FCC Test Report

(Part 90 Subpart R)

Report No.: RF191031C08-6

FCC ID: PY319400469

Test Model: MR5100

Received Date: Nov. 04, 2019

Test Date: Dec. 27, 2019 ~ Jan. 06, 2020

Issued Date: Jan. 30, 2020

Applicant: Netgear, Inc.

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Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
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FCC Registration / Designation Number: 788550 / TW0003

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Table of Contents

Release Control Record **4**

1 Certificate of Conformity **5**

2 Summary of Test Results **6**

2.1 Measurement Uncertainty 6
2.2 Test Site and Instruments 7

3 General Information **8**

3.1 General Description of EUT 8
3.2 Configuration of System under Test 9
3.2.1 Description of Support Units 9
3.3 Test Mode Applicability and Tested Channel Detail 10
3.4 EUT Operating Conditions 11
3.5 General Description of Applied Standards 11

4 Test Types and Results **12**

4.1 Output Power Measurement 12
4.1.1 Limits of Output Power Measurement 12
4.1.2 Test Procedures 12
4.1.3 Test Setup 13
4.1.4 Test Results 14
4.2 Modulation Characteristics Measurement 19
4.2.1 Limits of Modulation Characteristics 19
4.2.2 Test Procedure 19
4.2.3 Test Setup 19
4.2.4 Test Results 19
4.3 Frequency Stability Measurement 20
4.3.1 Limits of Frequency Stabiliity Measurement 20
4.3.2 Test Procedure 20
4.3.3 Test Setup 20
4.3.4 Test Results 21
4.4 Occupied Bandwidth Measurement 23
4.4.1 Limits of Occupied Bandwidth Measurement 23
4.4.2 Test Procedure 23
4.4.3 Test Setup 23
4.4.4 Test Result 24
4.5 Emission Mask Measurement 26
4.5.1 Limits of Emission Mask Measurement 26
4.5.2 Test Procedures 26
4.5.3 Test Setup 26
4.5.4 Test Results 27
4.6 Band Edge Measurement 28
4.6.1 Limits of Band Edge Measurement 28
4.6.2 Test Setup 28
4.6.3 Test Procedures 28
4.6.4 Test Results 29
4.7 Peak to Average Ratio 31
4.7.1 Limits of Peak to Average Ratio Measurement 31
4.7.2 Test Setup 31
4.7.3 Test Procedures 31
4.7.4 Test Results 32
4.8 Conducted Spurious Emissions 34
4.8.1 Limits of Conducted Spurious Emissions Measurement 34
4.8.2 Test Setup 34
4.8.3 Test Procedure 34
4.8.4 Test Results 35

4.9 Radiated Emission Measurement 39
4.9.1 Limits of Radiated Emission Measuremen 39
4.9.2 Test Procedure 39
4.9.3 Deviation from Test Standard 39
4.9.4 Test Setup 40
4.9.5 Test Results 41

5 Pictures of Test Arrangements 48

Appendix – Information of the Testing Laboratories 49

Release Control Record

Issue No.	Description	Date Issued
RF191031C08-6	Original release	Jan. 30, 2020

1 Certificate of Conformity

Product: 5G MHS Travel Router

Brand: NETGEAR

Test Model: MR5100

Sample Status: ENGINEERING SAMPLE

Applicant: Netgear, Inc.

Test Date: Dec. 27, 2019 ~ Jan. 06, 2020

Standards: FCC Part 90, Subpart R

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:** Jan. 30, 2020

Pettie Chen / Senior Specialist

Approved by : Bruce Chen , **Date:** Jan. 30, 2020

Bruce Chen / Senior Project Engineer

2 Summary of Test Results

Applied Standard: FCC Part 90 & Part 2			
FCC Clause	Test Item	Result	Remarks
2.1046 90.542 (a) (7)	Effective Radiated Power	Pass	Meet the requirement of limit.
2.1047	Modulation Characteristics	Pass	Meet the requirement.
2.1055 90.539 (d)	Frequency Stability	Pass	Meet the requirement of limit.
2.1049	Occupied Bandwidth (*)	Pass	Meet the requirement of limit.
90.210 (n) & (b)	Emission Masks	Pass	Meet the requirement of limit.
2.1051 90.543 (e) (2) & (3)	Band Edge Measurements	Pass	Meet the requirement of limit.
2.1051 90.543 (c)	Conducted Spurious Emissions	Pass	Meet the requirement of limit.
2.1053 90.543 (c) & (f)	Radiated Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -2.7dB at 1591.00MHz.

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

2.1 Measurement Uncertainty

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

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

2.2 Test Site and Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESIB7	100187	May 30, 2019	May 29, 2020
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100040	Sep. 23, 2019	Sep. 22, 2020
BILOG Antenna SCHWARZBECK	VULB9168	9168-155	Nov. 11, 2019	Nov. 10, 2020
HORN Antenna SCHWARZBECK	BBHA 9120D	9120D-1170	Nov. 24, 2019	Nov. 23, 2020
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Nov. 24, 2019	Nov. 23, 2020
Preamplifier Agilent (Below 1GHz)	8447D	2944A10631	Jul. 11, 2019	Jul. 10, 2020
Preamplifier KEYSIGHT (Above 1GHz)	83017A	MY53270295	Jun. 11, 2019	Jun. 10, 2020
RF Coaxial Cable WORKEN With 5dB PAD	8D-FB	Cable-CH4-01	Aug. 20, 2019	Aug. 19, 2020
RF Coaxial Cable EMCI	EMC102-KM-KM-3000	150929	Aug. 20, 2019	Aug. 19, 2020
RF Coaxial Cable EMCI	EMC102-KM-KM-600	150928	Aug. 20, 2019	Aug. 19, 2020
RF signal cable HUBER+SUHNER	SUCOFLEX 104	MY 13380+295012/04	Jul. 11, 2019	Jul. 10, 2020
RF signal cable HUBER+SUHNER	SUCOFLEX 104	Cable-CH4-03 (250724)	Jul. 11, 2019	Jul. 10, 2020
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower inn-co GmbH	MA 4000	010303	NA	NA
Antenna Tower Controller BV ADT	AT100	AT93021703	NA	NA
Turn Table BV ADT	TT100	TT93021703	NA	NA
Turn Table Controller BV ADT	SC100	SC93021703	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
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 4.

3 General Information

3.1 General Description of EUT

Product	5G MHS Travel Router				
Brand	NETGEAR				
Test Model	MR5100				
Status of EUT	Engineering Sample				
Power Supply Rating	5 or 9Vdc (adapter) 5Vdc (host equipment) 3.85Vdc (battery)				
Modulation Type	QPSK, 16QAM, 64QAM				
Operating Frequency	LTE Band 14	Channel Bandwidth 5MHz	790.5MHz ~ 795.5MHz		
		Channel Bandwidth 10MHz	793MHz		
Max. ERP Power	LTE Band 14		QPSK	16QAM	64QAM
		Channel Bandwidth 5MHz	301.995mW (24.8dBm)	245.471mW (23.9dBm)	199.526mW (23.0dBm)
		Channel Bandwidth 10MHz	316.228mW (25.0dBm)	251.189mW (24.0dBm)	204.174mW (23.1dBm)
Emission Designator	LTE Band 14		QPSK	16QAM	64QAM
		Channel Bandwidth 5MHz	4M49G7D	4M49D7W	4M49D7W
		Channel Bandwidth 10MHz	8M97G7D	8M97D7W	8M96D7W
Antenna Type	Refer to note				
Antenna Connector	Refer to note				
Accessory Device	Adapter x1, battery x1				
Cable Supplied	1m shielded USB cable without core (Brand: NIENYI, model: NYS2371-1)				

Note:

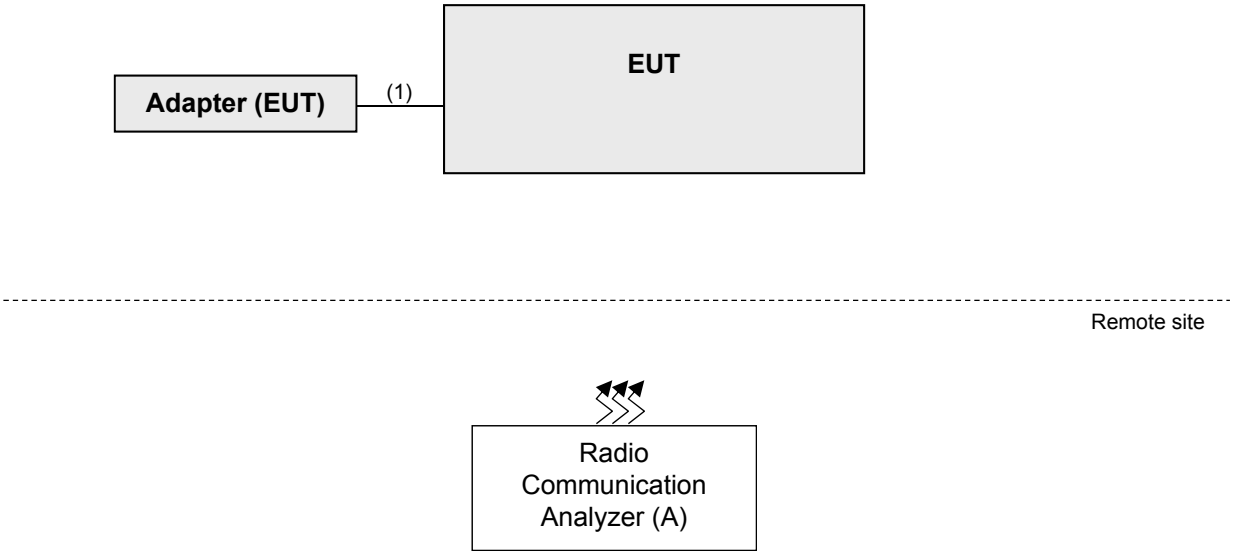
1. The following antennas were provided to the EUT.

Antenna Type	monopole	
Antenna Connector	NA	
Antenna Gain (dBi)	LTE Band 14	0.67

2. The EUT must be supplied with a power adapter or battery as following table:

Items	Brand	Model No.	Spec.
Adapter	NETGEAR	AD2122F20	Input: 100-240Vac~50/60Hz, 0.5A Output: 5Vdc / 2.0A or 9Vdc /1.8A
Battery	NETGEAR	W-20	3.85Vdc, 19.40Wh

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	MT8860C	1702001	NA	-

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.	USB cable	1	1	Y	0	Accessory of EUT

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 on X-plane. Following channel(s) was (were) selected for the final test as listed below:

EUT Configure Mode	Test item	Available channel	Tested channel	Channel Bandwidth	Modulation	Mode
-	ERP	23305 to 23355	23305(790.5MHz), 23330(793.0MHz), 23355(795.5MHz)	5MHz	QPSK / 16QAM / 64QAM	1 RB / 0 RB Offset
		23330	23330(793.0MHz)	10MHz	QPSK / 16QAM / 64QAM	Full RB
-	Modulation Characteristics	23330	23330(793.0MHz)	10MHz	QPSK / 16QAM / 64QAM	Full RB
-	Frequency Stability	23305 to 23355	23305(790.5MHz), 23355(795.5MHz)	5MHz	QPSK	Full RB
		23330	23330(793.0MHz)	10MHz	QPSK	Full RB
-	Occupied Bandwidth	23305 to 23355	23305(790.5MHz), 23330(793.0MHz), 23355(795.5MHz)	5MHz	QPSK / 16QAM / 64QAM	Full RB
		23330	23330(793.0MHz)	10MHz	QPSK / 16QAM / 64QAM	Full RB
-	Emission Mask	23305 to 23355	23305(790.5MHz), 23330(793.0MHz), 23355(795.5MHz)	5MHz	QPSK	Full RB
		23330	23330(793.0MHz)	10MHz	QPSK	Full RB
-	Band Edge	23305 to 23355	23305(790.5MHz), 23330(793.0MHz), 23355(795.5MHz)	5MHz	QPSK	1 RB / 0 RB Offset 1 RB /24 RB Offset 25RB / 0RB Offset
		23330	23330(793.0MHz)	10MHz	QPSK	1 RB / 0 RB Offset 1 RB / 49 RB Offset 50RB / 0RB Offset
-	Conducted Emission	23305 to 23355	23305(790.5MHz), 23330(793.0MHz), 23355(795.5MHz)	5MHz	QPSK	1 RB / 0 RB Offset
		23330	23330(793.0MHz)	10MHz	QPSK	1 RB / 0 RB Offset
-	Radiated Emission below 1GHz	23330	23330(793.0MHz)	5MHz,10MHz	QPSK	1 RB / 0 RB Offset
-	Radiated Emission above 1GHz	23305 to 23355	23305(790.5MHz), 23330(793.0MHz), 23355(795.5MHz)	5MHz	QPSK	1 RB / 0 RB Offset
		23330	23330(793.0MHz)	10MHz	QPSK	1 RB / 0 RB Offset

Note: The conducted output power for QPSK, 16QAM and 64QAM measured value of QPSK is higher than 16QAM and 64QAM mode. Therefore, only Modulation Characteristics, Emission Bandwidth and Peak to average ratio items had been tested under QPSK, 16QAM and 64QAM modes, the other test items were performed under QPSK mode only.

