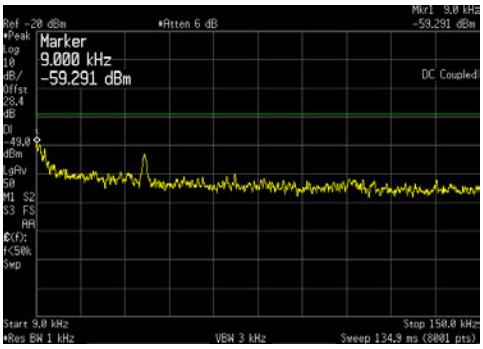
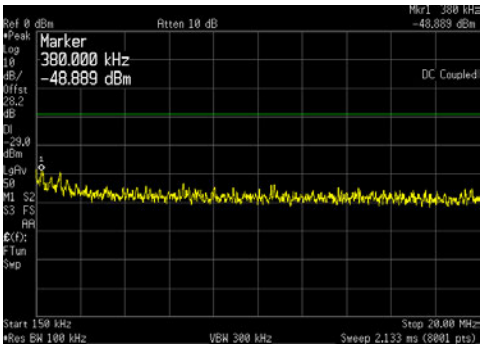
LTE3 Channel Bandwidth _ 16QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

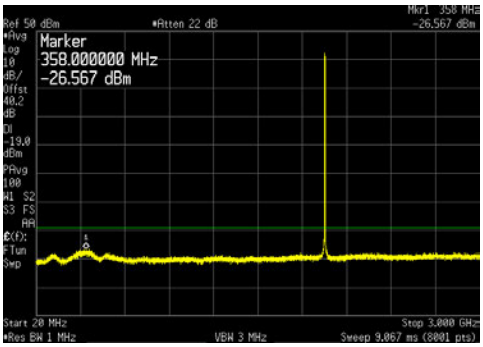
9kHz to 150kHz



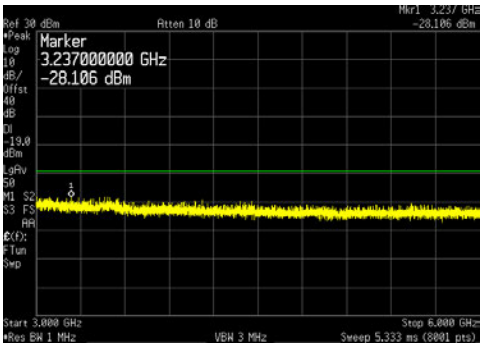
150kHz to 20MHz



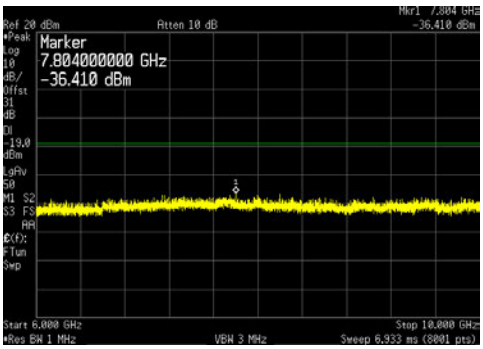
20MHz to 3GHz



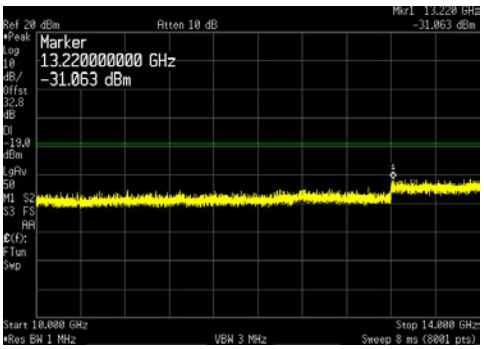
3GHz to 6GHz



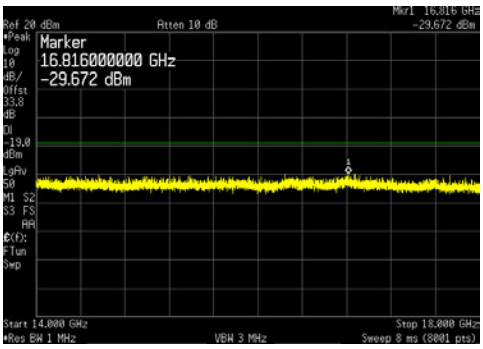
6GHz to 10GHz



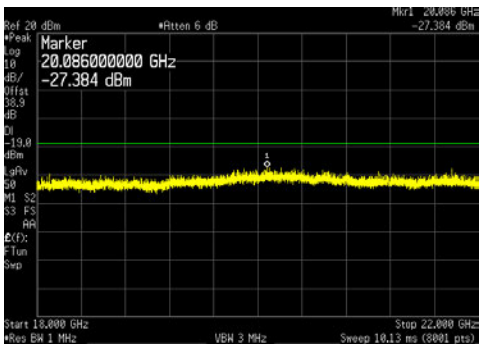
10GHz to 14GHz



14GHz to 18GHz

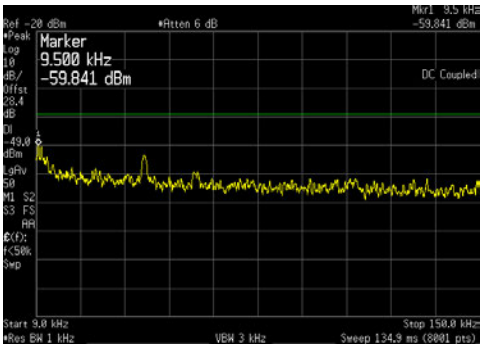


18GHz to 22GHz

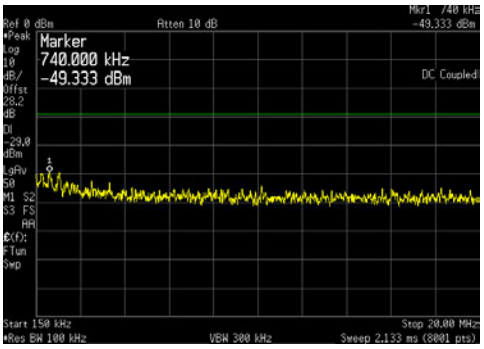


LTE3 Channel Bandwidth _ 64QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

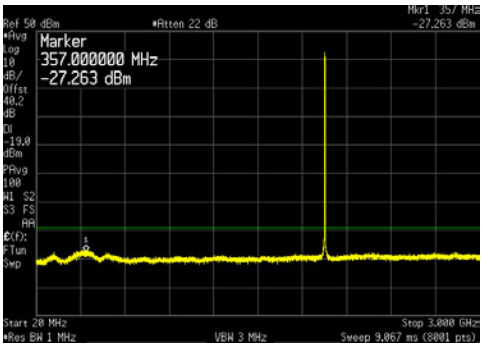
9kHz to 150kHz



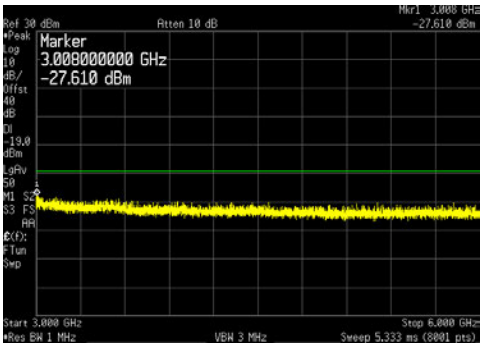
150kHz to 20MHz



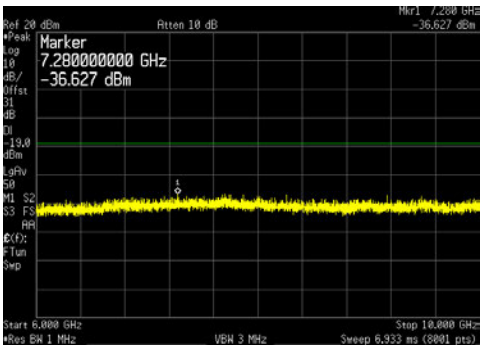
20MHz to 3GHz



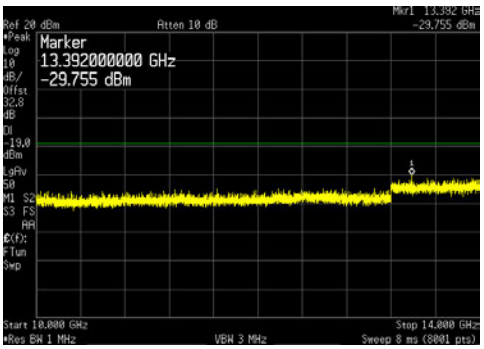
3GHz to 6GHz



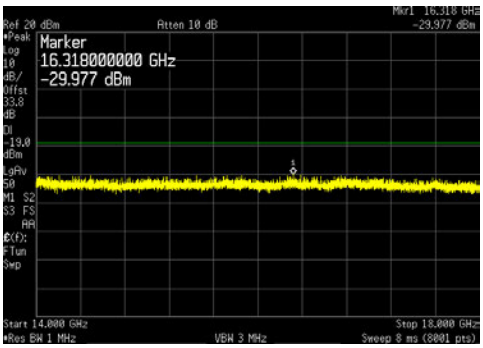
6GHz to 10GHz



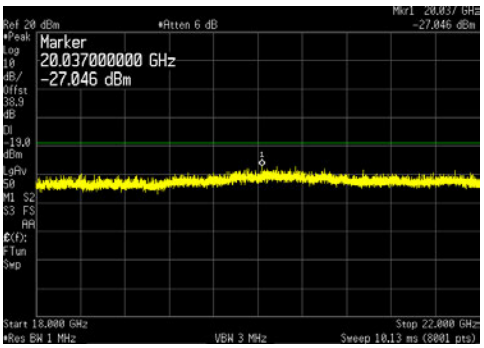
10GHz to 14GHz



14GHz to 18GHz

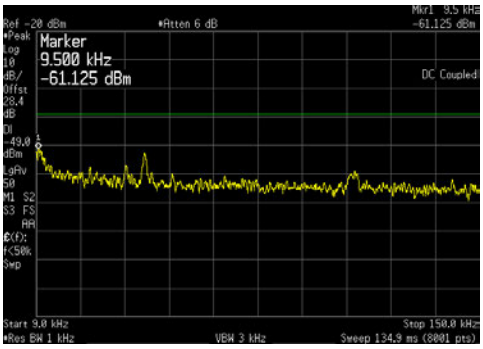


18GHz to 22GHz

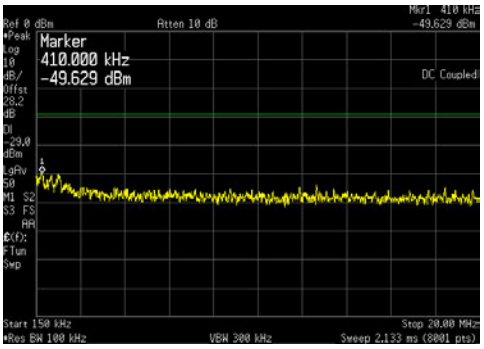


LTE3 Channel Bandwidth _ 256QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

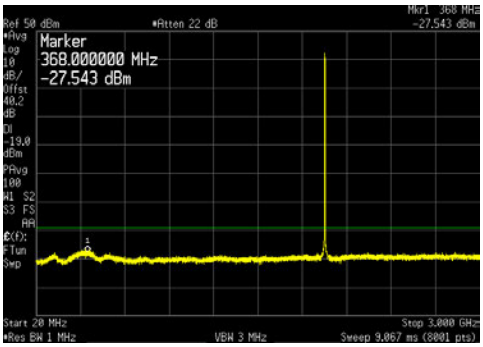
9kHz to 150kHz



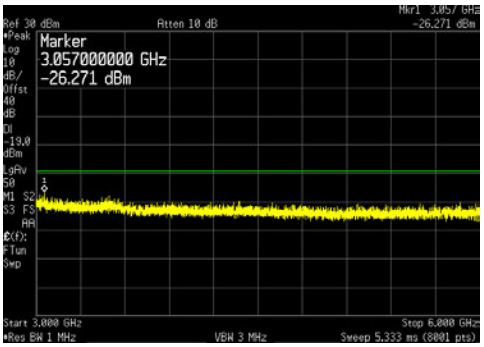
150kHz to 20MHz



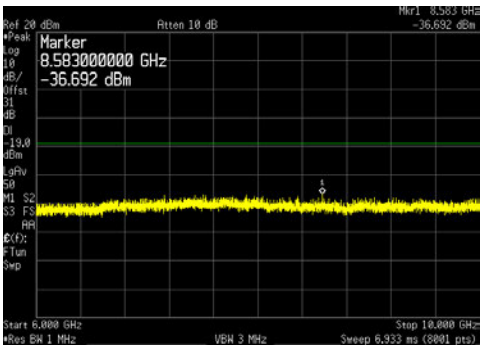
20MHz to 3GHz



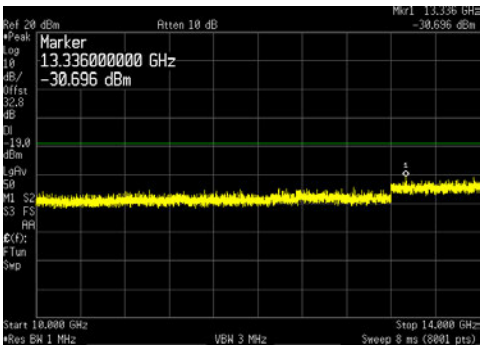
3GHz to 6GHz



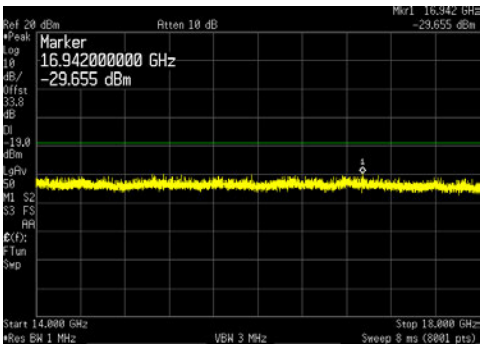
6GHz to 10GHz



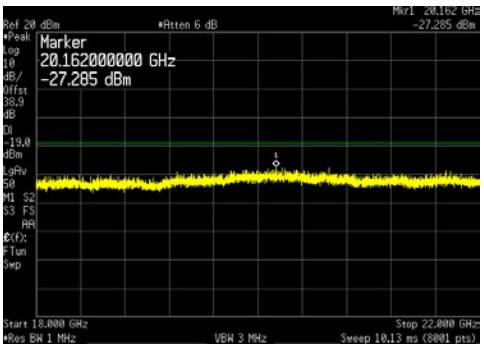
10GHz to 14GHz



14GHz to 18GHz

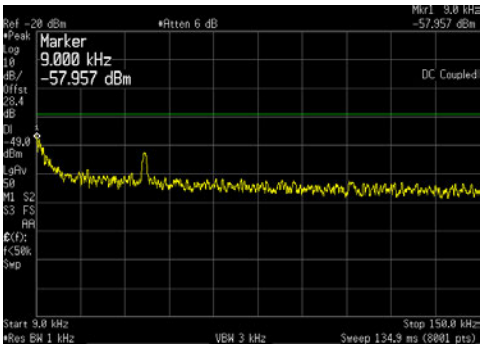


18GHz to 22GHz

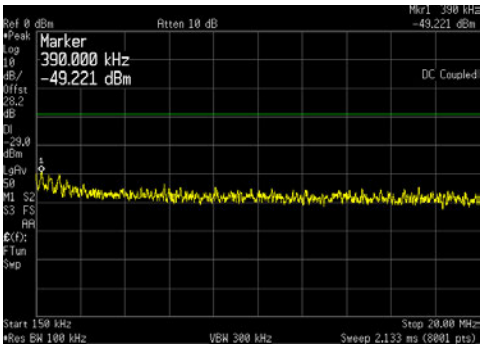


LTE5 Channel Bandwidth _ QPSK _ Middle Channel (1960MHz) at 40 watts/carrier:

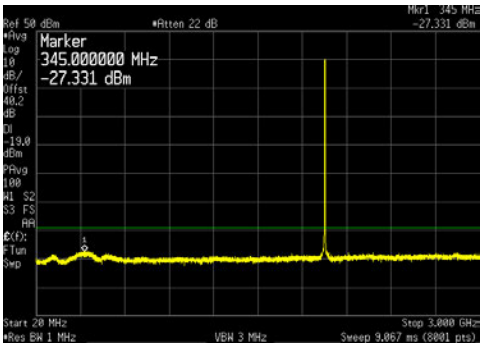
9kHz to 150kHz



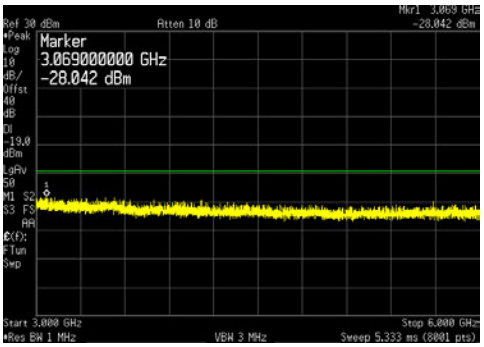
150kHz to 20MHz



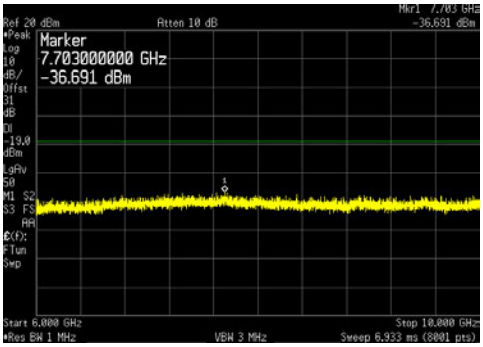
20MHz to 3GHz



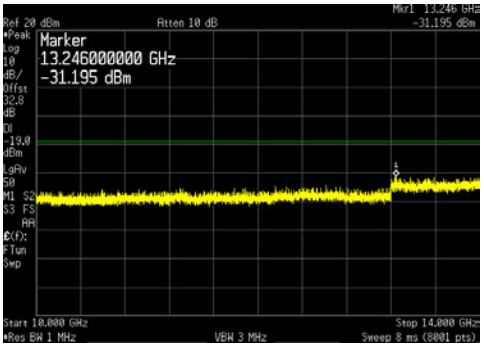
3GHz to 6GHz



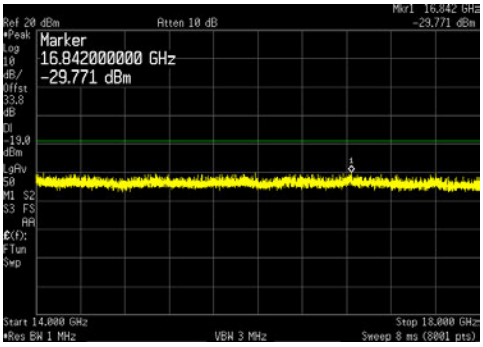
6GHz to 10GHz



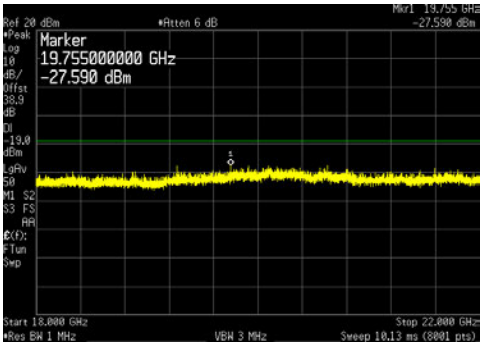
10GHz to 14GHz



14GHz to 18GHz

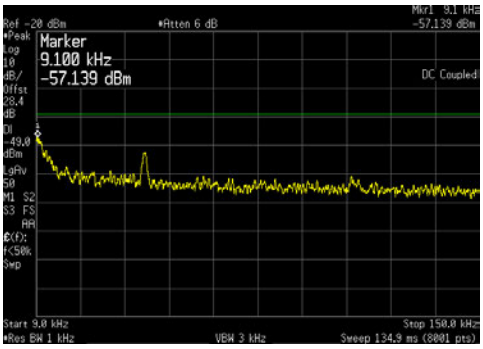


18GHz to 22GHz

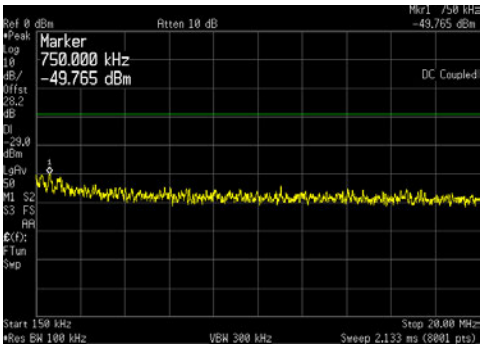


LTE5 Channel Bandwidth _ 16QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

