

## FCC 47 CFR PART 15 SUBPART C

### RF Test Report

Applicant : Trago, Inc.  
Product Type : SMART WATER BOTTLE  
Trade Name : TRAGO  
Model Number : TRAGO-C01  
Test Specification : FCC 47 CFR PART 15 SUBPART C  
ANSI C63.10:2013  
Receive Date : Dec. 01, 2016  
Test Period : Dec. 03 ~ Dec. 13, 2016  
Issue Date : Dec. 19, 2016

#### Issue by

A Test Lab Techno Corp.  
No. 140-1, Changan Street, Bade District,  
Taoyuan City 33465, Taiwan (R.O.C)  
Tel : +886-3-2710188 / Fax : +886-3-2710190



Taiwan Accreditation Foundation accreditation number: 1330

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### **Revision History**

Rev.	Issue Date	Revisions	Revised By
00	Dec. 19, 2016	Initial Issue	Snow Wang



## Verification of Compliance

Issued Date: Dec. 19, 2016

Applicant : Trago, Inc.  
Product Type : SMART WATER BOTTLE  
Trade Name : TRAGO  
Model Number : TRAGO-C01  
FCC ID : 2AJ2W-TRAGO-C01  
EUT Rated Voltage : DC 3V, 50mA  
Test Voltage : DC 3V  
Applicable Standard : FCC 47 CFR PART 15 SUBPART C  
ANSI C63.10:2013  
Test Result : Complied

Performing Lab. : A Test Lab Techno Corp.  
No. 140-1, Changan Street, Bade District,  
Taoyuan City 33465, Taiwan (R.O.C)  
Tel : +886-3-2710188 / Fax : +886-3-2710190  
Taiwan Accreditation Foundation accreditation number: 1330  
<http://www.atl-lab.com.tw/e-index.htm>



A Test Lab Techno Corp. 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 A Test Lab Techno Corp. 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.

Approved By : Fly Lu Reviewed By : Eric Ou Yang  
(Manager) (Fly Lu) (Testing Engineer) (Eric Ou Yang)

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## 1 General Information

### 1.1 Summary of Test Result

Standard	Item	Result	Remark
15.207	AC Power Conducted Emission	N/A	Not applicable, This device use button cell battery
15.247(d)	Transmitter Radiated Emissions	PASS	-----
15.247(b)(3)	Max. Output Power	PASS	-----
15.247(a)(2)	6dB RF Bandwidth	PASS	-----
15.247(e)	Power Spectral Density	PASS	-----
15.247(d)	Out of Band Conducted Spurious Emission	PASS	-----
15.203	Antenna Requirement	PASS	-----

The test results of this report relate only to the tested sample(s) identified in this report. Manufacturer or whom it may concern should recognize the pass or fail of the test result.

### 1.2 Measurement Uncertainty

Test Item	Frequency Range	Uncertainty (dB)
Conducted Emission	9kHz ~ 150KHz	2.7
	150kHz ~ 30MHz	2.7
Radiated Emission	9kHz ~ 30MHz	1.7
	30MHz ~ 1000MHz	5.7
	1000MHz ~ 18000MHz	5.5
	18000MHz ~ 26500MHz	4.8
	26500MHz ~ 40000MHz	4.8
Conducted Output Power	+0.27 dB / -0.28 dB	
RF Bandwidth	4.96%	
Power Spectral Density	+0.71 dB / -0.77 dB	



## 2 EUT Description

Applicant	Trago, Inc. 1711 E 16th St Austin US 78702 USA
Manufacturer	VirTex Assembly Service, Inc. 12234A N Interstate Hwy 35, Austin, Tx 78753
Product Type	SMART WATER BOTTLE
Trade Name	TRAGO
Model No.	TRAGO-C01
FCC ID	2AJ2W-TRAGO-C01
Frequency Range	Bluetooth LE: 2402 ~ 2480 MHz
Modulation Type	GFSK
Antenna Type	Ceramic antenna
Antenna Gain	0.5 dBi
RF Output Power	0.00077 W / -1.11 dBm

### 3 Test Methodology

#### 3.1. Mode of Operation

Decision of Test ATL has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: Continuous TX mode
Mode 2: Bluetooth LE Link Mode

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.

By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that "X axis" position was the worst, then the final test was executed the worst condition and test data were recorded in this report.

Note: The EUT was programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98%.

#### Tested System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

	Product	Manufacturer	Model Number	Serial Number	Power Cord
1.	Bluetooth Tester	R & S	CBT	100350	NA

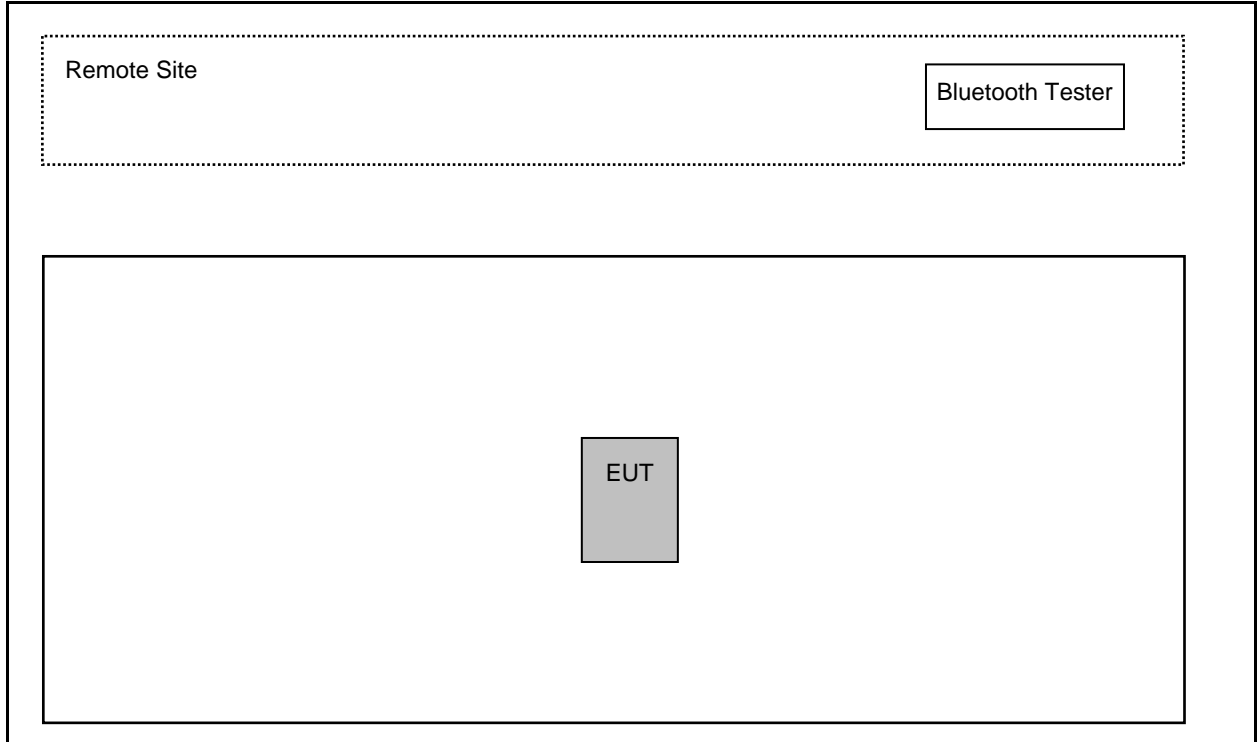
#### 3.2. EUT Exercise Software

1	Setup the EUT shown on 3.3.
2	Turn on the power of all equipment.
3	Turn on Bluetooth function and link to Bluetooth tester
4	EUT run test program.

