FCC Test Report (Part 96: LTE Band 42)

Report No.:	RF190605C17-1
FCC ID:	QI3BEC-6900R21
Test Model:	RidgeWave 6900
Series Model:	BEC 6900 R21 (refer to item 3.1 for more details)
Received Date:	Jun. 05, 2019
Test Date:	Jun. 21 ~ Sep. 18, 2019
Issued Date:	Sep. 18, 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
Lab Address:	No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan (R.O.C)
Test Location:	No. 19, Hwa Ya 2nd Rd, Wen Hwa Tsuen, Kwei Shan Hsiang, Taoyuan Hsien 333, Taiwan, R.O.C.
FCC Registration/ Designation Number:	788550 / TW0003

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Release Control Record

Issue No.	Description	Date Issued
RF190605C17-1	Original release.	Sep. 18, 2019

1 Certificate of Conformity

Product:	4G/LTE Outdoor Router
Brand:	BEC, BILLION
Test Model:	RidgeWave 6900
Series Model:	BEC 6900 R21 (refer to item 3.1 for more details)
Sample Status:	Engineering sample
Applicant:	BILLION ELECTRIC CO., LTD.
Test Date:	Jun. 21 ~ Sep. 18, 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 : Celine Chou , **Date:** Sep. 18, 2019

Celine Chou / Senior Specialist

Approved by : Bruce Chen , **Date:** Sep. 18, 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 -7.10dB at 7120.00MHz and 7159.60MHz.

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	4G/LTE Outdoor Router		
Brand	BEC, BILLION		
Test Model	RidgeWave 6900		
Series Model	BEC 6900 R21		
Model Difference	Refer to note		
Status of EUT	Engineering sample		
Modulation Type	QPSK, 16QAM, 64QAM		
Operating Frequency	LTE Band 42	Channel Bandwidth 20MHz	TX: 3560 ~ 3590 MHz RX: 3560 ~ 3590 MHz
Max. EIRP Power	LTE Band 42		QPSK
		Channel Bandwidth 20MHz	2697.739mW (34.31dBm)
Emission Designator	LTE Band 42	Channel Bandwidth 20MHz	35M8G7D
Antenna Type	PCB antenna with 14.5dBi gain		
Antenna Connector	i-pex (MHF)		
Accessory Device	PoE		
Data Cable Supplied	NA		

Note:

1. All models are listed as below. Model RidgeWave 6900 is the representative for final test.

Brand	Model	Difference
BEC, BILLION	RidgeWave 6900	For marketing purpose.
	BEC 6900 R21	

2. The EUT consumes power from the following PoE.

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

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	43190 to 43292 43388 to 43490	43190 (3560.0MHz)+ 43388 (3579.8MHz) 43240 (3565.0MHz)+ 43438 (3584.8MHz) 43292 (3570.2MHz)+ 43490 (3590.0MHz)	20MHz	QPSK, 16QAM, 64QAM
Frequency Stability	43190 to 43292 43388 to 43490	43190 (3560.0MHz)+ 43388 (3579.8MHz)	20MHz	QPSK
Occupied Bandwidth	43190 to 43292 43388 to 43490	43190 (3560.0MHz)+ 43388 (3579.8MHz) 43240 (3565.0MHz)+ 43438 (3584.8MHz) 43292 (3570.2MHz)+ 43490 (3590.0MHz)	20MHz	QPSK
Peak to Average Ratio	43190 to 43292 43388 to 43490	43190 (3560.0MHz)+ 43388 (3579.8MHz) 43240 (3565.0MHz)+ 43438 (3584.8MHz) 43292 (3570.2MHz)+ 43490 (3590.0MHz)	20MHz	QPSK
Conducted Emission	43190 to 43292 43388 to 43490	43190 (3560.0MHz)+ 43388 (3579.8MHz) 43240 (3565.0MHz)+ 43438 (3584.8MHz) 43292 (3570.2MHz)+ 43490 (3590.0MHz)	20MHz	QPSK
Radiated Emission Below 1GHz	43190 to 43292 43388 to 43490	43190 (3560.0MHz)+ 43388 (3579.8MHz)	20MHz	QPSK
Radiated Emission Above 1GHz	43190 to 43292 43388 to 43490	43190 (3560.0MHz)+ 43388 (3579.8MHz) 43240 (3565.0MHz)+ 43438 (3584.8MHz) 43292 (3570.2MHz)+ 43490 (3590.0MHz)	20MHz	QPSK

Note: This device was tested under all bandwidths, RB configurations and modulations. The worst case was found in QPSK modulation.

Test Condition:

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

3.3 Description of Support Units

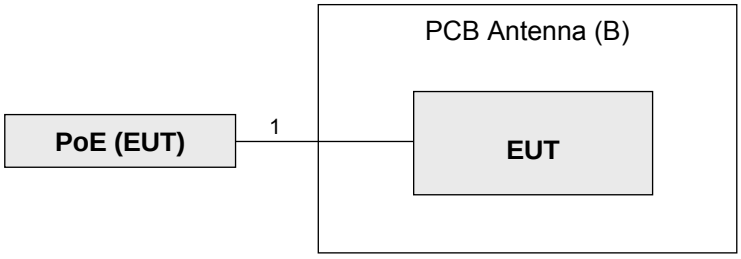
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Radio Communication Analyzer Anritsu	Anritsu	MT8821C	6261806803	N/A	-
B.	PCB Antenna	N/A	N/A	N/A	N/A	Accessory (Gain: 14.5dBi)

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	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	RJ45 Cable	1	1.5	N	0	-

3.3.1 Configuration of System under Test



Remote site

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.

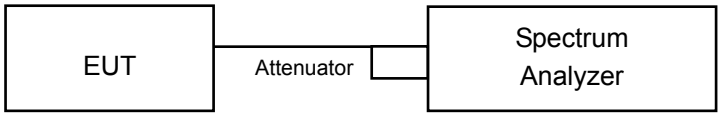
4 Test Types and Results

4.1 Maximum Output Power Measurement

4.1.1 Limits of Maximum Output Power Measurement

Device		Maximum EIRP (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)

Con fugure	Com-bination	PCC							SCC							Measurement Power		
		Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	Tx Power with UL-CA Active (dBm)		
																PCC	SCC	Total
Intra Band Conti-guous	42C	42	20	QPSK	1	0	43190	3560	42	20	QPSK	1	0	43388	3579.8	18.48	13.05	19.57
					1	99						1	99			18.15	12.92	19.29
		42	20	16QAM	1	0	43190	3560	42	20	16QAM	1	0	43388	3579.8	18.25	13.02	19.39
					1	99						1	99			18.11	12.85	19.24
		42	20	64QAM	1	0	43190	3560	42	20	64QAM	1	0	43388	3579.8	18.13	12.74	19.23
					1	99						1	99			18.06	12.78	19.19
	42C	42	20	QPSK	1	0	43240	3565	42	20	QPSK	1	0	43438	3584.8	18.26	12.83	19.35
					1	99						1	99			17.87	12.56	18.99
		42	20	16QAM	1	0	43240	3565	42	20	16QAM	1	0	43438	3584.8	18.11	12.75	19.22
					1	99						1	99			17.97	12.52	19.06
		42	20	64QAM	1	0	43240	3565	42	20	64QAM	1	0	43438	3584.8	18.05	12.66	19.15
					1	99						1	99			17.87	12.5	18.98
	42C	42	20	QPSK	1	0	43292	3570.2	42	20	QPSK	1	0	43490	3590	18.52	13.03	**19.60**
					1	99						1	99			17.94	12.79	19.10
		42	20	16QAM	1	0	43292	3570.2	42	20	16QAM	1	0	43490	3590	18.35	12.81	19.42
					1	99						1	99			17.82	12.92	19.04
		42	20	64QAM	1	0	43292	3570.2	42	20	64QAM	1	0	43490	3590	18.32	12.63	19.36
					1	99						1	99			17.75	12.79	18.95

