

FCC Part 15

EMI TEST REPORT

of

E.U.T. : 2.4GHz RF Module
MODEL : TWMX
FCC ID. : Y4O-TWMX
Frequency Range : 2433MHz~2473MHz

for

APPLICANT : inMusic Brands, Inc.
ADDRESS : 200 Scenic View Drive, Suite 201, Cumberland,
Rhode Island, 02864, USA

Test Performed by

ELECTRONICS TESTING CENTER, TAIWAN
NO. 34. LIN 5, DINGFU VIL., LINKOU DIST.,
NEW TAIPEI CITY, TAIWAN, 24442, R.O.C.
TEL : (02)26023052 FAX: (02)26010910

[http : // www.etc.org.tw](http://www.etc.org.tw); e-mail : emc@etc.org.tw

Report Number : 15-06-RBF-019-03

TEST REPORT CERTIFICATION

Applicant : inMusic Brands, Inc.
200 Scenic View Drive, Suite 201, Cumberland, Rhode Island, 02864,
USA

Manufacturer : Mascot Electric Co., Ltd.
No. 85 Chang Hsing First Street, Tai-tzu Village, Jen-Te Hsian, Tainan
Hsien, Taiwan, R.O.C.

Description of EUT

- a) Type of EUT : 2.4GHz RF Module
- b) Trade Name : ALTO
- c) Model No. : TWMX
- d) Power Supply : DC 3.6V
- e) Frequency Range : 2433MHz~2473MHz

Regulation Applied : FCC Rules and Regulations Part 15 Subpart C

I HEREBY CERTIFY THAT: The data shown in this report were made in accordance with the procedures given in ANSI C63.10-2009, and the energy emitted by the device was founded to be within the limits applicable. I assume full responsibility for accuracy and completeness of these data.

Note: 1. The result of the testing report relate only to the item tested.
2. The testing report shall not be reproduced expect in full, without the written approval of ETC.

Summary of Tests

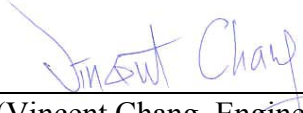
Test	Results
Radiated Emission	Pass
Conducted Emission	N/A
Band Edge Requirement	Pass

Date Test Item Received : Jun. 11, 2015

Date Test Campaign Completed : Jun. 12, 2015

Date of Issue : Jun. 15, 2015

Test Engineer :


(Vincent Chang, Engineer)

Approve & Authorized Signer :



S. S. Liou, Section Manager
EMC Dept. II of ELECTRONICS
TESTING CENTER, TAIWAN

Table of Contents	Page
Cover Page.....	I
TEST REPORT CERTIFICATION.....	II
Table of Contents.....	IV
1 GENERAL INFORMATION	1
1.1 Product Description.....	1
1.2 Characteristics of Device	1
1.3 Test Methodology	1
1.4 Test Facility.....	1
2 PROVISIONS APPLICABLE	2
2.1 Definition	2
2.2 Requirement for Compliance	3
2.3 Restricted Bands of Operation	5
2.4 Labeling Requirement.....	5
2.5 User Information	6
3. SYSTEM TEST CONFIGURATION	7
3.1 Justification	7
3.2 Devices for Tested System.....	7
4 RADIATED EMISSION MEASUREMENT.....	8
4.1 Applicable Standard.....	8
4.2 Measurement Procedure.....	8
4.3 Measuring Instrument	10
4.4 Radiated Emission Data	11
4.4.1 RF Portion.....	11
4.4.2 Other Emissions	17
4.5 Field Strength Calculation	19
4.6 Photos of Radiation Measuring Setup.....	20
5 CONDUCTED EMISSION MEASUREMENT	21
5.1 Standard Applicable.....	21
6 ANTENNA REQUIREMENT	22
6.1 Standard Applicable.....	22
6.2 Antenna Construction.....	22
7 BAND EDGES MEASUREMENT	23
7.1 Standard Applicable.....	23
7.2 Measurement Procedure.....	23

7.3 Measurement Equipment	24
7.4 Measurement Data	24

1 GENERAL INFORMATION

1.1 Product Description

- a) Type of EUT : 2.4GHz RF Module
- b) Trade Name : ALTO
- c) Model No. : TWMX
- d) Power Supply : DC 3.6V
- e) Frequency Range : 2433MHz~2473MHz

1.2 Characteristics of Device

The TWMX is a low cost true single chip 2.4 GHz transceiver designed for very low power wireless applications. The circuit is intended for the ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band at 2.4GHz band.

Frequency range: 2433 ~ 2473MHz.

Output power: 0 dBm max.

1.3 Test Methodology

Both conducted and radiated emissions were performed according to the procedures illustrated in ANSI C63.10-2009. Other required measurements were illustrated in separate sections of this test report for details.

1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the roof top of Building at No.34, Lin 5, Dingfu Vil., Linkou Dist., New Taipei City, Taiwan 24442, R.O.C.

This site is FCC 2.948 listed and accepted in a letter dated Jan. 29, 2014.

Registration Number: 90589

2 PROVISIONS APPLICABLE

2.1 Definition

Unintentional radiator:

A device that intentionally generates and radio frequency energy for use within the device, or that sends radio frequency signals by conduction to associated equipment via connecting wiring, but which is not intended to emit RF energy by radiation or induction.

Class A Digital Device:

A digital device which is marketed for use in commercial or business environment; exclusive of a device which is market for use by the general public, or which is intended to be used in the home.

Class B Digital Device :

A digital device which is marketed for use in a residential environment notwithstanding use in a commercial, business of industrial environment. Example of such devices that are marketed for the general public.

Note : A manufacturer may also qualify a device intended to be marketed in a commercial, business, or industrial environment as a Class B digital device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B Digital Device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B Digital Device, Regardless of its intended use.

Intentional radiator:

A device that intentionally generates and emits radio frequency energy by radiation or induction.

2.2 Requirement for Compliance

(1) Conducted Emission Requirement

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 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50MH/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 band edges.

Frequency MHz	Quasi Peak dB μ V	Average dB μ V
0.15 - 0.5	66-56	56-46
0.5 - 5.0	56	46
5.0 - 30.0	60	50

(2) Radiated Emission Requirement

For unintentional device, according to §15.109(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency MHz	Distance Meters	Radiated dB μ V/m	Radiated μ V/m
30 - 88	3	40.0	100
88 - 216	3	43.5	150
216 - 960	3	46.0	200
Above 960	3	54.0	500

For intentional device, according to §15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

For intentional radiator device, per §15.249(a), the field strength of emissions shall comply with the following :

Frequency MHz	Distance Meters	Fundamental		Harmonic	
		dB μ V/m	mV/m	dB μ V/m	μ V/m
902 - 928	3	94	50	54	500
2400 - 2483.5	3	94	50	54	500
5725 - 5875	3	94	50	54	500
24000 - 24250	3	108	250	68	2500

In accordance with §15.249(e), limits shown in above table are based on average limits for frequencies above 1000 MHz, and frequencies below 1000 MHz are based on quasi peak. However, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20 dB.

