LTE Band 48:
BW: 20MHz QPSK

ANT 0

Lowest channel

ANT 1

Lowest channel

Middle channel

Middle channel

Highest channel

Highest channel

LTE Band 48
BW: 20MHz, 64QAM

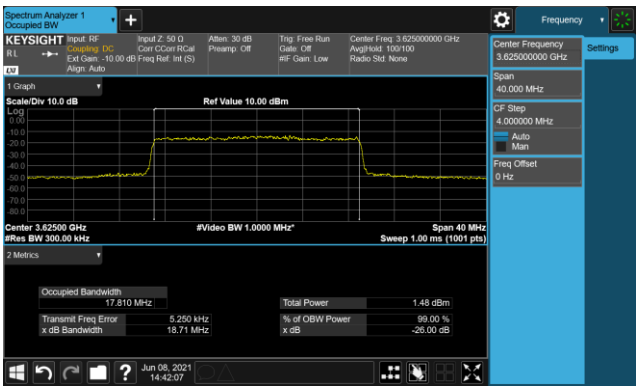
ANT 0

Lowest channel

ANT 1

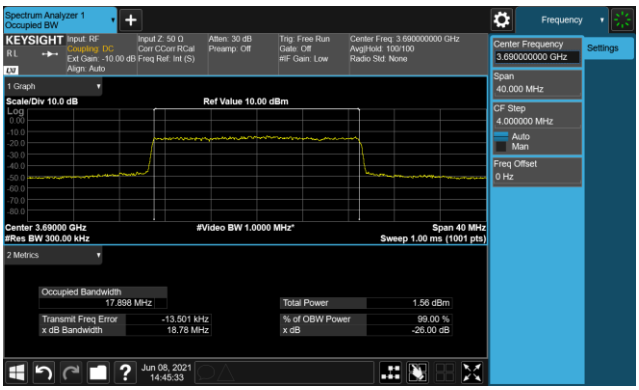
Lowest channel

Middle channel



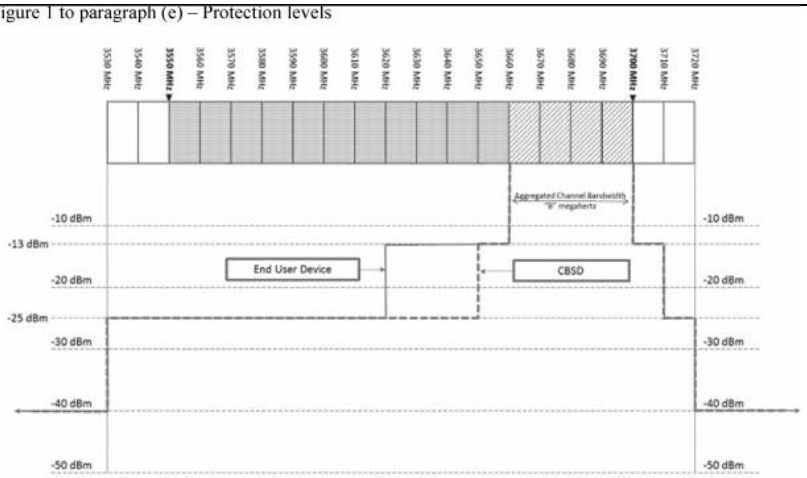
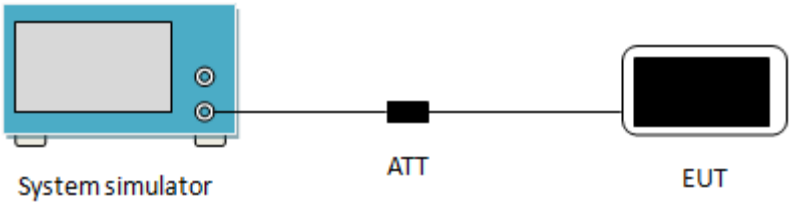
Middle channel

Highest channel



Highest channel

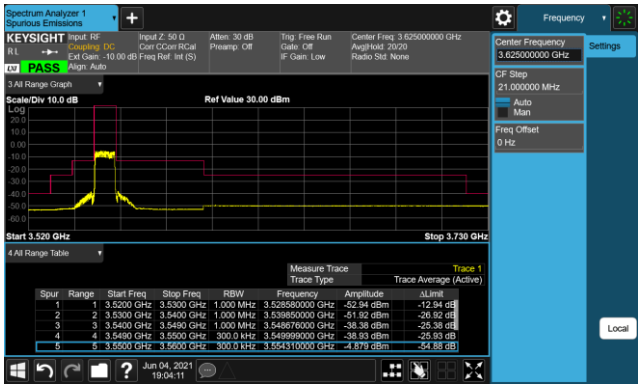
6.4 Emission Mask

Test Requirement:	FCC part 96.41(e)(1)(2)
Limit:	Figure 1 to paragraph (e) – Protection levels 
Test setup:	
Test Procedure:	1. The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. Measurements must be performed for low, mid, and high channels. 2. RBW=1% of fundamental for measurements within 1 MHz immediately outside the authorized channel; and 1 MHz for beyond 1 MHz outside the authorized channel. (eg.For 5MHz, RBW=51KHz within 1 MHz immediately outside the authorized channel) 3. Trace average at least 100 traces
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.3 for details
Test results:	PASS

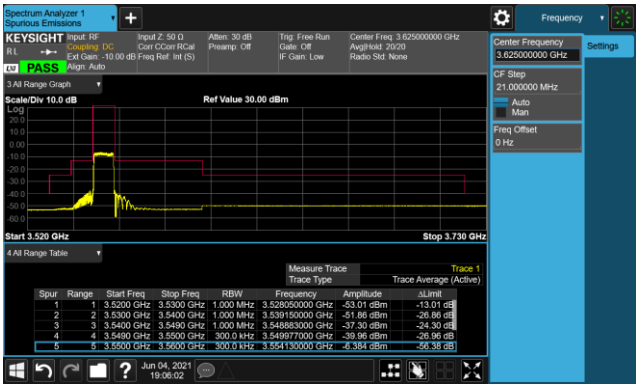
Test plots as below:

10MHz bandwidth-ANT 0

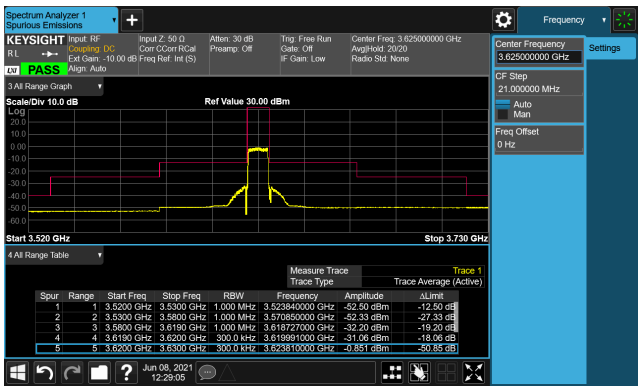
QPKS

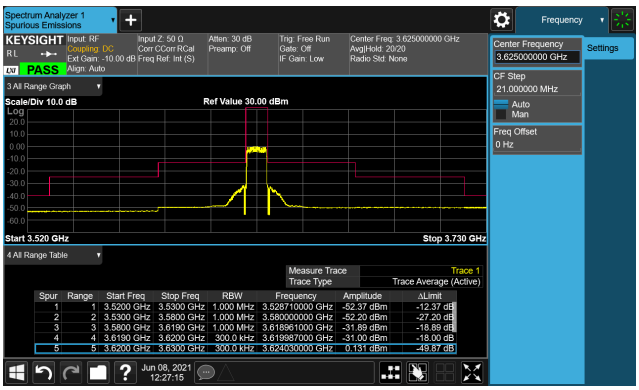


64QAM

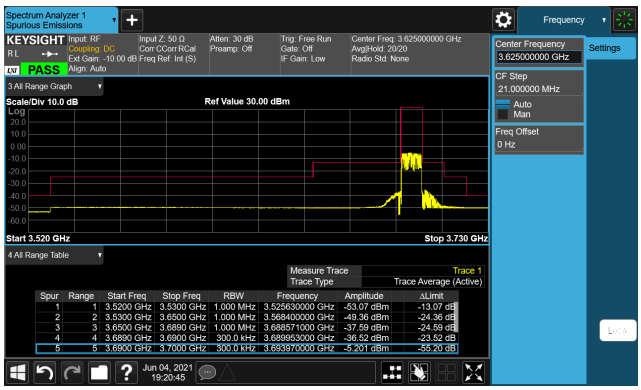


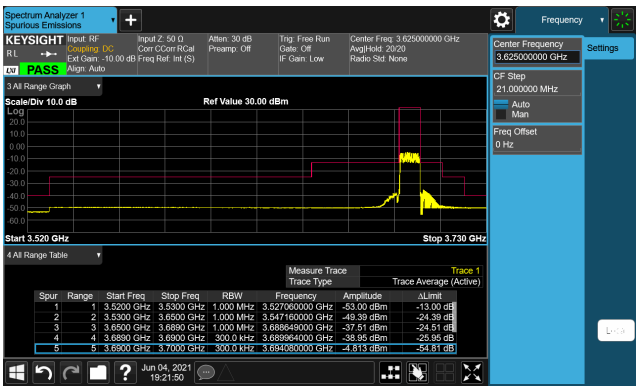
Lowest channel





Middle channel

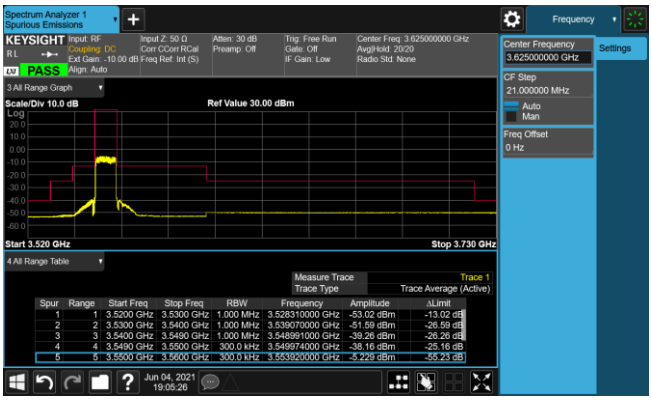


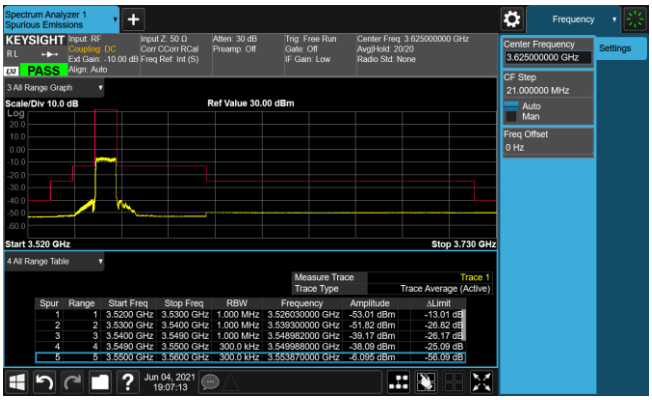


Highest channel

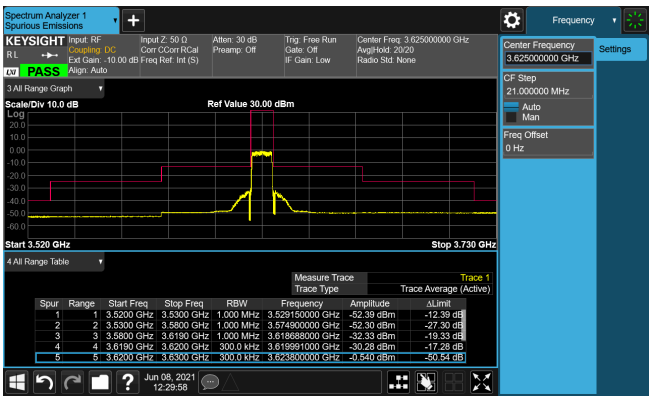
10MHz bandwidth-ANT 1

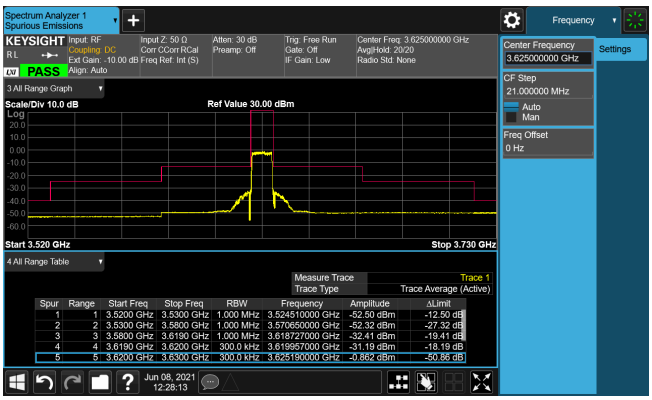
QPKS



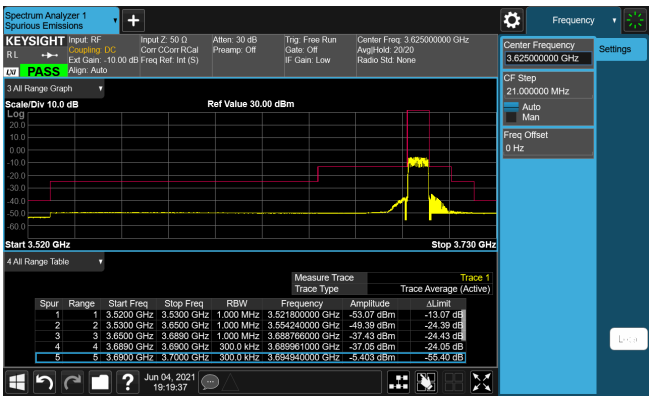


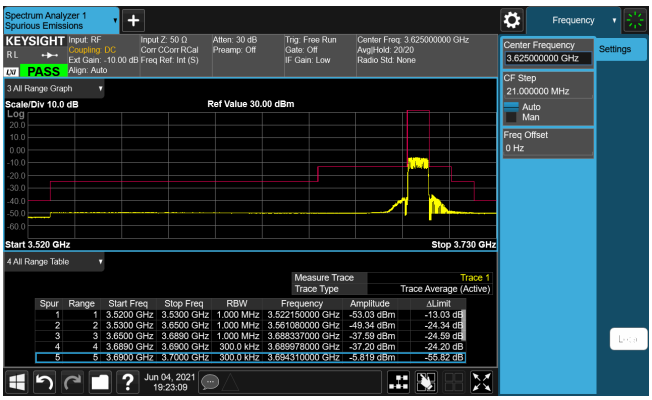
Lowest channel





Middle channel

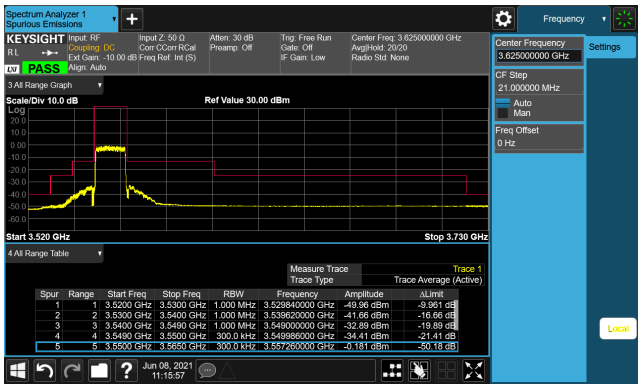




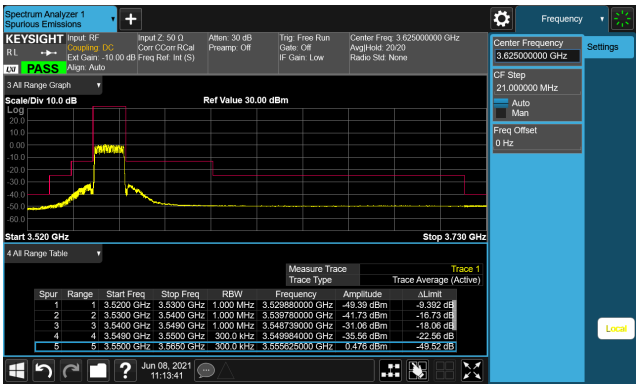
Highest channel

15MHz bandwidth-ANT 0

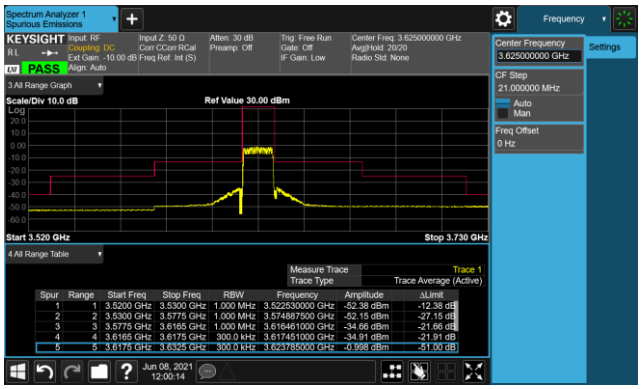
QPKS

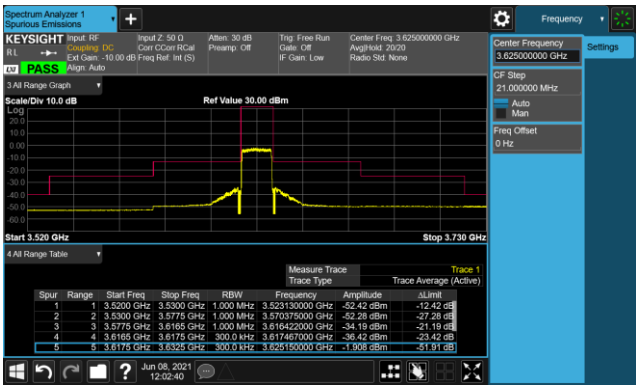


64QAM

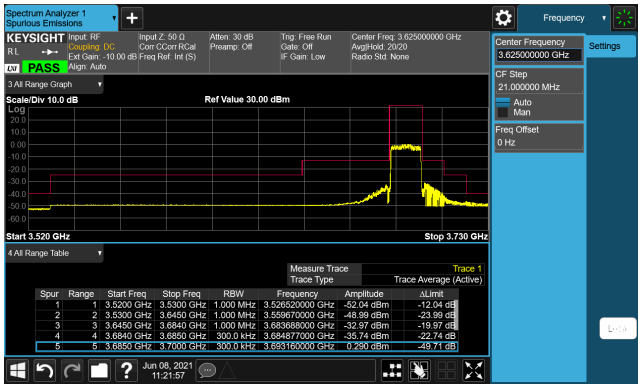


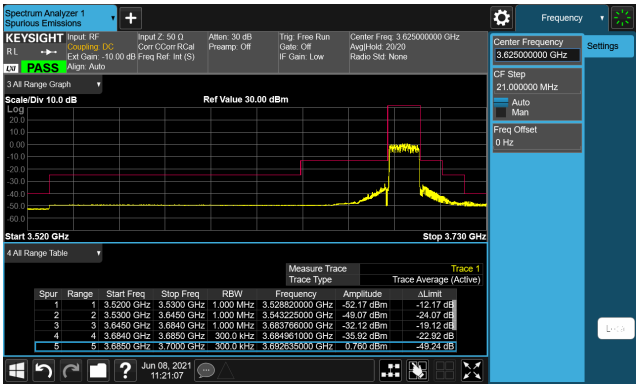
