RADIO TEST REPORT

Product	:	W04A
Model Name	:	Whistle GO
Series Model Name		Whistle GO Explore
FCC ID	:	S8W-W04A
Test Regulation	:	FCC 47 CFR Part 24, Subpart E
Received Date	:	Mar. 4, 2019
Test Date	:	Mar. 4, 2019 ~ Apr 8, 2019
Issued Date	:	May. 23, 2019
Applicant	:	Whistle Labs, Inc. 1355 Market Street Suite 210 San Francisco, CA 94103, USA
Issued By	:	Underwriters Laboratories Taiwan Co., Ltd. Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Testing Laboratory
3398

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REVISION HISTORY

Original Test Report No.: 4788872713-US-R2-V0

Rev.	Test report No.	Date	Page revised	Contents
Original	4788872713-US-R2-V0	May. 23, 2019	-	Initial issue

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1. Attestation of Test Results

APPLICANT:	Whistle Labs, Inc 1355 Market Street Suite 210 San Francisco, CA 94103, USA
MANUFACTURER	Whistle Labs, Inc 1355 Market Street Suite 210 San Francisco, CA 94103, USA
EUT DESCRIPTION:	W04A
BRAND:	Whistle
MODEL:	Whistle GO
SERIES MODEL:	Whistle GO Explore
SAMPLE STAGE:	PVT
DATE of TESTED:	Mar. 4, 2019 ~ Apr 8, 2019

APPLICABLE STANDARDS	
STANDARD	**Test Results**
FCC 47 CFR PART 24	PASS

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Evelyn Lee Date : May. 23, 2019
Project Handler

Approved and Authorized By:

Stanley Wu Date : May. 23, 2019
Senior Project Engineer

2. Summary of Test Results

WCDMA II & LTE 2, 25		
FCC Clause	**Test Items**	**Result**
§ 2.1046 § 24.232	RF Output Power	PASS
§ 24.232 (d)	Peak-to-Average Power Ratio	PASS
§ 2.1049 § 24.238 (b)	Occupied Bandwidth	PASS
§ 2.1055 § 24.235	Frequency Stability	PASS
§ 24.238 (a)	Band Edge Measurements	PASS
§ 2.1051 § 24.238	Spurious Emissions at Antenna Terminal	PASS
§ 2.1053 § 24.238	Radiated Spurious Emission	PASS

3. Test Methodology

The tests documented in this report were performed in accordance with 47 CFR FCC Part 2, 47 CFR FCC Part 24, KDB 971168 D01 Power Meas License Digital Systems v03r01, ANSI C63.26-2015 and ANSI/TIA-603-E.

4. Facilities and Accreditation

Test Location	Underwriters Laboratories Taiwan Co., Ltd.
Address	Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Accreditation Certificate	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398. The full scope of accreditation can be viewed at http://accreditation.taftw.org.tw/taf/public/basic/viewApplyItems.action?unitNo=3398

5. Measurement Uncertainty

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor k=2.

Test Item	Measurement Frequency Range	K	U(dB)
RF Output Power	30MHz ~ 40GHz	2	0.7dB
Effective Radiated Power	30MHz ~ 1GHz	2	5.6dB
Equivalent Isotropic Radiated Power	1GHz ~ 18GHz	2	4.2dB
Peak-to-Average Power Ratio	30MHz ~ 40GHz	2	3.10%
Occupied Bandwidth	30MHz ~ 40GHz	2	3.10%
Spurious Emissions at Antenna Terminal	30MHz ~ 40GHz	2	1.1dB
Frequency Stability	30MHz ~ 40GHz	2	299Hz
Radiated Spurious Emission	30MHz ~ 1GHz	2	5.6dB
	1GHz ~ 18GHz	2	4.2dB
	18GHz ~ 40GHz	2	4.4dB

6. Equipment under Test

6.1. Description of EUT

Product	W04A
Brand Name	Whistle
Model Name	Whistle GO
Series Model Name	Whistle GO Explore
Normal Voltage	5Vdc (adapter or host equipment) 3.8Vdc for battery
Voltage Operation Range	3.35~4.35 Vdc
Hardware Version	PVT1
Software Version	0.0.1-d2aa817
Model difference	Whistle GO is with small LED window while Whistle GO Explore is with big LED window

Note :

1. The EUT contains following accessory devices.

Product	Brand	Model	Description
USB Cable	Whistle	NA	0.77 meter, non-shielded cable, w/o ferrite core
Collar Attachment	Whistle	N/A	N/A

The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual.

6.2. Technical Information

Frequency Bands	**■ LTE Band 2**	1850 MHz to 1910 MHz (Uplink) 1930 MHz to 1990 MHz (Downlink)
Modulation Mode	QPSK / 16QAM	

6.3. Emission Designator

Frequency Bands	**■ LTE Band 2**	**BW 1.4 MHz**	1M09G7D
		BW 3 MHz	1M09G7D
		BW 5 MHz	1M10G7D
		BW 10 MHz	1M10G7D
		BW 15 MHz	1M10G7D
		BW 20 MHz	1M10G7D

6.4. Test Condition

Test Item	Test Site No.	Environmental Condition	Input Power	Test Date	Tested by
Antenna Port Conducted Measurement	SR4	22°C / 66%RH	120Vac / 60 Hz	Mar. 4, 2019 ~ Apr. 8, 2019	Howard Kao
Radiated Spurious Emission	966-2	25°C / 68%RH	120Vac / 60 Hz	Mar. 8, 2019 ~ Mar. 29, 2019	Will Chen

FCC Test Firm Registration Number: 498077

6.5. Description Of Available Antennas

Band	Antenna Type	Antenna Gain(dBi)
LTE Band 2	PCB	-5.6

6.6. Test Mode Applicability and Tested Channel Detail

Pre-Scan has been conducted to determine the worst-case mode from all mode and data rates and positions and RB size and modulations were investigated. Subsequently, only the worst case emissions are reported.

The EUT have two kinds of the enclosure and six colors, and other circuits design and PCB layout are the same; therefore, there is no more testing need to be verified.

The following testing in LTE is set based on the maximum RF Output Power.

Radiated measurements are performed by rotating the EUT in three different orthogonal (XYZ axis) test planes, the worst case was found when positioned as the table below.

Band	Axis
LTE Band 2	Z-plane

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

LTE Band 2

Test item	Bandwidth (MHz)	Modulation		Test Channel			RB		
		QPSK	16QAM	L	M	H	1	Partially	100%
RF Output Power	1.4	V	V	V	V	V	V	-	V
	3	V	V	V	V	V	V	-	V
	5	V	V	V	V	V	V	-	V
	10	V	V	V	V	V	V	V	V
	15	V	V	V	V	V	V	-	V
	20	V	V	V	V	V	V	-	V
Frequency Stability	1.4	V	-	V	-	V	-	-	V
	3	V	-	V	-	V	-	-	V
	5	V	-	V	-	V	-	-	V
	10	V	-	V	-	V	-	-	V
	15	V	-	V	-	V	-	-	V
	20	V	-	V	-	V	-	-	V
Occupied Bandwidth	1.4	V	-	V	V	V	-	-	V
	3	V	-	V	V	V	-	-	V
	5	V	-	V	V	V	-	-	V
	10	V	-	V	V	V	-	-	V
	15	V	-	V	V	V	-	-	V
	20	V	-	V	V	V	-	-	V
Band Edge	1.4	V	-	V	-	V	V	-	V
	3	V	-	V	-	V	V	-	V
	5	V	-	V	-	V	V	-	V
	10	V	-	V	-	V	V	-	V
	15	V	-	V	-	V	V	-	V
	20	V	-	V	-	V	V	-	V

Test item	Bandwidth (MHz)	Modulation		Test Channel			RB		
		QPSK	16QAM	L	M	H	1	Partially	100%
Peak to Average Ratio	1.4	V	V	V	V	V	V	-	-
	3	V	V	V	V	V	V	-	-
	5	V	V	V	V	V	V	-	-
	10	V	V	V	V	V	V	-	-
	15	V	V	V	V	V	V	-	-
	20	V	V	V	V	V	V	-	-
Spurious Emissions at Antenna Terminal	1.4	V	-	V	V	V	V	-	-
	3	V	-	V	V	V	V	-	-
	5	V	-	V	V	V	V	-	-
	10	V	-	V	V	V	V	-	-
	15	V	-	V	V	V	V	-	-
	20	V	-	V	V	V	V	-	-
Radiated Spurious Emissions	20	V	-	V	V	V	V	-	-

Note:
1. The mark “V” means that this configuration is chosen for testing.
2. The mark “-” means that this configuration is not testing.

7. Test Equipment

Test Equipment List					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Date**	**Cal. Interval**
Spectrum Analyzer	Keysight	N9010A	MY56070827	Nov. 8, 2018	1 year
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	Nov. 8, 2018	1 year
Loop Antenna	ETS lindgren	6502	00213440	Dec. 11, 2018	1 year
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck	VULB 9168 & N-6-05	774 & AT-N0538	Jan. 14, 2019	1 year
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck	VULB 9168 & N-6-05	773 & AT-N0539	Jan. 14, 2019	1 year
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	Jan. 25, 2019	1 year
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01686	Jan. 16, 2019	1 year
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	781	Jan.16, 2019	1 year
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	759	Nov. 13, 2018	1 year
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	Jan. 30, 2019	1 year
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	Jan. 29, 2019	1 year
Preamplifier (18-40GHz)	EMCI	EMC184040SE E	980426	Apr. 26, 2018	1 year
Signal Generator	Keysight	N5173B	MY53271122	Jan. 14,2019	1 year
RF Cable (9 KHz~18 GHz)	UltraPhase & EMC Instrument	A1K50-UP0358-A1K50-1500&EMC106-NM-SM-2500/7000	170111-4&170219/170102	Jan. 29,2019	1 year
RF Cable (18 GHz~40 GHz)	UltraPhase	K1K50-UP0264-K1K50-2500/2500/600	170214-2/170214-6/170111-1	Jan. 29,2019	1 year

Test Equipment List					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Date**	**Cal. Interval**
Spectrum Analyzer	Keysight	N9010A	MY56070834	Nov. 8, 2018	1 year
Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	161254	Dec. 5, 2018	1 year
Temperature &Humidity Test Chamber	GIANT FORCE	GTH-150-40-CP-AR	MAA1701-010	Mar.20,2018 Apr. 3, 2019	1 year

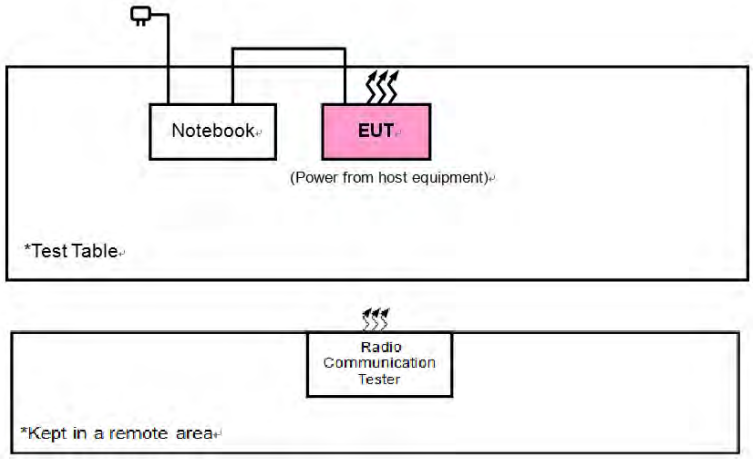
UL Software		
Description	**Name**	**Version**
Radiated measurement	AUDIX_E3	9.0

8. Description of Test Setup

Support Equipment

Item	Equipment	Brand Name	Model Name	S/N
1	DC Power Supply	GW Insrek	GPD-2303S	GEQ902318
2	Notebook	DELL	Latitude E5470	3JFKWF2

Setup Diagram for Test



9. Test Results

9.1. RF Output Power

Requirements

Mobile / Portable station are limited to 2 watts e.i.r.p.

