5.5. Band Edge Compliance

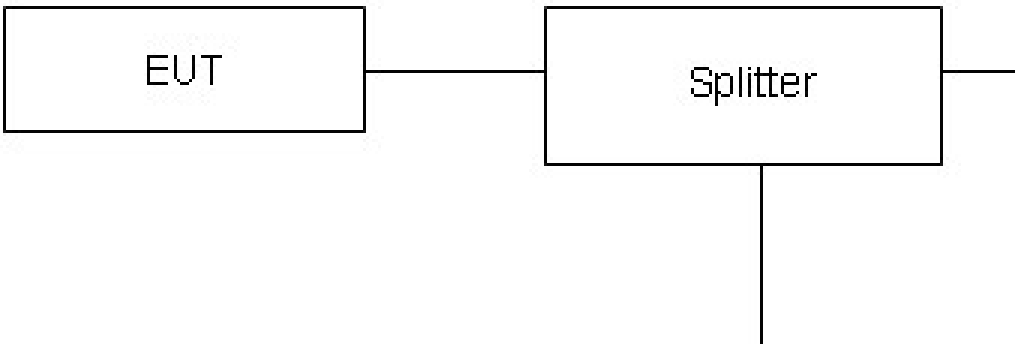
Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to Spectrum Analyzer and Base Station Simulator via power Splitter. The band edge of the lowest and highest channels were measured.
The testing follows KDB 971168 v03 Section 6.0
1.The EUT was connected to spectrum analyzer and system simulator via a power divider.
2. The band edges of low and high channels for the highest RF powers were measured.
RBW is set to 10kHz, VBW is set to 30 kHz for LTE Band 14 (769MHz~775MHz).
RBW is set to 100 kHz, VBW is set to 300kHz for LTE Band14 (775MHz~788MHz).
RBW is set to 10kHz, VBW is set to 30 kHz for LTE Band 14 (799MHz~805MHz).
3. Set spectrum analyzer with RMS detector.
4. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
5. Checked that all the results comply with the emission limit line.

Test Setup



Limits

90.543 Emission limitations (e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.

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(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

(f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 1.96, U=0.684dB.

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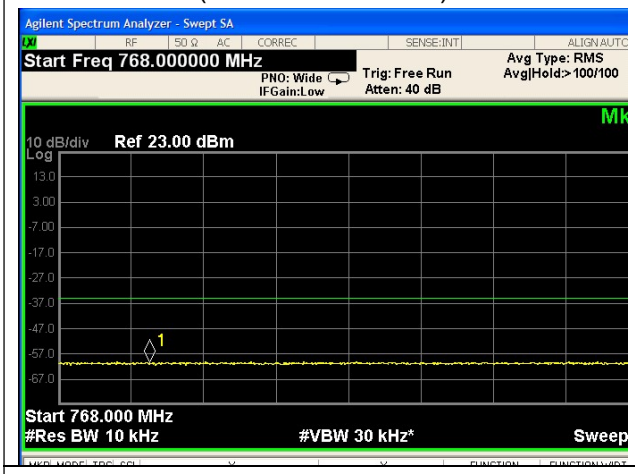
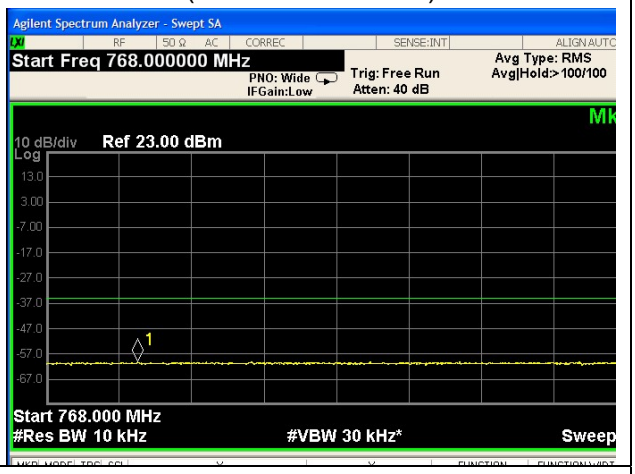
Test Result:

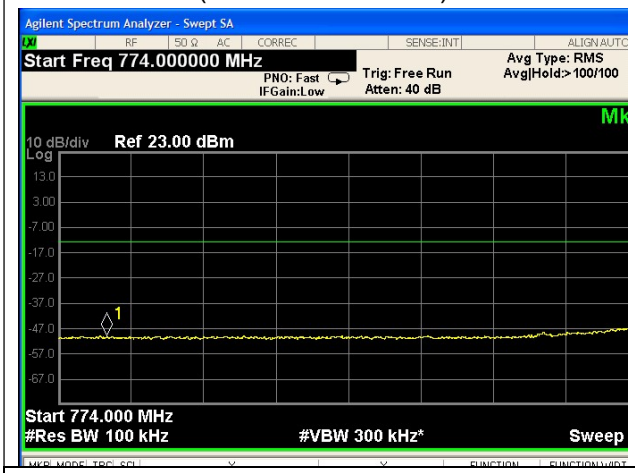
LTE Band 14 QPSK 5MHz 1 RB
(769MHz ~775MHz)



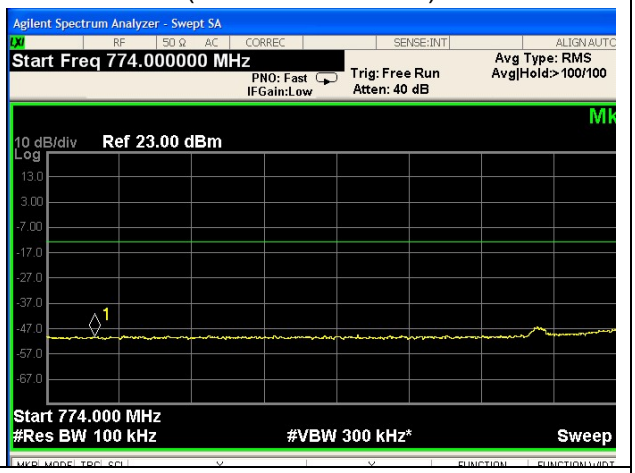
LTE Band 14 QPSK 10MHz 1 RB
(769MHz ~775MHz)



LTE Band 14 QPSK 5MHz 1 RB
(775MHz ~788MHz)



LTE Band 14 QPSK 10MHz 1 RB
(775MHz ~788MHz)