Measurement Software
1 EZ-EMC Ver. ATL-03A1-1

### 3.3. Configuration of Test System Details

Radiated Emissions



### 3.4. Test Site Environment

Items	Required (IEC 60068-1)	Actual
Temperature (°C)	15-35	26
Humidity (%RH)	25-75	60
Barometric pressure (mbar)	860-1060	950





## 4 Radiated Emission Measurement

### 4.1. Limit

According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ( $\mu\text{V}/\text{m}$ at meter)	Measurement Distance (meters)
0.009 – 0.490	2400 / F (kHz)	300
0.490 – 1.705	24000 / F (kHz)	30
1.705 – 30.0	30	30
30 - 88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

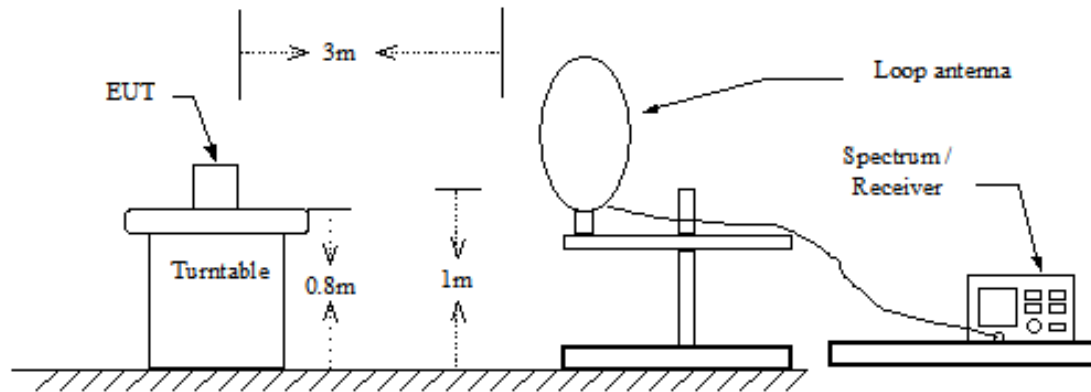
### 4.2. Test Instruments

3 Meter Chamber					
Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
RF Pre-selector	Agilent	N9039A	MY46520256	03/22/2016	1 year
Spectrum Analyzer	Agilent	E4446A	MY46180578	03/22/2016	1 year
Pre Amplifier	Agilent	8449B	3008A02237	10/11/2016	1 year
Pre Amplifier	Agilent	8447D	2944A11119	01/11/2016	1 year
Broadband Antenna	Schwarzbeck	VULB9168	416	10/13/2016	1 year
Horn Antenna (1~18GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA9120D	9120D-550	06/06/2016	1 year
Horn Antenna (18~40GHz)	ETS	3116	86467	09/05/2016	1 year
Loop Antenna	COM-POWER CORPORATION	AL-130	121014	02/01/2016	1 year
Microwave Cable	EMCI	EMC102-KM-KM-14000	151001	02/23/2016	1 year
Microwave Cable	EMCI	EMC-104-SM-SM-14000	140202	02/23/2016	1 year
Microwave Cable	EMCI	EMC104-SM-SM-600	140301	02/23/2016	1 year
Test Site	ATL	TE01	888001	08/29/2016	1 year

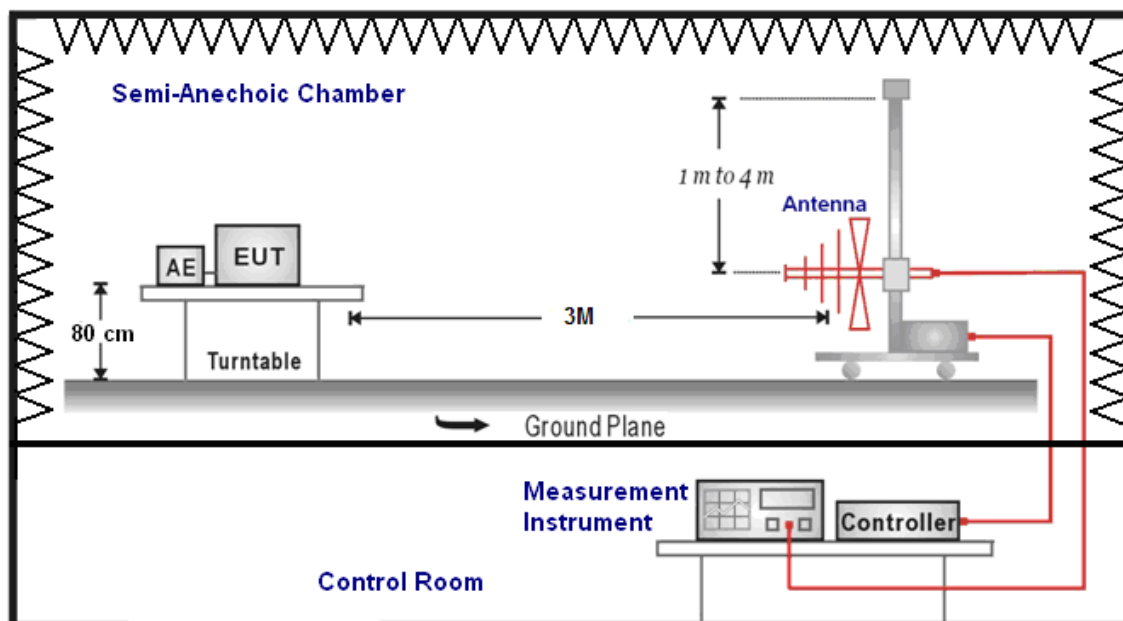
Note: N.C.R. = No Calibration Request.

### 4.3. Setup

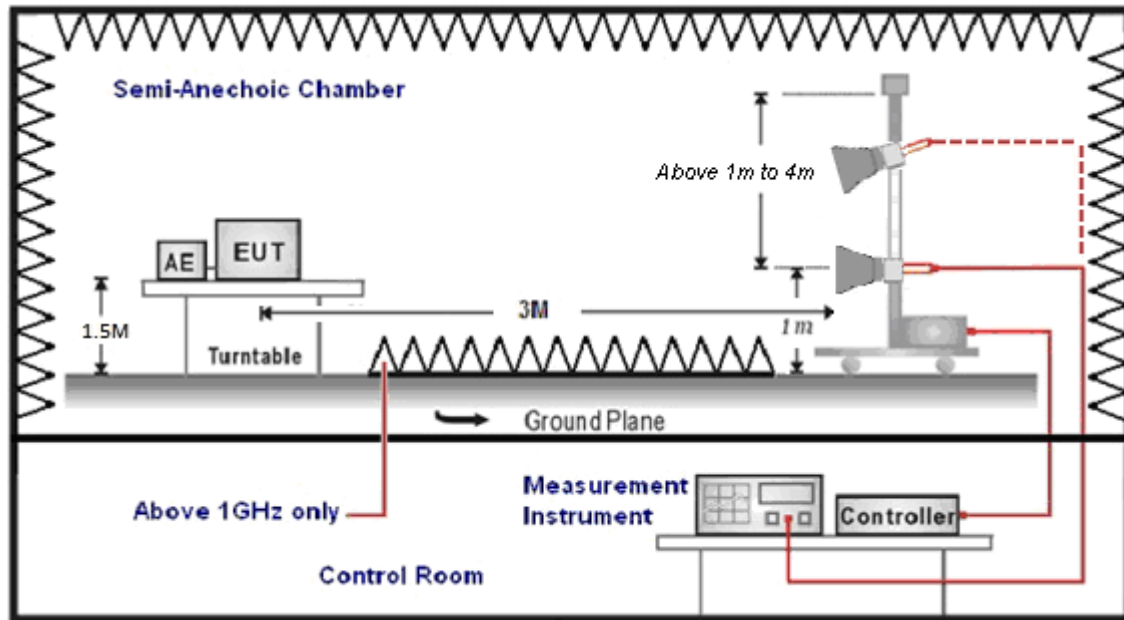
9kHz ~ 30MHz



Below 1GHz



Above 1GHz



#### 4.4. Test Procedure

Final radiation measurements were made on a three-meter, Semi Anechoic Chamber. The EUT system was placed on a nonconductive turntable which is 0.8 or 1.5 meters height(below 1GHz use 0.8m turntable / above 1GHz use 1.5m turntable), top surface 1.0 x 1.5 meter. The spectrum was examined from 250 MHz to 2.5 GHz in order to cover the whole spectrum below 10th harmonic which could generate from the EUT. During the test, EUT was set to transmit continuously & Measurements spectrum range from 9 kHz to 26.5 GHz is investigated.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements when Duty cycle >98% / 1/T for average measurements when Duty cycle <98%. A nonconductive material surrounded the EUT to supporting the EUT for standing on three orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

SCHWARZBECK MESS-ELEKTRONIK Biconilog Antenna at 3 Meter and the SCHWARZBECK Double Ridged Guide Antenna was used in frequencies 1 – 26.5 GHz at a distance of 1 meter. All test results were extrapolated to equivalent signal at 3 meters utilizing an inverse linear distance extrapolation Factor (20dB/decade).

For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer's 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvolt (dBuV) into field intensity in micro volts pre meter (uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in micro volts per meter (dBuV/m).

The actual field intensity in referenced to 1 microvolt per meter (dBuV/m) is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

$$(1) \text{ Amplitude (dBuV/m) = FI (dBuV) + AF (dBuV) + CL (dBuV) - Gain (dB)}$$

FI= Reading of the field intensity.

AF= Antenna factor.

CL= Cable loss.

P.S Amplitude is auto calculate in spectrum analyzer.

$$(2) \text{ Actual Amplitude (dBuV/m) = Amplitude (dBuV) - Dis(dB)}$$

The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:

(a) For fundamental frequency : Transmitter Output < +30dBm

(b) For spurious frequency : Spurious emission limits = fundamental emission limit /10

Data of measurement within this frequency range without mark 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.