Lowest channel





Middle channel

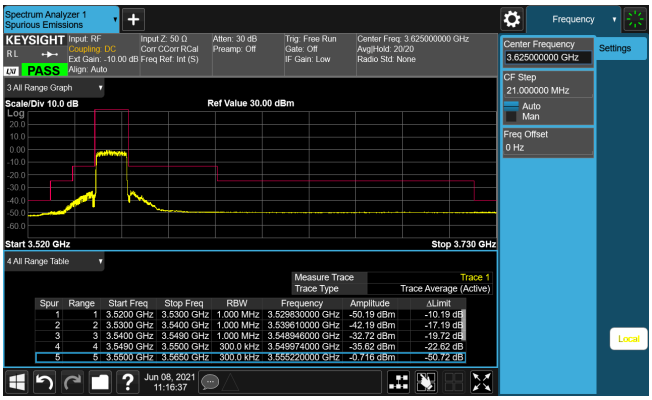




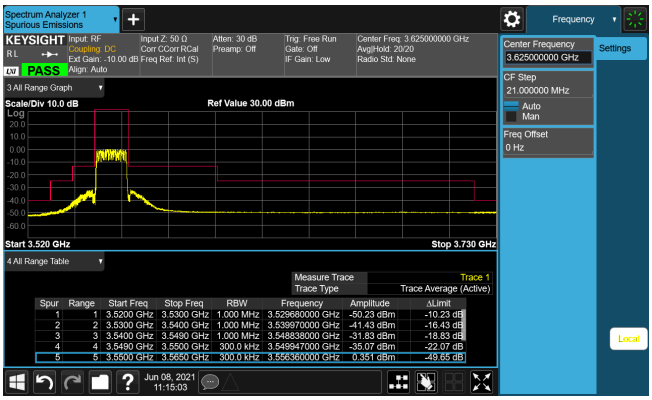
Highest channel

15MHz bandwidth-ANT 1

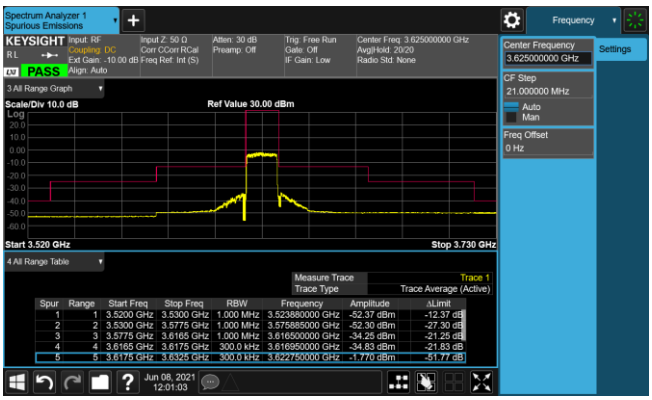
QPKS

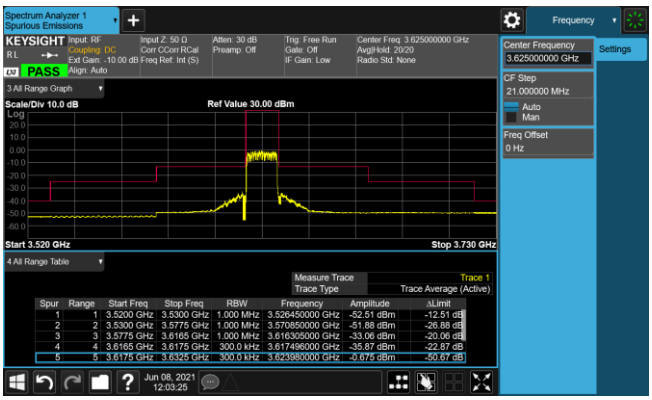


64QAM

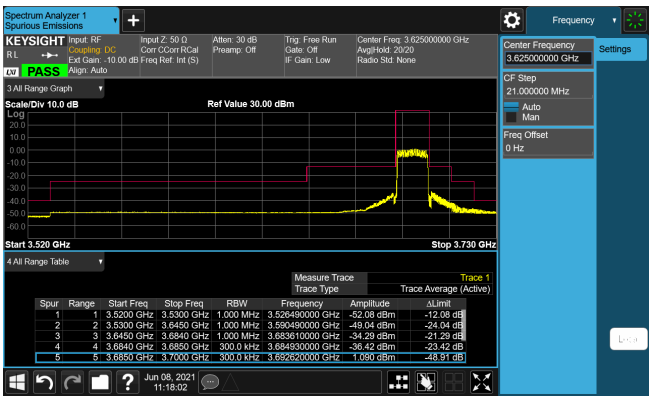


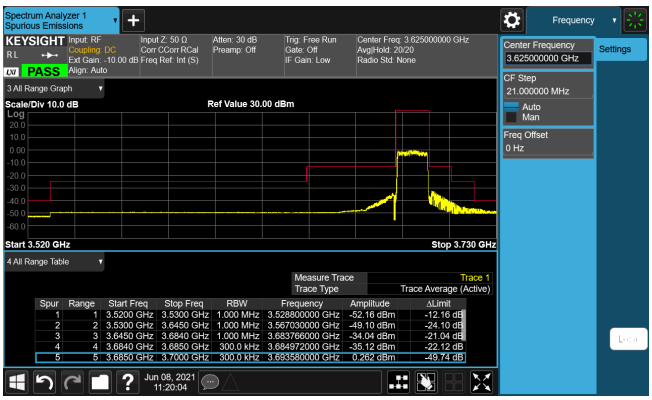
Lowest channel





Middle channel





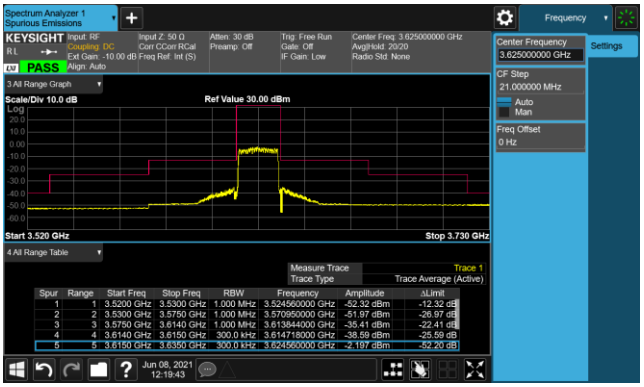
Highest channel

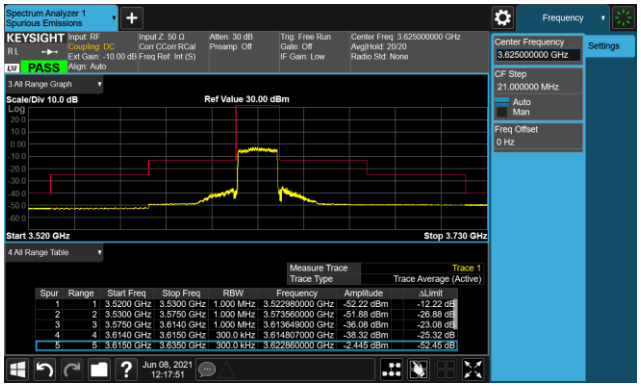
20MHz bandwidth-ANT 0

QPKS

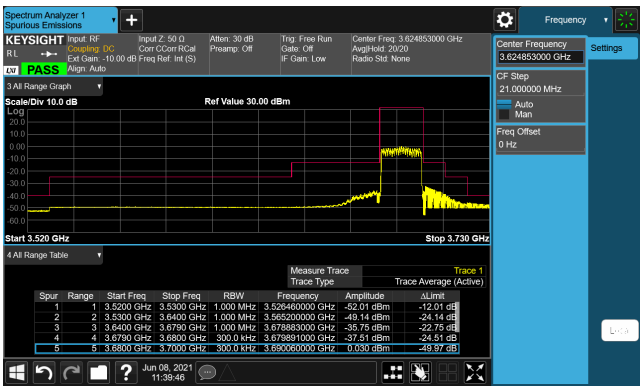
64QAM

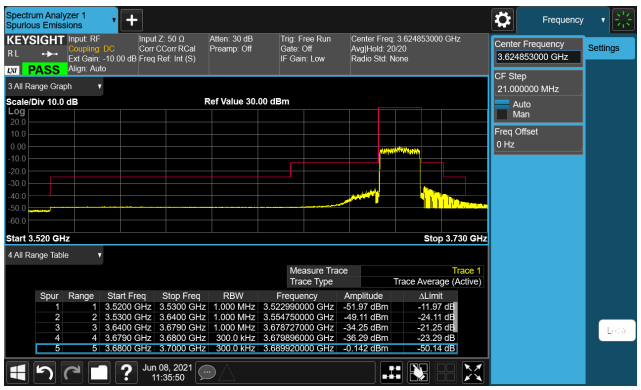
Lowest channel





Middle channel



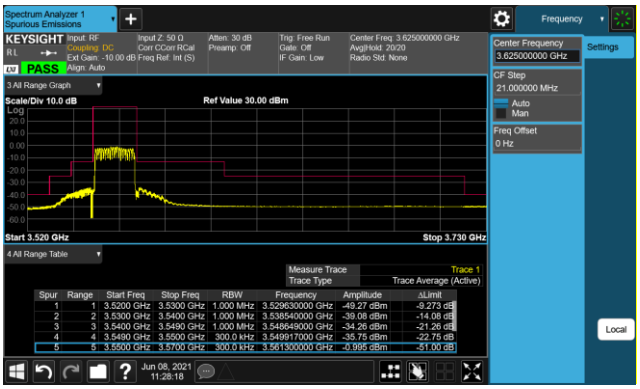


Highest channel

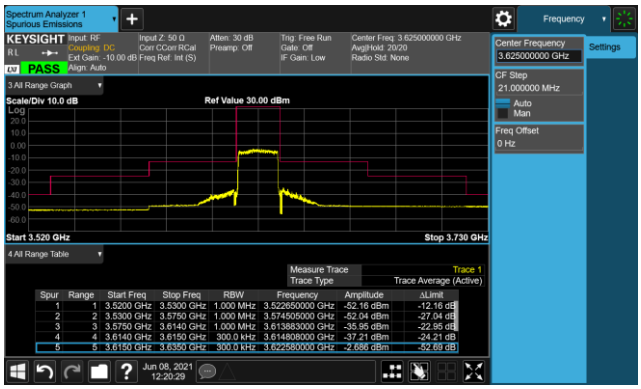
20MHz bandwidth-ANT 1

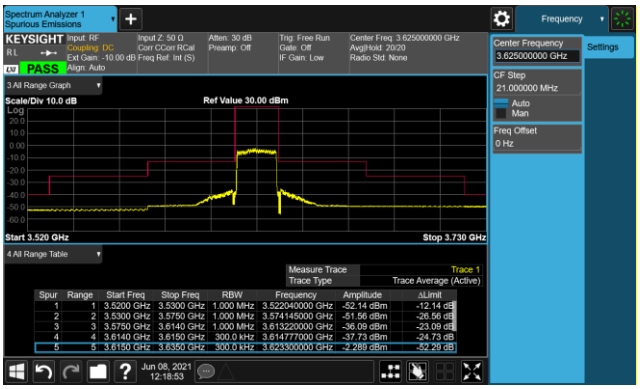
QPKS

64QAM

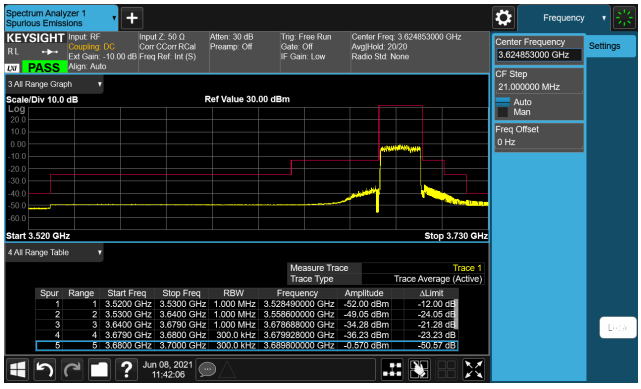