Test Condition:

Test Item	Environmental Conditions	Input Power	Tested By
ERP	25deg. C, 70%RH	120Vac, 60Hz	Noah Chang
Modulation characteristics	24deg. C, 64%RH	120Vac, 60Hz	James Yang
Frequency Stability	24deg. C, 64%RH	3.85Vdc	James Yang
Occupied Bandwidth	24deg. C, 64%RH	120Vac, 60Hz	James Yang
Emission Mask	24deg. C, 64%RH	120Vac, 60Hz	James Yang
Band Edge	24deg. C, 64%RH	120Vac, 60Hz	James Yang
Conducted Emission	24deg. C, 64%RH	120Vac, 60Hz	James Yang
Radiated Emission	25deg. C, 70%RH	120Vac, 60Hz	Noah Chang Luis 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

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 90

KDB 971168 D01 Power Meas License Digital Systems v03r01

ANSI/TIA/EIA-603-E 2016

ANSI 63.26-2015

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

4 Test Types and Results

4.1 Output Power Measurement

4.1.1 Limits of Output Power Measurement

Portable stations (hand-held devices) transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 3 watts ERP.

4.1.2 Test Procedures

EIRP / ERP Measurement:

a. All measurements were done at low, middle and high operational frequency range. RBW and VBW is 10MHz for LTE mode.

b. Substitution method is used for E.I.R.P measurement. 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.

c. The substitution horn 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 b. Record the power level of S.G

d. EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution horn.E.R.P power can be calculated form E.I.R.P power by subtracting the gain of dipole, E.R.P power = E.I.R.P power - 2.15dBi.

Where:

$ERP/EIRP = P_{Meas} + G_T - L_C$

P_{Meas} : Measure transmitter output power.
G_T : Gain of the transmitting antenna.
L_C : signal attenuation in the connecting cable between the transmitter and antenna.

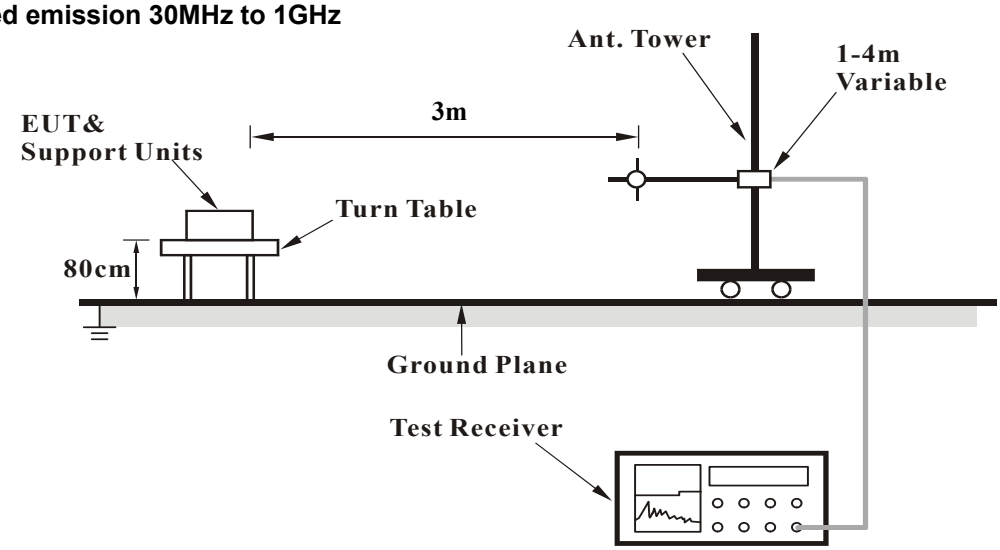
Conducted Power Measurement:

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.

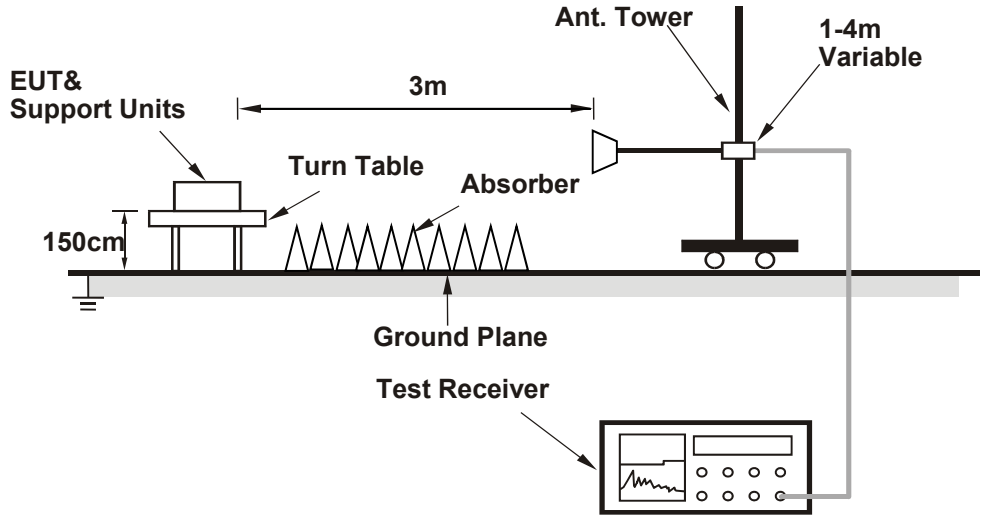
4.1.3 Test Setup

EIRP / ERP Measurement:

For radiated emission 30MHz to 1GHz

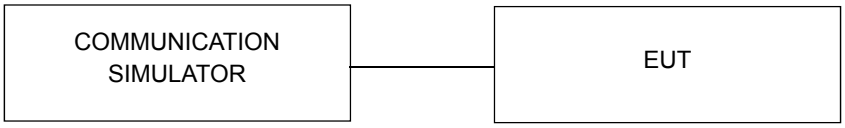


For radiated emission above 1GHz



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

Conducted Power Measurement:



4.1.4 Test Results

Conducted Output Power (dBm)

LTE Band 14							
BW	MCS Index	RB Size	RB Offset	Low	Mid	High	3GPP MPR (dB)
		Channel		23305	23330	23355	
		Frequency (MHz)		790.5	793	795.5	
5M	QPSK	1	0	22.65	22.90	22.76	0
		1	12	22.78	23.03	22.89	0
		1	24	22.83	23.08	22.94	0
		12	0	21.75	22.00	21.86	1
		12	6	21.85	22.10	21.96	1
		12	13	21.86	22.11	21.97	1
		25	0	21.74	21.99	21.85	1
	16QAM	1	0	21.61	21.86	21.72	1
		1	12	21.74	21.99	21.85	1
		1	24	21.79	22.04	21.90	1
		12	0	20.71	20.96	20.82	2
		12	6	20.81	21.06	20.92	2
		12	13	20.82	21.07	20.93	2
		25	0	20.70	20.95	20.81	2
	64QAM	1	0	20.56	20.81	20.67	2
		1	12	20.69	20.94	20.80	2
		1	24	20.74	20.99	20.85	2
		12	0	19.66	19.91	19.77	3
		12	6	19.76	20.01	19.87	3
		12	13	19.77	20.02	19.88	3
		25	0	19.65	19.90	19.76	3

LTE Band 14					
BW	MCS Index	RB Size	RB Offset	Mid	3GPP MPR (dB)
		Channel		23330	
		Frequency (MHz)		793	
10M	QPSK	1	0	22.96	0
		1	12	23.09	0
		1	24	23.14	0
		12	0	22.06	1
		12	6	22.16	1
		12	13	22.17	1
		25	0	22.05	1
	16QAM	1	0	21.92	1
		1	12	22.05	1
		1	24	22.10	1
		12	0	21.02	2
		12	6	21.12	2
		12	13	21.13	2
		25	0	21.01	2
	64QAM	1	0	20.90	2
		1	12	21.03	2
		1	24	21.08	2
		12	0	20.00	3
		12	6	20.10	3
		12	13	20.11	3
		25	0	19.99	3

ERP Power

Modulation Type: QPSK

LTE Band 14, Channel Bandwidth: 5MHz

Mode		TX channel 23305					
Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	790.50	-6.2	25.0	-0.3	24.7	34.8	-10.1
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	790.50	-13.1	18.9	-0.3	18.6	34.8	-16.2

Mode		TX channel 23330					
Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	793.00	-6.4	24.7	-0.2	24.5	34.8	-10.3
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	793.00	-13.4	18.5	-0.2	18.3	34.8	-16.5

Mode		TX channel 23355					
Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	795.50	-5.9	25.0	-0.2	24.8	34.8	-10.0
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	795.50	-13.2	18.7	-0.2	18.5	34.8	-16.3

Note: ERP (dBm) = S.G Power Value (dBm) + Correction Factor (dB).

LTE Band 14, Channel Bandwidth: 10MHz

Mode		TX channel 23330					
Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	793.00	-5.9	25.2	-0.2	25.0	34.8	-9.8
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	793.00	-12.9	19.1	-0.2	18.9	34.8	-15.9

Note: ERP (dBm) = S.G Power Value (dBm) + Correction Factor (dB).

Modulation Type: 16QAM

LTE Band 14, Channel Bandwidth: 5MHz

Mode		TX channel 23305					
Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	790.50	-7.0	24.2	-0.3	23.9	34.8	-10.9
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	790.50	-14.1	18.0	-0.3	17.7	34.8	-17.1

Mode		TX channel 23330					
Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	793.00	-7.2	23.8	-0.2	23.6	34.8	-11.2
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	793.00	-14.4	17.6	-0.2	17.4	34.8	-17.4

Mode		TX channel 23355					
Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	795.50	-6.9	24.1	-0.2	23.9	34.8	-10.9
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	795.50	-14.1	17.9	-0.2	17.7	34.8	-17.1

Note: ERP (dBm) = S.G Power Value (dBm) + Correction Factor (dB).

LTE Band 14, Channel Bandwidth: 10MHz

Mode		TX channel 23330					
Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	793.00	-6.9	24.2	-0.2	24.0	34.8	-10.8
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	793.00	-14.1	17.9	-0.2	17.7	34.8	-17.1

Note: ERP (dBm) = S.G Power Value (dBm) + Correction Factor (dB).