LTE Band 14 QPSK 5MHz 1 RB
(799MHz ~805MHz)

LTE Band 14 QPSK 10MHz 1 RB
(799MHz ~805MHz)

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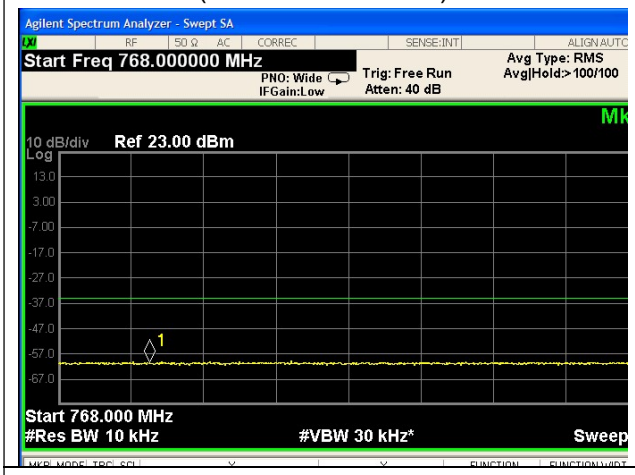
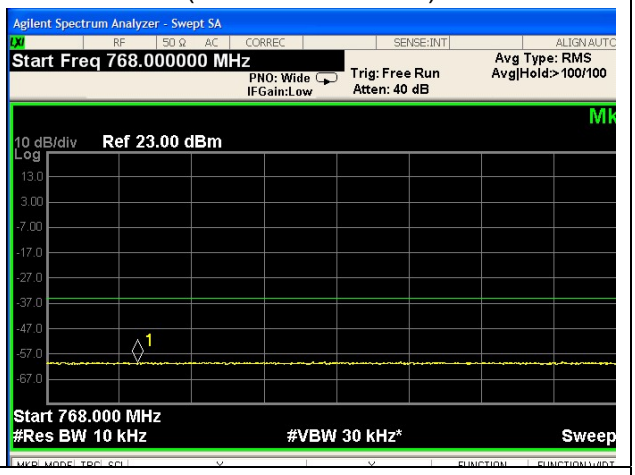
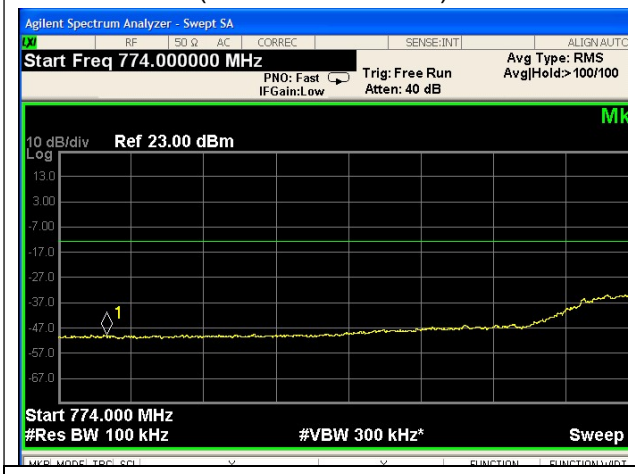
LTE Band 14 QPSK 5MHz 100%RB
(769MHz ~775MHz)



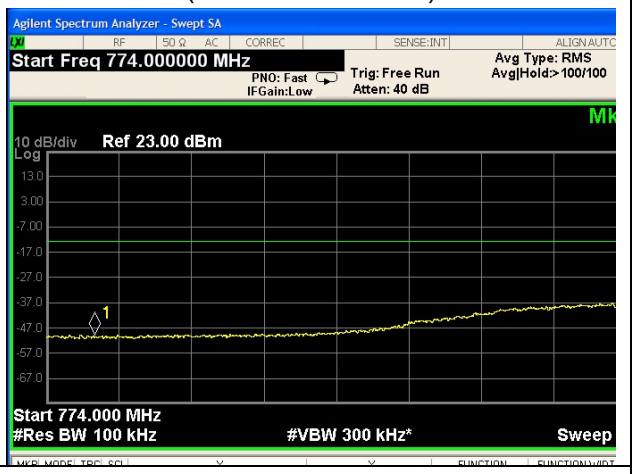
LTE Band 14 QPSK 10MHz 100%RB
(769MHz ~775MHz)



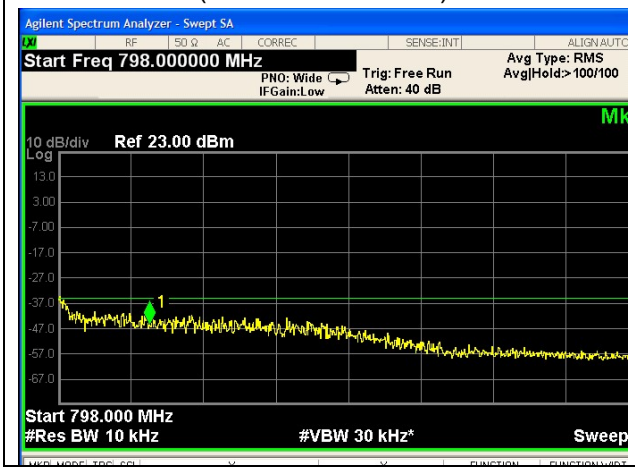
LTE Band 14 QPSK 5MHz 100%RB
(775MHz ~788MHz)



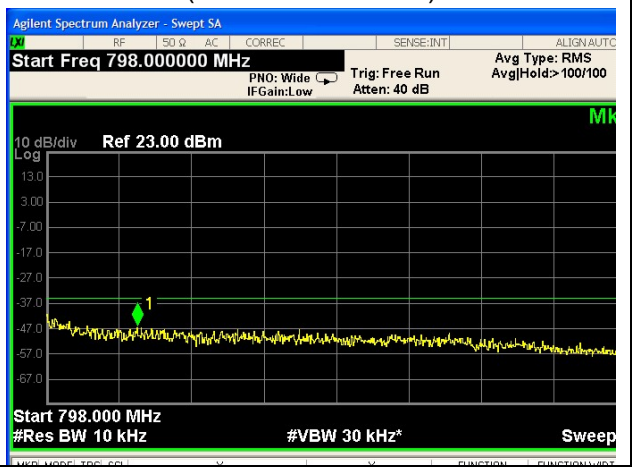
LTE Band 14 QPSK 10MHz 100%RB
(775MHz ~788MHz)



LTE Band 14 QPSK 5MHz 100%RB
(799MHz ~805MHz)