Test procedure

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

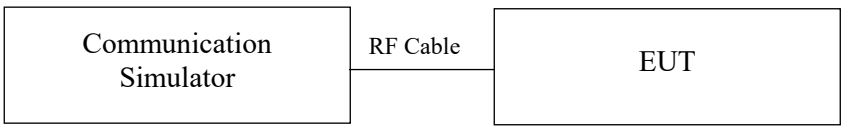
The relevant equation for determining the ERP or EIRP from the conducted RF output power measured using the guidance provided above is:

$$\text{ERP or EIRP} = P_{Meas} + GT - LC$$

where:

ERP or EIRP = effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as P_{Meas}, typically dBW or dBm);
P_{Meas} = measured transmitter output power or PSD, in dBm or dBW;
G_T = gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP);
L_C = signal attenuation in the connecting cable between the transmitter and antenna, in dB

Test Setup



The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

Test Results

Conducted Output Power (dBm)

Band / BW	RB Size	RB Offset	RB Index	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
				Low Ch 18607	Mid Ch 18900	High Ch 19193		Low Ch 18607	Mid Ch 18900	High Ch 19193	
				1850.7 MHz	1880.0 MHz	1909.3 MHz		1850.7 MHz	1880.0 MHz	1909.3 MHz	
2 / 1.4M	1	0	0	23.22	23.29	23.03	0	22.02	22.08	21.83	1
	1	5	0	23.24	23.31	23.05	0	22.01	22.07	21.82	1
	6	0	0	21.14	21.24	20.99	2				2

Band / BW	RB Size	RB Offset	RB Index	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
				Low Ch 18615	Mid Ch 18900	High Ch 19185		Low Ch 18615	Mid Ch 18900	High Ch 19185	
				1851.5 MHz	1880.0 MHz	1908.5 MHz		1851.5 MHz	1880.0 MHz	1908.5 MHz	
2 / 3M	1	0	0	23.31	23.40	23.17	0	22.30	22.42	22.17	1
	1	5	0	23.34	23.46	23.21	0	22.32	22.45	22.19	1
	6	0	0	21.30	21.38	21.10	2				2

Band / BW	RB Size	RB Offset	RB Index	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
				Low Ch 18625	Mid Ch 18900	High Ch 19175		Low Ch 18625	Mid Ch 18900	High Ch 19175	
				1852.5 MHz	1880.0 MHz	1907.5 MHz		1852.5 MHz	1880.0 MHz	1907.5 MHz	
2 / 5M	1	0	0	23.41	23.47	23.24	0	23.38	23.41	23.15	0
	1	5	3	23.44	23.42	23.23	0	23.41	23.40	23.13	0
	1	0	3	23.42	23.40	23.19	0	23.42	23.39	23.12	0
	1	5	0	23.41	23.43	23.22	0	23.41	23.45	23.15	0
	6	0	0	22.20	22.28	22.02	1				2
	6	0	3	22.30	22.26	22.00	1				2

Band / BW	RB Size	RB Offset	RB Index	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
				Low Ch 18650	Mid Ch 18900	High Ch 19150		Low Ch 18625	Mid Ch 18900	High Ch 19175	
				1855.0 MHz	1880.0 MHz	1905.0 MHz		1852.5 MHz	1880.0 MHz	1907.5 MHz	
2 / 10M	1	0	0	23.41	23.47	23.30	0	23.37	23.46	23.07	0
	1	5	7	23.49	23.44	23.26	0	23.44	23.47	23.01	0
	1	0	3	23.46	23.44	23.24	0	23.41	23.44	23.03	0
	1	5	4	23.44	23.45	23.24	0	23.45	23.45	23.04	0
	4	0	0	23.19	23.24	23.05	0	22.26	22.41	23.03	0
	4	2	7	23.27	23.26	23.00	0	22.27	22.29	23.02	0
	6	0	0	22.26	22.30	22.07	1				2
	6	0	7	22.31	22.25	22.02	1				2

Band / BW	RB Size	RB Offset	RB Index	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
				Low Ch 18675	Mid Ch 18900	High Ch 19125		Low Ch 18675	Mid Ch 18900	High Ch 19125	
				1857.5 MHz	1880.0 MHz	1902.5 MHz		1857.5 MHz	1880.0 MHz	1902.5 MHz	
2 / 15M	1	0	0	23.43	23.55	23.29	-	23.37	23.53	23.42	-
	1	5	11	23.51	23.47	23.28	-	23.48	23.46	23.41	-
	1	0	3	23.49	23.48	23.22	-	23.43	23.51	23.42	-
	1	5	8	23.45	23.51	23.27	-	23.47	23.47	23.44	-
	6	0	0	23.21	23.21	23.13	-				-
	6	0	11	23.22	23.16	23.04	-				-

Band / BW	RB Size	RB Offset	RB Index	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
				Low Ch 18705	Mid Ch 18900	High Ch 19100		Low Ch 18705	Mid Ch 18900	High Ch 19100	
				1860.0 MHz	1880.0 MHz	1900.0 MHz		1860.0 MHz	1880.0 MHz	1900.0 MHz	
2 / 20M	1	0	0	23.43	23.58	23.40	-	23.35	23.53	23.44	-
	1	5	15	23.57	23.49	23.32	-	23.50	23.50	23.31	-
	1	0	3	23.46	23.53	23.36	-	23.37	23.47	23.37	-
	1	5	12	23.52	23.47	23.27	-	23.49	23.47	23.39	-
	6	0	0	23.25	23.30	23.04	-				-
	6	0	15	23.32	23.19	22.98	-				-

E.I.R.P (dBm)

Band / BW	Mode	QPSK			16QAM		
	Channel	Low CH 18607	Mid CH 18900	High CH 19193	Low CH 18607	Mid CH 18900	High CH 19193
	Frequency	1850.7 MHz	1880 MHz	1909.3 MHz	1850.7 MHz	1880 MHz	1909.3 MHz
2 / 1.4M	Conducted power(dBm)	23.24	23.31	23.05	22.02	22.08	21.83
	Conducted power (Watts)	0.21	0.21	0.20	0.16	0.16	0.15
	E.I.R.P (dBm)	17.64	17.71	17.45	16.42	16.48	16.23
	E.I.R.P (Watts)	0.06	0.06	0.06	0.04	0.04	0.04

Band / BW	Mode	QPSK			16QAM		
	Channel	Low CH 18615	Mid CH 18900	High CH 19185	Low CH 18615	Mid CH 18900	High CH 19185
	Frequency	1851.5 MHz	1880 MHz	1908.5 MHz	1851.5 MHz	1880 MHz	1908.5 MHz
2 / 3M	Conducted power(dBm)	23.34	23.46	23.21	22.32	22.45	22.19
	Conducted power (Watts)	0.22	0.22	0.21	0.17	0.18	0.17
	E.I.R.P (dBm)	17.74	17.86	17.61	16.72	16.85	16.59
	E.I.R.P (Watts)	0.06	0.06	0.06	0.05	0.05	0.05

Band / BW	Mode	QPSK			16QAM		
	Channel	Low CH 18625	Mid CH 18900	High CH 19175	Low CH 18625	Mid CH 18900	High CH 19175
	Frequency	1852.5 MHz	1880 MHz	1907.5 MHz	1852.5 MHz	1880 MHz	1907.5 MHz
2 / 5M	Conducted power(dBm)	23.44	23.47	23.24	23.42	23.45	23.15
	Conducted power (Watts)	0.22	0.22	0.21	0.22	0.22	0.21
	E.I.R.P (dBm)	17.84	17.87	17.64	17.82	17.85	17.55
	E.I.R.P (Watts)	0.06	0.06	0.06	0.06	0.06	0.06

Band / BW	Mode	QPSK			16QAM		
	Channel	Low CH 18650	Mid CH 18900	High CH 19150	Low CH 18650	Mid CH 18900	High CH 19150
	Frequency	1855 MHz	1880 MHz	1905 MHz	1855 MHz	1880 MHz	1905 MHz
2 /10M	Conducted power(dBm)	23.49	23.47	23.3	23.45	23.47	23.07
	Conducted power (Watts)	0.22	0.22	0.21	0.22	0.22	0.20
	E.I.R.P (dBm)	17.89	17.87	17.7	17.85	17.87	17.47
	E.I.R.P (Watts)	0.06	0.06	0.06	0.06	0.06	0.06

Band / BW	Mode	QPSK			16QAM		
	Channel	Low CH 18675	Mid CH 18900	High CH 19125	Low CH 18675	Mid CH 18900	High CH 19125
	Frequency	1857.5 MHz	1880 MHz	1902.5 MHz	1857.5 MHz	1880 MHz	1902.5 MHz
2 / 15M	Conducted power(dBm)	23.51	23.55	23.29	23.48	23.53	23.44
	Conducted power (Watts)	0.22	0.23	0.21	0.22	0.23	0.22
	E.I.R.P (dBm)	17.91	17.95	17.69	17.88	17.93	17.84
	E.I.R.P (Watts)	0.06	0.06	0.06	0.06	0.06	0.06

Band / BW	Mode	QPSK			16QAM		
	Channel	Low CH 18700	Mid CH 18900	High CH 19100	Low CH 18700	Mid CH 18900	High CH 19100
	Frequency	1860 MHz	1880 MHz	1900 MHz	1860 MHz	1880 MHz	1900 MHz
2 / 20M	Conducted power(dBm)	23.57	23.58	23.4	23.5	23.53	23.44
	Conducted power (Watts)	0.23	0.23	0.22	0.22	0.23	0.22
	E.I.R.P (dBm)	17.97	17.98	17.8	17.9	17.93	17.84
	E.I.R.P (Watts)	0.06	0.06	0.06	0.06	0.06	0.06

9.2. Peak to Average Power Ratio

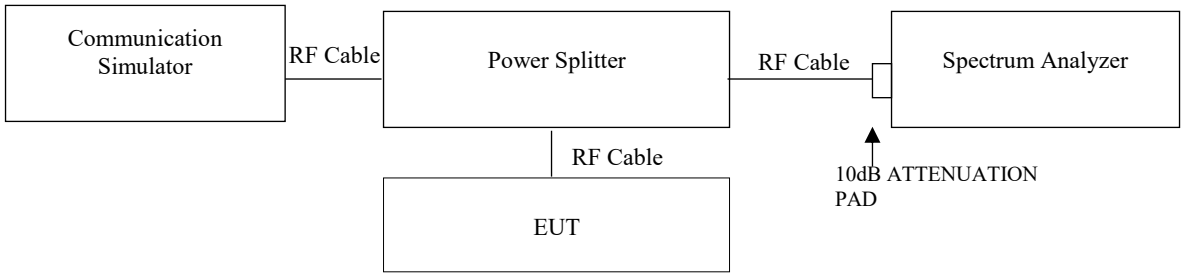
Requirements

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.

Test procedure

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 %.