Spectrum Plot of Worst Value
CH 43292+43490

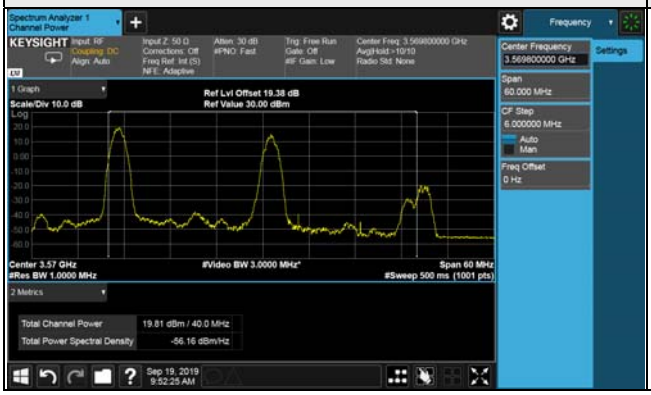
Maximum EIRP (dBm/ 10MHz)

Con fugure	Com-bination	PCC							SCC							Antenna gain (dBi)
		Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	14.5
																EIRP
Intra Band Conti-guous	42C	42	20	QPSK	1	0	43190	3560	42	20	QPSK	1	0	43388	3579.8	34.07
					1	99						1	99			33.79
		42	20	16QAM	1	0	43190	3560	42	20	16QAM	1	0	43388	3579.8	33.89
					1	99						1	99			33.74
		42	20	64QAM	1	0	43190	3560	42	20	64QAM	1	0	43388	3579.8	33.73
					1	99						1	99			33.69
	42C	42	20	QPSK	1	0	43240	3565	42	20	QPSK	1	0	43438	3584.8	33.85
					1	99						1	99			33.49
		42	20	16QAM	1	0	43240	3565	42	20	16QAM	1	0	43438	3584.8	33.72
					1	99						1	99			33.56
		42	20	64QAM	1	0	43240	3565	42	20	64QAM	1	0	43438	3584.8	33.65
					1	99						1	99			33.48
	42C	42	20	QPSK	1	0	43292	3570.2	42	20	QPSK	1	0	43490	3590	**34.10**
					1	99						1	99			33.60
		42	20	16QAM	1	0	43292	3570.2	42	20	16QAM	1	0	43490	3590	33.92
					1	99						1	99			33.54
		42	20	64QAM	1	0	43292	3570.2	42	20	64QAM	1	0	43490	3590	33.86
					1	99						1	99			33.45

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

Full Conducted Output Power (dBm / 40MHz)

Con fugure	Com-bination	PCC							SCC							Measurement Power
		Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	Tx Power with UL-CA Active (dBm)
																Total
Intra Band Conti-guous	42C	42	20	QPSK	1	0	43190	3560	42	20	QPSK	1	0	43388	3579.8	**19.81**
					1	99						1	99			19.51
		42	20	16QAM	1	0	43190	3560	42	20	16QAM	1	0	43388	3579.8	19.34
					1	99						1	99			19.11
		42	20	64QAM	1	0	43190	3560	42	20	64QAM	1	0	43388	3579.8	19.33
					1	99						1	99			19.32
	42C	42	20	QPSK	1	0	43240	3565	42	20	QPSK	1	0	43438	3584.8	19.54
					1	99						1	99			19.27
		42	20	16QAM	1	0	43240	3565	42	20	16QAM	1	0	43438	3584.8	19.43
					1	99						1	99			19.17
		42	20	64QAM	1	0	43240	3565	42	20	64QAM	1	0	43438	3584.8	19.27
					1	99						1	99			19.12
	42C	42	20	QPSK	1	0	43292	3570.2	42	20	QPSK	1	0	43490	3590	19.57
					1	99						1	99			19.33
		42	20	16QAM	1	0	43292	3570.2	42	20	16QAM	1	0	43490	3590	19.48
					1	99						1	99			19.21
		42	20	64QAM	1	0	43292	3570.2	42	20	64QAM	1	0	43490	3590	19.12
					1	99						1	99			19.15

Spectrum Plot of Worst Value	
CH 43190+43388	
	

Full EIRP (dBm / 40MHz)

Con fugure	Com-bination	PCC							SCC							Antenna gain (dBi)
		Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	14.5
																EIRP
Intra Band Conti-guous	42C	42	20	QPSK	1	0	43190	3560	42	20	QPSK	1	0	43388	3579.8	**34.31**
					1	99						1	99			34.01
		42	20	16QAM	1	0	43190	3560	42	20	16QAM	1	0	43388	3579.8	33.84
					1	99						1	99			33.61
		42	20	64QAM	1	0	43190	3560	42	20	64QAM	1	0	43388	3579.8	33.83
					1	99						1	99			33.82
	42C	42	20	QPSK	1	0	43240	3565	42	20	QPSK	1	0	43438	3584.8	34.04
					1	99						1	99			33.77
		42	20	16QAM	1	0	43240	3565	42	20	16QAM	1	0	43438	3584.8	33.93
					1	99						1	99			33.67
		42	20	64QAM	1	0	43240	3565	42	20	64QAM	1	0	43438	3584.8	33.77
					1	99						1	99			33.62
	42C	42	20	QPSK	1	0	43292	3570.2	42	20	QPSK	1	0	43490	3590	34.07
					1	99						1	99			33.83
		42	20	16QAM	1	0	43292	3570.2	42	20	16QAM	1	0	43490	3590	33.98
					1	99						1	99			33.71
		42	20	64QAM	1	0	43292	3570.2	42	20	64QAM	1	0	43490	3590	33.62
					1	99						1	99			33.65

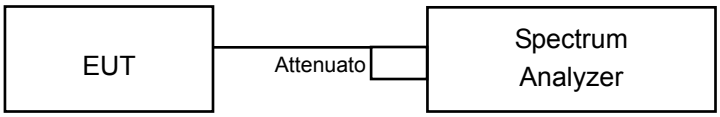
*Note: Full EIRP = Full Conducted Output Power (dBm / 40MHz) + Antenna Gain (14.5dBi)

4.2 Maximum Power Spectral Density Measurement

4.2.1 Limits of Maximum Power Spectral Density Measurement

Device	Maximum Radiated PSD (dBm/MHz)
End User Device	n/a
Category A CBSD	20
Category B CBSD	37

4.2.2 Test Setup



4.2.3 Test Instruments

Refer to section 4.1.3 to get information of above instrument.

4.2.4 Test Procedure

1. Connect the transmitter to the spectrum analyzer via coaxial cable while ensuring proper impedance matching.
2. Tune the analyzer to the nominal center frequency of the emission bandwidth (EBW).
3. Set the resolution bandwidth (RBW) to 1MHZ.
4. Set the video bandwidth (VBW) to ≧3 x RBW.
5. Select the average power (RMS) display detector.
6. Set the number of measurement points to ≧ 1001.
7. Use auto-coupled sweep time.
8. Perform the measurement over an interval of time when the transmission is continuous and at its maximum power level.

Maximum EIRP (dBm/MHz)

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)

4.2.5 Deviation from Test Standard

No deviation.

