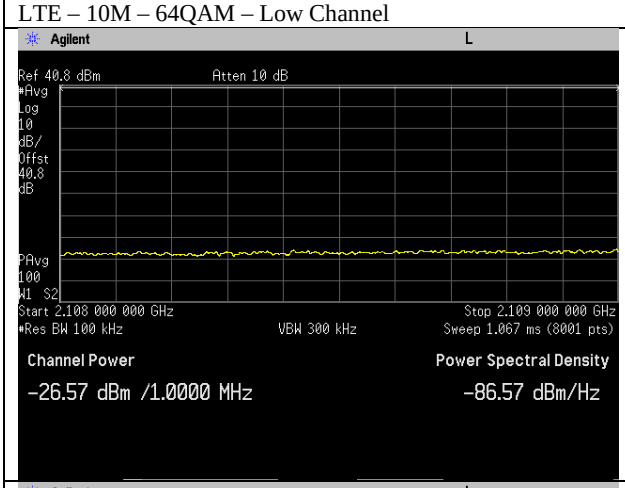
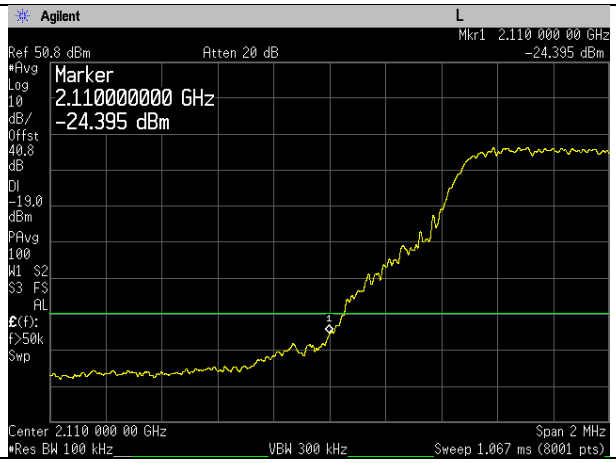
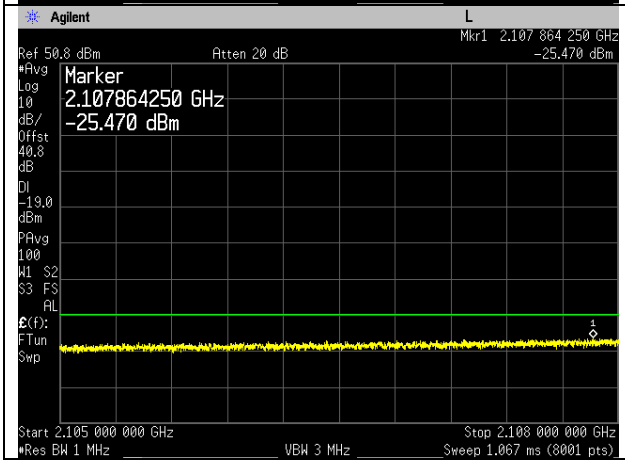
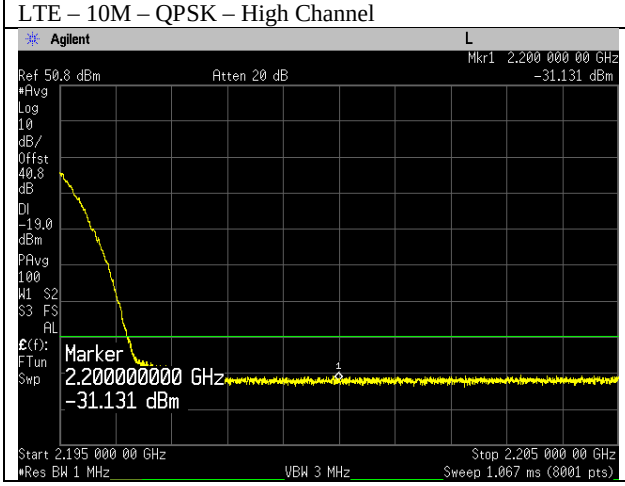
LTE – 10M – 64QAM – Low Channel



