

**FCC 47 CFR PART 15 SUBPART C &  
INDUSTRY CANADA RSS-247****TEST REPORT****For****802.11a/b/g/n 2Tx2R + BT V4.1LE USB Combo Module****Model: WCBN4516R****Trade Name: LITE-ON***Issued to***Lite-On Technology Corp.****Bldg. C, 90, Chien 1 Road, Chung Ho, New Taipei City 23585, Taiwan, R.O.C***Issued by***Compliance Certification Services Inc.****No.11, Wugong 6th Rd., Wugu Dist.,  
New Taipei City 24891, Taiwan. (R.O.C.)****<http://www.ccsrf.com>****[service@ccsrf.com](mailto:service@ccsrf.com)****Issued Date: October 4, 2016**

---

**Note:** This report shall not be reproduced except in full, without the written approval of Compliance Certification Services Inc. This document may be altered or revised by Compliance Certification Services Inc. personnel only, and shall be noted in the revision section of the document.

**Revision History**

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	October 4, 2016	Initial Issue	ALL	Becca Chen
01	October 19, 2016	1. Modify BT 4.0 to BT 4.1.	P5, P8~9, P24, P39	Becca Chen

## TABLE OF CONTENTS

<b>1. TEST RESULT CERTIFICATION.....</b>	<b>4</b>
<b>2. EUT DESCRIPTION.....</b>	<b>5</b>
<b>3. TEST METHODOLOGY.....</b>	<b>6</b>
3.1 EUT CONFIGURATION .....	6
3.2 EUT EXERCISE .....	6
3.3 GENERAL TEST PROCEDURES .....	6
3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS.....	7
3.5 DESCRIPTION OF TEST MODES.....	8
3.6 THE WORST CASE POWER SETTING PARAMETER.....	9
<b>4 INSTRUMENT CALIBRATION.....</b>	<b>10</b>
4.1 MEASURING INSTRUMENT CALIBRATION.....	10
4.2 MEASUREMENT EQUIPMENT USED.....	10
4.3 MEASUREMENT UNCERTAINTY .....	11
<b>5 FACILITIES AND ACCREDITATIONS.....</b>	<b>12</b>
5.1 FACILITIES.....	12
5.2 EQUIPMENT .....	12
5.3 TABLE OF ACCREDITATIONS AND LISTINGS .....	13
<b>6 SETUP OF EQUIPMENT UNDER TEST.....</b>	<b>14</b>
6.1 SETUP CONFIGURATION OF EUT.....	14
6.2 SUPPORT EQUIPMENT .....	14
<b>7 FCC PART 15.247 REQUIREMENTS &amp; RSS-247 REQUIREMENTS.....</b>	<b>15</b>
7.1 99% BANDWIDTH .....	15
7.2 6DB BANDWIDTH.....	18
7.3 PEAK POWER .....	21
7.4 AVERAGE POWER .....	22
7.5 BAND EDGES MEASUREMENT .....	23
7.6 PEAK POWER SPECTRAL DENSITY .....	33
7.7 RADIATED EMISSIONS .....	36
7.8 POWERLINE CONDUCTED EMISSIONS.....	48
<b>APPENDIX I PHOTOGRAPHS OF TEST SETUP .....</b>	<b>51</b>

## 1. TEST RESULT CERTIFICATION

**Applicant:** Lite-On Technology Corp.  
Bldg. C, 90, Chien 1 Road, Chung Ho, New Taipei City 23585,  
Taiwan, R.O.C

**Manufacturer:** LITE-ON TECHNOLOGY (Changzhou) CO., LTD  
A9 Building, No.88 Yanghu Road, Wujin Hi-Tech Industrial  
Development Zone, Changzhou City,  
Jiangsu Province 213100 China

**Equipment Under Test:** 802.11a/b/g/n 2Tx2R + BT V4.1LE USB Combo Module

**Model Number:** WCBN4516R

**Trade Name:** LITE-ON

**Date of Test:** September 22 ~ October 3, 2016

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 15 Subpart C Industry Canada RSS-247 Issue 1	No non-compliance noted
Deviation from Applicable Standard	
N/A	

### We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10: 2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements set forth in the above standards.

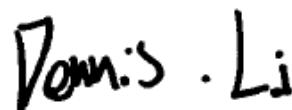
The test results of this report relate only to the tested sample EUT identified in this report.

Approved by:



Miller Lee  
Manager  
Compliance Certification Services Inc.

Tested by:



Dennis Li  
Engineer  
Compliance Certification Services Inc.

## 2. EUT DESCRIPTION

<b>Product</b>	802.11a/b/g/n 2Tx2R + BT V4.1LE USB Combo Module
<b>Model Number</b>	WCBN4516R
<b>Trade Name</b>	LITE-ON
<b>Model Discrepancy</b>	N/A
<b>Received Date</b>	September 9, 2016
<b>Power supply</b>	Power form host device.
<b>Frequency Range</b>	2402MHz ~ 2480MHz
<b>Transmit Power</b>	5.52 dBm
<b>Modulation Technique</b>	BT 4.1 LE mode, GFSK (1Mbps)
<b>Number of Channels</b>	40 Channels
<b>Antenna Specification</b>	PCB Antenna Gain: 4.85dBi
<b>Product SW/HW version</b>	VV1.0.3.16 / V01
<b>Radio SW version</b>	V1.0.3.16
<b>Radio HW version</b>	V01

**Remark:**

1. The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC ID: **PPQ-WCBN4516R** & ISED No. : **4491A-WCBN4516R** filing to comply with FCC Part 15C, Section 15.207, 15.209 and IC RSS-247 & RSS-GEN.

### **3. TEST METHODOLOGY**

The tests documented in this report were performed in accordance with ANSI C63.10: 2013 and FCC CFR 47 Part 15.207, 15.209, 15.247, KDB 558074 D01 DTS Meas Guidance v03r05

The tests documented in this report were performed in accordance with IC RSS-247, IC RSS-Gen and ANSI C63.10:2013.

This submittal(s) (test report) is intended for IC Certification with Industry Canada RSS-247.

#### **3.1 EUT CONFIGURATION**

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

#### **3.2 EUT EXERCISE**

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C and RSS-247

#### **3.3 GENERAL TEST PROCEDURES**

##### **Conducted Emissions**

According to the requirements in ANSI C63.10: 2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

##### **Radiated Emissions**

The EUT is placed on a turn table, which is 1.5 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in ANSI C63.10: 2013.

### 3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
<sup>1</sup> 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	( <sup>2</sup> )
13.36 - 13.41	322 - 335.4		

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

### **3.5 DESCRIPTION OF TEST MODES**

The EUT (model: WCBN4516R) had been tested under operating condition.

Software used to control the EUT for staying in continuous transmitting mode was programmed.

After verification, all tests were carried out with the worst case test modes as shown below except radiated spurious emission below 1GHz and power line conducted emissions below 30MHz, which worst case was in normal link mode only.

#### **BT 4.1**

Tested Channel	Frequency (MHz)
Low	2402
Mid	2440
High	2480

The field strength of spurious emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (Z axis) and the worst case was recorded.

### 3.6 THE WORST CASE POWER SETTING PARAMETER

#### BT4.1

Channel	Frequency (MHz)	RF power setting in TEST SW
Low	2402	Default
Mid	2440	Default
High	2480	Default

## 4 INSTRUMENT CALIBRATION

### 4.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

### 4.2 MEASUREMENT EQUIPMENT USED

#### Equipment Used for Emissions Measurement

Conducted Emissions Test Site					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Power Meter	Anritsu	ML2495A	1012009	07/04/2016	07/03/2017
Power Meter	Anritsu	MA2411B	917072	07/04/2016	07/03/2017
Spectrum Analyzer	R&S	FSV 40	101073	08/01/2016	07/31/2017

Wugu 966 Chamber A					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US42510252	12/08/2015	12/07/2016
Loop Ant	COM-POWER	AL-130	121051	02/25/2016	02/24/2017
Bilog Antenna	Sunol Sciences	JB3	A030105	07/03/2016	07/02/2017
Pre-Amplifier	EMEC	EM330	60609	06/08/2016	06/07/2017
Horn Antenna	ETC	MCTD 1209	DRH13M02003	09/02/2016	09/01/2017
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R
Software	EZ-EMC (CCS-3A1RE)				

Conducted Emission Room # B					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
LISN	SCHWARZBECK	NSLK 8127	8127-541	11/23/2015	11/22/2016
Receiver	R&S	ESCI	101073	08/20/2016	08/19/2017
Software	CCS-3A1-CE				

**Remark:**

1. Each piece of equipment is scheduled for calibration once a year and Precision Dipole is scheduled for calibration once three years.
2. N.C.R. = No Calibration Required.

### 4.3 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
Powerline Conducted Emission	+/- 1.2575
3M Semi Anechoic Chamber / 30M~200M	+/- 4.0138
3M Semi Anechoic Chamber / 200M~1000M	+/- 3.9483
3M Semi Anechoic Chamber / 1G~8G	+/- 2.5975
3M Semi Anechoic Chamber / 8G~18G	+/- 2.6112
3M Semi Anechoic Chamber / 18G~26G	+/- 2.7389
3M Semi Anechoic Chamber / 26G~40G	+/- 2.9683

**Remark:** This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

## 5 FACILITIES AND ACCREDITATIONS

### 5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

- No.199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.  
Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029
- No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.)  
Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045
- No.81-1, Lane 210, Bade 2nd Rd., Lujhu Township, Taoyuan County 33841, TAIWAN, R.O.C.  
Tel: 886-3-324-0332 / Fax: 886-3-324-5235

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10: 2013 and CISPR Publication 22.

### 5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, ridged waveguide, horn and/or Loop. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

### 5.3 TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	FCC	3M Semi Anechoic Chamber (FCC MRA: TW1039) to perform FCC Part 15 measurements	 FCC MRA: TW1039
Taiwan	TAF	LP0002, RTTE01, FCC Method-47 CFR Part 15 Subpart C, D, E, RSS-247, RSS-310 IDATE SRD, AS/NZS 4268, AS/NZS 4771, TS 12.1 & 12.2, ETSI EN 300 440-1, ETSI EN 300 440-2, ETSI EN 300 328, ETSI EN 300 220-1, ETSI EN 300 220-2, ETSI EN 301 893, ETSI EN 301 489-1/3/7/17 FCC OET Bulletin 65 + Supplement C, EN 50360, EN 50361, EN 50371, RSS 102, EN 50383, EN 50385, EN 50392, IEC 62209, CNS 14958-1, CNS 14959 FCC Method –47 CFR Part 15 Subpart B IEC / EN 61000-3-2, IEC / EN 61000-3-3, IEC / EN 61000-4-2/3/4/5/6/8/11	 Testing Laboratory 1309
Canada	Industry Canada	3M Semi Anechoic Chamber (IC 2324G-1 / IC 2324G-2) to perform	 IC 2324G-1 IC 2324G-2

*\* No part of this report may be used to claim or imply product endorsement by A2LA or any agency of the US Government.*

## 6 SETUP OF EQUIPMENT UNDER TEST

### 6.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix I for the actual connections between EUT and support equipment.

### 6.2 SUPPORT EQUIPMENT

No	Equipment	Brand	Model	Series No.	FCC ID	Data Cable	Power Cord
1	Notebook PC	IBM	1951-13V	N/A	Doc	Fixture to USB Cable 0.5m	AC I/P: Unshielded, 1.8m with a core DC O/P: Unshielded, 1.8m

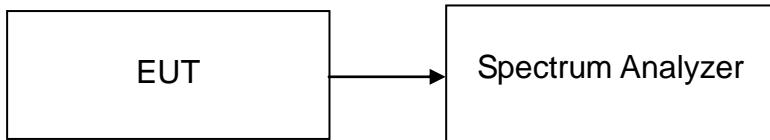
**Remark:**

1. *All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.*
2. *Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.*

## 7 FCC PART 15.247 REQUIREMENTS & RSS-247 REQUIREMENTS

### 7.1 99% BANDWIDTH

#### Test Configuration



#### TEST PROCEDURE

The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold.