4.2.6 EUT Operating Condition

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

4.2.7 Test Results

LTE Band 42, Channel Bandwidth 20MHz						
Channel	Frequency (MHz)	Conducted PSD (dBm/MHz)	Antenna Gain (dBi)	Radiated PSD (dBm/MHz)	Limit (dBm/MHz)	Pass/Fail
43190+43388	3560.0+3579.8	0.75	14.5	15.25	37	Pass
43240+43438	3565.0+3584.8	0.72	14.5	15.22	37	Pass
43292+43490	3570.2+3590.0	0.48	14.5	14.98	37	Pass

*Note: Radiated PSD= Conducted PSD (dBm/ MHz) + Antenna Gain (14.5dBi)

Spectrum Plot of Worst Value	
CH 43190+43388	
	

4.3 Frequency Stability Measurement

4.3.1 Limits of Frequency Stabiliity Measurement

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

4.3.2 Test Procedure

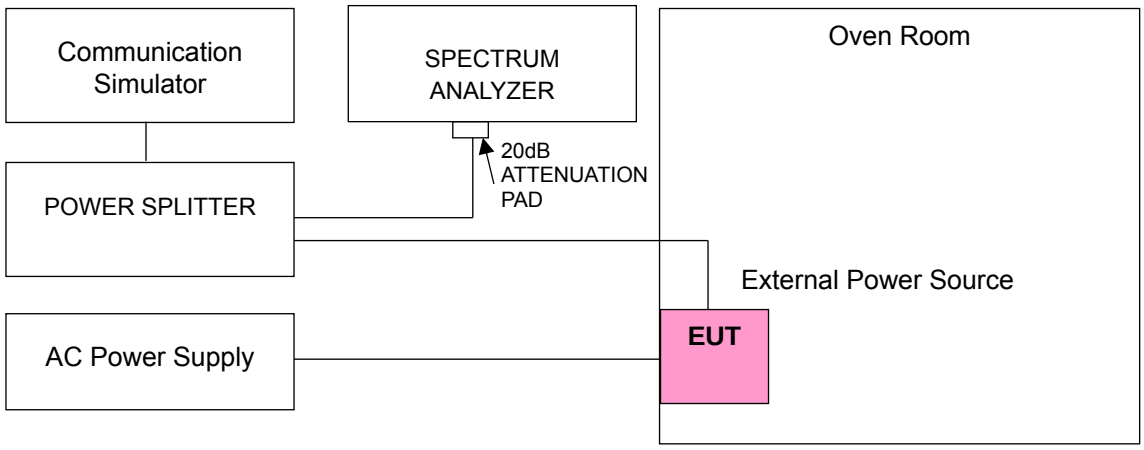
a. Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.

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 (Volts)	LTE Band 42, Channel Bandwidth: 20MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
50.4	3560.000001	0.000	3590.000000	0.000
56.0	3560.000002	0.000	3590.000000	0.001
61.6	3560.000003	0.001	3590.000000	0.000

Note: The applicant defined the normal working voltage is from 50.4Vdc to 61.6Vdc.

Frequency Error vs. Temperature

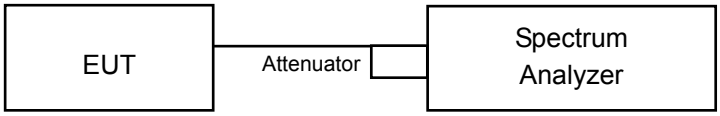
Temp. (℃)	LTE Band 42, Channel Bandwidth: 20MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	3560.000003	0.000	3590.000000	0.000
-20	3560.000003	0.001	3590.000000	0.001
-10	3560.000003	0.001	3590.000000	0.001
0	3560.000002	0.001	3590.000000	0.001
10	3560.000002	0.000	3590.000000	0.000
20	3559.999997	-0.001	3590.000000	-0.001
30	3559.999999	0.000	3590.000000	0.000
40	3559.999999	0.000	3590.000000	0.000
50	3559.999999	0.000	3590.000000	-0.001
60	3559.999998	-0.001	3590.000000	0.000

4.4 Emission Bandwidth Measurement

4.4.1 Emission Bandwidth Measurement

Reference only

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.1.3 to get information of above instrument.

4.4.4 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.

4.4.5 Deviation fromTest Standard

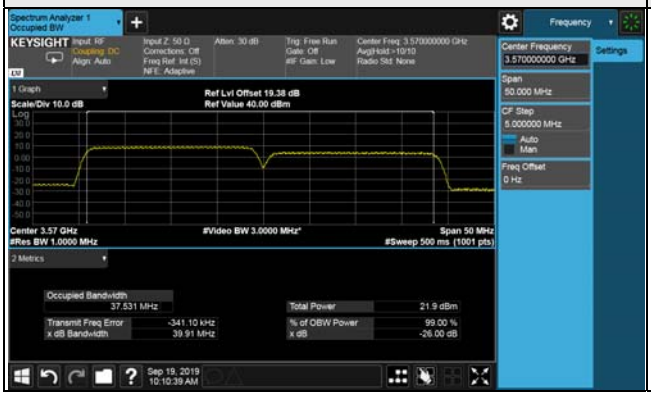
No deviation.

4.4.6 EUT Operating Conditions

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

4.4.7 Test Result (-26dB Bandwidth)

LTE Band 42, Channel Bandwidth 20MHz		
Channel	Frequency (MHz)	26dB Bandwidth (MHz)
		QPSK
		FullRB
43190+43388	3560.0+3579.8	39.91
43240+43438	3565.0+3584.8	39.85
43292+43490	3570.2+3590.0	39.85

Spectrum Plot of Worst Value	
CH 43292+43490 / FullRB	
	

4.4.8 Test Result (Occupied Bandwidth)

LTE Band 42, Channel Bandwidth 20MHz		
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
		QPSK
		FullRB
43190+43388	3560.0+3579.8	37.531
43240+43438	3565.0+3584.8	37.543
43292+43490	3570.2+3590.0	37.523

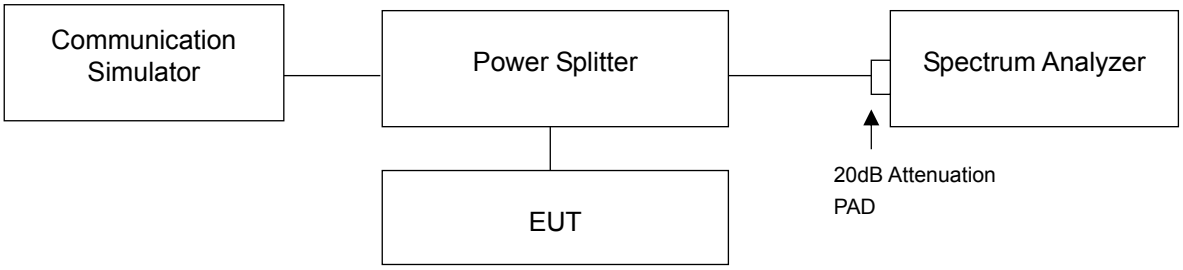
Spectrum Plot of Worst Value	
CH 43240+43438 / FullRB	
	

4.5 Peak to Average Ratio Measurement

4.5.1 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

4.5.2 Test Setup



4.5.3 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%.

4.5.4 Test Results

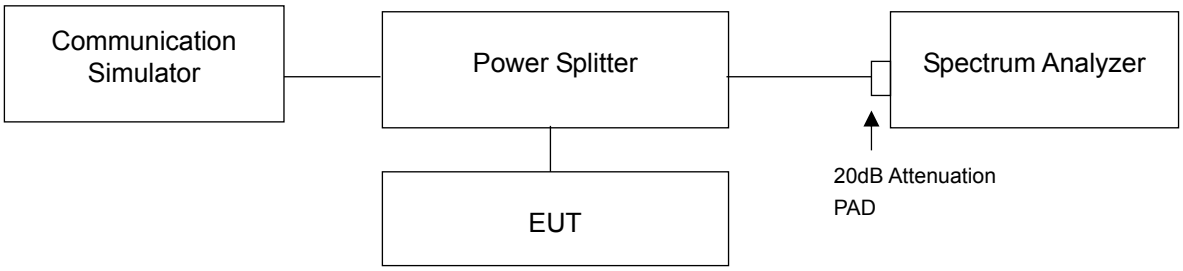
LTE Band 42, Channel Bandwidth 20MHz			
Channel	Frequency (MHz)	Peak To Average Ratio (dB)	
		QPSK	
		1RB0	1RB99
43190	3560.0	4.64	4.66
43388	3579.8	5.52	5.46
43240	3565.0	4.62	4.65
43438	3584.8	5.58	5.47
43292	3570.2	4.62	4.66
43490	3590.0	5.56	5.47

Spectrum Plot of Worst Value	
20MHz / 1RB0	
	

4.5.5 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 10MHz above the Assigned Channel	-25 dBm/MHz
Greater than 10MHz below the Assigned Channel	
Power of any emission below 3530MHz	-40 dBm/MHz
Power of any emission above 3720MHz	