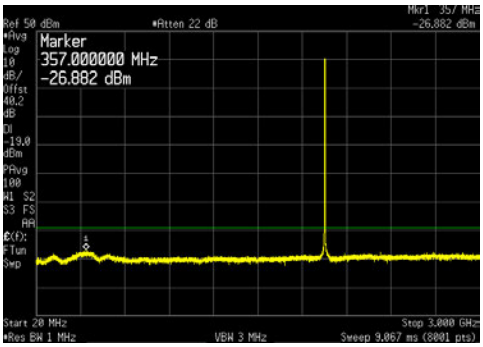
9kHz to 150kHz



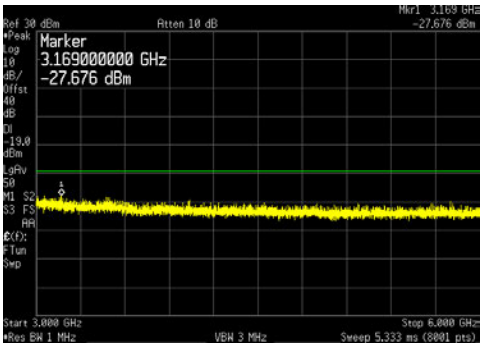
150kHz to 20MHz



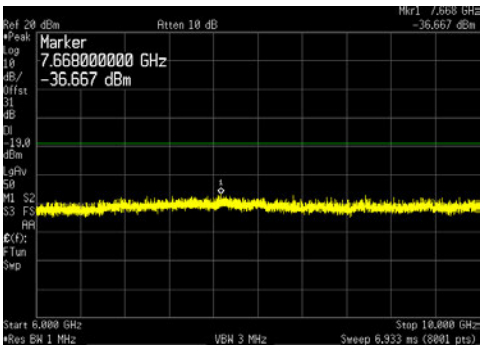
20MHz to 3GHz



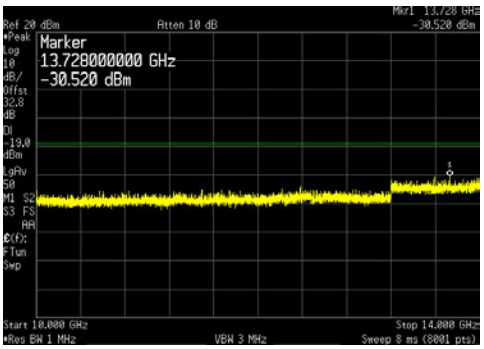
3GHz to 6GHz



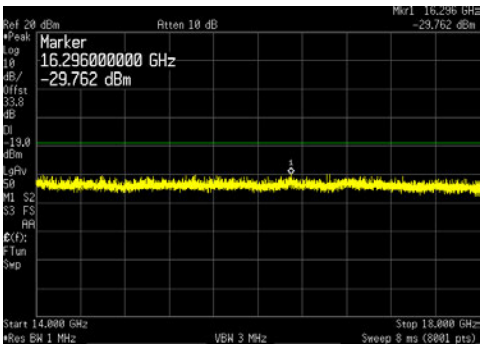
6GHz to 10GHz



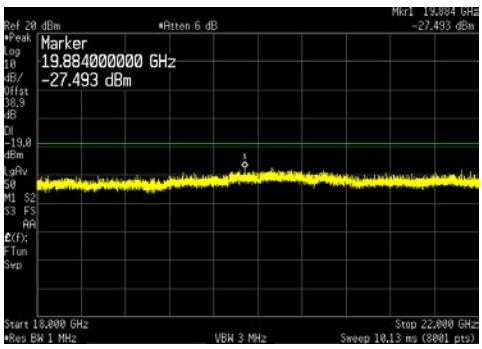
10GHz to 14GHz



14GHz to 18GHz

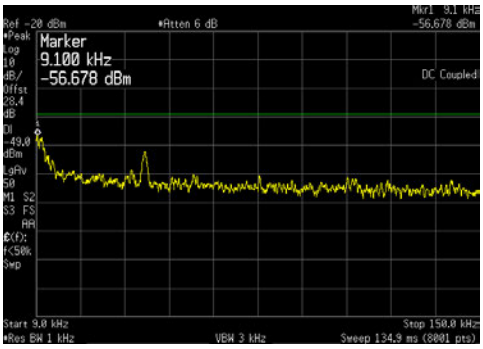


18GHz to 22GHz

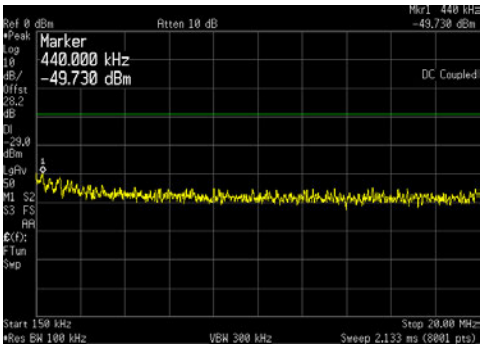


LTE5 Channel Bandwidth _ 64QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

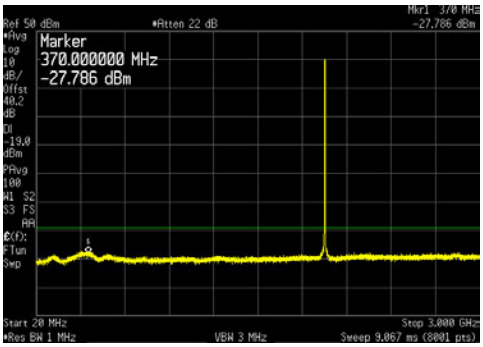
9kHz to 150kHz



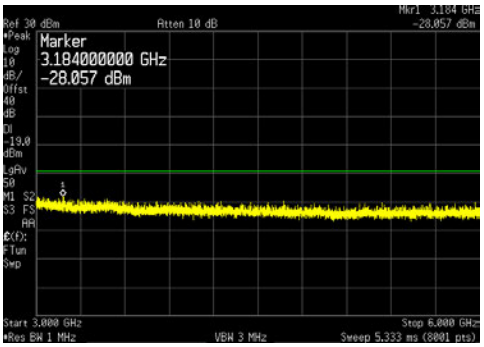
150kHz to 20MHz



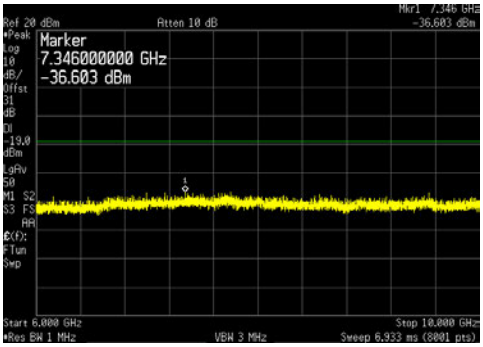
20MHz to 3GHz



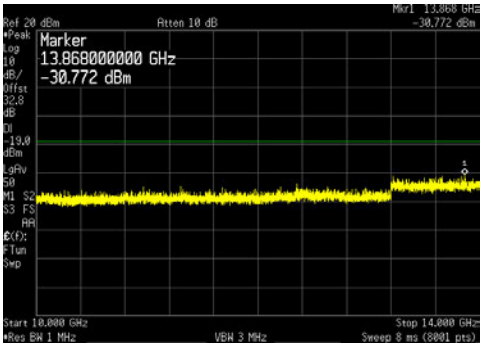
3GHz to 6GHz



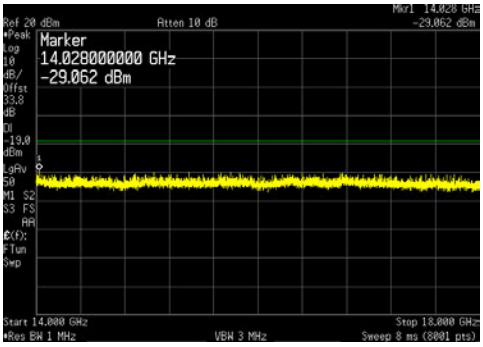
6GHz to 10GHz



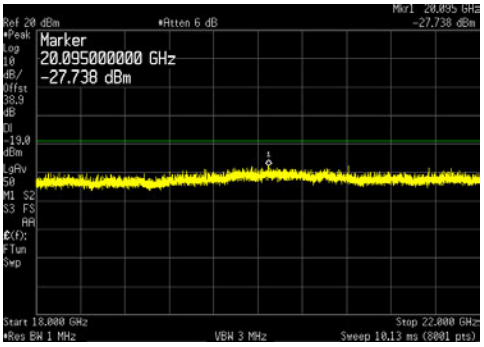
10GHz to 14GHz



14GHz to 18GHz

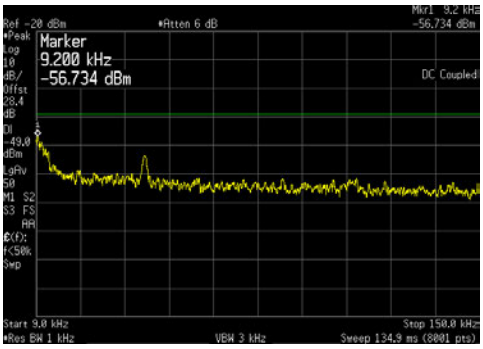


18GHz to 22GHz

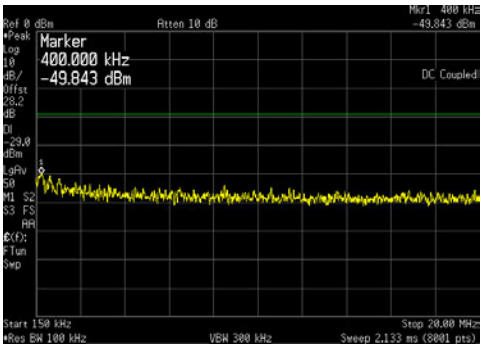


LTE5 Channel Bandwidth _ 256QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

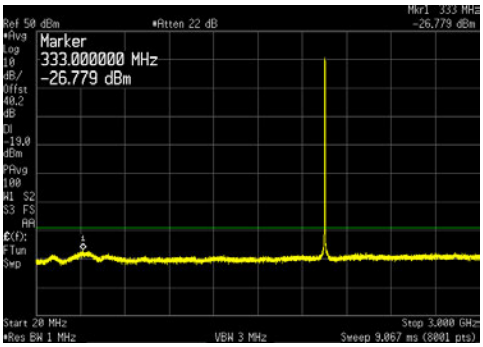
9kHz to 150kHz



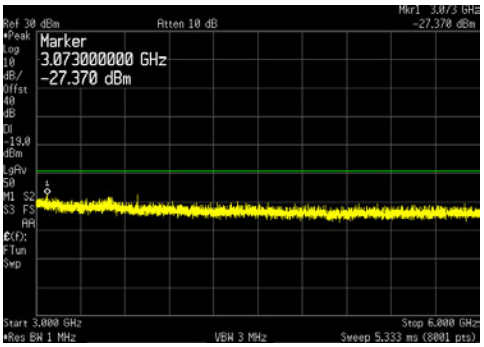
150kHz to 20MHz



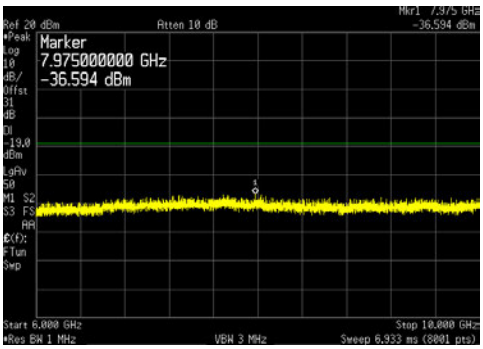
20MHz to 3GHz



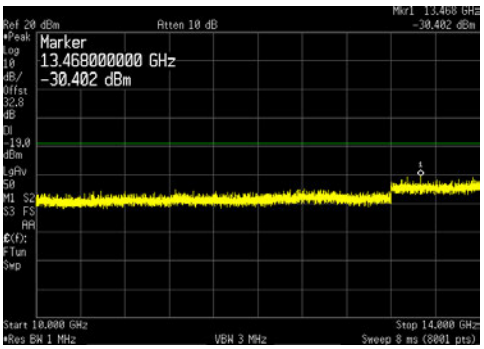
3GHz to 6GHz



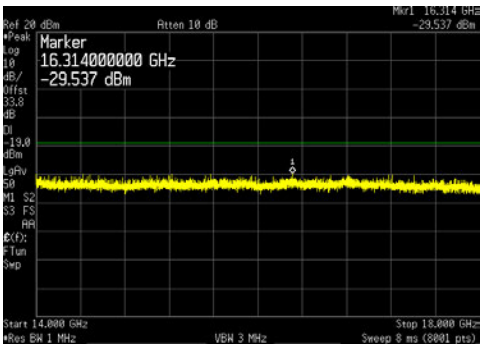
6GHz to 10GHz



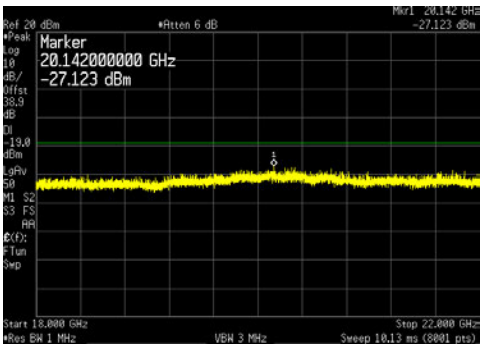
10GHz to 14GHz



14GHz to 18GHz

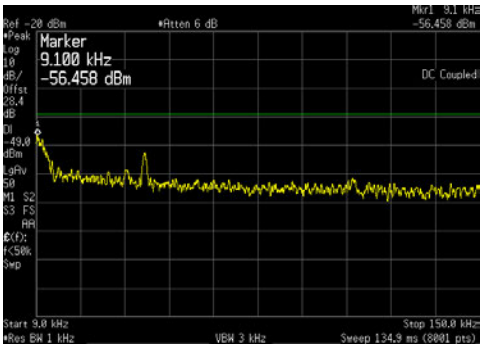


18GHz to 22GHz

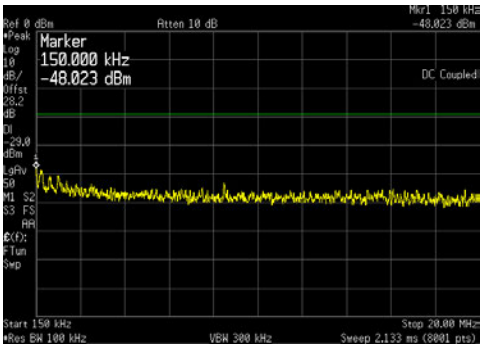


LTE10 Channel Bandwidth _ QPSK _ Middle Channel (1960MHz) at 40 watts/carrier:

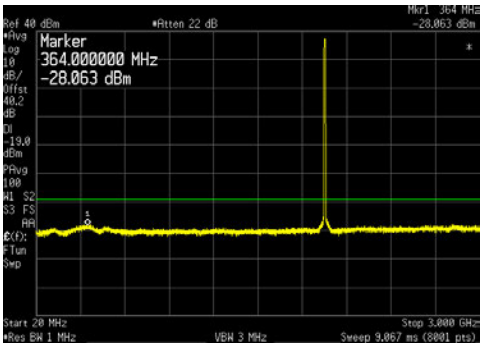
9kHz to 150kHz



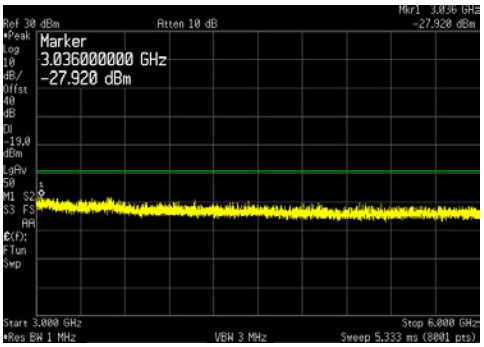
150kHz to 20MHz



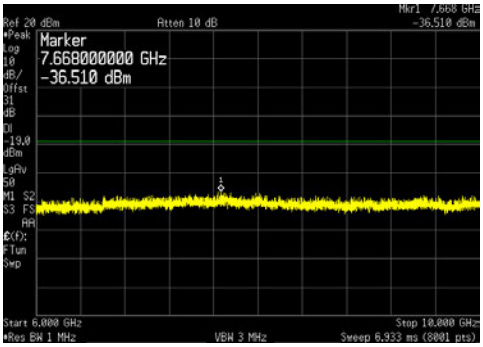
20MHz to 3GHz



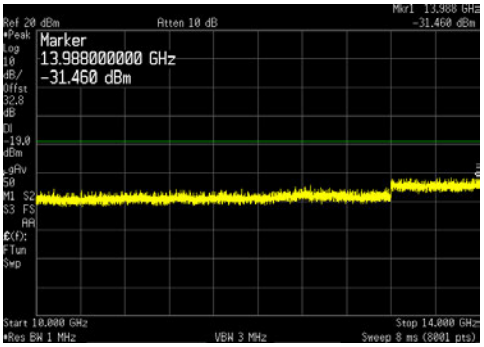
3GHz to 6GHz



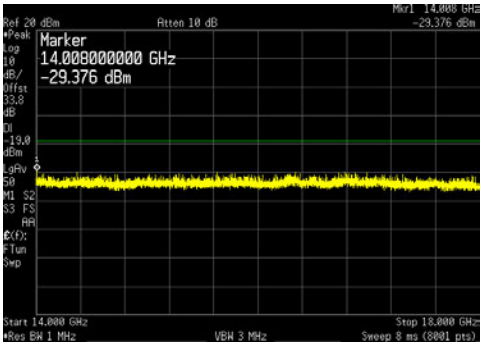
6GHz to 10GHz



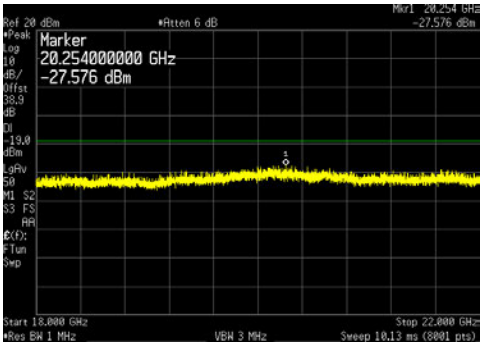
10GHz to 14GHz



14GHz to 18GHz

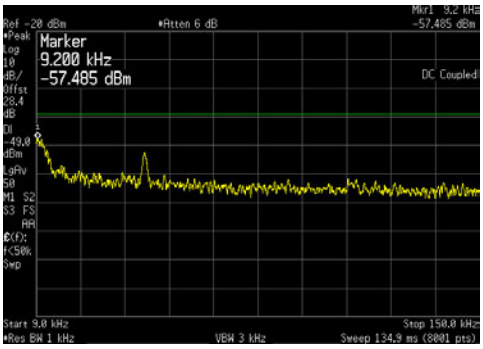


18GHz to 22GHz

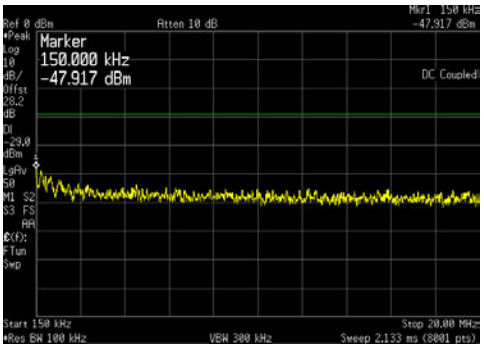


LTE10 Channel Bandwidth _ 16QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