#### TEST RESULTS

*No non-compliance noted.*

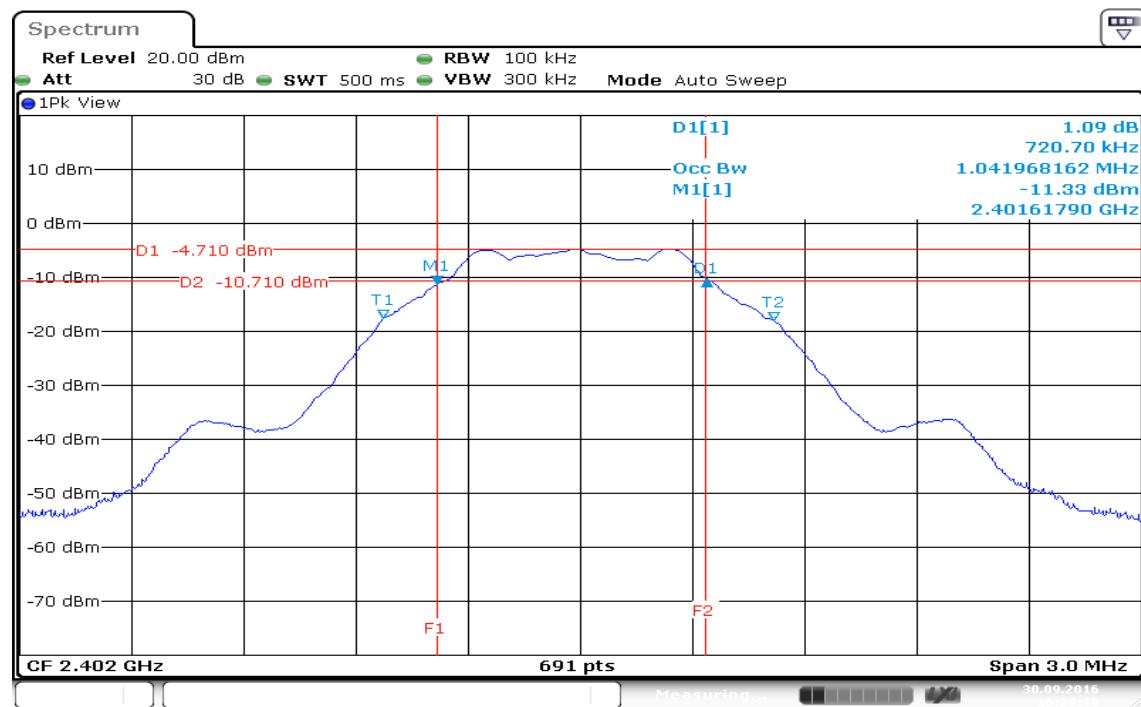
#### Test Data

##### For GFSK

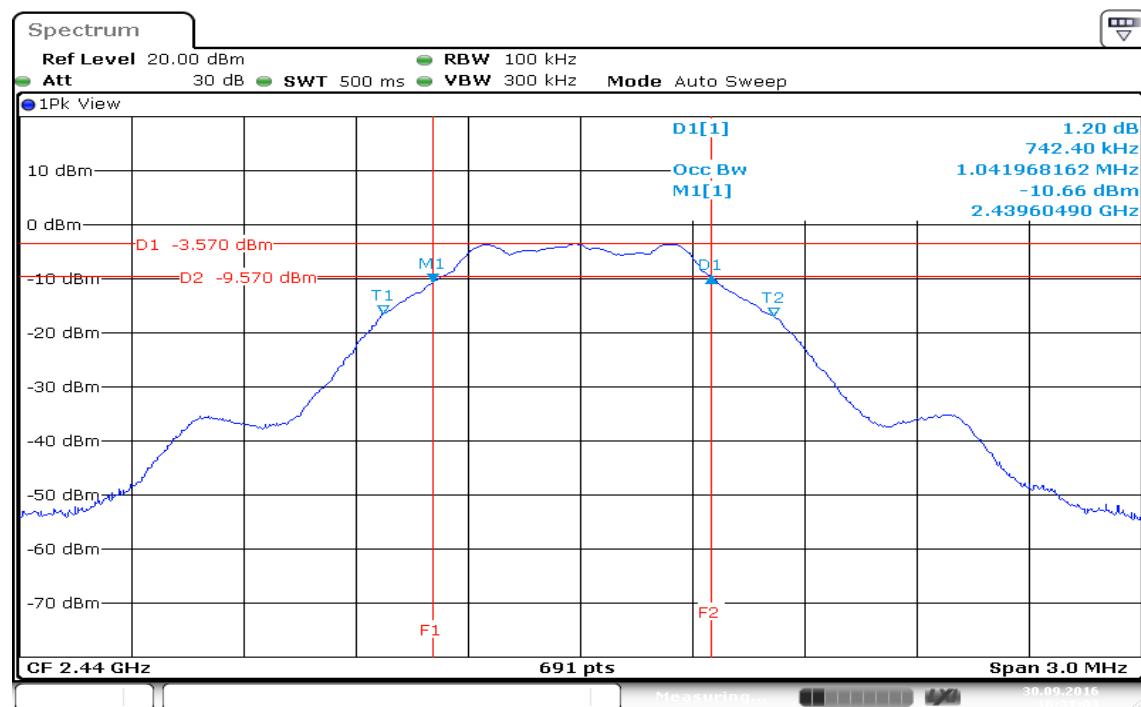
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0419
Mid	2440	1.0419
High	2480	1.0419

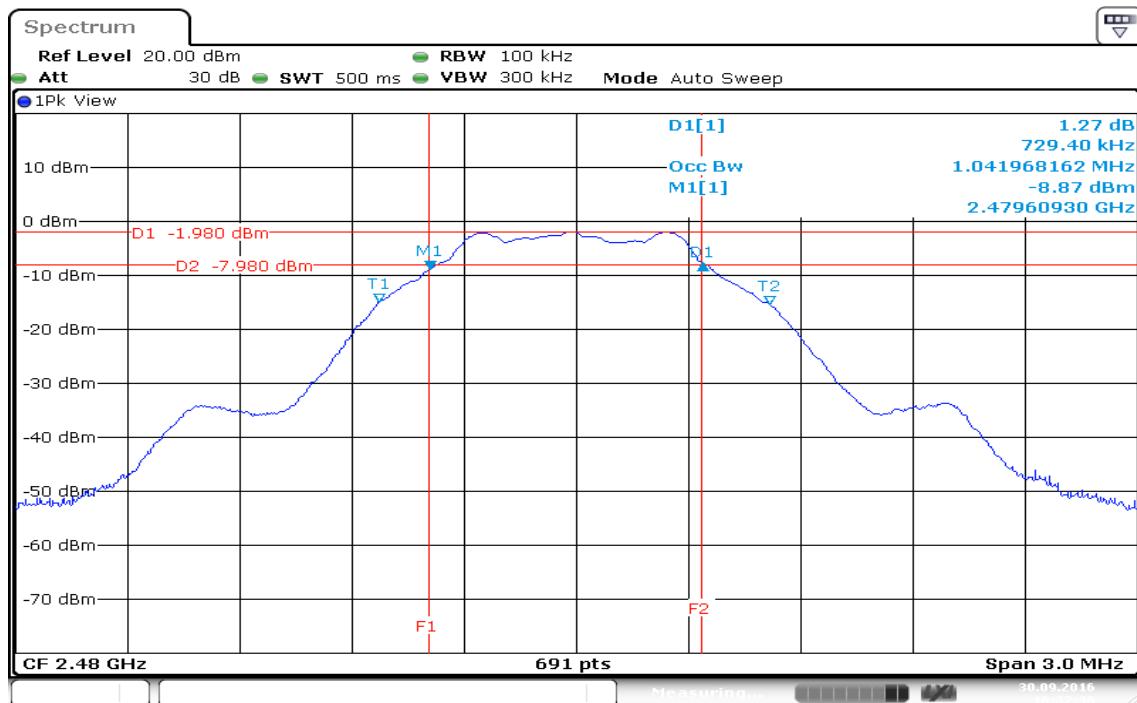
## Test Plot

### 99% Bandwidth (CH Low)



### 99% Bandwidth (CH Mid)



**99% Bandwidth (CH High)**

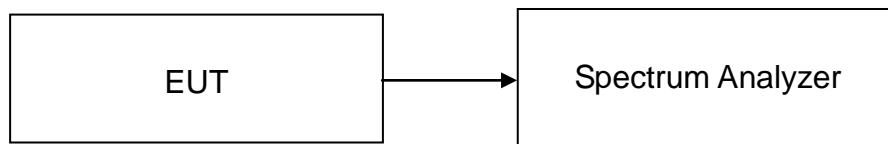
Date: 30 SEP 2016 16:32:30

## 7.2 6dB BANDWIDTH

### LIMIT

According to §15.247(a)(2) & RSS-247, systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

### Test Configuration



### TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. Set the RBW = 1%-5% of the emission bandwidth, VBW  $\geq$  3 x RBW, Detector = Peak, Trace mode = max hold, Sweep = auto couple. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6dB relative to the maximum level measured in the fundamental emission.

### TEST RESULTS

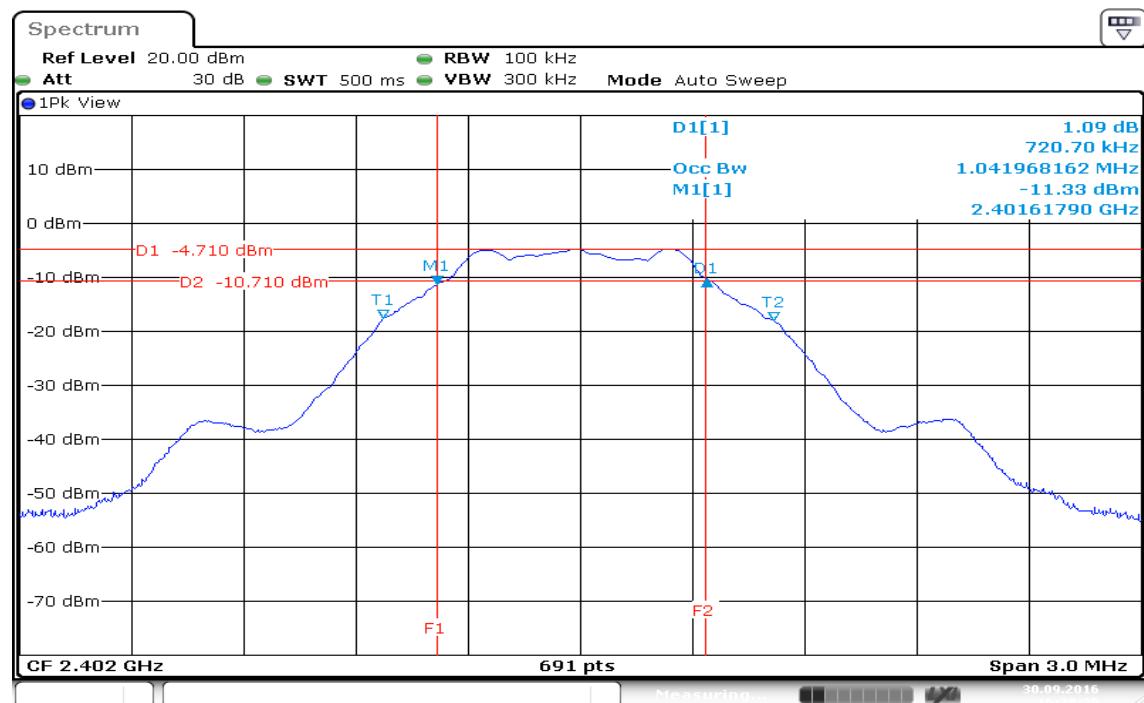
*No non-compliance noted*

### Test Data

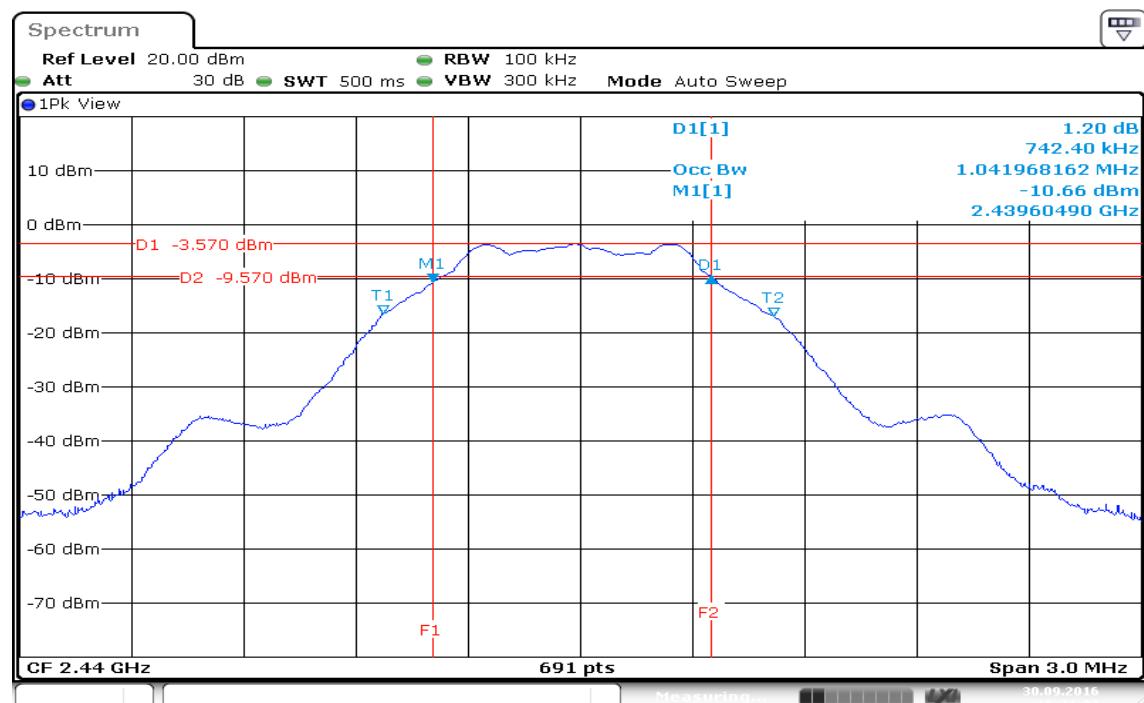
Channel	Frequency (MHz)	6dB Bandwidth (kHz)	Limit (kHz)	Test Result
Low	2402	720.70	>500	PASS
Mid	2440	742.40		PASS
High	2480	729.40		PASS

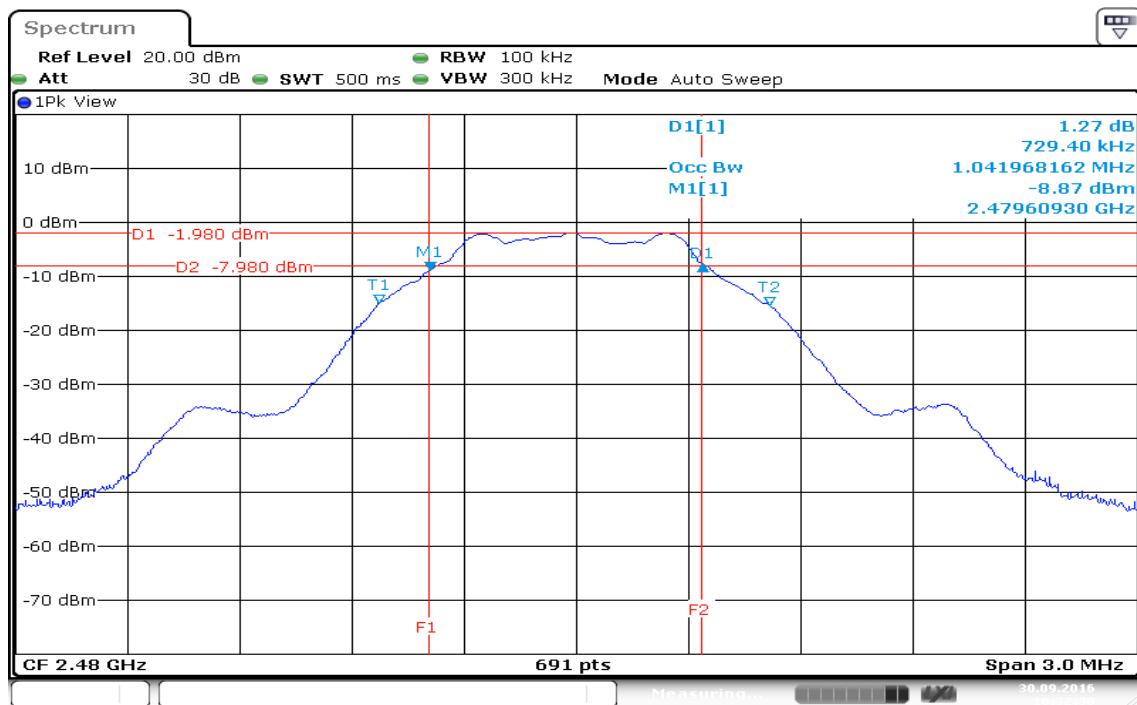
## Test Plot

### 6dB Bandwidth (CH Low)



### 6dB Bandwidth (CH Mid)



**6dB Bandwidth (CH High)**

Date: 30 SEP 2016 16:32:30

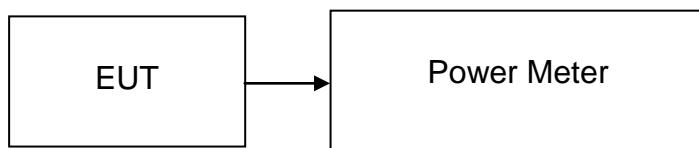
## 7.3 PEAK POWER

### LIMIT

The maximum peak output power of the intentional radiator shall not exceed the following:

1. According to §15.247(b)(3), for systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz: 1 Watt.
2. According to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
3. According to RSS-247, for systems employing digital modulation techniques operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

### Test Configuration



## TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. Set the RBW = 1MHz , VBW = 3MHz, Detector = Peak, Trace mode = max hold, Sweep = auto couple. Record the max reading.

