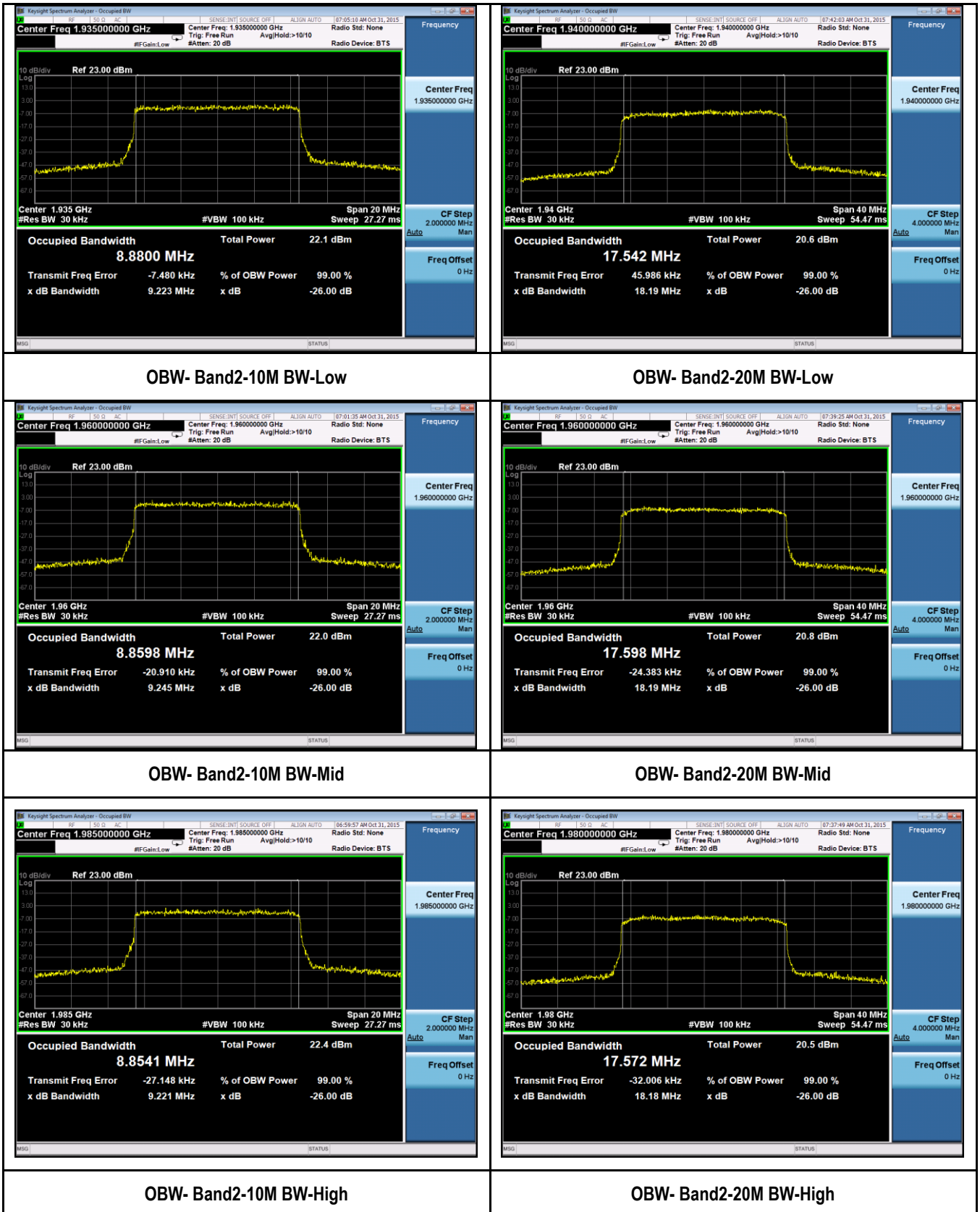
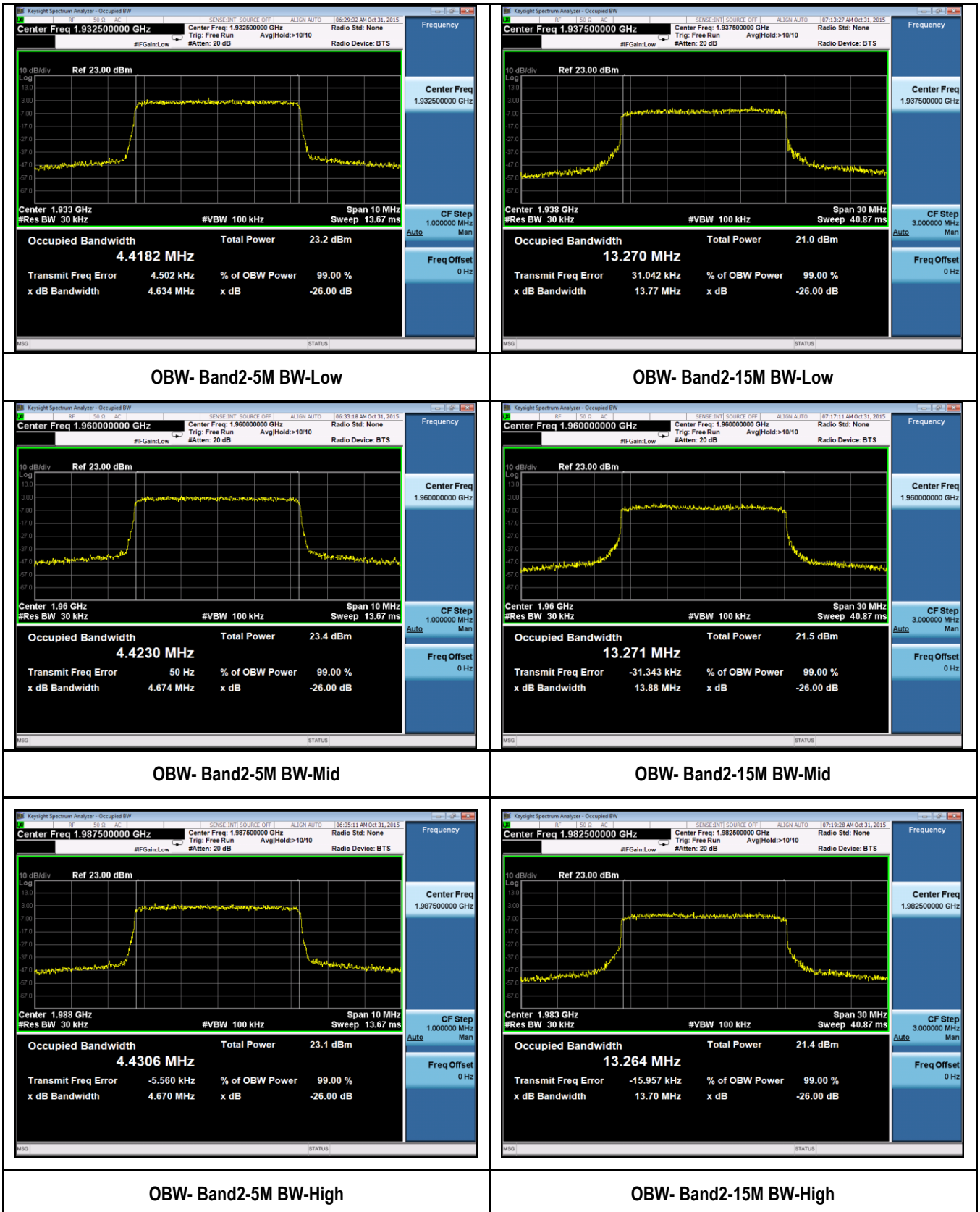


