FCC Test Report
(Part 27 – LTE Band 8)

Report No.:	RFBEDF-WTW-P21100617
FCC ID:	QI3BEC-MX200PL9
Test Model:	MXConnect® MX-200 PL9
Received Date:	Nov. 04, 2021
Test Date:	Nov. 05 ~ Nov. 11, 2021
Issued Date:	Dec. 22, 2021
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 (1):	No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, Taiwan
Test Location (2):	No. 70, Wenming Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)
FCC Registration / Designation Number (1):	788550 / TW0003
FCC Registration / Designation Number (2):	281270 / TW0032

Testing Laboratory
2021

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Release Control Record

Issue No.	Description	Date Issued
RFBEDF-WTW-P21100617	Original release	Dec. 22, 2021

1 Certificate of Conformity

Product:	4G LTE Industrial Router
Brand:	BEC, BILLION
Test Model:	MXConnect® MX-200 PL9
Sample Status:	Engineering sample
Applicant:	BILLION ELECTRIC CO., LTD.
Test Date:	Nov. 05 ~ Nov. 11, 2021
Standards:	FCC Part 27, Subpart C, P

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 : Pettie Chen , **Date:** Dec. 22, 2021

Pettie Chen / Senior Specialist

Approved by : Jeremy Lin , **Date:** Dec. 22, 2021

Jeremy Lin / Project Engineer

2 Summary of Test Results

Applied Standard: FCC Part 27 & Part 2			
FCC Clause	Test Item	Result	Remarks
2.1046 27.1507	Equivalent radiated power	Pass	Meet the requirement of limit.
2.1047	Modulation characteristics	Pass	Meet the requirement of limit.
2.1055 27.54	Frequency Stability	Pass	Meet the requirement of limit.
2.1049	Emission Bandwidth	Pass	Meet the requirement of limit.
2.1051 27.1509	Out of Band Emission Measurements	Pass	Meet the requirement of limit.
27.1507 (d)	Peak To Average Ratio	Pass	Meet the requirement of limit.
2.1051 27.1509	Conducted Spurious Emissions	Pass	Meet the requirement of limit.
2.1053 27.1509	Radiated Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -38.54dB at 32.81MHz.

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	9kHz ~ 30MHz	3.00 dB
	30MHz ~ 200MHz	2.91 dB
	200MHz ~1000MHz	2.93 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	1.76 dB
	18GHz ~ 40GHz	1.77 dB

2.2 Test Site and Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver Rohde & Schwarz	ESR3	102782	Dec. 21, 2020	Dec. 20, 2021
Spectrum Analyzer Rohde & Schwarz	FSW43	101582	Apr. 01, 2021	Mar. 31, 2022
BILOG Antenna SCHWARZBECK	VULB9168	9168-1213	Oct. 27, 2021	Oct. 26, 2022
HORN Antenna RF SPIN	DRH18-E	210103A18E	Nov. 14, 2021	Nov. 13, 2022
HORN Antenna SCHWARZBECK	BBHA 9170	9170-1048	Nov. 14, 2021	Nov. 13, 2022
Preamplifier EMCI	EMC330N	980782	Jan. 19, 2021	Jan. 18, 2022
Preamplifier EMCI	EMC118A45SE	980808	Jan. 03, 2021	Jan. 02, 2022
Preamplifier EMCI	EMC184045SE	980788	Jan. 18, 2021	Jan. 17, 2022
RF signal cable EMCI	EMC104-SM-SM-(9000+2000+1000)	201243+ 201231+ 210102	Jan. 18, 2021	Jan. 17, 2022
RF signal cable EMCI	EMCCFD400-NM-NM-(9000+300+500)	201236+ 201235+ 201233	Jan. 18, 2021	Jan. 17, 2022
RF signal cable EMCI	EMC101G-KM-KM-(5000+3000+2000)	201260+201257+201254	Jan. 18, 2021	Jan. 17, 2022
Software BV ADT	ADT_Radiated_V7.6.15.9.5	NA	NA	NA
Antenna Tower Max-Full	MFT-151SS-0.5T	NA	NA	NA
Turn Table Max-Full	MF-7802BS	NA	NA	NA
Turn Table Controller Max-Full	MF-7802BS	MF780208674	NA	NA
JFW 20dB attenuation	50HF-020-SMA	NA	NA	NA
Radio Communication Analyzer Anritsu	MT8821C	6201462755	Feb. 07, 2021	Feb. 06, 2022
Digital Multimeter Fluke	87-III	70360742	Jun. 24, 2021	Jun. 23, 2022
MXG Vector signal generator Agilent	N5182B	MY53050430	Nov. 25, 2020	Nov. 24, 2021
AC power supply Extech	6905S	1991553	NA	NA
Temperature & Humidity Chamber TERCHY	MHU-225AU	920842	Jun. 15, 2021	Jun. 14, 2022
Spectrum Analyzer Rohde & Schwarz	FSW43	101582	Apr. 01, 2021	Mar. 31, 2022

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 WM Chamber 8.

3 General Information

3.1 General Description of EUT

Product	4G LTE Industrial Router		
Brand	BEC, BILLION		
Test Model	MXConnect® MX-200 PL9		
Sample Status	Engineering sample		
Power Supply Rating	12Vdc (from adapter)		
Modulation Type	QPSK, 16QAM		
Operating Frequency	LTE Band 8 (Channel Bandwidth 1.4MHz)	898.2MHz ~ 899.8MHz	
	LTE Band 8 (Channel Bandwidth 3MHz)	899.0MHz	
Max. ERP Power		QPSK	16QAM
	LTE Band 8 (Channel Bandwidth 1.4MHz)	180.717mW (22.57dBm)	137.721mW (21.39dBm)
	LTE Band 8 (Channel Bandwidth 3MHz)	164.816mW (22.17dBm)	126.183mW (21.01dBm)
Emission Designator		QPSK	16QAM
	LTE Band 8 (Channel Bandwidth 1.4MHz)	1M08G7D	1M08D7W
	LTE Band 8 (Channel Bandwidth 3MHz)	2M68G7D	2M68D7W
Antenna Type	Dipole antenna with 1.1dBi gain		
Antenna Connector	SMA Plug		
Accessory Device	Adapter, IDU antenna (Brand: BEC, Model: SX-V2/ OA-L71-12-05-C5-BL)		
Cable Supplied	Refer to Note as below		

Note:

1. The EUT is powered by the following adapters.

Adapter 1	
Brand	BILLION
Model	BA018-120120AXU
Input Power	100-240Vac, 50/60Hz, 0.5A
Output Power	12Vdc, 1.2A
Power Cable	1.55m non-shielded cable without core

Adapter 2	
Brand	BILLION
Model	PA1015-120HUB120
Input Power	100-240Vac, 50/60Hz, 0.4A
Output Power	12.0Vdc, 1.2A
Power Cable	1.5m non-shielded cable without core

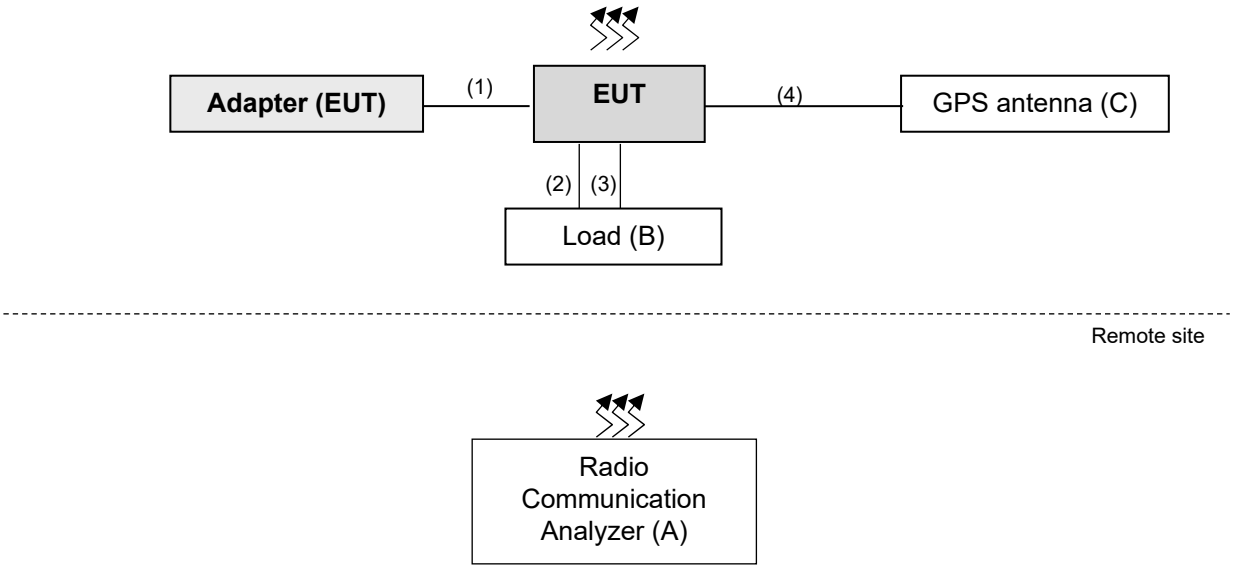
*Adapter 2 was the worst for the final tests.