(3) Spurious in Out Band Requirement

For intentional device, according to §15.249 (d), emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emission limits in §15.209.

(4) Antenna Requirement

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

2.3 Restricted Bands of Operation

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	4.5-5.25
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 - 156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3360-4400	Above 38.6
13.36-13.41			

** : Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

2.4 Labeling Requirement

The device shall bear the following statement in a conspicuous location on the device:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2.5 User Information

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual.

The Federal Communications Commission Radio Frequency Interference Statement includes the following paragraph.

This equipment has been tested and found to comply with the limits for a Class B Digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio / TV technician for help.

3. SYSTEM TEST CONFIGURATION

3.1 Justification

For both radiated and conducted emissions, the system was configured for testing in a typical fashion as a customer would normally use it. The peripherals other than EUT were connected in normally standing by situation.

All measurement were intentional to maximum the emissions from EUT by varying the connection cables, therefore, the test result is sure to meet the applicable requirement.

3.2 Devices for Tested System

Device	Manufacturer	Model / FCC ID	Description
* 2.4GHz RF Module	Mascot Electric Co., Ltd.	TWMX / Y4O-TWMX	---

Remark “*” means equipment under test.

4 RADIATED EMISSION MEASUREMENT

4.1 Applicable Standard

For intentional radiators, according to §15.249 (a), the fundamental field strength shall not exceed 94 dBuV/m and the harmonics shall not exceed 54 dBuV/m. For out band emission except for harmonics shall be comply with §15.209 or at least attenuated by 50 dB below the level of the fundamental.

4.2 Measurement Procedure

A. Preliminary Measurement For Portable Devices

For portable devices, the following procedure was performed to determine the maximum emission axis of EUT:

1. With the receiving antenna is H polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
2. With the receiving antenna is V polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
3. Compare the results derived from above two steps. So, the axis of maximum emission from EUT was determined and the configuration was used to perform the final measurement.

B. Final Measurement

1. Setup the configuration per figure 1 and 2 for frequencies measured below and above 1 GHz respectively. Turn on EUT and make sure that it is in normal function.
2. For emission frequencies measured below 1 GHz, a pre-scan is performed in a shielded chamber to determine the accurate frequencies of higher emissions will be checked on a open test site. As the same purpose, for emission frequencies measured above 1 GHz, a pre-scan also be performed with a 1 meter measuring distance before final test.
3. For emission frequencies measured below and above 1 GHz, set the spectrum analyzer on a 100 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2.
4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0 ° to 360 ° with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading. A RF test receiver is also used to confirm emissions measured.

5. Repeat step 4 until all frequencies need to be measured were complete.
6. Repeat step 5 with search antenna in vertical polarized orientations.
7. Check the three frequencies of highest emission with varying the placement of cables (if any) associated with EUT to obtain the worse case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration

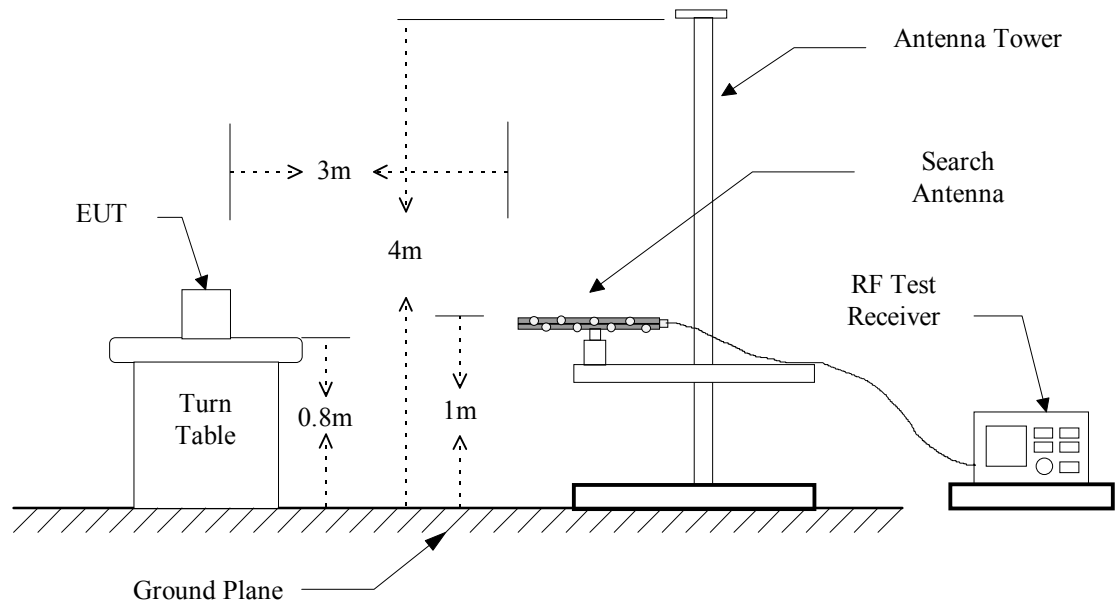
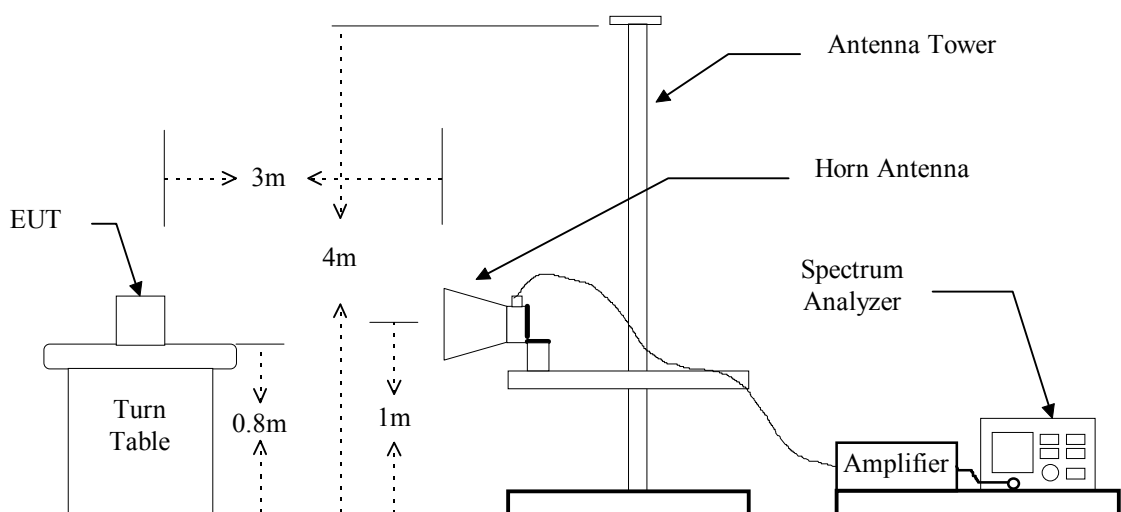