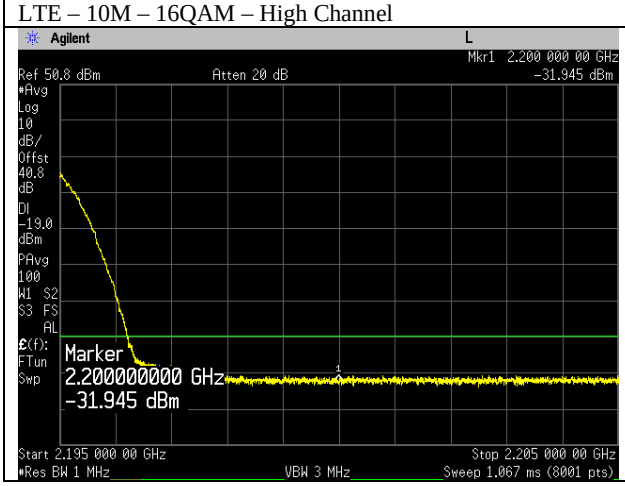




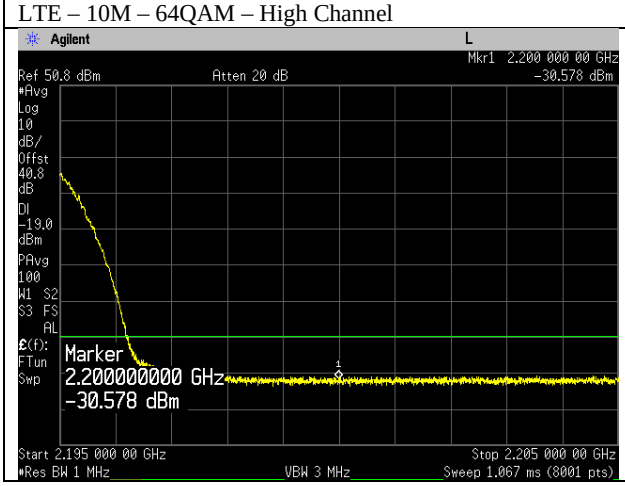
LTE – 10M – QPSK – High Channel



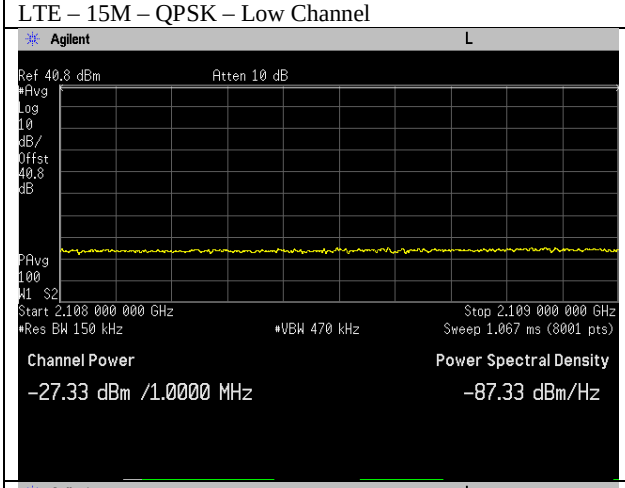
LTE – 10M – 16QAM – High Channel

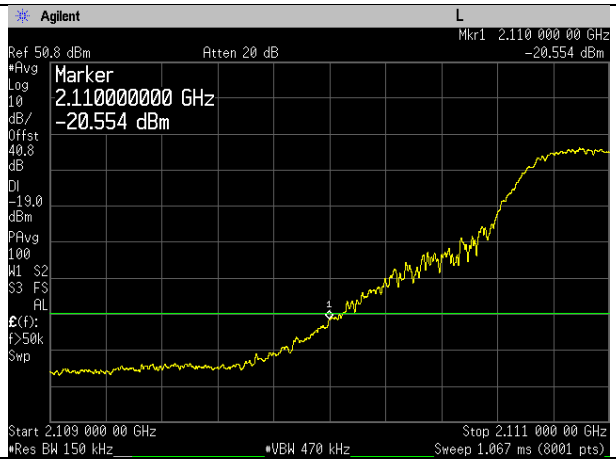


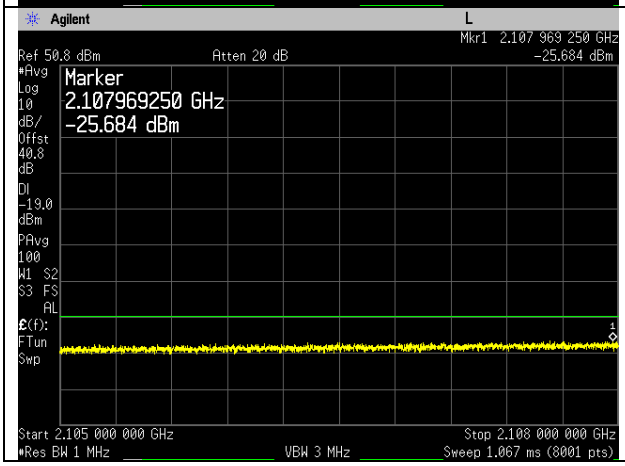
LTE – 10M – 64QAM – High Channel



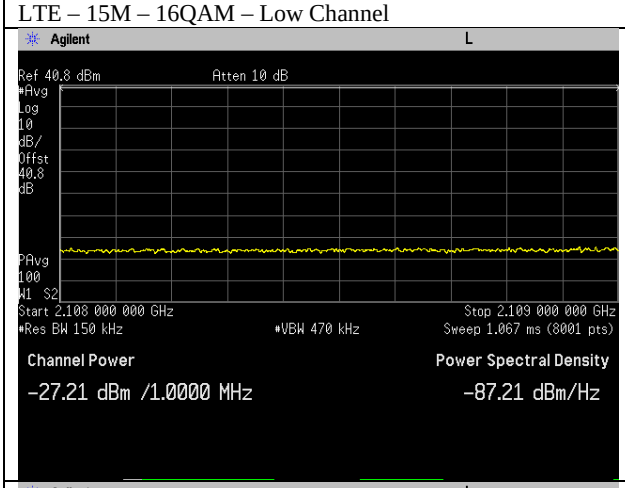
LTE – 15M – QPSK – Low Channel

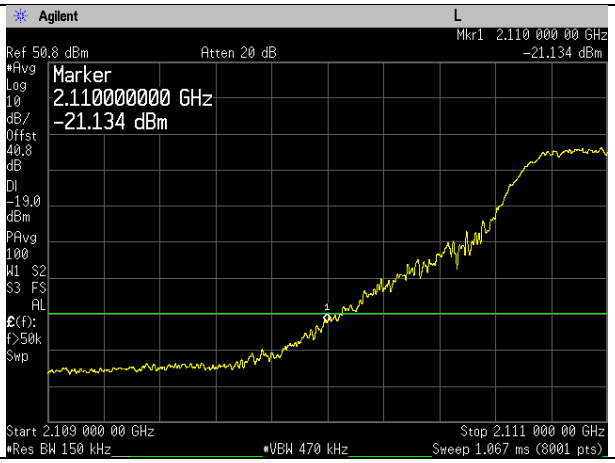


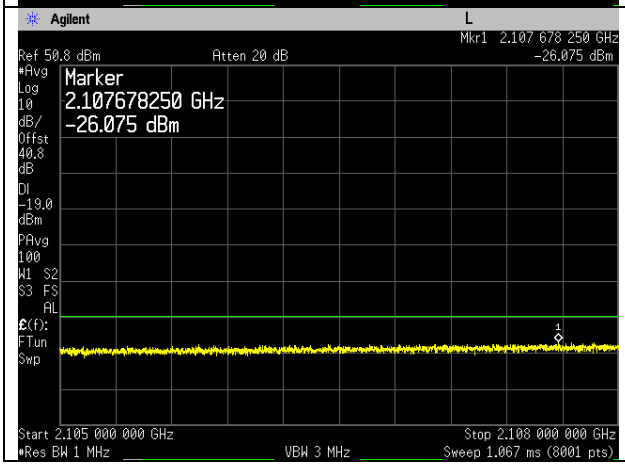




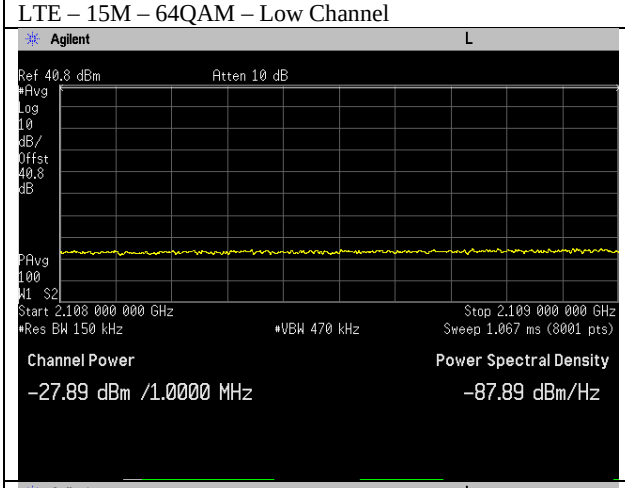
LTE – 15M – 16QAM – Low Channel

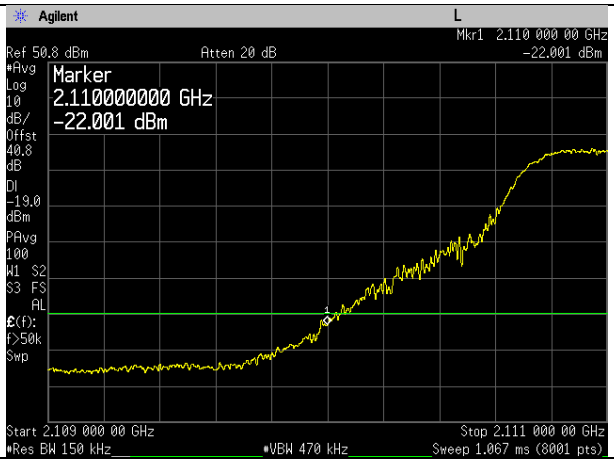


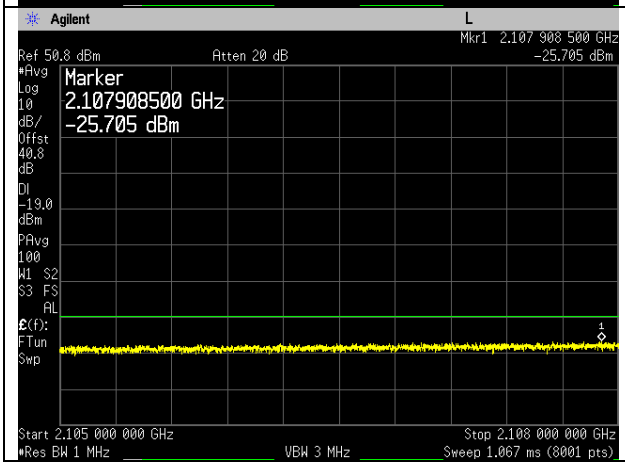




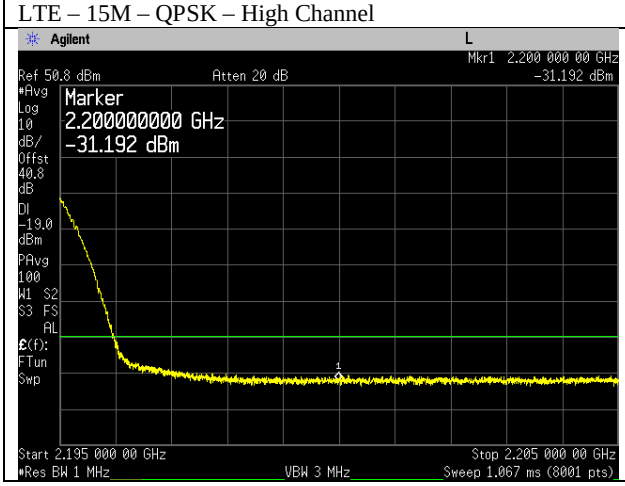
LTE – 15M – 64QAM – Low Channel



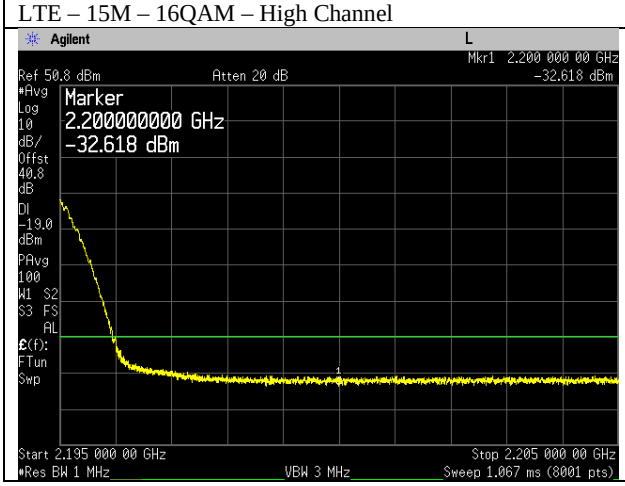




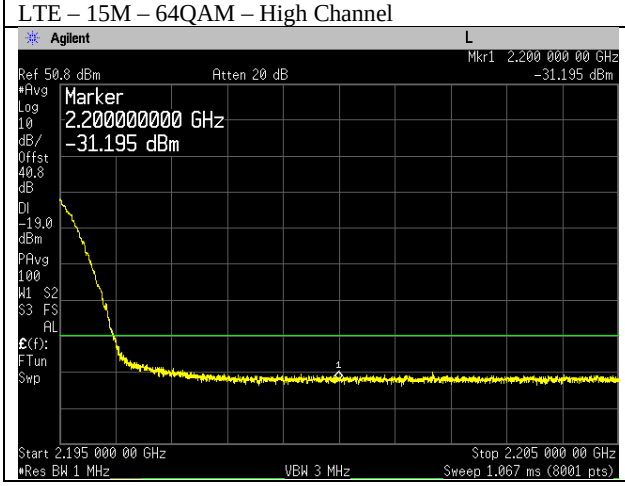
LTE – 15M – QPSK – High Channel



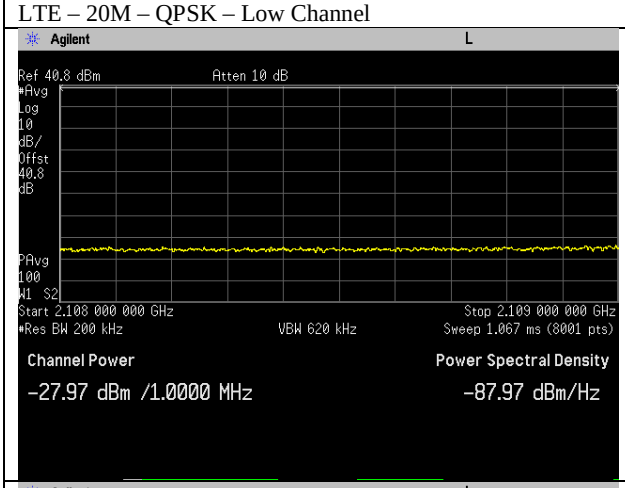
LTE – 15M – 16QAM – High Channel

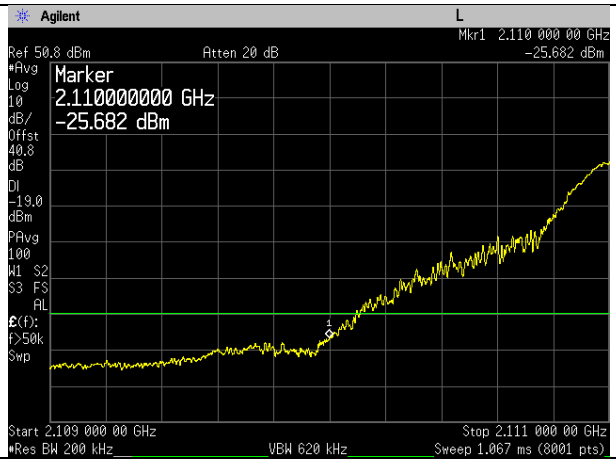


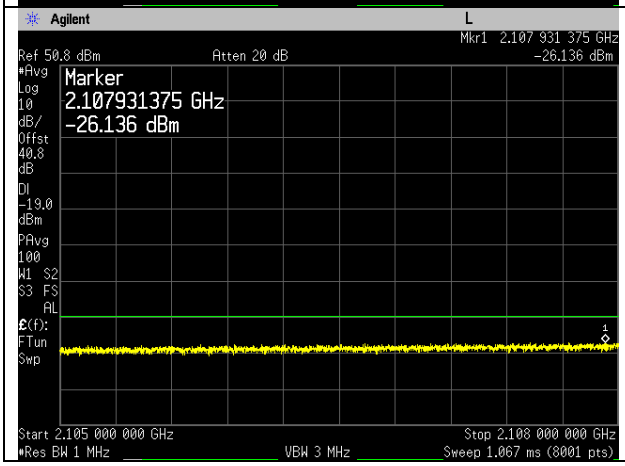
LTE – 15M – 64QAM – High Channel



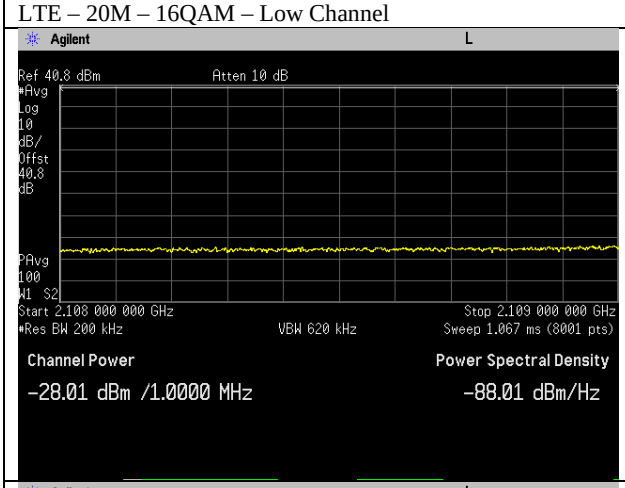
LTE – 20M – QPSK – Low Channel

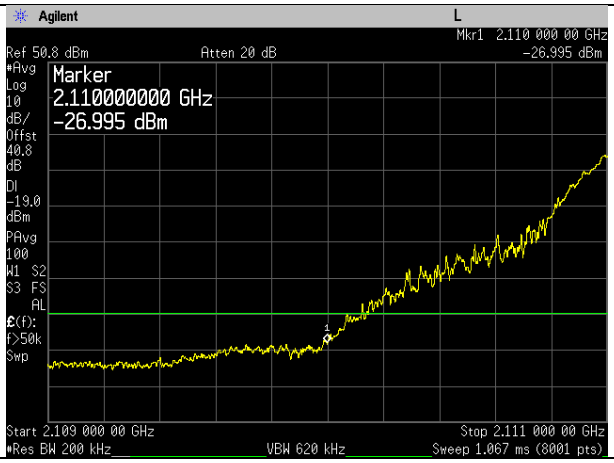


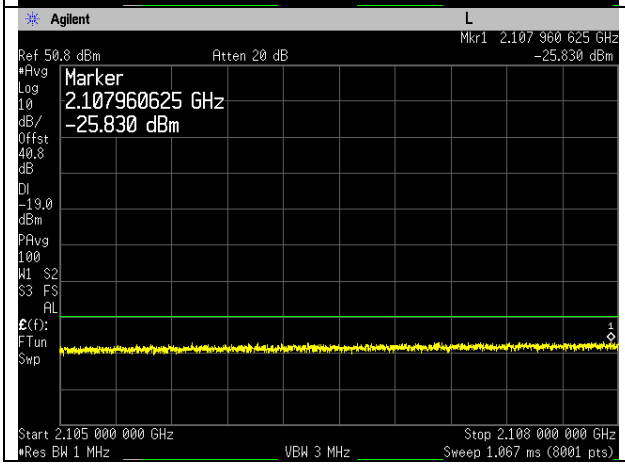




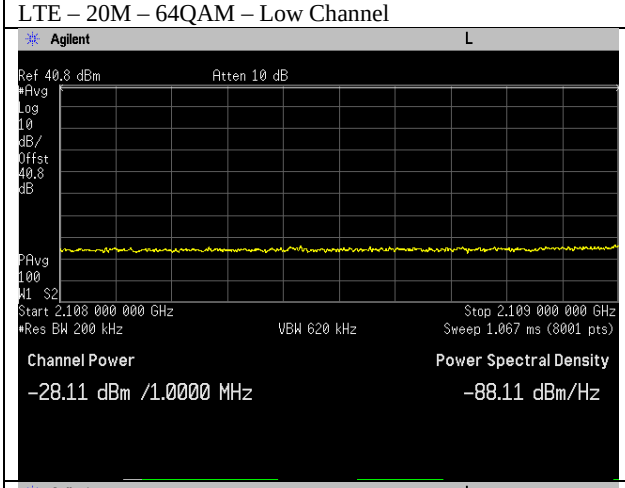
LTE – 20M – 16QAM – Low Channel

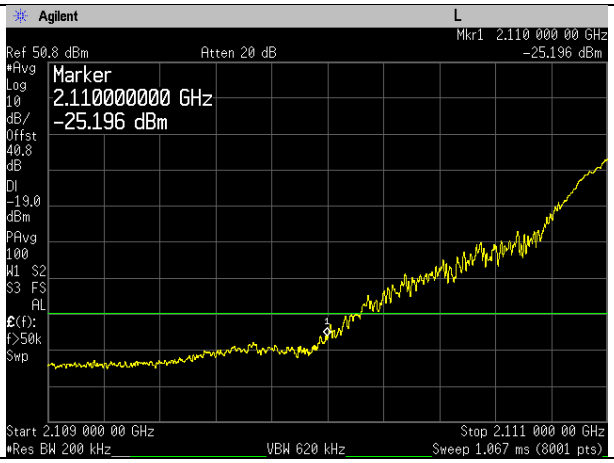


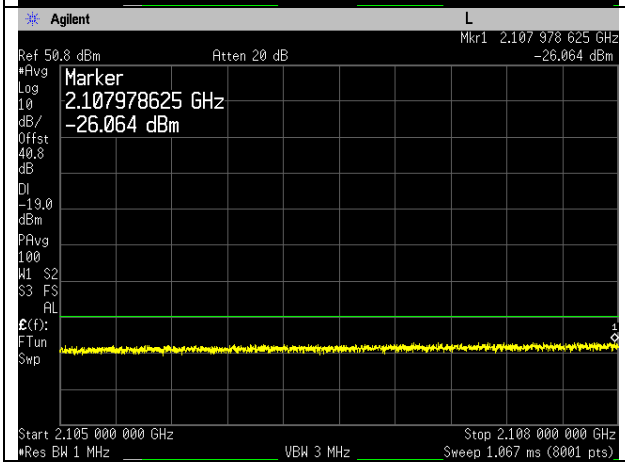




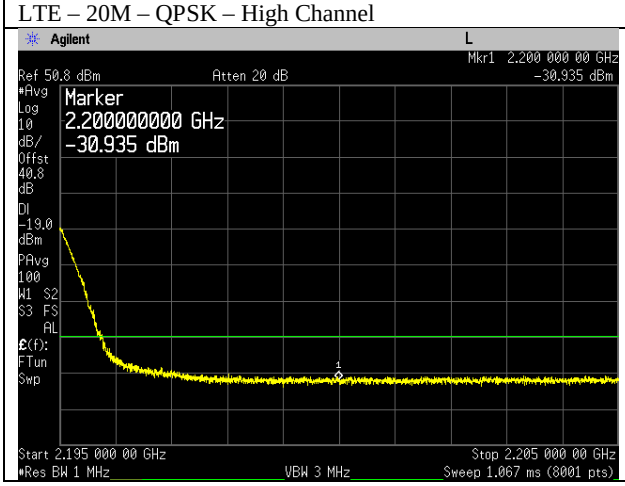
LTE – 20M – 64QAM – Low Channel



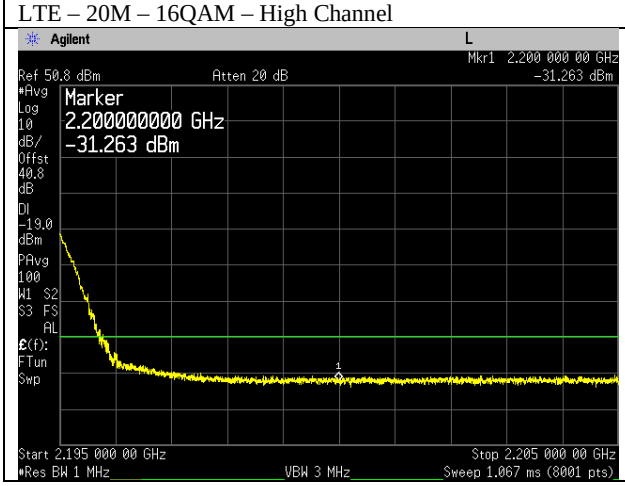




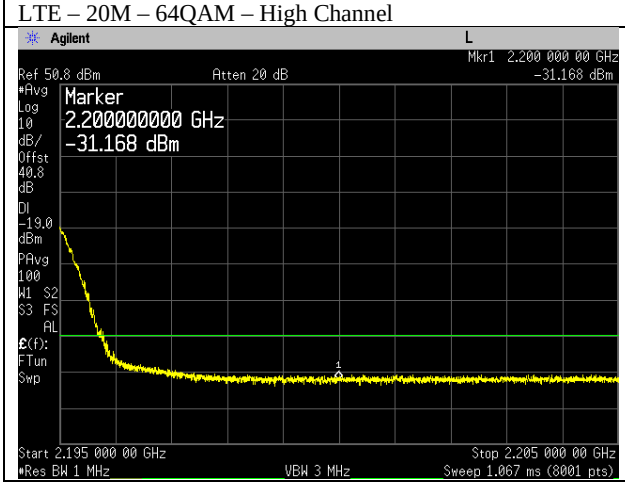
LTE – 20M – QPSK – High Channel



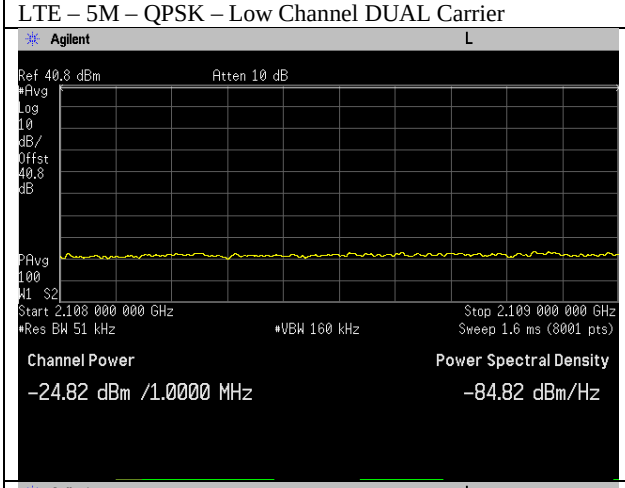
LTE – 20M – 16QAM – High Channel

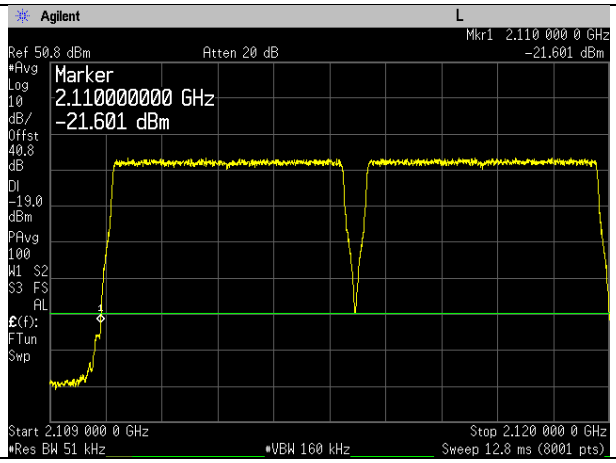


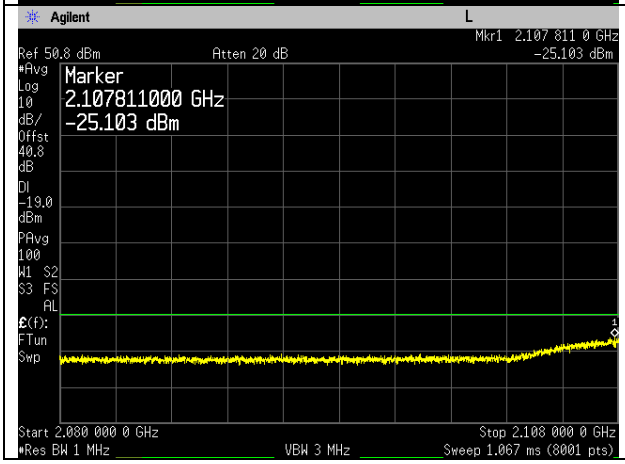
LTE – 20M – 64QAM – High Channel



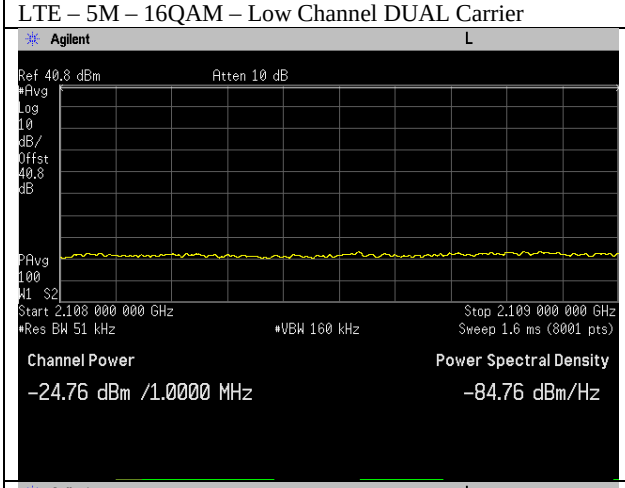
LTE – 5M – QPSK – Low Channel DUAL Carrier

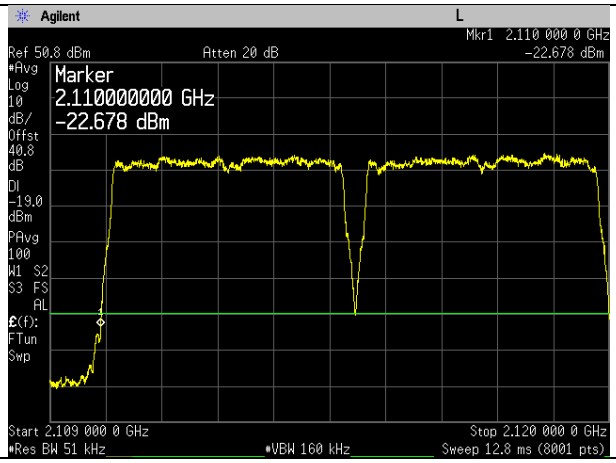


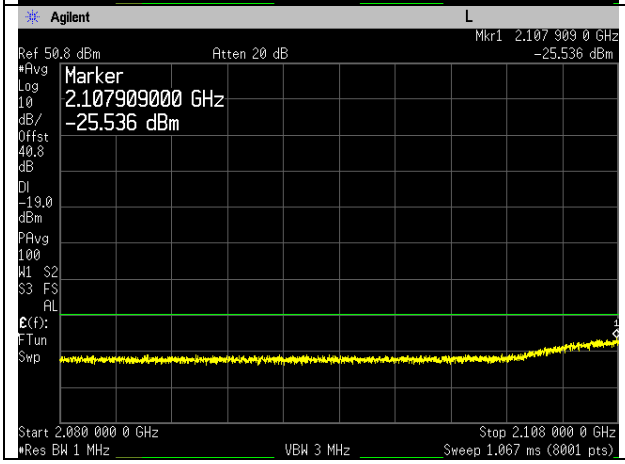




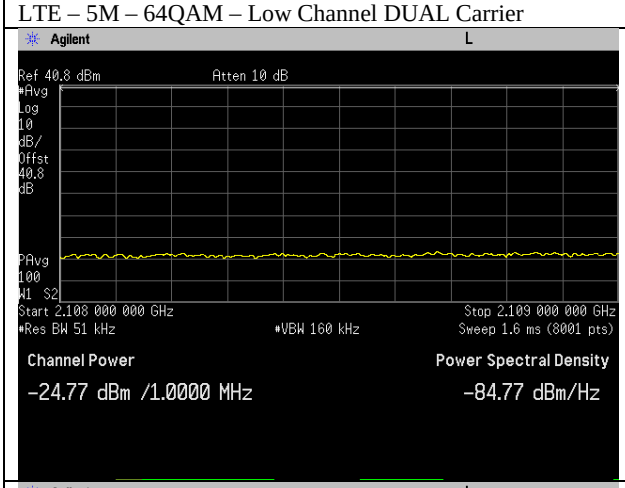
LTE – 5M – 16QAM – Low Channel DUAL Carrier

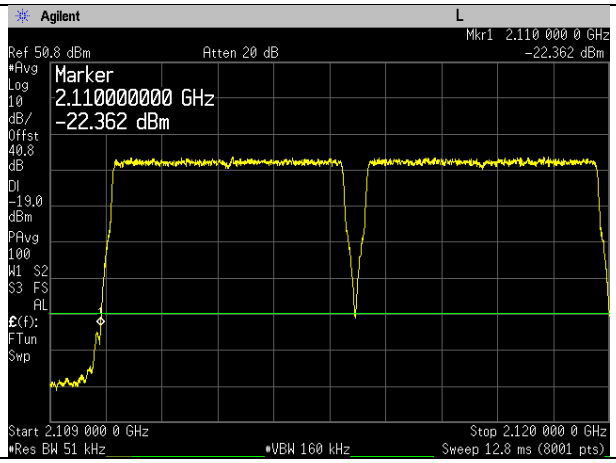


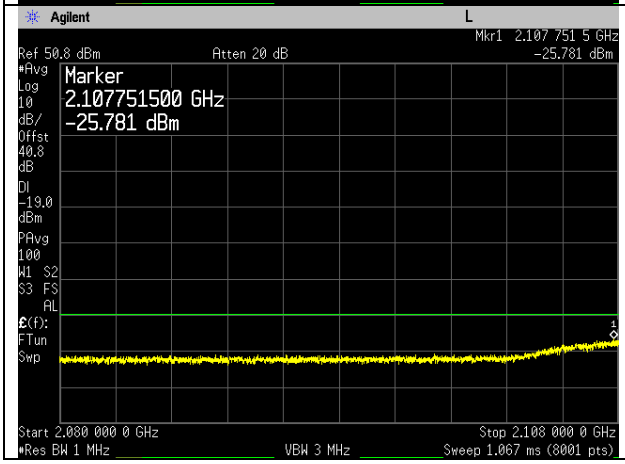




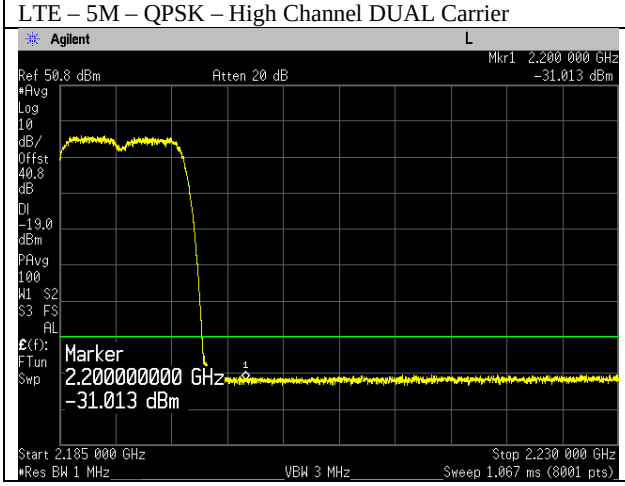
LTE – 5M – 64QAM – Low Channel DUAL Carrier



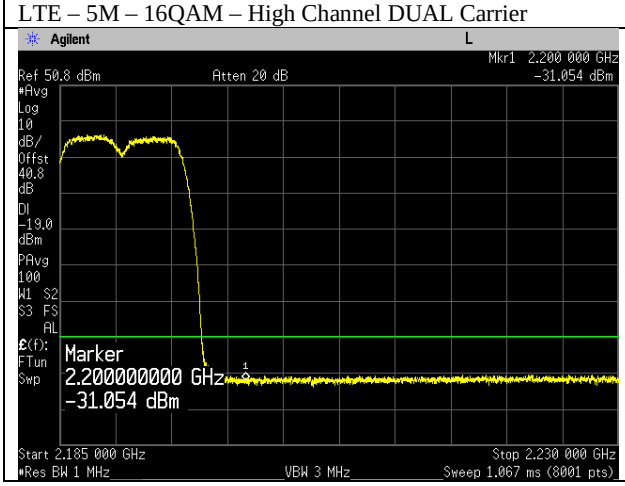




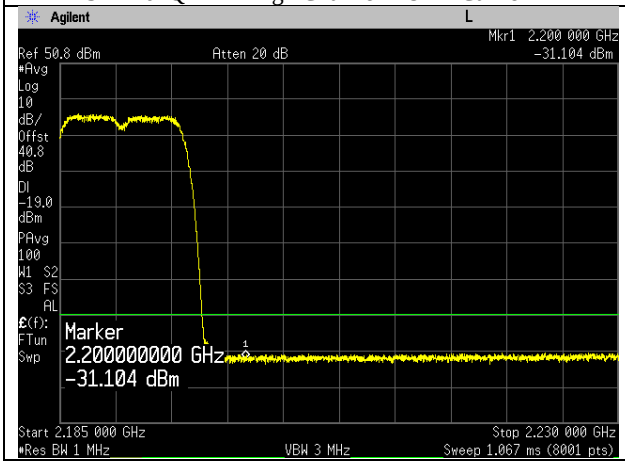
LTE – 5M – QPSK – High Channel DUAL Carrier



LTE – 5M – 16QAM – High Channel DUAL Carrier



LTE – 5M – 64QAM – High Channel DUAL Carrier



AWS - 4 Band Out of Band Emissions Requirement (2200-2290MHz)

Measurements made at the external notch filter (Filtronics p/n: US-PSD015-F1V1) output port using FRIJ Ant 4. Limit is -100.6 dBW/4kHz EIRP and is further reduced by 10*log(4) per FCC KDB 662911D01 v02r01 due to 4x4 MIMO operation. The Limit at the output of the external notch filter port is determined as follows:

-100.6dBW/4kHz (EIRP Limit) + 30dB (dBW to dBm) + 24dB (BW conversion 10log[1M/4k]) - 6dB (4 Port MIMO) – 17dBi (Nokia Design Assumed BTS Antenna Gain) = -69.6dBm/1MHz

Tests performed at Port 4 on Top channel for all modulations and channel bandwidth modes.

Results summary:

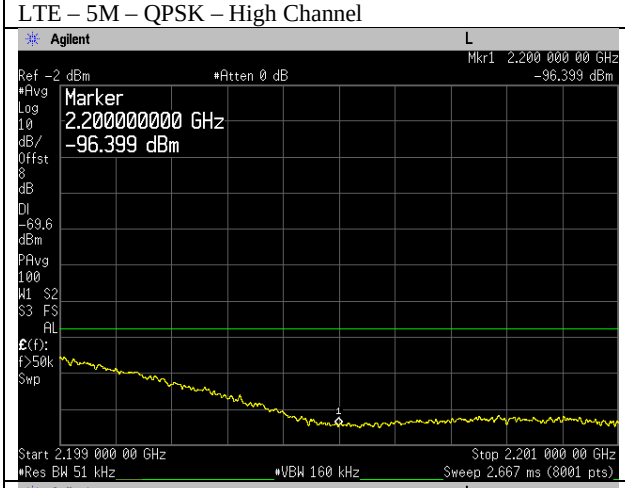
	LTE - QPSK	LTE - 16QAM	LTE - 64QAM
	2200-2290MHz	2200-2290MHz	2200-2290MHz
5M	-78.506dBm	-79.206dBm	-79.983dBm
10M	-78.41dBm	-78.61dBm	-78.61dBm
15M	-77.25dBm	77.63dBm	-77.18dBm
20M	-79.367dBm	-79.928dBm	-79.460dBm
5M Dual	-78.763dBm	-79.2dBm	-79.33dBm

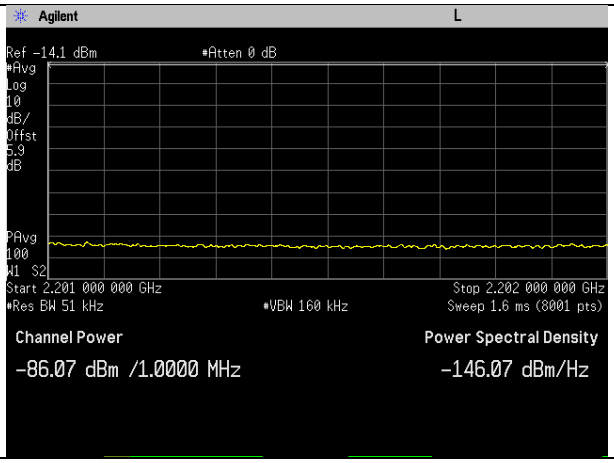
Measurements were performed in RMS average mode with 1MHz RBW and 3MHz VBW over 100 traces. In 1MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 1% of the emission bandwidth has been used. In 1 to 2 MHz frequency range outside upper bandedge (i.e.: 2201-2202 MHz) the RBW was again reduced to 1% of the emission bandwidth and power was integrated (over 1 MHz).

