

FCC Test Report (Part 96: LTE Band 42)

Report No.: RF190522C29-1

FCC ID: QI3BEC-CBRS12

Test Model: BEC CBRS-12

Received Date: May 22, 2019

Test Date: Jun. 06 ~ Jul. 22, 2019

Issued Date: Jul. 24, 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



This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification. The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any government agencies.

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	9
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	13
4.1.4 Test Procedures	14
4.1.5 Deviation from Test Standard	14
4.1.6 EUT Operating Conditions	14
4.1.7 Test Results	15
4.2 Frequency Stability Measurement	17
4.2.1 Limits of Frequency Stability Measurement	17
4.2.2 Test Procedure	17
4.2.3 Test Setup	17
4.2.4 Test Results	18
4.3 Emission Bandwidth Measurement	19
4.3.1 Emission Bandwidth Measurement	19
4.3.2 Test Setup	19
4.3.3 Test Instruments	19
4.3.4 Test Procedure	19
4.3.5 Deviation from Test Standard	19
4.3.6 EUT Operating Conditions	19
4.3.7 Test Result (-26dB Bandwidth)	20
4.3.8 Test Result (Occupied Bandwidth)	21
4.4 Peak to Average Ratio Measurement	22
4.4.1 Limits of Peak to Average Ratio Measurement	22
4.4.2 Test Setup	22
4.4.3 Test Procedures	22
4.4.4 Test Results	23
4.5 Conducted Spurious Emissions	24
4.5.1 Limits of Conducted Spurious Emissions Measurement	24
4.5.2 Test Setup	24
4.5.3 Test Procedure	24
4.5.4 Test Results	25
4.6 Radiated Emission Measurement	34
4.6.1 Limits of Radiated Emission Measurement	34
4.6.2 Test Instruments	34
4.6.3 Test Procedures	34
4.6.4 Deviation from Test Standard	34
4.6.5 Test Set Up	35
4.6.6 Test Results	36

5	Pictures of Test Arrangements	44
	Appendix – Information of the Testing Laboratories	45

Release Control Record

Issue No.	Description	Date Issued
RF190522C29-1	Original release.	Jul. 24, 2019

1 Certificate of Conformity

Product: CBRS Cat. 12 module

Brand: BEC, BILLION

Test Model: BEC CBRS-12

Sample Status: Engineering sample

Applicant: BILLION ELECTRIC CO., LTD.

Test Date: Jun. 06 ~ Jul. 22, 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 :



Pettie Chen / Senior Specialist

Date:

Jul. 24, 2019

Approved by :



Bruce Chen / Project Engineer

Date:

Jul. 24, 2019

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 -4.2dB at 197.29MHz.

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) ($\pm$)
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	CBRS Cat. 12 module		
Brand	BEC, BILLION		
Test Model	BEC CBRS-12		
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	Channel Bandwidth 20MHz	QPSK
			148.252mW (21.71dBm)
Emission Designator	LTE Band 42	Channel Bandwidth 20MHz: 1RB0	0M97G7D
		Channel Bandwidth 20MHz: 1RB99	1M05G7D
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 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	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:

1. 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	Jones Chang
Frequency Stability	25deg. C, 63%RH	56Vdc	Jones Chang
Occupied Bandwidth	25deg. C, 63%RH	56Vdc	Jones Chang
Peak to Average Ratio	25deg. C, 63%RH	56Vdc	Jones Chang
Conducuted 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)

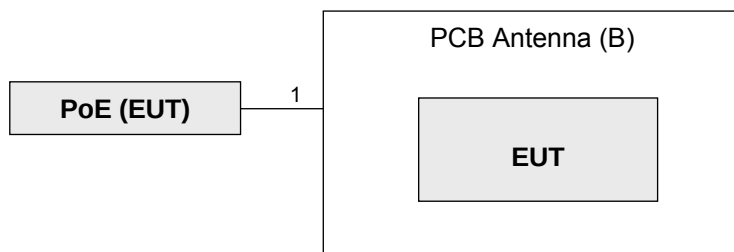
Note:

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

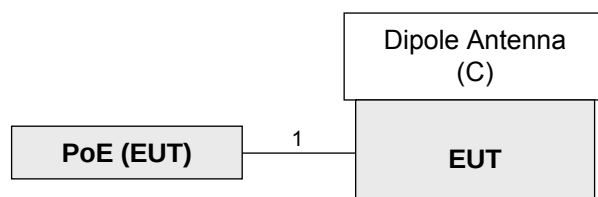
PCB antenna mode



Remote site



Dipole antenna mode



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

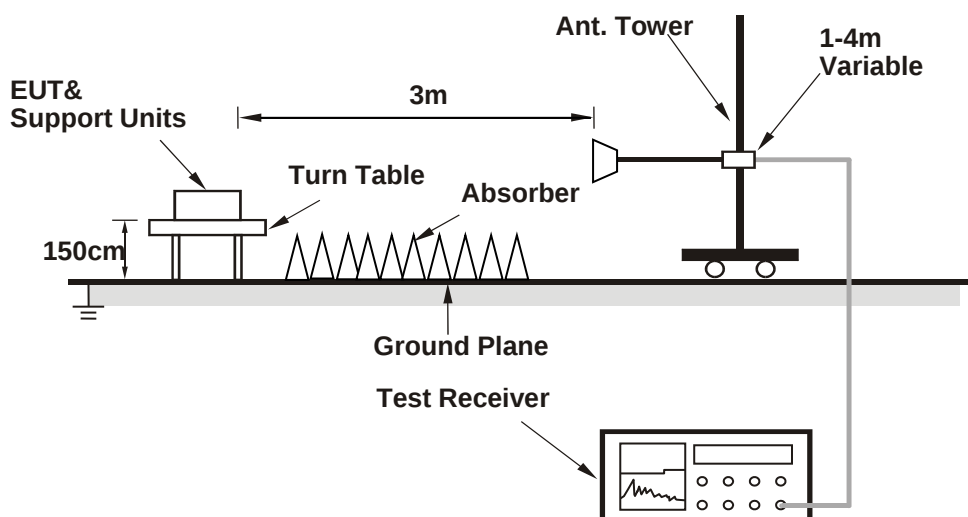
4.1 Maximum Output Power Measurement

4.1.1 Limits of Maximum Output Power Measurement

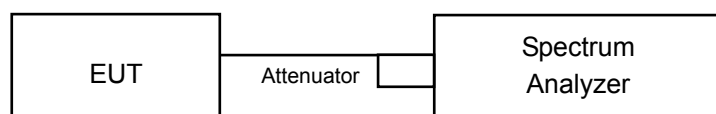
Device		Maximum Output Power (dBm/10 MHz)
☒	End User Device	23
☐	Category A CBSD	30
☐	Category B CBSD	47

4.1.2 Test Setup

Radiated Measurement Method



Conducted Measurement Method



4.1.3 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
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
Preamplifier Agilent (Above 1GHz)	8449B	3008A02367	Feb. 19, 2019	Feb. 18, 2020
RF signal cable HUBER+SUHNER&EMCI	SUCOFLEX 104 & EMC104-SM-SM80 00	CABLE-CH9-02 (248780+171006)	Jan. 19, 2019	Jan. 18, 2020
RF signal cable HUBER+SUHNER	SUCOFLEX 104	CABLE-CH9-(250 795/4)	Aug. 08, 2018	Aug. 07, 2019
RF signal cable Woken	8D-FB	Cable-CH9-01	Jul. 31, 2018	Jul. 30, 2019
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
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

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.

4.1.4 Test Procedures

Radiated Measurement Method

1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. 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.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to peak and/or average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.
6. EIRP = Output power level of S.G + Correction Factor (including Cable loss, Antenna gain, etc...)

Conducted Measurement Method

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 $\geq 3 \times$ RBW.
5. Set number of points in sweep $\geq 2 \times$ 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 $\geq 98\%$), 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 power measurement function, with the band limits set equal to the OBW band edges. If the instrument does not have a band 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.