LTE Band 14 QPSK 10MHz 100%RB
(799MHz ~805MHz)



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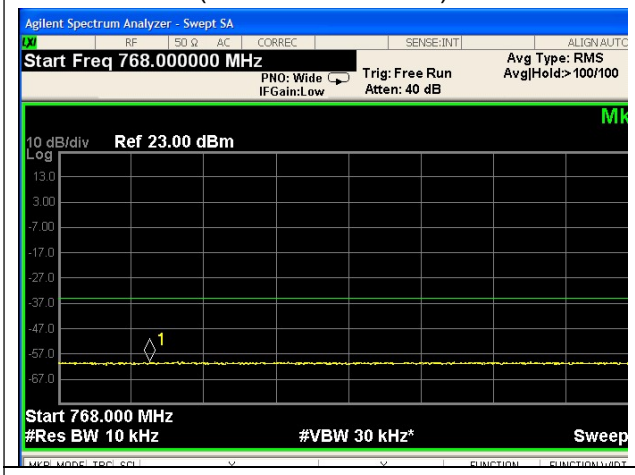
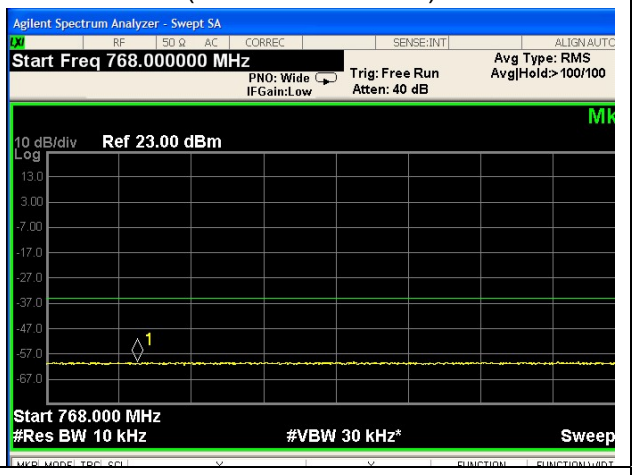
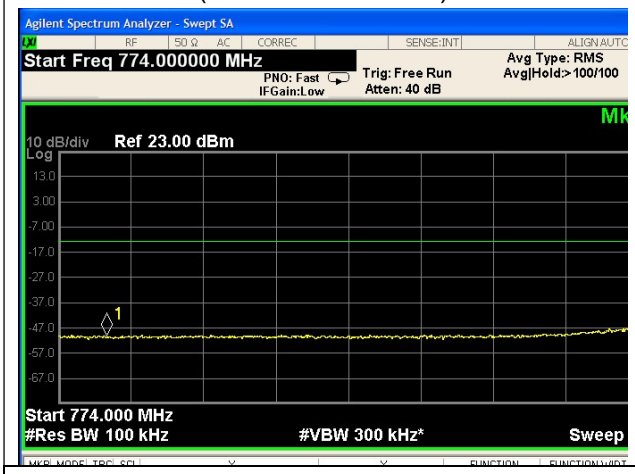
LTE Band 14 16QAM 5MHz 1 RB
(769MHz ~775MHz)



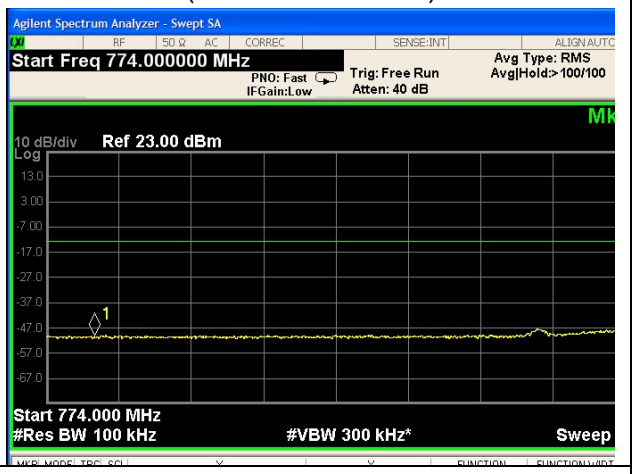
LTE Band 14 16QAM 10MHz 1 RB
(769MHz ~775MHz)



LTE Band 14 16QAM 5MHz 1 RB
(775MHz ~788MHz)

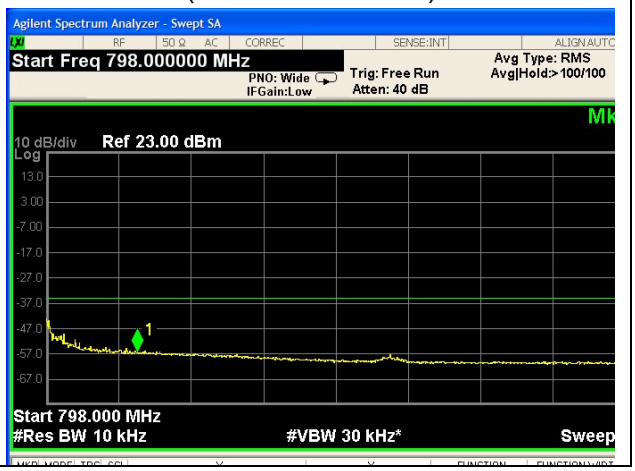


LTE Band 14 16QAM 10MHz 1 RB
(775MHz ~788MHz)



LTE Band 14 16QAM 5MHz 1 RB
(799MHz ~805MHz)

LTE Band 14 16QAM 10MHz 1 RB
(799MHz ~805MHz)