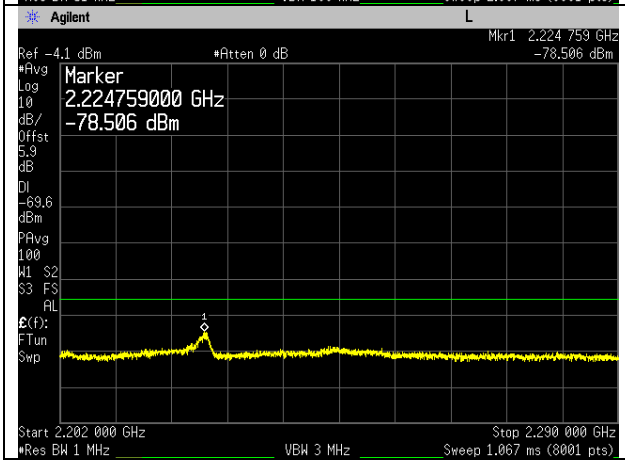
Total path losses of 8.0 dB for the 2200 to 2201 MHz frequency range and 5.9 dB for the 2201 to 2290 MHz frequency range were factored in via reference offset of the spectrum analyzer and the settings are shown on the corresponding plots. A customer supplier filter (Creowave filter p/n CW-DPF-2110-2996-E1-M2) was characterized for insertion loss and used to measure emissions in the 2200 to 2290 MHz range to reduce measurement instrumentation noise floor.

All corresponding plots are included on the following pages.