Figure 2 : Frequencies measured above 1 GHz configuration



4.3 Measuring Instrument

The following instrument are used for radiated emissions measurement:

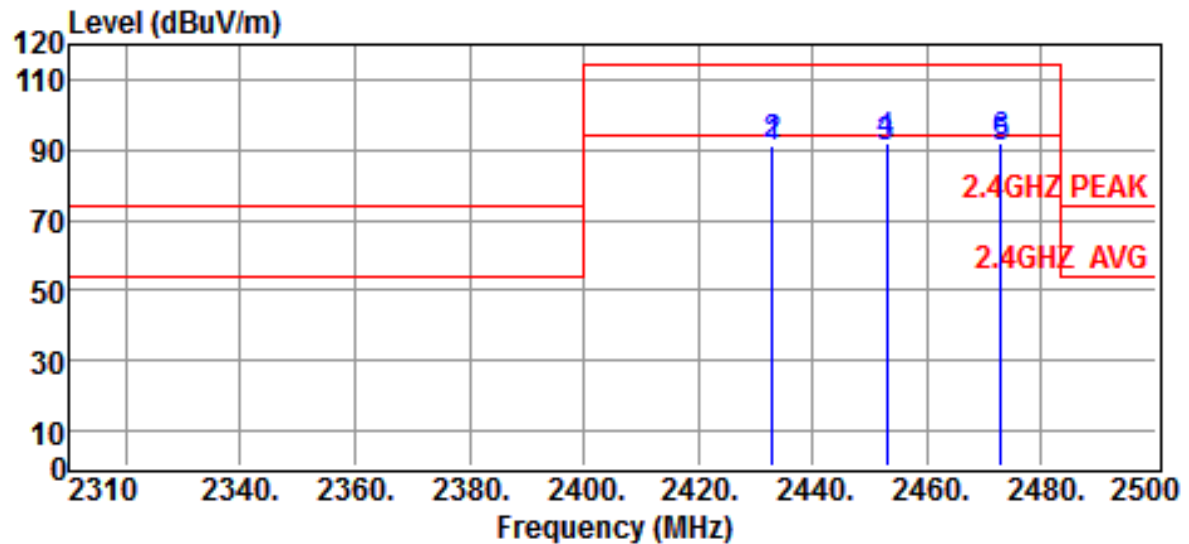
Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Test Receiver	Rohde & Schwarz	ESVS30	2014/05/29	2015/05/28
EMI Test Receiver	Rohde & Schwarz	ESL	2015/03/26	2016/03/25
Bi-Log Antenna	ETC	MCTD 2786	2014/07/09	2015/07/08
Log-periodic Antenna	EMCO	3146	2014/11/04	2015/11/03
Double Ridged Guide Horn Antenna	EMCO	3116	2014/08/13	2015/08/12
Biconical Antenna	EMCO	3110	2014/11/04	2015/11/03
Double Ridged Antenna	EMCO	3115	2014/08/18	2015/08/17
Amplifier	HP	8449B	2014/08/12	2015/08/11
Amplifier	HP	83051A	2014/10/22	2015/10/21
Amplifier	HP	8447D	2014/10/28	2015/10/27
EMI Test Receiver	Rohde & Schwarz	ESU 40	2014/08/15	2015/08/14

Measuring instrument setup in measured frequency band when specified detector function is used :

Frequency Band (MHz)	Instrument	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	RF Test Receiver	Quasi-Peak	120 kHz	N/A
	Spectrum Analyzer	Peak	100 kHz	100 kHz
Above 1000	Spectrum Analyzer	Peak	1 MHz	1 MHz
	Spectrum Analyzer	Average	1 MHz	10Hz

4.4 Radiated Emission Data

4.4.1 RF Portion

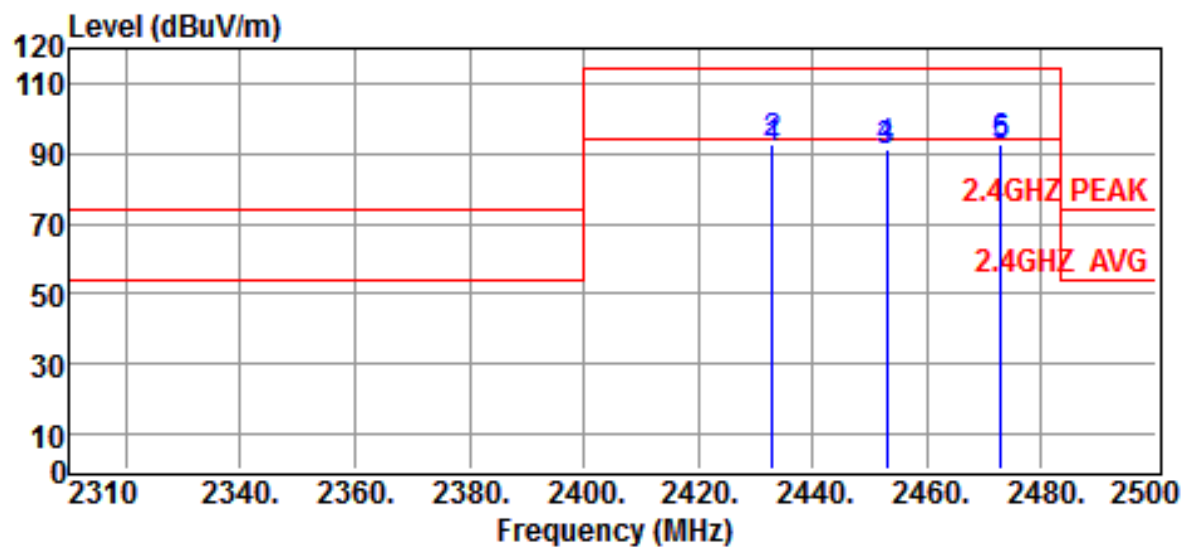


Site	:CHAMBER #2	Date	:2015-06-11
EUT	:2.4GHz RF Module	Ant. Pol.	:HORIZONTAL
Model	:TWMX	Detector	:
Power Rating	:DC 3.6V	Engineer	: VC
Limit	:2.4GHZ PEAK	Temp.	:27°C
Memo	:	Humi.	:65 %
Memo	: CH LO 2433 - MI 2453 - HI 2473MHz		
Test Mode	:EUT lay on table horizontally (worst case)		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
2433.0000	95.7	-5.6	90.1	94.0	-3.9	Average
2433.0000	96.8	-5.6	91.2	114.0	-22.8	Peak
2453.0000	95.8	-5.5	90.3	94.0	-3.7	Average
2453.0000	97.0	-5.5	91.5	114.0	-22.5	Peak
2473.0000	95.9	-5.4	90.5	94.0	-3.5	Average
2473.0000	96.9	-5.4	91.5	114.0	-22.5	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit - Result
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