Repeat the above procedure until the measurements for all frequencies are completed.

## TEST RESULTS

*No non-compliance noted*

### Test Data

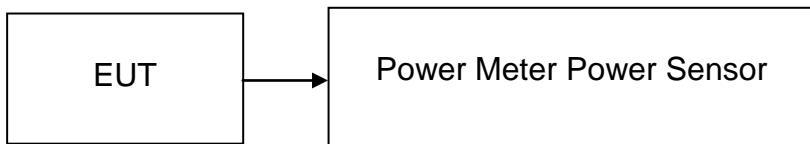
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Test Result
Low	2402	*5.52	0.0036	1	PASS
Mid	2440	5.29	0.0034		PASS
High	2480	5.36	0.0034		PASS

## 7.4 AVERAGE POWER

### LIMIT

None; for reporting purposes only.

### Test Configuration



### TEST PROCEDURE

The transmitter output is connected to the Power Meter. The Power Meter is set to the average power detection.

### TEST RESULTS

*No non-compliance noted.*

### Test Data

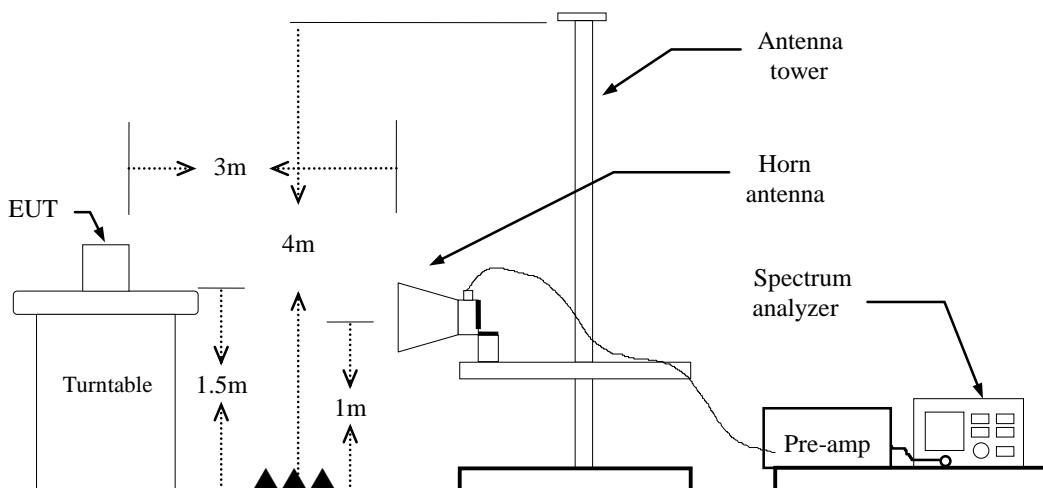
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	2402	4.56	0.0029
Mid	2440	4.54	0.0028
High	2480	<b>*4.58</b>	0.0029

## 7.5 BAND EDGES MEASUREMENT

### LIMIT

According to §15.247(d) & RSS-247, in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)).

### Test Configuration



## **TEST PROCEDURE**

### **For Radiated**

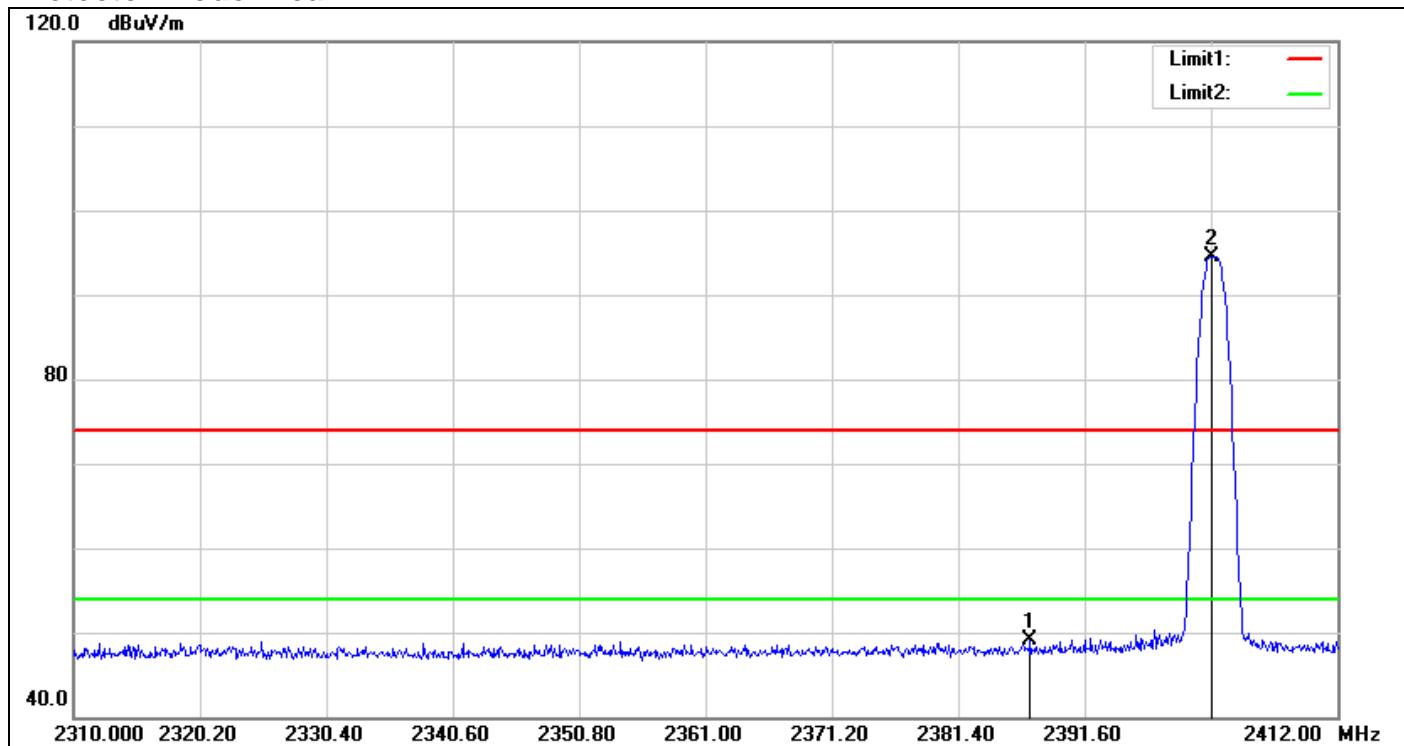
1. The EUT is placed on a turntable, which is 1.5m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
  - (a) PEAK: RBW=1MHz / VBW=3MHz / Sweep=AUTO
  - (b) AVERAGE: RBW=1MHz,  
if duty cycle  $\geq$  98%, VBW=10Hz.  
if duty cycle < 98% VBW=1/T.  
**BT4.1:** = 67%, VBW= 2.4kHz
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.
6. Result = Spectrum Reading + cable loss(spectrum to Amp) - Amp Gain + Cable loss(Amp to receive Ant)+ Receive Ant

### **For Un-restricted Band Emissions**

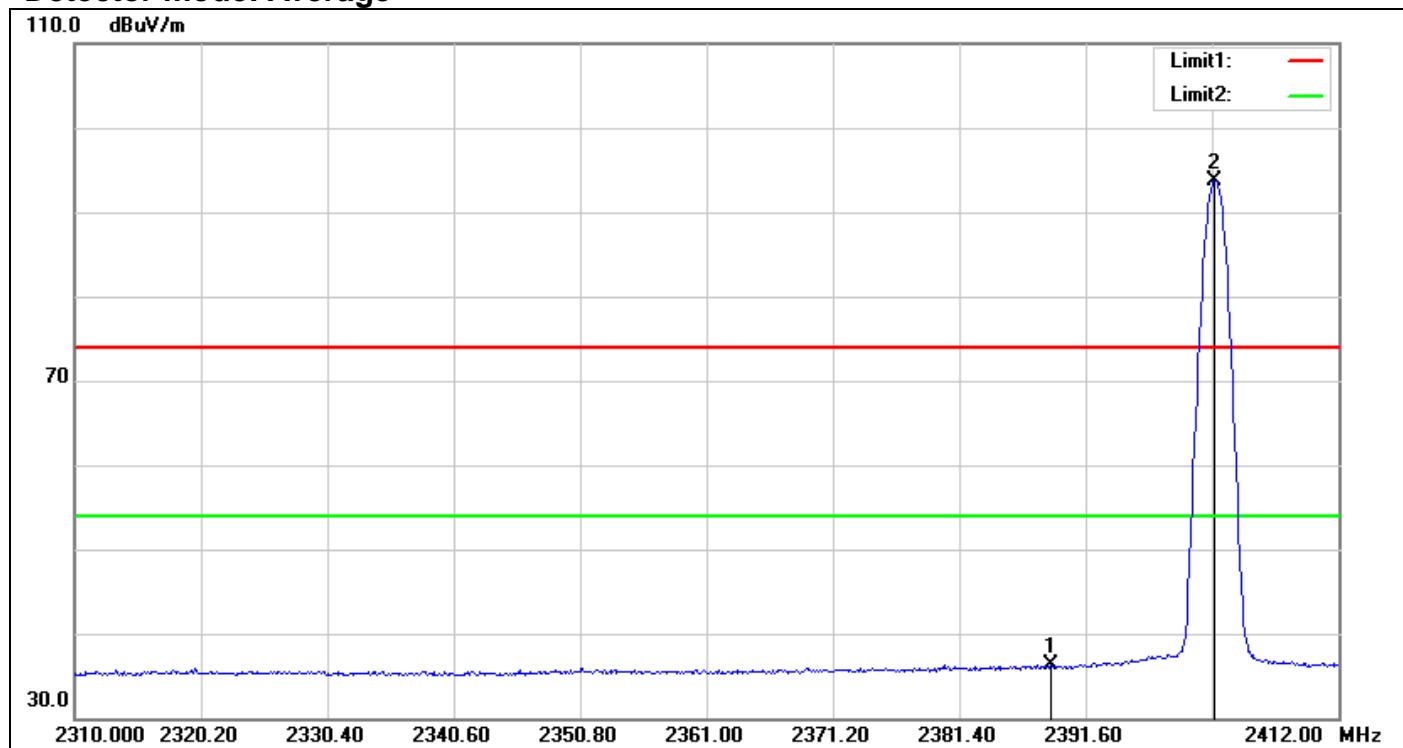
The peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.

## **TEST RESULTS**

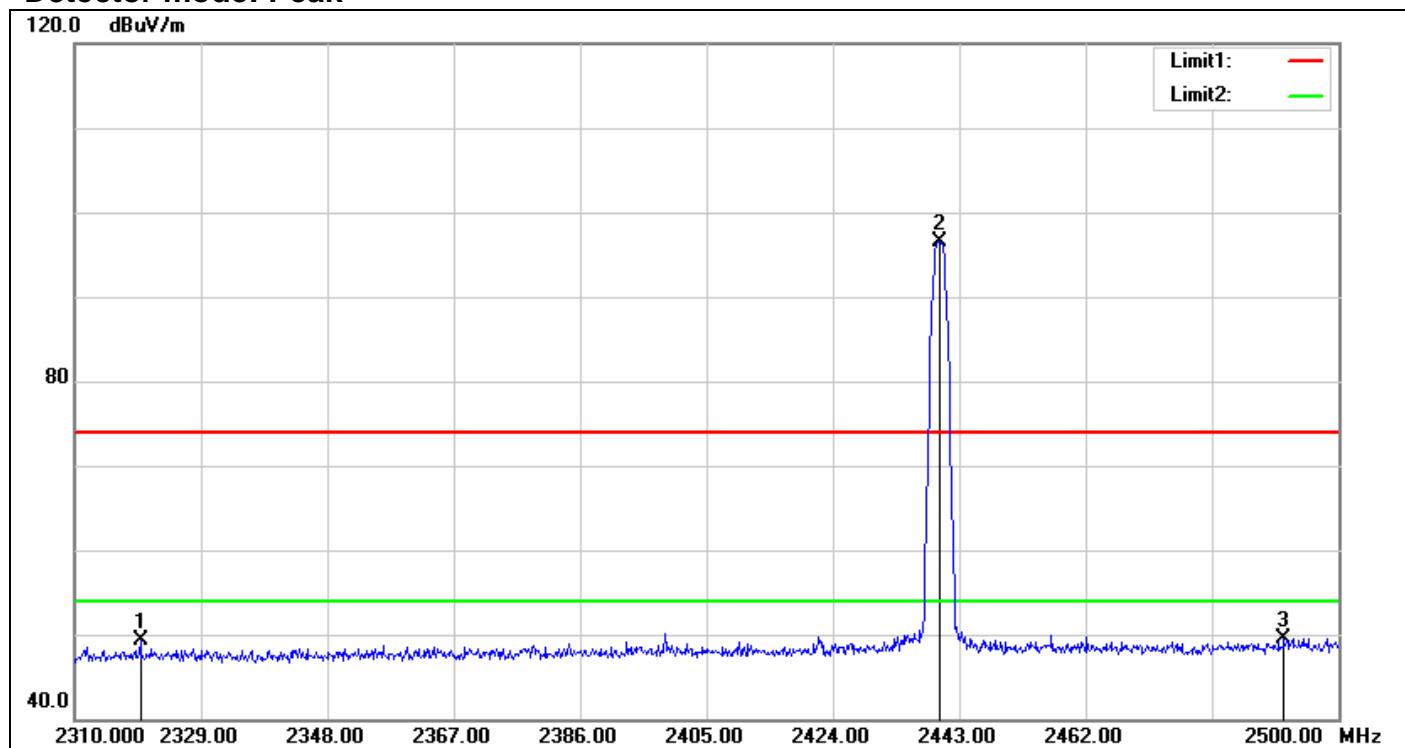
Refer to attach spectrum analyzer data chart.