#### 4.5. Test Result

##### Below 1GHz

Standard: FCC Part 15C		Test Distance: 3m					
Test Mode: Mode 1		Power: DC 3V					
		Temp.(°C)/Hum.(%RH): 26(°C)/60%RH					
		Date: 12/03/2016					
Description:							
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
46.4900	25.53	-16.34	9.19	40.00	-30.81	QP	H
54.2500	27.43	-16.66	10.77	40.00	-29.23	QP	H
462.6200	24.96	-6.96	18.00	46.00	-28.00	QP	H
547.0100	25.56	-9.42	16.14	46.00	-29.86	QP	H
676.0200	26.04	-5.02	21.02	46.00	-24.98	QP	H
930.1600	25.38	-7.14	18.24	46.00	-27.76	QP	H
144.4600	26.52	-17.50	9.02	43.50	-34.48	QP	V
191.0200	27.45	-17.63	9.82	43.50	-33.68	QP	V
248.2500	30.70	-19.85	10.85	46.00	-35.15	QP	V
522.7600	24.45	-9.72	14.73	46.00	-31.27	QP	V
705.1200	25.40	-3.90	21.50	46.00	-24.50	QP	V
970.9000	25.84	-2.61	23.23	54.00	-30.77	QP	V

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

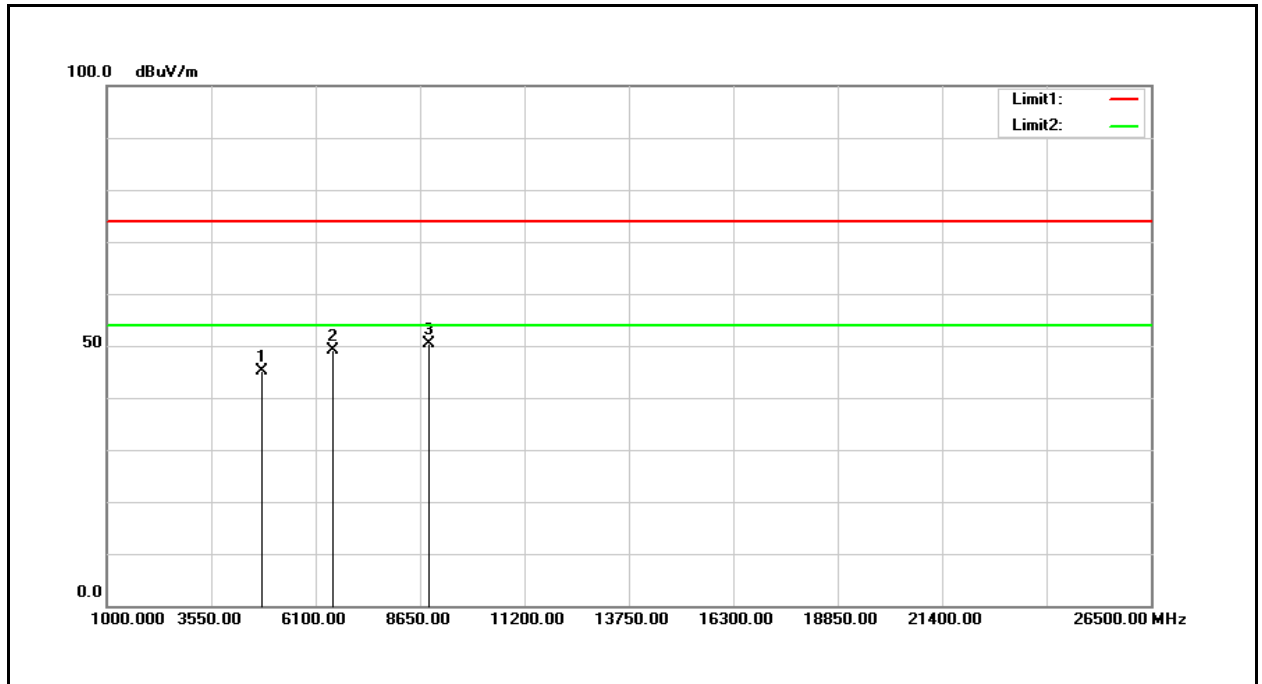
2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. No emission found between lowest internal used/generated frequencies to 30MHz (9 kHz~30MHz).



### Above 1GHz

Standard:	FCC Part 15C	Test Distance:	3m
Test Mode:	Mode 2	Power:	DC 3V
Frequency:	2402MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60%RH
Ant.Polar.:	Horizontal	Date:	12/07/2016



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4804.000	49.69	-4.45	45.24	74.00	-28.76	peak
2	6533.500	50.86	-1.70	49.16	74.00	-24.84	peak
3	8879.500	47.29	3.17	50.46	74.00	-23.54	peak

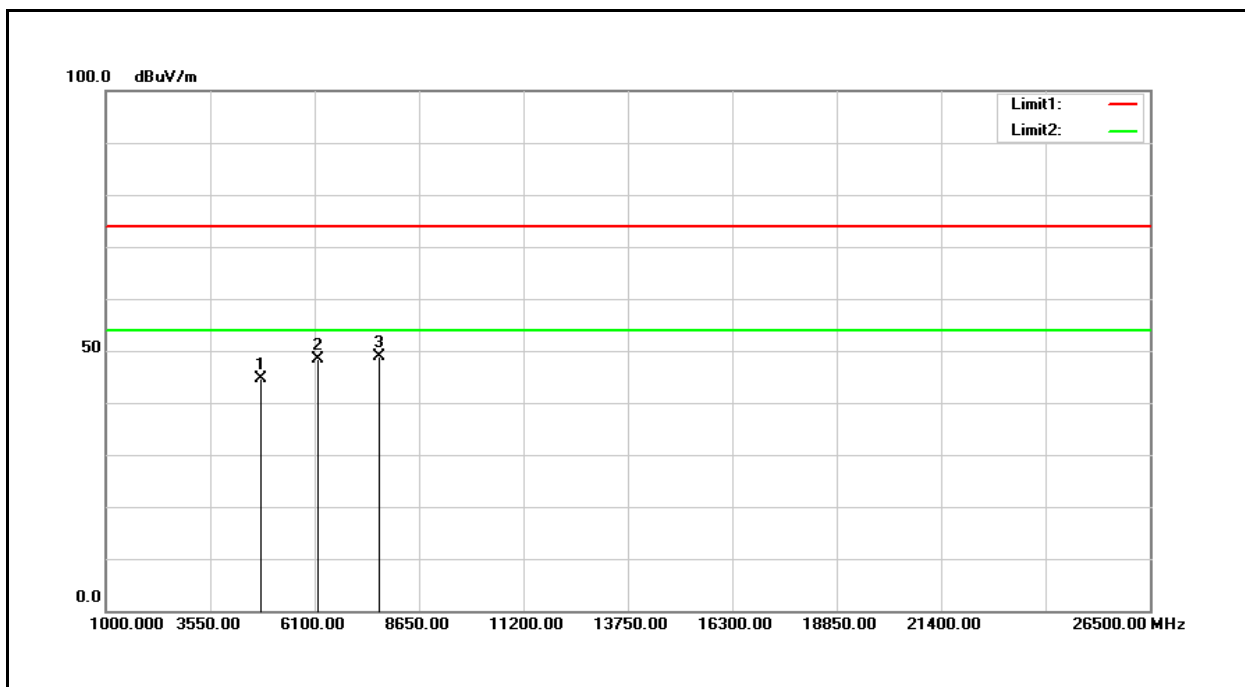
Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. When peak results are less than average limit, so not need to evaluate the average.



Standard:	FCC Part 15C	Test Distance:	3m
Test Mode:	Mode 2	Power:	DC 3V
Frequency:	2402MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60%RH
Ant.Polar.:	Vertical	Date:	12/07/2016



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4804.000	48.96	-4.45	44.51	74.00	-29.49	peak
2	6176.500	50.61	-2.34	48.27	74.00	-25.73	peak
3	7681.000	48.52	0.33	48.85	74.00	-25.15	peak