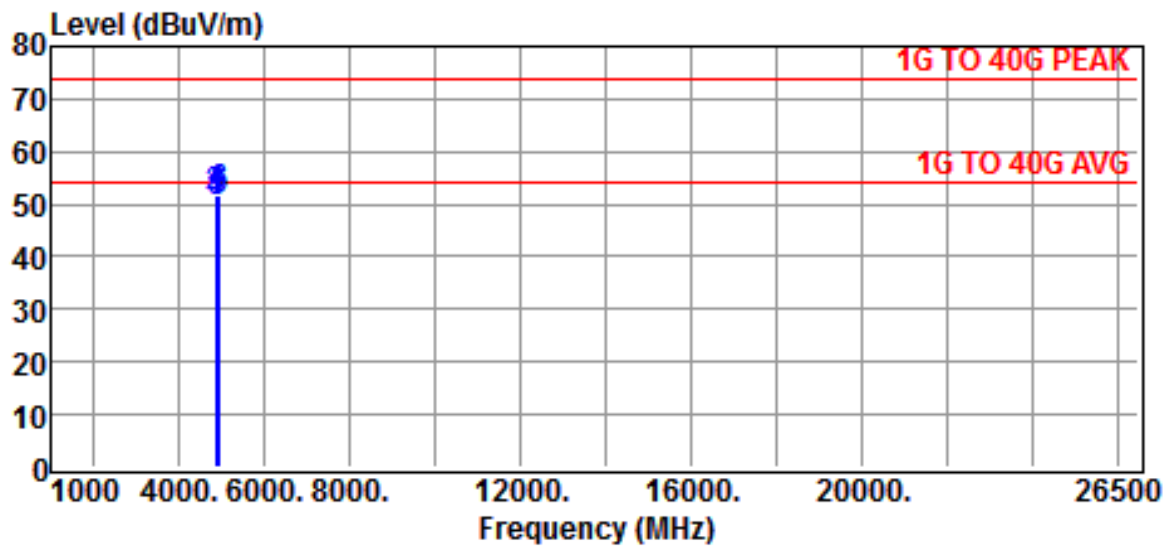


Site	:CHAMBER #2	Date	:2015-06-11
EUT	:2.4GHz RF Module	Ant. Pol.	:VERTICAL
Model	:TWMX	Detector	:
Power Rating	:DC 3.6V	Engineer	: VC
Limit	:2.4GHZ PEAK	Temp.	:27°C
Memo	:	Humi.	:65 %
Memo	:CH LO 2433 - MI 2453 - HI 2473MHz		
Test Mode	:EUT lay on table horizontally (worst case)		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
2433.0000	96.9	-5.6	91.3	94.0	-2.7	Average
2433.0000	98.0	-5.6	92.4	114.0	-21.6	Peak
2453.0000	95.9	-5.5	90.4	94.0	-3.6	Average
2453.0000	96.8	-5.5	91.3	114.0	-22.7	Peak
2473.0000	96.7	-5.4	91.3	94.0	-2.7	Average
2473.0000	97.9	-5.4	92.5	114.0	-21.5	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit – Result
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

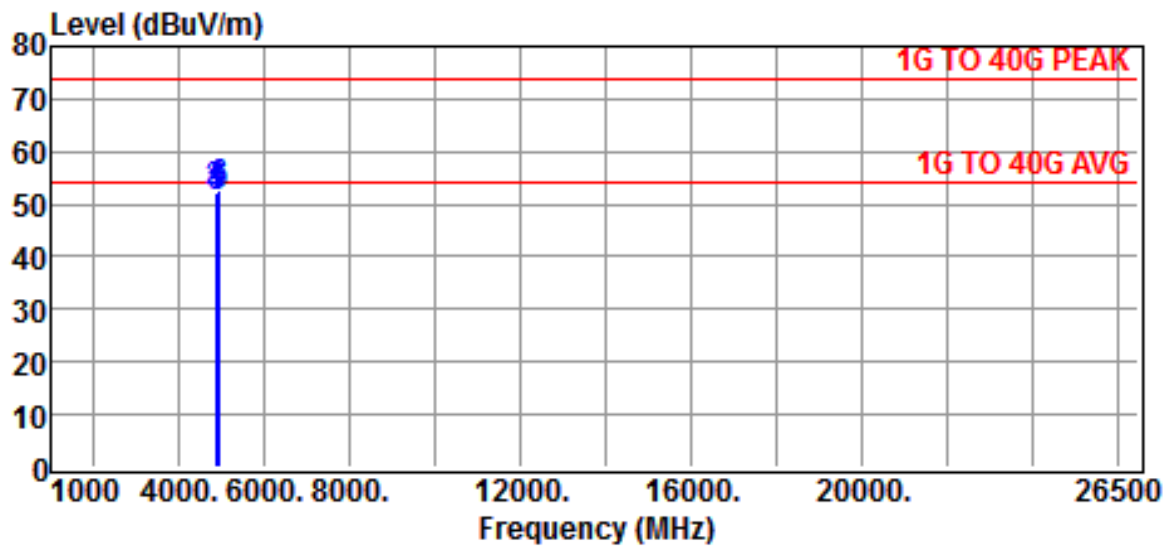


Site	:CHAMBER #2	Date	:2015-06-11
Limit	:1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:2.4GHz RF Module	Temp.	:27°C
Power Rating	:DC 3.6V	Humi.	:65%
Model	:TWMX	Engineer.	:VC
Test Mode	:CH LO 2433 - MI 2453 - HI 2473MHz		
Test Mode	:EUT lay on table horizontally (worst case)		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
4866.0000	48.5	1.5	50.0	54.0	-4.0	Average
4866.0000	49.7	1.5	51.2	74.0	-22.8	Peak
4906.0000	48.6	1.5	50.1	54.0	-3.9	Average
4906.0000	49.8	1.5	51.3	74.0	-22.7	Peak
4946.0000	48.9	1.7	50.6	54.0	-3.4	Average
4946.0000	50.1	1.7	51.8	74.0	-22.2	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit - Result
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