**Band Edges (CH Low)****Detector mode: Peak**

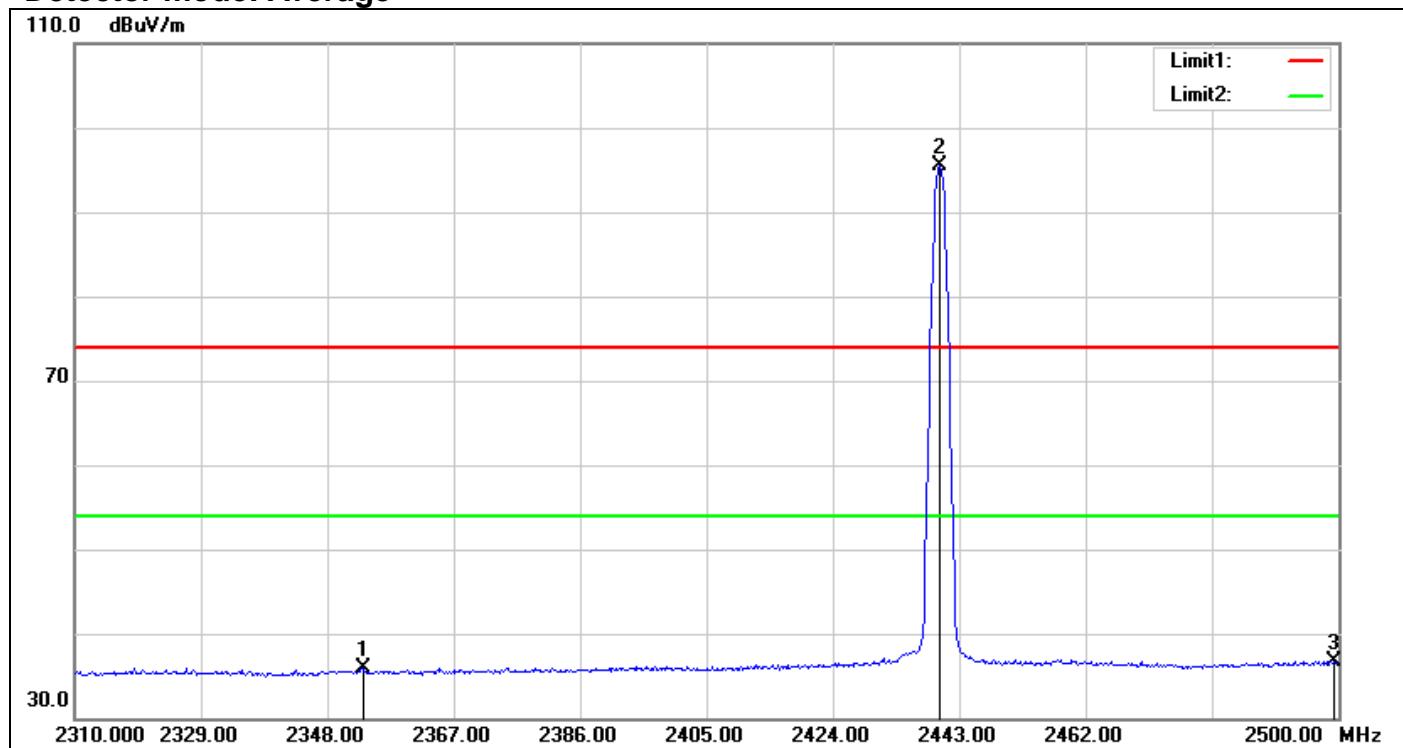
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2387.214	51.61	-2.52	49.09	74.00	-24.91	peak
2	2401.800	96.88	-2.41	94.47	--	--	peak

**Detector mode: Average**

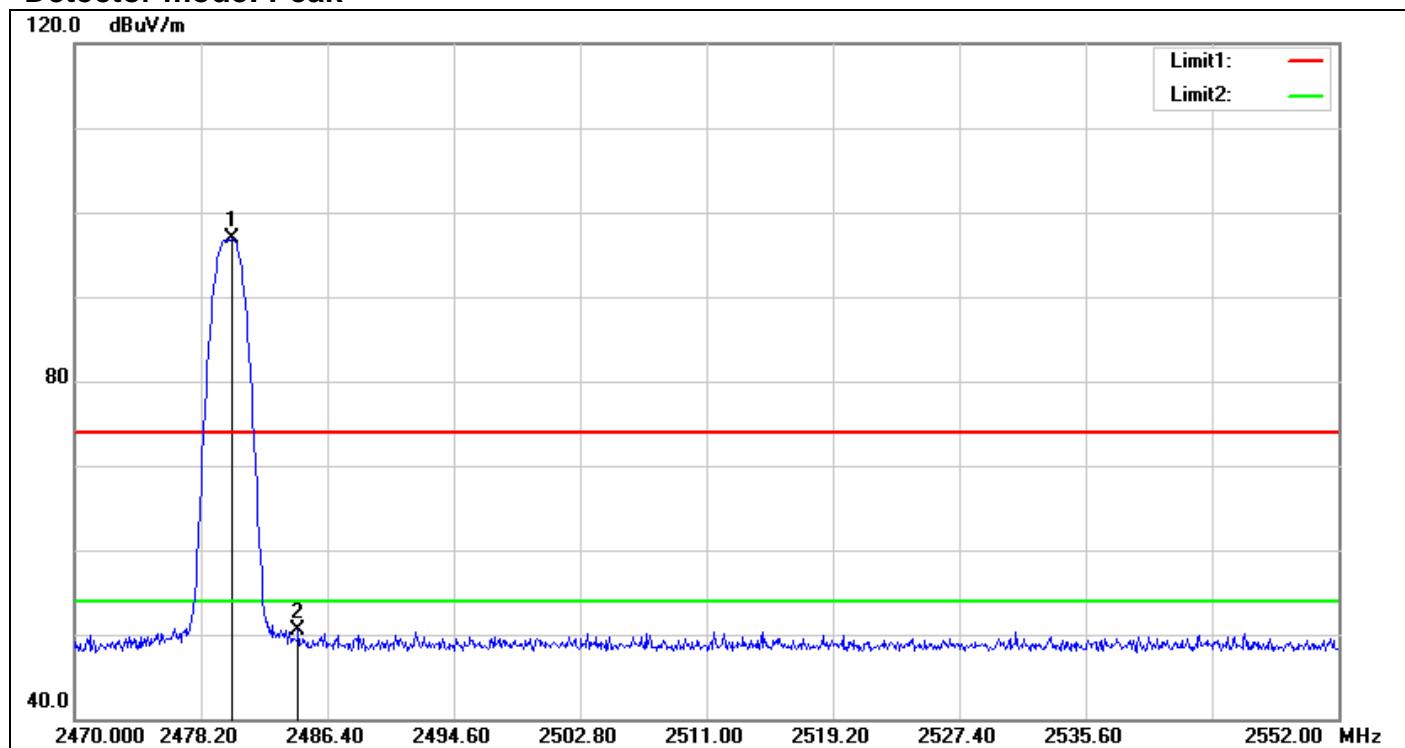
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2388.744	38.86	-2.50	36.36	54.00	-17.64	AVG
2	2402.004	96.18	-2.41	93.77	--	--	AVG

**Band Edges (CH Mid)****Detector mode: Peak**

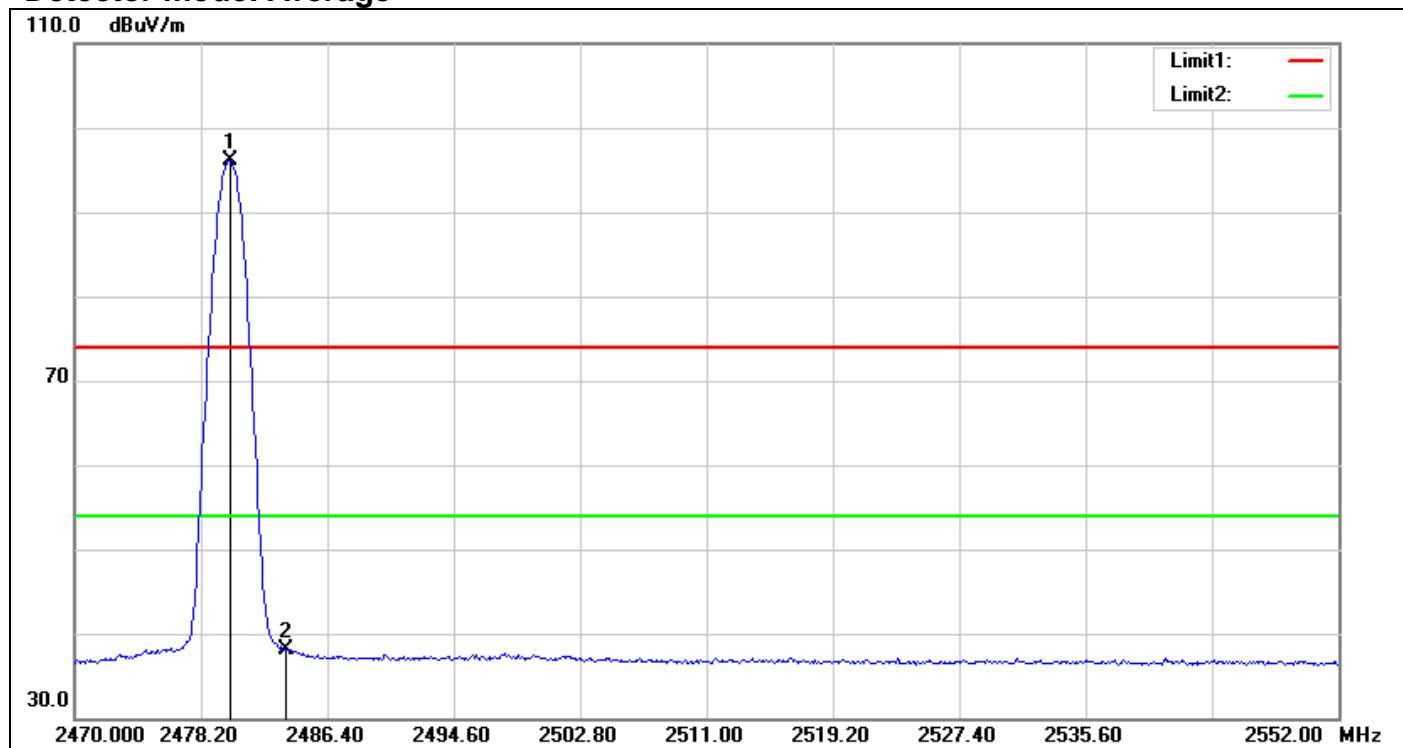
No.	Frequency (MHz)	Reading (dB <sub>uV</sub> )	Correct Factor(dB/m)	Result (dB <sub>uV/m</sub> )	Limit (dB <sub>uV/m</sub> )	Margin (dB)	Remark
1	2319.880	52.30	-2.97	49.33	74.00	-24.67	peak
2	2440.150	98.65	-2.21	96.44	--	--	peak
3	2491.830	51.47	-1.92	49.55	74.00	-24.45	peak

**Detector mode: Average**

No.	Frequency	Reading	Correct	Result	Limit	Margin	YRemark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2353.320	38.78	-2.80	35.98	54.00	-18.02	AVG
2	2440.150	97.80	-2.21	95.59	--	--	AVG
3	2499.240	38.55	-1.87	36.68	54.00	-17.32	AVG

