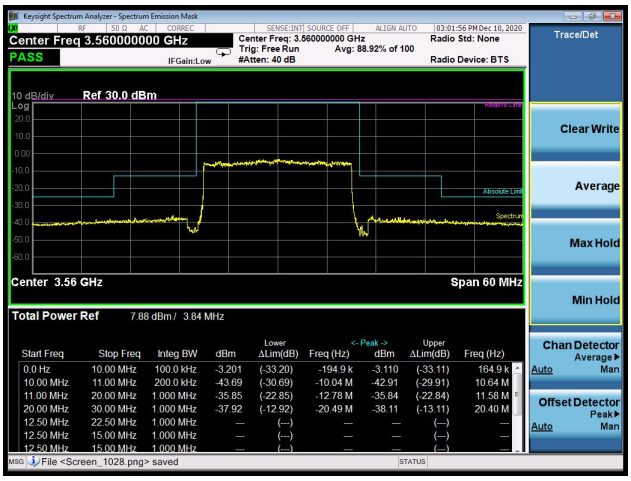
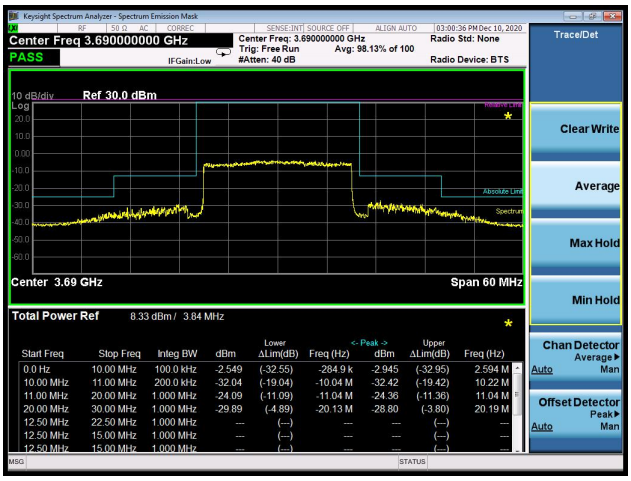
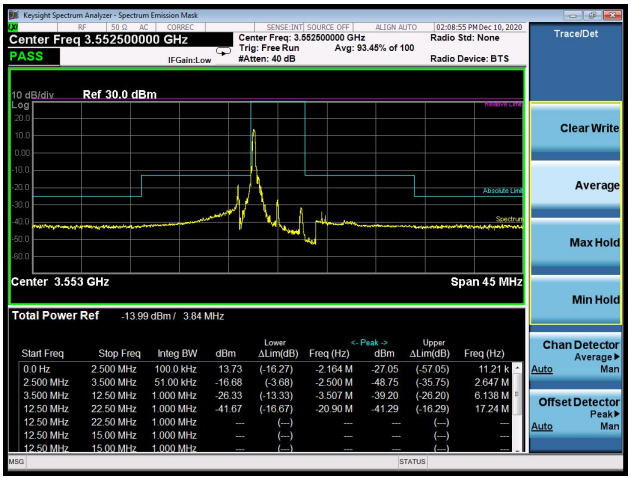
LTE Band 48 16QAM 20MHz CH-Low, 100%RB