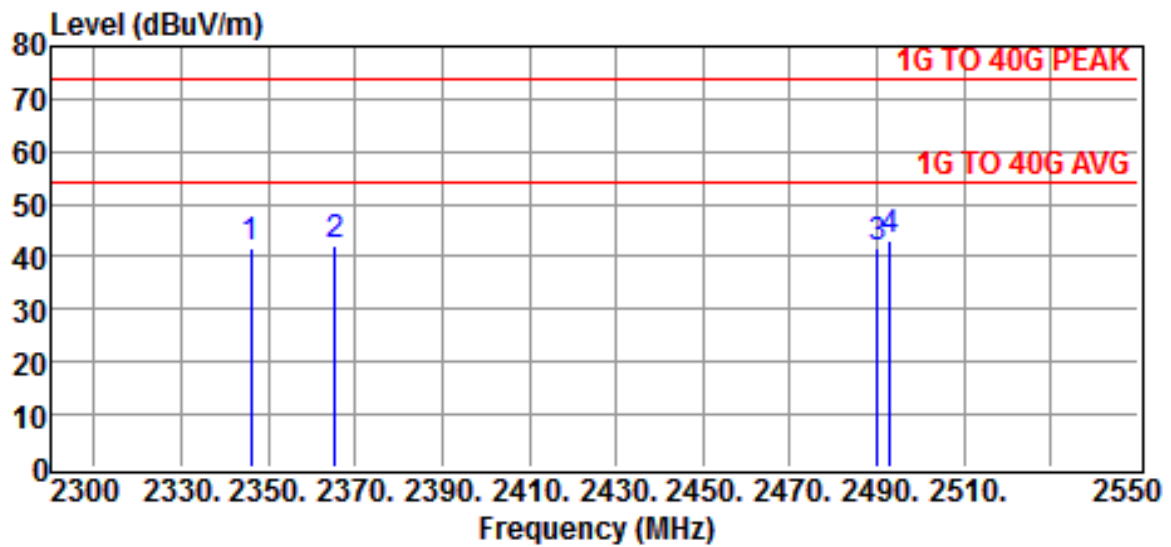


Site	:CHAMBER #2	Date	:2015-06-11
Limit	:1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:2.4GHz RF Module	Temp.	:27°C
Power Rating	:DC 3.6V	Humi.	:65%
Model	:TWMX	Engineer.	:VC
Test Mode	:CH LO 2433 - MI 2453 - HI 2473MHz		
Test Mode	:EUT lay on table horizontally (worst case)		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
4866.0000	49.6	1.5	51.1	54.0	-2.9	Average
4866.0000	50.5	1.5	52.0	74.0	-22.0	Peak
4906.0000	49.7	1.5	51.2	54.0	-2.8	Average
4906.0000	50.7	1.5	52.2	74.0	-21.8	Peak
4946.0000	49.6	1.7	51.3	54.0	-2.7	Average
4946.0000	50.8	1.7	52.5	74.0	-21.5	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit - Result
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

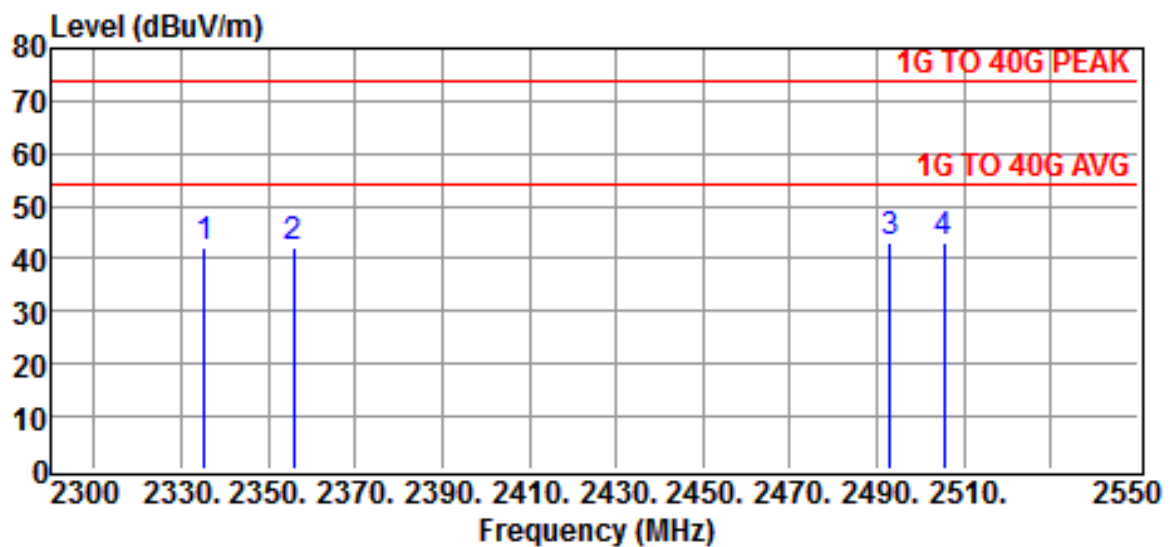


Site	:CHAMBER #2	Date	:2015-06-11
Limit	:1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:2.4GHz RF Module	Temp.	:27°C
Power Rating	:DC 3.6V	Humi.	:65%
Model	:TWMX	Engineer.	:VC
Test Mode	:CH LO & HI - Restricted Bands		
Test Mode	:EUT lay on table horizontally (worst case)		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
2346.0000	47.4	-5.9	41.5	74.0	-32.5	Peak
2365.5000	47.9	-5.8	42.1	74.0	-31.9	Peak
2490.0000	46.9	-5.4	41.5	74.0	-32.5	Peak
2493.0000	48.7	-5.4	43.3	74.0	-30.7	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit - Result
4. Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
5. The expanded uncertainty of the radiated emission tests is 3.53 dB.



Site	:CHAMBER #2	Date	:2015-06-11
Limit	:1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:2.4GHz RF Module	Temp.	:27°C
Power Rating	:DC 3.6V	Humi.	:65%
Model	:TWMX	Engineer.	:VC
Test Mode	:CH LO & HI - Restricted Bands		
Test Mode	:EUT lay on table horizontally (worst case)		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
2335.5000	48.2	-5.9	42.3	74.0	-31.7	Peak
2356.0000	47.8	-5.8	42.0	74.0	-32.0	Peak
2493.0000	48.8	-5.4	43.4	74.0	-30.6	Peak
2505.5000	48.6	-5.3	43.3	74.0	-30.7	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit - Result
4. Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
5. The expanded uncertainty of the radiated emission tests is 3.53 dB.