**Band Edges (CH High)****Detector mode: Peak**

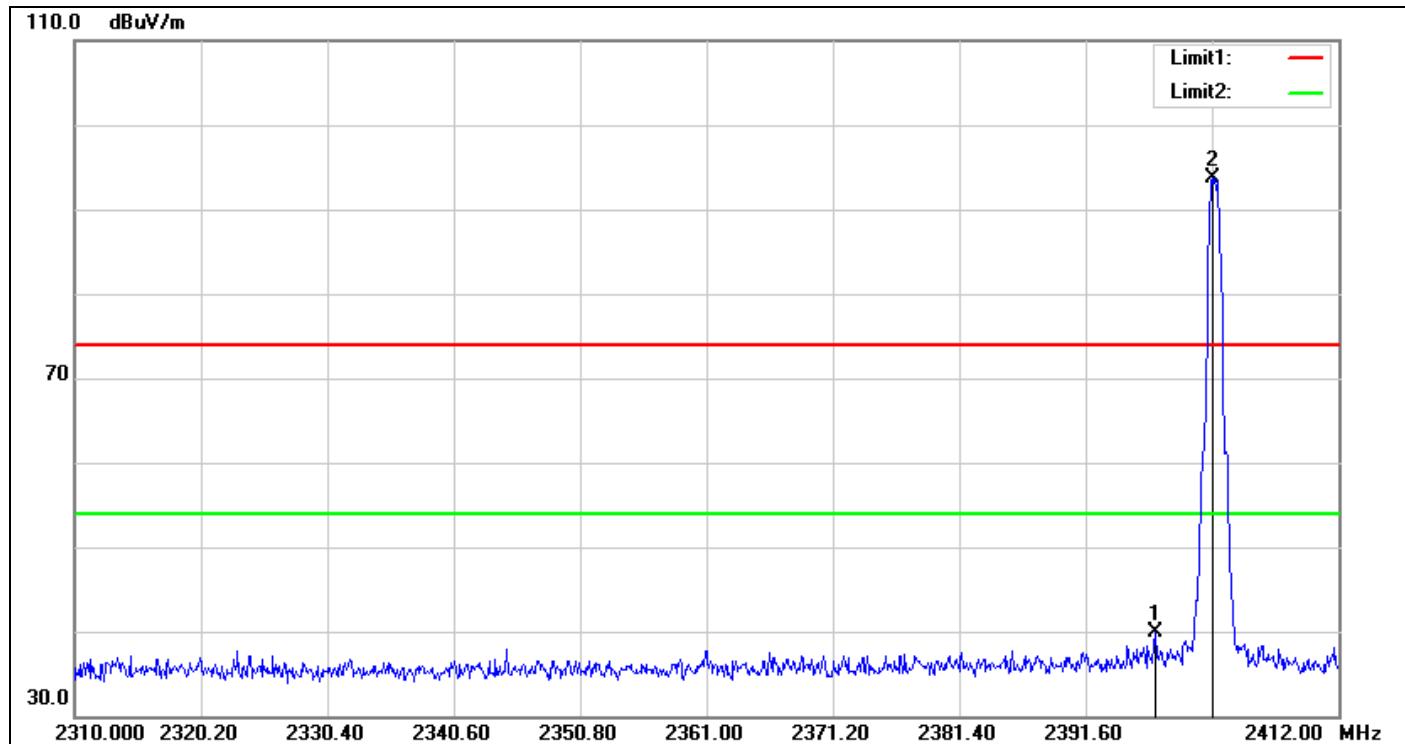
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2480.250	98.85	-2.03	96.82	--	--	peak
2	2484.514	52.57	-1.98	50.59	74.00	-23.41	peak

**Detector mode: Average**

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2480.086	98.15	-2.03	96.12	--	--	AVG
2	2483.694	40.11	-1.99	38.12	54.00	-15.88	AVG

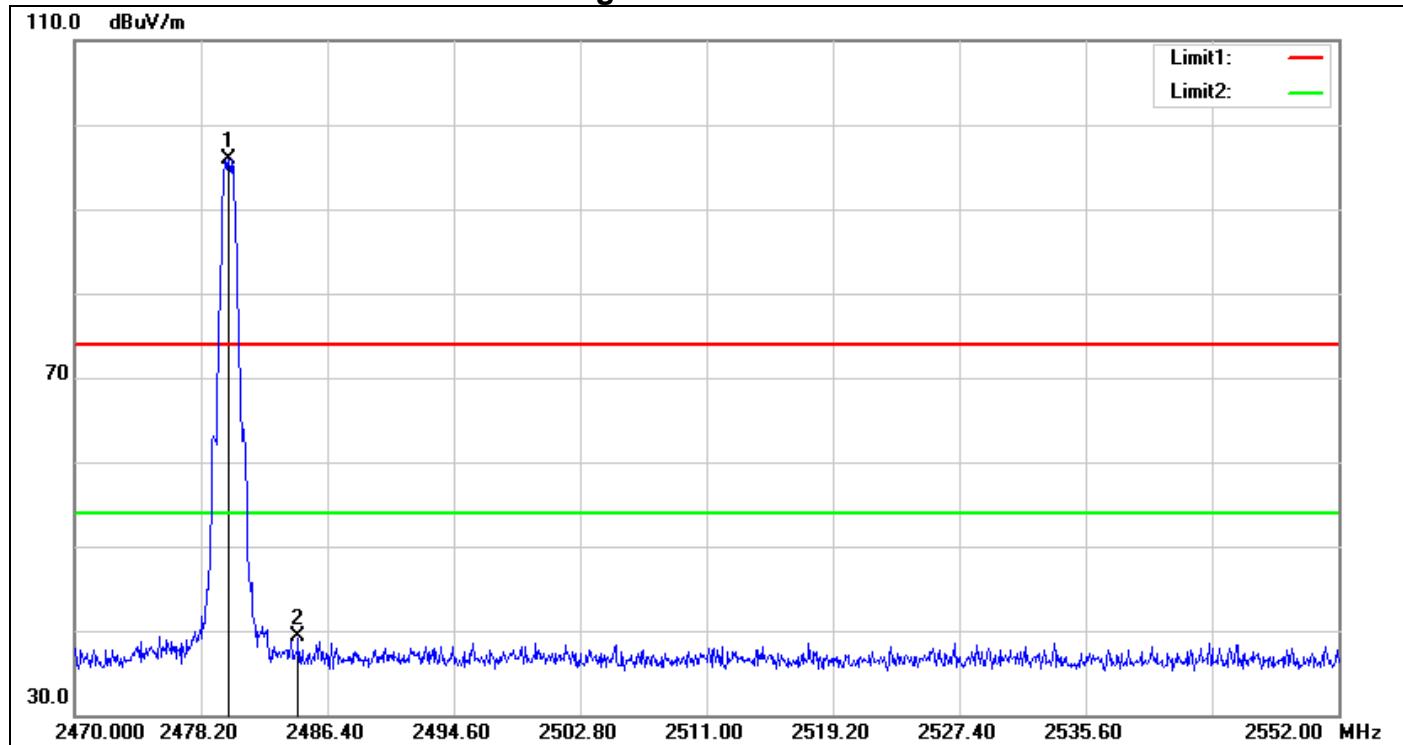
## Test Plot

### Un-restricted Band Emissions / CH Low



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Remark
1	2397.210	42.40	-2.43	39.97	peak
2	2401.800	96.09	-2.41	93.68	peak

**Note: Spurious emission levels that exceed the level of 20 dB below the applicable limit.**

**Un-restricted Band Emissions / CH High**

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Remark
1	2480.004	97.98	-2.03	95.95	peak
2	2484.514	41.18	-1.98	39.20	peak

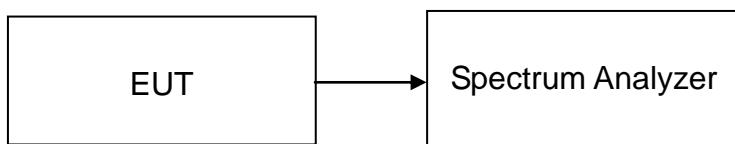
**Note: Spurious emission levels that exceed the level of 20 dB below the applicable limit.**

## 7.6 PEAK POWER SPECTRAL DENSITY

### LIMIT

1. According to §15.247(e) & RSS-247, for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.
2. According to §15.247(f) & RSS-247, the digital modulation operation of the hybrid system, with the frequency hopping turned off, shall comply with the power density requirements of paragraph (d) of this section.

### Test Configuration



### TEST PROCEDURE

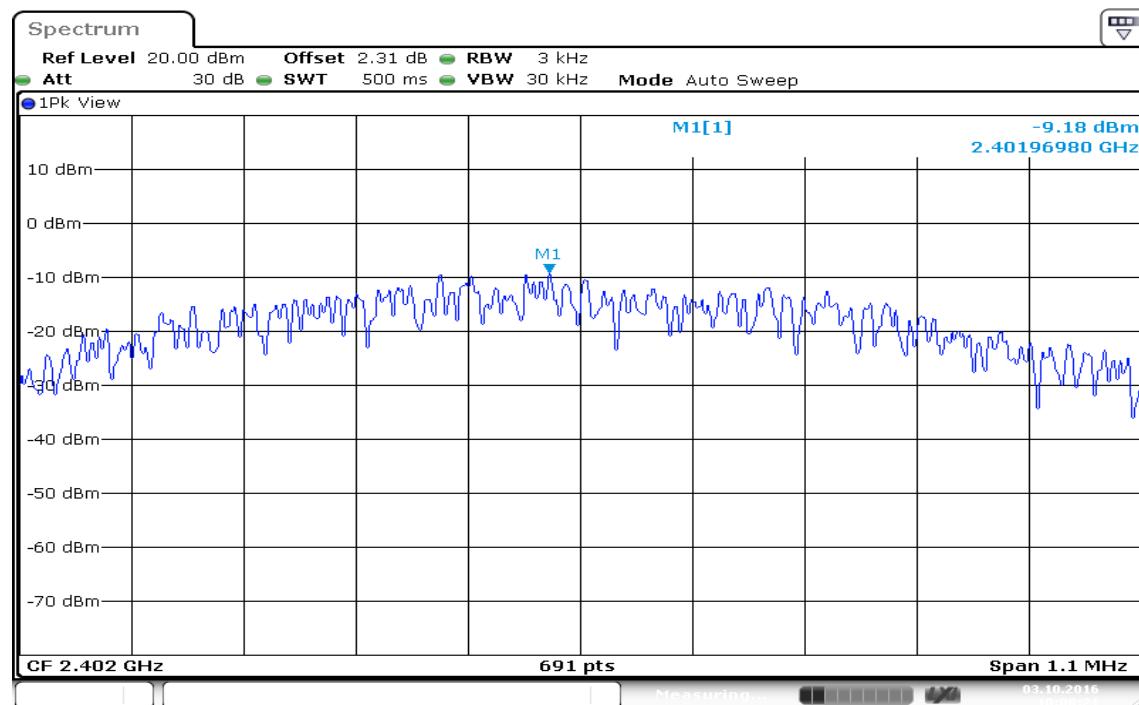
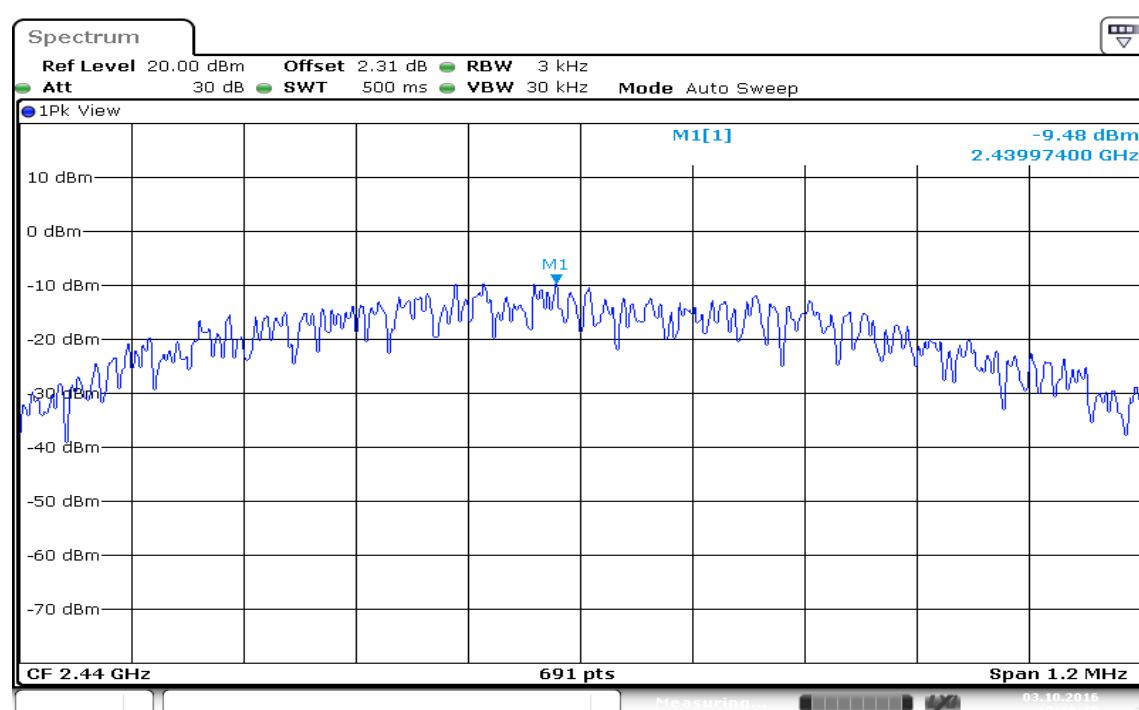
The transmitter output is connected to a spectrum analyzer. Set the RBW=3KHz, VBW=30KHz, span 5-30% greater than EBW, Detector = peak, Trace mode = max hold, Sweep =auto couple. Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF =  $10\log(3 \text{ kHz}/100 \text{ kHz}) = -15.2 \text{ dB}$ . Record the maximum reading. Repeat the above procedure until the measurements for all frequencies are completed.