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)

Con- figure	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	-2.52	6.68	7.17
					1	99						1	99			-2.29	6.69	7.21
		42	20	16QAM	1	0	43190	3560	42	20	16QAM	1	0	43388	3579.8	-2.55	6.62	7.12
					1	99						1	99			-2.42	6.66	7.17
		42	20	64QAM	1	0	43190	3560	42	20	64QAM	1	0	43388	3579.8	-2.56	6.61	7.11
					1	99						1	99			-2.52	6.64	7.14
	42C	42	20	QPSK	1	0	43240	3565	42	20	QPSK	1	0	43438	3584.8	-2.62	6.59	7.08
					1	99						1	99			-2.90	6.71	7.16
		42	20	16QAM	1	0	43240	3565	42	20	16QAM	1	0	43438	3584.8	-2.81	6.55	7.03
					1	99						1	99			-2.93	6.67	7.12
		42	20	64QAM	1	0	43240	3565	42	20	64QAM	1	0	43438	3584.8	-2.35	6.53	7.06
					1	99						1	99			-3.02	6.64	7.09
	42C	42	20	QPSK	1	0	43292	3570.2	42	20	QPSK	1	0	43490	3590	-2.40	6.43	6.96
					1	99						1	99			-2.93	6.64	7.09
		42	20	16QAM	1	0	43292	3570.2	42	20	16QAM	1	0	43490	3590	-2.40	6.41	6.95
					1	99						1	99			-3.03	6.58	7.03
		42	20	64QAM	1	0	43292	3570.2	42	20	64QAM	1	0	43490	3590	-2.41	6.40	6.94
					1	99						1	99			-3.10	6.56	7.01

EIRP Power

Con- figure	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	21.67
					1	99						1	99			21.71
		42	20	16QAM	1	0	43190	3560	42	20	16QAM	1	0	43388	3579.8	21.62
					1	99						1	99			21.67
		42	20	64QAM	1	0	43190	3560	42	20	64QAM	1	0	43388	3579.8	21.61
					1	99						1	99			21.64
	42C	42	20	QPSK	1	0	43240	3565	42	20	QPSK	1	0	43438	3584.8	21.58
					1	99						1	99			21.66
		42	20	16QAM	1	0	43240	3565	42	20	16QAM	1	0	43438	3584.8	21.53
					1	99						1	99			21.62
		42	20	64QAM	1	0	43240	3565	42	20	64QAM	1	0	43438	3584.8	21.56
					1	99						1	99			21.59
	42C	42	20	QPSK	1	0	43292	3570.2	42	20	QPSK	1	0	43490	3590	21.46
					1	99						1	99			21.59
		42	20	16QAM	1	0	43292	3570.2	42	20	16QAM	1	0	43490	3590	21.45
					1	99						1	99			21.53
		42	20	64QAM	1	0	43292	3570.2	42	20	64QAM	1	0	43490	3590	21.44
					1	99						1	99			21.51

4.2 Frequency Stability Measurement

4.2.1 Limits of Frequency Stability Measurement

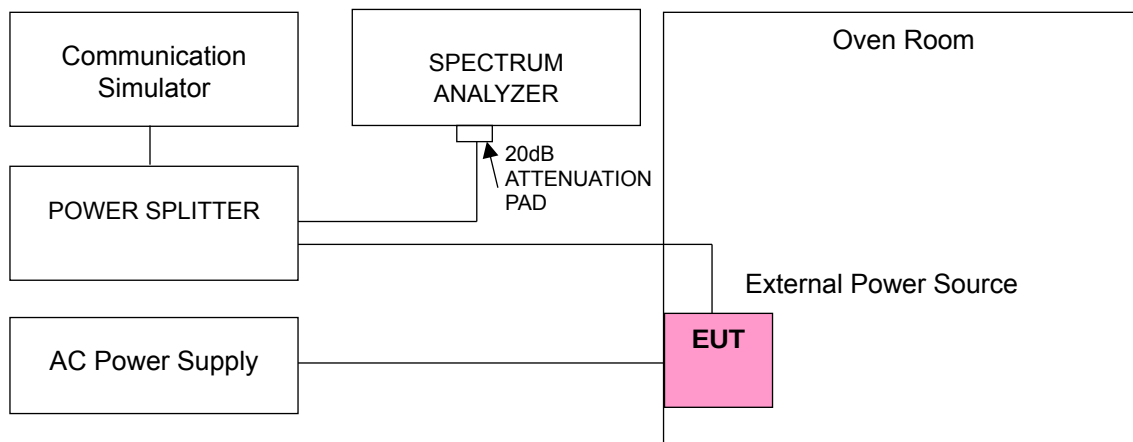
The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency band.

4.2.2 Test Procedure

- 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.
- 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.
- The temperature range step is 10 degrees in this test items. All temperature levels shall be hold the ± 0.5 °C 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 42, Channel Bandwidth: 20MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
50.4	3560.000002	0.0004	3590.000000	0.0003
56.0	3560.000001	0.0004	3590.000000	0.0010
61.6	3560.000004	0.0011	3590.000000	0.0005

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

Frequency Error vs. Temperature

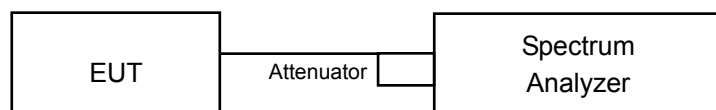
Temp. (°C)	LTE Band 42, Channel Bandwidth: 20MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	3560.000003	0.000	3590.000000	0.000
-20	3560.000003	0.001	3590.000000	0.001
-10	3560.000004	0.001	3590.000000	0.001
0	3560.000002	0.001	3590.000000	0.001
10	3560.000002	0.001	3590.000000	0.000
20	3559.999997	-0.001	3590.000000	-0.001
30	3559.999999	0.000	3590.000000	0.000
40	3559.999998	0.000	3590.000000	0.000
50	3559.999999	0.000	3590.000000	-0.001
60	3559.999997	-0.001	3590.000000	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 Bandwidth:

All measurements were done at low, middle and high operational frequency range. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth.

26dBc Bandwidth:

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW = 430 kHz (20 MHz bandwidth). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

4.3.5 Deviation from Test Standard

No deviation.

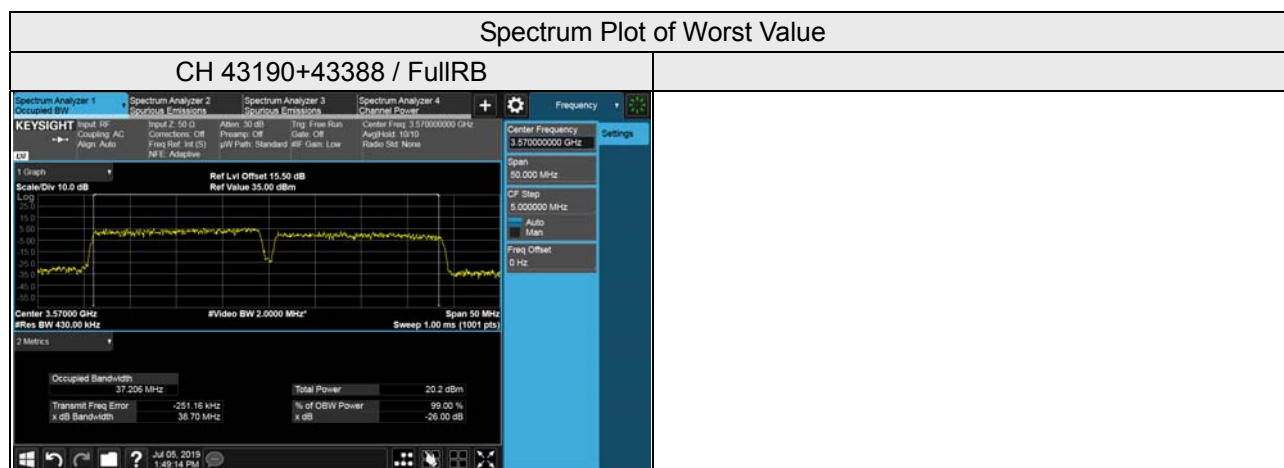
4.3.6 EUT Operating Conditions

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)

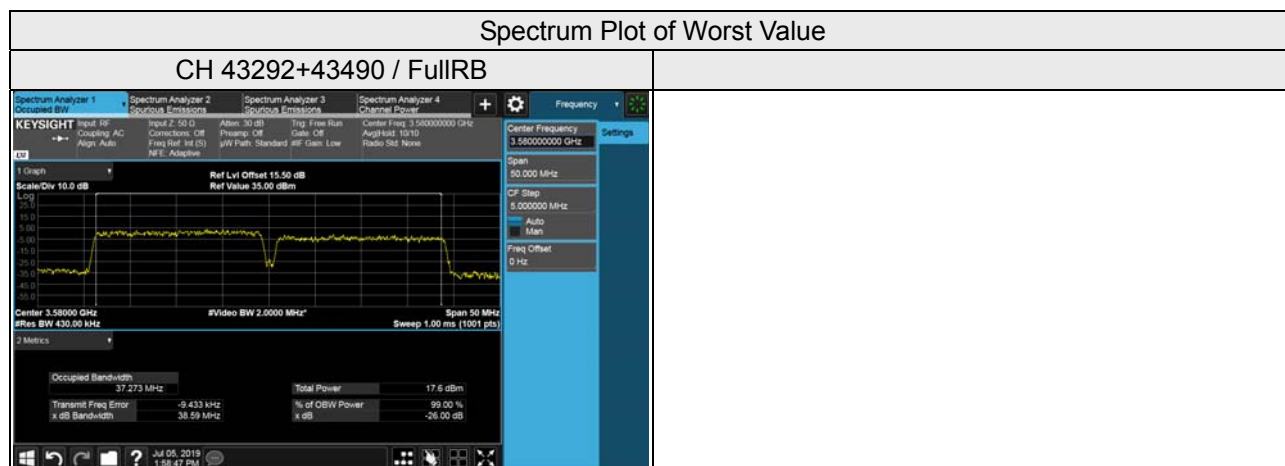
LTE Band 42

LTE Band 42, Channel Bandwidth 20MHz		
Channel	Frequency (MHz)	26dB Bandwidth (MHz)
		QPSK
		FullRB
43190+43388	3560.0+3579.8	38.70
43240+43438	3565.0+3584.8	38.67
43292+43490	3570.2+3590.0	38.59