2. The antenna information is listed as below.

Type	Connector	Gain (dBi)
Dipole	SMA	1.1

* The above Antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.

3.2 Configuration of System under Test



3.2.1 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.	Radio Communication Analyzer	Anritsu	MT8821C	6261806803	NA	-
B.	Load	NA	NA	NA	NA	-
C.	GPS Antenna	Cortec	AG1575-0230SM	NA	NA	Provided by client

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Item A acted as a communication partner to transfer data.

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	Power cable	1	1.5	N	1	Provided by client
2.	LAN cable	2	1.5	N	0	-
3.	Console cable	1	1.5	N	0	-
4.	GPS Antenna	1	3.0	N	0	Provided by client (Support unit)

Note: The core(s) is(are) originally attached to the cable(s).

3.3 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 as the table below. Following channel(s) was (were) selected for the final test as listed below:

Band	Radiated Emission
LTE Band 8	Z-plane

LTE Band 8

EUT Configure Mode	Test item	Available channel	Tested channel	Channel Bandwidth	Modulation	Mode
-	ERP	21632 to 21648	21632 (898.2MHz), 21640 (899.0MHz), 21648 (899.8MHz)	1.4MHz	QPSK / 16QAM	1 RB / 0 RB Offset 1 RB / 2 RB Offset 1 RB / 5 RB Offset 3 RB / 0 RB Offset 3 RB / 1 RB Offset 3 RB / 3 RB Offset 6 RB / 0 RB Offset
		21640	21640 (899.0MHz)	3MHz	QPSK / 16QAM	1 RB / 0 RB Offset 1 RB / 7 RB Offset 1 RB / 14 RB Offset 8 RB / 0 RB Offset 8 RB / 3 RB Offset 8 RB / 7 RB Offset 15 RB / 0 RB Offset
-	Modulation Characteristics	21640	21640 (899.0MHz)	3MHz	QPSK / 16QAM	15 RB / 0 RB Offset
-	Frequency Stability	21632 to 21648	21632 (898.2MHz), 21648 (899.8MHz)	1.4MHz	QPSK	6 RB / 0 RB Offset
		21640	21640 (899.0MHz)	3MHz	QPSK	15 RB / 0 RB Offset
-	Emission Bandwidth	21632 to 21648	21632 (898.2MHz), 21640 (899.0MHz), 21648 (899.8MHz)	1.4MHz	QPSK / 16QAM	6 RB / 0 RB Offset
		21640	21640 (899.0MHz)	3MHz	QPSK / 16QAM	15 RB / 0 RB Offset
-	Out-of-Band Emissions	21632 to 21648	21632 (898.2MHz), 21640 (899.0MHz), 21648 (899.8MHz)	1.4MHz	QPSK	1 RB / 0 RB Offset 1 RB / 5 RB Offset 6 RB / 0 RB Offset
		21640	21640 (899.0MHz)	3MHz	QPSK	1 RB / 0 RB Offset 1 RB / 14 RB Offset 15 RB / 0 RB Offset
-	Peak to Average Ratio	21632 to 21648	21632 (898.2MHz), 21640 (899.0MHz), 21648 (899.8MHz)	1.4MHz	QPSK / 16QAM	1 RB / 0 RB Offset
		21640	21640 (899.0MHz)	3MHz	QPSK / 16QAM	1 RB / 0 RB Offset

EUT Configure Mode	Test item	Available channel	Tested channel	Channel Bandwidth	Modulation	Mode
-	Conducted Emission	21632 to 21648	21632 (898.2MHz), 21640 (899.0MHz), 21648 (899.8MHz)	1.4MHz	QPSK	1 RB / 0 RB Offset
		21640	21640 (899.0MHz)	3MHz	QPSK	1 RB / 0 RB Offset
-	Radiated Emission (Frequency range below 1GHz)	21632 to 21648	21648 (899.8MHz)	1.4MHz	QPSK	1 RB / 0 RB Offset
-	Radiated Emission (Frequency range above 1GHz)	21632 to 21648	21648 (899.8MHz)	1.4MHz	QPSK	1 RB / 0 RB Offset
		21640	21640 (899.0MHz)	3MHz	QPSK	1 RB / 0 RB Offset

Note:

1. For radiated emission below 1GHz, select the worst radiated emission channel (above 1GHz) for final testing.
2. For radiated emission above 1GHz, according to 3GPP 36.521-1 Section 6.6.3.1.4.1, choose the 5MHz & highest channel bandwidth for final test.
3. The output power for QPSK and 16QAM, measured value of QPSK is higher than 16QAM mode. Therefore, only Modulation characteristics, occupied bandwidth and Peak to average ratio items had been tested under QPSK and 16QAM modes, the other test items were performed under worse mode according to the maximum output power.

Test Condition:

Test Item	Environmental Conditions	Input Power	Tested By
ERP	25deg. C, 60%RH	120Vac, 60Hz	James Yang
Modulation Characteristics	25deg. C, 60%RH	120Vac, 60Hz	James Yang
Frequency Stability	25deg. C, 60%RH	120Vac, 60Hz	James Yang
Occupied Bandwidth	25deg. C, 60%RH	120Vac, 60Hz	James Yang
Band Edge	25deg. C, 60%RH	120Vac, 60Hz	James Yang
Peak To Average Ratio	25deg. C, 60%RH	120Vac, 60Hz	James Yang
Conducted Emission	25deg. C, 60%RH	120Vac, 60Hz	James Yang
Radiated Emission	23deg. C, 68%RH	120Vac, 60Hz	Edison Lee

3.4 EUT Operating Conditions

The EUT makes a call to the communication simulator. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency

3.5 General Description of Applied Standards and References

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

Test Standard:

FCC 47 CFR Part 2

FCC 47 CFR Part 27

ANSI/TIA/EIA-603-E 2016

ANSI 63.26-2015

References Test Guidance:

KDB 971168 D01 Power Meas License Digital Systems v03r01

All test items have been performed as a reference to the above KDB test guidance.

4 Test Types and Results

4.1 Output Power Measurement

4.1.1 Limits of Output Power Measurement

Mobile, control and auxiliary test stations. Mobile, control and auxiliary test stations must not exceed 10 watts ERP.
Portable stations. Portable stations must not exceed 3 watts ERP.

4.1.2 Test Procedures

Conducted Power Measurement:

The EUT was set up for the maximum power with LTE link data modulation and link up with simulator. Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator.