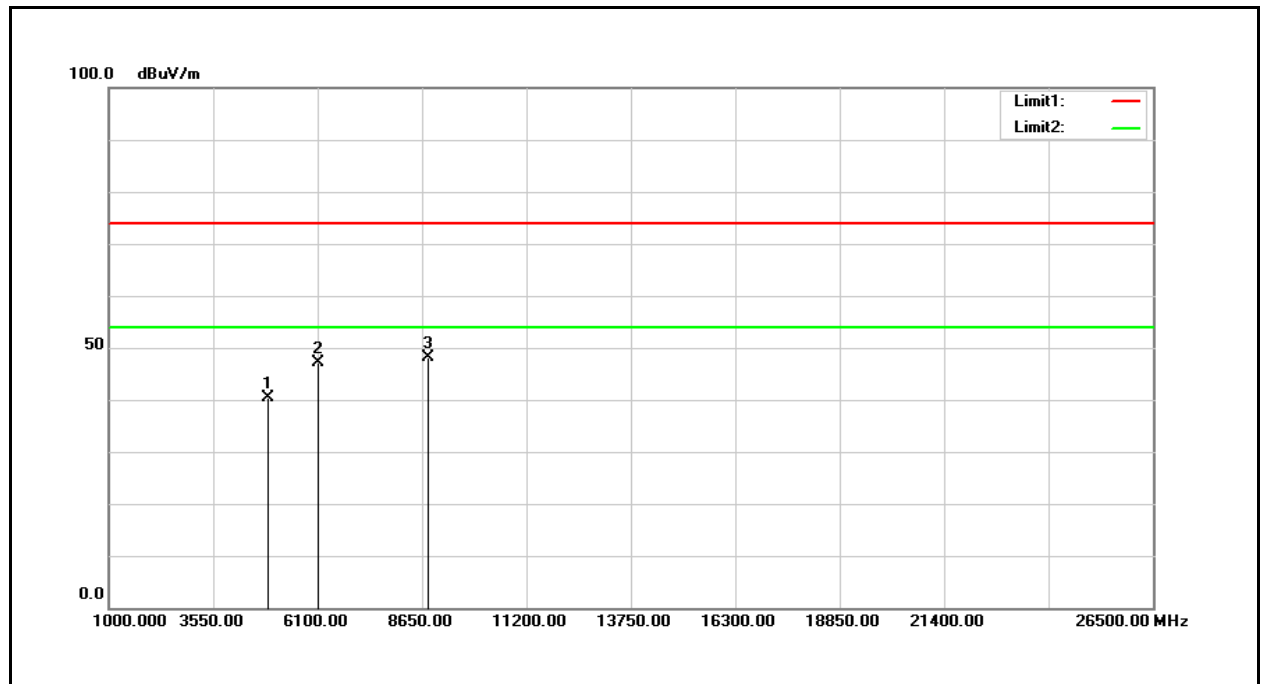
Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. When peak results are less than average limit, so not need to evaluate the average.



Standard:	FCC Part 15C	Test Distance:	3m
Test Mode:	Mode 2	Power:	DC 3V
Frequency:	2440MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60%RH
Ant.Polar.:	Horizontal	Date:	12/07/2016



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4880.000	44.98	-4.55	40.43	74.00	-33.57	peak
2	6100.000	49.57	-2.47	47.10	74.00	-26.90	peak
3	8803.000	45.18	2.87	48.05	74.00	-25.95	peak

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

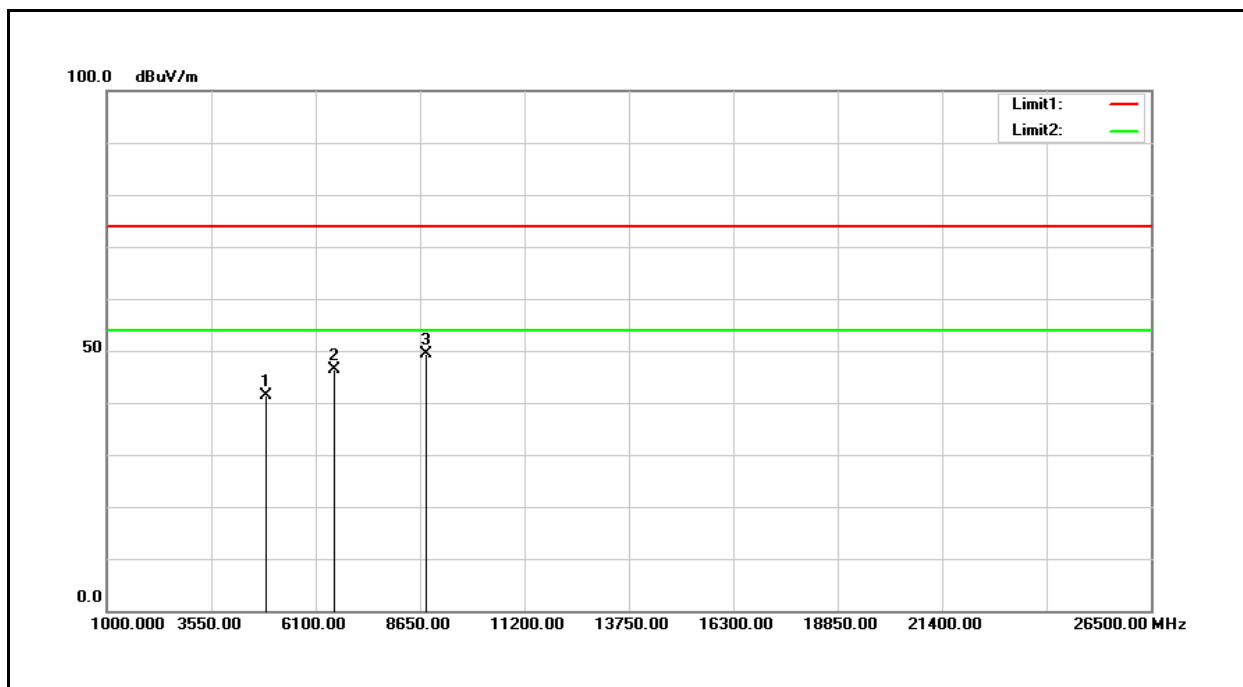
2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. When peak results are less than average limit, so not need to evaluate the average.





Standard:	FCC Part 15C	Test Distance:	3m
Test Mode:	Mode 2	Power:	DC 3V
Frequency:	2440MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60%RH
Ant.Polar.:	Vertical	Date:	12/07/2016



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4880.000	45.98	-4.55	41.43	74.00	-32.57	peak
2	6559.000	48.02	-1.70	46.32	74.00	-27.68	peak
3	8803.000	46.60	2.87	49.47	74.00	-24.53	peak

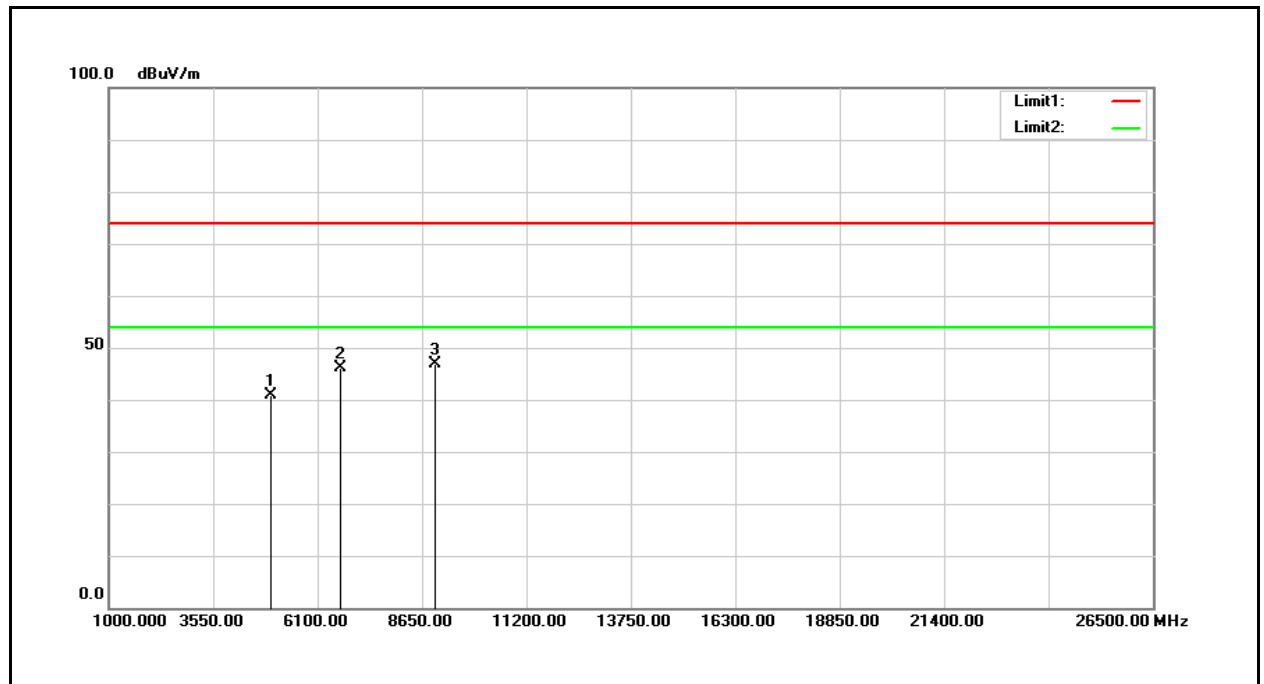
Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. When peak results are less than average limit, so not need to evaluate the average.