4.3.8 Test Result (Occupied Bandwidth)

LTE Band 42, Channel Bandwidth 20MHz		
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
		QPSK
		FullIRB
43190+43388	3560.0+3579.8	37.206
43240+43438	3565.0+3584.8	37.052
43292+43490	3570.2+3590.0	37.273

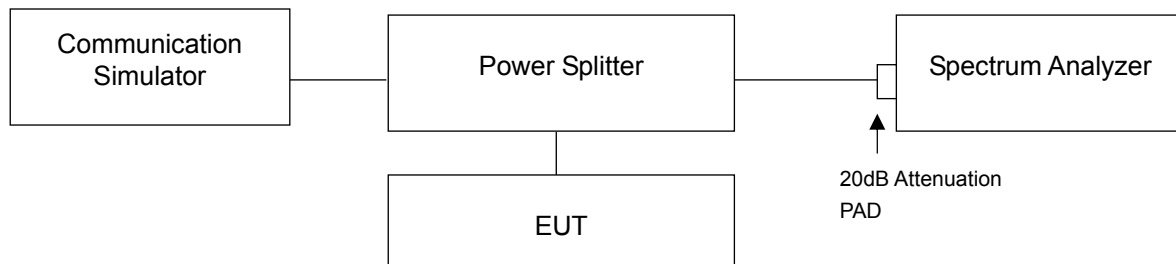


4.4 Peak to Average Ratio Measurement

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



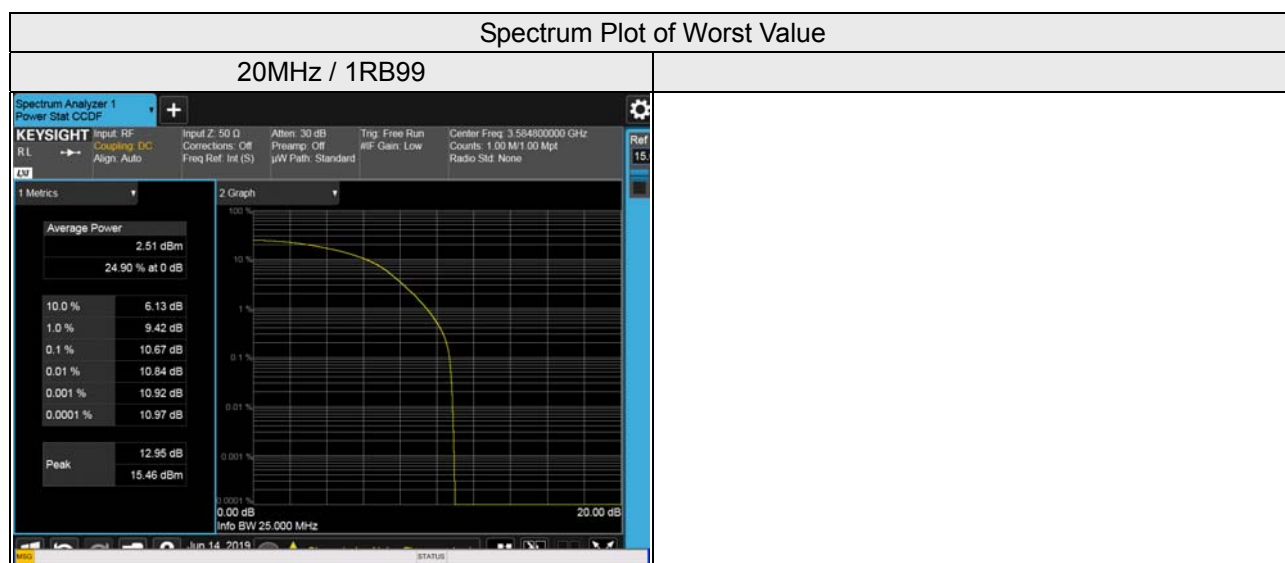
4.4.3 Test Procedures

- Set resolution/measurement bandwidth $\geq$ signal's occupied bandwidth;
- Set the number of counts to a value that stabilizes the measured CCDF curve;
- Record the maximum PAPR level associated with a probability of 0.1%.

4.4.4 Test Results

LTE Band 42

LTE Band 42, Channel Bandwidth 20MHz			
Channel	Frequency (MHz)	Peak To Average Ratio (dB)	
		QPSK	
		1RB0	1RB99
43190	3560.0	9.21	7.88
43388	3579.8	8.32	9.21
43240	3565.0	9.35	7.96
43438	3584.8	8.46	10.67
43292	3570.2	9.51	8.13
43490	3590.0	8.35	10.65

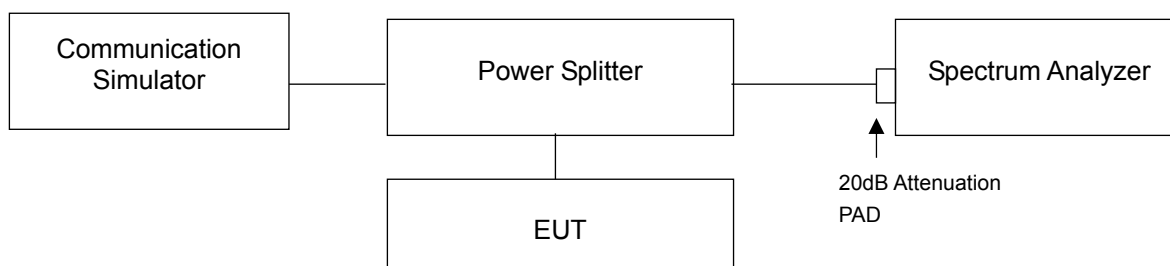


4.5 Conducted Spurious Emissions

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



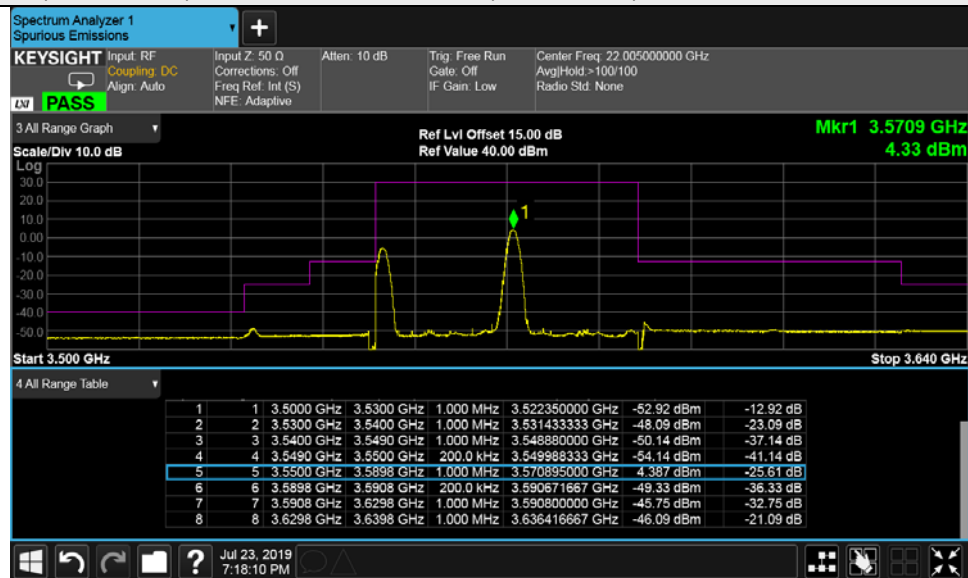
4.5.3 Test Procedure

- The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range.
- Measuring frequency range is from 9 kHz to 37 GHz. 20dB attenuation pad is connected with spectrum. RBW=300kHz and VBW=1MHz (For 9kHz~1GHz) and RBW=1MHz and VBW=3MHz (For 1GHz~37GHz) is used for conducted emission measurement.
- Measuring frequency band edge, 20dB attenuation pad is connected with spectrum. 1% of the fundamental emission bandwidth is used for conducted emission measurement.

