FCC Test Report (Part 96: LTE Band 48)

Report No.: RF190920C07

FCC ID: QI3BEC-CBRS6

Test Model: BEC CBRS-6

Received Date: Sep. 20, 2019

Test Date: Sep. 25 ~ Oct. 01, 2019

Issued Date: Oct. 15, 2019

Applicant: BILLION ELECTRIC CO., LTD.

Address: 8F., No. 192, Sec. 2, Zhongxing Rd., Xindian Dist., New Taipei City 231, Taiwan (R.O.C.)

Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Lin Kou Laboratories

Lab Address: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

Test Location: No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN

FCC Registration/ Designation Number: 788550 / TW0003

Testing Laboratory
2021

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Table of Contents

Release Control Record **4**

1 Certificate of Conformity **5**

2 Summary of Test Results **6**

2.1 Measurement Uncertainty 6
2.2 Modification Record 6

3 General Information **7**

3.1 General Description of EUT 7
3.2 Test Mode Applicability and Tested Channel Detail 8
3.3 Description of Support Units 10
3.3.1 Configuration of System under Test 10
3.4 General Description of Applied Standards 11

4 Test Types and Results **12**

4.1 Maximum Output Power Measurement 12
4.1.1 Limits of Maximum Output Power Measurement 12
4.1.2 Test Setup 12
4.1.3 Test Instruments 12
4.1.4 Test Procedures 13
4.1.5 Deviation from Test Standard 13
4.1.6 EUT Operating Conditions 13
4.1.7 Test Results 14
4.2 Frequency Stability Measurement 22
4.2.1 Limits of Frequency Stabiliity Measurement 22
4.2.2 Test Procedure 22
4.2.3 Test Setup 22
4.2.4 Test Results 23
4.3 Emission Bandwidth Measurement 27
4.3.1 Emission Bandwidth Measurement 27
4.3.2 Test Setup 27
4.3.3 Test Instruments 27
4.3.4 Test Procedure 27
4.3.5 Deviation fromTest Standard 27
4.3.6 EUT Operating Conditions 27
4.3.7 Test Result (-26dB Bandwidth) 28
4.3.8 Test Result (Occupied Bandwidth) 30
4.4 Peak to Average Ratio Measurement 32
4.4.1 Limits of Peak to Average Ratio Measurement 32
4.4.2 Test Setup 32
4.4.3 Test Procedures 32
4.4.4 Test Results 33
4.5 Conducted Spurious Emissions 35
4.5.1 Limits of Conducted Spurious Emissions Measurement 35
4.5.2 Test Setup 35
4.5.3 Test Procedure 35
4.5.4 Test Results 36
4.6 Radiated Emission Measurement 60
4.6.1 Limits of Radiated Emission Measurement 60
4.6.2 Test Instruments 60
4.6.3 Test Procedures 61
4.6.4 Deviation from Test Standard 61
4.6.5 Test Set Up 62
4.6.6 Test Results 63

5 Pictures of Test Arrangements 75
Appendix – Information of the Testing Laboratories 76

Release Control Record

Issue No.	Description	Date Issued
RF190920C07	Original release.	Oct. 15, 2019

1 Certificate of Conformity

Product: LTE module

Brand: BEC, BILLION

Test Model: BEC CBRS-6

Sample Status: Engineering sample

Applicant: BILLION ELECTRIC CO., LTD.

Test Date: Sep. 25 ~ Oct. 01, 2019

Standards: 47 CFR FCC Part 96

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

Prepared by : Polly Chien , **Date:** Oct. 15, 2019

Polly Chien / Specialist

Approved by : Bruce Chen , **Date:** Oct. 15, 2019

Bruce Chen / Senior Project Engineer

2 Summary of Test Results

47 CFR FCC Part 96			
FCC Clause	Test Item	Result	Remarks
2.1046 96.41(b)	Maximum Peak Output Power	Pass	Meet the requirement of limit.
2.1046 96.41(b)	Maximum Power Spectral Density	Pass	Meet the requirement of limit.
96.41(g)	Peak to Average Ration	Pass	Meet the requirement of limit.
2.1049	Emission Bandwidth	Pass	Meet the requirement of limit.
2.1055	Frequency Stability	Pass	Meet the requirement of limit.
2.1051 96.41(e)	Conducted Spurious Emissions	Pass	Meet the requirement of limit.
2.1053 96.41(e)	Radiated Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -5.4dB at 7105.00MHz.

Note: Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Radiated Emissions up to 1 GHz	9 kHz ~ 30MHz	3.04 dB
	30 MHz ~ 200 MHz	3.59 dB
	200 MHz ~ 1000 MHz	3.60 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	2.29 dB
	18 GHz ~ 40 GHz	2.29 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	LTE module			
Brand	BEC, BILLION			
Test Model	BEC CBRS-6			
Status of EUT	Engineering sample			
Modulation Type	QPSK, 16QAM			
Operating Frequency	LTE Band 48	Channel Bandwidth 5MHz	TX: 3552.5 ~ 3697.5 MHz	
			RX: 3552.5 ~ 3697.5 MHz	
		Channel Bandwidth 10MHz	TX: 3555 ~ 3695 MHz	
			RX: 3555 ~ 3695 MHz	
		Channel Bandwidth 15MHz	TX: 3557.5 ~ 3692.5 MHz	
			RX: 3557.5 ~ 3692.5 MHz	
		Channel Bandwidth 20MHz	TX: 3560 ~ 3690 MHz	
			RX: 3560 ~ 3690 MHz	
Max. EIRP Power	LTE Band 48		QPSK	16QAM
		Channel Bandwidth 5MHz	190.985mW (22.81dBm)	183.654mW (22.64dBm)
		Channel Bandwidth 10MHz	177.011mW (22.48dBm)	175.792mW (22.45dBm)
		Channel Bandwidth 15MHz	197.242mW (22.95dBm)	189.234mW (22.77dBm)
		Channel Bandwidth 20MHz	197.242mW (22.95dBm)	193.197mW (22.86dBm)
Emission Designator	LTE Band 48	Channel Bandwidth 5MHz	4M80G7D	4M81D7W
		Channel Bandwidth 10MHz	9M30G7D	9M31D7W
		Channel Bandwidth 15MHz	13M9G7D	13M9D7W
		Channel Bandwidth 20MHz	18M4G7D	17M4D7W
Antenna Type	PCB antenna with 14.5dBi gain Dipole antenna with 5.3dBi gain			
Antenna Connector	PCB antenna: i-pex (MHF) Dipole antenna: SMA			
Accessory Device	PoE			
Data Cable Supplied	NA			

Note:

1. The EUT uses following PoE.

Adapter	
Brand	BEC, BILLION
Model	BP035-560063PAX
Input Power	100-240Vac~50/60Hz 0.8A
Output Power	56Vdc / 0.625A

2. The EUT provides 1 completed transmitter and 4 receivers.
3. The above EUT information is declared by manufacturer and for more detailed features description, please refers to the manufacturer's specifications or user's manual.

3.2 Test Mode Applicability and Tested Channel Detail

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports
The worst case was found when positioned on Z-plane. Following channel(s) was (were) selected for the final test as listed below:

Test Item	Available Channel	Tested Channel	Channel Bandwidth	Modulation
Maximum Output Power	55265 to 56715	55265 (3552.5MHz), 55990 (3625.0MHz), 56715 (3697.5MHz)	5MHz	QPSK, 16QAM
	55290 to 56690	55290 (3555.0MHz), 55990 (3625.0MHz), 56690 (3695.0MHz)	10MHz	QPSK, 16QAM
	55315 to 56665	55315 (3557.5MHz), 55990 (3625.0MHz), 56665 (3692.5MHz)	15MHz	QPSK, 16QAM
	55340 to 56640	55340 (3560.0MHz), 55990 (3625.0MHz), 56640 (3690.0MHz)	20MHz	QPSK, 16QAM
Frequency Stability	55265 to 56715	55265 (3552.5MHz), 56715 (3697.5MHz)	5MHz	QPSK
	55290 to 56690	55290 (3555.0MHz), 56690 (3695.0MHz)	10MHz	QPSK
	55315 to 56665	55315 (3557.5MHz), 56665 (3692.5MHz)	15MHz	QPSK
	55340 to 56640	55340 (3560.0MHz), 56640 (3690.0MHz)	20MHz	QPSK
Occupied Bandwidth	55265 to 56715	55265 (3552.5MHz), 55990 (3625.0MHz), 56715 (3697.5MHz)	5MHz	QPSK, 16QAM
	55290 to 56690	55290 (3555.0MHz), 55990 (3625.0MHz), 56690 (3695.0MHz)	10MHz	QPSK, 16QAM
	55315 to 56665	55315 (3557.5MHz), 55990 (3625.0MHz), 56665 (3692.5MHz)	15MHz	QPSK, 16QAM
	55340 to 56640	55340 (3560.0MHz), 55990 (3625.0MHz), 56640 (3690.0MHz)	20MHz	QPSK, 16QAM
Peak to Average Ratio	55265 to 56715	55265 (3552.5MHz), 55990 (3625.0MHz), 56715 (3697.5MHz)	5MHz	QPSK, 16QAM
	55290 to 56690	55290 (3555.0MHz), 55990 (3625.0MHz), 56690 (3695.0MHz)	10MHz	QPSK, 16QAM
	55315 to 56665	55315 (3557.5MHz), 55990 (3625.0MHz), 56665 (3692.5MHz)	15MHz	QPSK, 16QAM
	55340 to 56640	55340 (3560.0MHz), 55990 (3625.0MHz), 56640 (3690.0MHz)	20MHz	QPSK, 16QAM

Test Item	Available Channel	Tested Channel	Channel Bandwidth	Modulation
Conducted Emission	55265 to 56715	55265 (3552.5MHz), 55990 (3625.0MHz), 56715 (3697.5MHz)	5MHz	QPSK
	55290 to 56690	55290 (3555.0MHz), 55990 (3625.0MHz), 56690 (3695.0MHz)	10MHz	QPSK
	55315 to 56665	55315 (3557.5MHz), 55990 (3625.0MHz), 56665 (3692.5MHz)	15MHz	QPSK
	55340 to 56640	55340 (3560.0MHz), 55990 (3625.0MHz), 56640 (3690.0MHz)	20MHz	QPSK
Radiated Emission Below 1GHz	55265 to 56715	55265 (3552.5MHz)	5MHz	QPSK
Radiated Emission Above 1GHz	55265 to 56715	55265 (3552.5MHz), 55990 (3625.0MHz), 56715 (3697.5MHz)	5MHz	QPSK
	55340 to 56640	55340 (3560.0MHz), 55990 (3625.0MHz), 56640 (3690.0MHz)	20MHz	QPSK

Note:

1. This device was tested under all bandwidths, RB configurations and modulations. The worst case was found in QPSK modulation.
2. For radiated emission below 1GHz, low, mid and high channels were pre-tested in chamber. Low channel in 5MHz was found to be the worst case and therefore had been chosen for all final tests.
3. For radiated emission above 1GHz, according to 3GPP 36.521 Section 6.6.3.1.4, choose the lowest, 5MHz & highest channel bandwidth for final test.

Test Condition:

Test Item	Environmental Conditions	Input Power	Tested By
Maximum Output Power	25deg. C, 63%RH	56Vdc	Jones Chang
Frequency Stability	25deg. C, 63%RH	120Vac	Jones Chang
Occupied Bandwidth	25deg. C, 63%RH	56Vdc	Jones Chang
Peak to Average Ratio	25deg. C, 63%RH	56Vdc	Jones Chang
Condcudeted Emission	25deg. C, 63%RH	56Vdc	Jones Chang
Radiated Emission	22deg. C, 66%RH	56Vdc	Han Wu

3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

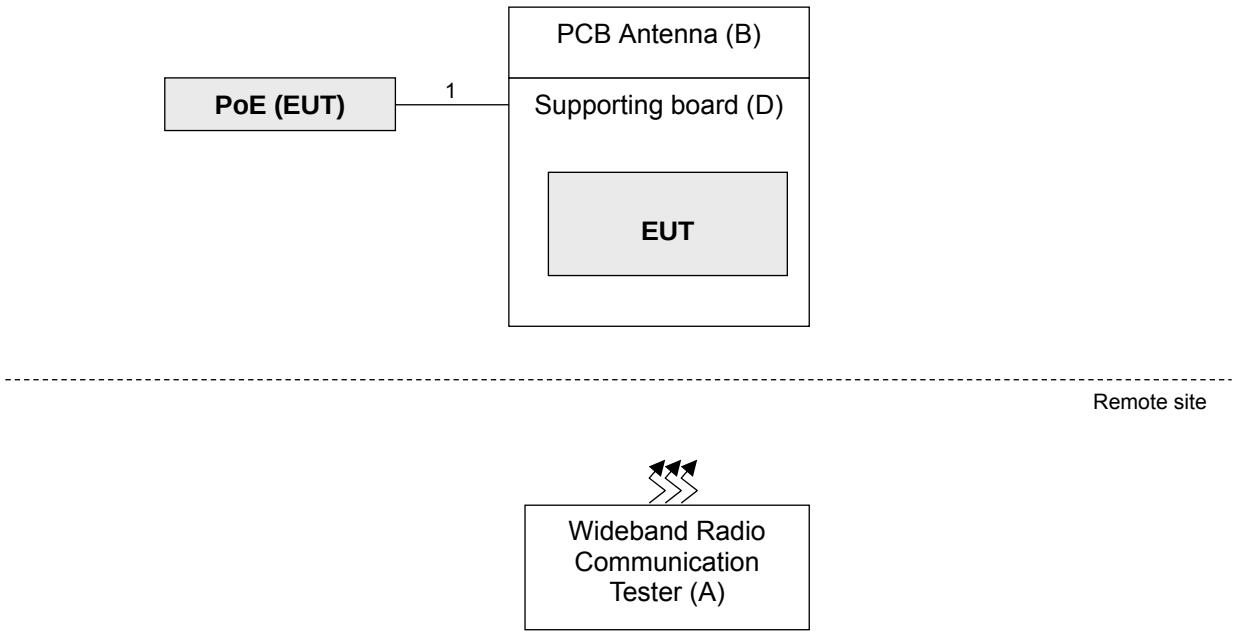
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Wideband Radio Communication Tester	R&S	CMW500	151084	N/A	-
B.	PCB Antenna	N/A	N/A	N/A	N/A	Accessory (Gain: 14.5dBi)
C.	Dipole Antenna	N/A	N/A	N/A	N/A	Accessory (Gain: 5.3dBi)
D.	Supporting board	N/A	N/A	N/A	N/A	Provided by applicant)

Note:
1. All power cords of the above support units are non-shielded (1.8m).
2. Items A acted as communication partners to transfer data.