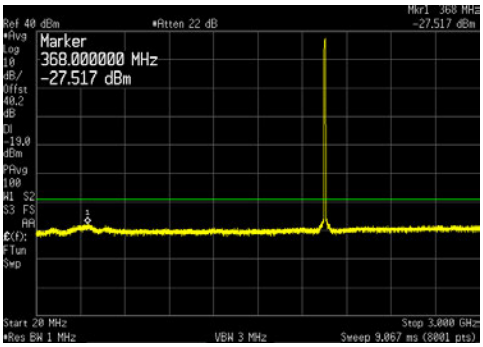
9kHz to 150kHz



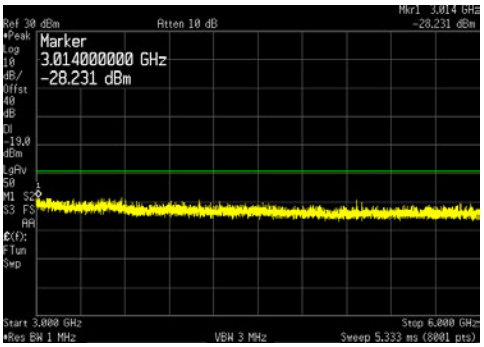
150kHz to 20MHz



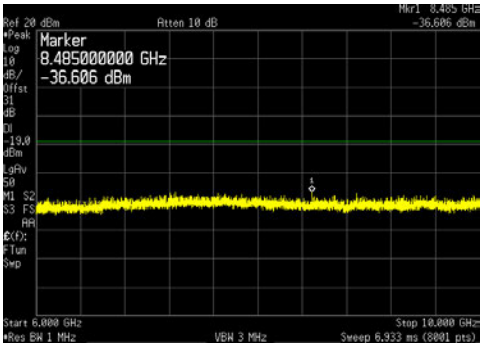
20MHz to 3GHz



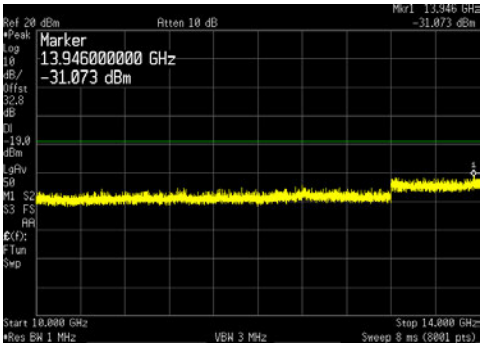
3GHz to 6GHz



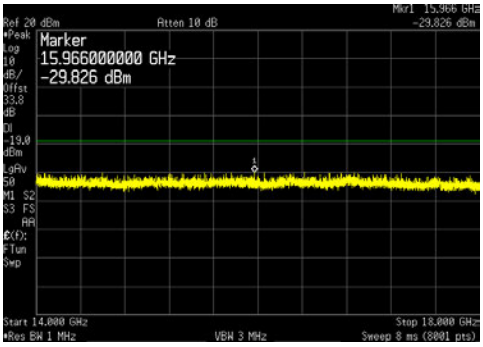
6GHz to 10GHz



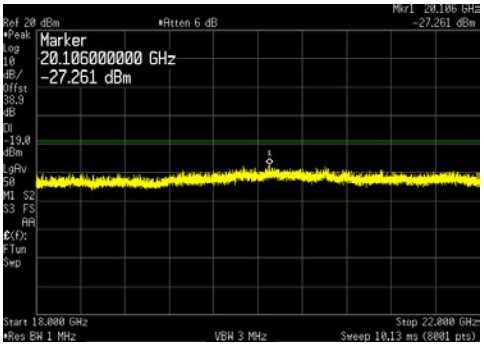
10GHz to 14GHz



14GHz to 18GHz

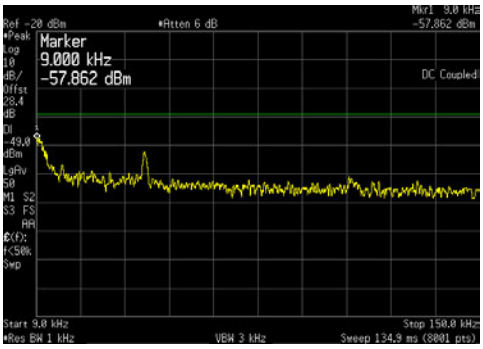


18GHz to 22GHz

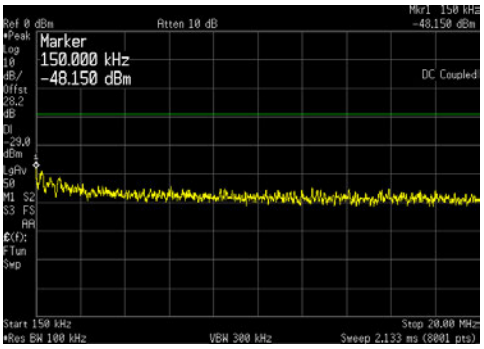


LTE10 Channel Bandwidth _ 64QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

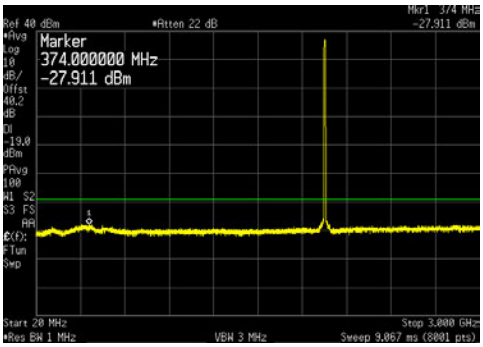
9kHz to 150kHz



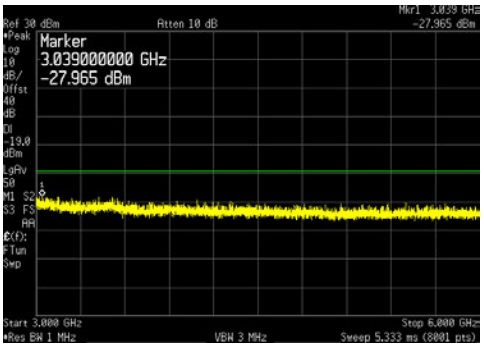
150kHz to 20MHz



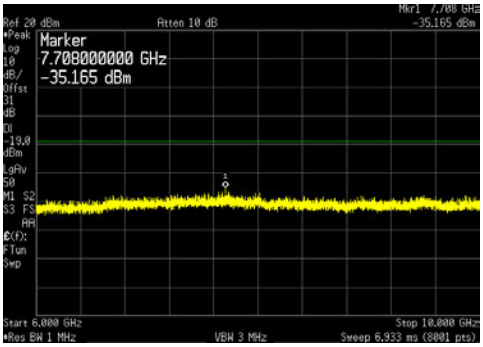
20MHz to 3GHz



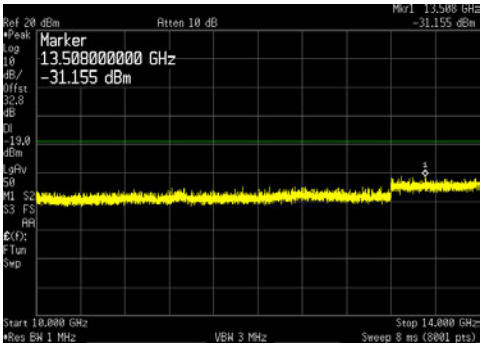
3GHz to 6GHz



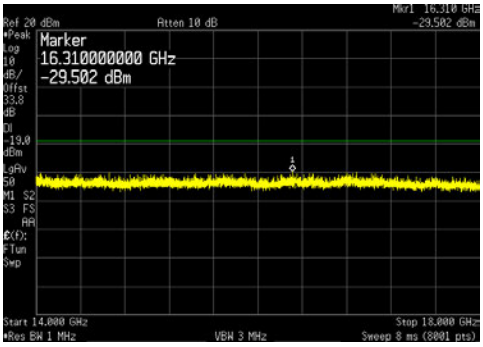
6GHz to 10GHz



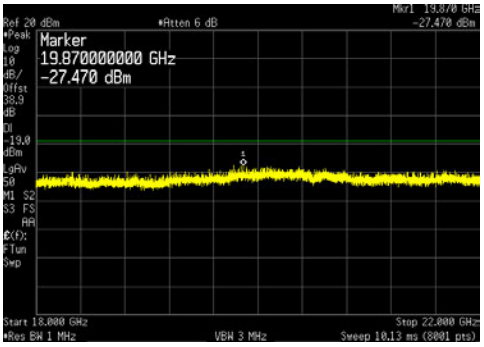
10GHz to 14GHz



14GHz to 18GHz

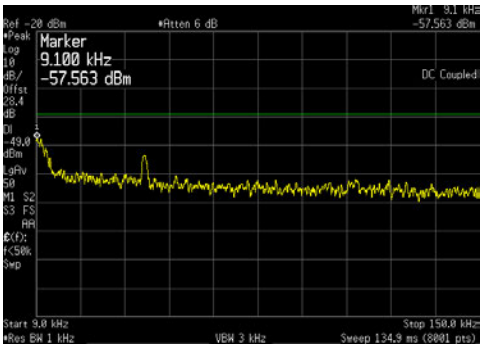


18GHz to 22GHz

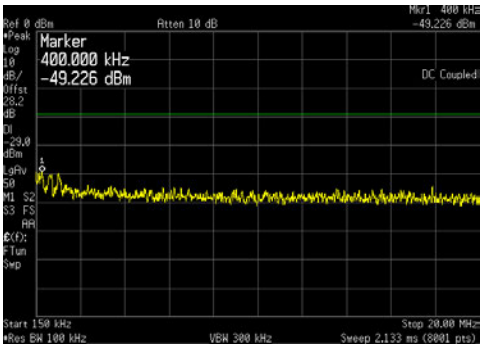


LTE10 Channel Bandwidth _ 256QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

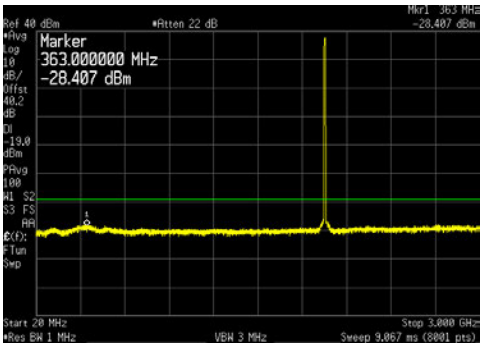
9kHz to 150kHz



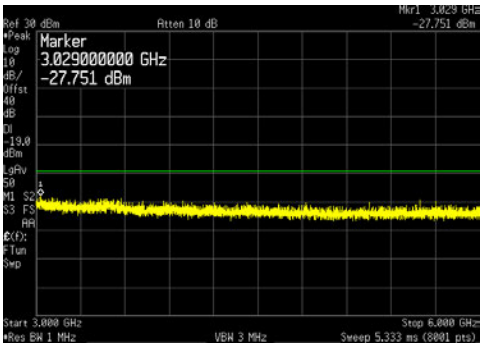
150kHz to 20MHz



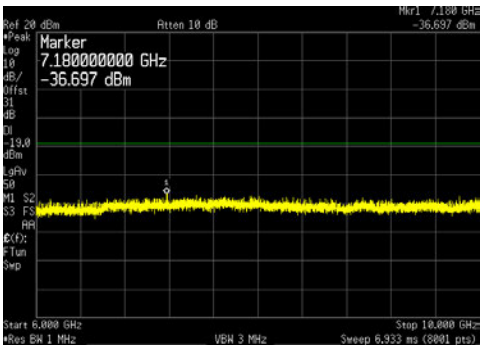
20MHz to 3GHz



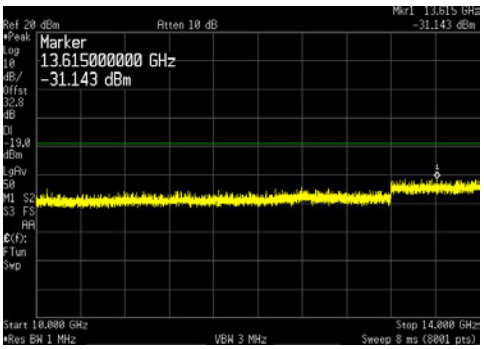
3GHz to 6GHz



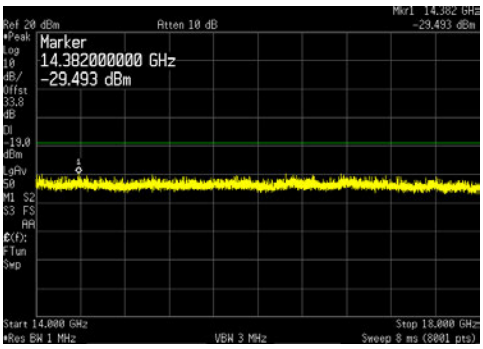
6GHz to 10GHz



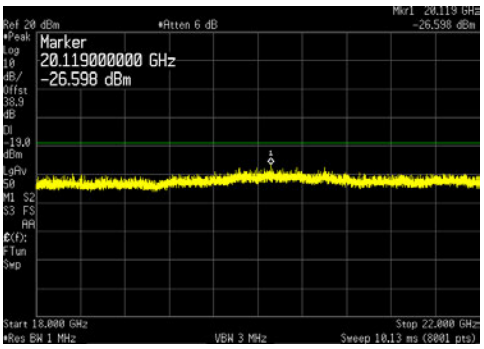
10GHz to 14GHz



14GHz to 18GHz

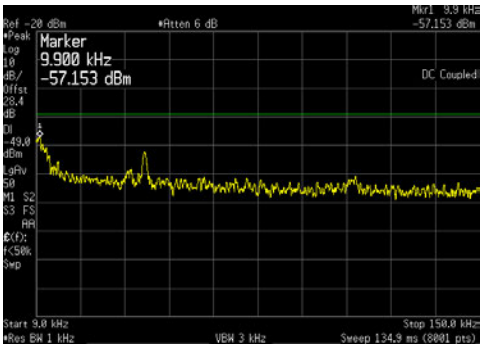


18GHz to 22GHz

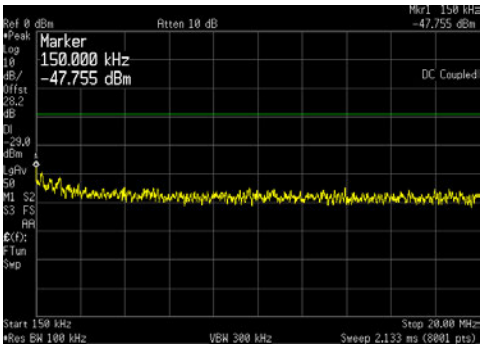


LTE15 Channel Bandwidth _ QPSK _ Middle Channel (1960MHz) at 40 watts/carrier:

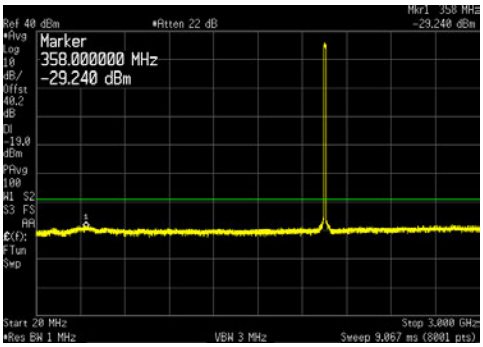
9kHz to 150kHz



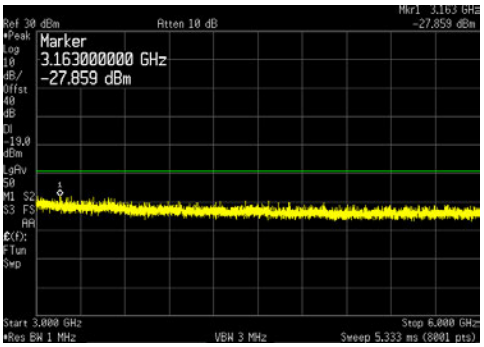
150kHz to 20MHz



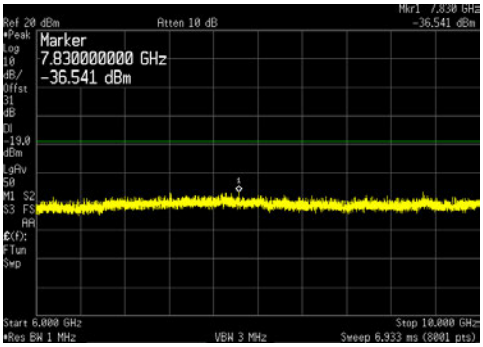
20MHz to 3GHz



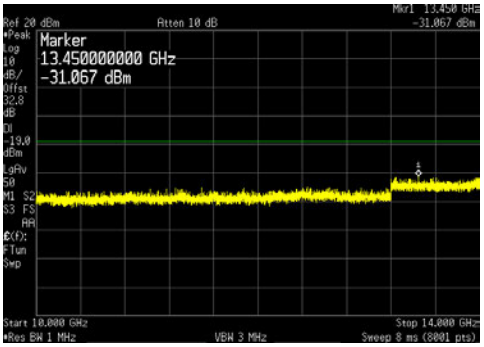
3GHz to 6GHz



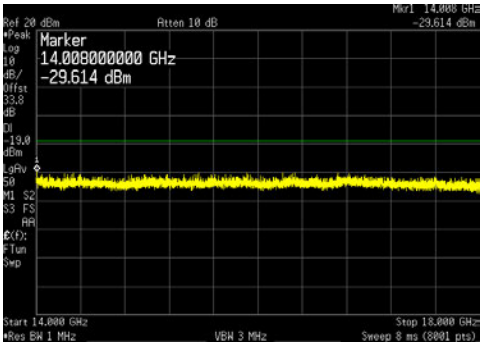
6GHz to 10GHz



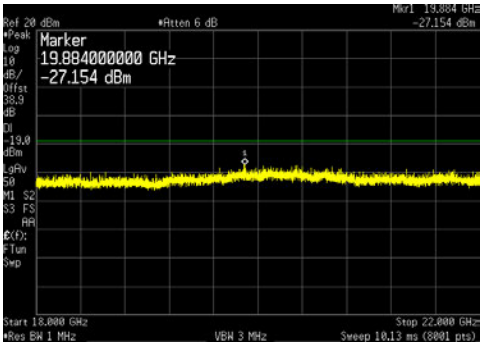
10GHz to 14GHz



14GHz to 18GHz

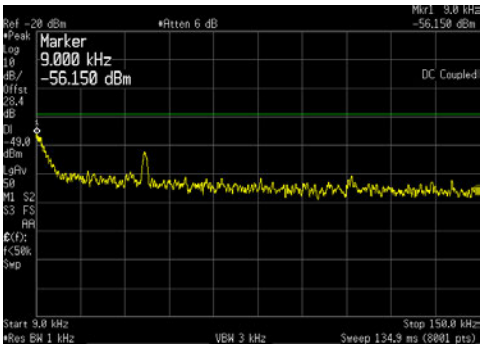


18GHz to 22GHz

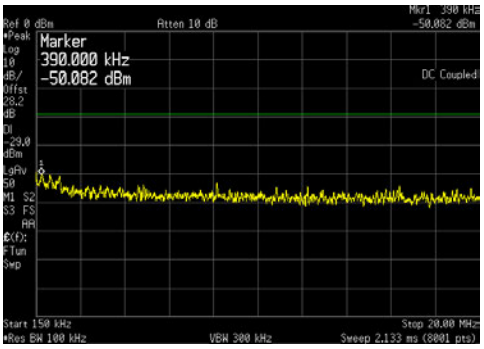


LTE15 Channel Bandwidth _ 16QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