4.4.2 Other Emissions

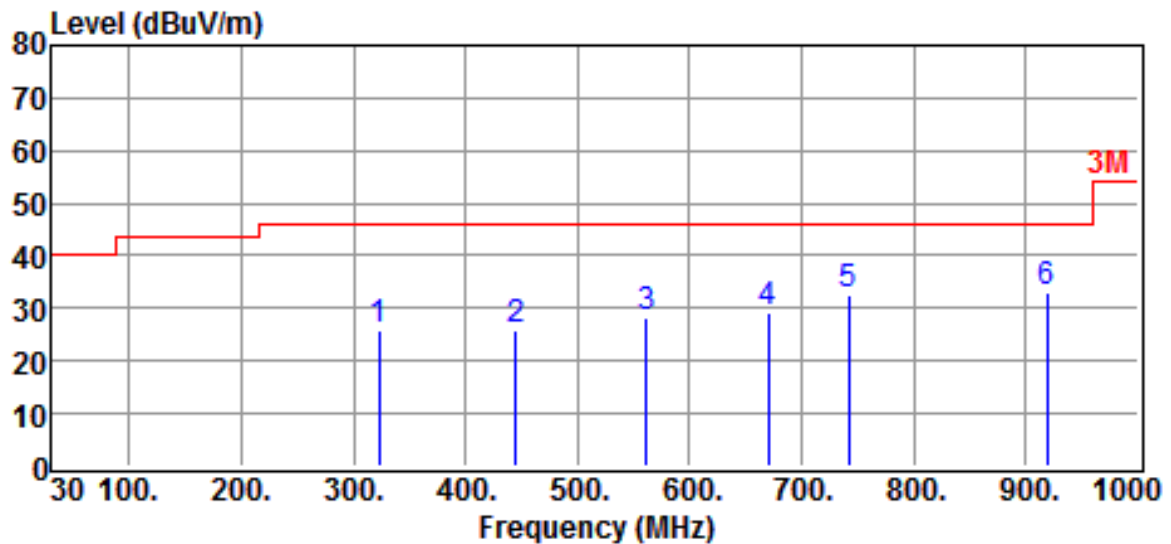
a) Emission frequencies below 1 GHz

Operation Mode : Operation

Test Date : Jun. 11, 2014

Temperature : 27 °C

Humidity : 65 %

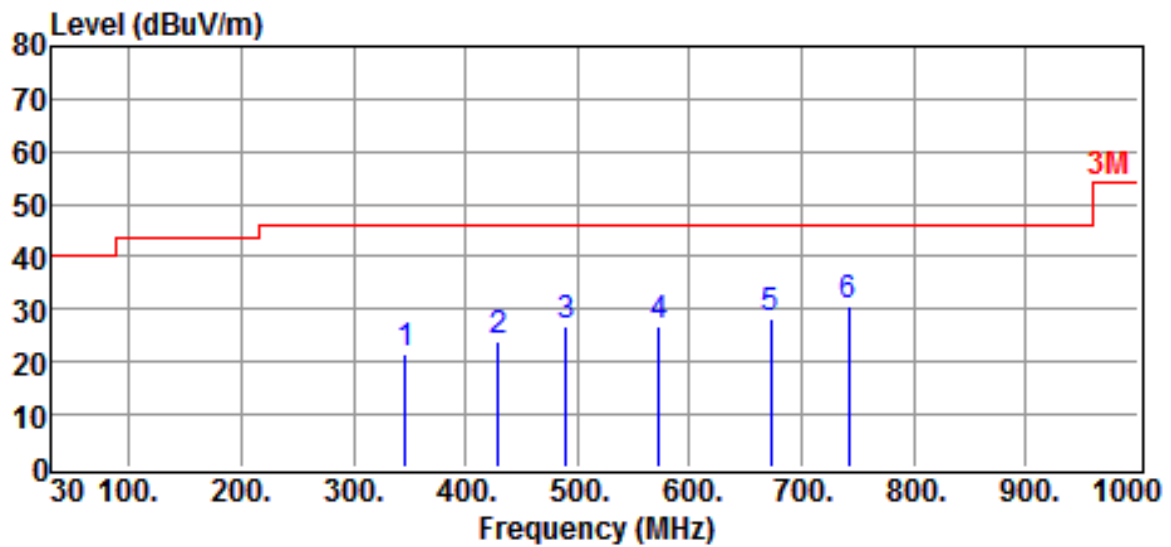


Site	:OPEN SITE	Date	:2015-06-11
Limit	:FCC CLASS-B	Ant. Pol.	:HORIZONTAL
EUT	:2.4GHz RF Module	Temp.	:27°C
Power Rating	:DC 3.6V	Humi.	:65%
Model	:TWMX	Engineer.	:VC
Test Mode	:EUT lay on table horizontally (worst case)		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
322.9400	8.5	17.6	26.1	46.0	-19.9	Peak
445.1600	5.3	20.2	25.5	46.0	-20.5	Peak
561.5600	6.0	22.4	28.4	46.0	-17.6	Peak
670.2000	5.3	24.4	29.7	46.0	-16.3	Peak
741.9800	6.6	25.6	32.2	46.0	-13.8	Peak
918.5200	4.8	28.3	33.1	46.0	-12.9	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit - Result
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.



Site	:OPEN SITE	Date	:2015-06-11
Limit	:FCC CLASS-B	Ant. Pol.	:VERTICAL
EUT	:2.4GHz RF Module	Temp.	:27°C
Power Rating	:DC 3.6V	Humi.	:65%
Model	:TWMX	Engineer.	:VC
Test Mode	:EUT lay on table horizontally (worst case)		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
346.2200	3.5	17.8	21.3	46.0	-24.7	Peak
429.6400	3.9	19.9	23.8	46.0	-22.2	Peak
489.7800	5.4	21.3	26.7	46.0	-19.3	Peak
573.2000	4.6	22.6	27.2	46.0	-18.8	Peak
672.1400	3.9	24.4	28.4	46.0	-17.6	Peak
741.9800	4.9	25.6	30.5	46.0	-15.5	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit - Result
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

b) Emission frequencies above 1 GHz

Radiated emission frequencies above 1 GHz to 26.5 GHz were too low to be measured with a pre-amplifier of 35 dB.

4.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor, High Pass Filter Loss(if used) and Cable Loss, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation calculation is as follows:

$$\textbf{Result} = \textbf{Reading} + \textbf{Corrected Factor}$$

where Corrected Factor

$$= \text{Antenna FACTOR} + \text{Cable Loss} + \text{High Pass Filter Loss} - \text{Amplifier Gain}$$

4.6 Photos of Radiation Measuring Setup



5 CONDUCTED EMISSION MEASUREMENT

5.1 Standard Applicable

This EUT is excused from investigation of conducted emission, for it is powered by DC battery only. According to §15.207 (d), measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

6 ANTENNA REQUIREMENT

6.1 Standard Applicable

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

6.2 Antenna Construction

The device is equipped with the permanently attached on-board PCB antenna. No consideration of replacement. Please refer to the construction Photo for details.

7 BAND EDGES MEASUREMENT

7.1 Standard Applicable

According to 15.249(d), out band emission except for harmonics shall be comply with §15.209 or at least attenuated by 50 dB below the level of the fundamental.

7.2 Measurement Procedure

A) 50 dB attenuation method

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
4. Repeat above procedures until all measured frequencies were complete.

B) Radiated Emission method

1. Following the measurement procedures in section 4.2 with the EUT set to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
2. Measure the highest amplitude appearing on spectral displayed.
3. Repeat above procedures until all measured frequencies were complete.