Standard:	FCC Part 15C	Test Distance:	3m
Test Mode:	Mode 2	Power:	DC 3V
Frequency:	2480MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60%RH
Ant.Polar.:	Horizontal	Date:	12/07/2016



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4960.000	45.44	-4.65	40.79	74.00	-33.21	peak
2	6661.000	47.78	-1.57	46.21	74.00	-27.79	peak
3	8956.000	43.38	3.47	46.85	74.00	-27.15	peak

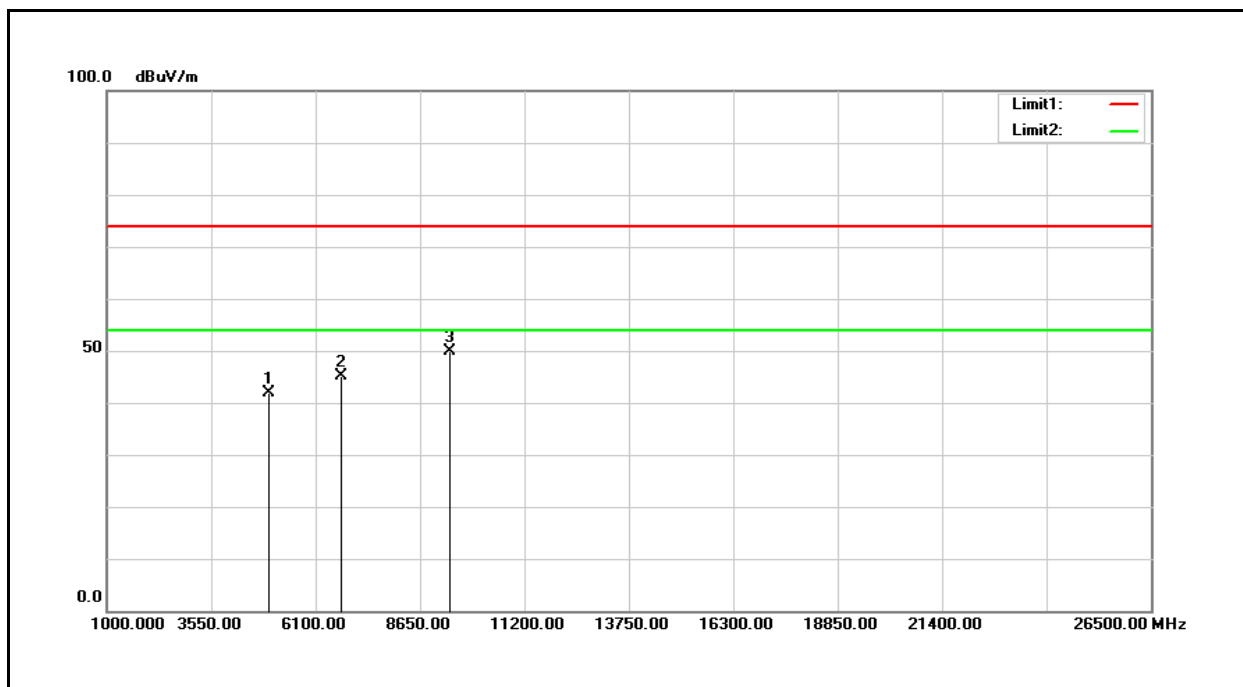
Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. When peak results are less than average limit, so not need to evaluate the average.



Standard:	FCC Part 15C	Test Distance:	3m
Test Mode:	Mode 2	Power:	DC 3V
Frequency:	2480MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60%RH
Ant.Polar.:	Vertical	Date:	12/07/2016



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	4960.000	46.61	-4.65	41.96	74.00	-32.04	peak
2	6712.000	46.61	-1.48	45.13	74.00	-28.87	peak
3	9389.500	45.48	4.40	49.88	74.00	-24.12	peak

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

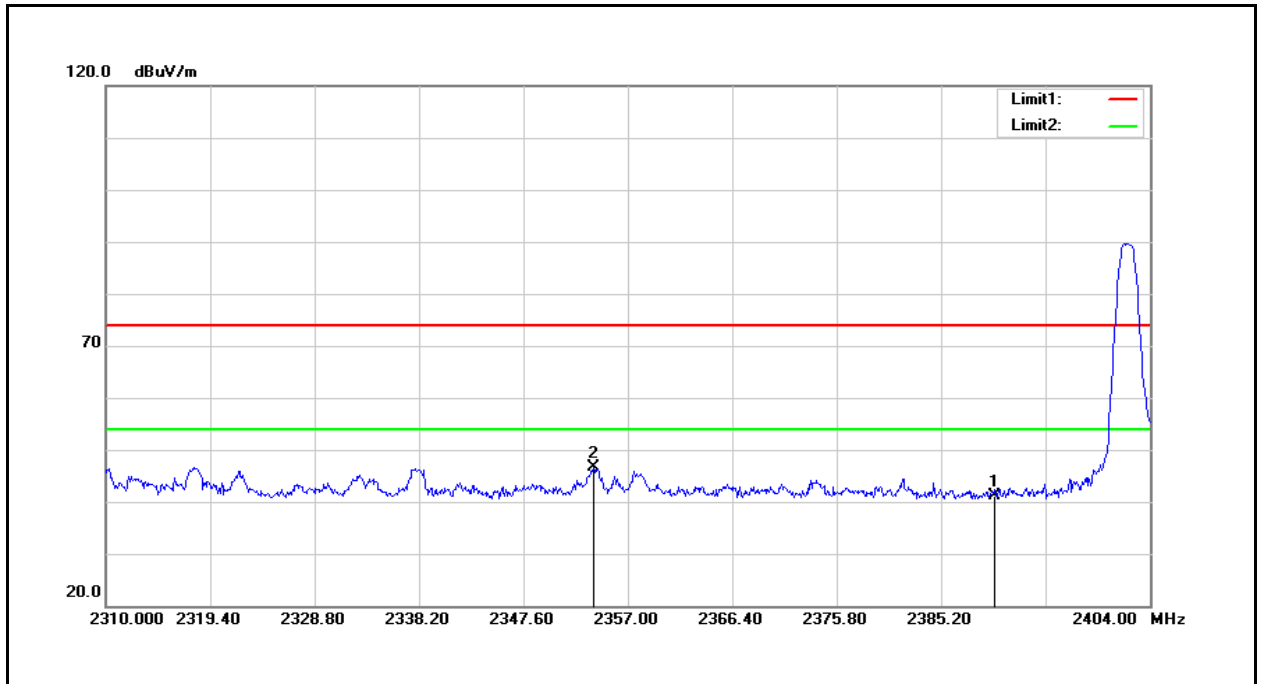
2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. When peak results are less than average limit, so not need to evaluate the average.



### Band Edge

Standard:	FCC Part 15C	Test Distance:	3m
Test Mode:	Mode 2	Power:	DC 3V
Frequency:	2402 MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60%RH
Ant.Polar.:	Horizontal	Date:	12/07/2016



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2390.000	50.98	-9.87	41.11	74.00	-32.89	peak
2	2353.898	56.74	-10.01	46.73	74.00	-27.27	peak

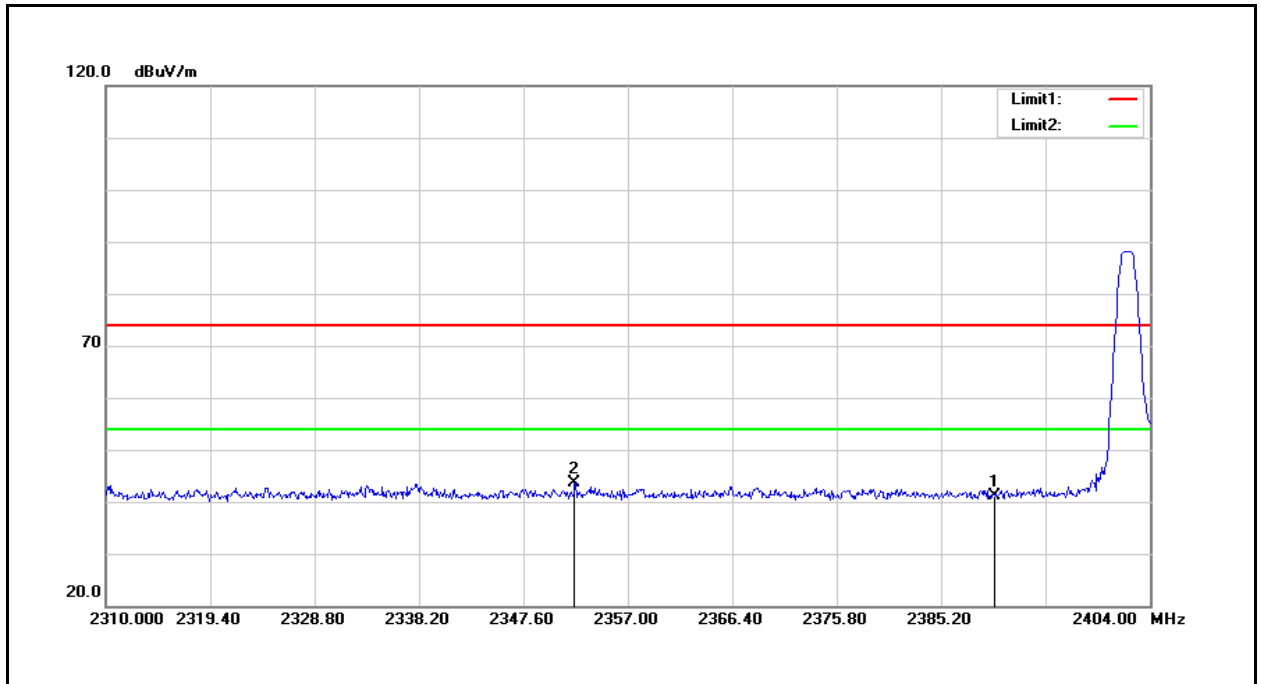
Note: 1. Result (dBuV/m) = Correction factor (dB/m) + Reading(dBuV).