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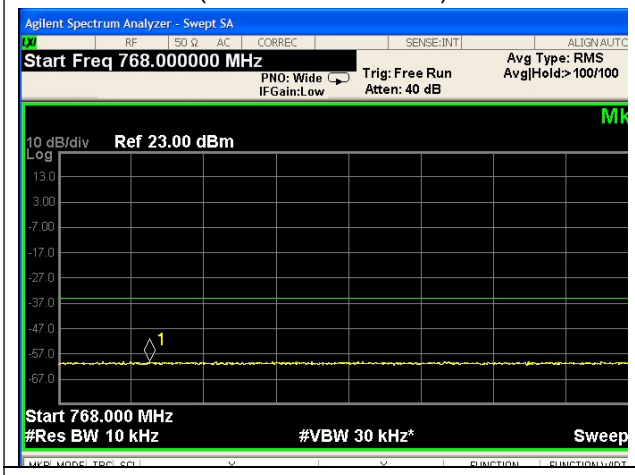
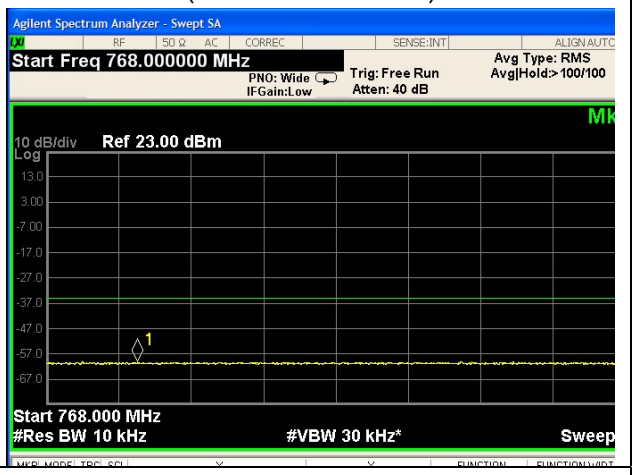
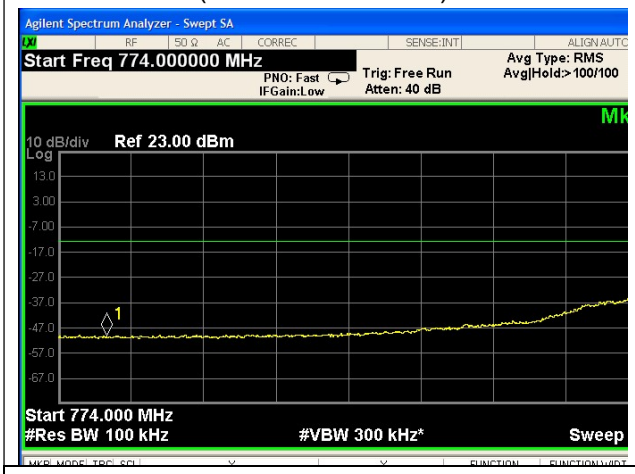
LTE Band 14 16QAM 5MHz 100%RB (769MHz ~775MHz)



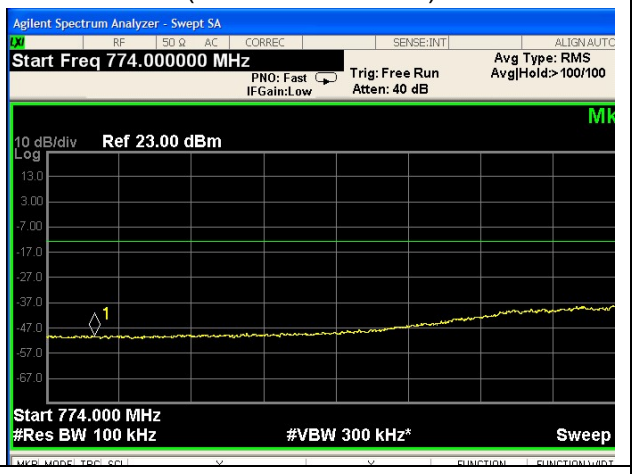
LTE Band 14 16QAM 10MHz 100%RB (769MHz ~775MHz)



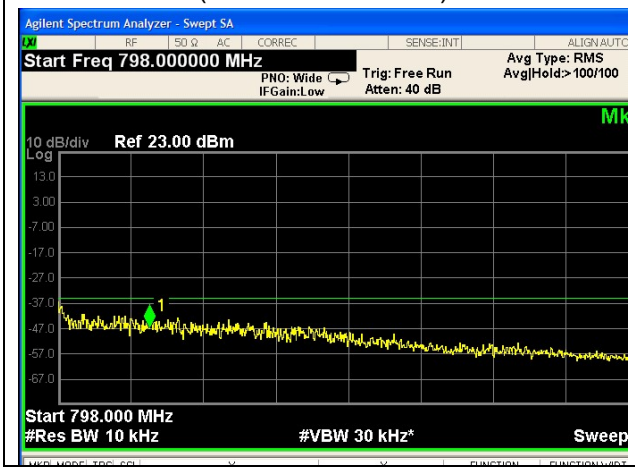
LTE Band 14 16QAM 5MHz 100%RB (775MHz ~788MHz)



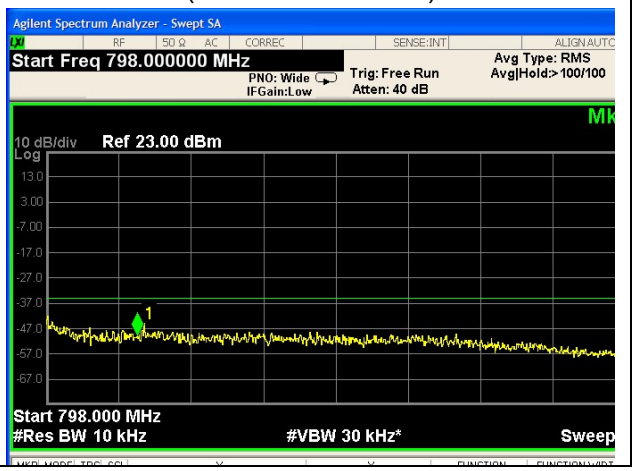
LTE Band 14 16QAM 10MHz 100%RB (775MHz ~788MHz)



LTE Band 14 16QAM 5MHz 100%RB (799MHz ~805MHz)



LTE Band 14 16QAM 10MHz 100%RB (799MHz ~805MHz)



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5.6. Peak-to-Average Power Ratio (PAPR)

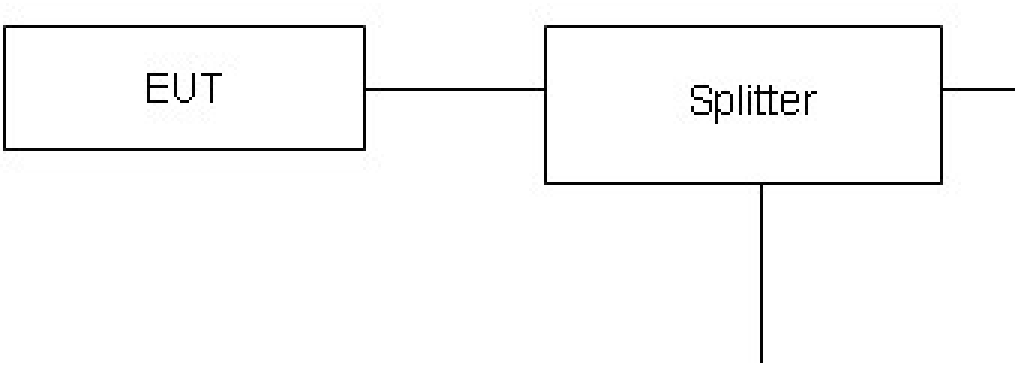
Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

Measure the total peak power and record as PPk. And measure the total average power and record as PAvg. Both the peak and average power levels must be expressed in the same logarithmic units (*e.g.*, dBm). Determine the PAPR from:
PAPR (dB) = PPk (dBm) - PAvg (dBm).

