

# FCC Part 15C

## Measurement and Test Report




For

**Hong Kong RFID Ltd.**

**Unit 11, 9/F, Wah Wai Centre, 38-40 Au Pui Wan Street, Fotan, Shatin,**

**Hong Kong**

**FCC ID: XNOHKRAT-RT03**

<b>FCC Rule(s):</b>	<u>FCC Part 15.247</u>
<b>Product Description:</b>	<u>2.4GHz WIRELESS ACTIVE RFID TAG</u>
<b>Tested Model:</b>	<u>HKRAT-RT03</u>
<b>Report No.:</b>	<u>WTX19X01003726W-2</u>
<b>Sample Receipt Date:</b>	<u>2019-01-16</u>
<b>Tested Date:</b>	<u>2019-01-16 to 2019-03-15</u>
<b>Issued Date:</b>	<u>2019-04-23</u>
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Note: This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by Shenzhen SEM Test Technology Co., Ltd.

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## 1. GENERAL INFORMATION

### 1.1 Product Description for Equipment Under Test (EUT)

#### Client Information

Applicant: Hong Kong RFID Ltd.  
Address of applicant: Unit 11, 9/F, Wah Wai Centre, 38-40 Au Pui Wan Street,  
Fotan, Shatin, Hong Kong

Manufacturer: Hong Kong RFID Ltd.  
Address of manufacturer: Unit 11, 9/F, Wah Wai Centre, 38-40 Au Pui Wan Street,  
Fotan, Shatin, Hong Kong

General Description of EUT	
Product Name:	2.4GHz WIRELESS ACTIVE RFID TAG
Brand Name:	/
Model No.:	HKRAT-RT03
Adding Model(s):	HKRAT-RT03-***** (*=0, H, I, M, R, T, Z )
Rated Voltage:	DC3V
<i>Note: The test data is gathered from a production sample, provided by the manufacturer. The appearance of others models listed in the report is different from main-test model HKRAT-RT03, but the circuit and the electronic construction do not change, declared by the manufacturer.</i>	

Technical Characteristics of EUT	
Bluetooth Version:	V5.0 (BLE mode)
Frequency Range:	2402-2480MHz
RF Output Power:	-0.106dBm (Conducted)
Data Rate:	1Mbps
Modulation:	GFSK
Quantity of Channels:	40
Channel Separation:	2MHz
Type of Antenna:	PCB
Antenna Gain:	0dBi

## 1.2 Test Standards

The tests were performed according to following standards:

**FCC Rules Part 15.247:** Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

**558074 D01 15.247 Meas Guidance v05:** Guidance For Compliance Measurements On Digital Transmission System, Frequency Hopping Spread Spectrum System, And Hybrid System Devices Operating Under Section 15.247 Of The Fcc Rules

**ANSI C63.10-2013:** American National Standard for Testing Unlicensed Wireless Devices.

**Maintenance of compliance** is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

## 1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05

The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

## 1.4 Test Facility

### **FCC – Registration No.: 125990**

Shenzhen SEM Test Technology Co., Ltd. Laboratory has been recognized to perform compliance testing on equipment subject to the Commissions Declaration Of Conformity (DOC). The Designation Number is CN5010, and Test Firm Registration Number is 125990.

### **Industry Canada (IC) Registration No.: 11464A**

The 3m Semi-anechoic chamber of Shenzhen SEM Test Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

## 1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, with a duty cycle equal to 100%, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	Low	2402MHz
TM2	Middle	2440MHz
TM3	High	2480MHz

Test Conditions	
Temperature:	22~25 °C
Relative humidity	50~55 %.
ATM Pressure:	1019 mbar

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

## 1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	$\pm 0.42\text{dB}$
Occupied Bandwidth	Conducted	$\pm 1.5\%$
Power Spectral Density	Conducted	$\pm 1.8\text{dB}$
Conducted Spurious Emission	Conducted	$\pm 2.17\text{dB}$
Conducted Emissions	Conducted	9-150kHz $\pm 3.74\text{dB}$
		0.15-30MHz $\pm 3.34\text{dB}$
	Radiated	30-200MHz $\pm 4.52\text{dB}$
		0.2-1GHz $\pm 5.56\text{dB}$
		1-6GHz $\pm 3.84\text{dB}$
Transmitter Spurious Emissions		6-18GHz $\pm 3.92\text{dB}$

## 1.7 Test Equipment List and Details

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due Date
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2018-05-22	2019-05-21
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2018-05-22	2019-05-21
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2018-05-22	2019-05-21
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2018-05-22	2019-05-21
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2018-05-22	2019-05-21
SEMT-1011	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2017-06-08	2020-06-07
SEMT-1042	Horn Antenna	ETS	3117	00086197	2017-06-08	2020-06-07
SEMT-1121	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170582	2017-06-08	2020-06-07
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2017-06-08	2020-06-07
SEMT-1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2018-05-22	2019-05-21
SEMT-1003	L.I.S.N	Schwarz beck	NSLK8126	8126-224	2018-05-22	2019-05-21
SEMT-1002	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2018-05-22	2019-05-21
SEMT-1168	Pre-amplifier	Direction Systems Inc.	PAP-0126	14141-12838	2018-05-22	2019-05-21
SEMT-1169	Pre-amplifier	Direction Systems Inc.	PAP-2640	14145-14153	2018-05-22	2019-05-21
SEMT-1163	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2018-05-22	2019-05-21
SEMT-1170	DRG Horn Antenna	A.H. SYSTEMS	SAS-574	571	2018-03-19	2021-03-18
SEMT-1166	Power Limiter	Agilent	N9356B	MY45450376	2018-05-22	2019-05-21
SEMT-1048	RF Limiter	ATTEN	AT-BSF-2400~2500	/	2018-05-22	2019-05-21
SEMT-1076	RF Switcher	Top Precision	RCS03-A2	/	2018-05-22	2019-05-21
SEMT-C001	Cable	Zheng DI	LL142-07-07-10M(A)	/	2018-03-19	2019-03-18
SEMT-C002	Cable	Zheng DI	ZT40-2.92J-2.92J-6M	/	2018-03-19	2019-03-18
SEMT-C003	Cable	Zheng DI	ZT40-2.92J-2.92J-2.5M	/	2018-03-19	2019-03-18
SEMT-C004	Cable	Zheng DI	2M0RFC	/	2018-03-19	2019-03-18
SEMT-C005	Cable	Zheng DI	1M0RFC	/	2018-03-19	2019-03-18
SEMT-C006	Cable	Zheng DI	1M0RFC	/	2018-03-19	2019-03-18

## 2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 2.1093	RF Exposure	Compliant
§ 15.203; § 15.247(b)(4)(i)	Antenna Requirement	Compliant
§15.205	Restricted Band of Operation	Compliant
§ 15.207(a)	Conducted Emission	N/A
§ 15.247(e)	Power Spectral Density	Compliant
§ 15.247(a)(2)	DTS Bandwidth	Compliant
§ 15.247(b)(3)	RF Output Power	Compliant
§ 15.209(a)	Radiated Emission	Compliant
§ 15.247(d)	Band Edge (Out of Band Emissions)	Compliant

N/A: not applicable



### **3. RF Exposure**

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#### **3.1 Standard Applicable**

According to § 1.1307 and § 2.1093, the portable transmitter must comply the RF exposure requirements.

#### **3.2 Test Result**

This product complied with the requirement of the RF exposure, please see the RF Exposure Report.



## **4. Antenna Requirement**

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### **4.1 Standard Applicable**

According to FCC Part 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

### **4.2 Evaluation Information**

This product has a PCB antenna, fulfill the requirement of this section.

## 5. Power Spectral Density

### 5.1 Standard Applicable

According to 15.247(a)(1)(iii), 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.