Modulation Type: 64QAM

LTE Band 14, Channel Bandwidth: 5MHz

Mode		TX channel 23305					
Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	790.50	-7.9	23.3	-0.3	23.0	34.8	-11.8
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	790.50	-14.9	17.2	-0.3	16.9	34.8	-17.9

Mode		TX channel 23330					
Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	793.00	-8.1	23.0	-0.2	22.8	34.8	-12.0
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	793.00	-15.1	16.8	-0.2	16.6	34.8	-18.2

Mode		TX channel 23355					
Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	795.50	-7.9	23.0	-0.2	22.8	34.8	-12.0
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	795.50	-15.4	16.6	-0.2	16.4	34.8	-18.4

Note: ERP (dBm) = S.G Power Value (dBm) + Correction Factor (dB).

LTE Band 14, Channel Bandwidth: 10MHz

Mode		TX channel 23330					
Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	793.00	-7.8	23.3	-0.2	23.1	34.8	-11.7
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	793.00	-15.6	16.4	-0.2	16.2	34.8	-18.6

Note: ERP (dBm) = S.G Power Value (dBm) + Correction Factor (dB).

4.2 Modulation Characteristics Measurement

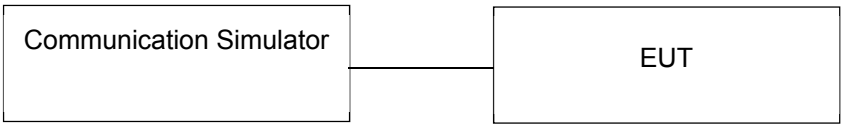
4.2.1 Limits of Modulation Characteristics

N/A

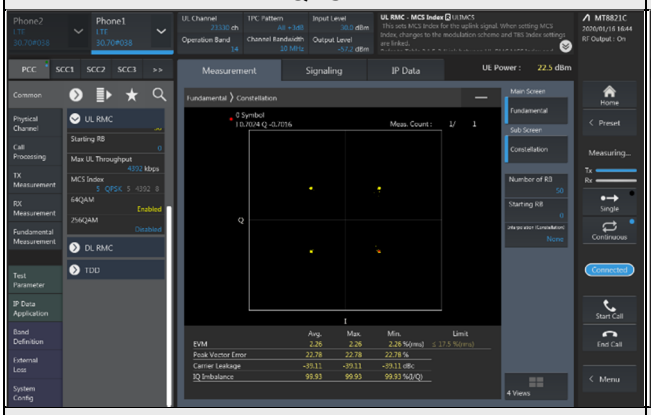
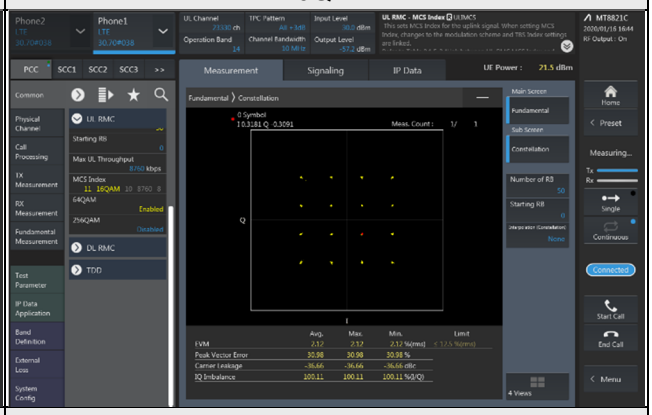
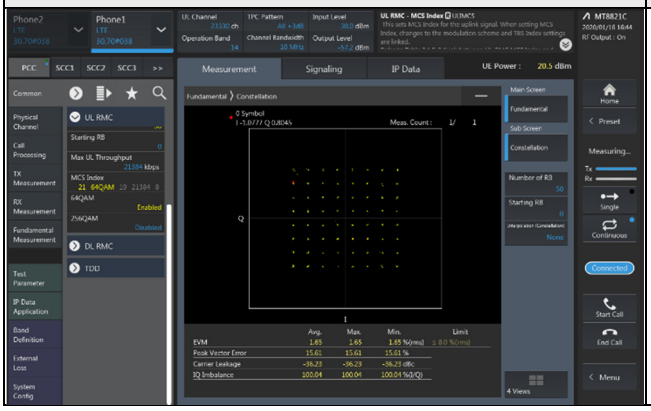
4.2.2 Test Procedure

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 14	
Spectrum Plot of Measurement Value	
Channel: 23330 / Frequency (MHz): 793.0MHz	
QPSK	16QAM
	
64QAM	
	

4.3 Frequency Stability Measurement

4.3.1 Limits of Frequency Stabiliity Measurement

The frequency stability of mobile, portable and control transmitters operating in the wideband segment must be 1.25 parts per million or better.
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℃ ~ 50℃.

4.3.2 Test Procedure

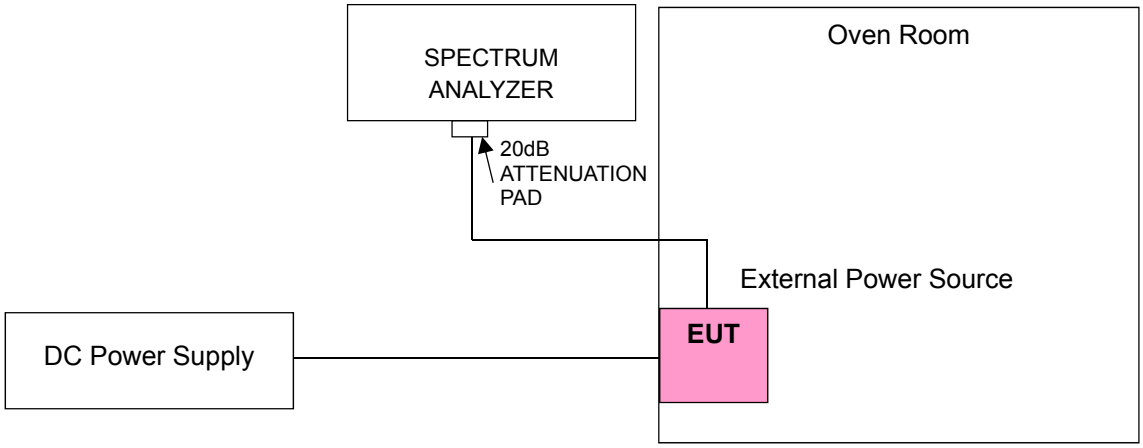
a. Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.

b. EUT is connected the external power supply to control the DC 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 14			
	Channel Bandwidth: 5 MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
3.4	790.500001	0.002	795.500000	0.004
3.85	790.500003	0.004	795.500000	0.003
4.4	790.500004	0.004	795.500000	0.001

Note: The applicant defined the normal working voltage is from 3.4Vdc to 4.4Vdc.

Frequency Error vs. Temperature

Temp. (℃)	LTE Band 14			
	Channel Bandwidth: 5 MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	790.500003	0.004	795.500000	0.004
-20	790.500004	0.005	795.500000	0.005
-10	790.500001	0.002	795.500000	0.004
0	790.500004	0.004	795.500000	0.003
10	790.500001	0.002	795.500000	0.005
20	790.499998	-0.003	795.500000	-0.004
30	790.499997	-0.004	795.500000	-0.002
40	790.499999	-0.002	795.500000	-0.002
50	790.499998	-0.003	795.500000	-0.005

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 14	
	Channel Bandwidth: 10 MHz	
	Frequency (MHz)	Frequency Error (ppm)
3.4	793.000003	0.003
3.85	793.000001	0.001
4.4	793.000003	0.004

Note: The applicant defined the normal working voltage is from 3.4Vdc to 4.4Vdc.

Frequency Error vs. Temperature

Temp. (℃)	LTE Band 14	
	Channel Bandwidth: 10 MHz	
	Frequency (MHz)	Frequency Error (ppm)
-30	793.000004	0.005
-20	793.000002	0.003
-10	793.000002	0.002
0	793.000003	0.004
10	793.000003	0.004
20	792.999998	-0.002
30	792.999998	-0.002
40	792.999997	-0.004
50	792.999998	-0.003

4.4 Occupied Bandwidth Measurement

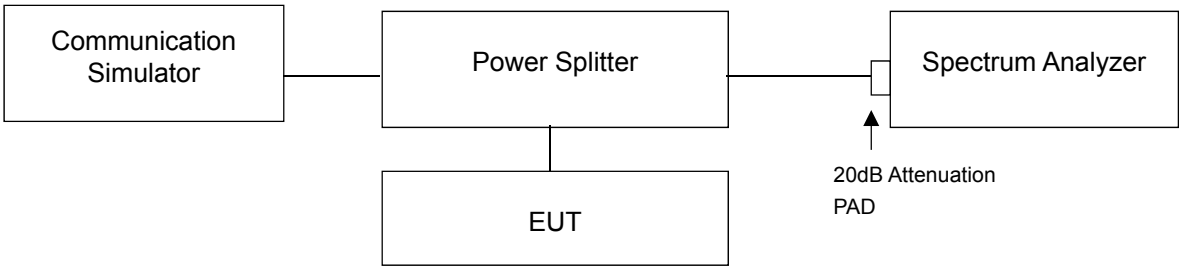
4.4.1 Limits of Occupied Bandwidth Measurement

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 %of the total mean power of a given emission.

4.4.2 Test Procedure

The EUT makes a call to the communication simulator. All measurements were done at low, middle and high operational frequency range, RB of the spectrum is 1% of occupied bnadwidth and VB of the spectrum is 3 times RBW. 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.

4.4.3 Test Setup



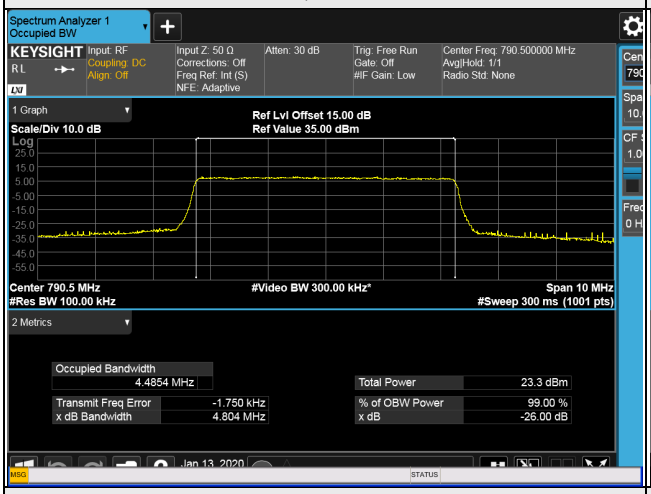
4.4.4 Test Result

LTE Band 14

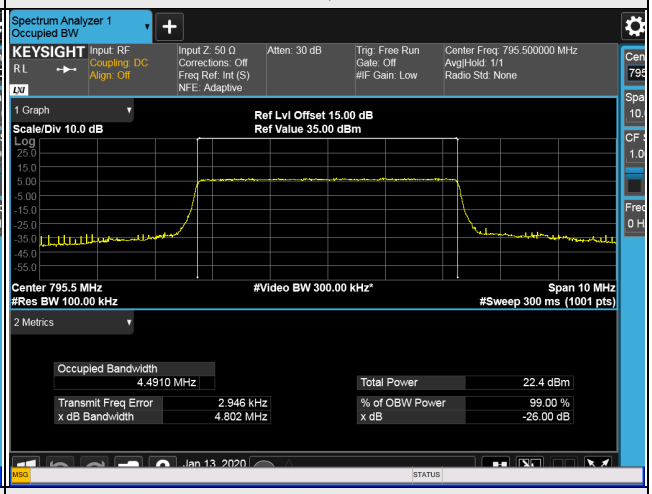
LTE Band 14, Channel Bandwidth 5MHz				
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)		
		QPSK	16QAM	64QAM
23305	790.5	4.49	4.49	4.49
23330	793	4.49	4.49	4.49
23355	795.5	4.49	4.49	4.49