Test Setup



Limits

In measuring transmissions in this band using an average power technique, the peakto-average ratio (PAR) of the transmission may not exceed 13 dB in 24.232(d).

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 0.4 dB.

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Test Results

LTE Band 14								
Modulation	Bandwidth (MHz)	Channel	Frequency (MHz)	Peak (dBm)	Avg (dBm)	PAPR (dB)	Limit (dB)	Conclusion
QPSK	5	23305	790.5	28.02	22.89	5.13	≤13	PASS
		23330	793	27.70	22.76	4.94	≤13	PASS
		23355	795.5	27.46	22.73	4.73	≤13	PASS
	10	23330	793	27.69	22.83	4.86	≤13	PASS
16QAM	5	23305	790.5	27.73	21.77	5.96	≤13	PASS
		23330	793	27.48	21.73	5.75	≤13	PASS
		23355	795.5	27.23	21.69	5.54	≤13	PASS
	10	23330	793	27.45	21.77	5.68	≤13	PASS

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5.7. Frequency Stability

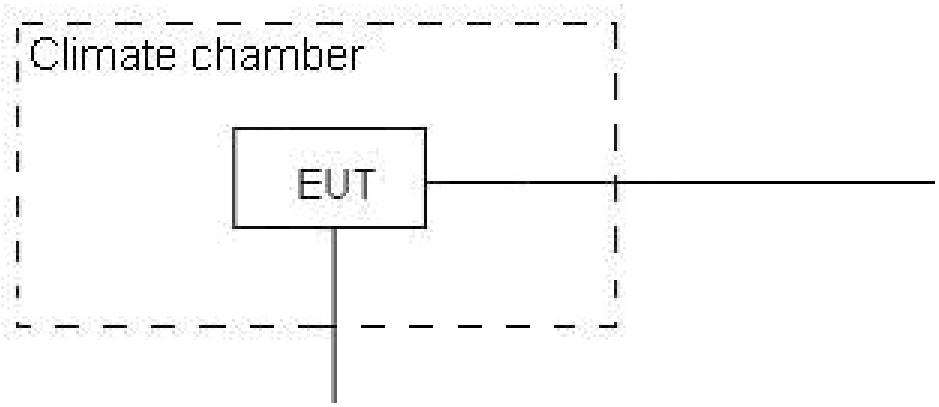
Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

1. Frequency Stability (Temperature Variation)
   The temperature inside the climate chamber is varied from -40°C to +85°C in 10°C step size,
   (1) With all power removed, the temperature was decreased to 0°C and permitted to stabilize for three hours.
   (2) Measure the carrier frequency with the test equipment in a “call mode”. These measurements should be made within 1 minute of powering up the mobile station, to prevent significant self warming.
   (3) Repeat the above measurements at 10°C increments from -40°C to +85°C. Allow at least 1.5 hours at each temperature, un-powered, before making measurements.
2. Frequency Stability (Voltage Variation)
   The frequency stability shall be measured with variation of primary supply voltage as follows:
   (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
   (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery-operating end point which shall be specified by the manufacturer.
   This transceiver is specified to operate with an input voltage of between 3.3 V and 4.3 V, with a nominal voltage of 3.8V.

Test setup



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Limits

90.539 (c) The frequency stability of mobile, portable, and control transmitters operating in the narrowband segment must be 400 parts per billion or better when AFC is locked to the base station. When AFC is not locked to the base station, the frequency stability must be at least 1.0 ppm for 6.25 kHz, 1.5 ppm for 12.5 kHz (2 channel aggregate), and 2.5 ppm for 25 kHz (4 channel aggregate).

Measurement Uncertainty

The assessed measurement uncertainty to ensure 99.75％ confidence level for the normal distribution is with the coverage factor k = 3,U= 0.01ppm.

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Test Result

LTE Band 14					
(QPSK, 10MHz BANDWIDTH)					
Condition		788	798	Delta (Hz)	Frequency Stability(ppm)
Temperature	Voltage	F low@-13dBm(MHz)	F high@-13dBm(MHz)		
Normal（25°C）	Normal	788.4918	797.5101	-2.28	-0.00322
Extreme（85°C）		788.4919	797.5131	-3.34	-0.00472
Extreme（80°C）		788.4928	797.5087	0.28	0.00040
Extreme（70°C）		788.4905	797.5102	3.65	0.00516
Extreme（60°C）		788.4905	797.5108	2.28	0.00322
Extreme（50°C）		788.4915	797.5104	-1.03	-0.00146
Extreme（40°C）		788.4930	797.5089	-3.51	-0.00496
Extreme（30°C）		788.4911	797.5108	-3.99	-0.00564
Extreme（20°C）		788.4908	797.5111	-4.47	-0.00632
Extreme（10C）		788.4923	797.5096	-6.77	-0.00957
Extreme（0°C）		788.4912	797.5107	3.04	0.00430
Extreme（-10°C）		788.4909	797.5116	0.71	0.00100
Extreme（-20°C）		788.4925	797.5094	-0.70	-0.00099
Extreme（-30°C）		788.4915	797.5104	-1.85	-0.00261
Extreme（-40°C）		788.4916	797.5103	-1.97	-0.00278
25°C	LV	788.4911	797.5108	-2.98	-0.00421
	HV	788.4917	797.5102	-6.40	-0.00905
(16QAM,10MHz BANDWIDTH)					
Condition		788	798	Delta (Hz)	Frequency Stability(ppm)
Temperature	Voltage	F low@-13dBm(MHz)	F high@-13dBm(MHz)		
Normal（25°C）	Normal	788.4932	797.5057	2.17	0.00307
Extreme（85°C）		788.4931	797.5056	1.02	0.00144
Extreme（80°C）		788.4926	797.5051	0.90	0.00127
Extreme（70°C）		788.4942	797.5067	-0.11	-0.00016
Extreme（60°C）		788.4947	797.5072	-3.53	-0.00499
Extreme（50°C）		788.4935	797.5062	-1.55	-0.00219
Extreme（40°C）		788.4920	797.5045	2.95	0.00417
Extreme（30°C）		788.4939	797.5064	2.20	0.00311
Extreme（20°C）		788.4942	797.5067	-5.42	-0.00766
Extreme（10C）		788.4927	797.5052	1.84	0.00260
Extreme（0°C）		788.4938	797.5063	3.15	0.00445
Extreme（-10°C）		788.4941	797.5066	-1.47	-0.00208
Extreme（-20°C）		788.4925	797.5051	0.23	0.00033
Extreme（-30°C）		788.4935	797.5062	0.02	0.00003