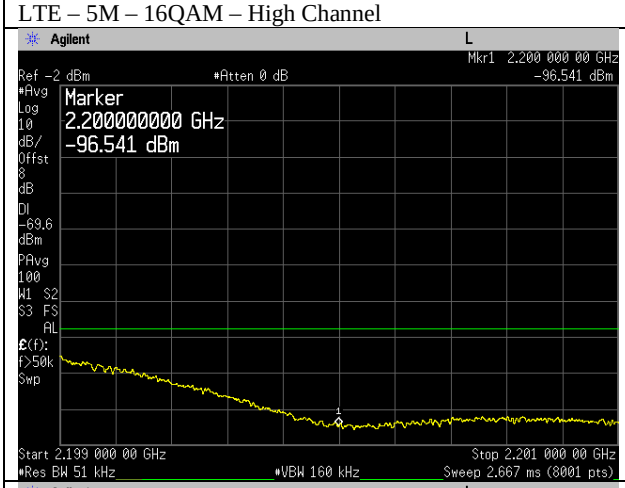
LTE – 5M – QPSK – High Channel

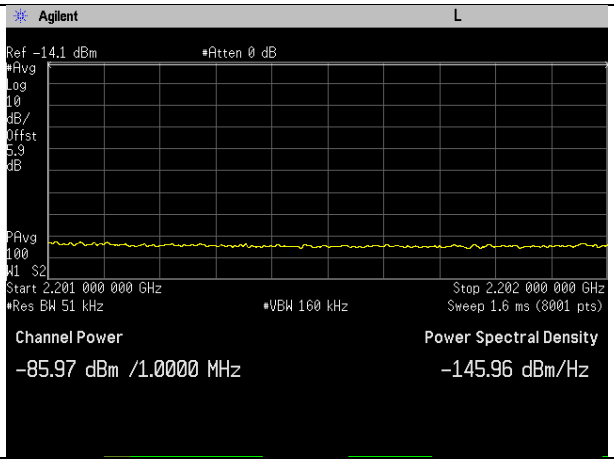


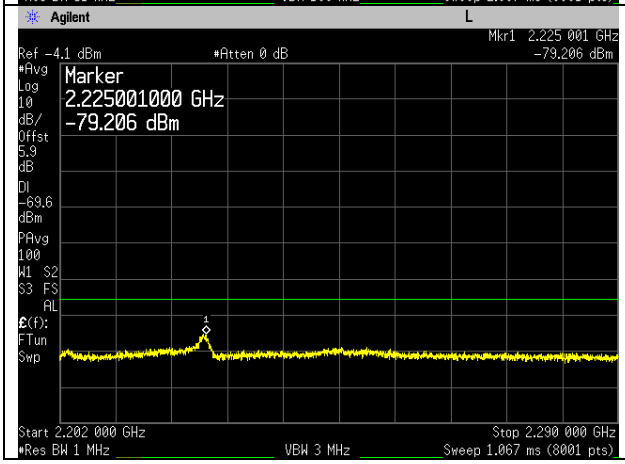




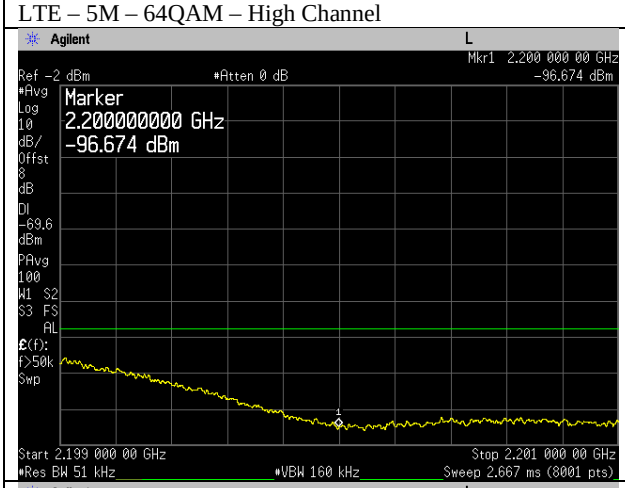
LTE – 5M – 16QAM – High Channel

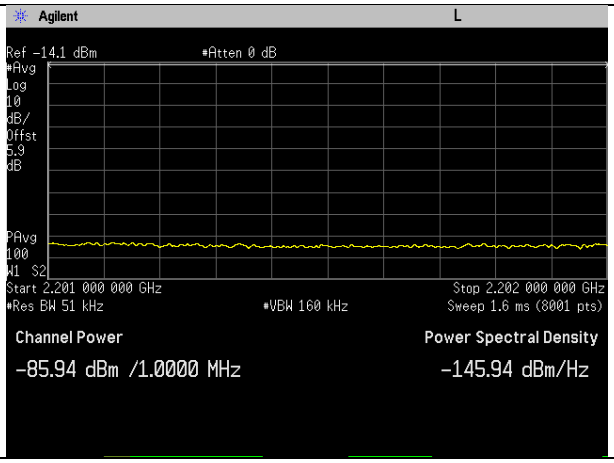


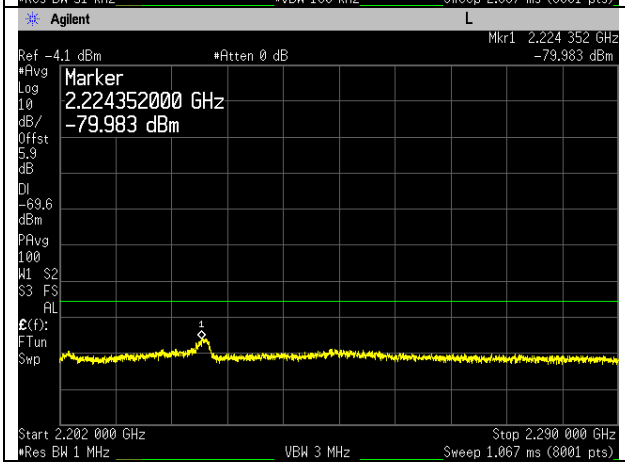




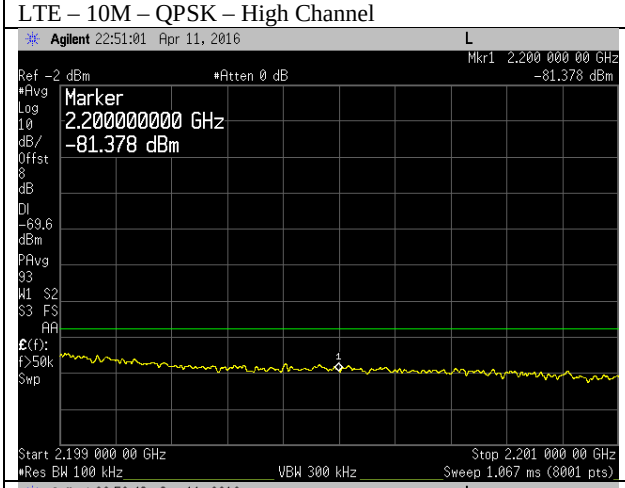
LTE – 5M – 64QAM – High Channel

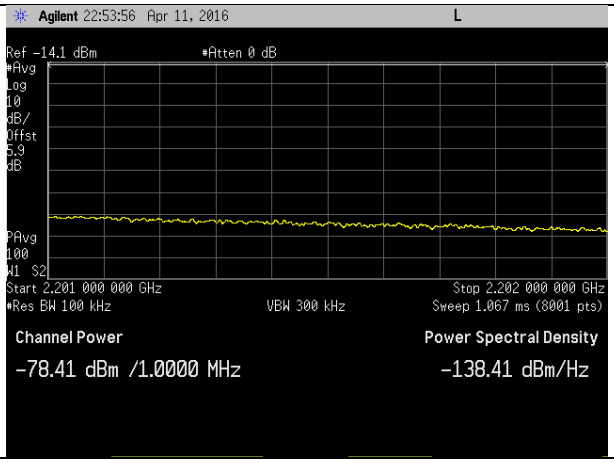


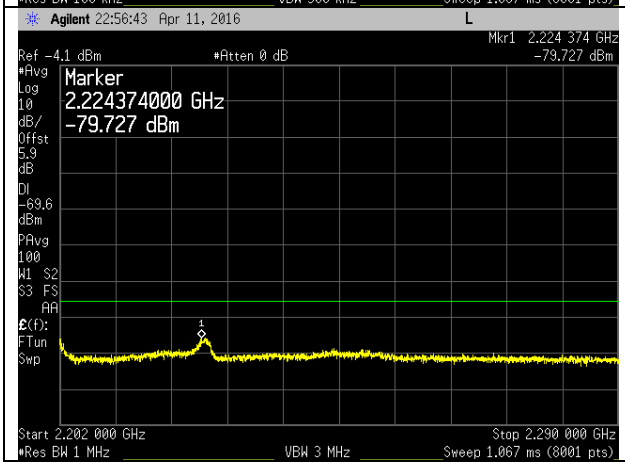




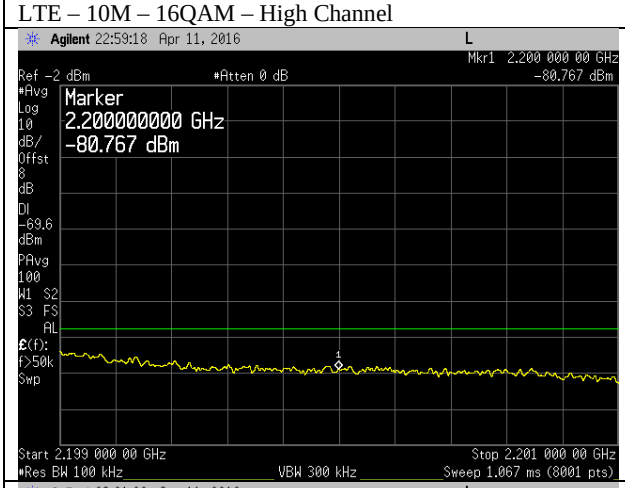
LTE – 10M – QPSK – High Channel

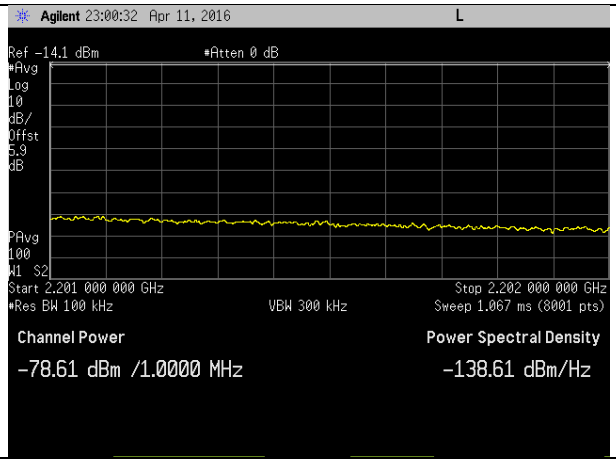


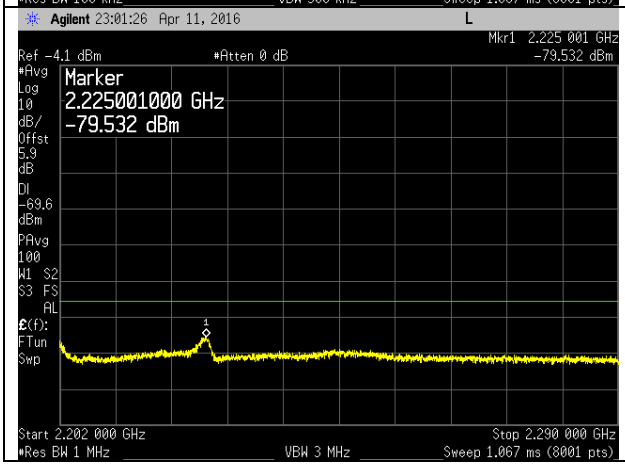




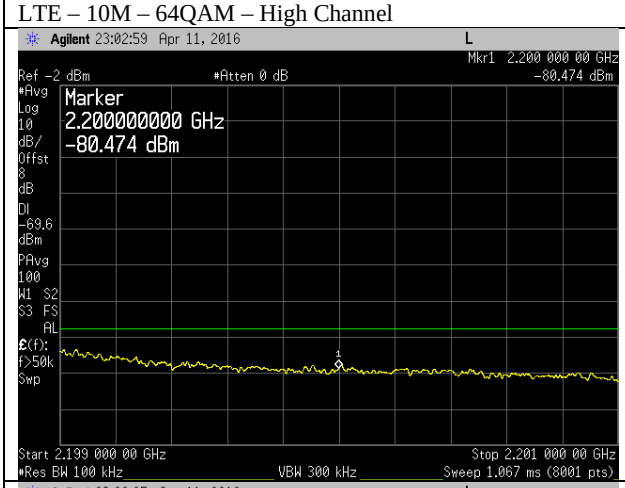
LTE – 10M – 16QAM – High Channel

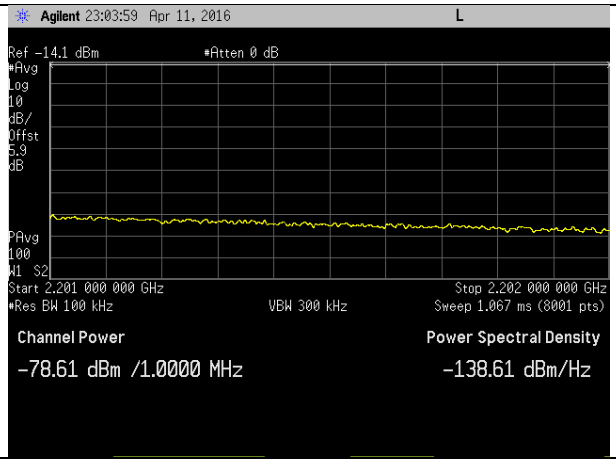


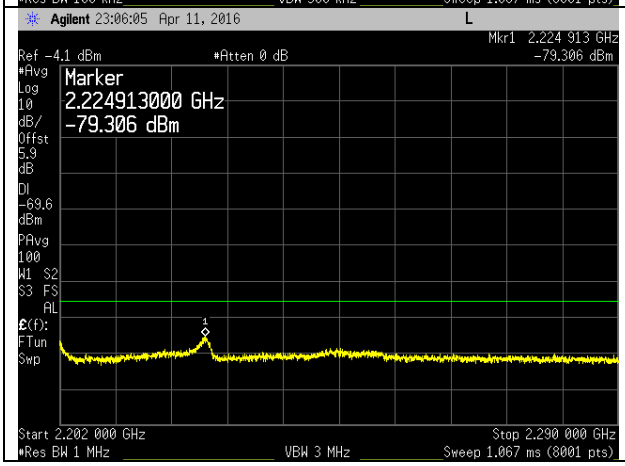




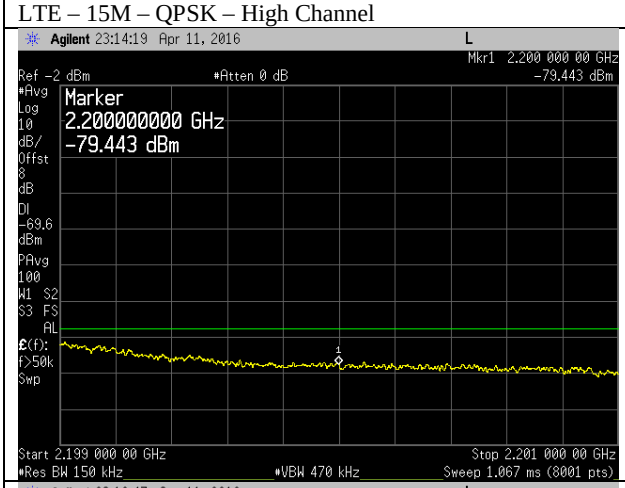
LTE – 10M – 64QAM – High Channel

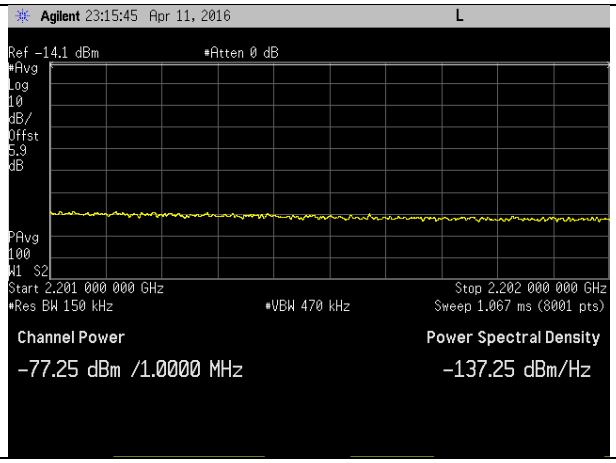


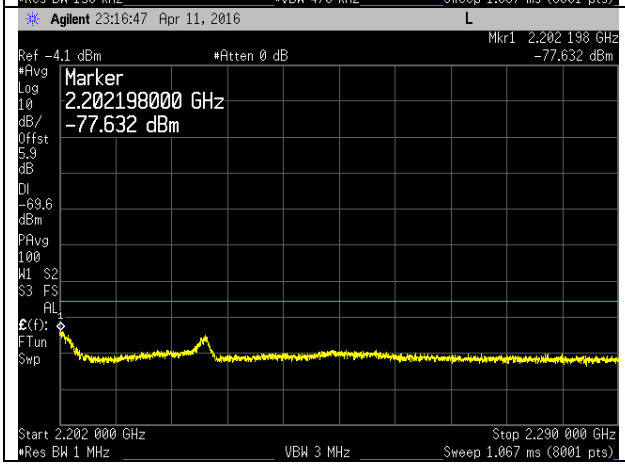




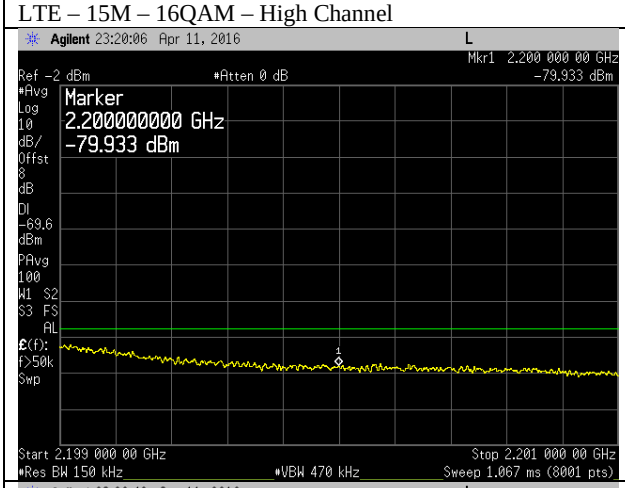
LTE – 15M – QPSK – High Channel

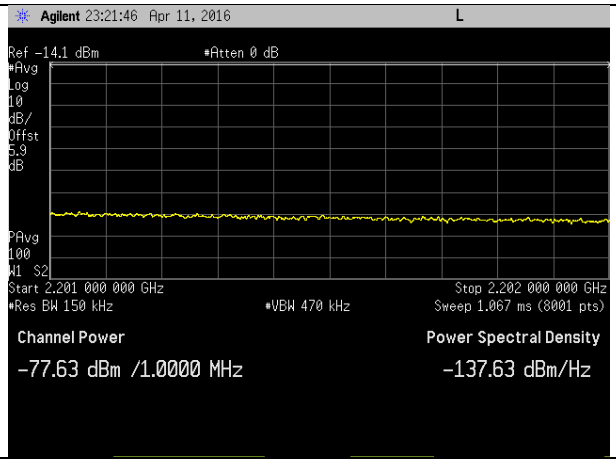


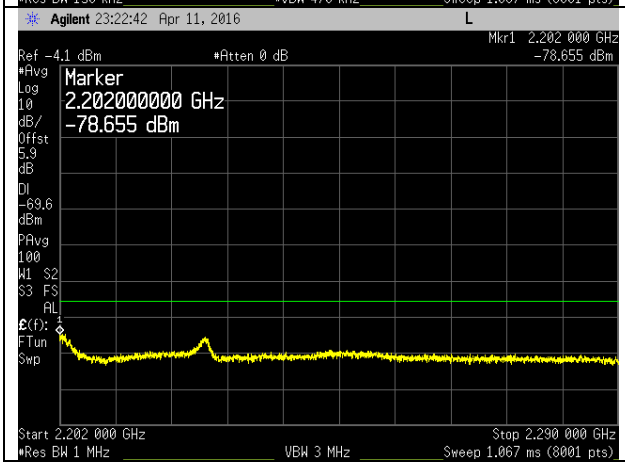




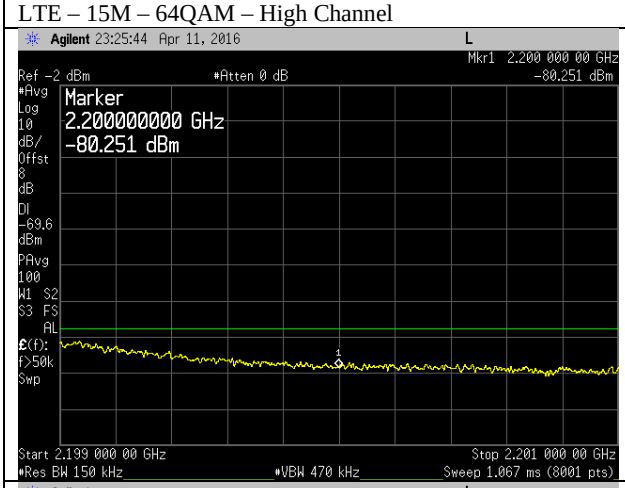
LTE – 15M – 16QAM – High Channel

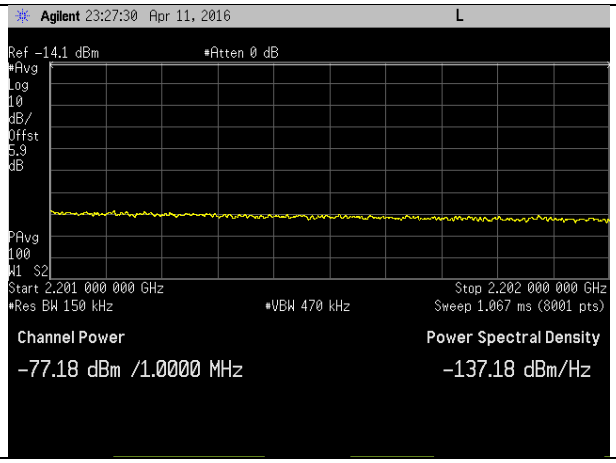


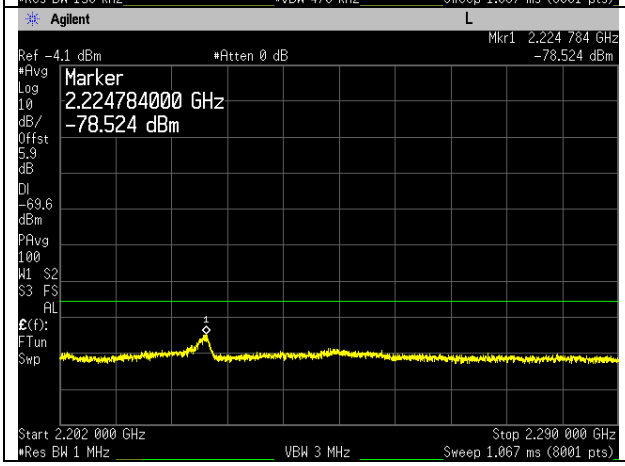




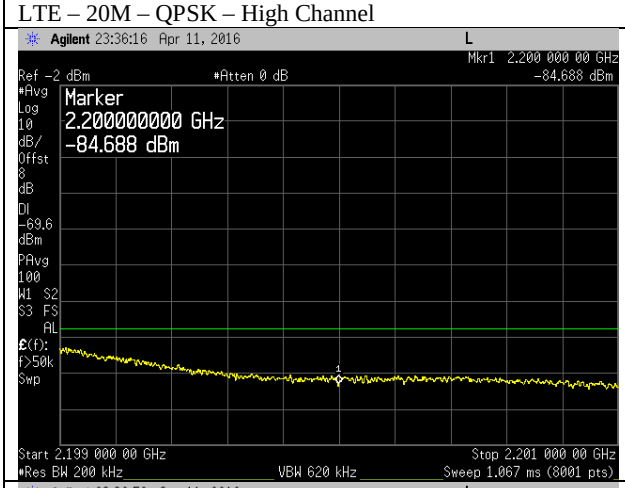
LTE – 15M – 64QAM – High Channel

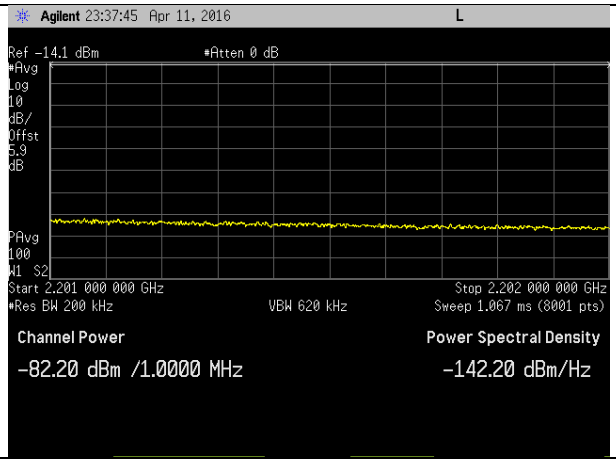


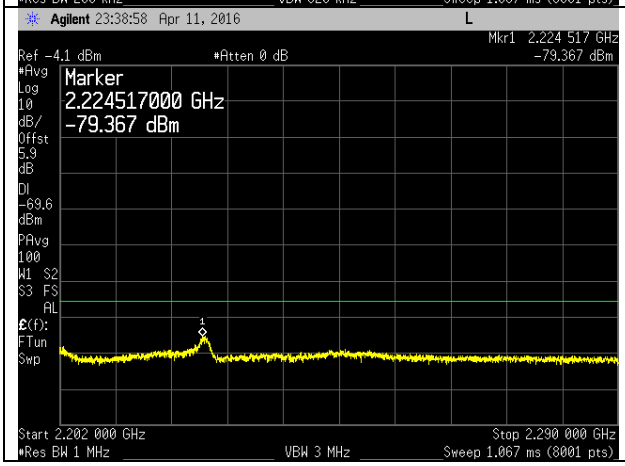




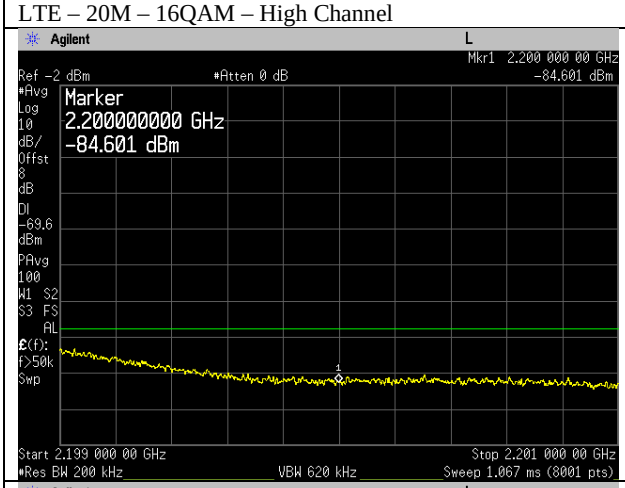
LTE – 20M – QPSK – High Channel

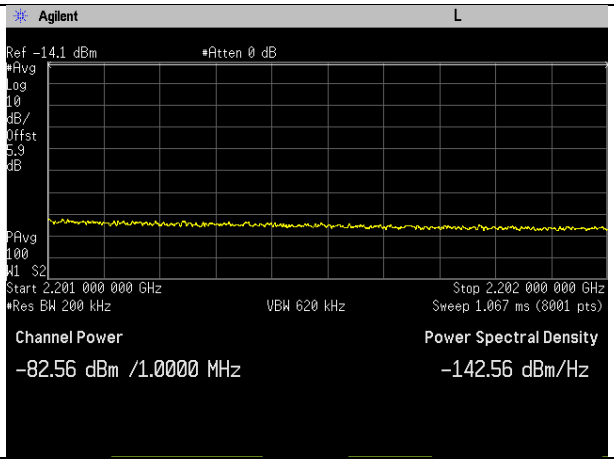


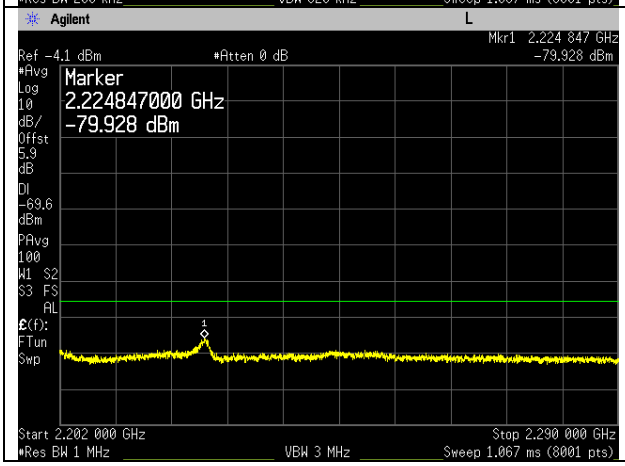




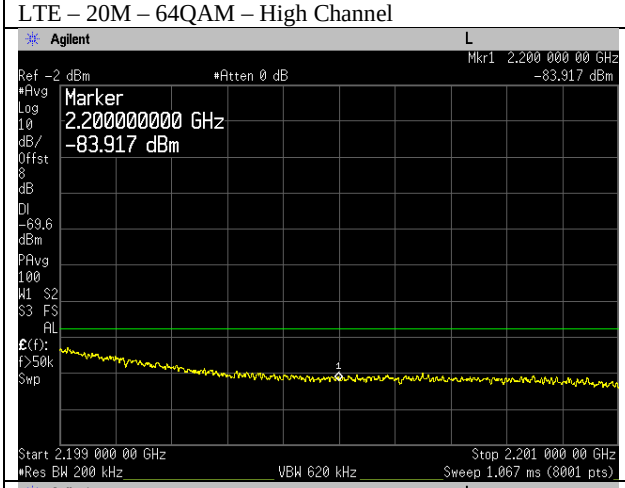
LTE – 20M – 16QAM – High Channel

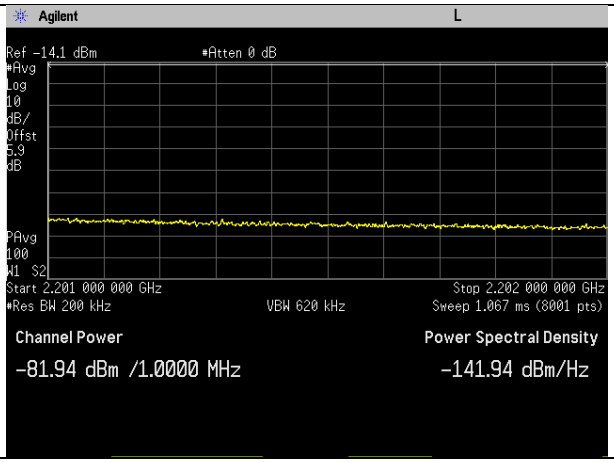


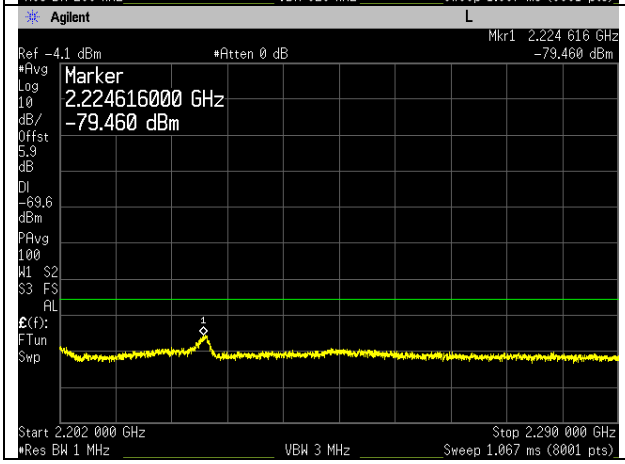




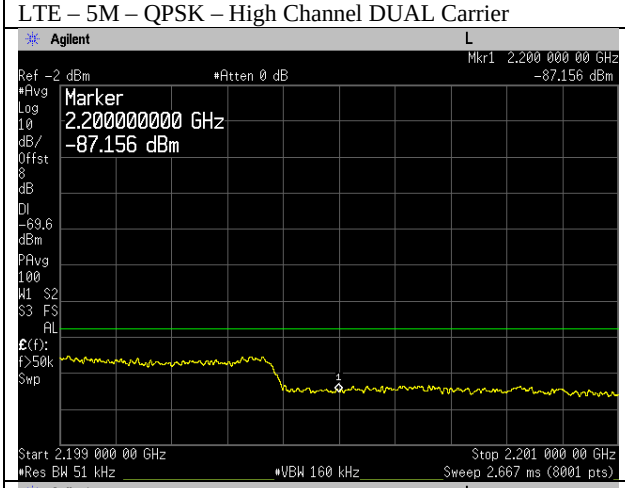
LTE – 20M – 64QAM – High Channel

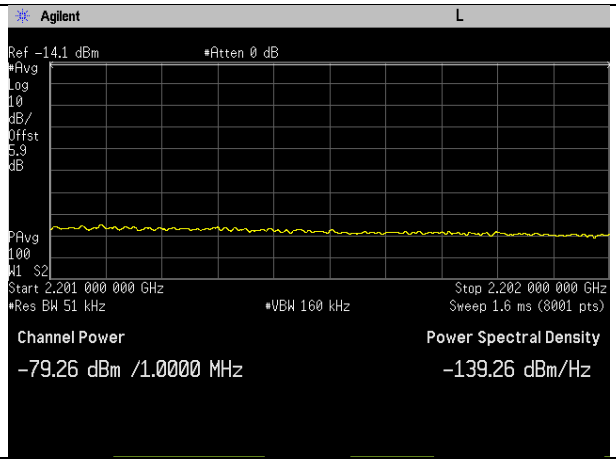


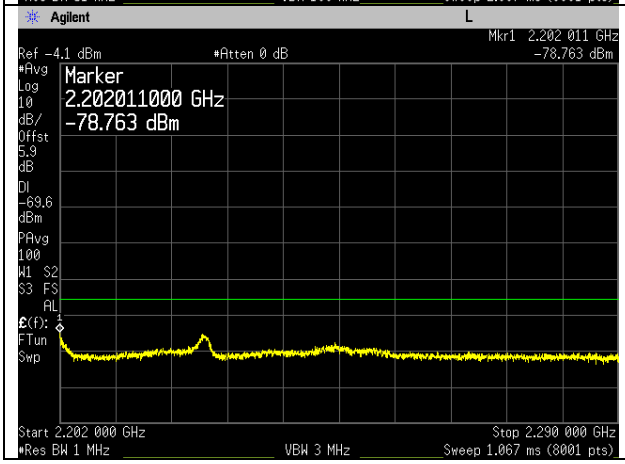




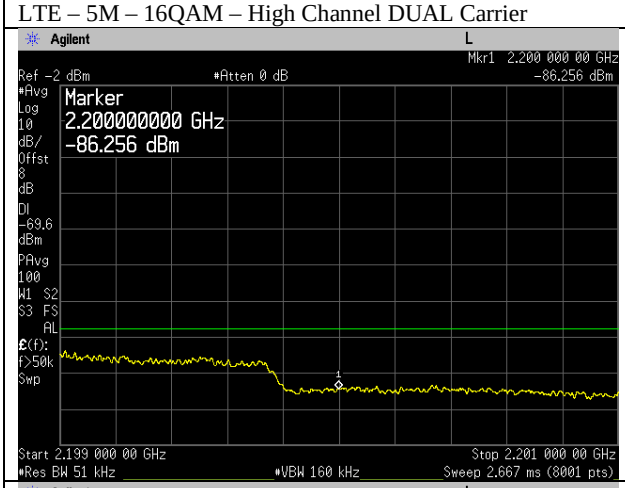
LTE – 5M – QPSK – High Channel DUAL Carrier

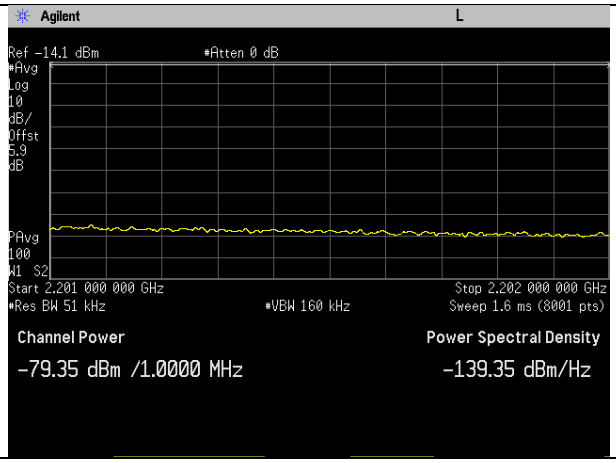


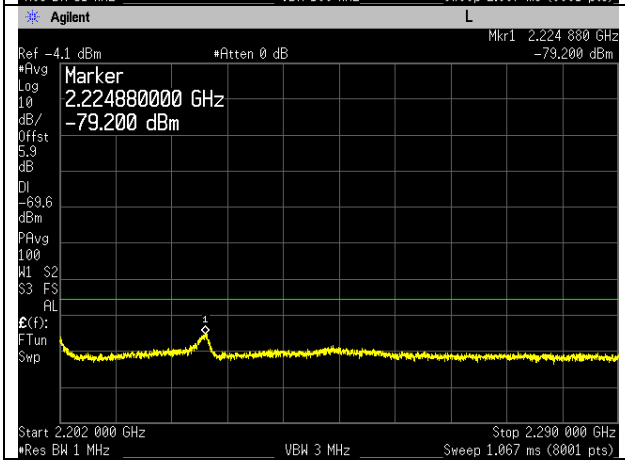




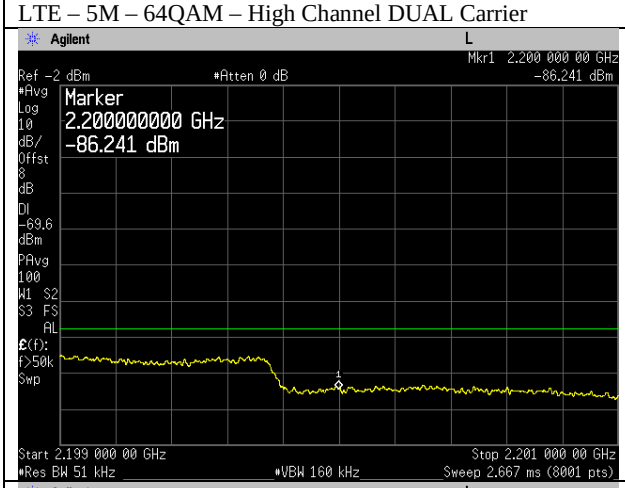
LTE – 5M – 16QAM – High Channel DUAL Carrier

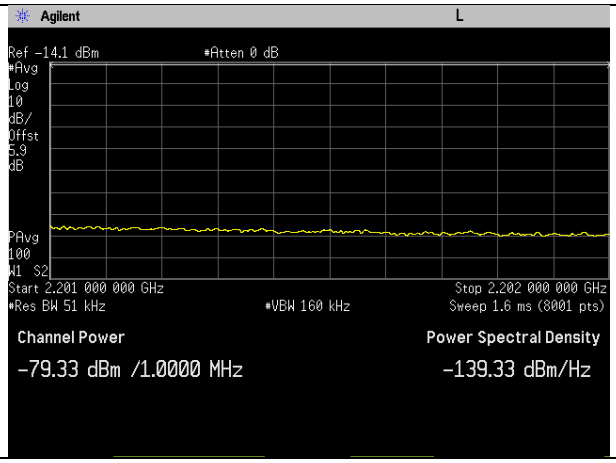


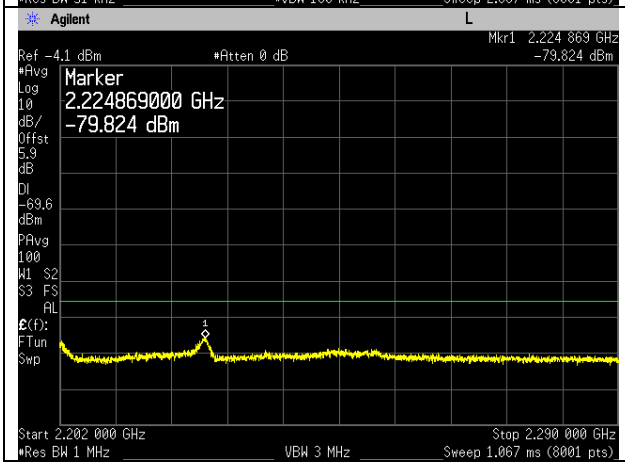




LTE – 5M – 64QAM – High Channel DUAL Carrier







Transmitter Antenna Port Conducted Spurious Emissions

Tests performed at Port 4 on center channel for all modulations and bandwidth modes. Due to 4x4 MIMO operation, limit is -19.03dBm (-13dBm – 10*log(4)) per FCC KDB 662911D01 v02r01. Measurements made at the external notch filter (Filtronics p/n: US-PSD015-F1V1) output port using FRIJ Ant 4.