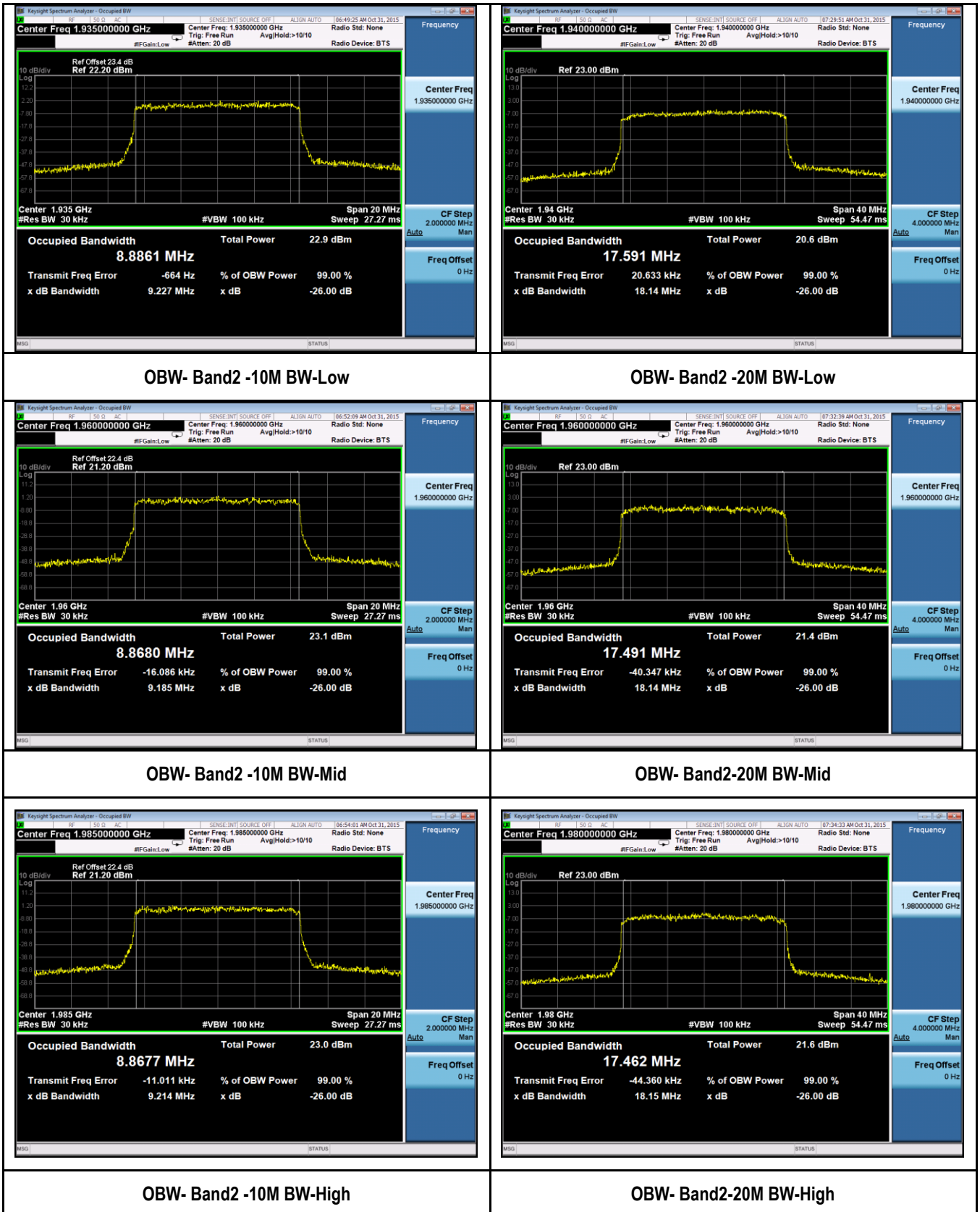
Test Plots for LTE Band2 QPSK



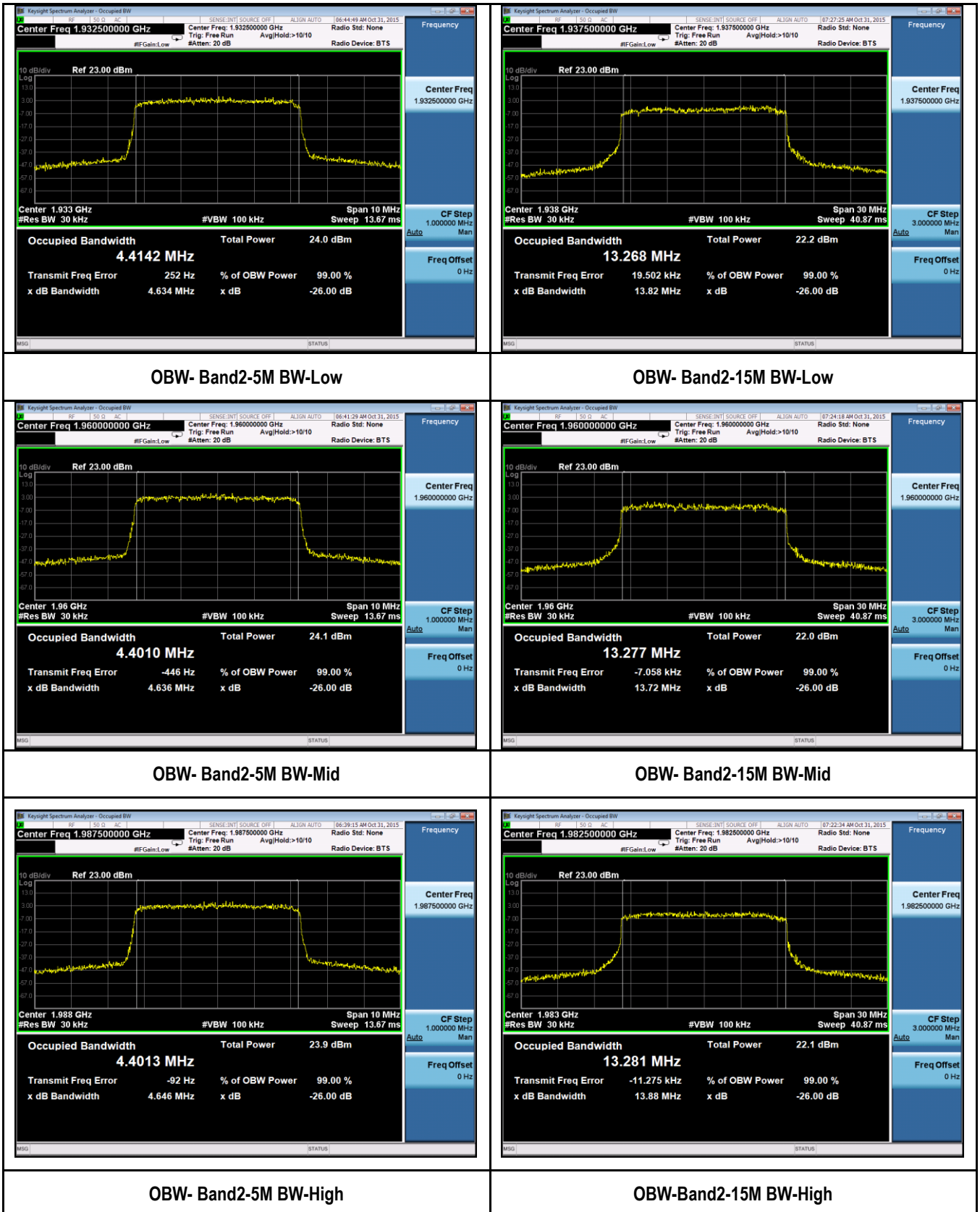
Test Plots for LTE Band2 QPSK



Test Plots for LTE Band2 64QAM

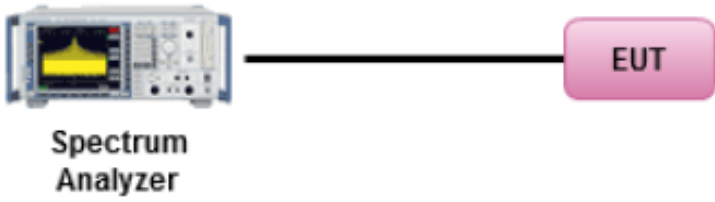


Test Plots for LTE Band2 64QAM



10.4 Band Edge

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR27.53	-	Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.	☒
47CFR24.238	-	Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.	☒
Test Setup	 The diagram illustrates the test setup. On the left is a Spectrum Analyzer with a yellow signal trace on its screen. A black line connects the Spectrum Analyzer to a pink rounded rectangle labeled 'EUT' (Equipment Under Test) on the right.		
Test Procedure	1. EUT was set for low, mid, high channel with modulated mode and highest RF output power. 2. The spectrum analyzer was connected to the antenna terminal. 3. A RBW of 1% greater than the 26 dB emission bandwidth should be used for band edge measurement or if narrower RBW is used, a correct factor calculated with formula $10 \cdot \log(EBW/BW_{meas})$ will be added to the result.		
Test Date	04/30/2015 - 05/03/2015 10/26/2015 – 11/02/2015	Environmental condition	Temperature 22°C Relative Humidity 48% Atmospheric Pressure 1008mbar
Remark	The EUT was scanned up to 25GHz. Both horizontal and vertical polarities were investigated. The results show only the worst case. Limit calculation: $Emission\ limit = Pd_{Bm} - [43 + 10 \log(PW)] = 10 \log(1000 \times PW) - 43 - 10 \log(PW) = 30\ dBm - 43 = -13\ dBm$ 100KHz RBW was used to make measurement for LTE Band 4 with 20MHz BW, so the correction factor will be added to correct the result to be using 200 KHz RBW.		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