Maximum EIRP / ERP

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

$EIRP = P_{Meas} + G_T$

$ERP = P_{Meas} + G_T - 2.15$

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)

4.1.3 Test Setup

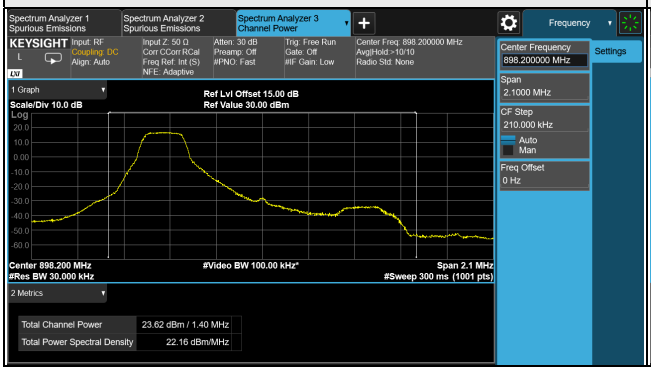
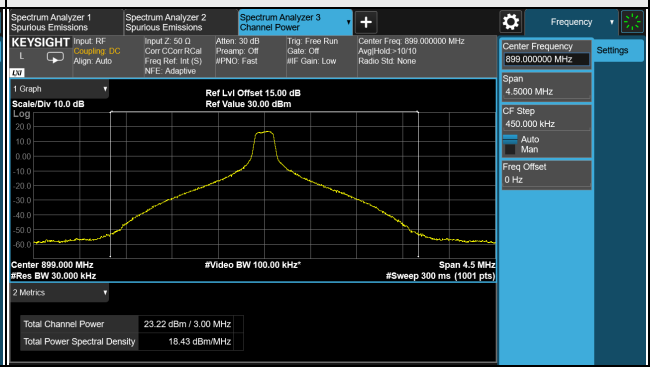
Conducted Power Measurement:

4.1.4 Test Results

Conducted Output Power (dBm)

LTE Band 8						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		21632	21640	21648
		Frequency (MHz)		898.2	899	899.8
1.4M	QPSK	1	0	23.62	23.36	23.03
		1	2	23.52	23.53	23.18
		1	5	23.56	23.31	23.23
		3	0	23.23	23.13	22.98
		3	1	23.35	23.09	23.07
		3	3	23.26	23.12	23.01
		6	0	22.24	21.91	21.82
1.4M	16QAM	1	0	22.14	22.26	22.01
		1	2	22.38	22.11	22.19
		1	5	22.23	22.06	22.09
		3	0	22.39	22.14	22.11
		3	1	22.44	22.20	22.01
		3	3	22.36	22.16	22.08
		6	0	21.27	21.16	21.09

LTE Band 8				
BW	MCS Index	RB Size	RB Offset	Mid
		Channel		21640
		Frequency (MHz)		899
3M	QPSK	1	0	22.85
		1	7	23.22
		1	14	23.01
		8	0	21.99
		8	3	21.87
		8	7	21.93
		15	0	21.94
3M	16QAM	1	0	22.05
		1	7	22.06
		1	14	21.94
		8	0	21.07
		8	3	21.01
		8	7	21.02
		15	0	21.06

Spectrum Plot of Measurement Value	
1.4M / QPSK / Ch 21632	3M / QPSK / Ch 21640
	

ERP Power (dBm)

LTE Band 8						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		21632	21640	21648
		Frequency (MHz)		898.2	899	899.8
1.4M	QPSK	1	0	22.57	22.31	21.98
		1	2	22.47	22.48	22.13
		1	5	22.51	22.26	22.18
		3	0	22.18	22.08	21.93
		3	1	22.30	22.04	22.02
		3	3	22.21	22.07	21.96
		6	0	21.19	20.86	20.77
1.4M	16QAM	1	0	21.09	21.21	20.96
		1	2	21.33	21.06	21.14
		1	5	21.18	21.01	21.04
		3	0	21.34	21.09	21.06
		3	1	21.39	21.15	20.96
		3	3	21.31	21.11	21.03
		6	0	20.22	20.11	20.04

*ERP = Conducted Output Power+ Gain (1.1dBi)-2.15

LTE Band 8				
BW	MCS Index	RB Size	RB Offset	Mid
		Channel		21640
		Frequency (MHz)		899
3M	QPSK	1	0	21.80
		1	7	22.17
		1	14	21.96
		8	0	20.94
		8	3	20.82
		8	7	20.88
		15	0	20.89
3M	16QAM	1	0	21.00
		1	7	21.01
		1	14	20.89
		8	0	20.02
		8	3	19.96
		8	7	19.97
		15	0	20.01

*ERP = Conducted Output Power+ Gain (1.1dBi)-2.15

4.2 Modulation Characteristics Measurement

4.2.1 Limits of Modulation Characteristics

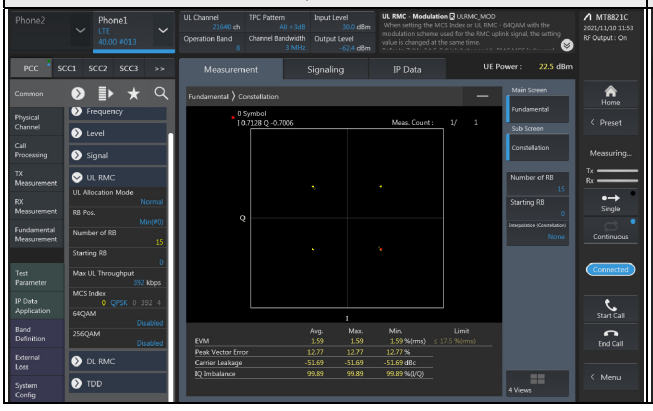
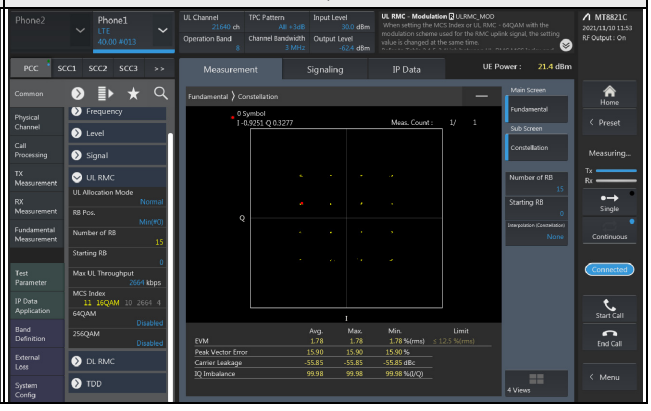
N/A

4.2.2 Test Procedure

Connect the EUT to Communication Simulator via the antenna connector, The frequency band is set as EUT supported Modulation and Channels, the EUT output is matched with 50 ohm load, the waveform quality and constellation of the EUT was tested.

4.2.3 Test Setup

4.2.4 Test Results

LTE Band 8	
Spectrum Plot of Measurement Value	
Channel: 21640 / Frequency (MHz): 899.0MHz	
QPSK	16QAM
	

4.3 Frequency Stability Measurement

4.3.1 Limits of Frequency Stability Measurement

According to the FCC part 2.1055 shall be tested the frequency stability. The rule is defined that" The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block." The test extreme voltage is according to the 2.1055(d)(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment and the extreme temperature rule is comply with specification of EUT -30℃ ~ 60℃.

4.3.2 Test Procedure

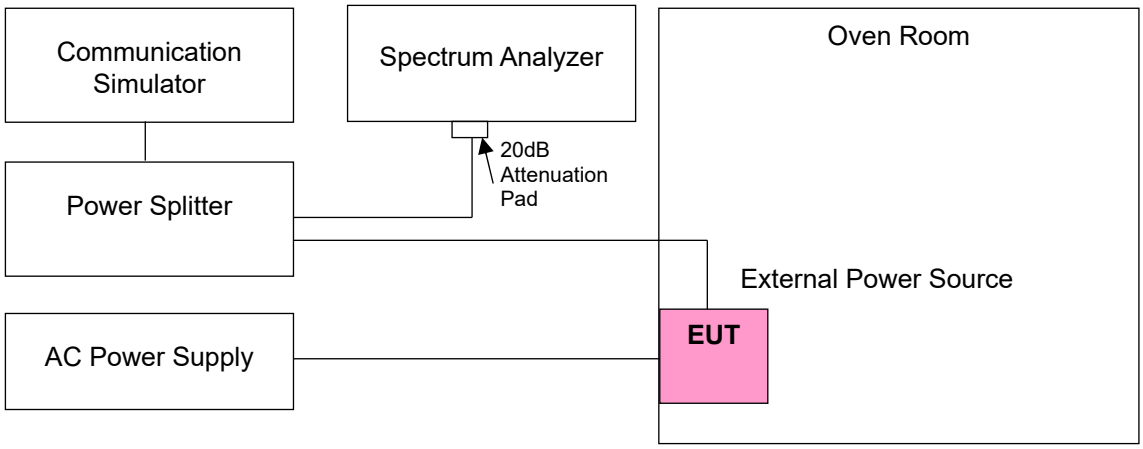
a. Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.