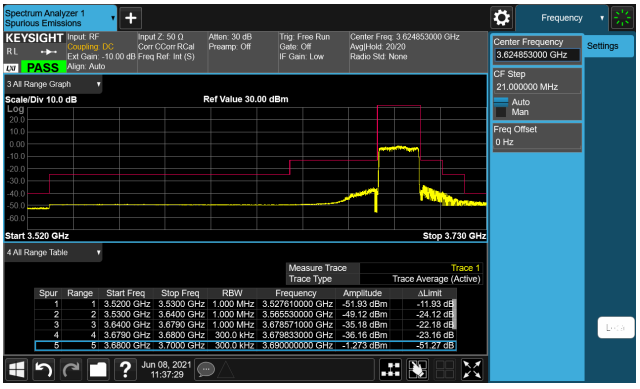
Lowest channel





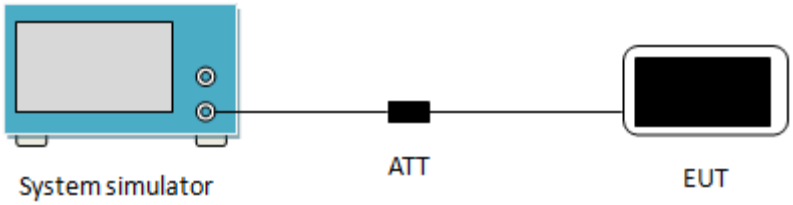
Middle channel





Highest channel

6.5 Out of band emission at antenna terminals

Test Requirement:	FCC part 96.41(e)(1)(2)
Limit:	below 3530 MHz and above 3720 MHz ≤ -40dBm
	
Test Procedure:	1 The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. 2 For the out of band: RBW =1 MHz, VBW=3 MHz, Start=30MHz, Stop= 10th harmonic. 3 Band Edge Requirements: In the 1 MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 1 percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to measure the out of band Emissions.(Band Edge test data refer to the Section 6.4)
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed
Remark:	The emission evaluation for MIMO mode is exempted because all the emissions on SISO mode are lower (at least) by 3.0dB than the limit masks.