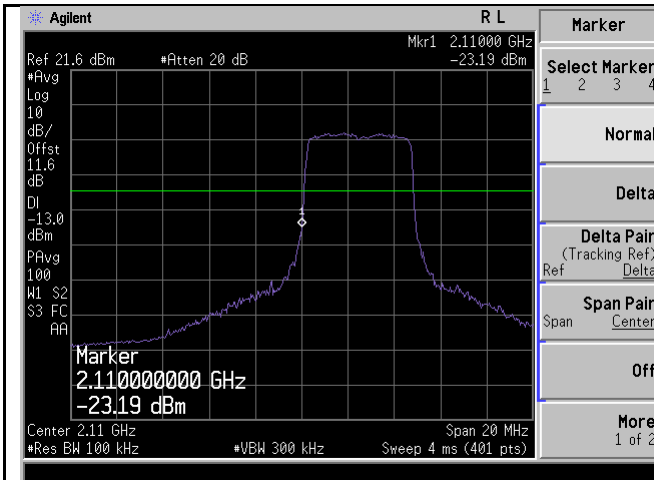
Band Edge Measurement Data for LTE band 4

Type	Channel	Channel Frequency (MHz)	Measurement Band Edge (dBm)	RBW Correction factor (dB)	Corrected Band Edge (dBm)	Limit (dBm)
5MHz BW, QPSK	Low	2115	-23.19	0	-23.19	-13
	High	2150	-26.13	0	-26.13	-13
5MHz BW, 16QAM	Low	2115	-38.97	0	-38.97	-13
	High	2150	-34.55	0	-34.55	-13
5MHz BW, 64QAM	Low	2115	-26.10	0	-26.10	-13
	High	2150	-29.02	0	-29.02	-13
10MHz BW, QPSK	Low	2120	-32.03	0	-32.03	-13
	High	2145	-32.66	0	-32.66	-13
10MHz BW, 16QAM	Low	2120	-42.35	0	-42.35	-13
	High	2145	-42.59	0	-42.59	-13
10MHz BW, 64QAM	Low	2120	-34.03	0	-34.03	-13
	High	2145	-35.73	0	-35.73	-13
15MHz BW, QPSK	Low	2115	-36.39	3.01	-33.38	-13
	High	2150	-37.51	3.01	-34.50	-13
15MHz BW, 16QAM	Low	2115	-41.83	3.01	-38.82	-13
	High	2150	-40.24	3.01	-37.23	-13
15MHz BW, 64QAM	Low	2115	-38.90	3.01	-35.89	-13
	High	2150	-37.41	3.01	-34.40	-13
20MHz BW, QPSK	Low	2120	-37.83	3.01	-34.82	-13
	High	2145	-39.44	3.01	-36.43	-13
20MHz BW, 16QAM	Low	2120	-45.58	3.01	-42.57	-13
	High	2145	-43.42	3.01	-40.41	-13
20MHz BW, 64QAM	Low	2120	-40.24	3.01	-37.23	-13
	High	2145	-40.52	3.01	-37.51	-13

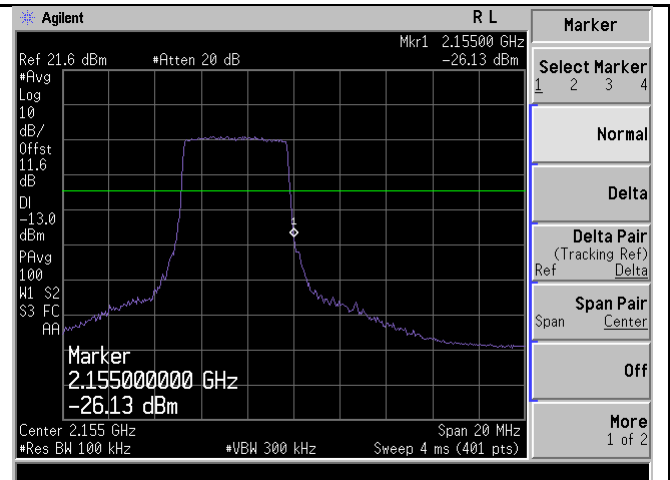
Band Edge Measurement Data for LTE band 2

Type	Channel	Channel Frequency (MHz)	Measurement Band Edge (dBm)	Limit (dBm)
5MHz BW, QPSK	Low	1932.5	-38.28	-13
	High	1987.5	-51.94	-13
5MHz BW, 64QAM	Low	1932.5	-38.28	-13
	High	1987.5	-52.28	-13
10MHz BW, QPSK	Low	1935	-38.26	-13
	High	1985	-48.27	-13
10MHz BW, 64QAM	Low	1935	-37.53	-13
	High	1985	-47.39	-13
15MHz BW, QPSK	Low	1937.5	-39.98	-13
	High	1982.5	-47.55	-13
15MHz BW, 64QAM	Low	1937.5	-36.06	-13
	High	1982.5	-47.72	-13
20MHz BW, QPSK	Low	1940	-46.08	-13
	High	1980	-48.38	-13
20MHz BW, 64QAM	Low	1940	-45.63	-13
	High	1980	-47.90	-13