4.5.6 Test Setup

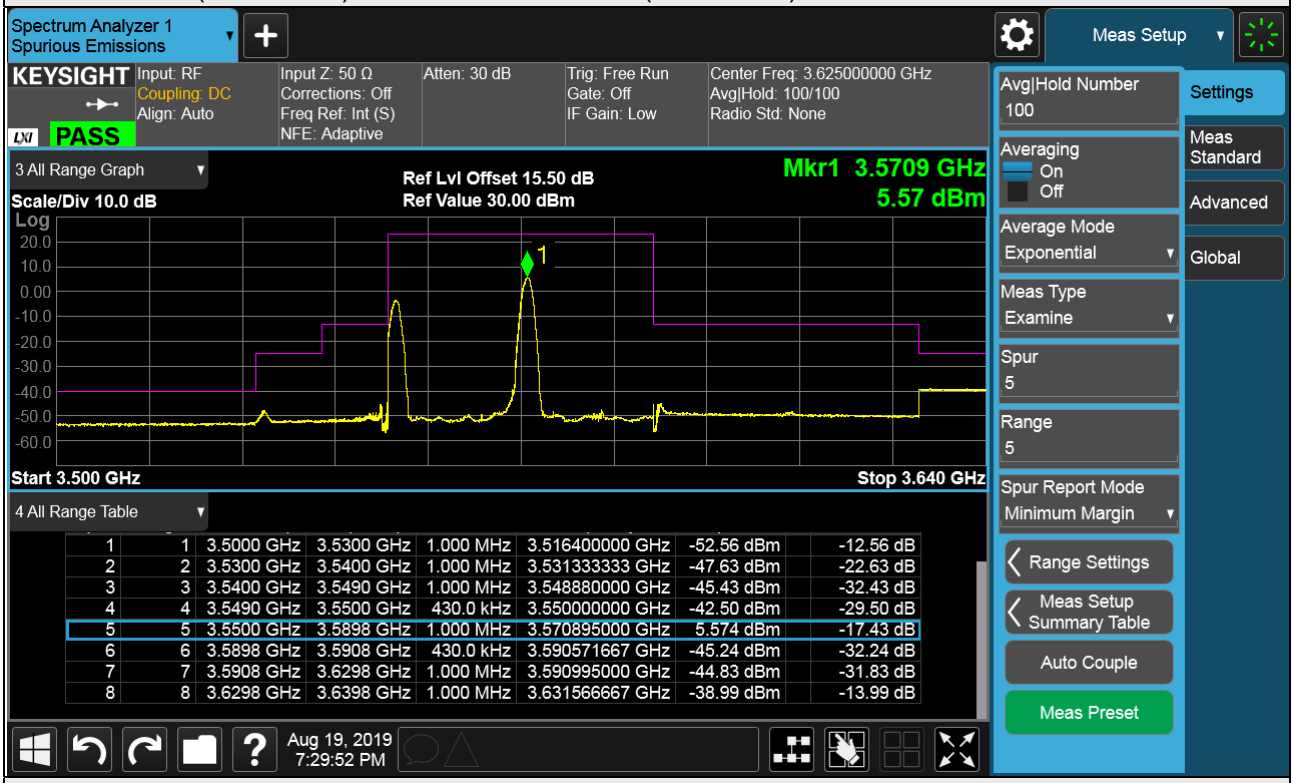


4.5.7 Test Procedure

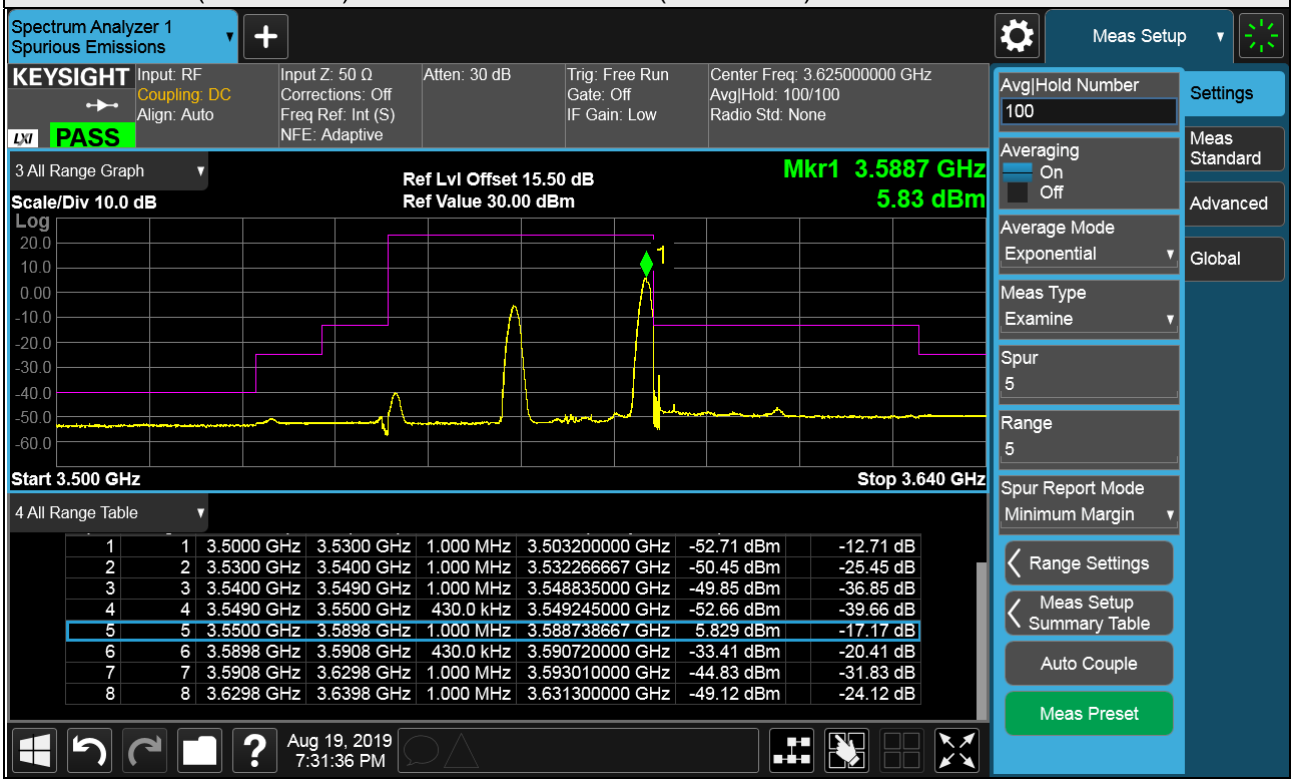
a. The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range.
b. Measuring frequency range is from 9 kHz to 40 GHz. 20dB attenuation pad is connected with spectrum. RBW=1MHz and VBW=3MHz is used for conducted emission measurement.
c. Measuring frequency band edge, 20dB attenuation pad is connected with spectrum. 1% of the fundamental emission bandwidth is used for conducted emission measurement.