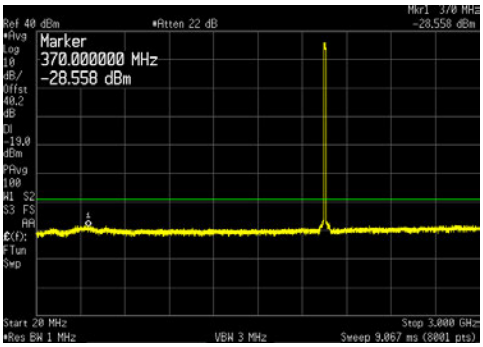
9kHz to 150kHz



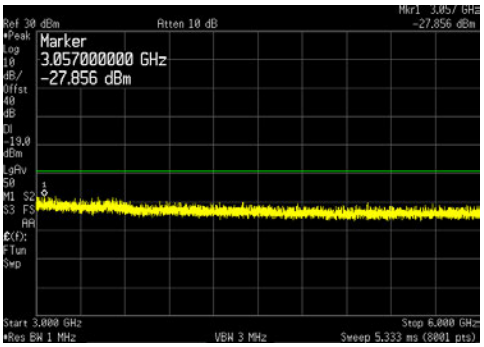
150kHz to 20MHz



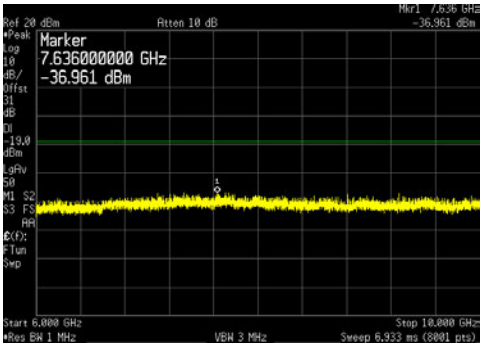
20MHz to 3GHz



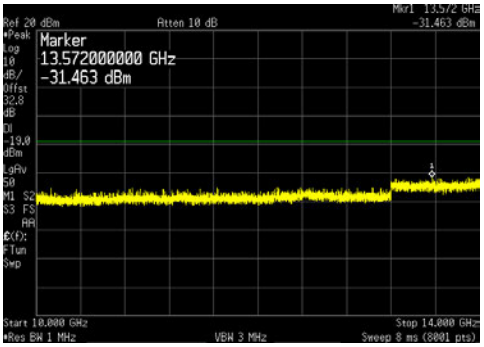
3GHz to 6GHz



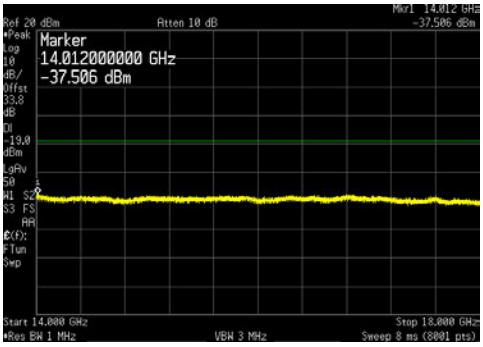
6GHz to 10GHz



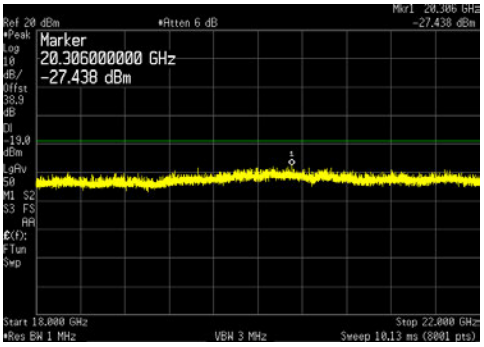
10GHz to 14GHz



14GHz to 18GHz

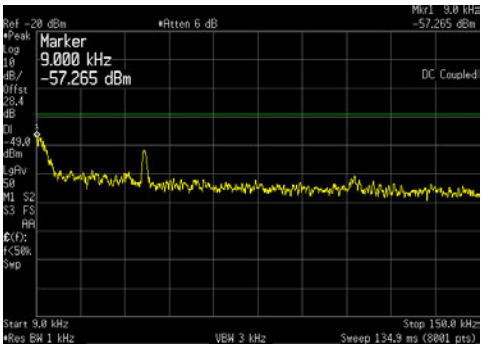


18GHz to 22GHz

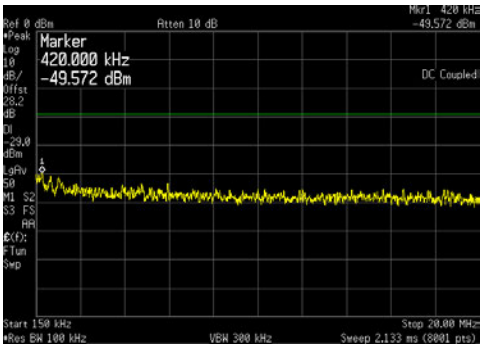


LTE15 Channel Bandwidth _ 64QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

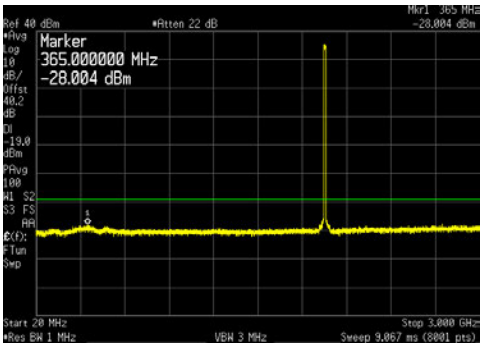
9kHz to 150kHz



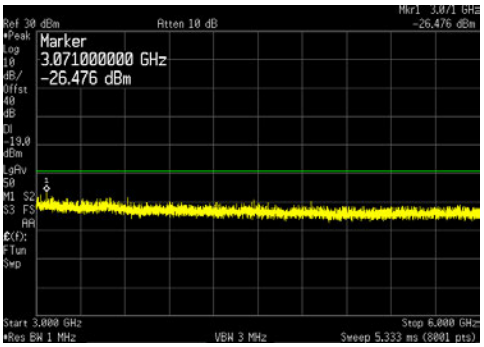
150kHz to 20MHz



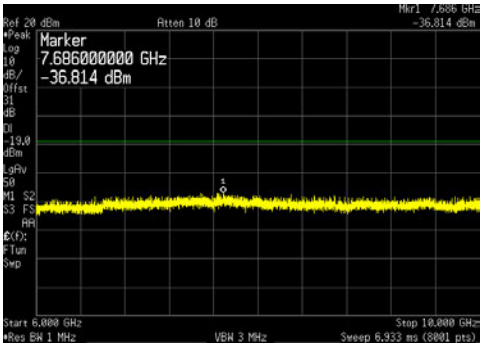
20MHz to 3GHz



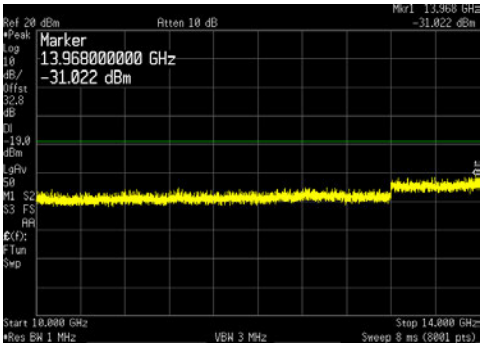
3GHz to 6GHz



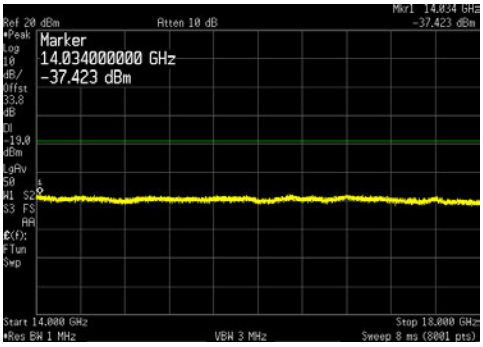
6GHz to 10GHz



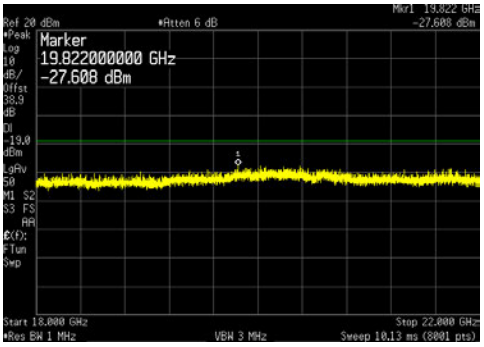
10GHz to 14GHz



14GHz to 18GHz

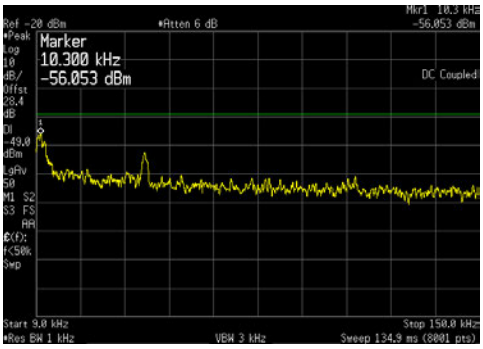


18GHz to 22GHz

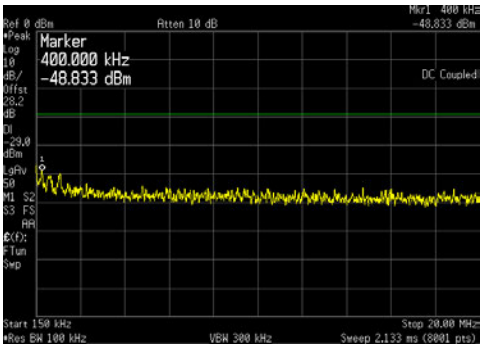


LTE15 Channel Bandwidth _ 256QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

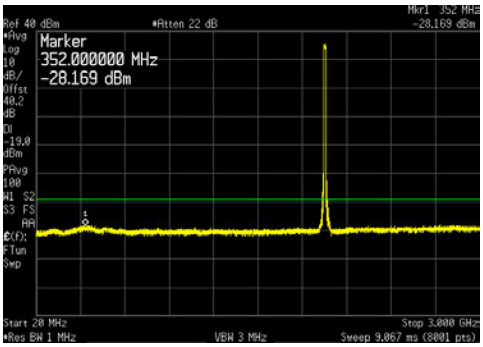
9kHz to 150kHz



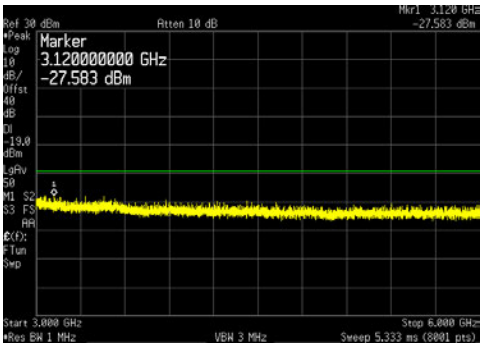
150kHz to 20MHz



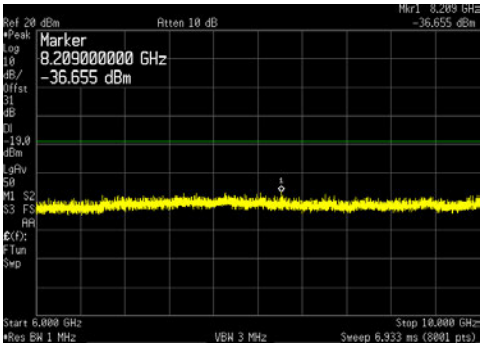
20MHz to 3GHz



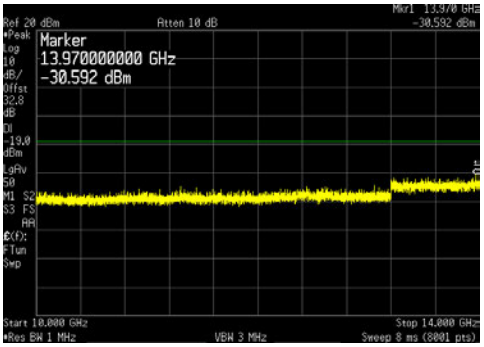
3GHz to 6GHz



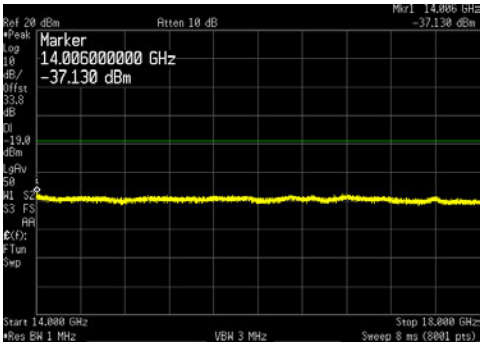
6GHz to 10GHz



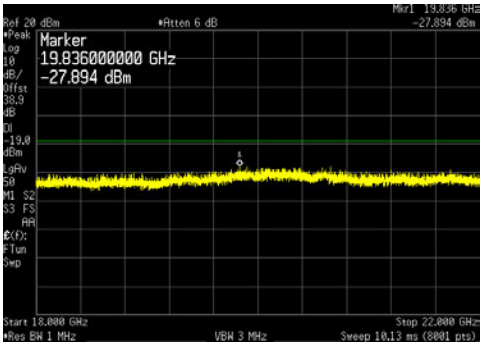
10GHz to 14GHz



14GHz to 18GHz

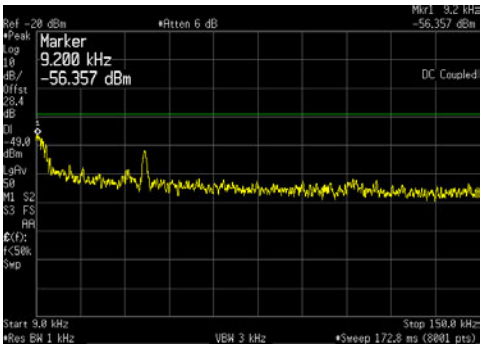


18GHz to 22GHz

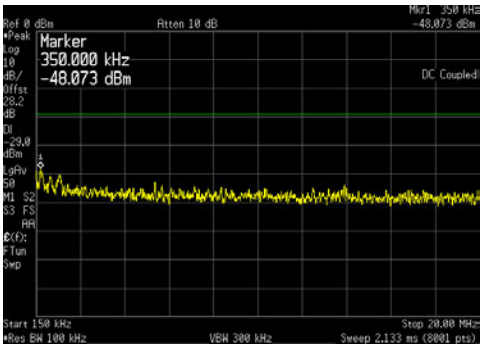


LTE20 Channel Bandwidth _ QPSK _ Middle Channel (1960MHz) at 40 watts/carrier:

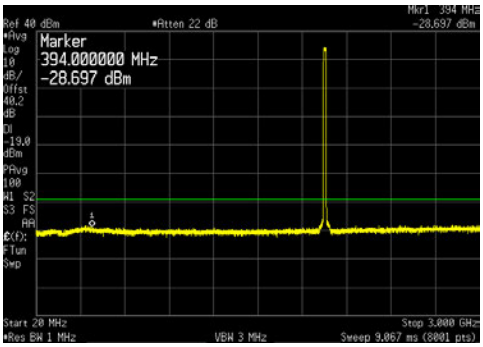
9kHz to 150kHz



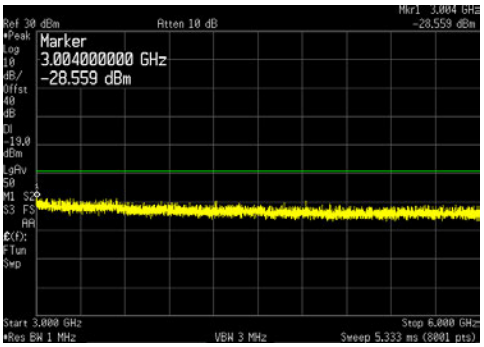
150kHz to 20MHz



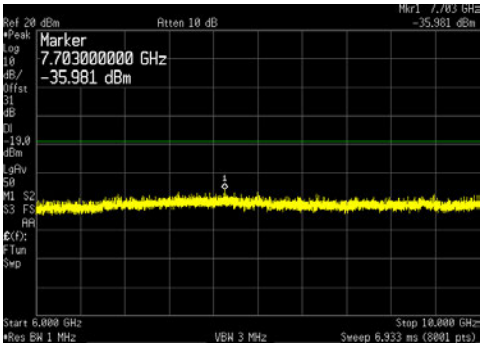
20MHz to 3GHz



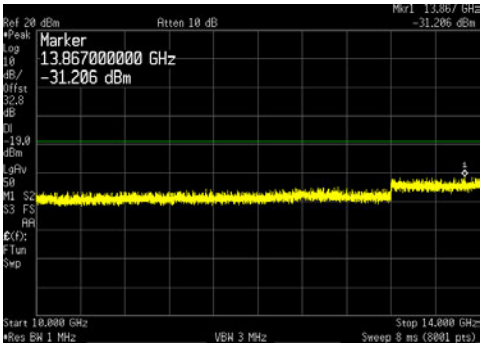
3GHz to 6GHz



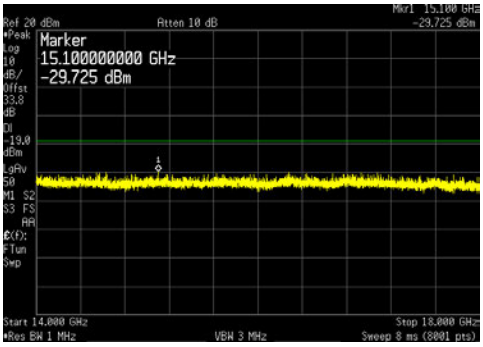
6GHz to 10GHz



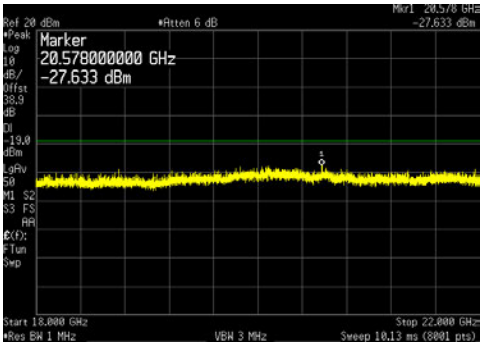
10GHz to 14GHz



14GHz to 18GHz

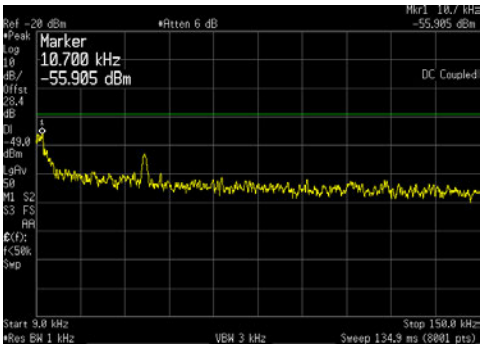


18GHz to 22GHz

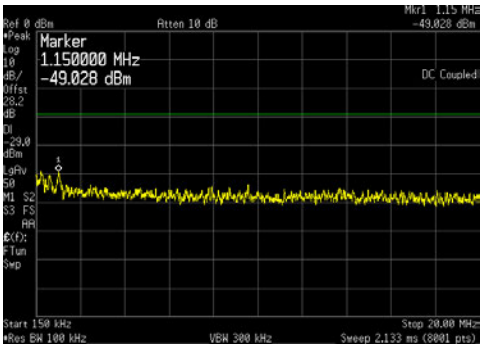


LTE20 Channel Bandwidth _ 16QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

