Channel Bandwidth: 10 MHz

Channel Bandwidth: 10 MHz						
Modulation	Channel	RB Configuration		Peak-to-Average Ratio [dB]	Limit [dB]	Verdict
		Size	Offset			
QPSK	LCH	1	0	4.26	<13	PASS
		1	24	4.25	<13	PASS
		1	49	4.33	<13	PASS
		25	0	4.29	<13	PASS
		25	12	4.14	<13	PASS
		25	25	4.65	<13	PASS
		50	0	4.96	<13	PASS
	MCH	1	0	4.43	<13	PASS
		1	24	4.36	<13	PASS
		1	49	4.20	<13	PASS
		25	0	4.44	<13	PASS
		25	12	4.20	<13	PASS
		25	25	4.58	<13	PASS
		50	0	4.77	<13	PASS
	HCH	1	0	4.15	<13	PASS
		1	24	4.29	<13	PASS
		1	49	3.58	<13	PASS
		25	0	3.99	<13	PASS
		25	12	3.47	<13	PASS
		25	25	4.43	<13	PASS
		50	0	4.79	<13	PASS
16QAM	LCH	1	0	4.60	<13	PASS
		1	24	4.36	<13	PASS
		1	49	4.68	<13	PASS
		25	0	4.75	<13	PASS
		25	12	4.59	<13	PASS
		25	25	5.23	<13	PASS
		50	0	/	<13	PASS
	MCH	1	0	4.39	<13	PASS
		1	24	4.27	<13	PASS
		1	49	4.20	<13	PASS
		25	0	4.44	<13	PASS

		25	12	3.97	<13	PASS
		25	25	4.42	<13	PASS
		50	0	/	<13	PASS
	HCH	1	0	4.01	<13	PASS
		1	24	3.98	<13	PASS
		1	49	4.38	<13	PASS
		25	0	4.61	<13	PASS
		25	12	3.89	<13	PASS
		25	25	4.53	<13	PASS
		50	0	/	<13	PASS

7. SPURIOUS EMISSION

7.1 CONDUCTED SPURIOUS EMISSION

7.1.1 MEASUREMENT METHOD

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible attenuation level of any spurious emission is 43 + log10(P[Watts]), where P is the transmitter power in Watts.

Test Procedure Used

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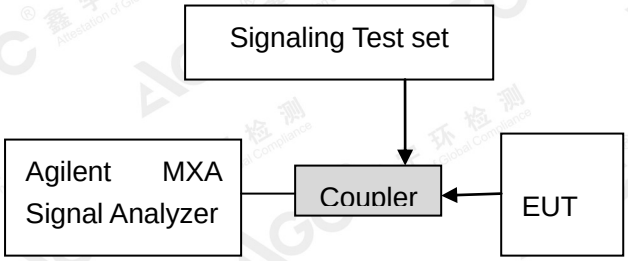
Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to at least 10 * the fundamental frequency (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = max hold
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



Test Instrument & Measurement Setup

shall be attenuated below the transmitter power (P, in Watts) by at least 43+10Log(P) dB. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm.

Test Note

Compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater for frequencies less than 1 GHz and 1 MHz or greater for frequencies greater than 1 GHz. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

7.1.2 MEASUREMENT RESULT

PLEASE REFER TO: APPENDIX A TEST PLOTS FOR CONDUCTED SPURIOUS EMISSION

Note: 1. No emission found in standby or receive mode, no recording in this report.

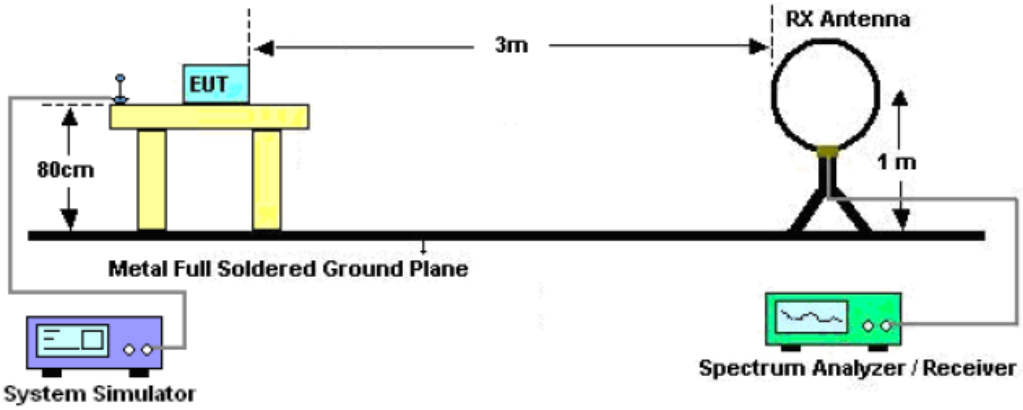
7.2 RADIATED SPURIOUS EMISSION

7.2.1. MEASUREMENT PROCEDURE

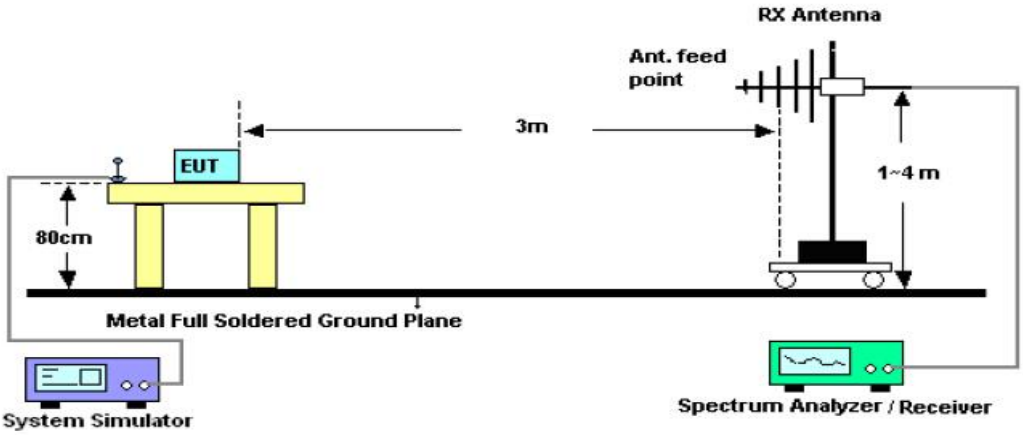
1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and RBW for peak reading. Then 1MHz RBW and 10Hz VBW for average reading in spectrum analyzer. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

7.2.2. TEST SETUP

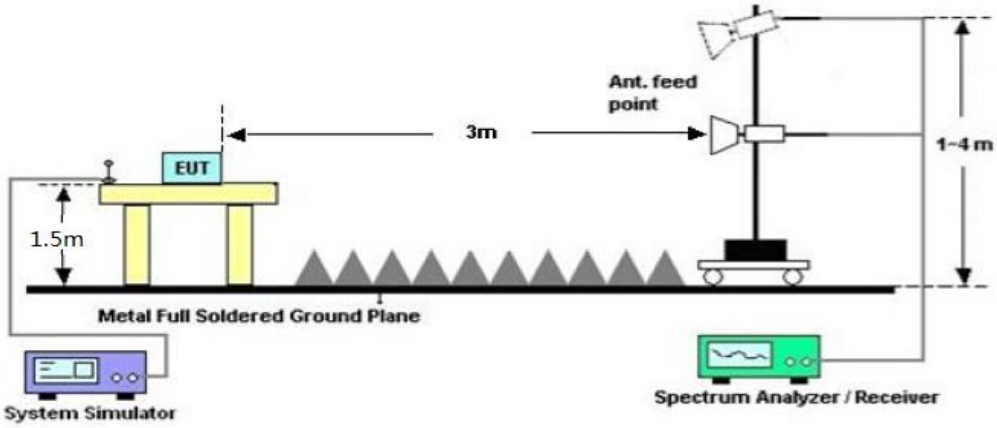
Radiated Emission Test-Setup Frequency Below 30MHz



RADIATED EMISSION TEST SETUP 30MHz-1000MHz



RADIATED EMISSION TEST SETUP ABOVE 1000MHz



7.2.3 PROVISIONS APPLICABLE

(a) On any frequency outside a licensee's frequency block (e.g. A, D, B, etc.) within the USPCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least 43+10Log(P) dB. The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB, which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

Note: Only record the worst condition of each test mode:

7.2.4 MEASUREMENT RESULT

LTE Band 2
Low channel

Frequency (MHz)	Polarity (H/V)	Emission Level (dBm)	Limit (dBm)	Margin (dB)
3720	V	-34.26	-13	-21.26
748.3	V	-38.51	-13	-25.51
257.2	V	-43.23	-13	-30.23
3720	H	-33.12	-13	-20.12
640.2	H	-39.49	-13	-26.49
221.4	H	-42.52	-13	-29.52

Middle channel

Frequency (MHz)	Polarity (H/V)	Emission Level (dBm)	Limit (dBm)	Margin (dB)
3760	V	-34.41	-13	-21.41
533.1	V	-40.33	-13	-27.33
256.5	V	-39.44	-13	-26.44
3760	H	-35.18	-13	-22.18
850.2	H	-41.44	-13	-28.44
451.4	H	-41.59	-13	-28.59

High channel

Frequency (MHz)	Polarity (H/V)	Emission Level (dBm)	Limit (dBm)	Margin (dB)
3800	V	-34.11	-13	-21.11
611.1	V	-39.95	-13	-26.95
256.5	V	-41.11	-13	-28.11
3800	H	-34.12	-13	-21.12
586.2	H	-39.47	-13	-26.47
351.4	H	-40.15	-13	-27.15

Note: 1. Margin = Emission Leve -Limit
2. (30MHz-20GHz) Below 30MHZ no Spurious found and the QPSK modes is the worst condition.

8. FREQUENCY STABILITY

8.1 MEASUREMENT METHOD

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the EUT in a “call mode”. This is accomplished with the use of R&S CMW500 DIGITAL RADIO COMMUNICATION TESTER.

1 Measure the carrier frequency at room temperature.

2 Subject the EUT to overnight soak at -10℃. With the EUT, powered via nominal voltage, connected to the CMW500 and in a simulated call on channel 20175 for LTE band 4 measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.

3 Repeat the above measurements at 10℃ increments from -10℃ to +50℃. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.

4 Re-measure carrier frequency at room temperature with nominal voltage. Vary supply voltage from minimum voltage to maximum voltage, in 0.1Volt increments re-measuring carrier frequency at each voltage. Pause at nominal voltage for 1 1/2 hours unpowered, to allow any self-heating to stabilize, before continuing.

5 Subject the EUT to overnight soak at +50℃.

6 With the EUT, powered via nominal voltage, connected to the CMW500 and in a simulated call on the centre channel, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.

7 Repeat the above measurements at 10℃ increments from +50℃ to -10℃. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.

8 At all temperature levels hold the temperature to +/- 0.5℃ during the measurement procedure.

8.2 PROVISIONS APPLICABLE

8.2.1 For Hand carried battery powered equipment

Frequency stability testing is performed in accordance with the guidelines of ANSI/TIA-603-E-2016. The frequency stability of the transmitter is measured by:

a.) Temperature: The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.

b.) Primary Supply Voltage: The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

For Part 22, the frequency stability of the transmitter shall be maintained within ±0.00025% (±2.5 ppm) of the center frequency. For Part 24 and Part 27, the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

8.2.2 For equipment powered by primary supply voltage

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a “standby” condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

8.3 MEASUREMENT RESULT (WORST)

LTE Band 2

Middle Channel, f_O = 1880 MHz				
Temperature (℃)	**Power Supplied**	**Frequency Error (Hz)**	**Frequency Error (ppm)**	**Limit (ppm)**
-10	3.7	-2.23	-0.001187	±2.5
0		-3.93	-0.002093	±2.5
10		-3.38	-0.001796	±2.5
20		-4.28	-0.002275	±2.5
30		-2.85	-0.001514	±2.5
40		-3.89	-0.002070	±2.5
50		-3.52	-0.001872	±2.5
55		-3.93	-0.002093	±2.5
25	4.2	-3.99	-0.002123	±2.5
	3.5	-3.66	-0.001948	±2.5

Note: The EUT doesn't work below -10℃

9. OCCUPIED BANDWIDTH

9.1 MEASUREMENT METHOD

The test set up and general procedure is similar to conducted peak output power test. Only different for setting the measurement configuration of the measuring instrument of Spectrum Analyzer.

9.2 PROVISIONS APPLICABLE

The emission bandwidth is defined as two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26dB below the transmitter power

9.3 MEASUREMENT RESULT

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.

LTE Band 2

Channel Bandwidth: 1.4 MHz

Channel Bandwidth: 1.4 MHz					
Modulation	Channel	RB Configuration		Occupied Bandwidth(MHz)	Verdict
		Size	Offset		
QPSK	LCH	6	0	1.0773	PASS
	MCH	6	0	1.0798	PASS
	HCH	6	0	1.0775	PASS
16QAM	LCH	6	0	1.0781	PASS
	MCH	6	0	1.0766	PASS
	HCH	6	0	1.0788	PASS

Channel Bandwidth: 3 MHz

Channel Bandwidth: 3 MHz					
Modulation	Channel	RB Configuration		Occupied Bandwidth(MHz)	Verdict
		Size	Offset		
QPSK	LCH	15	0	2.6844	PASS
	MCH	15	0	2.6831	PASS
	HCH	15	0	2.6859	PASS
16QAM	LCH	15	0	2.6841	PASS
	MCH	15	0	2.6848	PASS
	HCH	15	0	2.6823	PASS

Channel Bandwidth: 5 MHz

Channel Bandwidth: 5 MHz					
Modulation	Channel	RB Configuration		Occupied Bandwidth(MHz)	Verdict
		Size	Offset		
QPSK	LCH	25	0	4.4741	PASS
	MCH	25	0	4.4757	PASS
	HCH	25	0	4.4783	PASS
16QAM	LCH	25	0	4.4692	PASS
	MCH	25	0	4.4727	PASS
	HCH	25	0	4.4762	PASS

Channel Bandwidth: 10 MHz

Channel Bandwidth: 10 MHz					
Modulation	Channel	RB Configuration		Occupied Bandwidth (MHz)	Verdict
		Size	Offset		
QPSK	LCH	50	0	8.9301	PASS
	MCH	50	0	8.9215	PASS
	HCH	50	0	8.9531	PASS
16QAM	LCH	50	0	/	N/A
	MCH	50	0	/	N/A
	HCH	50	0	/	N/A

Note: Please refers to Appendix B for compliance test plots for Occupied Bandwidth (99%)

10. EMISSION BANDWIDTH

10.1 MEASUREMENT METHOD

The test set up and general procedure is similar to conducted peak output power test. Only different for setting the measurement configuration of the measuring instrument of Spectrum Analyzer.

10.2 PROVISIONS APPLICABLE

The emission bandwidth is defined as two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26dB below the transmitter power.

10.3 MEASUREMENT RESULT

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.

LTE Band 2

Channel Bandwidth: 1.4 MHz

Channel Bandwidth: 1.4 MHz					
Modulation	Channel	RB Configuration		26dB Bandwidth (MHz)	Verdict
		Size	Offset		
QPSK	LCH	6	0	1.232	PASS
	MCH	6	0	1.232	PASS
	HCH	6	0	1.240	PASS
16QAM	LCH	6	0	1.236	PASS
	MCH	6	0	1.255	PASS
	HCH	6	0	1.237	PASS

Channel Bandwidth: 3 MHz

Channel Bandwidth: 3 MHz					
Modulation	Channel	RB Configuration		26dB Bandwidth (MHz)	Verdict
		Size	Offset		
QPSK	LCH	15	0	2.913	PASS
	MCH	15	0	2.884	PASS
	HCH	15	0	2.897	PASS
16QAM	LCH	15	0	2.884	PASS
	MCH	15	0	2.890	PASS
	HCH	15	0	2.913	PASS

Channel Bandwidth: 5 MHz

Channel Bandwidth: 5 MHz					
Modulation	Channel	RB Configuration		26dB Bandwidth (MHz)	Verdict
		Size	Offset		
QPSK	LCH	25	0	4.833	PASS
	MCH	25	0	4.780	PASS
	HCH	25	0	4.805	PASS
16QAM	LCH	25	0	4.811	PASS
	MCH	25	0	4.814	PASS
	HCH	25	0	4.873	PASS

Channel Bandwidth: 10 MHz

Channel Bandwidth: 10 MHz					
Modulation	Channel	RB Configuration		26dB Bandwidth (MHz)	Verdict
		Size	Offset		
QPSK	LCH	50	0	9.453	PASS
	MCH	50	0	9.441	PASS
	HCH	50	0	9.524	PASS
16QAM	LCH	50	0	/	N/A
	MCH	50	0	/	N/A
	HCH	50	0	/	N/A

Note: Please refers to Appendix B for compliance test plots for emission bandwidth (-26dBc)

11. BAND EDGE

11.1 MEASUREMENT METHOD

The test set up and general procedure is similar to conducted peak output power test. Only different for setting the measurement configuration of the measuring instrument of Spectrum Analyzer.