Test Setup

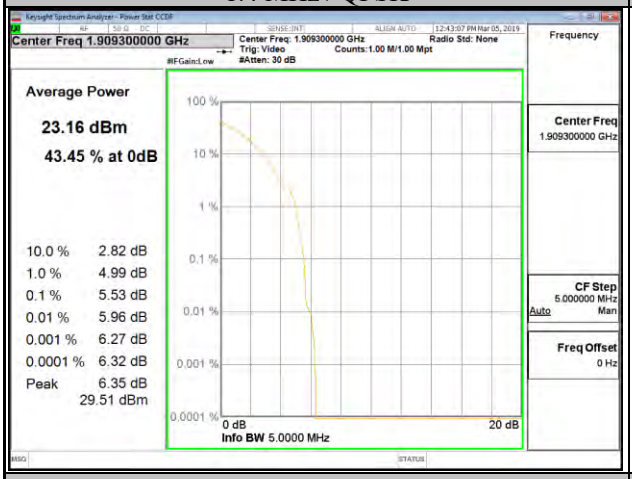
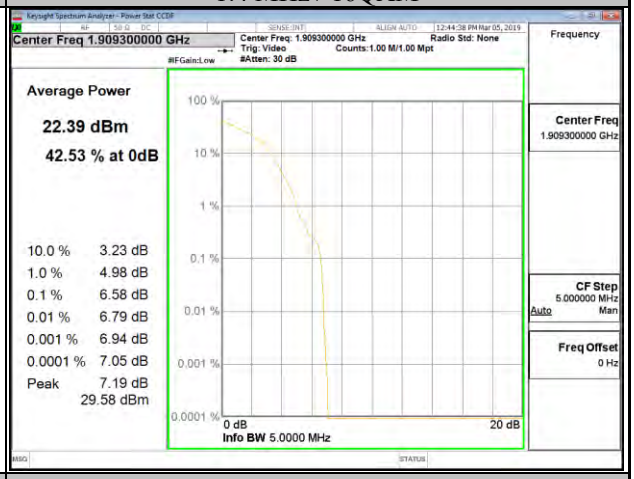
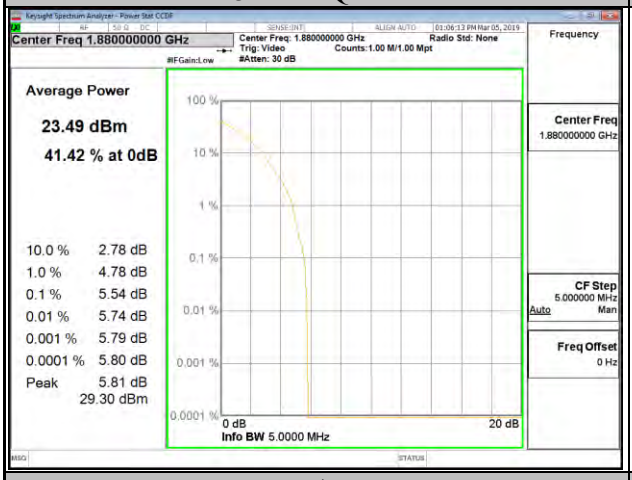
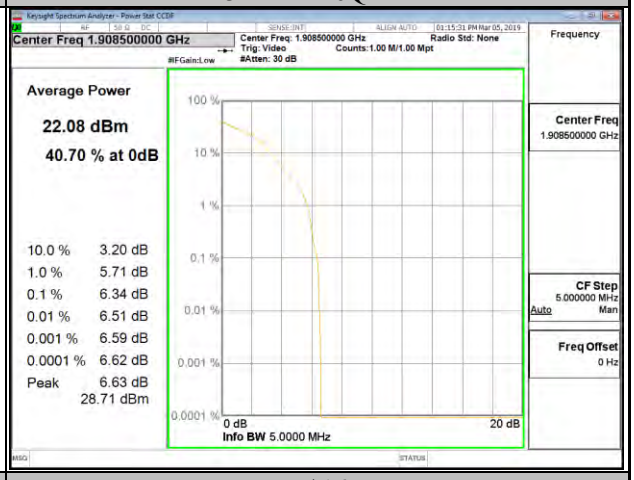
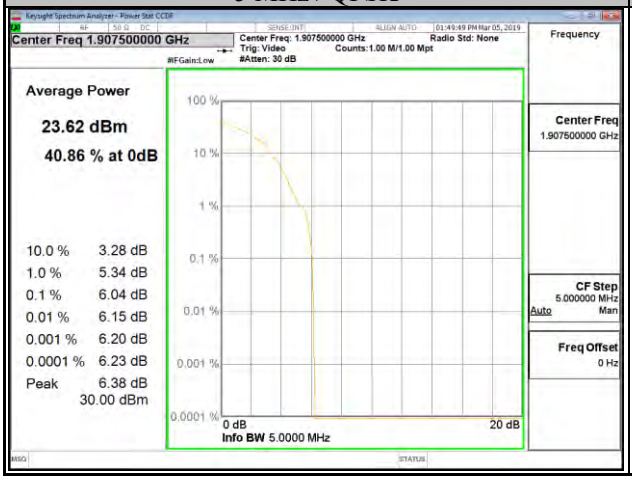
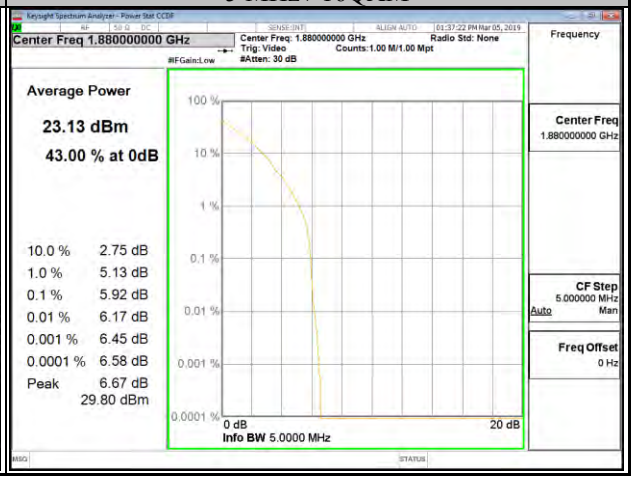


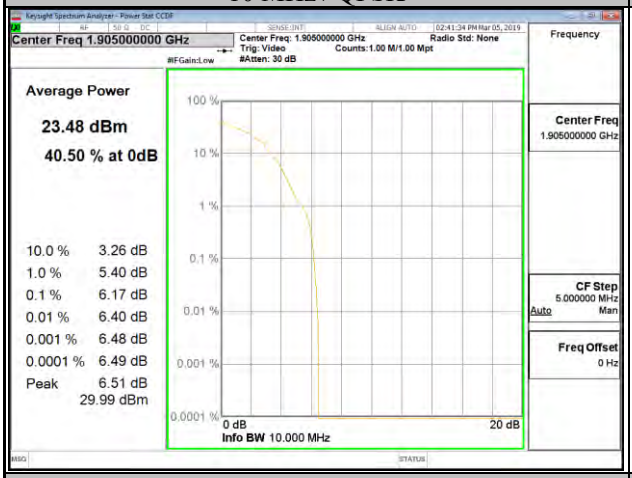
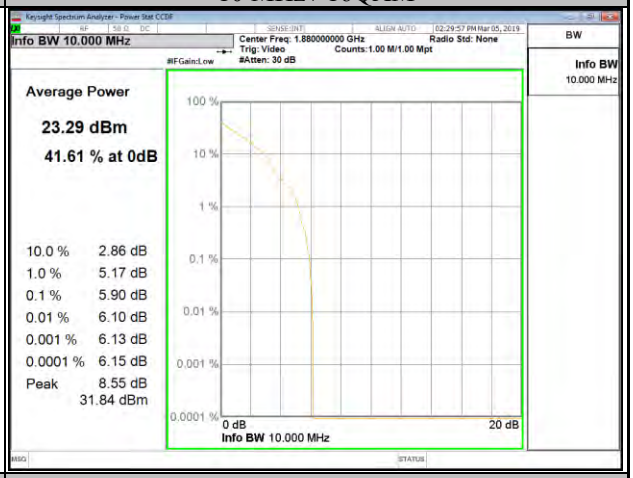
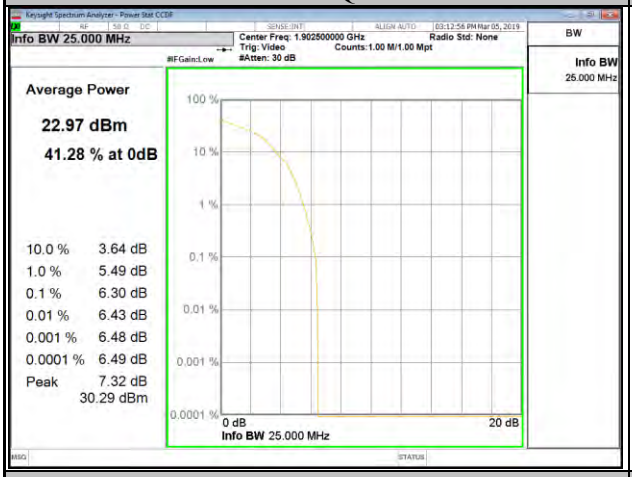
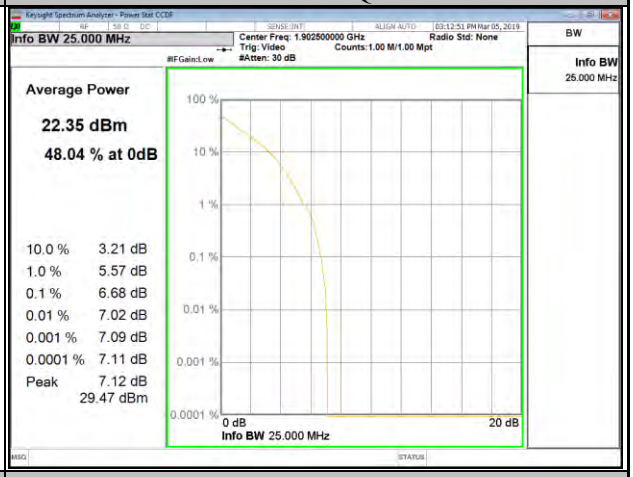
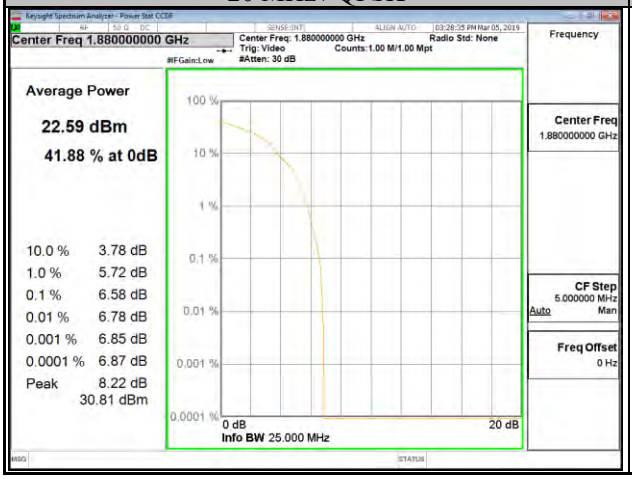
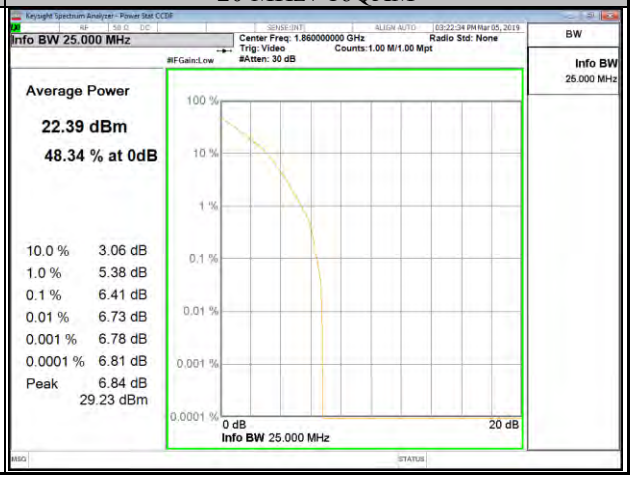
The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