### 5.2 Test Procedure

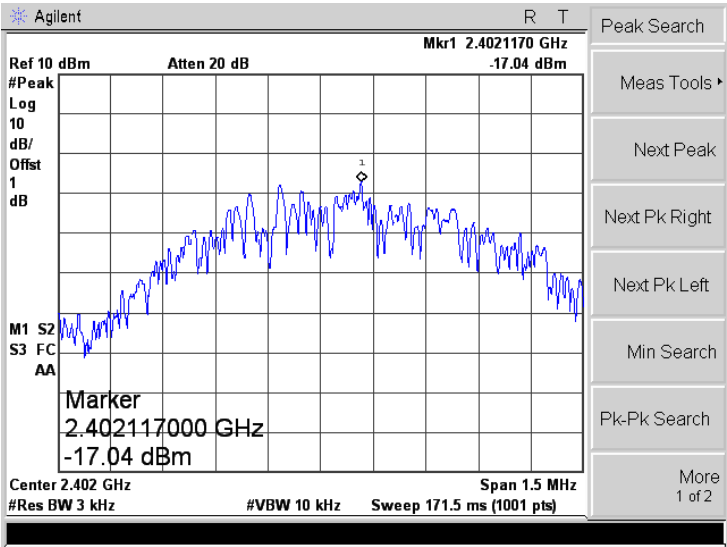
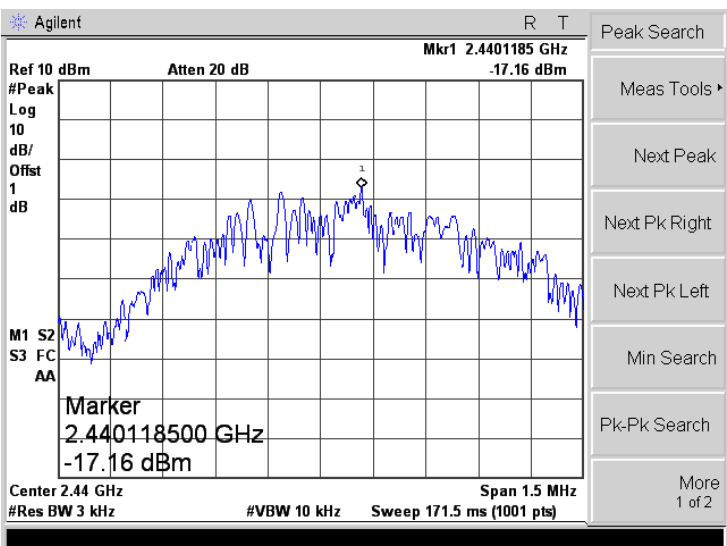
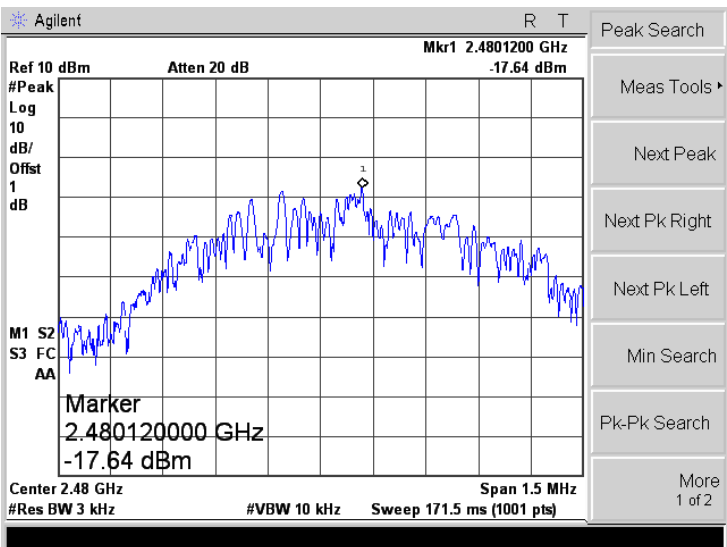
According to the KDB 558074 D01 v05 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.10.2, the test method of power spectral density as below:

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

### 5.3 Summary of Test Results/Plots

Test Mode	Test Channel	Power Spectral Density dBm/3kHz	Limit dBm/3kHz
GFSK(BLE)	Low	-17.04	8
	Middle	-17.16	8
	High	-17.64	8

Please refer to the following test plots:

<p>Low</p>	 <p>Agilent R T</p> <p>Ref 10 dBm Atten 20 dB Mkr1 2.4021170 GHz -17.04 dBm</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>M1 S2 S3 FC AA</p> <p>Marker 2.402117000 GHz -17.04 dBm</p> <p>Center 2.402 GHz Span 1.5 MHz #Res BW 3 kHz #VBW 10 kHz Sweep 171.5 ms (1001 pts)</p> <p>Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2</p>
<p>Middle</p>	 <p>Agilent R T</p> <p>Ref 10 dBm Atten 20 dB Mkr1 2.4401185 GHz -17.16 dBm</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>M1 S2 S3 FC AA</p> <p>Marker 2.440118500 GHz -17.16 dBm</p> <p>Center 2.44 GHz Span 1.5 MHz #Res BW 3 kHz #VBW 10 kHz Sweep 171.5 ms (1001 pts)</p> <p>Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2</p>
<p>High</p>	 <p>Agilent R T</p> <p>Ref 10 dBm Atten 20 dB Mkr1 2.4801200 GHz -17.64 dBm</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>M1 S2 S3 FC AA</p> <p>Marker 2.480120000 GHz -17.64 dBm</p> <p>Center 2.48 GHz Span 1.5 MHz #Res BW 3 kHz #VBW 10 kHz Sweep 171.5 ms (1001 pts)</p> <p>Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2</p>

## 6. DTS Bandwidth

### 6.1 Standard Applicable

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

### 6.2 Test Procedure

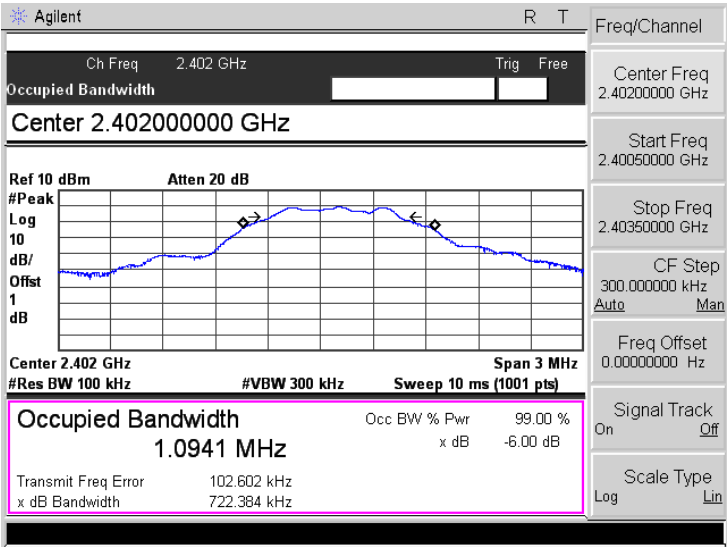
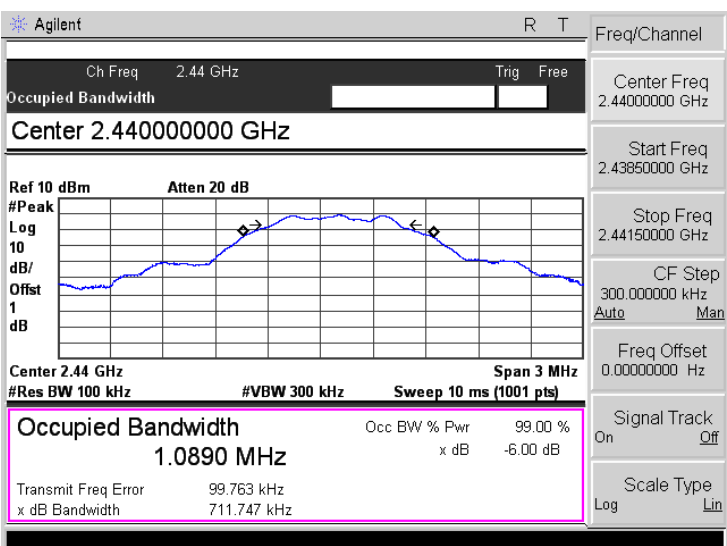
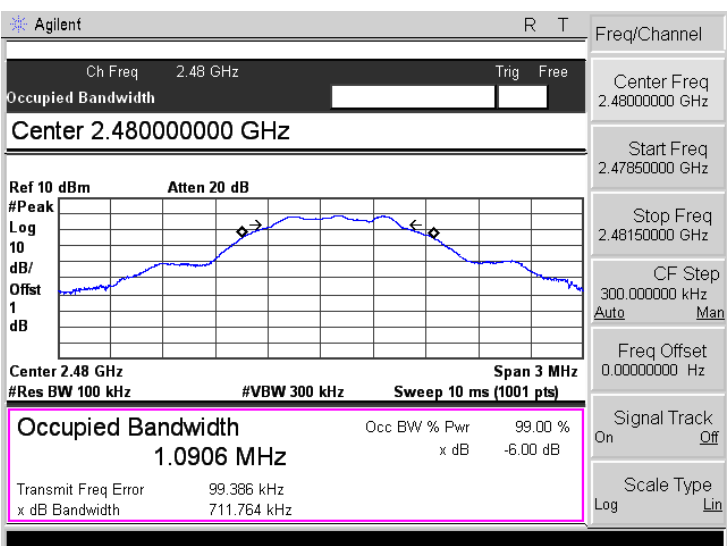
According to the KDB 558074 D01 v05 Subclause 8.2 and ANSI C63.10-2013 Subclause 11.8.1, the test method of DTS Bandwidth as below:

- Set RBW = 100 kHz.
- Set the video bandwidth (VBW)  $\geq 3 \times \text{RBW}$ .
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

### 6.3 Summary of Test Results/Plots

Test Mode	Test Channel	6 dB Bandwidth kHz	Limit kHz
GFSK(BLE)	Low	722.384	$\geq 500$
	Middle	711.747	$\geq 500$
	High	711.764	$\geq 500$

Please refer to the following test plots:

Low	 <p>Agilent R T</p> <p>Ch Freq 2.402 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Center 2.40200000 GHz</p> <p>Ref 10 dBm Atten 20 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 2.402 GHz Span 3 MHz</p> <p>#Res BW 100 kHz #VBW 300 kHz Sweep 10 ms (1001 pts)</p> <p><b>Occupied Bandwidth</b> 1.0941 MHz</p> <p>Occ BW % Pwr 99.00 % x dB -6.00 dB</p> <p>Transmit Freq Error 102.602 kHz</p> <p>x dB Bandwidth 722.384 kHz</p> <p>Freq/Channel</p> <p>Center Freq 2.40200000 GHz</p> <p>Start Freq 2.40050000 GHz</p> <p>Stop Freq 2.40350000 GHz</p> <p>CF Step 300.000000 kHz Auto Man</p> <p>Freq Offset 0.00000000 Hz</p> <p>Signal Track On Off</p> <p>Scale Type Log Lin</p>
Middle	 <p>Agilent R T</p> <p>Ch Freq 2.44 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Center 2.44000000 GHz</p> <p>Ref 10 dBm Atten 20 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 2.44 GHz Span 3 MHz</p> <p>#Res BW 100 kHz #VBW 300 kHz Sweep 10 ms (1001 pts)</p> <p><b>Occupied Bandwidth</b> 1.0890 MHz</p> <p>Occ BW % Pwr 99.00 % x dB -6.00 dB</p> <p>Transmit Freq Error 99.763 kHz</p> <p>x dB Bandwidth 711.747 kHz</p> <p>Freq/Channel</p> <p>Center Freq 2.44000000 GHz</p> <p>Start Freq 2.43850000 GHz</p> <p>Stop Freq 2.44150000 GHz</p> <p>CF Step 300.000000 kHz Auto Man</p> <p>Freq Offset 0.00000000 Hz</p> <p>Signal Track On Off</p> <p>Scale Type Log Lin</p>
High	 <p>Agilent R T</p> <p>Ch Freq 2.48 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Center 2.48000000 GHz</p> <p>Ref 10 dBm Atten 20 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 2.48 GHz Span 3 MHz</p> <p>#Res BW 100 kHz #VBW 300 kHz Sweep 10 ms (1001 pts)</p> <p><b>Occupied Bandwidth</b> 1.0906 MHz</p> <p>Occ BW % Pwr 99.00 % x dB -6.00 dB</p> <p>Transmit Freq Error 99.386 kHz</p> <p>x dB Bandwidth 711.764 kHz</p> <p>Freq/Channel</p> <p>Center Freq 2.48000000 GHz</p> <p>Start Freq 2.47850000 GHz</p> <p>Stop Freq 2.48150000 GHz</p> <p>CF Step 300.000000 kHz Auto Man</p> <p>Freq Offset 0.00000000 Hz</p> <p>Signal Track On Off</p> <p>Scale Type Log Lin</p>