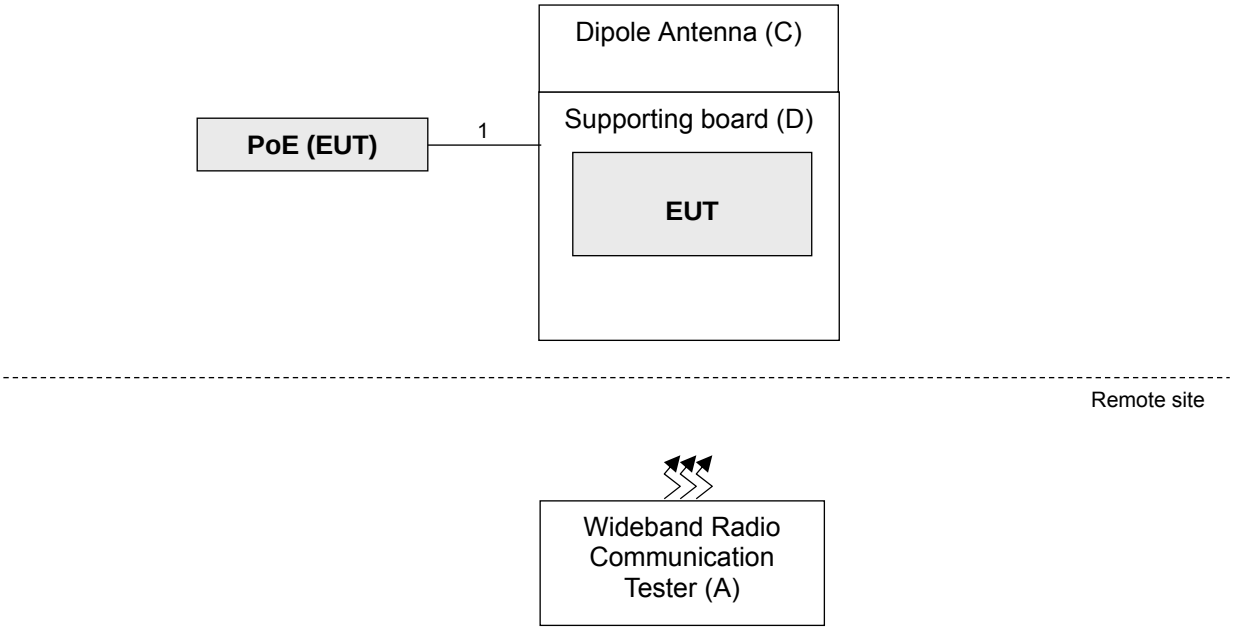
ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	LAN Cable	1	1.5	N	0	RJ45, Cat.5e

3.3.1 Configuration of System under Test

PCB antenna mode



Dipole antenna mode



3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC 47 CFR Part 2
FCC 47 CFR Part 96
KDB 971168 D01 Power Meas License Digital Systems v03r01
KDB 940660 D01 Part 96 CBRS Eqpt v02
ANSI/TIA/EIA-603-D-2010

All test items have been performed and recorded as per the above standards.

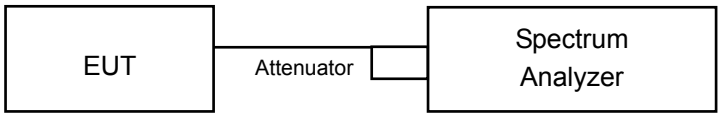
4 Test Types and Results

4.1 Maximum Output Power Measurement

4.1.1 Limits of Maximum Output Power Measurement

Device		Maximum Output Power (dBm/10 MHz)
☒	End User Device	23
☐	Category A CBSD	30
☐	Category B CBSD	47

4.1.2 Test Setup



4.1.3 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer KEYSIGHT	N9030A	MY53120770	Jan. 29, 2019	Jan. 28, 2020
Radio Communication Analyzer Anritsu	MT8821C	6261806803	Jan. 22, 2019	Jan. 21, 2020
RF cable	JB200	Cable-OVEN-02	NA	NA
DC-6GHz 20dB 50W Fixed attenuator Woken	MDC9331N-20	0724	Jun. 19, 2018	Jun. 18, 2020

Note: 1. The calibration interval of the above test instruments is 12/24 months and the calibrations are traceable to NML/ROC and NIST/USA.

4.1.4 Test Procedures

Conducted output power measurement

1. Connect the DUT transmitter output to the spectrum analyzer via coaxial cable while ensuring proper impedance matching.
2. Set span to at least 1.5 times the OBW.
3. Set RBW = 1-5% of the OBW, not to exceed 1 MHz.
4. Set VBW ≥ 3 × RBW.
5. Set number of points in sweep ≥ 2 × span / RBW.
6. Sweep time = auto-couple.
7. Detector = RMS (power averaging).
8. If the EUT can be configured to transmit continuously (i.e., burst duty cycle ≥ 98%), then set the trigger to free run.
9. If the EUT cannot be configured to transmit continuously (i.e., burst duty cycle < 98 %), then use a sweep trigger with the level set to enable triggering only on full power bursts and configure the EUT to transmit at full power for the entire duration of each sweep. Ensure that the sweep time is less than or equal to the transmission burst duration.
10. Trace average at least 100 traces in power averaging (i.e., RMS) mode.
11. Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band or channel power measurement function, with the band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

Maximum EIRP

The relevant equation for determining the maximum ERP or EIRP from the measured RF output power is given in Equation as follows:

ERP or EIRP = $P_{Meas} + G_T$

where

ERP or EIRP effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as P_{Meas}, e.g., dBm or dBW)

P_{Meas} measured transmitter output power or PSD, in dBm or dBW

G_T gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)

4.1.5 Deviation from Test Standard

No deviation.

4.1.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.1.7 Test Results

Conducted Output Power (dBm / 10MHz)

Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55265 3552.5 MHz	Mid CH 55990 3625 MHz	High CH 56715 3697.5 MHz	Low CH 55265 3552.5 MHz	Mid CH 55990 3625 MHz	High CH 56715 3697.5 MHz
48 / 5M	1	0	6.93	7.41	**8.31**	6.61	7.48	8.06
	1	12	6.64	7.34	7.91	6.55	7.41	8.02
	1	24	6.61	7.32	8.25	6.63	7.45	8.05
	12	0	6.85	7.38	8.21	6.59	7.71	**8.14**
	12	6	6.52	7.26	7.84	6.55	7.62	8.11
	12	13	6.53	7.22	7.84	6.57	7.60	8.03
	25	0	6.60	7.25	7.90	6.39	7.61	7.91

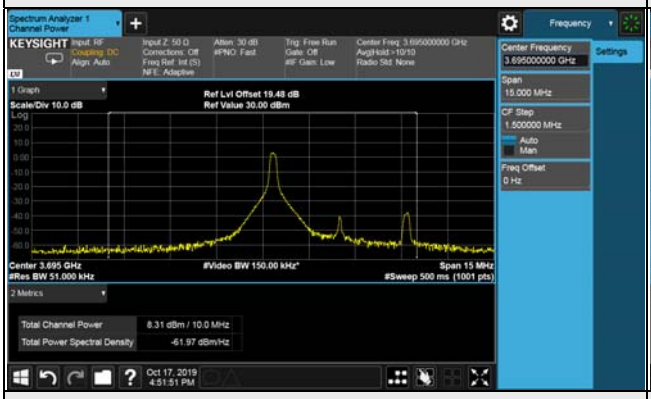
Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55290 3555 MHz	Mid CH 55990 3625 MHz	High CH 56690 3695 MHz	Low CH 55290 3555 MHz	Mid CH 55990 3625 MHz	High CH 56690 3695 MHz
48 / 10M	1	0	6.84	7.48	**7.98**	6.72	7.48	**7.95**
	1	24	6.33	7.45	7.93	6.55	7.33	7.88
	1	49	6.31	7.48	7.96	6.69	7.26	7.75
	25	0	6.23	7.09	7.83	6.23	7.04	7.86
	25	12	6.29	7.17	7.78	6.18	6.98	7.77
	25	25	6.32	7.08	7.75	6.14	7.00	7.69
	50	0	6.22	7.10	7.62	6.22	7.02	7.61

Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55315 3557.5 MHz	Mid CH 55990 3625 MHz	High CH 56665 3692.5 MHz	Low CH 55315 3557.5 MHz	Mid CH 55990 3625 MHz	High CH 56665 3692.5 MHz
48 / 15M	1	0	6.89	7.70	8.10	6.98	7.74	**8.25**
	1	37	6.52	7.49	7.89	6.65	7.71	8.19
	1	74	6.81	7.69	**8.43**	6.77	7.65	8.17
	36	0	6.24	7.08	7.81	6.30	7.11	7.81
	36	19	6.39	7.17	7.72	6.22	7.02	7.66
	36	39	6.33	7.23	7.86	6.28	7.06	7.67
	75	0	5.11	5.87	6.49	5.25	5.91	6.56

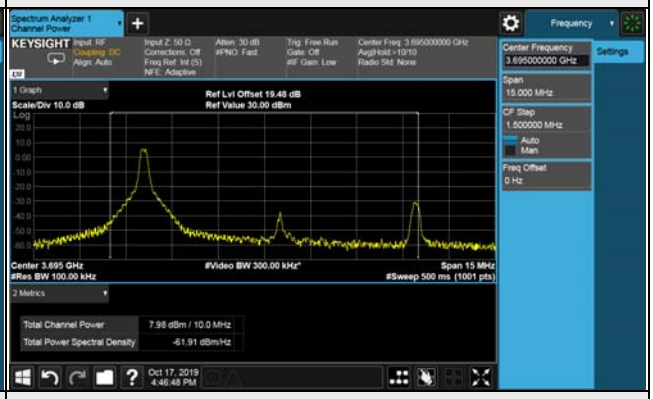
Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55340 3560 MHz	Mid CH 55990 3625 MHz	High CH 56640 3690 MHz	Low CH 55340 3560 MHz	Mid CH 55990 3625 MHz	High CH 56640 3690 MHz
48 / 20M	1	0	7.08	7.89	8.03	7.06	7.87	**8.35**
	1	50	6.72	7.60	**8.22**	6.99	7.82	8.33
	1	99	6.92	7.69	8.21	6.91	7.83	8.32
	50	0	6.77	7.56	8.09	6.72	7.40	8.12
	50	25	6.81	7.53	8.03	6.65	7.21	8.04
	50	50	6.73	7.58	8.18	6.55	7.16	8.06
	100	0	4.51	5.29	5.76	4.54	5.11	5.69

Spectrum Plot of Worst Value

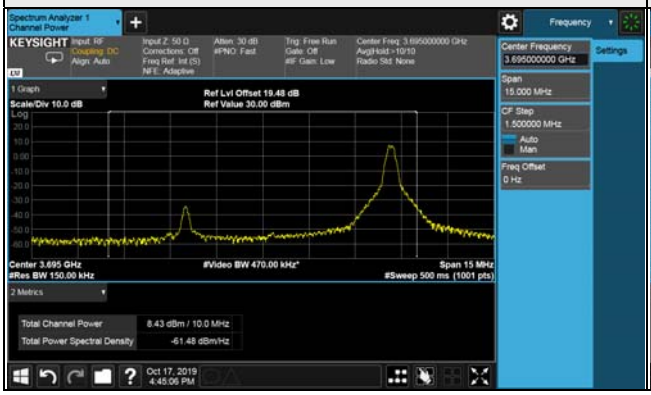
5MHz



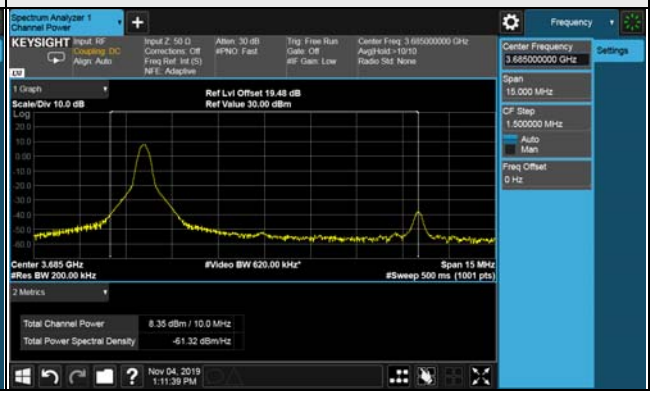
10MHz



15MHz



20MHz



Maximum EIRP (dBm/ 10MHz)

Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55265 3552.5 MHz	Mid CH 55990 3625 MHz	High CH 56715 3697.5 MHz	Low CH 55265 3552.5 MHz	Mid CH 55990 3625 MHz	High CH 56715 3697.5 MHz
48 / 5M	1	0	21.43	21.91	**22.81**	21.11	21.98	22.56
	1	12	21.14	21.84	22.41	21.05	21.91	22.52
	1	24	21.11	21.82	22.75	21.13	21.95	22.55
	12	0	21.35	21.88	22.71	21.09	22.21	**22.64**
	12	6	21.02	21.76	22.34	21.05	22.12	22.61
	12	13	21.03	21.72	22.34	21.07	22.10	22.53
	25	0	21.10	21.75	22.40	20.89	22.11	22.41

*Note: EIRP (dBm / 10MHz) = Conducted Output Power (dBm / 10MHz) + Antenna Gain (14.5dBi)

Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55290 3555 MHz	Mid CH 55990 3625 MHz	High CH 56690 3695 MHz	Low CH 55290 3555 MHz	Mid CH 55990 3625 MHz	High CH 56690 3695 MHz
48 / 10M	1	0	21.34	21.98	**22.48**	21.22	21.98	**22.45**
	1	24	20.83	21.95	22.43	21.05	21.83	22.38
	1	49	20.81	21.98	22.46	21.19	21.76	22.25
	25	0	20.73	21.59	22.33	20.73	21.54	22.36
	25	12	20.79	21.67	22.28	20.68	21.48	22.27
	25	25	20.82	21.58	22.25	20.64	21.50	22.19
	50	0	20.72	21.60	22.12	20.72	21.52	22.11

*Note: EIRP (dBm / 10MHz) = Conducted Output Power (dBm / 10MHz) + Antenna Gain (14.5dBi)

Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55315 3557.5 MHz	Mid CH 55990 3625 MHz	High CH 56665 3692.5 MHz	Low CH 55315 3557.5 MHz	Mid CH 55990 3625 MHz	High CH 56665 3692.5 MHz
48 / 15M	1	0	21.39	22.20	22.60	21.48	22.24	**22.75**
	1	37	21.02	21.99	22.39	21.15	22.21	22.69
	1	74	21.31	22.19	**22.93**	21.27	22.15	22.67
	36	0	20.74	21.58	22.31	20.80	21.61	22.31
	36	19	20.89	21.67	22.22	20.72	21.52	22.16
	36	39	20.83	21.73	22.36	20.78	21.56	22.17
	75	0	19.61	20.37	20.99	19.75	20.41	21.06

*Note: EIRP (dBm / 10MHz) = Conducted Output Power (dBm / 10MHz) + Antenna Gain (14.5dBi)

Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55340 3560 MHz	Mid CH 55990 3625 MHz	High CH 56640 3690 MHz	Low CH 55340 3560 MHz	Mid CH 55990 3625 MHz	High CH 56640 3690 MHz
48 / 20M	1	0	21.58	22.39	22.53	21.56	22.37	**22.85**
	1	50	21.22	22.10	**22.72**	21.49	22.32	22.83
	1	99	21.42	22.19	22.71	21.41	22.33	22.82
	50	0	21.27	22.06	22.59	21.22	21.90	22.62
	50	25	21.31	22.03	22.53	21.15	21.71	22.54
	50	50	21.23	22.08	22.68	21.05	21.66	22.56
	100	0	19.01	19.79	20.26	19.04	19.61	20.19

*Note: EIRP (dBm / 10MHz) = Conducted Output Power (dBm / 10MHz) + Antenna Gain (14.5dBi)

Full Conducted Output Power (dBm / 10MHz)

Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55265	Mid CH 55990	High CH 56715	Low CH 55265	Mid CH 55990	High CH 56715
			3552.5 MHz	3625 MHz	3697.5 MHz	3552.5 MHz	3625 MHz	3697.5 MHz
48 / 5M	1	0	6.93	7.41	**8.31**	6.61	7.48	8.06
	1	12	6.64	7.34	7.91	6.55	7.41	8.02
	1	24	6.61	7.32	8.25	6.63	7.45	8.05
	12	0	6.85	7.38	8.21	6.59	7.71	**8.14**
	12	6	6.52	7.26	7.84	6.55	7.62	8.11
	12	13	6.53	7.22	7.84	6.57	7.60	8.03
	25	0	6.60	7.25	7.90	6.39	7.61	7.91

Full Conducted Output Power (dBm / 10MHz)

Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55290	Mid CH 55990	High CH 56690	Low CH 55290	Mid CH 55990	High CH 56690
			3555 MHz	3625 MHz	3695 MHz	3555 MHz	3625 MHz	3695 MHz
48 / 10M	1	0	6.84	7.48	**7.98**	6.72	7.48	**7.95**
	1	24	6.33	7.45	7.93	6.55	7.33	7.88
	1	49	6.31	7.48	7.96	6.69	7.26	7.75
	25	0	6.23	7.09	7.83	6.23	7.04	7.86
	25	12	6.29	7.17	7.78	6.18	6.98	7.77
	25	25	6.32	7.08	7.75	6.14	7.00	7.69
	50	0	6.22	7.10	7.62	6.22	7.02	7.61

Full Conducted Output Power (dBm / 15MHz)

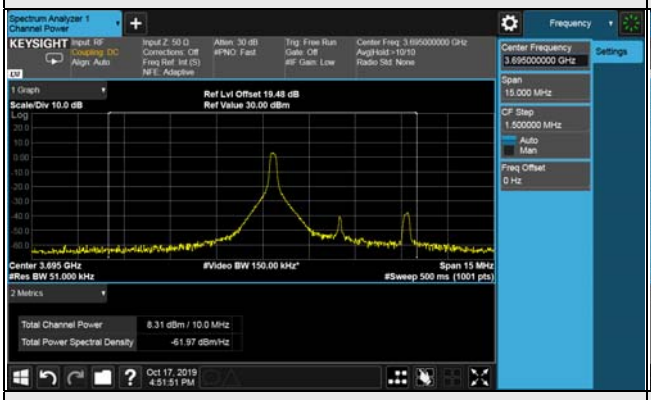
Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55315	Mid CH 55990	High CH 56665	Low CH 55315	Mid CH 55990	High CH 56665
			3557.5 MHz	3625 MHz	3692.5 MHz	3557.5 MHz	3625 MHz	3692.5 MHz
48 / 15M	1	0	6.87	7.65	8.18	6.97	7.72	**8.27**
	1	37	6.62	7.40	7.90	6.92	7.65	8.21
	1	74	6.84	7.83	**8.45**	6.99	7.63	8.19
	36	0	6.18	7.23	7.87	6.19	7.19	7.88
	36	19	6.46	7.25	7.82	6.05	7.05	7.77
	36	39	6.44	7.25	7.90	6.07	7.08	7.73
	75	0	6.46	7.28	7.81	6.47	7.20	7.84

Full Conducted Output Power (dBm / 20MHz)

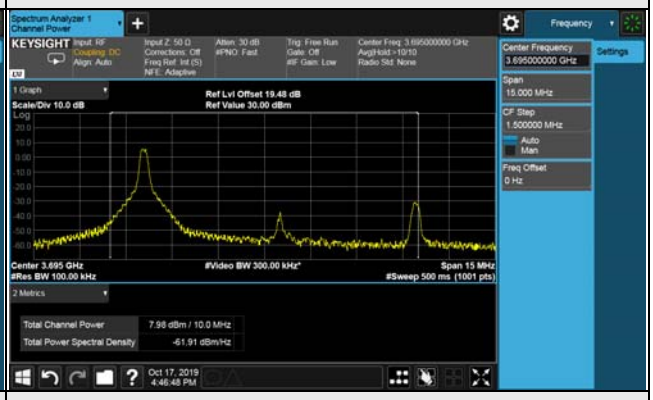
Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55340	Mid CH 55990	High CH 56640	Low CH 55340	Mid CH 55990	High CH 56640
			3560 MHz	3625 MHz	3690 MHz	3560 MHz	3625 MHz	3690 MHz
48 / 20M	1	0	7.11	7.88	8.33	7.29	7.88	**8.36**
	1	50	7.03	7.51	**8.45**	7.18	7.81	8.25
	1	99	7.08	7.93	8.26	7.11	7.69	8.24
	50	0	6.93	7.63	8.18	6.86	7.67	8.16
	50	25	6.97	7.58	8.28	6.80	7.51	8.20
	50	50	6.82	7.63	8.23	6.82	7.54	8.24
	100	0	6.95	7.64	8.17	6.93	7.67	8.08

Spectrum Plot of Worst Value

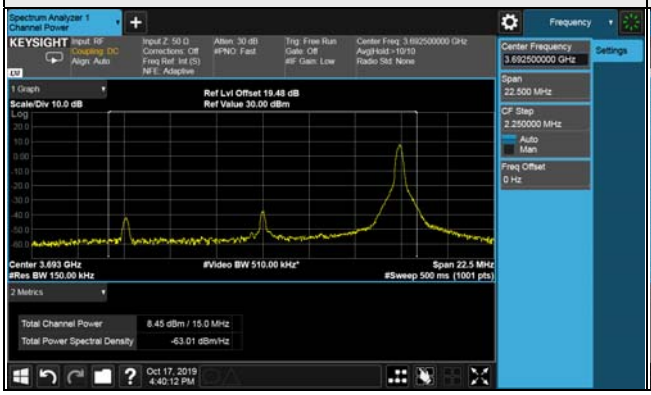
5MHz



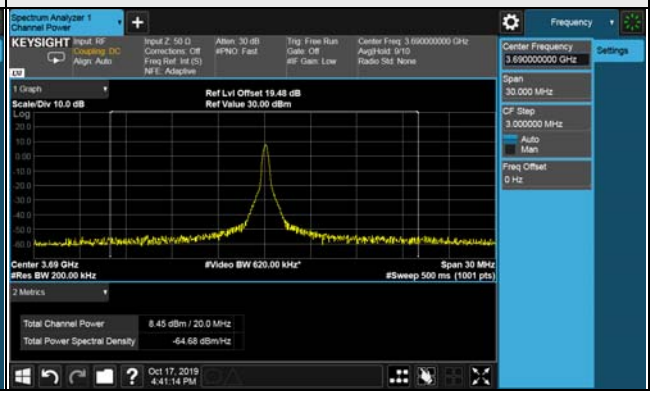
10MHz



15MHz



20MHz



Full EIRP (dBm / 10MHz)

Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55265 3552.5 MHz	Mid CH 55990 3625 MHz	High CH 56715 3697.5 MHz	Low CH 55265 3552.5 MHz	Mid CH 55990 3625 MHz	High CH 56715 3697.5 MHz
48 / 5M	1	0	21.43	21.91	**22.81**	21.11	21.98	22.56
	1	12	21.14	21.84	22.41	21.05	21.91	22.52
	1	24	21.11	21.82	22.75	21.13	21.95	22.55
	12	0	21.35	21.88	22.71	21.09	22.21	**22.64**
	12	6	21.02	21.76	22.34	21.05	22.12	22.61
	12	13	21.03	21.72	22.34	21.07	22.10	22.53
	25	0	21.10	21.75	22.40	20.89	22.11	22.41

*Note: Full EIRP = Full Conducted Output Power (dBm / 10MHz) + Antenna Gain (14.5dBi)

Full EIRP (dBm / 10MHz)

Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55290 3555 MHz	Mid CH 55990 3625 MHz	High CH 56690 3695 MHz	Low CH 55290 3555 MHz	Mid CH 55990 3625 MHz	High CH 56690 3695 MHz
48 / 10M	1	0	21.34	21.98	**22.48**	21.22	21.98	**22.45**
	1	24	20.83	21.95	22.43	21.05	21.83	22.38
	1	49	20.81	21.98	22.46	21.19	21.76	22.25
	25	0	20.73	21.59	22.33	20.73	21.54	22.36
	25	12	20.79	21.67	22.28	20.68	21.48	22.27
	25	25	20.82	21.58	22.25	20.64	21.50	22.19
	50	0	20.72	21.60	22.12	20.72	21.52	22.11

*Note: Full EIRP = Full Conducted Output Power (dBm / 10MHz) + Antenna Gain (14.5dBi)

Full EIRP (dBm / 15MHz)

Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55315 3557.5 MHz	Mid CH 55990 3625 MHz	High CH 56665 3692.5 MHz	Low CH 55315 3557.5 MHz	Mid CH 55990 3625 MHz	High CH 56665 3692.5 MHz
48 / 15M	1	0	21.37	22.15	22.68	21.47	22.22	**22.77**
	1	37	21.12	21.90	22.40	21.42	22.15	22.71
	1	74	21.34	22.33	**22.95**	21.49	22.13	22.69
	36	0	20.68	21.73	22.37	20.69	21.69	22.38
	36	19	20.96	21.75	22.32	20.55	21.55	22.27
	36	39	20.94	21.75	22.40	20.57	21.58	22.23
	75	0	20.96	21.78	22.31	20.97	21.70	22.34

*Note: Full EIRP = Full Conducted Output Power (dBm / 15MHz) + Antenna Gain (14.5dBi)

Full EIRP (dBm / 20MHz)

Band / BW	RB Size	RB Offset	QPSK			16QAM		
			Low CH 55340 3560 MHz	Mid CH 55990 3625 MHz	High CH 56640 3690 MHz	Low CH 55340 3560 MHz	Mid CH 55990 3625 MHz	High CH 56640 3690 MHz
48 / 20M	1	0	21.61	22.38	22.83	21.79	22.38	**22.86**
	1	50	21.53	22.01	**22.95**	21.68	22.31	22.75
	1	99	21.58	22.43	22.76	21.61	22.19	22.74
	50	0	21.43	22.13	22.68	21.36	22.17	22.66
	50	25	21.47	22.08	22.78	21.30	22.01	22.70
	50	50	21.32	22.13	22.73	21.32	22.04	22.74
	100	0	21.45	22.14	22.67	21.43	22.17	22.58

*Note: Full EIRP = Full Conducted Output Power (dBm / 20MHz) + Antenna Gain (14.5dBi)

4.2 Frequency Stability Measurement

4.2.1 Limits of Frequency Stabiliity Measurement

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency band.