Test plots as follows (worst case):

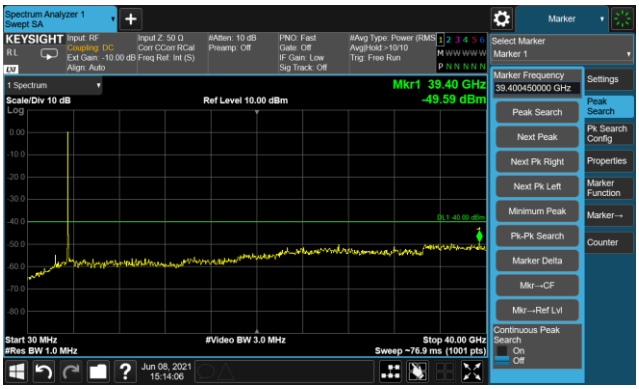
Spurious emission

LTE Band 48(10 MHz 64QAM)- ANT 0

LTE Band 48(10 MHz QPSK)- ANT 0

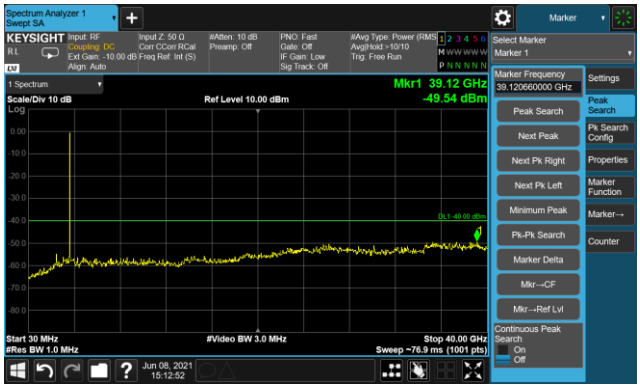
Lowest channel

30MHz~40GHz



30MHz~40GHz

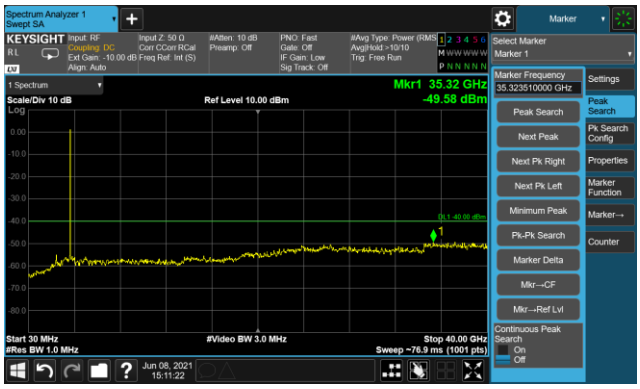
Middle channel



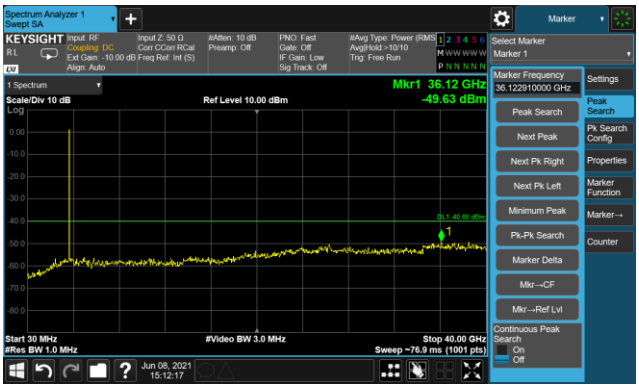
30MHz~40GHz

30MHz~40GHz

Highest channel



30MHz~40GHz

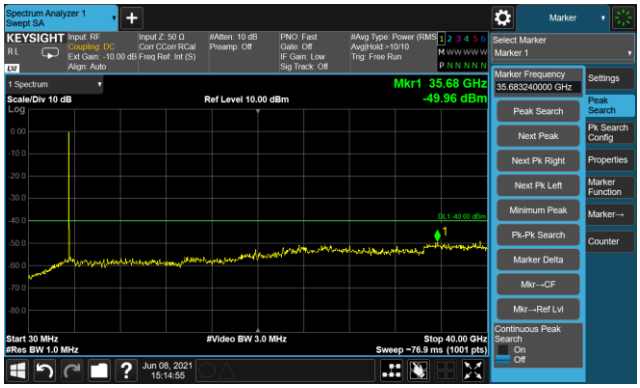


30MHz~40GHz

LTE Band 48(10 MHz 64QAM)- ANT 1

LTE Band 48(10 MHz QPSK)- ANT 1

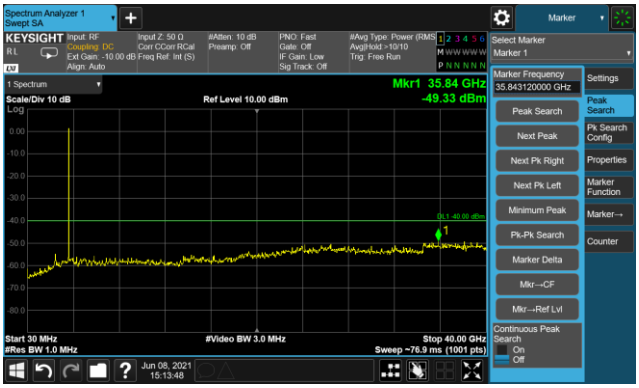
Lowest channel



30MHz~40GHz

30MHz~40GHz

Middle channel



30MHz~40GHz

30MHz~40GHz

Highest channel

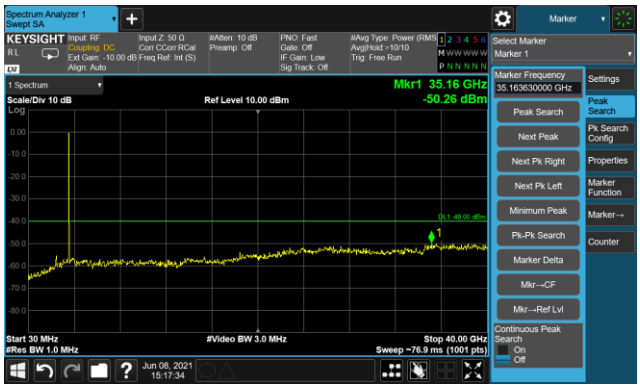
30MHz~40GHz

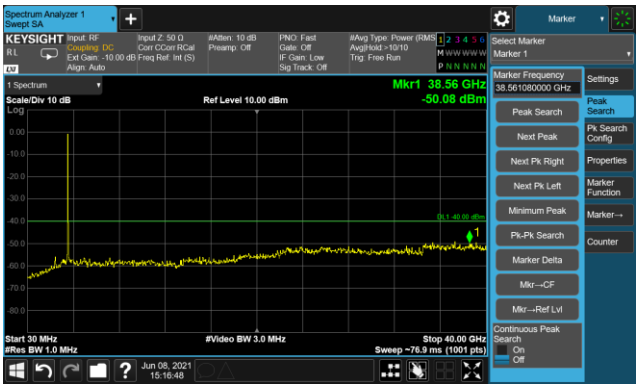
30MHz~40GHz

LTE Band 48(15 MHz 64QAM)- ANT 0

LTE Band 48(15 MHz QPSK)- ANT 0

Lowest channel

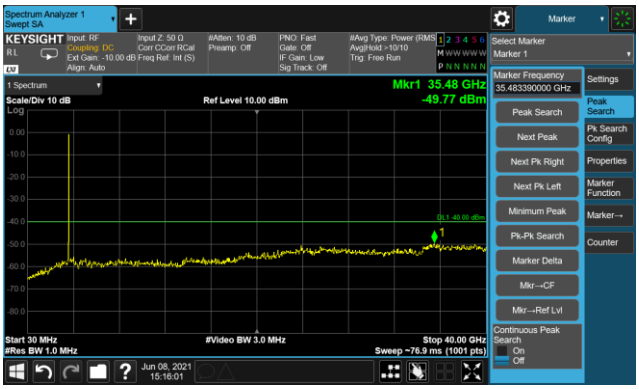




30MHz~40GHz

30MHz~40GHz

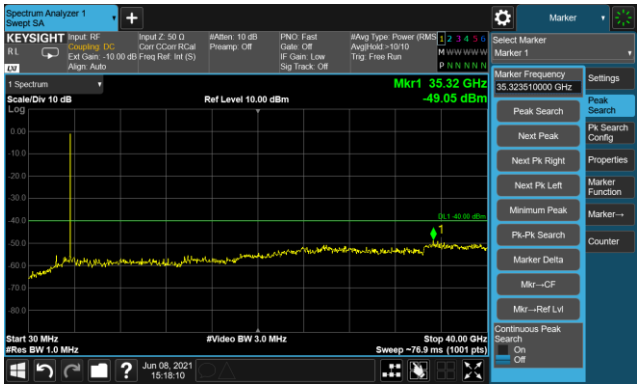
Middle channel

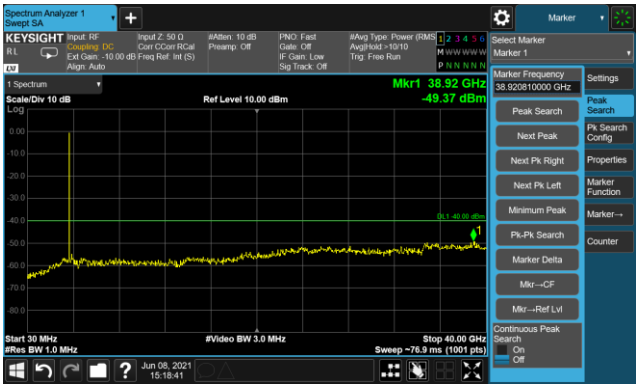


30MHz~40GHz

30MHz~40GHz

Highest channel





30MHz~40GHz

30MHz~40GHz

LTE Band 48(15 MHz 64QAM)- ANT 1

Lowest channel

30MHz~40GHz

Middle channel

30MHz~40GHz

Highest channel

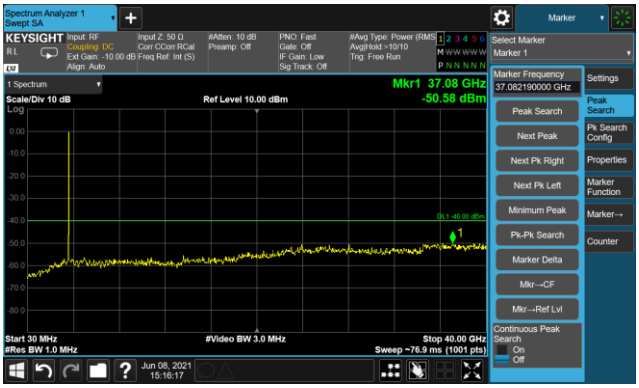
30MHz~40GHz

LTE Band 48(15 MHz QPSK)- ANT 1

Lowest channel

30MHz~40GHz

Middle channel



30MHz~40GHz

Highest channel