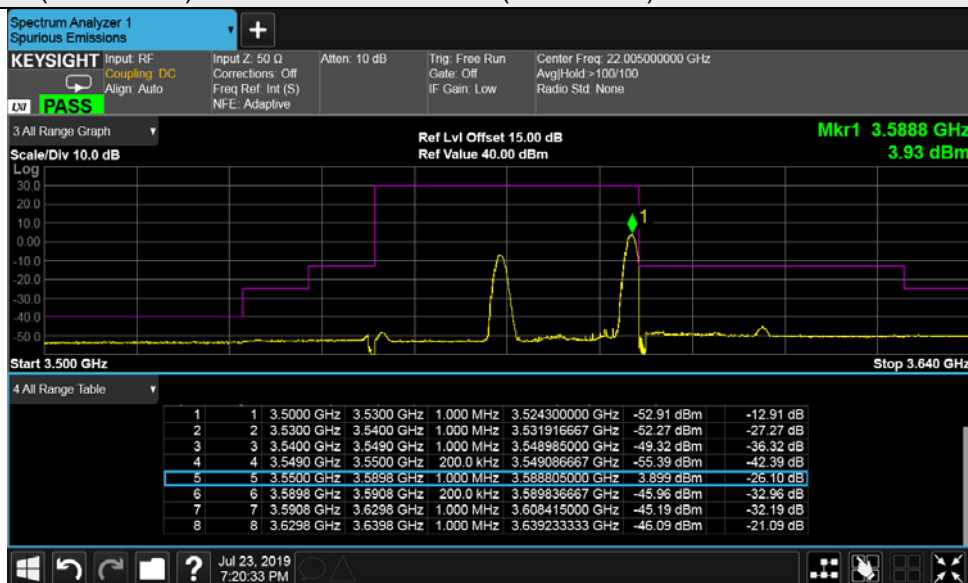
4.5.4 Test Results

LTE Band 42, Channel Bandwidth 20MHz

Channel 43190 (3560.0MHz) 1RB0 + Channel 43388 (3579.8MHz) 1RB0



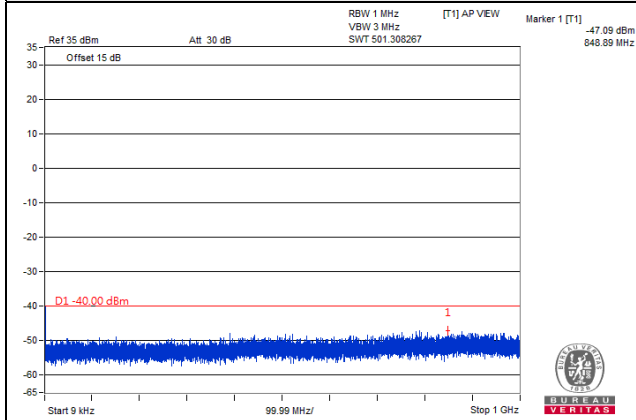
Channel 43190 (3560.0MHz) 1RB99 + Channel 43388 (3579.8MHz) 1RB99



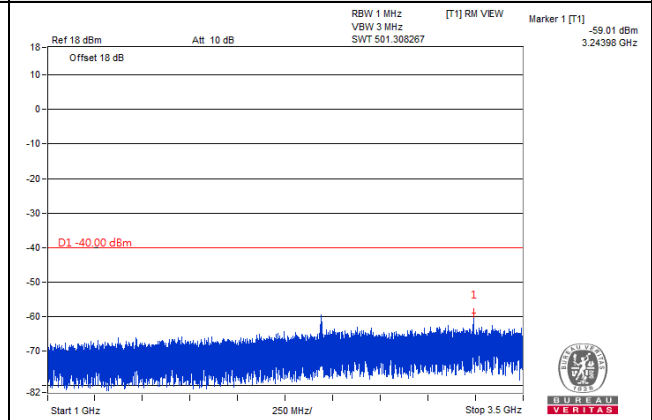
LTE Band 42, Channel Bandwidth 20MHz, 1RB0

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

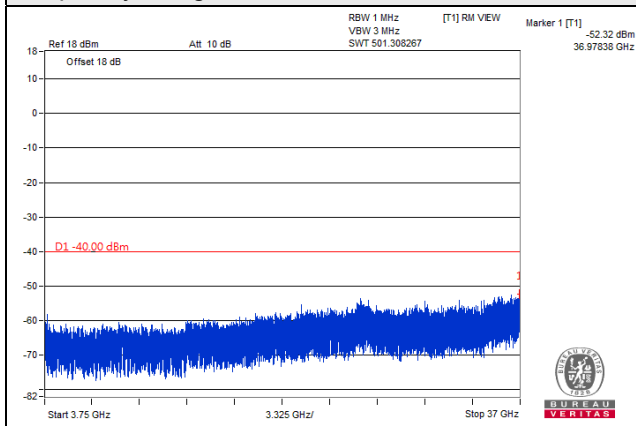
Frequency Range : 9kHz~1GHz



Frequency Range : 1GHz~3.5GHz



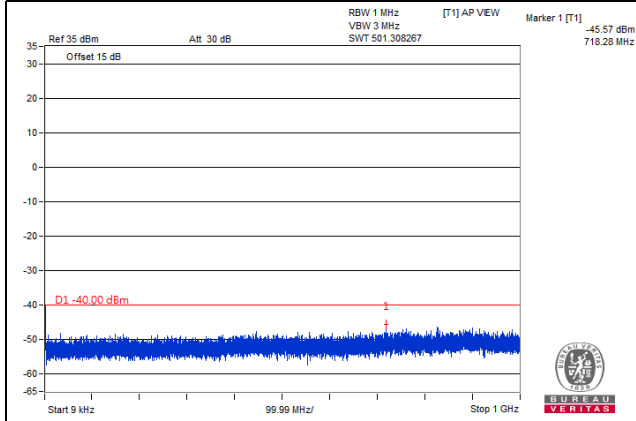
Frequency Range : 3.75GHz~37GHz



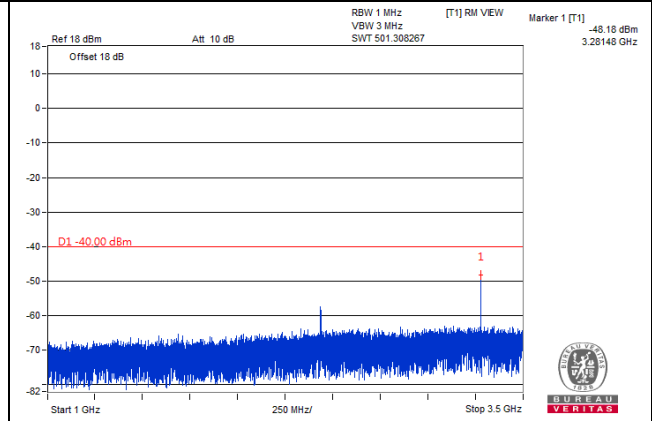
LTE Band 42, Channel Bandwidth 20MHz, 1RB99