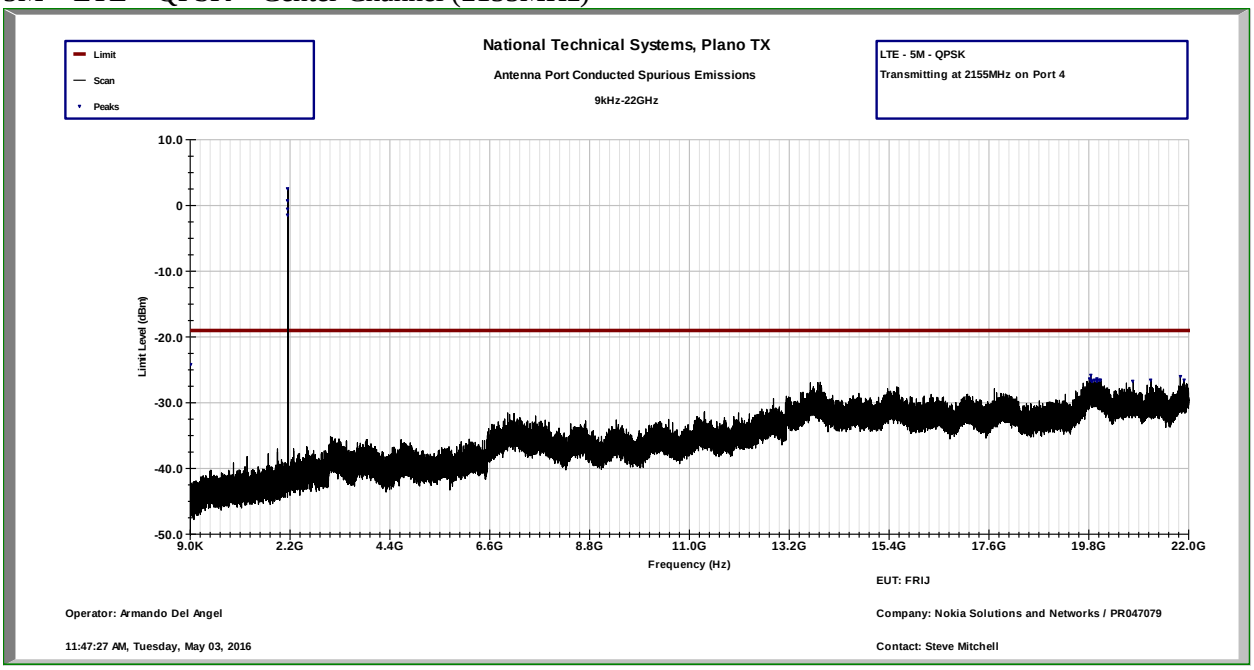
TILE6 measurement software was used during testing with the following settings:

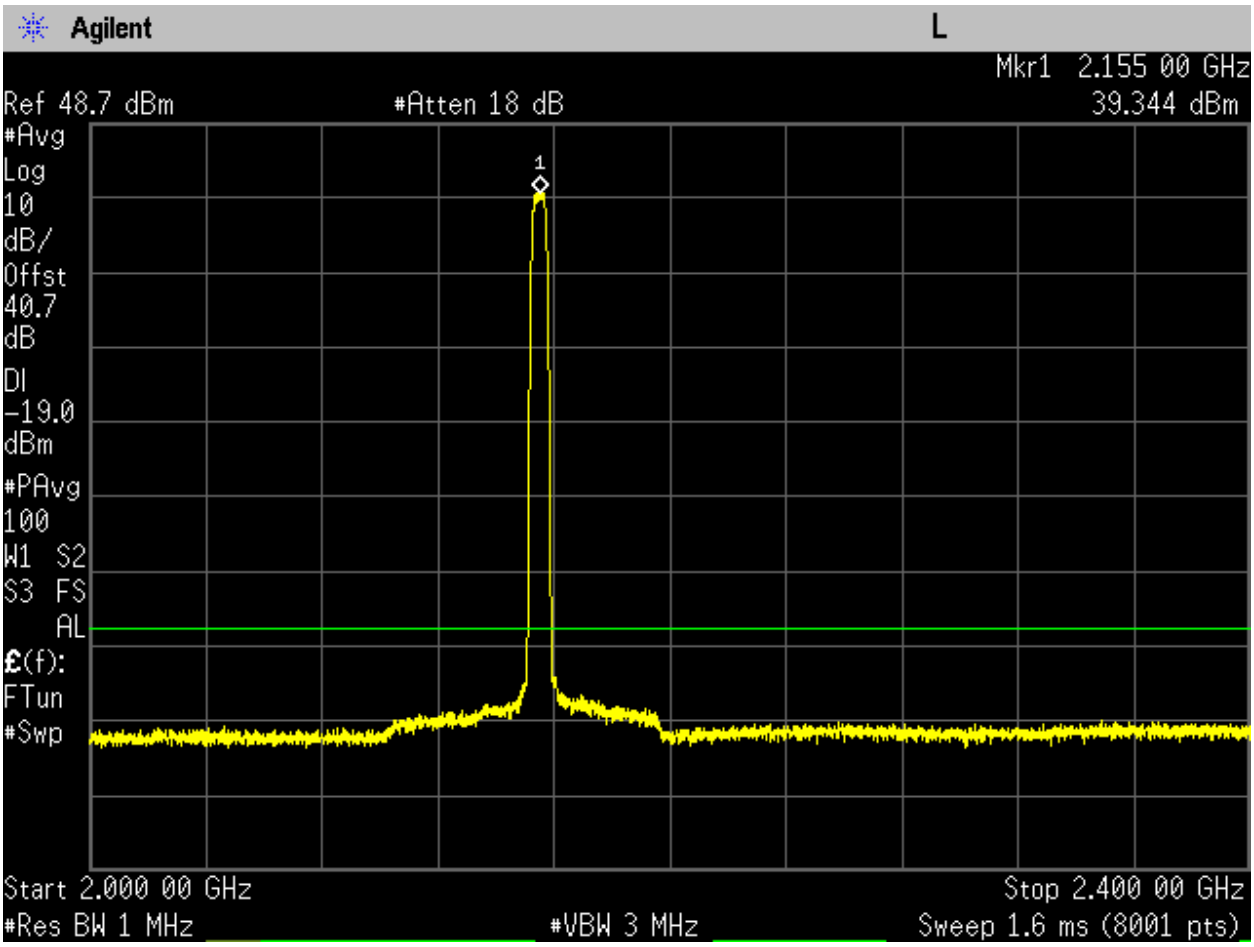
Frequency Range	RBW	VBW	Number of data points	Divided into	Detector	Sweep Time	Max hold over
9kHz-150kHz	1kHz	3kHz	8000	1 segment	Peak	Auto	50 sweeps
150kHz-1.5MHz	100kHz	300kHz	8000	1 segments	Peak	Auto	50 sweeps
1.5MHz-22GHz	1MHz	3MHz	8000	10 segments	Peak	Auto	50 sweeps

In order to reduce the measurement instrumentation noise floor in addition to a 40dB attenuator a notch filter was also used and the PSA's internal attenuation was reduced to 0dB. An additional measurement was taken without the filter in order to measure the filter's stop-band. In that case, only 40db of external attenuation was used.

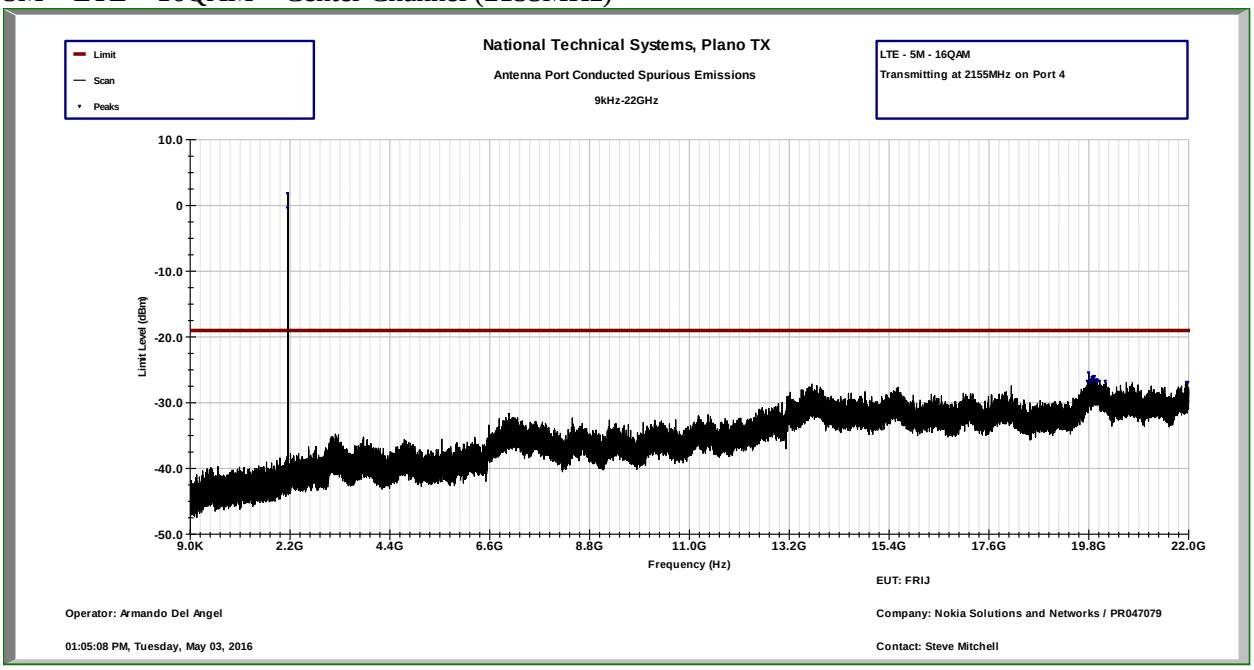
Corresponding plots are included on the following pages.

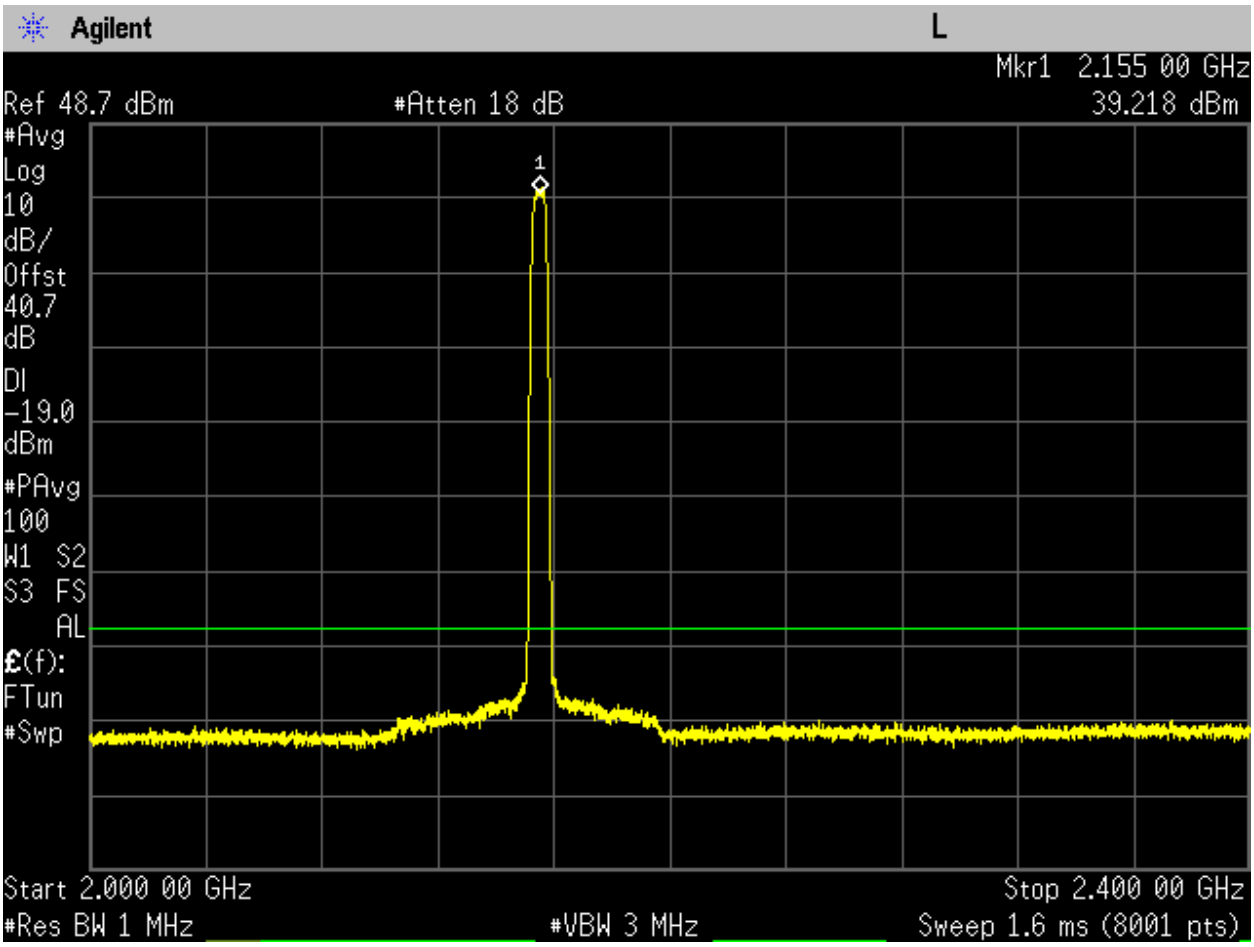
5M – LTE – QPSK – Center Channel (2155MHz)



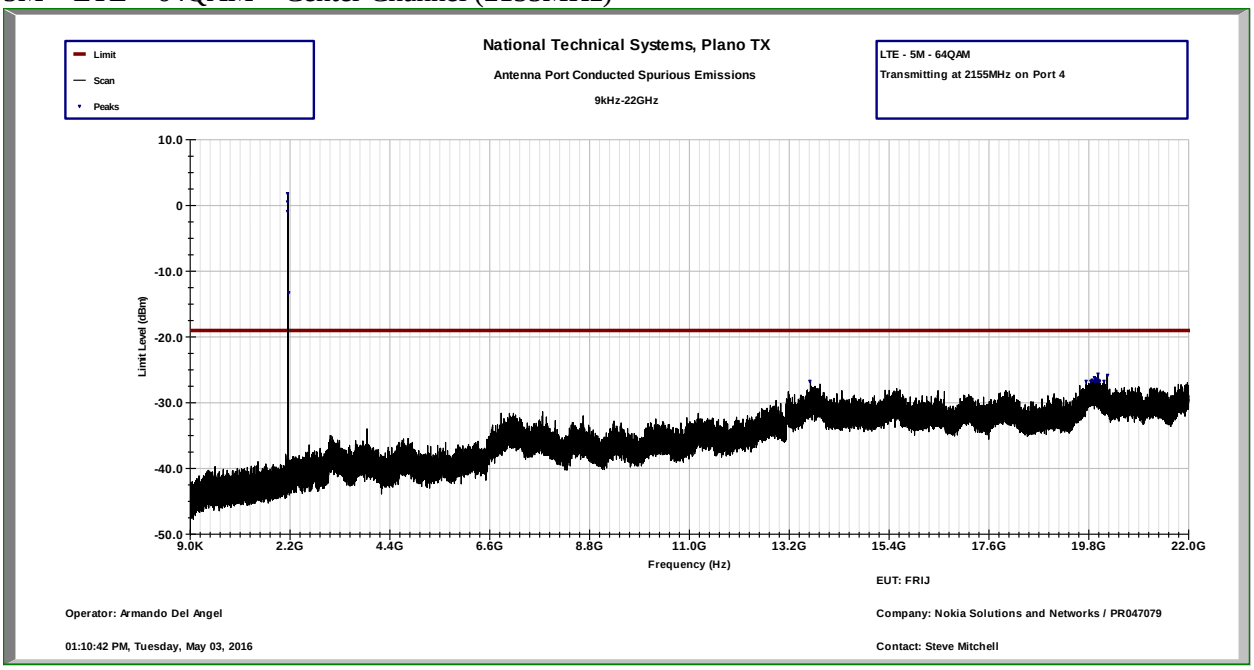


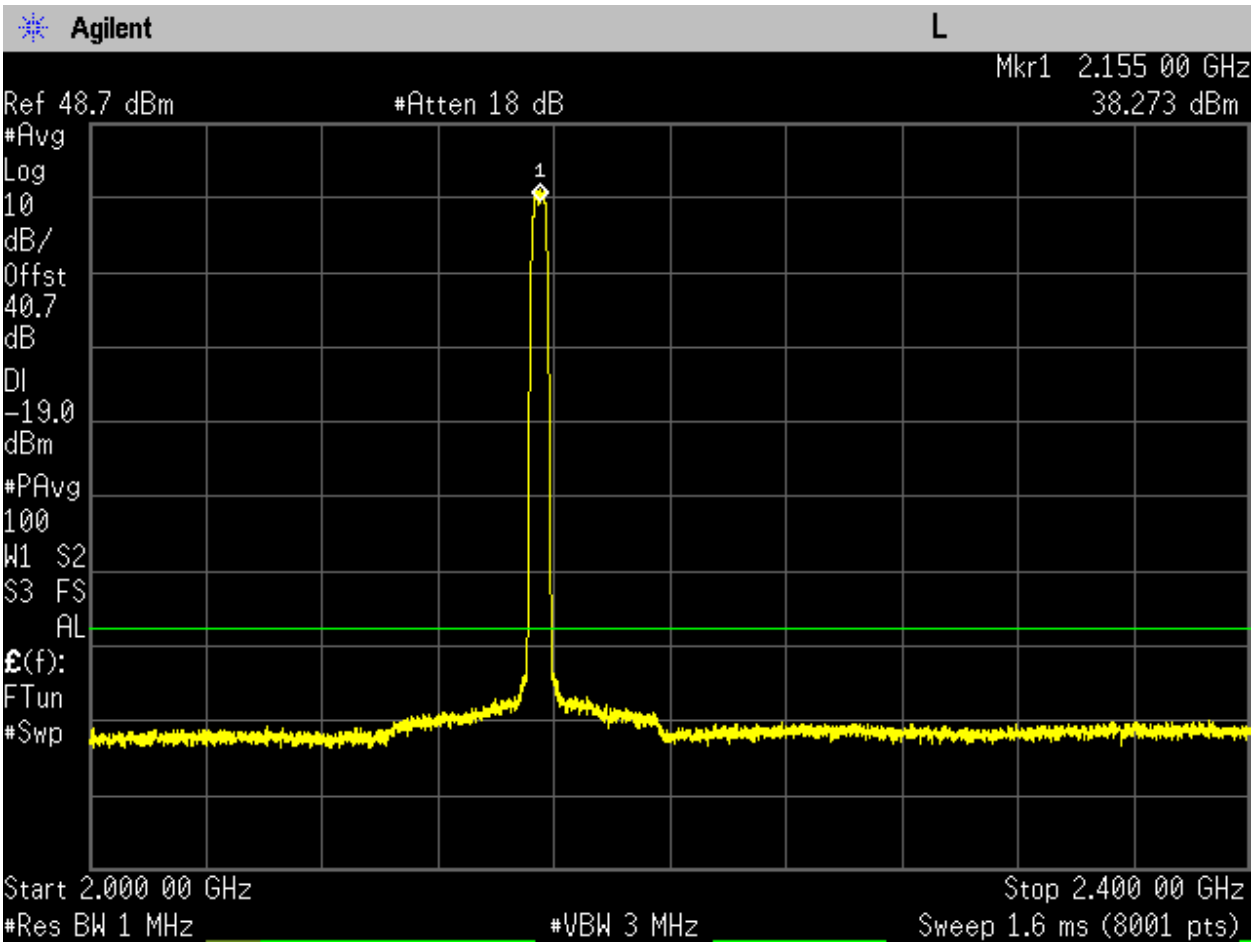
5M – LTE – 16QAM – Center Channel (2155MHz)



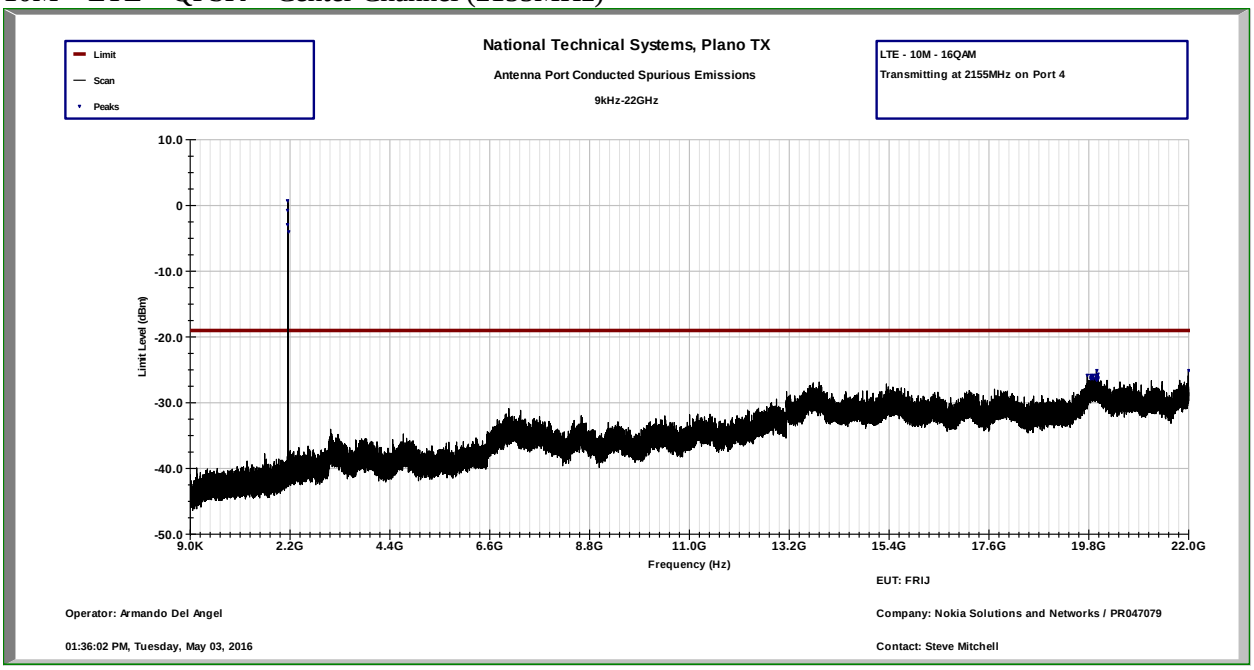


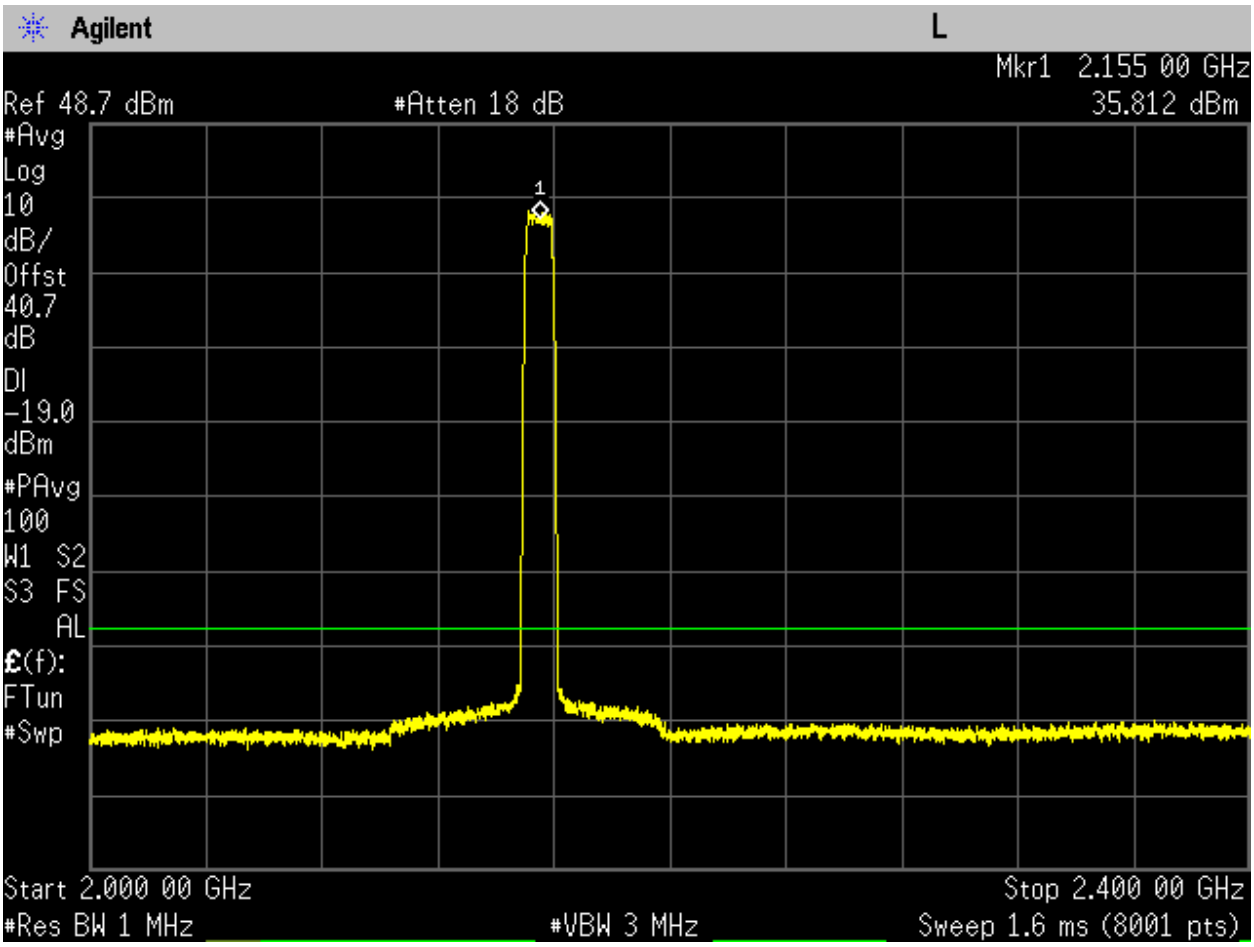
5M – LTE – 64QAM – Center Channel (2155MHz)