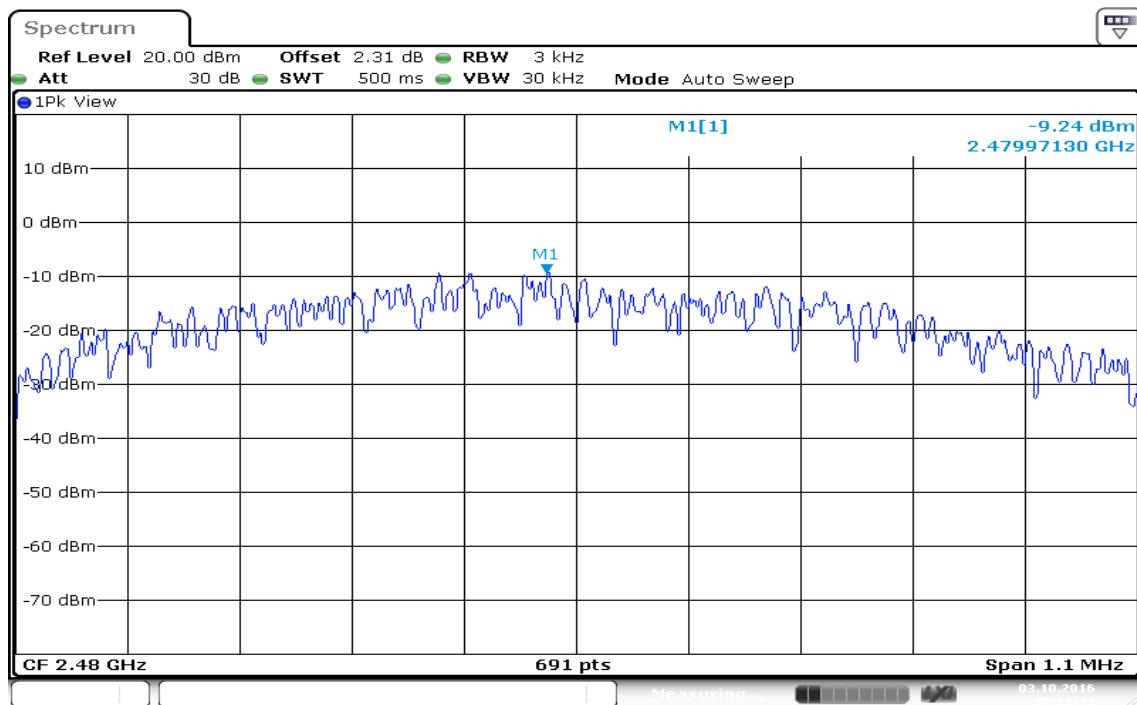
### TEST RESULTS

*No non-compliance noted*

### Test Data

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2402	-9.18	8.00	PASS
Mid	2440	-9.48		PASS
High	2480	-9.24		PASS

**Test Plot****PPSD (CH Low)****PPSD (CH Mid)**

**PPSD (CH High)**

Date: 3.OCT.2016 10:11:41

## 7.7 RADIATED EMISSIONS

### LIMIT

All spurious emissions shall comply with the limits of §15.209(a) and RSS-Gen Table 2 & Table 4.

#### RSS-Gen Table 2 & Table 4: General Field Strength Limits for Transmitters and Receivers at Frequencies Above 30 MHz (Note)

Frequency (MHz)	Field Strength microvolts/m at 3 metres (watts, e.i.r.p.)	
	Transmitters	Receivers
30-88	100 (3 nW)	100 (3 nW)
88-216	150 (6.8 nW)	150 (6.8 nW)
216-960	200 (12 nW)	200 (12 nW)
Above 960	500 (75 nW)	500 (75 nW)

**Note:** \*Measurements for compliance with limits in the above table may be performed at distances other than 3 metres, in accordance with Section 6.5.

Transmitting devices are not permitted in Table 1 bands or, unless stated otherwise, in TV bands (54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz).

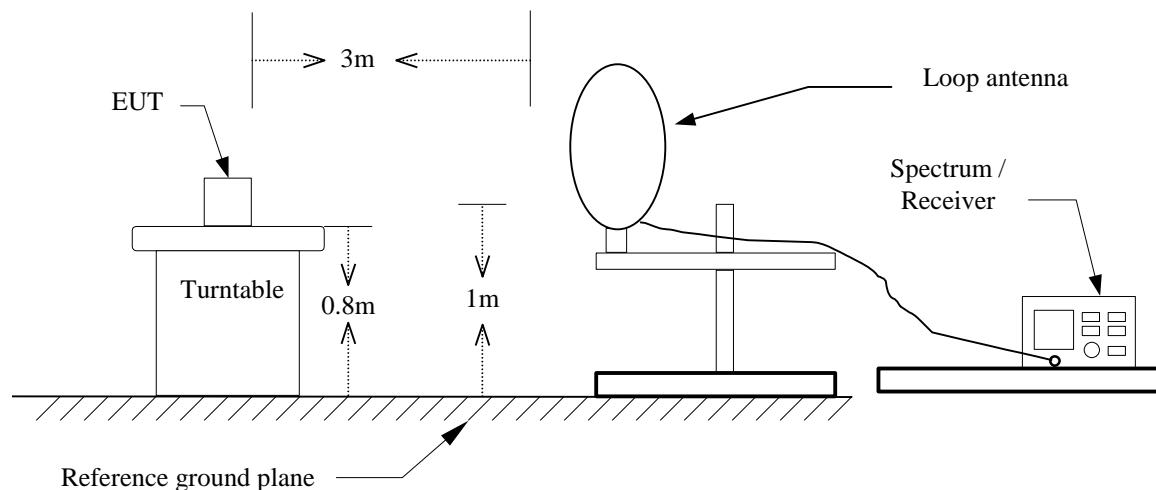
#### RSS-Gen Table 5: General Field Strength Limits for Transmitters at Frequencies Below 30 MHz (Transmit)

Frequency	Field Strength (microvolts/m)	Magnetic H-Field (microamperes/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	3000
490-1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1.705-30 MHz	30	N/A	30

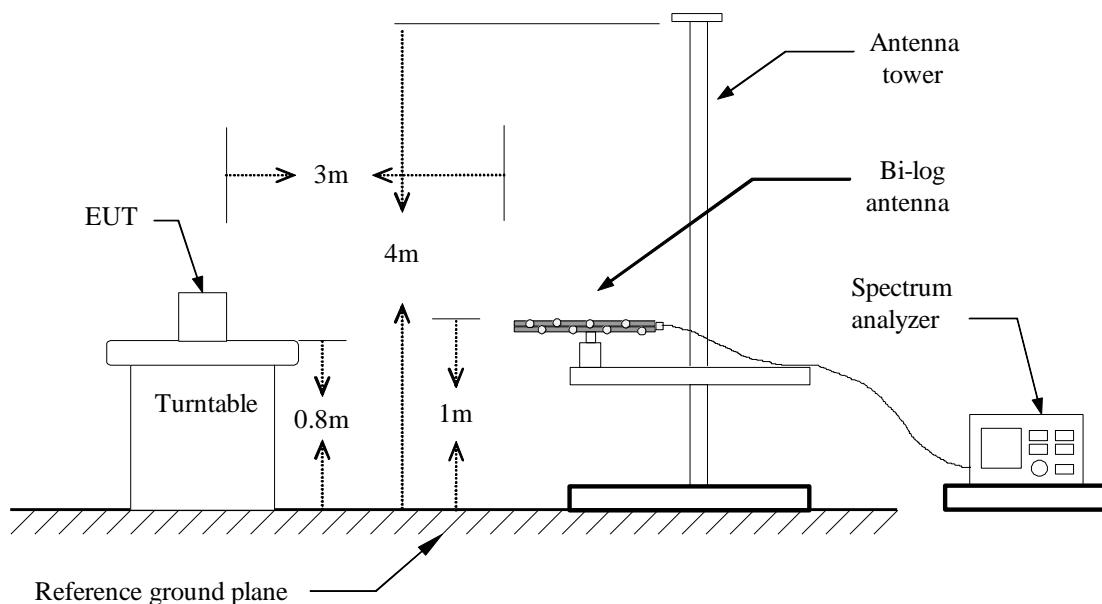
**Note:** The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing an average detector.

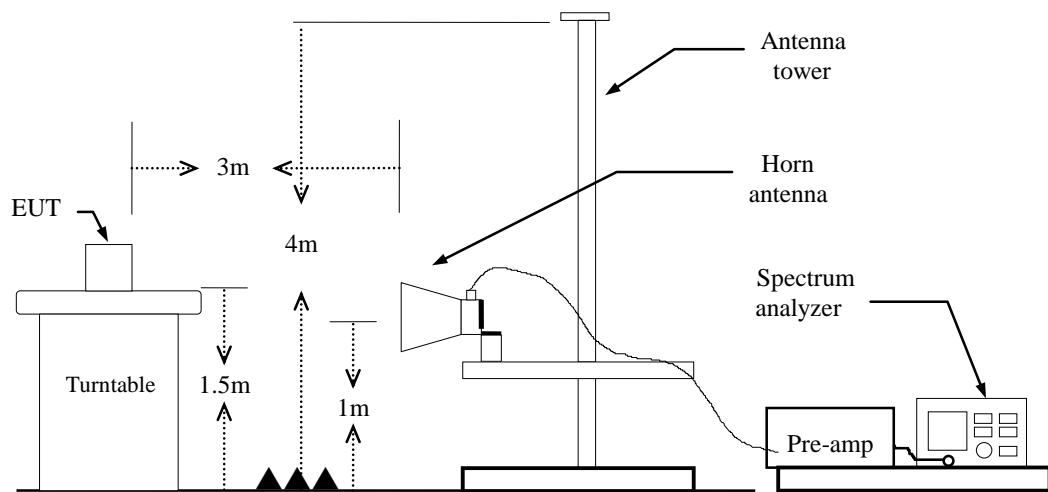
## Test Configuration

### **9kHz ~ 30MHz**



### **30MHz ~ 1GHz**



**Above 1 GHz**

## **TEST PROCEDURE**

1. The EUT is placed on a turntable, Above 1 GHz is 1.5m high and below 1 GHz is 0.8m high above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:

Below 1GHz:

RBW=100kHz / VBW=300kHz / Sweep=AUTO

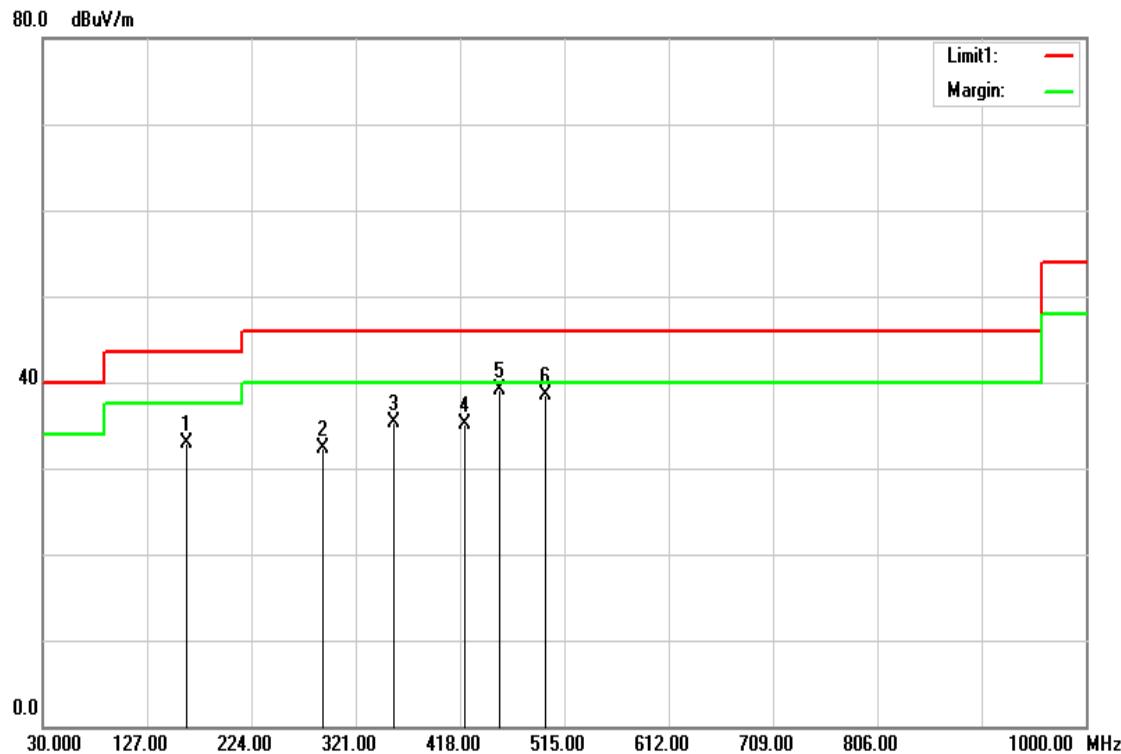
Above 1GHz:

(a)PEAK: RBW=1MHz / VBW=3MHz / Sweep=AUTO

(b)AVERAGE: RBW=1MHz,  
if duty cycle  $\geq 98\%$ , VBW=10Hz.  
if duty cycle  $< 98\%$  VBW=1/T.  
**BT4.1:** = 67%, VBW= 2.4kHz

7. Repeat above procedures until the measurements for all frequencies are complete.
8. Result = Spectrum Reading + cable loss(spectrum to Amp) - Amp Gain + Cable loss(Amp to receive Ant)+ Receive Ant

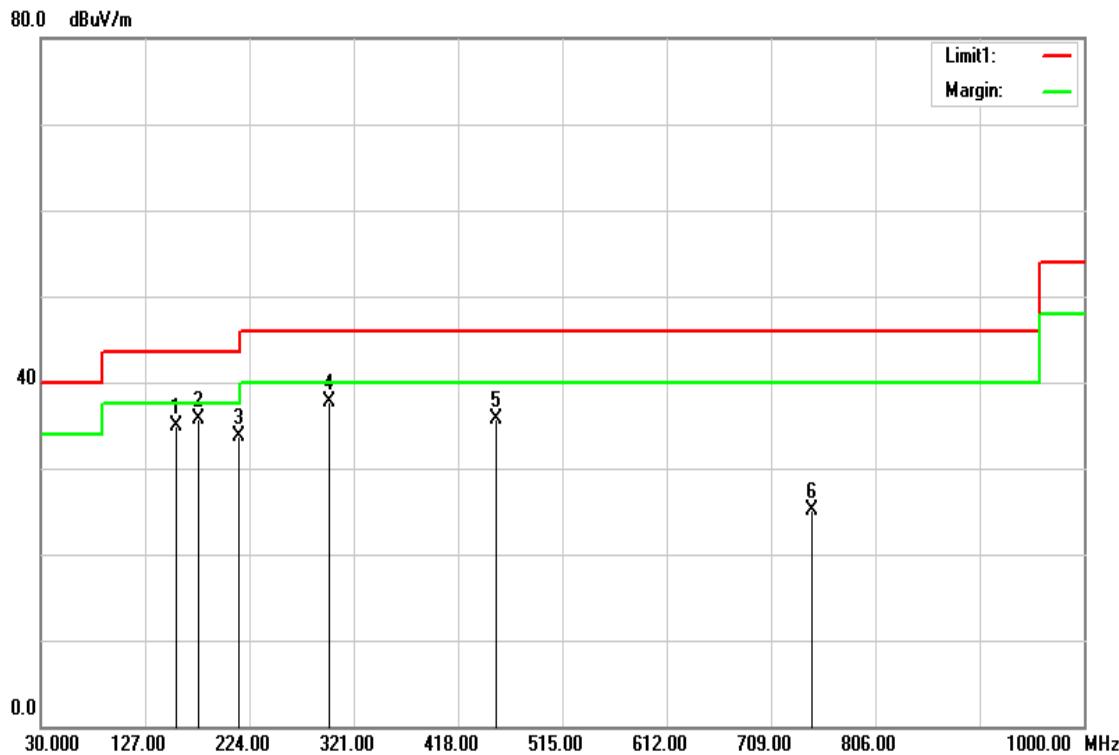
**Note:** We checked every harmonics frequencies from Fundamental frequencies with reduced VBW, and we mark a point to prove pass or not if we find any emission. For this case, there are no emissions hidden in the noise floor.