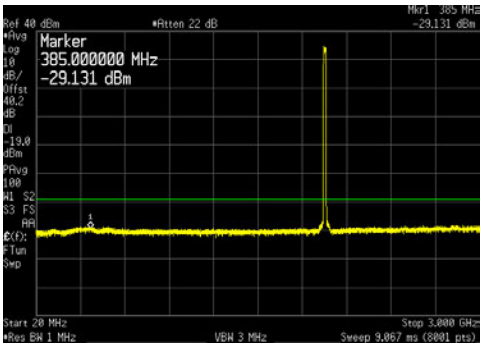
9kHz to 150kHz



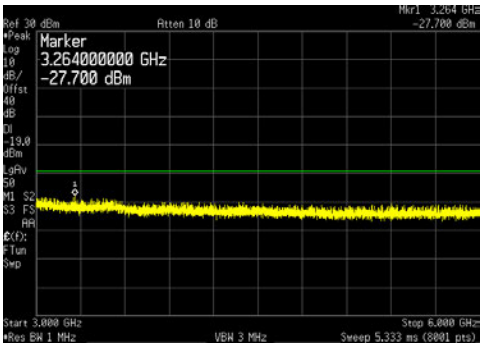
150kHz to 20MHz



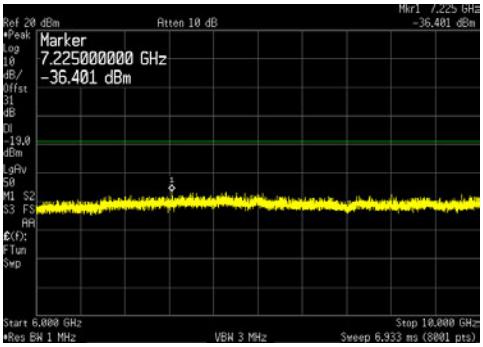
20MHz to 3GHz



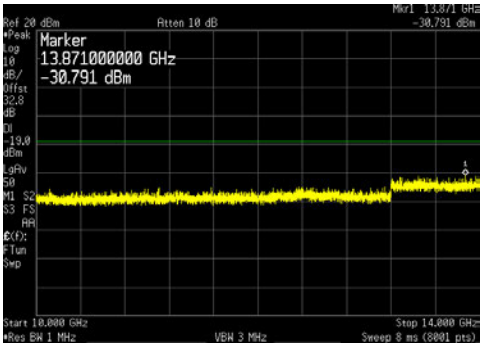
3GHz to 6GHz



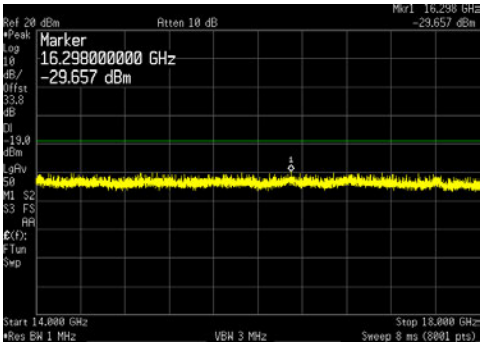
6GHz to 10GHz



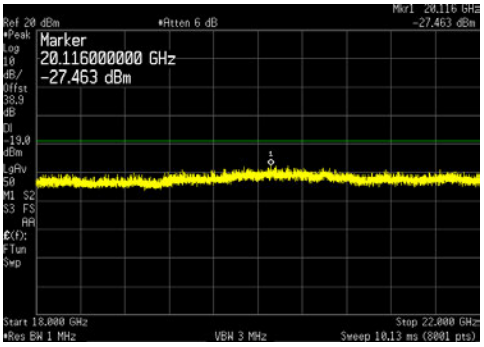
10GHz to 14GHz



14GHz to 18GHz

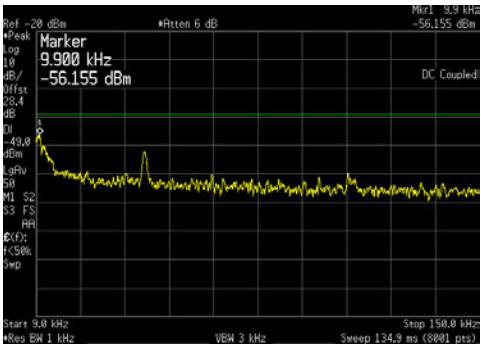


18GHz to 22GHz

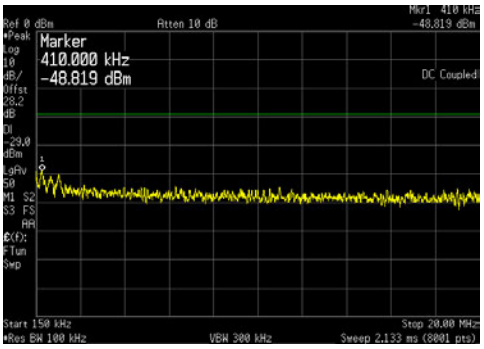


LTE20 Channel Bandwidth _ 64QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

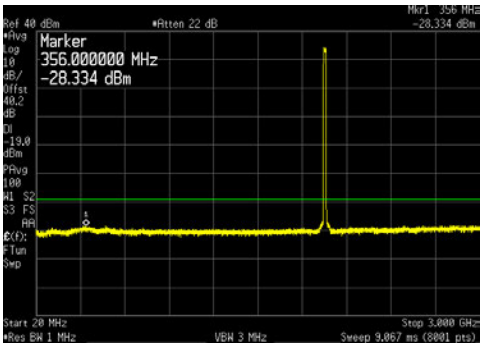
9kHz to 150kHz



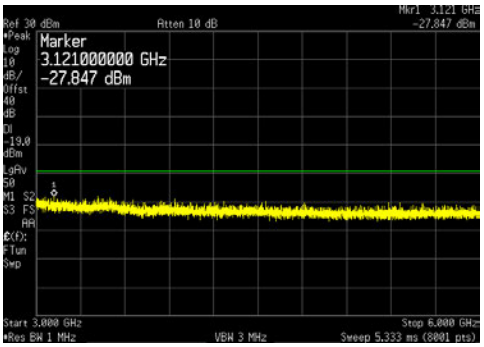
150kHz to 20MHz



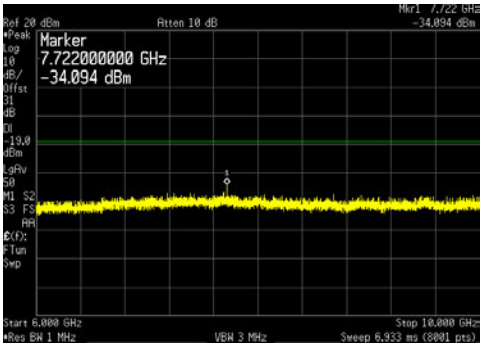
20MHz to 3GHz



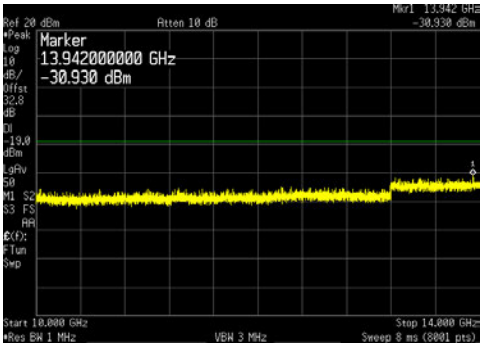
3GHz to 6GHz



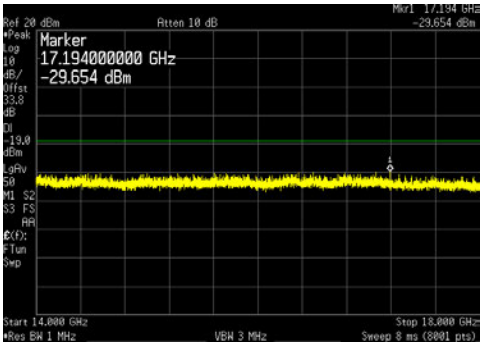
6GHz to 10GHz



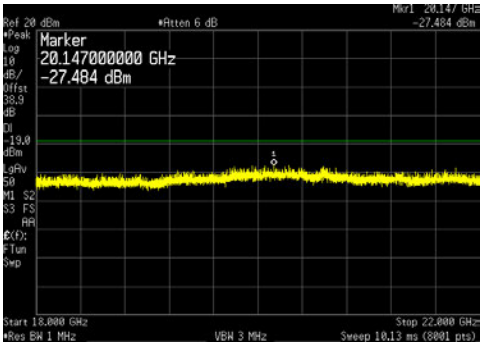
10GHz to 14GHz



14GHz to 18GHz

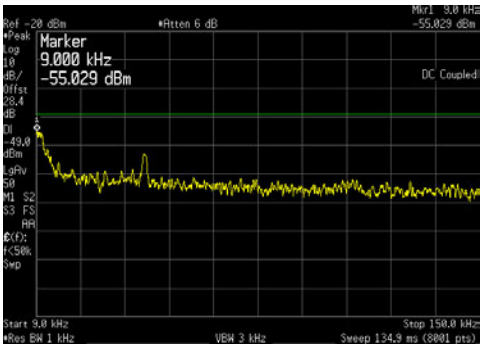


18GHz to 22GHz

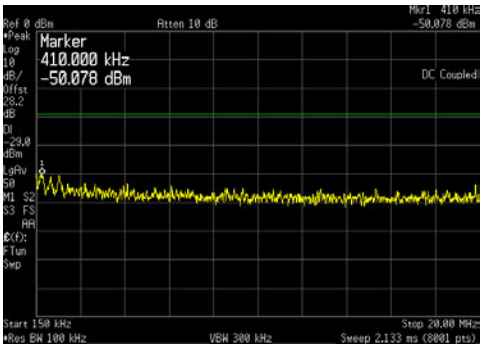


LTE20 Channel Bandwidth _ 256QAM _ Middle Channel (1960MHz) at 40 watts/carrier:

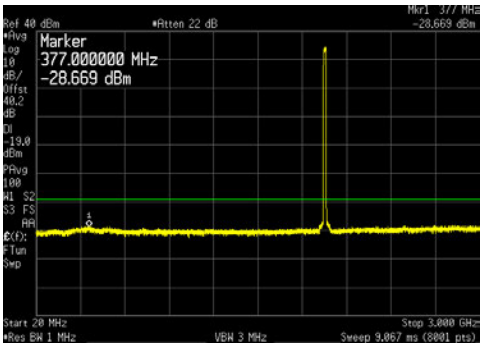
9kHz to 150kHz



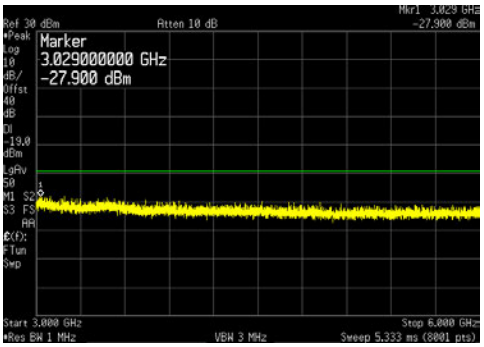
150kHz to 20MHz



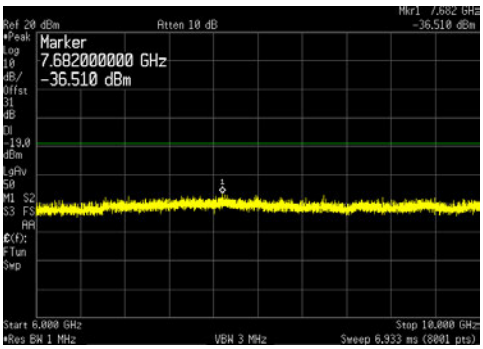
20MHz to 3GHz



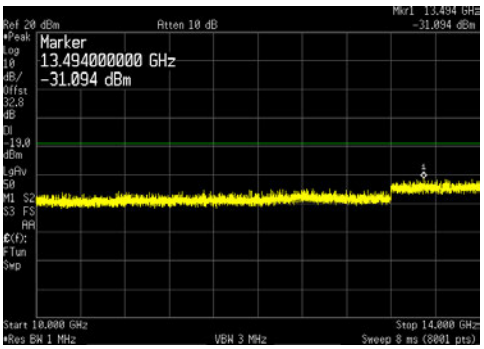
3GHz to 6GHz



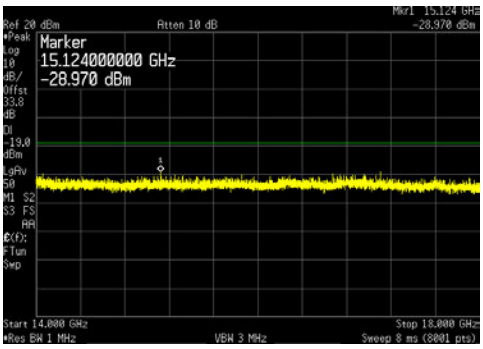
6GHz to 10GHz



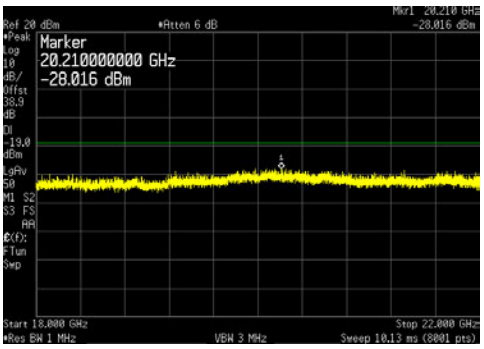
10GHz to 14GHz



14GHz to 18GHz

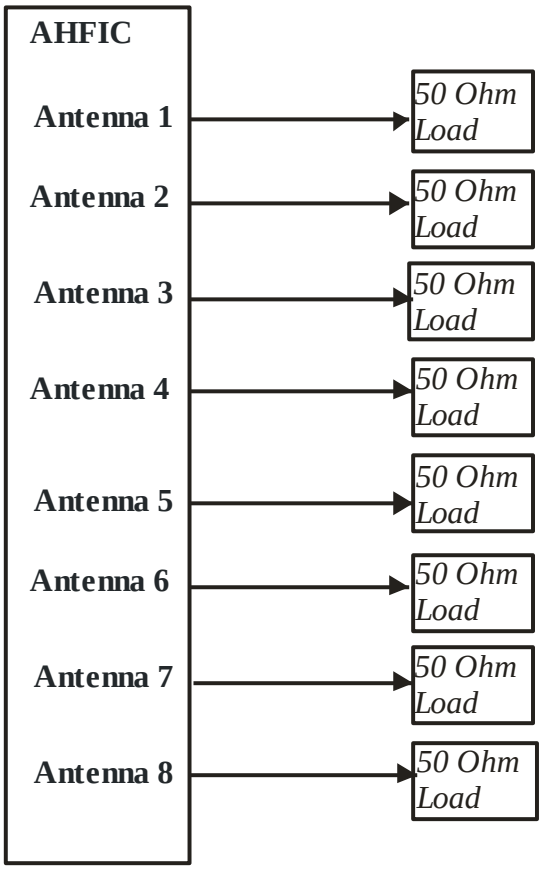


18GHz to 22GHz



Transmitter Radiated Spurious Emissions

During radiated emission testing all antenna ports of the base station were terminated with 50ohm termination blocks as shown in the diagram below.



Based on antenna port conducted spurious emissions tests results, preliminary scans for radiated spurious emissions were performed in 30MHz – 22GHz frequency range. Two test configurations are needed for radiated spurious emission measurements. The first test is with PCS and AWS carriers operating at 40W/carrier. The second test is with the PCS carriers operating at 20W/carrier and the AWS carriers operating at 60W/carrier.

The tests include channel bandwidth with the highest spectral density for both frequency bands. The bottom, middle and top frequency channels for each band are enabled. The carrier configurations for the radiated emission testing are provided below. Final maximized radiated emissions are measured in these modes.