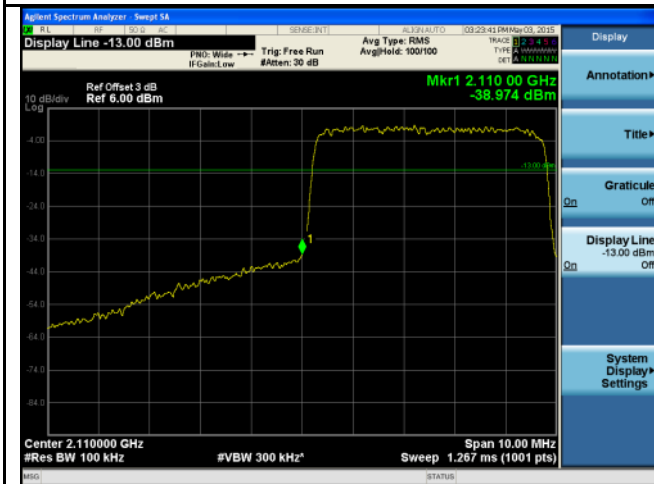
Test Plots



BandEdge-LTE-Band4-5MHz-QPSK-Low



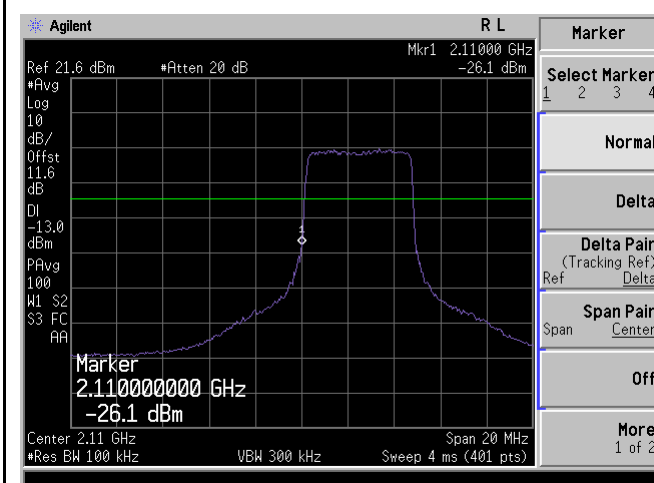
BandEdge-LTE-Band4-5MHz-QPSK-High



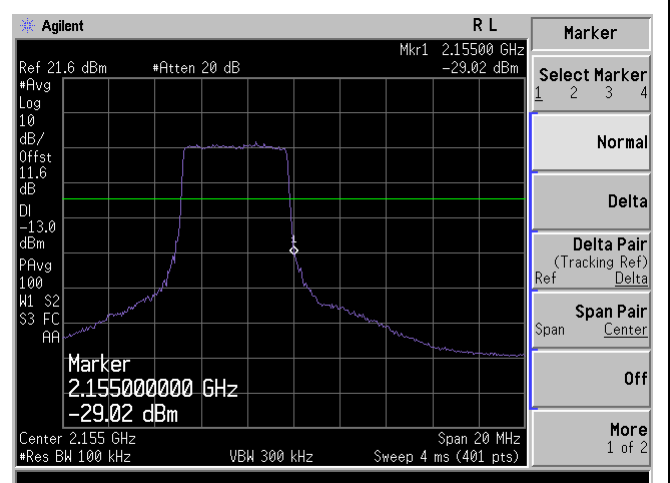
BandEdge-LTE-Band4-5MHz-16QAM-Low



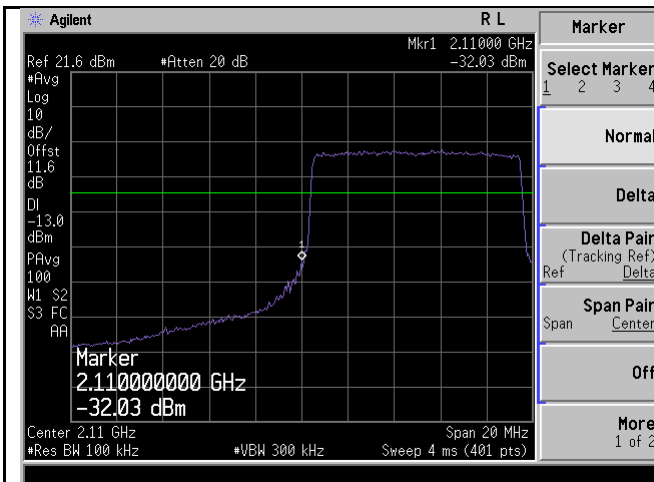
BandEdge-LTE-Band4-5MHz-16QAM-High



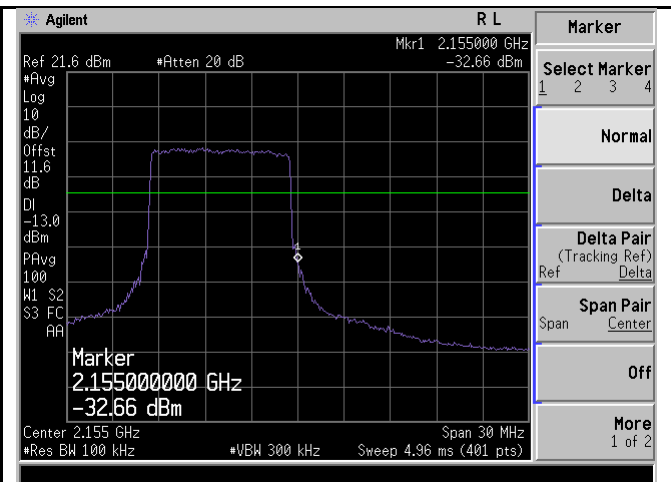
BandEdge-LTE-Band4-5MHz-64QAM-Low



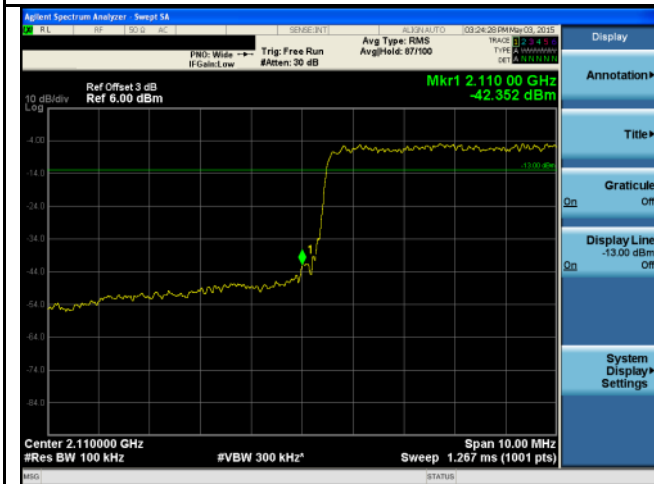
BandEdge-LTE-Band4-5MHz-64QAM-High



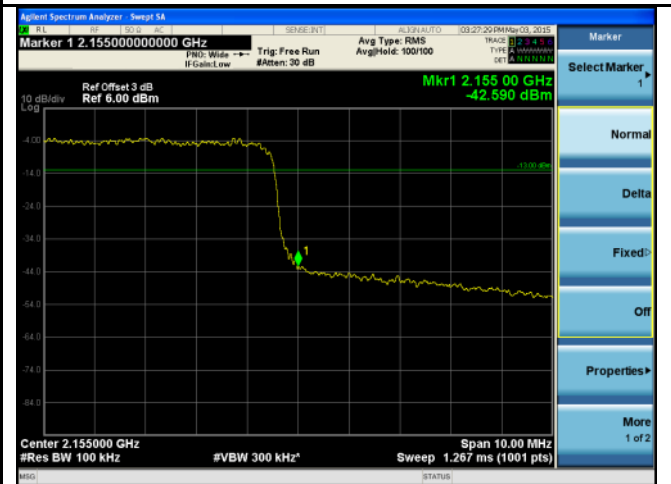
BandEdge-LTE-Band4-10MHz-QPSK-Low



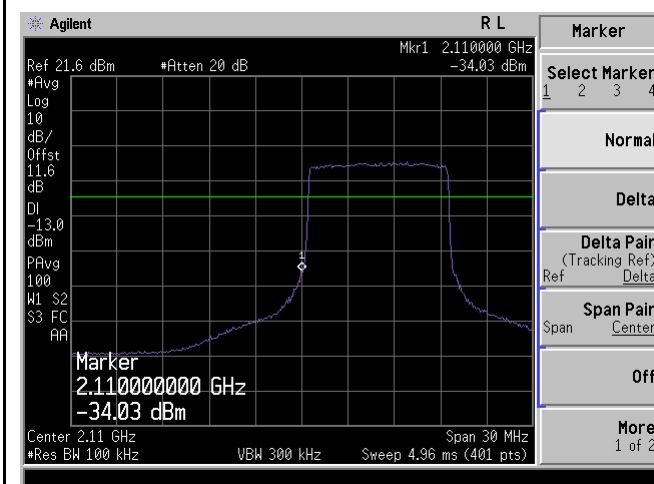
BandEdge-LTE-Band4-10MHz-QPSK-High