## 7. RF Output Power

### 7.1 Standard Applicable

According to 15.247(b)(3). For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

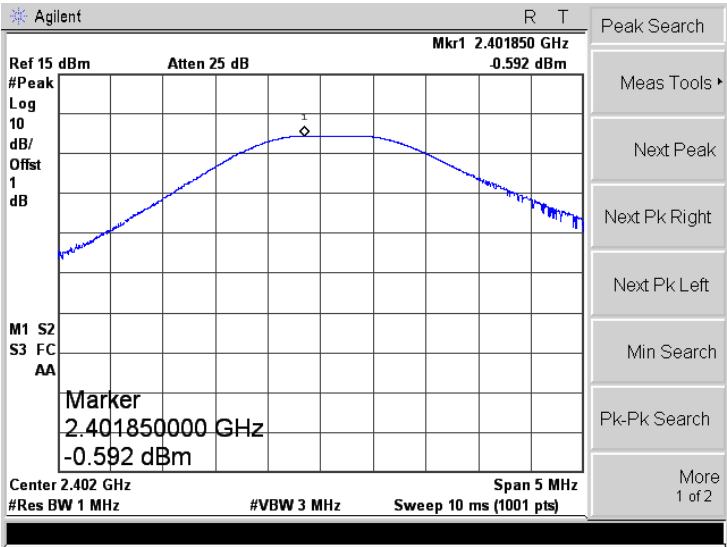
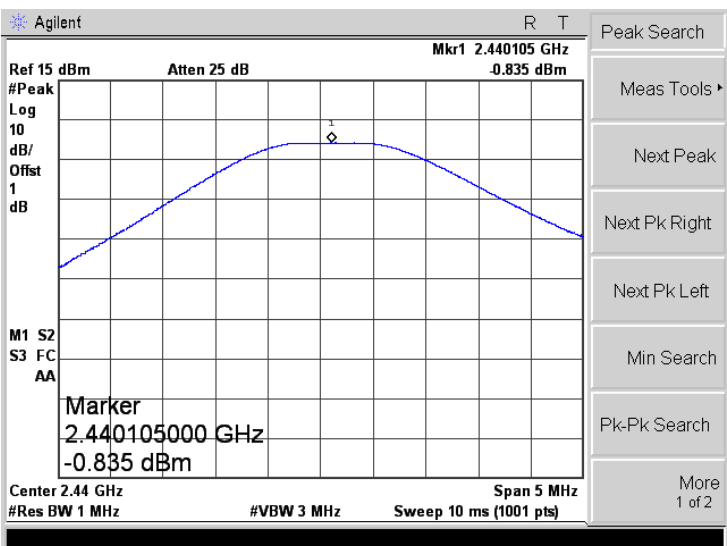
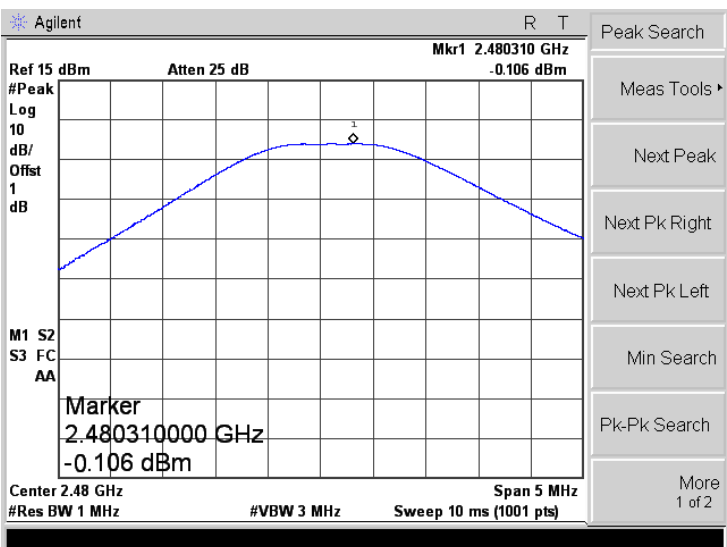
### 7.2 Test Procedure

According to the KDB-558074 D01 v05 Subclause 8.3.1.1 and ANSI C63.10-2013 Subclause 11.9.1.1, this procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

- a) Set the RBW  $\geq$  DTS bandwidth.
- b) Set VBW  $\geq 3 \times$  RBW.
- c) Set span  $\geq 3 \times$  RBW
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

### 7.3 Summary of Test Results/Plots

Test Mode	Test Channel	Reading dBm	Output Power mW	Limit mW
GFSK(BLE)	Low	-0.592	0.873	1000
	Middle	-0.835	0.825	1000
	High	-0.106	0.976	1000

Low	 <p>Agilent R T</p> <p>Ref 15 dBm Atten 25 dB Mkr1 2.401850 GHz -0.592 dBm</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>M1 S2 S3 FC AA</p> <p>Marker 2.401850000 GHz -0.592 dBm</p> <p>Center 2.402 GHz Span 5 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 10 ms (1001 pts)</p> <p>Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2</p>
Middle	 <p>Agilent R T</p> <p>Ref 15 dBm Atten 25 dB Mkr1 2.440105 GHz -0.835 dBm</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>M1 S2 S3 FC AA</p> <p>Marker 2.440105000 GHz -0.835 dBm</p> <p>Center 2.44 GHz Span 5 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 10 ms (1001 pts)</p> <p>Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2</p>
High	 <p>Agilent R T</p> <p>Ref 15 dBm Atten 25 dB Mkr1 2.480310 GHz -0.106 dBm</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>M1 S2 S3 FC AA</p> <p>Marker 2.480310000 GHz -0.106 dBm</p> <p>Center 2.48 GHz Span 5 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 10 ms (1001 pts)</p> <p>Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2</p>

## 8. Field Strength of Spurious Emissions

### 8.1 Standard Applicable

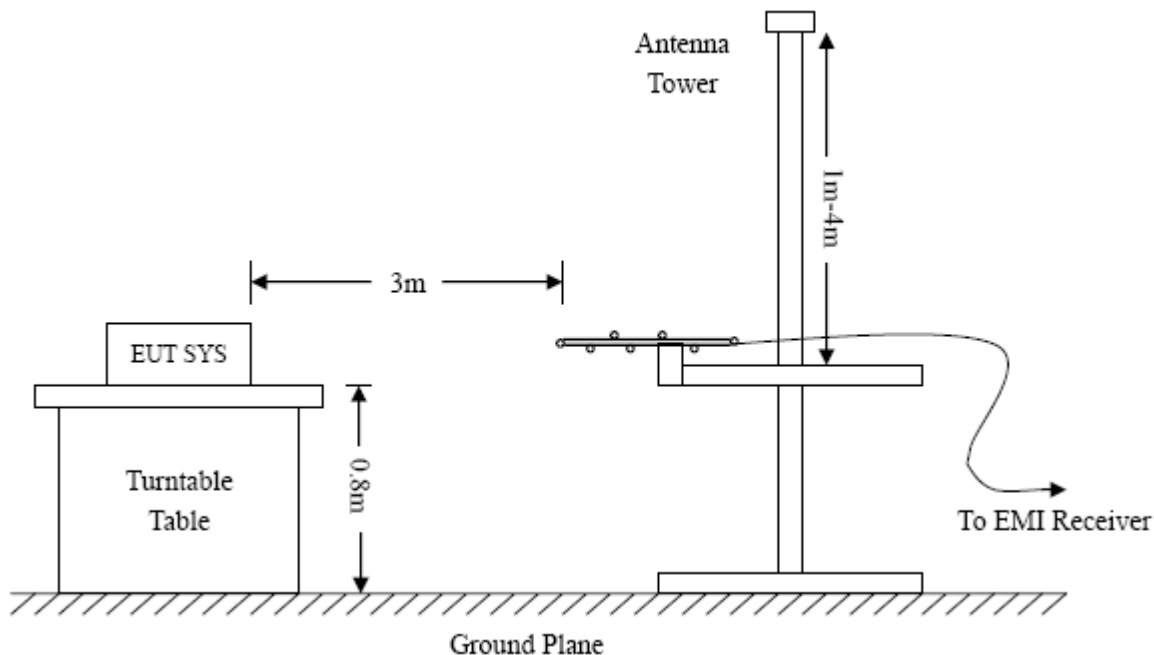
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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).