**Below 1 GHz****Operation Mode:** Normal Link**Test Date:** September 22, 2016**Temperature:** 27°C**Tested by:** Dennis Li**Humidity:** 53% RH**Polarity:** Ver.

Frequency (MHz)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Pol. (H/V)
163.8600	49.54	-16.55	32.99	43.50	-10.51	peak	V
290.9300	46.71	-14.41	32.30	46.00	-13.70	peak	V
355.9200	48.00	-12.75	35.25	46.00	-10.75	peak	V
421.8800	46.12	-11.04	35.08	46.00	-10.92	peak	V
454.8600	49.26	-10.10	39.16	46.00	-6.84	QP	V
497.5400	47.74	-9.29	38.45	46.00	-7.55	peak	V

**Remark:**

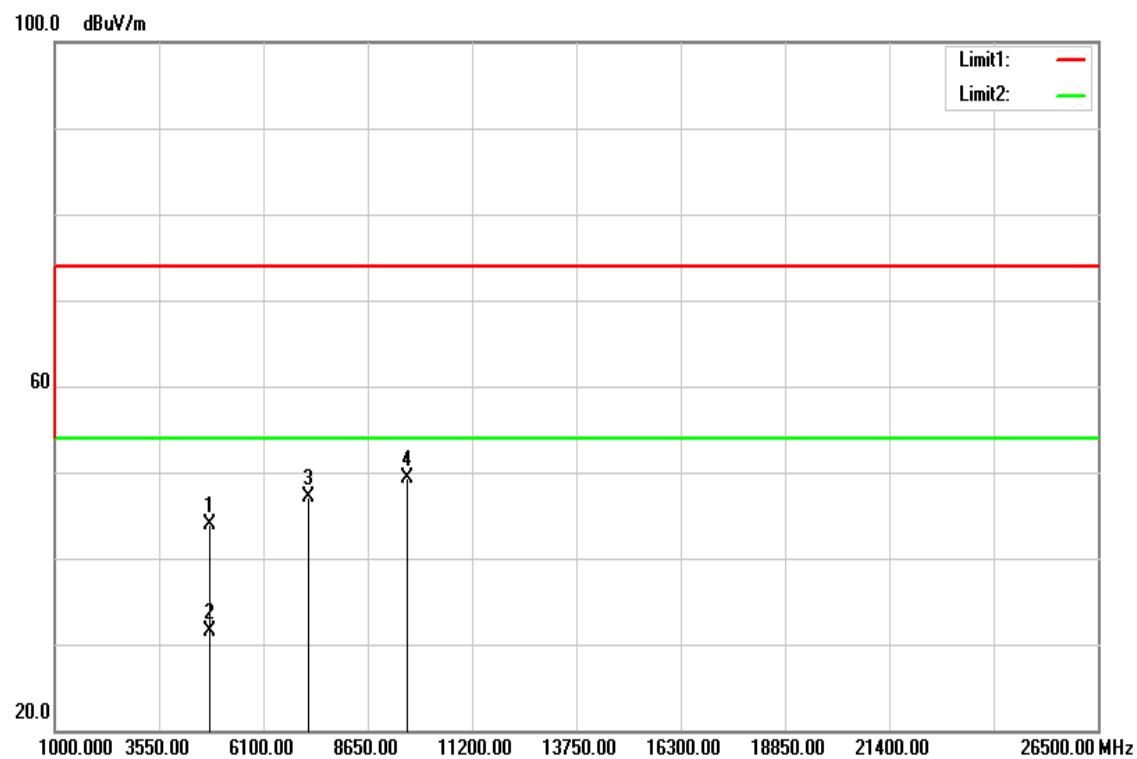
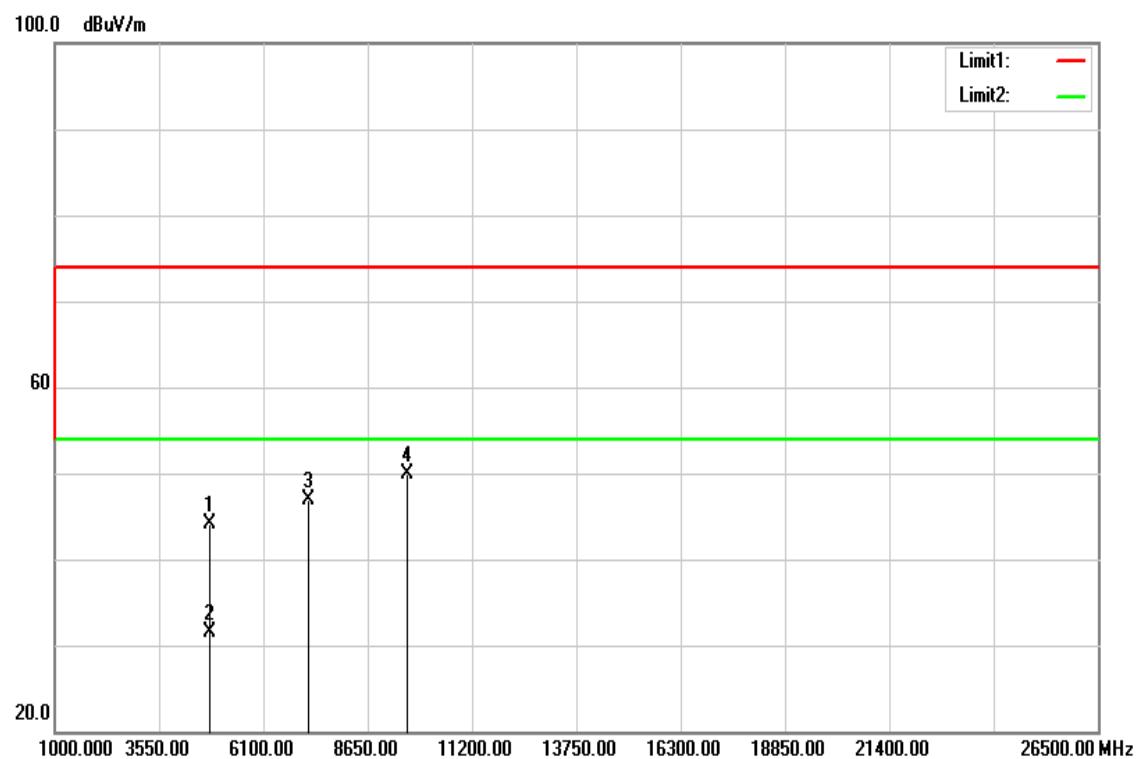
1. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz)
2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.
3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.
4. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with "N/A" remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
5. Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).

**Operation Mode:** Normal Link**Test Date:** September 22, 2016**Temperature:** 27°C**Tested by:** Dennis Li**Humidity:** 53% RH**Polarity:** Hor.

Frequency (MHz)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Pol. (H/V)
156.1000	51.16	-16.25	34.91	43.50	-8.59	QP	H
176.4700	52.78	-17.17	35.61	43.50	-7.89	QP	H
214.3000	50.19	-16.56	33.63	43.50	-9.87	QP	H
298.6900	51.93	-14.26	37.67	46.00	-8.33	peak	H
452.9200	45.81	-10.13	35.68	46.00	-10.32	peak	H
746.8300	30.04	-4.99	25.05	46.00	-20.95	QP	H

**Remark:**

1. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz)
2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.
3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.
4. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with "N/A" remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
5. Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).

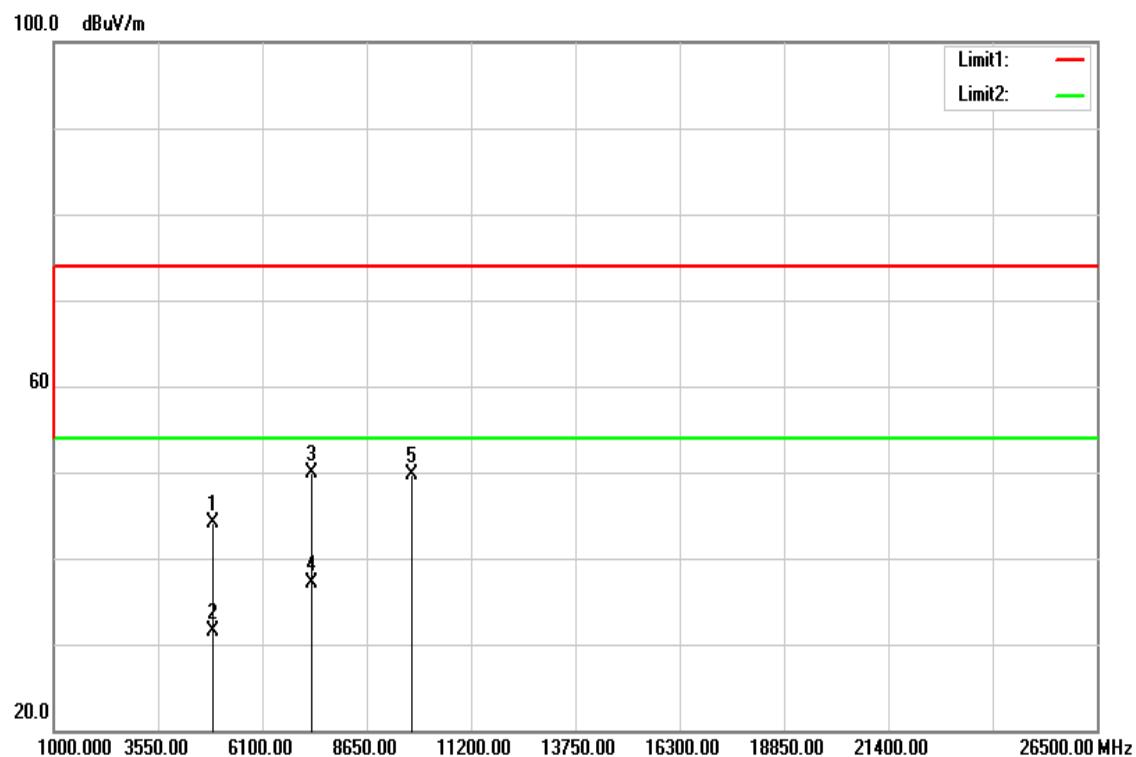
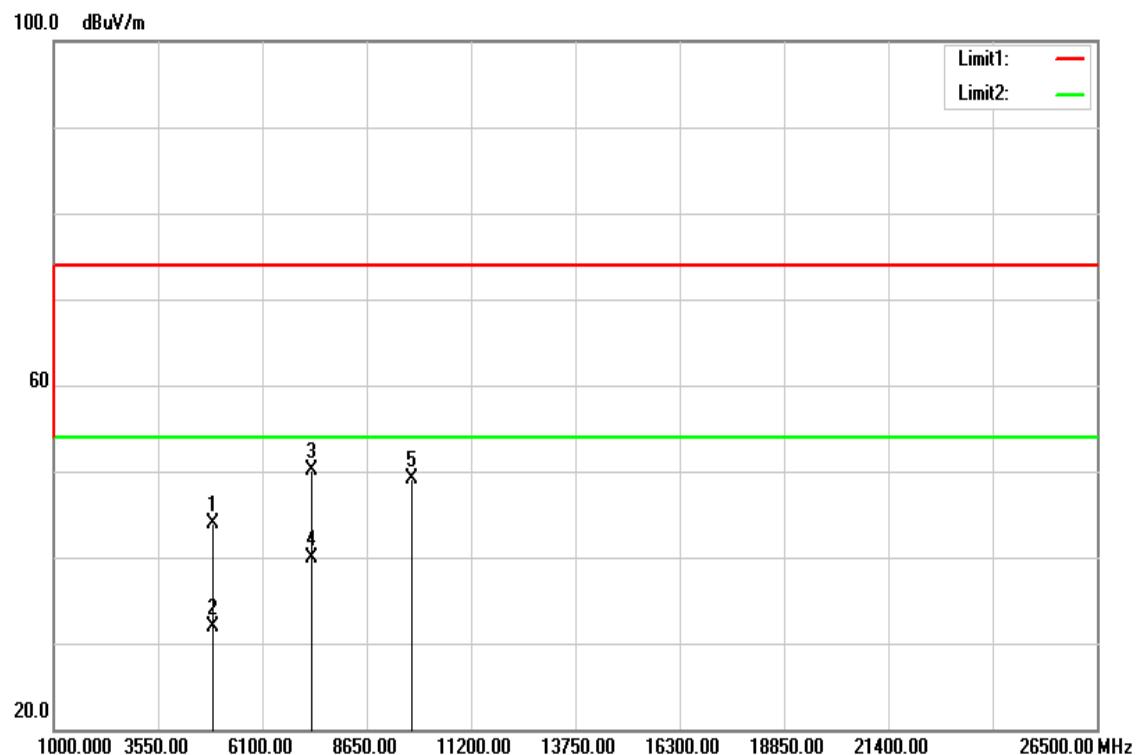
**Above 1 GHz****GFSK / TX / CH Low****Polarity: Vertical****Polarity: Horizontal**