11.2 PROVISIONS APPLICABLE

As Specified in FCC rules of §2.1051 §24.238(a) §27.53(g) §27.53(h) §27.53(m)
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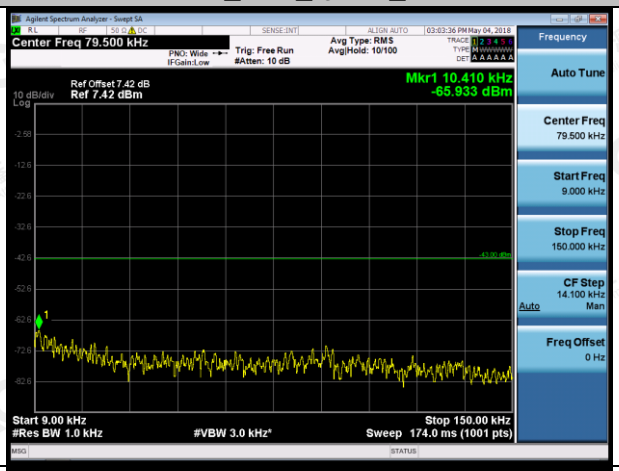
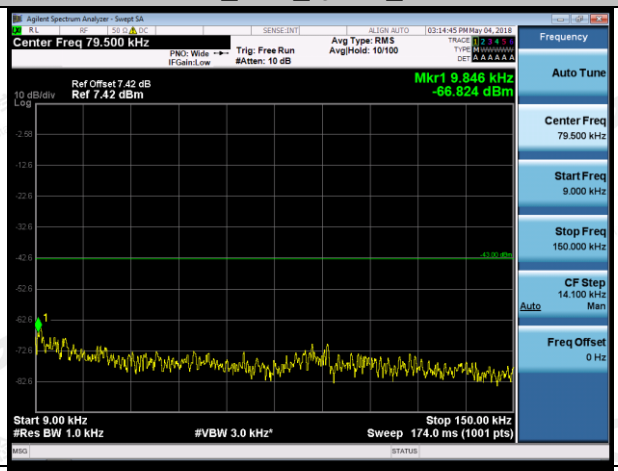
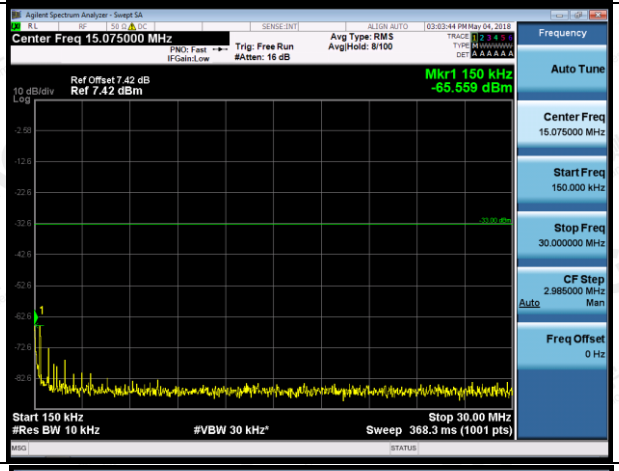
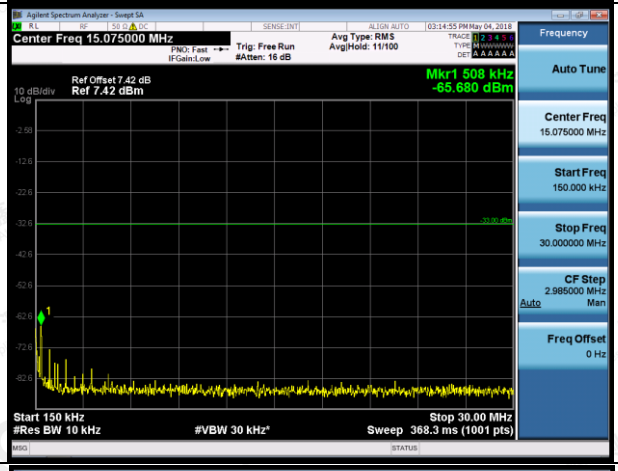
11.3 MEASUREMENT RESULT

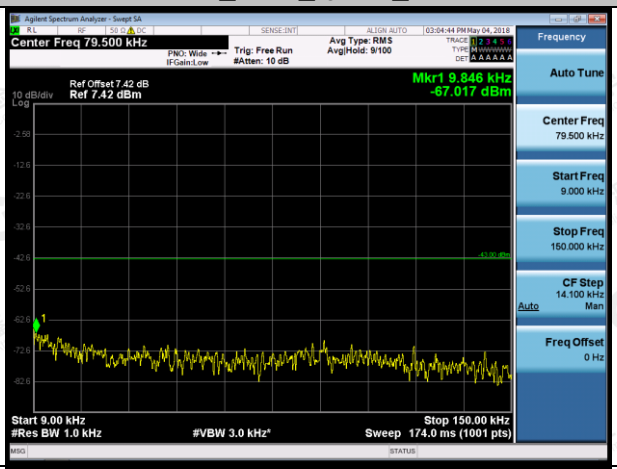
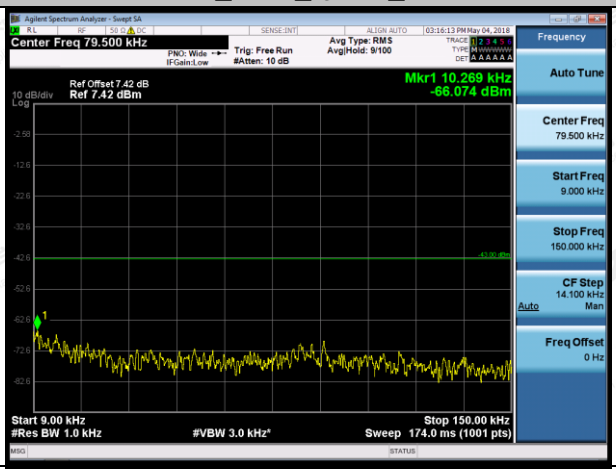
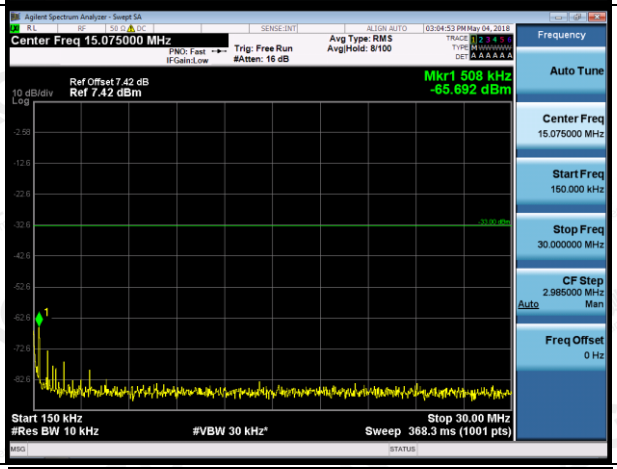
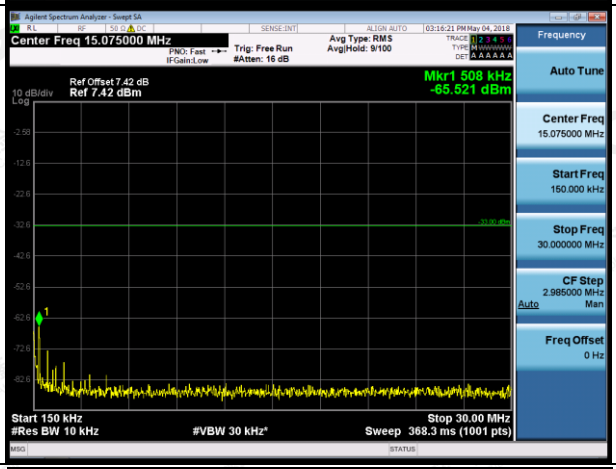
All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequency. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.
The minimum permissible attenuation level of any spurious emission is 43 + log10(P[Watts]), where P is the transmitter power in Watts.
Please refers to Appendix III for compliance test plots for band edge