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Extreme（-40°C）		788.4934	797.5059	-3.47	-0.00490
25°C	LV	788.4939	797.5064	0.81	0.00114
	HV	788.4933	797.5058	-2.42	-0.00342

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5.8. Spurious Emissions at Antenna Terminals

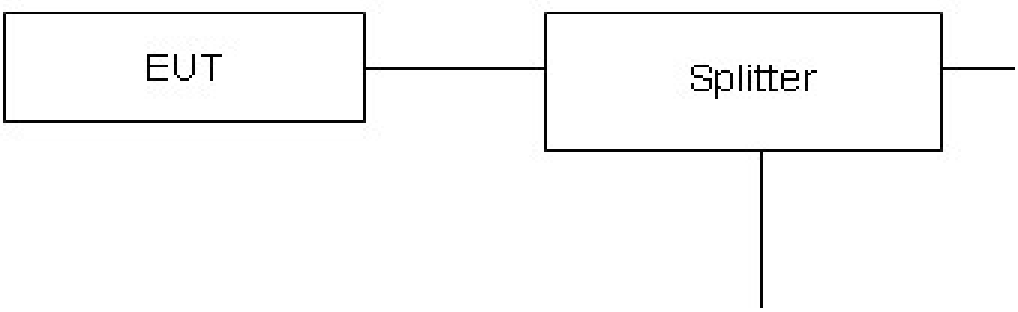
Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to Spectrum Analyzer and Base Station Simulator via power Splitter. The measurement is carried out using a spectrum analyzer. The spectrum analyzer scans from 9kHz to the 10th harmonic of the carrier. The peak detector is used.
RBW is set to 100kHz, VBW is set to 300kHz for 30MHz~1GHz
RBW is set to 1MHz, VBW is set to 3MHz for above 1GHz, Sweep is set to ATUO.
The modulation mode and RB allocation refer to section 5.1, using the maximum output power configuration.

Test setup



Limits

90.543 Emission limitations (e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.

(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

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(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

(f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 99.75% confidence level for the normal distribution is with the coverage factor *k* = 1.96.

Frequency	Uncertainty
9kHz-1GHz	0.684 dB
1GHz-10GHz	1.407 dB

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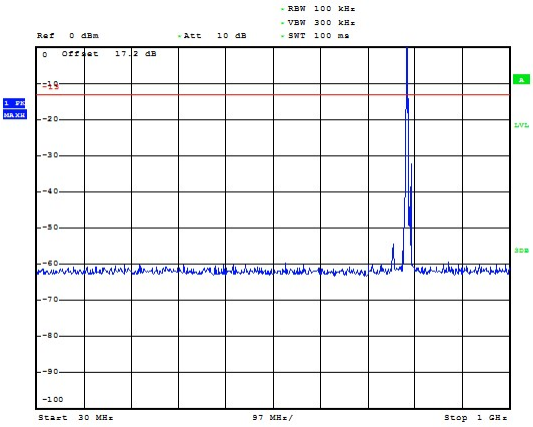
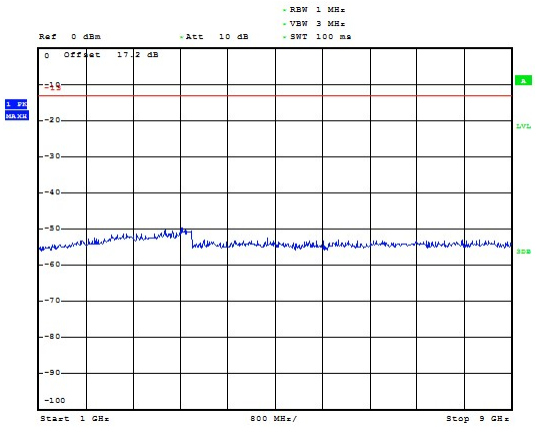
Test Result

If disturbances were found more than 20dB below limit line, the mark is not required for the EUT. The signal beyond the limit is carrier.