2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. When peak results are less than average limit, so not need to evaluate the average.



Standard:	FCC Part 15C	Test Distance:	3m
Test Mode:	Mode 2	Power:	DC 3V
Frequency:	2402 MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60%RH
Ant.Polar.:	Vertical	Date:	12/07/2016



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2390.000	50.97	-9.87	41.10	74.00	-32.90	peak
2	2352.206	53.60	-10.02	43.58	74.00	-30.42	peak

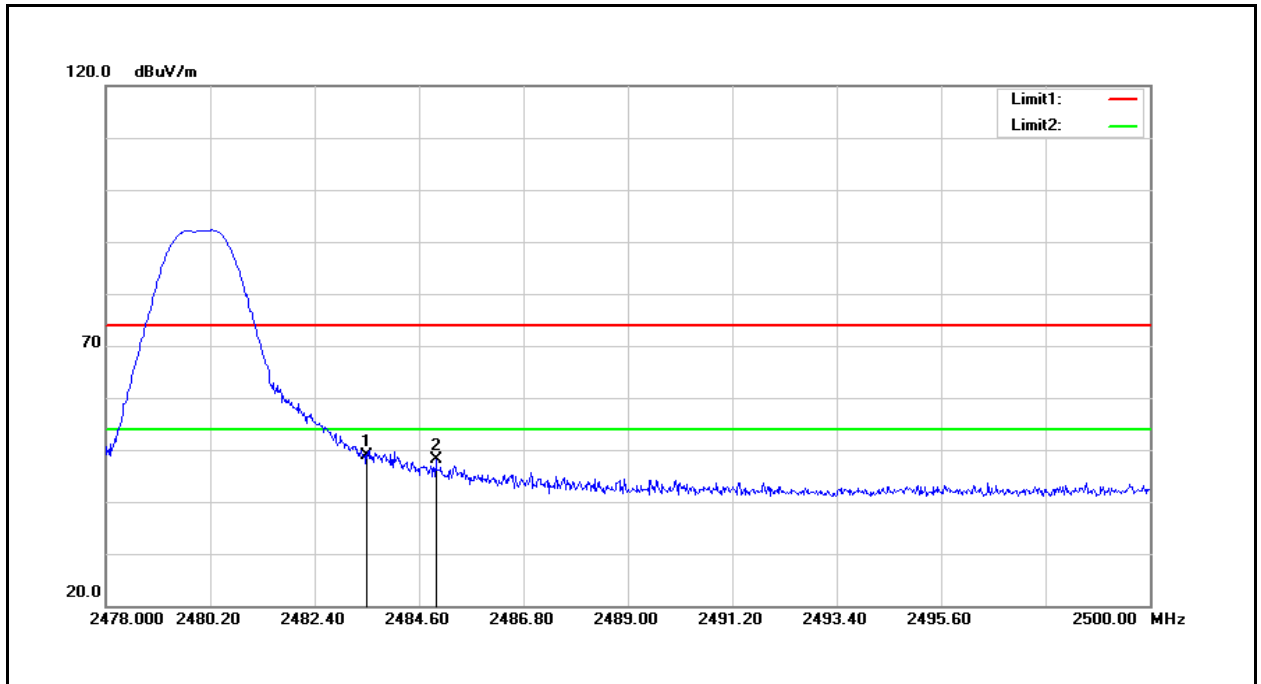
Note: 1. Result (dBuV/m) = Correction factor (dB/m) + Reading(dBuV).

2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. When peak results are less than average limit, so not need to evaluate the average.



Standard:	FCC Part 15C	Test Distance:	3m
Test Mode:	Mode 2	Power:	DC 3V
Frequency:	2480 MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60%RH
Ant.Polar.:	Horizontal	Date:	12/07/2016



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	58.51	-9.58	48.93	74.00	-25.07	peak
2	2484.952	57.72	-9.57	48.15	74.00	-25.85	peak

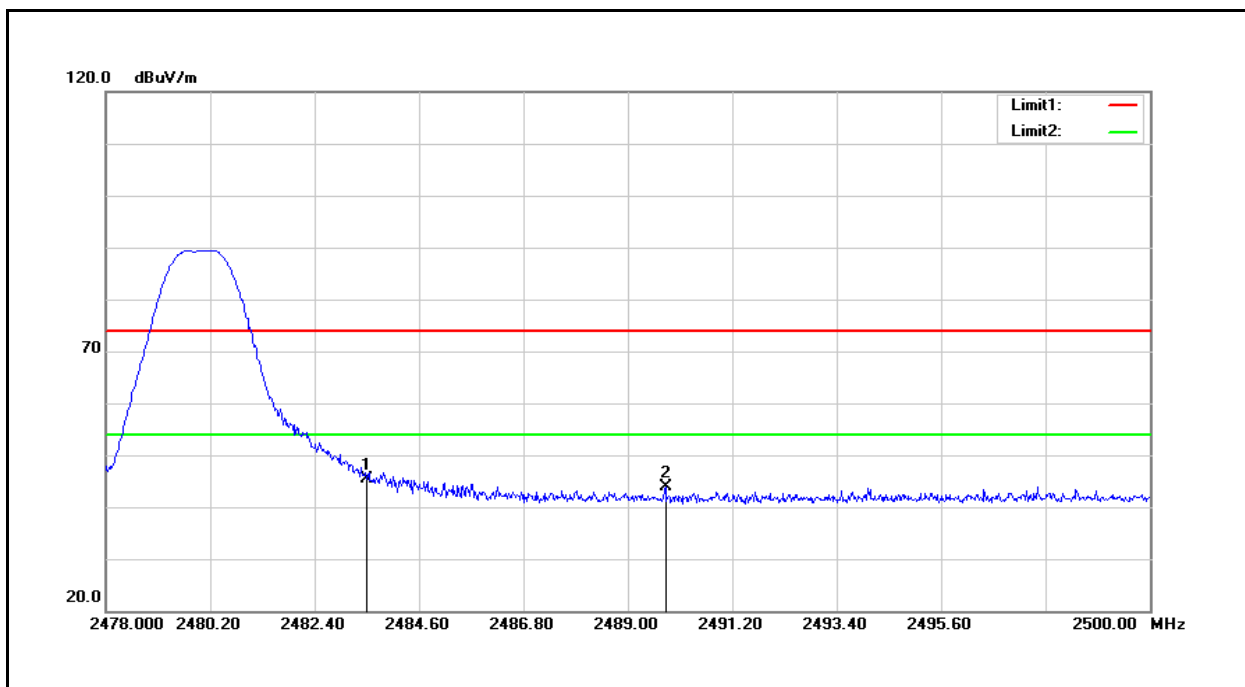
Note: 1. Result (dBuV/m) = Correction factor (dB/m) + Reading(dBuV).

2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. When peak results are less than average limit, so not need to evaluate the average.



Standard:	FCC Part 15C	Test Distance:	3m
Test Mode:	Mode 2	Power:	DC 3V
Frequency:	2480 MHz	Temp.(°C)/Hum.(%RH):	26(°C)/60%RH
Ant.Polar.:	Vertical	Date:	12/07/2016



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	55.06	-9.58	45.48	74.00	-28.52	peak
2	2489.792	53.39	-9.56	43.83	74.00	-30.17	peak

Note: 1. Result (dBuV/m) = Correction factor (dB/m) + Reading(dBuV).

2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

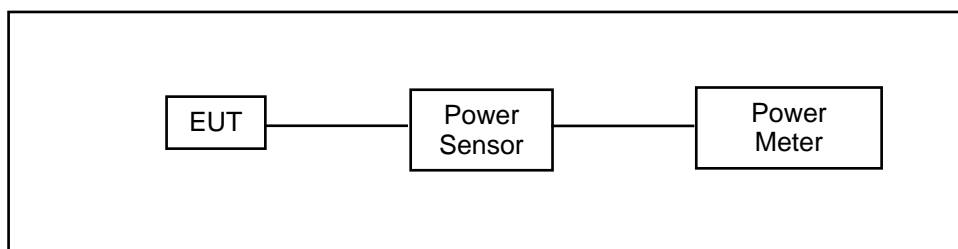
3. When peak results are less than average limit, so not need to evaluate the average.