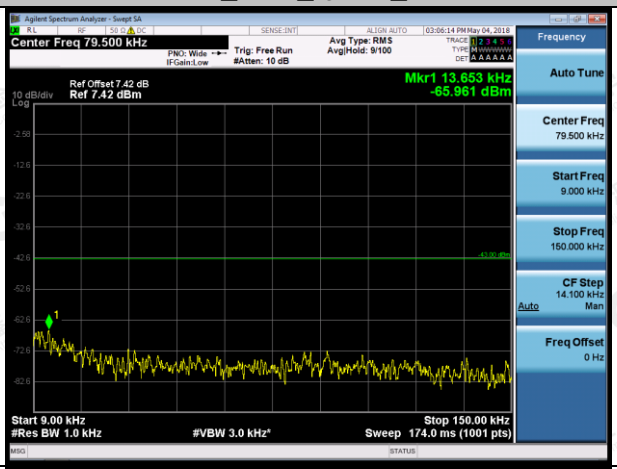
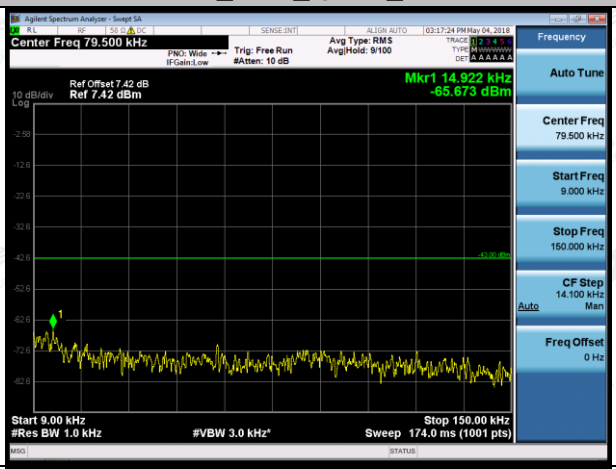
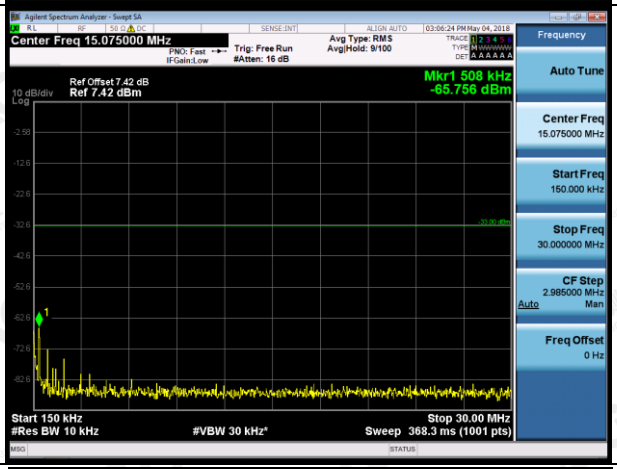
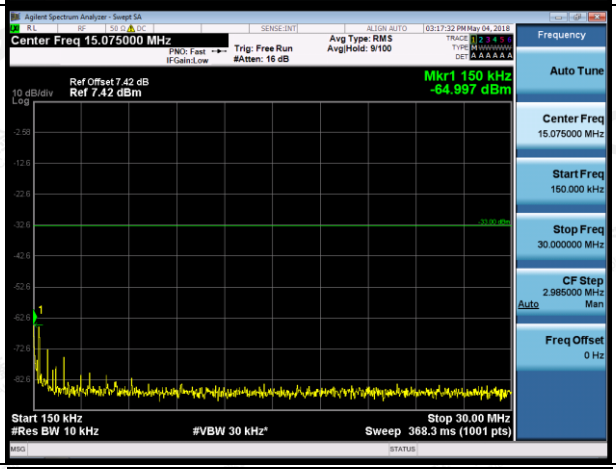
APPENDIX A

TEST PLOTS FOR CONDUCTED SPURIOUS EMISSION

LTE BAND 2

1.4MHz_LCH_QPSK_1RB#0	10MHz_LCH_QPSK_1RB#0
	
	
	

1.4MHz_MCH_QPSK_1RB#0	10MHz_MCH_QPSK_1RB#0
	
	
	

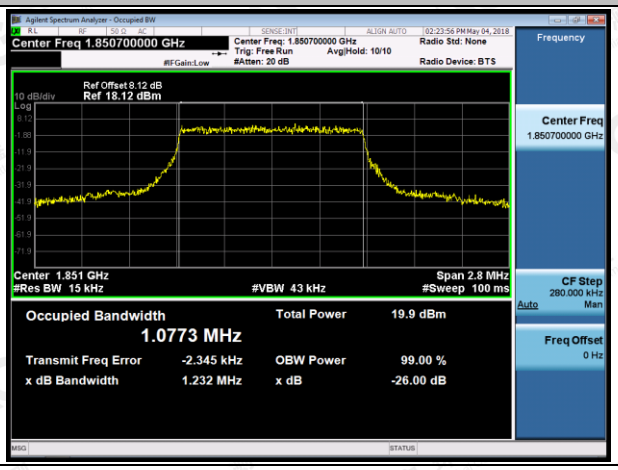
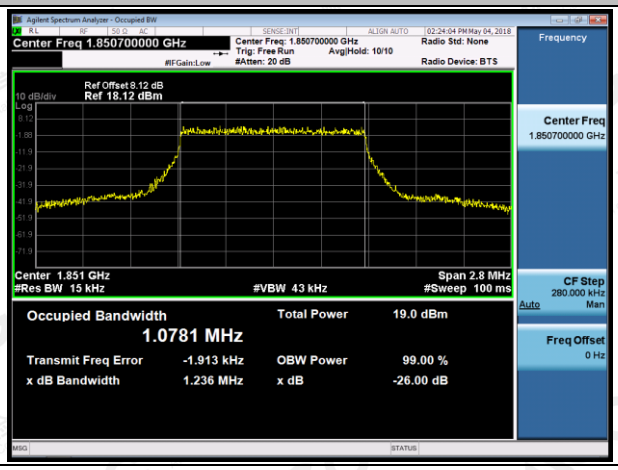
1.4MHz_HCH_QPSK_1RB#0	10MHz_HCH_QPSK_1RB#0
	
	
	

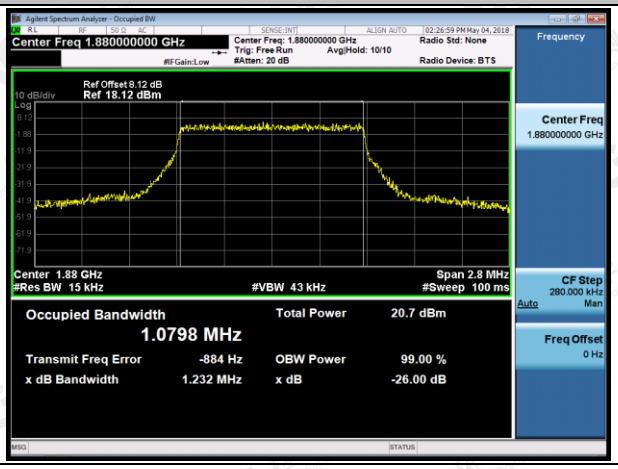
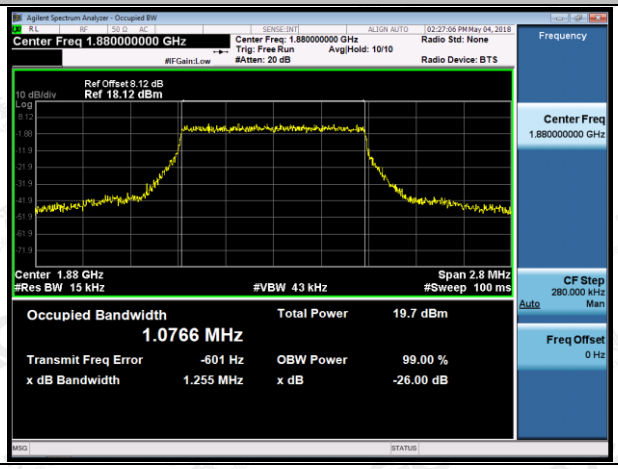
APPENDIX B

TEST PLOTS FOR OCCUPIED BANDWIDTH (99%)

EMISSION BANDWIDTH (-26dBC)