4.2.2 Test Procedure

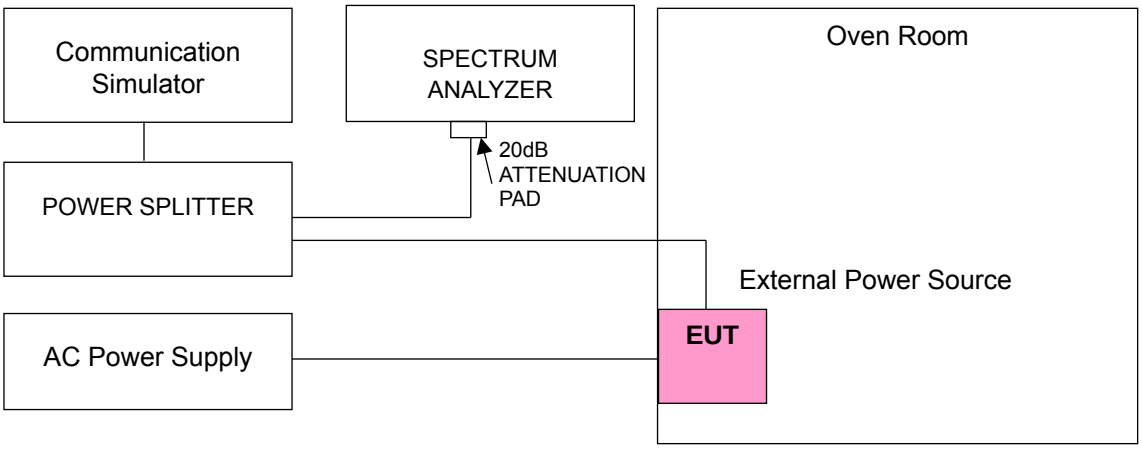
a. Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.

b. EUT is connected the external power supply to control the AC input power. The test voltage range is from minimum to maximum working voltage. Each step shall be record the frequency error rate.

c. The temperature range step is 10 degrees in this test items. All temperature levels shall be hold the ±0.5 ℃ during the measurement testing. The each temperature step shall be at least 0.5 hours, consider the EUT could be test under the stability condition.

NOTE: The frequency error was recorded frequency error from the communication simulator.

4.2.3 Test Setup



4.2.4 Test Results

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 48, Channel Bandwidth: 5MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
120	3552.500001	0.000	3697.500002	0.000
102	3552.500003	0.001	3697.500001	0.000
138	3552.500001	0.000	3697.500003	0.001

Note: The applicant defined the normal working voltage is from 102Vac to 138Vac.

Frequency Error vs. Temperature

Temp. (℃)	LTE Band 48, Channel Bandwidth: 5MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	3552.500001	0.000	3697.500001	0.000
-20	3552.500004	0.001	3697.500002	0.001
-10	3552.500001	0.000	3697.500004	0.001
0	3552.500003	0.001	3697.500003	0.001
10	3552.500001	0.000	3697.500003	0.001
20	3552.499998	-0.001	3697.499998	-0.001
30	3552.499997	-0.001	3697.499998	0.000
40	3552.499999	0.000	3697.499999	0.000
50	3552.499997	-0.001	3697.499997	-0.001
60	3552.499997	-0.001	3697.499996	-0.001

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 48, Channel Bandwidth: 10MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
120	3555.000001	0.000	3695.000004	0.001
102	3555.000003	0.001	3695.000002	0.001
138	3555.000003	0.001	3695.000001	0.000

Note: The applicant defined the normal working voltage is from 102Vac to 138Vac.

Frequency Error vs. Temperature

Temp. (℃)	LTE Band 48, Channel Bandwidth: 10MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	3555.000002	0.001	3695.000002	0.001
-20	3555.000002	0.001	3695.000002	0.001
-10	3555.000003	0.001	3695.000002	0.000
0	3555.000004	0.001	3695.000002	0.000
10	3555.000001	0.000	3695.000001	0.000
20	3554.999998	-0.001	3694.999999	0.000
30	3554.999999	0.000	3694.999996	-0.001
40	3554.999999	0.000	3694.999998	-0.001
50	3554.999998	-0.001	3694.999996	-0.001
60	3554.999999	0.000	3694.999999	0.000

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 48, Channel Bandwidth: 15MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
120	3557.500002	0.001	3692.500001	0.000
102	3557.500001	0.000	3692.500001	0.000
138	3557.500004	0.001	3692.500002	0.001

Note: The applicant defined the normal working voltage is from 102Vac to 138Vac.

Frequency Error vs. Temperature

Temp. (℃)	LTE Band 48, Channel Bandwidth: 15MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	3557.500004	0.001	3692.500003	0.001
-20	3557.500001	0.000	3692.500001	0.000
-10	3557.500003	0.001	3692.500002	0.000
0	3557.500003	0.001	3692.500002	0.001
10	3557.500003	0.001	3692.500004	0.001
20	3557.499997	-0.001	3692.499997	-0.001
30	3557.499998	-0.001	3692.499998	-0.001
40	3557.499998	0.000	3692.499997	-0.001
50	3557.499997	-0.001	3692.499997	-0.001
60	3557.499998	-0.001	3692.499997	-0.001

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 48, Channel Bandwidth: 20MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
120	3560.000002	0.001	3690.000004	0.001
102	3560.000002	0.000	3690.000004	0.001
138	3560.000002	0.001	3690.000002	0.000

Note: The applicant defined the normal working voltage is from 102Vac to 138Vac.

Frequency Error vs. Temperature

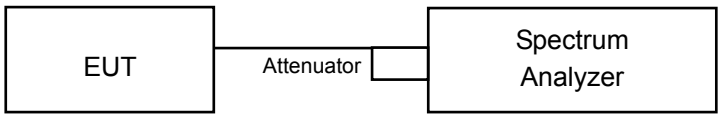
Temp. (℃)	LTE Band 48, Channel Bandwidth: 20MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	3560.000002	0.001	3690.000004	0.001
-20	3560.000002	0.001	3690.000003	0.001
-10	3560.000003	0.001	3690.000003	0.001
0	3560.000001	0.000	3690.000002	0.000
10	3560.000003	0.001	3690.000002	0.001
20	3559.999999	0.000	3689.999996	-0.001
30	3559.999998	-0.001	3689.999997	-0.001
40	3559.999999	0.000	3689.999999	0.000
50	3559.999998	-0.001	3689.999998	-0.001
60	3559.999999	0.000	3689.999998	0.000

4.3 Emission Bandwidth Measurement

4.3.1 Emission Bandwidth Measurement

Reference only

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.3 to get information of above instrument.

4.3.4 Test Procedure

Occupied Bandwdith & 26dBc Bandwidth

1. The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be wide enough to see sufficient roll off of the signal to make the measurement.
2. The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.
3. Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.
   NOTE—Step 1), step 2), and step 3) may require iteration to adjust within the specified tolerances.
4. The dynamic range of the spectrum analyzer at the selected RBW shall be more than 10 dB below the target "−X dB" requirement, i.e., if the requirement calls for measuring the −26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference level.
5. Set spectrum analyzer detection mode to peak, and the trace mode to max hold.
6. Determine the reference value by either of the following:
   a) Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
   b) Set the EUT to transmit an unmodulated carrier. Set the spectrum analyzer marker to the level of the carrier.
7. Determine the "−X dB amplitude" as equal to (Reference Value − X). Alternatively, this calculation can be performed on the spectrum analyzer using the delta-marker measurement function.

4.3.5 Deviation fromTest Standard

No deviation.

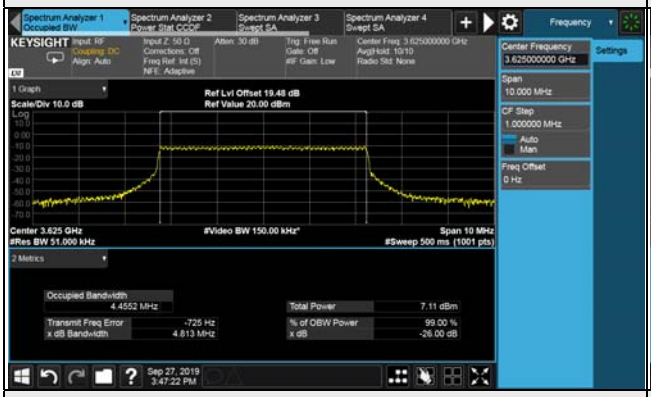
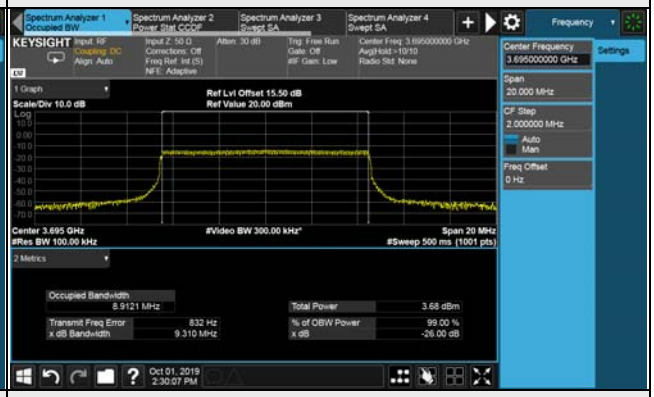
4.3.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.3.7 Test Result (-26dB Bandwidth)

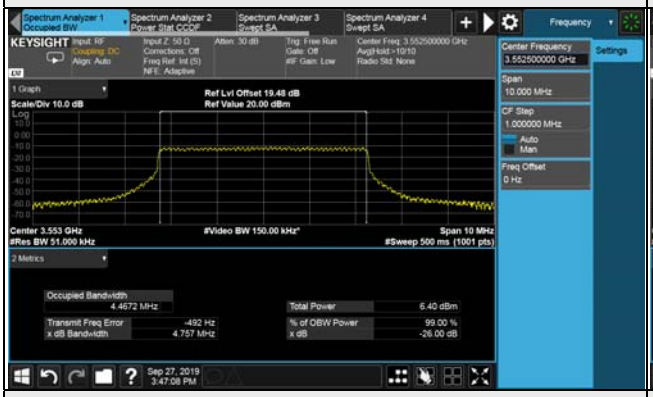
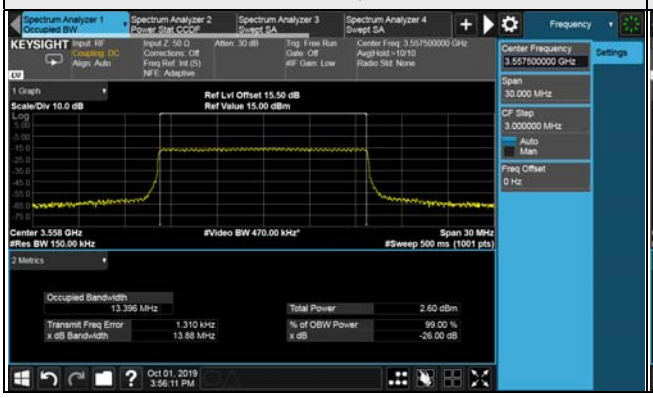
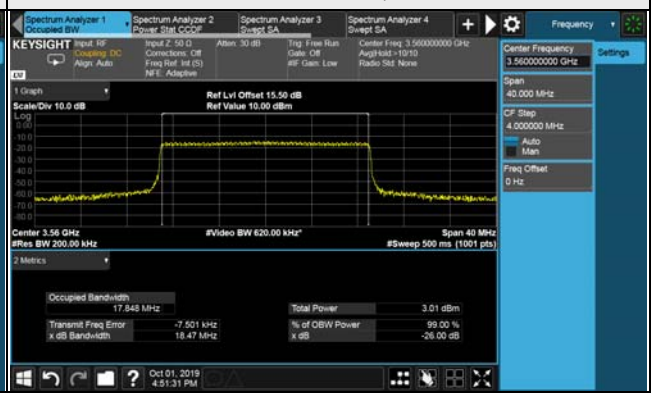
LTE Band 48