Frequency Band	Ant Port	RF BW	EARFCN	Transmit Frequency	Carrier Power
AWS	1	5 MHz	66443 (Bottom Channel)	2112.5 MHz	40 Watts
AWS	2	5 MHz	66786 (Middle Channel)	2145.0 MHz	40 Watts
AWS	3	5 MHz	66786 (Middle Channel)	2145.0 MHz	40 Watts
AWS	4	5 MHz	67129 (Top Channel)	2177.5 MHz	40 Watts
PCS	5	1.4 MHz	607 (Bottom Channel)	1930.7 MHz	40 Watts
PCS	6	1.4 MHz	900 (Middle Channel)	1960.0 MHz	40 Watts
PCS	7	1.4 MHz	900 (Middle Channel)	1960.0 MHz	40 Watts
PCS	8	1.4 MHz	1193 (Top Channel)	1989.3 MHz	40 Watts

PCS (at 40W/carrier) & AWS (at 40W/carrier) Carriers Enabled Simultaneously

Frequency Band	Ant Port	RF BW	EARFCN	Transmit Frequency	Carrier Power
AWS	1	5 MHz	66443 (Bottom Channel)	2112.5 MHz	60 Watts
AWS	2	5 MHz	66786 (Middle Channel)	2145.0 MHz	60 Watts
AWS	3	5 MHz	66786 (Middle Channel)	2145.0 MHz	60 Watts
AWS	4	5 MHz	67129 (Top Channel)	2177.5 MHz	60 Watts
PCS	5	1.4 MHz	607 (Bottom Channel)	1930.7 MHz	20 Watts
PCS	6	1.4 MHz	900 (Middle Channel)	1960.0 MHz	20 Watts
PCS	7	1.4 MHz	900 (Middle Channel)	1960.0 MHz	20 Watts
PCS	8	1.4 MHz	1193 (Top Channel)	1989.3 MHz	20 Watts

PCS (at 20W/carrier) & AWS (at 60W/carrier) Carriers Enabled Simultaneously

Radiated Spurious Data for the 40Wx40W configuration

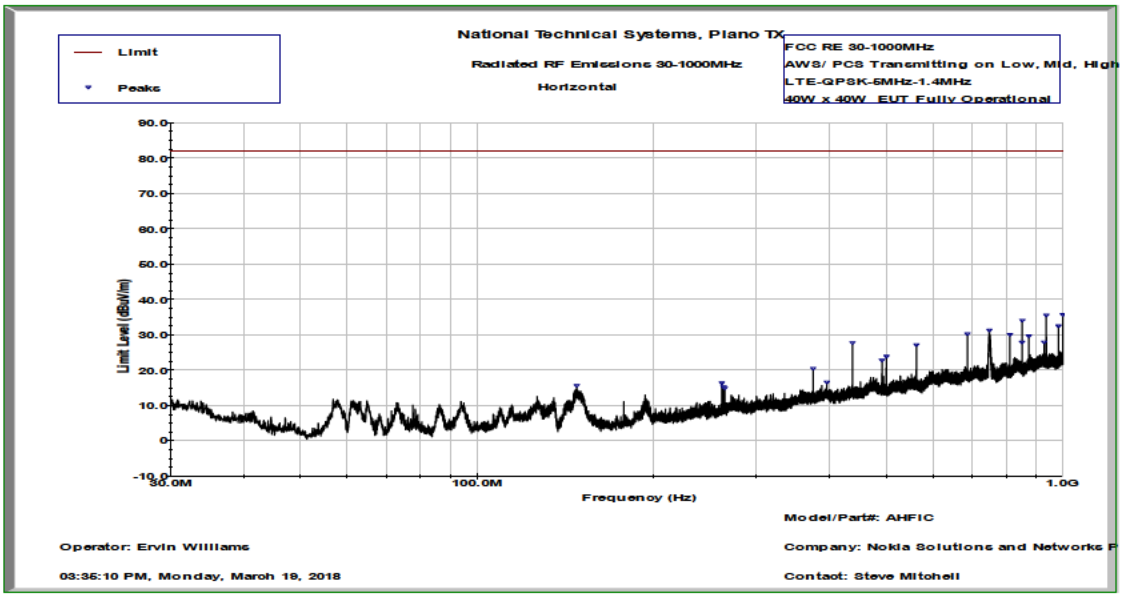
Frequency	Polarity	Peaks Raw	Antenna	Pre Amp	Cables	Peaks	Limit	Margin	Tower	Turntable
MHz	V/H	dBuV/m	dB	dB	dB	dBuV/m	dBuV/m	dB	cm	Degrees
17958.80	H	27.308	48.513	-28.887	11.288	58.079	91.7	-33.621	150	0
14666.30	H	34.686	40.674	-30.027	10.354	55.871	91.7	-35.829	150	0
13549.00	H	32.143	41.129	-28.632	9.903	54.426	91.7	-37.274	150	0
3932.24	V	39.478	32.676	-32.199	4.966	44.921	82.2	-37.279	135.1	305.1
9985.08	H	29.212	38.021	-30.913	8.429	44.748	82.2	-37.452	200.1	347.9
13355.60	H	32.071	41.017	-28.358	9.45	54.18	91.7	-37.52	150	0
17990.80	V	22.495	48.733	-28.916	11.314	53.406	91.7	-38.294	150	0.1
8830.83	V	28.282	37.652	-31.314	7.661	42.281	82.2	-39.919	200	213
14077.50	H	28.133	42.039	-29.721	10.409	50.86	91.7	-40.84	150	0
2949.23	H	40.845	29.718	-33.732	4.174	41.003	82.2	-41.197	200.1	265.1
3931.77	H	34.353	32.676	-32.199	4.965	39.794	82.2	-42.406	177	226.1
13541.90	V	26.449	41.144	-28.608	9.925	48.777	91.7	-42.923	150	-0.1
1000.00	V	48.428	23.8	-37.361	4.268	39.135	82.2	-43.065	300	209.1
5898.24	V	30.126	34.08	-31.827	6.465	38.844	82.2	-43.356	200.1	299.1
14663.00	V	27.066	40.671	-30.018	10.341	48.263	91.7	-43.437	150	0
2949.22	V	38.222	29.718	-33.732	4.174	38.38	82.2	-43.82	200	310.6
8839.07	H	23.532	37.654	-31.338	7.704	37.553	82.2	-44.647	200.1	287
13899.30	H	24.861	41.491	-29.684	10.286	46.952	91.7	-44.748	150	0
14067.90	V	23.59	42.013	-29.746	10.358	46.214	91.7	-45.486	150	-0.1
937.49	V	45.524	23.5	-37.002	3.895	35.922	82.2	-46.278	120.9	10.1
6881.07	V	26.166	35.223	-31.69	5.837	35.536	82.2	-46.664	200.1	359.1
937.51	H	45.117	23.5	-37.002	3.895	35.515	82.2	-46.685	105.9	323.9
6289.61	H	25.915	34.521	-32.068	6.465	34.832	82.2	-47.368	200.1	359.9
13215.70	V	21.994	40.965	-28.54	9.668	44.088	91.7	-47.612	150	-0.1
874.99	V	43.772	23	-36.781	3.364	33.357	82.2	-48.843	177	1
929.61	V	41.128	23.708	-36.955	3.848	31.732	82.2	-50.468	100.1	176
17039.70	V	16.43	42.269	-29.528	10.964	40.178	91.7	-51.522	150	0
687.49	V	42.974	21.6	-36.485	2.228	30.316	82.2	-51.884	162	359.1
812.51	H	41.551	22.35	-36.698	2.806	30.009	82.2	-52.191	100.1	334.1
687.45	H	42.209	21.6	-36.485	2.228	29.552	82.2	-52.648	185.8	275.9

A three-meter measurement distance was used for radiated emission less than 10GHz. A one-meter measurement distance was used for radiated emission greater than 10GHz. The highest radiated emissions detected were more than 20dB below the three-meter limit of 82.2dBuV/m and the one-meter limit of 91.7dBuV/m (equivalent to -13dBm EIRP). Since all maximized measurements were more than 20dB below these levels, substitution measurements were not performed. TILE software was used for all preliminary scans and plots that are included on the following pages.

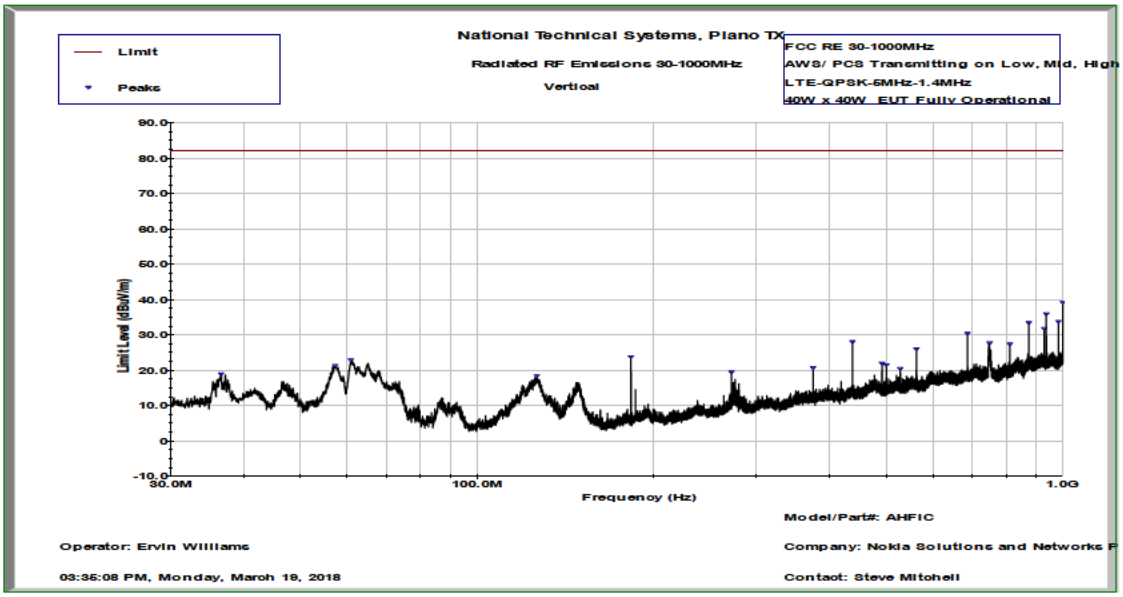
Radiated Spurious Data for the 60Wx20W configuration

Frequency	Polarity	Peaks Raw	Antenna	Pre Amp	Cables	Peaks	Limit	Margin	Tower	Turntable
MHz	V/H	dBuV/m	dB	dB	dB	dBuV/m	dBuV/m	dB	cm	Degrees
2949.02	V	53.537	29.716	-33.733	4.173	53.694	82.2	-28.506	127.1	317.1
17616.20	V	29.586	46.492	-28.679	1.09E+01	58.393	91.7	-33.307	150	0
17927.80	V	26.89	48.299	-28.859	1.13E+01	57.526	91.7	-34.174	150	-0.1
8810.66	V	33.343	37.647	-31.256	7.56E+00	47.29	82.2	-34.91	200.1	360.1
9994.78	H	31.112	38.043	-30.861	8.49E+00	46.779	82.2	-35.421	200.1	359.9
7352.41	V	34.619	36.446	-31.676	6.56E+00	45.949	82.2	-36.251	200.1	360
13449.30	H	31.862	41.092	-28.426	9.78E+00	54.164	91.7	-37.536	150	-0.2
14048.20	V	31.439	41.96	-29.798	1.03E+01	53.852	91.7	-37.848	150	-0.1
13185.40	V	31.922	40.731	-28.769	9.572	53.669	91.7	-38.031	150	-0.1
16852.50	H	28.583	41.744	-29.857	1.08E+01	51.364	91.7	-40.336	150	360
17922.40	H	20.74	48.262	-28.854	1.13E+01	51.353	91.7	-40.347	150	360.1
3932.19	V	36.089	32.676	-32.199	4.97E+00	41.532	82.2	-40.668	200.2	360
9037.27	H	27.498	37.567	-31.763	8.13E+00	41.431	82.2	-40.769	200.1	360
13748.50	V	28.239	41.168	-29.316	1.02E+01	50.286	91.7	-41.414	150	-0.1
13890.30	H	28.053	41.475	-29.662	1.03E+01	50.144	91.7	-41.556	150	-0.1
9971.66	V	24.081	37.99	-30.985	8.35E+00	39.436	82.2	-42.764	200	360
3932.21	H	32.948	32.676	-32.199	4.97E+00	38.391	82.2	-43.809	163.1	335
13523.80	V	25.182	41.182	-28.545	9.98E+00	47.624	91.7	-44.076	150	-0.1
13377.60	H	24.785	40.961	-28.374	9.477	46.849	91.7	-44.851	150	-0.1
528.82	V	53.411	18.8	-36.895	1.822	37.138	82.2	-45.062	100.2	0
2949.24	H	36.749	29.718	-33.732	4.174	36.907	82.2	-45.293	200	360
937.49	V	45.901	23.5	-37.002	3.895	36.298	82.2	-45.902	117	24
9116.61	H	22.057	37.545	-31.694	8.17E+00	36.072	82.2	-46.128	200	360
937.50	H	44.395	23.5	-37.002	3.90E+00	34.792	82.2	-47.408	300.1	14.3
687.50	V	46.21	21.6	-36.485	2.228	33.553	82.2	-48.647	99.8	262.9
5899.55	H	24.104	34.082	-31.825	6.47E+00	32.827	82.2	-49.373	200	360
7864.57	V	21.744	36.52	-31.944	6.26E+00	32.574	82.2	-49.626	200.1	360
875.00	V	42.102	23	-36.781	3.365	31.688	82.2	-50.512	300	70.9
749.45	H	43.589	21.922	-36.667	2.45E+00	31.29	82.2	-50.91	138.1	359
875.00	H	41.326	23	-36.781	3.37E+00	30.911	82.2	-51.289	113.1	359

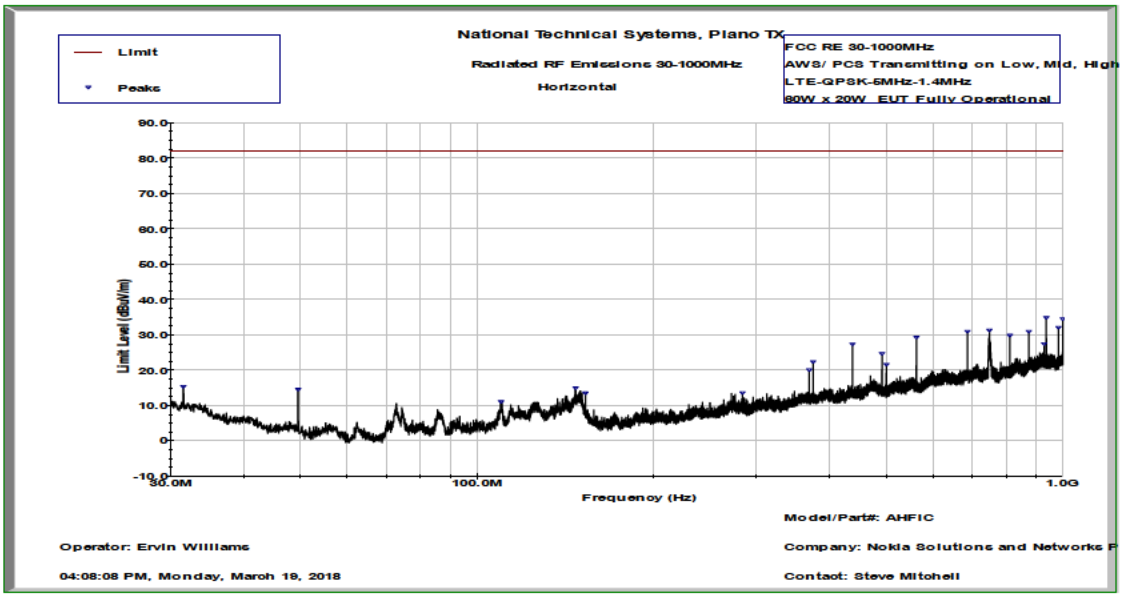
A three-meter measurement distance was used for radiated emission less than 10GHz. A one-meter measurement distance was used for radiated emission greater than 10GHz. The highest radiated emissions detected were more than 20dB below the three-meter limit of 82.2dBuV/m and the one-meter limit of 91.7dBuV/m (equivalent to -13dBm EIRP). Since all maximized measurements were more than 20dB below these levels, substitution measurements were not performed. TILE software was used for all preliminary scans and plots that are included on the following pages.



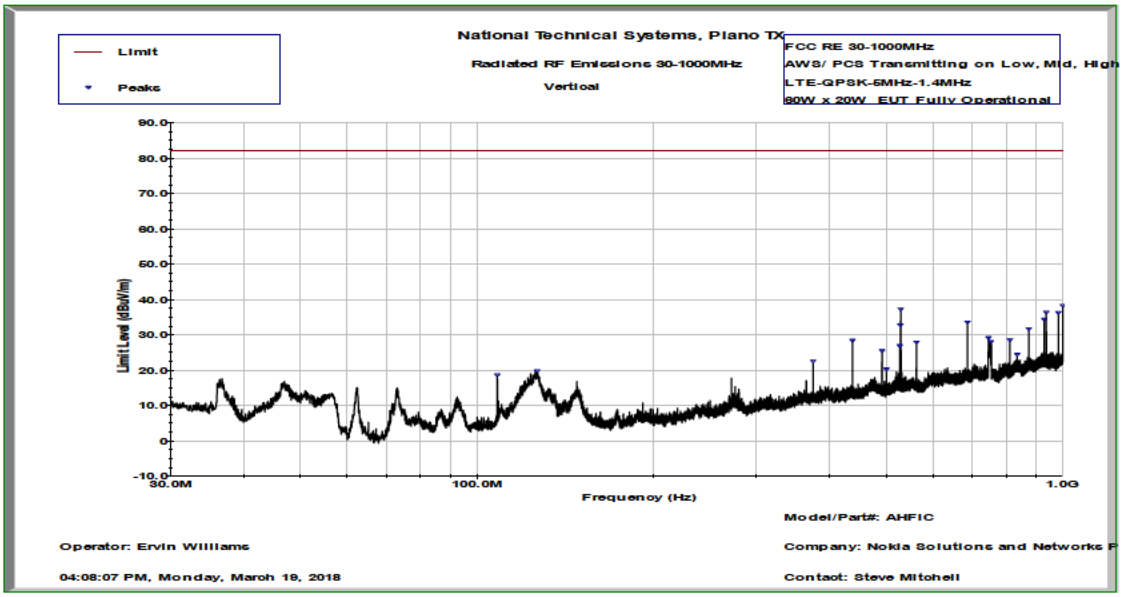
30-1000MHz – Horizontal 40w x 40w Configuration



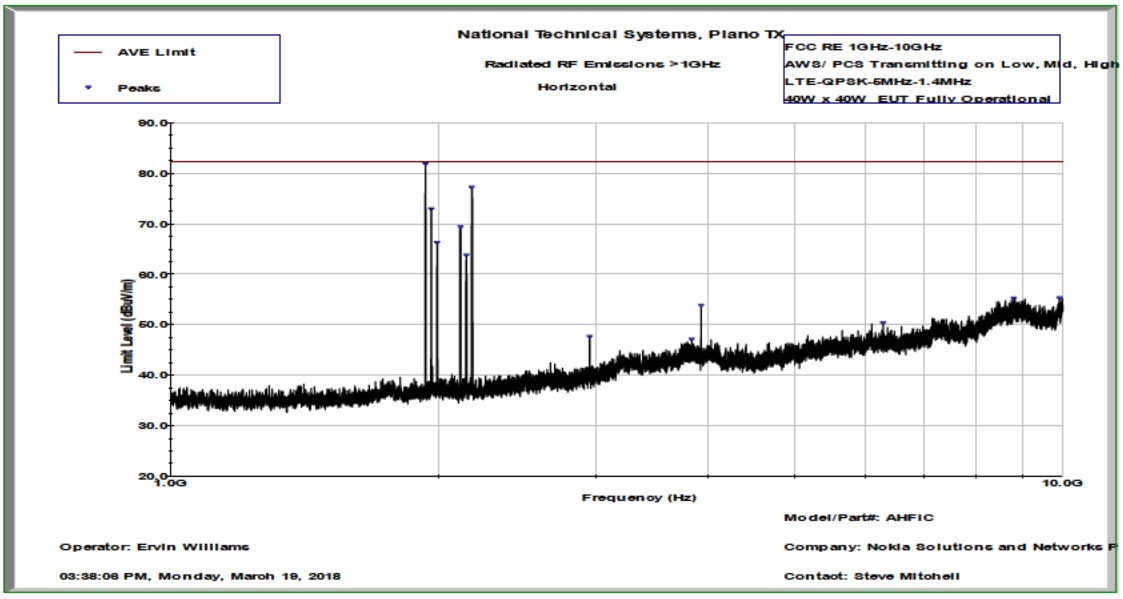
30-1000MHz – Vertical 40w x 40w Configuration