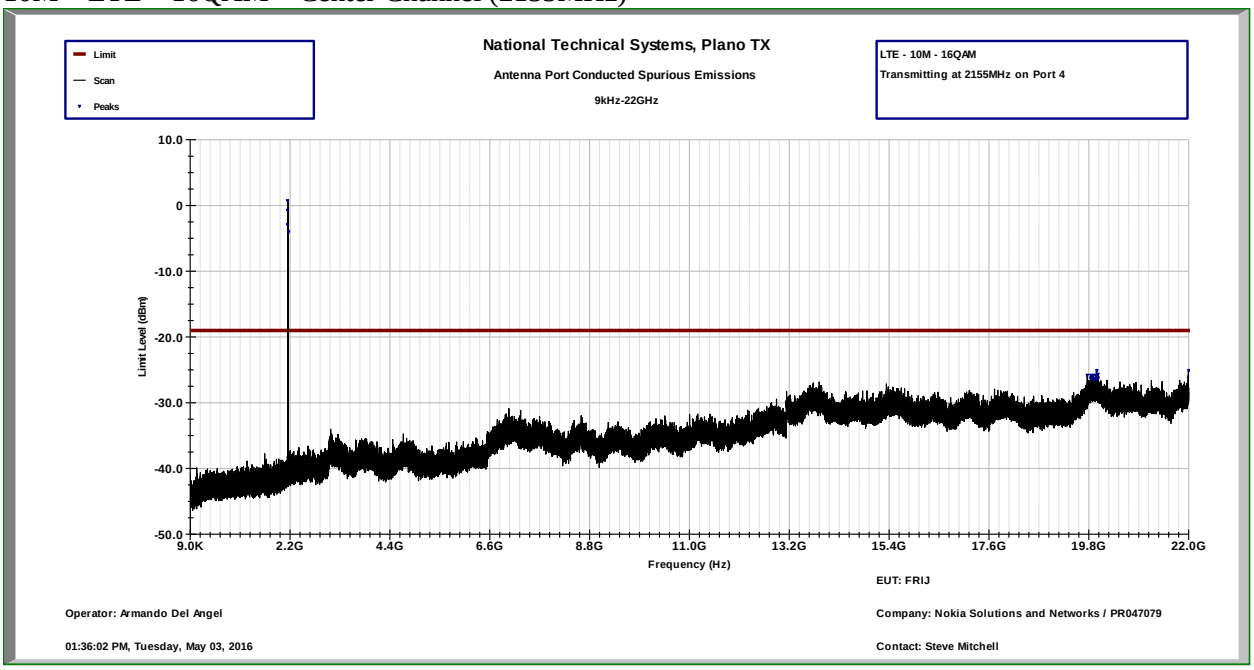


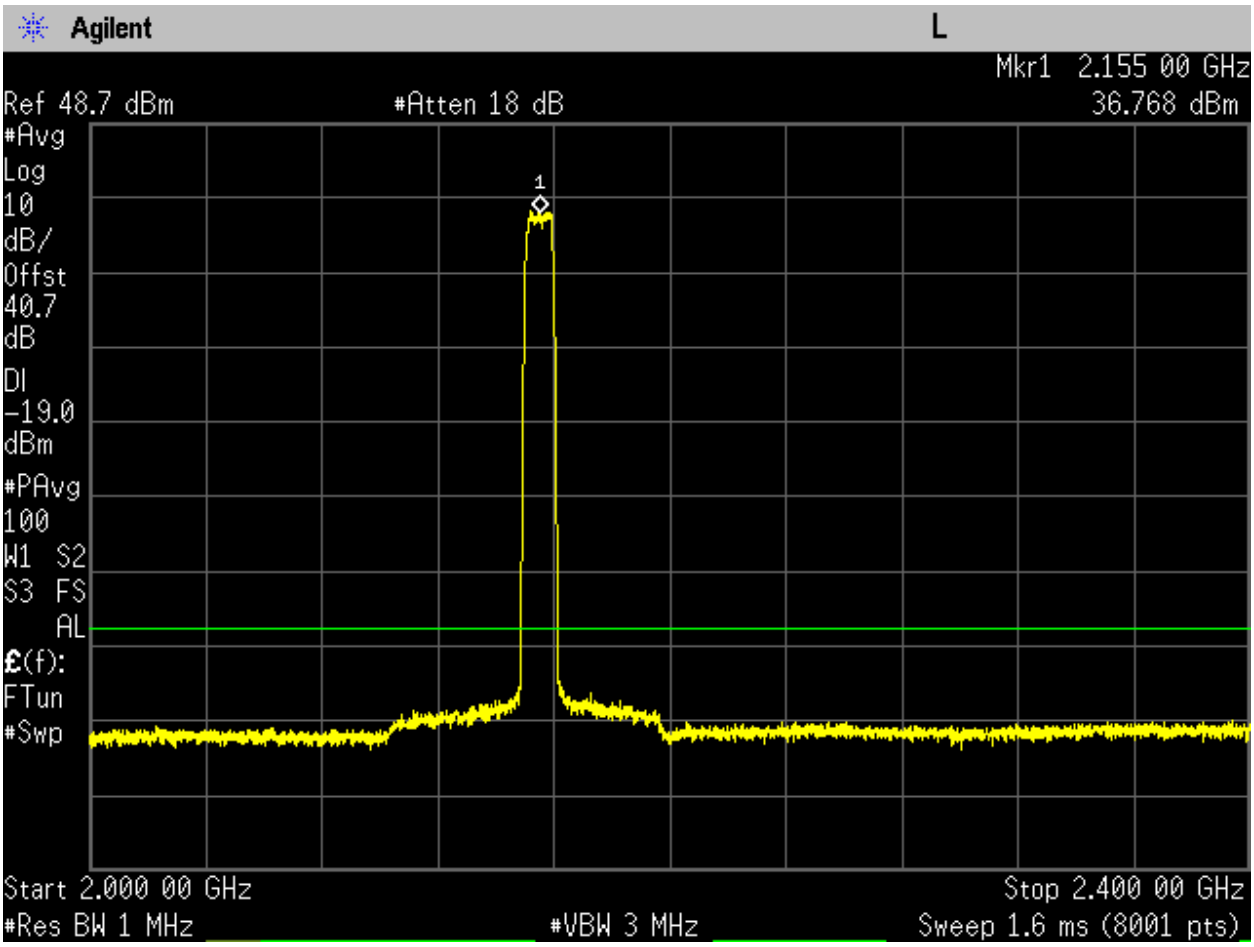
10M – LTE – QPSK – Center Channel (2155MHz)



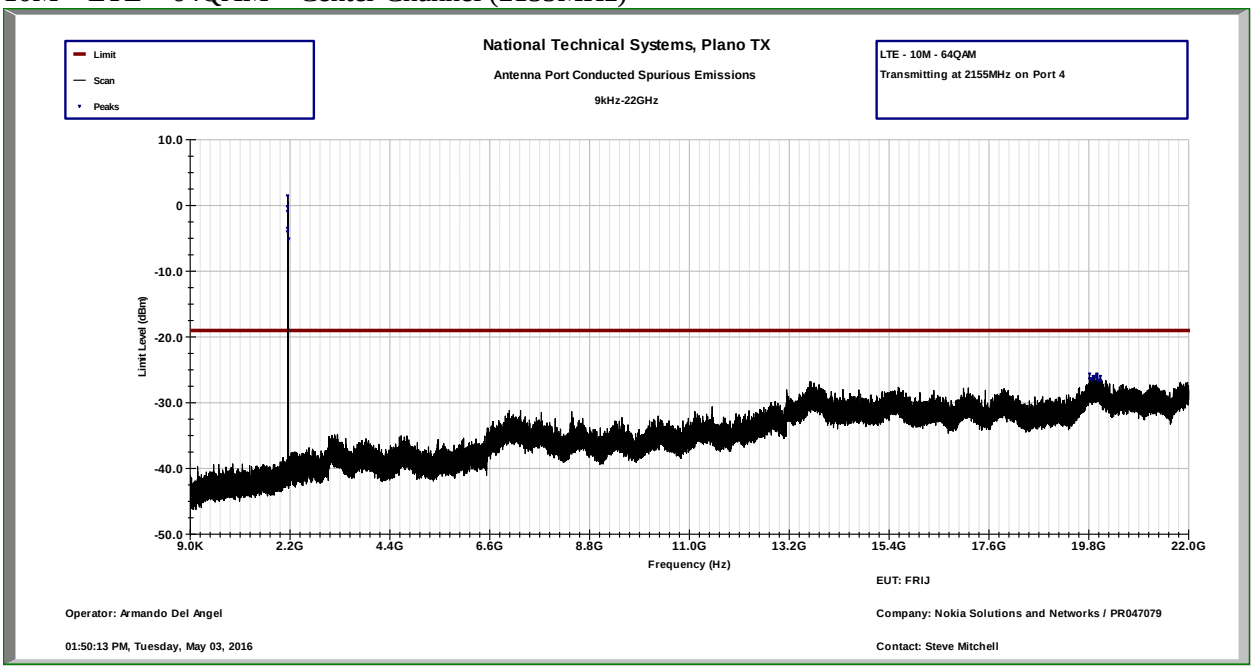


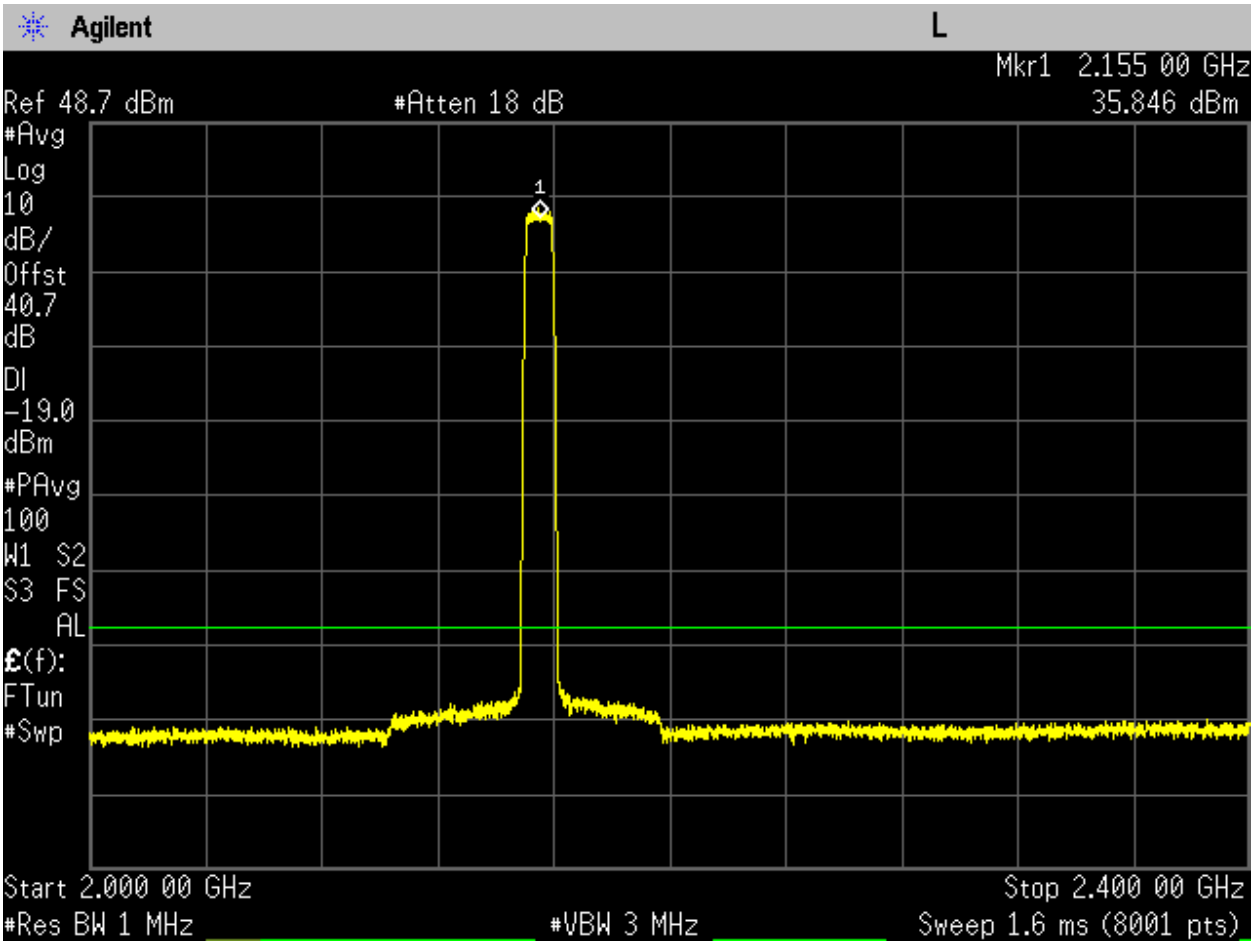
10M – LTE – 16QAM – Center Channel (2155MHz)



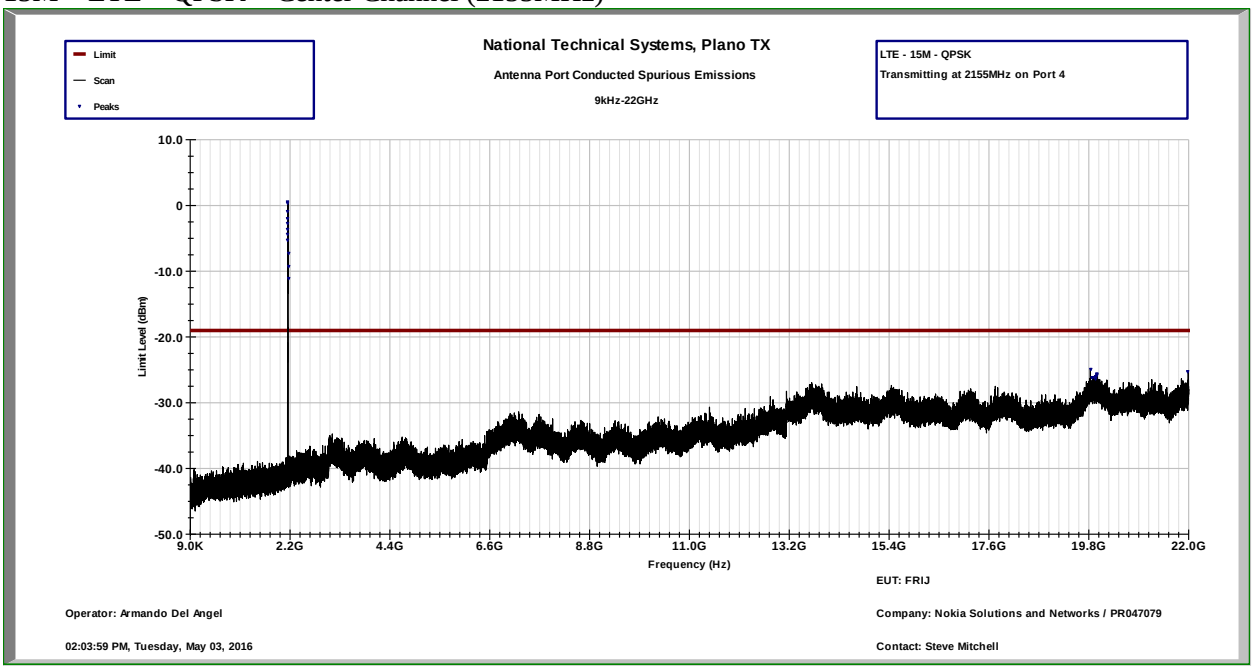


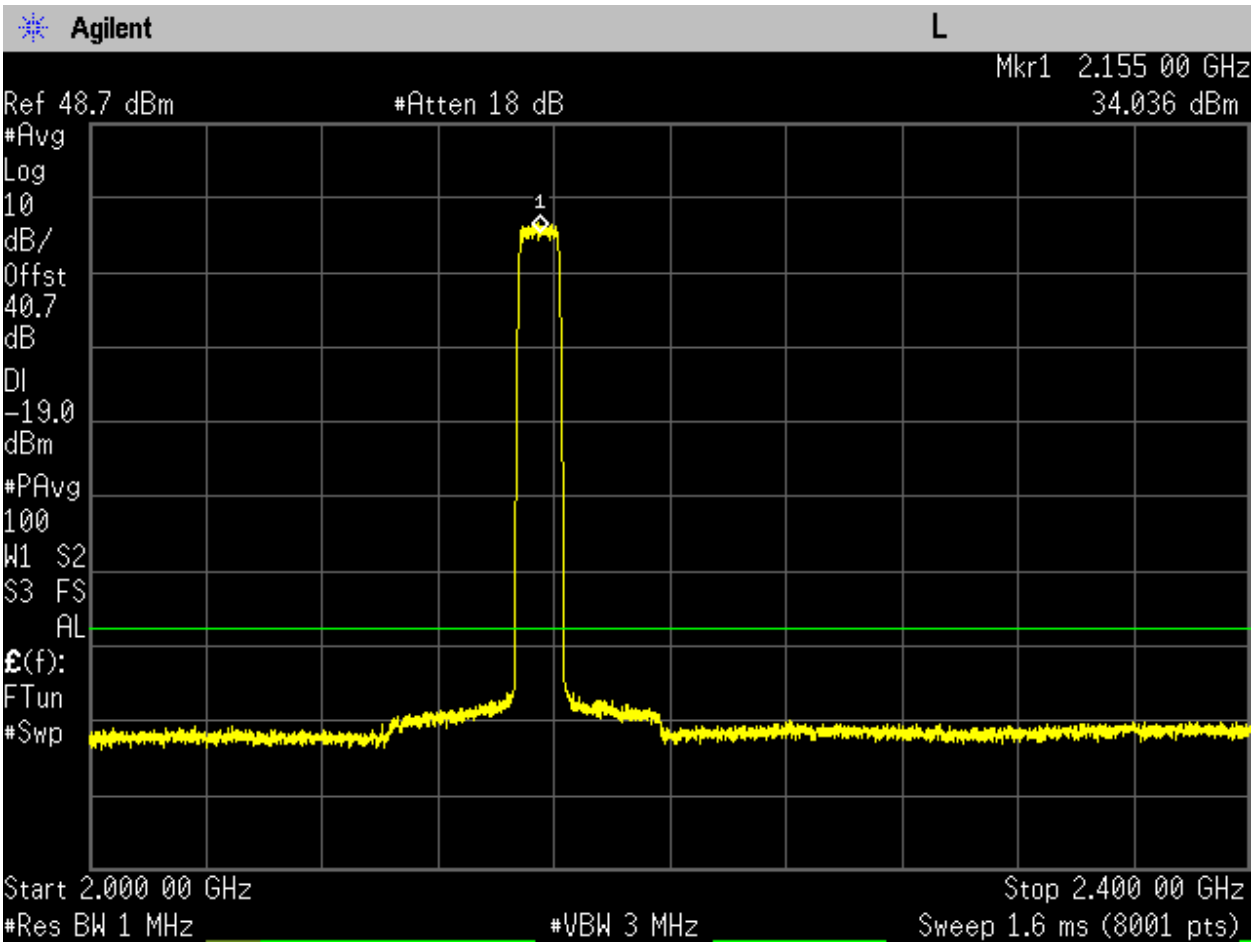
10M – LTE – 64QAM – Center Channel (2155MHz)