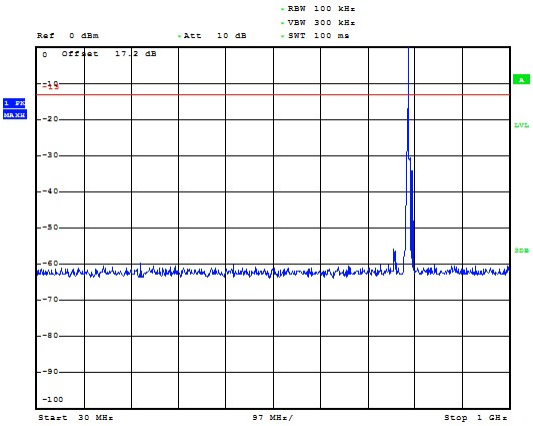
LTE Band 14 5MHz CH-Low 30MHz~1GHz



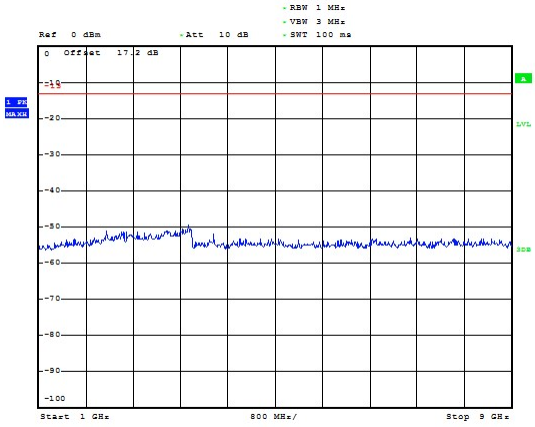
LTE Band 14 5MHz CH-Low 1GHz~9GHz



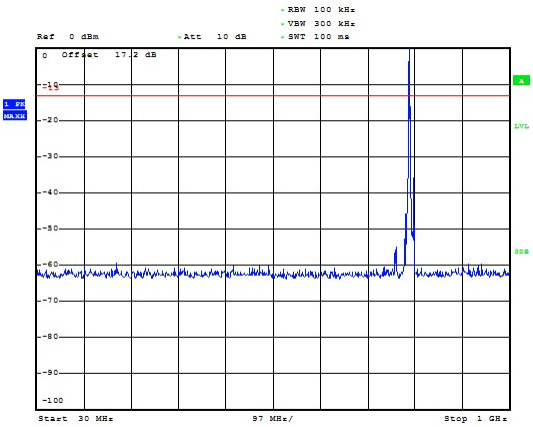
LTE Band 14 5MHz CH- Middle 30MHz~1GHz



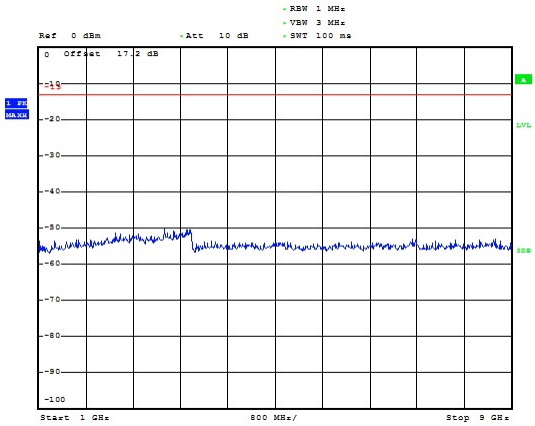
LTE Band 14 5MHz CH- Middle 1GHz~9GHz



LTE Band 14 5MHz CH-High 30MHz~1GHz



LTE Band 14 5MHz CH-High 1GHz~9GHz



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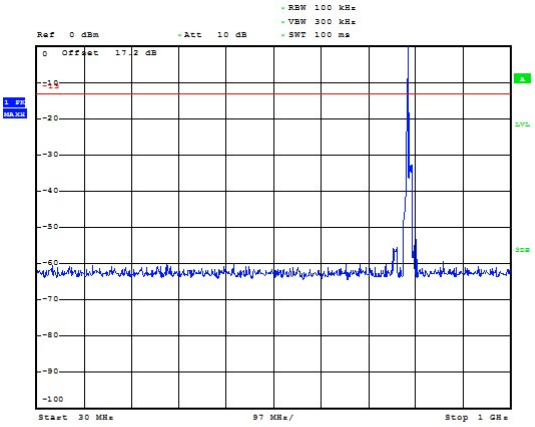
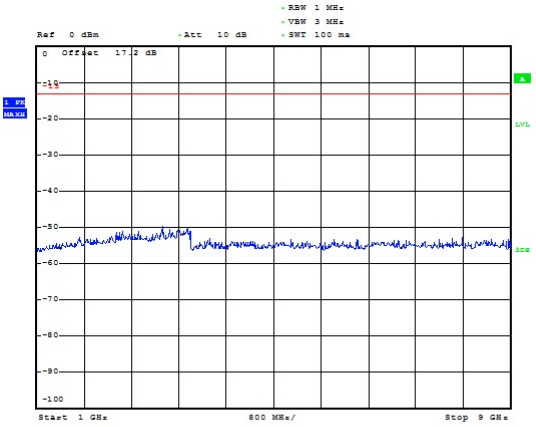
LTE Band 14 10MHz CH- Middle 30MHz~1GHz	LTE Band 14 10MHz CH- Middle 1GHz~9GHz
	

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5.9. Radiates Spurious Emission

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

1. The testing follows FCC KDB 971168 v03r01 Section 5.8 and ANSI C63.26 (2015).
2. The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).
3. A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
4. The EUT is then put into continuously transmitting mode at its maximum power level during the test.Set Test Receiver or Spectrum RBW=1MHz,VBW=3MHz, And the maximum value of the receiver should be recorded as (Pr).
5. The EUT shall be replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (PMea) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (Pr). The power of signal source (PMea) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
6. A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (Pcl) ,the Substitution Antenna Gain (Ga) and the Amplifier Gain (PAg) should be recorded after test.
7. The measurement results are obtained as described below:
Power(EIRP)=PMea- PAg - Pcl + Ga
The measurement results are amend as described below:
Power(EIRP)=PMea- Pcl + Ga
8. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP-2.15dBi.
The modulation mode and RB allocation refer to section 5.1, using the maximum output power configuration.

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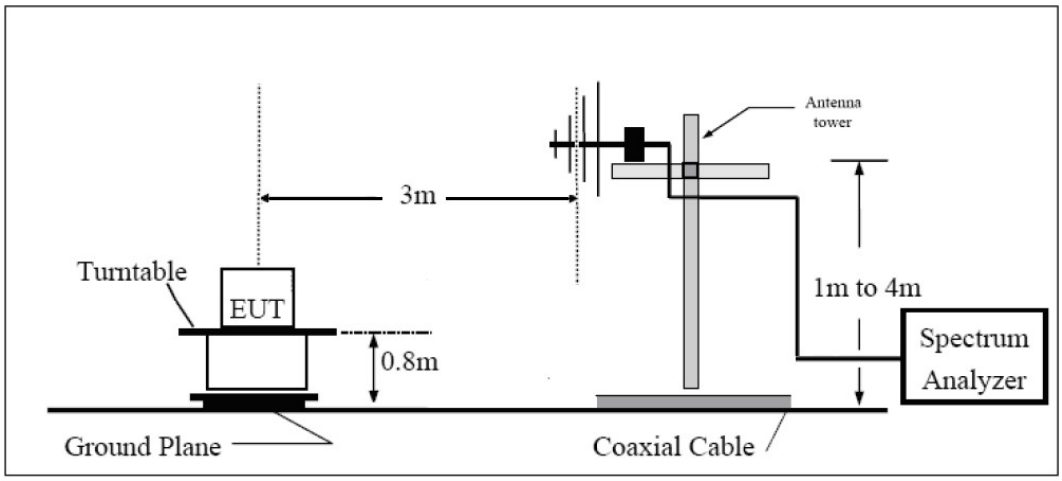
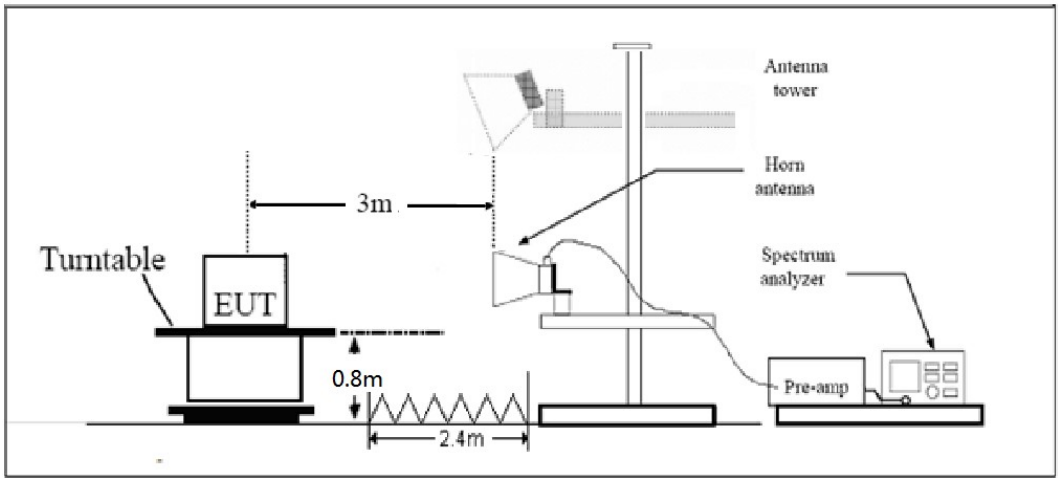
Test setup