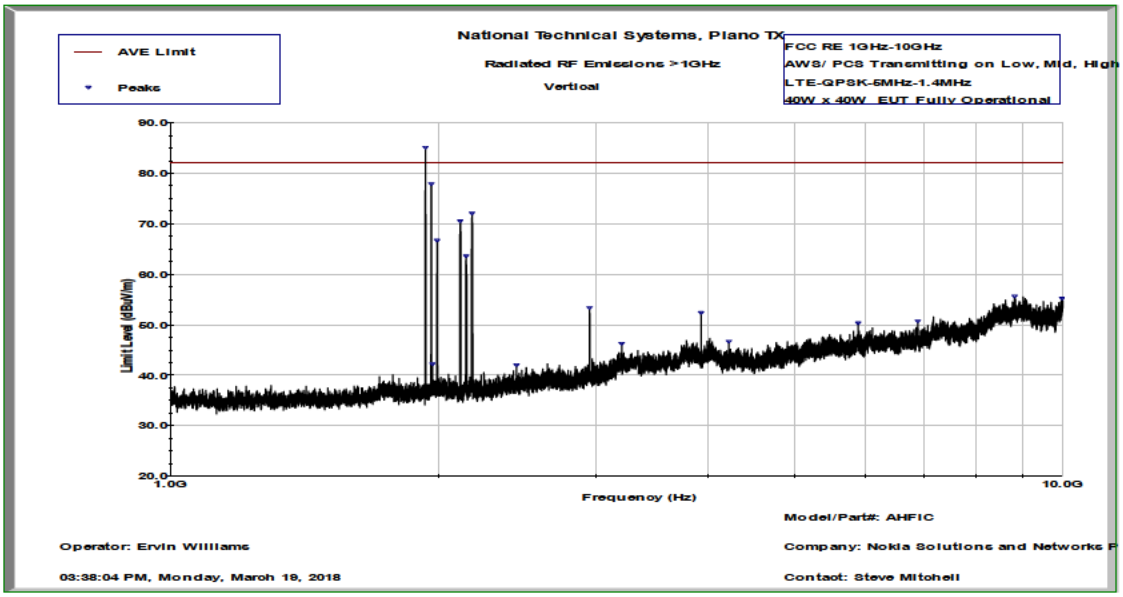
30-1000MHz – Horizontal 60w x 20w Configuration



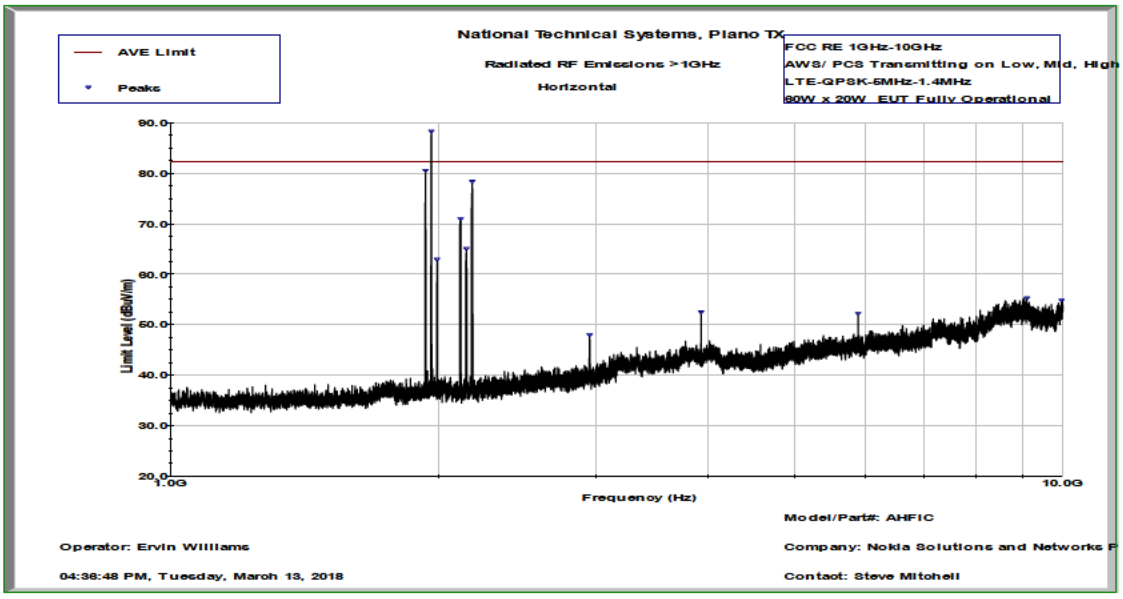
30-1000MHz – Vertical 60w x 20w Configuration



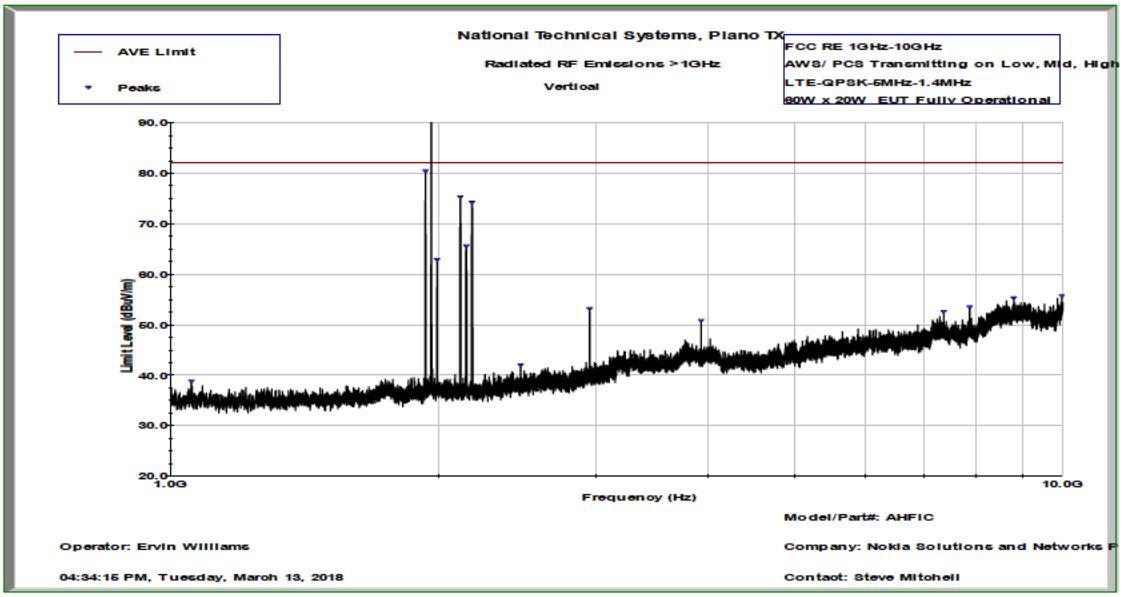
1-10GHz – Horizontal 40w x 40w Configuration



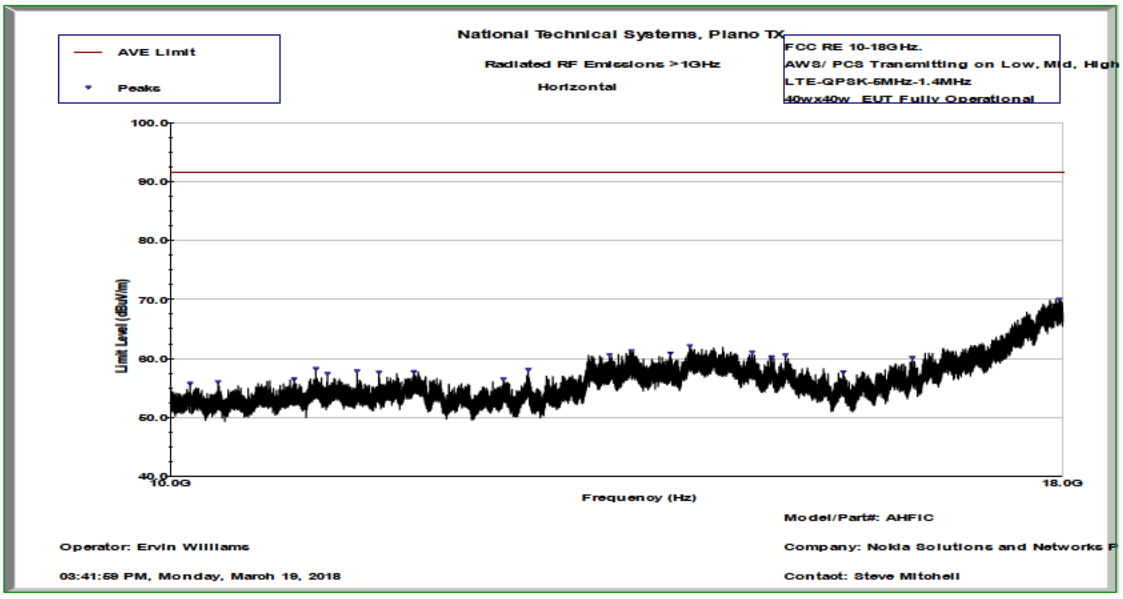
1-10GHz – Vertical 40w x 40w Configuration



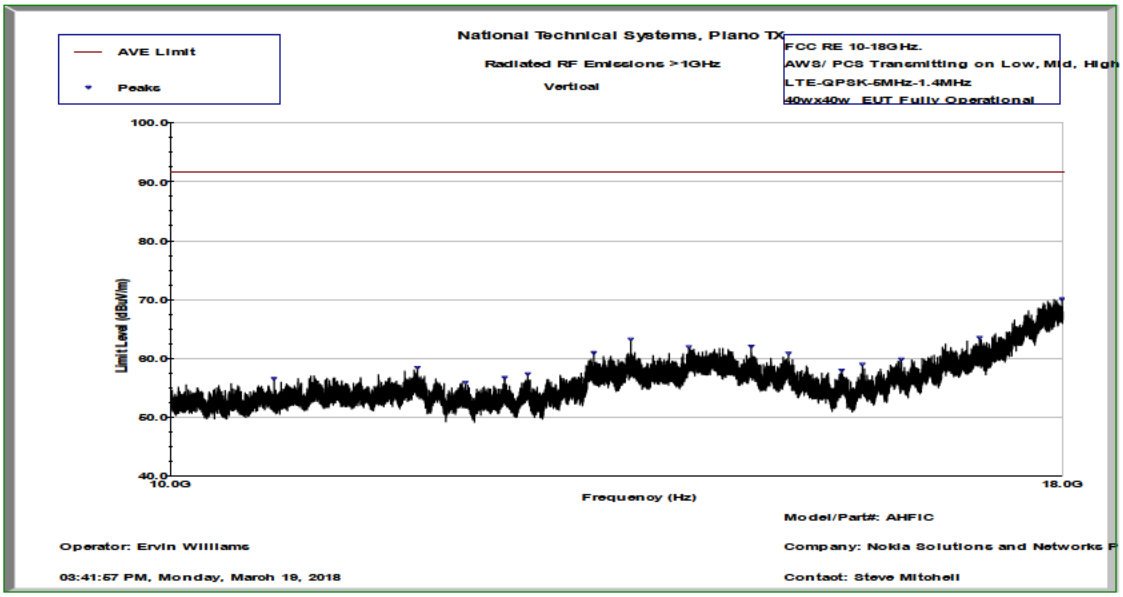
1-10GHz – Horizontal 60w x 20w Configuration



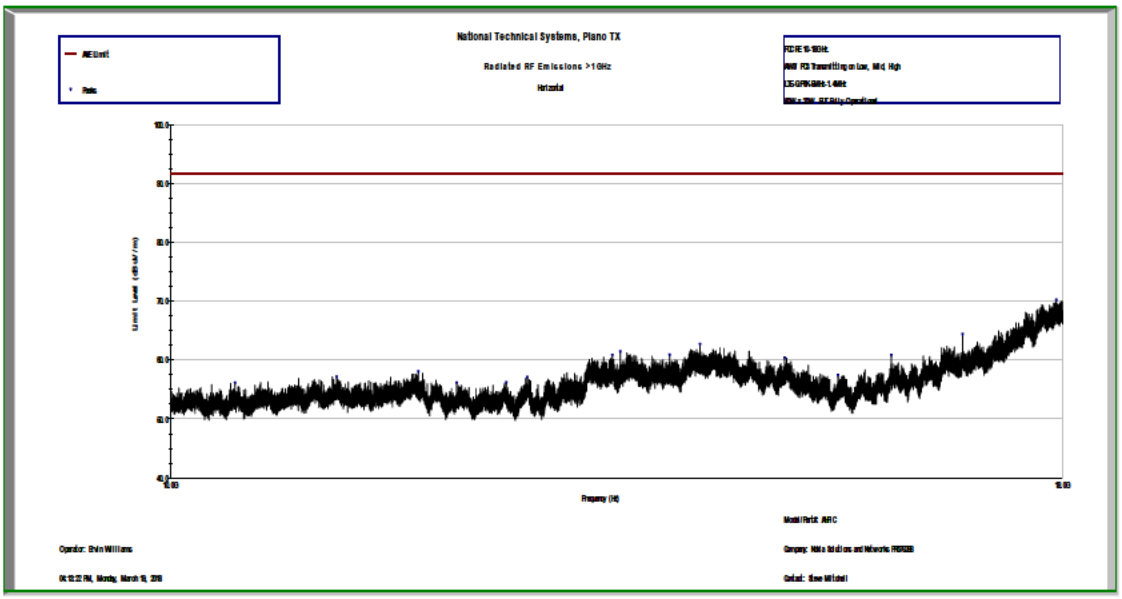
1-10GHz – Vertical 60w x 20w Configuration



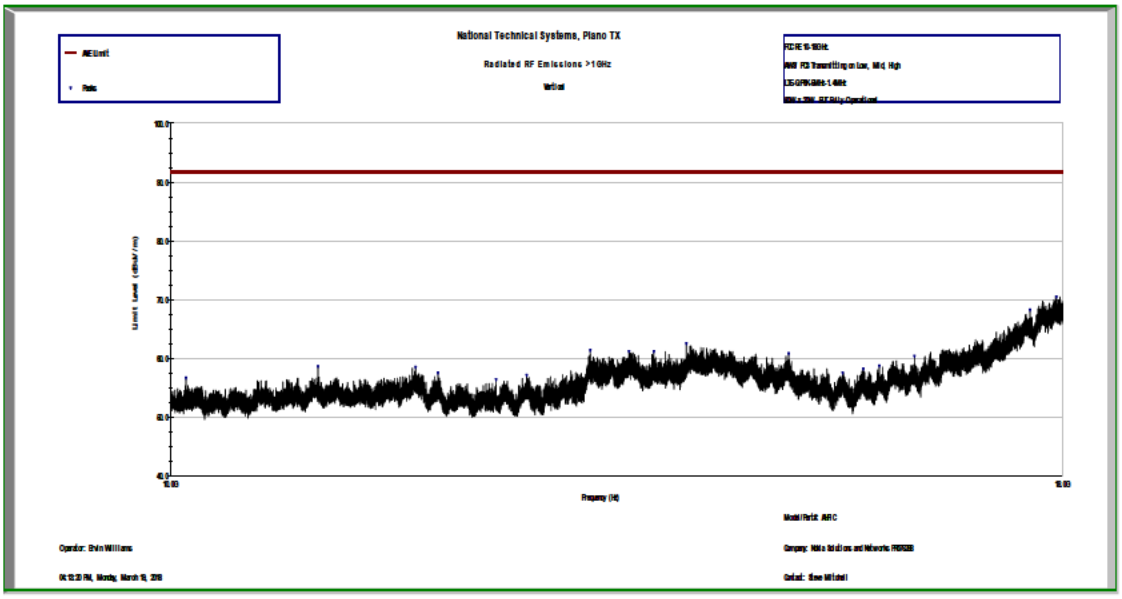
10-18GHz – Horizontal 40w x 40w Configuration



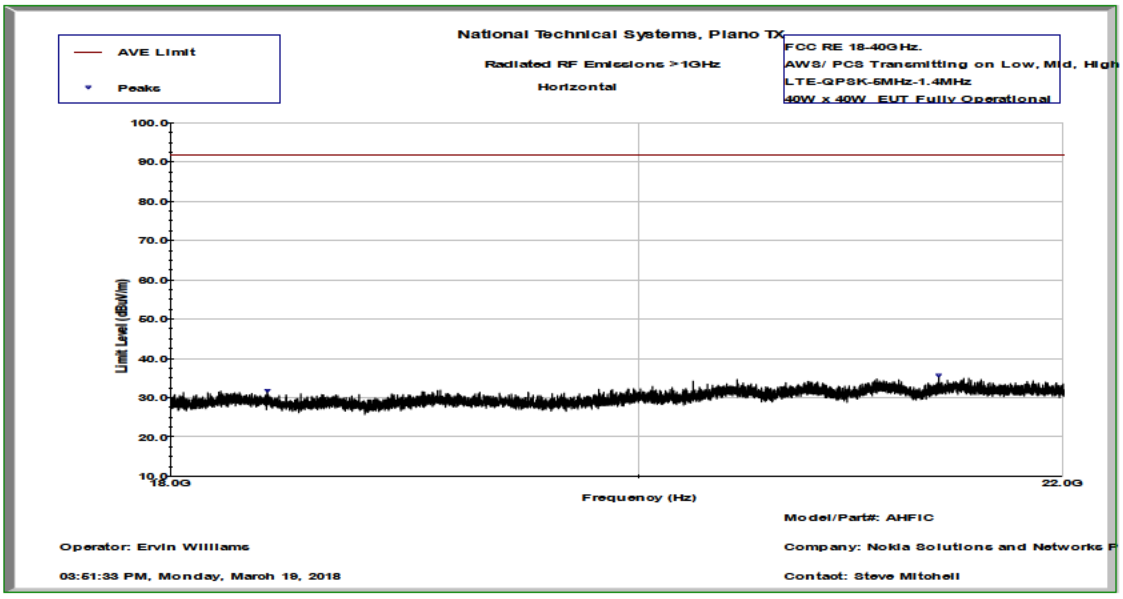
10-18GHz – Vertical 40w x 40w Configuration