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

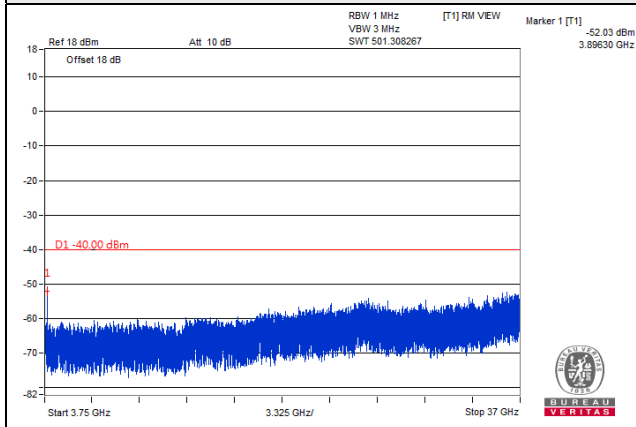
Frequency Range : 9kHz~1GHz



Frequency Range : 1GHz~3.5GHz

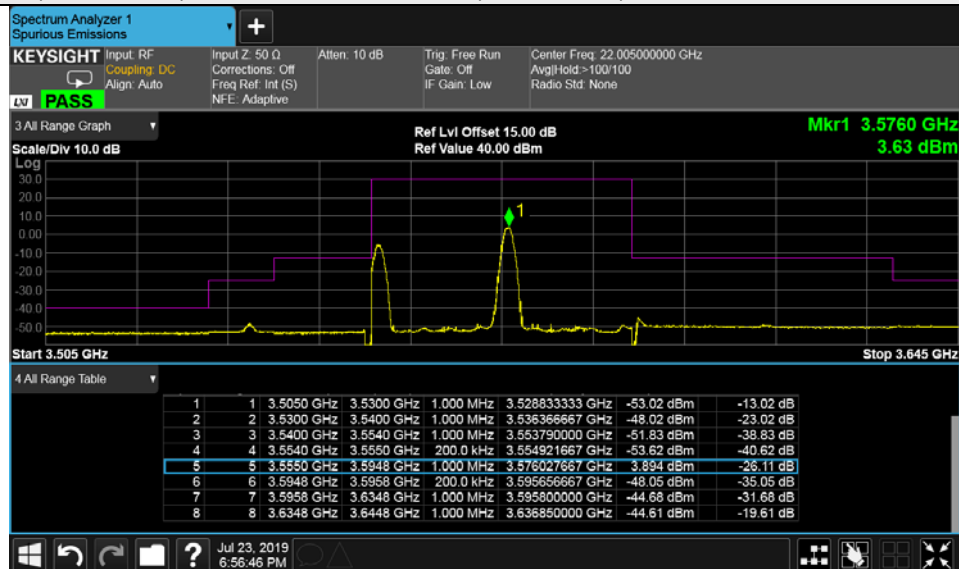


Frequency Range : 3.75GHz~37GHz

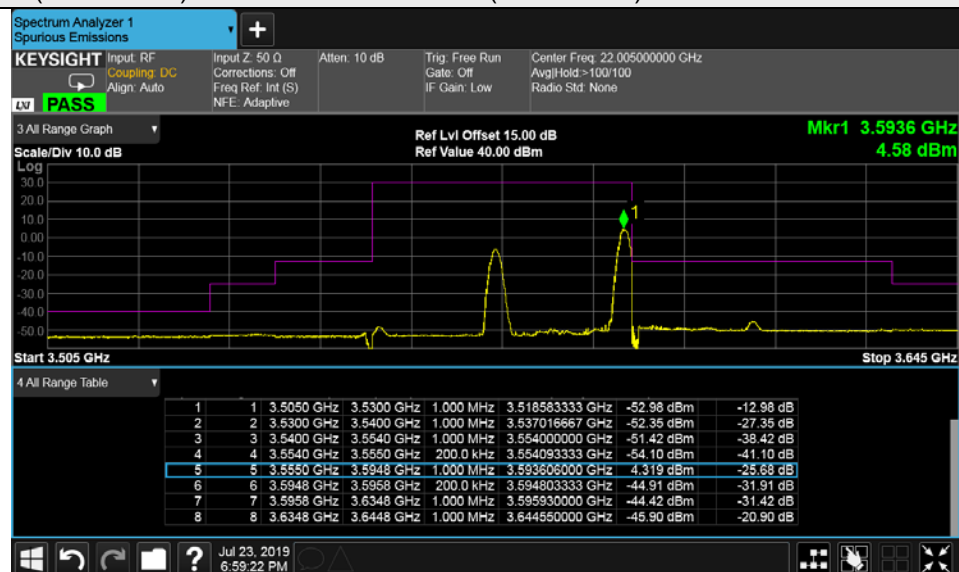


LTE Band 42, Channel Bandwidth 20MHz

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



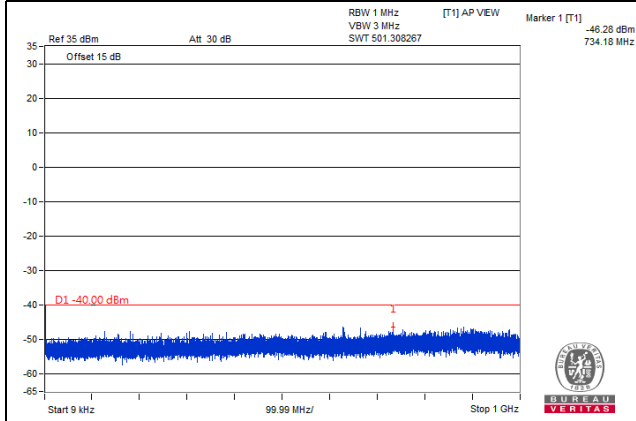
Channel 43240 (3565.0MHz) 1RB99 +Channel 43438 (3584.8MHz) 1RB99



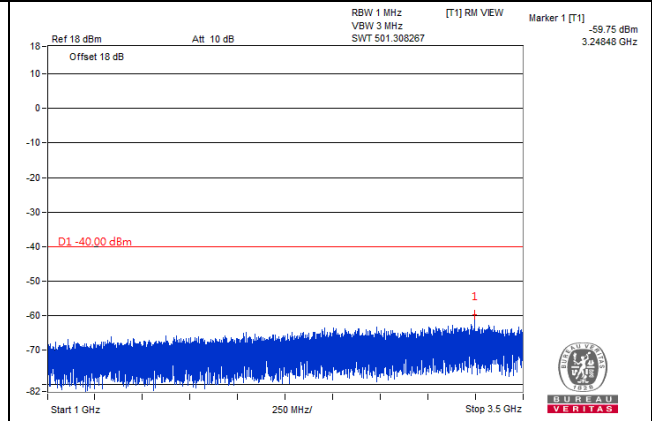
LTE Band 42, Channel Bandwidth 20MHz, 1RB0

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

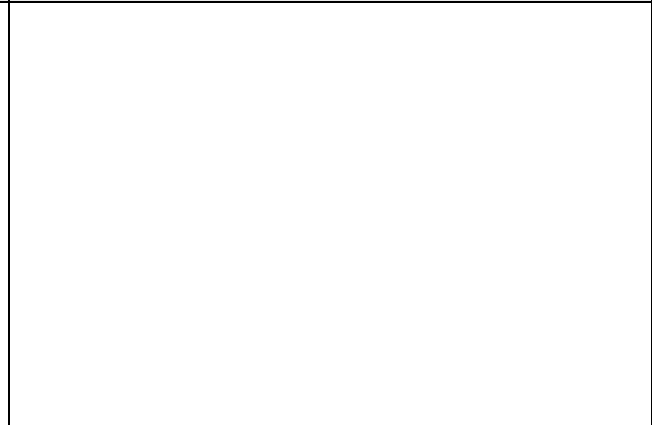
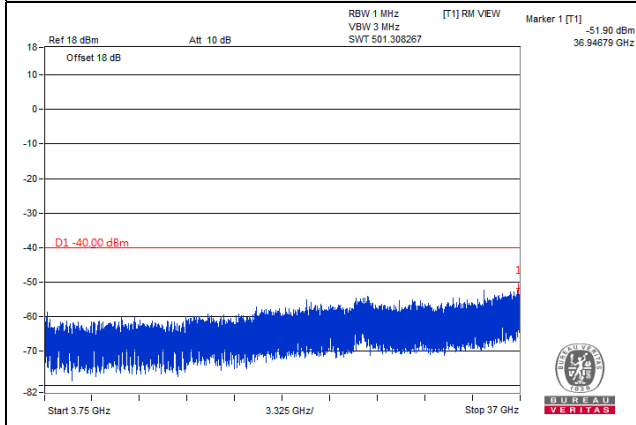
Frequency Range : 9kHz~1GHz



Frequency Range : 1GHz~3.5GHz



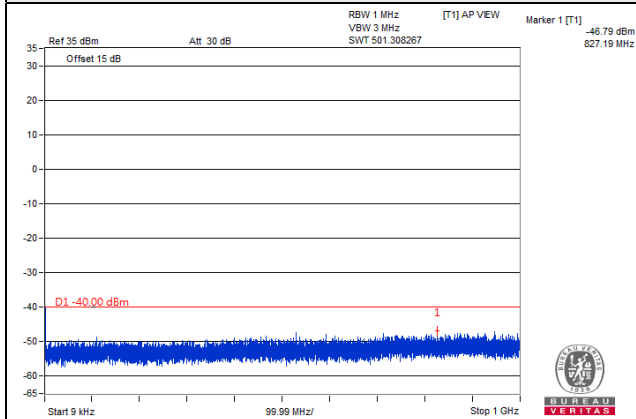
Frequency Range : 3.75GHz~37GHz



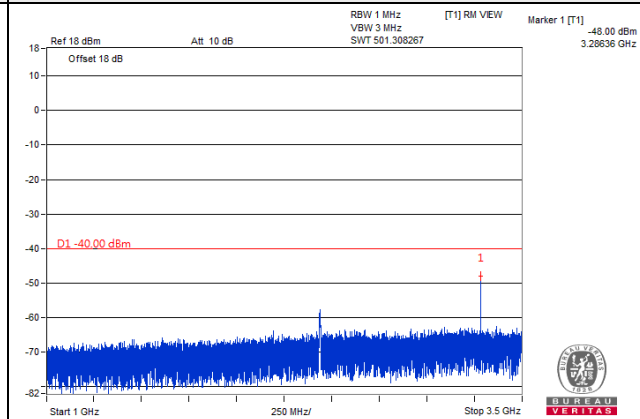
LTE Band 42, Channel Bandwidth 20MHz, 1RB99