30MHz~~~ 1GHz



Above 1GHz



Note: Area side:2.4mX3.6m

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in stand-up position (Z axis) and the worst case was recorded.

Limits

90.543 Emission limitations (e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.

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(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

(f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95％ confidence level for the normal distribution is with the coverage factor k = 1.96, U= 3.55 dB.

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Test Result

Sweep the whole frequency band through the range from 30MHz to the 10th harmonic of the carrier, the emissions below the noise floor will not be recorded in the report.

LTE Band 14 QPSK 5MHz CH-Middle, RB 1

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	ERP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	1582	-64.48	2.00	10.75	Horizontal	-57.88	-40.00	17.88	45
3	2379	-55.52	2.51	11.05	Horizontal	-49.13	-13.00	36.13	135
4	3172	-60.45	4.20	11.15	Horizontal	-55.65	-13.00	42.65	315
5	3965	-58.09	5.20	11.15	Horizontal	-54.29	-13.00	41.29	45
6	4758	-59.43	5.50	11.95	Horizontal	-55.13	-13.00	42.13	135
7	5551	-60.90	5.70	13.55	Horizontal	-55.20	-13.00	42.20	90
8	6344	-58.30	6.30	13.75	Horizontal	-53.00	-13.00	40.00	180
9	7137	-53.71	6.80	13.85	Horizontal	-48.81	-13.00	35.81	270
10	7930	-53.70	6.90	14.25	Horizontal	-48.50	-13.00	35.50	135

Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor.
2. The worst emission was found in the antenna is Horizontal position.

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6. Main Test Instruments

Name	Manufacturer	Type	Serial Number	Calibration Date	Expiration Date
Base Station Simulator	R&S	CMW500	113824	2019-05-19	2020-05-18
Power Splitter	Hua Xiang	SHX-GF2-2-13	10120101	/	/
Spectrum Analyzer	Key sight	N9010A	MY50210259	2019-05-19	2020-05-18
Universal Radio Communication Tester	Key sight	E5515C	MY48367192	2019-05-19	2020-05-18
Signal Analyzer	R&S	FSV30	100815	2018-12-16	2019-12-15
Loop Antenna	SCHWARZBECK	FMZB1519	1519-047	2017-09-26	2019-09-25
Trilog Antenna	SCHWARZBECK	VUBL 9163	9163-201	2017-11-18	2019-11-17
Horn Antenna	R&S	HF907	100126	2018-07-07	2020-07-06
Horn Antenna	ETS-Lindgren	3160-09	00102643	2018-06-20	2020-06-19
Signal generator	R&S	SMB 100A	102594	2019-05-19	2020-05-18
Climatic Chamber	ESPEC	SU-242	93000506	2017-12-17	2020-12-16
Preampflier	R&S	SCU18	102327	2019-05-19	2020-05-18
MOB COMMS DC SUPPLY	Keysight	66319D	MY43004105	2019-05-20	2020-05-21
RF Cable	Agilent	SMA 15cm	0001	2019-06-14	2019-09-13
Software	R&S	EMC32	9.26.0	/	/

*******END OF REPORT *******

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ANNEX A: The EUT Appearance

The EUT Appearance is submitted separately.

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ANNEX B: Test Setup Photos

The Test Setup Photos is submitted separately.

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ANNEX C: Product Change Description 1

Quectel Wireless Solutions Co., Ltd.

Statement

We, Quectel Wireless Solutions Co., Ltd, declare the following models as series application.

Name: LTE Module
Parent Model: EC25-AFX
Variant Model: EC25-AFXD, EC25-AFXD MINIPCIE

EC25-AFX, EC25-AFXD and EC25-AFXD MINIPCIE are all LTE modules. They use the same chipset, support same bands and share the same software & hardware design. The only difference is EC25-AFXD and EC25-AFXD MINIPCIE are data only modules which is configured by firmware based on EC25-AFX.

Following details are the difference of these modules.

Module	Frequency bands	Capability
EC25-AFX **EC25-AFX MINIPCIE**	FDD: B2/B4/B5/B12/B13/B14/B66/B71 WCDMA: B2/B4/B5	Cat.4 Data&Voice
EC25-AFXD **EC25-AFXD MINIPCIE**	FDD: B2/B4/B5/B12/B13/B14/B66/B71 WCDMA: B2/B4/B5	Cat.4 Data Only

Meanwhile, EC25-AFXD MINIPCIE makes up of EC25-AFXD module and PCIe carrier board. The carrier board switches EC25-AFXD module to follow PCI Express Mini Card 1.2 standard connector protocol. No any other internal changes in EC25-AFXD module. We hereby state that two models are identical in interior structure and components, and just connector interface is different for the marketing requirement.

Your assistance on this matter is highly appreciated.

Sincerely,
Name: Jean Hu Jean Hu
Title: Certification Section

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ANNEX D: Product Change Description 2

The Product Change Description are submitted separately.

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