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.

4.3.3 Test Setup



4.3.4 Test Results

Frequency Error vs. Voltage

Voltage (Vac)	LTE Band 8			
	Channel Bandwidth 1.4MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
93.5	898.200001	0.001	899.800003	0.003
110.0	898.200002	0.002	899.800002	0.002
126.5	898.200001	0.002	899.800002	0.002

Note: The applicant defined the normal working voltage is from 93.5Vac to 126.5Vac.

Frequency Error vs. Temperature

Temp. (℃)	LTE Band 8			
	Channel Bandwidth 1.4MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	898.200002	0.002	899.800001	0.001
-20	898.200003	0.003	899.800003	0.003
-10	898.200001	0.001	899.800003	0.003
0	898.200004	0.004	899.800003	0.003
10	898.200004	0.004	899.800002	0.002
20	898.199999	-0.001	899.799998	-0.002
30	898.199998	-0.002	899.799998	-0.002
40	898.199997	-0.004	899.799996	-0.004
50	898.199996	-0.004	899.799999	-0.001
60	898.199999	-0.001	899.799998	-0.002

Frequency Error vs. Voltage

Voltage (Vac)	LTE Band 8	
	Channel Bandwidth 3MHz	
	Frequency (MHz)	Frequency Error (ppm)
93.5	899.000004	0.004
110.0	899.000001	0.001
126.5	899.000004	0.004

Note: The applicant defined the normal working voltage is from 93.5Vac to 126.5Vac.

Frequency Error vs. Temperature

Temp. (℃)	LTE Band 8	
	Channel Bandwidth 3MHz	
	Frequency (MHz)	Frequency Error (ppm)
-30	899.000002	0.002
-20	899.000002	0.002
-10	899.000001	0.001
0	899.000003	0.004
10	899.000002	0.002
20	898.999997	-0.004
30	898.999999	-0.001
40	898.999997	-0.003
50	898.999996	-0.004
60	898.999996	-0.004

4.4 Emission Bandwidth Measurement

4.4.1 Limits of Emission Bandwidth Measurement

According to FCC 2.1049, the occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 % of the total mean power radiated by a given emission.

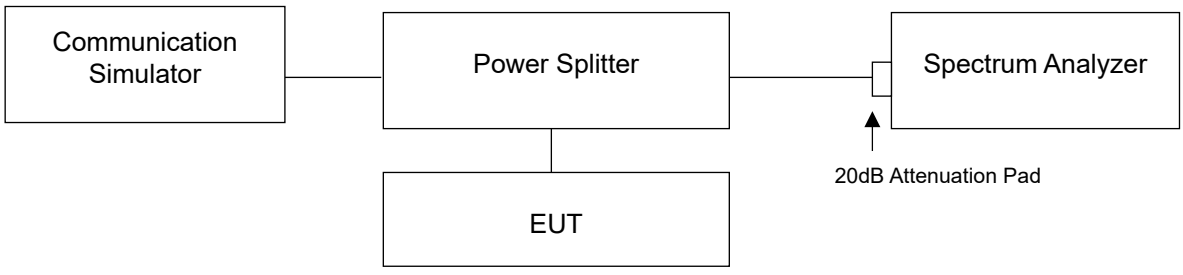
4.4.2 Test Procedure

For the 26dBc bandwidth measurement method, please refer to section 5.4.3 of ANSI C63.26.

a) 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.
b) The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.
c) 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. See guidance provided in 4.2.3.
d) 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.
e) Set spectrum analyzer detection mode to peak, and the trace mode to max hold.
f) Determine the following reference values: 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).
g) 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.
h) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below the "−X dB amplitude" determined in step f). If a marker is below this "−X dB amplitude" value it should be as close as possible to this value. The OBW is the positive frequency difference between the two markers.
i) The OBW shall be reported by providing plot(s) of the measuring instrument display, to include markers depicting the relevant frequency and amplitude information (e.g., marker table). The frequency and amplitude axis and scale shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

For the occupied bandwidth measurement method, please refer to section 5.4.4 of ANSI C63.26.

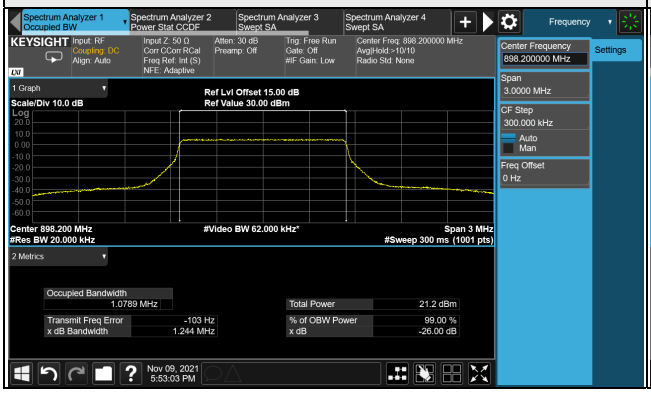
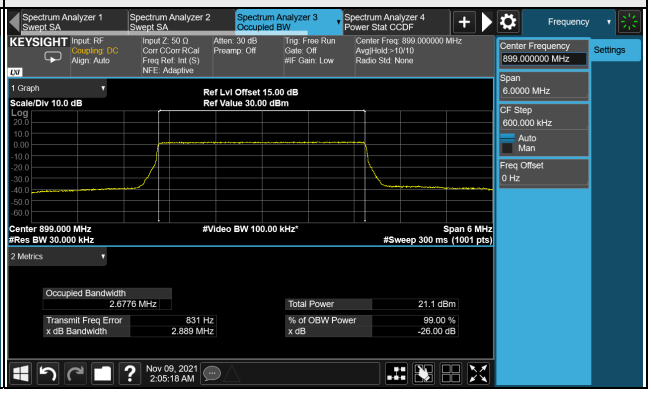
4.4.3 Test Setup



4.4.4 Test Result

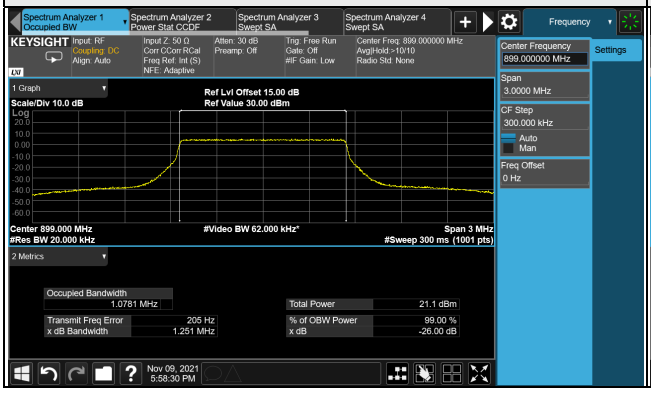
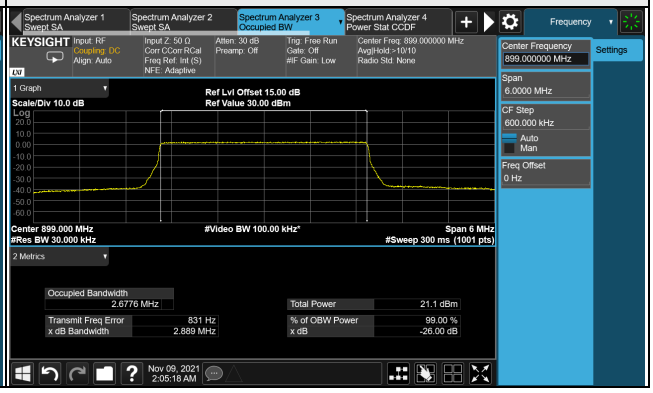
Occupied Bandwidth

LTE Band 8, Channel Bandwidth 1.4MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
21632	898.2	1.08	1.08
21640	899	1.08	1.08
21648	899.8	1.08	1.08
LTE Band 8, Channel Bandwidth 3MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
21640	899	2.68	2.68