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

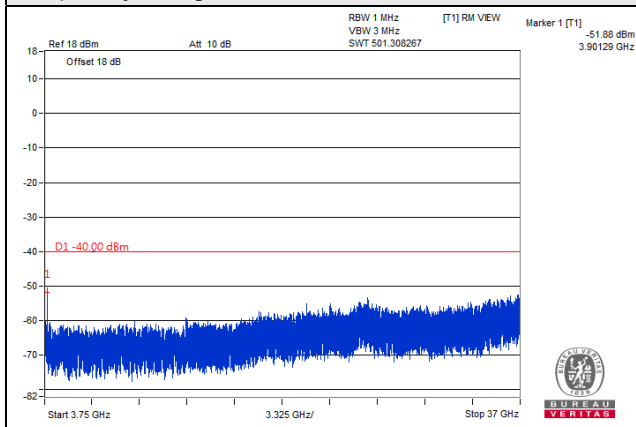
Frequency Range : 9kHz~1GHz



Frequency Range : 1GHz~3.5GHz

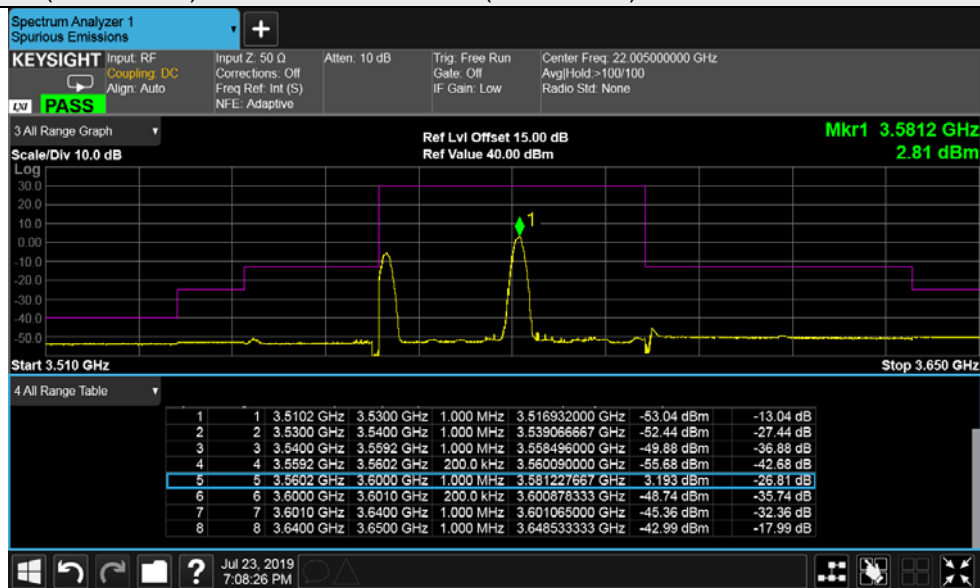


Frequency Range : 3.75GHz~37GHz

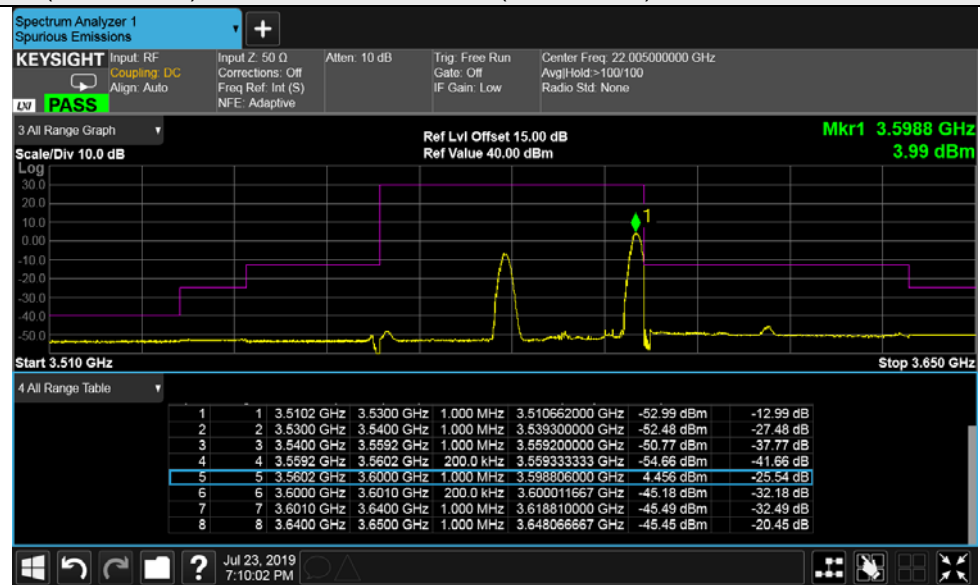


LTE Band 42, Channel Bandwidth 20MHz

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



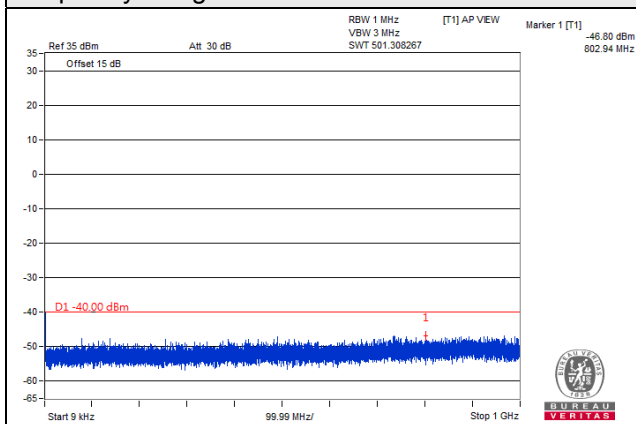
Channel 43292 (3570.2MHz) 1RB99 +Channel 43490 (3590.0MHz) 1RB99



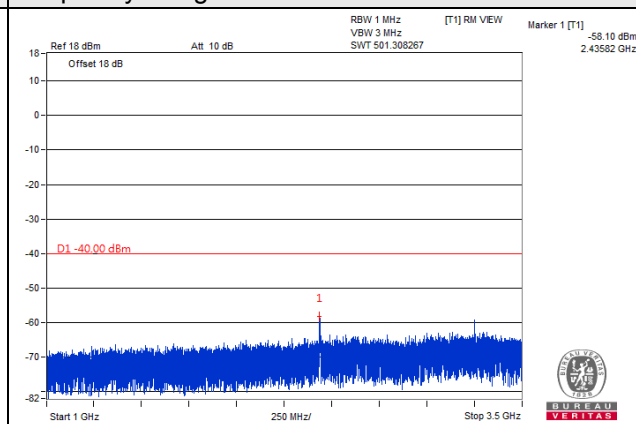
LTE Band 42, Channel Bandwidth 20MHz, 1RB0

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

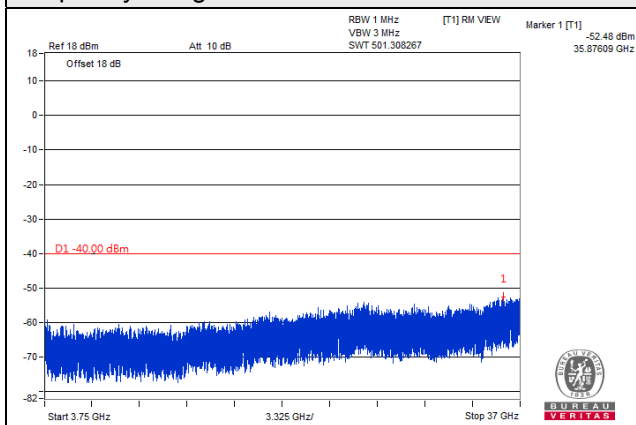
Frequency Range : 9kHz~1GHz



Frequency Range : 1GHz~3.5GHz



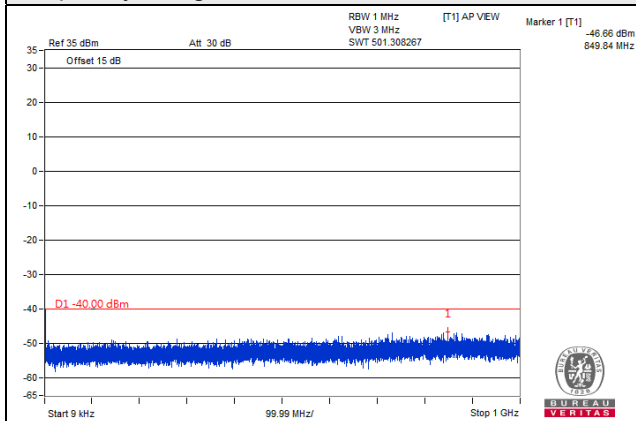
Frequency Range : 3.75GHz~37GHz



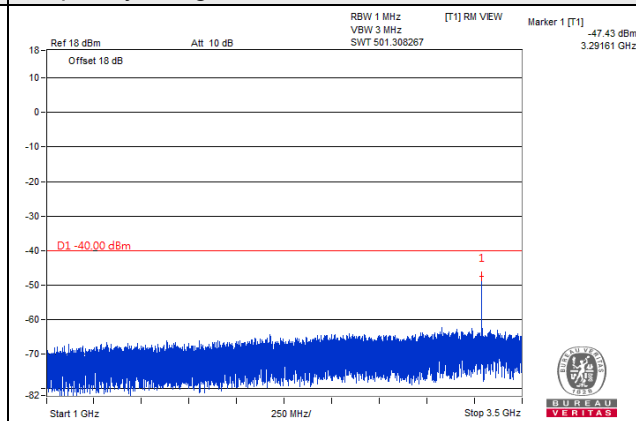
LTE Band 42, Channel Bandwidth 20MHz, 1RB99