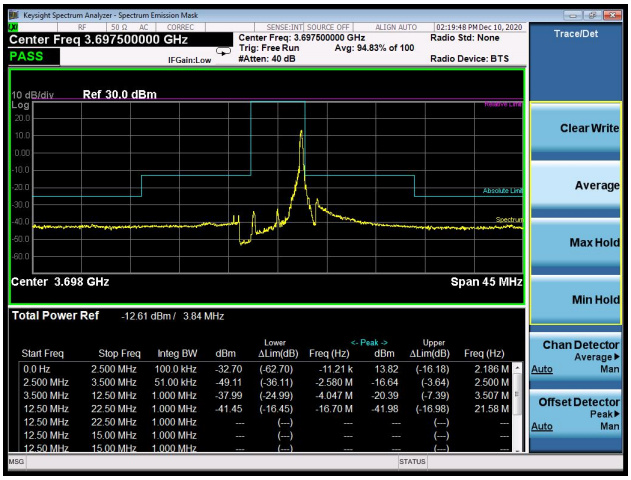
LTE Band 48 16QAM 20MHz CH-High, 100%RB



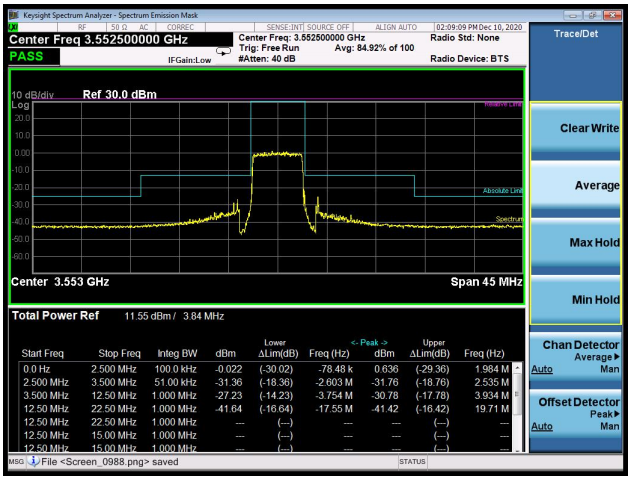
LTE Band 48 64QAM 5MHz CH-Low, 1 RB



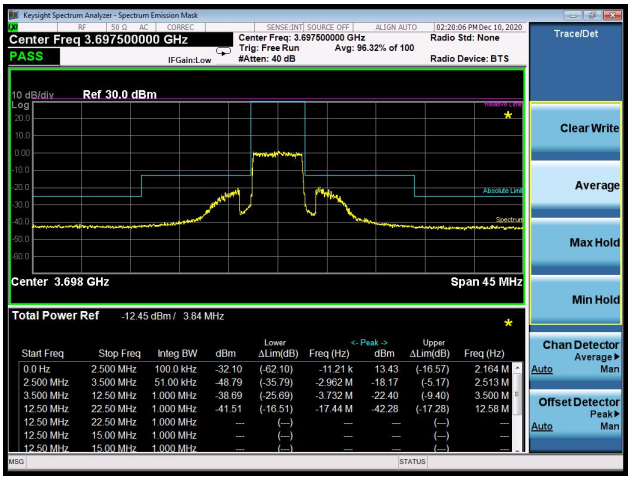
LTE Band 48 64QAM 5MHz CH-High, 1 RB



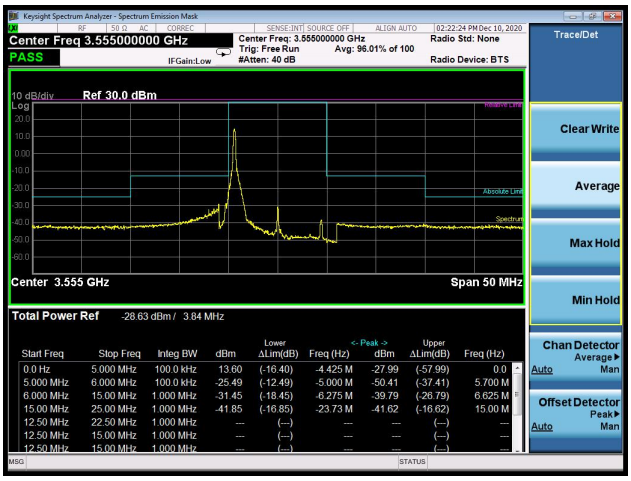
LTE Band 48 64QAM 5MHz CH-Low, 100%RB



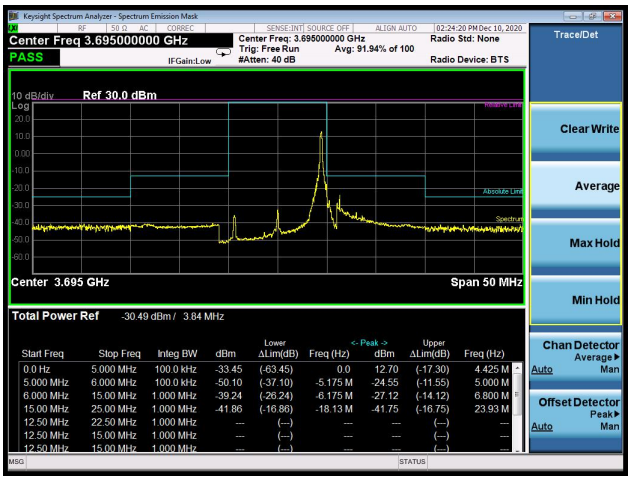
LTE Band 48 64QAM 5MHz CH-High, 100%RB



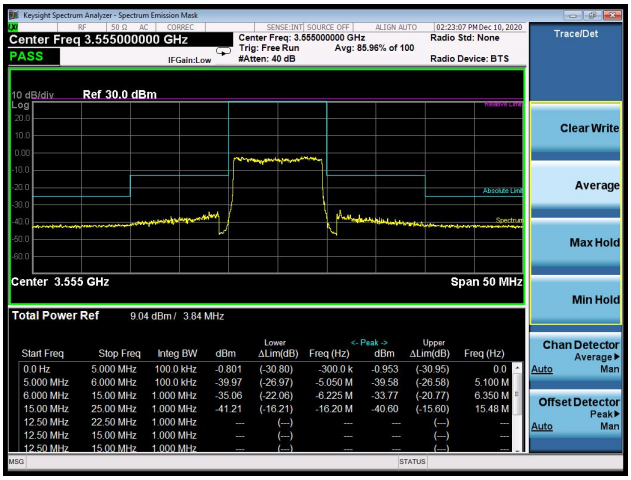
LTE Band 48 64QAM 10MHz CH-Low, 1 RB



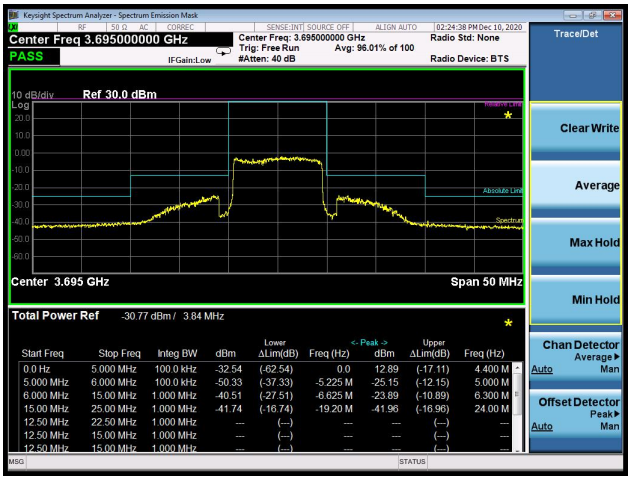
LTE Band 48 64QAM 10MHz CH-High, 1 RB



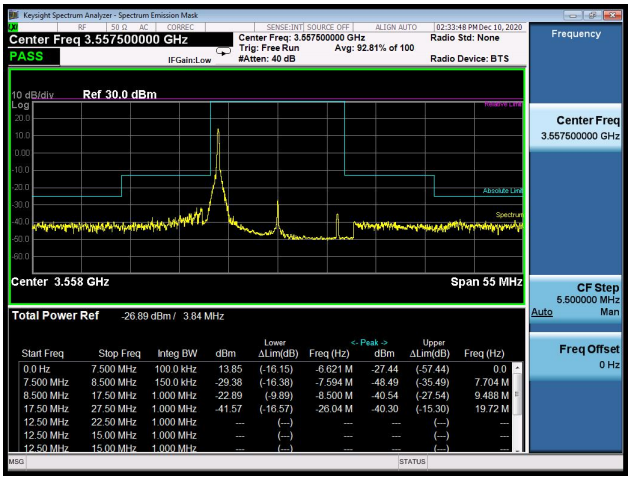
LTE Band 48 64QAM 10MHz CH-Low, 100%RB



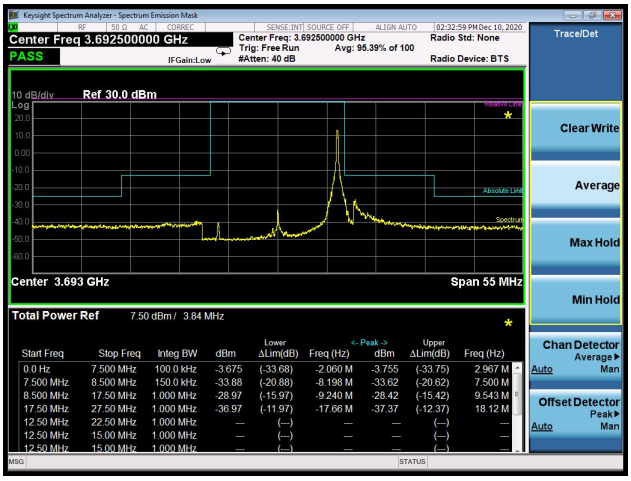
LTE Band 48 64QAM 10MHz CH-High, 100%RB