Spectrum Plot of Worst Value	
1.4MHz / 16QAM	3MHz / 16QAM
	

26dB Bandwidth

LTE Band 8, Channel Bandwidth 1.4MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
21632	898.2	1.23	1.24
21640	899	1.24	1.25
21648	899.8	1.24	1.24
LTE Band 8, Channel Bandwidth 3MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
21640	899	2.88	2.89

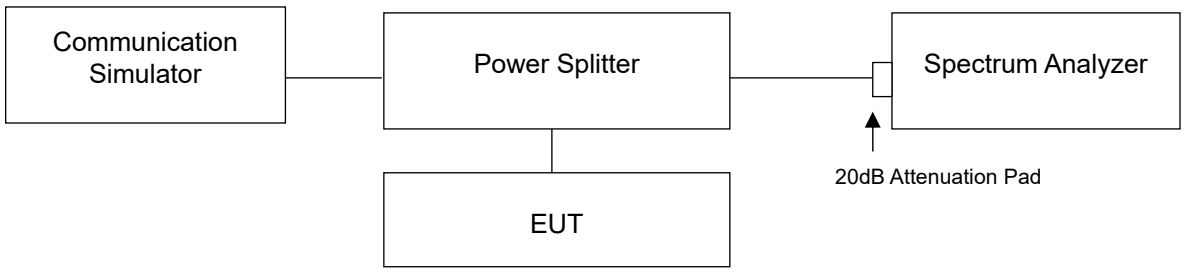
Spectrum Plot of Worst Value	
1.4MHz / 16QAM	3MHz / 16QAM
	

4.5 Channel Edge / Out-of-Band Emissions Measurement

4.5.1 Limits of Band Edge / Out-of-Band Emissions Measurement

According to FCC 27.1509, the power of any emission outside a licensee's frequency band of operation shall be attenuated below the transmitter power (P) by at least 43 +10 log (P) dB. The limit of emission is equal to -13 dBm. Compliance with the provisions of paragraphs (a) and (b) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the licensee's band, a resolution bandwidth of at least 1 percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

4.5.2 Test Setup



4.5.3 Test Procedures

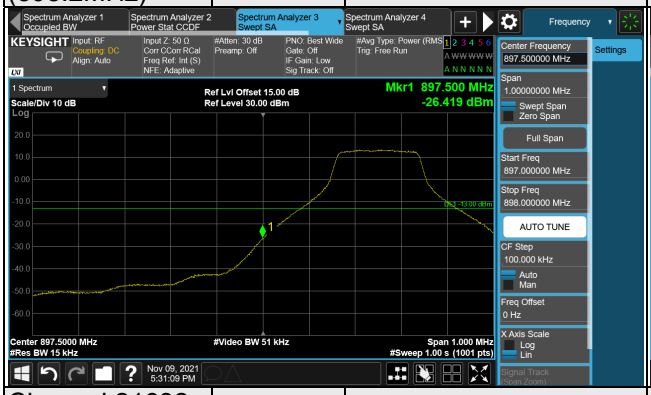
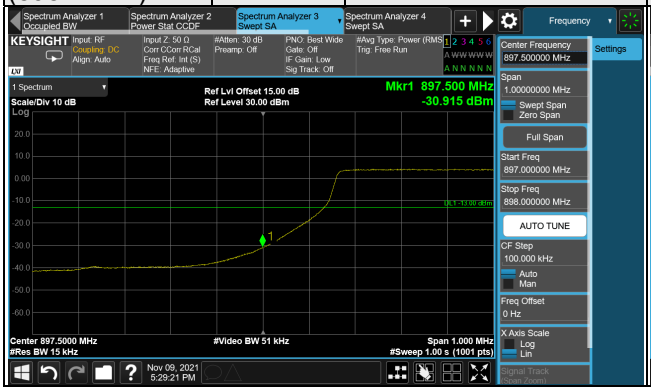
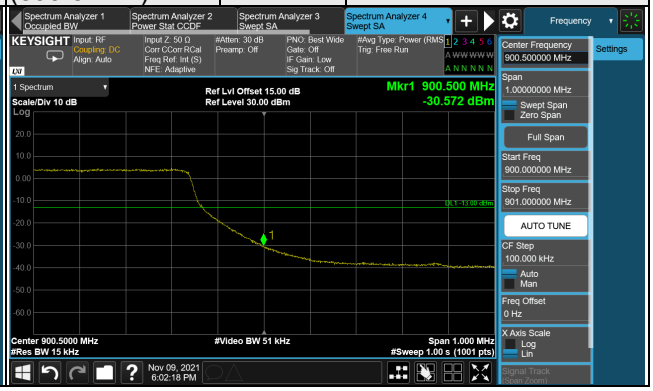
a. The EUT was set up for the rated peak power. The power was measured with Spectrum Analyzer. Band edge measurements were done at 2 channels: low and high operational frequency range.

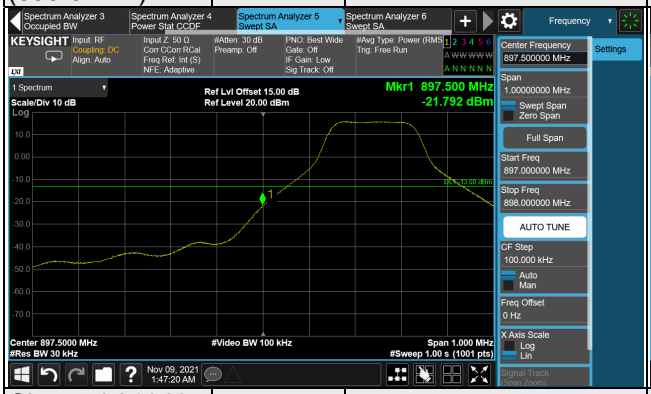
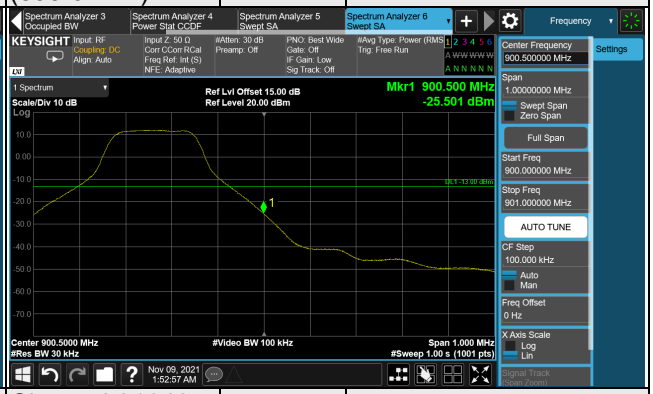
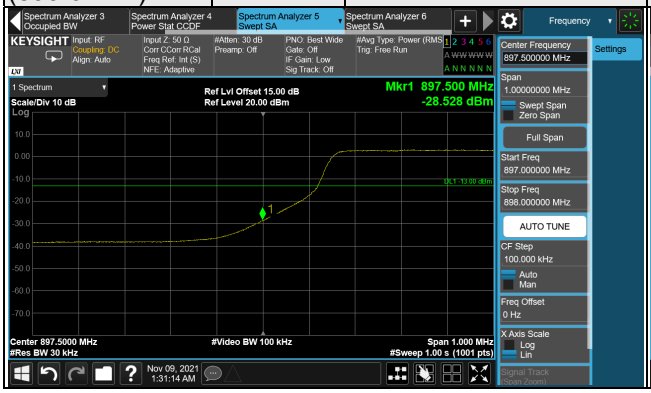
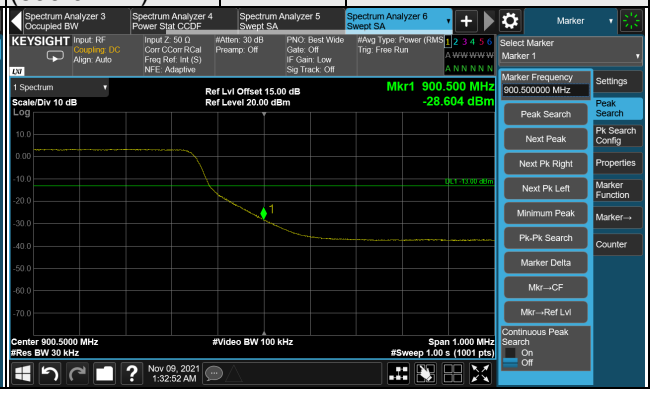
b. Measurement refer to ANSI C63.26 section 5.7.2 and 5.7.3.

c. Record the max trace plot into the test report.