## 5 Maximum Conducted Output Power Measurement

### 5.1. Limit

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm.

### 5.2. Test Setup



### 5.3. Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Power Sensor	Anritsu	MA2411B	1126022	08/29/2016	1 year
Power Meter	Anritsu	ML2495A	1135009	08/29/2016	1 year
Microwave Cable	EMCI	EMC104-SM-S M-1500	140303	02/23/2016	1 year
Test Site	ATL	TE05	TE05	N.C.R.	-----

Note: N.C.R. = No Calibration Request.

### 5.4. Test Procedure

The tests below are run with the EUT's transmitter set at high power in TX mode. The EUT is needed to force selection of output power level and channel number. While testing, EUT was set to transmit continuously. Remove the Subjective device's antenna and connect the RF output port to power sensor..

### 5.5. Test Result

Test Date:	12/03/2016				
Frequency (MHz)	Average Power		Peak Power		Limit (dBm)
	(dBm)	(W)	(dBm)	(W)	
2402	-3.21	0.00048	<b>-1.11</b>	<b>0.00077</b>	< 30
2440	-4.28	0.00037	-2.17	0.00061	< 30
2480	-4.93	0.00032	-2.81	0.00052	< 30

Note: The relevant measured result has the offset with cable loss already.

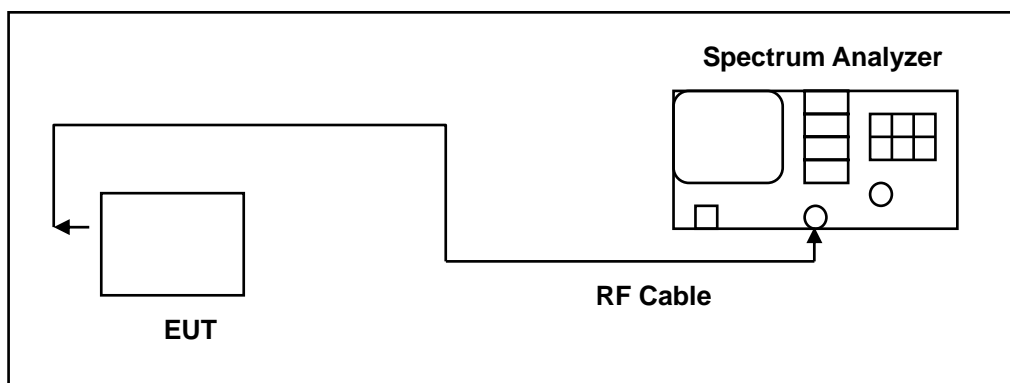


## 6 6dB RF Bandwidth Measurement

### 6.1. Limit

6dB RF Bandwidth: Systems using digital modulation techniques may operate in the 2400–2483.5 MHz bands. The minimum 6 dB band-width shall be at least 500 kHz.

### 6.2. Test Setup



### 6.3. Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	E4445A	MY45300744	12/15/2015	1 year
Microwave Cable	EMCI	EMC104-SM-S M-1500	140303	02/23/2016	1 year
Test Site	ATL	TE05	TE05	N.C.R.	-----

Note: N.C.R. = No Calibration Request.

### 6.4. Test Procedure

The EUT tested to DTS test procedure of KDB558074D01 for compliance to FCC 47CFR 15.247 requirements.




6dB RF Bandwidth: The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW was set to 100 kHz. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A peak output reading was taken, a DISPLAY line was drawn 6 dB lower than peak level. The 6 dB bandwidth was determined from where the channel output spectrum intersected the display line.

The test was performed at 3 channels (Channel low, middle, high)

### 6.5. Test Result

Test Date:	12/08/2016	
Frequency (MHz)	Measurement Results (kHz)	Limit (kHz)
2402	713.000	> 500
2440	717.200	> 500
2480	727.600	> 500

## 6.6. Test Graphs

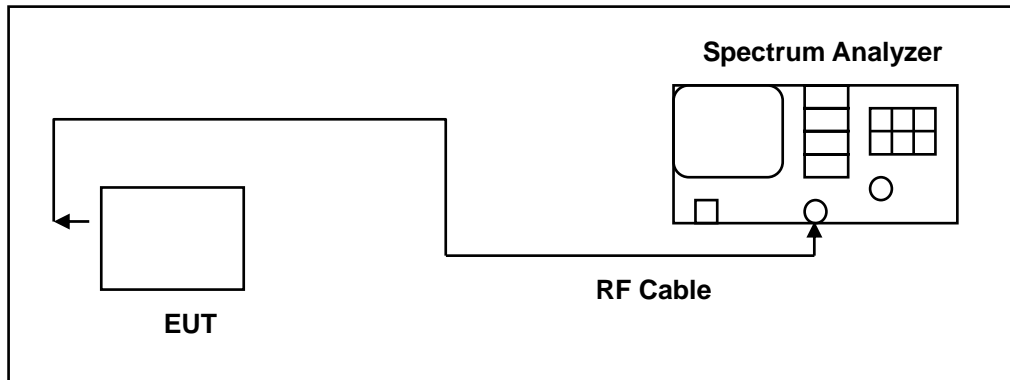
Test Mode:	Mode 2
2402 MHz	 <p>Center Freq 2.402000000 GHz</p> <p>Center Freq: 2.402000000 GHz</p> <p>Trig: Free Run</p> <p>Avg/Hold: &gt;10/10</p> <p>Radio Std: None</p> <p>Radio Device: BTS</p> <p>Ref Offset 1 dB</p> <p>Ref 20.00 dBm</p> <p>Center 2.402 GHz</p> <p>#Res BW 100 kHz</p> <p>#VBW 300 kHz</p> <p>Span 3 MHz</p> <p>Sweep 1 ms</p> <p>Occupied Bandwidth 1.0667 MHz</p> <p>Total Power 3.97 dBm</p> <p>Transmit Freq Error -35.451 kHz</p> <p>OBW Power 99.00 %</p> <p>x dB Bandwidth 713.0 kHz</p> <p>x dB -6.00 dB</p> <p>Frequency</p> <p>Center Freq 2.402000000 GHz</p> <p>CF Step 300.000 kHz</p> <p>Man</p> <p>Freq Offset 0 Hz</p>
2440 MHz	 <p>Center Freq 2.440000000 GHz</p> <p>Center Freq: 2.440000000 GHz</p> <p>Trig: Free Run</p> <p>Avg/Hold: &gt;10/10</p> <p>Radio Std: None</p> <p>Radio Device: BTS</p> <p>Ref Offset 1 dB</p> <p>Ref 20.00 dBm</p> <p>Center 2.44 GHz</p> <p>#Res BW 100 kHz</p> <p>#VBW 300 kHz</p> <p>Span 3 MHz</p> <p>Sweep 1 ms</p> <p>Occupied Bandwidth 1.0738 MHz</p> <p>Total Power 3.30 dBm</p> <p>Transmit Freq Error -35.798 kHz</p> <p>OBW Power 99.00 %</p> <p>x dB Bandwidth 717.2 kHz</p> <p>x dB -6.00 dB</p> <p>Frequency</p> <p>Center Freq 2.440000000 GHz</p> <p>CF Step 300.000 kHz</p> <p>Man</p> <p>Freq Offset 0 Hz</p>
2480 MHz	 <p>Center Freq 2.480000000 GHz</p> <p>Center Freq: 2.480000000 GHz</p> <p>Trig: Free Run</p> <p>Avg/Hold: &gt;10/10</p> <p>Radio Std: None</p> <p>Radio Device: BTS</p> <p>Ref Offset 1 dB</p> <p>Ref 20.00 dBm</p> <p>Center 2.48 GHz</p> <p>#Res BW 100 kHz</p> <p>#VBW 300 kHz</p> <p>Span 3 MHz</p> <p>Sweep 1 ms</p> <p>Occupied Bandwidth 1.0777 MHz</p> <p>Total Power 2.49 dBm</p> <p>Transmit Freq Error -36.454 kHz</p> <p>OBW Power 99.00 %</p> <p>x dB Bandwidth 727.6 kHz</p> <p>x dB -6.00 dB</p> <p>Frequency</p> <p>Center Freq 2.480000000 GHz</p> <p>CF Step 300.000 kHz</p> <p>Man</p> <p>Freq Offset 0 Hz</p>

## 7 Maximum Power Density Measurement

### 7.1. Limit

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.