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

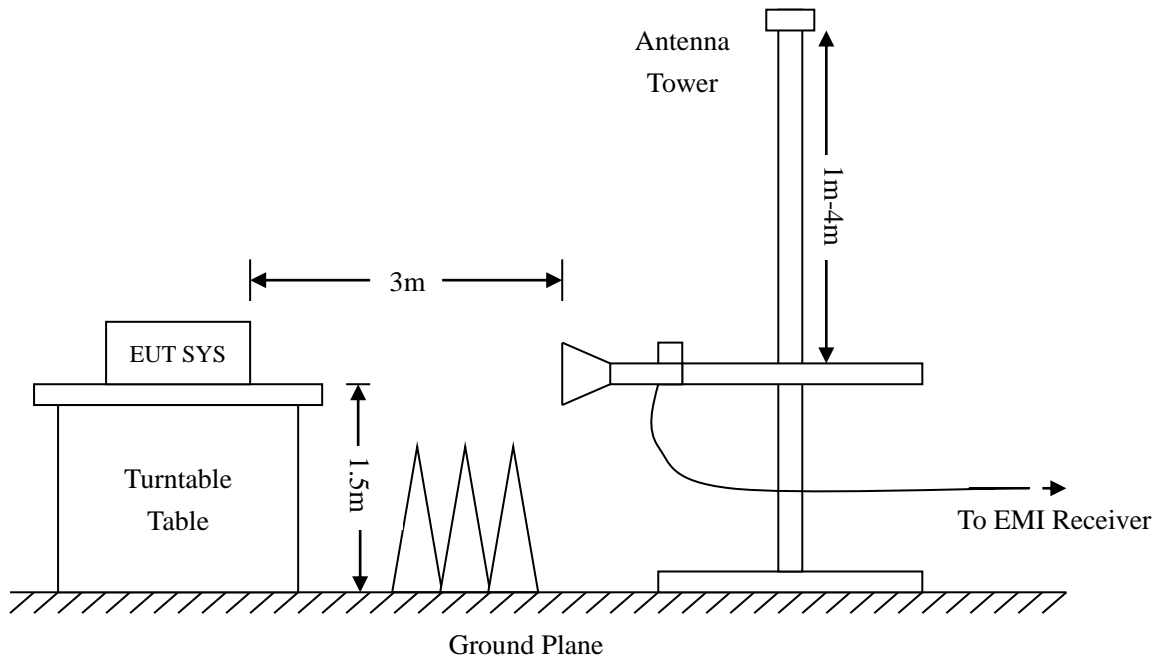
### 8.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle. The spacing between the peripherals was 10 cm.







Frequency :9kHz-30MHz

RBW=10KHz,

VBW =30KHz

Sweep time= Auto

Trace = max hold

Detector function = peak

Frequency :30MHz-1GHz

RBW=120KHz,

VBW=300KHz

Sweep time= Auto

Trace = max hold

Detector function = peak, QP

Frequency :Above 1GHz

RBW=1MHz,

VBW=3MHz(Peak), 10Hz(AV)

Sweep time= Auto

Trace = max hold

Detector function = peak, AV

### 8.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit. The equation for margin calculation is as follows:

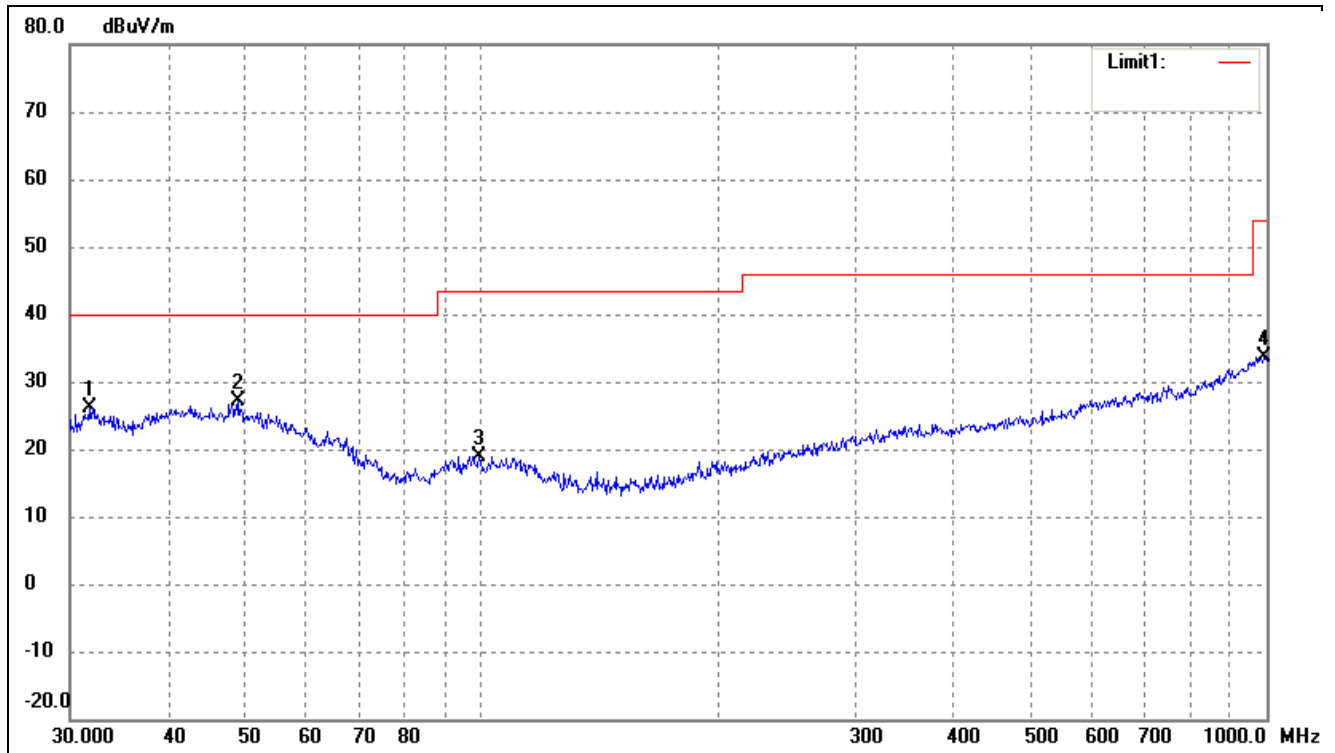
$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