LTE Band 2 Channel Bandwidth: 1.4 MHz

LCH_QPSK_6RB#0	LCH_16QAM_6RB#0
	

MCH_QPSK_6RB#0	MCH_16QAM_6RB#0
	

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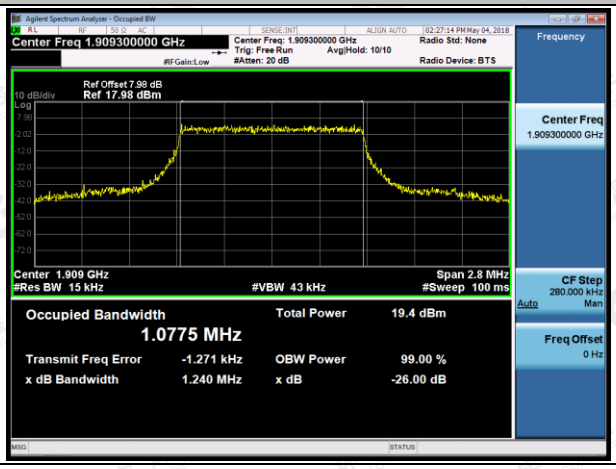	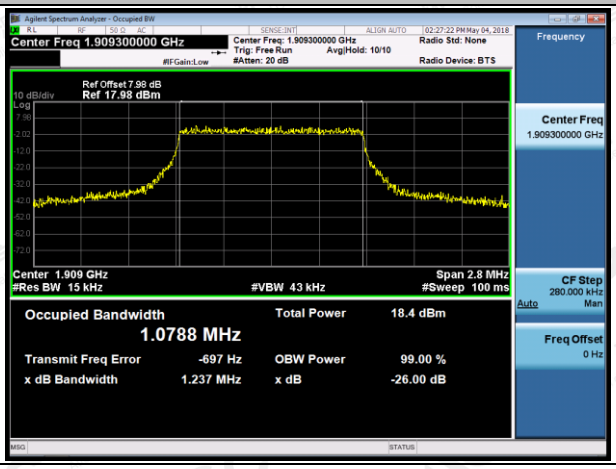

Channel Bandwidth: 3 MHz

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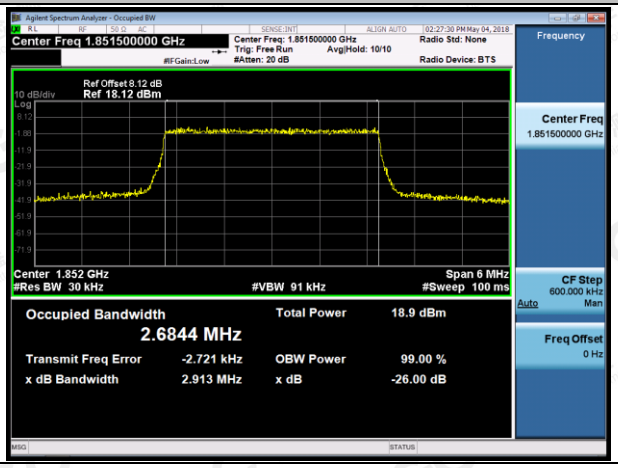	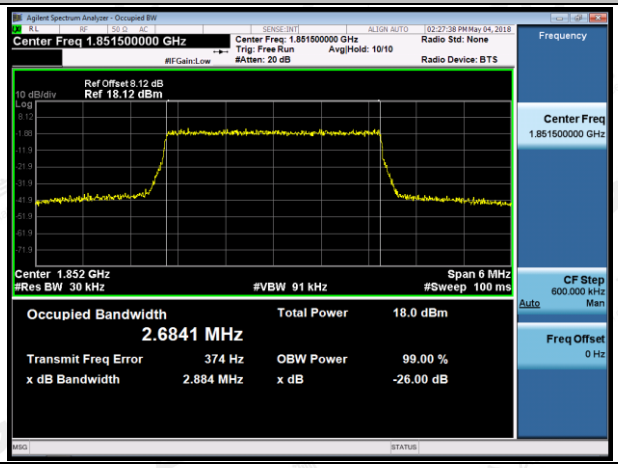

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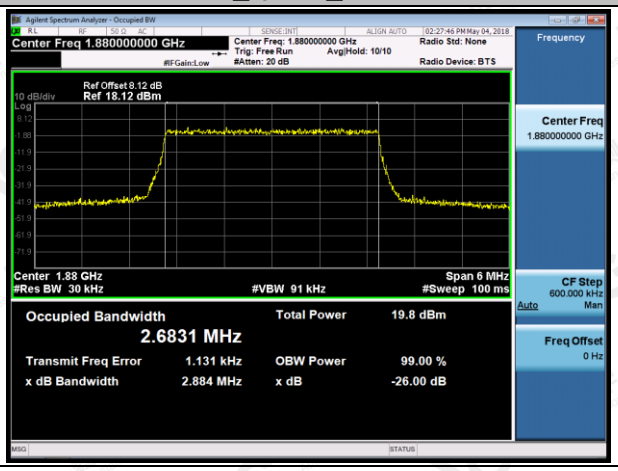	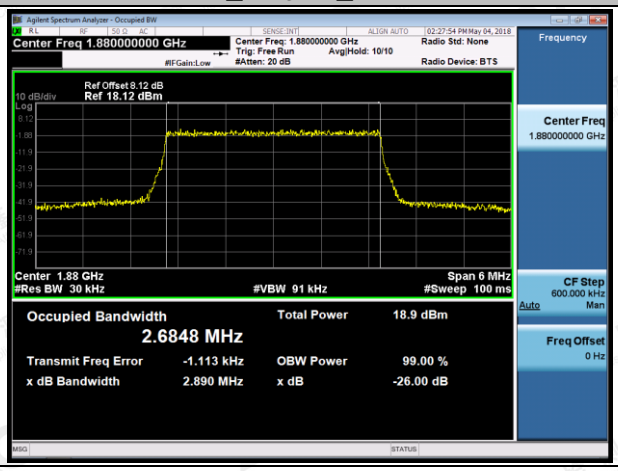

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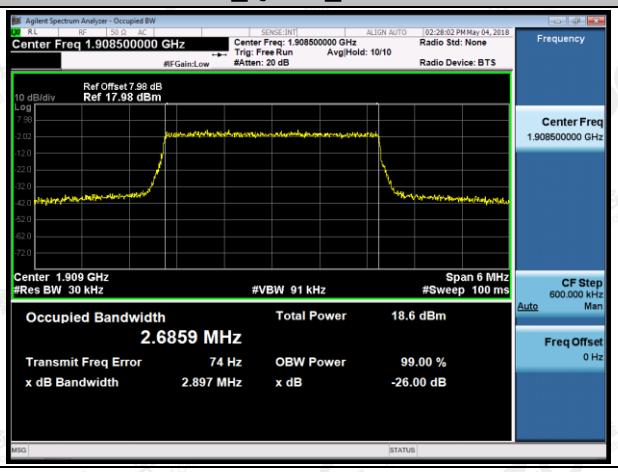	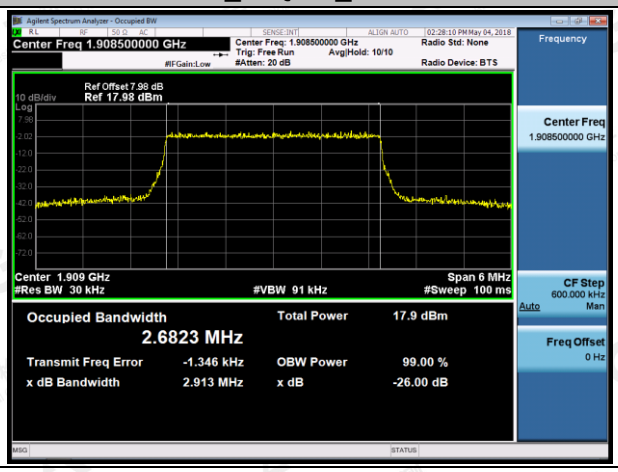