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

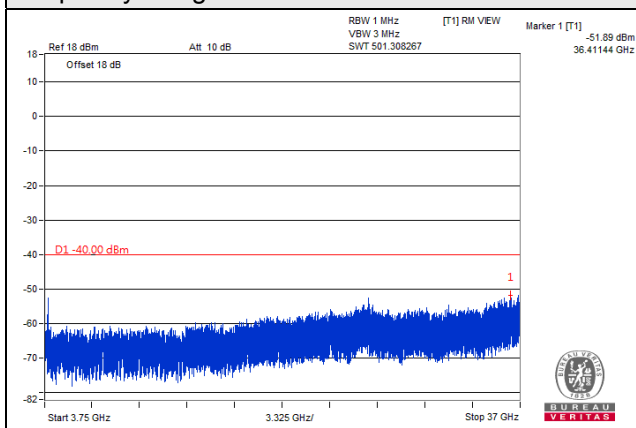
Frequency Range : 9kHz~1GHz



Frequency Range : 1GHz~3.5GHz



Frequency Range : 3.75GHz~37GHz



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

Refer to section 4.1.3 to get information of above instrument.

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. $EIRP = \text{Output power level of S.G} - \text{TX cable loss} + \text{Antenna gain of substitution horn}.$
- d. ERP power can be calculated form EIRP power by subtracting the gain of dipole, $ERP \text{ power} = EIRP \text{ power} - 2.15dBi.$

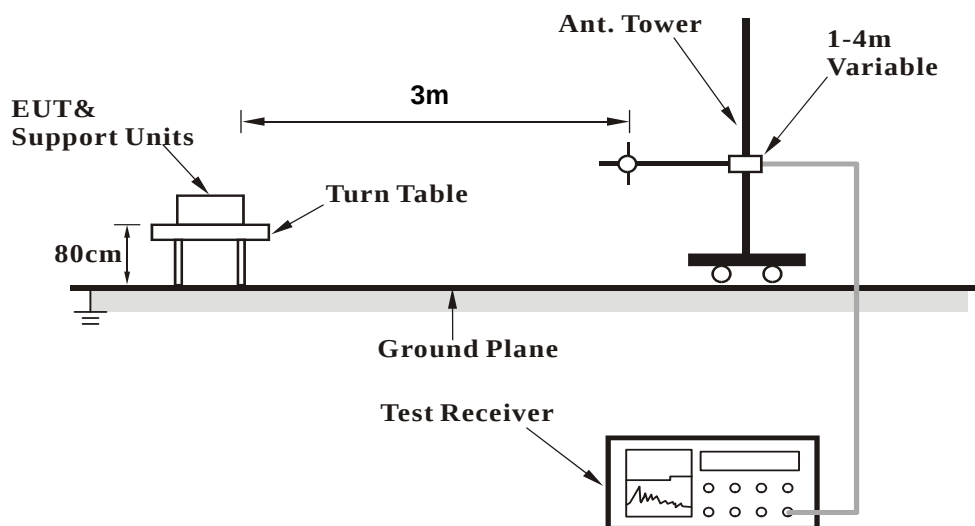
Note: The resolution bandwidth of spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz.

4.6.4 Deviation from Test Standard

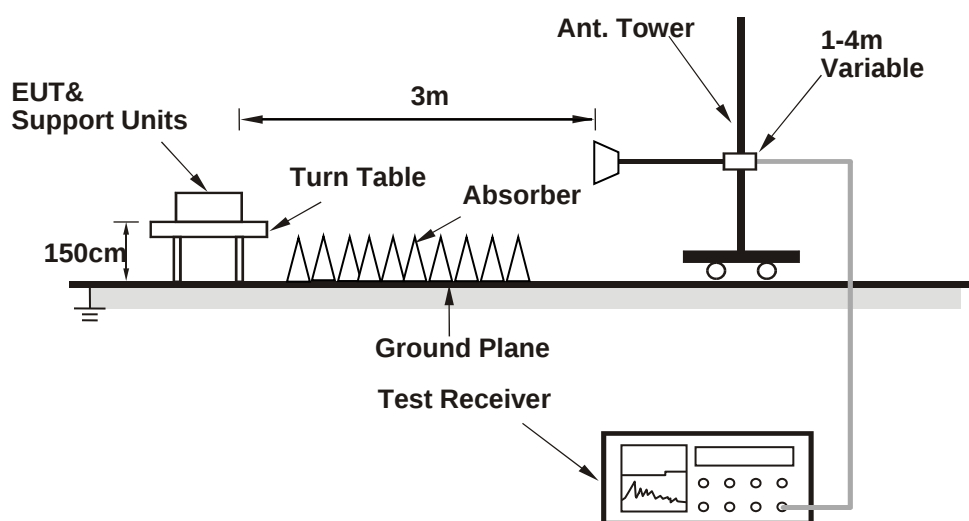
No deviation.

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

PCB antenna mode

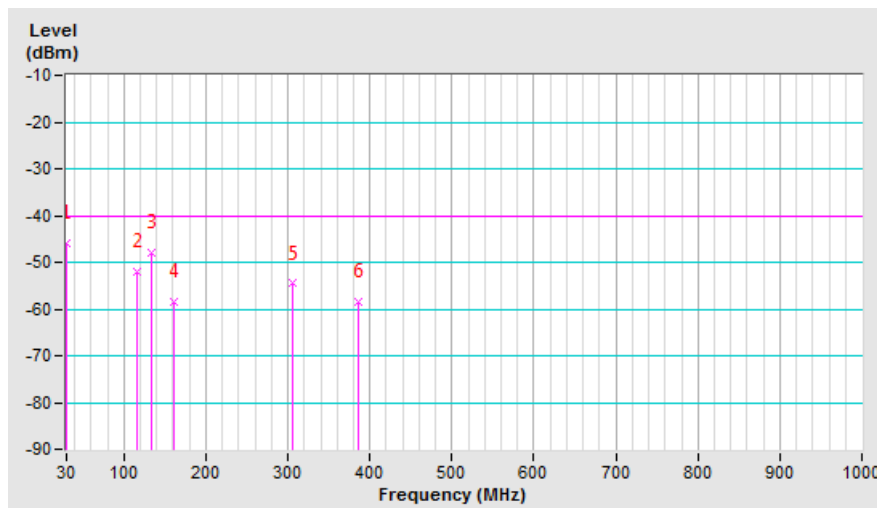
Channel Bandwidth: 20MHz / QPSK / 1RB99

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	30.00	-49.8	-26.4	-19.4	-45.8	-40.0	-5.8
2	116.33	-44.0	-49.0	-3.0	-52.0	-40.0	-12.0
3	133.79	-41.8	-44.5	-3.3	-47.8	-40.0	-7.8
4	160.95	-53.0	-55.4	-3.0	-58.4	-40.0	-18.4
5	306.45	-50.3	-58.5	3.9	-54.6	-40.0	-14.6
6	385.99	-57.6	-61.9	3.5	-58.4	-40.0	-18.4

Remarks:

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

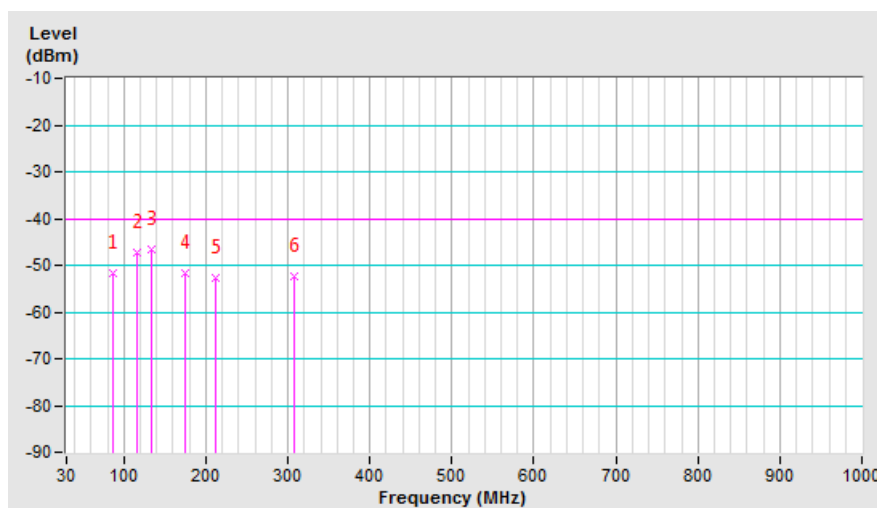


Mode	TX channel 43190 (3560.0MHz)+ TX channel 43388 (3579.8MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

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	87.23	-45.4	-51.5	-0.1	-51.6	-40.0	-11.6
2	116.33	-40.1	-44.3	-3.0	-47.3	-40.0	-7.3
3	133.79	-42.6	-43.2	-3.3	-46.5	-40.0	-6.5
4	175.50	-47.9	-48.8	-2.8	-51.6	-40.0	-11.6
5	211.39	-49.3	-50.6	-2.1	-52.7	-40.0	-12.7
6	307.42	-52.5	-56.3	3.9	-52.4	-40.0	-12.4

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 42, Channel Bandwidth 20MHz, 1RB99

Mode	TX channel 43190 (3560.0MHz)+ TX channel 43388 (3579.8MHz)	Frequency Range	1GHz ~ 37GHz
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	-63.2	-45.2	0.7	-44.5	-40.0	-4.5
2	7159.60	-64.4	-46.6	0.8	-45.8	-40.0	-5.8
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	-64.2	-46.5	0.7	-45.8	-40.0	-5.8
2	7159.60	-64.2	-46.4	0.8	-45.6	-40.0	-5.6

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 43240 (3565.0MHz)+ TX channel 43438 (3584.8MHz)	Frequency Range	1GHz ~ 37GHz
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	-64.0	-46.0	0.7	-45.3	-40.0	-5.3
2	7169.60	-64.5	-46.7	0.8	-45.9	-40.0	-5.9
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	-64.3	-46.5	0.7	-45.8	-40.0	-5.8
2	7169.60	-64.7	-46.9	0.8	-46.1	-40.0	-6.1

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 43292 (3570.2MHz)+ TX channel 43490 (3590.0MHz)	Frequency Range	1GHz ~ 37GHz
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	-65.0	-47.1	0.8	-46.3	-40.0	-6.3
2	7180.00	-64.7	-46.9	0.8	-46.1	-40.0	-6.1
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	7140.40	-64.1	-46.4	0.8	-45.6	-40.0	-5.6
2	7180.00	-64.5	-46.7	0.8	-45.9	-40.0	-5.9

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

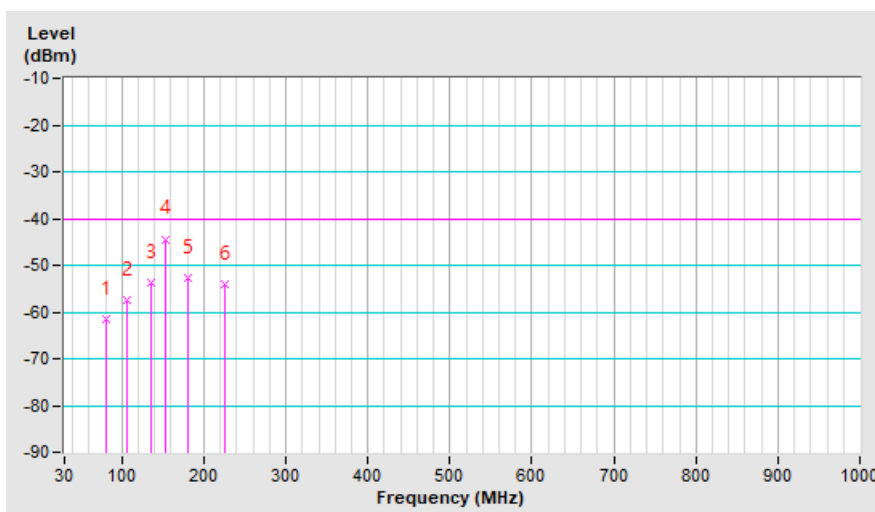
Channel Bandwidth: 20MHz / QPSK / 1RB0

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	80.61	-56.6	-62.0	0.5	-61.5	-40.0	-21.5
2	105.91	-49.3	-55.2	-2.2	-57.4	-40.0	-17.4
3	135.43	-47.8	-50.6	-3.2	-53.8	-40.0	-13.8
4	153.71	-40.1	-41.5	-2.9	-44.4	-40.0	-4.4
5	180.42	-44.7	-49.8	-2.9	-52.7	-40.0	-12.7
6	225.41	-46.1	-52.3	-1.8	-54.1	-40.0	-14.1

Remarks:

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

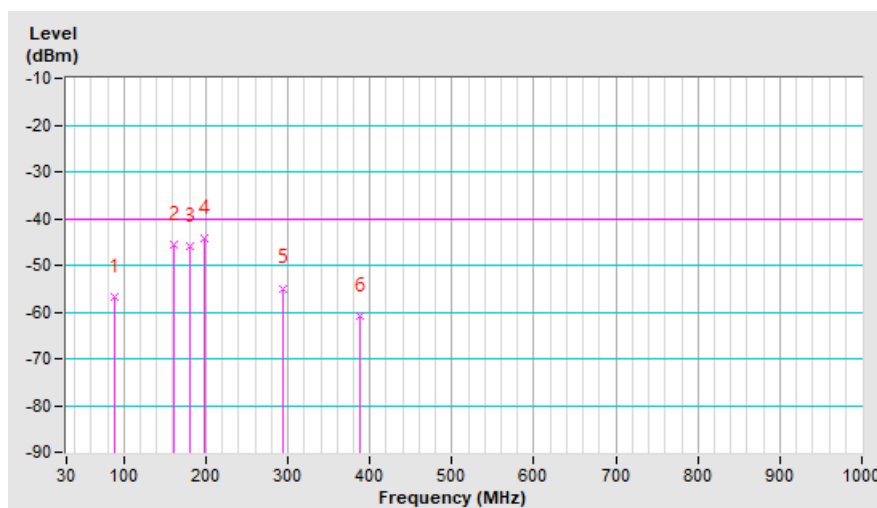


Mode	TX channel 43190 (3560.0MHz)+ TX channel 43388 (3579.8MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

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	89.04	-50.4	-56.6	-0.1	-56.7	-40.0	-16.7
2	160.74	-42.5	-42.5	-3.0	-45.5	-40.0	-5.5
3	180.42	-42.6	-43.1	-2.9	-46.0	-40.0	-6.0
4	197.29	-43.3	-41.8	-2.4	-44.2	-40.0	-4.2
5	294.29	-55.0	-53.1	-1.8	-54.9	-40.0	-14.9
6	388.48	-60.1	-64.1	3.4	-60.7	-40.0	-20.7

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 ~ 37GHz
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	-65.0	-47.0	0.7	-46.3	-40.0	-6.3
2	7159.60	-64.5	-46.7	0.8	-45.9	-40.0	-5.9
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	-64.9	-47.2	0.7	-46.5	-40.0	-6.5
2	7159.60	-64.9	-47.1	0.8	-46.3	-40.0	-6.3

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 43240 (3565.0MHz)+ TX channel 43438 (3584.8MHz)	Frequency Range	1GHz ~ 37GHz
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	-64.4	-46.4	0.7	-45.7	-40.0	-5.7
2	7169.60	-64.5	-46.7	0.8	-45.9	-40.0	-5.9
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	-64.6	-46.8	0.7	-46.1	-40.0	-6.1
2	7169.60	-64.8	-47.0	0.8	-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 43292 (3570.2MHz)+ TX channel 43490 (3590.0MHz)	Frequency Range	1GHz ~ 37GHz
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	-64.3	-46.4	0.8	-45.6	-40.0	-5.6
2	7180.00	-64.7	-46.9	0.8	-46.1	-40.0	-6.1
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	7140.40	-64.6	-46.9	0.8	-46.1	-40.0	-6.1
2	7180.00	-64.4	-46.6	0.8	-45.8	-40.0	-5.8

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.

--- END ---