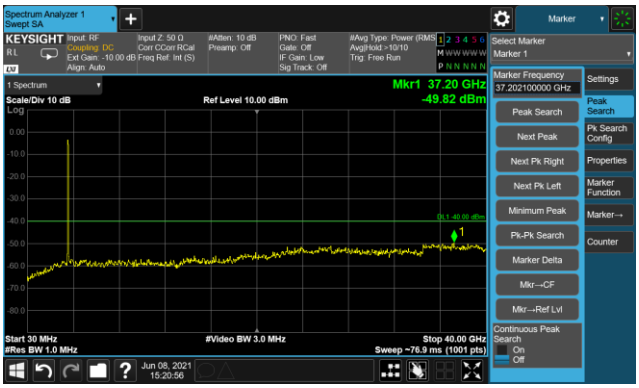
30MHz~40GHz

LTE Band 48(20 MHz 64QAM)- ANT 0

LTE Band 48(20 MHz QPSK)- ANT 0

Lowest channel

30MHz~40GHz



30MHz~40GHz

Middle channel

30MHz~40GHz

30MHz~40GHz

Highest channel

30MHz~40GHz

30MHz~40GHz

LTE Band 48(20 MHz 64QAM)- ANT 1

Lowest channel

30MHz~40GHz

Middle channel

30MHz~40GHz

Highest channel

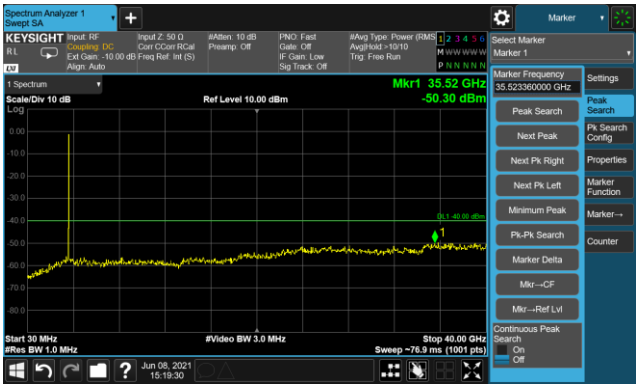
30MHz~40GHz

LTE Band 48(20 MHz QPSK)- ANT 1

Lowest channel

30MHz~40GHz

Middle channel

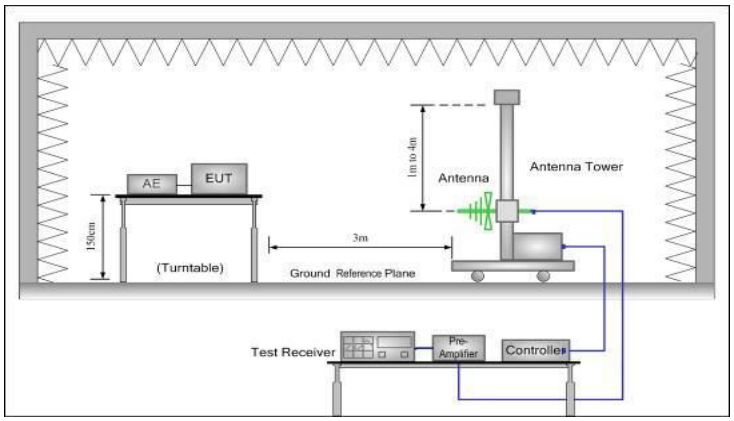
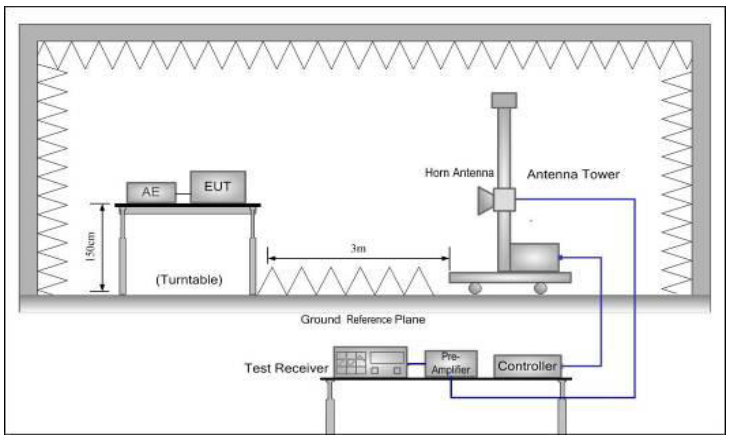
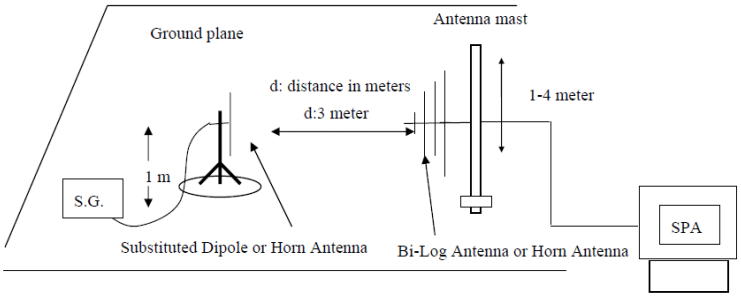


30MHz~40GHz

Highest channel

30MHz~40GHz

6.6 Field strength of spurious radiation measurement

Test Requirement:	Part 96.41(e)(1)(2)
Limit:	-40 dBm/MHz
Test setup:	Below 1GHz  Above 1GHz  Substituted method: 
Test Procedure:	1. The EUT was placed on an non-conductive turntable using a non-conductive support. The radiated emission at the fundamental frequency was measured at 3 m with a test antenna and EMI spectrum analyzer. 2. During the tests, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations. 3. The frequency range up to tenth harmonic was investigated for each of three fundamental frequency (low, middle and high channels). Once spurious emission was identified, the power of the emission was determined using the substitution method.