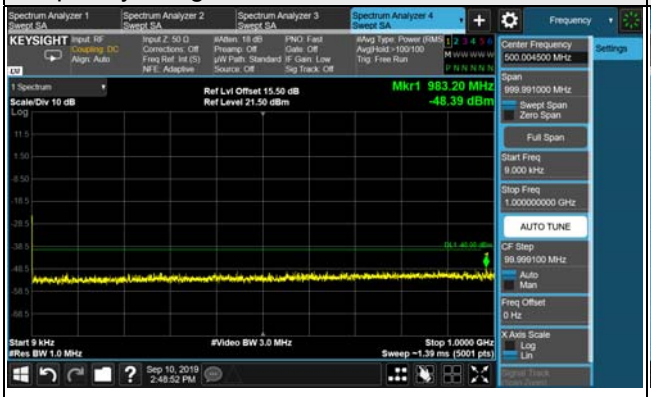
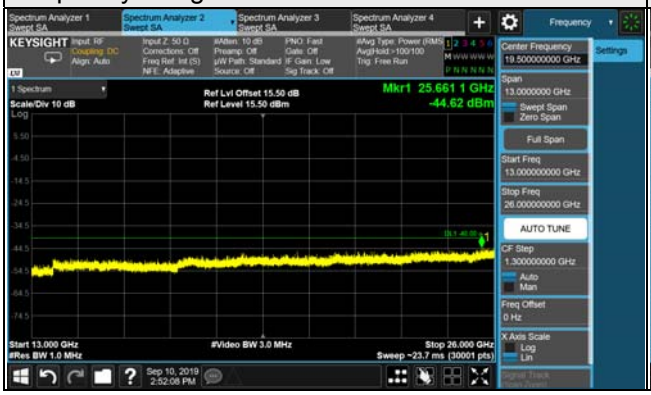
4.5.8 Test Results

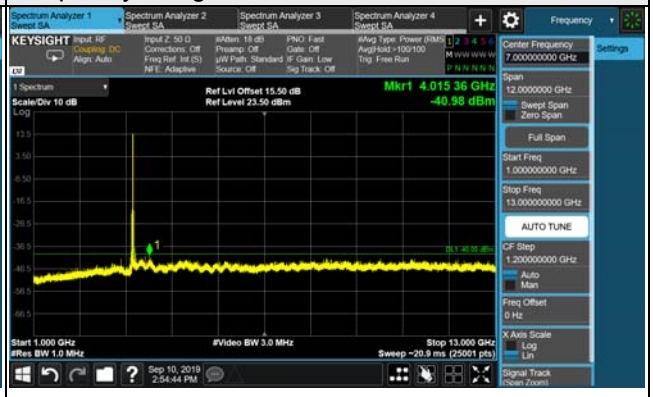
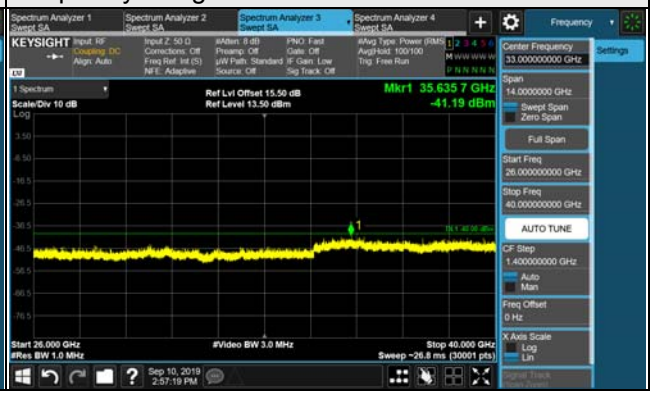
LTE Band 42, Channel Bandwidth 20MHz
Channel 43190 (3560.0MHz) 1RB0 + Channel 43388 (3579.8MHz) 1RB0



Channel 43190 (3560.0MHz) 1RB99 + Channel 43388 (3579.8MHz) 1RB99

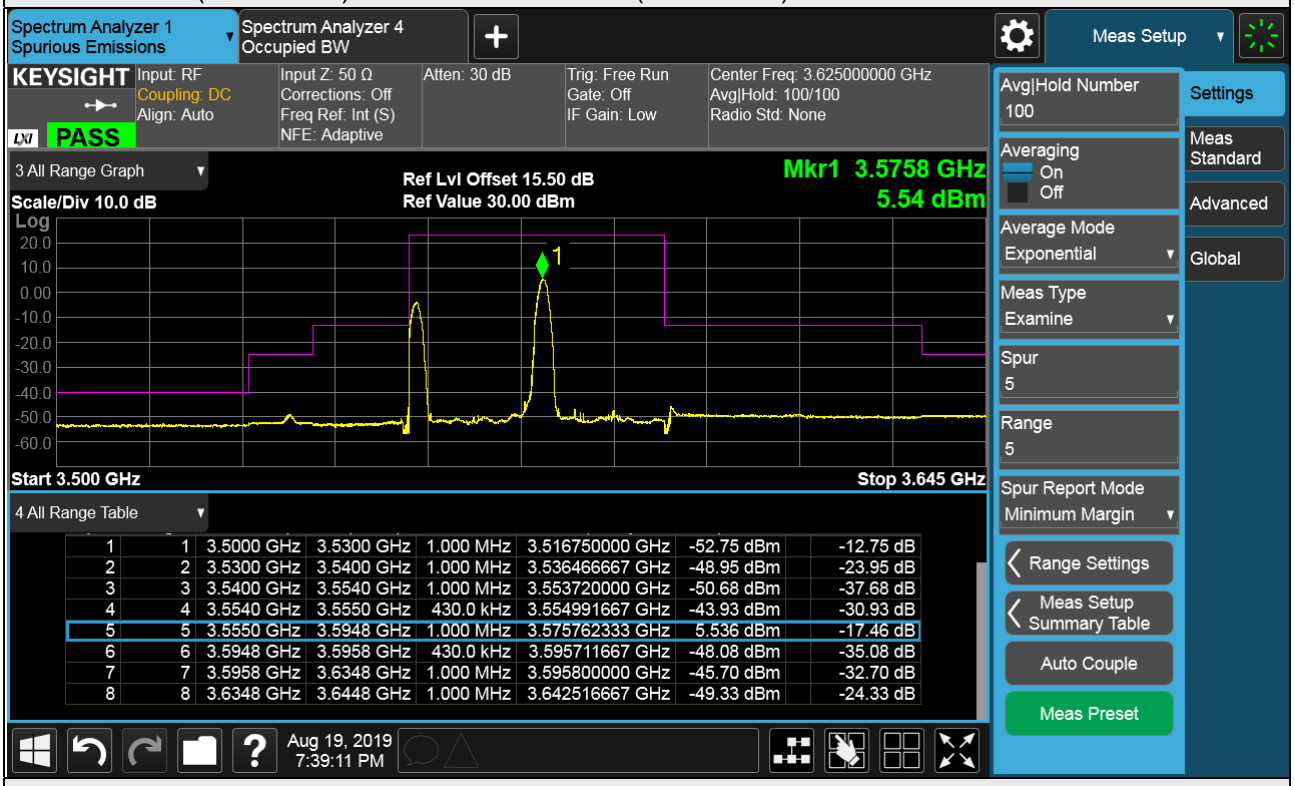


LTE Band 42, Channel Bandwidth 20MHz, 1RB0	
Channel 43190 (3560.0MHz)+Channel 43388 (3579.8MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~13GHz
	