Test Results

LTE Band 2

Bandwidth (MHz)	Channel	Peak to Average Ratio (dB)		Bandwidth (MHz)	Channel	Peak to Average Ratio (dB)	
		QPSK	16QAM			QPSK	16QAM
1.4	18607	5.52	6.10	3	18615	5.23	6.21
	18900	5.39	6.55		18900	5.54	5.94
	19193	5.53	6.58		19185	5.27	6.34
5	18625	5.85	5.87	10	18650	6.15	5.63
	18900	5.80	5.92		18900	5.94	5.90
	19175	6.04	5.59		19150	6.17	5.60
15	18675	6.21	6.52	20	18700	6.33	6.41
	18900	6.13	6.45		18900	6.58	6.41
	19125	6.30	6.68		19100	6.29	6.32

Spectrum Plot of Worst Value	
1.4 MHz / QPSK	1.4 MHz / 16QAM
	
3 MHz / QPSK	3 MHz / 16QAM
	
5 MHz / QPSK	5 MHz / 16QAM
	

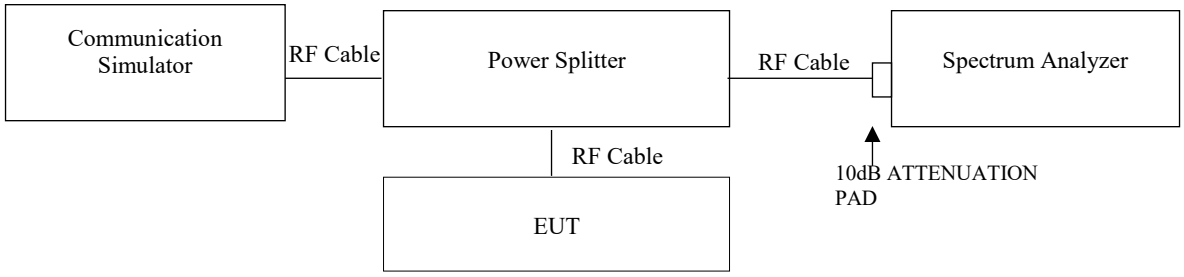
10 MHz / QPSK	10 MHz / 16QAM
	
15 MHz / QPSK	15 MHz / 16QAM
	
20 MHz / QPSK	20 MHz / 16QAM
	

9.3. Occupied Bandwidth

Test procedure

The EUT makes a call to the communication simulator. 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.

Test Setup

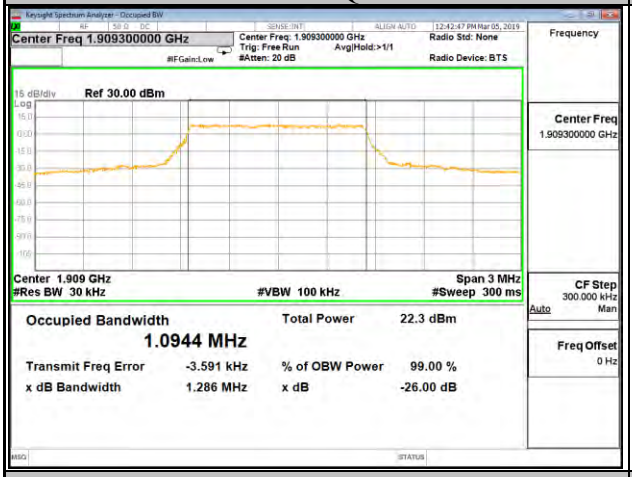
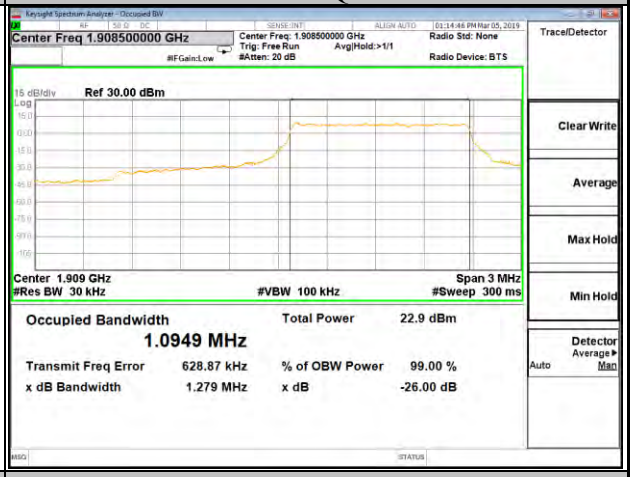
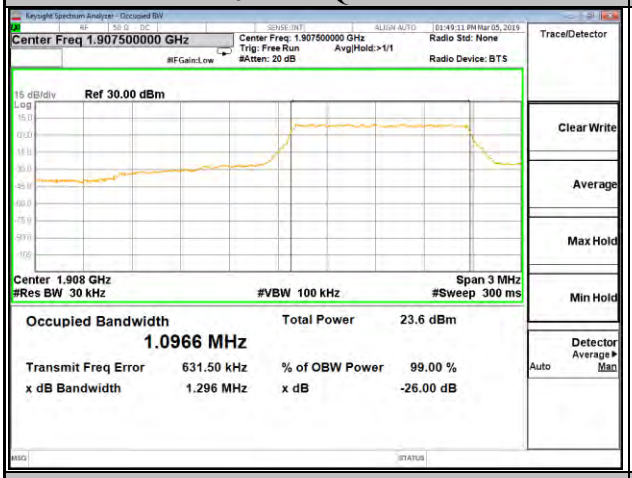
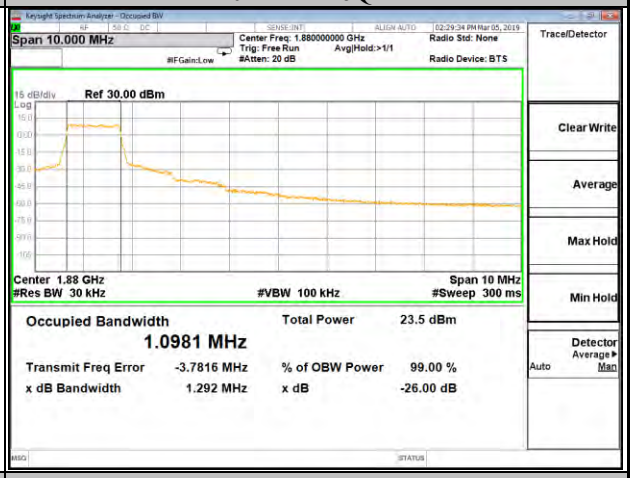
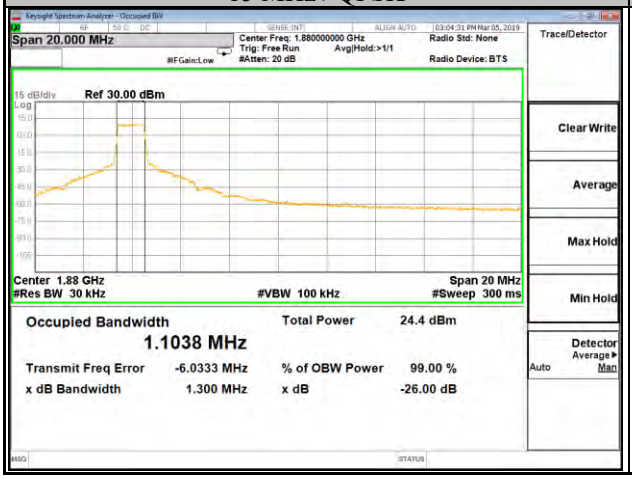
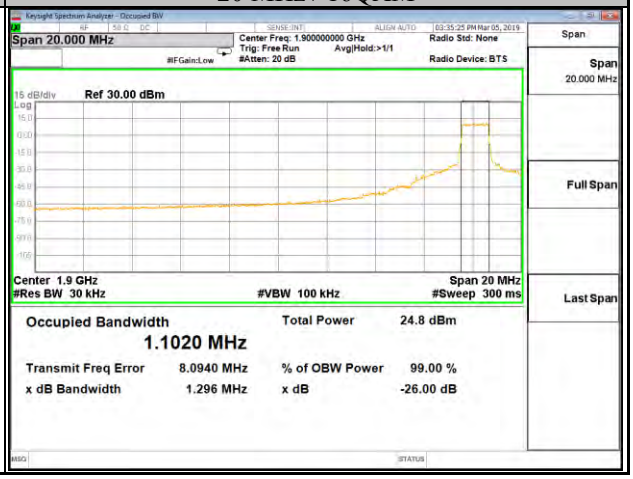


The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

Test Results

LTE Band 2

Bandwidth (MHz)	Channel	99 % Occupied Bandwidth (MHz)	Bandwidth (MHz)	Channel	99 % Occupied Bandwidth (MHz)
		QPSK			QPSK
1.4	18607	1.0905	3	18615	1.0934
	18900	1.0915		18900	1.0926
	19193	1.0944		19185	1.0949
5	18625	1.0947	10	18650	1.0932
	18900	1.0952		18900	1.0981
	19175	1.0966		19150	1.0958
15	18675	1.1017	20	18700	1.1001
	18900	1.1038		18900	1.0959
	19125	1.0929		19100	1.1020

Spectrum Plot of Worst Value	
1.4 MHz / QPSK	3 MHz / QPSK
	
5 MHz / QPSK	10 MHz / 16QAM
	
15 MHz / QPSK	20 MHz / 16QAM
	

9.4. Frequency Stability

Requirements

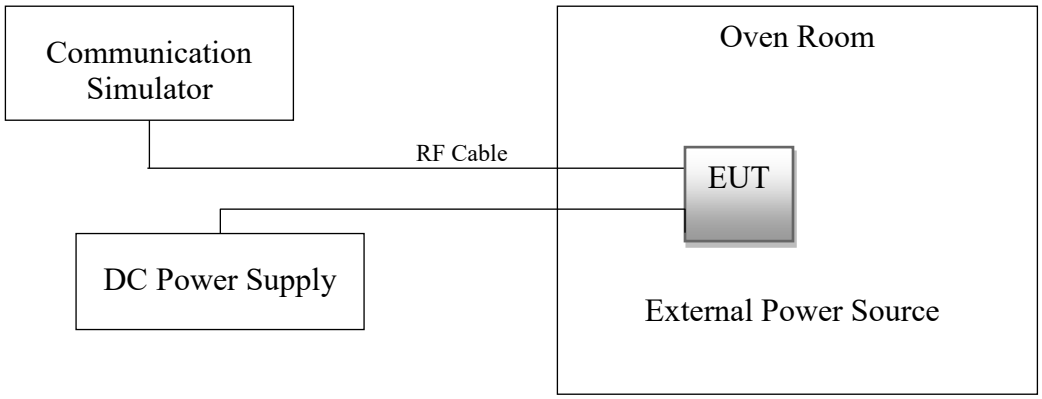
The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Test procedure

1. 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.
2. 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.
3. 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.

Test Setup



The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

Test Results

LTE Band 2

Channel Bandwidth: 1.4 MHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
V_{nom}	T_{nom}	1850.700005	0.002	1909.300009	0.005
V_{min}		1850.700006	0.003	1909.300008	0.004
V_{max}		1850.700008	0.004	1909.300007	0.004

Channel Bandwidth: 1.4 MHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
	0	1850.700004	0.002	1909.300004	0.002
	10	1850.700008	0.004	1909.300006	0.003
	20	1850.700009	0.005	1909.300007	0.004
	30	1850.700005	0.003	1909.300004	0.002
	40	1850.700009	0.005	1909.300008	0.004

Note:

1. The applicant declared that the normal operating temperature of the EUT is from 0° C to 40° C.
2. The EUT would shut down automatically as below -0° C.