	4. The spurious emissions attenuation was calculated as the difference between radiated power at the fundamental frequency and the spurious emissions frequency. ERP / EIRP = S.G. output (dBm) + Antenna Gain(dB/dBi) – Cable Loss (dB)
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.3 for details.
Test results:	Passed
Remark:	During the test, pre-scan the QPSK, 64QAM modulation, and found the QPSK modulation is the worst case.

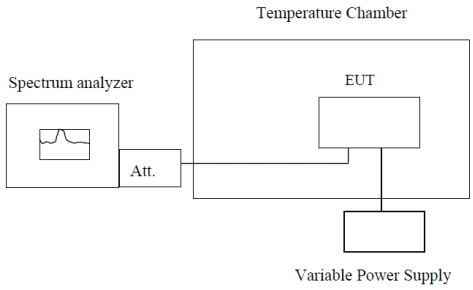
Measurement Data (worst case):

Band 48 (10 MHz) QPSK							
Lowest channel							
Frequency (MHz)	Level at antenna terminals (dBm)	Substitute antenna gain (dBi)	Cable Loss (dBi)	Spurous Emission level (dBm)	Limit Line (dBm)	Over Limit (dBm)	Polarization
7110.00	-58.65	11.38	1.60	-48.87	-40.00	-8.87	Vertical
10665.00	-54.45	11.23	1.94	-45.16	-40.00	-5.16	Vertical
14220.00	-52.56	12.18	2.16	-42.54	-40.00	-2.54	Vertical
7110.00	-59.54	11.38	1.60	-49.76	-40.00	-9.76	Horizontal
10665.00	-54.73	11.23	1.94	-45.44	-40.00	-5.44	Horizontal
14220.00	-52.38	12.18	2.16	-42.36	-40.00	-2.36	Horizontal
Middle channel							
Frequency (MHz)	Level at antenna terminals (dBm)	Substitute antenna gain (dBi)	Cable Loss (dBi)	Spurous Emission level (dBm)	Limit Line (dBm)	Over Limit (dBm)	Polarization
7250.00	-58.30	11.35	1.61	-48.56	-40.00	-8.56	Vertical
10875.00	-54.13	11.09	1.95	-44.99	-40.00	-4.99	Vertical
14500.00	-52.99	12.40	2.17	-42.76	-40.00	-2.76	Vertical
7250.00	-59.33	11.35	1.61	-49.59	-40.00	-9.59	Horizontal
10875.00	-54.60	11.09	1.95	-45.46	-40.00	-5.46	Horizontal
14500.00	-52.79	12.40	2.17	-42.56	-40.00	-2.56	Horizontal
Highest channel							
Frequency (MHz)	Level at antenna terminals (dBm)	Substitute antenna gain (dBi)	Cable Loss (dBi)	Spurous Emission level (dBm)	Limit Line (dBm)	Over Limit (dBm)	Polarization
7390.00	-58.20	11.32	1.62	-48.50	-40.00	-8.50	Vertical
11085.00	-54.77	11.13	1.96	-45.60	-40.00	-5.60	Vertical
14780.00	-52.76	12.62	2.17	-42.31	-40.00	-2.31	Vertical
7390.00	-59.22	11.32	1.62	-49.52	-40.00	-9.52	Horizontal
11085.00	-54.61	11.13	1.96	-45.44	-40.00	-5.44	Horizontal
14780.00	-53.08	12.62	2.17	-42.63	-40.00	-2.63	Horizontal
Remark: *The emission levels of below 1 GHz are lower than the limit 20dB and not show in test report.*							

Band 48 (15 MHz) QPSK							
Lowest channel							
Frequency (MHz)	Level at antenna terminals (dBm)	Substitute antenna gain (dBi)	Cable Loss (dBi)	Spurous Emission level (dBm)	Limit Line (dBm)	Over Limit (dBm)	Polarization
7115.00	-58.90	11.38	1.60	-49.12	-40.00	-9.12	Vertical
10672.50	-54.08	11.23	1.94	-44.79	-40.00	-4.79	Vertical
14230.00	-52.22	12.18	2.16	-42.20	-40.00	-2.20	Vertical
7115.00	-59.12	11.38	1.60	-49.34	-40.00	-9.34	Horizontal
10672.50	-54.81	11.23	1.94	-45.52	-40.00	-5.52	Horizontal
14230.00	-51.95	12.18	2.16	-41.93	-40.00	-1.93	Horizontal
Middle channel							
Frequency (MHz)	Level at antenna terminals (dBm)	Substitute antenna gain (dBi)	Cable Loss (dBi)	Spurous Emission level (dBm)	Limit Line (dBm)	Over Limit (dBm)	Polarization
7250.00	-58.41	11.35	1.61	-48.67	-40.00	-8.67	Vertical
10875.00	-54.35	11.09	1.95	-45.21	-40.00	-5.21	Vertical
14500.00	-52.84	12.40	2.17	-42.61	-40.00	-2.61	Vertical
7250.00	-58.99	11.35	1.61	-49.25	-40.00	-9.25	Horizontal
10875.00	-54.83	11.09	1.95	-45.69	-40.00	-5.69	Horizontal
14500.00	-52.33	12.40	2.17	-42.10	-40.00	-2.10	Horizontal
Highest channel							
Frequency (MHz)	Level at antenna terminals (dBm)	Substitute antenna gain (dBi)	Cable Loss (dBi)	Spurous Emission level (dBm)	Limit Line (dBm)	Over Limit (dBm)	Polarization
7385.00	-57.86	11.32	1.62	-48.16	-40.00	-8.16	Vertical
11077.50	-54.50	11.12	1.96	-45.34	-40.00	-5.34	Vertical
14770.00	-53.11	12.62	2.17	-42.66	-40.00	-2.66	Vertical
7385.00	-59.04	11.32	1.62	-49.34	-40.00	-9.34	Horizontal
11077.50	-55.09	11.12	1.96	-45.93	-40.00	-5.93	Horizontal
14770.00	-53.55	12.62	2.17	-43.10	-40.00	-3.10	Horizontal
Remark: *The emission levels of below 1 GHz are lower than the limit 20dB and not show in test report.*							

Band 48 (20 MHz) QPSK							
Lowest channel							
Frequency (MHz)	Level at antenna terminals (dBm)	Substitute antenna gain (dBi)	Cable Loss (dBi)	Spurous Emission level (dBm)	Limit Line (dBm)	Over Limit (dBm)	Polarization
7120.00	-58.91	11.38	1.60	-49.13	-40.00	-9.13	Vertical
10680.00	-54.28	11.22	1.94	-45.00	-40.00	-5.00	Vertical
14240.00	-52.16	12.19	2.16	-42.13	-40.00	-2.13	Vertical
7120.00	-59.78	11.32	1.60	-50.06	-40.00	-10.06	Horizontal
10680.00	-54.38	11.22	1.94	-45.10	-40.00	-5.10	Horizontal
14240.00	-52.72	12.19	2.16	-42.69	-40.00	-2.69	Horizontal
Middle channel							
Frequency (MHz)	Level at antenna terminals (dBm)	Substitute antenna gain (dBi)	Cable Loss (dBi)	Spurous Emission level (dBm)	Limit Line (dBm)	Over Limit (dBm)	Polarization
7250.00	-58.48	11.35	1.61	-48.74	-40.00	-8.74	Vertical
10875.00	-54.08	11.09	1.95	-44.94	-40.00	-4.94	Vertical
14500.00	-53.05	12.40	2.17	-42.82	-40.00	-2.82	Vertical
7250.00	-59.02	11.35	1.61	-49.28	-40.00	-9.28	Horizontal
10875.00	-54.14	11.09	1.95	-45.00	-40.00	-5.00	Horizontal
14500.00	-52.44	12.40	2.17	-42.21	-40.00	-2.21	Horizontal
Highest channel							
Frequency (MHz)	Level at antenna terminals (dBm)	Substitute antenna gain (dBi)	Cable Loss (dBi)	Spurous Emission level (dBm)	Limit Line (dBm)	Over Limit (dBm)	Polarization
7380.00	-58.40	11.32	1.62	-48.70	-40.00	-8.70	Vertical
11070.00	-54.18	11.11	1.96	-45.03	-40.00	-5.03	Vertical
14760.00	-53.41	12.61	2.17	-42.97	-40.00	-2.97	Vertical
7380.00	-59.48	11.32	1.62	-49.78	-40.00	-9.78	Horizontal
11070.00	-54.14	11.11	1.96	-44.99	-40.00	-4.99	Horizontal
14760.00	-53.22	12.61	2.17	-42.78	-40.00	-2.78	Horizontal
Remark: *The emission levels of below 1 GHz are lower than the limit 20dB and not show in test report.*							

