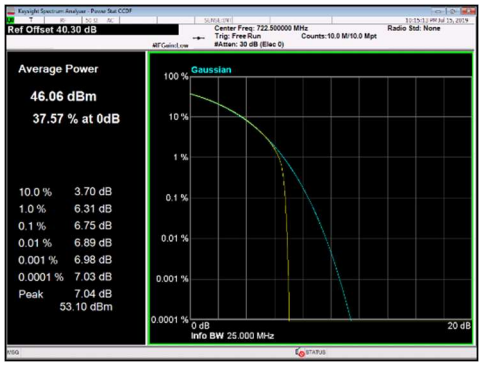
Port 2_ Middle Channel_ CCDF

Port 2_ Middle Channel_ Average

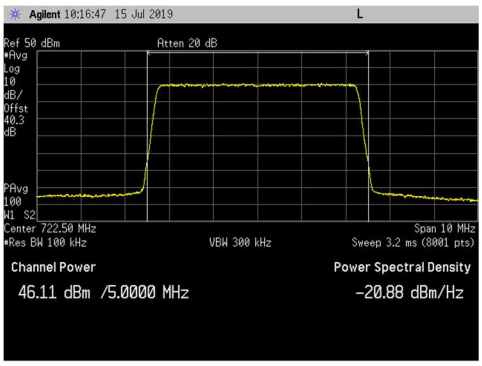


LTE5 Channel Power Plots for Antenna Port 2 at Middle Channel and all Modulation Types:

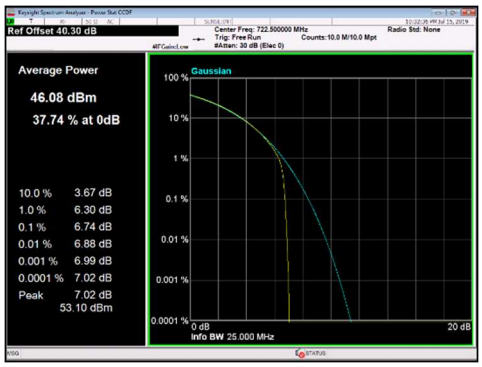
QPSK_ CCDF



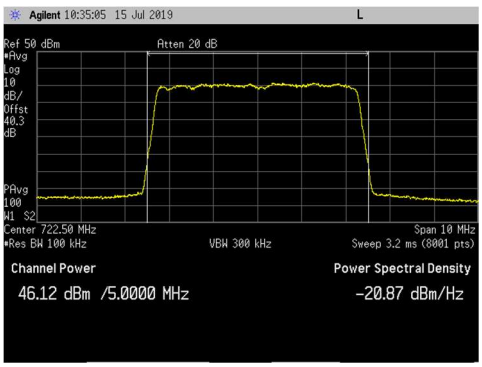
QPSK_ Average



16QAM_ CCDF

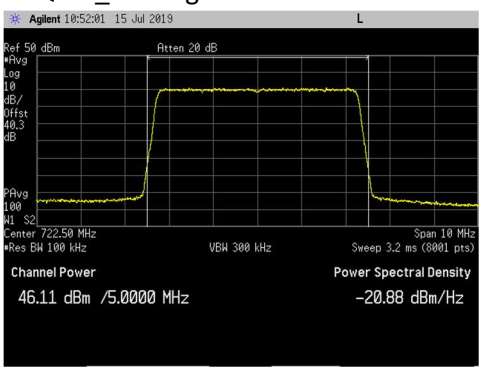


16QAM_ Average

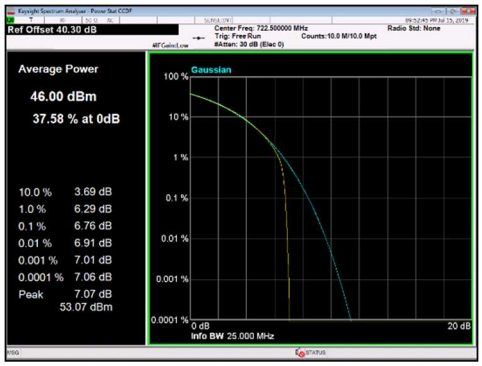


64QAM_ CCDF

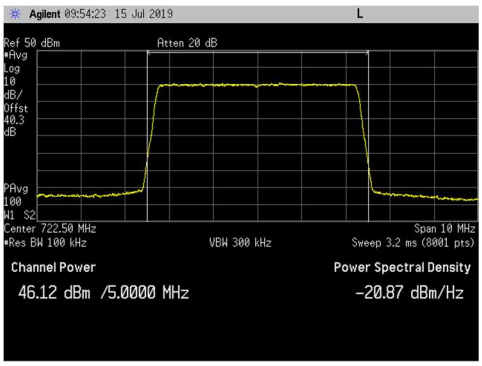
64QAM_ Average



256QAM_ CCDF

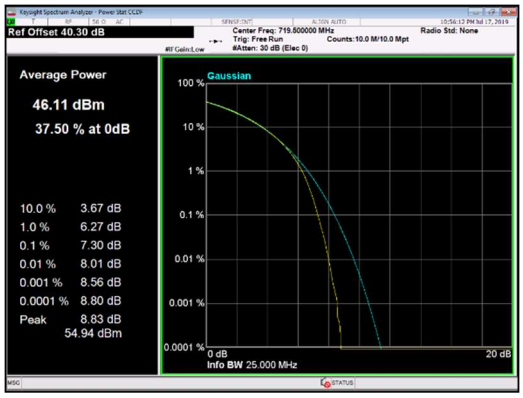


256QAM_ Average

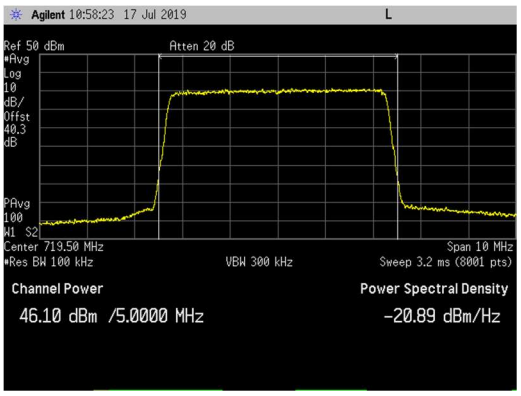


LTE5 Channel Power Plots for Antenna Port 2 and 256QAM Modulation:

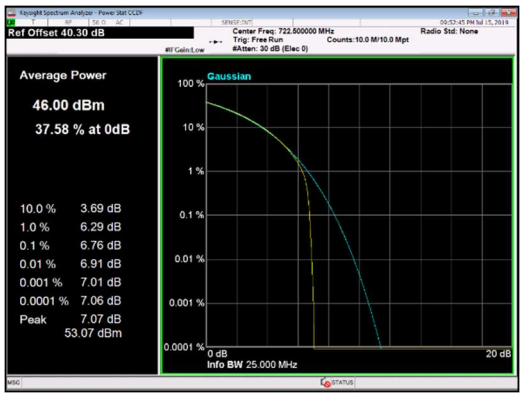
Bottom Channel_ CCDF



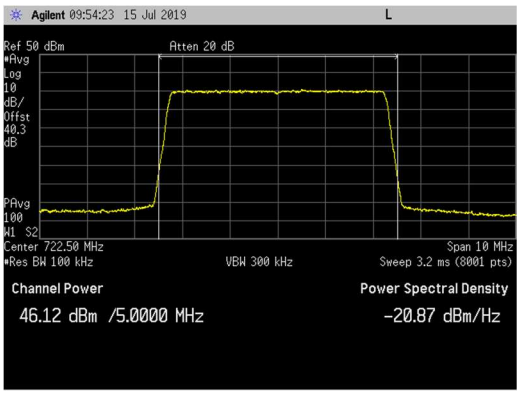
Bottom Channel_ Average



Middle Channel_ CCDF

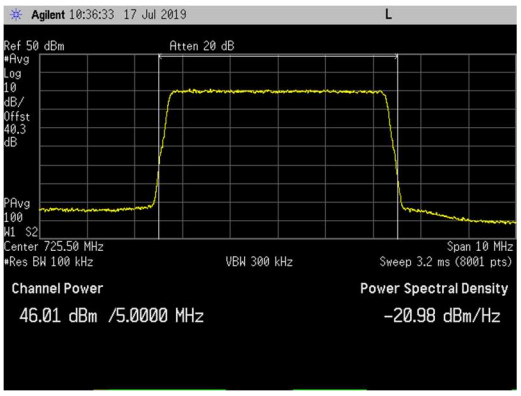


Middle Channel_ Average



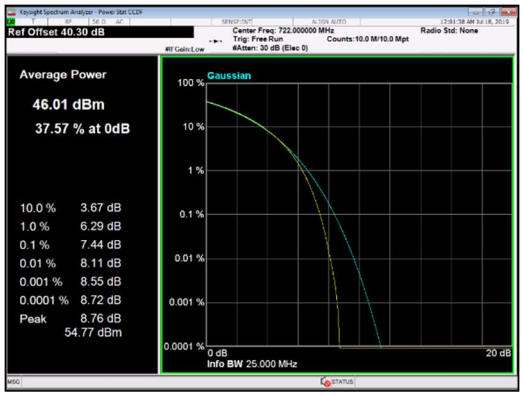
Top Channel_ CCDF

Top Channel_ Average

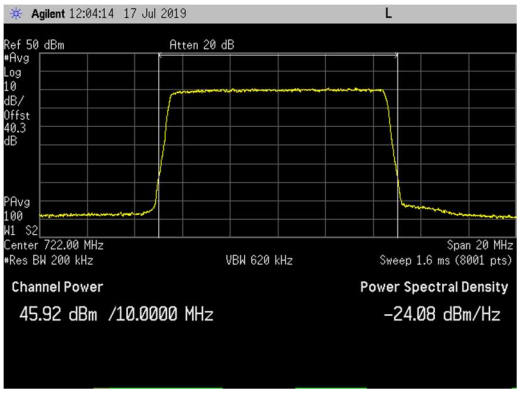


LTE10 Channel Power Plots for Antenna Port 2 and 256QAM Modulation:

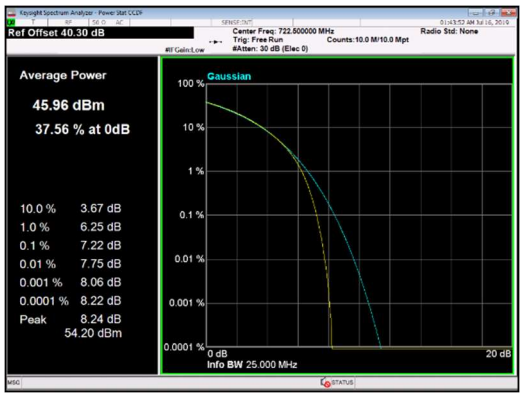
Bottom Channel_ CCDF



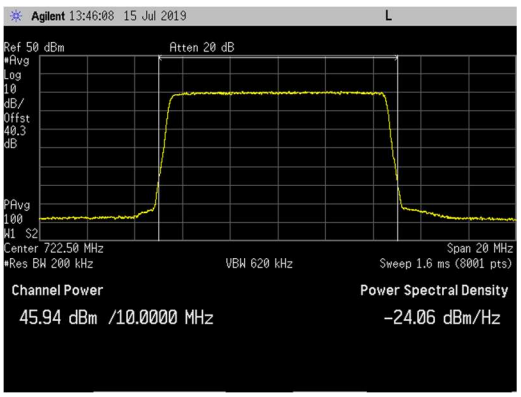
Bottom Channel_ Average



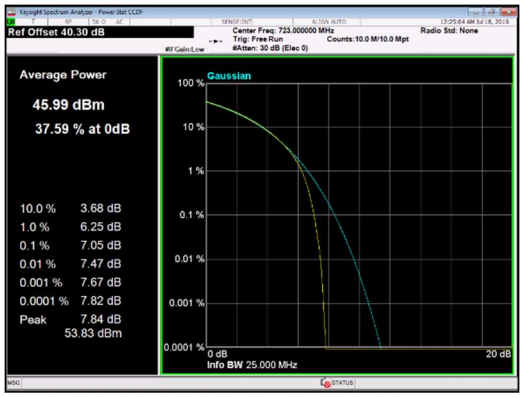
Middle Channel_ CCDF



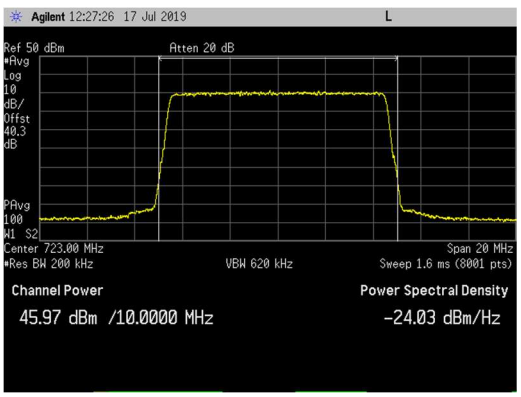
Middle Channel_ Average



Top Channel_ CCDF



Top Channel_ Average



Emission Bandwidth (26 dB down and 99%)

Emission bandwidth measurements were made at antenna port 2 on the middle channel (722.5MHz) with maximum RF output power. All available LTE modulations (QPSK, 16QAM, 64QAM, 256QAM) were used. All available LTE channel bandwidths (5MHz and 10MHz) were used.

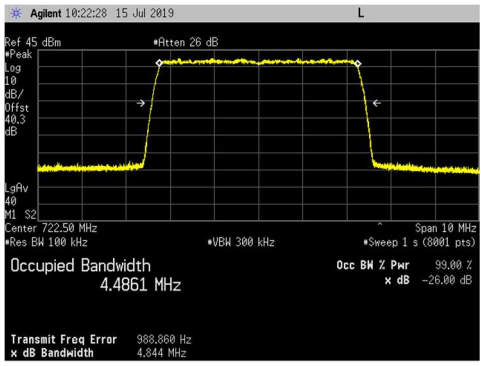
The 26dB emission bandwidth was measured in accordance with section 4 of FCC KDB 971168 D01v03r01 and ANSI C63.26 section 5.4. The 99% occupied bandwidth was measured in accordance with section 6.7 of RSS-Gen Issue 5. For both measurements, an occupied bandwidth built-in function in the spectrum analyzer was used. The results are provided in the following table. The largest emission bandwidths in each channel type are highlighted.

LTE Channel Bandwidth	Modulation Type							
	QPSK		16QAM		64QAM		256QAM	
	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)
5M	**4.844**	4.4861	4.817	4.4814	4.836	4.4928	4.839	**4.4936**
10M	9.632	8.9546	9.617	**8.9708**	**9.641**	8.9541	9.630	8.9546

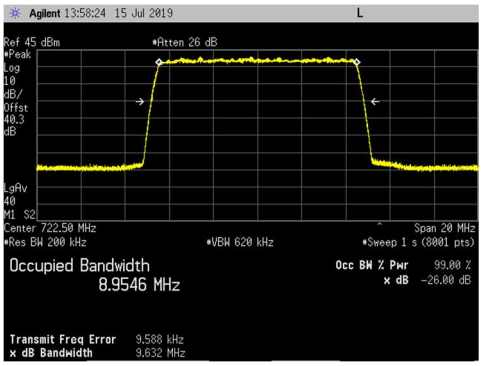
Emission bandwidth measurement data are provided in the following pages.

LTE5 and LTE10 Emission Bandwidth Plots on the Middle Channel (722.5MHz) for Antenna Port 2:

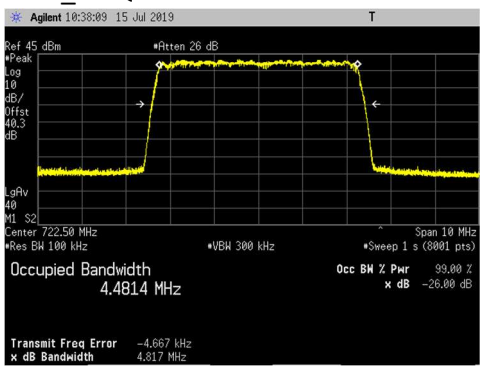
LTE5_ QPSK



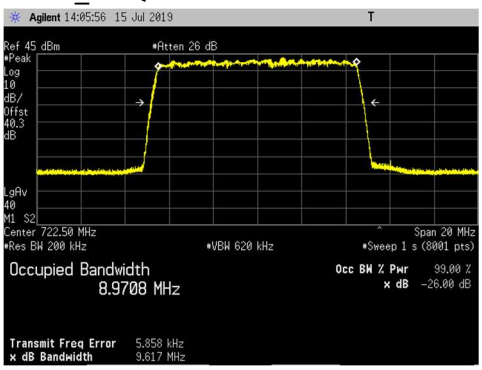
LTE10_ QPSK



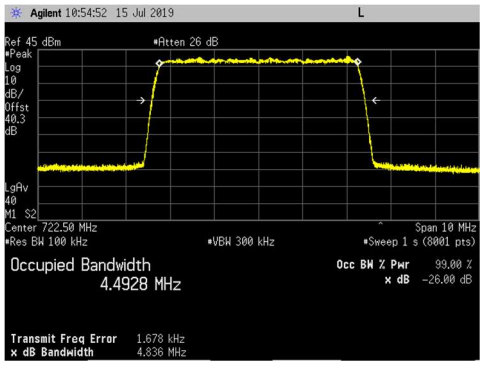
LTE5_ 16QAM



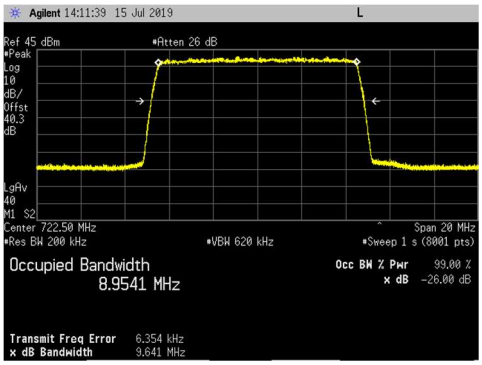
LTE10_ 16QAM



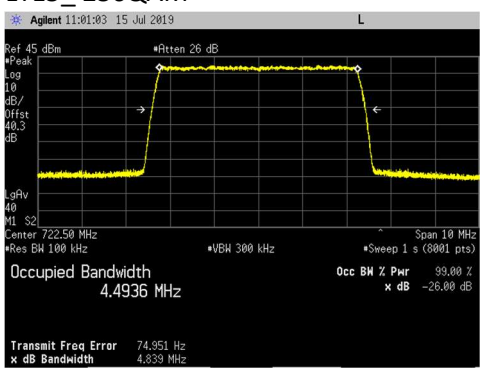
LTE5_ 64QAM



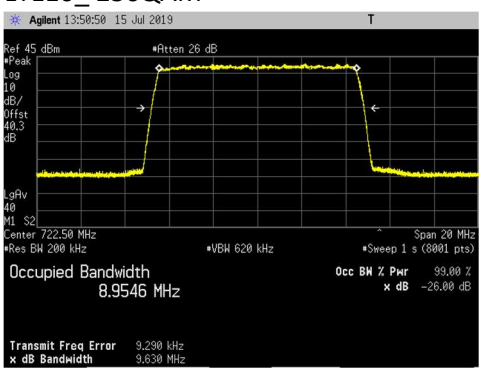
LTE10_ 64QAM



LTE5_ 256QAM



LTE10_ 256QAM



Antenna Port Conducted Band Edge

Conducted band edge measurements were made at RRH antenna port 2.

Single Carrier Test Cases
The RRH was operated at the Band 5 and Band 29 band edge channels simultaneously with all modulation types (QPSK, 16QAM, 64QAM, 256QAM) for all available LTE bandwidths (Band 5: 1.4MHz, 3MHz, 5MHz and 10MHz; Band 29: 5MHz and 10MHz). The Band 5 and Band 29 carriers were enabled at maximum power (80 watts/port and 40 watts/carrier). The same modulation type was used for both carriers. The Band 5 band edge results are detailed in Appendix A.

Multicarrier Multiband Test Case
In Band 5_Three LTE1.4 carriers (based upon KDB 971168 D03v01) using two carriers (with minimum spacing between carrier frequencies) at the lower band edge (EARFCN 2407: 869.7 MHz and EARFCN 2421: 871.1 MHz) and a third carrier with maximum spacing between the other two carrier frequencies (EARFCN 2643: 893.3 MHz) at the upper band edge. In Band 29_ Two LTE5 carriers with maximum spacing at the lower and upper band edges (EARFCN 9685: 719.5 & EARFCN 9745: 725.5MHz. Three carrier operation is not available because it exceeds the Band 29 downlink bandwidth. The smallest channel bandwidth was selected to maximize carrier power spectral density. The carriers were operated at maximum power (~13W/Band 5 carrier and ~20W/Band 29 carrier) with at total port power of 80 watts (40W for Band 5 carriers + 40W for Band 29 carriers). The same modulation type was used for both Band 5 and Band 29 carriers.

The limit of -16dBm was used in the certification testing. The limit is adjusted to -16dBm [-13dBm -10 log (2)] per FCC KDB 662911D01 v02r01 because the BTS may operate as a 2 port MIMO Band 29 transmitter.

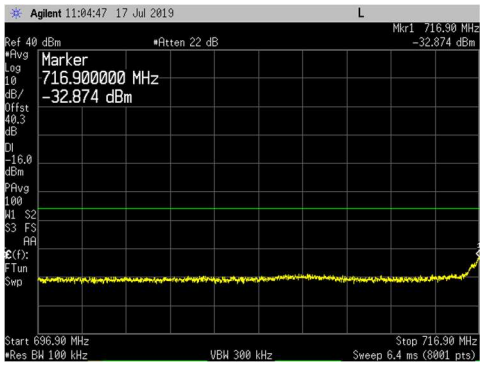
Measurements were performed with the spectrum analyzer in the RMS average mode over 100 traces. In the 100kHz bands outside and adjacent to the frequency block, a resolution bandwidth of 30kHz was used as allowed by FCC 27.53(c)(5) and RSS-130 4.7. In the 100kHz to 20.1MHz frequency range outside the band edge (i.e.: 696.9 to 716.9MHz and 728.1 to 748.1MHz bands) a 100kHz RBW and 300kHz VBW was used. The results are summarized in the following table. The highest (worst case) emissions from the measurement data are provided.