LTE Band 48, Channel Bandwidth 5MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
55265	3552.5	4.80	4.75
55990	3625.0	4.77	4.81
56715	3697.5	4.76	4.80
LTE Band 48, Channel Bandwidth 10MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
55290	3555.0	9.30	9.27
55990	3625.0	9.29	9.28
56690	3695.0	9.30	9.31
LTE Band 48, Channel Bandwidth 15MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
55315	3557.5	13.88	13.91
55990	3625.0	13.90	13.91
56665	3692.5	13.88	13.88
LTE Band 48, Channel Bandwidth 20MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
55340	3560.0	18.49	18.47
55990	3625.0	18.48	18.49
56640	3690.0	18.46	18.49

Spectrum Plot of Worst Value	
5MHz / 16QAM	10MHz / 16QAM
	
15MHz / 16QAM	20MHz / QPSK

4.3.8 Test Result (Occupied Bandwidth)

LTE Band 48, Channel Bandwidth 5MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
55265	3552.5	4.46	4.47
55990	3625.0	4.46	4.45
56715	3697.5	4.46	4.46
LTE Band 48, Channel Bandwidth 10MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
55290	3555.0	8.91	8.92
55990	3625.0	8.90	8.91
56690	3695.0	8.91	8.91
LTE Band 48, Channel Bandwidth 15MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
55315	3557.5	13.40	13.37
55990	3625.0	13.39	13.35
56665	3692.5	13.37	13.38
LTE Band 48, Channel Bandwidth 20MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
55340	3560.0	17.82	17.85
55990	3625.0	17.84	17.82
56640	3690.0	17.84	17.81

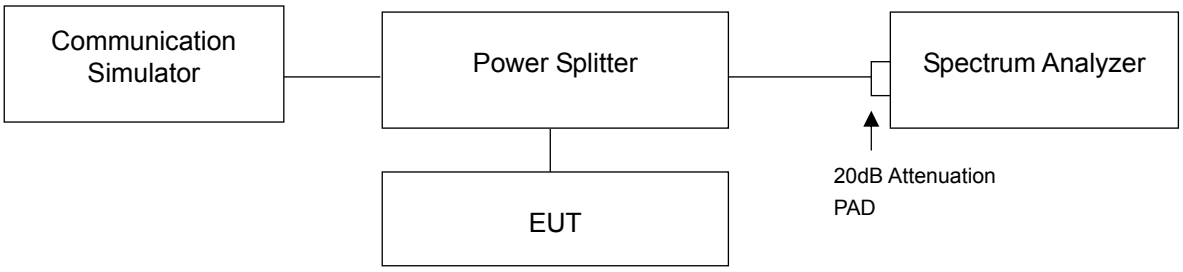
Spectrum Plot of Worst Value	
5MHz / 16QAM	10MHz / 16QAM
	
15MHz / QPSK	20MHz / 16QAM
	

4.4 Peak to Average Ratio Measurement

4.4.1 Limits of Peak to Average Ratio Measurement

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

4.4.2 Test Setup



4.4.3 Test Procedures

a. Set resolution/measurement bandwidth ≥ signal's occupied bandwidth;

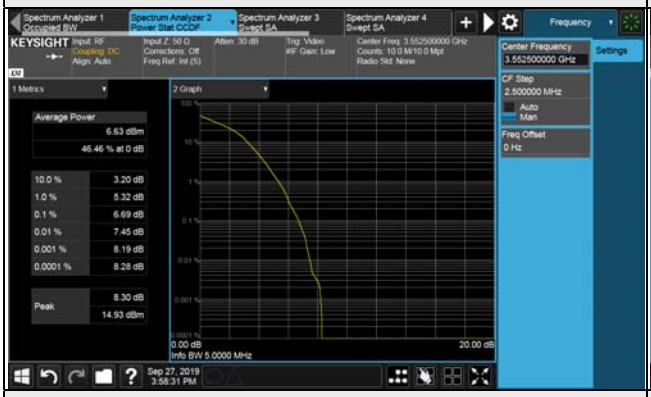
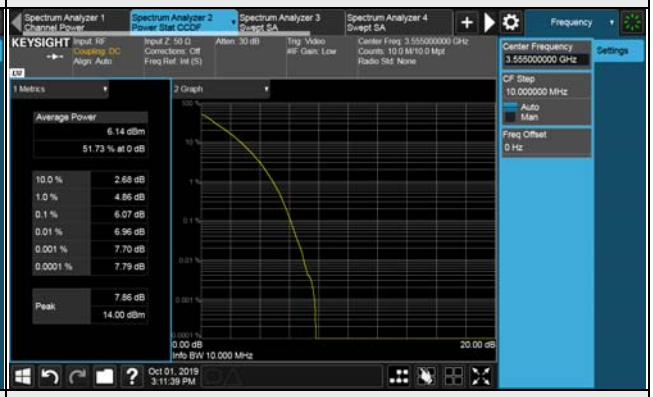
b. Set the number of counts to a value that stabilizes the measured CCDF curve;

c. Record the maximum PAPR level associated with a probability of 0.1%.

4.4.4 Test Results

LTE Band 48

LTE Band 48, Channel Bandwidth 5MHz			
Channel	Frequency (MHz)	Peak To Average Ratio (dB)	
		QPSK	16QAM
55265	3552.5	6.11	6.69
55990	3625.0	6.16	6.64
56715	3697.5	6.18	6.64
LTE Band 48, Channel Bandwidth 10MHz			
Channel	Frequency (MHz)	Peak To Average Ratio (dB)	
		QPSK	16QAM
55290	3555.0	6.05	6.07
55990	3625.0	6.01	6.00
56690	3695.0	5.95	6.03
LTE Band 48, Channel Bandwidth 15MHz			
Channel	Frequency (MHz)	Peak To Average Ratio (dB)	
		QPSK	16QAM
55315	3557.5	6.02	6.05
55990	3625.0	5.88	5.86
56665	3692.5	5.96	5.95
LTE Band 48, Channel Bandwidth 20MHz			
Channel	Frequency (MHz)	Peak To Average Ratio (dB)	
		QPSK	16QAM
55340	3560.0	6.10	6.13
55990	3625.0	5.91	5.84
56640	3690.0	5.98	5.93

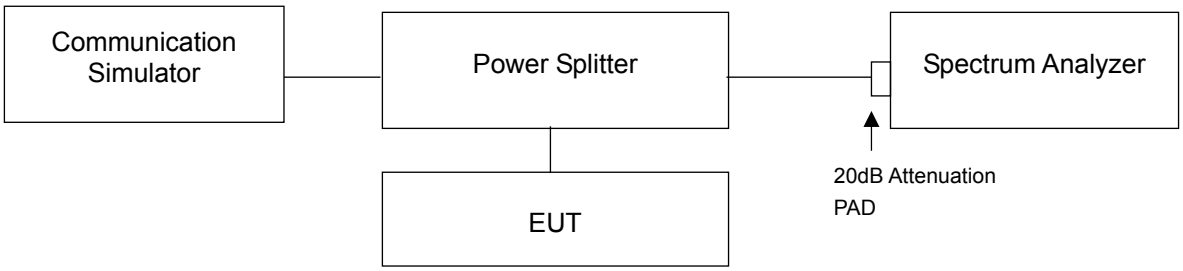
Spectrum Plot of Worst Value	
5MHz / 16QAM	10MHz / 16QAM
	
15MHz / 16QAM	20MHz / 16QAM

4.5 Conducted Spurious Emissions

4.5.1 Limits of Conducted Spurious Emissions Measurement

Power of any emissions outside the Fundamental	Limit
Within 0-10MHz above the Assigned Channel	-13 dBm/MHz
Within 0-10MHz below the Assigned Channel	
Greater than 0-10MHz above the Assigned Channel	-25 dBm/MHz
Greater than 0-10MHz below the Assigned Channel	
Power of any emission below 3530MHz	-40 dBm/MHz
Power of any emission above 3720MHz	

4.5.2 Test Setup



4.5.3 Test Procedure

a. The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range.

b. Measuring frequency range are from 9 kHz to 40GHz. 20dB attenuation pad is connected with spectrum. RBW=1MHz and VBW=3MHz is used for conducted emission measurement.

c. Measuring frequency band edge, 20dB attenuation pad is connected with spectrum. 1% of the fundamental emission bandwidth is used for conducted emission measurement.

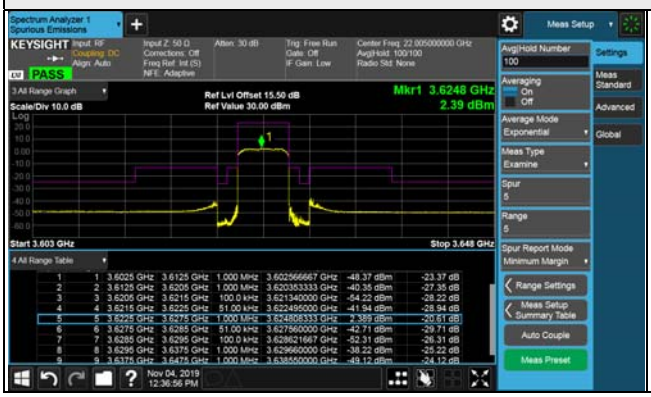
d. For 5 MHz and 10 MHz channel BW mode, extend the 1% range from 1M to 2M above and below the channel edge and then reduce the limit further by 10 log (1000/51)=13dB (i.e. total -13 + -13=-26dB) to compensate for the integration from 51k to 1M.

4.5.4 Test Results

LTE Band 48, Channel Bandwidth 5MHz
Channel 55265 (3552.5MHz)
1RB
Full RB

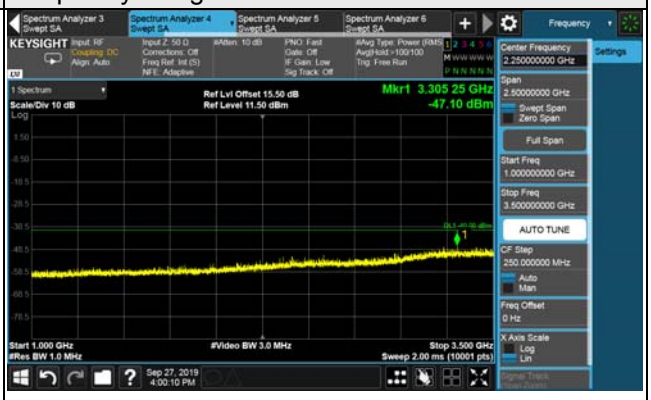
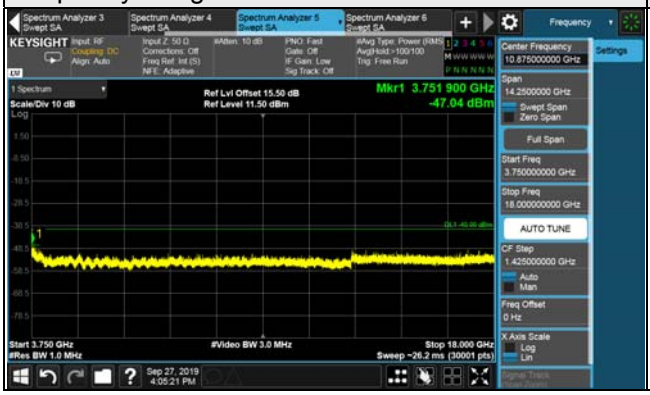
Channel 55990 (3625.0MHz)
1RB

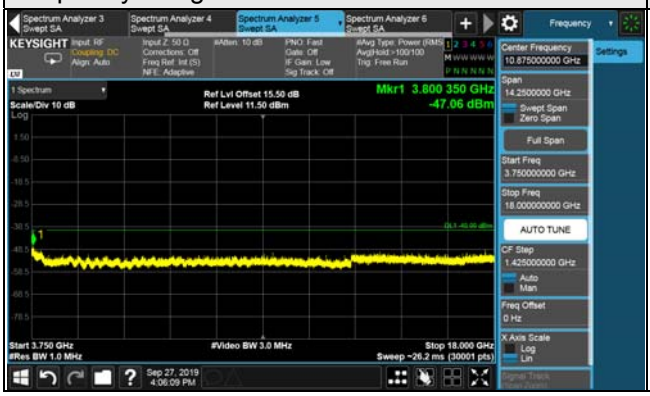
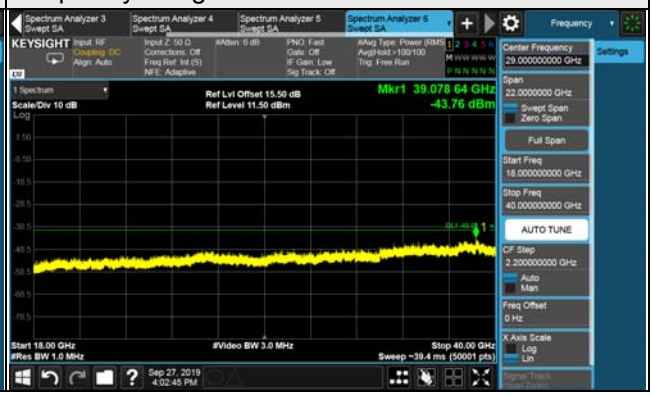
Full RB