### 8.4 Summary of Test Results/Plots

*Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.*

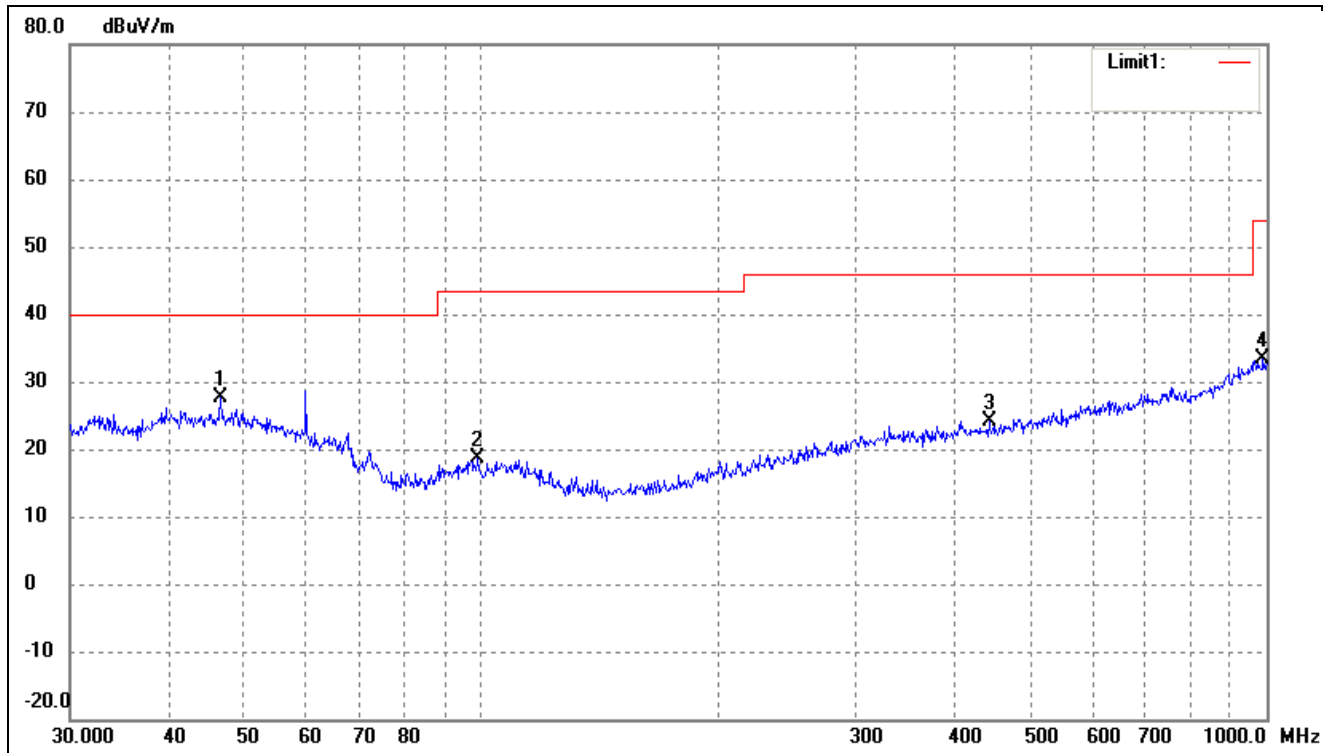
## ➤ Spurious Emissions Below 1GHz

Test Channel	Low	Polarity:	Horizontal
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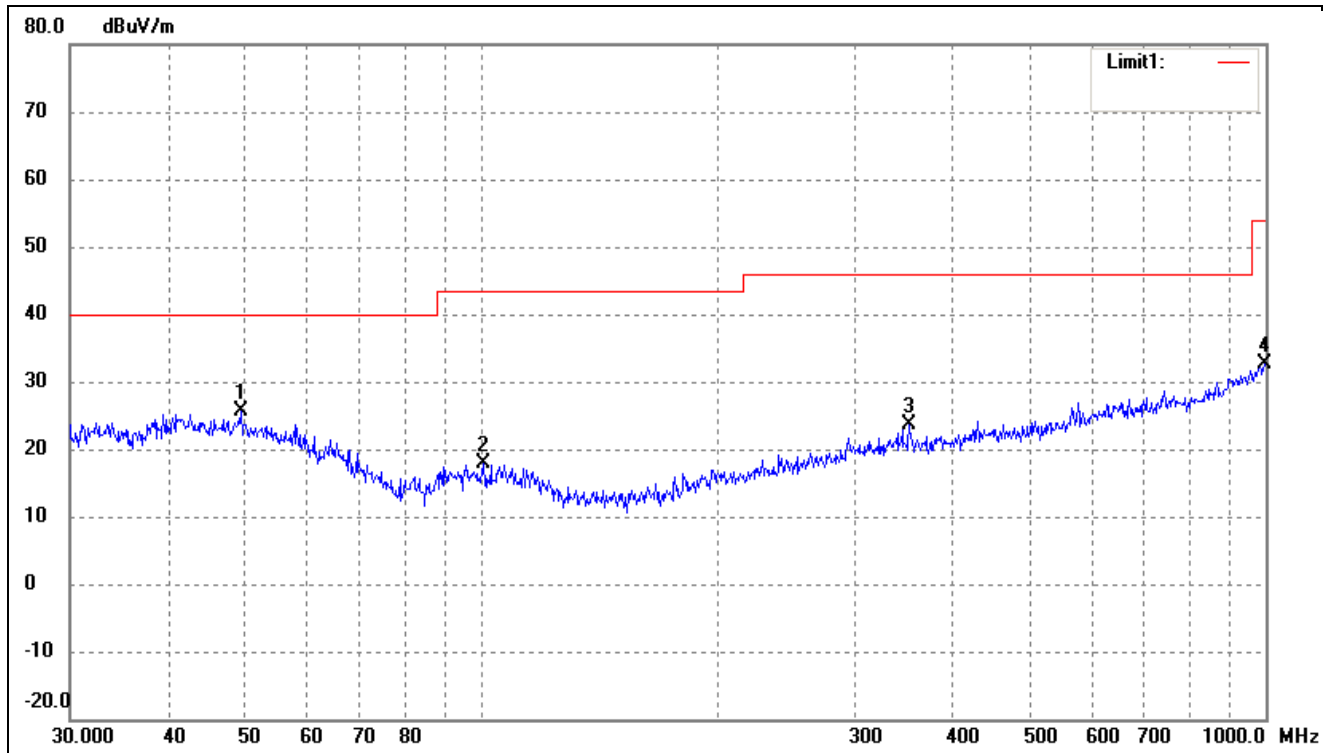
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	31.7313	35.79	-9.66	26.13	40.00	-13.87	221	100	peak
2	49.1865	35.51	-8.38	27.13	40.00	-12.87	90	100	peak
3	99.5281	33.92	-14.94	18.98	43.50	-24.52	137	100	peak
4	993.0114	29.78	3.93	33.71	54.00	-20.29	95	100	peak

Test Channel	Low	Polarity:	Vertical
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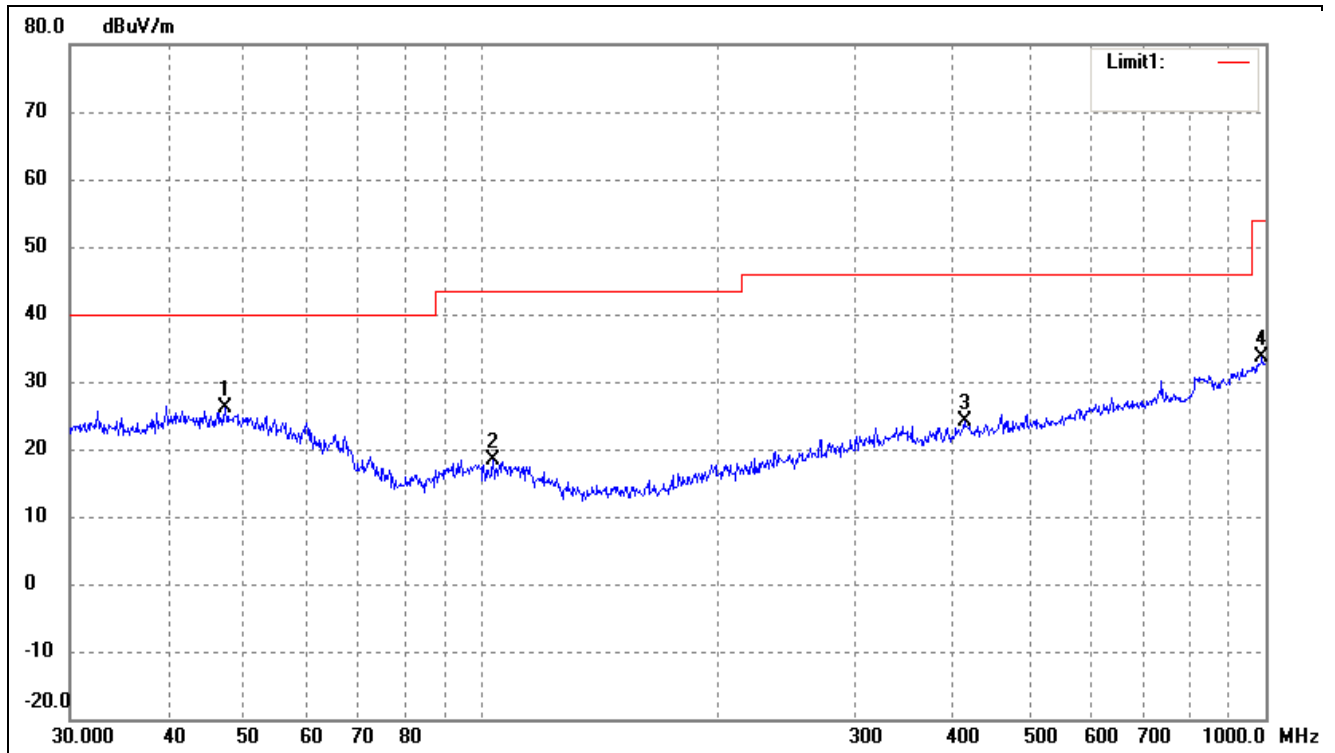
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	46.6664	35.82	-8.12	27.70	40.00	-12.30	282	100	peak
2	99.1797	33.70	-14.95	18.75	43.50	-24.75	93	100	peak
3	443.2943	31.18	-6.95	24.23	46.00	-21.77	351	100	peak
4	989.5355	29.43	3.88	33.31	54.00	-20.69	115	100	peak

Test Channel	Middle	Polarity:	Horizontal
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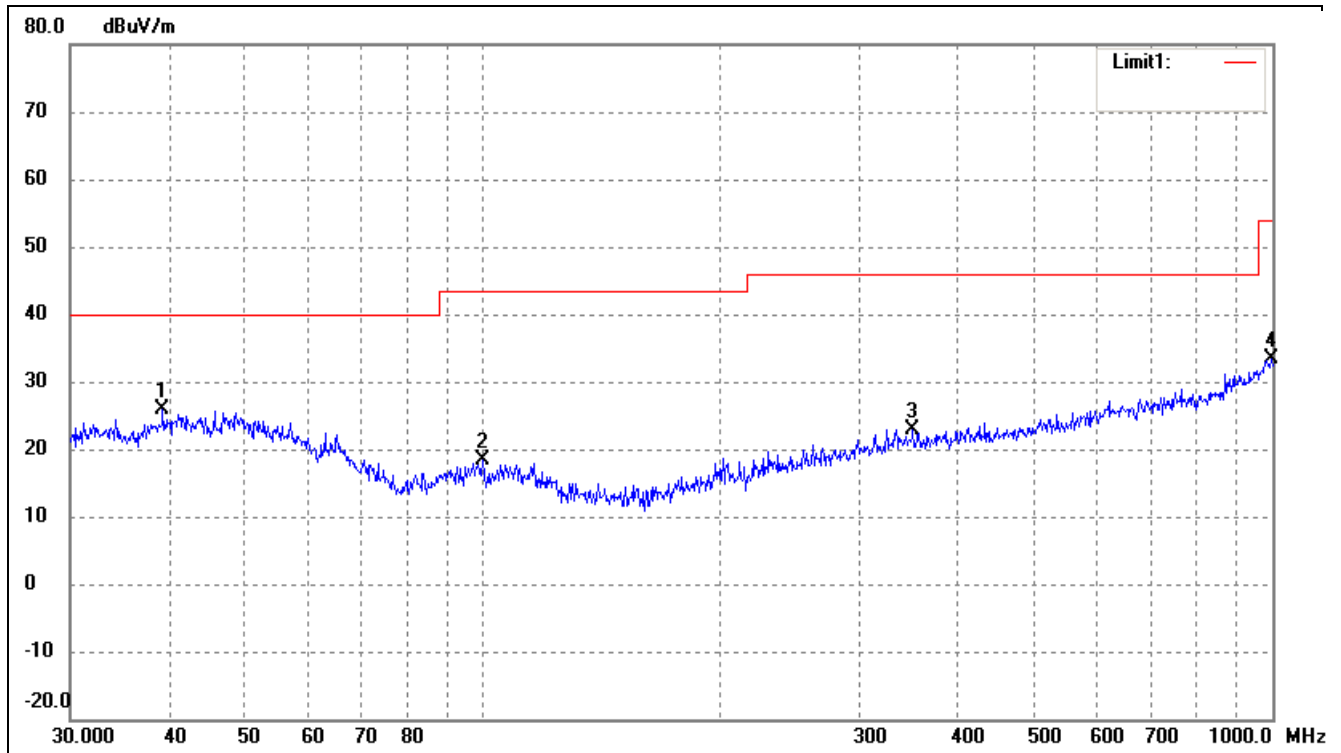
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	49.5328	34.13	-8.45	25.68	40.00	-14.32	190	100	peak
2	100.9340	32.78	-14.84	17.94	43.50	-25.56	155	100	peak
3	351.7079	31.72	-7.98	23.74	46.00	-22.26	77	100	peak
4	996.4996	28.75	3.98	32.73	54.00	-21.27	241	100	peak