Channel Bandwidth: 5 MHz

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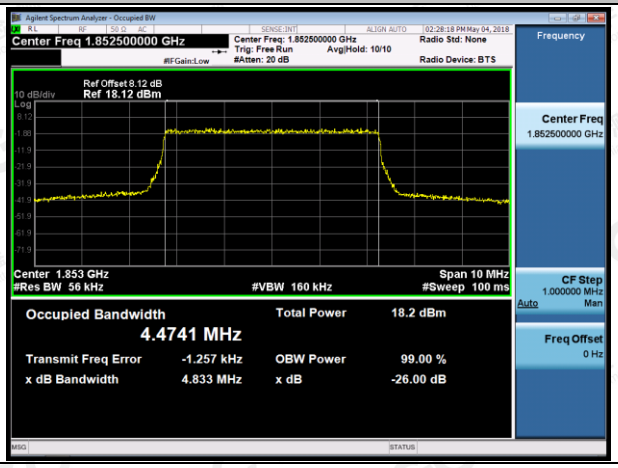	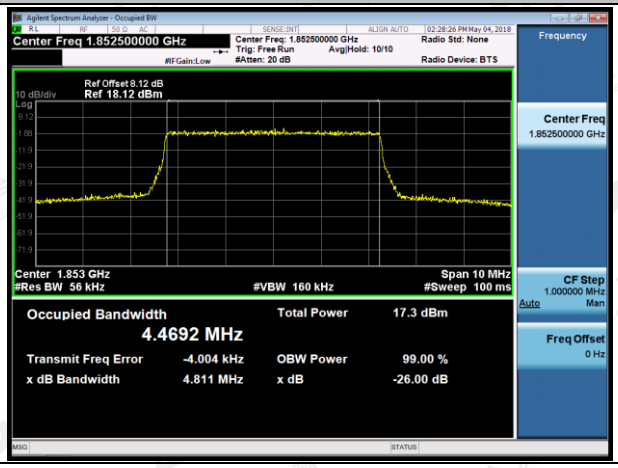
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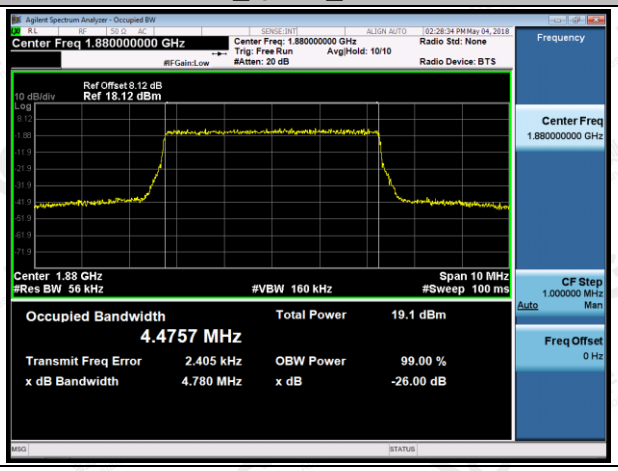	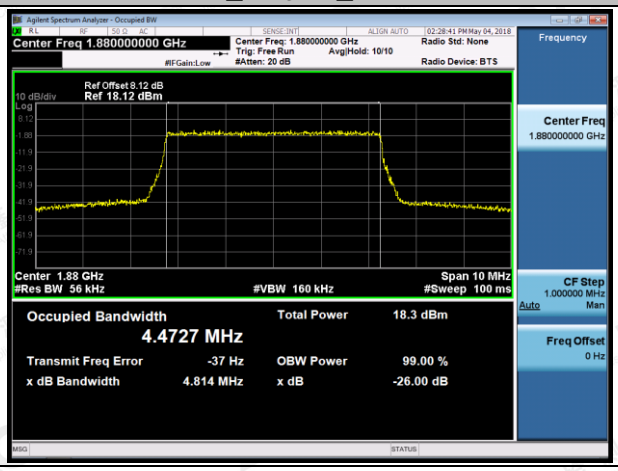
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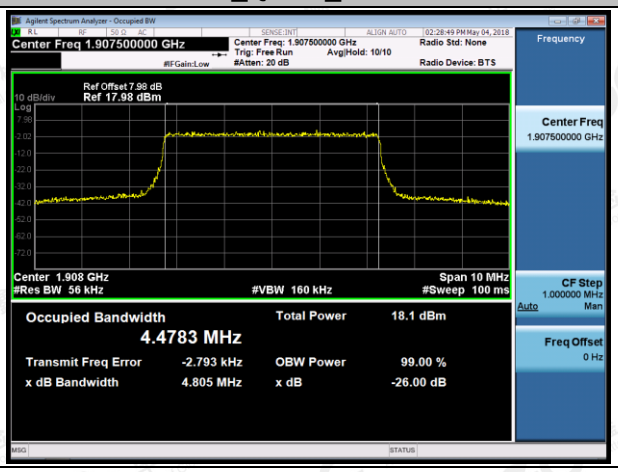	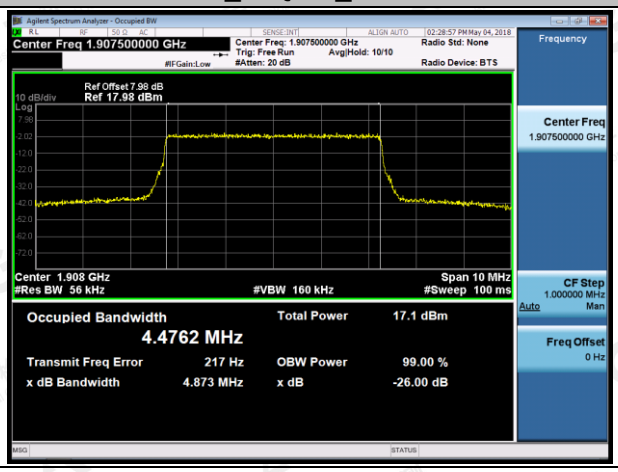

Channel Bandwidth: 10 MHz

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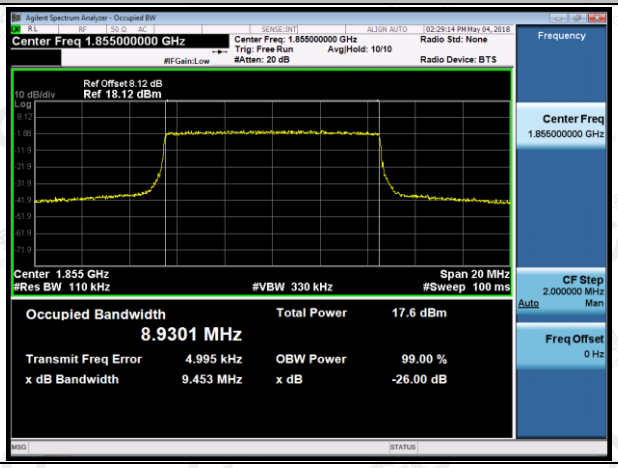	

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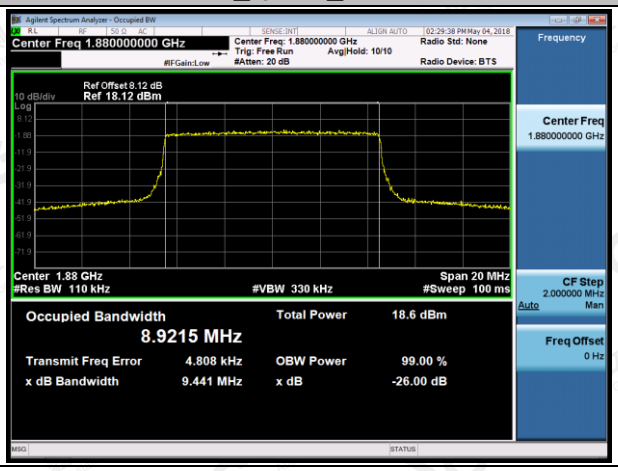	

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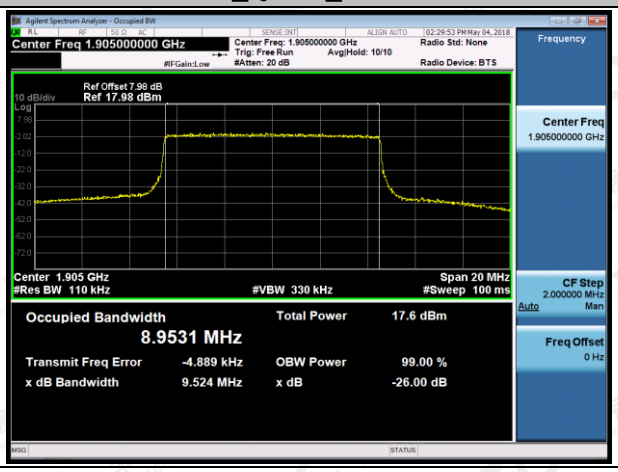	