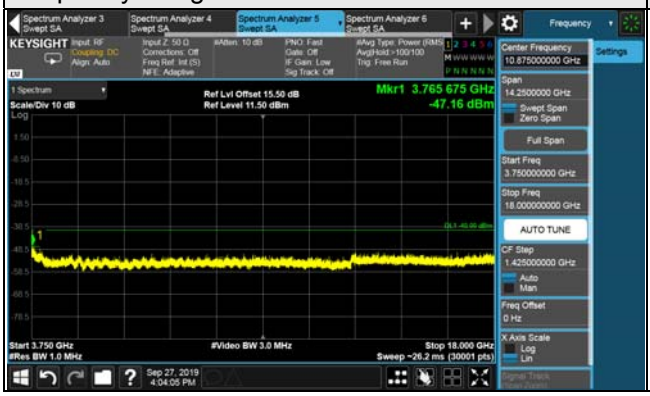
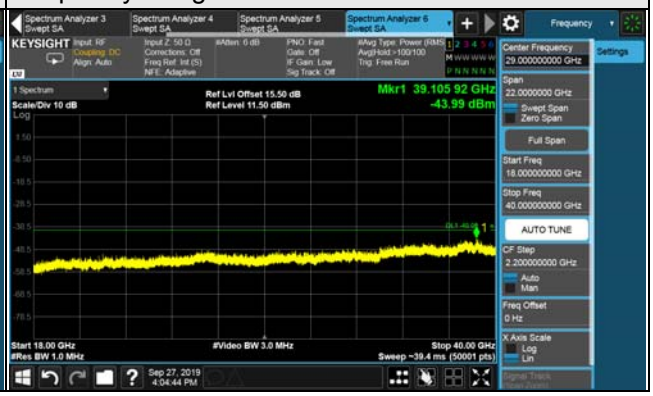


Channel 56715 (3697.5MHz)
1RB

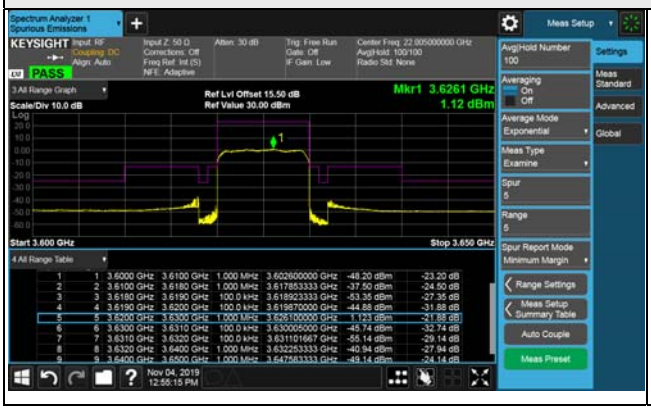
Full RB

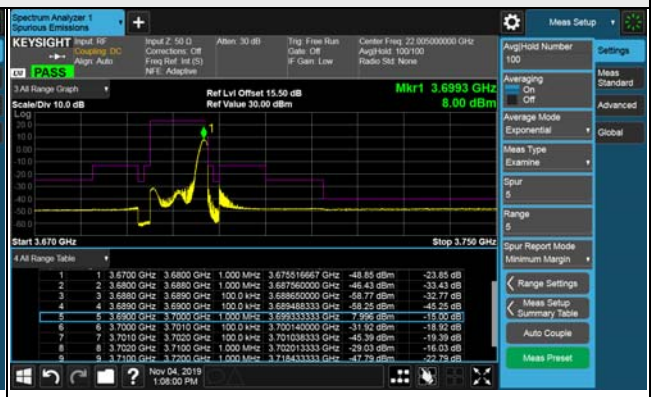
LTE Band 48, Channel Bandwidth 5MHz	
Channel 55265 (3552.5MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~3.5GHz
	
Frequency Range : 3.75GHz~18GHz	Frequency Range : 18GHz~40GHz
	

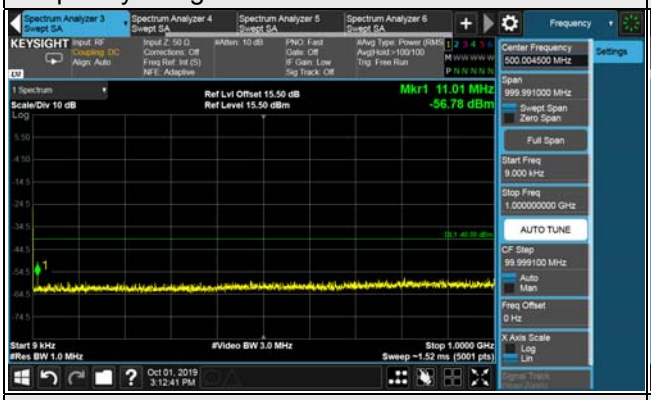
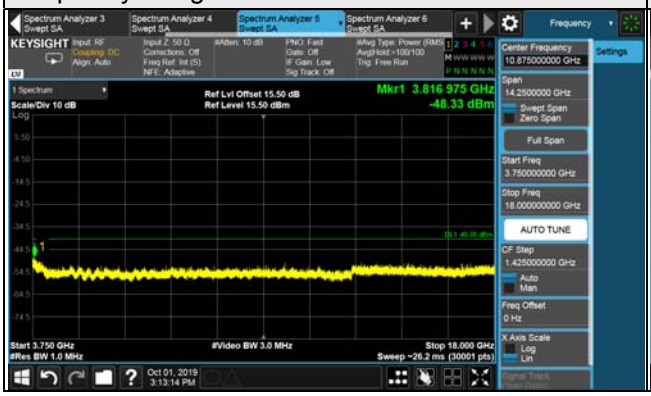
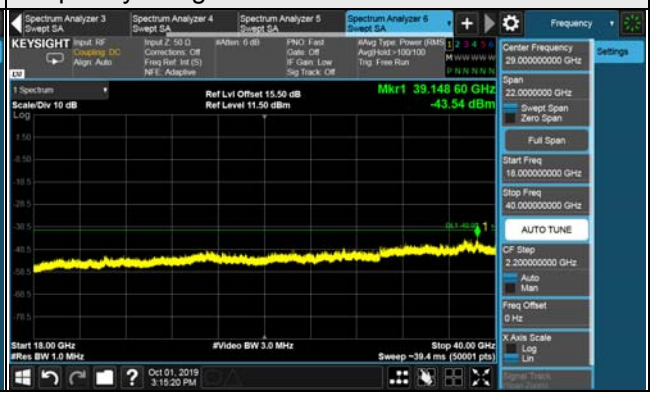
LTE Band 48, Channel Bandwidth 5MHz	
Channel 55990 (3625.0MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~3.5GHz
Frequency Range : 3.75GHz~18GHz	Frequency Range : 18GHz~40GHz
	

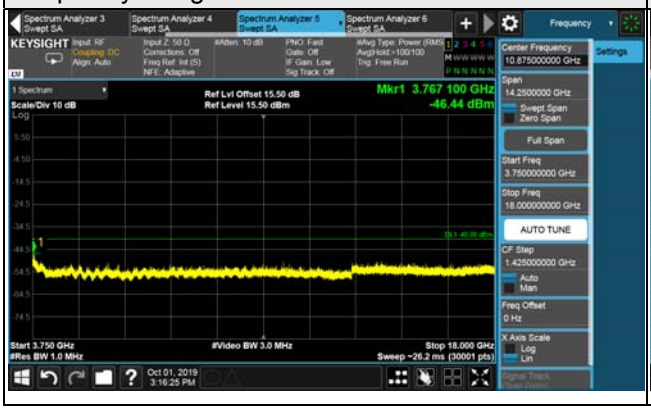
LTE Band 48, Channel Bandwidth 5MHz	
Channel 56715 (3697.50MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~3.5GHz
Frequency Range : 3.75GHz~18GHz	Frequency Range : 18GHz~40GHz
	

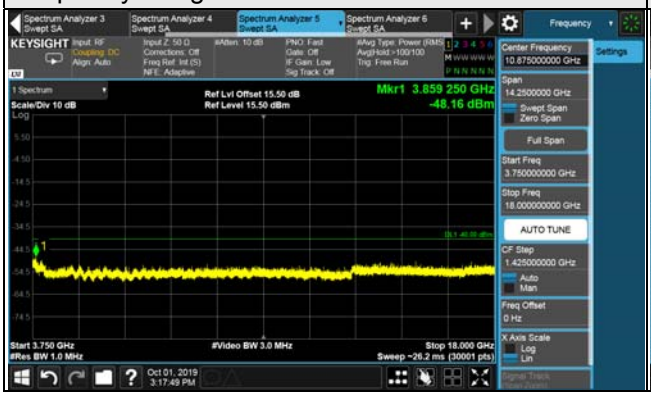
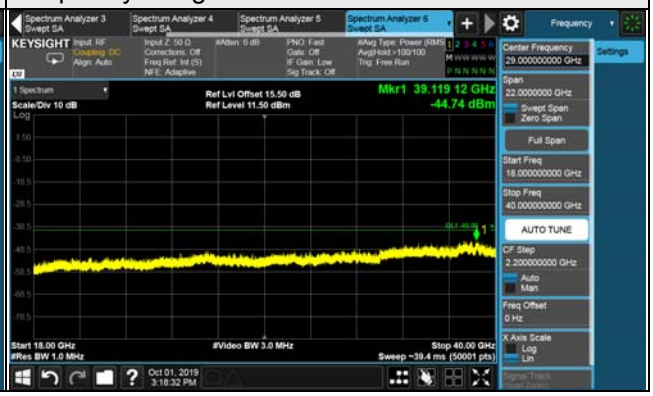
LTE Band 48, Channel Bandwidth 10MHz	
Channel 55290 (3555.0MHz)	
1RB	
Full RB	

Channel 55990 (3625.00MHz)	
1RB	
Full RB	
	

Channel 56690 (3695.0MHz)	
1RB	
	
Full RB	

LTE Band 48, Channel Bandwidth 10MHz	
Channel 55290 (3555.0MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~3.5GHz
	
Frequency Range : 3.75GHz~18GHz	Frequency Range : 18GHz~40GHz
	

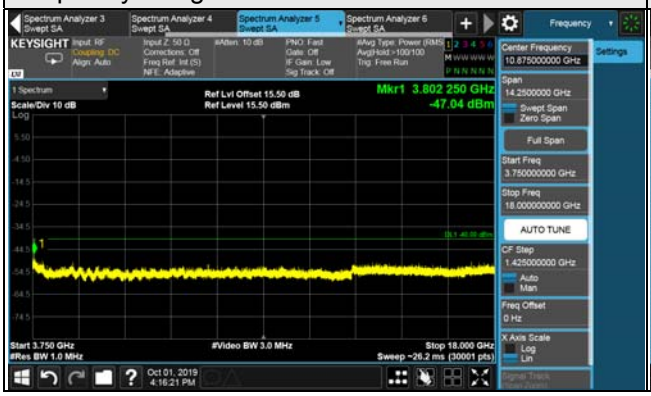
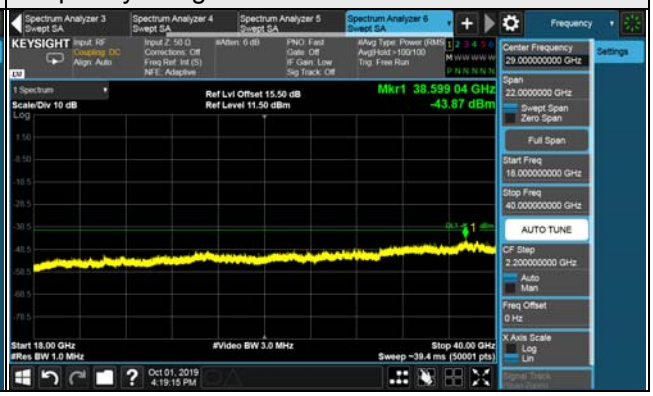
LTE Band 48, Channel Bandwidth 10MHz	
Channel 55990 (3625.00MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~3.5GHz
Frequency Range : 3.75GHz~18GHz	Frequency Range : 18GHz~40GHz
	

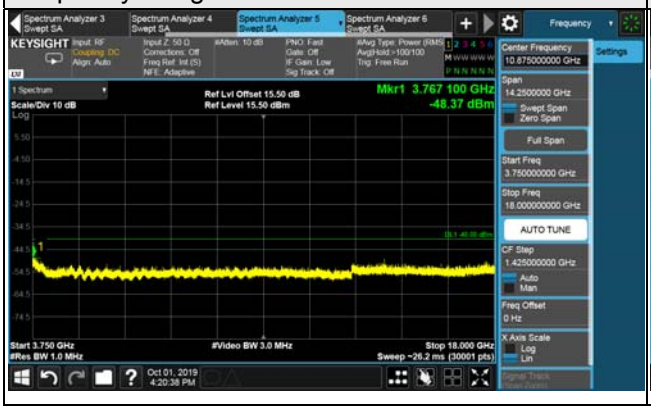
LTE Band 48, Channel Bandwidth 10MHz	
Channel 56690 (3695.0MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~3.5GHz
Frequency Range : 3.75GHz~18GHz	Frequency Range : 18GHz~40GHz
	