Test Channel	Middle	Polarity:	Vertical
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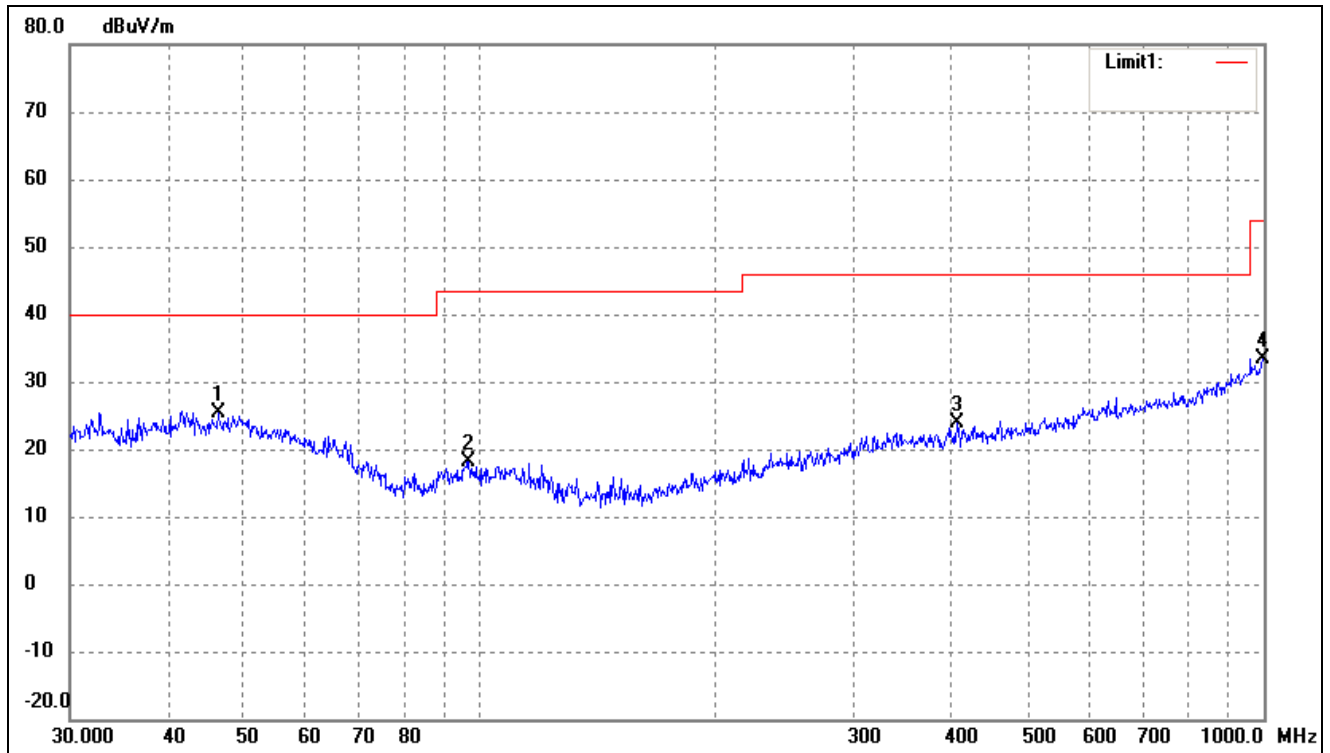
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	47.3255	34.20	-8.14	26.06	40.00	-13.94	72	100	peak
2	103.8055	33.05	-14.61	18.44	43.50	-25.06	219	100	peak
3	413.2706	31.12	-7.07	24.05	46.00	-21.95	83	100	peak
4	989.5355	29.72	3.88	33.60	54.00	-20.40	144	100	peak

Test Channel	High	Polarity:	Horizontal
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	39.2991	34.44	-8.63	25.81	40.00	-14.19	195	100	peak
2	99.8777	33.18	-14.92	18.26	43.50	-25.24	108	100	peak
3	350.4768	30.81	-7.96	22.85	46.00	-23.15	129	100	peak
4	996.4996	29.35	3.98	33.33	54.00	-20.67	145	100	peak

Test Channel	High	Polarity:	Vertical
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	46.3402	33.41	-8.09	25.32	40.00	-14.68	54	100	peak
2	96.7749	33.08	-15.04	18.04	43.50	-25.46	95	100	peak
3	406.0880	31.06	-7.27	23.79	46.00	-22.21	50	100	peak
4	996.4996	29.38	3.98	33.36	54.00	-20.64	92	100	peak

## ➤ Spurious Emissions Below 1GHz

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2402MHz							
4804	59.61	-3.59	56.02	74	-17.98	H	PK
4804	40.41	-3.59	36.82	54	-17.18	H	AV
7206	59.09	-0.52	58.57	74	-15.43	H	PK
7206	39.28	-0.52	38.76	54	-15.24	H	AV
4804	61.12	-3.59	57.53	74	-16.47	V	PK
4804	39.87	-3.59	36.28	54	-17.72	V	AV
7206	60.96	-0.52	60.44	74	-13.56	V	PK
7206	40.72	-0.52	40.2	54	-13.8	V	AV
Middle Channel-2440MHz							
4880	59.33	-3.49	55.84	74	-18.16	H	PK
4880	38.97	-3.49	35.48	54	-18.52	H	AV
7320	60.48	-0.47	60.01	74	-13.99	H	PK
7320	41.9	-0.47	41.43	54	-12.57	H	AV
4880	60.14	-3.49	56.65	74	-17.35	V	PK
4880	39.33	-3.49	35.84	54	-18.16	V	AV
7320	59.94	-0.47	59.47	74	-14.53	V	PK
7320	40.43	-0.47	39.96	54	-14.04	V	AV
High Channel-2480MHz							
4960	61.69	-3.41	58.28	74	-15.72	H	PK
4960	41.17	-3.41	37.76	54	-16.24	H	AV
7440	60.11	-0.42	59.69	74	-14.31	H	PK
7440	41.81	-0.42	41.39	54	-12.61	H	AV
4960	59.63	-3.41	56.22	74	-17.78	V	PK
4960	40.61	-3.41	37.2	54	-16.8	V	AV
7440	61.1	-0.42	60.68	74	-13.32	V	PK
7440	41.38	-0.42	40.96	54	-13.04	V	AV

*Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*



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## 9. Out of Band Emissions

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### 9.1 Standard Applicable

According to §15.247 (d) 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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).

### 9.2 Test Procedure

According to the KDB 558074D01 v05 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.11, the Emissions in nonrestricted frequency bands test method as follows:

- a) Set the center frequency and span to encompass frequency range to be measured.
- b) Set the RBW = 100 kHz.
- c) Set the VBW  $\geq [3 \times \text{RBW}]$ .
- d) Detector = peak.
- e) Sweep time = auto couple.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use the peak marker function to determine the maximum amplitude level.

According to the KDB 558074 D01 v05 Subclause 8.5 and ANSI C63.10-2013 Subclause 11.12, the Emissions in restricted frequency bands test method as follows:

#### A. Radiated emission measurements:

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2420MHz for low bandedge, 2460MHz to 2500MHz for the high bandedge)

RBW = 1MHz, VBW = 1MHz for peak value measured

RBW = 1MHz, VBW = 10Hz for average value measured

Sweep = auto; Detector function = peak/average; Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement KDB publication number: 913591 may be used for the radiated bandedge measurements.

**B. Antenna-port conducted measurements**

Peak emission levels are measured by setting the instrument as follows:

- a) RBW = as specified in Table 9/
- b)  $VBW \geq [3 \times RBW]$ .
- c) Detector = peak.
- d) Sweep time = auto.
- e) Trace mode = max hold.
- f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be lengthened for low-duty-cycle applications.)