Ch BW, Car Freq, Car Pwr		QPSK (dBm)		16QAM (dBm)		64QAM (dBm)		256QAM (dBm)	
Band 5	**Band 29**	**LBE**	**UBE**	**LBE**	**UBE**	**LBE**	**UBE**	**LBE**	**UBE**
LTE5, BC, 40W	LTE5, BC, 40W	-29.993	N/A	-29.972	N/A	-29.922	N/A	-29.239	N/A
LTE10, BC, 40W	LTE10, BC, 40W	-34.525	N/A	-34.331	N/A	-34.043	N/A	-34.088	N/A
LTE5, TC, 40W	LTE5, TC, 40W	N/A	-28.320	N/A	-29.110	N/A	-27.898	N/A	**-26.459**
LTE10, TC, 40W	LTE10, TC, 40W	N/A	-32.512	N/A	-32.363	N/A	-31.826	N/A	-31.971
Multicar LTE1.4 BC, BC+1, & TC 13W + 13W+13W	Multicar LTE5 BC & TC 20W + 20W	-29.525	-28.323	-31.478	-28.496	-30.950	-29.493	-30.826	-28.457

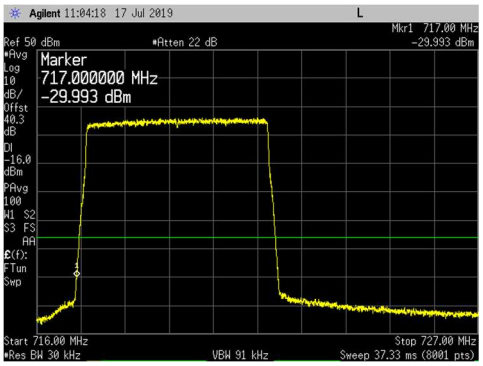
The total measurement RF path loss of the test setup (attenuator and test cables) was 40.3 dB and is accounted for by the spectrum analyzer reference level offset. The display line on the plots reflects the required limit. Conducted band edge measurements are provided in the following pages.

LTE5 Lower Band Edge Plots for Antenna Port 2:

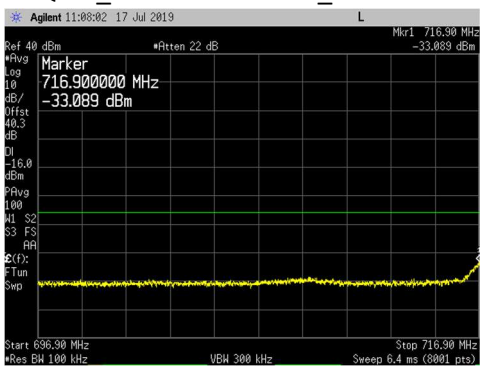
QPSK_ Bottom Channel _696.9MHz to 716.9MHz



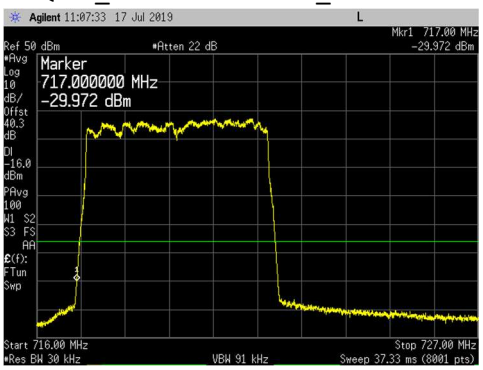
QPSK_ Bottom Channel _716MHz to 727MHz



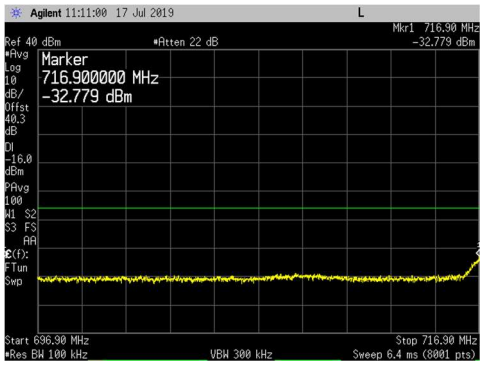
16QAM_ Bottom Channel _696.9MHz to 716.9MHz



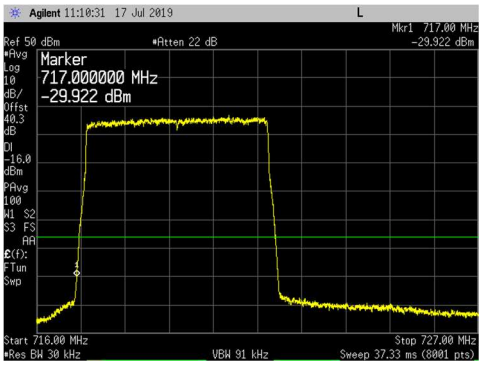
16QAM_ Bottom Channel _716MHz to 727MHz



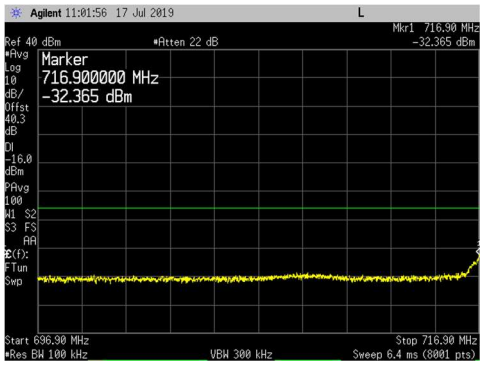
64QAM_ Bottom Channel _696.9MHz to 716.9MHz