Spectrum Plot of Worst Value

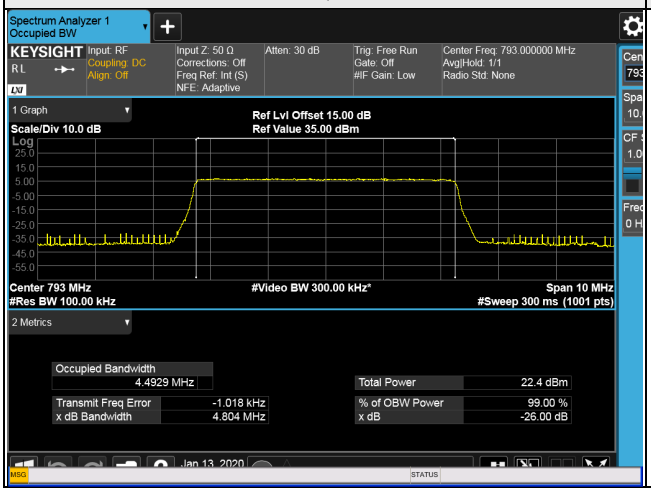
QPSK



16QAM



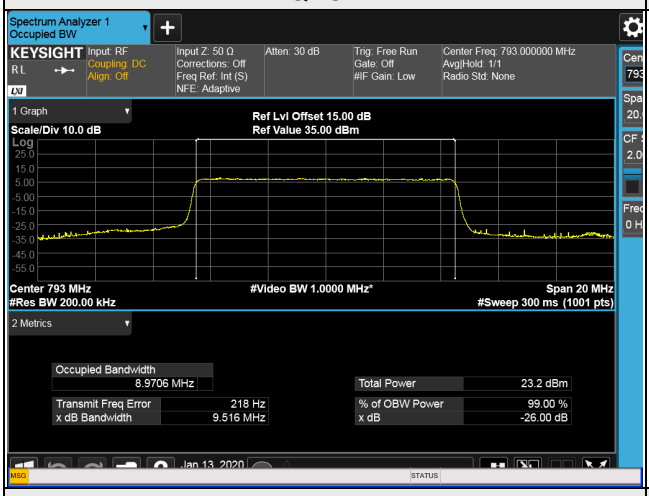
64QAM



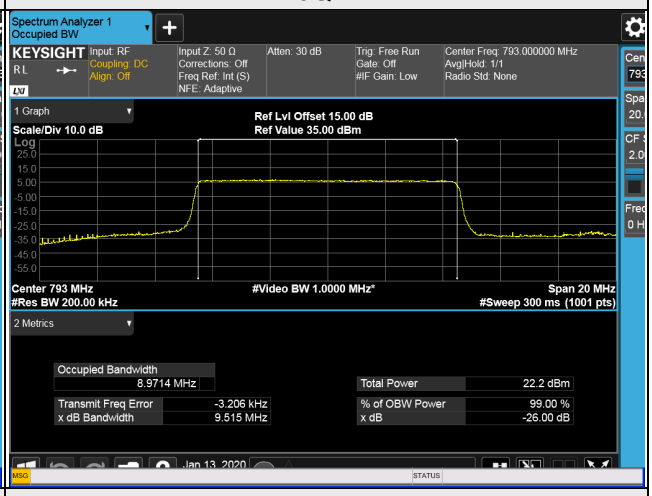
LTE Band 14, Channel Bandwidth 10MHz				
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)		
		QPSK	16QAM	64QAM
23330	793	8.97	8.97	8.96

Spectrum Plot of Worst Value

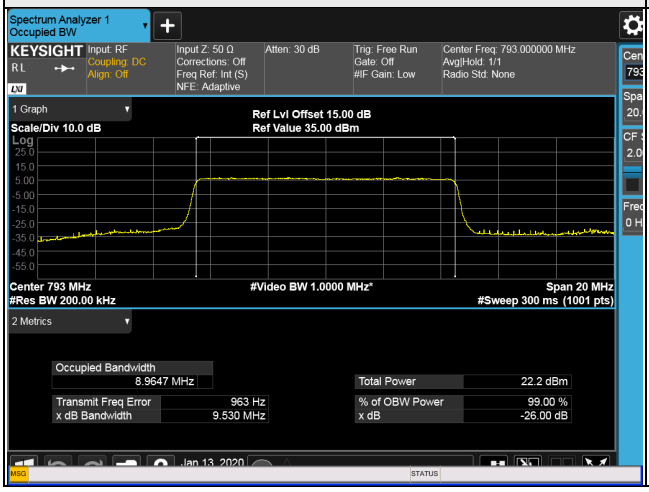
QPSK



16QAM



64QAM



4.5 Emission Mask Measurement

4.5.1 Limits of Emission Mask Measurement

Per 90.210(n), Emission mask shall comply with 90.210(b)

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

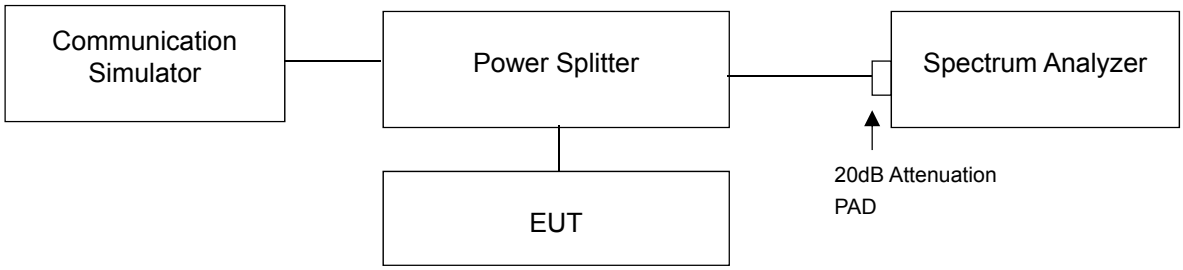
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB

4.5.2 Test Procedures

a. The measurement used the power splitter via EUT RF power connector between signal generator and spectrum analyzer.

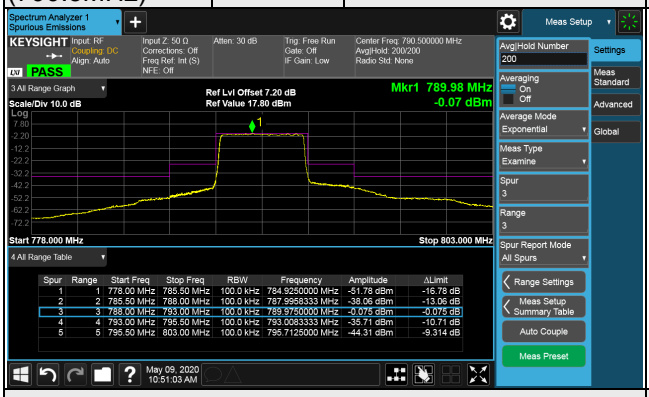
b. Record the test plot.

4.5.3 Test Setup

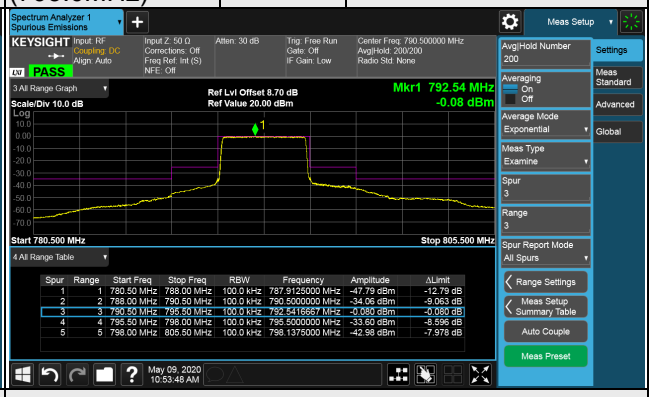


4.5.4 Test Results

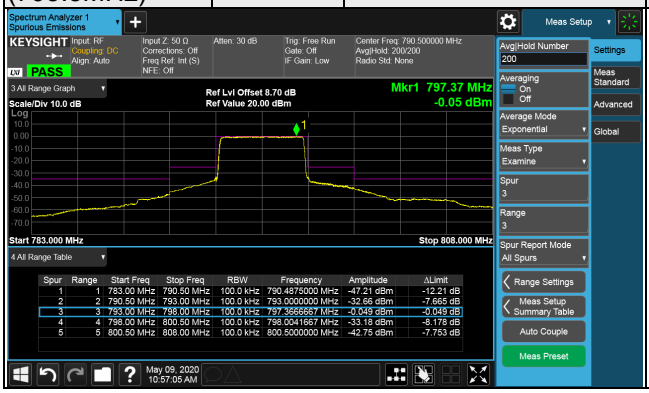
Channel Bandwidth: 5MHz		
Channel 23305 (790.5MHz)	QPSK	Full RB



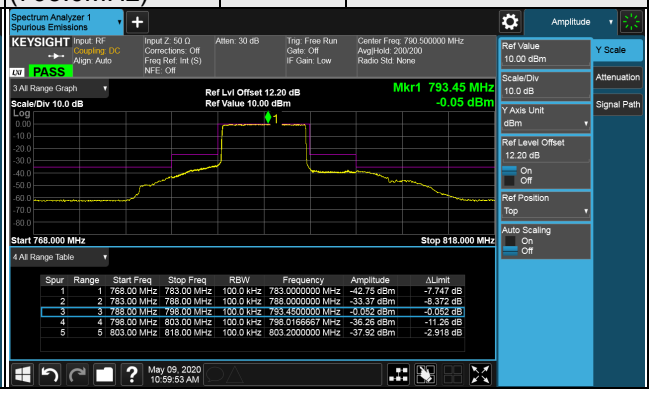
Channel Bandwidth: 5MHz		
Channel 23330 (793.0MHz)	QPSK	Full RB