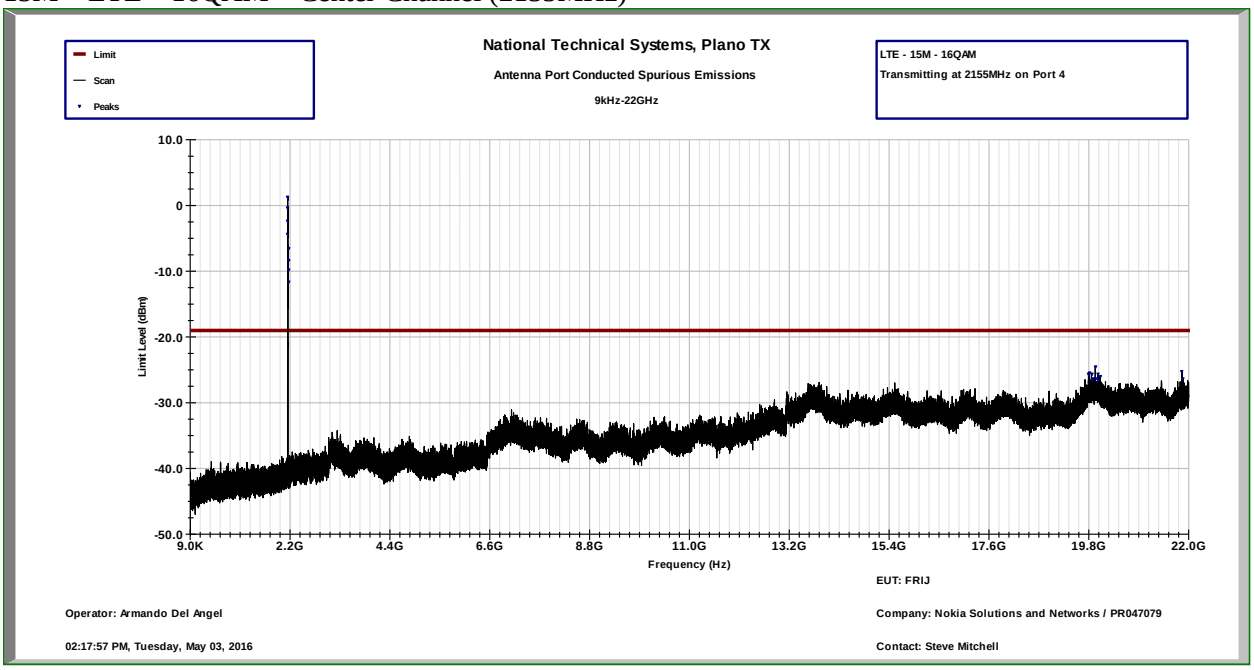


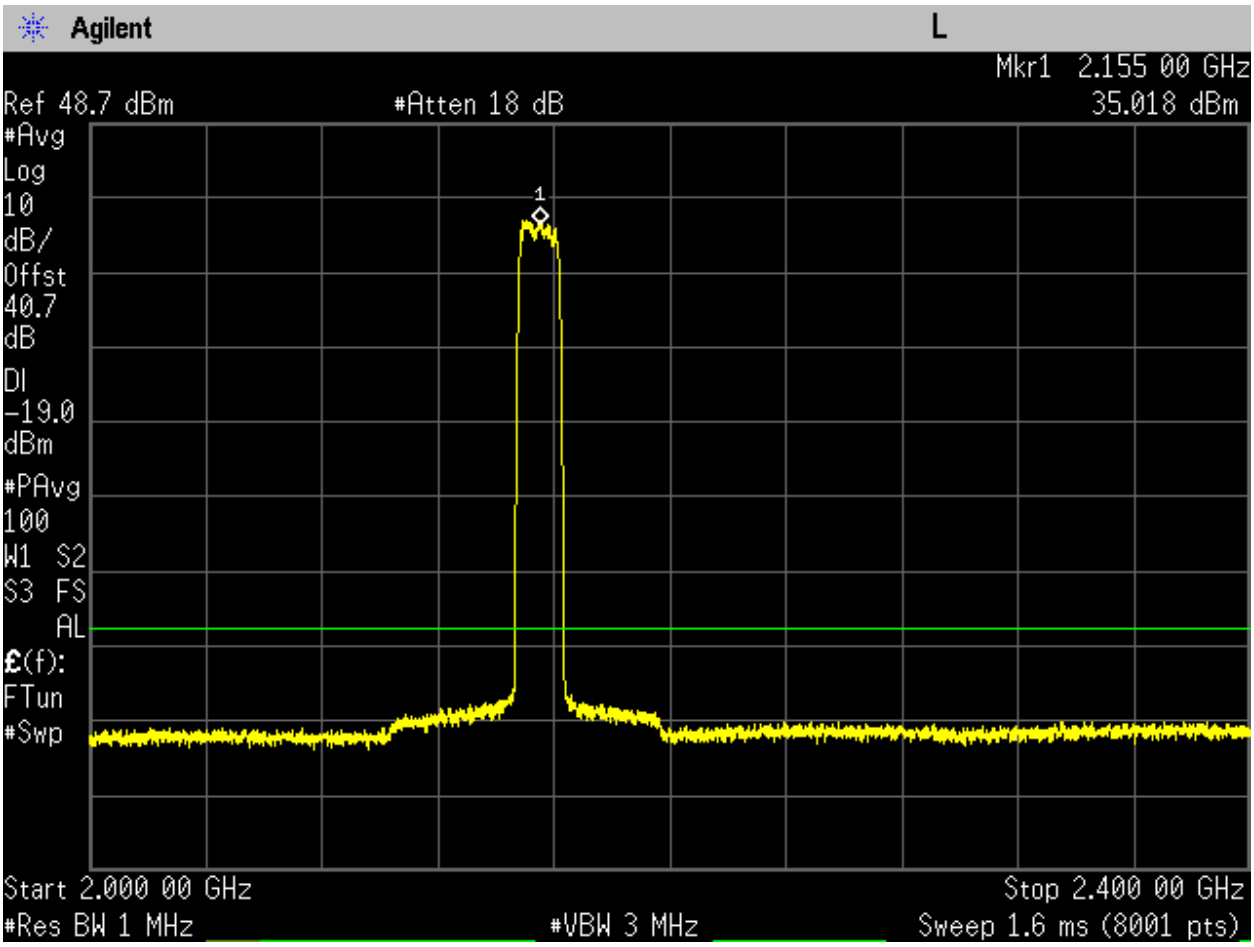
15M – LTE – QPSK – Center Channel (2155MHz)



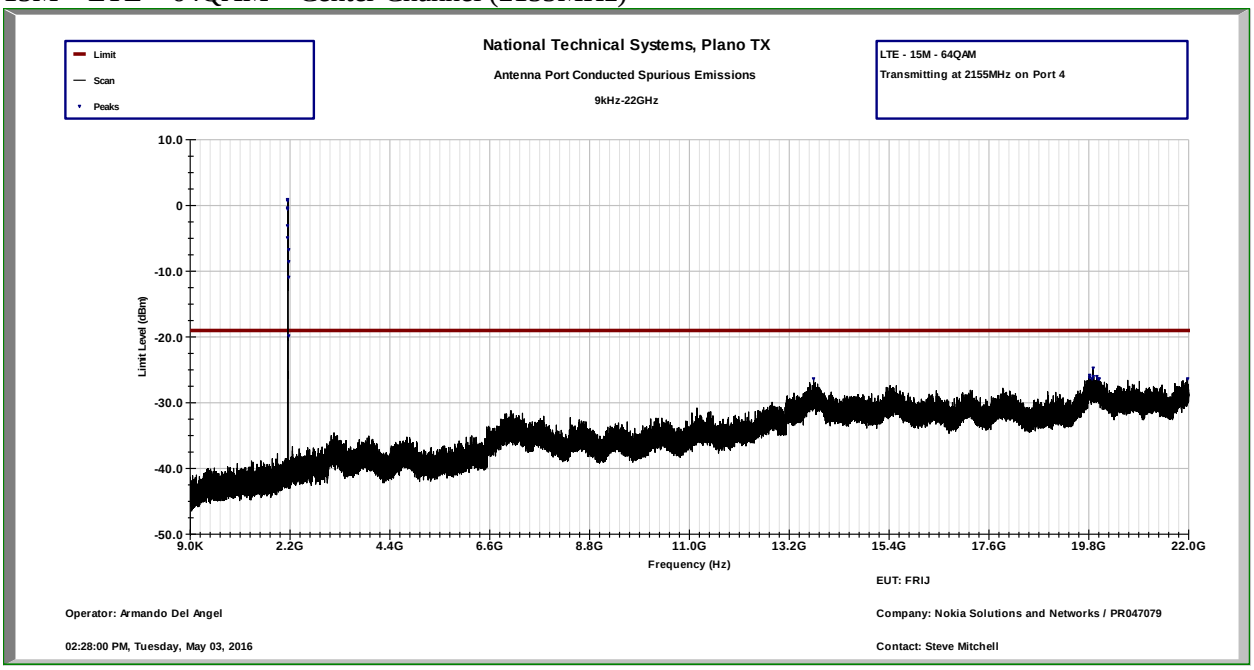


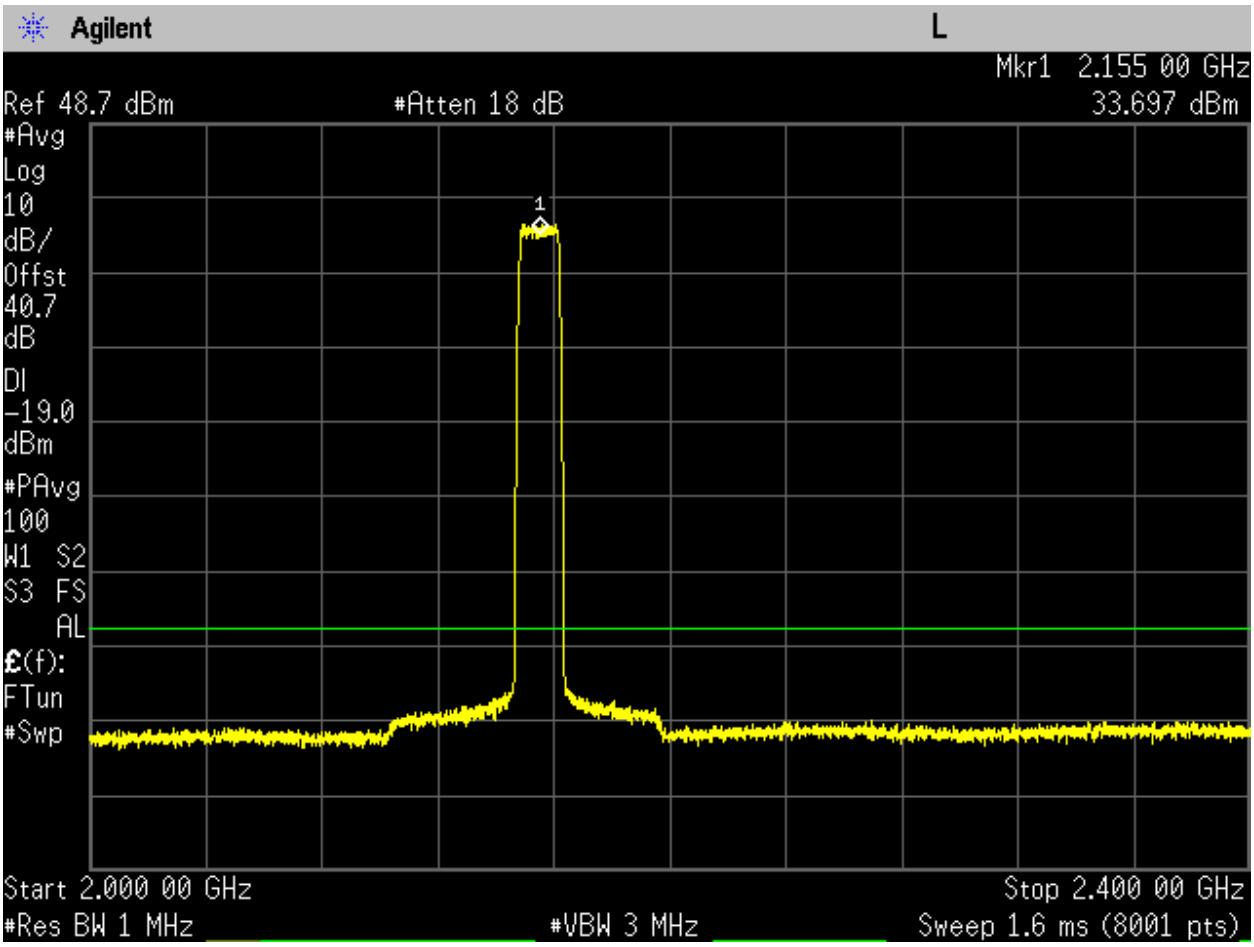
15M – LTE – 16QAM – Center Channel (2155MHz)



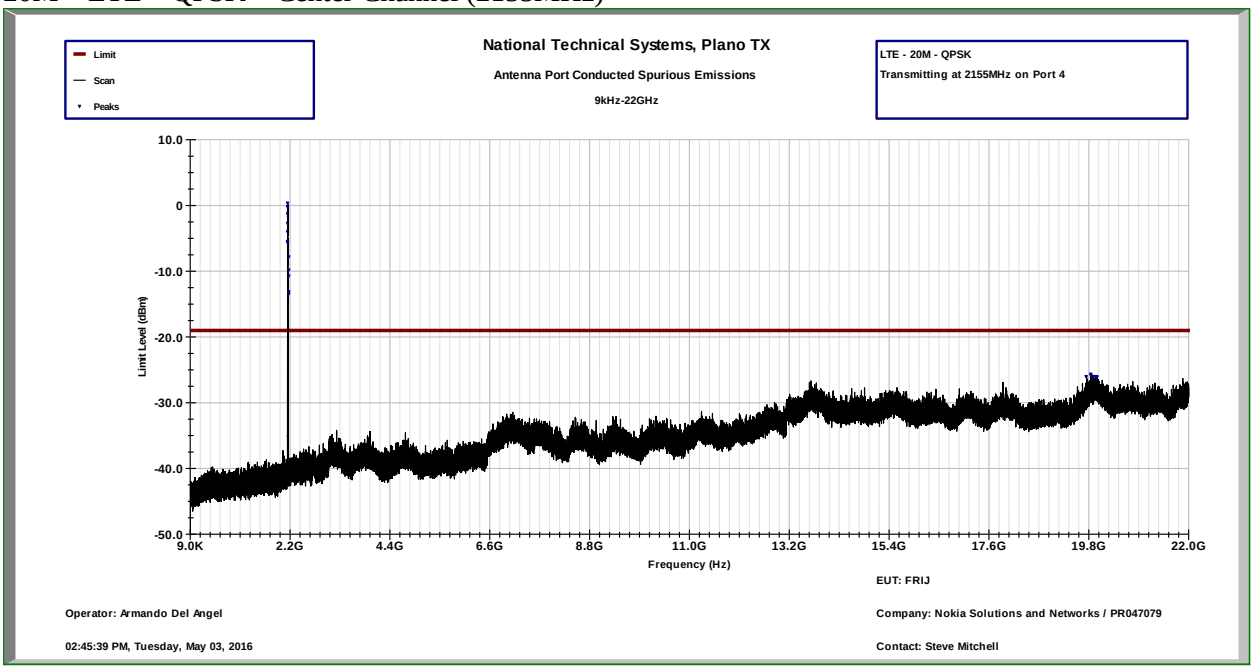


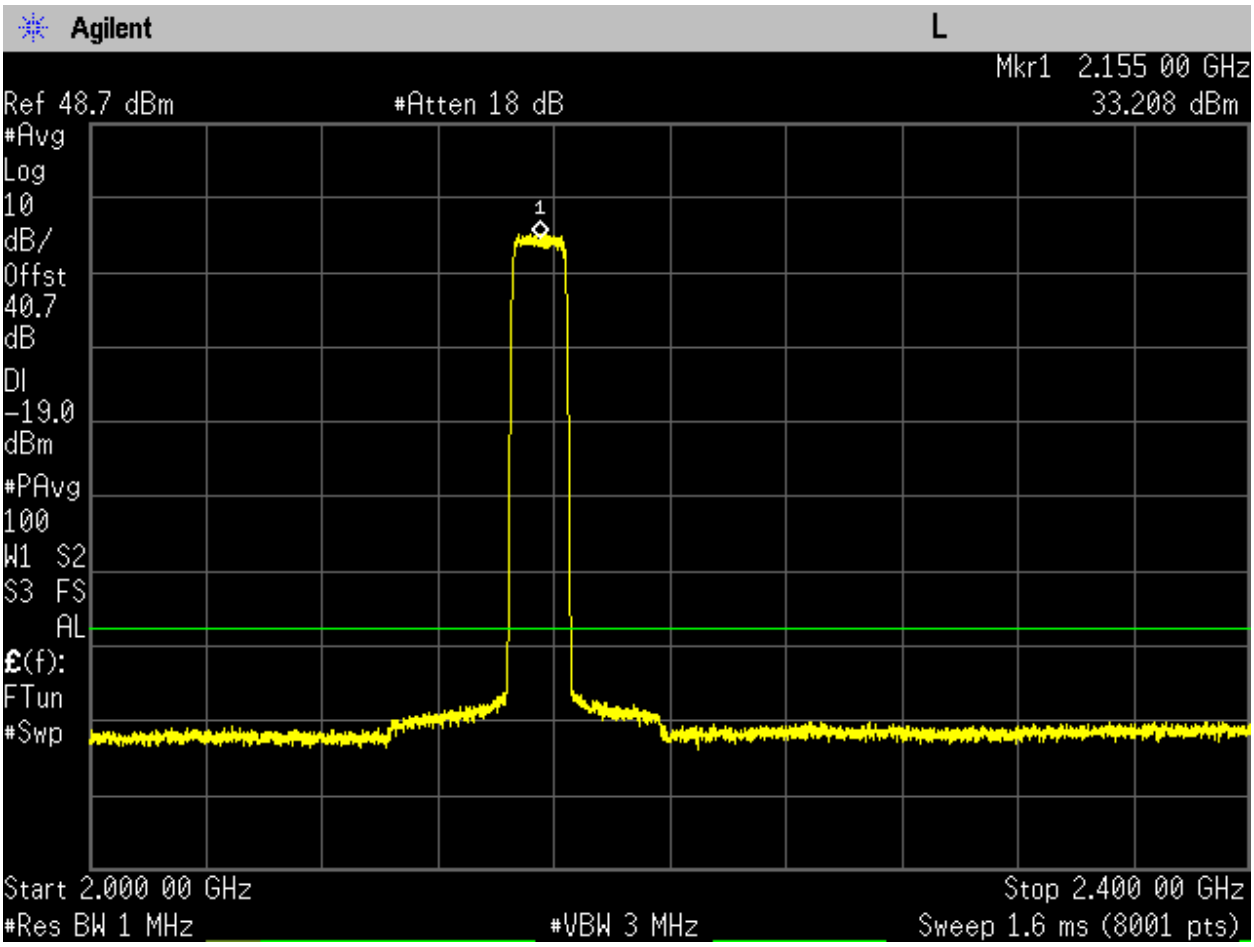
15M – LTE – 64QAM – Center Channel (2155MHz)



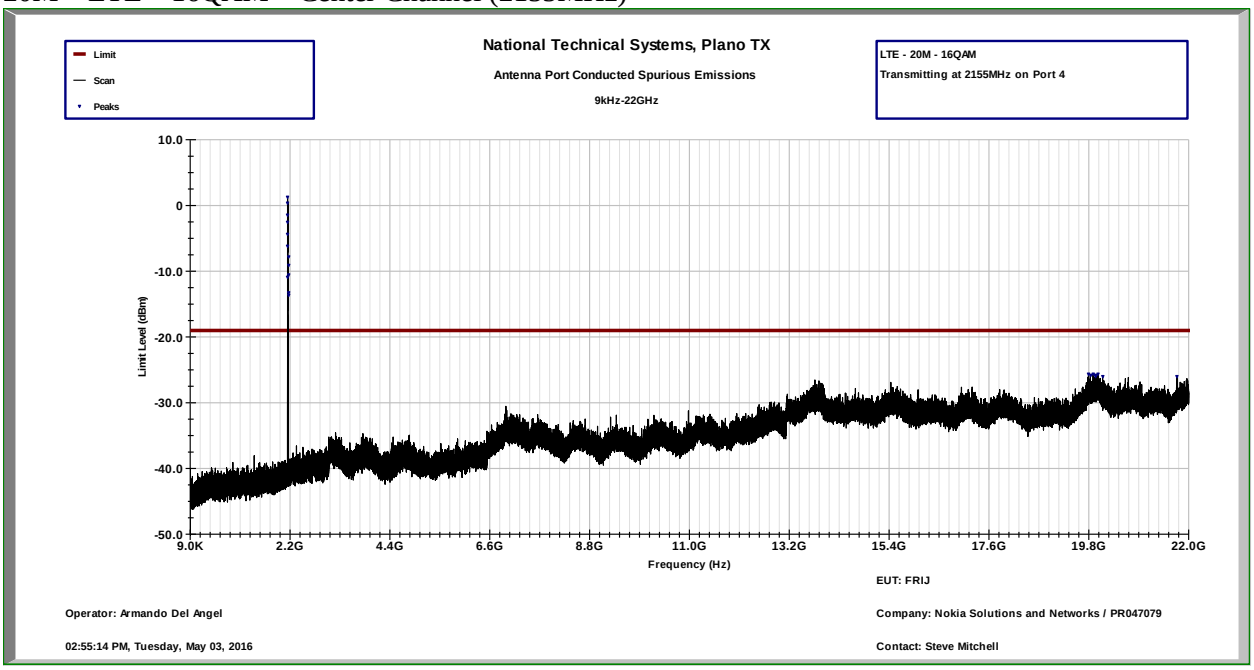


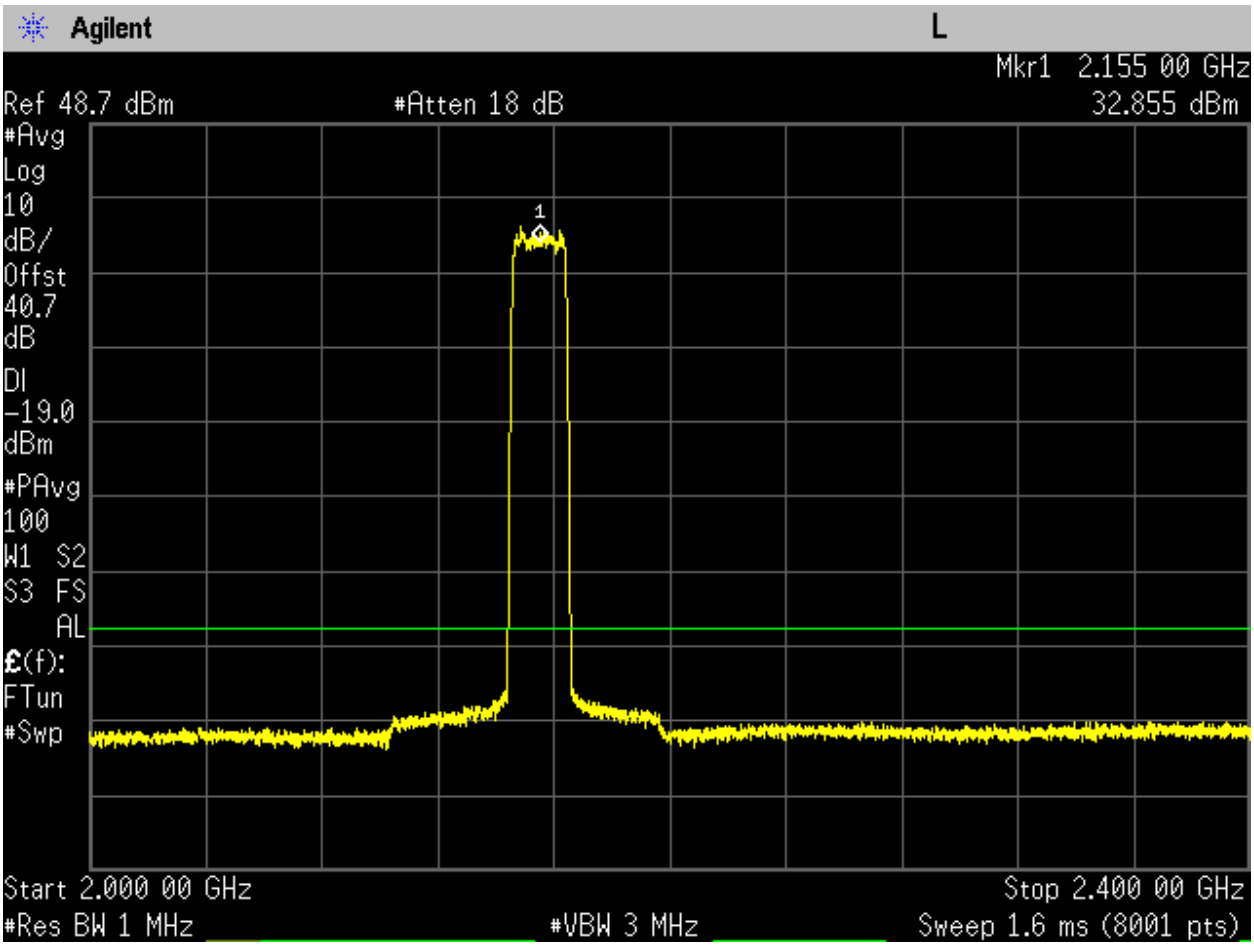
20M – LTE – QPSK – Center Channel (2155MHz)