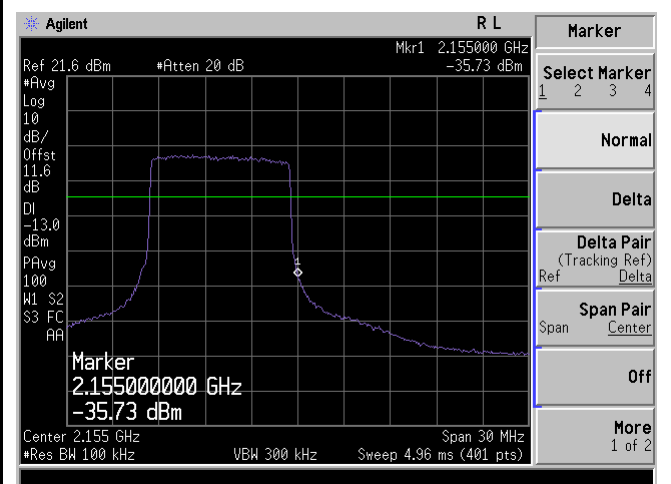
BandEdge-LTE-Band4-10MHz-16QAM-Low



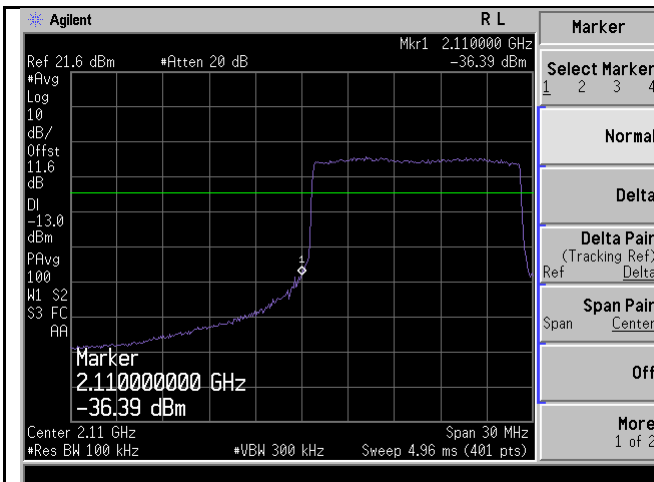
BandEdge-LTE-Band4-10MHz-16QAM-High



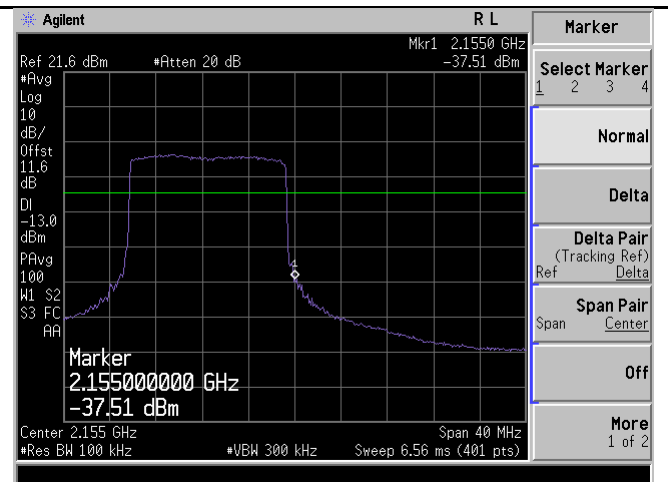
BandEdge-LTE-Band4-10MHz-64QAM-Low



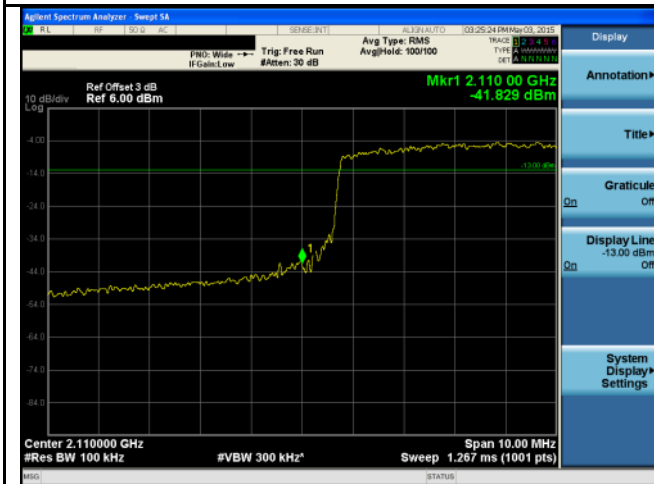
BandEdge-LTE-Band4-10MHz-64QAM-High



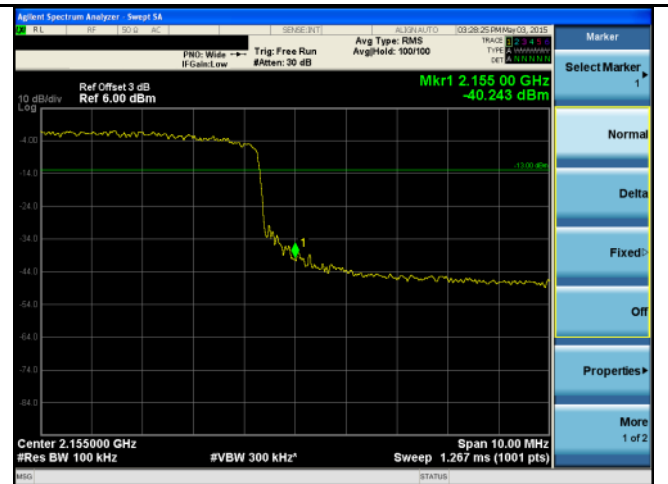
BandEdge-LTE-Band4-15MHz-QPSK-Low



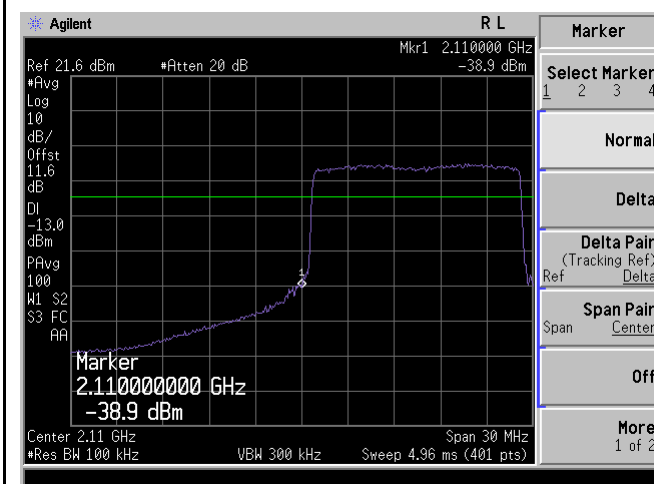
BandEdge-LTE-Band4-15MHz-QPSK-High



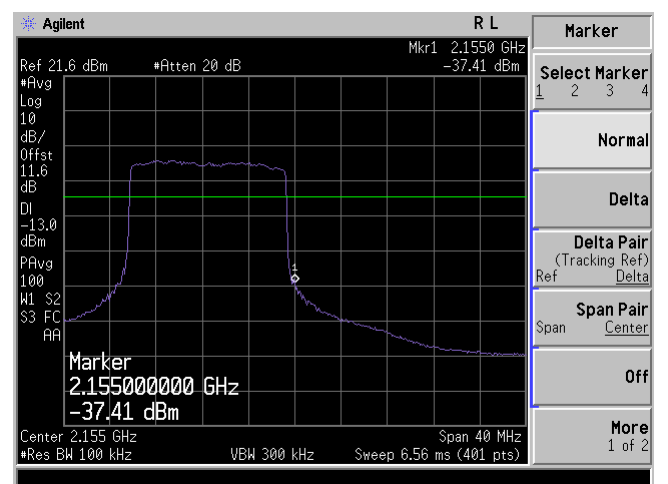
BandEdge-LTE-Band4-15MHz-16QAM-Low



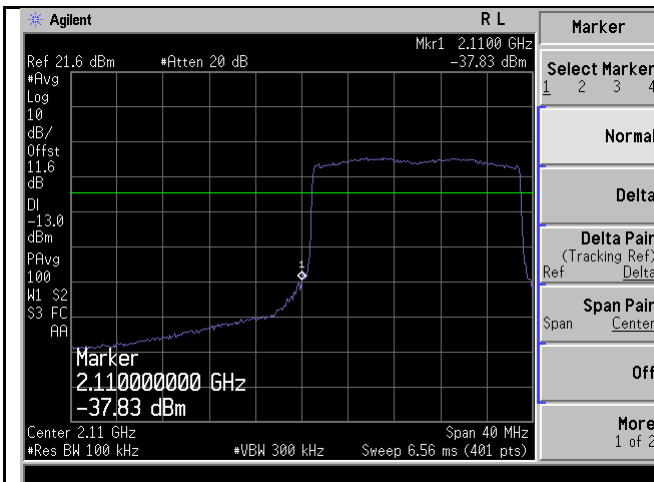
BandEdge-LTE-Band4-15MHz-16QAM-High