Measuring instrument setup in measured frequency band when specified detector function is used :

Frequency Band (MHz)	Instrument	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	RF Test Receiver	Quasi-Peak	120 kHz	N/A
	Spectrum Analyzer	Peak	100 kHz	100 kHz
Above 1000	Spectrum Analyzer	Peak	1 MHz	1 MHz
	Spectrum Analyzer	Average	1 MHz	10Hz

7.3 Measurement Equipment

A) 50 dB attenuation method

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
EMI Test Receiver	Rohde & Schwarz	ESU 40	2014/08/15	2015/08/14

B) Radiated Emission method

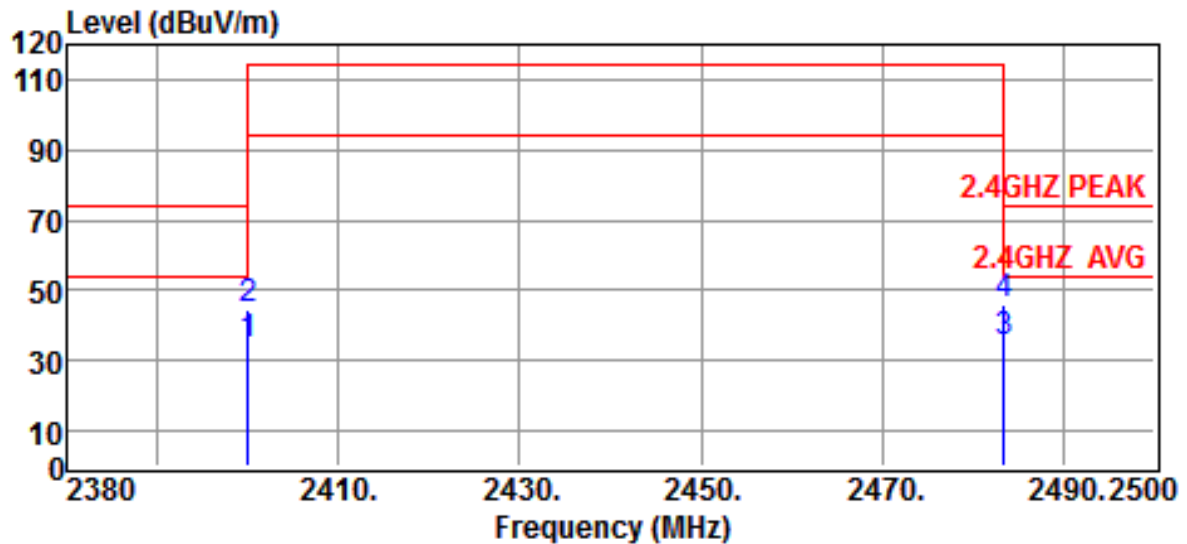
Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Test Receiver	Rohde & Schwarz	ESVS30	2014/05/29	2015/05/28
EMI Test Receiver	Rohde & Schwarz	ESL	2015/03/26	2016/03/25
Bi-Log Antenna	ETC	MCTD 2786	2014/07/09	2015/07/08
Log-periodic Antenna	EMCO	3146	2014/11/04	2015/11/03
Double Ridged Guide Horn Antenna	EMCO	3116	2014/08/13	2015/08/12
Biconical Antenna	EMCO	3110	2014/11/04	2015/11/03
Double Ridged Antenna	EMCO	3115	2014/08/18	2015/08/17
Amplifier	HP	8449B	2014/08/12	2015/08/11
Amplifier	HP	83051A	2014/10/22	2015/10/21
Amplifier	HP	8447D	2014/10/28	2015/10/27
EMI Test Receiver	Rohde & Schwarz	ESU 40	2014/08/15	2015/08/14

7.4 Measurement Data

Test Result: (Radiated Emission method)

The radiated emission test results of the lower and the upper band edges were comply with §15.209. Please refer to the following pages for test results.

Radiated Emission Test Results of the Band Edges

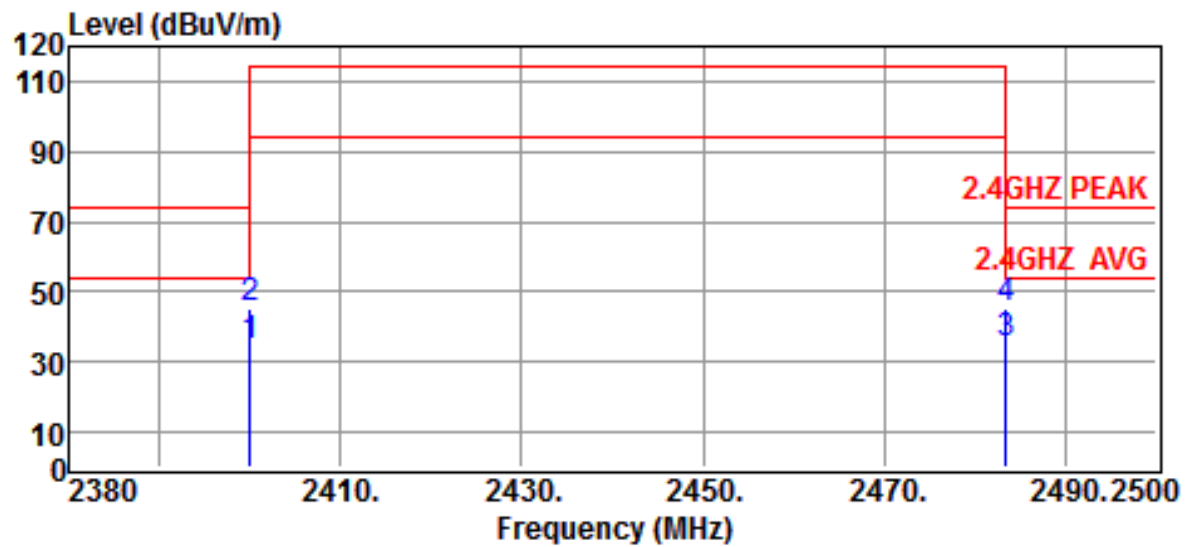


Site	:CHAMBER #2	Date	:2015-06-11
Limit	:2.4GHZ PEAK	Ant. Pol.	:HORIZONTAL
EUT	:2.4GHz RF Module	Temp.	:27°C
Power Rating	:DC 3.6V	Humi.	:65%
Model	:TWMX	Engineer.	:VC
Test Mode	:CH LO & HI - BANDEDGE		
Test Mode	:EUT lay on table horizontally (worst case)		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
2400.0000	40.2	-5.6	34.6	54.0	-19.4	Average
2400.0000	50.0	-5.6	44.4	74.0	-29.6	Peak
2483.5000	40.6	-5.4	35.2	54.0	-18.8	Average
2483.5000	51.2	-5.4	45.8	74.0	-28.2	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit - Result
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.