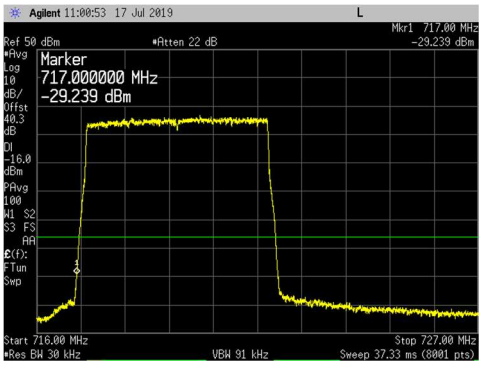
64QAM_ Bottom Channel _716MHz to 727MHz



256QAM_ Bottom Channel _696.9MHz to 716.9MHz

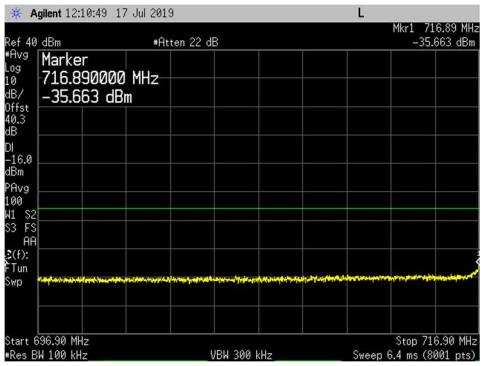


256QAM_ Bottom Channel _716MHz to 727MHz

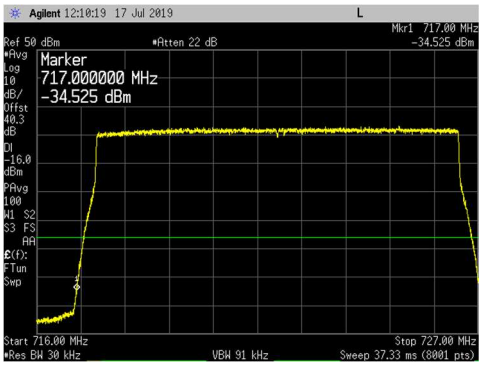


LTE10 Lower Band Edge Plots for Antenna Port 2:

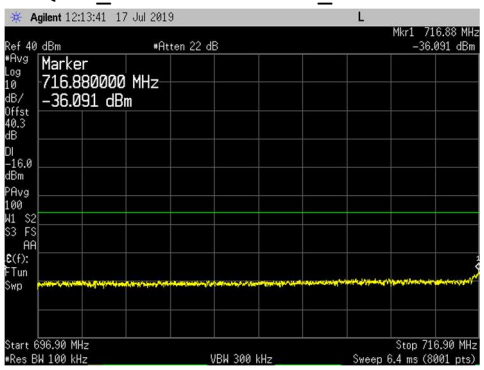
QPSK_ Bottom Channel _696.9MHz to 716.9MHz



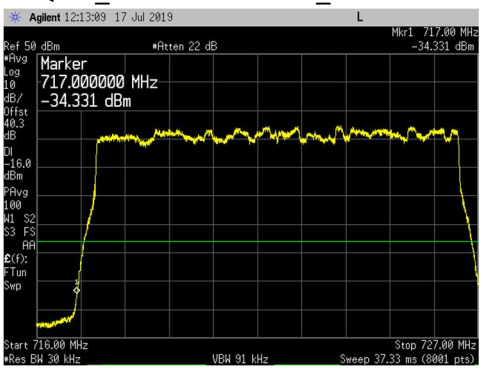
QPSK_ Bottom Channel _716MHz to 727MHz



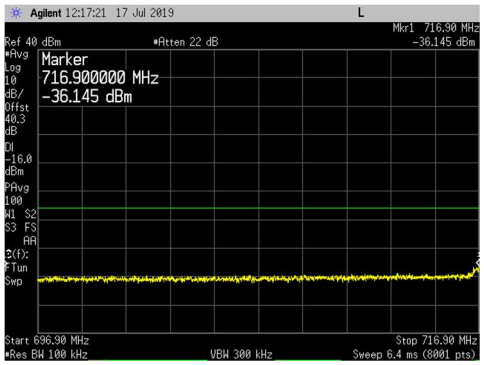
16QAM_ Bottom Channel _696.9MHz to 716.9MHz



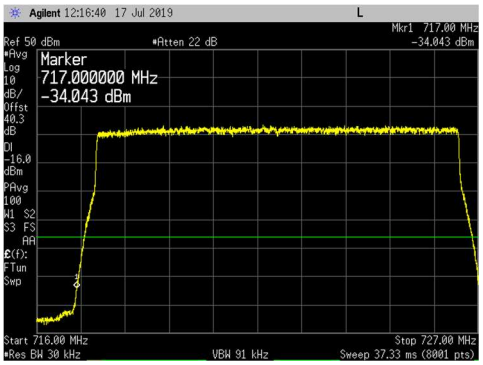
16QAM_ Bottom Channel _716MHz to 727MHz



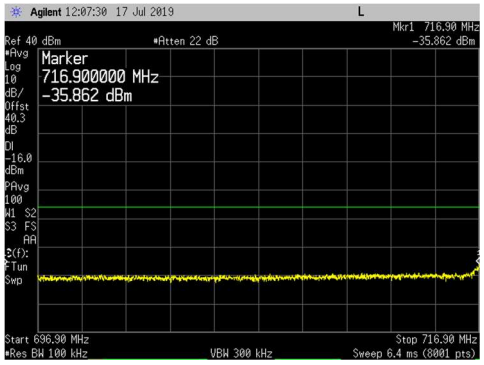
64QAM_ Bottom Channel _696.9MHz to 716.9MHz