Channel Bandwidth: 3 MHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
V_{nom}	T_{nom}	1851.500007	0.004	1907.499993	-0.004
V_{min}		1851.500007	0.004	1907.499991	-0.005
V_{max}		1851.500006	0.003	1907.499992	-0.004

Channel Bandwidth: 3 MHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
	0	1851.500009	0.005	1907.499996	-0.002
	10	1851.500006	0.003	1907.499992	-0.004
	20	1851.500004	0.002	1907.499993	-0.004
	30	1851.500005	0.003	1907.499990	-0.005
	40	1851.500008	0.005	1907.499993	-0.004

Note:

1. The applicant declared that the normal operating temperature of the EUT is from 0° C to 40° C.
2. The EUT would shut down automatically as below 0° C.

Channel Bandwidth: 5 MHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
V_{nom}	T_{nom}	1852.500006	0.003	1907.500007	0.004
V_{min}		1852.500008	0.004	1907.500007	0.004
V_{max}		1852.500006	0.003	1907.499997	-0.002

Channel Bandwidth: 5 MHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
	0	1852.500009	0.005	1907.500011	0.006
	10	1852.500010	0.005	1907.500005	0.003
	20	1852.500006	0.003	1907.500010	0.005
	30	1852.500003	0.002	1907.500008	0.004
	40	1852.500005	0.003	1907.500006	0.003

Note:

1. The applicant declared that the normal operating temperature of the EUT is from 0° C to 40° C.
2. The EUT would shut down automatically as below 0° C.

Channel Bandwidth: 10 MHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
V_{nom}	T_{nom}	1855.000005	0.003	1905.000010	0.005
V_{min}		1855.000005	0.003	1905.000006	0.003
V_{max}		1855.000004	0.002	1905.000010	0.006

Channel Bandwidth: 10 MHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
	0	1855.000008	0.004	1905.000006	0.003
	10	1855.000006	0.003	1905.000009	0.005
	20	1855.000004	0.002	1905.000007	0.004
	30	1855.000009	0.005	1905.000009	0.005
	40	1855.000007	0.004	1905.000006	0.003

Note:

1. The applicant declared that the normal operating temperature of the EUT is from 0° C to 40° C.
2. The EUT would shut down automatically as below 0° C.

Channel Bandwidth: 15 MHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
V_{nom}	T_{nom}	1857.500006	0.003	1902.500008	0.004
V_{min}		1857.500005	0.003	1902.500006	0.003
V_{max}		1857.500004	0.002	1902.500005	0.002

Channel Bandwidth: 15 MHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
	0	1857.500007	0.004	1902.499994	-0.003
	10	1857.500009	0.005	1902.500010	0.005
	20	1857.500005	0.003	1902.500008	0.004
	30	1857.500004	0.002	1902.500012	0.006
	40	1857.500005	0.002	1902.500005	0.003

Note:

1. The applicant declared that the normal operating temperature of the EUT is from 0° C to 40° C.
2. The EUT would shut down automatically as below 0° C.

Channel Bandwidth: 20 MHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
V_{nom}	T_{nom}	1860.000007	0.004	1900.000007	0.004
V_{min}		1860.000005	0.002	1900.000009	0.005
V_{max}		1860.000004	0.002	1900.000006	0.003

Channel Bandwidth: 20 MHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
	0	1860.000006	0.003	1900.000006	0.003
	10	1860.000008	0.004	1900.000006	0.003
	20	1860.000005	0.002	1900.000001	0.001
	30	1860.000005	0.003	1900.000005	0.002
	40	1860.000008	0.004	1900.000006	0.003

Note:

1. The applicant declared that the normal operating temperature of the EUT is from 0° C to 40° C.
2. The EUT would shut down automatically as below 0° C.

9.5. Band Edge Measurements

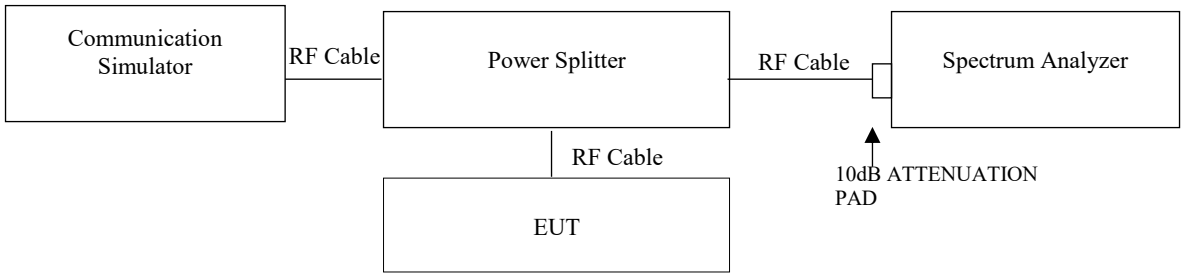
Requirements

Power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

Test procedure

1. All measurements were done at low and high operational frequency range.
2. The center frequency of spectrum is the band edge frequency and span is 5 MHz. RB of the spectrum is 16 kHz and VB of the spectrum is 51 kHz.
3. Record the max trace plot into the test report.

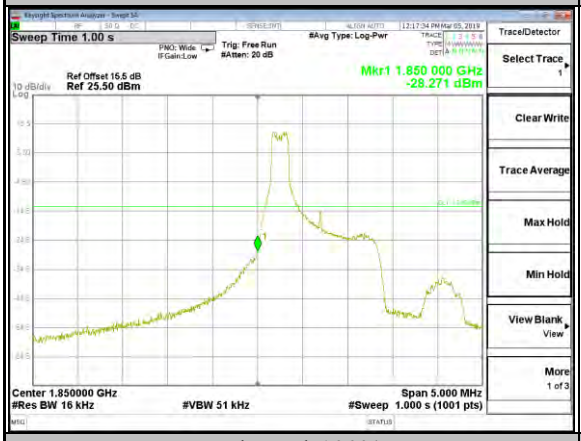
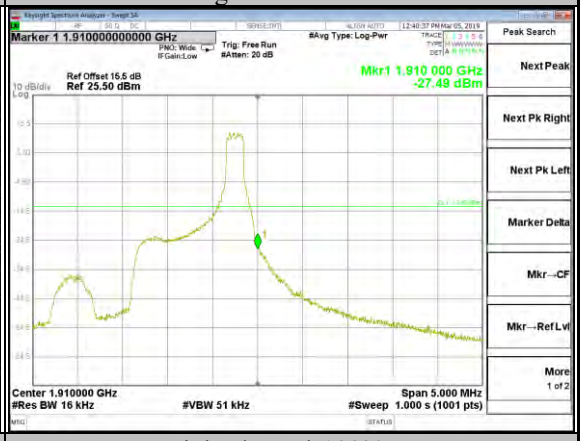
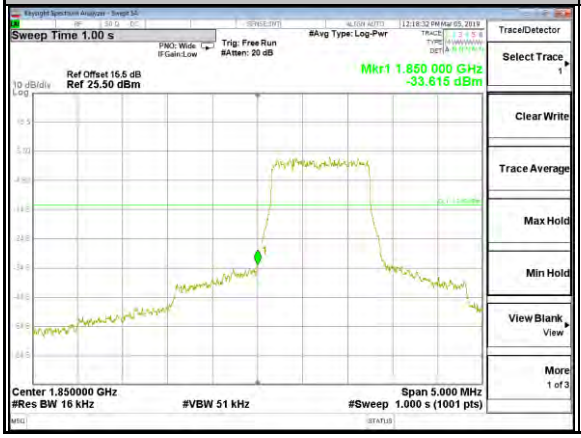
Test Setup

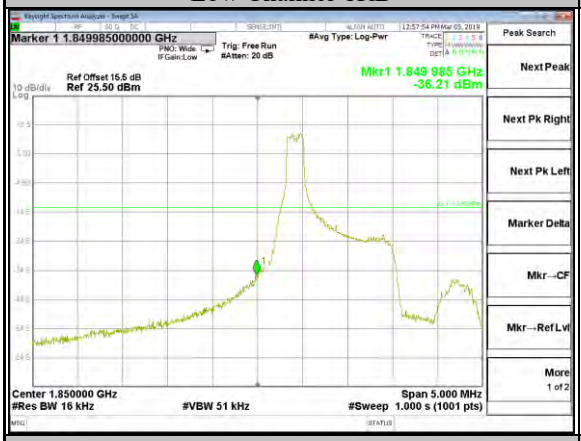
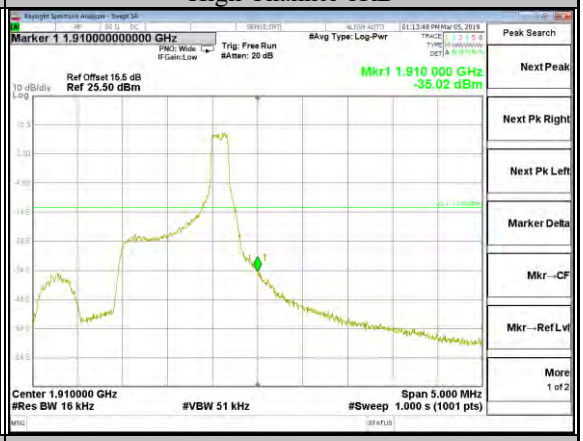
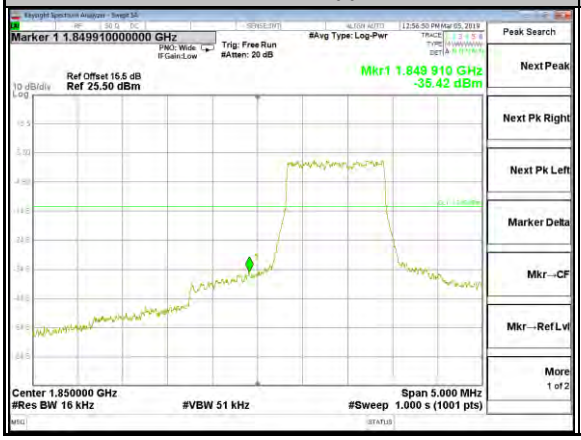
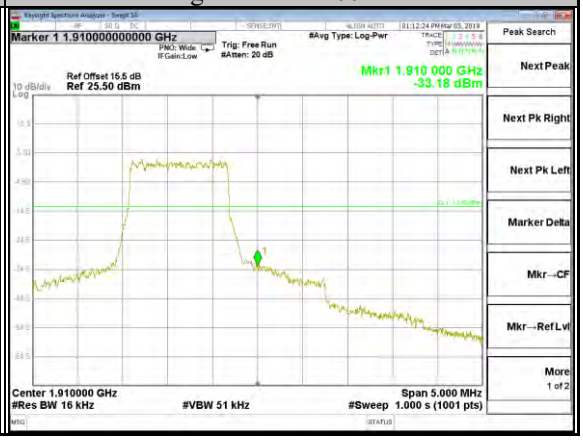