Channel Bandwidth: 5MHz		
Channel 23355 (795.5MHz)	QPSK	Full RB



Channel Bandwidth: 10MHz		
Channel 23330 (793.0MHz)	QPSK	Full RB



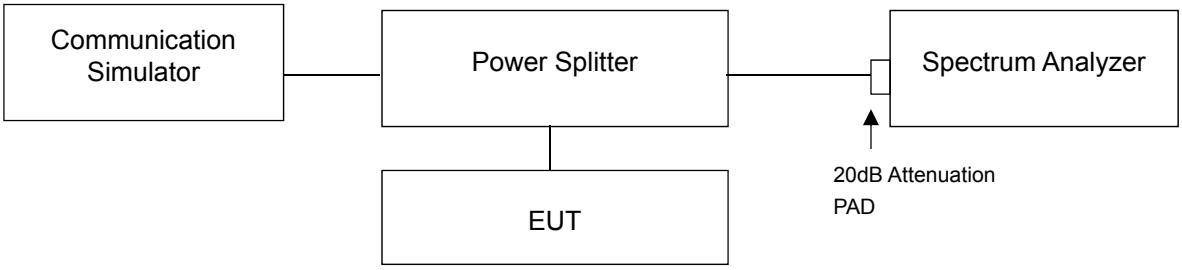
4.6 Band Edge Measurement

4.6.1 Limits of Band Edge Measurement

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

(2) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

4.6.2 Test Setup



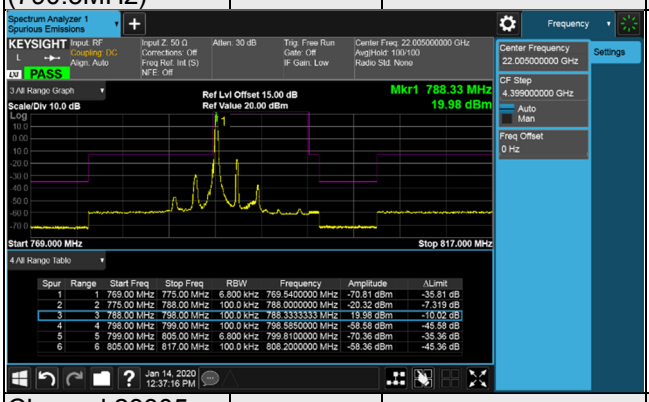
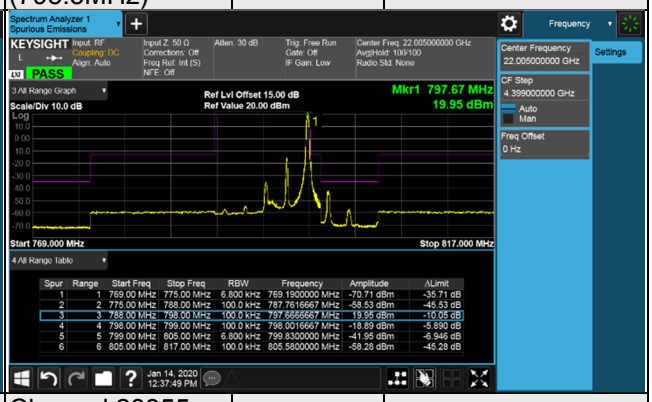
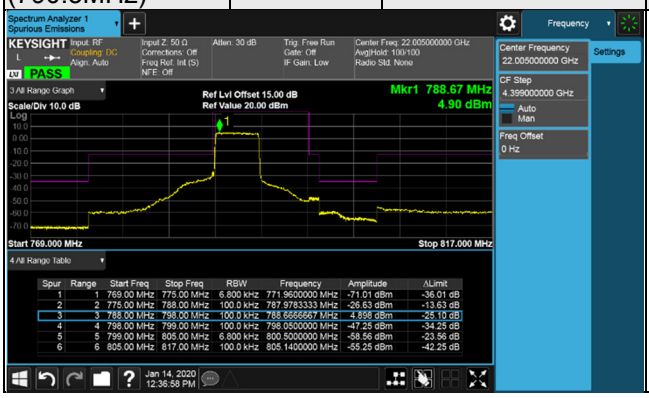
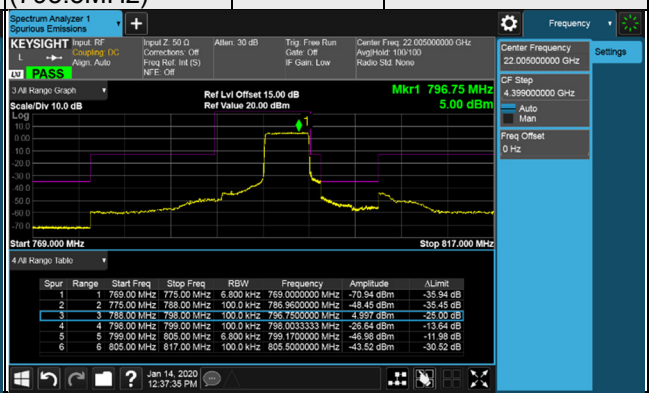
4.6.3 Test Procedures

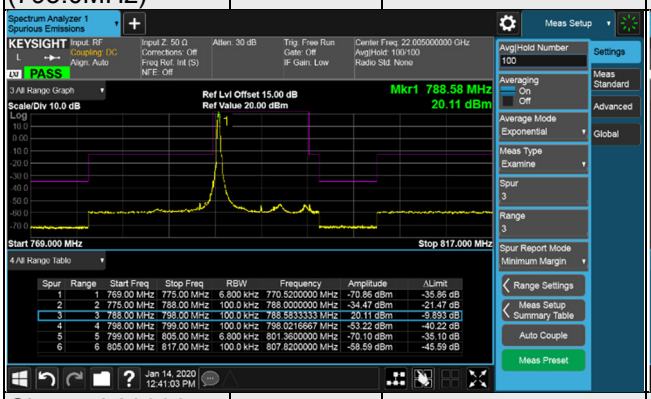
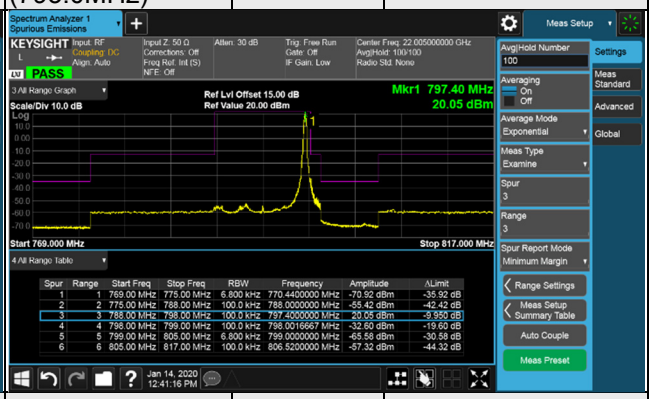
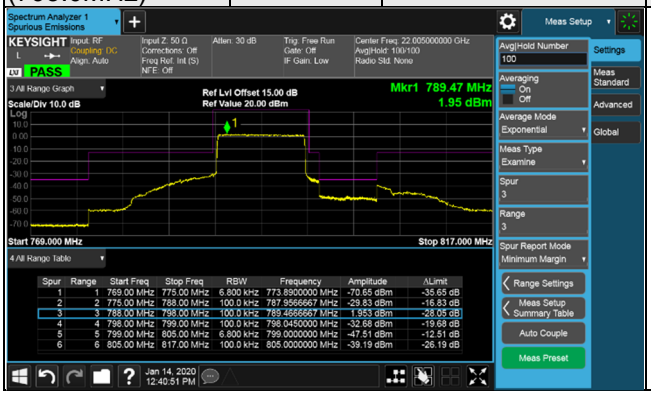
a. All measurements were done at low, middle and high operational frequency range.

b. The band edge measurement used the power splitter via EUT RF power connector between signal generator and spectrum analyzer. This splitter loss, attenuator loss and cable loss are the worst loss 21 dB in the transmitted path track.

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

4.6.4 Test Results

LTE Band 14, Channel Bandwidth 5MHz					
Channel 23305 (790.5MHz)	QPSK	1 RB / 0 RB Offset	Channel 23355 (795.5MHz)	QPSK	1 RB / 24 RB Offset
					
Channel 23305 (790.5MHz)	QPSK	25 RB / 0 RB Offset	Channel 23355 (795.5MHz)	QPSK	25 RB / 0 RB Offset
					

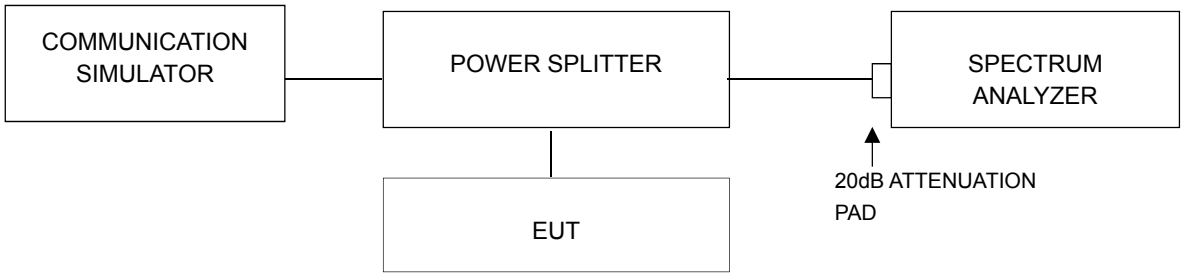
LTE Band 14, Channel Bandwidth 10MHz					
Channel 23330 (793.0MHz)	QPSK	1 RB / 0 RB Offset	Channel 23330 (793.0MHz)	QPSK	1 RB / 49 RB Offset
					
Channel 23330 (793.0MHz)	QPSK	50 RB / 0 RB Offset			
					

4.7 Peak to Average Ratio

4.7.1 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

4.7.2 Test Setup



4.7.3 Test Procedures

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

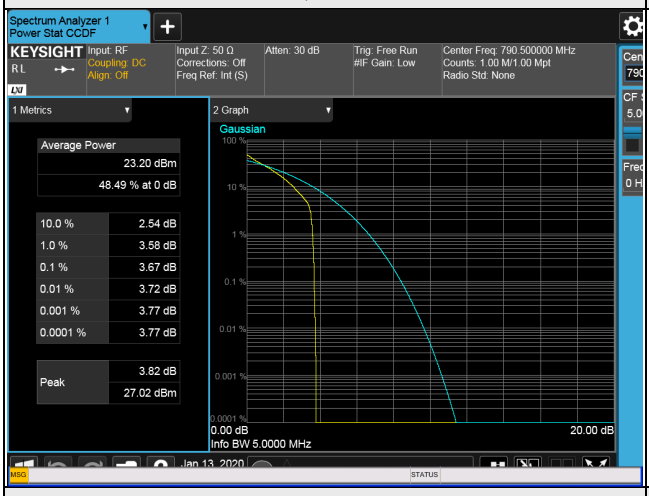
4.7.4 Test Results

LTE Band 14

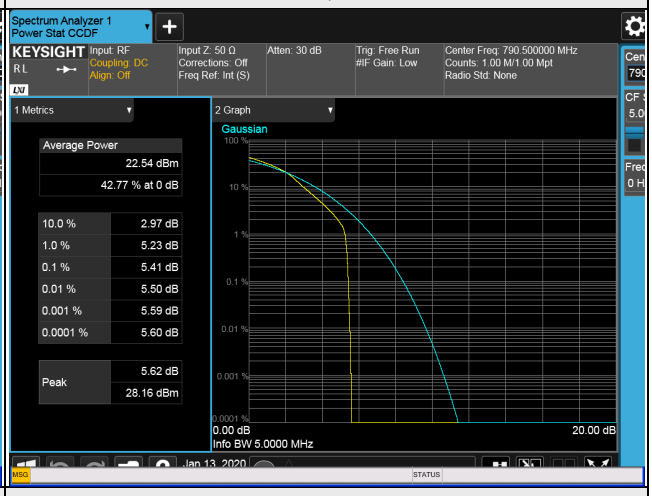
LTE Band 14, Channel Bandwidth 5MHz				
Channel	Frequency (MHz)	Peak To Average Ratio (dB)		
		QPSK	16QAM	64QAM
23305	790.5	3.67	5.41	5.46
23330	793	3.56	5.32	5.29
23355	795.5	3.56	5.24	5.28