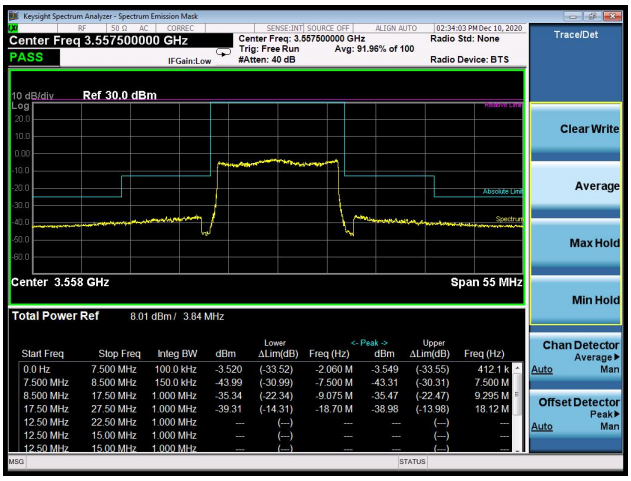
LTE Band 48 64QAM 15MHz CH-Low, 1 RB



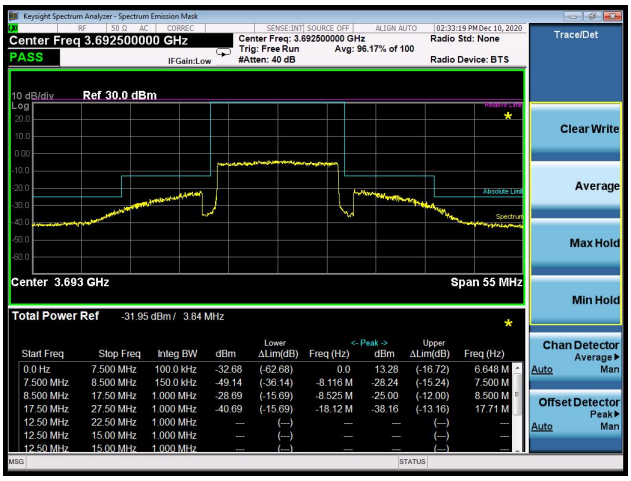
LTE Band 48 64QAM 15MHz CH-High, 1 RB



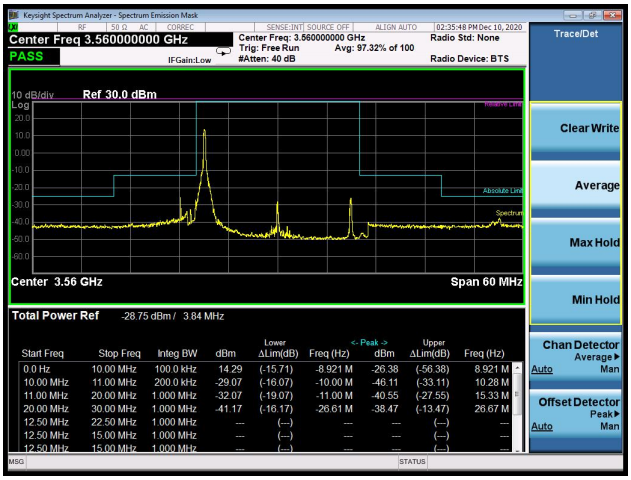
LTE Band 48 64QAM 15MHz CH-Low, 100%RB



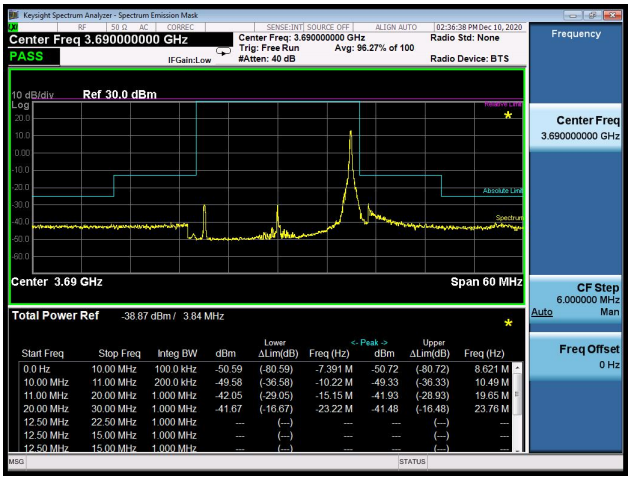
LTE Band 48 64QAM 15MHz CH-High, 100%RB



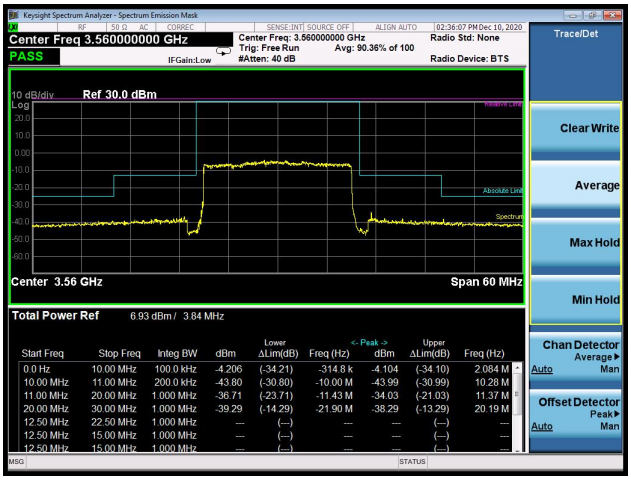
LTE Band 48 64QAM 20MHz CH-Low, 1 RB



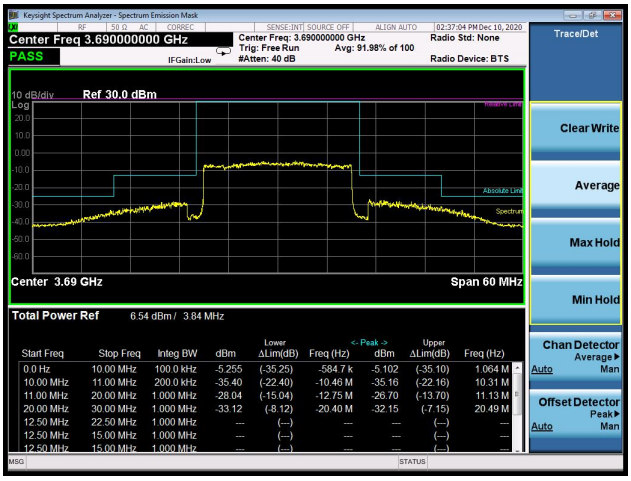
LTE Band 48 64QAM 20MHz CH-High, 1 RB



LTE Band 48 64QAM 20MHz CH-Low, 100%RB



LTE Band 48 64QAM 20MHz CH-High, 100%RB



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

Ambient condition

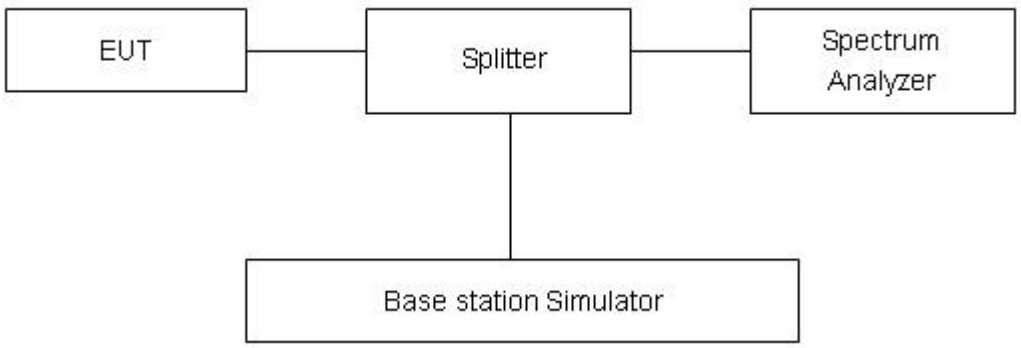
Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