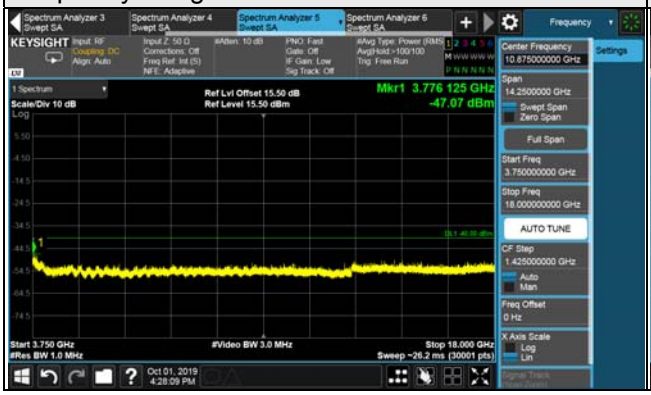
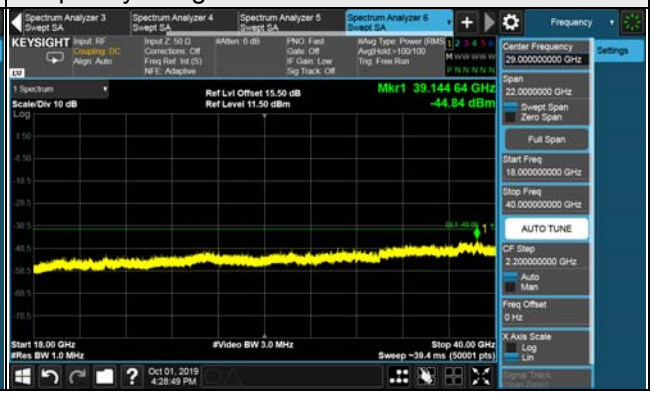
LTE Band 48, Channel Bandwidth 15MHz	
Channel 55315 (3557.50MHz)	
1RB	
Full RB	

Channel 55990 (3625.0MHz)	
1RB	
Full RB	

Channel 56665 (3692.5MHz)	
1RB	
Full RB	

LTE Band 48, Channel Bandwidth 15MHz	
Channel 55315 (3557.50MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~3.5GHz
Frequency Range : 3.75GHz~18GHz	Frequency Range : 18GHz~40GHz
	

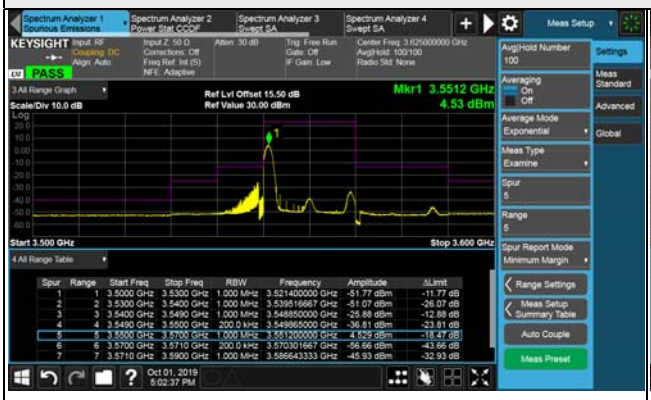
LTE Band 48, Channel Bandwidth 15MHz	
Channel 55990 (3625.0MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~3.5GHz
Frequency Range : 3.75GHz~18GHz	Frequency Range : 18GHz~40GHz
	

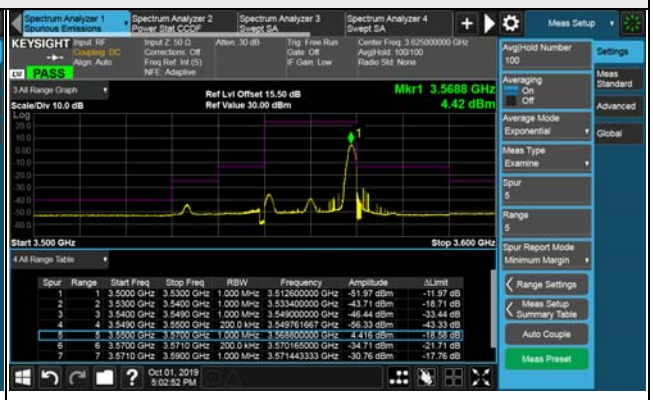
LTE Band 48, Channel Bandwidth 15MHz	
Channel 56665 (3692.50MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~3.5GHz
Frequency Range : 3.75GHz~18GHz	Frequency Range : 18GHz~40GHz
	

LTE Band 48, Channel Bandwidth 20MHz

Channel 55340 (3560.0MHz)

1RB

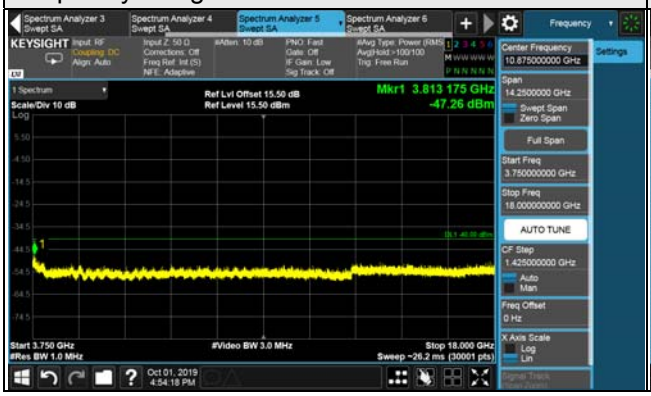
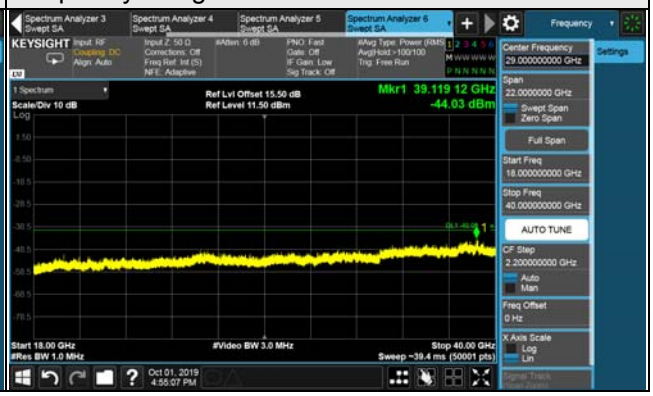


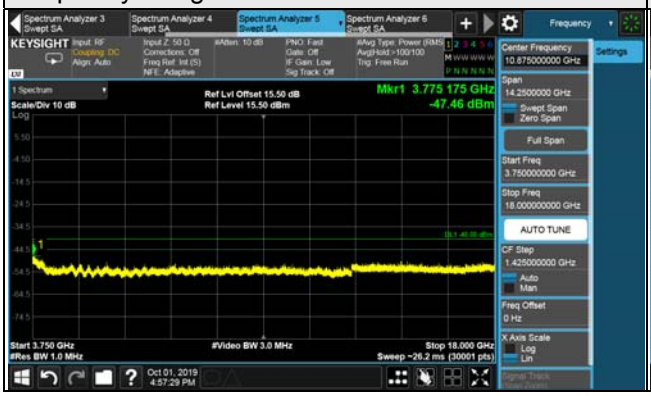
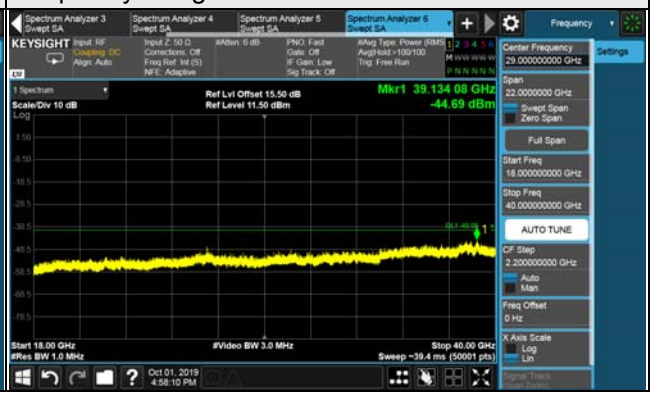


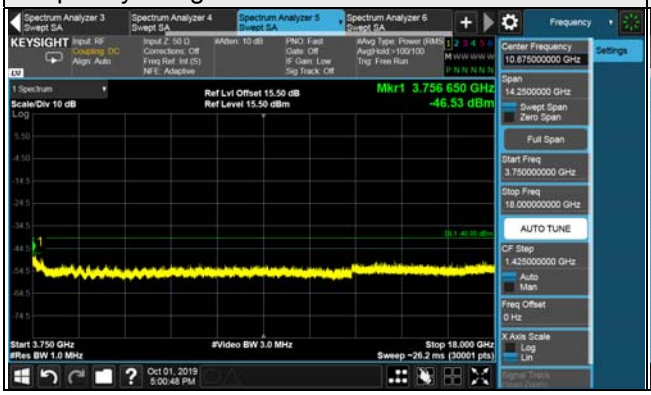
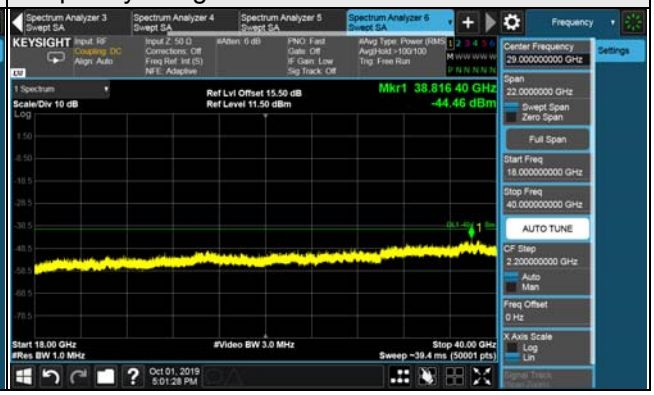
Full RB

Channel 55990 (3625.0MHz)	
1RB	
Full RB	

Channel 56640 (3690.0MHz)	
1RB	
Full RB	

LTE Band 48, Channel Bandwidth 20MHz	
Channel 55340 (3560.0MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~3.5GHz
Frequency Range : 3.75GHz~18GHz	Frequency Range : 18GHz~40GHz
	

LTE Band 48, Channel Bandwidth 20MHz	
Channel 55990 (3625.0MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~3.5GHz
Frequency Range : 3.75GHz~18GHz	Frequency Range : 18GHz~40GHz
	

LTE Band 48, Channel Bandwidth 20MHz	
Channel 56640 (3690.0MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~3.5GHz
Frequency Range : 3.75GHz~18GHz	Frequency Range : 18GHz~40GHz
	

4.6 Radiated Emission Measurement

4.6.1 Limits of Radiated Emission Measurement

The power of any emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.

4.6.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver KEYSIGHT	N9038A	MY55420137	Apr. 15, 2019	Apr. 14, 2020
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100269	Jun. 04, 2019	Jun. 03, 2020
BILOG Antenna SCHWARZBECK	VULB9168	9168-160	Nov. 21, 2018	Nov. 20, 2019
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-1169	Nov. 25, 2018	Nov. 24, 2019
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Nov. 25, 2018	Nov. 24, 2019
Preamplifier Agilent (Below 1GHz)	8447D	2944A10638	Jul. 11, 2019	Jul. 10, 2020
Preamplifier Agilent (Above 1GHz)	8449B	3008A02367	Feb. 19, 2019	Feb. 18, 2020
RF signal cable HUBER+SUHNER&EMCI	SUCOFLEX 104 & EMC104-SM-SM8000	CABLE-CH9-02 (248780+171006)	Jan. 19, 2019	Jan. 18, 2020
RF signal cable HUBER+SUHNER	SUCOFLEX 104	CABLE-CH9-(250795/4)	Jul. 11, 2019	Jul. 10, 2020
RF signal cable Woken	8D-FB	Cable-CH9-01	Jul. 30, 2019	Jul. 29, 2020
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower EMCO	2070/2080	512.835.4684	NA	NA
Turn Table EMCO	2087-2.03	NA	NA	NA
Antenna Tower &Turn BV ADT	AT100	AT93021705	NA	NA
Turn Table BV ADT	TT100	TT93021705	NA	NA
Turn Table Controller BV ADT	SC100	SC93021705	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Pre-amplifier (18GHz-40GHz) EMC	EMC184045B	980175	Nov. 14, 2018	Nov. 13, 2019
WIT Standard Temperature And Humidity Chamber	TH-4S-C	W981030	Jun. 03, 2019	Jun. 02, 2020
JFW 20dB attenuation	50HF-020-SMA	NA	NA	NA
True RMS Clamp Meter Fluke	325	31130711WS	May 21, 2019	May 20, 2020

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 9.

4.6.3 Test Procedures

a. Substitution method is used for EIRP measurement. In the semi-anechoic chamber, EUT placed on the 0.8m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum polar radiated power. The “Read Value” is the spectrum reading the maximum power value.

b. The substitution antenna is substituted for EUT at the same position and signals generator export the CW signal to the substitution antenna via a TX cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to “Read Value” of step a. Record the power level of S.G

c. EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution horn.

d. ERP power can be calculated form EIRP power by subtracting the gain of dipole, ERP power = EIRP power - 2.15dBi.