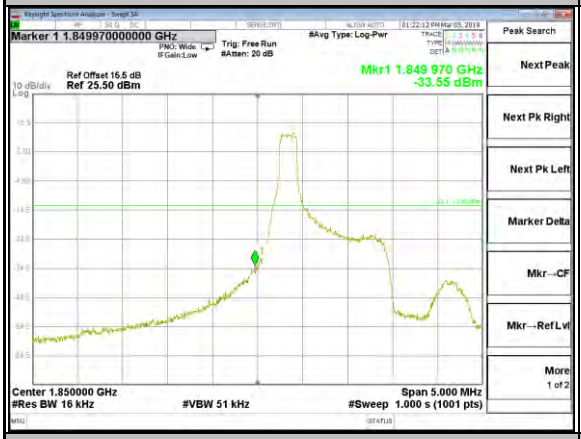
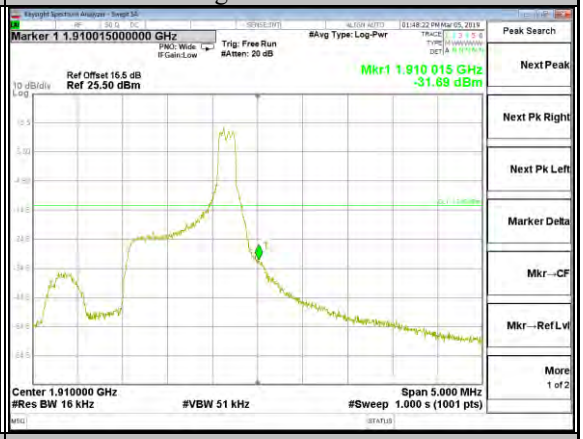
The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

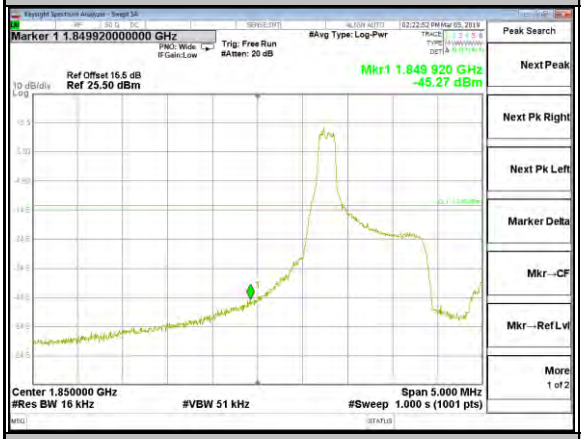
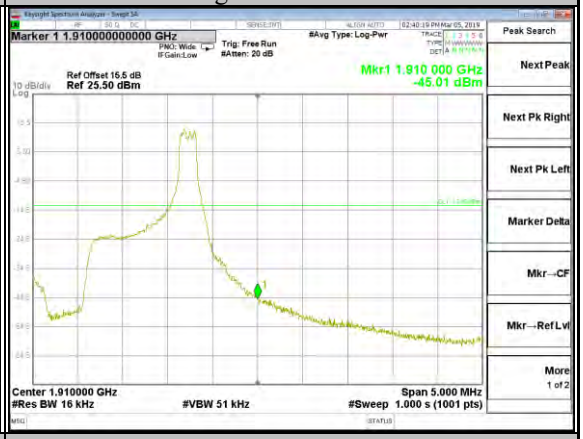
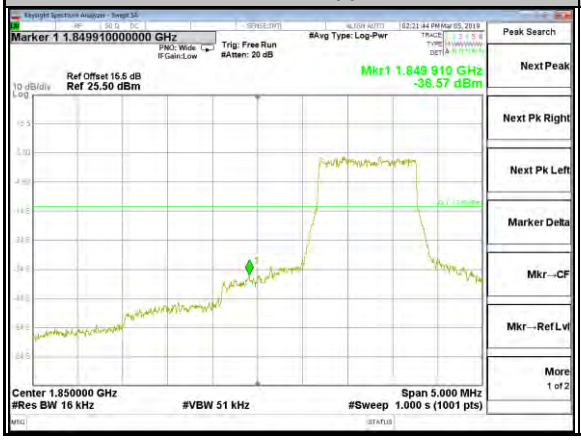
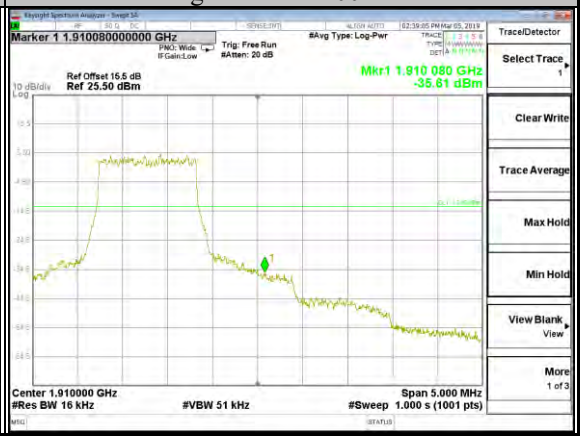
Test Results

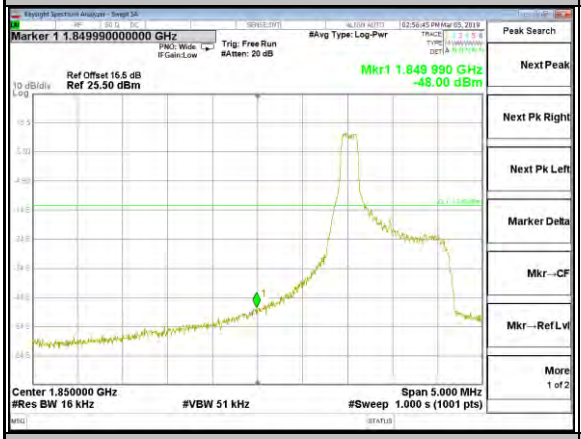
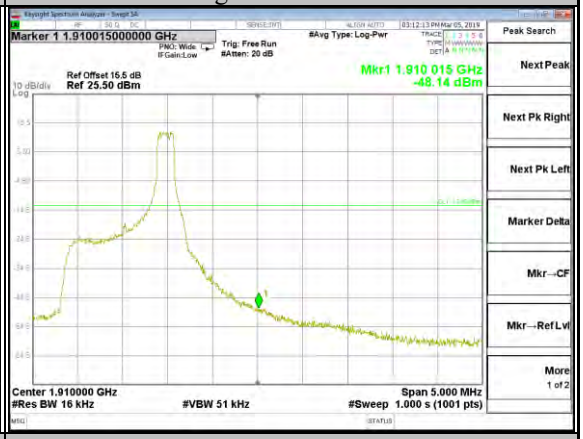
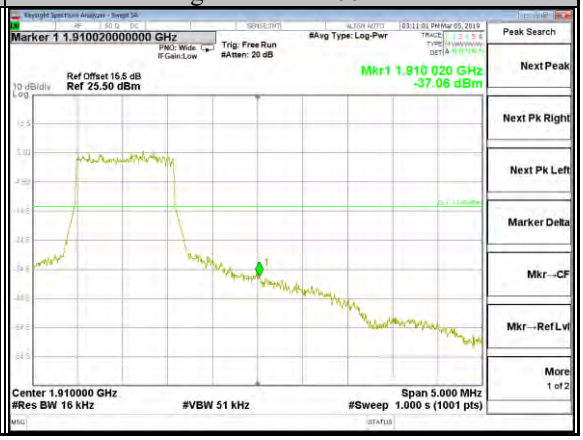
LTE Band 2

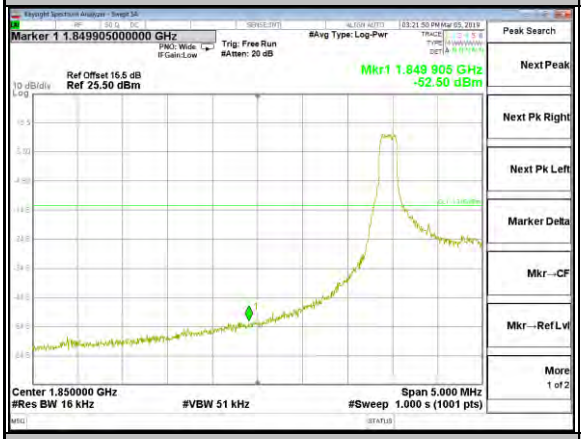
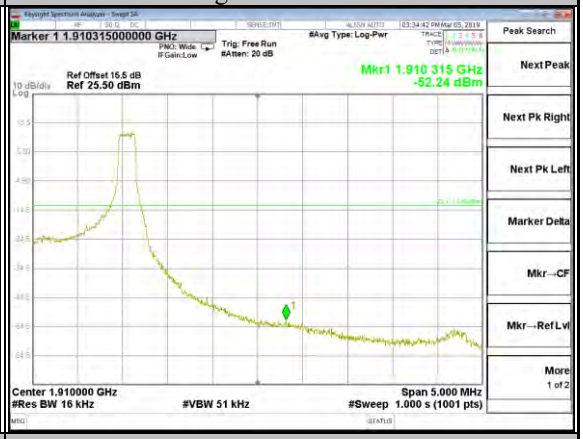
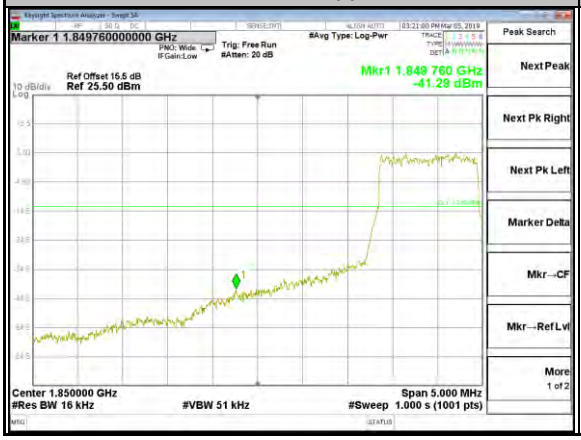
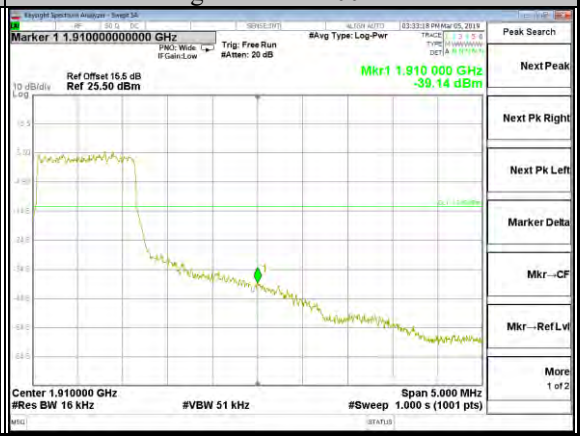
Channel Bandwidth: 1.4 MHz	
Low Channel-1RB	High Channel-1RB
	
Low Channel-100%RB	High Channel-100%RB
	

Channel Bandwidth: 3 MHz	
Low Channel-1RB	High Channel-1RB
	
Low Channel-100%RB	High Channel-100%RB
	

Channel Bandwidth: 5 MHz	
Low Channel-1RB	High Channel-1RB
	
Low Channel-100%RB	High Channel-100%RB
	

Channel Bandwidth: 10 MHz	
Low Channel-1RB	High Channel-1RB
	
Low Channel-100%RB	High Channel-100%RB
	

Channel Bandwidth: 15 MHz	
Low Channel-1RB	High Channel-1RB
	
Low Channel-100%RB	High Channel-100%RB
	

Channel Bandwidth: 20 MHz	
Low Channel-1RB	High Channel-1RB
	
Low Channel-100%RB	High Channel-100%RB
	

9.6. Spurious Emissions at Antenna Terminal

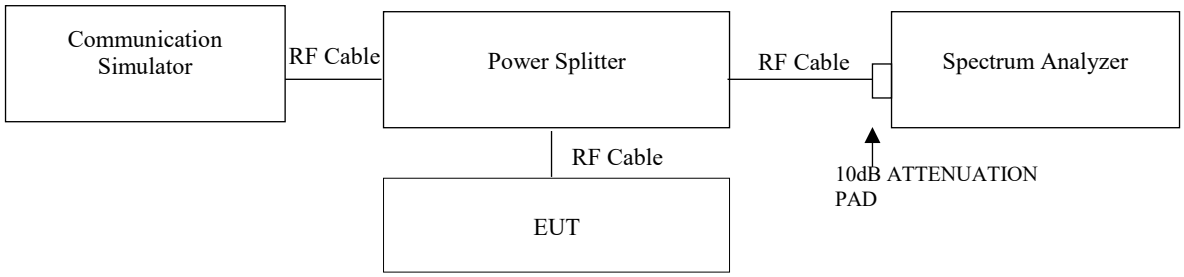
Requirements

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. The emission limit equal to –13 dBm.