Power Complementary Cumulative Distribution Function (CCDF) curves provide a means for characterizing the power peaks of a digitally modulated signal on a statistical basis. A CCDF curve depicts the probability of the peak signal amplitude exceeding the average power level. Most contemporary measurement instrumentation include the capability to produce CCDF curves for an input signal provided that the instrument's resolution bandwidth can be set wide enough to accommodate the entire input signal bandwidth.

The testing follows FCC KDB 971168 D01 v03r01 Section 5.7.1
1. The EUT was connected to spectrum and system simulator via a power divider.
2. Set the CCDF (Complementary Cumulative Distribution Function) option in spectrum analyzer.
3. The highest RF powers were measured and recorded the maximum PAPR level associated with a probability of 0.1 %.
4. Record the deviation as Peak to Average Ratio

Test Setup



Limits

Rule Part 96.41(g), The peak-to-average power ratio (PAPR) of any CBSD transmitter output power must not exceed 13 dB.

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.

Test Results

LTE Band 48								
Modulation	Bandwidth (MHz)	Channel	Frequency (MHz)	Peak (dBm)	Avg (dBm)	PAPR (dB)	Limit (dB)	Conclusion
QPSK	5	55265	3552.5	25.46	16.70	8.76	≤13	PASS
		55990	3625	25.03	16.66	8.37	≤13	PASS
		56715	3697.5	24.23	15.44	8.79	≤13	PASS
	10	55290	3555	25.19	16.75	8.44	≤13	PASS
		55990	3625	24.79	15.81	8.98	≤13	PASS
		56690	3695	24.14	15.89	8.25	≤13	PASS
	15	55315	3557.5	25.31	16.56	8.75	≤13	PASS
		55990	3625	24.87	15.90	8.97	≤13	PASS
		56665	3692.5	24.34	16.06	8.28	≤13	PASS
	20	55340	3560	25.26	16.21	9.05	≤13	PASS
		55990	3625	24.84	16.36	8.48	≤13	PASS
		5660	3690	24.21	15.11	9.10	≤13	PASS
16QAM	5	55265	3552.5	25.10	15.37	9.73	≤13	PASS
		55990	3625	24.51	15.15	9.36	≤13	PASS
		56715	3697.5	24.13	15.45	8.68	≤13	PASS
	10	55290	3555	24.91	15.49	9.42	≤13	PASS
		55990	3625	24.35	14.91	9.44	≤13	PASS
		56690	3695	23.97	14.63	9.34	≤13	PASS
	15	55315	3557.5	24.99	15.64	9.35	≤13	PASS
		55990	3625	24.38	15.14	9.24	≤13	PASS
		56665	3692.5	24.10	14.91	9.19	≤13	PASS
	20	55340	3560	24.92	15.30	9.62	≤13	PASS
		55990	3625	24.33	15.05	9.28	≤13	PASS
		5660	3690	24.01	14.54	9.47	≤13	PASS
64QAM	5	55265	3552.5	24.42	14.76	9.66	≤13	PASS
		55990	3625	24.02	14.45	9.57	≤13	PASS
		56715	3697.5	23.73	14.13	9.60	≤13	PASS
	10	55290	3555	24.20	14.85	9.35	≤13	PASS
		55990	3625	23.85	14.25	9.60	≤13	PASS
		56690	3695	23.54	14.08	9.46	≤13	PASS

	15	55315	3557.5	24.32	15.02	9.30	≤13	PASS
		55990	3625	23.87	14.50	9.37	≤13	PASS
		56665	3692.5	23.59	13.90	9.69	≤13	PASS
	20	55340	3560	24.22	14.49	9.73	≤13	PASS
		55990	3625	23.78	14.28	9.50	≤13	PASS
		5660	3690	23.48	13.89	9.59	≤13	PASS

5.6. Frequency Stability

Ambient condition

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

Method of Measurement

Test Procedures for Temperature Variation

The testing follows FCC KDB 971168 D01 v03r01 Section 9.0.

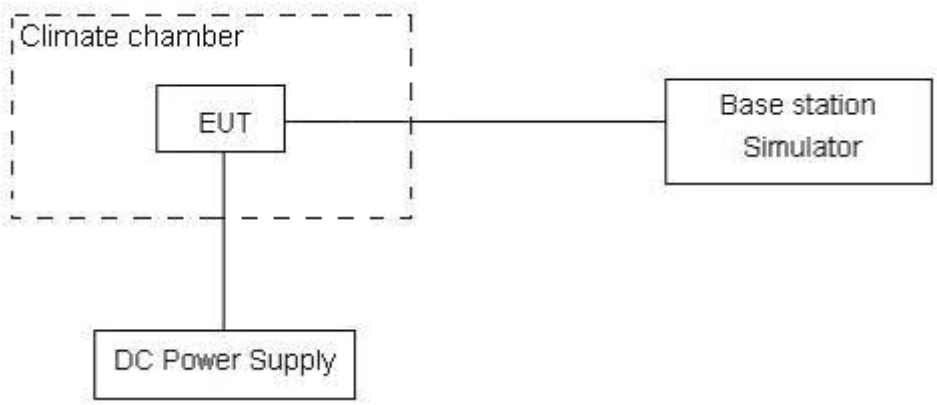
1. The EUT was set up in the thermal chamber and connected with the system simulator.
2. With power OFF, the temperature was decreased to -30°C and the EUT was stabilized before testing. Power was applied and the maximum change in frequency was recorded within one minute.
3. With power OFF, the temperature was raised in 10°C step up to 50°C. The EUT was stabilized at each step for at least half an hour. Power was applied and the maximum frequency change was recorded within one minute.

Test Procedures for Voltage Variation

The testing follows FCC KDB 971168 D01 v03r01 Section 9.0.

1. The EUT was placed in a temperature chamber at 25±5° C and connected with the system simulator.
2. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value measured at the input to the EUT.
3. The variation in frequency was measured for the worst case.

Test setup



Limits

The frequency stability shall be measured by variation of ambient temperature and variation of primary supply voltage to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within ±0.00025% (±2.5ppm) of the center frequency

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.