Frequency Range : 13GHz~26GHz	Frequency Range : 26GHz~40GHz
	

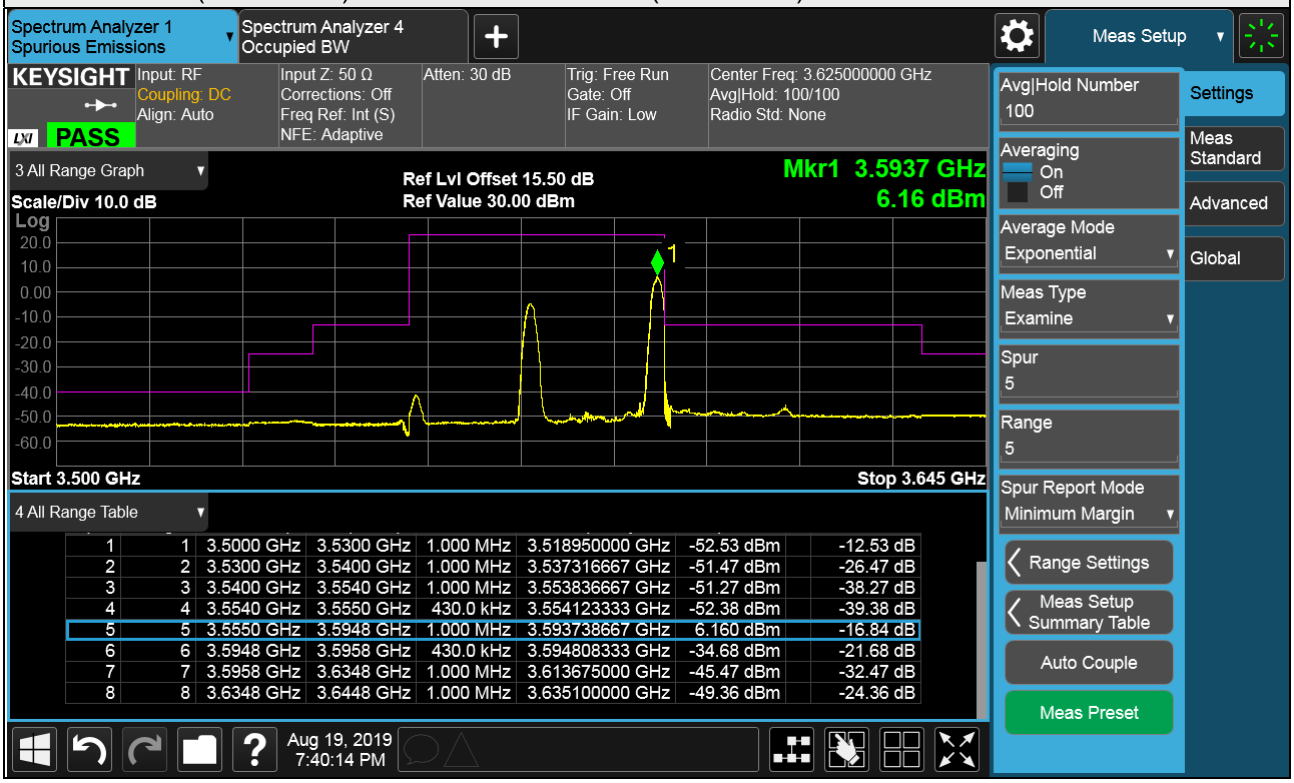
LTE Band 42, Channel Bandwidth 20MHz, 1RB99	
Channel 43190 (3560.0MHz)+Channel 43388 (3579.8MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~13GHz
	
Frequency Range : 13GHz~26GHz	Frequency Range : 26GHz~40GHz
	

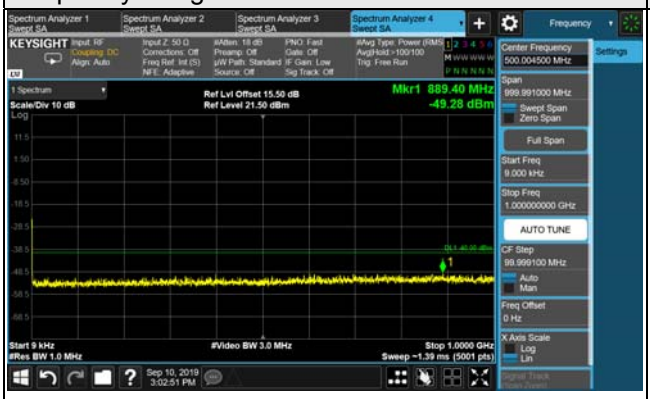
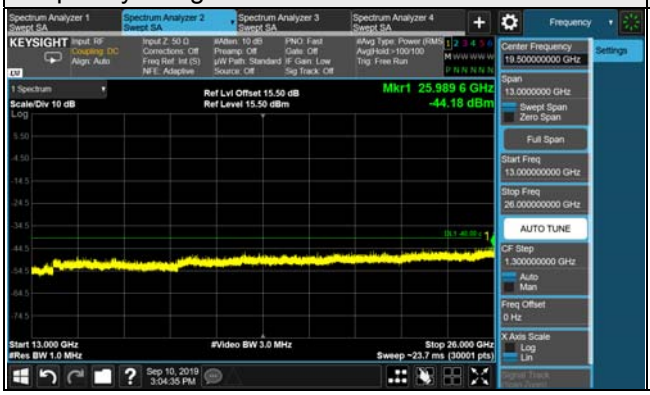
LTE Band 42, Channel Bandwidth 20MHz

Channel 43240 (3565.0MHz) 1RB0 +Channel 43438 (3584.8MHz) 1RB0



Channel 43240 (3565.0MHz) 1RB99 +Channel 43438 (3584.8MHz) 1RB99

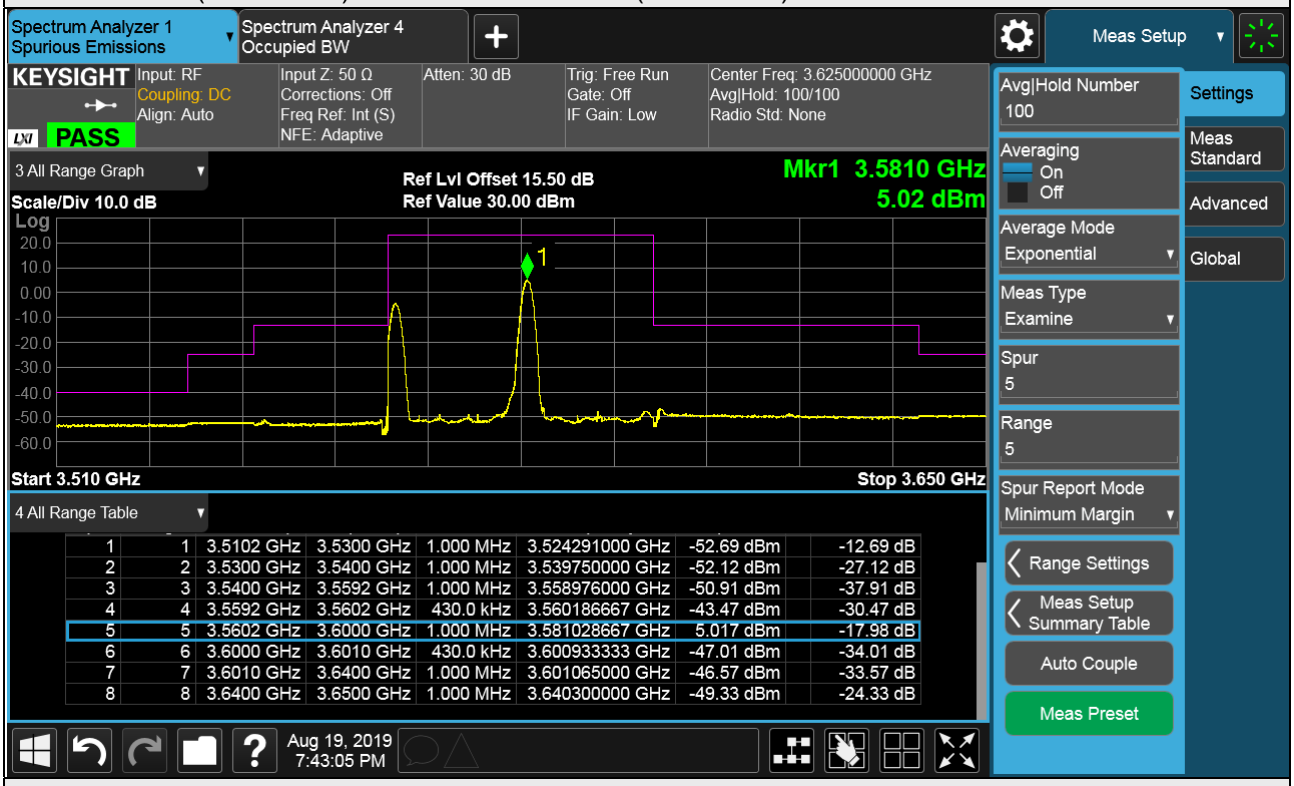


LTE Band 42, Channel Bandwidth 20MHz, 1RB0	
Channel 43240 (3565.0MHz)+Channel 43438 (3584.8MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~13GHz
	