4.5.4 Test Results

Out-of-Band Emission

LTE Band 8, Channel Bandwidth 1.4MHz					
Channel 21632 (898.2MHz)	QPSK	1 RB / 0 RB Offset	Channel 21648 (899.8MHz)	QPSK	1 RB / 5 RB Offset
					
Channel 21632 (898.2MHz)	QPSK	6 RB / 0 RB Offset	Channel 21648 (899.8MHz)	QPSK	6 RB / 0 RB Offset
					

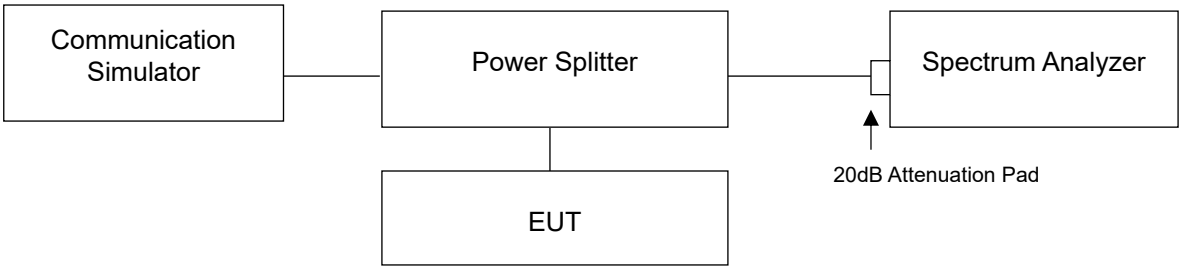
LTE Band 8, Channel Bandwidth 3MHz					
Channel 21640 (899.0MHz)	QPSK	1 RB / 0 RB Offset	Channel 21640 (899.0MHz)	QPSK	1 RB / 14 RB Offset
					
Channel 21640 (899.0MHz)	QPSK	15 RB / 0 RB Offset	Channel 21640 (899.0MHz)	QPSK	15 RB / 0 RB Offset
					

4.6 Peak to Average Ratio

4.6.1 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

4.6.2 Test Setup



4.6.3 Test Procedures

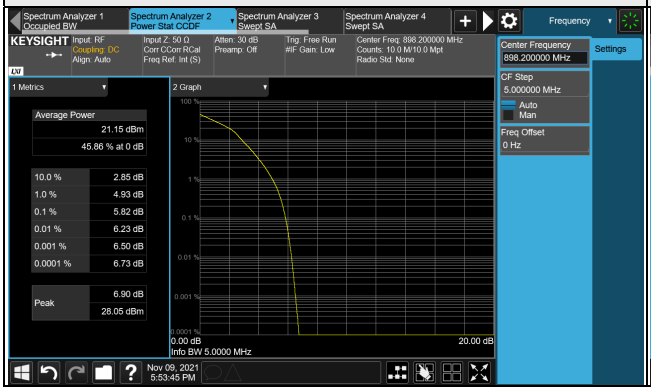
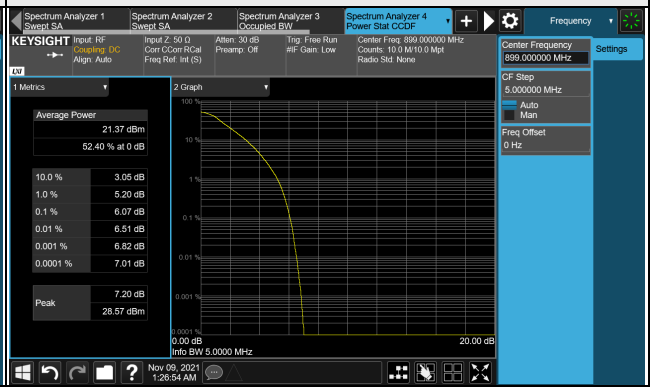
a. Set resolution/measurement bandwidth ≥ signal's occupied bandwidth;

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%.

4.6.4 Test Results

LTE Band 8, Channel Bandwidth 1.4MHz			
Channel	Frequency (MHz)	Peak To Average Ratio (dB)	
		QPSK	16QAM
21632	898.2	5.03	5.82
21640	899	5.03	5.81
21648	899.8	5.00	5.79
LTE Band 8, Channel Bandwidth 3MHz			
Channel	Frequency (MHz)	Peak To Average Ratio (dB)	
		QPSK	16QAM
21640	899	6.07	5.81

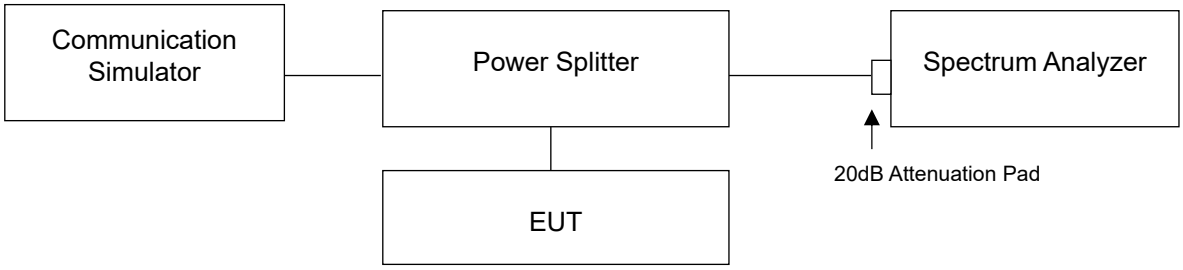
Spectrum Plot of Worst Value	
1.4MHz / 16QAM	3MHz / QPSK
	

4.7 Conducted Spurious Emissions

4.7.1 Limits of Conducted Spurious Emissions Measurement

According to FCC 27.1509, the power of any emission outside a licensee's frequency band of operation shall be attenuated below the transmitter power (P) by at least 43 +10 log (P) dB. The limit of emission is equal to -13 dBm.