APPENDIX C
TEST PLOTS FOR BAND EDGES
LTE BAND 2 Channel Bandwidth: 1.4 MHz

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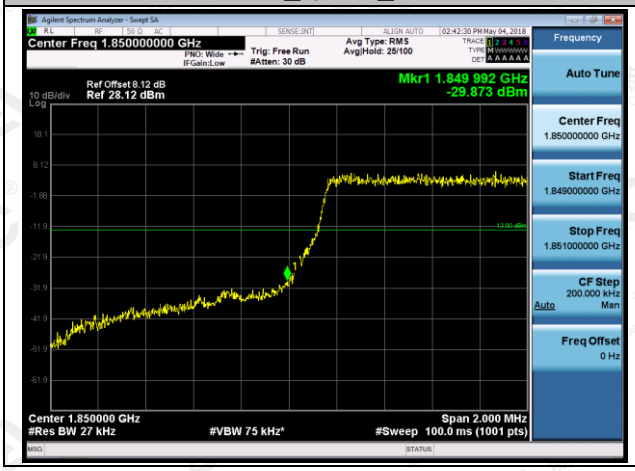
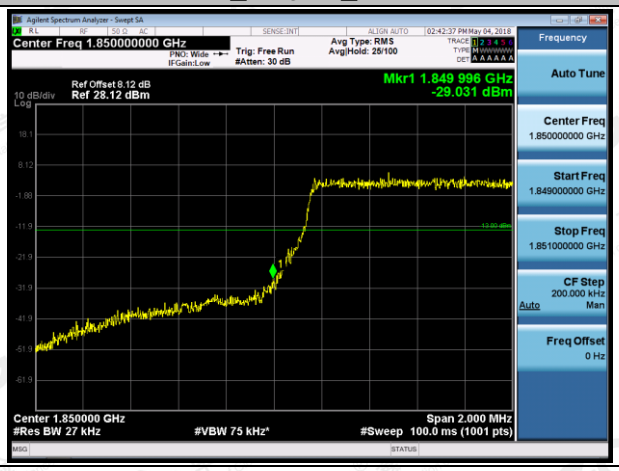
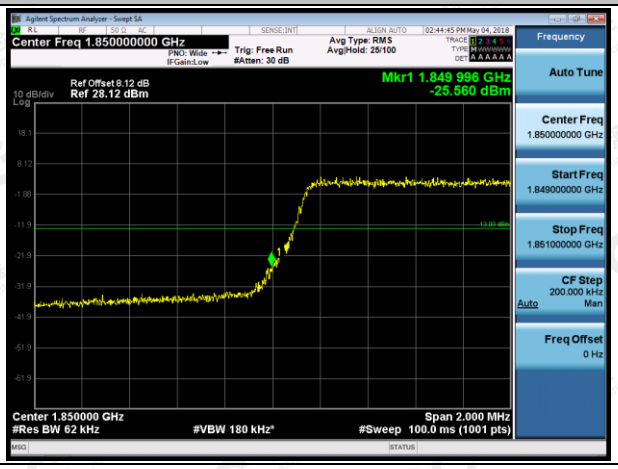
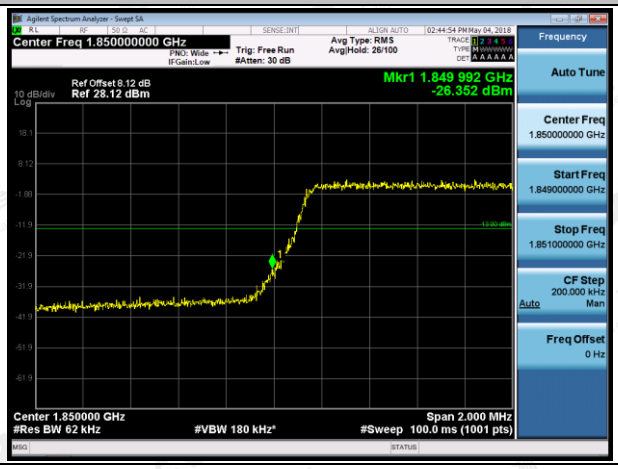
	

HCH_QPSK_6RB#0	HCH_16QAM_6RB#0
	

Channel Bandwidth: 3 MHz

LCH_QPSK_15RB#0	LCH_16QAM_15RB#0
	

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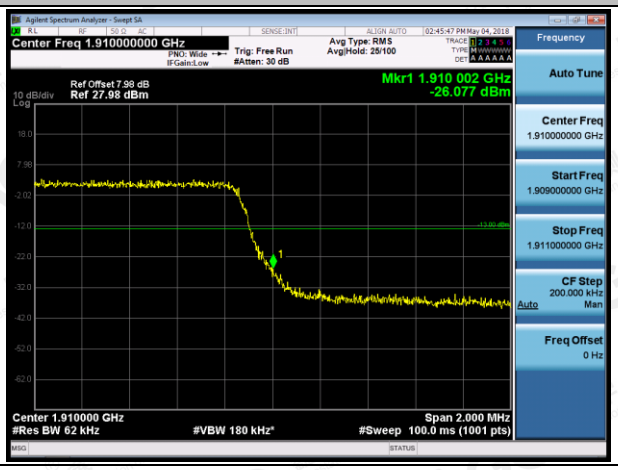
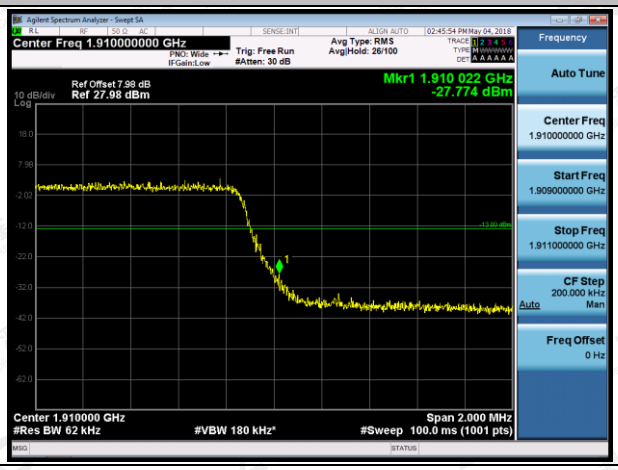
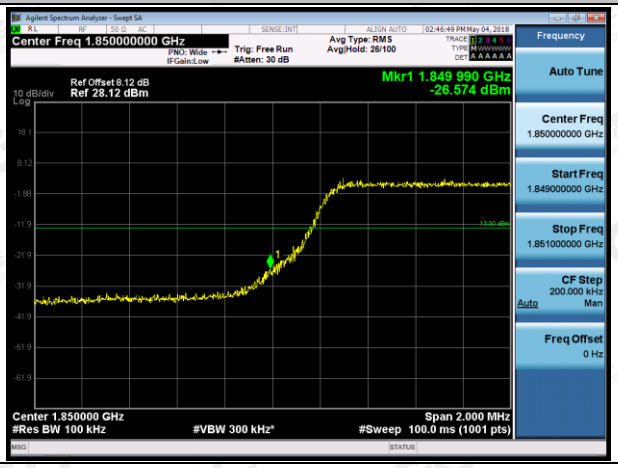
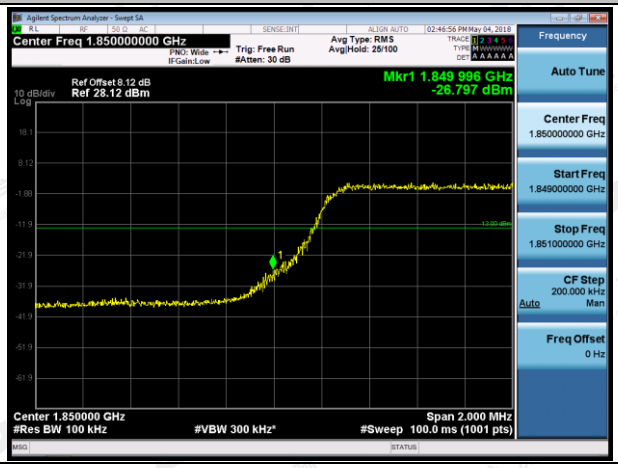
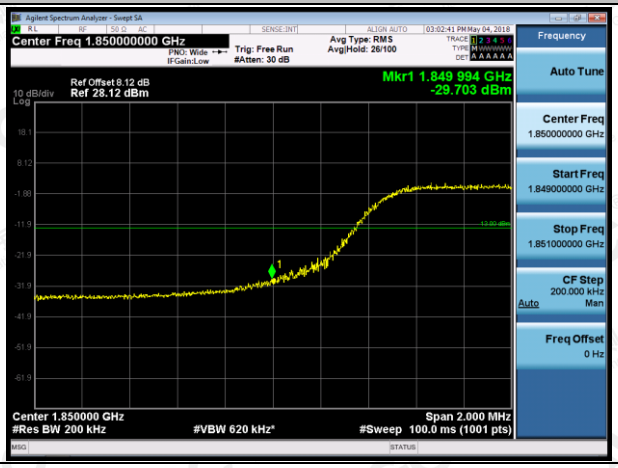
	