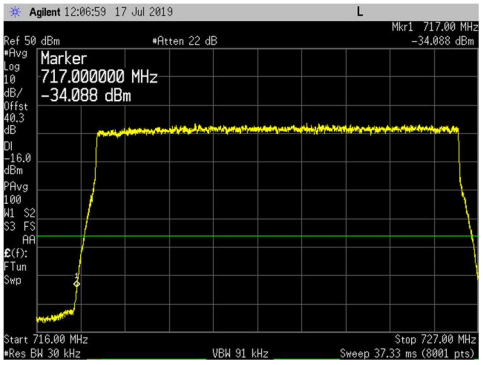
64QAM_ Bottom Channel _716MHz to 727MHz



256QAM_ Bottom Channel _696.9MHz to 716.9MHz

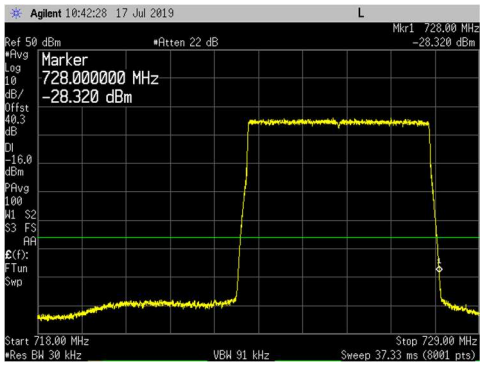


256QAM_ Bottom Channel _716MHz to 727MHz

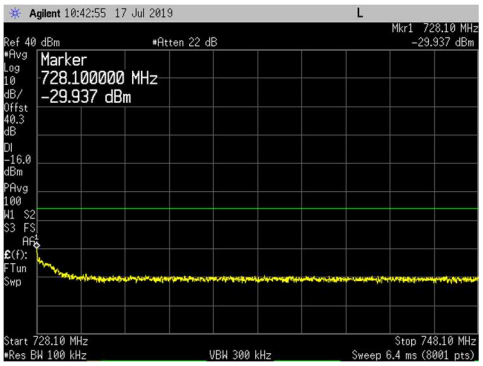


LTE5 Upper Band Edge Plots for Antenna Port 2:

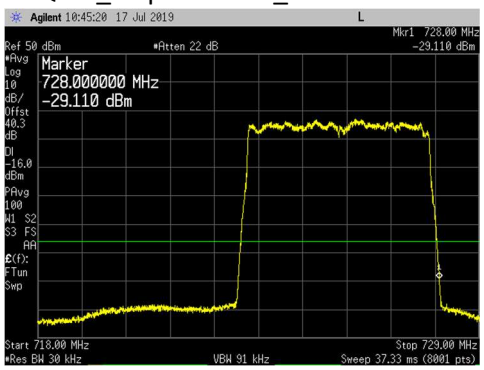
QPSK_ Top Channel _718MHz to 729MHz



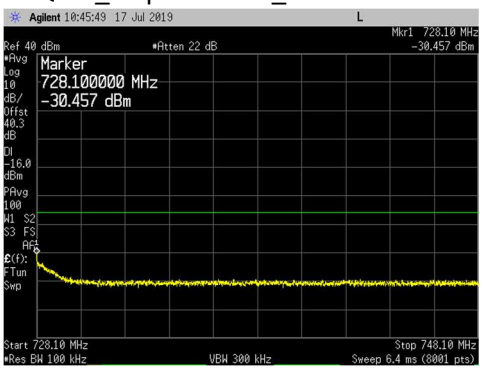
QPSK_ Top Channel _728.1MHz to 748.1MHz



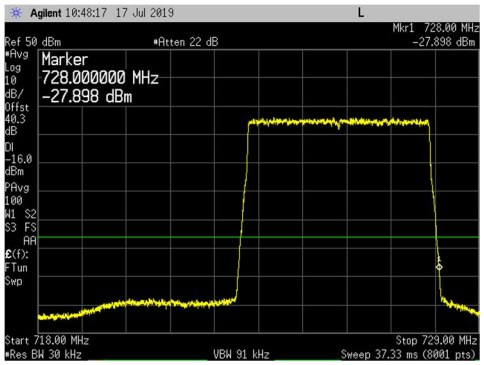
16QAM_ Top Channel _718MHz to 729MHz



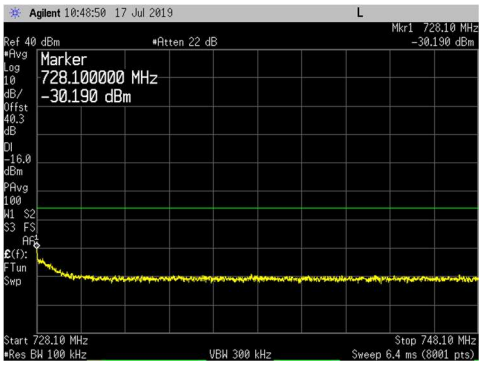
16QAM_ Top Channel _728.1MHz to 748.1MHz



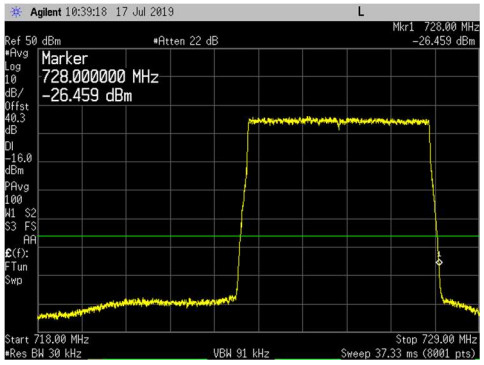
64QAM_ Top Channel _718MHz to 729MHz



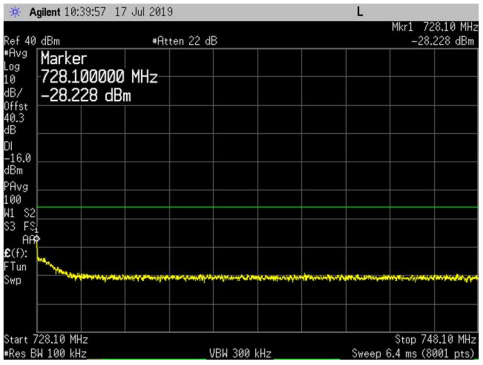
64QAM_ Top Channel _728.1MHz to 748.1MHz