Test Result

LTE Band 48								
Condition		Freq.Error (Hz)	Freq.Error (Hz)	Freq.Error (Hz)	Frequency Stability （ppm）	Frequency Stability （ppm）	Frequency Stability （ppm）	Verdict
BANDWIDTH	5MHz							
Temperature	Voltage	64QAM	16QAM	QPSK	64QAM	16QAM	QPSK	
Normal（25℃）	Normal	16.79	8.77	12.88	0.00893	0.00467	0.00685	PASS
Extreme（50℃）		13.58	4.07	1.09	0.00722	0.00216	0.00058	PASS
Extreme（40℃）		6.88	6.54	15.81	0.00366	0.00348	0.00841	PASS
Extreme（30℃）		8.34	7.91	5.13	0.00444	0.00421	0.00273	PASS
Extreme（20℃）		12.02	15.55	8.74	0.00639	0.00827	0.00465	PASS
Extreme（10℃）		4.42	17.78	2.06	0.00235	0.00946	0.00110	PASS
Extreme（0℃）		11.02	6.48	1.22	0.00586	0.00345	0.00065	PASS
Extreme（-10℃）		8.85	15.38	9.32	0.00471	0.00818	0.00496	PASS
Extreme（-20℃）		2.58	16.50	2.84	0.00137	0.00878	0.00151	PASS
Extreme（-30℃）		17.59	3.90	5.55	0.00936	0.00208	0.00295	PASS
25℃	LV	6.69	4.88	6.44	0.00356	0.00260	0.00343	PASS
	HV	12.67	15.41	5.47	0.00674	0.00820	0.00291	PASS
Condition		Freq.Error (Hz)	Freq.Error (Hz)	Freq.Error (Hz)	Frequency Stability （ppm）	Frequency Stability （ppm）	Frequency Stability （ppm）	Verdict
BANDWIDTH	10MHz							
Temperature	Voltage	64QAM	16QAM	QPSK	64QAM	16QAM	QPSK	
Normal（25℃）	Normal	1.71	4.38	13.45	0.00091	0.00233	0.00716	PASS
Extreme（50℃）		12.72	10.56	15.15	0.00677	0.00562	0.00806	PASS
Extreme（40℃）		6.97	6.17	15.70	0.00371	0.00328	0.00835	PASS
Extreme（30℃）		2.80	5.25	12.63	0.00149	0.00280	0.00672	PASS
Extreme（20℃）		11.48	3.95	15.47	0.00611	0.00210	0.00823	PASS
Extreme（10℃）		12.96	14.77	6.47	0.00689	0.00786	0.00344	PASS
Extreme（0℃）		9.52	15.29	8.65	0.00507	0.00813	0.00460	PASS
Extreme（-10℃）		12.15	1.53	13.03	0.00646	0.00082	0.00693	PASS
Extreme（-20℃）		12.66	7.10	12.97	0.00673	0.00378	0.00690	PASS
Extreme（-30℃）		17.09	6.98	3.15	0.00909	0.00371	0.00168	PASS
25℃	LV	12.71	11.46	13.97	0.00676	0.00610	0.00743	PASS
	HV	7.13	10.87	10.78	0.00379	0.00578	0.00573	PASS
Condition		Freq.Error (Hz)	Freq.Error (Hz)	Freq.Error (Hz)	Frequency Stability （ppm）	Frequency Stability （ppm）	Frequency Stability （ppm）	Verdict
BANDWIDTH	15MHz							
Temperature	Voltage	64QAM	16QAM	QPSK	64QAM	16QAM	QPSK	
Normal（25℃）	Normal	7.41	15.78	1.09	0.00394	0.00839	0.00058	PASS
Extreme（50℃）		13.53	11.32	11.70	0.00720	0.00602	0.00622	PASS

Extreme（40℃）		14.37	14.58	14.79	0.00764	0.00775	0.00787	PASS
Extreme（30℃）		15.22	12.30	4.99	0.00810	0.00654	0.00265	PASS
Extreme（20℃）		1.16	12.72	6.13	0.00062	0.00677	0.00326	PASS
Extreme（10℃）		12.97	12.61	15.00	0.00690	0.00671	0.00798	PASS
Extreme（0℃）		17.43	9.79	12.19	0.00927	0.00521	0.00649	PASS
Extreme（-10℃）		17.88	8.23	1.69	0.00951	0.00438	0.00090	PASS
Extreme（-20℃）		5.57	3.24	13.74	0.00297	0.00172	0.00731	PASS
Extreme（-30℃）		15.08	5.09	16.02	0.00802	0.00271	0.00852	PASS
25℃	LV	14.55	17.23	5.20	0.00774	0.00916	0.00277	PASS
	HV	1.77	6.27	10.88	0.00094	0.00333	0.00579	PASS
Condition		Freq.Error (Hz)	Freq.Error (Hz)	Freq.Error (Hz)	Frequency Stability（ppm）	Frequency Stability（ppm）	Frequency Stability（ppm）	Verdict
BANDWIDTH	20MHz							
Temperature	Voltage	64QAM	16QAM	QPSK	64QAM	16QAM	QPSK	
Normal（25℃）	Normal	1.35	7.36	16.80	0.00072	0.00391	0.00894	PASS
Extreme（50℃）		14.97	5.61	1.99	0.00796	0.00299	0.00106	PASS
Extreme（40℃）		3.63	13.68	1.71	0.00193	0.00728	0.00091	PASS
Extreme（30℃）		2.42	17.54	2.60	0.00129	0.00933	0.00138	PASS
Extreme（20℃）		17.88	11.69	10.95	0.00951	0.00622	0.00582	PASS
Extreme（10℃）		13.96	8.25	15.03	0.00743	0.00439	0.00799	PASS
Extreme（0℃）		15.63	13.97	13.07	0.00831	0.00743	0.00695	PASS
Extreme（-10℃）		12.30	7.64	13.76	0.00654	0.00406	0.00732	PASS
Extreme（-20℃）		12.61	17.93	12.70	0.00671	0.00954	0.00676	PASS
Extreme（-30℃）		10.11	16.51	3.99	0.00538	0.00878	0.00212	PASS
25℃	LV	11.76	5.44	17.72	0.00625	0.00289	0.00943	PASS
	HV	1.61	10.68	1.30	0.00085	0.00568	0.00069	PASS