Test procedure

1. The EUT was connected to Spectrum Analyzer and Communication Simulator via power Splitter. All measurements were done at low, middle and high operational frequency range. The measurement is carried out using a spectrum analyzer.
2. Sweep the whole frequency band through the range from 30MHz to the 10th harmonic of the carrier. 10 dB attenuation pad is connected with spectrum. RBW = 1 MHz and VBW = 3 MHz is used for conducted emission measurement.

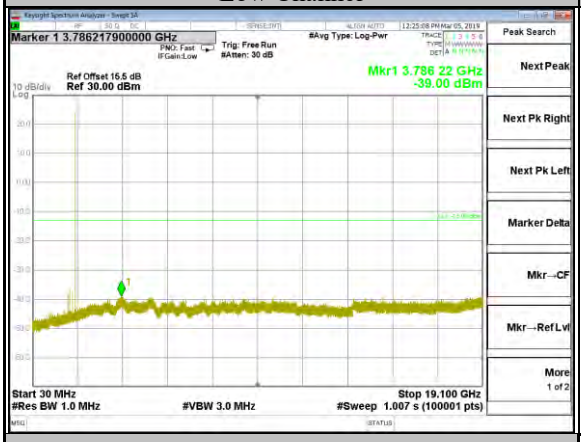
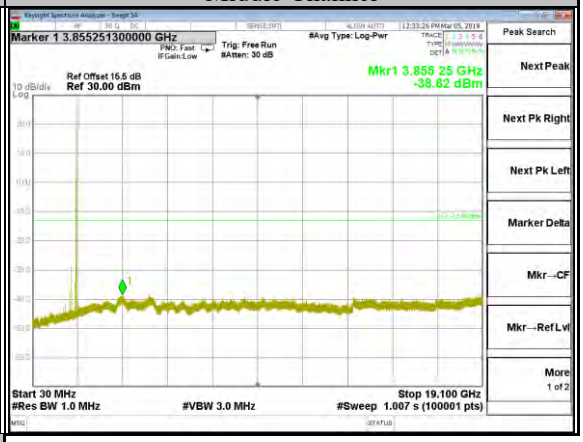
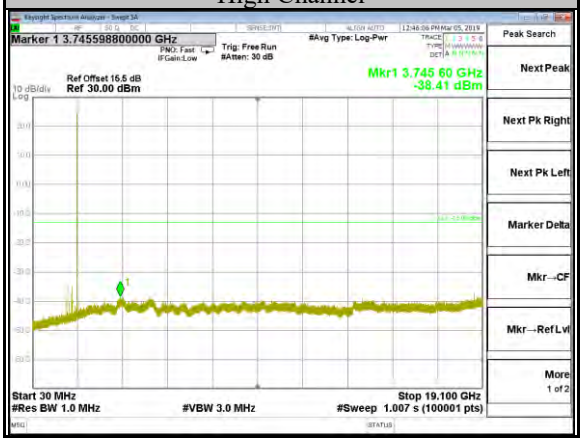
Test Setup

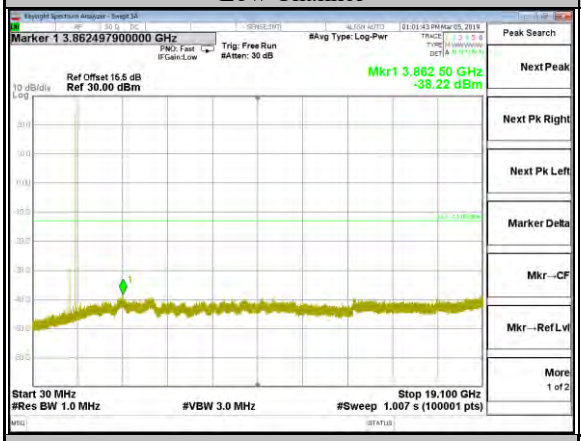
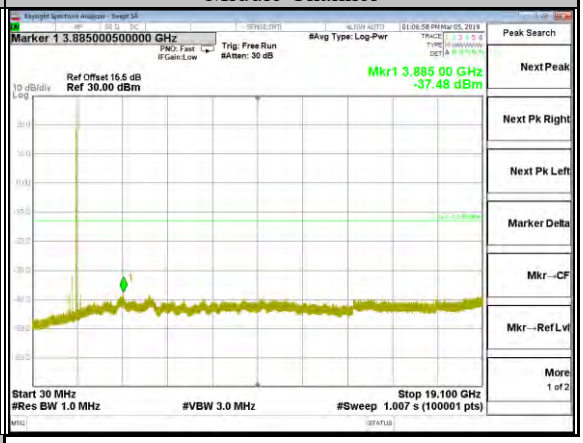
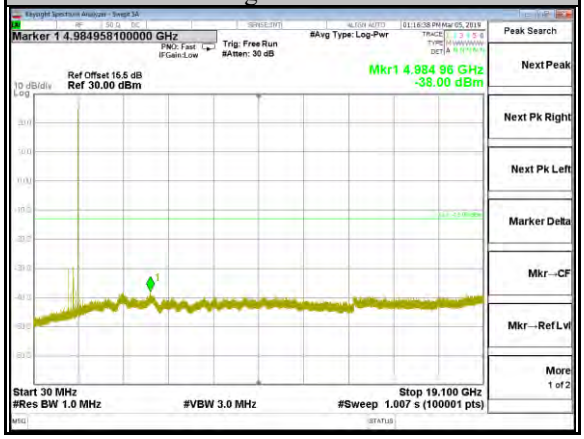


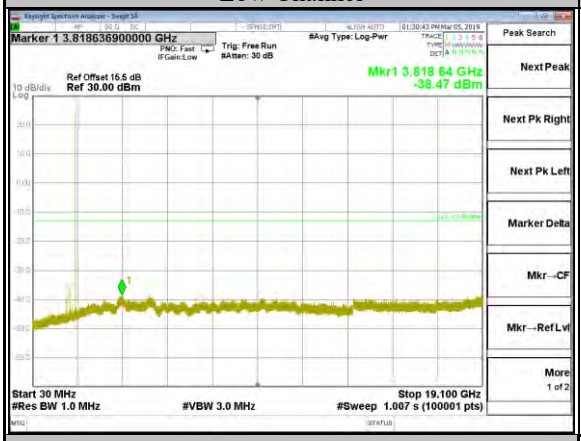
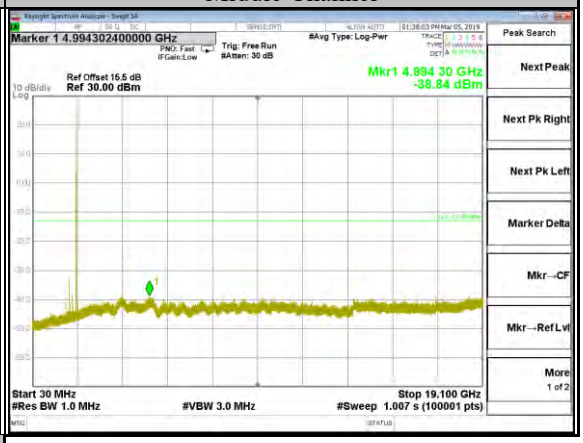
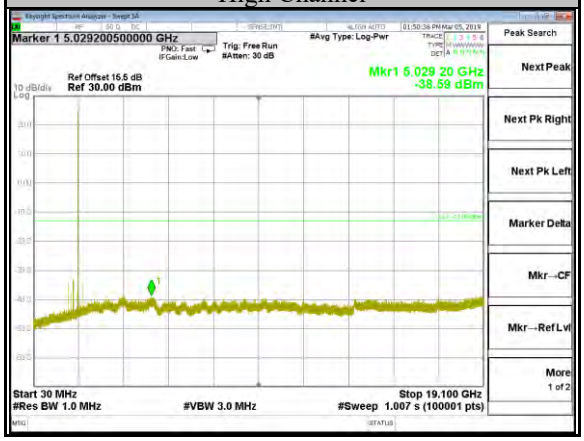
The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

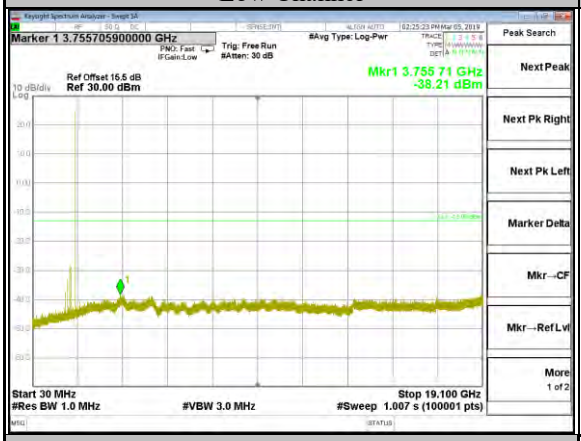
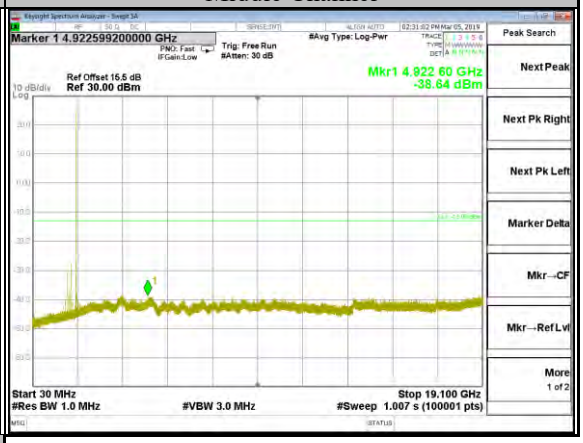
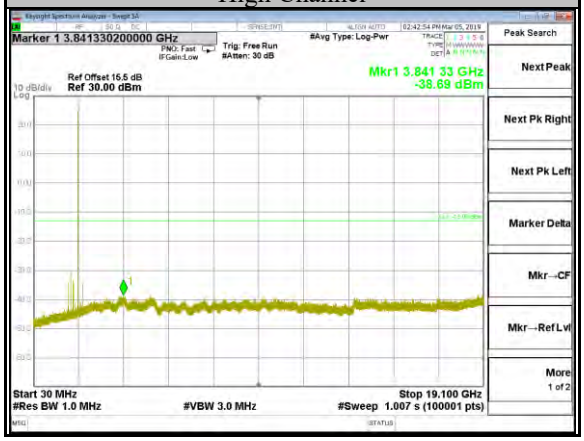
Test Results