Frequency Range : 13GHz~26GHz	Frequency Range : 26GHz~40GHz
	

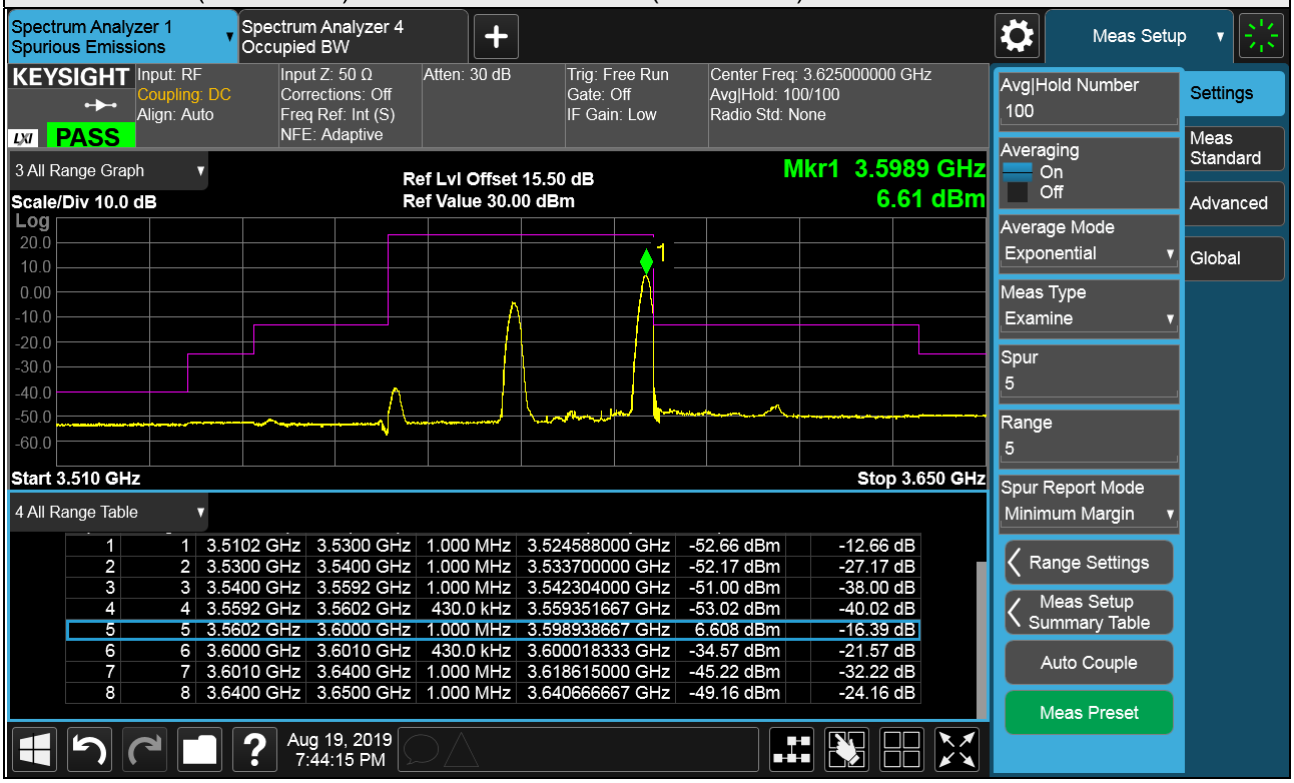
LTE Band 42, Channel Bandwidth 20MHz, 1RB99	
Channel 43240 (3565.0MHz)+Channel 43438 (3584.8MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~13GHz
	
Frequency Range : 13GHz~26GHz	Frequency Range : 26GHz~40GHz
	

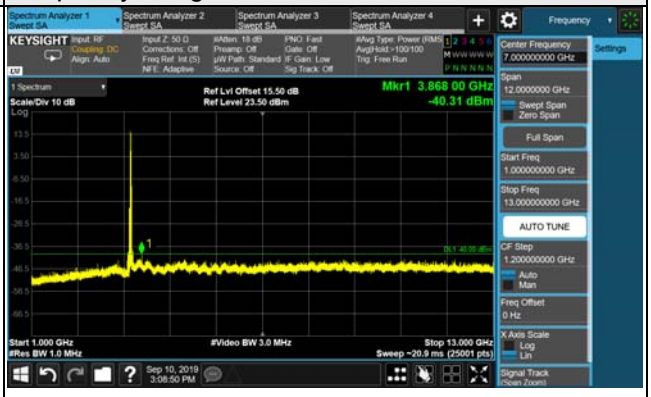
LTE Band 42, Channel Bandwidth 20MHz

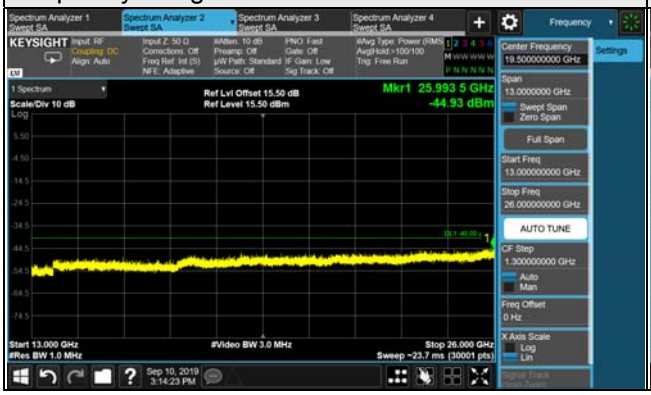
Channel 43292 (3570.2MHz) 1RB0 +Channel 43490 (3590.0MHz) 1RB0



Channel 43292 (3570.2MHz) 1RB99 +Channel 43490 (3590.0MHz) 1RB99



LTE Band 42, Channel Bandwidth 20MHz, 1RB0	
Channel 43292 (3570.2MHz)+Channel 43490 (3590.0MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~13GHz
	
Frequency Range : 13GHz~26GHz	Frequency Range : 26GHz~40GHz
	

LTE Band 42, Channel Bandwidth 20MHz, 1RB99	
Channel 43292 (3570.2MHz)+Channel 43490 (3590.0MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~13GHz
	
Frequency Range : 13GHz~26GHz	Frequency Range : 26GHz~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	Aug. 08, 2018	Aug. 07, 2019
			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)	Aug. 08, 2018	Aug. 07, 2019
			Jul. 11, 2019	Jul. 10, 2020
RF signal cable Woken	8D-FB	Cable-CH9-01	Jul. 31, 2018	Jul. 30, 2019
			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.

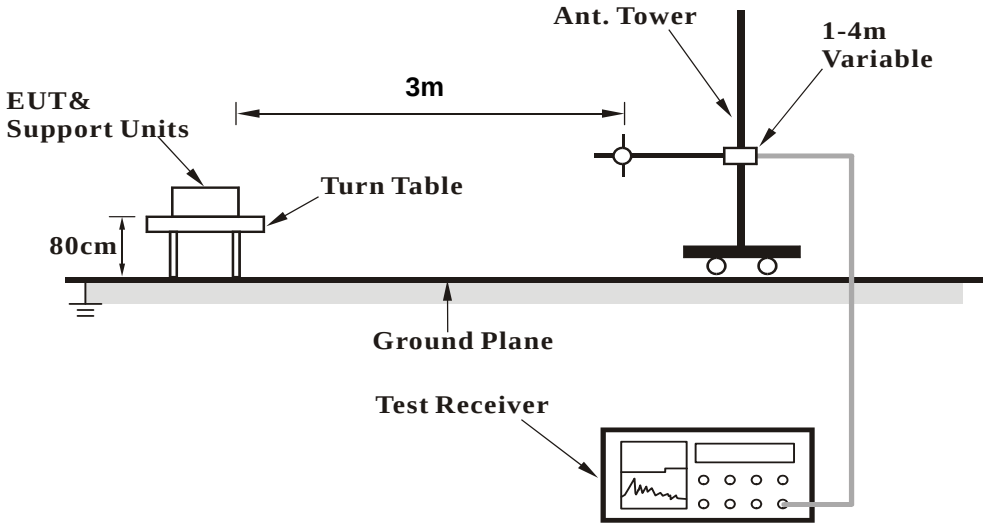
Note: The resolution bandwidth of spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz.