256QAM_ Top Channel _718MHz to 729MHz

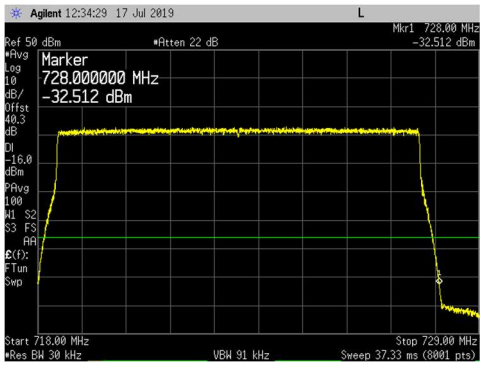


256QAM_ Top Channel _728.1MHz to 748.1MHz

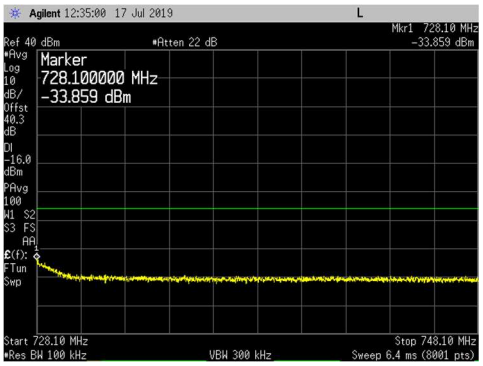


LTE10 Upper Band Edge Plots for Antenna Port 2:

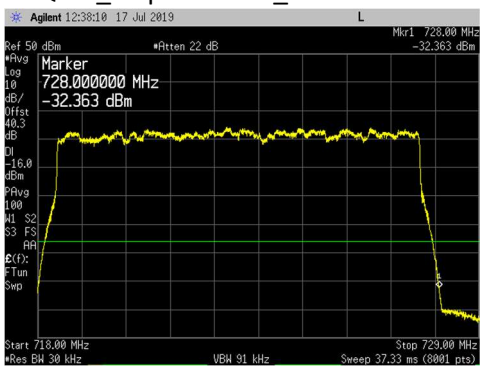
QPSK_ Top Channel _718MHz to 729MHz



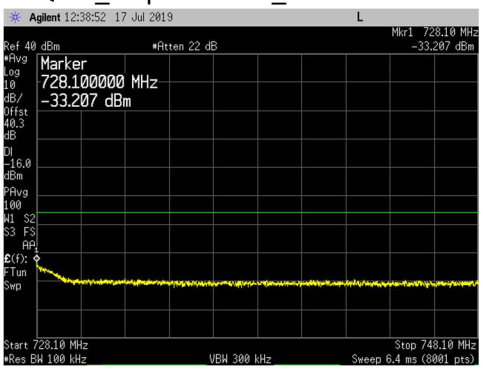
QPSK_ Top Channel _728.1MHz to 748.1MHz



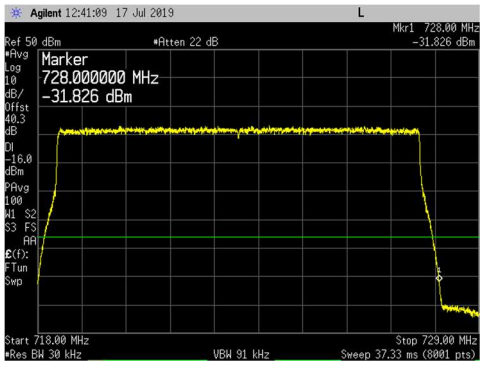
16QAM_ Top Channel _718MHz to 729MHz



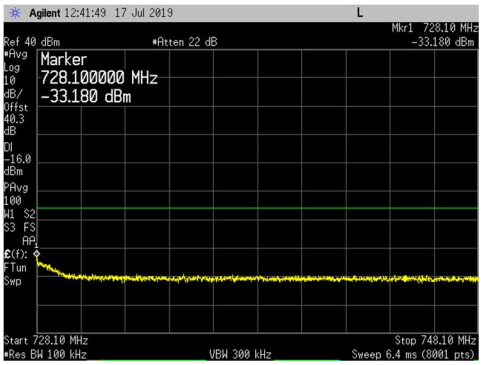
16QAM_ Top Channel _728.1MHz to 748.1MHz



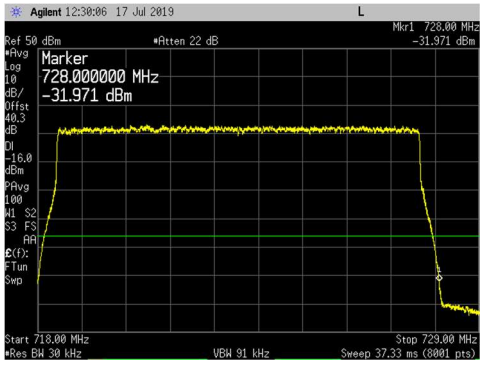
64QAM_ Top Channel _718MHz to 729MHz



64QAM_ Top Channel _728.1MHz to 748.1MHz



256QAM_ Top Channel _718MHz to 729MHz



256QAM_ Top Channel _728.1MHz to 748.1MHz