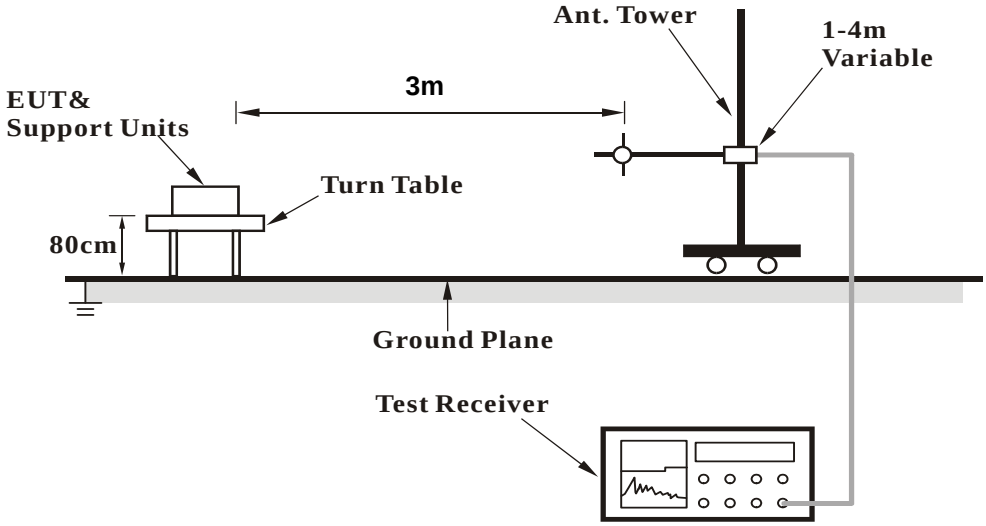
Note: The resolution bandwidth of spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz.

4.6.4 Deviation from Test Standard

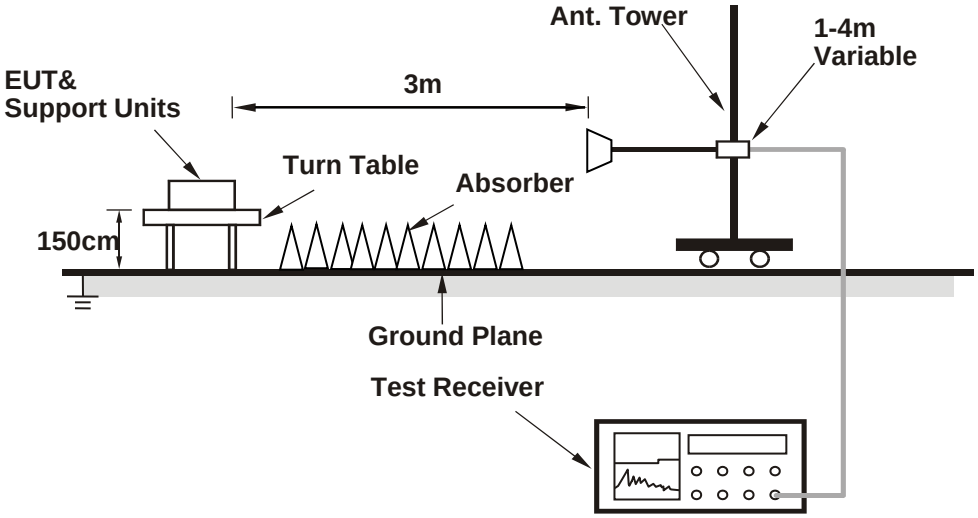
No deviation.

4.6.5 Test Set Up

<Frequency Range below 1GHz>



<Frequency Range above 1GHz>



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.6.6 Test Results

Test was done with 50ohm terminator on antenna port.

Below 1GHz Data：

LTE Band 48

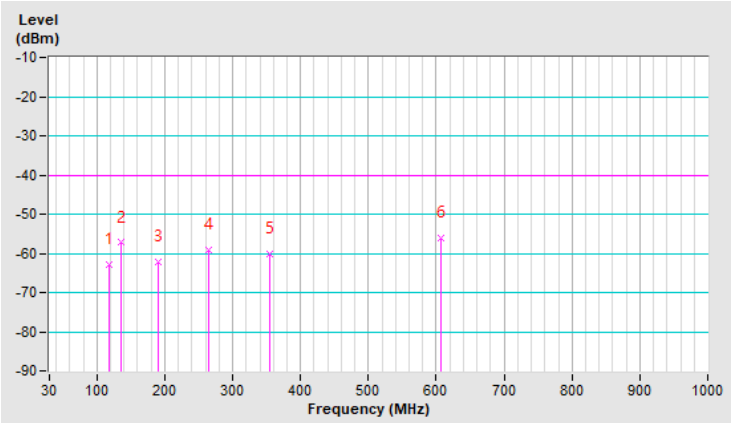
PCB antenna mode

Channel Bandwidth: 5 MHz / QPSK

Mode	TX channel 55265 (3552.5MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	117.30	-55.1	-60.0	-2.9	-62.9	-40.0	-22.9
2	134.76	-51.3	-54.1	-3.2	-57.3	-40.0	-17.3
3	191.02	-53.8	-59.5	-2.7	-62.2	-40.0	-22.2
4	264.74	-54.5	-57.4	-1.6	-59.0	-40.0	-19.0
5	353.98	-56.9	-63.9	3.9	-60.0	-40.0	-20.0
6	606.18	-57.8	-59.8	3.7	-56.1	-40.0	-16.1

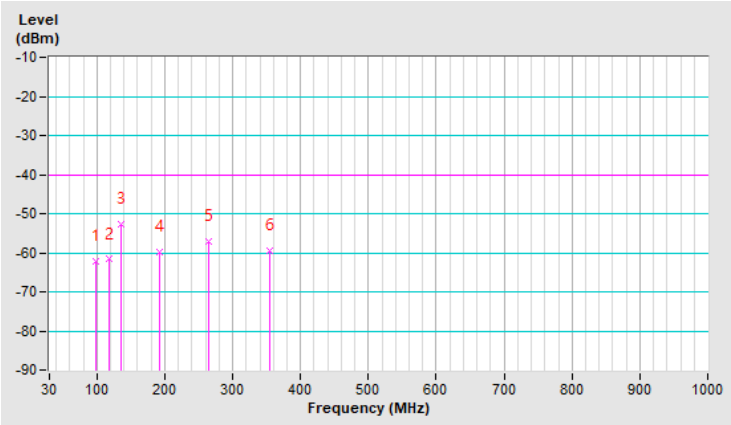
Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).



Mode	TX channel 55265 (3552.5MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	97.90	-54.2	-60.9	-1.4	-62.3	-40.0	-22.3
2	117.30	-54.8	-58.8	-2.9	-61.7	-40.0	-21.7
3	134.76	-49.1	-49.5	-3.2	-52.7	-40.0	-12.7
4	192.96	-58.4	-57.3	-2.6	-59.9	-40.0	-19.9
5	264.74	-58.1	-55.5	-1.6	-57.1	-40.0	-17.1
6	353.98	-59.0	-63.3	3.9	-59.4	-40.0	-19.4

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).



Above 1GHz

LTE Band 48, Channel Bandwidth 5MHz

Mode	TX channel 55265 (3552.5MHz)	Frequency Range	1GHz ~ 40GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7105.00	-66.9	-48.8	0.7	-48.1	-40.0	-8.1
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7105.00	-66.5	-48.8	0.7	-48.1	-40.0	-8.1

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

Mode	TX channel 55990 (3625.0MHz)	Frequency Range	1GHz ~ 40GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7250.00	-66.7	-48.9	0.9	-48.0	-40.0	-8.0
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7250.00	-66.5	-48.6	0.9	-47.7	-40.0	-7.7

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

Mode	TX channel 56715 (3697.5MHz)	Frequency Range	1GHz ~ 40GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7395.00	-67.0	-48.4	0.9	-47.5	-40.0	-7.5
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7395.00	-66.5	-48.8	0.9	-47.9	-40.0	-7.9

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

LTE Band 48, Channel Bandwidth 20MHz

Mode	TX channel 55340 (3560.0MHz)	Frequency Range	1GHz ~ 40GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7120.00	-66.5	-48.5	0.7	-47.8	-40.0	-7.8
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7120.00	-66.7	-49.0	0.7	-48.3	-40.0	-8.3

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

Mode	TX channel 55990 (3625.00MHz)	Frequency Range	1GHz ~ 40GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7250.00	-66.5	-48.7	0.9	-47.8	-40.0	-7.8
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7250.00	-66.3	-48.4	0.9	-47.5	-40.0	-7.5

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

Mode	TX channel 56640 (3690.00MHz)	Frequency Range	1GHz ~ 40GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7380.00	-66.6	-48.1	0.9	-47.2	-40.0	-7.2
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7380.00	-66.7	-49.0	0.9	-48.1	-40.0	-8.1

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

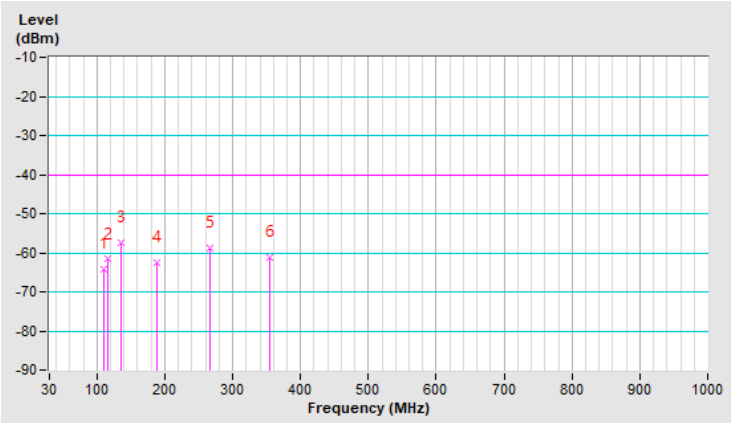
Dipole antenna mode

Channel Bandwidth: 5 MHz / QPSK

Mode	TX channel 55265 (3552.5MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	109.54	-56.4	-61.8	-2.5	-64.3	-40.0	-24.3
2	115.36	-53.7	-58.8	-2.9	-61.7	-40.0	-21.7
3	134.76	-51.6	-54.4	-3.2	-57.6	-40.0	-17.6
4	189.08	-54.0	-59.6	-2.8	-62.4	-40.0	-22.4
5	266.68	-54.4	-57.1	-1.6	-58.7	-40.0	-18.7
6	353.98	-58.2	-65.2	3.9	-61.3	-40.0	-21.3

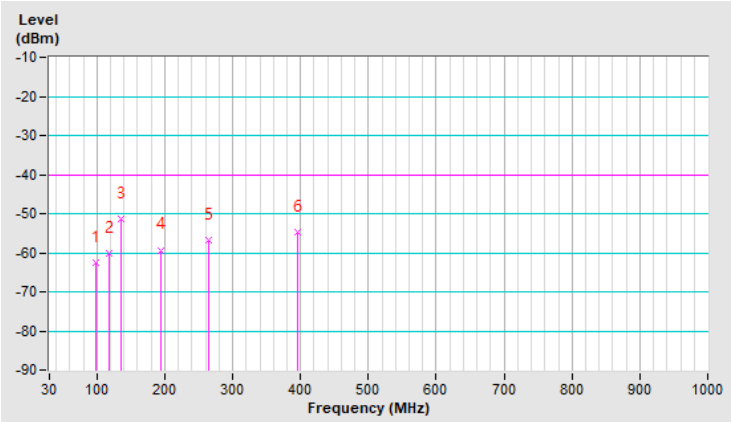
Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).



Mode	TX channel 55265 (3552.5MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	97.90	-54.5	-61.2	-1.4	-62.6	-40.0	-22.6
2	117.30	-53.3	-57.3	-2.9	-60.2	-40.0	-20.2
3	134.76	-47.6	-48.0	-3.2	-51.2	-40.0	-11.2
4	194.90	-58.2	-56.7	-2.6	-59.3	-40.0	-19.3
5	264.74	-57.7	-55.1	-1.6	-56.7	-40.0	-16.7
6	396.66	-53.9	-57.9	3.3	-54.6	-40.0	-14.6

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).



Above 1GHz

LTE Band 48, Channel Bandwidth 5MHz

Mode	TX channel 55265 (3552.5MHz)	Frequency Range	1GHz ~ 40GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	**7105.00**	**-64.2**	**-46.1**	**0.7**	**-45.4**	**-40.0**	**-5.4**
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7105.00	-64.6	-46.9	0.7	-46.2	-40.0	-6.2

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

Mode	TX channel 55990 (3625.0MHz)	Frequency Range	1GHz ~ 40GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7250.00	-67.0	-49.2	0.9	-48.3	-40.0	-8.3
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7250.00	-66.4	-48.5	0.9	-47.6	-40.0	-7.6

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

Mode	TX channel 56715 (3697.5MHz)	Frequency Range	1GHz ~ 40GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7395.00	-66.8	-48.2	0.9	-47.3	-40.0	-7.3
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7395.00	-66.6	-48.9	0.9	-48.0	-40.0	-8.0

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

LTE Band 48, Channel Bandwidth 20MHz

Mode	TX channel 55340 (3560.0MHz)	Frequency Range	1GHz ~ 40GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7120.00	-66.7	-48.7	0.7	-48.0	-40.0	-8.0
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7120.00	-66.3	-48.6	0.7	-47.9	-40.0	-7.9

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

Mode	TX channel 55990 (3625.00MHz)	Frequency Range	1GHz ~ 40GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7250.00	-67.0	-49.2	0.9	-48.3	-40.0	-8.3
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7250.00	-66.4	-48.5	0.9	-47.6	-40.0	-7.6

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

Mode	TX channel 56640 (3690.00MHz)	Frequency Range	1GHz ~ 40GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7380.00	-66.9	-48.4	0.9	-47.5	-40.0	-7.5
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	7380.00	-66.6	-48.9	0.9	-48.0	-40.0	-8.0

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Lin Kou EMC/RF Lab
Tel: 886-2-26052180
Fax: 886-2-26051924

Hsin Chu EMC/RF Lab/Telecom Lab
Tel: 886-3-6668565
Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab
Tel: 886-3-3183232
Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com
Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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