4.6.4 Deviation from Test Standard

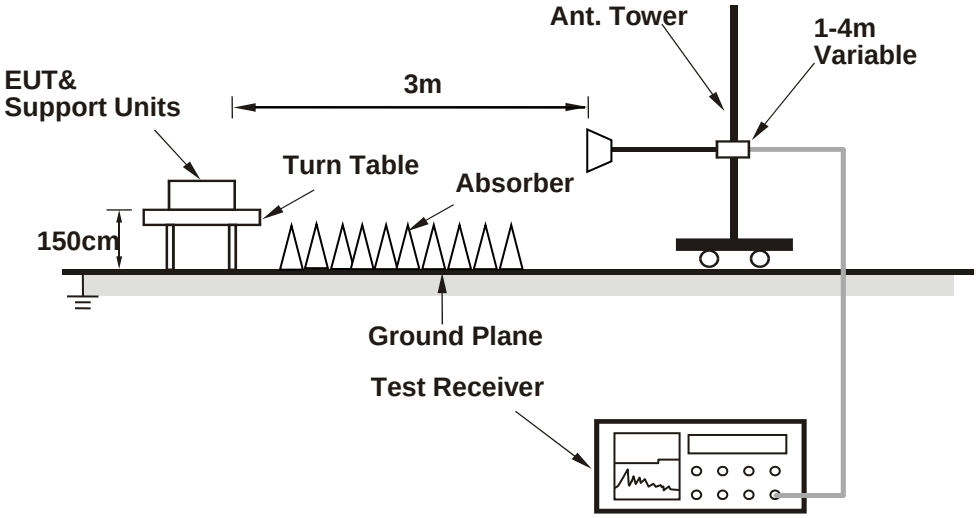
No deviation.

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.

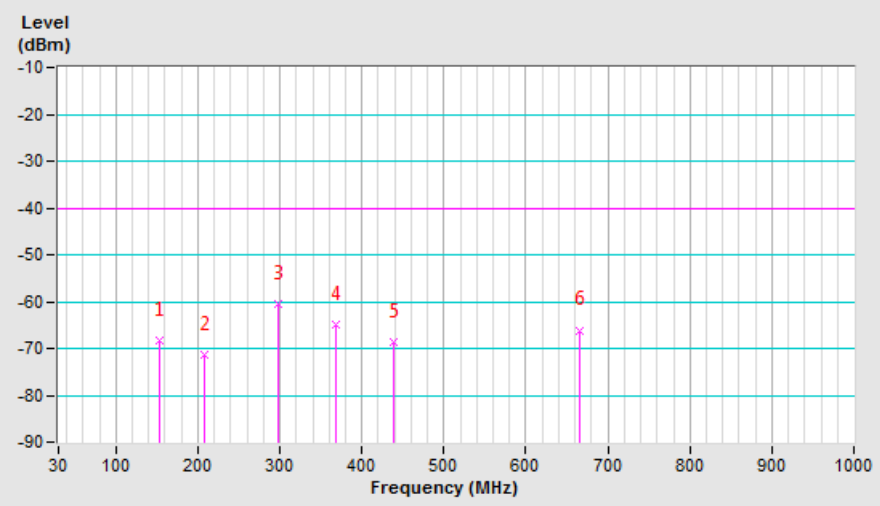
Below 1GHz Data

LTE Band 42, Channel Bandwidth 20MHz, 1RB99

Mode	TX channel 43190 (3560.0MHz)+ TX channel 43388 (3579.8MHz)	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	154.16	-63.90	-65.30	-2.90	-68.20	-40.00	-28.20
2	208.48	-62.90	-69.30	-2.00	-71.30	-40.00	-31.30
3	297.72	-57.70	-58.70	-1.70	-60.40	-40.00	-20.40
4	367.56	-62.40	-68.60	3.80	-64.80	-40.00	-24.80
5	439.34	-68.40	-72.10	3.50	-68.60	-40.00	-28.60
6	666.32	-68.60	-69.70	3.60	-66.10	-40.00	-26.10

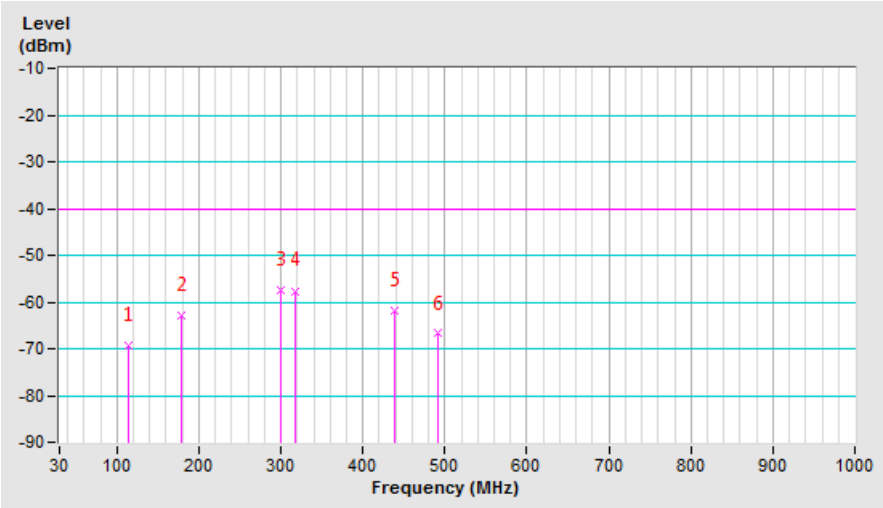
Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).



Mode	TX channel 43190 (3560.0MHz)+ TX channel 43388 (3579.8MHz)	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	113.42	-62.00	-66.70	-2.70	-69.40	-40.00	-29.40
2	179.38	-59.40	-59.90	-2.90	-62.80	-40.00	-22.80
3	299.66	-57.40	-59.80	2.50	-57.30	-40.00	-17.30
4	317.12	-57.60	-61.70	4.10	-57.60	-40.00	-17.60
5	439.34	-61.90	-65.40	3.50	-61.90	-40.00	-21.90
6	491.72	-66.70	-70.50	3.70	-66.80	-40.00	-26.80

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 42, Channel Bandwidth 20MHz, 1RB99

Mode	TX channel 43190 (3560.0MHz)+ TX channel 43388 (3579.8MHz)	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**	**-65.80**	**-47.80**	**0.70**	**-47.10**	**-40.00**	**-7.10**
2	7159.60	-66.30	-48.50	0.80	-47.70	-40.00	-7.70
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	-65.90	-48.20	0.70	-47.50	-40.00	-7.50
2	**7159.60**	**-65.70**	**-47.90**	**0.80**	**-47.10**	**-40.00**	**-7.10**

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

LTE Band 42, Channel Bandwidth 20MHz, 1RB0

Mode	TX channel 43240 (3565.0MHz)+ TX channel 43438 (3584.8MHz)	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	7130.00	-66.20	-48.20	0.70	-47.50	-40.00	-7.50
2	7169.60	-66.60	-48.80	0.80	-48.00	-40.00	-8.00
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	7130.00	-66.40	-48.60	0.70	-47.90	-40.00	-7.90
2	7169.60	-66.20	-48.40	0.80	-47.60	-40.00	-7.60

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

LTE Band 42, Channel Bandwidth 20MHz, 1RB0

Mode	TX channel 43292 (3570.2MHz)+ TX channel 43490 (3590.0MHz)	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	7140.40	-66.40	-48.50	0.80	-47.70	-40.00	-7.70
2	7180.00	-66.00	-48.20	0.80	-47.40	-40.00	-7.40
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	7140.40	-65.80	-48.10	0.80	-47.30	-40.00	-7.30
2	7180.00	-66.00	-48.20	0.80	-47.40	-40.00	-7.40

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:

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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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