Spectrum Plot of Worst Value

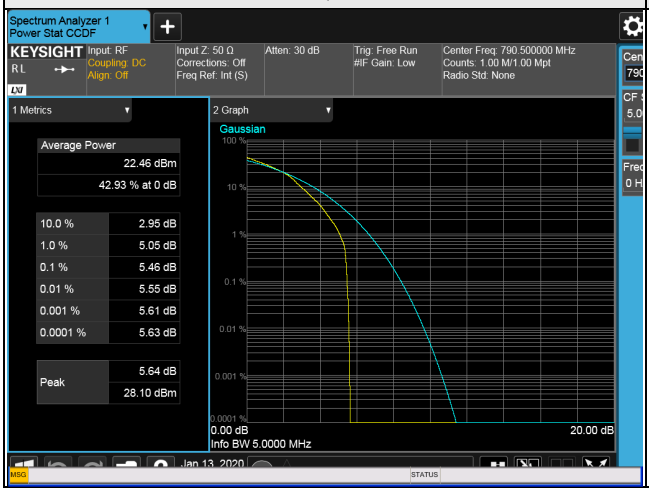
QPSK



16QAM



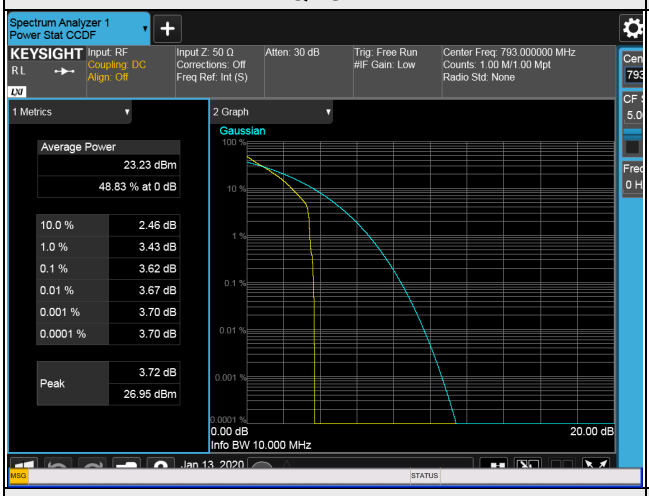
64QAM



LTE Band 14, Channel Bandwidth 10MHz				
Channel	Frequency (MHz)	Peak To Average Ratio (dB)		
		QPSK	16QAM	64QAM
23330	793	3.62	5.31	5.51

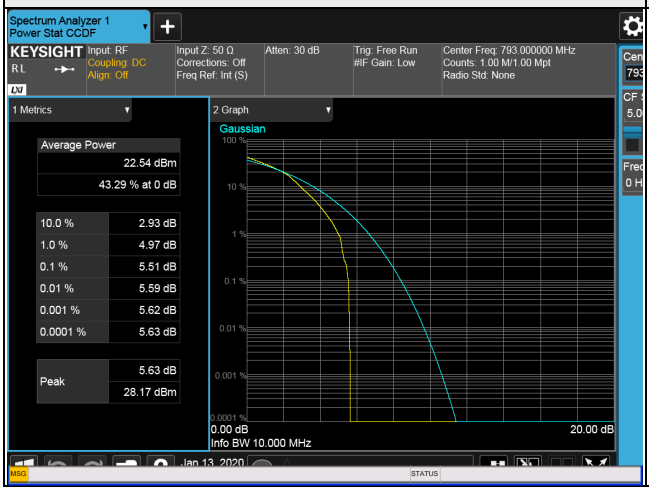
Spectrum Plot of Worst Value

QPSK



16QAM

64QAM

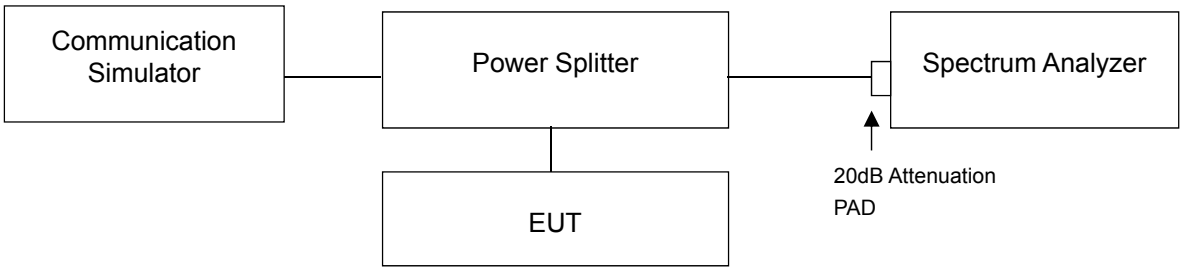


4.8 Conducted Spurious Emissions

4.8.1 Limits of Conducted Spurious Emissions Measurement

On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least 43 + 10log (P) dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

4.8.2 Test Setup

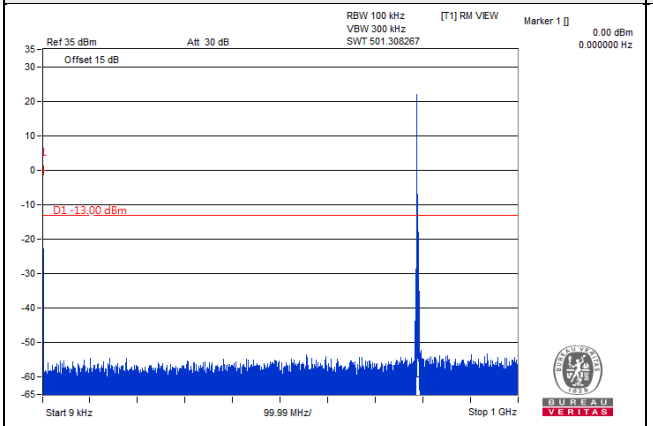
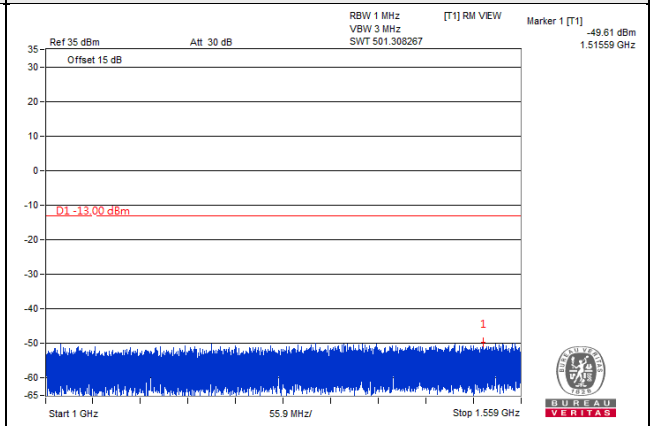
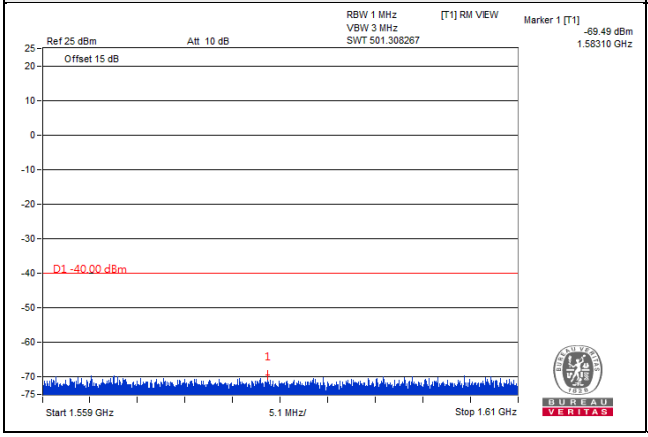
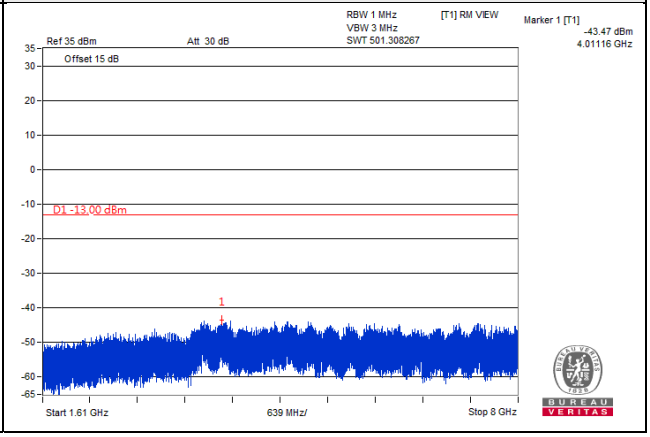


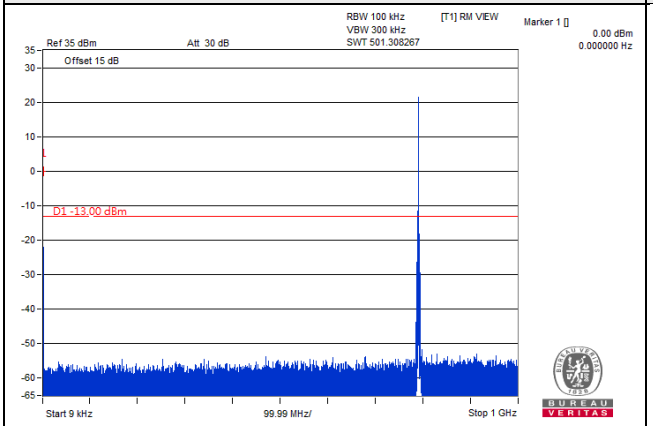
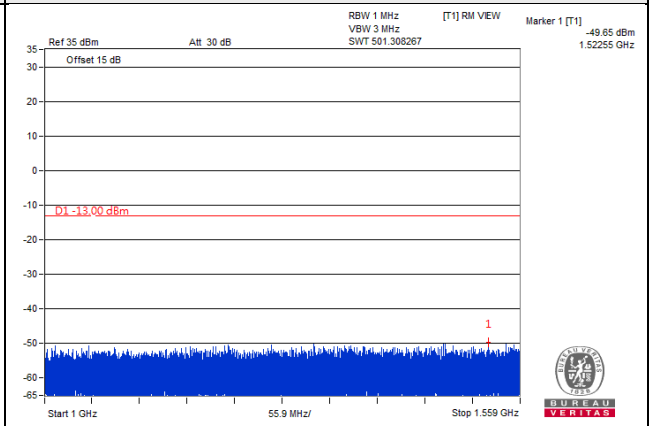
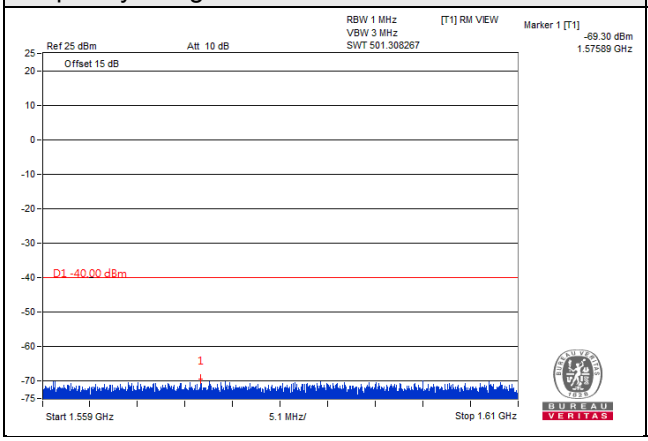
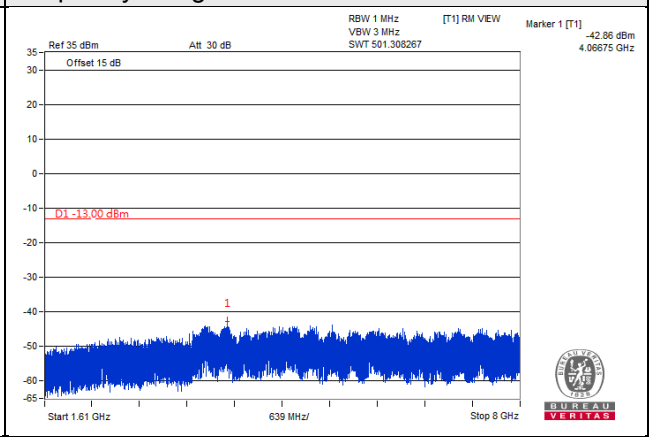
4.8.3 Test Procedure