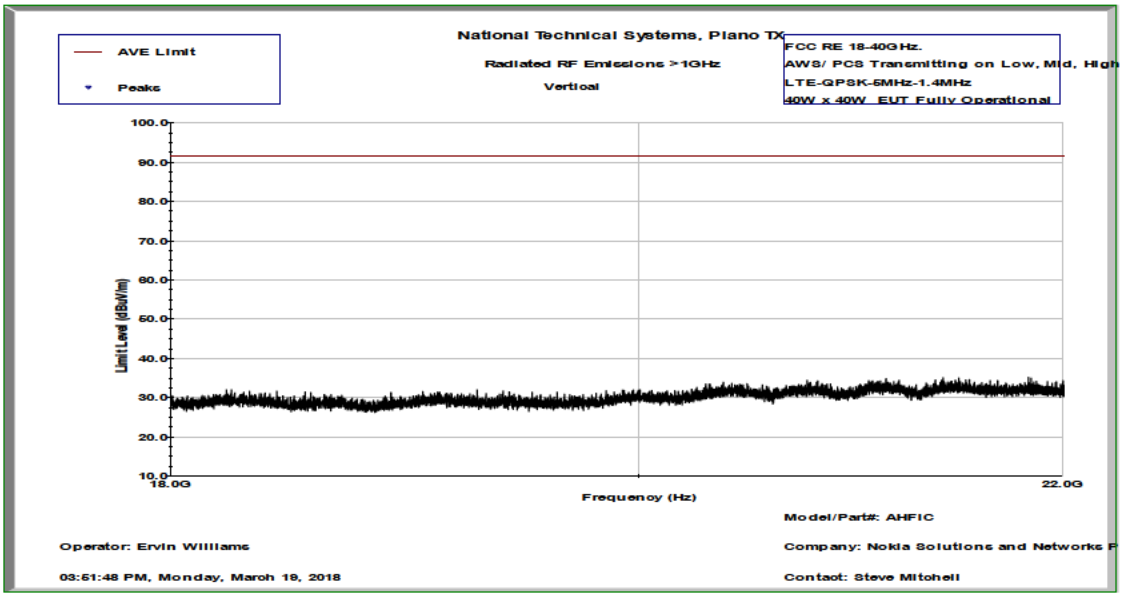
10-18GHz – Horizontal 60w x 20w Configuration



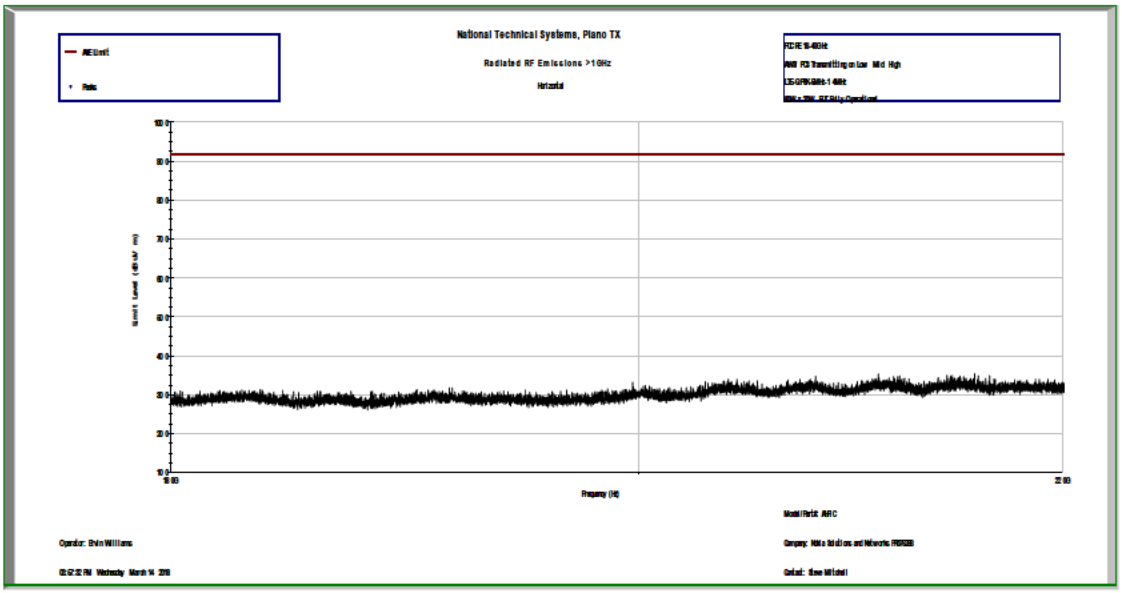
10-18GHz – Vertical 60w x 20w Configuration



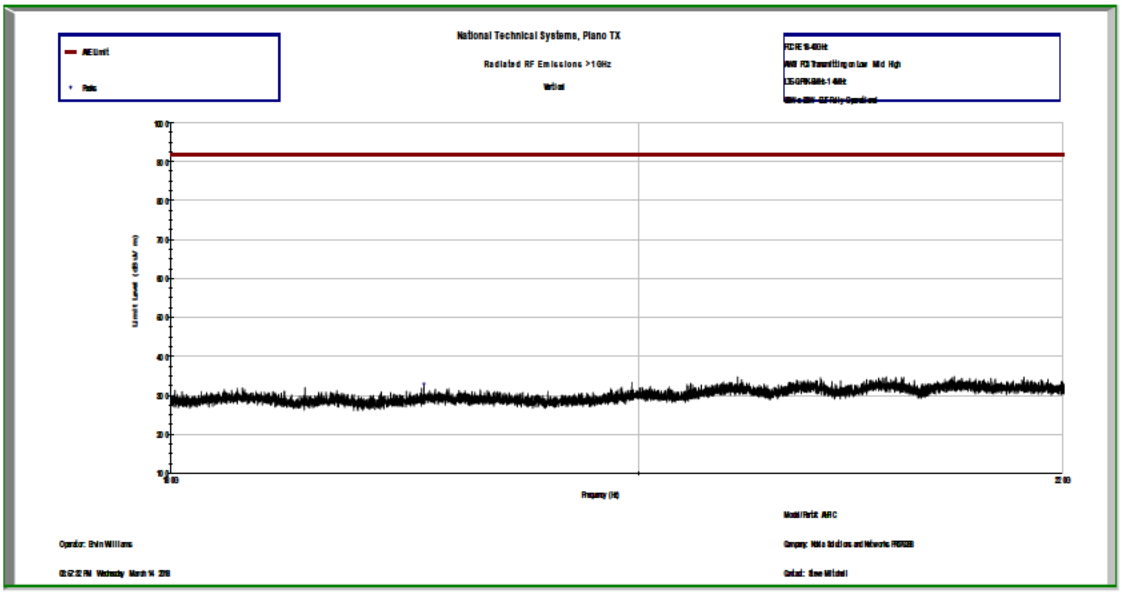
18-22GHz – Horizontal 40w x 40w Configuration



10-22GHz – Vertical 40w x 40w Configuration



18-22GHz – Horizontal 60w x 20w Configuration



18-22GHz – Vertical 60w x 20w Configuration

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 (1960MHz) on port 7.
(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	1.33
100%	48.0	**1.84**
115%	55.2	1.51

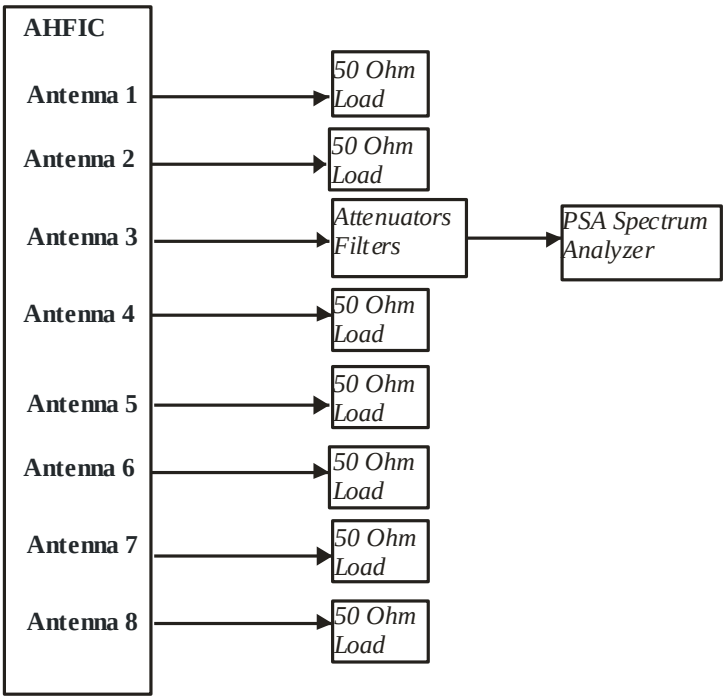
Extreme Temperatures:

Temperature	Maximum Frequency Error (Hz) at 48VDC
-30 °C	1.63
-20 °C	1.69
-10 °C	1.39
0 °C	1.44
10 °C	1.39
20 °C	**1.84**
30 °C	1.81
40 °C	1.32
50 °C	1.52

Based on the results above, highest recorded frequency error (1.84Hz or ~0.001 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 AHFIC antenna ports 1 through 4 for the AWS band measurements. The test setup used is provided below.



Test Setup Used for Conducted RF Measurements on AHFIC

RF Output Power

The 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	55.41	47.53	7.88
Port 2 Middle Channel	5M	55.35	47.50	7.85
Port 3 Middle Channel	5M	55.48	47.65	7.83
Port 4 Middle Channel	5M	55.46	47.62	7.84

The variation in RMS output power levels between the antenna ports is 0.15 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 3 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 3 Middle Channel LTE5	55.48	47.71	55.36	47.59	55.47	47.64	55.48	47.65

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 0.12dB for the data snapshot provided. The variation of peak power output versus modulation type is 0.12dB 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 3 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.
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 3 and the results presented below. The highest measured values are highlighted.

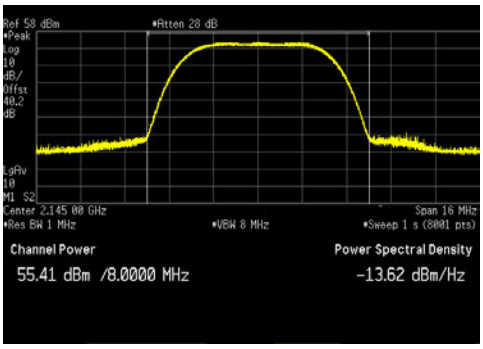
Antenna LTE Channel	LTE Bandwidth	LTE - 256QAM		
		Peak (dBm)	Ave (dBm)	PAPR (dB)
Port 3 Bottom Channel	5M	55.47	47.62	7.85
	10M	**55.70**	47.69	8.01
	15M	55.68	47.62	**8.06**
	20M	55.69	47.64	8.05
Port 3 Middle Channel	5M	55.48	47.65	7.83
	10M	55.67	47.67	8.00
	15M	55.66	47.71	7.95
	20M	55.67	47.64	8.03
Port 3 Top Channel	5M	55.43	47.62	7.81
	10M	55.69	47.74	7.95
	15M	55.65	**47.75**	7.90
	20M	55.51	47.58	7.93

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 (0.07dB).

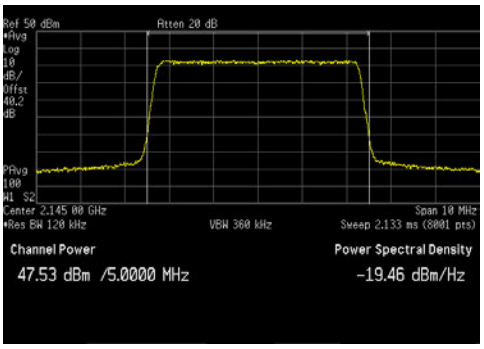
All measurement results are provided in the following pages. The total measurement RF path loss of the test setup (attenuator and test cables) was 40.2 dB and is accounted for by the spectrum analyzer reference level offset.

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

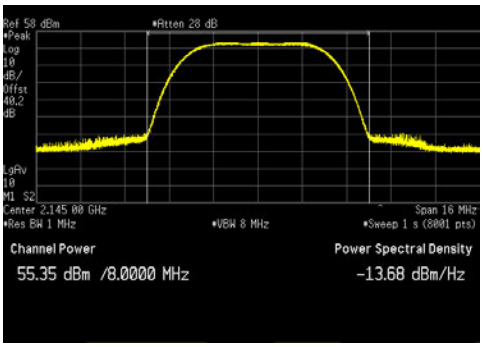
Port 1 - LTE5_ Middle Channel_Peak



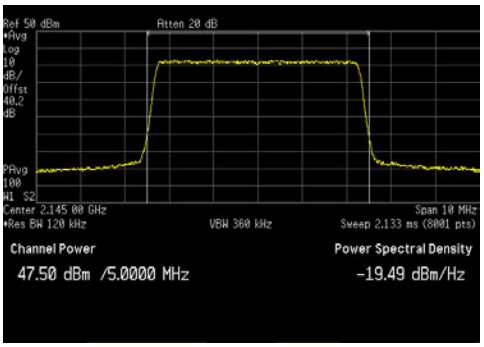
Port 1 - LTE5_ Middle Channel_Average



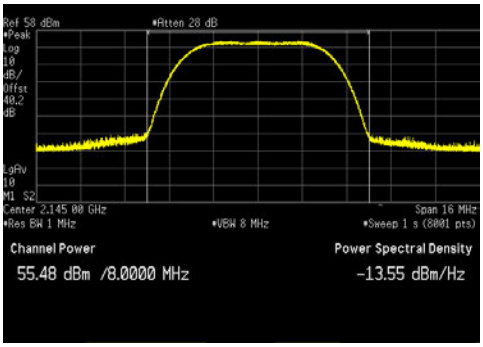
Port 2 - LTE5_Middle Channel_Peak



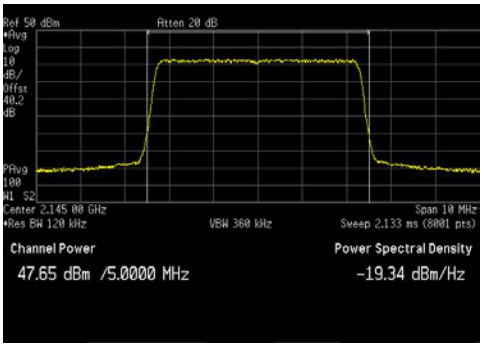
Port 2 - LTE5_Middle Channel_Average



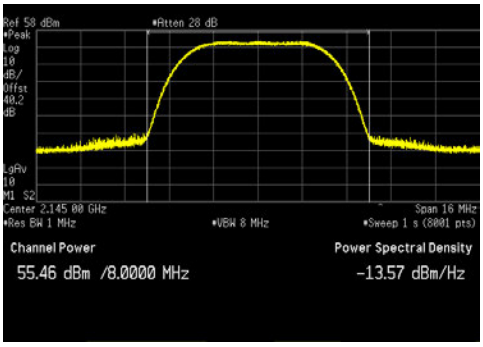
Port 3 - LTE5_ Middle Channel_Peak



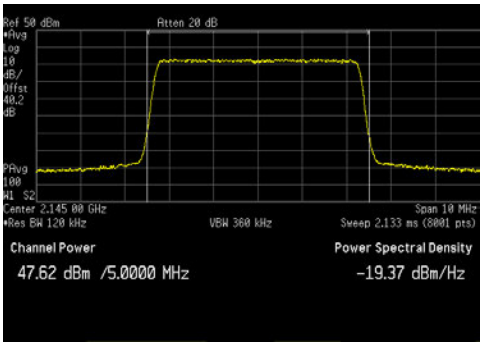
Port 3 - LTE5_ Middle Channel_Average



Port 4 - LTE5_ Middle Channel_Peak

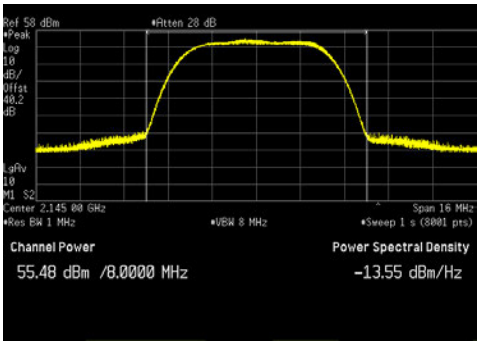


Port 4 - LTE5_ Middle Channel_Average

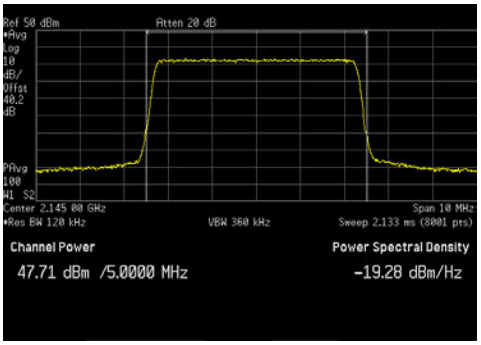


LTE5 Channel Power Plots for Antenna Port 3 at Middle Channel and all Modulation Types:

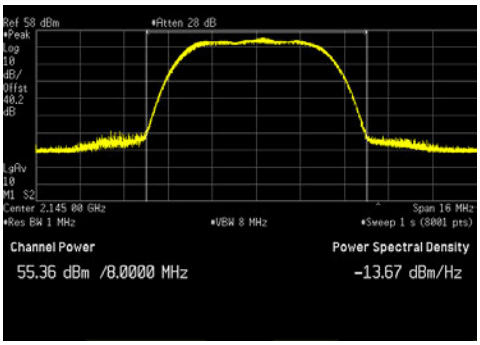
LTE5_ Middle Channel_QPSK_Peak



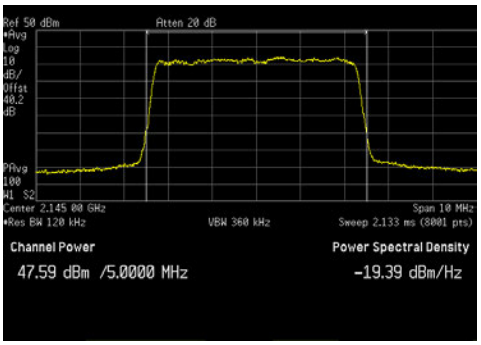
LTE5_ Middle Channel_QPSK_Average



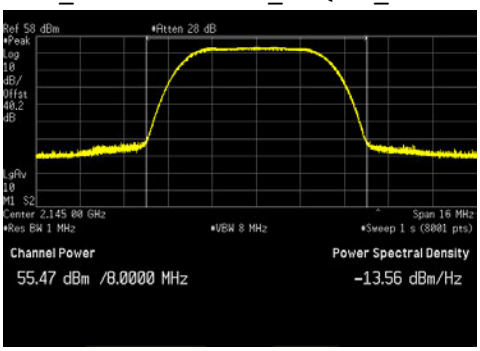
LTE5_Middle Channel_16QAM_Peak



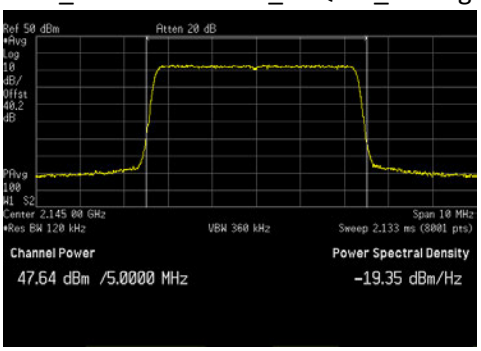
LTE5_Middle Channel_16QAM_Average



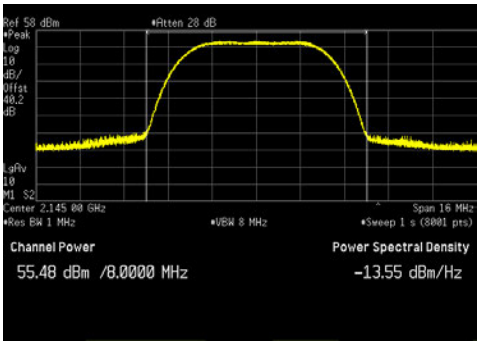
LTE5_ Middle Channel_64QAM_Peak



LTE5_ Middle Channel_64QAM_Average



LTE5_ Middle Channel_256QAM_Peak



LTE5_ Middle Channel_256QAM_Average