### 7.2. Test Setup



### 7.3. Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	E4445A	MY45300744	12/15/2015	1 year
Microwave Cable	EMCI	EMC104-SM-S M-1500	140303	02/23/2016	1 year
Test Site	ATL	TE05	TE05	N.C.R.	-----

Note: N.C.R. = No Calibration Request.

### 7.4. Test Procedure

The EUT tested to DTS test procedure of KDB558074D01 for compliance to FCC 47CFR 15.247 requirements.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
4. Set the VBW  $\geq 3 \times \text{RBW}$ .
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.






## 7.5. Test Result

Test Date:	12/08/2016	
Frequency (MHz)	Measurement Results (dBm/3KHz)	Limit (dBm)
2402	-18.095	< 8
2440	-18.750	< 8
2480	-19.681	< 8



## 7.6. Test Graphs

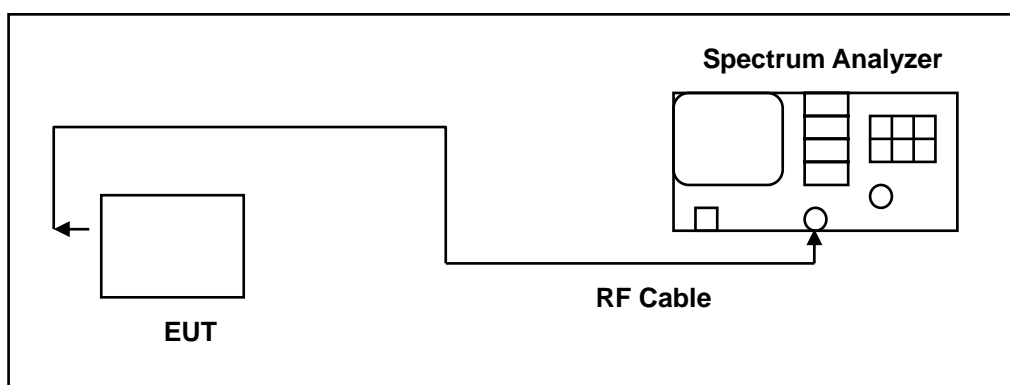
Test Mode:	Mode 2
2402 MHz	
2440 MHz	
2480 MHz	

## 8 Out of Band Conducted Emissions Measurement

### 8.1. Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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

### 8.2. Test Setup



### 8.3. Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	E4445A	MY45300744	12/15/2015	1 year
Spectrum Analyzer	Agilent	E4408B	MY45107753	08/08/2016	1 year
Microwave Cable	EMCI	EMC104-SM-S M-1500	140303	02/23/2016	1 year
Test Site	ATL	TE05	TE05	N.C.R.	-----

Note: N.C.R. = No Calibration Request.


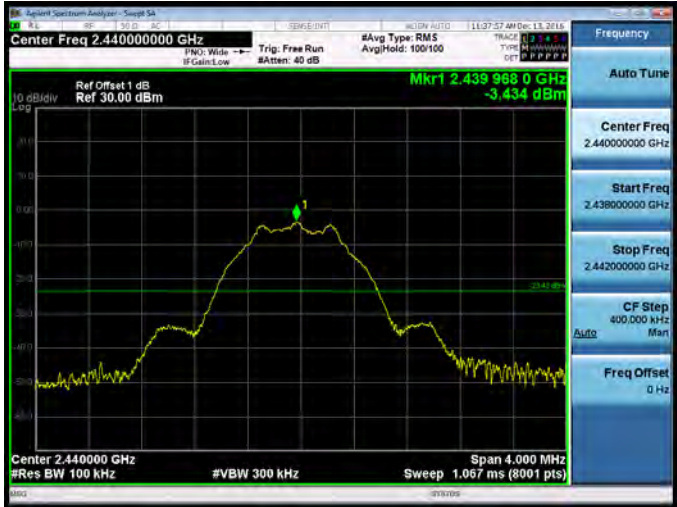

### 8.4. Test Procedure

In any 100 kHz bandwidth outside the EUT pass band, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function. All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the pass band. The test was performed at 3 channels.








## 8.5. Test Graphs

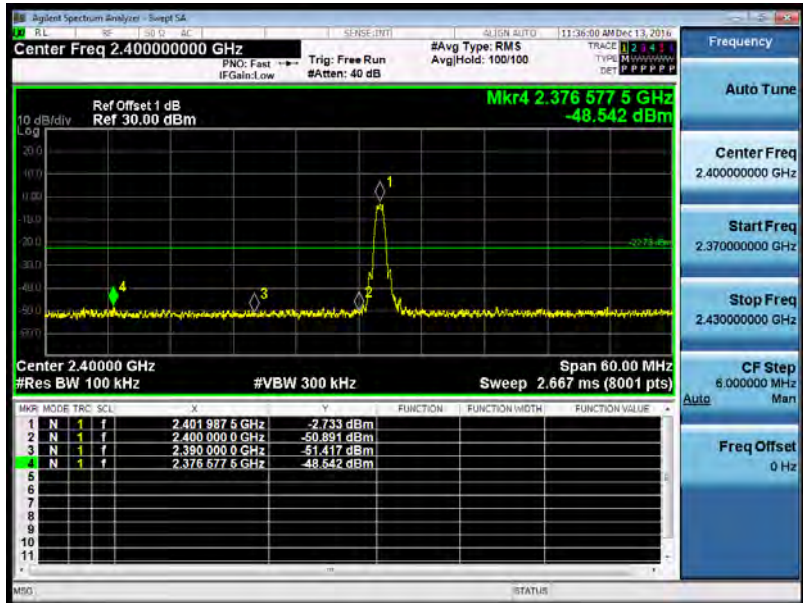
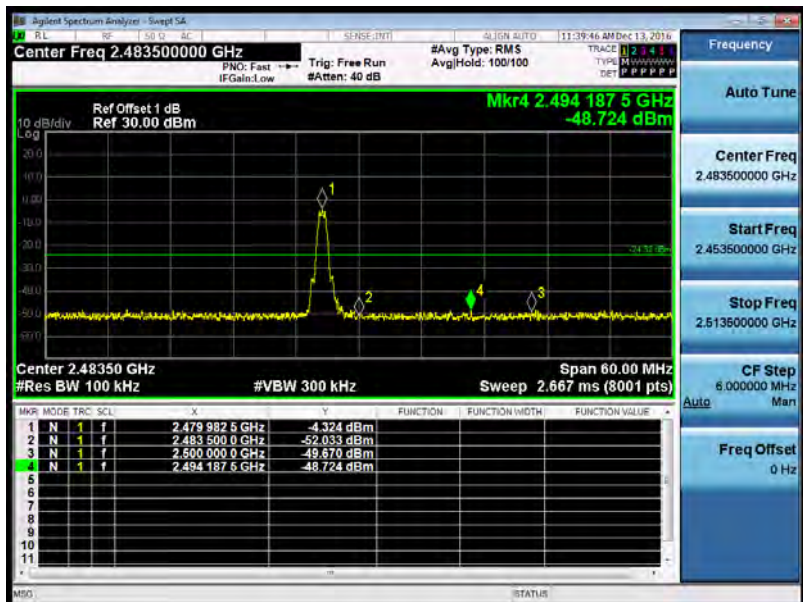
Reference level	
Test Date:	12/13/2016
Test Mode:	Mode 2
2402 MHz	
2440 MHz	
2480 MHz	



Out of Band Conducted Emissions	
Test Date:	12/13/2016
Test Mode:	Mode 2
2402 MHz	
2440 MHz	
2480 MHz	





Conducted Band Edge																																														
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Test Mode:	Mode 2																																													
2402 MHz	 <table><tr><th>MN</th><th>MODE</th><th>TRC</th><th>SCL</th><th>X</th><th>Y</th><th>FUNCTION</th><th>FUNCTION WIDTH</th><th>FUNCTION VALUE</th></tr><tr><td>1</td><td>N</td><td>1</td><td>f</td><td>2.4019875 GHz</td><td>-2.733 dBm</td><td></td><td></td><td></td></tr><tr><td>2</td><td>N</td><td>1</td><td>f</td><td>2.4000000 GHz</td><td>-50.891 dBm</td><td></td><td></td><td></td></tr><tr><td>3</td><td>N</td><td>1</td><td>f</td><td>2.3900000 GHz</td><td>-51.417 dBm</td><td></td><td></td><td></td></tr><tr><td>4</td><td>N</td><td>1</td><td>f</td><td>2.3765775 GHz</td><td>-48.542 dBm</td><td></td><td></td><td></td></tr></table>	MN	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	N	1	f	2.4019875 GHz	-2.733 dBm				2	N	1	f	2.4000000 GHz	-50.891 dBm				3	N	1	f	2.3900000 GHz	-51.417 dBm				4	N	1	f	2.3765775 GHz	-48.542 dBm			
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## **9 Antenna Measurement**

### **9.1. Limit**

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.

And According to 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

### **9.2. Antenna Connector Construction**

See section 2 – antenna information.