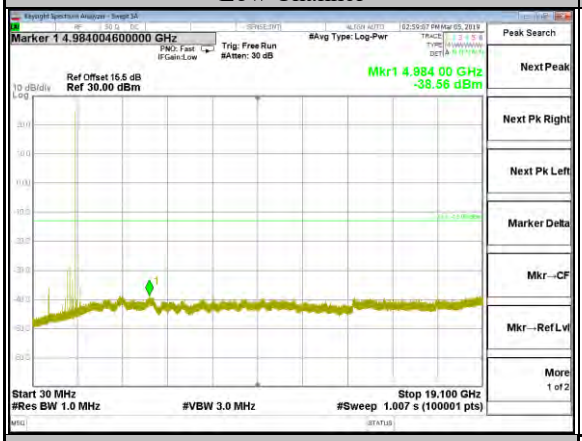
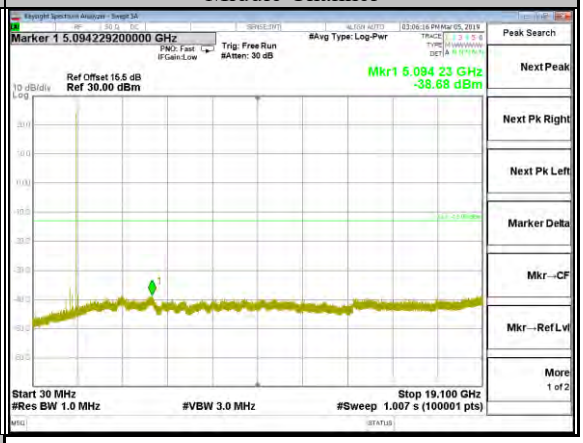
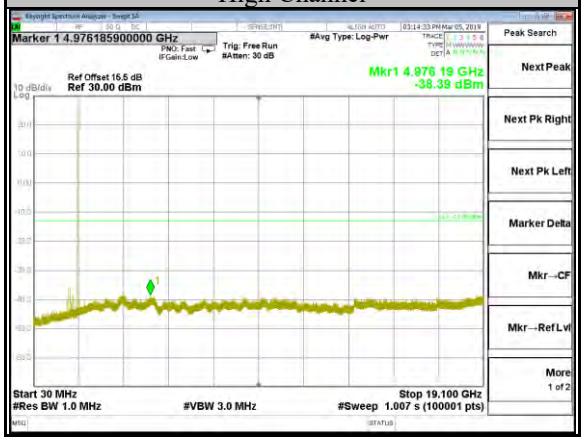
LTE Band 2

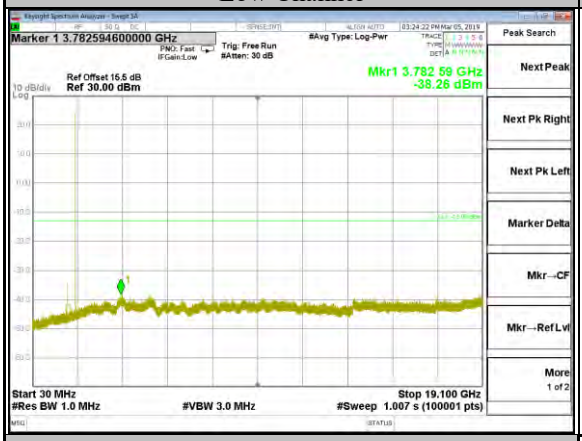
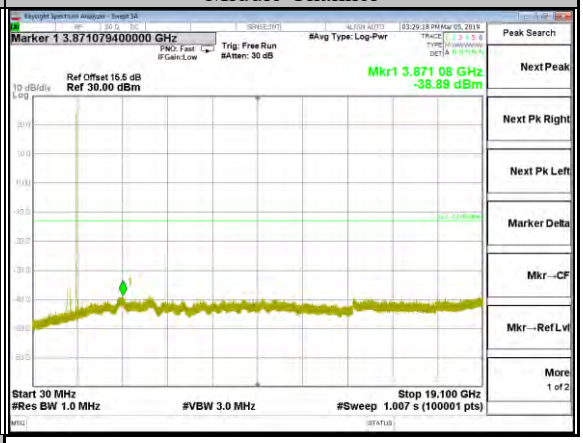
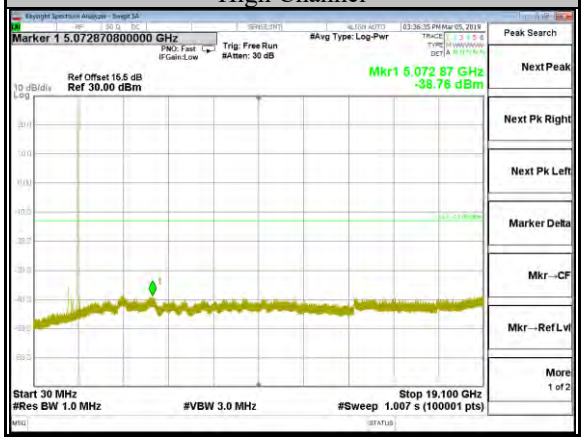
Channel Bandwidth: 1.4 MHz	
Low Channel	Middle Channel
	
High Channel	
	

Channel Bandwidth: 3 MHz	
Low Channel	Middle Channel
	
High Channel	
	

Channel Bandwidth: 5 MHz	
Low Channel	Middle Channel
	
High Channel	
	

Channel Bandwidth: 10 MHz	
Low Channel	Middle Channel
	
High Channel	
	

Channel Bandwidth: 15 MHz	
Low Channel	Middle Channel
	
High Channel	
	

Channel Bandwidth: 20 MHz	
Low Channel	Middle Channel
	
High Channel	
	

9.7. Radiated Spurious Emission

Requirements

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. The emission limit is equal to –13 dBm.

Test procedure

1. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8 m 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 1 m to 4 m to find the maximum polar radiated power. The "Read Value" is the spectrum reading the maximum power value.
2. 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.

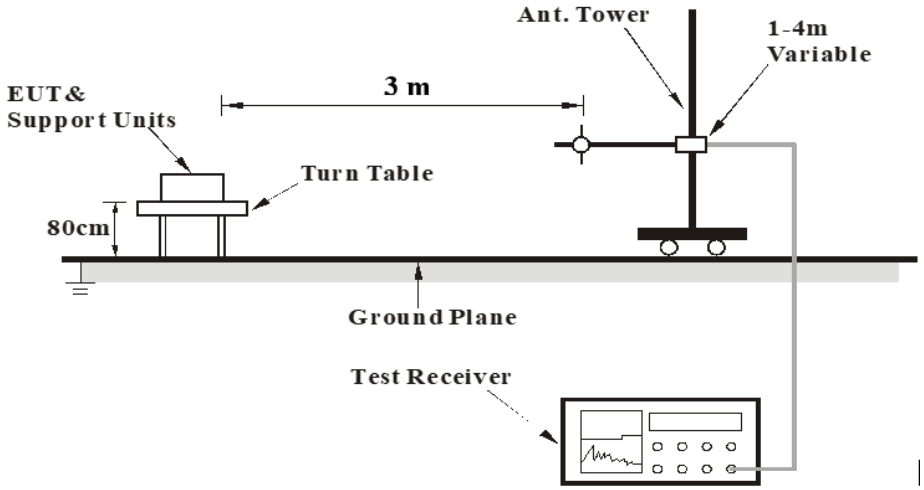
   EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution horn.

   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.P.R power - 2.15 dBi.

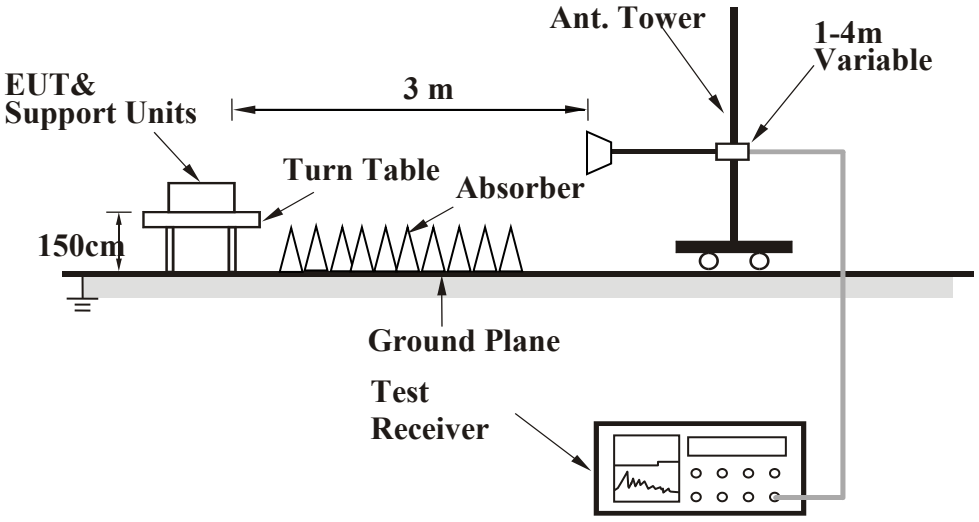
Note: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz/3 MHz.

Test Setup

<Frequency Range 30 MHz ~ 1 GHz >



<Frequency Range above 1 GHz>



For the actual test configuration, please refer to the Setup Configurations

Test Results

- Sweep the whole frequency band through the range from 30MHz to the 10th harmonic of the carrier.
- The spurious emissions within 30-1000MHz were found more than 20dB below the permissible value is not required to be report.

LTE Band 2

EUT Test Condition		Measurement Detail	
Channel Bandwidth	20MHz	**Frequency Range**	Above 1 GHz
Channel	Low Channel		

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA. Reading (dBm)	S.G. Value (dBm)	Correction Factor (dB)	Polarization (H/V)
3720	-46.76	-13	-33.76	-51.63	-57.54	10.78	H
5580	-41.38	-13	-28.38	-49.59	-52.98	11.60	H
9300	-52.30	-13	-39.30	-69.00	-60.88	8.58	H
3720	-41.91	-13	-28.91	-46.69	-52.69	10.78	V
5580	-41.16	-13	-28.16	-49.40	-52.76	11.60	V
9300	-52.94	-13	-39.94	-67.32	-61.52	8.58	V

Remarks:

1. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).
2. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
3. The other emission levels were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel Bandwidth	20MHz	Frequency Range	Above 1 GHz
Channel	Middle Channel		

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA. Reading (dBm)	S.G. Value (dBm)	Correction Factor (dB)	Polarization (H/V)
3760	-48.02	-13	-35.02	-52.99	-58.75	10.73	H
5640	-40.02	-13	-27.02	-48.31	-51.58	11.56	H
9400	-51.78	-13	-38.78	-68.84	-60.07	8.29	H
3760	-41.38	-13	-28.38	-46.30	-52.11	10.73	V
5640	-42.12	-13	-29.12	-50.43	-53.68	11.56	V
9400	-50.96	-13	-37.96	-65.51	-59.25	8.29	V

Remarks:

1. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).
2. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
3. The other emission levels were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel Bandwidth	20MHz	Frequency Range	Above 1 GHz
Channel	High Channel		

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA. Reading (dBm)	S.G. Value (dBm)	Correction Factor (dB)	Polarization (H/V)
3800	-47.32	-13	-34.32	-47.32	-57.95	10.63	H
5700	-39.09	-13	-26.09	-39.09	-50.63	11.54	H
9500	-48.40	-13	-35.40	-48.40	-56.58	8.18	H
3800	-42.68	-13	-29.68	-47.73	-53.31	10.63	V
5700	-43.78	-13	-30.78	-52.17	-55.32	11.54	V
9500	-47.82	-13	-34.82	-62.55	-56.00	8.18	V

Remarks:

1. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).
2. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
3. The other emission levels were very low against the limit.