5.7. Spurious Emissions at Antenna Terminals

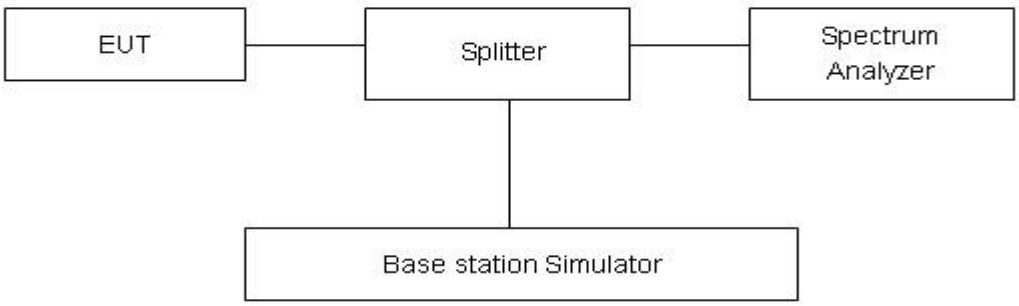
Ambient condition

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

Method of Measurement

The testing follows FCC KDB 971168 D01 v03r01 Section 6.0.
1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.
The path loss was compensated to the results for each measurement.
3. The middle channel for the highest RF power within the transmitting frequency was measured.
4. The conducted spurious emission for the whole frequency range was taken.
5. Make the measurement with the spectrum analyzer's
RBW is set to 1 kHz (0.009MHz~ 0.15 MHz),
RBW is set to 10 kHz (0.15 MHz~ 30 MHz)
RBW is set to 100 kHz (30MHz~1000 MHz)
RBW is set to 1000 kHz (above 1000MHz).
6. Set spectrum analyzer with RMS detector.
7. Taking the record of maximum spurious emission.
8. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
9. The limit line is −40dBm/MHz.

Test setup



Limits

Rule Part 96.41(e) (2) *Additional protection levels.* Notwithstanding paragraph (e)(1) of this section, for CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed −25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.

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
100kHz-2GHz	0.684 dB
2GHz-18GHz	1.407 dB
18GHz-40GHz	1.515 dB

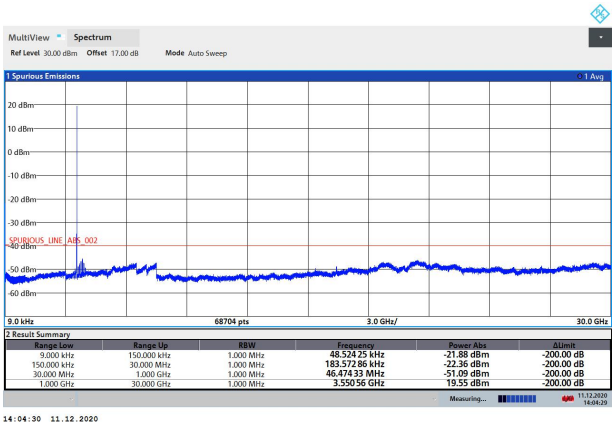
Test Result

Sweep from 9 kHz to 30MHz, and the emissions more than 20 dB below the permissible value are not reported.

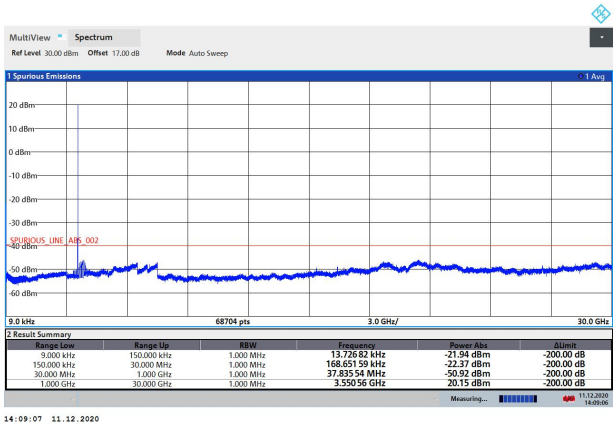
If disturbances were found more than 20dB below limit line, the mark is not required for the EUT.

The signal beyond the limit is carrier.