**Table 9—RBW as a function of frequency**

Frequency	RBW
9 kHz to 150 kHz	200 Hz to 300 Hz
0.15 MHz to 30 MHz	9 kHz to 10 kHz
30 MHz to 1000 MHz	100 kHz to 120 kHz
>1000 MHz	1 MHz

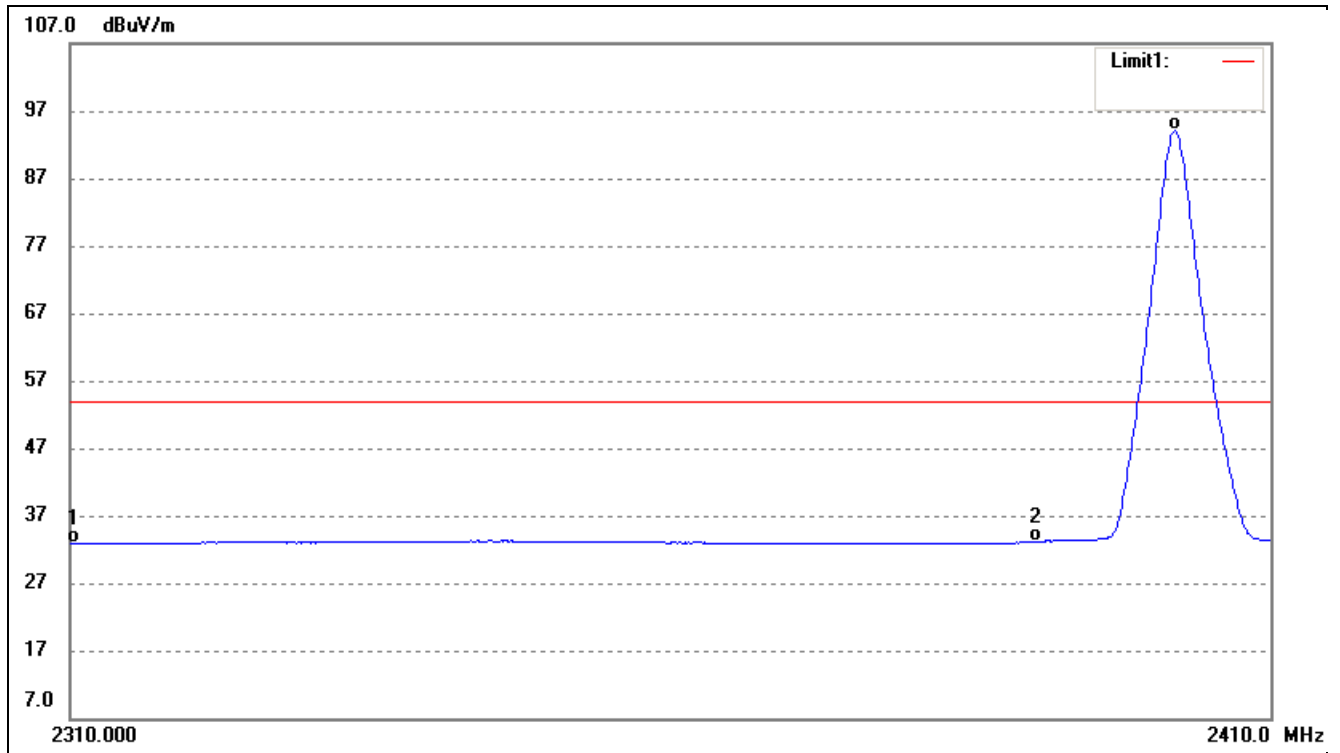
If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in section 8.1. Report the three highest emissions relative to the limit.

**9.3 Summary of Test Results/Plots**

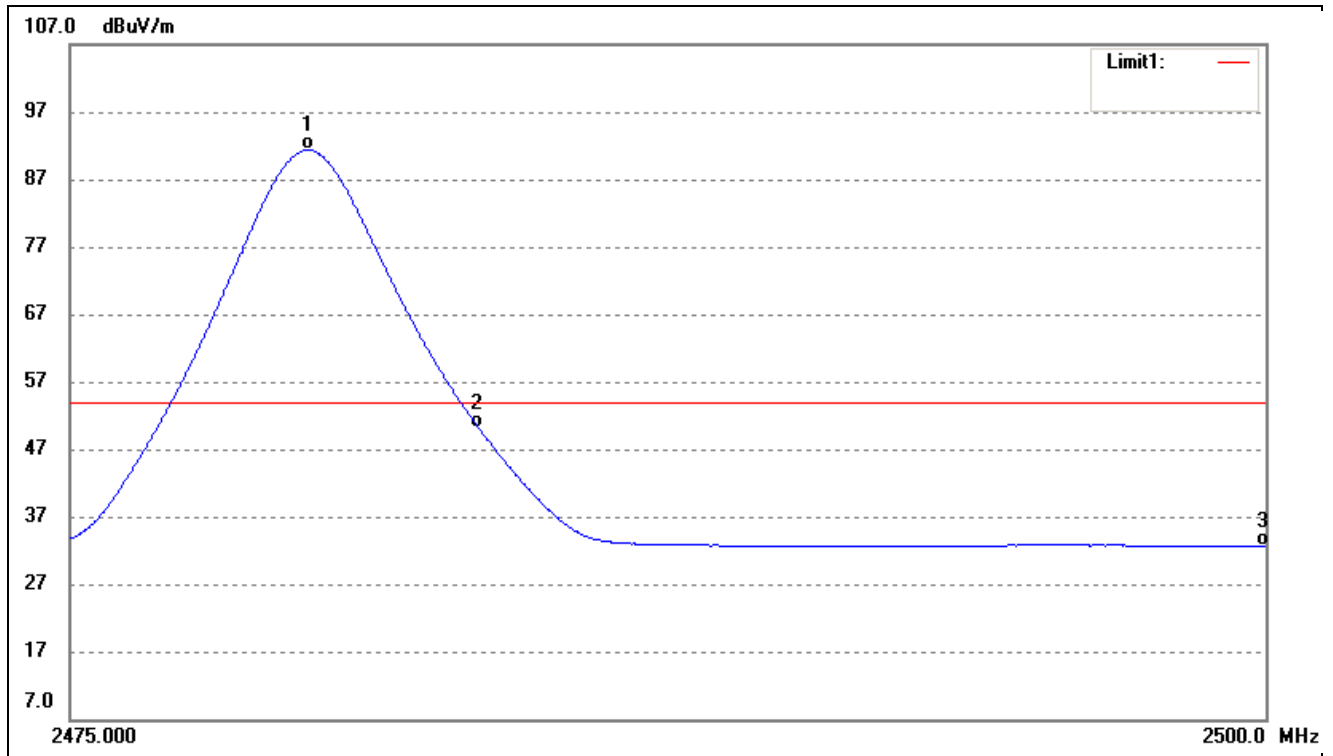
➤ Radiated test

Test Channel	Low	Polarity:	Vertical(worst case)
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000	40.66	-7.78	32.88	54.00	-21.12	Average Detector
	2310.000	53.23	-7.78	45.45	74.00	-28.55	Peak Detector
2	2390.000	40.48	-7.32	33.16	54.00	-20.84	Average Detector
	2390.000	52.74	-7.32	45.42	74.00	-28.58	Peak Detector
3	2401.843	101.38	-7.25	94.13	/	/	Average Detector
	2402.148	106.60	-7.25	99.35	/	/	Peak Detector