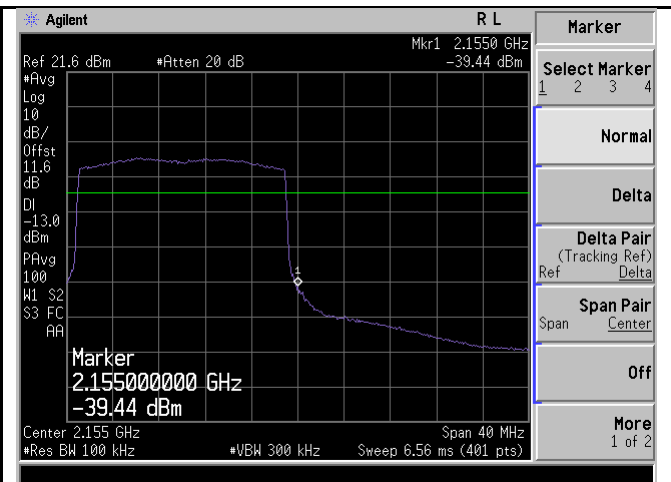
BandEdge-LTE-Band4-15MHz-64QAM-Low



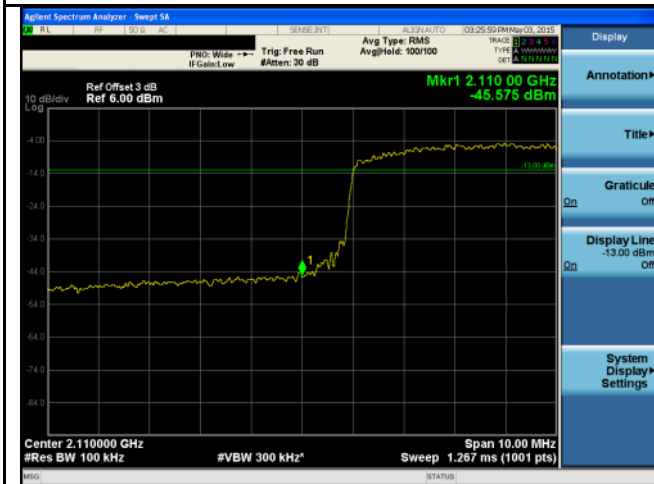
BandEdge-LTE-Band4-15MHz-64QAM-High



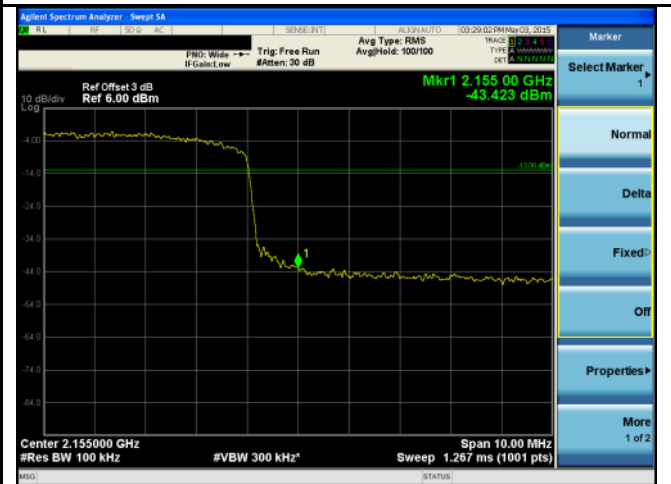
BandEdge-LTE-Band4-20MHz-QPSK-Low



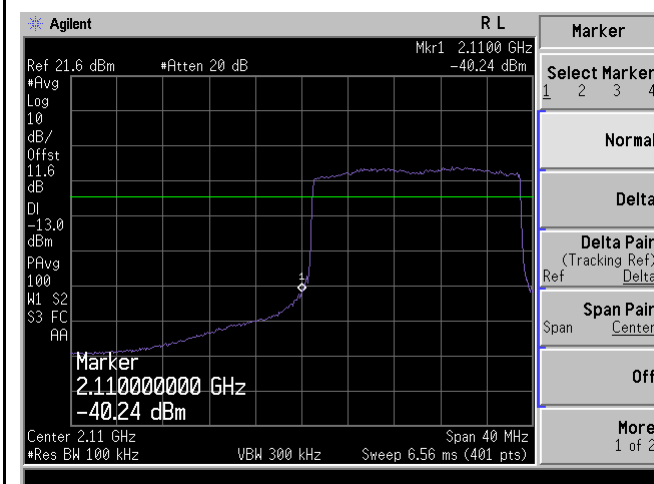
BandEdge-LTE-Band4-20MHz-QPSK-High



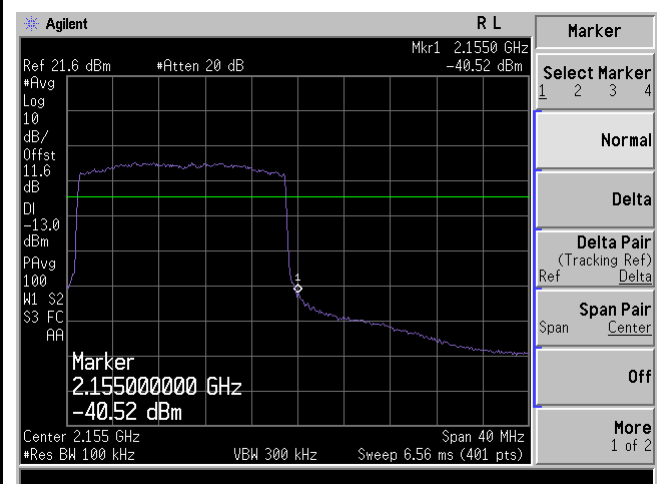
BandEdge-LTE-Band4-20MHz-16QAM-Low



BandEdge-LTE-Band4-20MHz-16QAM-High

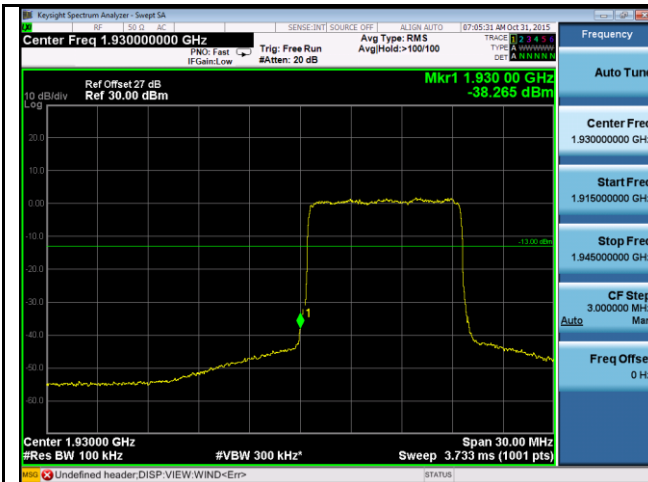


BandEdge-LTE-Band4-20MHz-64QAM-Low



BandEdge-LTE-Band4-20MHz-64QAM-High

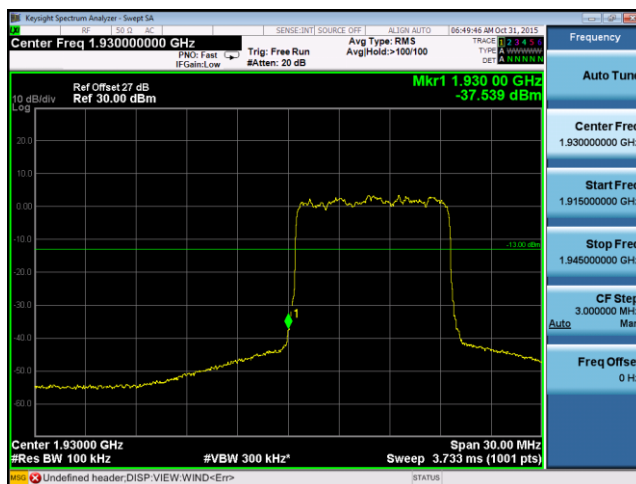
Test Plots for Band 2:



BandEdge-LTE-Band2-10MHz-QPSK-Low



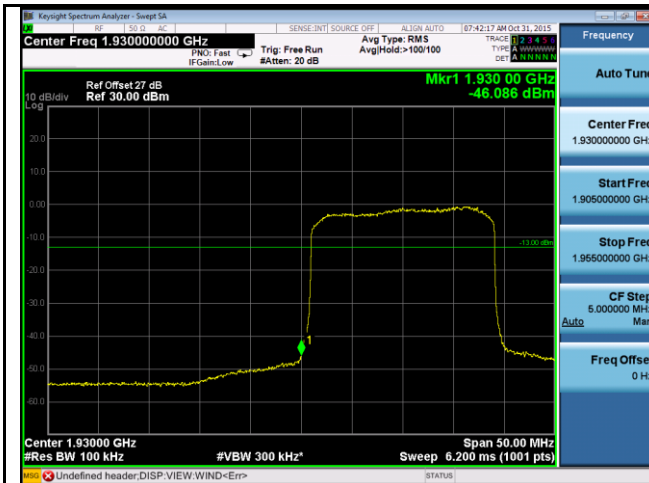
BandEdge-LTE-Band2-10MHz-QPSK-High



BandEdge-LTE- Band2-10MHz-64QAM-Low



BandEdge-LTE- Band2-10MHz-64QAM-High



BandEdge-LTE- Band2-20MHz-QPSK-Low



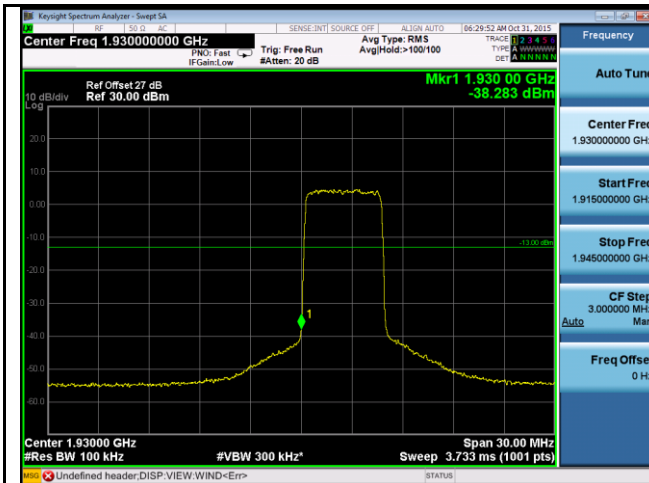
BandEdge-LTE- Band2-20MHz-QPSK-High



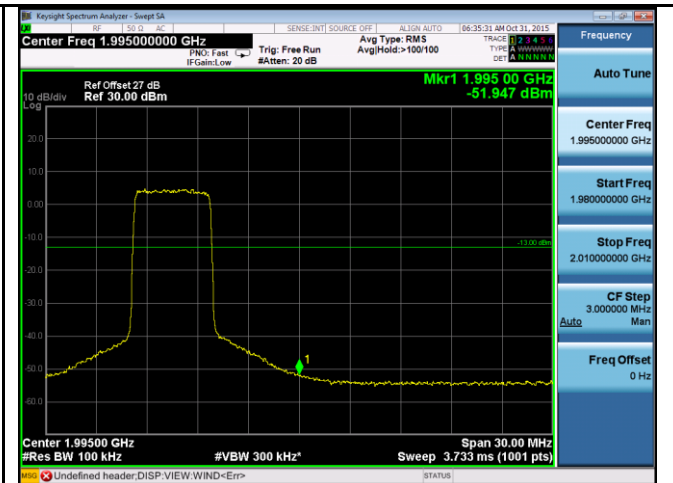
BandEdge-LTE- Band2-20MHz-64QAM-Low



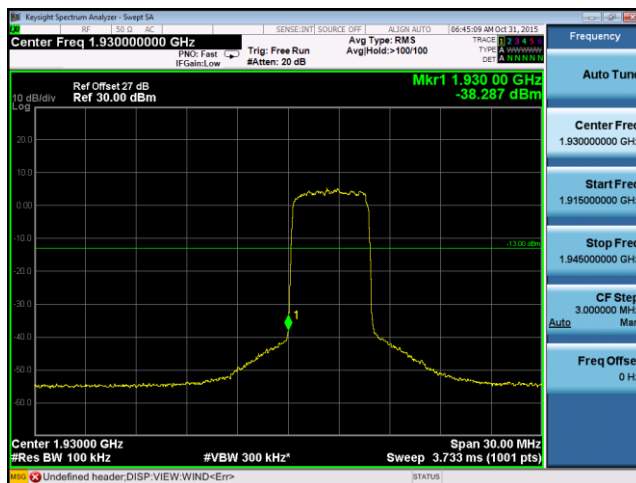
BandEdge-LTE- Band2-20MHz-64QAM-High



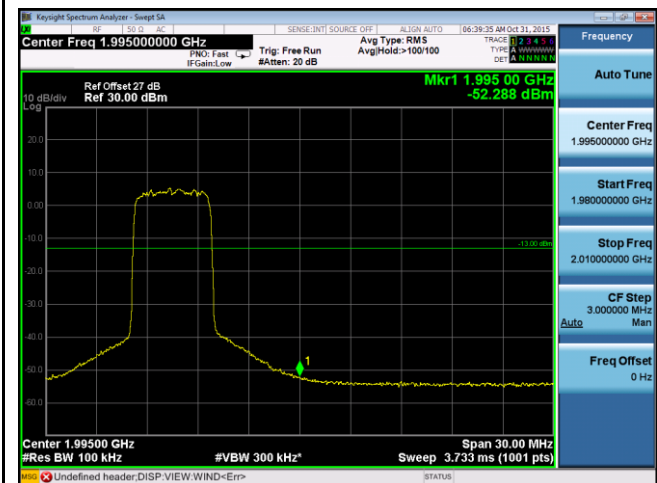
BandEdge-LTE- Band2-5MHz-QPSK-Low



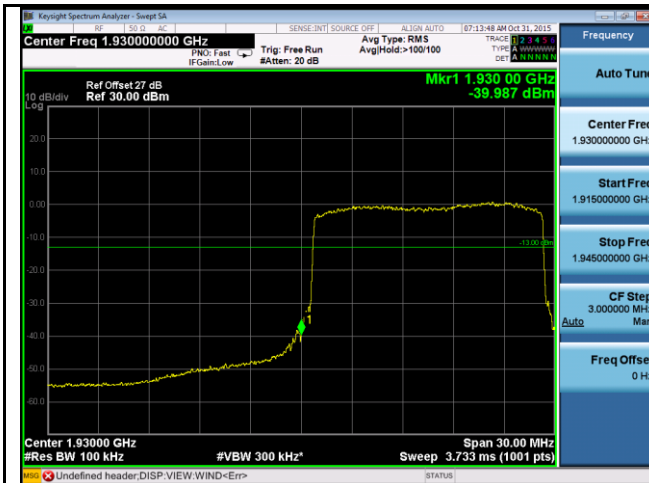
BandEdge-LTE- Band2-5MHz -QPSK-High



BandEdge-LTE- Band2-5MHz -64QAM-Low



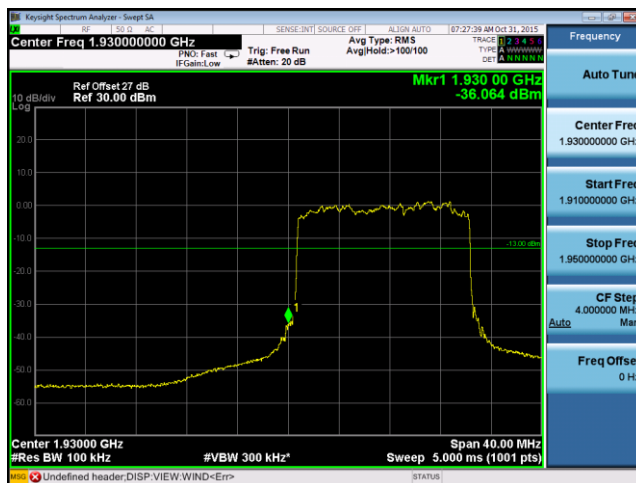
BandEdge-LTE- Band2-5MHz -64QAM-High



BandEdge-LTE- Band2-15MHz-QPSK-Low



BandEdge-LTE- Band2-15MHz-QPSK-High



BandEdge-LTE- Band2-15MHz-64QAM-Low

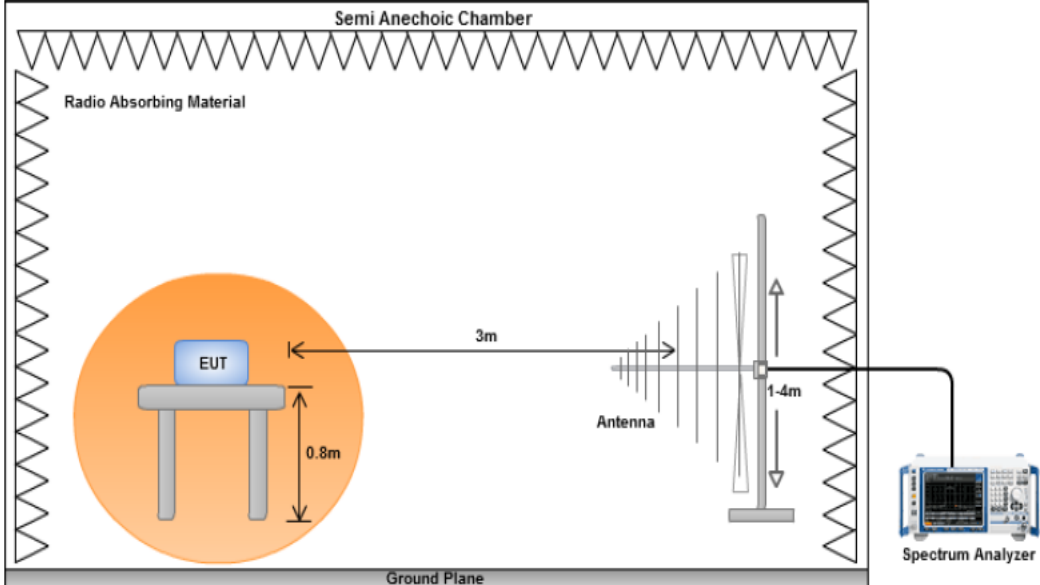


BandEdge-LTE- Band2-15MHz-64QAM-High

10.5 Radiated Spurious Emission below 1GHz

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR27.53	-	Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.	☒
47CFR24.238	-	Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.	☒

Test Setup			
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Test Procedure	<u>Substitution method:</u> - The EUT was switched on and allowed to warm up to its normal operating condition. - The test was carried out at the selected frequency points obtained from the EUT characterisation. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner: - Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen. - The EUT was then rotated to the direction that gave the maximum emission. - Finally, the antenna height was adjusted to the height that gave the maximum emission. - Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. - Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a nonradiating cable. With the antennas at both ends horizontally polarized, and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. - Steps 4 were repeated for the next frequency point, until all selected frequency points were measured.		
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Test Date	04/30/2015 10/26/2015 – 11/02/2015	Environmental condition	Temperature 23°C Relative Humidity 48% Atmospheric Pressure 1008mbar
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Remark	The EUT was scanned up to 25GHz. Both horizontal and vertical polarities were investigated. The results show only the worst case. Limit calculation: $\text{Emission limit} = \text{PdBm} - [43 + 10 \log(\text{PW})] = 10 \log(1000 \times \text{PW}) - 43 - 10 \log(\text{PW}) = 30 \text{ dBm} - 43 = -13 \text{ dBm}$ All different modulation and bandwidth configuration has been verified and only the test data of worst case with QPSK modulation and greatest bandwidth was presented in this report.		
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Result	☒ Pass ☐ Fail		
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Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Radiated Emission Test Results for LTE band 4

Test specification	below 1GHz		Result	Pass
Environmental Conditions:	Temp (°C):	22		
	Humidity (%)	45		
	Atmospheric (mbar):	1008		
Mains Power:	48VDC			
Tested by:	David Zhang			
Test Date:	04/30/2015			
Remarks:	LTE band4-Mid CH-20MHz BW, QPSK			

Frequency MHz	SG Level dBm	Cable Loss dB	Antenna Gain dBd	Substituted Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail
492.52	-65.94	4.11	0	-70.82	RMS Max	H	186.00	315.00	-13.00	-57.82	Pass
500.22	-62.48	4.15	0	-66.17	RMS Max	H	133.00	293.00	-13.00	-53.17	Pass
486.57	-58.12	4.09	0	-61.8	RMS Max	H	159.00	224.00	-13.00	-48.8	Pass
68.95	-43.67	1.44	0	-47.33	RMS Max	V	284.00	344.00	-13.00	-34.33	Pass
125.01	-46.92	2.03	0	-50.6	RMS Max	V	359.00	305.00	-13.00	-37.6	Pass
224.41	-57.08	2.65	0	-60.8	RMS Max	H	332.00	356.00	-13.00	-47.8	Pass

Note: Dipole antenna was used for substitution method.