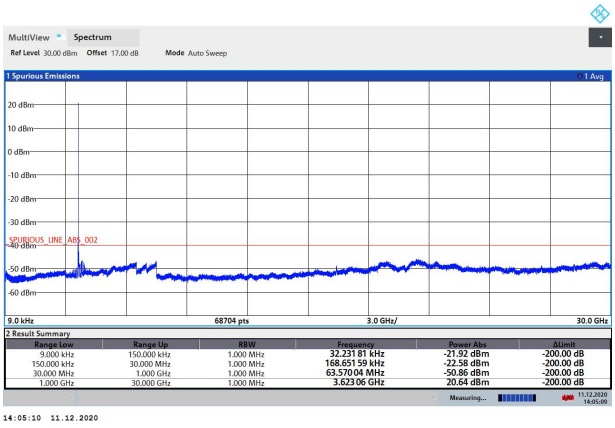
LTE Band 48 5MHz CH-Low 9kHz~30GHz



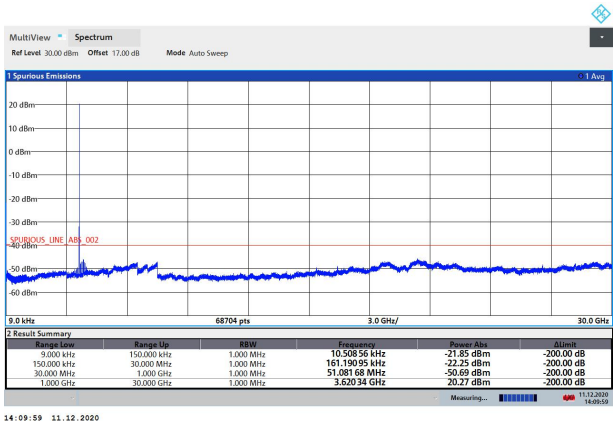
LTE Band 48 10MHz CH- Low 9kHz~30GHz



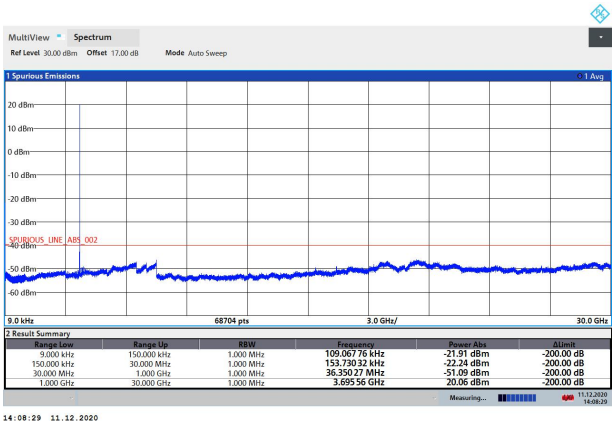
LTE Band 48 5MHz CH- Middle 9kHz~30GHz



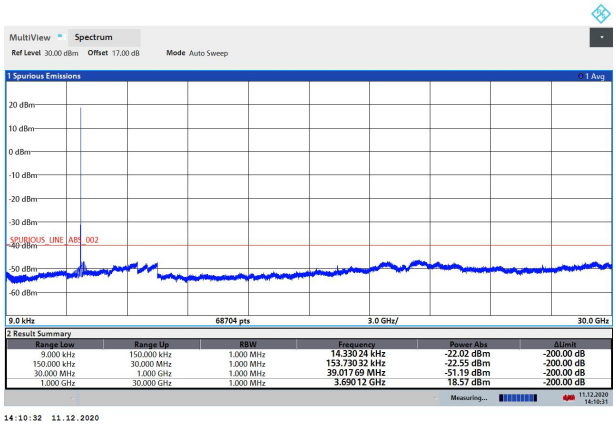
LTE Band 48 10MHz CH- Middle 9kHz~30GHz



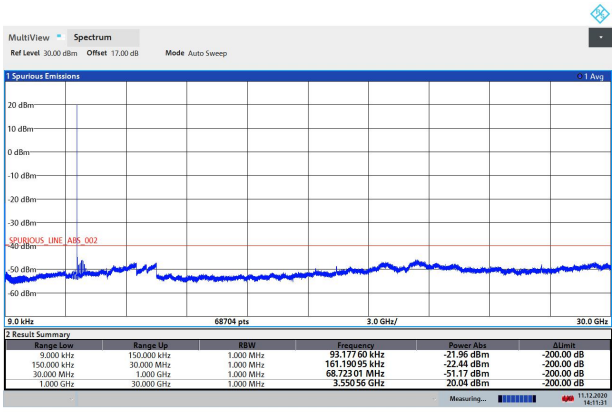
LTE Band 48 5MHz CH- High 9kHz~30GHz



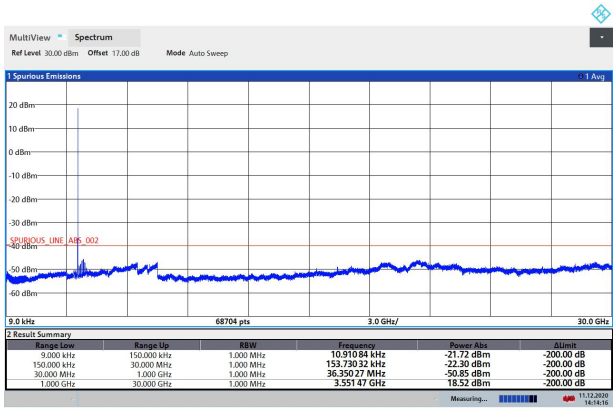
LTE Band 48 10MHz CH-High 9kHz~30GHz



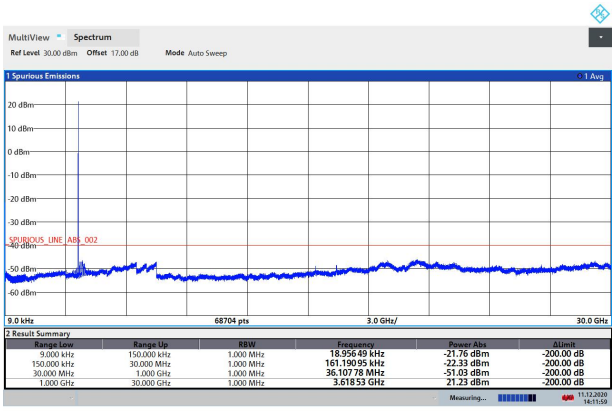
LTE Band 48 15MHz CH- Low 9kHz~30GHz



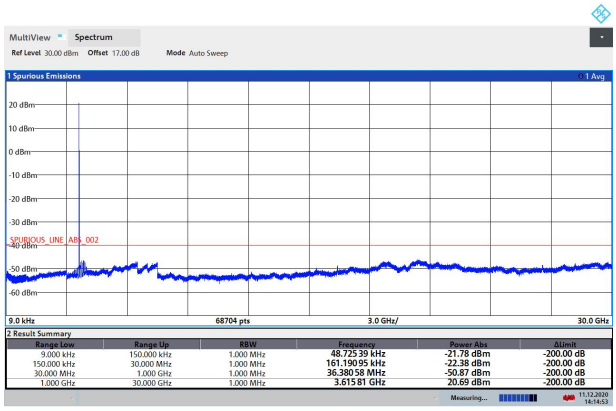
LTE Band 48 20MHz CH-Low 9kHz~30GHz



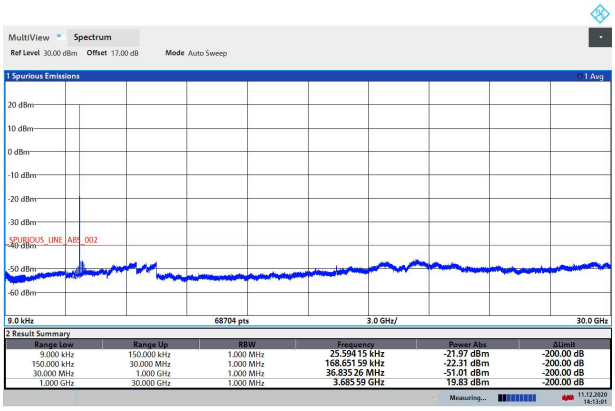
LTE Band 48 15MHz CH- Middle 9kHz~30GHz



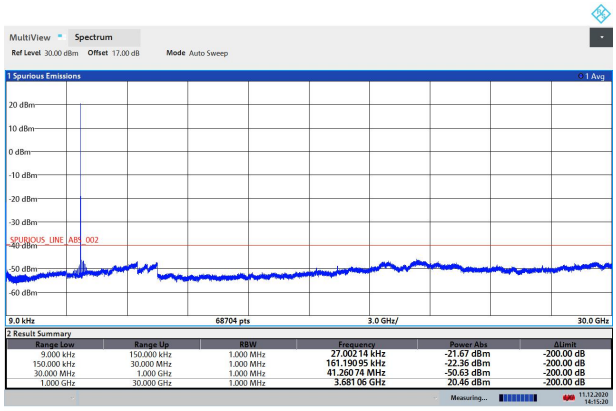
LTE Band 48 20MHz CH- Middle 9kHz~30GHz



LTE Band 4815MHz CH-High 9kHz~30GHz



LTE Band 48 20MHz CH- High 9kHz~30GHz



5.8. Radiates Spurious Emission

Ambient condition

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

Method of Measurement

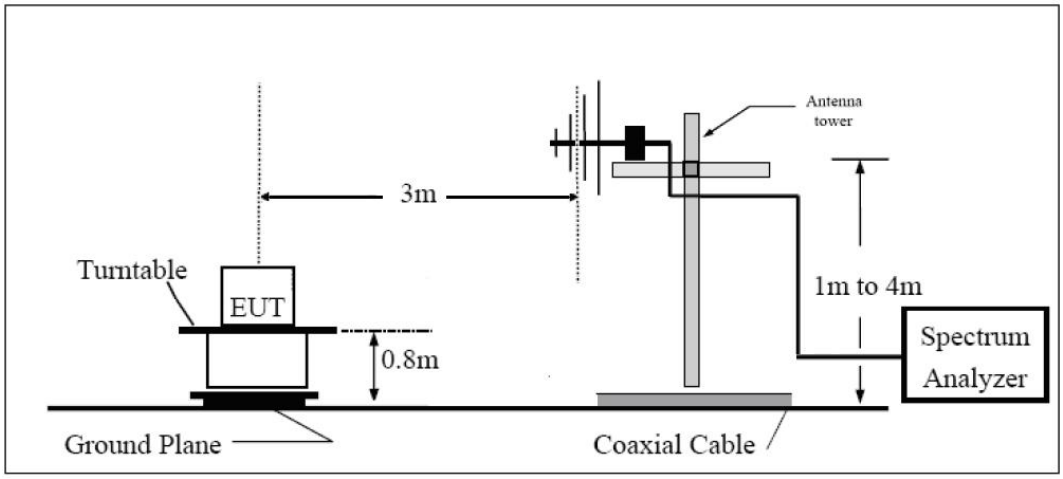
1. The testing follows FCC KDB 971168 D01 v03r01 Section 5.8 and ANSI C63.26 (2015).
2. Below 1GHz: The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable 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). Above 1GHz: (Note: the FCC's permission to use 1.5m as an alternative per TCBC Conf call of Dec. 2, 2014.) The EUT is placed on a turntable 1.5 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 loop antenna, A log-periodic antenna or 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=200Hz,VBW=600Hz for 9kHz150kHz , RBW=10kHz, VBW=30kHz 150kHz-30MHz ,RBW=100kHz,VBW=300kHz for 30MHz to 1GHz and RBW=1MHz, VBW=3MHz for above 1GHz 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.

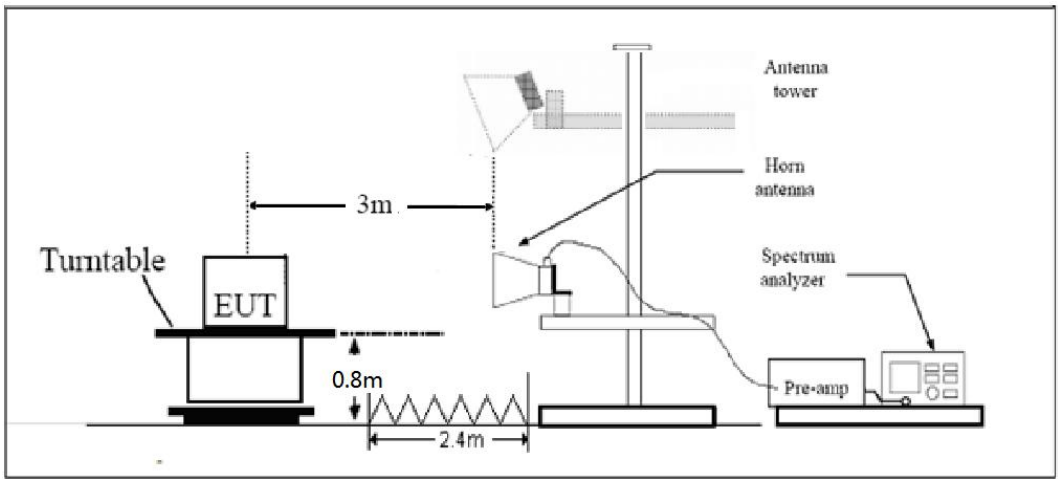
The modulation mode and RB allocation refer to section 5.1, using the maximum output power configuration.

Test setup

30MHz~~~ 1GHz



Above 1GHz



Note: Area side:2.4mX3.6m

Limits

Rule Part 96.41(e) (2) specifies that "*Additional protection levels.* Notwithstanding paragraph (e)(1) of this section, for CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed −25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz."

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.

Test Result