**Operation Mode:** GFSK / TX / CH Low**Test Date:** September 22, 2016**Temperature:** 27°C**Tested by:** Dennis Li**Humidity:** 53 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
4804.000	38.94	5.04	43.98	74.00	-30.02	peak	V
4804.000	26.43	5.04	31.47	54.00	-22.53	AVG	V
7206.000	34.47	12.62	47.09	74.00	-26.91	peak	V
9608.000	31.67	17.60	49.27	74.00	-24.73	peak	V
N/A							
4804.000	39.09	5.04	44.13	74.00	-29.87	peak	H
4804.000	26.54	5.04	31.58	54.00	-22.42	AVG	H
7206.000	34.38	12.62	47.00	74.00	-27.00	peak	H
9608.000	32.32	17.60	49.92	74.00	-24.08	peak	H
N/A							

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown “ --- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “ N/A ” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

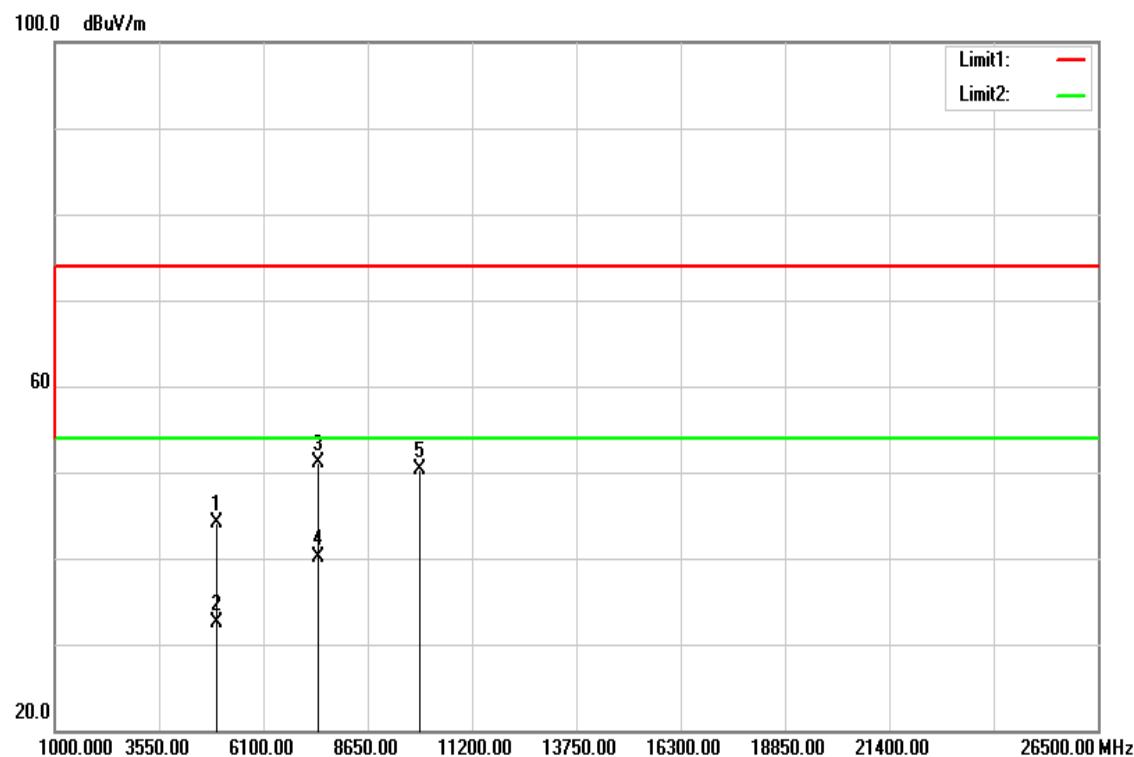
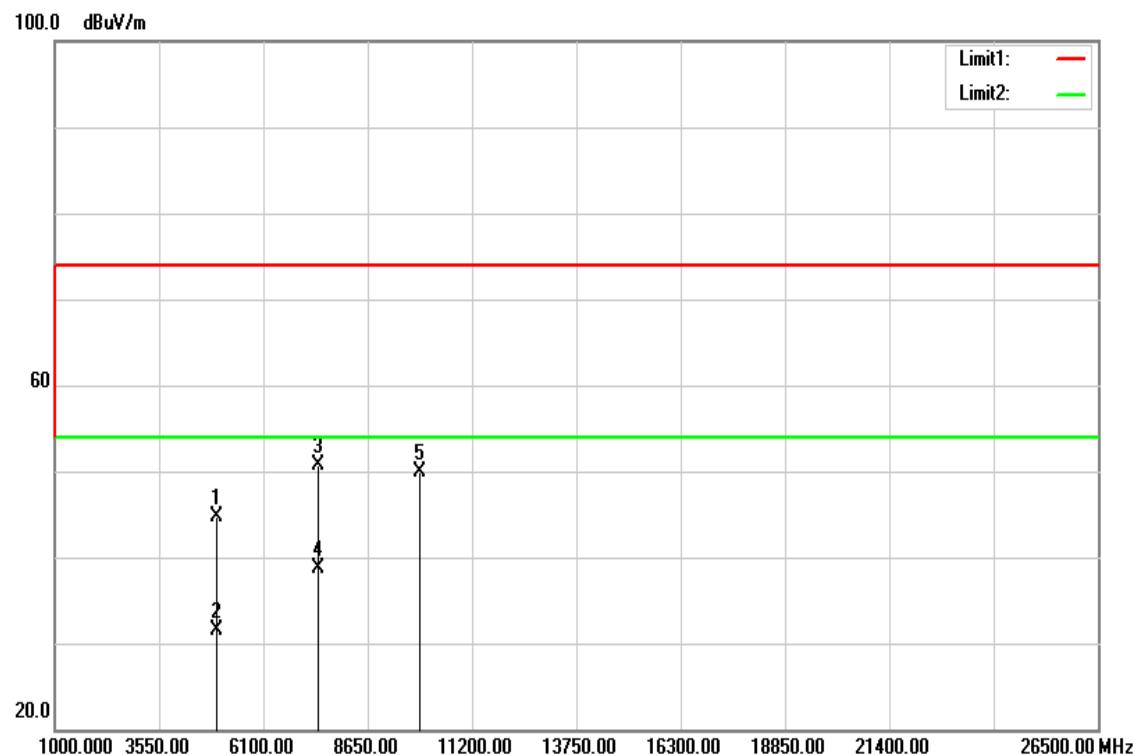
**GFSK / TX / CH Mid****Polarity: Vertical****Polarity: Horizontal**

**Operation Mode:** GFSK / TX / CH Mid**Test Date:** September 22, 2016**Temperature:** 27°C**Tested by:** Dennis Li**Humidity:** 53 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
4880.000	38.76	5.25	44.01	74.00	-29.99	peak	V
4880.000	26.31	5.25	31.56	54.00	-22.44	AVG	V
7320.000	36.97	12.97	49.94	74.00	-24.06	peak	V
7320.000	24.18	12.97	37.15	54.00	-16.85	AVG	V
9760.000	32.07	17.60	49.67	74.00	-24.33	peak	V
N/A							
4880.000	38.69	5.25	43.94	74.00	-30.06	peak	H
4880.000	26.60	5.25	31.85	54.00	-22.15	AVG	H
7320.000	37.05	12.97	50.02	74.00	-23.98	peak	H
7320.000	26.90	12.97	39.87	54.00	-14.13	AVG	H
9760.000	31.57	17.60	49.17	74.00	-24.83	peak	H
N/A							

**Remark:**

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.*
3. *Average test would be performed if the peak result were greater than the average limit or as required by the applicant.*
4. *Data of measurement within this frequency range shown “ --- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*
5. *Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “ N/A ” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.*
6. *Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).*

**GFSK / TX / CH High****Polarity: Vertical****Polarity: Horizontal**

**Operation Mode:** GFSK / TX / CH High**Test Date:** September 22, 2016**Temperature:** 27°C**Tested by:** Dennis Li**Humidity:** 53 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
4960.000	38.72	5.46	44.18	74.00	-29.82	peak	V
4960.000	26.98	5.46	32.44	54.00	-21.56	AVG	V
7440.000	37.78	13.33	51.11	74.00	-22.89	peak	V
7440.000	26.80	13.33	40.13	54.00	-13.87	AVG	V
9920.000	32.75	17.60	50.35	74.00	-23.65	peak	V
N/A							
4960.000	39.15	5.46	44.61	74.00	-29.39	peak	H
4960.000	26.12	5.46	31.58	54.00	-22.42	AVG	H
7440.000	37.32	13.33	50.65	74.00	-23.35	peak	H
7440.000	25.41	13.33	38.74	54.00	-15.26	AVG	H
9920.000	32.28	17.60	49.88	74.00	-24.12	peak	H
N/A							

**Remark:**

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.*
3. *Average test would be performed if the peak result were greater than the average limit or as required by the applicant.*
4. *Data of measurement within this frequency range shown “ --- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*
5. *Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “ N/A ” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.*
6. *Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).*

## 7.8 POWERLINE CONDUCTED EMISSIONS

### LIMIT

According to §15.207(a) & RSS-Gen §8.8, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency Range (MHz)	Limits (dB $\mu$ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

### Test Configuration

See test photographs attached in Appendix II for the actual connections between EUT and support equipment.

### TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

## **TEST RESULTS**

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

### **Test Data**

<b>Operation Mode:</b>	Normal Link	<b>Test Date:</b>	September 30, 2016
<b>Temperature:</b>	22°C	<b>Tested by:</b>	Zeus Chen
<b>Humidity:</b>	53% RH		

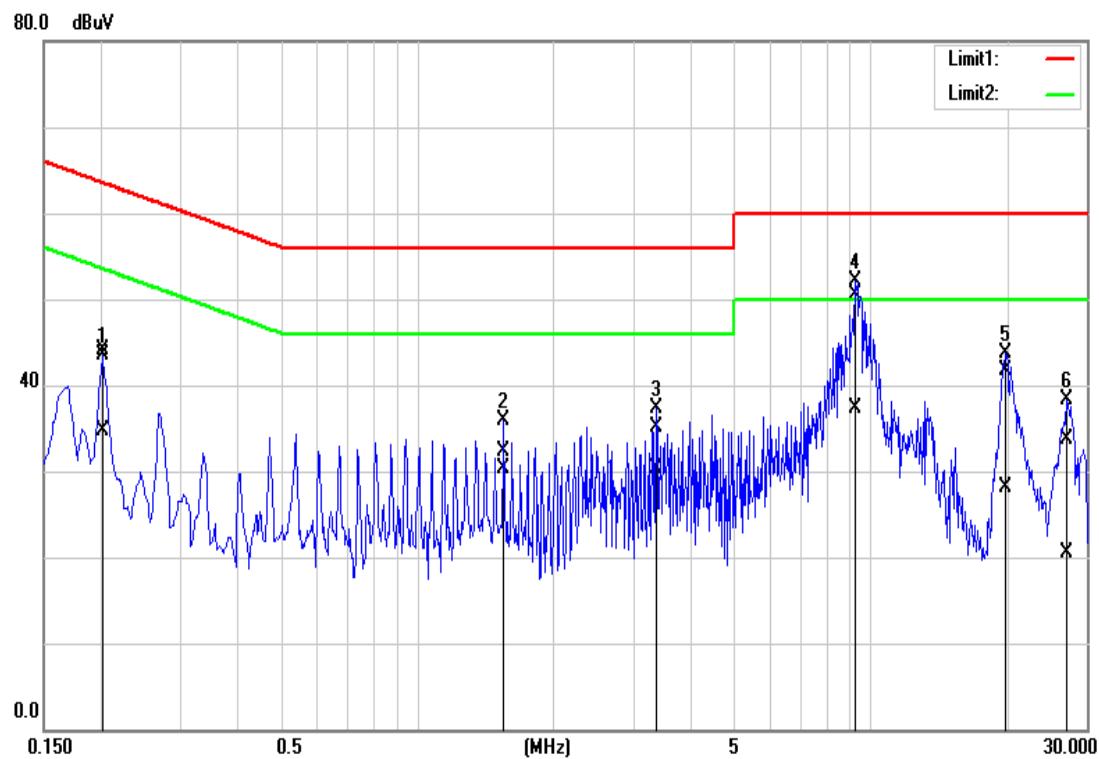
Freq. (MHz)	QP Reading (dBuV)	AV Reading (dBuV)	Corr. factor (dB/m)	QP Result (dBuV/m)	AV Result (dBuV/m)	QP Limit (dBuV)	AV Limit (dBuV)	QP Margin (dB)	AV Margin (dB)	Note
0.2020	34.38	25.04	9.70	44.08	34.74	63.52	53.53	-19.44	-18.79	L1
1.5540	22.53	20.50	9.81	32.34	30.31	56.00	46.00	-23.66	-15.69	L1
3.3780	25.13	20.40	9.89	35.02	30.29	56.00	46.00	-20.98	-15.71	L1
9.2540	40.41	27.23	10.02	50.43	37.25	60.00	50.00	-9.57	-12.75	L1
19.9260	31.58	17.96	10.10	41.68	28.06	60.00	50.00	-18.32	-21.94	L1
27.0140	23.68	10.46	10.01	33.69	20.47	60.00	50.00	-26.31	-29.53	L1
0.1660	30.01	25.20	9.75	39.76	34.95	65.16	55.16	-25.40	-20.21	L2
0.2060	31.15	21.37	9.71	40.86	31.08	63.37	53.37	-22.51	-22.29	L2
0.8100	22.89	21.22	9.77	32.66	30.99	56.00	46.00	-23.34	-15.01	L2
9.2500	38.73	25.50	10.05	48.78	35.55	60.00	50.00	-11.22	-14.45	L2
19.9140	31.03	14.94	10.15	41.18	25.09	60.00	50.00	-18.82	-24.91	L2
27.4780	27.60	13.14	10.18	37.78	23.32	60.00	50.00	-22.22	-26.68	L2

### **Remark:**

1. Measuring frequencies from 0.15 MHz to 30MHz.
2. The emissions measured in frequency range from 0.15 MHz to 30MHz were made with an instrument using Quasi-peak detector and average detector.
3. The IF bandwidth of SPA between 0.15MHz to 30MHz was 10kHz; the IF bandwidth of Test Receiver between 0.15MHz to 30MHz was 9kHz;
4. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)

## Test Plots

### **Conducted emissions (Line 1)**



### **Conducted emissions (Line 2)**