Radiated Emission Test Results for LTE band 2

Test specification	below 1GHz		Result	Pass
Environmental Conditions:	Temp (°C):	24		
	Humidity (%)	39		
	Atmospheric (mbar):	1012		
Mains Power:	48VDC			
Tested by:	Chen Ge			
Test Date:	10/26/2015 – 11/02/2015			
Remarks:	LTE band2-Mid CH-20MHz BW, QPSK			

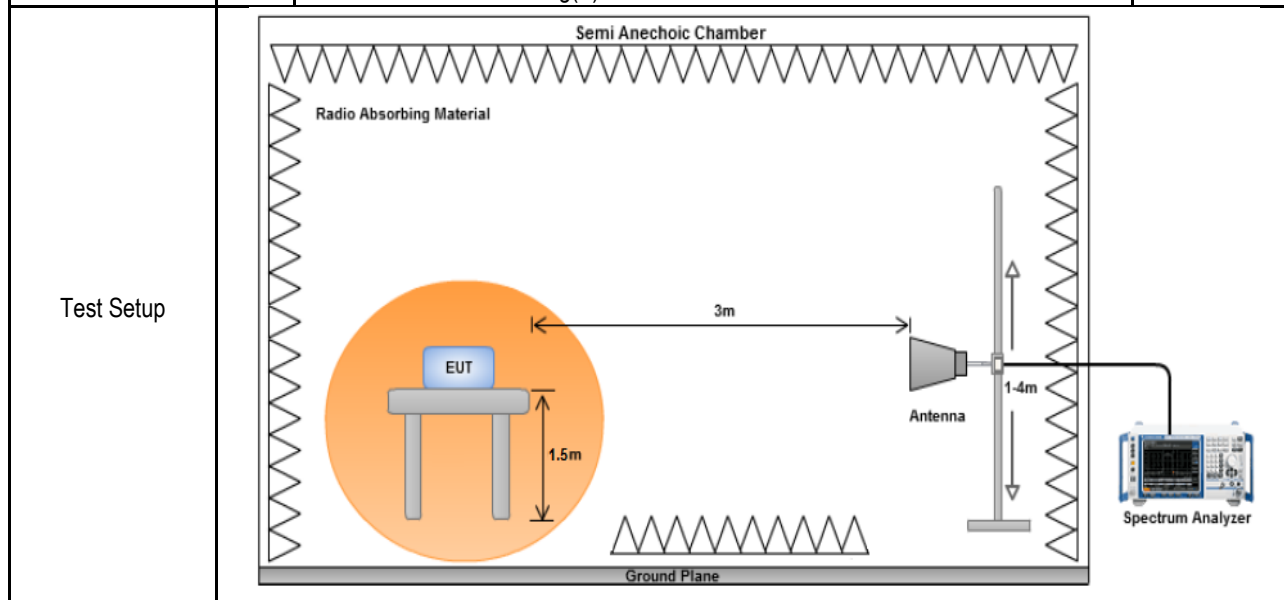
Frequency MHz	SG Level dBm	Cable Loss dB	Antenna Gain dBd	Substituted Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail
750.05	-46.23	4.88	0	-51.11	RMS Max	H	109	27	-13	-38.11	Pass
454.18	-48.19	3.69	0	-51.88	RMS Max	V	178	29	-13	-38.88	Pass
456.81	-48.84	3.68	0	-52.52	RMS Max	V	100	228	-13	-39.52	Pass
444.73	-50.38	3.66	0	-54.04	RMS Max	V	170	302	-13	-41.04	Pass
448.66	-51.86	3.68	0	-55.54	RMS Max	V	196	269	-13	-42.54	Pass
463.42	-51.86	3.72	0	-55.58	RMS Max	V	154	260	-13	-42.58	Pass

Note: Dipole antenna was used for substitution method.

10.6 Radiated Spurious Emissions above 1GHz

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR27.53	-	Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.	☒
47CFR24.238	-	Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.	☒



Test Procedure	<u>Substitution method:</u>		
	- The EUT was switched on and allowed to warm up to its normal operating condition. - The test was carried out at the selected frequency points obtained from the EUT characterisation. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner: - Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen. - The EUT was then rotated to the direction that gave the maximum emission. - Finally, the antenna height was adjusted to the height that gave the maximum emission. - Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. - Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a nonradiating cable. With the antennas at both ends horizontally polarized, and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. - Steps 4 were repeated for the next frequency point, until all selected frequency points were measured.		

Test Date	04/30/2015 – 05/03/2015	Environmental condition	Temperature	23°C
	10/26/2015 – 11/02/2015		Relative Humidity	48%
			Atmospheric Pressure	1008mbar

Remark	The EUT was scanned up to 25GHz. Both horizontal and vertical polarities were investigated. The results show only the worst case. Limit calculation: $\text{Emission limit} = \text{PdBm} - [43 + 10 \log(\text{PW})] = 10 \log(1000 \times \text{PW}) - 43 - 10 \log(\text{PW}) = 30 \text{ dBm} - 43 = -13 \text{ dBm}$ All different modulation and bandwidth configuration has been verified and only the test data of worst case with QPSK modulation and greatest bandwidth was presented in this report.		
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Result	☒ Pass ☐ Fail
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Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☐ Yes (See below) ☒ N/A

Radiated Emission Test Results (Above 1GHz)

LTE band 4 Low Channel, 20MHz BW, QPSK

Frequency MHz	SG Level dBm	Cable Loss dB	Antenna Gain dBd	Substituted Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail
8009.29	-54.63	14.97	9.97	-59.63	RMS Max	V	223.00	254.00	-13.00	-46.63	Pass
2143.31	-62.91	13.36	6.28	-69.99	RMS Max	H	150.00	211.00	-13.00	-56.99	Pass
1001.19	-65.54	12.51	3.61	-74.44	RMS Max	H	153.00	267.00	-13.00	-61.44	Pass

LTE band 4 Mid Channel, 20MHz BW, QPSK

Frequency MHz	SG Level dBm	Cable Loss dB	Antenna Gain dBd	Substituted Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail
8662.96	-53.92	14.97	8.93	-59.96	RMS Max	V	187.00	290.00	-13.00	-40.92	Pass
4091.46	-60.34	13.36	7.99	-65.71	RMS Max	V	283.00	88.00	-13.00	-47.34	Pass
1001.19	-59.83	12.51	3.61	-68.73	RMS Max	H	153.00	267.00	-13.00	-46.83	Pass

LTE band 4 High Channel, 20MHz BW, QPSK

Frequency MHz	SG Level dBm	Cable Loss dB	Antenna Gain dBd	Substituted Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail
6997.09	-54.13	15.45	9.65	-59.93	RMS Max	H	162.00	261.00	-13.00	-46.93	Pass
3167.55	-63.65	13.67	7.15	-70.17	RMS Max	V	297.00	183.00	-13.00	-57.17	Pass
12661.61	-54.88	16.26	10.08	-61.06	RMS Max	H	137.00	161.00	-13.00	-48.06	Pass

LTE band 2 Low Channel, 20MHz BW, QPSK

Frequency MHz	SG Level dBm	Cable Loss dB	Antenna Gain dBd	Substituted Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail
3863.68	-52.02	17.51	15.51	-54.02	Average Max	V	108	57	-13	-41.02	Pass
7743.91	-48.54	20.44	12.39	-56.59	Average Max	V	100	283	-13	-43.59	Pass
2395.48	-53.64	16.53	14.27	-55.9	Average Max	V	166	216	-13	-42.9	Pass

LTE band 4 Mid Channel, 20MHz BW, QPSK

Frequency MHz	SG Level dBm	Cable Loss dB	Antenna Gain dBd	Substituted Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail
5292.43	-52.9	18.21	12.63	-58.48	Average Max	H	126	133	-13	-45.48	Pass
3896.89	-51.79	17.54	15.57	-53.76	Average Max	V	108	220	-13	-40.76	Pass
7814.57	-48.12	20.45	12.43	-56.14	Average Max	V	118	324	-13	-43.14	Pass

LTE band 4 High Channel, 20MHz BW, QPSK

Frequency MHz	SG Level dBm	Cable Loss dB	Antenna Gain dBd	Substituted Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail
5291.34	-52.89	18.21	12.63	-58.47	Average Max	H	189	0	-13	-45.47	Pass
7916.86	-42.82	20.46	12.49	-50.79	Average Max	V	125	317	-13	-37.79	Pass
3962.08	-40.16	17.58	15.69	-42.05	Average Max	V	102	323	-13	-29.05	Pass
2398.59	-53.39	16.54	14.27	-55.66	Average Max	H	100	103	-13	-42.66	Pass