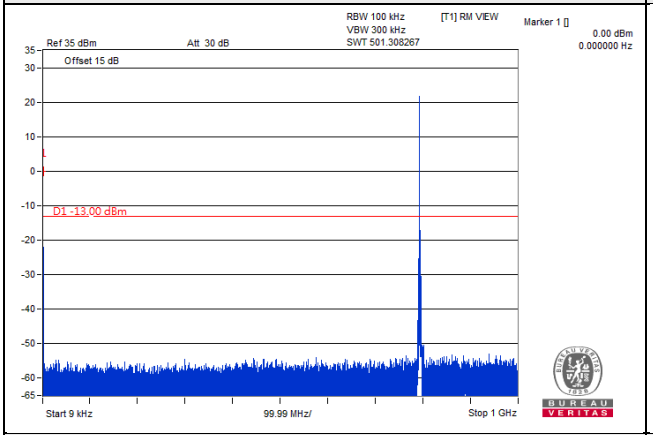
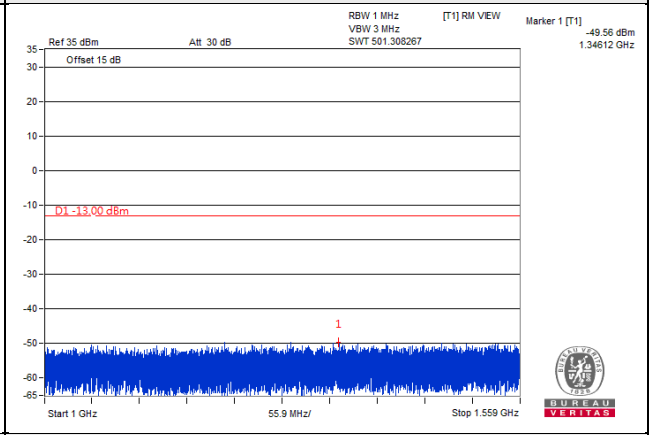
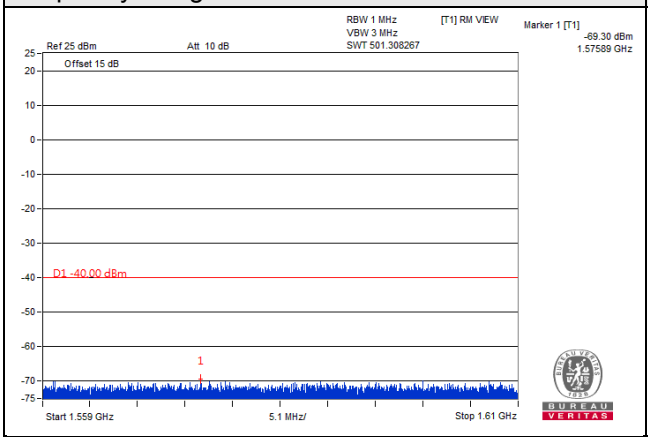
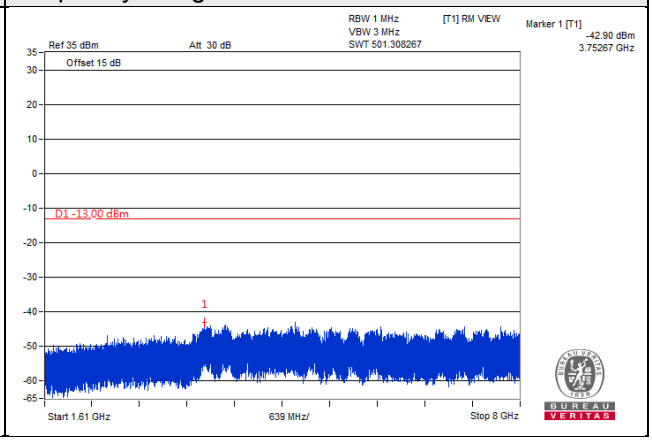
a. The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range.

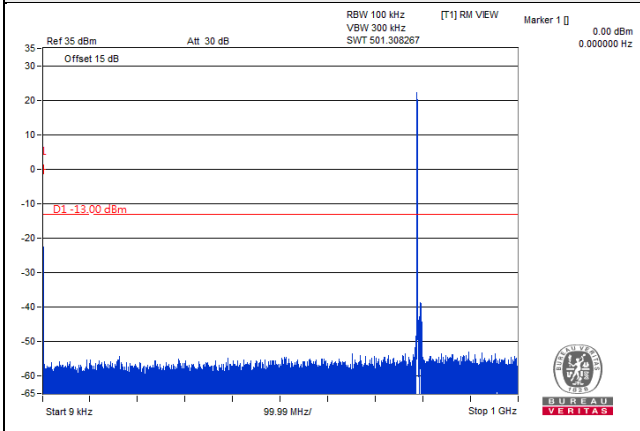
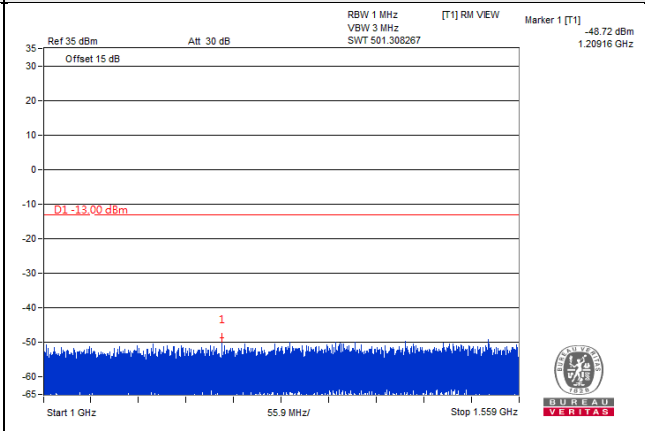
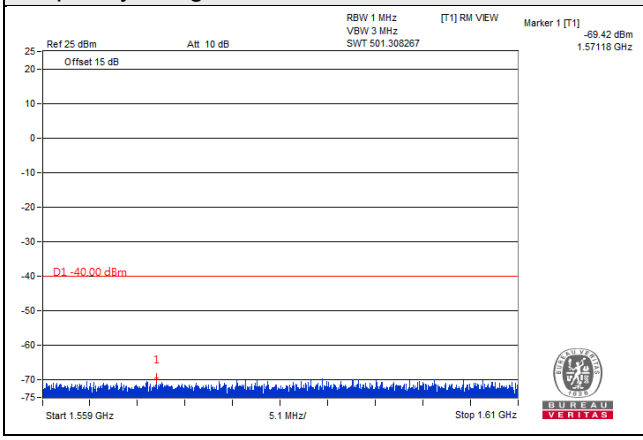
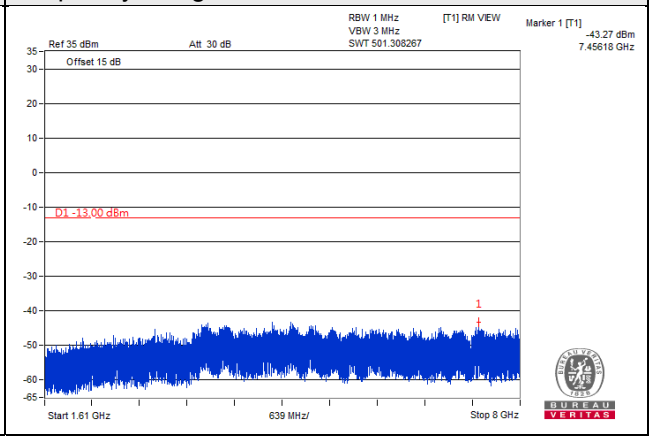
b. Measuring frequency range is from 9 kHz to 8GHz. 10 dB attenuation pad is connected with spectrum. RBW = 100 kHz and VBW = 300 kHz for 9 kHz to 1 GHz and RBW = 1 MHz and VBW = 3 MHz for 1 GHz to 8GHz are used for conducted emission measurement.

4.8.4 Test Results

Channel Band width: 5MHz	
Channel 23305 (790.5MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~1.559GHz
	
Frequency Range : 1.559GHz~1.61GHz	Frequency Range : 1.61GHz~8GHz
	

Channel Band width: 5MHz	
Channel 23330 (793.0MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~1.559GHz
	
Frequency Range : 1.559GHz~1.61GHz	Frequency Range : 1.61GHz~8GHz
	

Channel Band width: 5MHz	
Channel 23355 (795.5MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~1.559GHz
	
Frequency Range : 1.559GHz~1.61GHz	Frequency Range : 1.61GHz~8GHz
	

Channel Band width: 10MHz	
Channel 23330 (793.0MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~1.559GHz
	
Frequency Range : 1.559GHz~1.61GHz	Frequency Range : 1.61GHz~8GHz
	

4.9 Radiated Emission Measurement

4.9.1 Limits of Radiated Emission Measuremen

For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth.

Note: Emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals.
{The limits is adjusted to -40dBm (-70dBW)}

4.9.2 Test Procedure

a. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8m (below or equal 1 GHz) and/or 1.5 m (above 1 GHz) 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 horn 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. E.R.P power can be calculated form E.I.R.P power by subtracting the gain of dipole, E.R.P power = E.I.R.P power - 2.15dBi.

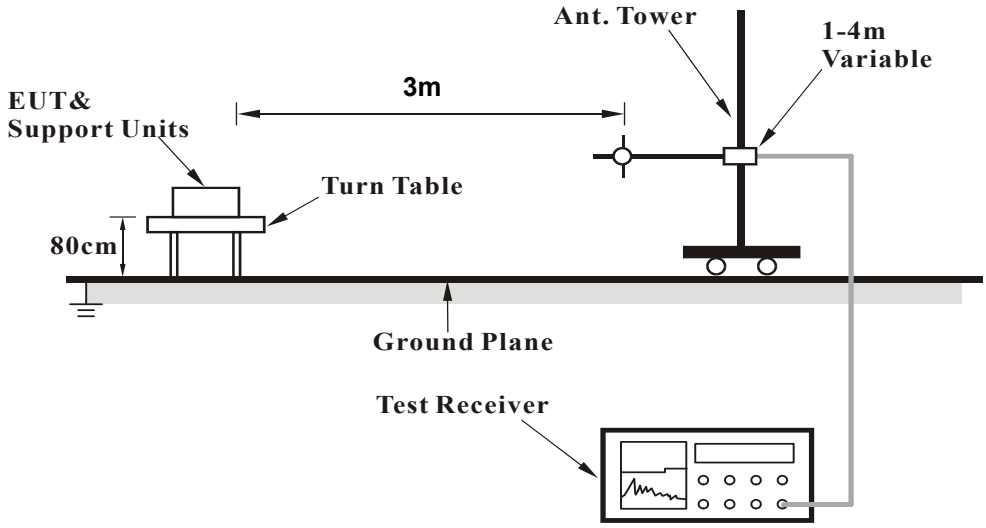
Note: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz/3MHz.