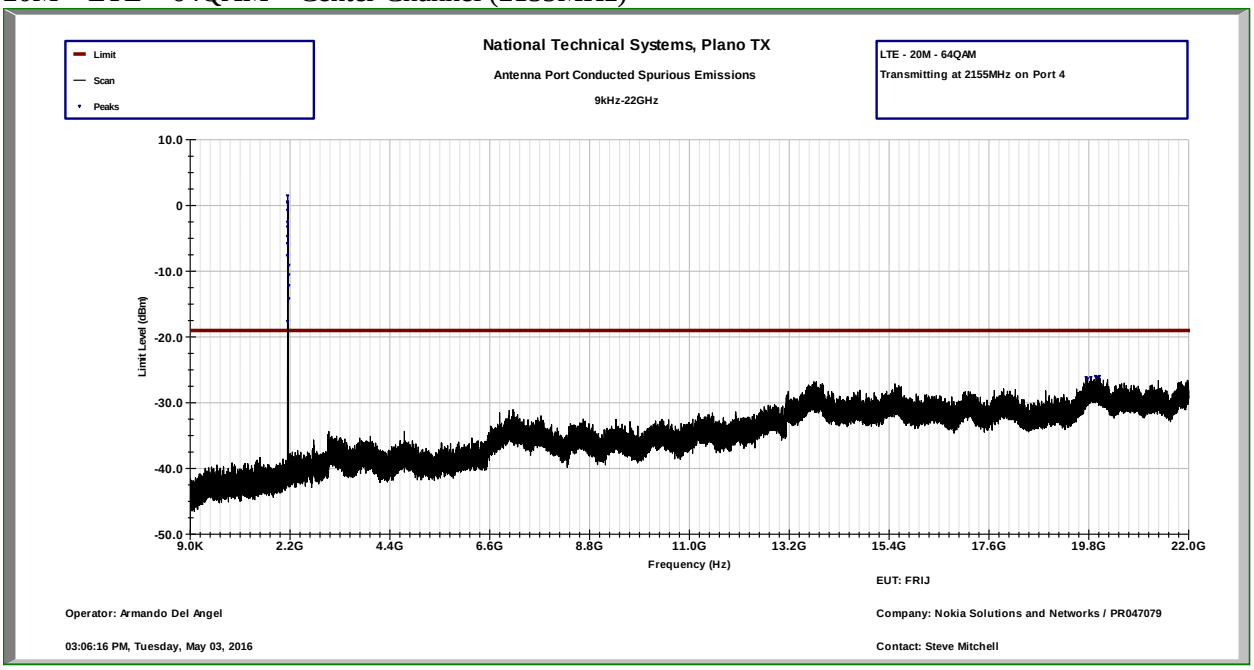


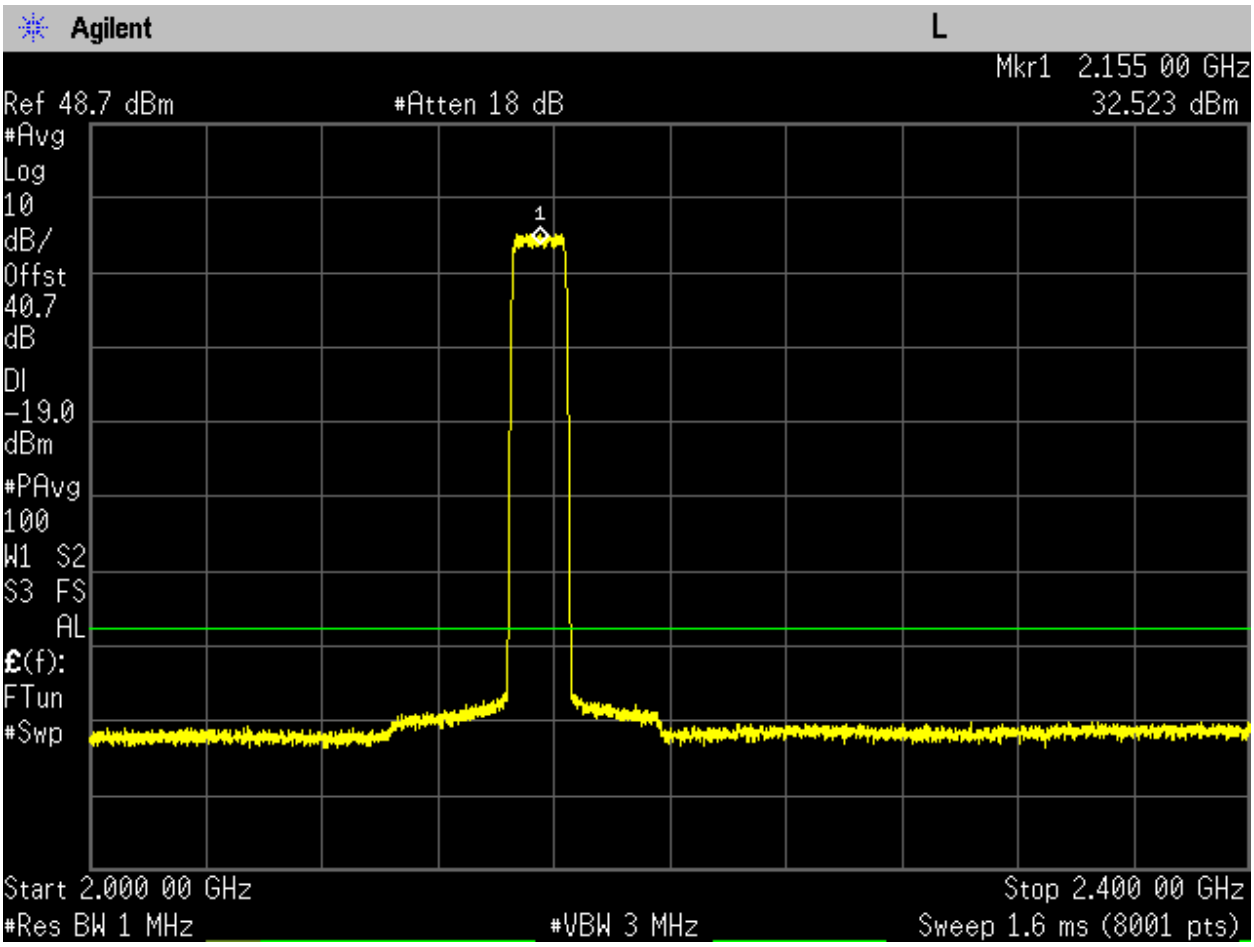
20M – LTE – 16QAM – Center Channel (2155MHz)





20M – LTE – 64QAM – Center Channel (2155MHz)





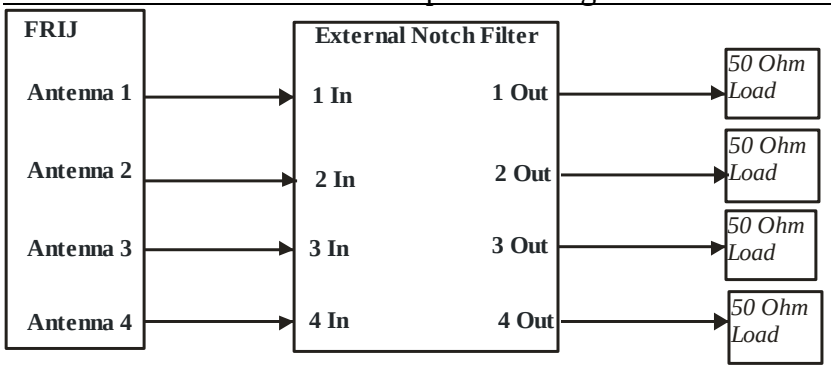
Transmitter Radiated Spurious Emissions (AWS-4 Band Out of Band Emission Requirement)

During testing all antenna ports of the base station were terminated with 50ohm termination blocks and unit was transmitting on all of its ports at full power as described below. The radiated emission limit for FCC part 27.1134(e)(i) and RSS 170 requirement was calculated for the FRIJ operating in four port MIMO as follows:
-100.6dBW/4kHz (EIRP Limit) + 30dB (dBW to dBm) + 24dB (BW conversion 10 log[1M/4k]) - 0dBi (Antenna Gain) = -46.6dBm/1MHz or at a max field strength of 50.8dBuV/m at 3 meters
Note that a BTS antenna gain of 0dBi is used since the radiated emissions are being measured are off the RRH hardware (all antenna ports are terminated into 50 ohm loads).

FRIJ Transmit Frequencies used in Radiated Emission Testing for 2200 to 2290MHz

FRIJ Antenna Port	EARFCN	LTE Channel Bandwidth	Modulation Type	Transmit Frequency
1	67261 (Notch Filter Top Channel)	5 MHz	QPSK	2192.5 MHz
2	67261 (Notch Filter Top Channel)	5 MHz	QPSK	2192.5 MHz
3	67261 (Notch Filter Top Channel)	5 MHz	QPSK	2192.5 MHz
4	67261 (Notch Filter Top Channel)	5 MHz	QPSK	2192.5 MHz

FRIJ Radiated Emission RF Setup Block Diagram for 2200 to 2290MHz



2200-2290MHz @ 3m Distance

Peak Readings

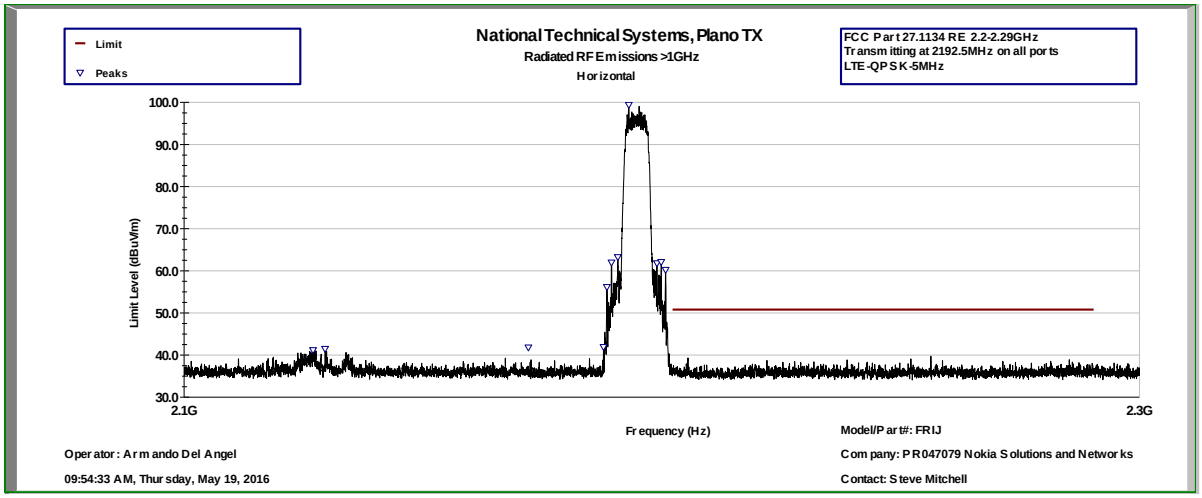
Frequency (GHz)	Polarity (H/V)	Raw Pk Reading at 3m (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Pak Field Strength at 3m (dBuV/m)	Limit at 3m (dBuV/m)	Margin (dB)
2.255	H	51.205	-41.934	27.506	2.936	39.711	50.8	-11.089
2.203	H	50.864	-42.09	27.658	2.882	39.314	50.8	-11.486
2.250	H	50.589	-41.947	27.502	2.932	39.074	50.8	-11.726
2.285	H	50.24	-41.845	27.533	2.967	38.894	50.8	-11.906
2.237	H	50.375	-41.988	27.546	2.917	38.849	50.8	-11.951
2.220	H	50.239	-42.039	27.602	2.9	38.701	50.8	-12.099
2.257	H	50.139	-41.927	27.509	2.939	38.658	50.8	-12.142
2.281	H	49.907	-41.857	27.53	2.963	38.541	50.8	-12.259
2.270	H	49.908	-41.888	27.52	2.952	38.491	50.8	-12.309
2.226	H	49.987	-42.022	27.583	2.906	38.453	50.8	-12.347
2.230	H	49.937	-42.009	27.569	2.91	38.406	50.8	-12.394
2.285	H	49.671	-41.843	27.534	2.968	38.328	50.8	-12.472
2.236	V	49.035	-41.99	27.547	2.917	37.508	50.8	-13.292
2.282	V	48.681	-41.854	27.53	2.964	37.319	50.8	-13.481
2.287	V	48.553	-41.837	27.536	2.97	37.221	50.8	-13.579
2.272	V	48.609	-41.883	27.522	2.954	37.2	50.8	-13.6
2.251	V	48.686	-41.945	27.503	2.932	37.174	50.8	-13.626
2.223	V	48.589	-42.03	27.592	2.903	37.053	50.8	-13.747
2.274	V	48.324	-41.877	27.523	2.956	36.924	50.8	-13.876
2.243	V	48.38	-41.969	27.525	2.924	36.858	50.8	-13.942
2.280	V	48.204	-41.858	27.529	2.962	36.836	50.8	-13.964
2.276	V	48.208	-41.871	27.525	2.958	36.818	50.8	-13.982
2.279	V	48.183	-41.861	27.528	2.961	36.81	50.8	-13.99
2.246	V	48.327	-41.96	27.515	2.927	36.807	50.8	-13.993

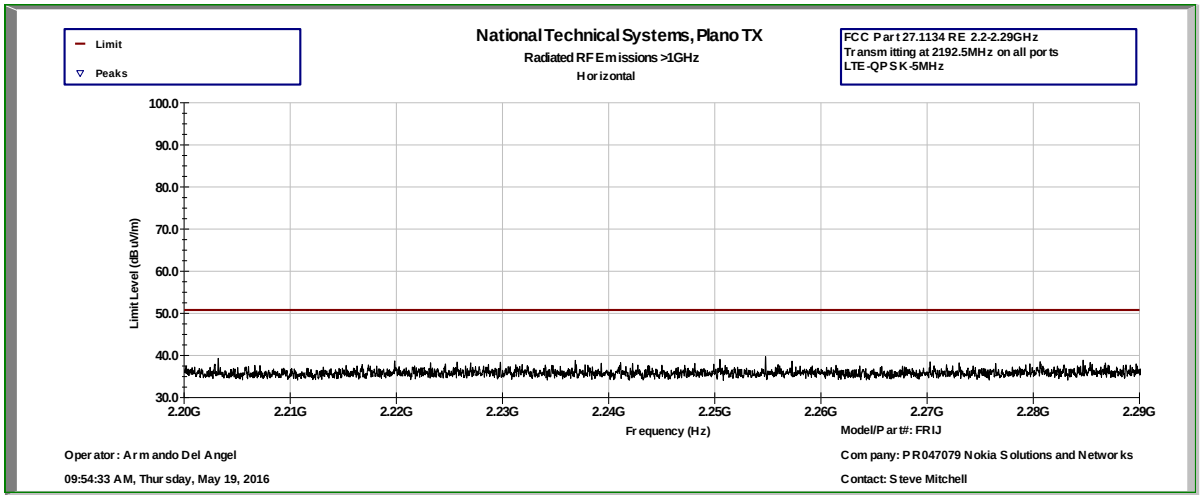
Maximized Average Readings

Frequency (GHz)	Polarity (H/V)	Raw Reading at 3m (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Field Strength at 3m (dBuV/m)	Limit at 3m (dBuV/m)	Margin (dB)
2.29	H	37.887	-41.829	27.538	2.973	26.568	50.8	-24.232
2.20	H	37.937	-42.097	27.666	2.88	26.385	50.8	-24.415
2.25	H	37.751	-41.949	27.502	2.931	26.234	50.8	-24.566
2.29	V	36.52	-41.826	27.539	2.974	25.207	50.8	-25.593
2.20	V	36.6	-42.098	27.667	2.88	25.048	50.8	-25.752
2.25	V	36.111	-41.947	27.502	2.932	24.597	50.8	-26.203

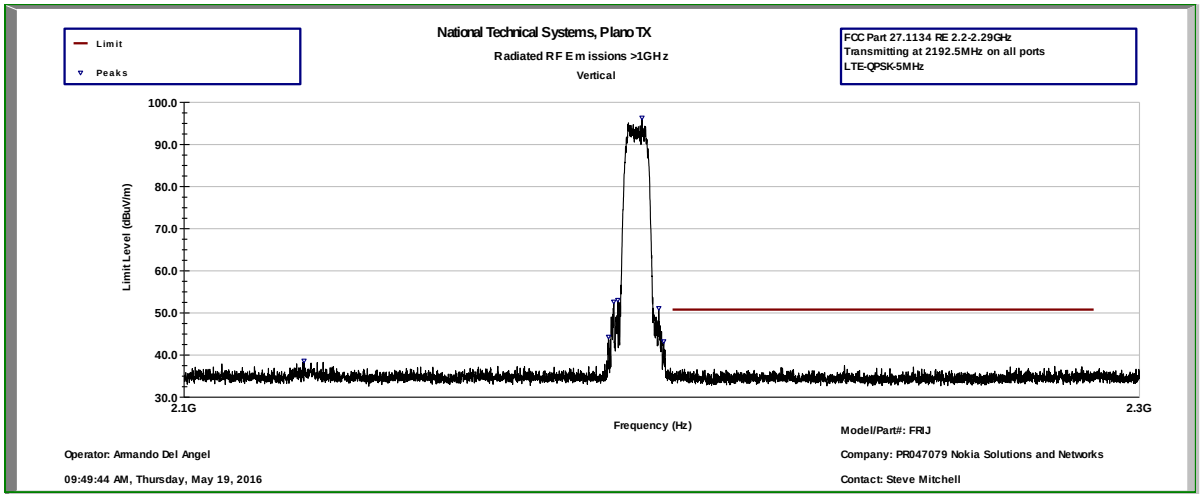
Since all maximized readings were more than 20dB below the limit, substitution measurements were not performed. TILE software was used for all preliminary scans and plots included on the following pages.

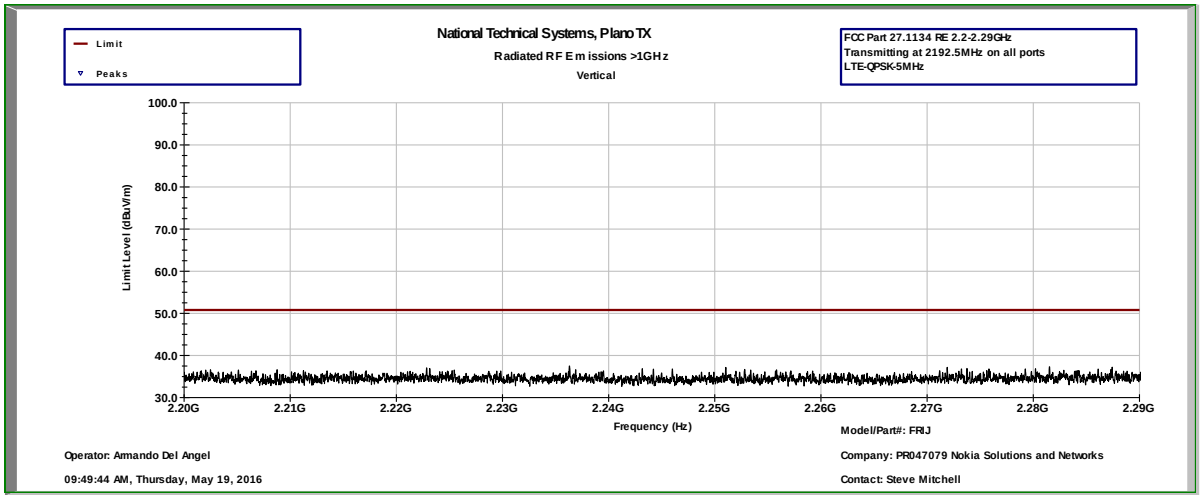
2200MHz – 2290MHz Peak Prescan at 3m – H





2200MHz – 2290MHz Peak Prescan at 3m - V





Frequency Stability

See results in annex A

End of Report

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