Site	:CHAMBER #2	Date	:2015-06-11
Limit	:2.4GHZ PEAK	Ant. Pol.	:VERTICAL
EUT	:2.4GHz RF Module	Temp.	:27°C
Power Rating	:DC 3.6V	Humi.	:65%
Model	:TWMX	Engineer.	:VC
Test Mode	:CH LO & HI - BANDEDGE		
Test Mode	:EUT lay on table horizontally (worst case)		

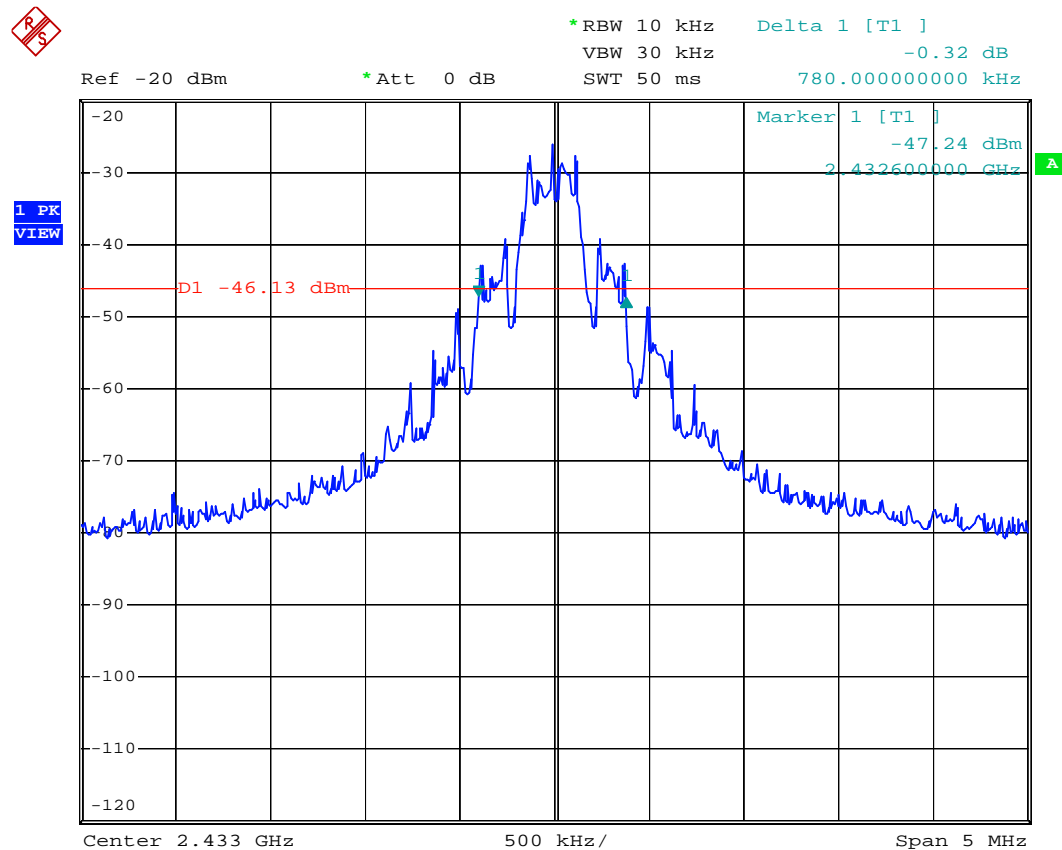
Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
2400.0000	40.1	-5.6	34.5	54.0	-19.5	Average
2400.0000	50.9	-5.6	45.3	74.0	-28.7	Peak
2483.5000	40.8	-5.4	35.4	54.0	-18.6	Average
2483.5000	50.7	-5.4	45.3	74.0	-28.7	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit - Result
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

20dB Bandwidth

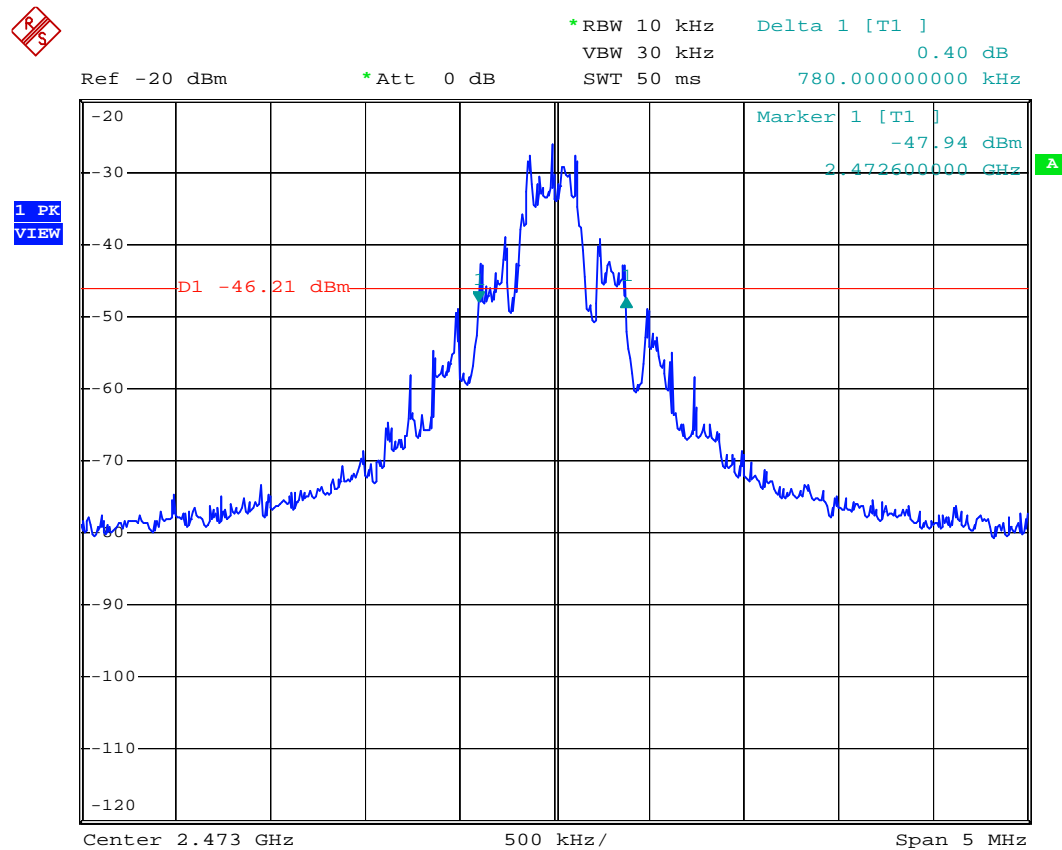
Lower band edge / -20dB BW plot of the lowest channel



The 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section 15.249.

20dB Bandwidth

Upper band edge / -20dB BW plot of the highest channel



The 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section 15.249.