4.7.2 Test Setup



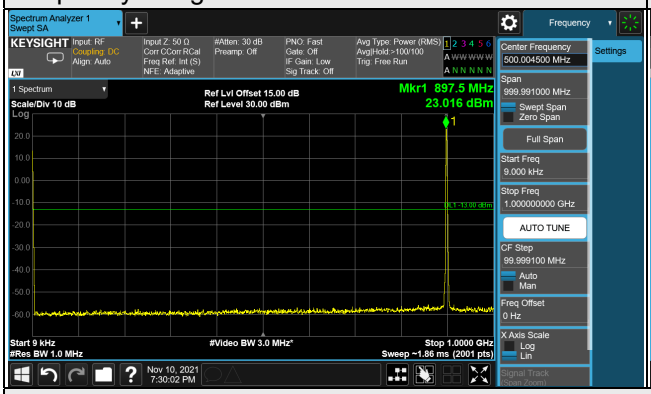
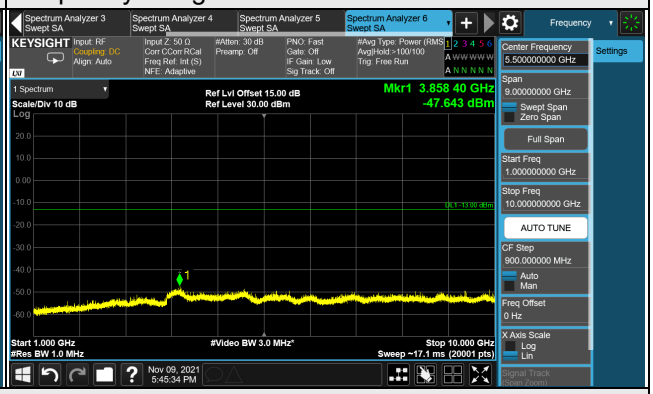
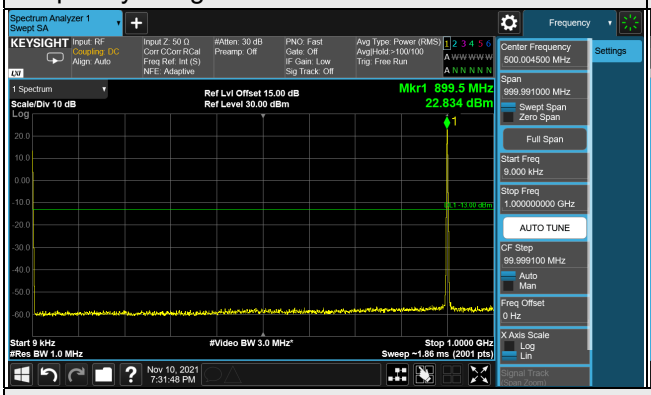
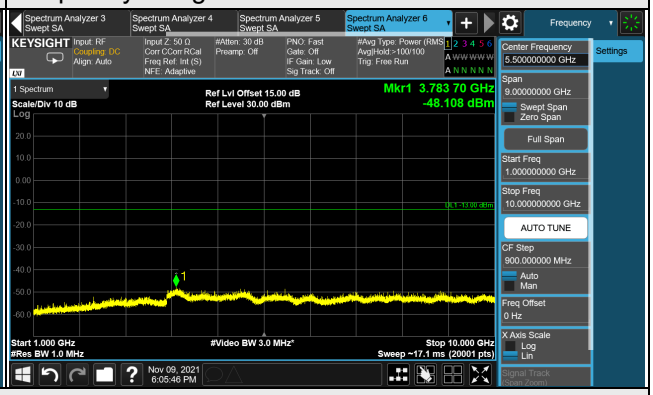
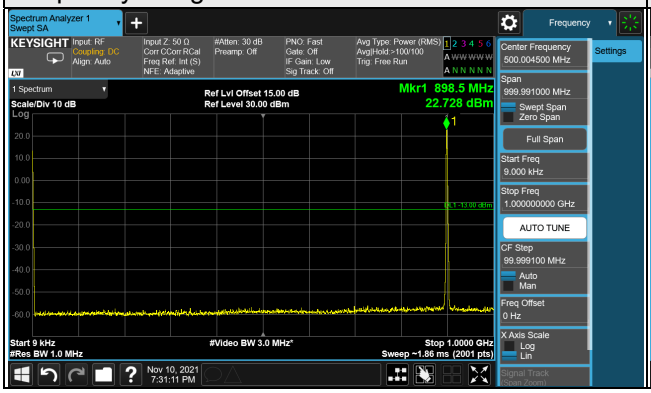
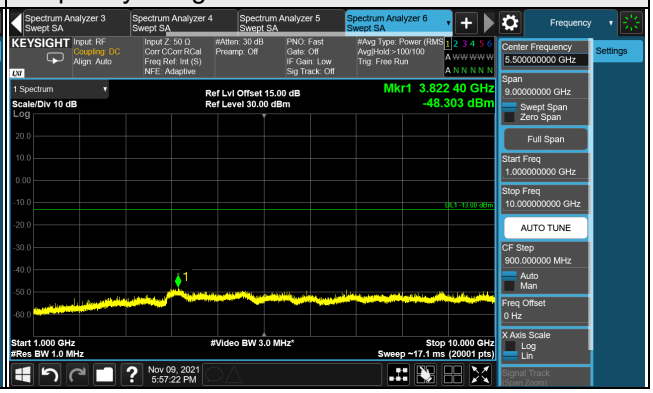
4.7.3 Test Procedure

a. All measurements were done at low, middle and high channels operational frequency range.

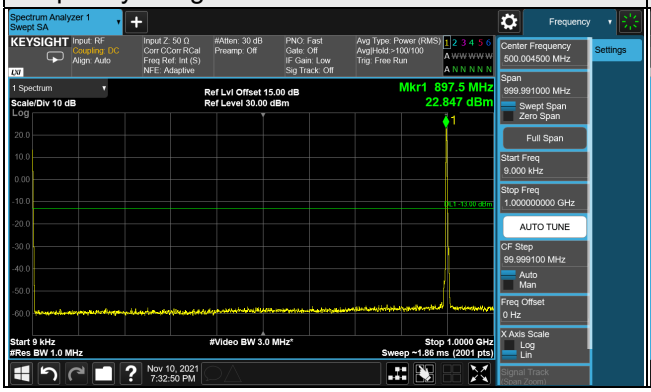
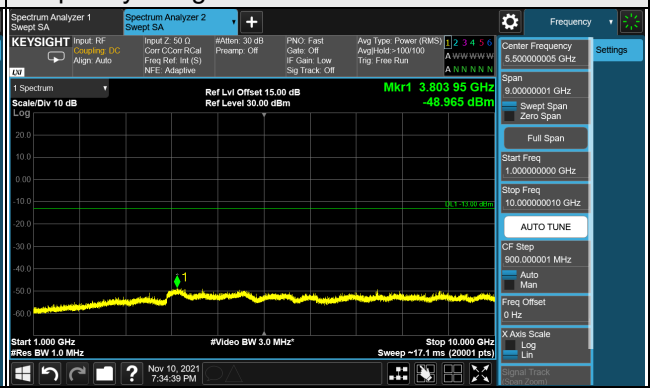
b. Measuring frequency range is from 9kHz to 1GHz. 20dB attenuation pad is connected with spectrum. RBW=1MHz and VBW=3MHz are used for LTE Band 8 conducted emission measurement.

c. Measuring frequency range is from 1GHz to 10GHz. 20dB attenuation pad is connected with spectrum. RBW=1MHz and VBW=3MHz are used for conducted emission measurement.

4.7.4 Test Results

LTE Band 8, Channel Bandwidth 1.4MHz	
Channel 21632 (898.2MHz)	
Frequency Range : 9kHz ~ 1GHz	Frequency Range : 1GHz ~ 10GHz
	
Channel 21640 (899.0MHz)	
Frequency Range : 9kHz ~ 1GHz	Frequency Range : 1GHz ~ 10GHz
	
Channel 21648 (899.8MHz)	
Frequency Range : 9kHz ~ 1GHz	Frequency Range : 1GHz ~ 10GHz
	

*The 9kHz signal over the limit is from Spectrum.

LTE Band 8, Channel Bandwidth 3MHz	
Channel 21640 (899.0MHz)	
Frequency Range : 9kHz ~ 1GHz	Frequency Range : 1GHz ~ 10GHz
	

*The 9kHz signal over the limit is from Spectrum.

4.8 Radiated Emission Measurement

4.8.1 Limits of Radiated Emission Measurement

According to FCC 27.1509, the power of any emission outside a licensee's frequency band of operation shall be attenuated below the transmitter power (P) by at least 43 +10 log (P) dB. The limit of emission is equal to -13 dBm.

4.8.2 Test Procedure

a. In the semi-anechoic chamber, EUT placed on the 0.8m(below or equal 1GHz) and/or 1.5m(above 1GHz) 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 height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

c. Perform a field strength measurement and record the worse read value, is the field strength value via a spectrum reading obtained corrected for antenna factor, cable loss and pre-amplifier factor and then mathematically convert the measured field strength level to EIRP/ERP level.

d. Following C63.26 section 5.5 and 5.2.7
   - EIRP (dBm) = E (dBμV/m) + 20log(D) - 104.8; where D is the measurement distance (in the far field region) in m.
   - ERP (dBm) = E (dBμV/m) + 20log(D) - 104.8 - 2.15; where D is the measurement distance (in the far field region) in m.