Channel Bandwidth: 5 MHz

LCH_QPSK_25RB#0	LCH_16QAM_25RB#0
	

HCH_QPSK_25RB#0	HCH_16QAM_25RB#0
	

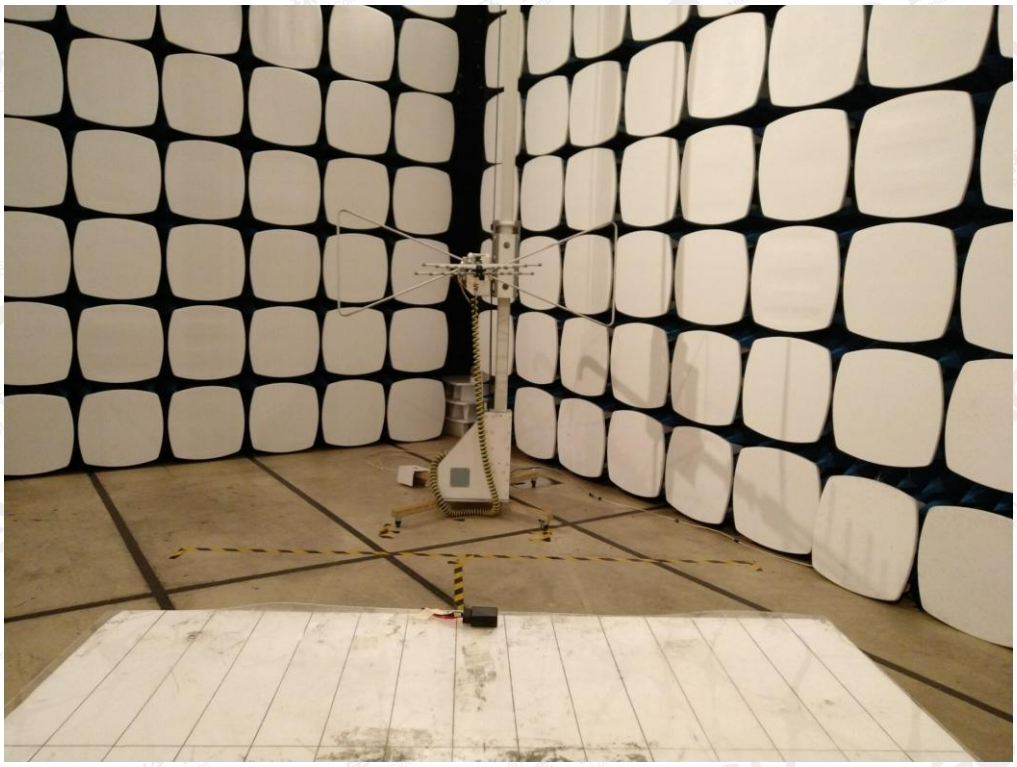
Channel Bandwidth: 10 MHz

LCH_QPSK_50RB#0	
	

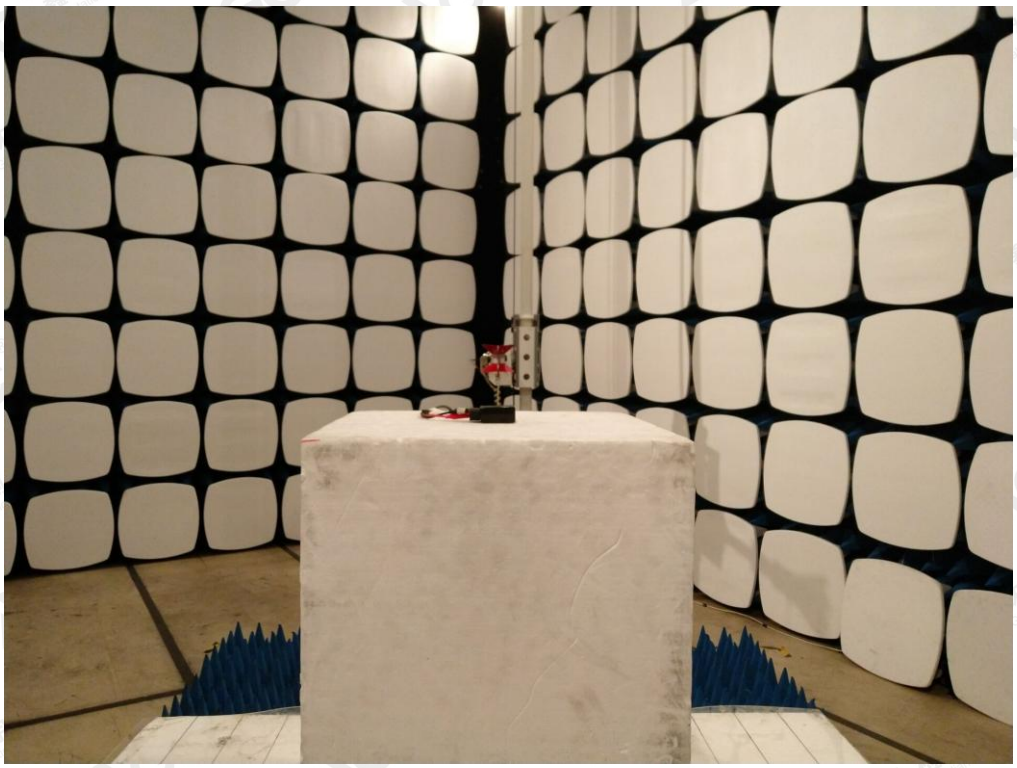
HCH_QPSK_50RB#0	
	

APPENDIX D PHOTOGRAPHS OF TEST SETUP

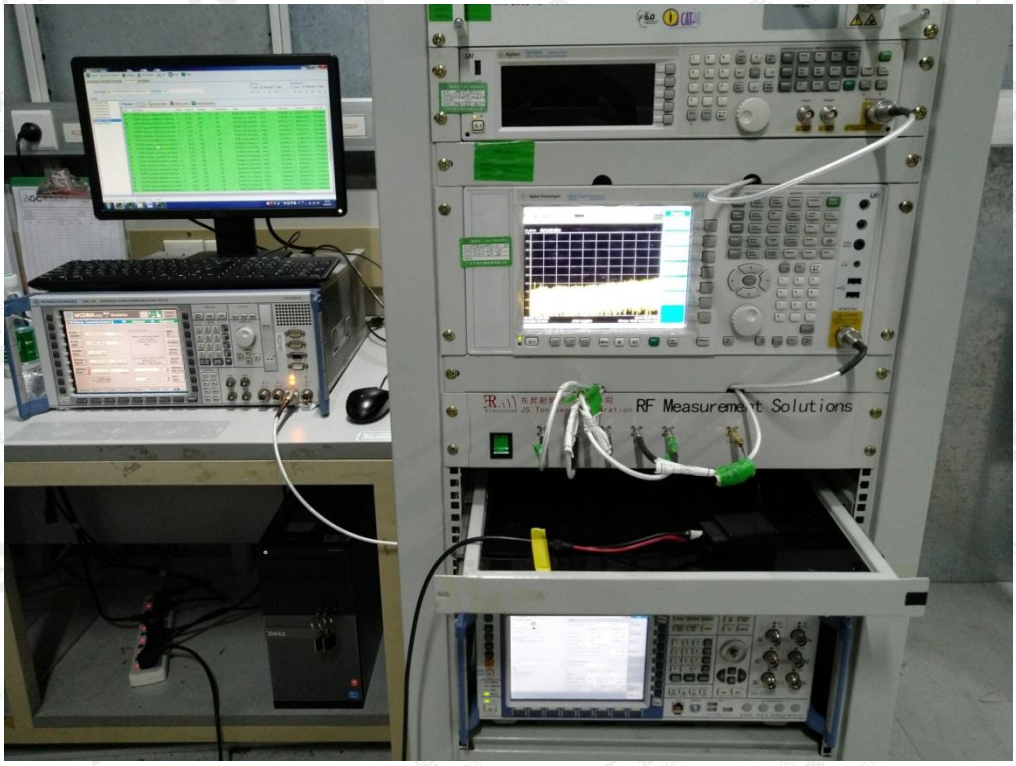
RADIATED SPURIOUS EMISSION



RADIATED SPURIOUS ABOVE 1G EMISSION



CONDUCTED MEASUREMENTS



----END OF REPORT----