LTE Band 48 QPSK 5MHz CH-Middle, RB 1

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	EIRP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	7245.76	-49.49	2.6	10.75	Horizontal	-41.34	-40.00	1.34	45
3	10868.64	-63.27	2.4	11.05	Horizontal	-54.62	-40.00	14.62	315
4	14491.52	-58.99	4.5	11.15	Horizontal	-52.34	-40.00	12.34	90
5	18114.40	-	-	-	-	-	-	-	-
6	21737.28	-	-	-	-	-	-	-	-
7	25360.16	-	-	-	-	-	-	-	-
8	28983.04	-	-	-	-	-	-	-	-
9	32605.92	-	-	-	-	-	-	-	-
10	36228.80	-	-	-	-	-	-	-	-
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.									

LTE Band 48 QPSK 20MHz CH-Middle, RB 1

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	EIRP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	7232.26	-48.78	2.6	10.75	Horizontal	-40.63	-40.00	0.63	45
3	10848.39	-60.30	2.4	11.05	Horizontal	-51.65	-40.00	11.65	45
4	14464.52	-59.32	4.5	11.15	Horizontal	-52.67	-40.00	12.67	90
5	18080.65	-	-	-	-	-	-	-	-
6	21696.78	-	-	-	-	-	-	-	-
7	25312.91	-	-	-	-	-	-	-	-
8	28929.04	-	-	-	-	-	-	-	-
9	32545.17	-	-	-	-	-	-	-	-
10	36161.30	-	-	-	-	-	-	-	-
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.									

6. Main Test Instruments

Name	Manufacturer	Type	Serial Number	Calibration Date	Expiration Date
Base Station Simulator	R&S	CMW500	113824	2020-05-18	2021-05-17
Power Splitter	Hua Xiang	SHX-GF2-2-13	10120101	/	/
Spectrum Analyzer	Key sight	N9010A	MY50210259	2020-05-18	2021-05-17
Signal Analyzer	R&S	FSV30	100815	2019-12-15	2020-12-14
				2020-12-13	2021-12-12
Loop Antenna	SCHWARZBECK	FMZB1519	1519-047	2020-04-02	2023-04-01
TRILOG Broadband Antenna	SCHWARZBECK	VULB 9163	391	2019-12-16	2021-12-15
Horn Antenna	R&S	HF907	102723	2018-08-11	2021-08-10
Horn Antenna	ETS-Lindgren	3160-09	00102643	2018-06-20	2021-06-19
Signal generator	R&S	SMB 100A	102594	2020-05-18	2021-05-17
Climatic Chamber	ESPEC	SU-242	93000506	2017-12-17	2020-12-16
				2020-12-13	2021-12-12
Preampflier	R&S	SCU18	102327	2020-05-18	2021-05-17
MOB COMMS DC SUPPLY	Keysight	66319D	MY43004105	2020-05-18	2021-05-17
RF Cable	Agilent	SMA 15cm	0001	2020-06-12	2020-12-11
				2020-12-10	2021-06-09
Software	R&S	EMC32	9.26.0	/	/

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

ANNEX A: The EUT Appearance

The EUT Appearance are submitted separately.

ANNEX B: Test Setup Photos

The Test Setup Photos are submitted separately.