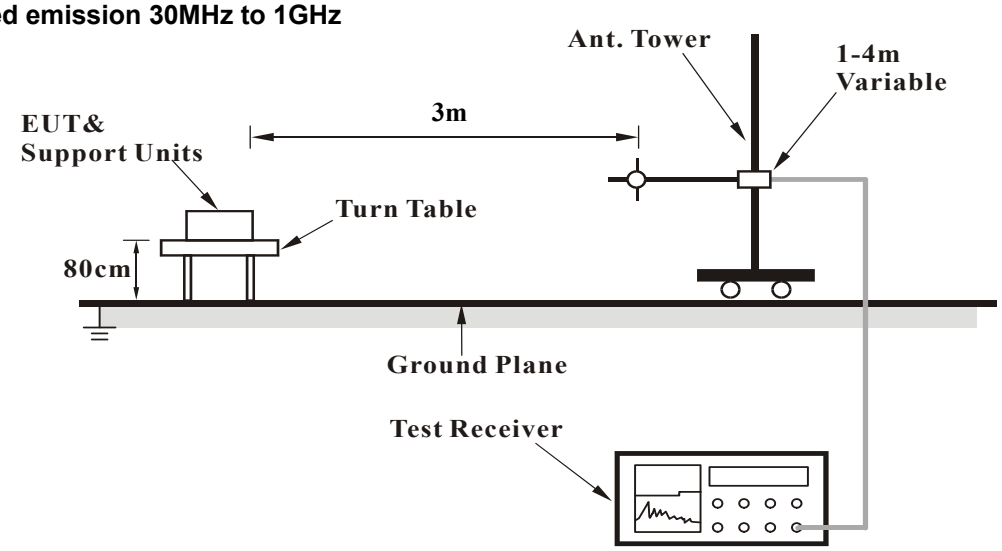
Note:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz/3MHz.
2. The emission levels were against the limit of frequency range 9 kHz ~ 30 MHz:
   The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

4.8.3 Deviation from Test Standard

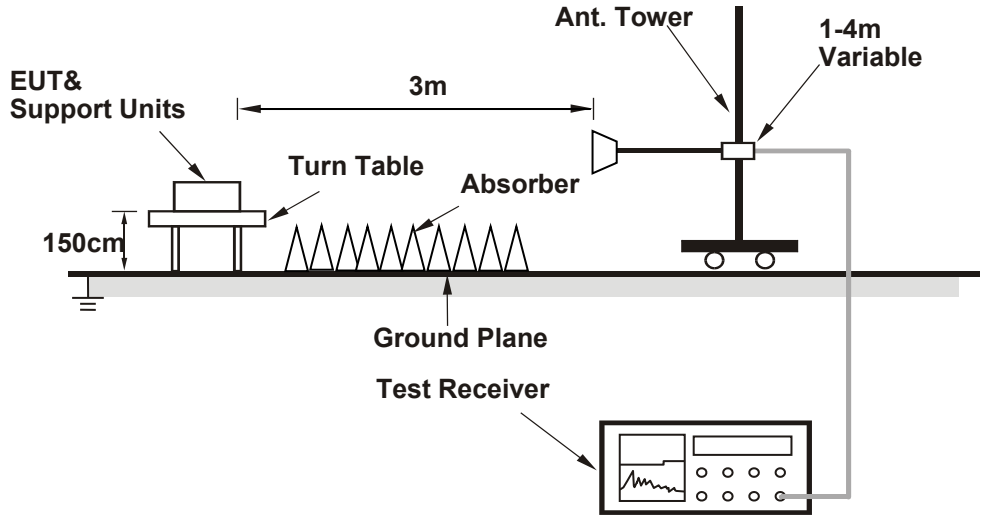
No deviation.

4.8.4 Test Setup

For radiated emission 30MHz to 1GHz



For radiated emission above 1GHz



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

4.8.5 Test Results

Below 1GHz

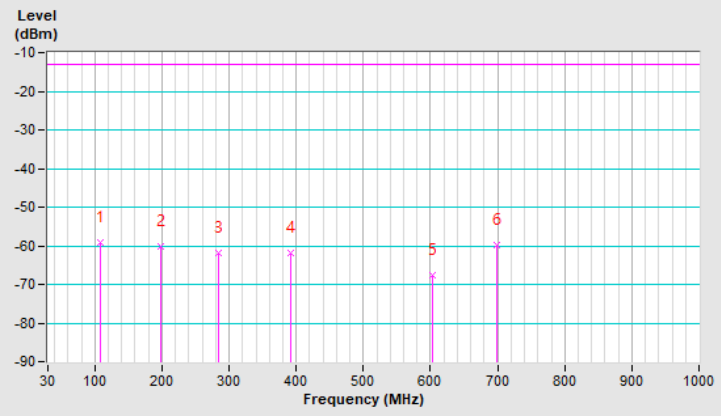
LTE Band 8, Channel Bandwidth 1.4MHz

Mode	TX channel 21648 (899.8MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	23deg. C, 68%RH	Input Power	120Vac, 60Hz
Tested By	Edison Lee		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	108.72	-59.08	-13.00	-46.08	1.50 H	321	59.76	-118.84
2	197.29	-60.02	-13.00	-47.02	1.50 H	8	58.96	-118.98
3	284.45	-61.99	-13.00	-48.99	1.00 H	19	53.32	-115.31
4	391.29	-61.93	-13.00	-48.93	2.00 H	169	50.82	-112.75
5	603.57	-67.53	-13.00	-54.53	1.00 H	23	40.01	-107.54
6	699.16	-59.78	-13.00	-46.78	2.00 H	177	46.68	-106.46

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8-2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.

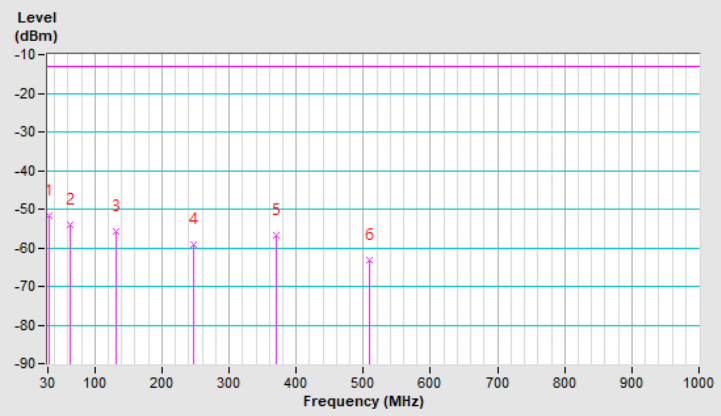


Mode	TX channel 21648 (899.8MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	23deg. C, 68%RH	Input Power	120Vac, 60Hz
Tested By	Edison Lee		

Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	**32.81**	**-51.54**	**-13.00**	**-38.54**	**1.00 V**	**251**	**65.55**	**-117.09**
2	62.33	-54.13	-13.00	-41.13	1.00 V	233	62.87	-117.00
3	132.62	-55.63	-13.00	-42.63	1.00 V	60	61.00	-116.63
4	246.49	-59.09	-13.00	-46.09	1.50 V	333	57.78	-116.87
5	370.20	-56.75	-13.00	-43.75	2.00 V	108	56.52	-113.27
6	509.38	-63.24	-13.00	-50.24	1.00 V	152	46.77	-110.01

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8-2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.



Above 1GHz

LTE Band 8, Channel Bandwidth 1.4MHz

Mode	TX channel 21632 (898.2MHz)	Frequency Range	1GHz ~ 27GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Hans Wu		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1796.40	-56.33	-13.00	-43.33	1.47 H	124	47.80	-104.13
Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1796.40	-52.73	-13.00	-39.73	1.22 V	180	51.40	-104.13

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8-2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.

Mode	TX channel 21640 (899.0MHz)	Frequency Range	1GHz ~ 27GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Hans Wu		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1798.00	-55.92	-13.00	-42.92	1.51 H	123	48.20	-104.12
Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1798.00	-52.32	-13.00	-39.32	1.25 V	177	51.80	-104.12

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8-2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.

Mode	TX channel 21648 (899.8MHz)	Frequency Range	1GHz ~ 27GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Hans Wu		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1799.60	-57.72	-13.00	-44.72	1.43 H	110	46.40	-104.12
Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1799.60	-52.02	-13.00	-39.02	1.28 V	174	52.10	-104.12

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8-2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.

LTE Band 8, Channel Bandwidth 3MHz

Mode	TX channel 21640 (899.0MHz)	Frequency Range	1GHz ~ 27GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Hans Wu		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1798.00	-56.42	-13.00	-43.42	1.44 H	116	47.70	-104.12
Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1798.00	-52.42	-13.00	-39.42	1.24 V	167	51.70	-104.12

Remarks:

1. EIRP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8
3. Margin value = EIRP – Limit value
4. The other EIRP levels were very low against the limit.

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 FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

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

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