4.9.3 Deviation from Test Standard

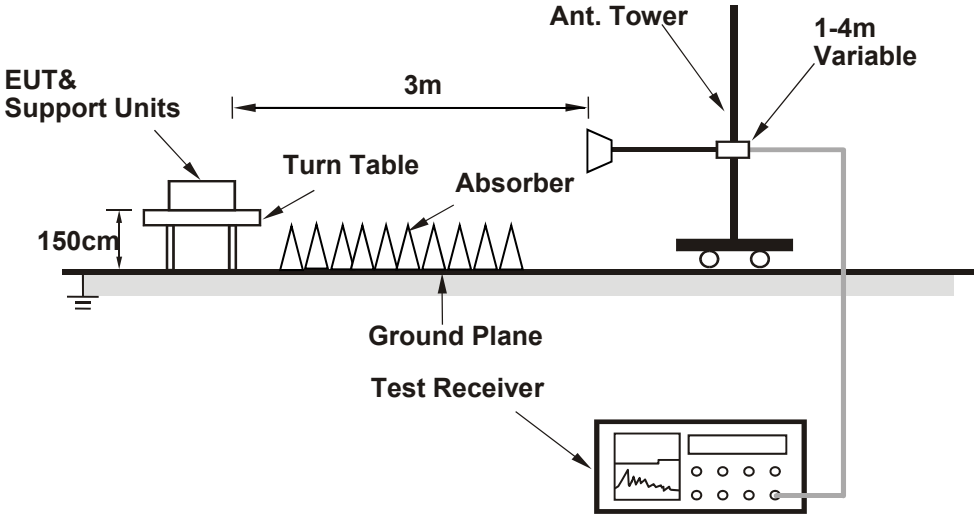
No deviation.

4.9.4 Test Setup

For Radiated Emission below or equal 1GHz



For Radiated Emission above 1GHz



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

4.9.5 Test Results

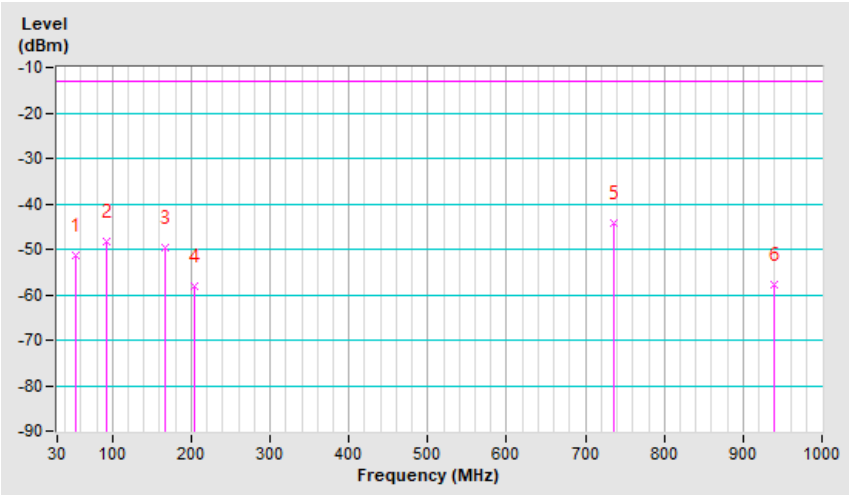
Below 1GHz

Channel Bandwidth: 5MHz

Mode	TX channel 23330 (793.0MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	25deg. C, 70%RH	Input Power	120Vac, 60Hz
Tested By	Luis Lee		

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	54.25	-49.7	-43.0	-8.3	-51.3	-13.0	-38.3
2	92.08	-40.5	-49.5	1.1	-48.4	-13.0	-35.4
3	166.77	-43.3	-50.8	1.2	-49.6	-13.0	-36.6
4	203.63	-49.3	-63.4	5.4	-58.0	-13.0	-45.0
5	736.16	-47.8	-49.2	4.8	-44.4	-13.0	-31.4
6	938.89	-65.0	-61.8	3.9	-57.9	-13.0	-44.9

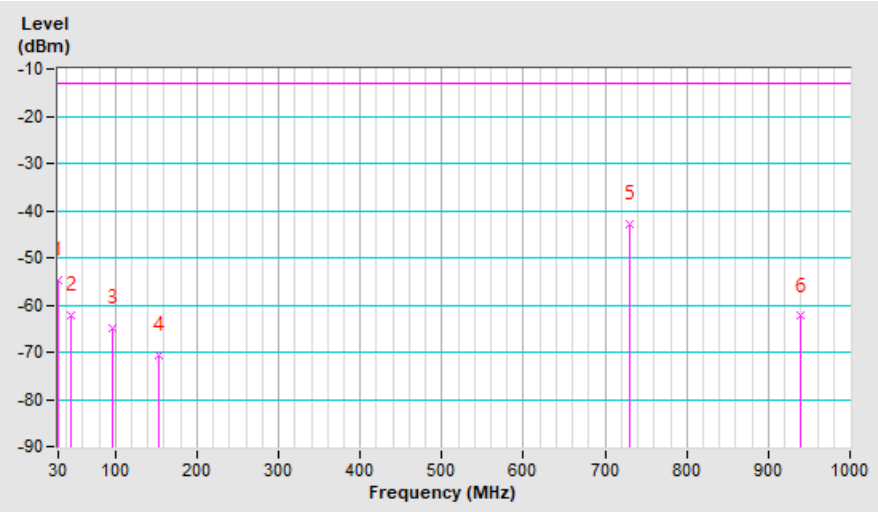
Remarks:
1. EIRP = S.G Value + Correction Factor
2. Correction Factor = Substitution Antenna Gain (dBi) + Cable Loss.



Mode	TX channel 23330 (793.0MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	25deg. C, 70%RH	Input Power	120Vac, 60Hz
Tested By	Luis Lee		

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	30.00	-44.5	-42.7	-12.2	-54.9	-13.0	-41.9
2	45.52	-55.9	-52.3	-10.0	-62.3	-13.0	-49.3
3	96.93	-59.2	-65.8	1.0	-64.8	-13.0	-51.8
4	153.19	-69.6	-70.7	0.0	-70.7	-13.0	-57.7
5	730.34	-48.7	-47.9	4.9	-43.0	-13.0	-30.0
6	939.86	-71.2	-66.3	3.9	-62.4	-13.0	-49.4

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

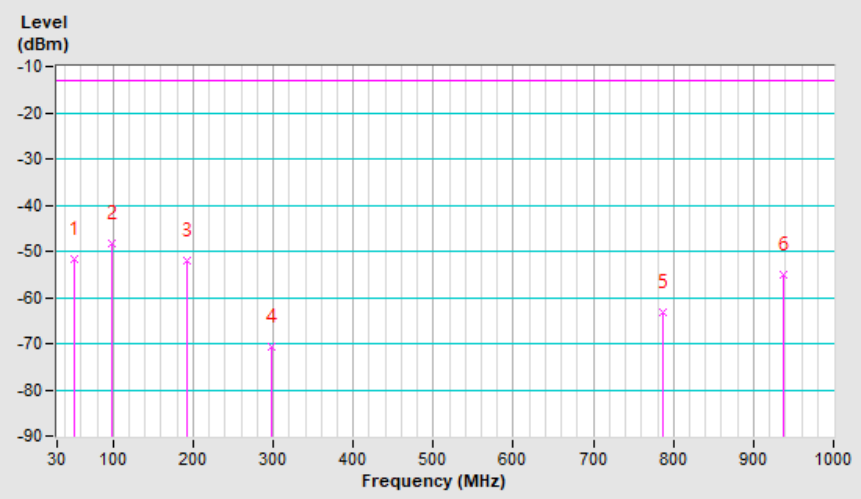


Channel Bandwidth: 10MHz

Mode	TX channel 23330 (793.0MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	25deg. C, 70%RH	Input Power	120Vac, 60Hz
Tested By	Luis Lee		

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	51.34	-50.4	-42.7	-8.9	-51.6	-13.0	-38.6
2	98.87	-40.8	-49.2	0.9	-48.3	-13.0	-35.3
3	191.99	-43.3	-56.7	4.5	-52.2	-13.0	-39.2
4	298.69	-67.1	-75.7	5.1	-70.6	-13.0	-57.6
5	787.57	-68.5	-67.4	4.2	-63.2	-13.0	-50.2
6	937.92	-62.3	-59.1	3.9	-55.2	-13.0	-42.2

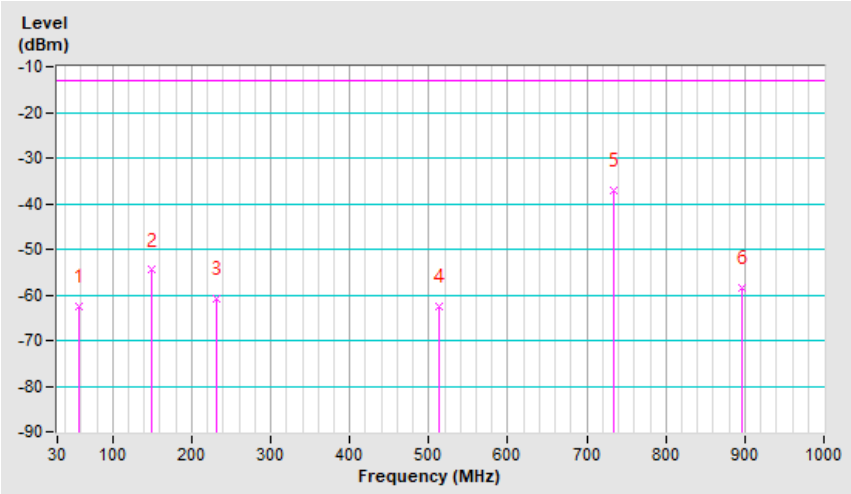
Remarks:
1. EIRP = S.G Value + Correction Factor
2. Correction Factor = Substitution Antenna Gain (dBi) + Cable Loss.



Mode	TX channel 23330 (793.0MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	25deg. C, 70%RH	Input Power	120Vac, 60Hz
Tested By	Luis Lee		

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	57.16	-55.5	-54.5	-8.2	-62.7	-13.0	-49.7
2	149.31	-52.6	-54.4	-0.2	-54.6	-13.0	-41.6
3	231.76	-60.4	-66.3	5.4	-60.9	-13.0	-47.9
4	513.06	-62.0	-67.3	4.8	-62.5	-13.0	-49.5
5	734.22	-42.7	-41.9	4.8	-37.1	-13.0	-24.1
6	897.18	-65.4	-62.3	3.9	-58.4	-13.0	-45.4

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



Above 1GHz

Channel Bandwidth: 5MHz

Mode	TX channel 23305 (790.5MHz)	Frequency Range	1 ~ 10GHz
Environmental Conditions	25deg. C, 70%RH	Input Power	120Vac, 60Hz
Tested By	Noah Chang		

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	1581.00	-48.7	-49.9	5.3	-44.6	-40.0	-4.6
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	1581.00	-49.7	-49.3	5.3	-44.0	-40.0	-4.0

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

Mode	TX channel 23330 (793.0MHz)	Frequency Range	1 ~ 10GHz
Environmental Conditions	25deg. C, 70%RH	Input Power	120Vac, 60Hz
Tested By	Noah Chang		

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	1586.00	-47.4	-48.7	5.3	-43.4	-40.0	-3.4
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	1586.00	-48.7	-48.3	5.3	-43.0	-40.0	-3.0

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

Mode	TX channel 23355 (795.5MHz)	Frequency Range	1 ~ 10GHz
Environmental Conditions	25deg. C, 70%RH	Input Power	120Vac, 60Hz
Tested By	Noah Chang		

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	**1591.00**	**-46.7**	**-48.0**	**5.3**	**-42.7**	**-40.0**	**-2.7**
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	1591.00	-48.6	-48.1	5.3	-42.8	-40.0	-2.8

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

Channel Bandwidth: 10MHz

Mode	TX channel 23330 (793.0MHz)	Frequency Range	1 ~ 10GHz
Environmental Conditions	25deg. C, 70%RH	Input Power	120Vac, 60Hz
Tested By	Noah Chang		

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	1586.00	-46.9	-48.2	5.3	-42.9	-40.0	-2.9
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	1586.00	-49.3	-48.9	5.3	-43.6	-40.0	-3.6

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

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.

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/Telecom Lab
Tel: 886-3-6668565
Fax: 886-3-6668323

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

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

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

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