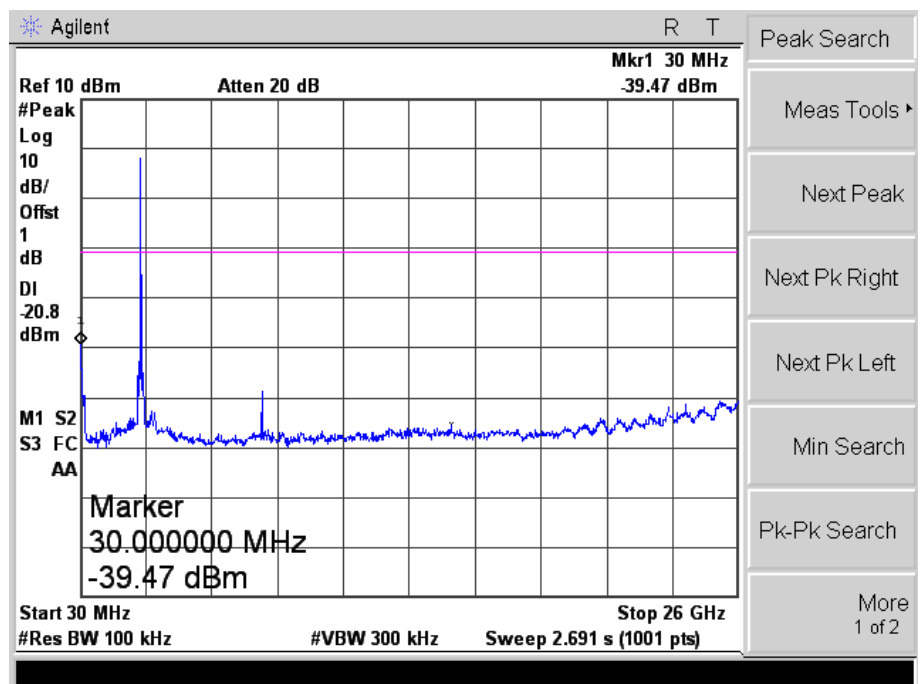
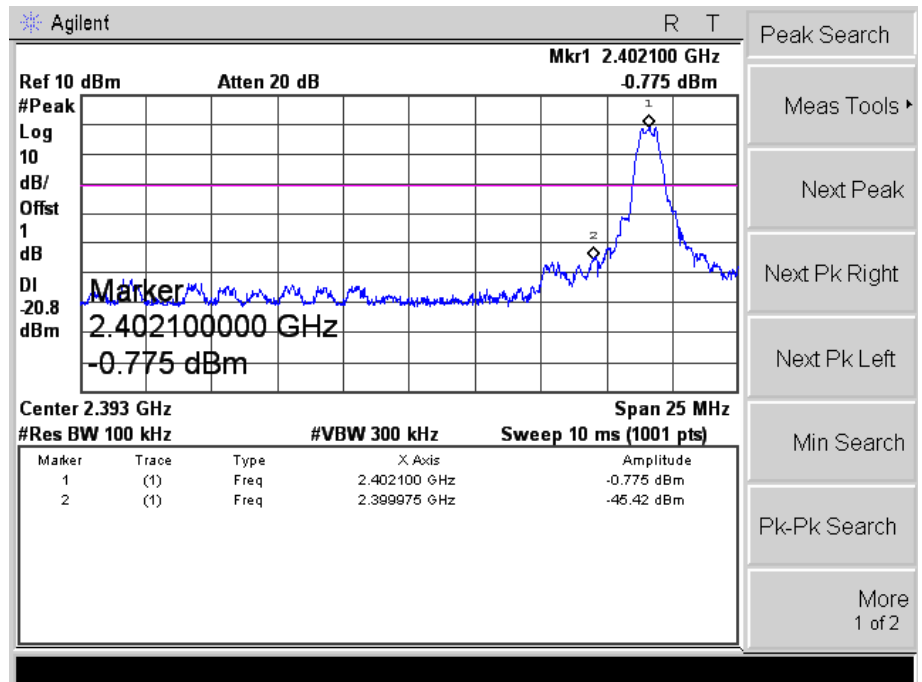
Test Channel	High	Polarity:	Vertical(worst case)
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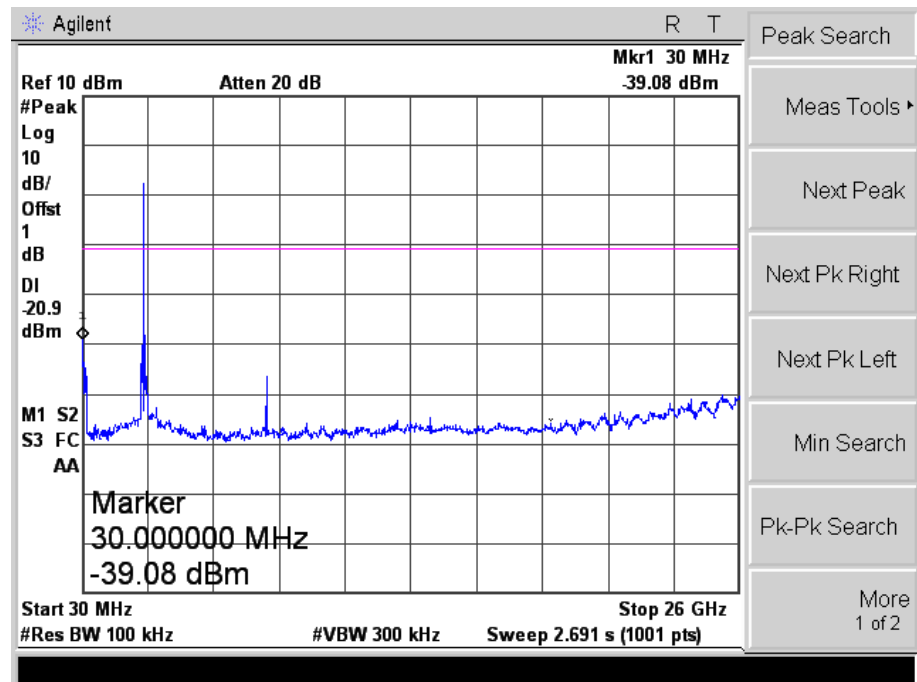
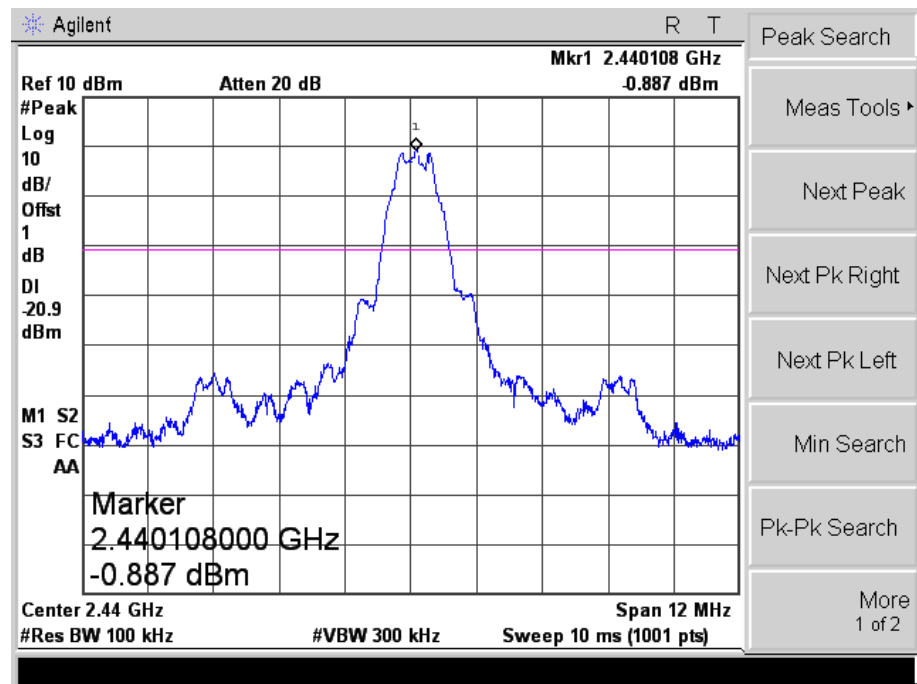
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2479.955	98.15	-6.79	91.36	/	/	Average Detector
	2479.731	103.27	-6.79	96.48	/	/	Peak Detector
2	2483.500	56.90	-6.77	50.13	54.00	-3.87	Average Detector
	2483.500	64.34	-6.77	57.57	74.00	-16.43	Peak Detector
3	2500.000	39.24	-6.67	32.57	54.00	-21.43	Average Detector
	2500.000	51.31	-6.67	44.64	74.00	-29.36	Peak Detector

➤ Conducted test

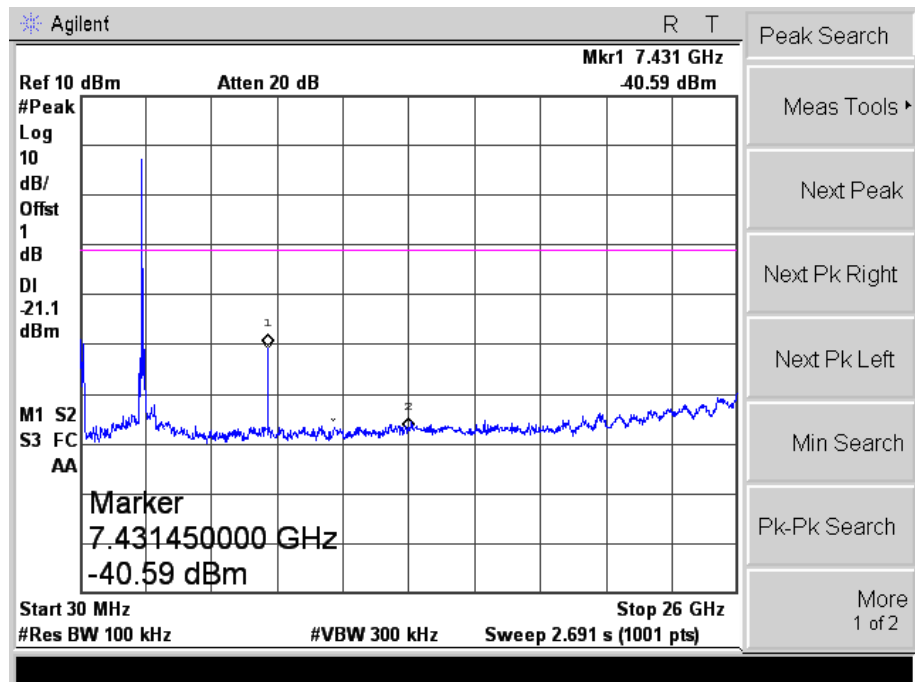
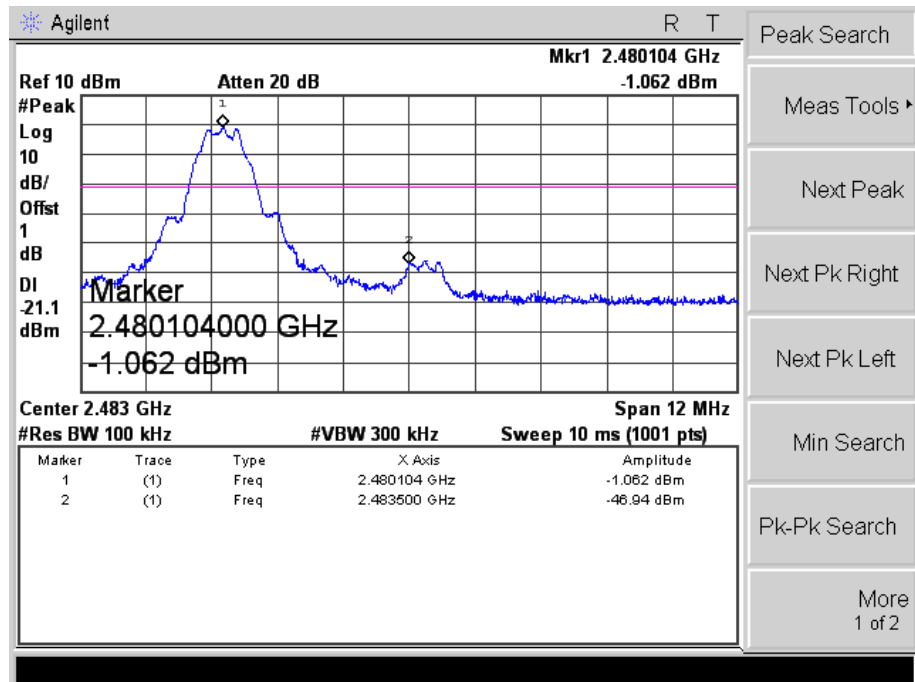
Low



Middle



High



\*\*\*\*\* END OF REPORT \*\*\*\*\*