6.7 Frequency stability V.S. Temperature measurement

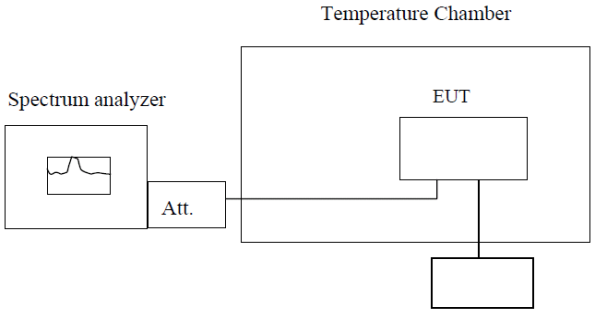
Test Requirement:	FCC Part 2.1055(a)(b)
Limit:	FCC: Frequency range (MHz) / Fixed and base stations (±ppm) / Mobile stations (±ppm): Over 2 watts output power / 2 watts or less output power Below 25: 100 / 100 / 200 25–50: 20 / 20 / 50 72–76: 5 / / 50 150–174: 5 / 5 / 50 216–220: 1.0 / / 1.0 220–222: 0.1 / 1.5 / 1.5 421–512: 2.5 / 5 / 5 806–809: 1.0 / 1.5 / 1.5 809–824: 1.5 / 2.5 / 2.5 851–854: 1.0 / 1.5 / 1.5 854–869: 1.5 / 2.5 / 2.5 896–901: 0.1 / 1.5 / 1.5 902–928: 2.5 / 2.5 / 2.5 902–928: 2.5 / 2.5 / 2.5 929–930: 1.5 / / / 935–940: 0.1 / 1.5 / 1.5 1427–1435: 300 / 300 / 300 Above 2450 / / /
Test setup:	 **Note :** Measurement setup for testing on Antenna connector
Test procedure:	1. The equipment under test was connected to an external DC power supply and input rated voltage. 2. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. 3. The EUT was placed inside the temperature chamber. 4. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 25℃ operating frequency as reference frequency. 5. Repeat step measure with 10℃ increased per stage until the highest temperature of +50℃ reached
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed
Remark:	All three channels of all modulations have been tested, but only the worst channel and the worst modulation show in this test item.

Measurement Data (the worst channel):

Reference Frequency: Lowest channel=3555.0MHz(10MHz for QPSK)			
Power supplied (Vac)	Temperature (℃)	Frequency error	
		Hz	ppm
120.00	-40	126	0.035443
	-30	192	0.054008
	-20	191	0.053727
	-10	187	0.052602
	0	176	0.049508
	10	180	0.050633
	20	144	0.040506
	30	150	0.042194
	40	132	0.037131
	50	126	0.035443
	55	128	0.036006
Reference Frequency: Lowest channel=3557.5MHz(15MHz for QPSK)			
Power supplied (Vac)	Temperature (℃)	Frequency error	
		Hz	ppm
120.00	-40	197	0.055376
	-30	123	0.034575
	-20	165	0.046381
	-10	111	0.031202
	0	144	0.040478
	10	187	0.052565
	20	154	0.043289
	30	164	0.046100
	40	188	0.052846
	50	177	0.049754
	55	120	0.033732
Reference Frequency: Lowest channel=3560.0MHz(20MHz for QPSK)			
Power supplied (Vac)	Temperature (℃)	Frequency error	
		Hz	ppm
120.00	-40	203	0.057103
	-30	190	0.053446
	-20	189	0.053165
	-10	187	0.052528
	0	165	0.046348
	10	174	0.048876
	20	123	0.034551
	30	160	0.044944
	40	144	0.040449
	50	150	0.042135
	55	147	0.041350

Reference Frequency: Lowest channel=3555.0MHz(10MHz for 64QAM)			
Power supplied (Vac)	Temperature (℃)	Frequency error	
		Hz	ppm
120.00	-40	214	0.060197
	-30	206	0.057947
	-20	203	0.057103
	-10	186	0.073373
	0	181	0.050914
	10	165	0.046414
	20	171	0.048101
	30	123	0.034599
	40	132	0.037131
	50	136	0.038256
	55	138	0.038819
Reference Frequency: Lowest channel=3557.5MHz(15MHz for 64QAM)			
Power supplied (Vac)	Temperature (℃)	Frequency error	
		Hz	ppm
120.00	-40	198	0.055657
	-30	165	0.046381
	-20	111	0.031202
	-10	123	0.034575
	0	160	0.044975
	10	174	0.048911
	20	158	0.044413
	30	107	0.030077
	40	188	0.052846
	50	171	0.048067
	55	103	0.028953
Reference Frequency: Lowest channel=3560.0MHz(20MHz for 64QAM)			
Power supplied (Vac)	Temperature (℃)	Frequency error	
		Hz	ppm
120.00	-40	212	0.059634
	-30	207	0.058228
	-20	201	0.056540
	-10	198	0.055618
	0	180	0.050562
	10	156	0.043820
	20	132	0.037079
	30	144	0.040449
	40	171	0.048034
	50	105	0.029494
	55	121	0.034037

6.8 Frequency stability V.S. Voltage measurement

Test Requirement:	FCC Part 2.1055(b)
Limit:	FCC: Frequency range (MHz) / Fixed and base stations (±ppm) / Mobile stations (±ppm): Over 2 watts output power / 2 watts or less output power Below 25: 100 / 100 / 200 25–50: 20 / 20 / 50 72–76: 5 / / 50 150–174: 5 / 5 / 50 216–220: 1.0 / / 1.0 220–222: 0.1 / 1.5 / 1.5 421–512: 2.5 / 5 / 5 806–809: 1.0 / 1.5 / 1.5 809–824: 1.5 / 2.5 / 2.5 851–854: 1.0 / 1.5 / 1.5 854–869: 1.5 / 2.5 / 2.5 896–901: 0.1 / 1.5 / 1.5 902–928: 2.5 / 2.5 / 2.5 902–928: 2.5 / 2.5 / 2.5 929–930: 1.5 / / 935–940: 0.1 / 1.5 / 1.5 1427–1435: 300 / 300 / 300 Above 2450 / / /
Test setup:	 **Note :** Measurement setup for testing on Antenna connector
Test procedure:	1. Set chamber temperature to 25℃. Use a variable DC power source to power the EUT and set the voltage to rated voltage. 2. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency. 3. Reduce the input voltage to specify extreme voltage variation (+/- 15%) and endpoint, record the maximum frequency change.
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.3 for details, and all channels have been tested, only shows the worst channel data in this report.
Test results:	Passed
Remark:	All three channels of all modulations have been tested, but only the worst channel and the worst modulation show in this test item.

Measurement Data (the worst channel):

Reference Frequency: Lowest channel=3555.0MHz(10MHz for QPSK)			
Temperature (℃)	Power supplied (Vac)	Frequency error	
		Hz	ppm
25	102.00	89	0.025035
	120.00	78	0.021941
	138.00	90	0.025316
Reference Frequency: Lowest channel=3557.5MHz(15MHz for QPSK)			
Temperature (℃)	Power supplied (Vac)	Frequency error	
		Hz	ppm
25	102.00	98	0.027547
	120.00	57	0.016022
	138.00	88	0.024736
Reference Frequency: Lowest channel=3560.0MHz(20MHz for QPSK)			
Temperature (℃)	Power supplied (Vac)	Frequency error	
		Hz	ppm
25	102.00	99	0.027809
	120.00	71	0.019944
	138.00	80	0.022472

Reference Frequency: Lowest channel=3555.0MHz(10MHz for 64QAM)			
Temperature (℃)	Power supplied (Vac)	Frequency error	
		Hz	ppm
25	102.00	84	0.023629
	120.00	96	0.027004
	138.00	73	0.020534
Reference Frequency: Lowest channel=3557.5MHz(15MHz for 64QAM)			
Temperature (℃)	Power supplied (Vac)	Frequency error	
		Hz	ppm
25	102.00	98	0.027547
	120.00	67	0.018833
	138.00	90	0.025299
Reference Frequency: Lowest channel=3560.0MHz(20MHz for 64QAM)			
Temperature (℃)	Power supplied (Vac)	Frequency error	
		Hz	ppm
25	102.00	98	0.027528
	120.00	85	0.023876
	138.00	60	0.016854